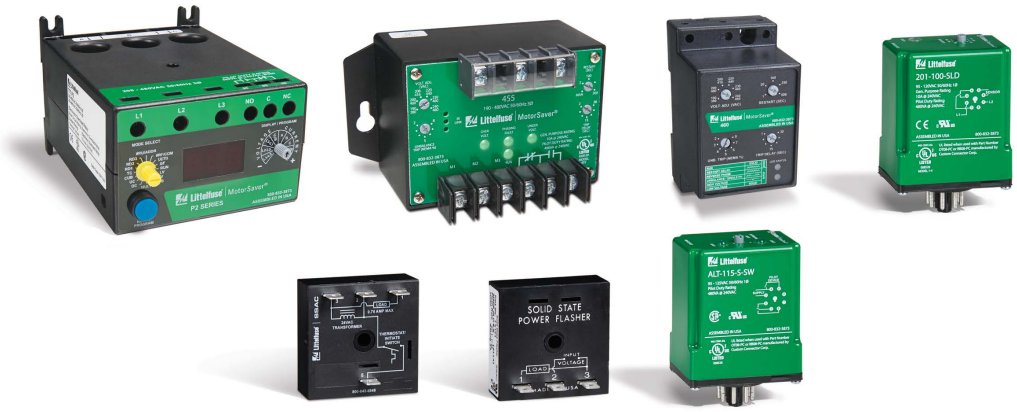
Littelfuse®

Expertise Applied | Answers Delivered

PROTECTION RELAYS & CONTROLS CATALOG

MOTOR & PUMP PROTECTION GROUND-FAULT PROTECTION FEEDER PROTECTION
ARC-FLASH PROTECTION SWITCHING RELAYS & CONTROLS GROUND-CONDUCTOR MONITORING
RESISTANCE GROUNDING/NGR MONITORING AC SYSTEM MONITORS/LOAD SENSORS
PUMP CONTROLLERS TOWER AND OBSTRUCTION LIGHTING CONTROL TIMERS FLASHERS

Over 1000 Littelfuse MotorSaver®, PumpSaver®, and SSAC parts added!



New Arc-Flash Relays

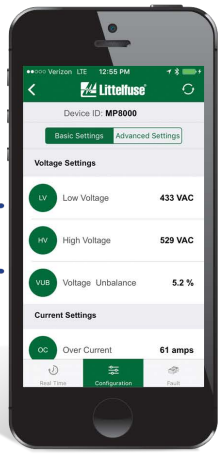
AF0500 with zone protection and AF0100 with compact, cost-effective design

AF0500
Arc-Flash Relay

AF0100
Arc-Flash Relay

New Smart Motor Protection Relay MP8000 with Bluetooth* capabilities

MP8000
Motor Protection Relay



MP8000
Motor Protection
Smartphone Application

*Bluetooth is a trademark of its respective owner.

Your **questions answered,** any way **you ask** them.

Choose *your preferred* product-selection method from the examples below.

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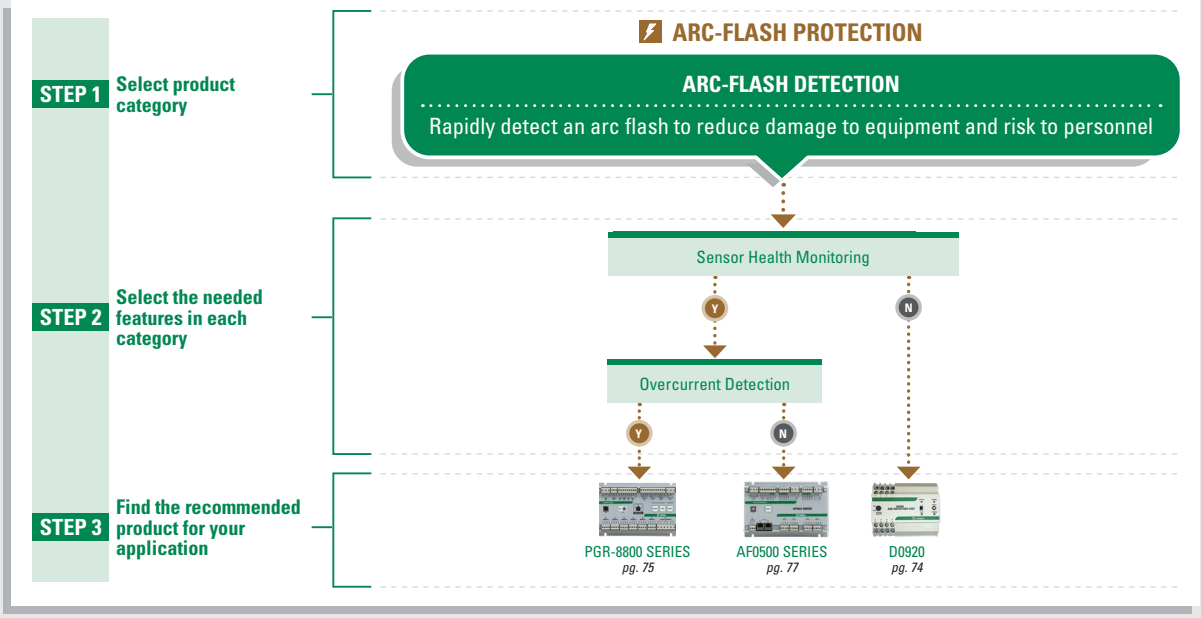
GENERATORS	- Insulation breakdown due to vibration and corrosion - Ground-fault currents often exceed short-circuit current - Arc-flash hazard from local and paralleled generators	Ground Fault (pg 43) Resistance Grounding (pg 61) Arc Flash (pg 73)
TRANSFORMERS	- Overloading and overvoltage	Resistance Grounding (pg 61) Feeder (pg 69)

→ By **Feature Set** ..... Pg 7-10

Arc-Flash Relays

FEATURE	PGR-8800	AF0100	AF0500
Current detection	✔		
Point sensors	✔	✔	✔
Fiber optic sensors	✔	-	✔

→ By Product Category & Common Questions: **Product Selection Guide** ..... Pg 11-41



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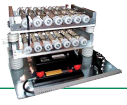

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TYPICAL PRODUCT APPLICATIONS

APPLICATION	COMMON PROBLEMS	PRODUCT PROTECTION CATEGORY (PG NO.)
GENERATORS	- Insulation breakdown due to vibration and corrosion - Ground-fault currents often exceed short-circuit current - Arc-flash hazard from local and paralleled generators	Ground Fault Resistance Grounding Arc Flash
TRANSFORMERS	- Overloading and overvoltage	Resistance Grounding Feeder
SWITCHGEAR & MCCs	- Highest average downtime (IEEE 493-1997) - Arc-flash risk to personnel maintaining and working on live equipment - A fault on one load or feeder trips the entire lineup	Ground Fault Resistance Grounding Motor Feeder Arc Flash Pump Control
SWITCHBOARDS & PANELBOARDS	- Low-level leakage current undetected by typical OCPDs	Ground Fault
DRIVES	- Switching frequencies cause nuisance tripping - Resistance grounded drives require sensitive, wide-frequency ground-fault protection	Ground Fault Motor Arc Flash
MOTORS & PUMPS	- Winding faults due to overloading, water, dust and vibration - Pump damage due to dry running, deadheading, rapid cycling, seal failure (submersible pumps), over heating, plugged intake, jammed impeller, or voltage fault conditions.	Ground Fault Motor Voltage Monitoring Pump Control
FEEDER CIRCUITS	- Temperature and mechanical stress lead to severe damage - Older electromechanical protection is difficult to maintain - Uncoordinated feeders causing unnecessary downtime	Ground Fault Feeder
PORTABLE EQUIPMENT	- Movement causing broken conductors and failed insulation - Requirement to keep low ground-fault potential - Loss of ground or high ground resistance due to cable faults	Ground Fault Feeder Arc Flash Ground-Conductor Monitoring Resistance Grounding/NGR Monitoring
GROUNDING RESISTORS	- Open-circuit resistors due to corrosion or loose connections	Resistance Grounding
WATER/WASTEWATER	- Electrocution hazard due to personnel working on submersible pumps or in vicinity of water and electricity - Pump damage due to dry running, deadheading, rapid cycling, seal failure (submersible pumps), over heating, plugged intake, jammed impeller, or voltage fault conditions. - Higher risk of arc flash and steam blast due to moisture - Electrical conductors can cause explosions in explosive methane atmosphere - H2S causing premature electronics failure	Ground Fault Motor Arc Flash Pump Control Time Delay Resistance Grounding
HVACR	- Voltage issues causing premature failure - Short cycling increasing wear and tear on compressors - Worn contactor causing voltage fault on compressor motor - Rapid cycling - Low voltage/brownout condition - Contactor chatter - Reverse phase in a 3-phase system - Overload	Motor Time Delay

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FEATURE COMPARISONS

Use the feature tables below and the Product Selection Guide on pages 11-41 to choose the appropriate protection relay or monitor for your application.

Ground-Fault Protection Relays

FEATURE	SE-601	EL731	PGR-3100	PGR-3200	SE-502	SE-701 SE-703 SE-704	SE-105 SE-107	SE-134C SE-135	SE-325	SE-330 SE-330HV SE-330AU
Detects GF via Voltage			✔	✔	✔				✔	✔
Detects GF via Current	✔	✔			✔	✔	✔	✔	✔	✔
Detects DC GF	✔	✔								
Adjustable GF Pickup	✔	✔				✔	✔	✔	✔	✔
Adjustable Time Delay	✔	✔				✔	✔	✔	✔	✔
Remote Reset	✔	✔		✔	✔	✔	✔	✔	✔	✔
Analog Output	✔	✔		✔		✔				✔
Fail-Safe Option	✔	✔			✔	✔	✔	✔	✔	✔
Harmonic Filtering		✔		✔		✔	✔	✔	✔	✔
CT-Loop Monitoring		✔				✔		✔		
Insulation Monitoring				✔						
Ground-Check Monitoring							✔	✔		
Grounding-Resistor Monitoring									✔	✔
PTC/RTD Overtemperature		✔								
Communications		✔								✔
Conformal Coating	‡	✔	✔	‡	‡	‡	✔	✔	✔	✔

Arc-Flash Relays

FEATURE	PGR-8800	AF0100	AF0500
Current Detection	✔		
Point Sensors	✔	✔	✔
Fiber Optic Sensors	✔	-	✔
Cable Monitoring on Sensor Inputs	✔	✔	✔
USB	✔	✔	✔
DC Supply	✔	✔	✔
AC Supply	✔	✔	✔
Data Logging	✔		✔
Multi-Zone			✔
Communications	✔		✔

NOTE: Tables are for reference only and include standard and optional configurations. Please see the respective catalog page for exact product specifications.

‡ Optional

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FEATURE COMPARISONS

Pump Controllers

FUNCTION		MP8000	777-KW	77C-KW	MPU-32	MPS
Supply Voltage		Single-Phase or 3-Phase 90–690 VAC	3-Phase 200-480 VAC*	Single-Phase 100-240 VAC*	65-265 VAC, 80-275 VDC	
Monitored Current		0.5-1,000A (>100A w/external CTs)	2-800A (>90 A w/external CTs)*		Accepts broad range of external CTs	
HP Rating		Any	871		Any	
Control Box Compatibility		-	-	-	-	-
Overload		✔			✔	✔
Underload/Dry-well/Dead-head		✔	✔	✔		✔
Undercurrent/Dry-well/Dead-head		✔			✔	✔
Overcurrent/Jam		✔	✔	✔	✔	✔
Reduced Overcurrent Mode					✔	✔
Current Unbalance, Phase Loss/ Reversal		✔	✔		✔	✔
Over/Undervoltage		✔	✔	✔		✔
Voltage Unbalance		✔	✔			✔
Ground Fault		Calculated	Calculated	Calculated	✔	✔
Overtemperature					✔	✔
Dynamic Thermal Model					✔	✔
Over/Underfrequency					✔	✔
Failure to Accelerate/Underspeed					✔	✔
Power Factor						✔
Rapid Cycling/Jog		✔	✔	✔	✔	✔
Starter Control						✔
Differential					✔	✔
Output Contact Rating		10 A at 240 VAC	10 A at 240 VAC*		8 A at 250 VAC	
Internal CT's		✔ (up to 100 A)*	✔ (up to 90 A)*			
On-unit Metering			3 Digit display		4 line x 20 characters	
Remote Display		Via smartphone	✔	✔	✔	✔
Remote Reset Button			✔	✔	✔	✔
Datalogging		Last 1,000 faults	Last fault	Last fault	100 events	64 events
Local Communications			RS-485	RS-485	RS-232	RS-485
Bluetooth® Communication to Smartphone App**		✔				
NETWORK COMS. (Optional)	Modbus TCP	✔	✔		✔	✔
	Modbus RTU	✔	✔	✔	✔	✔
	DeviceNet		✔		✔	✔
	Profibus		✔			✔
	Ethernet/IP		✔		✔	✔
	Allen-Bradley DF1					✔
Analog Output					✔	✔
Analog Input (Prog.)						✔
Digital Input (Prog.)					✔	✔
Conformal Coating					✔	✔
Operating Temp Degree C		-40 to 70	-20 to 70	-20 to 70	-40 to 60	-40 to 60
Warranty		5 year			10 year	
Certifications		UL, CSA, CE			UL Recognized, CSA, CE, RCM	

*Other versions exist with different voltage ranges, current monitoring ranges, output contact ratings, and temperature monitoring. Consult specific series datasheets for more details.
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FEATURE COMPARISONS

Pump Controllers

FUNCTION		111P	111-INSIDER-P, 231-INSIDER-P	232-INSIDER	233P	234-P	235P
Supply Voltage		Single-Phase 115 VAC	Single-Phase 115 VAC or 230 VAC	Single-Phase 230 VAC	Single-Phase 230 VAC	Single-Phase 230 VAC	Single-Phase 230 VAC
Monitored Current		-	-	-	-	-	-
HP Rating		1/3 – 1hp	1/3 – ½hp or 1/3 – 1hp	1/3 – 1hp	1/3 – 1.5hp or 1/3 – 3hp	1/3 – 3hp	5 – 15hp (external CT required)
Control Box Compatibility		-	Franklin™, Pentek®, CentriPro™, Flint & Walling™, Grundfos® (mid-2014 or later)	Grundfos® (prior to mid-2014)	-	Grundfos®	-
Overload							
Underload/Dry-well/Dead-head		✔	✔	✔	✔	✔	✔
Undercurrent/Dry-well/Dead-head							
Overcurrent/Jam		✔	✔	✔	✔	✔	✔
Reduced Overcurrent Mode							
Current Unbalance, Phase Loss/ Reversal							
Over/Undervoltage		✔	✔	✔	✔	✔	✔
Voltage Unbalance							
Ground Fault							
Overtemperature							
Dynamic Thermal Model							
Over/Underfrequency							
Failure to Accelerate/Underspeed							
Power Factor							
Rapid Cycling/Jog		✔	✔	✔	✔	✔	✔
Starter Control							
Differential							
Output Contact Rating							
Internal CT's							
On-unit Metering							
Remote Display		Remote display capability when using the Informer via IR					
Remote Reset Button							
Datalogging		Remote display capability when using the Informer via IR					
Local Communications							
Bluetooth® Communication to Smartphone App**							
NETWORK COMS. (Optional)	Modbus TCP						
	Modbus RTU						
	DeviceNet						
	Profibus						
	Ethernet/IP						
	Allen-Bradley DF1						
Analog Output							
Analog Input (Prog.)							
Digital Input (Prog.)							
Conformal Coating							
Operating Temp Degree C		-40 to 60	-40 to 60	-40 to 60	-40 to 60	-40 to 60	-40 to 60
Warranty		5 year					
Certifications		cULus	cURus	cCSAus, cURus	cULus		cULus

*Other versions exist with different voltage ranges, current monitoring ranges, output contact ratings, and temperature monitoring. Consult specific series datasheets for more details.
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FEATURE COMPARISONS

Motor & Feeder Protection Relays

FUNCTION/FEATURE (IEEE#)	MP8000	777	77C	MPU-32	MPS	FPU-32	FPS
Supply Voltage	Single or 3-Phase 90-690 VAC	3-Phase 200-480 VAC*	Single-Phase 100-240 VAC*	65-265 VAC, 80-275 VDC			
Monitored Current	0.5-1,000A (>100A w/ external CTs)	2-800A (>90A w/external CTs)*		Accepts broad range of external CTs			
Overload (49, 51)	✔			✔	✔	✔	✔
Underload	✔	KW/HP Version			✔		
Overcurrent (50, 51)/Jam	✔	✔	✔	✔	✔	✔	✔
Reduced Overcurrent Mode				✔	✔	✔	✔
Undercurrent (37)	✔	✔	✔	✔	✔		
Current Unbalance, Phase Loss/Reversal (37)	✔	✔		✔	✔	✔	✔
Over (59)/Undervoltage (27)	✔	✔	✔		✔		✔
Voltage Unbalance (47)	✔	✔			✔		✔
Ground Fault (50G/N, 51G/N)	Calculated	Calculated	Calculated	✔	✔	✔	✔
Overtemperature (49)		*		✔	✔	✔	✔
Dynamic Thermal Model				✔	✔	✔	✔
Over/Underfrequency (81)				✔	✔	✔	✔
Failure to Accelerate/Underspeed				✔	✔		
Power Factor (55)					✔		✔
Rapid Cycling/Jog	✔	✔	✔	✔	✔		
Starter Control					✔		
Breaker Control							✔
Differential (87)				✔	✔		
Feeder Protection						✔	✔
Definite-time Overcurrent						✔	✔
Inverse-time Overcurrent						✔	
Output Contact Rating	10A at 240 VAC	10A at 240 VAC*		8A at 250 VAC			
Internal CT's	✔ (up to 100 A)	✔ (up to 90 A)*					
On-unit Metering		3 Digit display		4 line x 20 characters			
Remote Display	Via smartphone	✔	✔	✔	✔	✔	✔
Remote Reset Button		✔	✔	✔	✔	✔	✔
Datalogging	Last 1,000 faults	Last fault	Last fault	100 events	64 events	100 events	64 events
Local Communications		RS-485	RS-485	RS-232	RS-485	RS-232	RS-485
Bluetooth® Communication to Smartphone App**	✔						
NETWORK COMS. (Optional) Modbus TCP	✔	✔		✔	✔	✔	✔
Modbus RTU	✔	✔	✔	✔	✔	✔	✔
DeviceNet		✔		✔	✔	✔	✔
Profibus		✔			✔		✔
Ethernet/IP	✔			✔	✔	✔	✔
Allen-Bradley DF1					✔		✔
Analog Output				✔	✔	✔	✔
Analog Input (Prog.)					✔		✔
Digital Input (Prog.)				✔	✔	✔	✔
Conformal Coating				✔	✔	✔	✔
Operating Temp Deg C	-40 to +70	-20 to +70	-20 to +70	-40 to +60	-40 to +60	-40 to +60	-40 to +60
Warranty	5 year	5 year	5 year	10 year	10 year	10 year	10 year
Certifications	UL, CSA, CE			UL Recognized, CSA, CE, RCM			

*Other versions exist with different voltage ranges, current monitoring ranges, output contact ratings, and temperature monitoring. Consult specific series datasheets for more details.
** iPhone® and select Android™ smartphones and tablets are supported via Littelfuse app

NOTE: IEEE Device Numbers are shown in parenthesis after the applicable features.

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PRODUCT SELECTION GUIDE

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Feeder Protection 14
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Timers 26
Flashers, Tower and Obstruction Lighting Control 40

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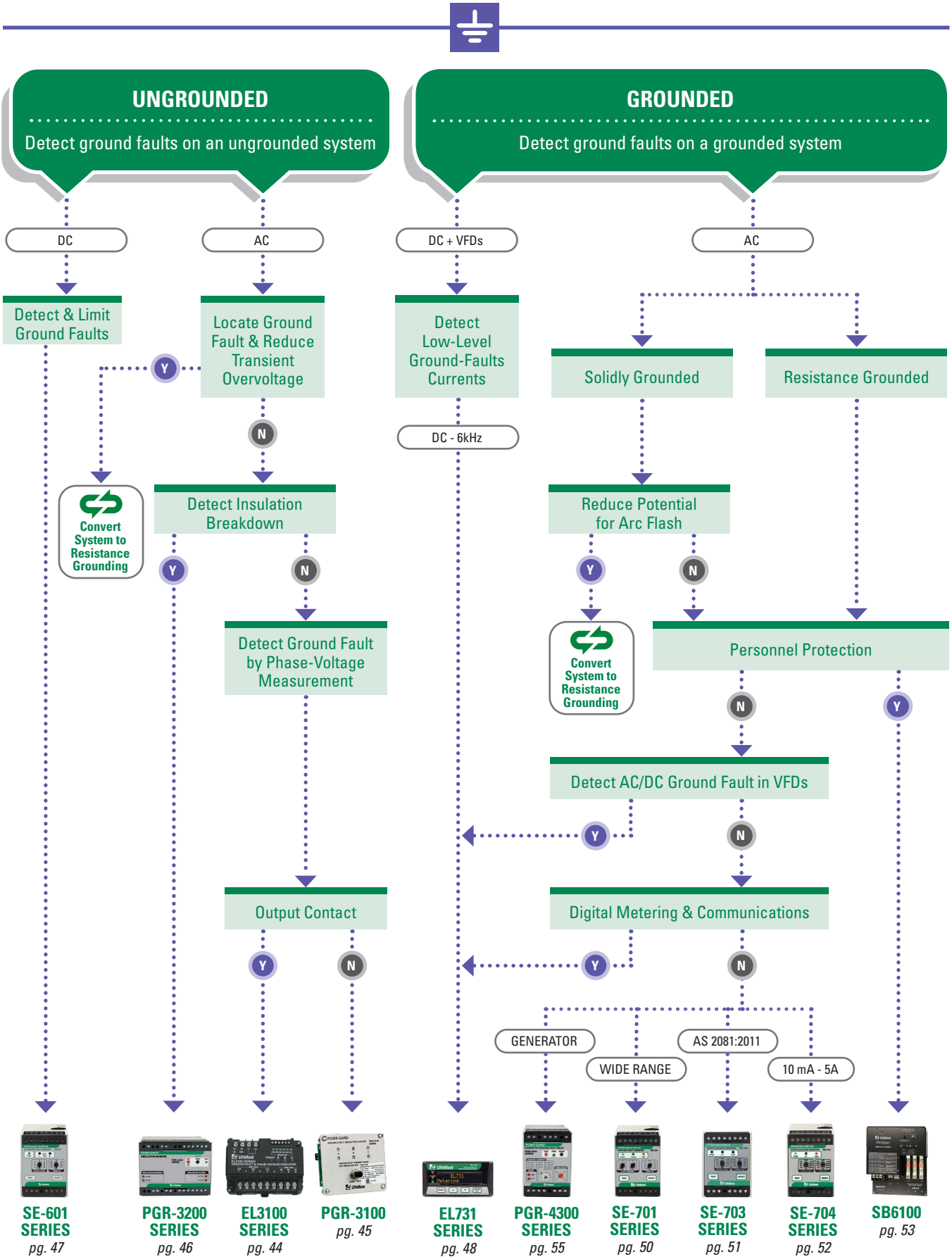
GROUND-FAULT PROTECTION



GROUND-CONDUCTOR MONITORING

RESISTANCE GROUNDING/NGR MONITORING

GROUND-FAULT & GROUND-CHECK

Ensure ground- conductor continuity for portable equipment and submersible pumps, and detect ground faults

- Cable Voltage
  - <5kV
    -
    - **SE-105, SE-107 SERIES**
    - *pg. 58*
  - >5kV
    -
    - **SE-134C, SE-135 SERIES**
    - *pg. 59*

Ground-Conductor Monitoring Relays

RESISTANCE-GROUNDED AC

Solve problems commonly associated with ungrounded and solidly grounded systems and monitor the neutral-to-ground connection

- Neutral-Grounding Resistance (NGR) Continuity Monitoring
  - Pulsing, Digital Filtering, Communications, or Software
    - Y
      - Identify Faulted Feeder
        - Y
          -
          - **SE-330 & SE-701 SERIES**
          - (use in combination)
          - *pg. 63* *pg. 50*
        - N
          -
          - **SE-330 SERIES**
          - *pg. 63*
    - N
      -
      - **SE-325 SERIES**
      - *pg. 62*
- Implement Resistance Grounding
  -
  - **NGR SERIES**
  - *pg. 66*

Resistance Grounding Systems & NGR Monitors

STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

FEEDER PROTECTION

STANDARD

Protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities

Current Protection & Metering IEEE/IEC Overcurrent

FPU-32 SERIES
pg. 70

ADVANCED

Monitor voltage and current using a modular system with integrated protection, breaker control, metering, and data-logging functions

Current Protection, Voltage Protection, & Metering IEEE/IEC Overcurrent

FPS SERIES
pg. 70

Feeder Protection Relays

ARC-FLASH PROTECTION

ARC-FLASH DETECTION

Rapidly detect an arc flash to reduce damage to equipment and risk to personnel

Sensor Health Monitoring

Y

Overcurrent Detection

Y

PGR-8800 SERIES
pg. 75

N

Multiple Zones, Communications, & Data Logging

Y

AF0500 SERIES
pg. 77

N

AF0100 SERIES
pg. 79

N

D0920
pg. 74

Arc-Flash Relays

SWITCHING RELAYS & CONTROLS

SOLID-STATE RELAYS

Designed for industrial applications requiring rugged, reliable operation

Optical Isolation Between the Control Voltage Input and the Solid-State Output

- Y → Random Switching for Inductive Loads
  - Y → SIR1 SERIES *pg. 86*
  - N → Zero Voltage Switching for Resistive and Incandescent Loads → SIR2 SERIES *pg. 86*
- N → Random Switching for Inductive Loads → SLR SERIES *pg. 88*

Solid-State Switching Relays

PHASE CONTROL

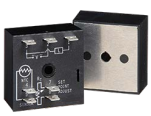
Designed for changing lamp intensity, varying the speed of a fan, or controlling the temperature of a heater

PHS SERIES *pg. 84*

Phase Control Switching Relays

TEMPERATURE CONTROL

A single set point controller with high current, solid state output for resistive loads



TCR9C *pg. 90*

Temperature Control Relays

MOTOR & PUMP PROTECTION

SUPPLEMENTAL PROTECTION (MOTOR)

Protection for motors against insulation degradation, overheating, or ventilation failure

BASIC (PUMP)

Protection of single-phase pumps against dry-well, dead-head, jammed impeller, rapid-cycling and over/under voltage

- Ground-Fault Protection & Insulation Monitoring
- Temperature Monitoring Using RTDs
- Mounting Options
  - SURFACE MOUNT
    - Voltage
      - 115V
      - 230V
        - HP
          - <3HP
          - >5HP
  - OPEN BOARD
    - Voltage
      - 115V
      - 230V
        - HP
          - 1/3 - 1HP
            - Control Box Type
              - FRANKLIN™, PENTEK®, CENTRIPRO™
              - GRUNDFOS®
          - 1/3 - 3HP
- Hand-Held Diagnostic Tool Helpful for Trouble-shooting
  - FOR ALL BASIC SINGLE-PHASE UNITS ON THIS PAGE

PGR-6100 SERIES
pg. 94

SIO-RTD-02-00 SERIES
pg. 128

111P
pg. 106

233P SERIES
pg. 106

235P
pg. 110

111-INSIDER-P
pg. 101

231-INSIDER-P
pg. 101

232-INSIDER
pg. 104

234-P
pg. 108

INFORMER
pg. 250

MOTOR & PUMP PROTECTION

STANDARD

Multi-function protection for low and medium voltage motors

Single-Phase

Under Power Protection for Pump Applications

- Y → **77C-KW/HP SERIES** *pg. 125*
- N → **77C SERIES** *pg. 118*

Three-Phase

Under Power Protection for Pump Applications

- Y → 4-20mA Output Power
  - Y → **777-ACCUPOWER & COM 4-20** (use in combination) *pg. 123* *pg. 261*
  - N → **777-KW/HP-P2 SERIES** *pg. 120*
- N → Temperature Protection & Reduced Overcurrent
  - Y → **MPU-32 SERIES** *pg. 96*
  - N → **777-P2 SERIES** *pg. 114*

Standard Motor & Pump Protection

STANDARD WITH BLUETOOTH®

Multi-function protection for single-phase and three-phase low and medium voltage motors and pumps with real-time data, programming and troubleshooting via iPhone® or Android™ app

MP8000 SERIES *pg. 112*

Standard Motor & Pump Protection with Bluetooth*

*Bluetooth is a trademark of its respective owner

STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

MOTOR & PUMP PROTECTION

PUMP CONTROLLERS

ADVANCED

Comprehensive voltage protection and starter control for medium voltage motors and pumps

RETROFITS

Pre-wired plug & play replacement for obsolete and competitors' relays

SEAL LEAK DETECTORS

Detect pump seal leaks & motor overheating on submersible pumps

Controller Functionality

SINGLE-CHANNEL

DUAL-CHANNEL

Mounting Option

Seal Leak & Over Temperature

8-PIN SOCKET

DIN RAIL

Y

N

Dual Seal Leak

MPS SERIES
pg. 98

MPU-32-X69X SERIES
pg. 100

MPS-469X SERIES
pg. 100

201-100-SLD
pg. 136

460-15-100-SLD
pg. 139

PC-102CICI-LT
pg. 132

PC-102CICI-DL
pg. 132

Advanced Motor & Pump Protection

Retrofits

Seal Leak Detection

PUMP CONTROLLERS

LIQUID LEVEL CONTROLS

Control liquid pumping operations in a pump-up or pump-down application

Sensing Type

- PROBE
- FLOAT

Mounting Option

- 8-PIN SOCKET
- 8-PIN SOCKET
- 11-PIN SOCKET
- DIN RAIL/ SURFACE MOUNT
- OPEN BOARD

Probe Style

- SINGLE PROBE
- DUAL PROBE

Compatibility

- GEM'S SERIES 16M LIQUID LEVEL CONTROL
- CROUZET'S PNR & PNRU SERIES LIQUID LEVEL CONTROL

Low Liquid Level Cut-off Protection That Meets UL 353

Probe Style

- SINGLE PROBE
- DUAL PROBE

Low Liquid Level Cut-off Protection That Meets UL 353

- Y
- N

LLC4 SERIES *pg. 145*

LLC5 SERIES *pg. 147*

PC-XXX-LLC-GM SERIES *pg. 134*

PC-XXX-LLC-CZ SERIES *pg. 134*

LLC6 SERIES *pg. 149*

460-15-100-LLS *pg. 137*

LLC8 SERIES *pg. 151*

LLC1 SERIES *pg. 141*

LLC2 SERIES *pg. 143*

PC-105 *pg. 133*

PUMP CONTROLLERS

ALTERNATING RELAYS

Used in duplex pumping applications to balance the run time of both pumps

Float Switch Configuration

- SINGLE → Mode Selector Switch
  - Y → Debounce Delay
    - Y → 8-Pin, SPDT
      - Y → **ALTXXX-S-SW SERIES** *pg. 133*
      - N → 11-PIN, DPDT → **ALT-XXX-1-SW SERIES** *pg. 155*
    - N → 8-Pin, SPDT
      - Y → **ARPX1S SERIES** *pg. 157*
      - N → 11-PIN, DPDT → **ARPX2S SERIES** *pg. 157*
  - N → Debounce Delay
    - Y → 600VAC Rated Contacts
      - Y → **50R-400-ALT** *pg. 159*
      - N → **ALTXXX-S SERIES** *pg. 133*
    - N → **ARP41** *pg. 157*
- DUAL → Mode Selector Switch
  - Y → Debounce Delay
    - Y → **ALTXXX-X-SW SERIES** *pg. 133*
    - N → **ARPX3S SERIES** *pg. 157*
  - N → Debounce Delay
    - Y → **ALTXXX-X SERIES** *pg. 133*
    - N → **ARP43** *pg. 157*
- DUAL PLUS STOP FLOAT → Mode Selector Switch
  - Y → Debounce Delay
    - Y → **ALT-XXX-3-SW SERIES** *pg. 155*

PUMP CONTROLLERS

ALARM CONTROLS/ BATTERY CHARGERS

Dual-purpose alarm control/battery charger for pump control panels

INTRINSICALLY SAFE RELAYS

Used to interface between hazardous and non-hazardous areas

INTRINSICALLY SAFE PUMP CONTROLLER

Programmable to control/equalize run time of 2, 3, or 4 pumps, with the ability to interface between hazardous and non-hazardous areas

12-Pin Socket Included

- Y
- N

Number of Channels

- SINGLE-CHANNEL
- TWO CHANNELS
- THREE CHANNELS
- FOUR CHANNELS
- FIVE CHANNELS

Mounting Option

- DIN RAIL/ SURFACE MOUNT
- 8-PIN SOCKET

ACBC-120 -SD
pg. 130

ACBC-120
pg. 130

Alarm Control/Battery Charger

ISS-100
pg. 160

ISS-101
pg. 161

ISS-102 SERIES
pg. 163

ISS-105-ISO-3
pg. 165

ISS-105-ISO-4
pg. 165

ISS-105-ISO
pg. 165

Intrinsically Safe Relays

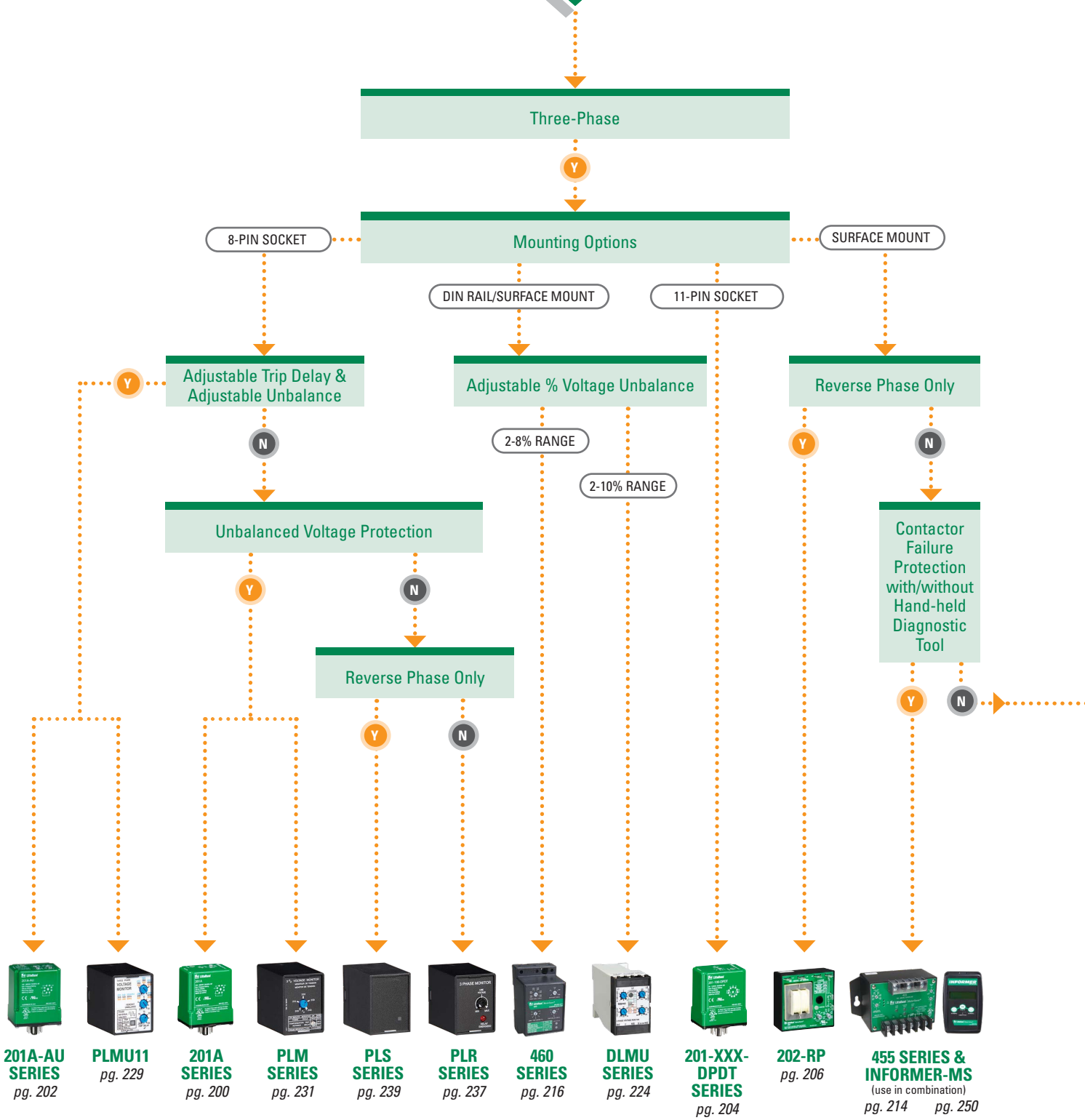
ISS-105
pg. 165

Intrinsically Safe Pump Controller

AC SYSTEM MONITORS/LOAD SENSORS

VOLTAGE MONITORS (1 of 2)

Highly accurate and precise voltage measurements to provide high sensitivity while minimizing nuisance tripping



201A-AU SERIES *pg. 202*

PLMU11 *pg. 229*

201A SERIES *pg. 200*

PLM SERIES *pg. 231*

PLS SERIES *pg. 239*

PLR SERIES *pg. 237*

460 SERIES *pg. 216*

DLMU SERIES *pg. 224*

201-XXX-DPDT SERIES *pg. 204*

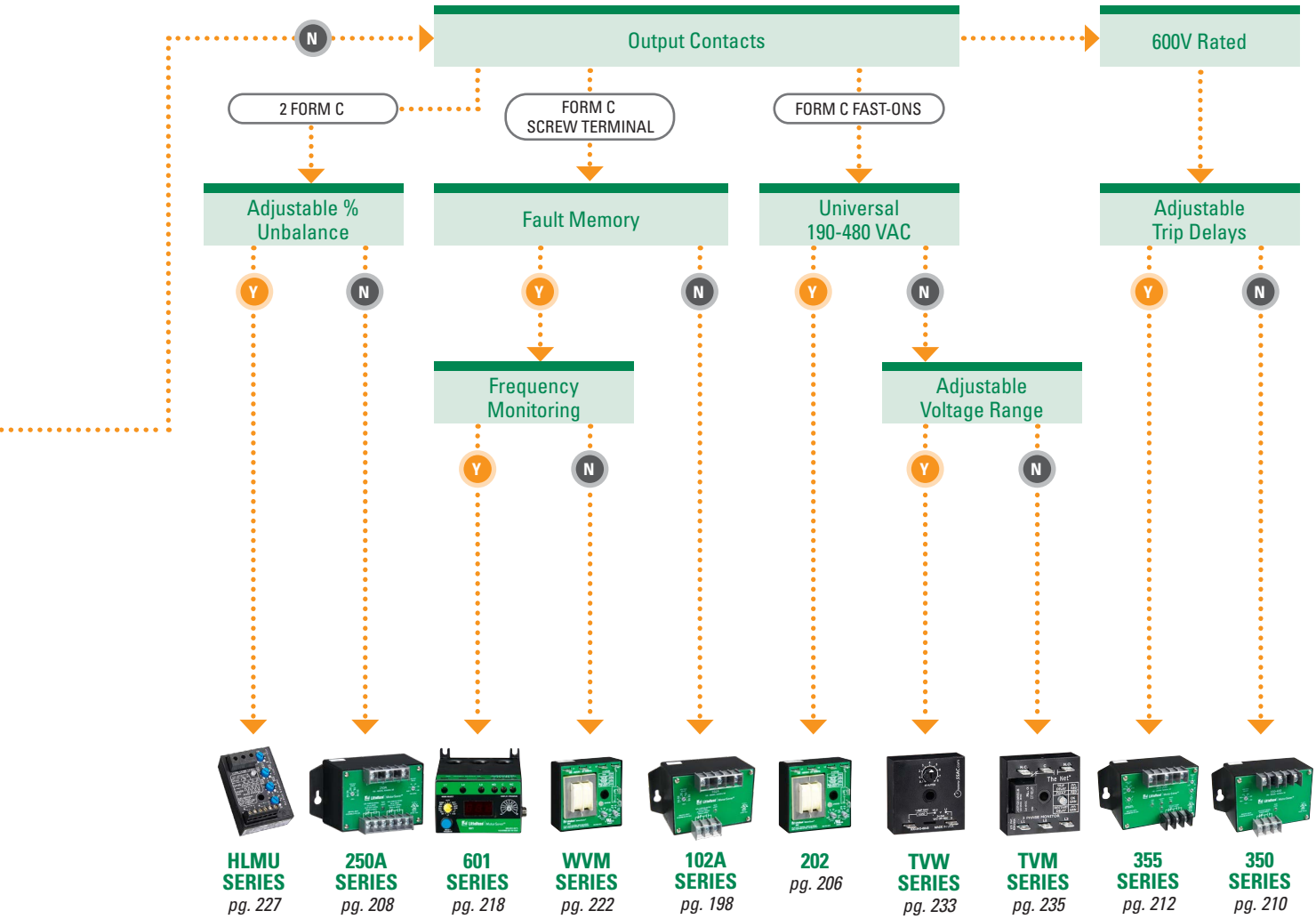
202-RP *pg. 206*

455 SERIES & INFORMER-MS (use in combination) *pg. 214* *pg. 250*

Voltage Monitoring Relays

VOLTAGE MONITORS (1 of 2)

(Continued from previous page)



AC SYSTEM MONITORS/LOAD SENSORS

VOLTAGE MONITORS (2 of 2)

(Continued from previous page)

Single-Phase

Y

Mounting Options

SURFACE MOUNT

8-PIN SOCKET

DIN RAIL/ SURFACE MOUNT

Screw Terminals

2 Isolated Form C Contacts

Y N

Adjustable Restart Delay

Y N

Power Relay Output

Y N

50R SERIES *pg. 188*

HLVA6I23 *pg. 241*

202-200-SP *pg. 194*

KVM SERIES *pg. 243*

201-XXX-SP-DPDT SERIES *pg. 192*

201-XXX-SP SERIES *pg. 190*

460-XXX-SP SERIES *pg. 196*

Voltage Monitoring Relays

CURRENT MONITORS/LOAD SENSORS (1 of 2)

Multi-purpose controls used for pump and motor protection, to provide closed-loop feedback in a system, as a proof relay to indicate a load is energized, and more...

Self Powered

Y N

Relay Output

Y N

SPDT Form C

Y N

SPST FORM A

Depluggable Terminal Block

Y N

0.25" QUICK CONNECTS

LSR-0 *pg. 169*

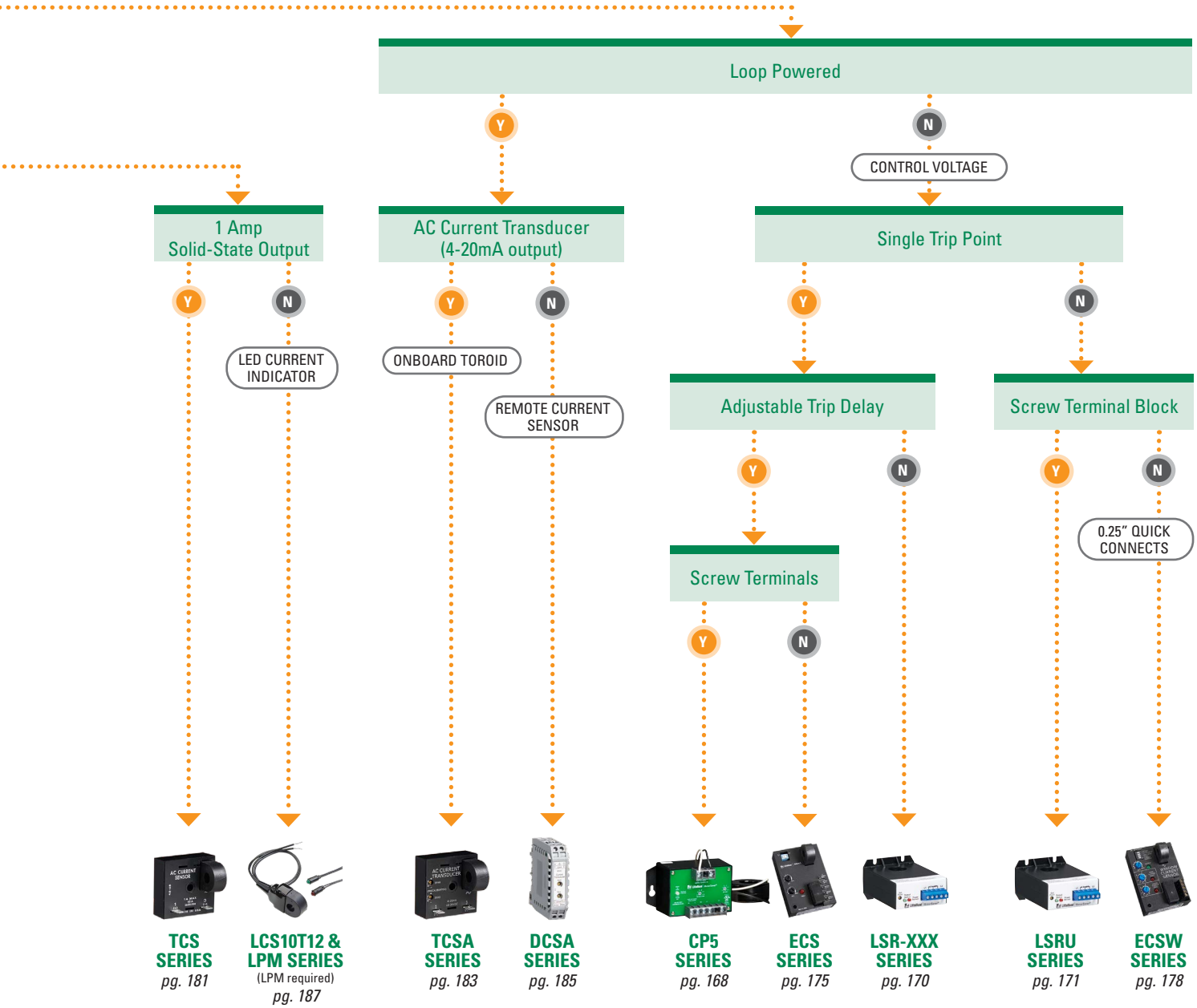
LSRX-C SERIES *pg. 173*

LSRX *pg. 173*

Current Monitoring/Load Sensing Relays

CURRENT MONITORS/LOAD SENSORS (2 of 2)

(Continued from previous page)



STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

FACTORY PROGRAMMABLE

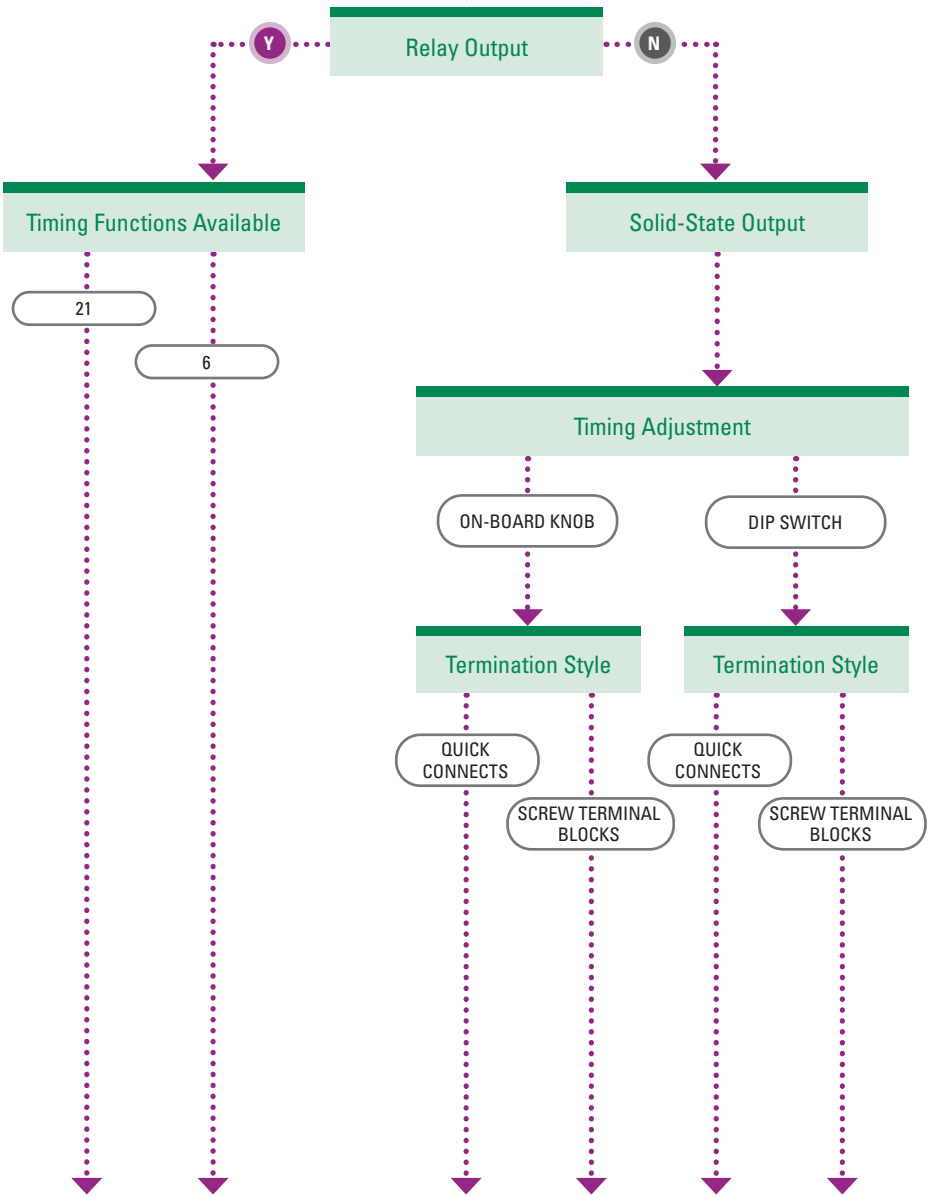
Microprocessor based circuitry provides excellent repeat accuracy and stability

- Relay Output
  - Y → High Power Relay Output
    - Y → Isolated Contacts
      - Y → **HRIS SERIES** *pg. 317*
      - N → **HRPSD12HI** *pg. 317*
    - N → Dual Function
      - Y → 1 of 12 DUAL FUNCTIONS → **KRPD SERIES** *pg. 424*
      - N → Single Function → 1 of 12 SINGLE FUNCTIONS → **KRPS SERIES** *pg. 281*
  - N → Solid-State Output → Dual Function
    - Y → DIP Switch Adjustment
      - Y → **HSPZA22SL** *pg. 339*
      - N → **KSPD SERIES** *pg. 406*
    - N → Single Function → DIP Switch Adjustment
      - Y → **KSPU SERIES** *pg. 370*
      - N → **KSPS SERIES** *pg. 288*

Factory Programmable Timers

MULTIFUNCTION

Universal and fully programmable timing relays



TRDU SERIES
pg. 265

TRU SERIES
pg. 268

ASQU SERIES
pg. 270

ASTU SERIES
pg. 270

DSQU SERIES
pg. 272

DSTU SERIES
pg. 272

Multifunction Timers

TIMERS

DEDICATED — SINGLE FUNCTION

Wide product offering to meet OEM and industrial requirements

DELAY-ON-MAKE

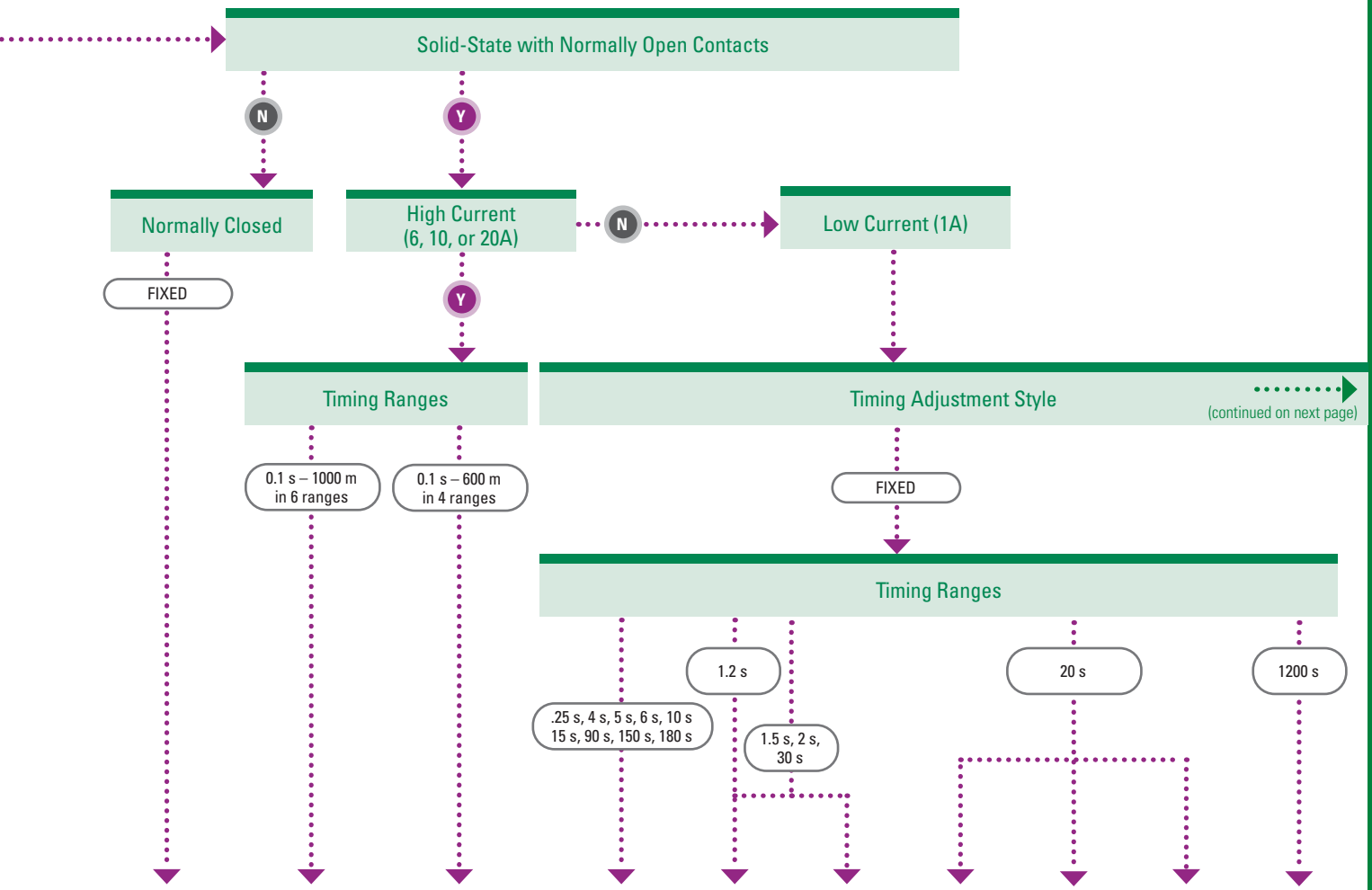
Package Style

- 8-PIN PLUG-IN → DIP Switch Adjustment
  - Y → Timing Ranges
    - 1-1023 s in increments of 1 s → **TDM SERIES** *pg. 297*
    - 10-10,230 s in increments of 10 s → **TDMH SERIES** *pg. 297*
    - 0.1-102.3 s in increments of 0.1 s → **TDML SERIES** *pg. 297*
  - N → KNOB TIMING ADJUSTMENT → **PRLM SERIES** *pg. 295*
- 8-PIN OR 11-PIN PLUG-IN → Relay with Isolated DPDT or SPDT → **TRM SERIES** *pg. 307*
- OPEN PC BOARD → Isolated DPDT Relay → **ORM SERIES** *pg. 293*
- PC MOUNT/ STRANDED WIRE LEADS TO REPLACE BIMETAL TYPE TIMERS → **MSM SERIES** *pg. 291*
- SURFACE MOUNT → Relay Output
  - N → **HRDM SERIES** *pg. 277*
  - Y → Isolated
    - N → **HRDM SERIES** *pg. 277*
    - Y → Contact Type
      - DPDT → **ERDM SERIES** *pg. 275*
      - SPDT → 480/600V Contacts
        - Y → **T10** *pg. 274*
        - N → **KRDM SERIES** *pg. 279*

Delay-on-Make Timers

DEDICATED — SINGLE FUNCTION

(Continued from previous page)



TS441165 *pg. 313*
THD1B410.5S *pg. 303*
TH1 SERIES *pg. 301*
TS1 SERIES *pg. 309*
TSD1 SERIES *pg. 311*
KSD1 SERIES *pg. 284*
TSD1 SERIES *pg. 311*
KSD1 SERIES *pg. 284*
KSDU SERIES *pg. 286*
KSDU SERIES *pg. 286*

DEDICATED — SINGLE FUNCTION

(Continued from previous page)

(continued from previous page)

Timing Adjustment Style

- DIP SWITCH
  -
  - **TDU SERIES** *pg. 299*
- KNOB
  - **Timing Ranges**
    - 0.1 – 8 m range
      -
      - **TMV8000** *pg. 305*
    - 0.1 s – 100 h in 7 ranges
      -
      - **TSD1 SERIES** *pg. 311*
    - 0.1 s – 1000 m in 6 ranges
      -
      - **KSD1 SERIES** *pg. 284*
- EXTERNAL
  - **Timing Ranges**
    - 0.05 s – 120 s in 4 ranges
      -
      - **TS1 SERIES** *pg. 309*
    - 5 – 480 s in 4 ranges
      -
      - **TSU2000** *pg. 305*
    - 0.1 s – 100 h in 7 ranges
      -
      - **TSD1 SERIES** *pg. 311*
    - 0.1 s – 1000 m in 3 ranges
      -
      - **KSD1 SERIES** *pg. 284*

DEDICATED — SINGLE FUNCTION

Wide product offering to meet OEM and industrial requirements

DELAY-ON-BREAK

Package Style

- 8-PIN OR 11-PIN PLUG-IN
  - **DIP Switch Adjustment**
    - Y
      - **Timing Ranges**
        - 1-1023 s in increments of 1 s
        - 10-10,230 s in increments of 10 s
        - 0.1-102.3 s in increments of 0.1 s
    - N
      - KNOB ADJUSTMENT
- OPEN PC BOARD
  - **Isolated**
    - SPDT/DPDT
- SURFACE MOUNT
  - **Relay Output**
    - Y
      - **Isolated**
        - SPDT
          - **Timing Ranges**
            - 0.1 s to 100 m in 5 ranges
            - 0.1 s to 1000 m in 6 ranges
    - N
      - **Solid-State with Normally Open Contacts**

TDB SERIES
pg. 325

TDBH SERIES
pg. 325

TDBL SERIES
pg. 325

TRB SERIES
pg. 331

ORB SERIES
pg. 323

HRDB SERIES
pg. 315

KRDB SERIES
pg. 319

Delay-on-Break Timers

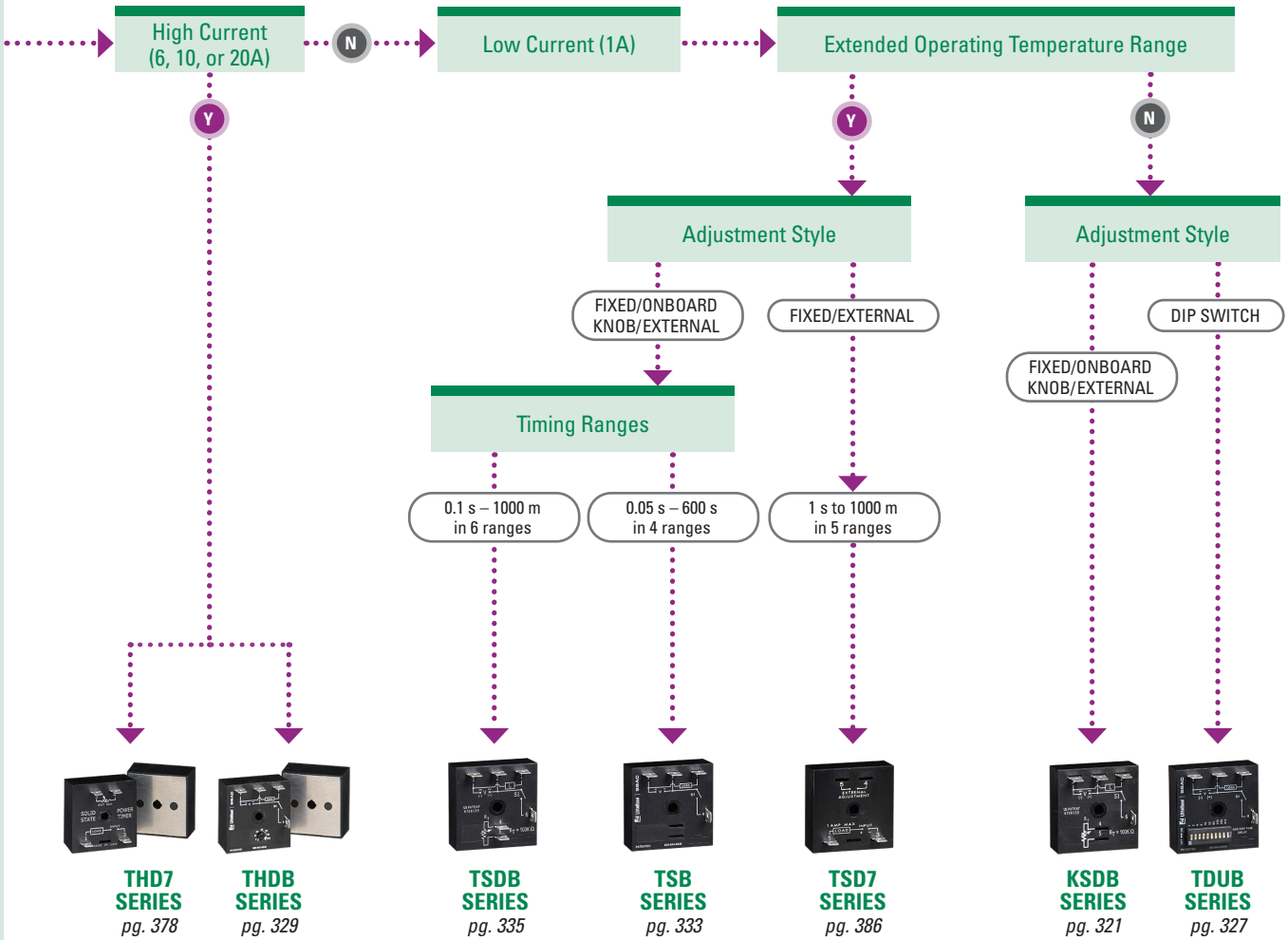
STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

DEDICATED — SINGLE FUNCTION

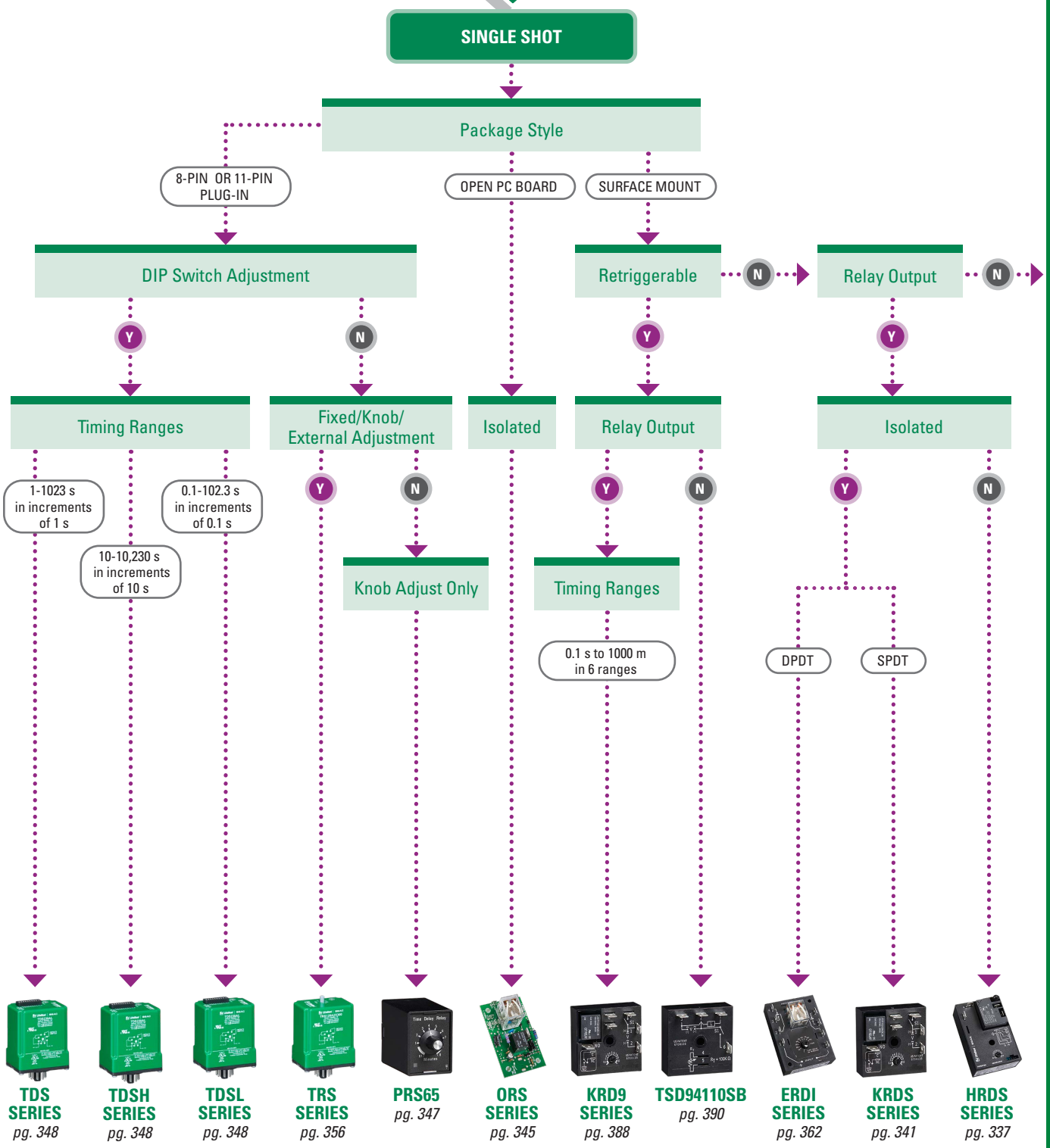
(Continued from previous page)



Delay-on-Break Timers

DEDICATED — SINGLE FUNCTION

Wide product offering to meet OEM and industrial requirements



Single Shot Timers

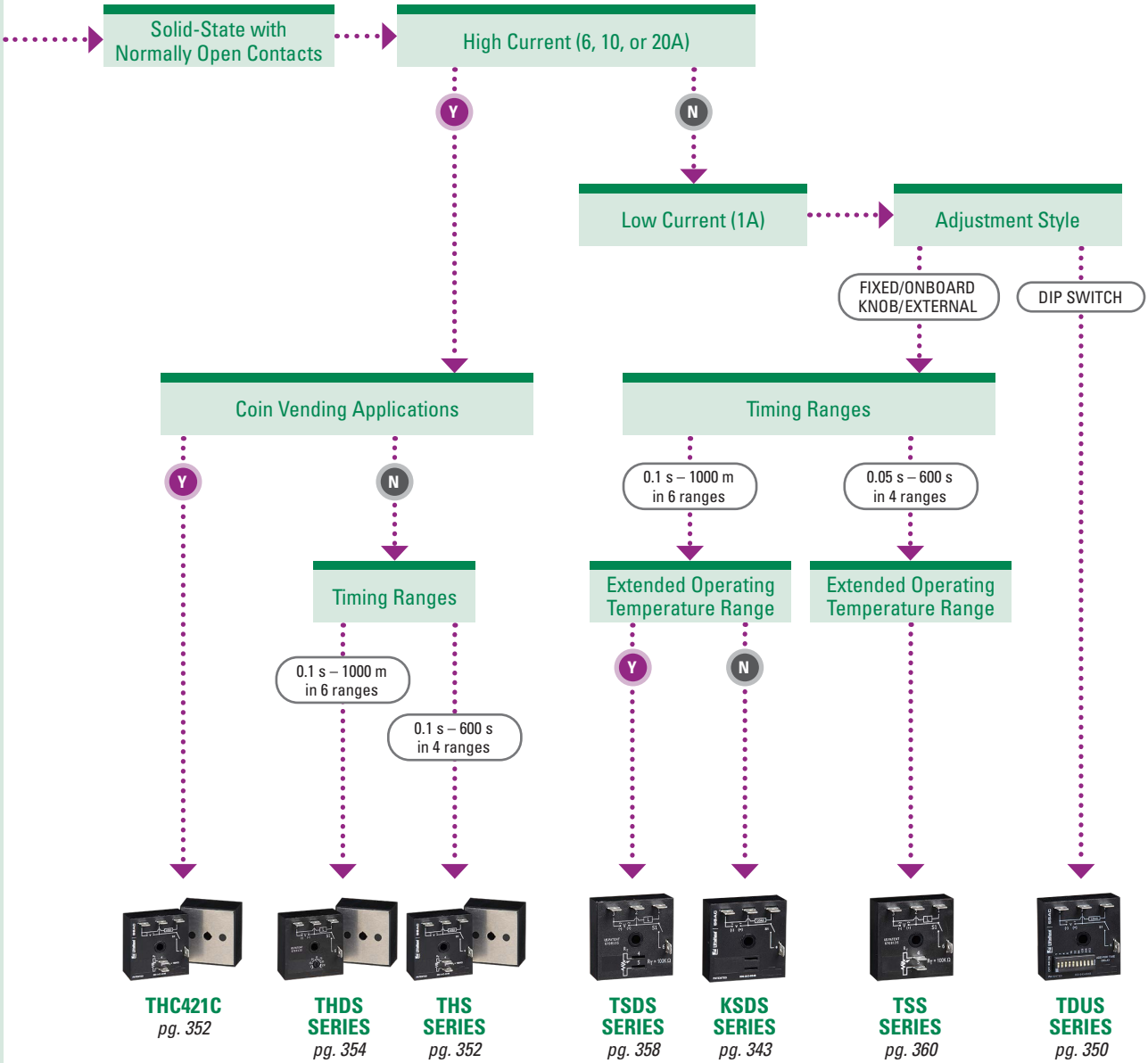
STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

DEDICATED — SINGLE FUNCTION

(Continued from previous page)



Single Shot Timers

DEDICATED — SINGLE FUNCTION

Wide product offering to meet OEM and industrial requirements

INTERVAL

- Package Style
  - 8-PIN PLUG-IN → Timing Ranges
    - 1-1023 s in increments of 1 s → **TDI SERIES** *pg. 372*
    - 10-10,230 s in increments of 10 s → **TDIH SERIES** *pg. 372*
    - 0.1-102.3 s in increments of 0.1 s → **TDIL SERIES** *pg. 372*
  - SURFACE MOUNT → Relay Output
    - N → Solid-State Output
      - High Current (6, 10, or 20A)
        - N
        - Y → Timing Ranges
          - 0.1 s to 1000 m in 6 ranges → **THD2 SERIES** *pg. 376*
          - 1 s to 1000 m in 5 ranges → **THD7 SERIES** *pg. 378*
    - Y → Isolated
      - Y
        - DPDT → **ERDI SERIES** *pg. 362*
        - SPDT → **KRDI SERIES** *pg. 366*
      - N → **HRDI SERIES** *pg. 364*

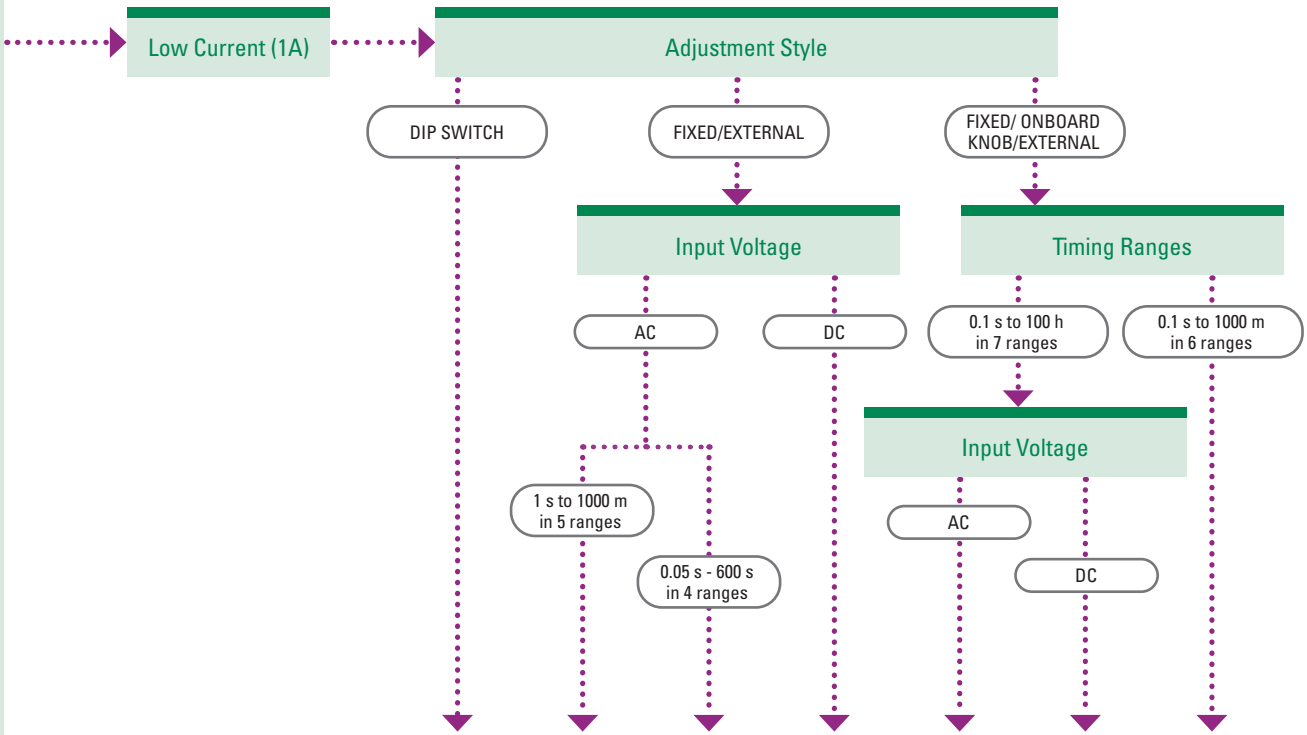
STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

DEDICATED — SINGLE FUNCTION

(Continued from previous page)



TDUI SERIES *pg. 374*

TSD7 SERIES *pg. 386*

TS2 SERIES *pg. 380*

TS6 SERIES *pg. 380*

TSD2 SERIES *pg. 382*

TSD6 SERIES *pg. 384*

KSD2 SERIES *pg. 368*

DEDICATED — SINGLE FUNCTION

Wide product offering to meet OEM and industrial requirements

RECYCLING

- Package Style
  - 8-PIN PLUG-IN → **TDR SERIES** *pg. 410*
  - SURFACE MOUNT → Relay Output
- Relay Output
  - N → Solid-State with Normally Open Contacts
  - Y → Isolated
- Solid-State with Normally Open Contacts → Recycling Flashers
- Recycling Flashers
  - N → (next)
  - Y → High Current (6, 10, or 20A)
- Isolated
  - Y → Contacts Type
    - SPDT → Adjustment Style
      - FIXED/ ONBOARD KNOB → **KRDR SERIES** *pg. 400*
      - FIXED/ONBOARD KNOB/EXTERNAL → **KRD3 SERIES** *pg. 398*
    - DPDT → **ERD3425A** *pg. 391*
  - N → Timing Ranges
    - 0.1 s to 1000 m in 6 ranges → **HRDR SERIES** *pg. 396*
- High Current (6, 10, or 20A)
  - Y → **THD3C42A0** *pg. 412*
  - N → Low Current (1A)
    - Extended Operating Temperature Range
      - Y → FIXED → **TSD3411S** *pg. 414*
      - N → 0.1 s to 1000 m in 6 ranges → **KSD3 SERIES** *pg. 402*

STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

DEDICATED — SINGLE FUNCTION

(Continued from previous page)

PERCENTAGE

Adjustment Style

- DIP SWITCH
- EXTERNAL
- KNOB/EXTERNAL/FIXED

Input Voltage

- AC/DC
- AC

RS SERIES
pg. 408

KSDR SERIES
pg. 404

ESDR SERIES
pg. 393

TSDR SERIES
pg. 416

Recycling Timers

PTHF4900DK
pg. 418

Percentage Timers

TIMERS

DEDICATED

Wide product offering to meet OEM and industrial requirements

DUAL FUNCTION

- DELAY-ON-MAKE/ DELAY-ON-BREAK
- DELAY-ON-MAKE/ INTERVAL

HVAC

- Lockout Delay
  - Y → Anti-short Cycle with Random Start
    - Y
    - N → Low Voltage Brownout Protection
      - Y
      - N
  - N → Anti-short Cycle with Random Start
    - Y
    - N → Fan Delay

COIN VENDING

TDMB SERIES
pg. 420

ESD5 SERIES
pg. 422

T2D120A15M SERIES
pg. 428

TSA141300
pg. 436

TA SERIES
pg. 430

TL SERIES
pg. 434

TAC1 SERIES
pg. 432

CT SERIES
pg. 426

HRV SERIES
pg. 437

Dedicated Timers – Dual Function

Dedicated Timers – HVAC

Dedicated Timers – Coin Vending

FLASHERS, TOWER & OBSTRUCTION LIGHTING CONTROL

STEP 1 Select product category

STEP 2 Select the needed features in each category

STEP 3 Find the recommended product for your application

FLASHERS

Designed to cycle power to lamps and LEDs to turn them on and off repeatedly

Solid-State with No Moving Parts

- Y → 3 or 4 Channel Chaser Designed for Sequential Circuit Flashing of Incandescent Lamp Loads
  - Y → **SC3/SC4 SERIES** *pg. 453*
  - N → Flashes Per Minute (FPM)
    - 10-100 ON-BOARD ADJUSTABLE
    - 45-150 (CUSTOM) 75 (FIXED)
    - 10-180 (CUSTOM) 90 (FIXED)
    - 45-150 (CUSTOM) 75 (FIXED)
    - 60-150 (CUSTOM) 75 (FIXED)

For Controlling Inductive, Incandescent, or Resistive Loads

- 24-240VAC; 1, 6, 10 or 20 AMP → **FSU1000 SERIES** *pg. 440*
- 24 or 120VAC LOW AMP → **FS126 FS127 FS146** *pg. 442*
- Medium Amp
  - 24, 120, or 230VAC → **FS143 FS152 FS162** *pg. 444*
  - 12VDC → **FS219-45** *pg. 446*
  - 24VDC → **FS224** *pg. 446*

Low Leakage for Controlling LED or Resistive Loads → **FS491** *pg. 450*

High Immunity to Line Noise and Transients for Moving Vehicle Applications

- 12VDC → **FS312** *pg. 448*
- 24VDC → **FS324** *pg. 448*

- N → 8-PIN SOCKET → **FS500 SERIES** *pg. 451*

FLASHERS, TOWER & OBSTRUCTION LIGHTING CONTROL

ALARM RELAYS

Monitors any failures in flashers & incandescent beacons, obstruction and universal lamps

FLASHER AND INCANDESCENT BEACON

Used to Monitor the Operation of One Two-lamp Incandescent Beacon and One Beacon Flasher

FB SERIES
pg. 457

BEACON OR OBSTRUCTION LAMP

Used to Provide Remote Monitoring of Steady Burning Incandescent Marker and Obstruction Lighting

SCR490D
pg. 458

UNIVERSAL LAMP

Designed to Sense the Failure of Various Kinds of Lamps

BEACON LAMPS/ STEADY SIDE LIGHTS

SCR SERIES
pg. 459

FLASHING LED BEACON LAMPS

FB9L
pg. 461

FLASHING/STEADY LED BEACON LAMPS/ OBSTRUCTION LAMPS

SCR9L
pg. 463

FLASHERS, TOWER & OBSTRUCTION LIGHTING CONTROL

BEACON TOWER FLASHERS

Designed for use on communication towers, smoke stacks, cooling towers, tall buildings, bridges, and utility towers

FLASHER (OFF FIRST)

AUXILIARY MODULES

FS SERIES
pg. 455

FA SERIES
pg. 455

Beacon Tower Flashers

PHOTO CONTROL

Designed to meet the demands of the most vigorous requirement tower & obstruction lighting control. Factory calibrated to meet FAA and FCC specifications

PCR SERIES
pg. 465

Photo Control

GROUND-FAULT PROTECTION

Create safer working environments and reduce incidents of arc flash without affecting the uptime of critical operations. Vital in manufacturing and processing environments, sensitive ground-fault relays with advanced filtering will detect breakdown in insulation resistance without nuisance trips. Breakdown in insulation resistance can be caused by moisture, vibration, chemicals and dust.

Ungrounded AC Systems

EL3100 Series Ground-Fault & Phase-Voltage Indicator 44
PGR-3100 Series Ground-Fault Indication System 45
PGR-3200 Series Insulation Monitor 46

Ungrounded DC System

SE-601 Series DC Ground-Fault Monitor 47

AC/DC Earthed System

EL731 Series AC/DC Sensitive Earth-Leakage Relay 48

Solidly Grounded Systems

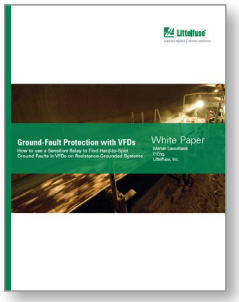
SE-701 Series Ground-Fault Monitor 50
SE-703 Series Earth-Leakage Monitor 51
SE-704 Series Earth-leakage monitor 52

Ground-Fault Circuit Interrupters – Personnel Protection

SB5000 Series Industrial Shock Block 53
SB6000 Series Industrial Shock Block 55

Generator and Single-Function

PGR-4300 Series Generator Ground-Fault Relay 57



For More Information…
and to download our White Paper on Ground-Fault Protection with VFDs, visit
Littelfuse.com/TechnicalCenter

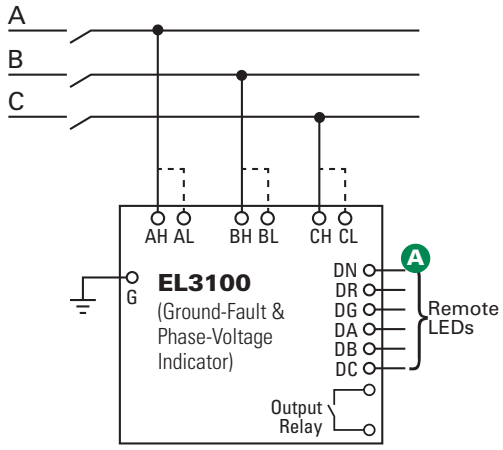
EL3100 SERIES

Ground-Fault & Phase-Voltage Indicator

Description

The EL3100 is a self-powered ground-fault and phase-voltage indication system for 3-phase systems. The EL3100 meets the National Electrical Code (NEC) and the Canadian Electrical Code (CEC) requirements for ground detectors for ungrounded alternating-current systems. Voltage connections are provided on the EL3100 for 208, 240, 480, and 600-V systems. Three green LED's on the EL3100 indicate the presence of phase-to-ground voltage and one red LED indicates a ground fault. The EL3100 can operate stand-alone or with up to five remote LED indicators. A solid-state relay output provides indication of a ground fault. The output relay is closed when the 3-phase neutral voltage shifts as the result of ground leakage.

Simplified Circuit Diagram



Features & Benefits

FEATURES	BENEFITS
NEC® and CEC Code compliant	Meets National Electrical Code (NEC®) Article 250.21 and Canadian Electrical Code Part 1, Section 10-106 (2) requirements for ungrounded systems
Low-voltage remote LEDs	System voltage is not present at the remote LED location
Phase-voltage indication	Indicates the presence of voltage on both grounded and ungrounded systems
Output relay	Allows for remote ground-fault indication

Accessories

A

Remote LEDs
High-intensity 16-mm IP67 LED lamps available in red and green colors.

Ordering Information

ORDERING NUMBER	MOUNTING
EL3100-00	DIN, Surface

ACCESSORIES	REQUIREMENT
RK-310X-0Y	Optional

Note: X=R for red LED and G for green LED
Y=0 for no label and 1 for a ground-fault label

Specifications

Input Voltage Input L: 208/240 Vac
Input H: 480/600 Vac

Dimensions **H** 87.0 mm (3.43"); **W** 112.5 mm (4.43")
D 56.0 mm (2.2")

Approvals CSA certified, UL Listed (E340889), RCM (Australia)

Conformally Coated Standard feature

Warranty 5 years

Mounting DIN, Surface

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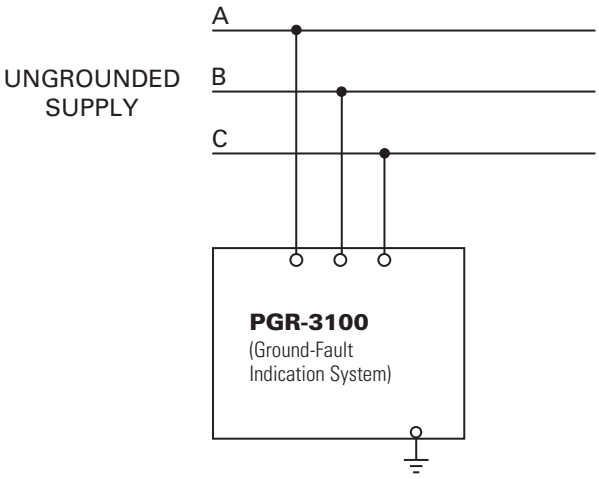
PGR-3100 SERIES

Ground-Fault Indication System

Description

The PGR-3100 indicates the presence of voltage on each phase of a three-phase system. The LEDs on the panel illuminate when voltage is present. When a ground-fault occurs, the voltage on the faulted phase reduces to ground potential, causing the LEDs for the faulted phase to dim and the LEDs for the unfaulted phases to become brighter. Ungrounded ac systems are required by the National Electrical Code (NEC®) Article 250.21(B) and the Canadian Electrical Code Part 1, Section 10-106 (2) to have ground detectors, such as the PGR-3100, installed on the system. External potential transformers (PTs) can be used to step down system voltage, allowing the PGR-3100 to be applied to any system voltage. PTs are not required for system voltages up to 600 V ac.

Simplified Circuit Diagram



Features & Benefits

FEATURES	BENEFITS
NEC® and CE Code compliant	Meets National Electrical Code (NEC) Article 250.21(B) and Canadian Electrical Code Part 1, Section 10-106 (2) requirements for ungrounded systems
Phase LEDs	Indicates presence of a ground fault and the faulted phase as well as phase-to-ground voltage on an energized bus
Redundant LEDs	Redundant long-life LEDs (two per phase) to ensure reliability
Lamp test button	Verifies LEDs are operating

Specifications

Input Voltage	Up to 600 V ac 50/60 Hz
Indicator Off Voltage	< 30 V ac line to ground
Dimensions	**H** 88.9 mm (3.5”); **W** 108 mm (4.3”); **D** 54 mm (2.1”)
Test Button	Local
Approvals	CSA certified, UL Listed
Conformally Coated	Standard feature
Warranty	5 years
Mounting	Panel

Ordering Information

ORDERING NUMBER	MOUNTING
PGR-3100	Panel mount

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PGR-3200 SERIES

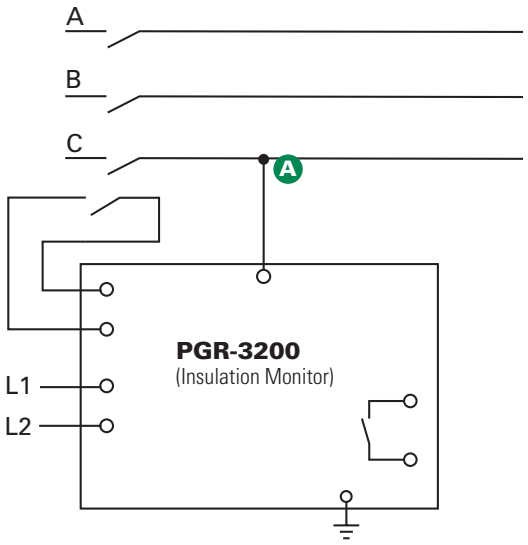
Insulation Monitor

Description

The PGR-3200 detects ground faults by continuously monitoring the insulation integrity of ungrounded electrical systems. The relay monitors the insulation for damage and assists with predictive maintenance and troubleshooting of developing ground faults by providing two warning and an alarm level. The PGR-3200 operates on one- or three-phase ungrounded systems up to 6 kV.

The PGR-3200 can also be used on a grounded system to monitor the insulation for damage, while the power system is de-energized. The mode-of-operation terminals (27-28) are connected to the circuit breaker or contactor auxiliary contacts to toggle the relay off when the contactor or breaker is closed.

Simplified Circuit Diagram



Features & Benefits

FEATURES	BENEFITS
NEC® and CEC Code compliant	Meets National Electrical Code (NEC®) Article 250.21(B) and Canadian Electrical Code Part 1, Section 10-106 (2) requirements for ungrounded systems
Output contact (50 kΩ)	Form C output contact for alarming when the insulation resistance is below 50 kΩ
Output contact (10 kΩ)	Form C output contact for tripping when the insulation resistance is below 10 kΩ
Analog output (0-1 mA)	Provides means for connecting to an optional meter (PGA-0510) or control system
DIN-rail or surface mount	Flexible options for ease of installation

Accessories

A

PGH Series High-Tension Coupler
A PGH Series high-tension coupler is required for systems between 1,300 V and 6,000 V.

PGA-0510 Analog Ohm Meter
Optional PGA-0510 Analog Meter allows for metering of insulation resistance.

Ordering Information

ORDERING NUMBER	CONTROL POWER
PGR-3200	240 Vac(1)
PGR-3200-120	120 Vac

ACCESSORIES	REQUIREMENT
PGH Series	Required >1,300 V
PGA-0510	Optional

Note: For optional conformal coating please consult factory. To convert to a resistance grounded system, see neutral-grounding-resistors packages.

(1) UL Not Available

Specifications

IEEE Device Numbers	Undervoltage Relay (27) Ground Detector Relay (64)
Input Voltage	*See ordering information*
Dimensions	**H** 75 mm (3"); **W** 100 mm (3.9"); **D** 115 mm (4.5")
Resistance Ratings	Insulation warning (30 kΩ and 50 kΩ) Insulation alarm (10 kΩ)
Contact Operating Mode	Non-fail-safe
Test Button	Local
Reset Button	Local and remote
Output Contacts	Two Form C
Analog Output	0-1 mA
Conformally Coated	Consult factory
Approvals	UL Listed (E183688)
Warranty	5 years
Mounting	DIN, Surface

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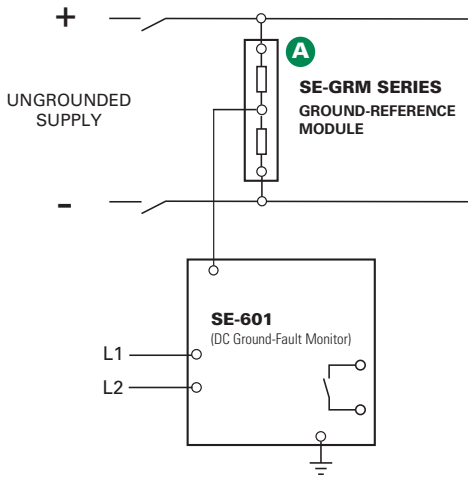
SE-601 SERIES (PGR-2601)

DC Ground-Fault Monitor

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	CONTROL POWER
SE-601-OU	120/240 Vac/Vdc
SE-601-OD	12/24 Vdc
SE-601-OT	48 Vdc

ACCESSORIES	REQUIREMENT
SE-GRM SERIES	Required
PGA-0500	Optional
PMA-55	Optional
PMA-60	Optional

Note: For optional conformal coating please consult factory.

Description

The SE-601 is a microprocessor-based ground-fault relay for ungrounded dc systems. It provides sensitive ground-fault protection without the problems associated with nuisance tripping. Ground-fault current is sensed using an SE-GRM Series Ground-Reference Module—a resistor network that limits ground-fault current to 25 mA. The SE-601 is used on ungrounded dc systems ranging from industrial 24-Vdc control circuits to 1000-Vdc solar and transportation systems.

Features & Benefits

FEATURES	BENEFITS
Adjustable pickup (1-20 mA)	Ten settings provide a wide range of low-level protection
Adjustable time delay (50 ms-2.5 s)	Adjustable trip delay allows quick protection or delayed response
Output contacts	Form A and Form B output contacts for operation of separate annunciation and trip circuits
Analog output (0-5 V)	Provides means for connecting to a meter (PGA-0500) or a control system
Non-volatile trip Memory	Retains trip state when de-energized to simplify troubleshooting
Selectable contact operating mode	Selectable fail-safe or non-fail-safe operating modes allow connection to shunt or undervoltage breaker coil
Microprocessor based	No calibration required saves on maintenance cost

Accessories

A

SE-GRM Series Ground-Reference Module
Required accessory, used to connect the SE-601 DC Ground-Fault Monitor to the DC bus.

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of 22 mA.

Specifications

IEEE Device Numbers	DC Overcurrent Relay (76G)
Input Voltage	See ordering information
Dimensions	**H** 75 mm (3.0"); **W** 55 mm (2.2"); **D** 115 mm (4.5")
Trip Level Settings	1-20 mA
Trip Time Settings	0.05-2.5 s
Output Contacts	Isolated Form A and Form B
Contact Operating Mode	Selectable fail-safe or non-fail-safe
Test Button	Local
Reset Button	Local and remote
Analog Output	0-5 V
Conformally Coated	Consult factory
Approvals	CSA certified, UL Listed (E340889), CE (European Union), C-Tick (Australian)
Warranty	5 years
Mounting	DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

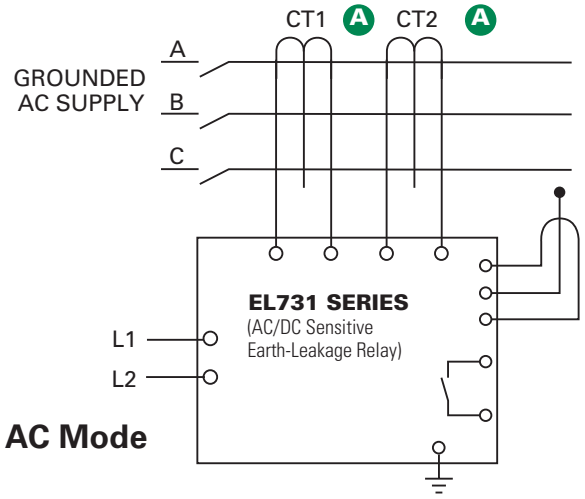
EL731 SERIES

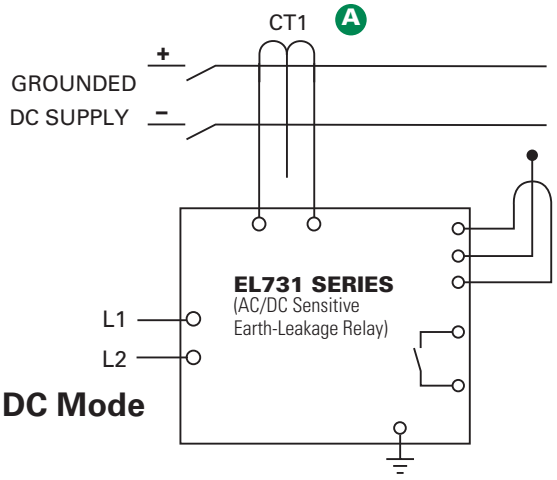
AC/DC Sensitive Earth-Leakage Relay

Description

The EL731 is a microprocessor-based AC/DC Sensitive Earth-Leakage Relay that offers complete coverage for all frequencies from 0 to 6,000 Hz. Two CTs are required for the entire frequency range, or one CT can be used for only low- or high-frequency detection. An RTD/PTC sensor input allows over-temperature protection for a motor or drive. The EL731 offers metering, password-protected alarm and trip settings and optional network communications. It is primarily used to add low-level ground-fault protection to variable-speed drives, and to dc circuits.

Simplified Circuit Diagram





For detailed wiring diagram, see adjacent page.

Ordering Information

ORDERING NUMBER	CONTROL POWER	COMMUNICATIONS
EL731-00-X0	120/240 Vac/Vdc	None
EL731-01-X0	120/240 Vac/Vdc	DeviceNet™
EL731-02-X0	120/240 Vac/Vdc	Profibus®
EL731-03-X0	120/240 Vac/Vdc	EtherNet/IP™
EL731-04-X0	120/240 Vac/Vdc	Modbus® TCP
EL731-10-X0	48 Vdc & 24 Vac	None
EL731-11-X0	48 Vdc & 24 Vac	DeviceNet™
EL731-12-X0	48 Vdc & 24 Vac	Profibus®
EL731-13-X0	48 Vdc & 24 Vac	EtherNet/IP™
EL731-14-X0	48 Vdc & 24 Vac	Modbus® TCP
EL731-20-X0	24 Vdc	None
EL731-21-X0	24 Vdc	DeviceNet™
EL731-22-X0	24 Vdc	Profibus®
EL731-23-X0	24 Vdc	EtherNet/IP™
EL731-24-X0	24 Vdc	Modbus® TCP

Accessories

A

EFCT Series Earth-Fault Current Transformer
Required zero-sequence current transformer specifically designed for low level detection.

AC700-CUA Series Communication Adapter
Optional network-interface and firmware-upgrade communications adapters field-install in EL731.

AC700-SMK DIN-rail & Surface-mount Adapter
EL731 plugs into adapter for back-plane mounting.

ACCESSORIES	REQUIREMENT
EFCT Series CT	One Required
AC700-CUA Series Com. Unit	Optional
AC700-SMK Surface-Mount Kit	Optional
AC700-CVR-00 Watertight Cover (IP66) for Panel-Mount Applications	Optional
PGA-0520 Analog Meter	Optional

Note: When building a part number, replace the "X" with "1" for AS/NZS 2081:2011 Compliant product, "0" otherwise.

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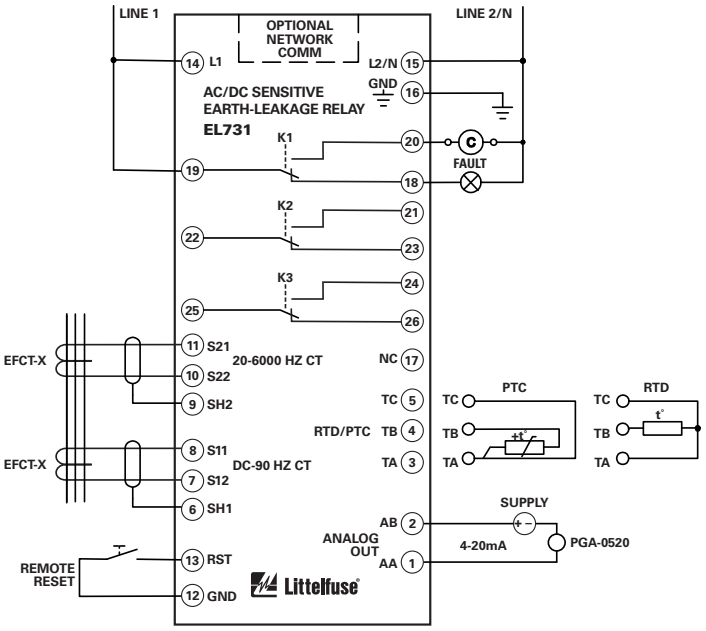
EL731 SERIES

AC/DC Sensitive Earth-Leakage Relay

Features & Benefits

FEATURES	BENEFITS
Adjustable pickup (30-5,000 mA)	Adjustable trip setting provides a wide range of low-level protection and system coordination
Frequency range (0-90 Hz, 20-6,000 Hz)	Operate in either AC or DC mode or both. Use single or combined ranges. Separate metering
32-char OLED display	Earth-leakage metering, setup and programming
Local LED indication	Visual Trip, Alarm, CT connection indication
CT-Loop monitoring	Alarms when CT is not connected
Analog output (4-20 mA)	Connect to DCS. Allows connection to an optional meter (PGA-0520) or control system
Adjustable time delay	Adjustable trip delay for quick protection and system coordination
Alarm and trip settings	Detect a deteriorating condition before damage occurs
Temperature-sensor input	Drive or motor temperature protection
Output contacts	3 programmable: Operate 2 alarm and 1 trip circuit
Network communication	Optional connection to plant network
Harmonic filtering	Eliminates nuisance tripping due to harmonic noise
Microprocessor based	No required calibration saves maintenance cost
Universal power supply	Provides flexibility for numerous applications

Wiring Diagram



Specifications

IEEE Device Numbers	AC ground fault (50G/N, 51G/N), DC ground fault (79G), PTC overtemperature (49), RTD temperature (38, 49)
Supply Voltage	120/240 Vac/Vdc, 24 Vdc, 48 Vdc/24 Vac
Trip Level Settings	30-5,000 mA AC and DC
Alarm Level Settings	30-5,000 mA AC and DC
Trip Delay	0.05-2 s
Output Contacts	3 Form C (programmable)
Contact Operating Mode	Fail-safe & non-fail-safe
Reset	Front panel and remote
Freq. Response, CT1	0-90 Hz
Freq. Response, CT2	20-6,000, 190-6,000, 20-90, 20-3,000 Hz; selectable
Current Transformer	EFCT-x series
CT Detection	Open & short detection
Terminals	Plug-in, wire clamping, 24 to 12 AWG (0.2-2.5 mm^2)
Communications	EtherNet/IP™, DeviceNet™, Profibus®, Modbus® TCP (optional)
Analog Output	4-20 mA (selectable 0-5 A or 0-100% trip-level setting)
Conformal Coating	Standard feature
Dimensions	**H** 48 mm (1.9"); **W** 96 mm (3.8"); **D** 129 mm (5.0")
Approvals	UL Listed (E340889), CSA, RCM (Australia), CE
Warranty	5 years
Mounting	Panel; Surface and DIN (with optional AC700-SMK)

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SE-701 SERIES (PGR-5701)

Ground-Fault Monitor

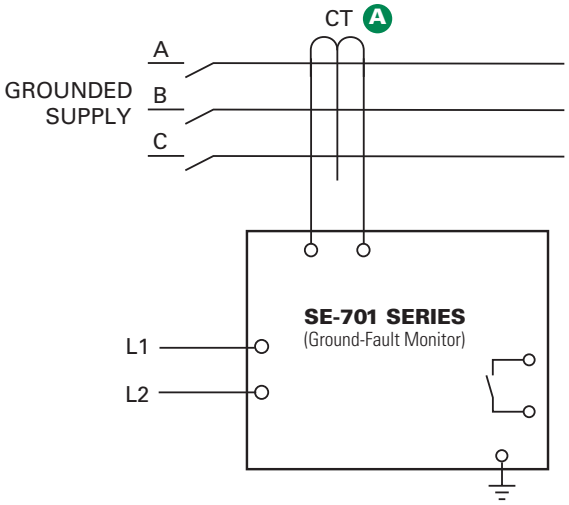
Description

The SE-701 is a microprocessor-based ground-fault relay for resistance- and solidly-grounded systems. In addition to common systems, it is uniquely suited for use on systems with significant harmonic content. The SE-701 can provide main-plant protection, feeder-level protection, or individual-load protection. Proper current transformer selection provides the desired pickup range. The output contacts can be connected for use in protective tripping circuits or in alarm indication circuits. The analog output can be used with a PLC or a meter.

Features & Benefits

FEATURES	BENEFITS
Adjustable pickup (1-99%)	Trip setting based on input CT primary, allows use with any CT. Minimum 50 mA with EFCT Series.
Adjustable time delay (50 ms-2.5 s)	Adjustable trip delay allows quick protection and system coordination
Output contacts	Form A and Form B ground-fault output contacts for operation of separate annunciation and trip circuits
Analog output (0-5 V)	Allows for connecting an optional meter (PGA-0500) or a control system
CT-Loop monitoring	Alarms when CT is not connected
Selectable DFT or peak detection filtering	Compatible with variable-speed drives
Harmonic filtering	Eliminates nuisance tripping
Non-volatile trip memory	Retains trip state while de-energized to simplify troubleshooting
Microprocessor based	No calibration required, saves on maintenance cost
Universal power supply	Allows operation in application where one side of PT is faulted, provides flexibility for numerous applications

Simplified Circuit Diagram



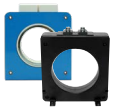
Ordering Information

ORDERING NUMBER	CONTROL POWER
SE-701-0U	120/240 Vac/Vdc
SE-701-0D	12/24 Vdc
SE-701-0T	48 Vdc
SE-701-03	24 Vac

ACCESSORIES	REQUIREMENT
Current Transformer	Required
PGA-0500	Optional
PMA-55, PMA-60	Optional
SE-EFVC Voltage Clamp	Optional

Note: For optional conformal coating please consult factory.

Accessories

A 

Ground-Fault Current Transformer
Required current transformer model depends on application. We offer a variety of sensitive CTs with 5- and 30-A primaries.

B

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of the CT primary rating.

Specifications

IEEE Device Numbers	Ground fault (50G/N, 51G/N)
Input Voltage	See ordering information
Dimensions	**H** 75 mm (3.0"); **W** 55 mm (2.2"); **D** 115 mm (4.5")
Trip Level Settings	1-99% CT-Primary Rating
Trip Time Settings	0.05-2.5 s
Contact Operating Mode	Selectable fail-safe or non-fail-safe
Harmonic Filtering	Standard feature
Test Button	Standard feature
Reset Button	Standard feature
CT-Loop Monitoring	Standard feature
Output Contacts	Isolated Form A and Form B
Approvals	CSA certified, UL Listed (E340889), CE (European Union), C-Tick (Australian)
Analog Output	0-5 V
Conformally coated	Consult factory
Warranty	5 years
Mounting	DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

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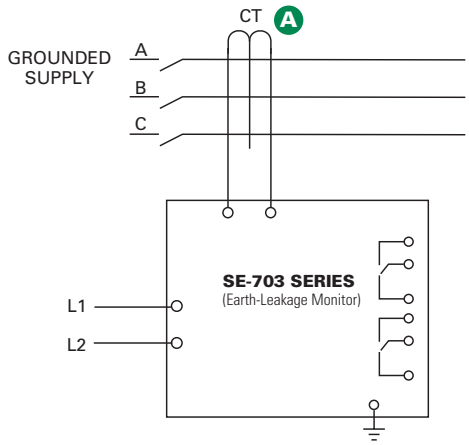
SE-703 SERIES

Earth-Leakage Monitor

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	CONTROL POWER
SE-703-0U-0x	120/240 Vac/Vdc
SE-703-0D-0x	12/24 Vdc
SE-703-0T-0x	48 Vdc
SE-703-03-0x	24 Vac

Note: x=0 for AS/NZS 2081:2011 compliance (fail-safe output contacts)
x=2 for AS/NZS 2081:2002 compliance (selectable fail-safe or non-fail-safe output contacts

ACCESSORIES	REQUIREMENT
EFCT Series	Required
PGA-0500	Optional
PMA-55	Optional
PMA-60	Optional
SE-EFVC Voltage Clamp	Optional

Description

The SE-703 is a microprocessor-based earth-fault relay for resistance- and solidly earthed systems. It offers sensitive earth-fault detection as low as 25 mA and can be used on systems with significant harmonic content. The SE-703 provides feeder-level protection or individual-load protection. The output contacts can be connected for use in protective tripping circuits or in alarm indication circuits. The analog output can be used with a PLC or a meter. The SE-703 is specifically designed to be AS/NZS 2081 compliant to either 2011 or 2002 (see ordering options).

Features & Benefits

FEATURES	BENEFITS
Adjustable pickup (25-500 mA)	Adjustable trip setting provides a wide range of low-level protection and system coordination
Adjustable time delay (INST-500 ms)	Adjustable trip delay allows quick protection and system coordination
Output contacts	2 Form C ground-fault output contacts for operation of separate annunciation and trip circuits
Analog output (0-5 V)	Allows for connecting an optional meter (PGA-0500) or control system
CT-Loop monitoring	Alarms when CT is not connected
Contact operating mode	Fail-safe operating mode for undervoltage applications, optional non-fail-safe mode available
Harmonic filtering	Eliminates nuisance tripping
Non-volatile trip memory	Retains trip state while de-energized to simplify troubleshooting
Microprocessor based	No calibration required, saves maintenance cost
Universal power supply	Allows operation in application where one side of PT is faulted, provides flexibility for numerous applications
Global certifications	Compliant with US, Canadian, European, and Australian standards for applications in almost any country

Accessories

A

EFCT Series Ground-Fault Current Transformer
Required zero-sequence current transformer specifically designed for low-level detection.

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of the set-point or 5 A.

PMA-60 Series – Mounting Adapter
Required when panel mounting for AS/NZS 2081:2011 compliance

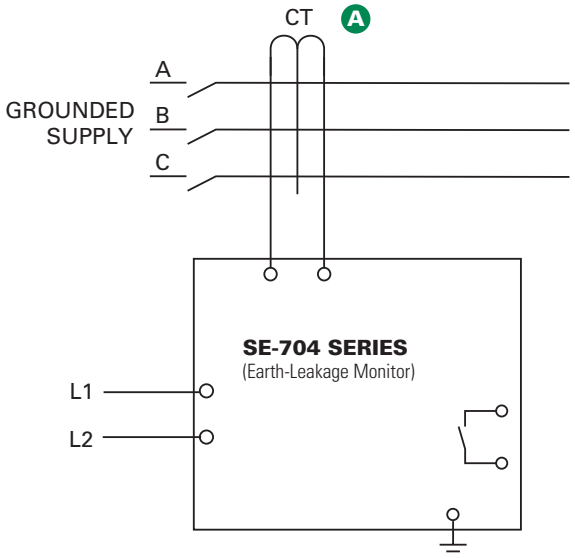
Specifications

IEEE Device Numbers	Ground fault (50G/N, 51G/N)
Input Voltage	See ordering information
Dimensions	**H** 75 mm (3.0"); **W** 55 mm (2.2"); **D** 115 mm (4.5")
Trip Level Settings	25-500 mA
Trip Time Settings	INST-500 ms
Contact Operating Mode	Fail-safe (x=0 models) or selectable (x=2 models)
Harmonic Filtering	Standard feature
Test Button	Standard feature
Reset Button	Standard feature
CT-Loop Monitoring	Standard feature
Output Contacts	Two isolated Form C contacts
Approvals	CSA certified, UL Listed (E340889),
Compliance	CE (European Union), RCM (Australian) AS/NZS 2081:2011 (x=0 models) or AS/NZS 2081: 2002 (x=2 models)
Analog Output	0-5 V
Conformally coated	Yes
Warranty	5 years
Mounting	DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

SE-704 SERIES (PGR-4704)

Earth-Leakage Monitor

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	CONTROL POWER
SE-704-0U	120/240 Vac/Vdc
SE-704-0D	12/24 Vdc
SE-704-0T	48 Vdc
SE-704-03	24 Vac

ACCESSORIES	REQUIREMENT
SE-CS30 Series	Required
PGA-0500	Optional
PMA-55, PMA-60	Optional

Note: For optional conformal coating please consult factory.

Description

The SE-704 is a microprocessor-based ground-fault relay for resistance- and solidly-grounded systems. It offers very sensitive ground-fault detection as low as 10 mA and can be used on systems with significant harmonic content. The output contacts can be connected for use in protective tripping circuits (such as for marina or boatyard feeder circuits) or in alarm indication circuits. The analog output can be used with a PLC or a meter. The SE-704 can be integrated with a shunt trip circuit breaker to meet CE code C22.1-21 Section 78-052(2) and NEC article 555.35(A)(1), 555.35(3), and 555.53 for marina applications.

Features & Benefits

FEATURES	BENEFITS
Adjustable pickup (10 mA–5 A)	Adjustable trip setting provides a wide range of low-level protection and system coordination
Adjustable time delay (30 ms–2.0 s)	Adjustable trip delay allows quick protection and system coordination
Output contacts	Form A and Form B ground-fault output contacts for operation of separate annunciation and trip circuits
Analog output (0–5 V & 0–1 mA)	Allows for connecting an optional meter (PGA-0500) or control system
CT-Loop monitoring	Alarms when CT is not connected
Selectable contact operating mode	Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil
Harmonic filtering	Eliminates nuisance tripping
Non-volatile trip memory	Retains trip state when de-energized to simplify troubleshooting
Microprocessor based	No calibration required saves maintenance cost
Universal power supply	Allows operation in application where one side of PT is faulted, provides flexibility for numerous applications

Accessories

A

ELCT30 or SE-CS30 Series Current Transformer
Required zero-sequence current transformer specifically designed for low level detection. Flux conditioner is included to prevent saturation.

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of the set-point or 5 A.

Specifications

IEEE Device Numbers	Ground fault (50G/N, 51G/N)
Input Voltage	See ordering information
Dimensions	**H** 75 mm (3.0"); **W** 55 mm (2.2"); **D** 115 mm (4.5")
Trip Level Settings	10 mA–5.0 A
Trip Time Settings	30–2000 ms
Contact Operating Mode	Selectable fail-safe or non-fail-safe
Harmonic Filtering	Standard feature
Test Button	Standard feature
Reset Button	Standard feature
CT-Loop Monitoring	Standard feature
Output Contacts	Isolated Form A and Form B
Approvals	UL Listed (E340889), CSA, CE (European Union) RCM (Australian)
Analog Output	0–5 V & 0–1 mA
Conformally coated	Optional
Warranty	5 years
Mounting	DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

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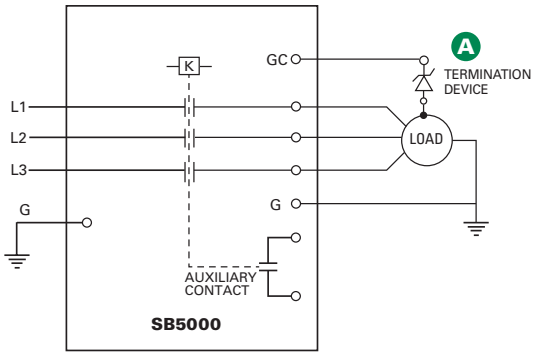
SB5000 SERIES

Industrial SHOCK BLOCK® LITTELFUSE® Products

Simplified Circuit Diagram



Features & Benefits

FEATURES	BENEFITS
UL 943 inverse time trip curve	Inverse time detection circuit protects people while also reducing the probability of nuisance tripping
DFT (Discrete Fourier Transform) filtering algorithm	Eliminates nuisance trips due to harmonics
Minimum trip time < 20 msec	Reduces the risk of ventricular fibrillation for leakage current of 250 mA and above
Fixed 6 mA (UL 943) or 20 mA (UL 943C) trip level	UL Listed GFCI and Special-Purpose GFCI personnel protection for industrial and commercial loads up to 60 A
Selectable trip levels (EGFPD)	The settings below 20 mA provide extra safety. The settings above 20 mA can reduce nuisance tripping on systems with high leakage current
Two-stage ground monitor with Zener termination that meets UL 943C, CSA M421	Proactively protects from shock by tripping if continuity of ground wire between Industrial Shock Block and load is broken
Flexible configuration	Selectable manual reset or autoreset for brownout, power up, and ground monitor interruptions to fit plant safety protocols
Conformal coating	Internal PWB is conformally coated to protect against corrosion and moisture
Auxiliary contact	Alerts your SCADA system if the Shock Block is energized or tripped
Automatic self-test	The Shock Block will continuously test itself and will trip if there is an internal failure
GFCI Class A, C, D and EGFPD options in one series	Simplified planning and operator familiarity for multiple applications/requirements

Description

Special-Purpose Ground-Fault Circuit Interrupter (SPGFCI), Class C and Class D

Industrial Shock Block (ISB) is a personnel protection device designed to meet the requirements for special-purpose GFCIs defined by UL 943C. This standard outlines GFCI classes specifically designed for use in industrial facilities. Class C GFCIs are intended to be used on three-phase systems where the line-to-line voltage is 480 V or less with a trip level of 20 mA, while Class D GFCIs are intended to be used on 600 V systems. The Industrial Shock Block includes DFT harmonic filtering, an automatic self-test feature and is compliant to the UL 1998 Software in Programmable Components standard.

Ground-Fault Circuit Interrupter (GFCI), Class A

The Shock Block is available as a 208 V Class A GFCI, allowing commercial kitchens, construction sites, and other non-dwelling units with wet areas to meet NEC 210.8(B) for their three-phase loads up to 60 A.

Equipment Ground-Fault Protective Device (EGFPD)

Industrial Shock Block is also available with adjustable protection settings as an EGFPD. The EGFPD models can be set to trip at 6 mA or from 10–100 mA in increments of 10 mA. This offers more flexibility since GFCI devices are not allowed to have an adjustable trip level.

Ratings and Models

Industrial Shock Block (GFCI & EGFPD) is available for three-phase voltages from 208 to 600 V with a maximum full load current of either 32 or 60 A. The power system can be either solidly or high-resistance grounded and the load must be three phase without a neutral.

The standard enclosure is IP 69K/NEMA 4X and outdoor rated, suitable for all industrial environments including high-temperature washdown used in food production. A Class II, Division 2 option is also available for applications where explosive dust may be present (future option).

Ground Wire (Load-Ground) Monitor

The Industrial Shock Block also monitors the ground wire (load-ground) connection between the Industrial Shock Block and load. This is a required feature for Class C and D GFCI devices and is recommended for Class A GFCI and EGFPD devices. If the ground-return path is broken, the Industrial Shock Block will trip and provide an alarm by changing the state of the alarm contacts. This monitoring circuit includes an extra wire (pilot wire) between the Industrial Shock Block and load. At the load, the pilot wire is connected to a termination device. The other end of the termination device is connected to the load ground (typically the enclosure).

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SB5000 SERIES

Ordering Information

ORDERING NUMBER	LOAD RATING (A)	VOLTAGE (V)	TRIP LEVEL (MA)	UL CLASS
SB5032-00x-0	32	208	20 (Fixed)	UL 943C Class C SPGFCI
SB5032-20x-0		480		
SB5032-30x-0		600		UL 943C Class D SPGFCI
SB5032-01x-0		208	6, 10–100 in increments of 10 (Selectable)	UL 943/UL 1053 EGFPD
SB5032-21x-0		480		
SB5032-31x-0		600		
SB5032-02x-0		208	6 (Fixed)	UL 943 Class A GFCI
SB5060-00x-0	60	208	20 (Fixed)	UL 943C Class C SPGFCI
SB5060-20x-0		480		
SB5060-30x-0		600		UL 943C Class D SPGFCI
SB5060-01x-0		208	6, 10–100 in increments of 10 (Selectable)	UL 943/UL 1053 EGFPD
SB5060-21x-0		480		
SB5060-31x-0		600		
SB5060-02x-0		208	6 (Fixed)	UL 943 Class A GFCI

Note: Replace x with 1 for IP 69K/NEMA 4X Enclosure; replace with 2 to add Class II, Division 2 rating (future option).

Accessories

Ⓐ

1N5339B - Termination Device
Axial-lead ground-check termination, included with SB5000 series

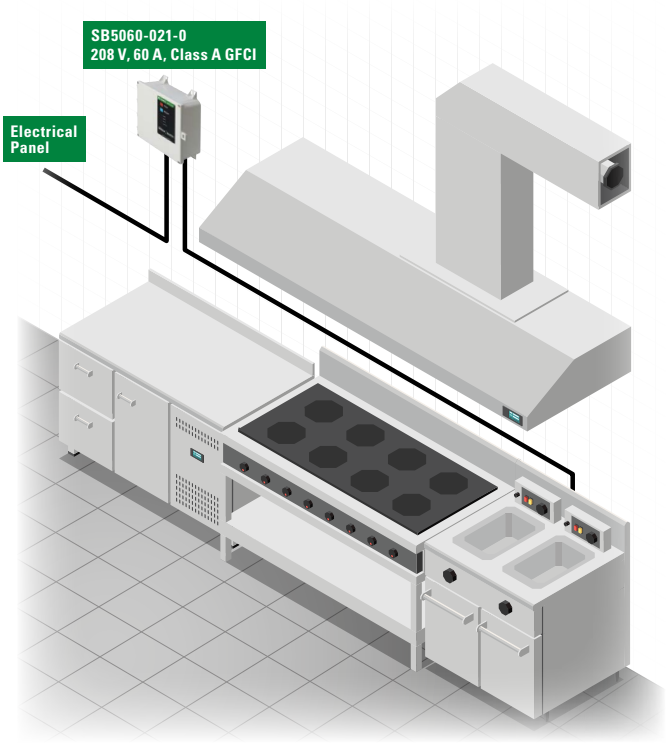
SE-TA6 - Termination Assembly
Optional termination assembly with terminals and mounting holes

SE-TA6-SM Stud-Mount Termination Assembly
Optional ground-check termination for submersible pumps

SE-TA6ASF-WL Series - Termination Assembly
Compact 12 W ground-check termination assembly

Connection Diagram

The SB5000 is installed in-line between incoming power or existing overcurrent protection device and the load.



Specifications

Voltage Rating	208 V, 480 V, 600 V
Current Rating	32 or 60 A (continuous)
System Type	Three-phase, 3-wire (no neutral), 60 Hz
Short-Circuit Current Rating	10,000 A
Trip Level Settings	Fixed at 6 mA (Class A models) Fixed at 20 mA (Class C/D models) Selectable 6, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 mA (EGFPD models)
Trip Time Setting	Inverse time curve according to UL 943
Ground Monitoring Circuit	Selectable short or Zener termination; Fail-safe; CSA M421 compliant
Enclosure	IP 69K and NEMA 4X (Outdoor), Polycarbonate, Lockable
Operating Temperature	-35 °C (-31 °F) to 40 °C (104 °F), up to 60 °C (151 °F) with derating
Approvals	cULus Listed Class A GFCI (UL 943) UL Listed Class C, D SPGFCI (UL 943C) cULus Listed EGFPD (UL 943/UL 1053) All models CSA Certified UL 1998
Dimensions	**H** 285.6 mm (11.25 in.); **W** 244.4 mm (9.62 in.); **D** 119.6 mm (4.71 in.)

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Littelfuse
Expertise Applied | Answers Delivered

SB6000 SERIES

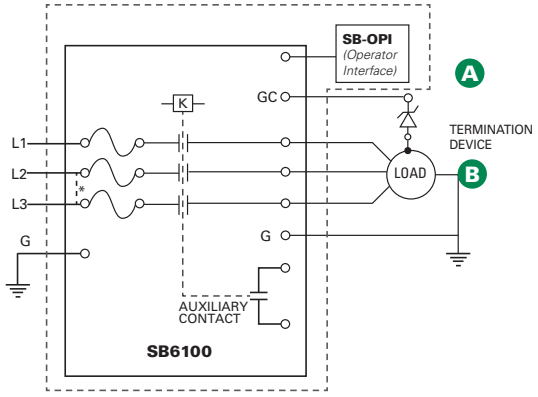
Industrial SHOCK BLOCK® LITTELFUSE® Products

Enclosed Model* Open-Chassis Model*

*Patented

Operator Interface*

Simplified Circuit Diagram



ENCLOSED SB6100 MODELS

Ordering Information

ORDERING NUMBER	VOLTAGE (V)	TRIP LEVEL (MA)	UL CATEGORY/CLASS
SB6100-00x-0	208	20 (Fixed)	UL 943C Class C special-purpose GFCI
SB6100-10x-0	240		
SB6100-20x-0	480		
SB6100-30x-0	600		UL 943C Class D special-purpose GFCI
SB6100-01x-0	208	6, 10–100 in increments of 10	UL 943/UL 1053 Equipment ground-fault protective device (EGFPD)
SB6100-11x-0	240		
SB6100-21x-0	480		
SB6100-31x-0	600		
SB6100-02x-0	208	6 (Fixed)	UL 943 Class A GFCI

Note: x=0 for open-chassis models and 1 for enclosed models

Description

Special-Purpose Ground-Fault Circuit Interrupter (GFCI), Class C and Class D

Industrial Shock Block (ISB) is a personnel protection device designed to meet the requirements for special-purpose GFCIs defined by UL 943C. This standard outlines GFCI classes specifically designed for use in industrial facilities. Class C GFCIs are intended to be used on three-phase systems where the line-to-line voltage is 480 V or less with a trip level of 20 mA, while Class D GFCIs are intended to be used on 600 V systems. The Industrial Shock Block includes an automatic self-test feature and is compliant to the UL 1998 Software in Programmable Components standard.

Ground-Fault Circuit Interrupter (GFCI), Class A

The Shock Block is available as a Class A GFCI, allowing commercial kitchens and commercial establishments with wet areas to meet NEC 210.8(B) for their 3-phase loads up to 100 A.

Equipment Ground-Fault Protective Device (EGFPD)

Industrial Shock Block is also available with adjustable protection settings as an EGFPD. The EGFPD models can be set to trip at 6 mA or from 10-100 mA in increments of 10 mA. This offers more flexibility since GFCI devices are not allowed to have an adjustable trip level.

Rating and Models

Industrial Shock Block (GFCI & EGFPD) is available for three-phase voltages from 208 to 600 V with a maximum full load current of 100 A, and a built-in overcurrent protection supplied by Littelfuse Class T fuses. The load must be 3-phase, however, cannot have a neutral. The power system can either be solidly-grounded or high-resistance grounded.

Two options for enclosures are available: UL-recognized open-chassis models are available for installation in existing electrical enclosures and UL-listed enclosed models include a NEMA-4X enclosure for stand-alone installations.

Ground Wire (Load-Ground) Monitor

The Industrial Shock Block also monitors the ground wire (load-ground) connection between the Industrial Shock Block and load. This is a required feature for Class C and D GFCI devices and and is recommended for Class A and EGFPD devices devices. If the connection is broken, the Industrial Shock Block will trip and provide an alarm by changing the state of the alarm contacts. This monitoring circuit includes an extra wire (pilot wire) between the Industrial Shock Block and load (since the monitoring current is low, only a small wire is required). At the load, the pilot wire is connected to a termination device. The other end of the termination device is connected to the load ground (typically the enclosure).

Features & Benefits

FEATURES	BENEFITS
UL 943 inverse time trip curve	Detects and interrupts to protect people and reduce the probability of nuisance tripping
Minimum trip time < 20 msec	Reduces the risk of ventricular fibrillation for leakage current of 250 mA and above
Fixed 6 mA (UL 943) or 20 mA (UL 943C) trip level	Personnel protection for industrial and commercial systems on loads up to 100 A
Selectable trip levels (EGFPD)	Provides extra safety when a customer is able to operate with a setting below 20 mA (GFCI) and the settings above 20 mA can reduce nuisance tripping on systems with high leakage current
UL 943C ground monitor/ interrupt	Protects from shock by tripping if continuity of ground wire between Industrial Shock Block and load is broken
Undervoltage, brownout, chatter detection	Ensures proper operation and prolongs the internal contactor lifetime
3 x Class T, 600 V incoming fuses	The fuses provide overcurrent protection for a 100 A circuit and a higher short-circuit current rating (SCCR) of 50 kA
Conformal coating	Internal circuits are conformally coated to protect against corrosion and moisture, yet still repairable
Operator Interface	Shows unit status, alarm types, percentage of leakage current, and allows for Test and Reset capabilities
Auxiliary Contact	Provides a normally-open contact for remote indication
Automatic Self-Test	All units include an automatic self-test feature include an automatic self-test feature
Motor Starter	Allows the user to start and stop the motor from the interface

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SB6000 SERIES

Accessories

A

Operator Interface (AC6000-OPI-00)

B

1N5339B - Termination Device
Axial-lead ground-check termination, included with SB6000 series

SE-TA6 - Termination Assembly
Optional termination assembly with terminals and mounting holes

SE-TA6-SM Stud-Mount Termination Assembly
Optional ground-check termination for submersible pumps

AC6000-CART-00 Two-wheeled Cart
Optional for mounting ISB to allow for moving the unit while power is off

AC6000-MNT-00 Mounting Frame
Optional for mounting ISB to a cart or other surface. Included with the AC6000-CART-00.

Ordering Information - Accessories

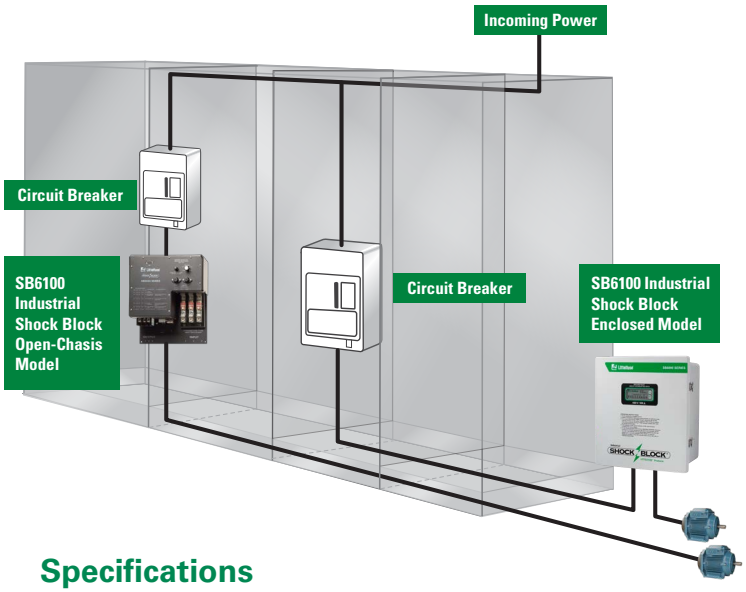
ACCESSORIES	REQUIREMENT	PAGE*
AC6000-OPI-00	Included	N/A
1N5339B	Included	120
SE-TA6	Optional	120
SE-TA6-SM	Optional	120
SE-TA6ASF-WL	Optional	120
AC6000-CART-00	Optional	N/A
AC6000-MNT-00	Optional	N/A

** Page in Protection Relay & Controls Catalog*

Connection Diagram

The SB6100 is installed in-line between incoming power or existing overcurrent protection device and the load.

The open-chassis SB6100 can be installed in electrical equipment and the enclosed version is typically wall-mounted.



Specifications

Voltage Rating	See ordering information
Current Rating	100 A (continuous)
System Type	3-phase, 3-wire (no neutral), 60 Hz
Short-Circuit Current Rating	50,000 A
Trip Level Settings	Selectable (6, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 mA), fixed at 6 mA, or fixed at 20 mA
Trip Time Setting	Inverse time trip curve
Enclosure	NEMA 4X, Polyester, Lockable
Operating Temperature	–35 °C (–31 °F) to + 40 °C (104 °F), up to + 66 °C (151 °F) with derating
Wiring Requirements	2/0 AWG (maximum)
Approval	GFCI: UL Listed (enclosed models) and UL Recognized Component (open-chassis models) EGFPD: cULus Listed (enclosed models) and cURus Recognized Component (open-chassis models); UL1998 Compliant (revision 01 or higher); All models except SB6100-02x-0 CSA Certified
Dimensions	**Enclosed: H** 453.8 mm (17.9"); **W** 406.2 mm (16.0"); **D** 223.3 mm (8.8") **Open-chassis: H** 455.0 mm (17.9"); **W** 340.7 mm (13.4"); **D** 174.9 mm (6.8")
Warranty	1 year

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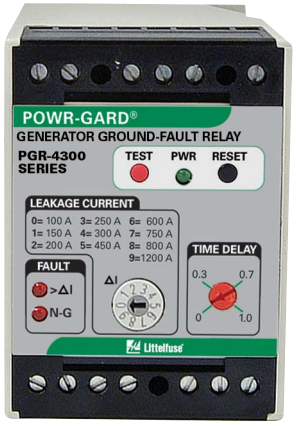
PGR-4300 SERIES (GFA300)

Generator Ground-Fault Relay



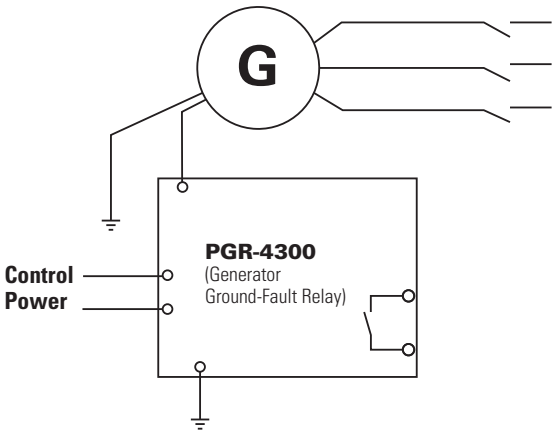
Description

The PGR-4300 Generator Ground-Fault Relay provides a simple method for detecting a ground-fault condition on generators without the need for current transformers (CTs). This greatly simplifies the installation. In addition, it is compatible with both three- and four-pole transfer switches. This relay also monitors the neutral-to-ground path for continuity. The PGR-4300 is ideal for any generator or application where there is not sufficient space to install CTs.

Features & Benefits

FEATURES	BENEFITS
No CTs required	Saves space and simplifies installation
Adjustable pickup (100-1200 A)	Adjustable trip setting provides a wide range of protection and allows system coordination
Adjustable time delay (0-1.0 s)	Adjustable trip delay allows quick protection and system coordination
Output contacts	Form C ground-fault output contacts for alarming or tripping purposes
Analog output (0-1 mA)	Provides means for connecting to an optional meter (PGA-0500) or control system
N-G continuity alarm	Monitors neutral-to-ground integrity and alarms if ground path becomes open circuit
Passive filtering	Eliminates nuisance tripping

Simplified Circuit Diagram



Accessories

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of the set-point.

Ordering Information

ORDERING NUMBER	CONTROL POWER
PGR-4300-12	12 Vdc
PGR-4300-24	24 Vdc
PGR-4300-120	120 Vac

ACCESSORIES	REQUIREMENT
PGA-0500	Optional
PMA-55	Optional
PMA-60	Optional

Note: For optional conformal coating please consult factory.

Specifications

IEEE Device Numbers	Ground Fault (50G/N, 51G/N)
Input Voltage	See ordering information
Dimensions	**H** 75 mm (3.0"); **W** 55 mm (2.2"); **D** 115 mm (4.5")
Trip Level Settings	100-1200 A
Trip Time Delay Settings	0-1.0 s
Contact Operating Mode	Non-fail-safe
Test Button	Local
Reset Button	Local and remote
Output Contacts	Form C
Analog Output	0-1 mA
Conformally Coated	Consult factory
Approvals	UL Listed (E183688)
Warranty	5 years
Mounting	DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

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GROUND-CONDUCTOR MONITORING

Continuously monitor the integrity of the ground conductor to protect portable equipment from hazardous voltages caused by ground faults.

SE-105 / SE-107 Series Ground-Fault Ground-Check Monitor..... 60
SE-134C / SE-135 Series Ground-Fault Ground-Check Monitor..... 61

For More Information…
and to download our technical note on Ground-Fault Ground-Check, visit
Littelfuse.com/Ground-faultPaper

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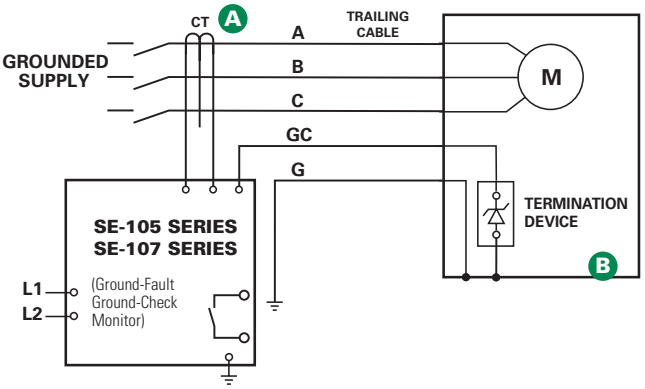
SE-105 / SE-107 SERIES

Ground-Fault Ground-Check Monitor

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	CONTROL POWER
SE-105	120 Vac
SE-105D	120 Vac/Vdc
SE-105E	240 Vac
SE-107	120 Vac
SE-107D	120 Vac/Vdc
SE-107E	240 Vac

Consult manual online for additional ordering options.

ACCESSORIES	REQUIREMENT
CT200 Series	Required
1N5339B	Included
SE-TA6, SE-TA6-SM	Optional
SE-TA6A Series	Optional
RK-102, RK-105, RK-105I	Optional
RK-13	Optional
PPI-600V	Optional

Description

The SE-105/SE-107 is a combination ground-wire monitor and ground-fault relay for resistance-grounded systems. It continuously monitors the integrity of the ground conductor to protect portable equipment from hazardous voltages caused by ground faults. The SE-105/SE-107 is an excellent choice for trailing cables 5 kV and under in underground mining applications. For higher voltages or long-cable applications, see the SE-134C/SE-135.

Features & Benefits

FEATURES	BENEFITS
Adjustable pickup (0.5, 2.0, 4.0 A)	Unit can be used on a wide variety of trailing cable applications
Adjustable time delay (0.1-2.0 s)	Adjustable trip delay for quick protection and system coordination
Harmonic filter	Prevents false operation
Zener-characteristic termination assembly	Provides reliable ground-check loop verification
Fail-safe ground-check circuit	Ensures ground-check circuit remains safe even in the event of equipment failure
Conformal coating	Additional coating protects circuit boards against harsh environment
SE-105: selectable UV- or shunt-trip mode	Provides flexibility for different applications
SE-107: UV-trip mode only	Eliminates chance of unauthorized change to trip circuit

Accessories

A

CT200 Series Current Transformer
Required CT detects ground-fault current.

B

1N5339B Termination Device
5 W axial-lead ground-check termination; included with SE-105/SE-107.

SE-TA6 Termination Assembly
Optional termination assembly with convenient terminals and mounting holes

SE-TA6-SM Stud-Mount Termination Assembly
Optional 50 W ground-check termination that is robust and compact for submersible pumps. Wire lead simplifies installation.

Specifications

IEEE Device Numbers — Checking or Interlocking Relay (3GC), Ground Fault (50G/N, 51G/N)
Input Voltage — See ordering information
Dimensions — **H** 150 mm (5.9"); **W** 109 mm (4.3"); **D** 100 mm (4.0")
Trip Level Settings — 0.5, 2.0, 4.0 A
Trip Time Settings — 0.1-1.0 s
Contact Operating Mode — Selectable fail-safe or non-fail-safe (SE-105) Fail-safe only (SE-107)
Harmonic Filtering — Standard feature
Reset Button — Local and remote
Output Contacts — Isolated Form A
Approvals — CSA certified, UL Listed (E340889), C-Tick (Australian)
Conformally Coated — Standard feature
Warranty — 5 years
Mounting — Surface

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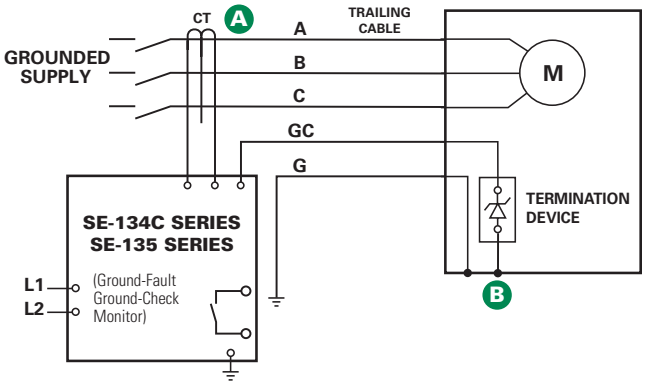
SE-134C / SE-135 SERIES

Ground-Fault Ground-Check Monitor

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	OPTION	POWER SUPPLY	COMM
SE-134C	Blank or XGC	0=120/240 Vac/Vdc 1=24/48 Vdc (1)	0=None
SE-135	Blank or XGC	0=120/240 Vac/Vdc 1=24/48 Vdc (1) (2)	0=None 3=Ethernet (1)

ACCESSORIES	REQUIREMENT
SE-CS10 Series	Required
SE-CS40 Series (for SE-135)	Optional
SE-TA6A Series (for SE-134C)	Required
SE-TA12A/SE-TA12B Combination (for SE-134C)	Optional
SE-TA12A Series (for SE-135)	Required
SE-IP65CVR-G	Optional
RK-132	Optional
PPI-600V	Optional

(1) CE/C-Tick not available.
(2) Not available with Ethernet option 3.
(3) See ordering information.
See Current Transformer Selection Guide and Accessory Information.

Description

The SE-134C/SE-135 is a microprocessor-based, combination ground-wire monitor and ground-fault relay for resistance-grounded or solidly grounded systems. It continuously monitors the integrity of the ground conductor to protect portable equipment from hazardous voltages caused by ground faults. The SE-134C/SE-135 is field proven in monitoring trailing cables on large mobile equipment such as drag-lines, mining shovels, shore-to-ship power cables, dock-side cranes, stacker-reclaimers, submersible pumps, and portable conveyors.

Features & Benefits

FEATURES	BENEFITS
Adjustable pickup (0.5-12.5 A for SE-CS10) (2 - 50 A for SE-CS40)	Unit can be used on a wide variety of trailing cable applications
Adjustable time delay (0.1-2.5 s)	Adjustable trip delay for quick protection and system coordination
Output contacts	Separate annunciation of ground-fault and ground-check faults
Ground-check LED indication	Indication of open or short ground-check wire makes it easier to find faults
CT-loop monitoring	Alarms when CT is not connected
High-induced-ac rejection	Makes unit suitable for applications with high voltages and long cables
DFT (Harmonic) filter	Prevents false operation
Zener-characteristic termination assembly	Provides reliable ground-check loop verification
Fail-safe circuits	Ensures ground-check and ground-fault circuits remain safe even in the event of equipment failure
Conformal coating	Additional coating protects circuit boards against harsh environment
XGC option	Increases maximum cable length for ground-check monitoring (10 km typical)

Accessories

A

SE-CS10 or SE-CS40 Series Ground-Fault Current Transformer
Required zero-sequence current transformer detects ground-fault current.

B

SE-TA6A Series, SE-TA12A Series Termination Assembly
Required termination assembly; temperature compensated.

Specifications

IEEE Device Numbers — Checking or Interlocking Relay (3GC), Ground fault (50G/N, 51G/N)
Input Voltage — 65-265 Vac; 85-275 Vdc; 18-72 Vdc
Dimensions — **H** 213 mm (8.4"); **W** 99 mm (3.9"); **D** 132 mm (5.2")
Trip Level Settings — 0.5-12.5 A for SE-CS10, 2 - 50 A for SE-CS40
Trip Time Settings — 0.1-2.5 s
Contact Operating Mode — Selectable fail-safe or non-fail-safe
Harmonic Filtering — Standard feature
Test Button — Standard feature
Reset Button — Standard feature
Output Contacts — Isolated Form A and Form B, Two Form C
Approvals — CSA certified, UL Listed (E340889), C-Tick (Australia)(3), CE(3)
Conformally Coated — Standard feature
Warranty — 5 years
Mounting — Panel, Surface
GC Trip Resistance — 28Ω (Standard), 45Ω (XGC Option)

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RESISTANCE GROUNDING/NGR MONITORING

Continuously monitoring the neutral-grounding resistor (NGR) and the neutral-to-ground path is critical to ensure the system operates as expected. Current-sensing ground-fault relays will not operate if the NGR or system ground is open circuit.

Neutral Grounding Resistor Sizing Chart 63

SE-325 Series — Neutral Grounding Resistor Monitor 64

SE-330 / SE-330HV Series — Neutral Grounding Resistor Monitor 65

SE-330AU Series — Neutral Earthing Resistor Monitor 67

NGR Series–US — Neutral Grounding Resistor System 68

NGR Series–Canada — Neutral Grounding Resistor System 77

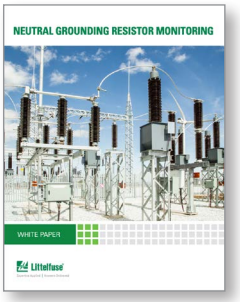
NGRM-ENC Series — Enclosed Neutral Grounding Resistor Monitor ... 83

Neutral Grounding Resistor Sizing Chart

System Voltage (Line-to-line)	NGR Let-Through Current and Resistance	Time Rating
208 V	5 A / 24 Ohms	Continuous
480 V	5 A / 55 Ohms	Continuous
600 V	5 A / 69 Ohms	Continuous
2,400 V	5 A / 277 Ohms or 10 A / 139 Ohms	Continuous or 10 sec
4,160 V	5 A / 480 Ohms or 10 A / 240 Ohms	Continuous or 10 sec
13,800 V	10 A / 798 Ohms or 200 A / 40 Ohms	10 seconds
25,000 V	200 A / 72 Ohms or 400 A / 36 Ohms	10 seconds
34,500 V	200 A / 100 Ohms or 400 A / 50 Ohms	10 seconds

Note: The values shown are for any size transformer and are typical.

Note: The above table is for illustrative purposes only. Actual values may differ based on a variety of individual system considerations, such as capacitive charging current and co-ordination study results.

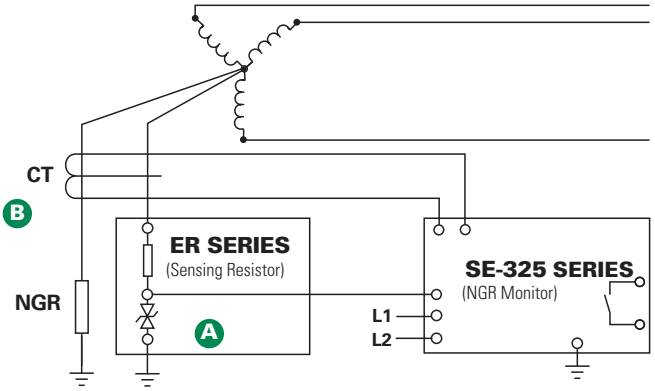


For More Information…
and to download our White Paper Why NGRs Need Contiuous Monitoring, visit
Littelfuse.com/TechnicalCenter

SE-325 SERIES (PGM-8325)

Neutral Grounding Resistor Monitor

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	CONTROL POWER
SE-325	120 Vac
SE-325D	120 Vac/Vdc
SE-325E	240 Vac

Consult manual online for additional ordering options.

ACCESSORIES	REQUIREMENT
CT200 Series	Required
ER Series	Required
SE-MRE-600	Optional
RK-325, RK-325I, RK-302	Optional
RK-13	Optional
NGRM-ENC	Optional

Description

The SE-325 Neutral Grounding Resistor Monitor is used on resistance-grounded systems up to 25 kV to monitor the integrity of the neutral-to-ground path and to detect ground faults. It measures current and voltage in a transformer or generator neutral-to-ground connection and continuity of the neutral-grounding resistor (NGR). The SE-325 coordinates these three measurements to detect a loose connection, corrosion, ground fault, or NGR failure, and provides one alarm or trip output contact.

Features & Benefits

FEATURES	BENEFITS
Continuous NGR monitoring	Detects resistor failure within seconds, reduces transient-overvoltage risk, removes risk of ground-fault-detection failure
Ground-fault Detection	Main or backup protection to detect a ground fault anywhere on the monitored system
Adjustable pickup (0.5-4 A)	Select greatest sensitivity without false operation
Adjustable time delay (0.1-2 s)	Adjustable trip delay allows system coordination
Output contacts	Form A output contact
Selectable contact operating mode	Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil or alarm system

Accessories

A

ER Series Sensing Resistor
Required interface between the power system and the SE-325. Eliminates hazardous voltage levels at the monitor.

B

CT200 Series Current Transformer
Required CT detects ground-fault current.

RK Series Remote Indication and Reset
Optional panel-mounted remote indication and reset assemblies. Available in NEMA 1 or NEMA 4 configurations.

Specifications

IEEE Device Numbers	Ground Fault (50G/N, 51G/N), Overvoltage (59N), Lockout Relay (86), Checking Relay (3)
Input Voltage	See ordering information
Dimensions	**H** 150 mm (5.9"); **W** 109 mm (4.3"); **D** 100 mm (4.0")
GF Trip Level Settings	0.5-4.0 A
GF Trip Time Settings	0.1-2.0 s
RF Trip-Level Settings	20-400 Vac (≤5 kV systems) 100-2,000 Vac (>5 kV systems)
Contact Operating Mode	Selectable fail-safe or non-fail-safe
Reset Button	Standard feature
Output Contacts	Form A
Approvals	CSA certified, UL Listed (E340889), C-Tick (Australian)
Conformally coated	Standard feature
Warranty	5 years
Mounting	Surface

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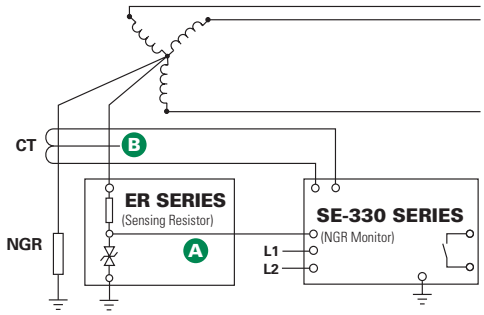
SE-330, SE-330HV SERIES

Neutral Grounding Resistor Monitor

Simplified Circuit Diagram



For detailed wiring diagram, see adjacent page.

Ordering Information

ORDERING NUMBER		POWER SUPPLY	COMM			K4 UNIT HEALTHY CONTACT
SE-330	-	X	X	-	0	X
SE-330 for applications 35 kV or less SE-330HV for 72 kV applications		0=120/240 V ac/V dc 2=48 Vdc	0=USB Only 1=DeviceNet 3=EtherNet (Dual RJ45) 4=EtherNet (SC Fiber & RJ45) 5=EtherNet (Dual SC Fiber) 6=IEC61850 (Dual RJ45) 7=IEC61850 (SC Fiber & RJ45) 8=IEC61850 (Dual SC Fiber)			0=Normally Open 1=Normally Closed

NOTE: For Australian applications, see the SE-330AU.

ACCESSORIES	REQUIREMENT
ER Series Sensing Resistor	Required
Current Transformer	Required
SE-IP65CVR-G	Optional
SE-MRE-600	Optional
RK-332	Optional
NGRM-ENC	Optional
PGA-0520	Optional
SE-330-SMA	Optional

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Description

The SE-330 is an advanced ground-fault and neutral-grounding-resistor monitoring relay that is compliant with Rule10-302 of the 2018 Canadian Electrical Code Part I (CE Code). It measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance. It provides continuous monitoring of the neutral-to-ground path to verify that the neutral-grounding resistor (NGR) is intact and that it has not been bypassed or shorted. An open NGR renders current-sensing ground-fault protection inoperative and could result in a false belief that the system is functioning properly. A shorted NGR results in higher-than-expected ground-fault current. The SE-330 can be used with low- and medium-voltage transformers and generators with low- or high-resistance grounding used in processing, manufacturing, chemical, pulp and paper, petroleum, and water-treatment facilities. For high-voltage applications, use the SE-330HV. For applications that require conformance to Australian standards, use the SE-330AU.

Resistor Monitoring

The SE-330 combines the measured values of resistance, current, and voltage to continuously determine that an NGR is intact. It is able to detect an open or shorted resistor with or without a ground fault present. Sensing resistors are matched to the system voltage and are used to monitor NGRs on systems up to 72 kV.

Ground-Fault Monitoring

The SE-330 uses an application-appropriate current transformer to reliably detect ground-fault currents as small as 100 mA. Discrete-Fourier Transform (DFT) filtering ensures that false trips due to harmonic noise from adjustable-speed drives do not occur. Should the resistor open and a ground fault subsequently occur, the SE-330 will detect the fault through voltage measurement, while other current-only sensing relays would be ineffective.

Pulsing Ground-Fault Location

The SE-330 is capable of controlling a pulsing contactor, which is used to switch the NGR resistance in a pulsing-compatible NGR package. The resulting ground-fault current is distinguishable from charging currents and noise and will only appear upstream of the ground fault, making fault location fast and easy, even without isolating feeders or interrupting loads.

Accessories

A

ER Series Sensing Resistor
Required interface between the power system and the SE-330/SE-330HV. Eliminates hazardous voltage levels at the relay.

B

ELCT5 Series Ground-Fault Current Transformer
Sensitive ground-fault current detection (5 A primary).

ELCT30 Series Ground-Fault Current Transformer
Sensitive ground-fault current detection (30 A primary).

Other Current Transformer
For low-resistance NGRs choose a CT primary approximately equal to the NGR rating. Inputs are provided for 1- and 5- A- secondary CTs.

SE-IP65CVR-G Hinged Transparent Cover
Watertight cover, tamper resistant, IP65 protection.

SE-330, SE-330HV SERIES

Neutral Grounding Resistor Monitor

Features & Benefits

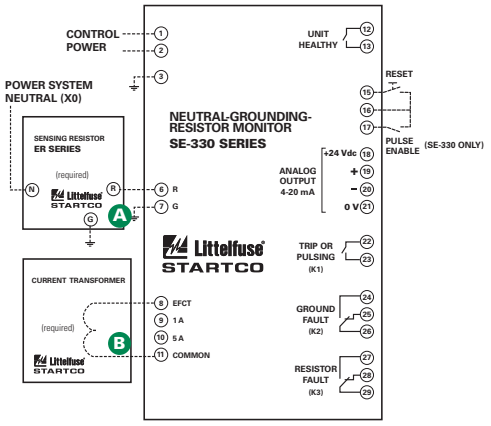
FEATURES	IEEE #	BENEFITS
Continuous NGR monitoring	3	Detects resistor failure within seconds, reduces transient-overvoltage risk, removes risk of ground-fault-detection failure
Shorted NGR detection	3	Detects a ground fault on the neutral that could bypass the resistor, ensures fault current is not higher than expected
Ground-fault detection	50G/N, 51G/N, 59N	Main or backup protection to detect a ground fault anywhere on the monitored system
Adjustable pickup (2–100 %)		Select greatest sensitivity without false operation, adjustable in 1% increments (MEM setting)
Adjustable time delay (0.1–10 s)		Adjustable trip delay allows quick protection and system coordination
Universal CT compatibility		Allows the use of a CT that gives required ground-fault settings
Programmable output contacts		Two programmable Form C and One programmable Form A (Ground Fault, Resistor Fault, Unit Health)
Selectable contact operating mode		Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil or alarm circuit (K1, K2, and K3 output contacts)
Analog output (4–20 mA)		Connect an optional PGA-0520 meter or control system
Pulsing output (SE-330 only)		Control the operation of a pulsing ground-fault-location circuit
Trip records		On-board 100-event (with date and time) recorder helps with system diagnostics
Harmonic filtering (DFT)		Eliminate false trips due to harmonic noise from ASDs
Local communications		Mini USB port to view measured values, configure settings, and check event records
Data logging		On-board microSD card (included) can be used for long-term data logging
Network communications		Remotely view measured values and event records, reset trips, and cause a remote trip Available Protocol Options: **IEC 61850**– with dual RJ45, SC Fiber and RJ45, or Dual SC Fiber Interface **Modbus TCP and Ethernet/IP**– with dual RJ45, SC Fiber and RJ45, or Dual SC Fiber Interface **DeviceNet**– with CAN interface
Software		PC-interface software (SE-MON330) is available at Littelfuse.com/RelaySoftware
Selectable reset mode		Selectable latching or auto-reset operation
Unit-healthy output		Verifies SE-330 is operating correctly, available as Form A or Form B output contact
Conformal coating		Internal circuits are conformally coated to protect against corrosion and moisture

Typical Values

SYSTEM VOLTAGE (VOLTS)	NEUTRAL-GROUNDING RESISTOR		SENSING RESISTOR		GROUND-FAULT PICKUP LEVEL (AMPERES)	V_N PICKUP LEVEL (VOLTS)
	CURRENT (AMPERES)	RESISTANCE (OHMS)	MODEL	RESISTANCE (SWITCH S5 SETTING)		
480	5	55	ER-600VC	20 kΩ	2.5	170
600	5	69	ER-600VC	20 kΩ	2.5	200
2,400	5	277	ER-5KV	20 kΩ	2.5	800
4,160	5	480	ER-5KV	20 kΩ	3	1,700
7,200	10	416	ER-15KV	100 kΩ	2	170 x 5 = 850
14,400	15	554	ER-15KV	100 kΩ	3	340 x 5 = 1,700

DISCLAIMER: The above table is for illustrative purposes only. Actual values may differ based on a variety of individual system considerations, such as capacitive charging current and coordination study results.

Wiring Diagram



Specifications

IEEE Device Numbers	Ground Fault (50G/N, 51G/N, 59N), Checking Relay (3), Lockout Relay (86)
Input Voltage	See ordering information
Dimensions	**H** 213 mm (8.4"); **W** 98 mm (3.9"); **D** 132 mm (5.2")
GF Trip-Level Settings	2–100 % of CT-Primary Rating in 1% increments
GF Trip-Time Settings	0.1–10 s
Vn Trip-Level Settings	20–2,000 V ac (≤5 kV systems) 100-10,000 V ac (>5 kV systems)
Contact Operating Mode	Selectable fail-safe or non-fail-safe (K1, K2, K3)
Harmonic Filtering	Standard feature
Reset Button	Standard feature
Output Contacts	Two Form A and two Form C
Pulsing Circuit	1.0–3.0 s in 0.2 s increments (SE-330 only)
Approvals	CSA certified, UL Listed (E340889), CE (European Union), RCM (Australian)
Communications	Mini USB (standard); DeviceNet (optional), IEC 61850 (optional), Modbus TCP and EtherNet/IP (optional)
Analog Output	4–20 mA, self or loop powered
Conformally Coated	Standard feature
Warranty	5 years
Mounting	Panel and surface (optional)

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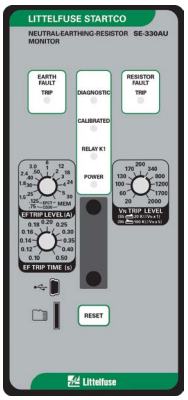
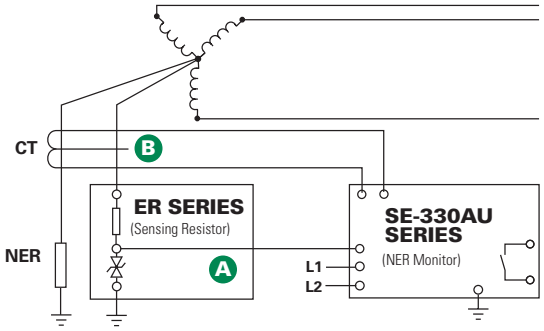
SE-330AU SERIES

Neutral Earthing Resistor Monitor



Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER		POWER SUPPLY	COMM			K4 UNIT HEALTHY CONTACT
SE-330AU	-	X	X	-	0	X
SE-330AU for all apps. 35 kV or less SE-330HV for 72 kV apps.		0=120/240 Vac/Vdc 2=48 Vdc	0=USB Only 1=DeviceNet 3=EtherNet (Dual RJ45) 4=EtherNet (SC Fiber & RJ45) 5=EtherNet (Dual SC Fiber) 6=IEC61850 (Dual RJ45) 7=IEC61850 (SC Fiber & RJ45) 8=IEC61850 (Dual SC Fiber)			0=Normally Open 1=Normally Closed

ACCESSORIES	REQUIREMENT
ER Series Sensing Resistor	Required
Current Transformer	Required
SE-IP65CVR-G	Optional
SE-MRE-600	Optional
RK-332	Optional

Description

The SE-330AU Series is an advanced earth-fault and earthing-resistor monitoring relay for low- and medium-voltage transformers and generators. It monitors neutral current, neutral-to-earth voltage, and neutral-to-earth resistance. It provides continuous monitoring of the neutral-to-earth path to verify that the neutral-earthing resistor (NER) is intact. This is of utmost importance—an open NER renders current-sensing earth-fault protection inoperative and could result in a false belief that the system is functioning properly. The SE-330AU earth-fault function complies with AS/NZS 2081.3:2002. Outputs include four relay outputs, and an analog output. A mini USB port is included to view measured values, configure settings, and check event records. An on-board micro SD card can be used for long-term data logging. Network communications options are available. For non-AS/NZS 2081 applications, see the SE-330 or SE-330HV Series.

Resistor Monitoring

The SE-330AU combines the measured values of resistance, current, and voltage to continuously determine that the NER is intact. It is able to detect a resistor failure with or without an earth fault present. Sensing resistors are matched to the system voltage and are used to monitor NGRs on systems up to 35 kV.

Earth-Fault Monitoring

The SE-330AU uses a 5- or 30-A-primary current transformer to provide a pickup-setting range of 0.125 to 5 A or 0.75 to 30 A to comply with AS/NZS 2081.3:2002. DFT filtering ensures that false trips due to harmonic noise from adjustable-speed drives do not occur. Open-CT detection is provided.

Accessories

A

ER Series Sensing Resistor
Required interface between the power system and the SE-330AU. Eliminates hazardous voltage levels at the relay.

B

EFCT Series Earth-Fault Current Transformer
Sensitive earth-fault current detection (5 A primary).

SE-CS30 Series Earth-Fault Current Transformer
Sensitive earth-fault current detection (30 A primary).

Specifications

Input Voltage	See ordering information
Dimensions	**H** 213 mm (8.4"); **W** 98 mm (3.9"); **D** 132 mm (5.2")
GF Trip-Level Settings	0.125 to 30 A
GF Trip-Time Settings	0.1 to 0.5 s
Vn Trip-Level Settings	20-2,000 Vac (≤5 kV systems) 100-10,000 Vac (>5 kV systems)
Output Contacts	Two Form A, Two Form C
Operating Mode	Fail-Safe
Harmonic Filtering	Standard feature
Reset	Front panel push button and remote input
Approvals	C-Tick (Australian), CE
Communications	Mini USB (standard); DeviceNet (optional), IEC 61850 (optional), Modbus TCP and EtherNet/IP (optional)
Analog Output	4-20 mA, self or loop powered
Conformal Coating	Standard feature
Warranty	5 years
Mounting	Panel, Surface (optional)

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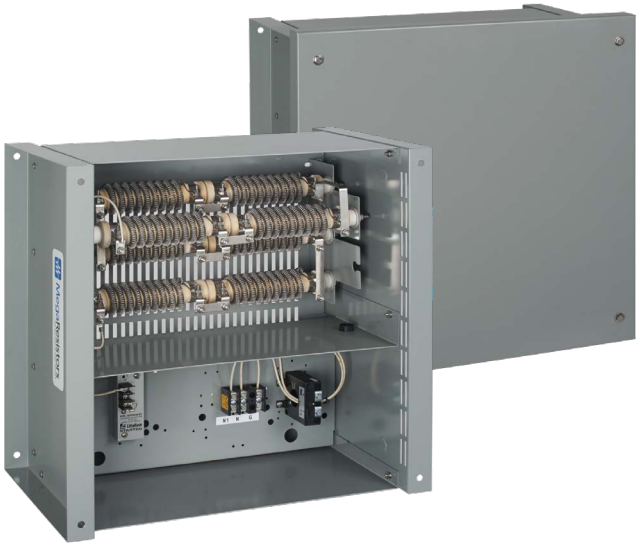
NGR SERIES – US

Neutral Grounding Resistor System

UL OR CSA



Description

High-resistance grounding prevents many of the problems that are associated with ungrounded and solidly grounded electrical distribution and utilization systems. High-resistance grounding can limit point-of-fault damage, eliminate transient overvoltages, reduce the arc-flash hazards, limit voltage exposure to personnel, and provide adequate tripping levels for selective current-based ground-fault detection and coordination.

The Littelfuse Neutral Grounding Resistor System is a neutral grounding resistor (NGR), current transformer, and sensing resistor installed in a NEMA 3R enclosure used to high-resistance ground transformers and generators. The NGR system is designed for use with Littelfuse Neutral Grounding Resistor Monitors for complete system grounding and grounding protection.

The NGR series – US systems are designed for use in US applications and all other parts of the world, not including Canada. For applications in Canada, please use the NGR series – Canada.

Applications

High-resistance grounding is applied on transformers and generators where safety and continuity of service are important. A faulted feeder may remain in operation until it is safe to repair the fault, where allowed by the local electrical code.

Features

Enclosure
The NGR Series – US comes pre-installed in a ventilated NEMA 3R galvanized steel enclosure and components are pre-wired to terminals for ease of installation. Back view shown on left.

ER Series Sensing Resistor
Use with the SE-325 or the SE-330 to continuously monitor the continuity of a neutral-grounding resistor and eliminate hazardous voltage levels at the relay.

- ER-600VC is designed for use on systems up to 600 V for indoor applications. Available in optional moisture-proof enclosure (shown on left) for outdoor applications.

- ER-5KV for use on systems up to 4160 V for indoor applications.

- ER-5WP is designed for use on systems up to 4160 V and comes with weather-protected terminals for outdoor installations.

Earth-Fault Current Transformer
Used with the SE-325 or the SE-330 to measure ac current flowing through the NGR for use with the continuity monitoring circuit and to detect ground faults.

- ELCT5-31 used with SE-330 for 5 A and 10 A NGRs.

- SE-CS10-2.5 used with SE-330 for 10 A and 15 A NGRs.

- CT200 used with the SE-325 for all applications.
- 5SHT-101-E (not shown) used with SE-330 for 25 A NGRs.

Benefits

- Eliminate phase-to-ground arc-flash incidents
- Eliminate transient overvoltages
- Reduce point-of-fault damage
- Can provide continuity of service during a ground fault
- Includes current transformer and ER series sensing resistor for use with Littelfuse monitoring relay and for ease of installation.

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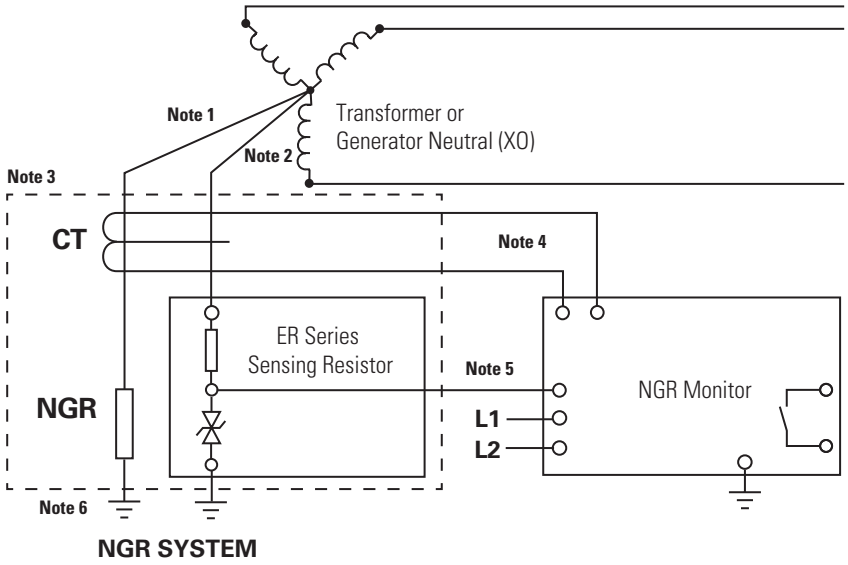
Simplified Circuit Diagram with Littelfuse Neutral Grounding Resistor Monitor



Note 1: Use minimum #8 AWG white or grey conductor insulated to system voltage to connect NGR to neutral.
Note 2: Use conductor insulated to system voltage (#14 AWG is typically used) and a separate lug at the X0 point to connect ER Series Sensing Resistor to neutral.
Note 3: Locate NGR system near transformer or generator.
Note 4: Two-conductor twisted cable required, shielded recommended.
Note 5: Voltage between ER Series Sensing Resistor terminals R and G is limited to 100 V by internal clamp.
Note 6: Use minimum #8 AWG green or bare conductor to connect NGR to ground.

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NGR SERIES – US

Ordering Information

PART NUMBER	LINE-LINE VOLTAGE (V)	LET-THROUGH CURRENT (A)	IMPEDANCE (OHMS)	TIME RATING	CURRENT TRANSFOMER	CT PRIMARY RATING (A)	CT SECONDARY RATING (A)	SENSING RESISTOR	ENCLOSURE
NGRUS138	480	2	138	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R
NGRUS278	480	2	138	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS314	480	2	138	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGRUS315	480	2	138	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS003	480	5	55.4	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R
NGRUS194	480	5	55.4	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS316	480	5	55.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGRUS317	480	5	55.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS318	600	2	173.5	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGRUS319	600	2	173.5	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS354	600	2	173.5	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R
NGRUS355	600	2	173.5	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS169	600	5	69.4	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R
NGRUS170	600	5	69.4	Continuous	CT200	200***	5.0	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS320	600	5	69.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGRUS321	600	5	69.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGRUS114	4160	5	480.9	Continuous	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS115	4160	5	480.9	Continuous	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS322	4160	5	480.9	10 s	ELCT5-31	5*	0.05	ER-5KV	NEMA 3R
NGRUS323	4160	5	480.9	10 s	ELCT5-31	5*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS324	4160	5	480.9	Continuous	ELCT5-31	5*	0.05	ER-5KV	NEMA 3R
NGRUS325	4160	5	480.9	Continuous	ELCT5-31	5*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS356	4160	5	480.9	10s	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS357	4160	5	480.9	10s	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS326	4160	10	240.5	10 s	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGRUS327	4160	10	240.5	10 s	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor

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NGR SERIES – US

Ordering Information

PART NUMBER	LINE-LINE VOLTAGE (V)	LET-THROUGH CURRENT (A)	IMPEDANCE (OHMS)	TIME RATING	CURRENT TRANSFOMER	CT PRIMARY RATING (A)	CT SECONDARY RATING (A)	SENSING RESISTOR	ENCLOSURE
NGRUS328	4160	10	240.5	Continuous	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGRUS329	4160	10	240.5	Continuous	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS358	4160	10	240.5	10s	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS359	4160	10	240.5	10s	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS360	4160	10	240.5	Continuous	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS361	4160	10	240.5	Continuous	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS330	4160	15	160.3	10 s	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGRUS331	4160	15	160.3	10 s	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS332	4160	15	160.3	Continuous	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGRUS333	4160	15	160.3	Continuous	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS362	4160	15	160.3	10s	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS363	4160	15	160.3	10s	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS364	4160	15	160.3	Continuous	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS365	4160	15	160.3	Continuous	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS244	4160	25	96.2	10s	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS334	4160	25	96.2	10 s	5SHT-101-E	20**	1	ER-5KV	NEMA 3R
NGRUS335	4160	25	96.2	10 s	5SHT-101-E	20**	1	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS336	4160	25	96.2	Continuous	5SHT-101-E	20**	1	ER-5KV	NEMA 3R
NGRUS337	4160	25	96.2	Continuous	5SHT-101-E	20**	1	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS366	4160	25	96.2	10s	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGRUS367	4160	25	96.2	Continuous	CT200	200***	5.0	ER-5KV	NEMA 3R
NGRUS368	4160	25	96.2	Continuous	CT200	200***	5.0	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor

* Connect to SE-330 terminals 8 and 11
** Connect to SE-330 terminals 9 and 11
*** Connect to SE-325 terminals CT1 and CT2

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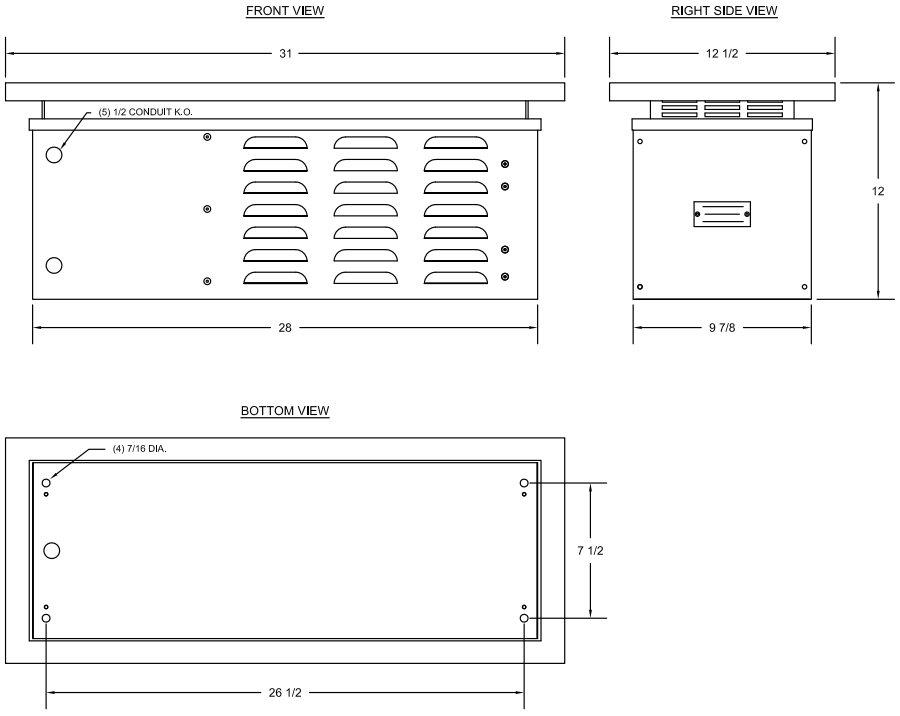
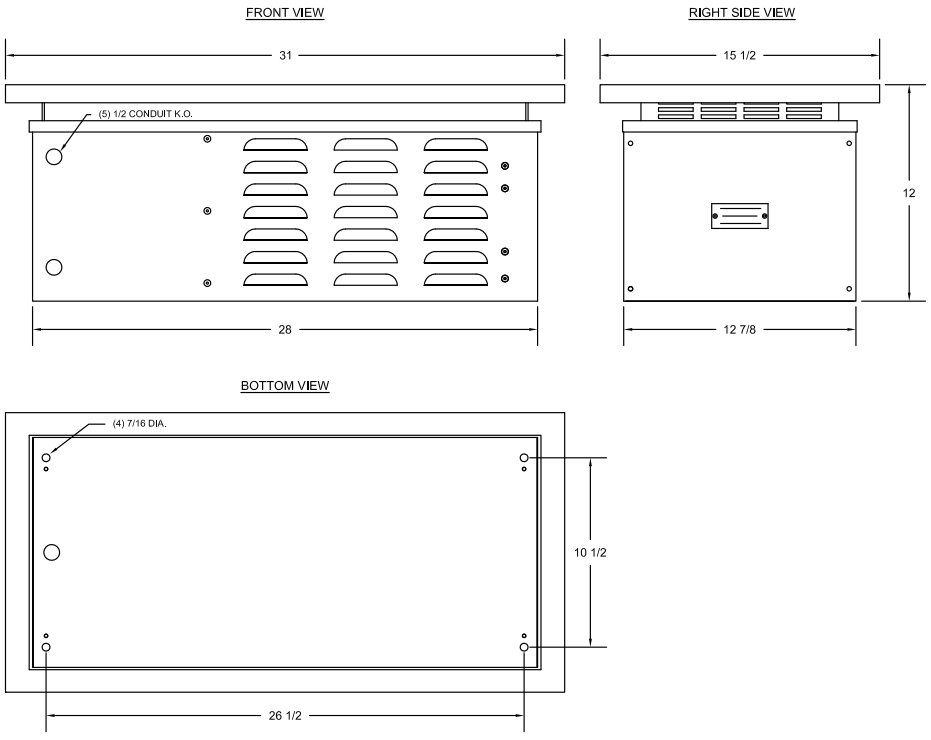
Dimensions (in inches) and Mounting Diagrams

480 V & 600 V NGR Systems:

- NGRUS314
- NGRUS316
- NGRUS318
- NGRUS320



- NGRUS315
- NGRUS317
- NGRUS319
- NGRUS321



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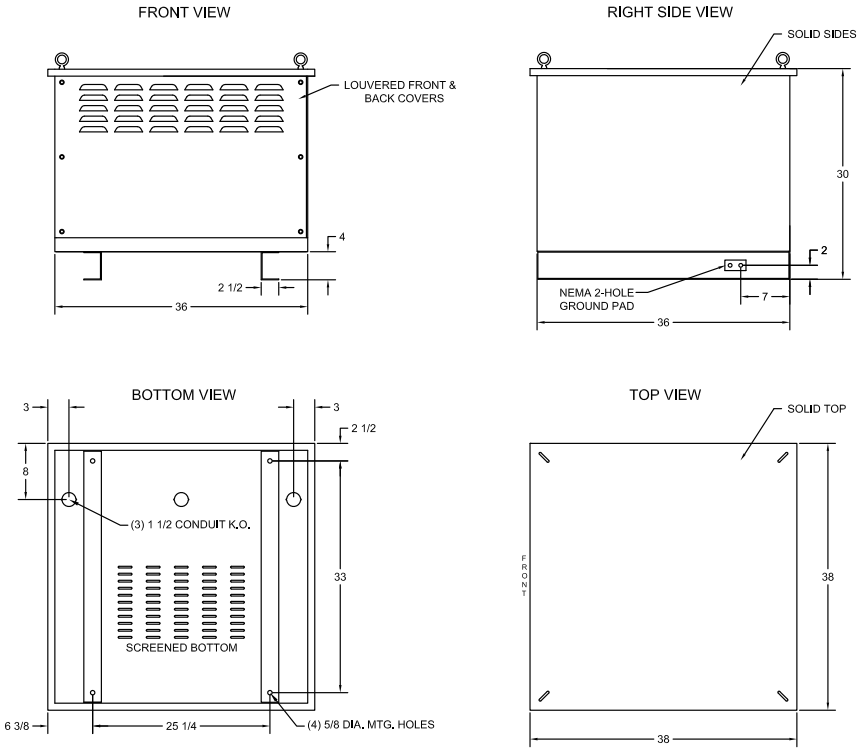
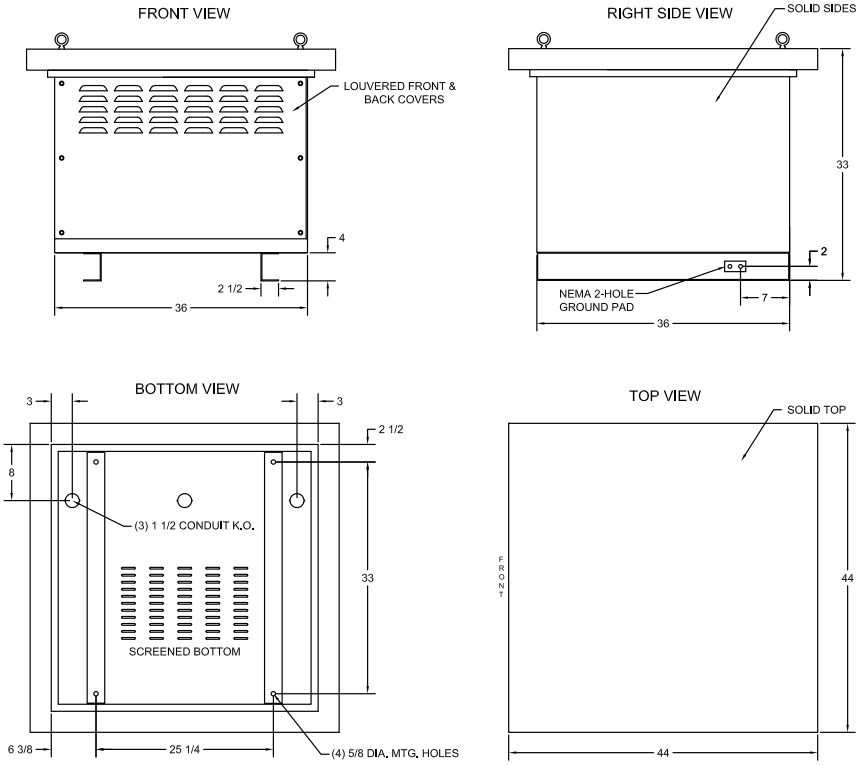
Dimensions (in inches) and Mounting Diagrams

4160 V NGR Systems:

- NGRUS322
- NGRUS323
- NGRUS326
- NGRUS327
- NGRUS330
- NGRUS331
- NGRUS344
- NGRUS345



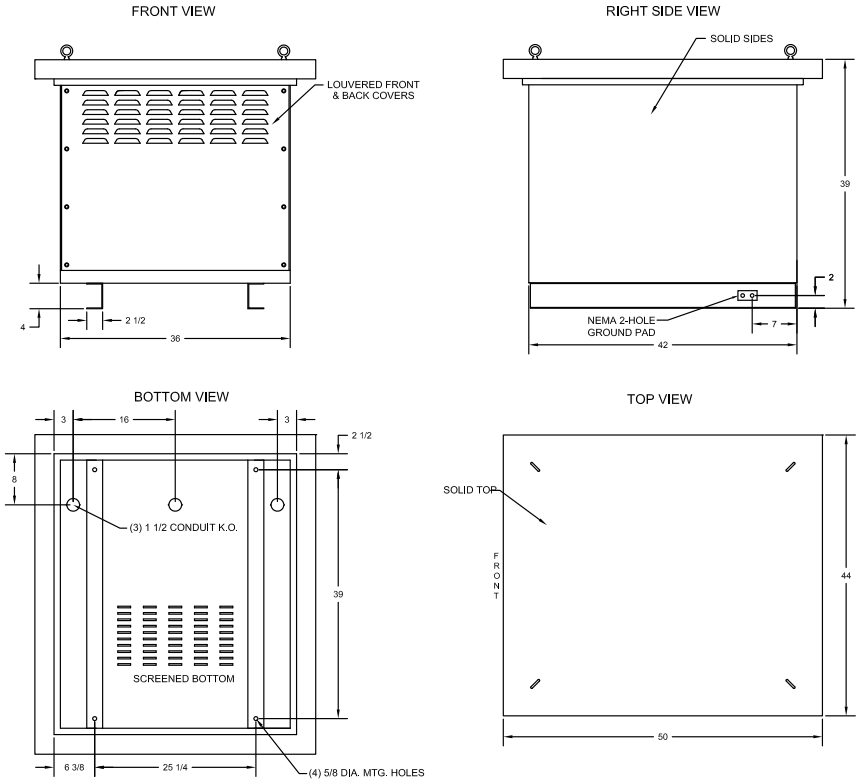
- NGRUS324
- NGRUS325



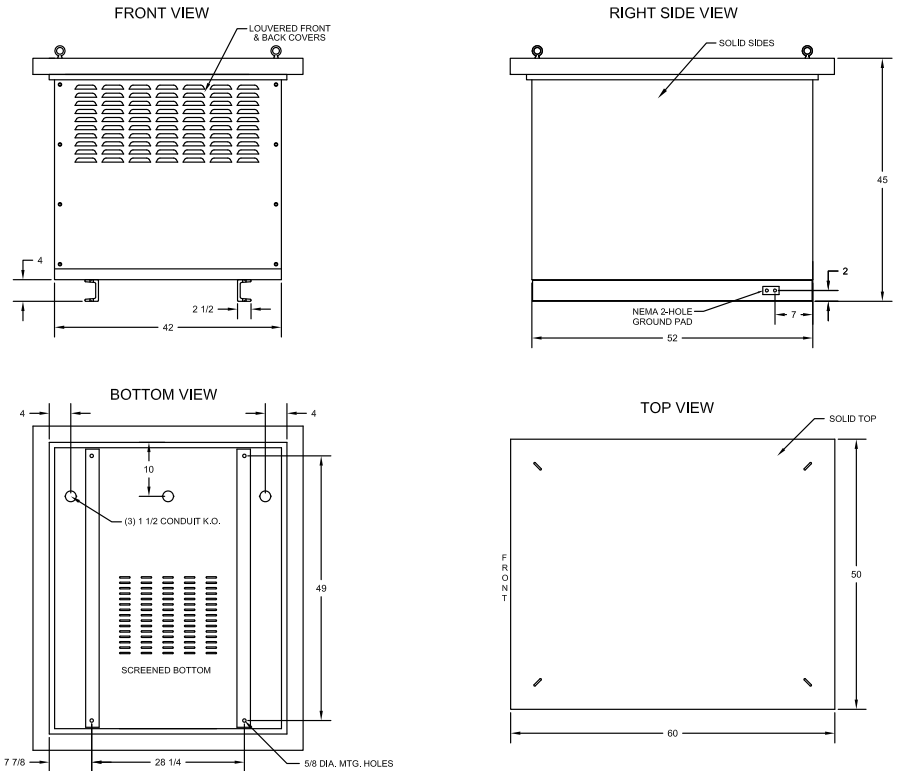
Dimensions (in inches) and Mounting Diagrams

4160 V NGR Systems:

- NGRUS328
- NGRUS329
- NGRUS332
- NGRUS333



- NGRUS336
- NGRUS337



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NGR SERIES – US

Specifications: 480 V NGR Systems

Voltage	480 V line-to-line, 277 V line-to-neutral
Let-Through Current	2 A or 5 A
Resistance	138.5 Ω (2 A) or 55.4 Ω (5 A)
Tolerance	+/- 10 % resistance
Duty Cycle	Continuous rated
Current Transformer	**ELCT5-31:** For use with SE-330 NGR Monitor Turns Ratio: 100:1 Current Rating: 5:0.05 A Primary Rating with SE-330: 5 A when connected to terminals 8 and 11 GF Trip Range: 100 mA to 5 A Window Diameter: 31 mm (1.22") **CT200:** For use with SE-325 NGR Monitor Turns Ratio: 200:5 Current Rating: 200:5 A GF Trip Range: 0.5, 2.0, 4.0 A Window Diameter: 56 mm (2.2")
Sensing Resistor	ER-600VC; Optional installation in NEMA 4 enclosure for outdoor applications
Insulation Level	11 KV BIL
Temperature Rise	385 °C (725 °F)
Resistor Type	Stainless steel wire wound
Dimensions	Refer to dimensions drawings
Weight	23 kg (50 lbs)
Altitude	0–2000 masl
Enclosure Style	NEMA 3R, galvanized steel
Finish	Powder coated
Color	ANSI 61 grey
Mounting	Floor mount
Siesmic Bracing	Included
Approvals	cULus or CSA at customer request
Warranty	12 months in service or 18 months from the date of shipment whichever occurs first

Specifications: 600 V NGR Systems

Voltage	600 V line-to-line, 347 V line-to-neutral
Let-Through Current	2 A or 5 A
Resistance	174 Ω (2 A) or 69 Ω (5 A)
Tolerance	+/- 10 % resistance
Duty Cycle	Continuous rated
Frequency	50–60 Hz
Current Transformer	**ELCT5-31:** For use with SE-330 NGR Monitor Turns Ratio: 100:1 Current Rating: 5:0.05 A Primary Rating with SE-330: 5 A when connected to terminals 8 and 11 GF Trip Range: 100 mA to 5 A Window Diameter: 31 mm (1.22") **CT200:** For use with SE-325 NGR Monitor Turns Ratio: 200:5 Current Rating: 200:5 A GF Trip Range: 0.5, 2.0, 4.0 A Window Diameter: 56 mm (2.2")
Sensing Resistor	ER-600VC; Optional installation in NEMA 4 enclosure for outdoor applications
Insulation Level	11 KV BIL
Temperature Rise	385 °C (725 °F)
Resistor Type	Stainless steel wire wound
Dimensions	Refer to dimensions drawings
Weight	23 kg (50 lbs)
Altitude	0–2000 masl
Enclosure Style	NEMA 3R, galvanized steel
Finish	Powder coated
Color	ANSI 61 grey
Mounting	Floor mount
Siesmic Bracing	Included
Approvals	cULus or CSA at customer request
Warranty	12 months in service or 18 months from the date of shipment whichever occurs first

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Specifications: 4160 V NGR Systems

Voltage	4160 V line-to-line, 2400 V line-to-neutral
Let-Through Current	5 A, 10 A, 15 A, or 25 A
Resistance	480 Ω (5 A), 240 Ω (10 A), 160 Ω (15 A), or 96 Ω (25 A)
Tolerance	+/- 10 % resistance
Duty Cycle	Continuous-duty or 10-second-duty rating
Frequency	50-60 Hz
Current Transformer	**ELCT5-31:** For use with SE-330 NGR Monitor Turns Ratio: 100:1 Current Rating: 5:0.05 A Primary Rating with SE-330: 5 A when connected to terminals 8 and 11 GF Trip Range: 100 mA to 5 A Window Diameter: 31 mm (1.22") **SE-CS10-2.5:** For use with SE-330 NGR Monitor Turns Ratio: 200:1 Current Rating: 12.5:0.0625 A Primary Rating with SE-330: 10 A when connected to terminals 8 and 11 GF Trip Range: 200 mA to 10 A Window Diameter: 63.5 mm (2.5") Turns Ratio: 100:5 Current Rating: 100:5 A Primary Rating with SE-330: 20 A when connected to terminals 9 and 11 GF Trip Range: 400 mA to 20 A Window Diameter: 40 mm (1.56") **CT200:** For use with SE-325 NGR Monitor Turns Ratio: 200:5 Current Rating: 200:5 A GF Trip Range: 0.5, 2.0, 4.0 A Window Diameter: 56 mm (2.2")
Sensing Resistor	ER-5KV Optional ER-5WP for outdoor applications
Insulation Level	75 KV BIL
Temperature Rise	Continuous-duty rated: 385 °C (725 °F) 10-second-duty rated: 760 °C (1400 °F)
Resistor Type	Stainless Steel Wire Wound
Dimensions	Refer to dimensions drawings
Weights	
5 A, continuous-duty rated:	192 kg (424 lbs)
10 A, continuous-duty rated:	235 kg (519 lbs)
15 A, continuous-duty rated:	258 kg (568 lbs)
25 A, continuous-duty rated:	320 kg (705 lbs)
5 A, 10-second-duty rated:	136 kg (300 lbs)
10 A, 10-second-duty rated:	136 kg (300 lbs)
15 A, 10-second-duty rated:	136 kg (300 lbs)
25 A, 10-second-duty rated:	136 kg (300 lbs)
Altitude	0-1000 masl
Enclosure Style	NEMA 3R, galvanized steel
Finish	Powder coated
Color	ANSI 61 grey
Mounting	Floor mount
Siesmic Bracing	Included
Approvals	cULus or CSA at customer request
Warranty	12 months in service or 18 months from the date of shipment, whichever occurs first

Accessories

SE-325 Neutral Grounding Resistor Monitor
Basic ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground continuity.

SE-330 Neutral Grounding Resistor Monitor
Advanced ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance.

NGRM-ENC Enclosed Neutral Grounding Resistor (NGR) Monitor
Type 4X enclosure housing a Littelfuse Startco SE-325 or SE-330 Neutral Grounding Resistor Monitor and optional accessories that include a 480/600 V control power transformer (CPT), faulted-phase indication (FPI; implemented with an EL3100 Ground-Fault & Phase-Voltage Indicator), earth-leakage panel meter, pulse-enable control, and mounting options. Appropriate fusing is included and field wiring is to terminal blocks.

Custom NGR Systems

Additional custom NGR systems are also available from Littelfuse. For NGR systems not listed on this sheet please contact Littelfuse by emailing **NGRquotes@Littelfuse.com**

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NGR SERIES – CANADA

Neutral Grounding Resistor System

Description

High-resistance grounding prevents many of the problems that are associated with ungrounded and solidly grounded electrical distribution and utilization systems. High-resistance grounding can limit point-of-fault damage, eliminate transient overvoltages, reduce the arc-flash hazards, limit voltage exposure to personnel, and provide adequate tripping levels for selective current-based ground-fault detection and coordination.

The Littelfuse Neutral Grounding Resistor System is a neutral grounding resistor (NGR), current transformer, and sensing resistor installed in a NEMA 3R enclosure used to high-resistance ground transformers and generators. The NGR system is designed for use with Littelfuse Neutral Grounding Resistor Monitors for complete system grounding and grounding protection.

The NGR series – Canada systems are specifically designed for use in Canadian applications. For applications in the US and other parts of the world, please use the NGR series – US.

Applications

High-resistance grounding is applied on transformers and generators where safety and continuity of service are important. A faulted feeder may remain in operation until it is safe to repair the fault, where allowed by the local electrical code.

Features

Enclosure
The NGR Series - Canada comes pre-installed in a ventilated NEMA 3R galvanized steel enclosure and components are pre-wired to terminals for ease of installation. Back view shown on left.

ER Series Sensing Resistor
Use with the SE-330 to continuously monitor the continuity of a neutral-grounding resistor and eliminate hazardous voltage levels at the relay.

- ER-600VC is designed for use on systems up to 600 V for indoor applications. Available in optional moisture-proof enclosure (shown on left) for outdoor applications.

- ER-5KV for use on systems up to 4160 V for indoor applications.

- ER-5WP is designed for use on systems up to 4160 V and comes with weather-protected terminals for outdoor installations.

Earth-Fault Current Transformer
Used with the SE-330 to measure ac current flowing through the NGR for use with the continuity monitoring circuit and to detect ground faults.

- ELCT5-31 used with SE-330 for 5 A and 10 A NGRs.

- SE-CS10-2.5 used with SE-330 for 10 A and 15 A NGRs.

- 5SHT-101-E used with SE-330 for 25 A NGRs.

Benefits

- Eliminate phase-to-ground arc-flash incidents
- Eliminate transient overvoltages
- Reduce point-of-fault damage
- Can provide continuity of service during a ground fault
- Includes current transformer and ER series sensing resistor for use with Littelfuse monitoring relay and for ease of installation.

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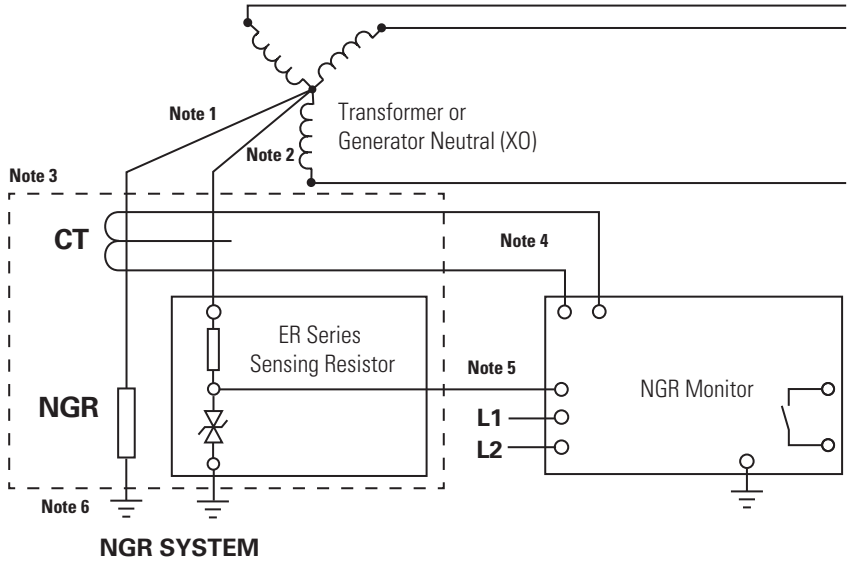
Simplified Circuit Diagram with Littelfuse Neutral Grounding Resistor Monitor



Note 1: Use minimum #8 AWG white or grey conductor insulated to system voltage to connect NGR to neutral.
Note 2: Use conductor insulated to system voltage (#14 AWG is typically used) and a separate lug at the X0 point to connect ER Series Sensing Resistor to neutral.
Note 3: Locate NGR system near transformer or generator.
Note 4: Two-conductor twisted cable required, shielded recommended.
Note 5: Voltage between ER Series Sensing Resistor terminals R and G is limited to 100 V by internal clamp.
Note 6: Use minimum #8 AWG green or bare conductor to connect NGR to ground.

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NGR SERIES – CANADA

Ordering Information

PART NUMBER	LINE-LINE VOLTAGE (V)	LET-THROUGH CURRENT (A)	IMPEDANCE (OHMS)	TIME RATING	CURRENT TRANSFOMER	CT PRIMARY RATING (A)	CT SECONDARY RATING (A)	SENSING RESISTOR	ENCLOSURE
NGR1050	480	2	138	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGR1041	480	2	138	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGR1036	480	5	55.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGR1051	480	5	55.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGR1052	600	2	173.5	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGR1053	600	2	173.5	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGR1038	600	5	69.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGR1045	600	5	69.4	Continuous	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R; Weather Protected Sensing Resistor
NGR1066	4160	5	480.9	10 s	ELCT5-31	5*	0.05	ER-600VC	NEMA 3R
NGR1067	4160	5	480.9	10 s	ELCT5-31	5*	0.05	ER-5KV	NEMA 3R; Weather Protected Sensing Resistor
NGR1068	4160	5	480.9	Continuous	ELCT5-31	5*	0.05	ER-5WP	NEMA 3R
NGR1069	4160	5	480.9	Continuous	SE-CS10-2.5	5*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGR1070	4160	10	240.5	10 s	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGR1071	4160	10	240.5	10 s	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGR1072	4160	10	240.5	Continuous	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGR1073	4160	10	240.5	Continuous	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGR1074	4160	15	160.3	10 s	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGR1075	4160	15	160.3	10 s	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGR1076	4160	15	160.3	Continuous	SE-CS10-2.5	10*	0.05	ER-5KV	NEMA 3R
NGR1077	4160	15	160.3	Continuous	SE-CS10-2.5	10*	0.05	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGR1078	4160	25	96.2	10 s	5SHT-101-E	20**	1	ER-5KV	NEMA 3R
NGR1079	4160	25	96.2	10 s	5SHT-101-E	20**	1	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor
NGR1080	4160	25	96.2	Continuous	5SHT-101-E	20**	1	ER-5KV	NEMA 3R
NGR1081	4160	25	96.2	Continuous	5SHT-101-E	20**	1	ER-5WP	NEMA 3R; Weather Protected Sensing Resistor

* Connect to SE-330 terminals 8 and 11
** Connect to SE-330 terminals 9 and 11

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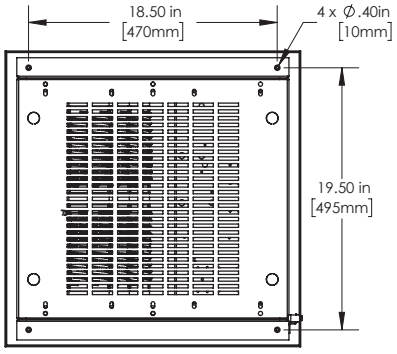
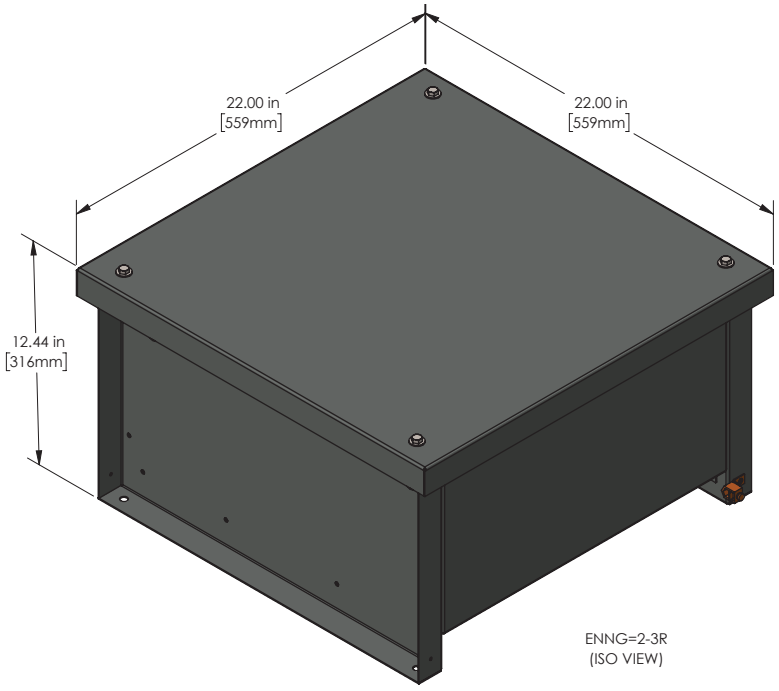
Dimensions and Mounting Diagrams

For 480 V NGR Systems:

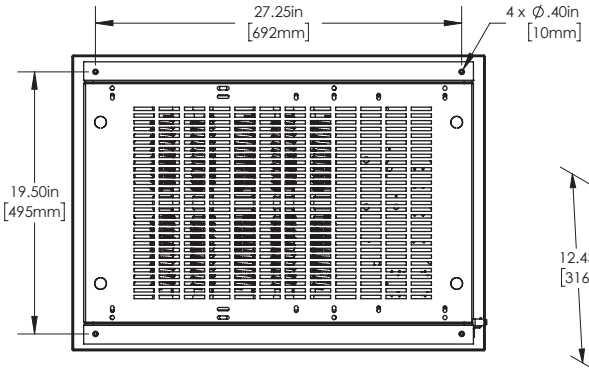


BOTTOM VIEW
(MOUNTING DIMENSIONS)

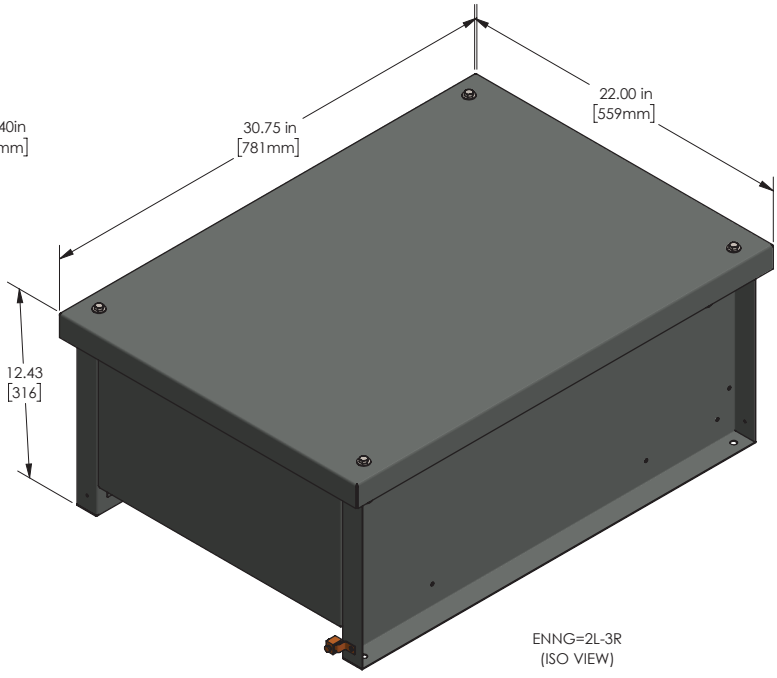


ENNG=2-3R
(ISO VIEW)

For 600 V NGR Systems:



BOTTOM VIEW
(MOUNTING DIMENSIONS)



ENNG=2L-3R
(ISO VIEW)

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NGR SERIES – CANADA

Specifications: 480 V NGR Systems

Voltage	480 V line-to-line, 277 V line-to-neutral
Let-Through Current	2 A or 5 A
Resistance	138.5 Ω (2 A) or 55.4 Ω (5 A)
Tolerance	+/- 10 % resistance
Duty Cycle	Continuous rated
Current Transformer	**ELCT5-31:** For use with SE-330 NGR Monitor Turns Ratio: 100:1 Current Rating: 5:0.05 A Primary Rating with SE-330: 5 A when connected to terminals 8 and 11 GF Trip Range: 100 mA to 5 A Window Diameter: 31 mm (1.22")
Sensing Resistor	ER-600VC; Optional installation in NEMA 4 enclosure for outdoor applications
Insulation Level	11 KV BIL
Temperature Rise	385 °C (725 °F)
Resistor Type	Stainless steel wire wound
Dimensions	**H** 324 mm (12.75"); **W** 558 mm (22.00"); **D** 558 mm (22.00")
Weight	23 kg (50 lbs)
Altitude	0–2000 masl
Enclosure Style	NEMA 3R, galvanized steel
Finish	Powder coated
Color	ANSI 61 grey
Mounting	Floor mount
Siesmic Bracing	Included
Approvals	cULus
Warranty	12 months in service or 18 months from the date of shipment whichever occurs first

Specifications: 600 V NGR Systems

Voltage	600 V line-to-line, 347 V line-to-neutral
Let-Through Current	2 A or 5 A
Resistance	174 Ω (2 A) or 69 Ω (5 A)
Tolerance	+/- 10 % resistance
Duty Cycle	Continuous rated
Frequency	50–60 Hz
Current Transformer	**ELCT5-31:** For use with SE-330 NGR Monitor Turns Ratio: 100:1 Current Rating: 5:0.05 A Primary Rating with SE-330: 5 A when connected to terminals 8 and 11 GF Trip Range: 100 mA to 5 A Window Diameter: 31 mm (1.22")
Sensing Resistor	ER-600VC; Optional installation in NEMA 4 enclosure for outdoor applications
Insulation Level	11 KV BIL
Temperature Rise	385 °C (725 °F)
Resistor Type	Stainless steel wire wound
Dimensions	**H** 324 mm (12.75"); **W** 558 mm (22.00"); **D** 558 mm (22.00")
Weight	23 kg (50 lbs)
Altitude	0–2000 masl
Enclosure Style	NEMA 3R, galvanized steel
Finish	Powder coated
Color	ANSI 61 grey
Mounting	Floor mount
Siesmic Bracing	Included
Approvals	cULus
Warranty	12 months in service or 18 months from the date of shipment whichever occurs first

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NGR SERIES – CANADA

Specifications: 4160 V NGR Systems

Voltage	4160 V line-to-line, 2400 V line-to-neutral
Let-Through Current	5 A, 10 A, 15 A, or 25 A
Resistance	480 Ω (5 A), 240 Ω (10 A), 160 Ω (15 A), or 96 Ω (25 A)
Tolerance	+/- 10 % resistance
Duty Cycle	Continuous-duty or 10-second-duty rating
Frequency	50-60 Hz
Current Transformer	**ELCT5-31:** For use with SE-330 NGR Monitor Turns Ratio: 100:1 Current Rating: 5:0.05 A Primary Rating with SE-330: 5 A when connected to terminals 8 and 11 GF Trip Range: 100 mA to 5 A Window Diameter: 31 mm (1.22") **SE-CS10-2.5:** For use with SE-330 NGR Monitor Turns Ratio: 200:1 Current Rating: 12.5:0.0625 A Primary Rating with SE-330: 10 A when connected to terminals 8 and 11 GF Trip Range: 200 mA to 10 A Window Diameter: 63.5 mm (2.5") Turns Ratio: 100:5 Current Rating: 100:5 A Primary Rating with SE-330: 20 A when connected to terminals 9 and 11 GF Trip Range: 400 mA to 20 A Window Diameter: 40 mm (1.56")
Sensing Resistor	ER-5KV Optional ER-5WP for outdoor applications
Insulation Level	75 KV BIL
Temperature Rise	Continuous-duty rated: 385 °C (725 °F) 10-second-duty rated: 760 °C (1400 °F)
Resistor Type	Stainless Steel Wire Wound
Weights and Dimensions	
5 A, continuous-duty rated:	**H** 1226 mm (48.28"); **W** 1143 mm (45.00"); **D** 940 mm (37.00"); 192 kg (424 lbs)
10 A, continuous-duty rated:	**H** 1214 mm (47.78"); **W** 1270 mm (50.00"); **D** 1143 mm (45.00"); 235 kg (519 lbs)
15 A, continuous-duty rated:	**H** 1214 mm (47.78"); **W** 1270 mm (50.00"); **D** 1143 mm (45.00"); 258 kg (568 lbs)
25 A, continuous-duty rated:	**H** 1283 mm (50.50"); **W** 1575 mm (62.00"); **D** 1143 mm (45.00"); 320 kg (705 lbs)
5 A, 10-second-duty rated:	**H** 749 mm (29.50"); **W** 1143 mm (45.00"); **D** 940 mm (37.00"); 136 kg (300 lbs)
10 A, 10-second-duty rated:	**H** 749 mm (29.50"); **W** 1143 mm (45.00"); **D** 940 mm (37.00"); 136 kg (300 lbs)
15 A, 10-second-duty rated:	**H** 749 mm (29.50"); **W** 1143 mm (45.00"); **D** 940 mm (37.00"); 136 kg (300 lbs)
25 A, 10-second-duty rated:	**H** 749 mm (29.50"); **W** 1143 mm (45.00"); **D** 940 mm (37.00"); 136 kg (300 lbs)

Altitude	0-1000 masl
Enclosure Style	NEMA 3R, galvanized steel
Finish	Powder coated
Color	ANSI 61 grey
Mounting	Floor mount
Siesmic Bracing	Included
Approvals	cULus
Warranty	12 months in service or 18 months from the date of shipment, whichever occurs first

Accessories

SE-330 Neutral Grounding Resistor Monitor
Advanced ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance.

NGRM-ENC Enclosed Neutral Grounding Resistor (NGR) Monitor
Type 4X enclosure housing a Littelfuse Startco SE-330 Neutral Grounding Resistor Monitor and optional accessories that include a 480/600 V control power transformer (CPT), faulted-phase indication (FPI; implemented with an EL3100 Ground-Fault & Phase-Voltage Indicator), earth-leakage panel meter, pulse-enable control, and mounting options. Appropriate fusing is included and field wiring is to terminal blocks.

Custom NGR Systems

Additional custom NGR systems are also available from Littelfuse. For NGR systems not listed on this sheet please contact Littelfuse by emailing **NGRquotes@Littelfuse.com**

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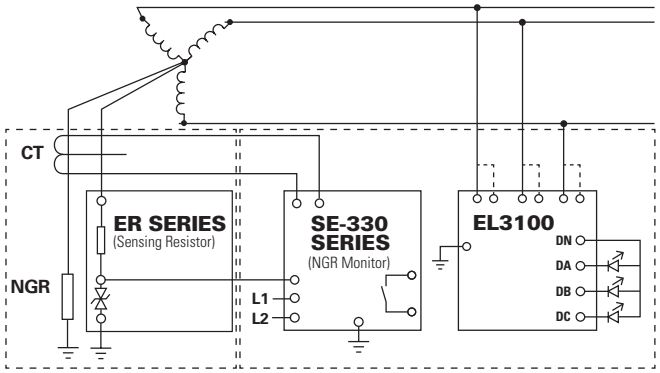
NGRM-ENC SERIES

NGRM-ENC

Simplified Circuit Diagram



NGR Assembly
(ordered separately)

NGRM-ENC
(SE-330 with voltage indication shown)

Description

The NGRM-ENC Enclosed Neutral-Grounding-Resistor (NGR) Monitor series is a Type 4X enclosure housing a Littelfuse Startco SE-325 or SE-330 Neutral-Grounding-Resistor Monitor and optional accessories that include a 480/600-V control power transformer (CPT), faulted-phase indication (FPI; implemented with an EL3100 Ground-Fault & Phase-Voltage Indicator), earth-leakage panel meter, pulse-enable control, and mounting options. Appropriate fusing is included and field wiring is to terminal blocks.

Options

SE-325 Neutral-Grounding-Resistor Monitor
Measures current and voltage in a transformer or generator neutral-to-ground connection and continuity of the neutral-grounding resistor. For applications in Canada use the SE-330 to meet 2018 CEC 22.1 requirements.

SE-330 Neutral-Grounding-Resistor Monitor
Advanced ground-fault and neutral-grounding resistor monitoring relay that measures neutral current, neutral-to-ground voltage, and neutral-to-ground resistance.

EL3100 Ground-Fault & Phase-Voltage Indicator
Three panel-mounted LEDs indicate the ground-faulted phase.

Panel Meter
Panel-mounted meter displays earth leakage current as a percentage of the ground-fault-CT-primary rating.

RK-332/RK-302 Remote Indication and Reset
Panel-mounted remote indication and reset assemblies are included with SE-325 and surface-mounted SE-330 configurations.

Ordering Information

The following options are available with a faster delivery time and are commonly stock items:

ORDERING NUMBER	PROTECTION RELAY OPTION	NGR MONITOR MOUNTING OPTION	AMMETER & PULSE CONTROL OPTION	COMMS	CONTROL-POWER TRANSFORMER OPTION
NGRM-ENC-000-00	SE-325	Surface Mount	None	None	None
NGRM-ENC-200-00	SE-330 (N.O. K4)	Surface Mount	None	None	None

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NGRM-ENC SERIES

Ordering Information

The following options are built to order:

ORDERING NUMBER	PROTECTION RELAY OPTION	NGR MONITOR MOUNTING OPTION	AMMETER & PULSE CONTROL OPTION	COMMS	CONTROL-POWER TRANSFORMER OPTION
NGRM-ENC-000-01	SE-325	Surface Mount	None	None	CPT
NGRM-ENC-200-01	SE-330 (N.O. K4)	Surface Mount	None	None	CPT
NGRM-ENC-200-10	SE-330 (N.O. K4)	Surface Mount	Earth leakage Panel Meter	None	None
NGRM-ENC-200-20	SE-330 (N.O. K4)	Surface Mount	Earth leakage Panel Meter & Pulse Enable Switch	None	None
NGRM-ENC-201-00	SE-330 (N.O. K4)	Panel Mount	None	None	None
NGRM-ENC-201-10	SE-330 (N.O. K4)	Panel Mount	Earth leakage Panel Meter	None	None
NGRM-ENC-201-20	SE-330 (N.O. K4)	Panel Mount	Earth leakage Panel Meter & Pulse Enable Switch	None	None
NGRM-ENC-201-21	SE-330 (N.O. K4)	Panel Mount	Earth leakage Panel Meter & Pulse Enable Switch	None	CPT
NGRM-ENC-230-00	SE-330 (N.O. K4)	Surface Mount	None	Ethernet, dual RJ45	None
NGRM-ENC-231-01	SE-330 (N.O. K4)	Panel Mount	None	Ethernet, dual RJ45	CPT
NGRM-ENC-241-00	SE-330 (N.O. K4)	Panel Mount	None	Ethernet, 1 RJ45 & 1 Fiber	None
NGRM-ENC-331-01	SE-330 (N.O. K4) & Voltage Indication	Panel Mount	None	Ethernet, dual RJ45	CPT
NGRM-ENC-401-00	SE-330 (N.C. K4)	Panel Mount	None	None	None
NGRM-ENC-401-20	SE-330 (N.C. K4)	Panel Mount	Earth leakage Panel Meter & Pulse Enable Switch	None	None
NGRM-ENC-430-00	SE-330 (N.C. K4)	Surface Mount	None	Ethernet, dual RJ45	None
NGRM-ENC-431-21	SE-330 (N.C. K4)	Panel Mount	Earth leakage Panel Meter & Pulse Enable Switch	Ethernet, dual RJ45	CPT
NGRM-ENC-530-11	SE-330 (N.C. K4) & Voltage Indication	Surface Mount	Earth leakage Panel Meter	Ethernet, dual RJ45	CPT
NGRM-ENC-540-00	SE-330 (N.C. K4) & Voltage Indication	Surface Mount	None	Ethernet, 1 RJ45 & 1 Fiber	None
NGRM-ENC-540-10	SE-330 (N.C. K4) & Voltage Indication	Surface Mount	Earth leakage Panel Meter	Ethernet, 1 RJ45 & 1 Fiber	None

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FEEDER PROTECTION

Protect feeder circuits from overcurrents, earth faults, phase loss and other detrimental conditions in critical applications and processes.They provide essential data for predictive and preventive maintenance, extending the life of equipment, enhancing safety and maximizing efficiency.

FPU-32 Series	Feeder Protection Unit	86
FPS Series	Feeder Protection System	87

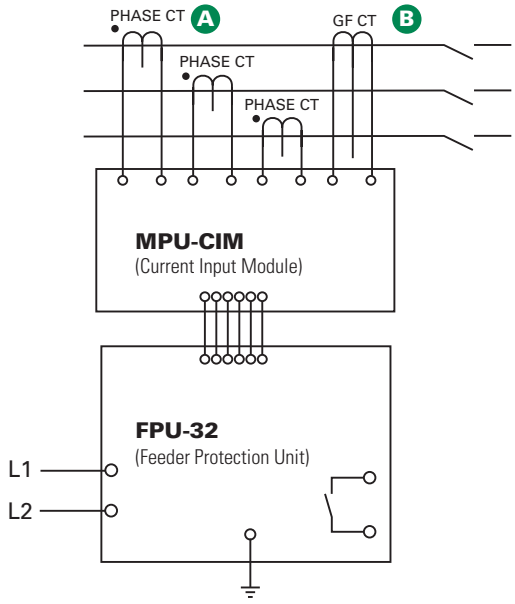
For More Information…
and to download datasheets and manuals on our Feeder Protection Relays, click Technical Resources at
Littelfuse.com/FeederProtection

FPU-32 SERIES (PGR-7200)

Feeder Protection Unit

NOTE: The FPU-32 consists of the Feeder Protection Unit (pictured above) and the MPU-CIM Current Input Module (not pictured).

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	COMMUNICATIONS
FPU-32-00-00	TIA-232
FPU-32-01-00	TIA-232 & RS-485
FPU-32-02-00	TIA-232 & DeviceNet™
FPU-32-04-00	TIA-232 & Ethernet

NOTE: One of the following is required: MPU-CIM-00-00 Current Input Module, or MPU-CTI-RT-00 Current Input Module with ring-tonque terminals.

ACCESSORIES	REQUIREMENT
Phase CTs	Recommended
Ground-Fault CT	Optional
MPU-16A-Y92A-96N	Optional

Description

The FPU-32 Feeder Protection Unit provides integrated protection, metering, and data-logging functions. It is an excellent choice for retrofitting and upgrading older relays because of its compact size and ability to use existing CTs. The FPU-32 is used to protect distribution feeders in processing, manufacturing, petroleum, chemical, and wastewater treatment facilities.

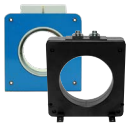
Features & Benefits

FEATURES	BENEFITS
IEC & IEEE overcurrent protection curves	Definite and inverse time settings for system coordination; prevents catastrophic failures
Two setpoint groups	Create distinctive settings for maintenance or for two different loads
Reduced overcurrent mode	Maintenance mode setting to reduce the risk of arc-flash hazards
Data logging	On-board 100-event recorder and remote data logging helps with system diagnostics
Overload	Thermal protection for connected load
Phase loss/Phase reverse (current)	Detects unhealthy supply conditions
Unbalance (current)	Prevents overheating due to unbalanced phases
Communications	Remotely view measured values, event records & reset trips

Accessories

A

Phase Current Transformers
Phase CTs are required to detect phase currents.

B 

Ground-Fault Transformer
Zero-sequence current transformer detects ground-fault current. Available with 5-A and 30-A primary ratings for low-level pickup.

Specifications

Protective Functions (IEEE #)

Overload (49, 51)	Definite-time overcurrent (50, 51)
Phase sequence (46)	Inverse-time overcurrent (50, 51)
Unbalance (46)	Ground fault (50G/N, 51G/N)
Phase loss (46)	RTD/PTC temperature (49)

Input Voltage 65-265 Vac, 30 VA; 80-275 Vdc, 25 W
Power-Up Time 800 ms at 120 vac
Ride-Through Time 100 ms minimum
24-Vdc Source 400 mA maximum
AC Measurements True RMS and DFT, Peak 32 samples/cycle and positive and negative sequence of fundamental
Frequency 50, 60 Hz
Output Contacts Three Form C
Approvals CSA certified, CE, C-Tick (Australian), UL Recognized
Communications TIA-232 (standard); TIA-485, DeviceNet™, Ethernet (optional)
Analog Output 4-20 mA, programmable
Conformally Coated Standard feature
Warranty 10 years
Mounting
(Control Unit) Panel (standard)
Surface (with MPU-32-SMK converter kit)
(Current Input Module) DIN, Surface

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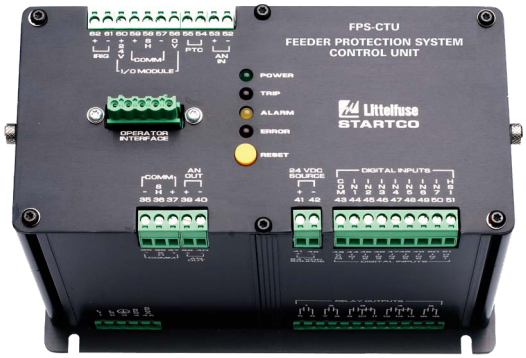
FPS SERIES

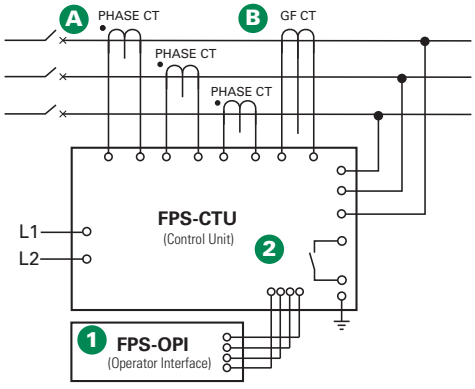
Feeder Protection System

1



2

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	COMMUNICATIONS
FPS-CTU-01-00	RS-485
FPS-CTU-02-00	RS-485 & DeviceNet™
FPS-CTU-03-00	RS-485 & Profibus®
FPS-CTU-04-00	RS-485 & Ethernet

ACCESSORIES	REQUIREMENT
FPS-OPI-01-00	Recommended
SE-IP65CVR-M	Optional
Phase CTs	Required
Ground-Fault CT	Recommended
MPS-RTD-01-00	Optional

Description

The FPS Feeder Protection System monitors voltage and current to provide a comprehensive package of 17 protective functions. The FPS is a modular system with integrated protection, breaker control, metering, and data-logging functions.

1 Operator Interface (FPS-OPI)

- Large, bright, 4 x 20 vacuum-fluorescent display
- Display metered values
- Access set points
- Powered by Control Unit
- Panel mount or attach directly to Control Unit
- Remote mounting (1.2 km or 4000 ft maximum loop length)
- 1/2 DIN size
- Hazardous-location certified

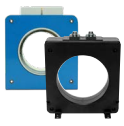
2 Control Unit (FPS-CTU)

- Current inputs—5-A or 1-A secondary phase current transformers
- Voltage inputs—up to 600 V without PTs
- Earth-leakage input—5-A or 1-A secondary or sensitive transformer
- 8 digital inputs, 5 relay outputs, 1 analog input and output
- 24-Vdc supply for OPI and RTD modules, and for digital inputs
- IRIG-B time-code input
- 1/2 DIN size, surface mount
- RS-485 network communications (Standard)
- DeviceNet™, Profibus®, or Ethernet communications available

Accessories

A

Phase Current Transformers
Phase CTs are required to detect phase currents.

B 

Ground-Fault Current Transformer
Zero-sequence current transformer detects ground-fault current. Available with 5-A and 30-A primary ratings for low-level pickup.

C

MPS-RTD Temperature Input Module
Optional module provides 8 inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.

SE-IP65CVR-M Cover
Optional gasketed, transparent cover for limited access and IP65 protection for an Operator Interface Module.

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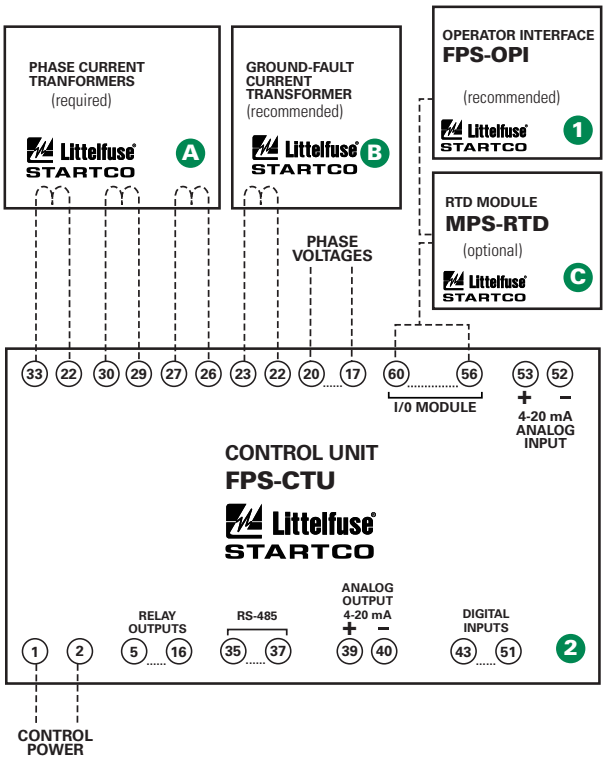
FPS SERIES

Feeder Protection System

Features & Benefits

FEATURES	IEEE #	BENEFITS
Overload	49, 51	Long-time overcurrent provides thermal protection for feeder or load
Inverse-time overcurrent	50, 51	Coordination using IEEE and IEC Curves
Definite-time overcurrent	50, 51	Instantaneous overcurrent to detect catastrophic failure
Current unbalance/ Phase loss/Phase reverse	46	Detects an open or high-impedance phase
Ground fault	50G/N, 51G/N	Inverse and definite time. Early insulation-failure detection.
RTD temperature	38, 49	Optional protection (MPS-RTD module) for load-temperature monitoring
Overvoltage	59	Limits stress to insulation
Undervoltage	27	Detects a damaging brown-out condition
Voltage unbalance	47	Detects unhealthy supply voltage
Two setting groups		Minimizes Arc-Flash hazards during maintenance
Breaker control		Allows local and remote operation; reduces component count
Metering		Displays the measured and calculated parameters
Data logging		On-board 64-event recorder helps with system diagnosis
Communications		Remotely view measured values, event records, & reset trips
Conformal coating		Internal circuits are conformally coated to protect against corrosion and moisture

Wiring Diagram



Specifications

Protective Functions (IEEE Device Numbers)	Overload (49, 51) Phase reverse (current) (46) Overfrequency (81) Overcurrent (50, 51) Underfrequency (81) Ground fault (50G/N, 51G/N) Unbalance (voltage) (47) RTD temperature (38, 49) Unbalance (current) (46) Phase loss (voltage) (47) Overvoltage (59) Phase loss (current) (46) Undervoltage (27) Phase reverse (voltage) (47) Power factor (55)
Input Voltage	65-265 Vac, 25 VA; 80-275 Vdc, 25 W
Power-Up Time	800 ms at 120 Vac
Ride-Through Time	100 ms minimum
24-Vdc Source	100 mA maximum
AC Measurements	True RMS and DFT, Peak, 16 samples/cycle, and positive and negative sequence of fundamental
Frequency	50 or 60 Hz
Inputs	Phase current, Earth-leakage current, Phase voltage, 7 digital, 1 analog
Output Contacts	5 contacts — See Product Manual
Approvals	CSA certified, C-Tick (Australian)
Communications	Allen-Bradley® DFI and Modbus® RTU (Standard); DeviceNet™, Profibus®, Ethernet (Optional)
Conformal Coating	Standard feature
Warranty	10 years
Mounting:	
Control Unit	Surface
Operator Interface	Panel, Control-Unit mounted

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ARC-FLASH PROTECTION

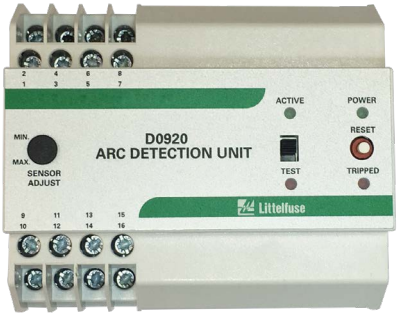
Rapidly detects developing Arc-Flash incidents and sends a trip signal to interrupt power before significant damage occurs.

D0920	Arc Detection Unit	90
PGR-8800 Series	Arc-Flash Relay	91
AF0500 Series	Arc-Flash Relay	93
AF0100 Series	Arc-Flash Relay	95
A0220 Series	Light Sensor	96
PGA-1100	Diode Logic	97

For More Information…
and to download our White Paper on Key Considerations for Selecting an Arc-Flash Relay or our Arc-Flash Energy Reduction Workbook, visit
Littelfuse.com/ArcFlash

D0920 ARC DETECTION UNIT

Arc Detection Unit

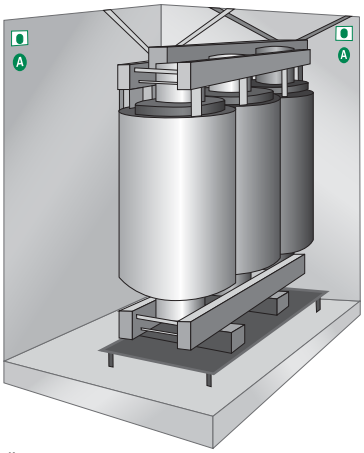


Description

The D0920 Arc-Flash relay provides a simple and cost effective solution for Arc-Flash monitoring. Two light sensors can be connected directly to one relay.

Light Sensors react to light and have a 180° detection zone. Sensors are supplied with 10 or 15 m of cable. 1-2 sensors are recommended per cubicle or drawer.

Installation Diagram



Install sensors in line of sight to possible arc faults.

Features & Benefits

FEATURES	BENEFITS
Compact module	Fits into wide range of Arc-Flash applications
Trip time <1 ms	Limits Arc-Flash damage and risk of injury
Two optical sensor cable lengths	Point sensors with 10 or 15 m of cable
Inputs for two sensors	Single Arc-Flash relay can monitor 2 sensors
Adjustable light sensitivity	Allows operation in bright environments and maximum sensitivity in dark environments
Service mode	Allows relay and sensor test without tripping system

Ordering Information

ORDERING NUMBER	DESCRIPTION
D0920.0060	230 V AC +15, -30%, remains powered on after trip, slide switch instead of key switch, electronic reset button instead of mechanical reset button, CCC approved

ACCESSORIES	REQUIREMENT
A0033.0010 Detector cable 2 x 0.25 mm² w/screen. 100 m	Optional
A0220.0010 Arc Detector V-Type; 10 m cable	Required: At least one sensor per monitored zone
A0220.0020 Arc Detector V-Type; 15 m cable	
PGA-1100/D1100 Diode Logic Unit	Optional

Accessories

A

A0220 Light Sensors
Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Available with 10 or 15 m cable.

PGA-1100/D1100 Diode Logic Unit
For tripping one circuit breaker with multiple D0920 Relays

Specifications

Supply Voltage	230 V AC +15,-30%
Thyristor Output	325 V DC from charged capacitor, nominal energy 3.5 J
Sensitivity	Adjustable 2 - 24 klux
Number of Sensors	Max. 2
Response Time	Less than 1 ms
Power Consumption	3.5 VA
Ambient Temperature	–25°C to 70°C
Dimensions	**H** 90 mm (3.5"); **W** 105 mm (4.1"); **D** 61 mm (2.4")
Certification	CE, CCC

5 ARC-FLASH PROTECTION

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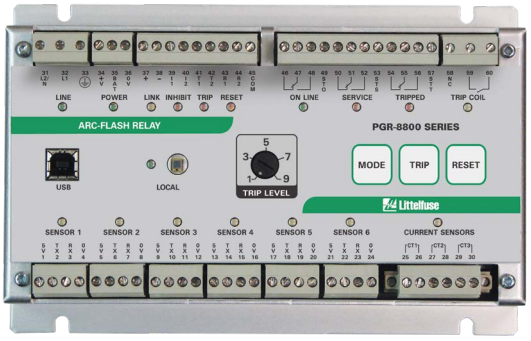
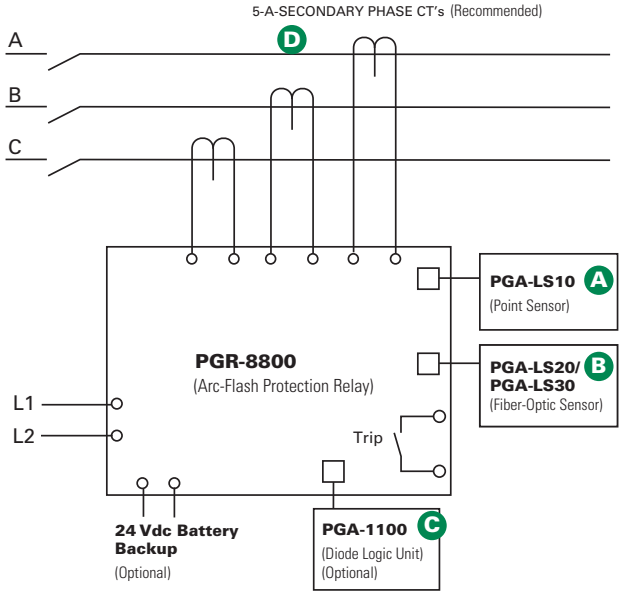
PGR-8800 SERIES (D1000)

Arc-Flash Relay



Simplified Circuit Diagram



For detailed wiring diagram, see adjacent page.

Ordering Information

ORDERING NUMBER	DESCRIPTION
PGR-8800-00 (UL, CE, CSA, RCM)	Arc-Flash Relay
PGR-8800-00-CC (UL, CE, CSA, RCM)	Arc-Flash Relay, Conformally Coated

ACCESSORIES	REQUIREMENT
PGA-LS10	Required*
PGA-LS20, PGA-LS30	Required*
PGA-1100	Optional
Current Transformer	Recommended

*At least one sensor is required. However, the exact number of sensors for proper coverage depends on the application.

Description

The PGR-8800 Series is a microprocessor-based relay that limits arc-fault damage by detecting the light from an arc flash and rapidly tripping. Phase-current-transformer inputs are provided for current-constrained arc-flash protection and, when so equipped, a programmable definite-time overcurrent function can be enabled. An optical sensor on the PGR-8800 and adjustable trip level reduce the chance of nuisance tripping by setting a threshold for ambient light. Sensors, inputs, and connections are monitored to ensure fail-safe operation. A secondary solid-state trip circuit provides a redundant trip path. A USB port is used for configuration and access to event logs and graphs.

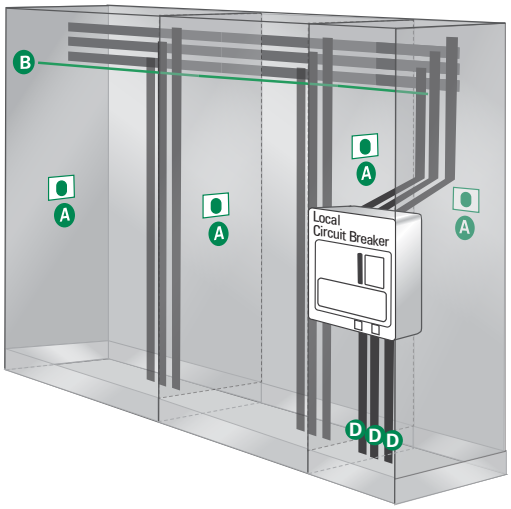
Optical Sensors

The PGR-8800 accepts both PGA-LS10 and PGA-LS20/ PGA-LS30 optical sensors, designed to collect light over a wide angle and with high sensitivity. For fast fault location, front-panel and sensor LED's indicate sensor health and which sensor detected an arc fault.

Sensor Placement

The PGR-8800 Arc-Flash Relay and sensors are easily installed in retrofit projects and new switchgear with little or no re-configuration. Even elaborate systems with multiple power sources take minutes to configure using the relay's built-in USB interface software.

Generally, it is recommended to mount 1 or 2 sensors per cubicle to cover all horizontal and vertical bus bars, breaker compartments, drawers, and anywhere that there is potential for an arc-fault. Threading a fiber-optic sensor through the cabinets and in areas where point-sensor coverage is uncertain results in complete coverage and an added level of redundancy. Even if policy is to only work on de-energized systems, all maintenance areas should be monitored to prevent potential damage and additional cost. At least one sensor should have visibility of an arc fault if a person blocks the other sensor(s).

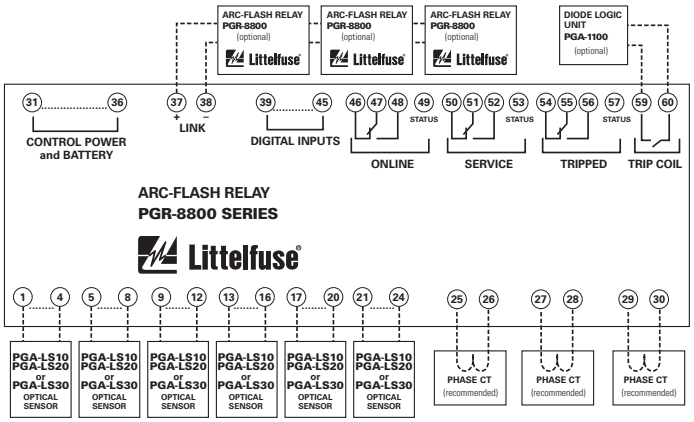


PGR-8800 SERIES (D1000)

Features & Benefits

FEATURES	BENEFITS
Arc-Flash trip time <1 ms	Limits arc-flash damage and risk of injury
Multiple sensors (up to 24)	Single module can monitor 6 sensors. Up to 4 PGR-8800 units can be linked into one system
Fail-safe system	Continuous monitoring of optical sensors and inputs ensures protection
Redundant trip circuit	Solid-state backup arc-detection circuit adds a second layer of safety
Adjustable light sensitivity	Allows for operation in bright environments and maximum sensitivity in dark environments
LED indication (on unit and each sensor)	18 LEDs provide at-a glance status for module and I/O state
Current detection	Phase-CT inputs provide overcurrent protection and prevent nuisance trips
Optical detection	Point and fiber-optic sensors provide wide detection area with sensor health trip indication
Digital inputs (6)	Two each: remote trip, inhibit, and reset inputs
Service mode	Allows for system test without tripping
Trip coil contact	Solid-state 24-300 Vdc/24-300 Vac IGBT
Indication contacts	Form C and status outputs
USB interface	Data logging and configuration software uses a USB interface with no drivers or software installation
Built-in sensor	Can be used in single-sensor systems, as a seventh sensor, and for calibration
Universal power supply/Battery backup	100-240 Vac, 14-48 Vdc, or 110-250 Vdc supply accepted. Ability to charge and run off an external, user-supplied 24 Vdc battery
Data logging	On-board event recorder helps with system diagnostics
Modbus	Remotely view measured values, event records & reset trips
Upstream Tripping	Ability to trip upstream device if the local breaker fails to clear the fault

Wiring Diagram



Accessories

A

PGA-LS10 Point Sensor
Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Sensor health and trip indication. Dimensions: See PGR-8800 Manual

B

PGA-LS20/PGA-LS30 Fiber-Optic Sensor
360° light sensor for tricky installations with many shadows or to run along bus bars. Sensor health and trip indication. Dimensions: See PGR-8800 Manual

C

PGA-1100 Diode Logic Unit
This module allows multiple PGR-8800 relays to trip the same breaker, for example an upstream or a tie-breaker. Dimensions: **H** 80mm (3.15"); **W** 20mm (0.79"); **D** 70mm (2.76")

D

Current Transformers
Eliminate nuisance arc-flash trips and use for overcurrent protection.

Specifications

IEEE Device Numbers	Overcurrent (50), Arc Flash (AFD)
Input Voltage	100-240 Vac, 14-48 Vdc, and 110-250 Vdc
Dimensions	**H** 130 mm (5.1"); **W** 200 mm (7.9"); **D** 54 mm (2.1")
Optical Trip Settings	9-25 klux, 800 µs-20 s
Current Trip Setting (A)	Programmable
Indication Contact Mode	Fail-safe
Trip Coil Voltage[1]	24-300 Vdc, 24-300 Vac
Trip Coil Contact Mode	Selectable fail-safe or non-fail-safe
Redundant Trip Circuit	Standard feature
Input Monitoring	Standard feature
USB Interface	Standard feature
Trip, Reset, Service Buttons	Standard feature
Expandable System	Link up to 4 PGR-8800 units
Warranty	5 years
Mounting	Surface, DIN (with D0050 adapter clips)
Approvals	UL, CE, CSA, RCM, FCC, DNV type approval, ABS type approval

NOTE (1) - Contact Littelfuse for trip coil voltages higher than 300 Vdc/Vac.

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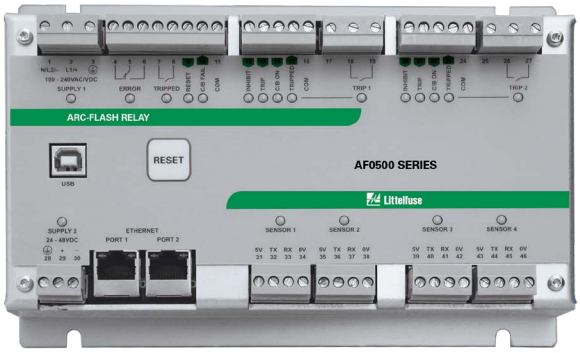
AF0500 SERIES

Arc-Flash Relay



Features & Benefits

FEATURES	BENEFITS
4 arc sensor inputs	Supports both point and fiber sensors
Arc-Flash trip time <1ms	Limits arc-flash damage and risk of injury
2 IGBT high speed trip outputs	Supports applications such as upstream breaker tripping or tie breaker tripping
Universal Power Supply	100-240 Vac, 24-48 Vdc, or 110-250 Vdc supply
Fail-safe system	Continuous monitoring of optical sensors and inputs ensures protection
LED indication (on unit and each sensor)	Trip and sensor status indicated both on relay and sensors
Discrete wire networking	Multiple AF0500 units can be interconnected to form a system
USB interface	Data logging and configuration software uses a USB interface with no drivers or software installation
Data logging	On-board event recorder for system diagnostics (2048 log lines)
Ethernet interface	Modbus® TCP communication

Ordering Information

ORDERING NUMBER	DESCRIPTION
AF0500-00	Arc-Flash Relay
AF0500-00-CC	Arc-Flash Relay, Conformally Coated

ACCESSORIES	REQUIREMENT
PGA-LS10	Required*
PGA-LS20, PGA-LS30	Required*
PGA-1100	Optional

Description

The AF0500 is a microprocessor-based arc-flash relay that limits arc-fault damage by detecting the light from an arc flash and rapidly tripping the feeder breaker. The unit is well suited for switchgear, transformer and power converter applications.

Sensors, inputs, and connections are health monitored to ensure fail-safe operation. A secondary solid-state trip circuit provides a redundant trip path. A USB port is used for configuration and access to event logs.

AF0500 includes an Ethernet interface and supports Modbus® TCP communication. Zone tripping, upstream breaker tripping and tie breaker tripping applications can be easily configured.

A number of control inputs allows interconnection of multiple AF0500 units to form a system.

Optical Sensors

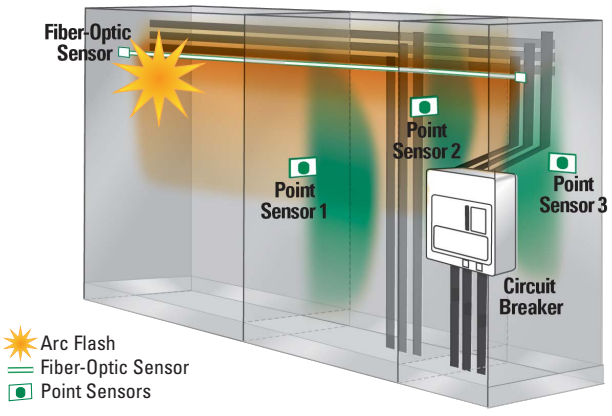
The AF0500 accepts both PGA-LS10 point sensors and PGA-LS20/PGA-LS30 fiber-optical sensors. Thus any combination of fiber or point sensors is supported.

For fast fault location, front-panel and sensor LEDs indicate sensor health and which sensor detected an arc fault.

Sensor Placement

The AF0500 Arc-Flash Relay and sensors are easily installed in retrofit projects and new switchgear with little or no re-configuration. Simple applications work straight out of the box with no need of PC configuration. More complex systems with multiple power sources are configured using the relay's built-in USB interface software.

Generally, it is recommended to mount 1 or 2 sensors per cubicle to cover all horizontal and vertical bus bars, breaker compartments, drawers, and anywhere that there is a risk for an arc fault. Threading a fiber-optic sensor through the cabinets and in areas where point-sensor coverage is uncertain results in complete coverage and an added level of redundancy. Even if policy is to only work on de-energized systems, all maintenance areas should be monitored to prevent potential damage and additional cost.

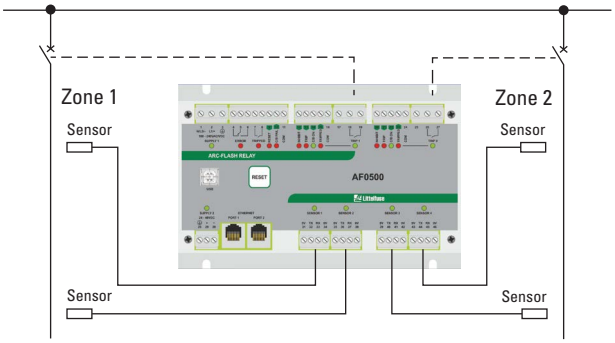


AF0500 SERIES

Applications

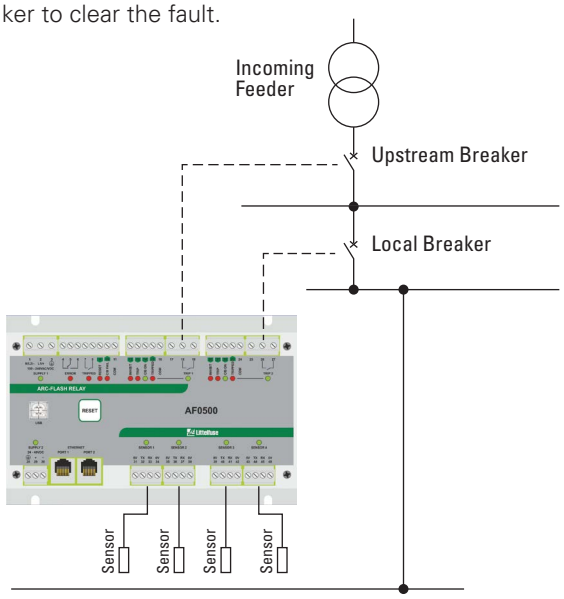
Zone Tripping

AF0500 can trip 2 separate zones. Sensors can be assigned to the zones individually through PC configuration.



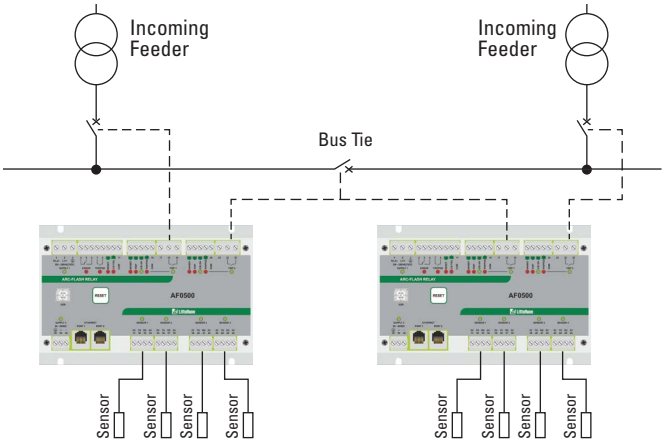
Upstream Breaker Tripping

In case of failure of the local circuit breaker to open, another trip command is sent after a short delay to an upstream breaker to clear the fault.



Tie Breaker Tripping

In case of an arc in one section of the switchboard, the AF0500 can trip both the incoming feeder and the tie breaker simultaneously. Thus the affected part of the switchboard is isolated from the non-affected part.



Accessories

PGA-LS10 Point Sensor
Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Includes Sensor health and trip indication.

PGA-LS20/PGA-LS30 Fiber-Optic Sensor
360° light sensor to run along bus bars. Sensor health and trip indication.

PGA-1100 Diode Logic Unit
This module allows multiple arc-flash relays to trip a common breaker, for example a tie-breaker.

Specifications

Power Supply

Universal	100 to 240 Vac (+10%, -15%) 50/60 Hz, 20 VA, 110 to 250 Vdc (+10%, -20%) 8 W
Low Voltage	24 to 48 Vdc (+10%, -20%), 4 W
Sensor Inputs	4 light sensor inputs for PGA-LS10, PGA-LS20 and PGA-LS30 sensors
Trip Outputs	2 IGBT switches
UL Rating	120/240 Vac, 1800 VA, 0.75 A maximum continuous, 125/250 Vdc, 138 VA, 0.75 A maximum continuous

Supplemental Rating

Make/Carry	30 A for 0.2s
Voltage Rating	24 to 300 Vac, 24 to 300 Vdc
Current Rating	20 A for 2 s, 10 A for 5 s

Communication	Ethernet, 2 ports with internal Ethernet switch, Modbus® TCP
Dimensions	**H** 130 mm (5.1"); **W** 200 mm (7.9"); **D** 54 mm (2.1")
Shipping Weight	0.9 kg (2 lb)
Operating Temp.	–40°C to +70°C (–40°F to 158°F)
Approvals	UL Listed (UL508), CE, RCM, FCC, CSA
Warranty	5 years
Mounting	Surface, DIN (with optional D0050 adapter clips)

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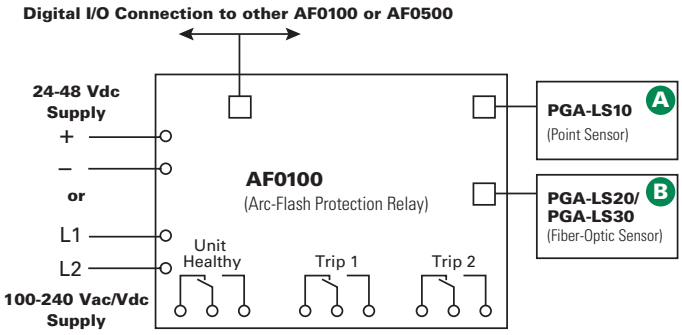
AF0100 SERIES

Arc-Flash Relay

Simplified Circuit Diagram



For dimensional drawing see: Appendix page 510, Figure 11.

Ordering Information

ORDERING NUMBER	DESCRIPTION
AF0100-00	Arc-Flash Relay, Universal Supply
AF0100-10	Arc-Flash Relay, 24-48 Vdc

Specifications

Input Voltage	
AF0100-00	100-240 Vac/Vdc, 24-48 Vdc
AF0100-10	24-48 Vdc
Dimensions	**H** 90 mm (3.5"); **W** 128 mm (5.0"); **D** 60 mm (2.4")
Trip, Error Relays	Form C, 250 Vac/30 Vdc, 6 A resistive
Sensitivity	10-25 klux programmable
Mounting	Surface, DIN rail
Operating Temperature	-40°C to +70°C (-40°F to 158°F)
Shipping Weight	1.0 kg (2.2 lb)
Certifications	Contact factory
Warranty	5 years

Description

The AF0100 Series arc-flash relay is a cost-effective solution that reduces arc-fault damage by detecting the light from an arc flash and rapidly tripping. Two remote light sensors can be connected to one relay and multiple AF0100 and/or AF0500 relays can be connected to monitor additional sensors, providing complete coverage for a wide range of applications. The compact, DIN-rail or surface-mountable body makes this an ideal solution for equipment manufacturers.

Two isolated Form-C contacts are provided for applications with multiple devices that must be tripped. This is especially useful for generator applications where the generator and breaker need to be tripped in case of an arc flash.

The AF0100 accepts PGA-LS10 point sensors and PGA-LS20/ PGA-LS30 fiber-optic sensors in any combination. Sensor health is continuously monitored to ensure fail-safe operation. A solid-state redundant trip circuit provides an internal fail-safe mechanism and fast arc-flash response during power up.

Front-panel and sensor LEDs indicate sensor health and fault location.

Features & Benefits

FEATURES	BENEFITS
Compact	Fits into a wide range of arc-flash applications
Two optical sensor types	Point sensors or fiber-optic sensors can be used in any combination for coverage flexibility
Dual sensor inputs	One relay can monitor two arc-flash sensors
Adjustable light sensitivity	Allows for operation in bright environments and maximum sensitivity in dark environments
Discrete wire networking	Multiple AF0100 or AF0500 units can be interconnected to form a system
Fail-safe system	Continuous monitoring of optical sensors and inputs ensures protection
USB interface	Configuration software is easy to use with no drivers or software installation
Unit health	Ensures continuous protection with self diagnostic and remote unit-healthy indication
LED Indication	Trip and sensor status indication both on relay and sensors

Accessories

A

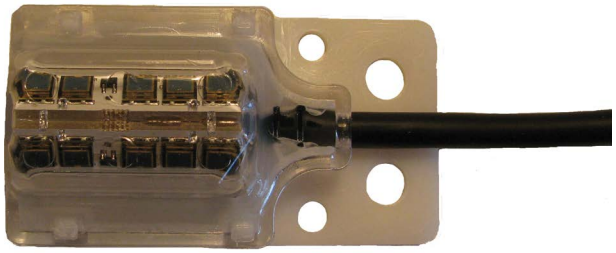
PGA-LS10 Point Sensor
Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Includes sensor health and trip indication.

B

PGA-LS20/PGA-LS30 Fiber-Optic Sensor
360° light sensor to run along bus bars. Includes sensor health and trip indication.

A0220 SERIES

Arc Detecting Point Sensor

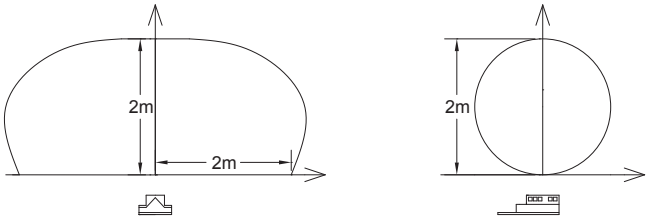


Description

The A0220 Arc Detector is a photo electric sensor. It has a sensitive area of 180°. Sensor signal is a mA current signal of 0.5 mA/klux. The sensor includes 10 m of shielded two-wire electrical cable which can easily be shortened or extended to a maximum of 50 m. Use Belden 85240 or equivalent cable (2 x 0.50 mm^2).

The sensor is compatible with the D0920, D1000 and PGR-8800 Littelfuse Arc Flash Relays.

Detection range for a 3kA fault



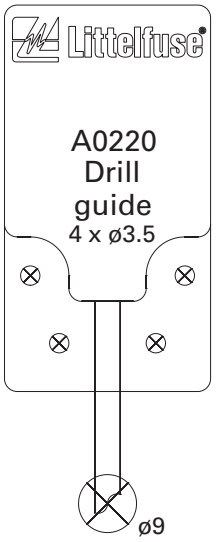
A0220 Sensor Installation

The sensors include an adhesive-backed drill template for easy surface or panel-mount installation. All dimensions are shown in millimetres.

Affix the drill template where the sensor is to be mounted. Either M4 or M5 screws or pop rivets (4 mm or 5 mm) can be used.

Mounting screws are M4 for the top holes. This template matches the mounting dimensions for the A1000 or PGA-LS10 sensor.

The bottom mounting holes are either for 5mm self-drilling screws (3.5mm drill) or for M5 (4.2 mm drill). This template matches the mounting dimensions for the A0200 and A0300 sensors.



For placement of sensors please refer to the relay manual.

Ordering Information

ORDERING NUMBER	CONTROL POWER
A0220.0010	Arc Detector type V, 10 m
A0220.0020	Arc Detector type V, 15 m
A0220.0030	Arc Detector type V, 10 m, CCC approved
A0220.0040	Arc Detector type V, 15 m, CCC approved

Specifications

Sensitivity	0.5 mA/ klux
Range for D0920	2 klux to 30 klux
Range for PGR-8800	10 klux to 30 klux
Ambient temperature	-25˚C to +70˚C
Degree of protection	IP65

Type Selection Table:
A0220 Arc Detector includes 10m cable

Connection to D0920 relay

SENSOR WIRE	TERMINAL
Red	1
Green	2
Screen	3

Connection to PGR-8800 relay

SENSOR WIRE	SENSOR 1 TERMINAL	SENSOR 2 TERMINAL	SENSOR 3 TERMINAL	SENSOR 4 TERMINAL	SENSOR 5 TERMINAL	SENSOR 6 TERMINAL
Green	4	8	12	16	20	24
Red	3	7	11	15	19	23
Screen	Chassis	Chassis	Chassis	Chassis	Chassis	Chassis

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PGA-1100 (D1100)

Diode Logic

Description

The PGA-1100 Diode Logic module is an optional accessory for the Littelfuse Arc-Flash Relays.

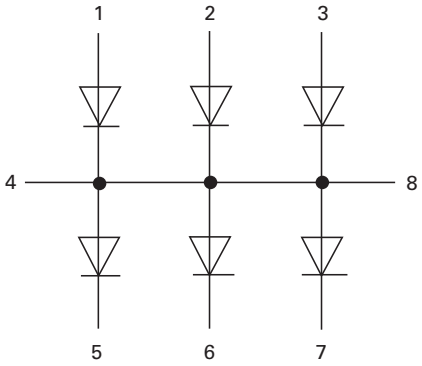
It is used in installations with more than one breaker and more than one Arc-Flash Relay. Purpose of the unit is to separate the trip paths, so the breakers can be tripped independently from each other.

Typical applications are a switchboards with two incoming feeders and one tie breaker or switchboards with several protected zones and tripping of a common upstream circuit breaker.

The unit has three input diodes to handle the outputs of three Arc-Flash relays and three output diodes to handle the trip coils of three circuit breakers. If more than three relays/ circuit breakers are needed, more units can be added by connecting terminal 8 of one box to terminal 4 of the next one, thus increasing the number of inputs and outputs with multiples of three.

For more application information please refer to the arc-flash relay manuals.

Simplified Circuit Diagram



Specifications

Diodes	1000V reverse voltage, 3A continuous, 25A for 1 second
Certification	CE
Dimensions	**H** 70 mm (2.76"); **W** 20 mm (0.79"); **D** 80 mm (3.15")

Ordering Information

ORDERING NUMBER	DESCRIPTION
PGA-1100.0010	Diode logic unit

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SWITCHING RELAYS & CONTROLS

Simple controls perform a specific function such as changing lamp intensity; vary the speed of a motor; or manage temperature of a heater.

PHS Series	Phase Control	100
SIR Series	Solid-State Relay - Isolated	102
SLR Series	Solid-State Relay - Non-Isolated	104
TCR9C	Temperature Controller	106

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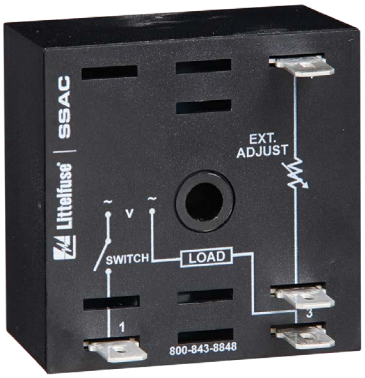
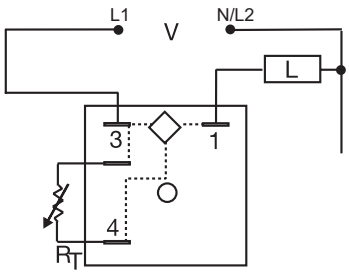
PHS SERIES

Phase Control



Wiring Diagram



Triac Output Device
V = Voltage
L = Load
RT = External Adjustment

For dimensional drawing see: Appendix, page 512, Figure 19.

Ordering Information

MODEL	INPUT VOLTAGE	RATING
PHS120A10	120VAC	10A
PHS120A20	120VAC	20A
PHS120A6	120VAC	6A
PHS230A10	230VAC	10A
PHS230A20	230VAC	20A
PHS230A6	230VAC	6A

If you don't find the part you need, call us for a custom product 800-843-8848

Description

The PHS Series is an ideal method of changing lamp intensity, varying the speed of a fan/motor, or controlling the temperature of a heater. The effective output voltage is adjusted with an accessory external potentiometer suitable for line voltage applications.

Operation

Upon application of input voltage, effective output voltage can be varied by changing the external resistance value. As the external resistance increases, the effective output voltage decreases. The inverse is also true.

Features & Benefits

FEATURES	BENEFITS
External adjustment - 230VAC rated potentiometer	Allows control of heavy loads directly, solid state design will provide long life
Up to 20A steady state - 200A inrush	Allows control of heavy loads directly, solid state design will provide long life
Single hole surface mounting	Provides quick and easy installation

Accessories

P1004-174 (100kΩ 1W)**, P1004-175** (200kΩ 2W)
Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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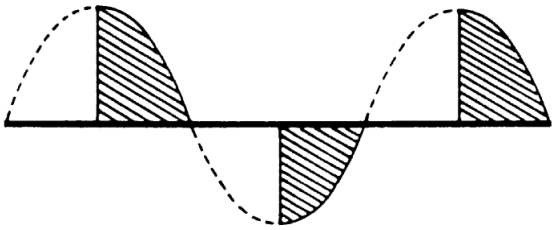
PHS SERIES

Specifications

Output		
Type	Variable voltage phase angle control	
Rating	**Steady State (at 100% On)**	**Inrush***
	1A	10A
	6A	60A
	10A	100A
	20A	200A
Minimum Load Current	100mA	
Voltage Drop	≅ 2.0V at rated current	
Input		
Voltage	120 or 230VAC	
Tolerance	±20%	
AC Line Frequency	50/60Hz	
Protection		
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface	
Insulation Resistance	≥100MΩ	
Mechanical		
Mounting *	Surface mount with one #10 (M5 x 0.8) screw	
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.4 mm (1.51")	
Termination	0.25 in. (6.35 mm) male quick connect terminals	
Environmental		
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C	
Humidity	95% relative, non-condensing	
Weight	1A: ≅ 2.4 oz (68 g) 6, 10, & 20A: ≅ 3.9 oz (111 g)	
External Adjustment Potentiometer		
120VAC	100KΩ rated at 1W	
230VAC	200KΩ rated at 2W Must have insulation resistance suitable for line voltage applications.	

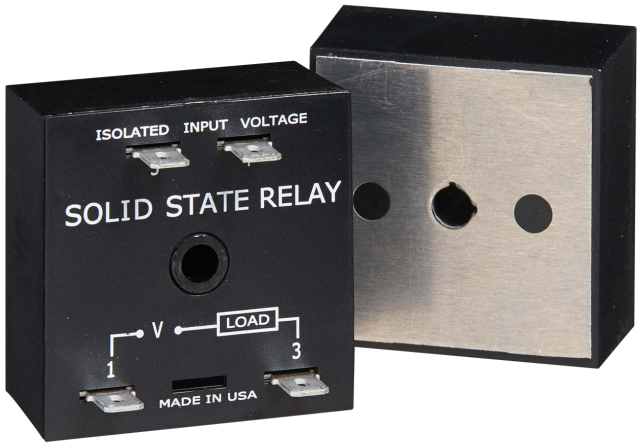
*Units rated ≥ 6A must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

Typical Output Waveform



SIR SERIES

Solid-State Relay - Isolated



Description

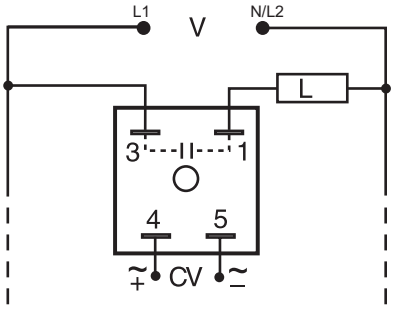
The SIR Series is designed for industrial applications requiring rugged reliable operation. Provides an optically isolated, high capacity, solid-state output, with power switching capability up to 20A steady state, 200A inrush. Zero voltage switching SIR2 extends the life of an incandescent lamp up to 10 times. Random switching SIR1 is ideal for inductive loads. When fully insulated female terminals are used on the connection wires, the system meets the requirements for touch-proof connections.

Operation

The solid-state output is located between terminals 1 and 3, and is normally open or normally closed without control voltage applied to terminals 4 and 5. When control voltage is applied to terminals 4 and 5, the solid-state output opens or closes respectively.

Reset: Removing control voltage resets the output. The unit is also reset if output voltage is removed.

Wiring Diagram



V = Voltage
CV = Control Voltage
L = Load

Load may be connected to terminal 3 or 1.

Note: Normally open output is shown. Normally closed output is also available.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Compact design measures 2 in. (50.8mm) square	Perfect for OEM applications where space is limited
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration and humidity
Up to 20A, 200A inrush output rating	Provides direct control of heavy inductive, incandescent or resistive loads
Switching output is optically isolated from the control input	Provides the ability to interface between 2 different electrical circuits
SIR1 models provide random switching	Designed for use with resistive and incandescent loads, extending lamp life up to 10 times
SIR2 models provide zero voltage switching	Perfect for resistive and incandescent loads
Metalized mounting surface	Facilitates heat transfer in high current applications

Ordering Information

MODEL	SWITCHING	CONTROL VOLTAGE	RATING	OUTPUT FORM	OUTPUT VOLTAGE
SIR1A1A4	Random	9 to 30VAC or DC	3A	Normally open	120VAC
SIR1A20A4	Random	9 to 30VAC or DC	20A	Normally open	120VAC
SIR1B6B4	Random	90 to 150VAC or DC	6A	Normally closed	120VAC
SIR1C20B6	Random	190 to 290VAC or DC	20A	Normally closed	230VAC
SIR2A20A4	Zero voltage	9 to 30VAC or DC	20A	Normally open	120VAC
SIR2B20A4	Zero voltage	90 to 150VAC or DC	20A	Normally open	120VAC
SIR2B20B4	Zero voltage	90 to 150VAC or DC	20A	Normally closed	120VAC

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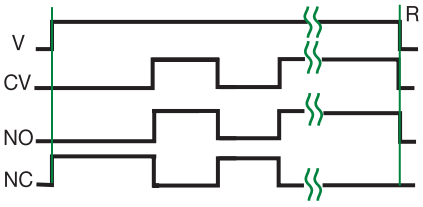
SIR SERIES

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect** These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Function Diagram



V = Voltage
CV = Control Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
R = Reset
⌇⌇ = Undefined Time

Specifications

Output

Type	Optical isolation, totally solid state		
Form	SPST, NO or NC		
Voltage	24, 120, or 230VAC		
Tolerance	±20%		
Ratings	**Steady State**	**Inrush***	**Output Device**
	3A	30A	Triac
	6A	60A	Triac
	10A	100A	Triac
	20A	200A	Triac
Minimum Load Current	≅ 50mA		
Voltage Drop	≅ 2.0V at rated current		
Leakage Current (Open State)	≅ 6mA		

Input

Type	Optical isolation LED/photo transistor
Control Voltage	9 to 290VAC/DC in 3 ranges
Power Consumption	≤ 0.5W

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting*	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -55° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

*Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

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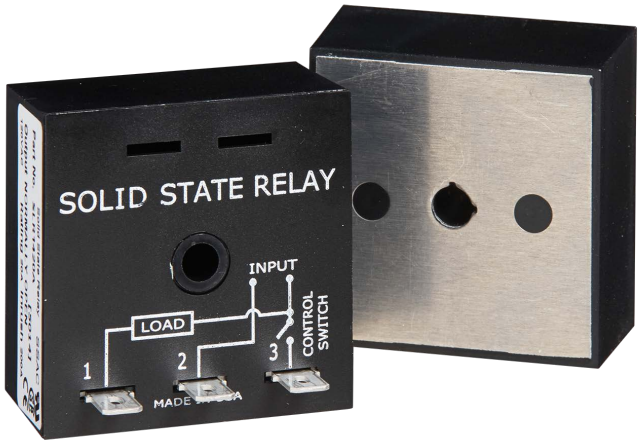
SLR SERIES

Solid-State Relay - Non-Isolated



Description

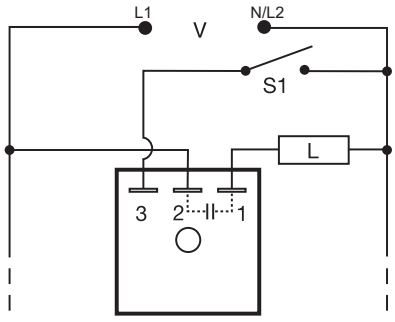
The SLR Series has no isolation between the control switch input and the solid-state output. Select the SLR for applications where the control switch is the same voltage source as the load. Provides the noiseless, reliability and long life of a solid-state relay, without the cost of isolation circuitry. The SLR Series offers random switching and is normally used for inductive loads. When fully insulated female terminals are used on the connection wires, the system meets the requirements for touch-proof connections.

Operation

The solid-state output is located between terminals 1 and 2 and can be ordered as either normally open or normally closed, when voltage is applied and S1 is open. When S1 is closed, the solid-state output between terminals 1 and 2 closes (or opens). If S1 is opened, the solid-state output will open (or close).

Reset: Opening S1 resets the output to its original state. Reset is also accomplished by removing input voltage.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
L = Load

Note: Normally open output is shown. Normally closed output is also available.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Compact design measures 2 in. (50.8mm) square	Perfect for OEM applications where space is limited
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Up to 20A steady, 200A inrush output rating	Provides direct control of heavy inductive, resistive, or incandescent loads
Metalized mounting surface	Facilitates heat transfer in high current applications

Ordering Information

MODEL	SWITCHING	INPUT VOLTAGE	OUTPUT RATING	OUTPUT FORM
SLR1420A	Random	120VAC	20A	Normally open
SLR1610A	Random	230VAC	10A	Normally open

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Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect** These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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SLR SERIES

Specifications

Output (Contact)

Type	Non-isolated solid state		
Form	SPST, NO or NC		
Voltage	24, 120, or 230VAC		
Tolerance	±20%		
Ratings	**Steady State**	**Inrush***	**Output Device**
	1A	10A	SCR & Bridge Rectifier
	6 A	60A	Triac
	10A	100A	Triac
	20A	200A	Triac
Minimum Load Current	≅ 50mA		
Voltage Drop (at Rated Current)	≅ 2.0V - 6, 10, & 20A units; ≅ 2.5V - 1A units		
Leakage Current (Open State)	≤ 5mA		
Initiate Switch Voltage	Same as the output voltage		
Power Consumption	≤ 0.5W		

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100MΩ

Mechanical

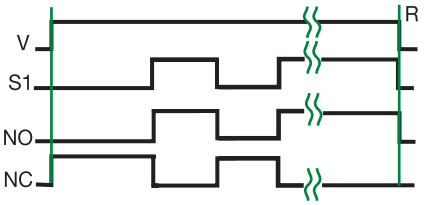
Mounting*	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	1A units: ≅ 2.4 oz (68 g); 6, 10, 20A units: ≅ 3.9 oz (111 g)

*Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

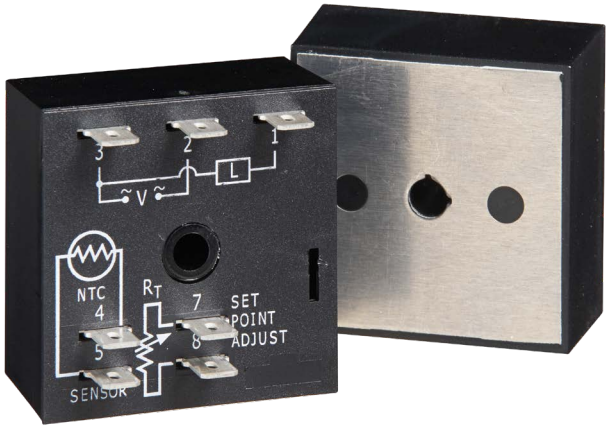
Function Diagram



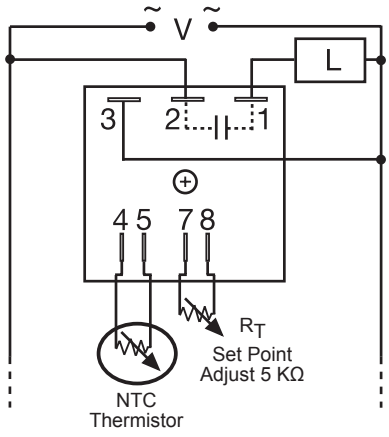
V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
R = Reset
—⌇— = Undefined Time

TCR9C

Temperature Controller



Wiring Diagram



V = Voltage
L = Load

Caution: NTC Thermistor must be electrically insulated, 1500 volts RMS minimum.

For dimensional drawing see: Appendix, page 512, Figure 19.

Description

The TCR9C of solid-state temperature control is a low cost modular approach to accurate control of temperature. The high power output is available in 20 amperes and provides setpoint temperature control. The efficient mounting surface allows for utilization of equipment as the heat sink. Designed for use with resistive loads.

Operation

Setpoint Control: TCR9C is a single setpoint temperature controller. When the thermistor resistance is high (above the setpoint), the solid-state output is ON. When the thermistor resistance decreases (temperature increases) to setpoint or below, the output turns OFF. It must be recognized that temperature differential (under and overshoot) is largely due to the system as a whole. The mass of the system, size of the heaters and sensor all play an important part. Single setpoint control is best when there is little or no lag time between heater and sensor, and when the heater is not oversized.

Features & Benefits

- NTC thermistor sensing for low cost setpoint control
- Solid-state output to control resistive heaters
- External adjustment of the setpoint
- Small package, encapsulated, single-screw mounting
- Metal mounting surface utilizes equipment as heat sink

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect** These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

Specifications

Control

Type	Single setpoint, negative temperature coefficient resistance sensing
Sensor Type	Thermistor, negative temperature coefficient (customer supplied) Electrically insulated for 1500V RMS min.
Adjustment	Temperature setpoint selected by means of an external resistance
Accuracy	≤ ±5% of the setpoint resistance Add the tolerance of the NTC thermistor and the drift of the adj. pot over temp. range
Setpoint vs. Ambient Temperature and Operating Voltage	±5% of setpoint resistance
Reset Time	≤ 150ms

Input

Voltage	120 - 240VAC
Tolerance	±15%
AC Line Frequency	50/60 Hz

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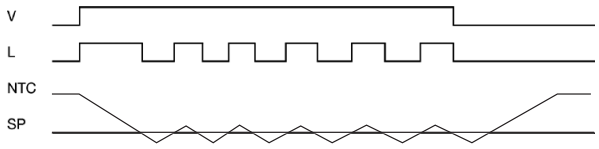
TCR9C

Output			
Type	Solid state		
Form	Non-isolated, single pole, zero voltage switching		
Rating	**Model**	**Steady State**	**Inrush***
	C	20A	200A*
Minimum Load Current	100mA		
Voltage Drop	≅ 2V at rated current		
Off State Leakage Current	≅ 5mA @ 230VAC		
Protection			
Dielectric Breakdown	≥2000 volts terminals to mounting surface		
Isolation Voltage	≥100mΩ		
Circuitry	Encapsulated		
Mechanical			
Mounting	Surface mount with one #10 (M5 x 0 .8) screw		
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")		
Termination	0.25 in. (6.35mm) male quick connect terminals		
Environmental			
Operating/Storage Temperature	-40° to 60°C / -40°to 85°C		
Humidity	95% relative, non-condensing		
Weight	≅ 2 .7 oz (77 g)		

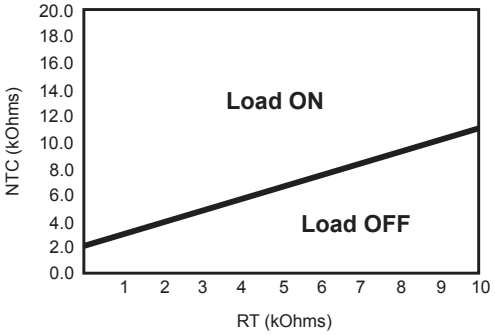
* Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: non-repetitive for 16ms.

Function Diagram



V = Voltage
L = Load
SP = Setpoint
NTC = Negative Temperature Coefficient Thermistor

Adjustment vs. Thermistor Resistance



Note: If R_T value exceeds 13kOhms, the output will not energize.

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MOTOR & PUMP PROTECTION

Prevent damage to motors caused by overloads, jams, phase loss or unbalance, heat from non-electric sources, heavy start-ups and excessive operational cycles. Dynamic thermal curves, as well as integrated protection, metering, and data-logging functions extend motor life and maximize process efficiency.

PGR-6100 Series	Motor Ground-Fault & Insulation Relay	110
PGR-6101-120	Motor Ground-Fault & Insulation Relay	111
MPU-32 Series	Motor Protection Unit	112
MPS Series	Motor Protection System	114
MPU-32-X69X Series	Motor Protection Relay Retrofit Kit	116
MPS-469X Series	Motor Protection Relay Retrofit Kit	116
111-Insider-P / 231-Insider-P	Single-Phase Pump Monitor	117
232-Insider	Single-Phase Pump Monitor	120
111P / 233P / 233P-1.5 Series	Single-Phase Pump Monitor	122
234-P	Single-Phase Pump Monitor	124
235P	Single-Phase Pump Monitor	126
MP8000 Series	Bluetooth Current & Voltage Monitor	128
777 Series	3-Phase Current & Voltage Monitor	132
777 / 77C Series	Single-Phase Current & Voltage Monitor	134
777-KW/HP-P2 Series	3-Phase Current & Voltage Monitor	136
777-AccuPower	3-Phase Current & Voltage Monitor	139
77C-KW/HP Series	Single-Phase Current & Voltage Monitor	140
SIO-RTD-02-00	Temperature Input Monitor	144

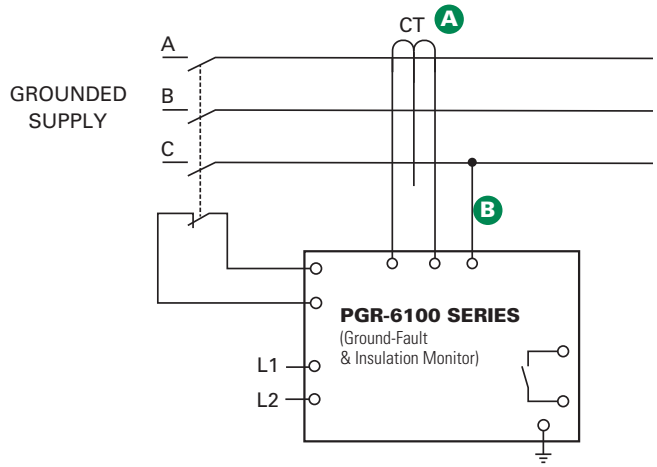
For More Information…
and to download our Motor Protection Brochure or White Paper, click on Technical Resources at
Littelfuse.com/MotorProtection

*Bluetooth is a trademark of its respective owner.

PGR-6100 SERIES (GFR4000)

Ground-Fault & Insulation Monitor

Simplified Circuit Diagram



Description

The PGR-6100 combines the features of a ground-fault protection relay and insulation monitor into one unit. It protects against ground faults by monitoring insulation resistance when the motor is de-energized and by monitoring ground-fault current when the motor is energized. The PGR-6100 features two separate analog outputs for optional current and ohm meters, and two separate alarm relays. It operates on one- or three-phase solidly grounded, resistance-grounded and ungrounded systems up to 6 kV.

Features & Benefits

FEATURES	BENEFITS
Adjustable GF pickup (10 mA-3 A)	Trip setting provides a wide range of low-level protection and system coordination
Adjustable insulation pickup (250 kΩ-2 MΩ)	Customizable insulation resistance setpoints for maximum protection
Adjustable time delay (50 ms-1.0 s)	Adjustable trip delay for quick protection and system coordination
Output contacts	Two Form C output contacts for ground fault and insulation-resistance fault
Analog outputs (0-1 mA)	Two analog outputs indicate insulation resistance and ground-fault current
CT-Loop monitoring	Alarms when CT is not connected
Selectable contact operating mode	Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil

Accessories

SE-CS30 Series Ground-Fault CTs
Required zero-sequence current transformer specifically designed for low level detection. Flux conditioner is included to prevent saturation.

PGH Family High Tension Couplers
Required (for systems >1,300 V) PGH Family high-tension coupler must be connected between the phase conductor and the PGR-6100.

PGA-0500 Analog % Current Meter
PGA-0510 Analog Ohm Meter
Optional panel-mounted meters display ground-fault current as a percentage of the set-point and insulation resistance.

Specifications

IEEE Device Numbers	Ground Fault (50G/N, 51G/N), Ground detector (64), Alarm Relay (74)
Input Voltage	*See ordering information*
Dimensions	**H** 75 mm (3"); **W** 100 mm (3.9"); **D** 115 mm (4.5")
Response delay	< 50 ms
Contact Operating Mode	Selectable fail-safe or non-fail-safe
Harmonic Filtering	Standard feature
Test Button	Standard feature
Reset Button	Standard feature
CT-Loop Monitoring	Standard feature
Output Contacts	Two Form C
Analog Output	0-1 mA
Approvals	UL Listed (E183688) [1]
Warranty	5 years
Mounting	DIN, Surface

Ordering Information

ORDERING NUMBER	CONTROL POWER
PGR-6100-120	120 Vac
PGR-6100-240[1]	240 Vac [1]

ACCESSORIES	REQUIREMENT
SE-CS30 Series	Required
PGH Family	Required >1300 V
PGA-0500	Optional
PGA-0510	Optional

Note (1) - PGR-6100-240 ordering option is not UL Listed.
For optional conformal coating please consult factory.

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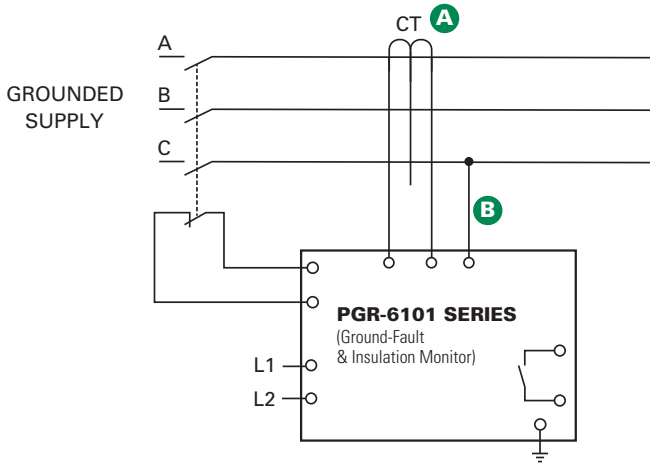
PGR-6101-120 (GFR4001)

Ground-Fault & Insulation Monitor

Simplified Circuit Diagram



Ordering Information

ACCESSORIES	REQUIREMENT
SE-CS30 Series	Required
PGH Family	Required >1300 V
PGA-0500	Optional
PGA-0510	Optional

For optional conformal coating please consult factory.

Description

The PGR-6101-120 combines the features of a ground-fault protection relay and insulation monitor into one unit. It protects against ground faults by monitoring insulation resistance when the motor is de-energized and by monitoring ground-fault current when the motor is energized. The PGR-6101-120 features two separate analog outputs for optional current and ohm meters, and two separate alarm relays. It operates on one- or three-phase solidly grounded, resistance grounded and ungrounded systems up to 6 kV.

Features & Benefits

FEATURES	BENEFITS
Adjustable GF pickup (30-200 mA)	Trip setting provides a wide range of low-level protection and system coordination
Adjustable insulation pickup (60-600 kΩ)	Customizable insulation resistance setpoints for maximum protection
Adjustable time delay (50-250 ms)	Adjustable trip delay for quick protection and system coordination
Output contacts	Two Form C output contacts for ground fault and insulation-resistance fault
Analog outputs (0-1 mA)	Two analog outputs indicate insulation resistance and ground-fault current
CT-Loop monitoring	Alarms when CT is not connected
Selectable contact operating mode	Selectable fail-safe or non-fail-safe operating modes allows connection to shunt or undervoltage breaker coil

Accessories

A

SE-CS30 Series Ground-Fault Transformers
Required zero-sequence current transformer specifically designed for low level detection. Flux conditioner is included to prevent saturation.

B

PGH Family High Tension Couplers
Required (for systems >1,300 V) PGH Family high-tension coupler must be connected between the phase conductor and the PGR-6101-120.

PGA-0500 Analog % Current Meter
PGA-0510 Analog Ohm Meter
Optional panel-mounted meters display ground-fault current as a percentage of the set-point and insulation resistance.

Specifications

IEEE Device Numbers	Ground Fault (50G/N, 51G/N), Ground detector (64), Alarm Relay (74)
Input Voltage	120 Vac
Dimensions	**H** 75 mm (3"); **W** 100 mm (3.9"); **D** 115 mm (4.5")
Response delay	< 50 ms
Contact Operating Mode	Selectable fail-safe or non-fail-safe
Harmonic Filtering	Standard feature
Test Button	Standard feature
Reset Button	Standard feature
CT-Loop Monitoring	Standard feature
Output Contacts	Two Form C
Analog Output	0-1 mA
Approvals	UL Listed (E183688)
Warranty	5 years
Mounting	DIN, Surface

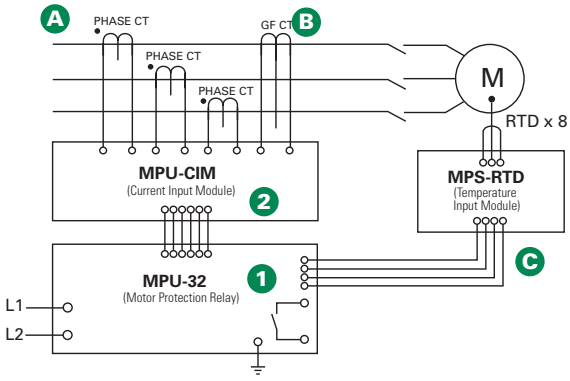
MPU-32 SERIES (PGR-6200)

Motor Protection Unit

1

2

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	COMMUNICATION
MPU-32-00-00	TIA-232
MPU-32-01-00	TIA-232 & TIA-485
MPU-32-02-00	TIA-232 & DeviceNet™
MPU-32-04-00	TIA-232 & EtherNet/IP™ & Modbus® TCP

NOTE: One of the following is required: MPU-CIM-00-00 Current Input Module, or MPU-CTI-RT-00 Current Input Module with ring-tongue terminals.

ACCESSORIES	REQUIREMENT
Phase CTs	Required
MPS-RTD-01-00	Optional
MPS-DIF-01-00	Optional
MPU-32-SMK	Optional
CA-945	Optional
MPU-16A-Y92A-96N	Optional

Description

The MPU-32 Motor Protection Unit is used to provide current- and temperature-based protection, metering, and data logging for three-phase low-voltage medium-horsepower induction motors. This relay is ideal for retrofitting and upgrading obsolete or aging motor protection using existing CTs. See the PMA Family of Panel Mount Adapter Kits to replace common obsolete relays.

1 Motor Protection Unit

- Three ac-current inputs
- Earth-leakage-CT input
- Programmable digital input
- 24-Vdc source for digital input
- Programmable 4-20-mA analog output
- On-board temperature-sensor input,
- 100-Ω-Platinum RTD or PTC
- Three programmable output relays
- Local RS-232 communications, optional Network Communications
- PC-interface software (SE-Comm-RIS)
- 4 line x 20 character backlit LCD display
- Keypad for programming and display selection
- 4 LEDs; 1 user programmable

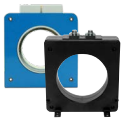
2 Current Input Module (MPU-CIM)

The MPU-CIM Current Input Module is the interface between the MPU-32 relay and the 5-A-secondary, 1-A-secondary, and sensitive current transformers. The MPU-CIM is ordered separately from the MPU-32 and can be surface or DIN-rail mounted. Wire-clamping terminals are standard, but the MPU-CTI is available for those who require ring-tongue terminals.

Accessories

A

Phase Current Transformers
Phase CTs are required to detect phase currents. For upgrade applications, existing CTs can be used.

B 

Ground-Fault Current Transformer
Optional zero-sequence current transformer detects ground-fault current. Available with 5-A and 30-A primary ratings for low-level pickup.

C

MPS-RTD Temperature Input Module
Optional module provides 8 inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.

D

MPS-DIF Differential Current Module
Optional motor differential protection, compatible with core balance and summation current transformer connections.

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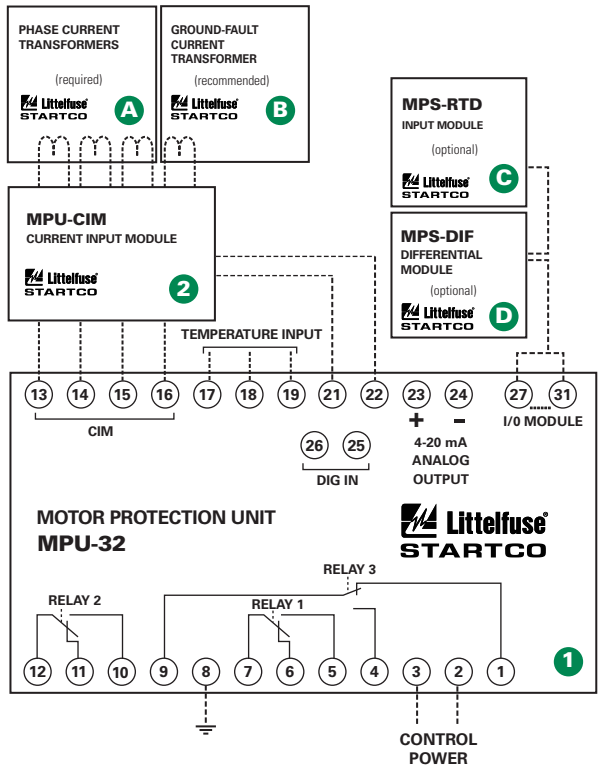
MPU-32 SERIES (PGR-6200)

Features & Benefits

FEATURES	IEEE #	BENEFITS
Overload	49, 51	Extends motor life and prevents insulation failures and fires
Dynamic thermal model		Provides protection through starting, running, and cooling cycles
Communications		Remotely view measured values and event records, reset trips, and access setpoints
Ground fault	50G/N, 51G/N	Prevents catastrophic failures and fires
Current unbalance/ Phase loss/Phase reverse	46	Prevents overheating due to unbalanced phases
RTD temperature	38, 49	RTD temperature protection (MPS-RTD module) for high-ambient or loss-of-ventilation protection
Phase loss/Phase reverse (current)	46	Detects unhealthy supply conditions
Overcurrent	50, 51	Prevents catastrophic failures and fires; extends motor life
Jam		Prevents motor damage by detecting mechanical jams or excessive loading
Undercurrent	37	Detects low level or no-load conditions
PTC overtemperature	49	Overtemperature (PTC) protection for high-ambient or loss-of-ventilation detection
Starts per hour	66	Limits the motor starts per hour to prevent overheating
Differential	87	Optional MPS-DIF module for sensitive winding-fault protection
Reduced overcurrent mode		Minimizes arc-flash hazards during maintenance
Metering		View measured and calculated parameters with on-board display
MPU-CIM		Separate current input module to reduce risk of open-CT hazard and for convenient installation
Analog output		Provides means for metering selectable parameters
Data logging		On-board 100-event recorder for data logging
Conformal coating		Internal circuits are conformally coated to protect against corrosion and moisture

Wiring Diagram



Specifications

Protective Functions (IEEE Device Numbers)	Overload (49, 51) Phase reverse (current) (46) Overcurrent (50, 51) Jam Ground fault (50G/N, 51G/N) PTC overtemperature (49	RTD temperature (38, 49) Unbalance (current) (46) Starts per hour (66) Differential (87) Phase loss (current) (46) Undercurrent (37)
Input Voltage	65-265 Vac, 25 VA; 80-275 Vdc, 25 W	
Power-Up Time	800 ms at 120 Vac	
Ride-Through Time	100 ms minimum	
24-Vdc Source	100 mA maximum	
AC Measurements	True RMS and DFT, Peak, 16 samples/cycle, and positive and negative sequence of fundamental	
Frequency	50, 60 Hz or ASD	
Output Contacts	Three Form C programmables	
Communications	TIA-232 (standard); TIA-485, DeviceNet™, Ethernet (optional)	
Analog Output	4-20 mA, programmable	
Conformally Coated	Standard feature	
Warranty	10 years	
Mounting (Control Unit)	Panel (standard) Surface (with MPU-32-SMK converter kit)	
(Current Input Module)	DIN, Surface	
Approvals	CSA certified, CE (European Union), UL Recognized, C-Tick (Australian)	

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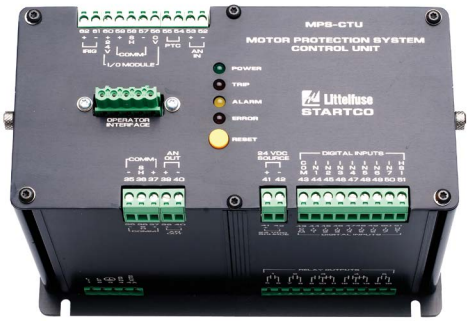
MPS SERIES (PGR-6300)

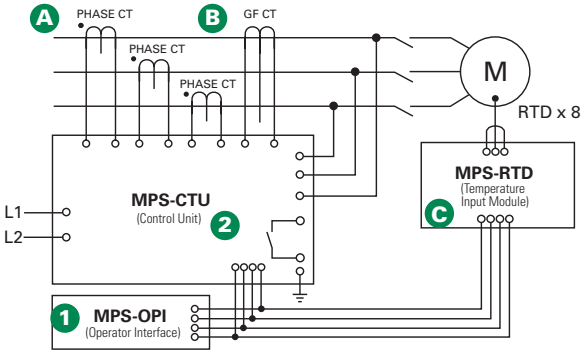
Motor Protection System

1



2

Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	COMMUNICATIONS
MPS-CTU-01-00	RS-485
MPS-CTU-02-00	RS-485 & DeviceNet™
MPS-CTU-03-00	RS-485 & Profibus®
MPS-CTU-04-00	RS-485 & EtherNet/IP™ & Modbus® TCP

ACCESSORIES	REQUIREMENT
MPS-OPI-01-00	Recommended
Phase CTs	Required
Ground-Fault CT	Recommended
MPS-RTD-01-00	Optional
MPS-DIF-01-00	Optional
SE-IP65CVR-M	Optional

Description

The MPS Motor Protection System monitors voltage, current, and temperature to provide a comprehensive package of 22 protective functions. The MPS is a modular system with integrated protection, motor control, metering, and data-logging functions. This system is typically used to provide protection for three-phase low- and medium-voltage, medium- to high-horsepower induction motors.

1 Operator Interface (MPS-OPI)

- Large, bright, 4 x 20 vacuum-fluorescent display
- Display metered values
- Access set points
- Powered by Control Unit
- Panel mount or attach directly to Control Unit
- Remote mounting (1.2 km or 4000 ft maximum loop length)
- ½ DIN size
- Hazardous-location certified

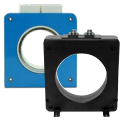
2 Control Unit (MPS-CTU)

- Current inputs—5-A or 1-A secondary phase current transformers
- Voltage inputs—up to 600 V without PTs
- Earth-leakage input—5-A or 1-A secondary or sensitive transformer
- Tachometer (high-speed pulse) input
- 8 digital inputs, 5 relay outputs, 1 analog input and output
- 24-Vdc supply for OPI and RTD modules, and for digital inputs
- IRIG-B time-code input
- ½ DIN size, surface mount
- RS-485 network communications (Standard)
- DeviceNet™, Profibus®, or Ethernet communications available

Accessories

A

Phase Current Transformers
Phase CTs are required to detect phase currents.



B

Ground-Fault Current Transformer
Required zero-sequence current transformer detects ground-fault current. Available with 5-A and 30-A primary ratings for low-level pickup.

C

MPS-RTD Temperature Input Module
Optional module provides 8 inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.

D

MPS-DIF Differential Current Module
Optional motor differential protection, compatible with core balance and summation current transformer connections.

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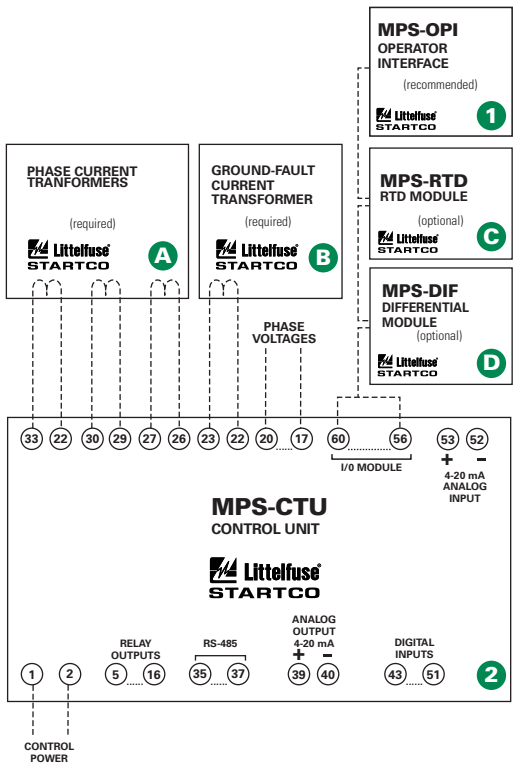
MPS SERIES (PGR-6300)

Features & Benefits

FEATURES	IEEE #	BENEFITS
Overload	49, 51	Extends motor life and prevents insulation failures and fires
Current unbalance/ Phase loss/Phase reverse	46	Prevents overheating and extends motor life
Overcurrent/Jam	50, 51	Prevents catastrophic failures and fires and extends motor life
Undercurrent	37	Detects low-level or no-load conditions
Ground fault	50g/N, 51G/N	Prevents catastrophic failures and fires
RTD temperature	38, 49	Optional RTD temperature protection (MPS-RTD module) for high ambient or loss of ventilation protection
Overvoltage	59	Prevents stress to insulation
Undervoltage	27	Prevents a start attempt when it will damage the motor
Voltage unbalance	47	Detects unhealthy supply voltage
Phase differential	87	Provides sensitive protection for high-resistance winding faults
Dynamic thermal mode		Provides protection through starting, running, overload, and cooling cycles
Reduced overcurrent mode		Minimizes Arc-Flash hazards during maintenance
Starter control		Simplifies the installation by reducing component count
Metering		Displays the measured and calculated motor parameters
Data logging		On-board 64-event recorder helps with system diagnosis
Communications		Remotely view measured values, event records & reset trips
Conformal coating		Internal circuits are conformally coated to protect against corrosion and moisture

Wiring Diagram



Specifications

Protective Functions (IEEE Device Numbers)

- Overload (49, 51)
- Phase reverse (current) (46)
- Overfrequency (81)
- Overcurrent (50, 51)
- Jam
- Underfrequency (81)
- Ground fault (50G/N, 51G/N)
- Undercurrent (37)
- Unbalance (voltage) (47)
- Failure to accelerate
- RTD temperature (38, 49)
- Unbalance (current) (46)
- Underspeed (14)
- Starts per hour (66)
- Phase loss (voltage) (47)
- Overvoltage (59)
- Differential (87)
- Phase loss (current) (46)
- Undervoltage (27)
- Phase reverse (voltage) (47)
- Power factor (55)

Input Voltage	65-265 Vac, 25 VA; 80-275 Vdc, 25 W
Power-Up Time	800 ms at 120 Vac
Ride-Through Time	100 ms minimum
24-Vdc Source	100 mA maximum
AC Measurements	True RMS and DFT, Peak, 16 samples/cycle, and positive and negative sequence of fundamental
Frequency	50, 60 Hz or ASD
Inputs	Phase current, Earth-leakage current, Phase voltage, 7 digital, tachometer, 1 analog
Output Contacts	5 contacts — See Product Manual
Approvals	CSA Certified, RCM (Australian), UL Recognized
Communications	Allen-Bradley® DFI and Modbus® RTU (Standard); DeviceNet™, Profibus®, Ethernet (Optional)
Conformally Coated	Standard feature
Warranty	10 years
Mounting	
(Control Unit)	Surface
(Operator Interface)	Panel, Control-Unit mounted

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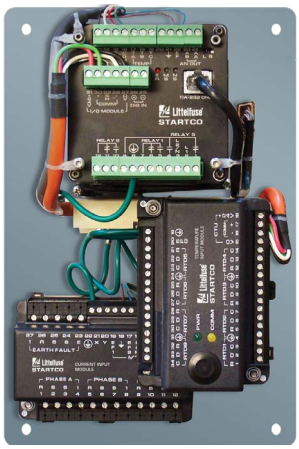
MPU-32-X69X (PGR-6210) SERIES / MPS-469X (PGR-6310) SERIES

Motor Protection Retrofit Kits

1 MPU-32-X69X

Front



Back

2 MPS-469X

Front

Back

Description

Littelfuse Startco retrofit kits are an excellent choice for upgrading motor protection, providing current- and temperature-based protection, metering, and data logging.

1 MPU-32-X69X

The MPU-32-X69X Motor Protection Retrofit Kit is designed to replace GE Multilin 169, 269, and 369 relays. It includes the MPU-32 Motor Protection Relay, MPU-CIM Current Input Module, and optional MPS-RTD Temperature Input Modules, which are pre-wired on a panel. The kit fits in the existing space and typically can utilize existing current transformers and wiring to simplify the upgrade procedure.

2 MPS-469X

The MPS-469X Motor Protection Retrofit Kit replaces the GE Multilin 469 relay. It includes the MPS Motor Protection System and optional RTD and differential modules mounted on a panel that can be installed in the existing 469 cutout. Existing current transformer and wiring can be utilized, simplifying the upgrade procedure.

Features & Benefits

FEATURES	BENEFITS
Mounting	Fits in existing mounting holes and panel openings
Quick installation	Existing CTs and RTDs can be used to reduce installation time
Factory tested	100% factory-tested, pre-assembled components ensure reliability
Communications	Add communications capability to older switchgear and improve system performance
Microprocessor based	No calibration required saves on maintenance cost
Reduced overcurrent mode	Maintenance mode setting to reduce the risk of Arc-Flash Hazards
Conformal coating	Protects circuit boards against corrosion and moisture
Additional protection	Additional protective functions, including dynamic thermal model and ability to match existing overcurrent curves

MPU-32-X69X Ordering Information

		RTD INPUTS	MPU-32 COMMUNICATIONS	GROUND-FAULT CT	FUTURE OPTIONS
MPU-32-X69X	–	X	X	X	00
		0 = One Platinum 100 Ω	0 = TIA232	0 = Wired for Sensitive Ground-Fault CT (50 mA Secondary)	
		1 = One Platinum 100 Ω and 8-input MPS-RTD Module	1 = TIA232 & TIA485	1 = Wired for 1- or 5-A Secondary Ground-Fault CT	
			2 = TIA232 & DeviceNet		
			4 = TIA232 & Ethernet		

MPS-469X Ordering Information

		MODULE CONFIGURATION	MPS COMMUNICATIONS	FUTURE OPTIONS
MPS-469X	–	X	X	000
		0 = None	1 = RS485	
		1 = One MPS-RTD Module	2 = RS485 & DeviceNet	
		2 = Two MPS-RTD Modules	3 = RS485 & Profibus	
		3 = One MPS-DIF Module	4 = RS485 & Ethernet	
		4 = One MPS-RTD Module and One MPS-DIF Module		

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111-INSIDER-P / 231-INSIDER-P

Single-Phase Pump Monitor

Description

The Littelfuse 111-Insider-P single-phase products fit inside ⅓ and ½, 115V control boxes and the 231-Insider-P fits inside ⅓ ½, ¾, and 1 hp, 230V control boxes. Both models are designed to protect single-phase pumps from dry-well, dead-head, jammed impeller, rapid-cycle, overvoltage, and undervoltage conditions.

A calibration adjustment allows the Insider to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the product deactivates its output relay and directly disconnects the pump motor. The unit then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the unit reactivates its output relay and turns the pump back on. By leaving the restart delay knob in the reset position, the unit will operate in manual reset mode.

The Insider communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults. An IR Kit-12 (12" fiber optic kit) is included with each Insider, allowing the Informer to access these parameters even when the Insider is enclosed in a control box. This is valuable for troubleshooting the pump while it is running.

NOTE: The 111/231-Insider-P models have a sensitivity adjustment for the dry-well trip point. After calibration is done, you can adjust the sensitivity for the dry-well/dead-head trip point from 70-90% of the full load. This makes the unit even more adaptable to varying pumping applications. If you have a very low producing well, you increase the sensitivity closer to the 90% mark, or if you have a very heavy producing well, you would decrease the sensitivity around the 70% mark.

Wiring Diagrams

See next page.

Accessories

Informer
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system. Includes the Informer IR Kit-12

Informer IR Kit-12
12" infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel. Included with the Informer

Ordering Information

MODEL	VOLTAGE	DESCRIPTION
111-Insider-P	115VAC	⅓ - ½ hp, includes IR Kit-12
231-Insider-P	230VAC	⅓ - 1 hp, includes IR Kit-12

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed impeller, rapid cycling, and voltage faults
Onboard sensitivity adjustment	Allows user to adjust the current sensitivity for the dry-well / dead-head trip point from 70% - 90% of the full load.
Adjustable restart delay	Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset
Built in IR communications link	Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it's running
LED indication	Provides status and diagnostics for troubleshooting

111-INSIDER-P / 231-INSIDER-P

Specifications

Functional Specifications

Adjustments/Settings	
Overcurrent	125% of calibration point
Underload (dry-well)	Adjustable (70 to 90% of calibrated run power)
Overvoltage	
111-Insider-P	132.5VAC
231-Insider-P	265VAC
Undervoltage	
111-Insider-P	95VAC
231-Insider-P	190VAC
Number of restarts allowed in a 60-sec. period (rapid-cycling)	4
Trip Delay Times	
Overcurrent	5 seconds
Dry-well	4 seconds
Restart Delay Times	
Over/Undervoltage	2 seconds
All other faults	Manual, 2-225 minutes

Input Characteristics

Supply Voltage	
111-Insider-P	115VAC
231-Insider-P	230VAC
Load Range	
111-Insider-P	⅓ – ½ hp
231-Insider-P	⅓ – 1 hp
Frequency	50*/60Hz

Output Characteristics

Output Contact Rating-SPST	
111-Insider-P	½hp@120VAC (17 amps max.)
231-Insider-P	1hp@ 240VAC (17 amps max.)

General Characteristics

Operating Temperature	-40° to 60° C (-40° to 140° F)
Maximum Input Power	5 W
Safety Marks	
cUR**	UL508, C22.2 No. 14
Weight	10 oz.
Mounting Methods	Inside a Pentek®, Franklin™, CentriPro™, Flint and Walling™, and Grundfos®*** control box

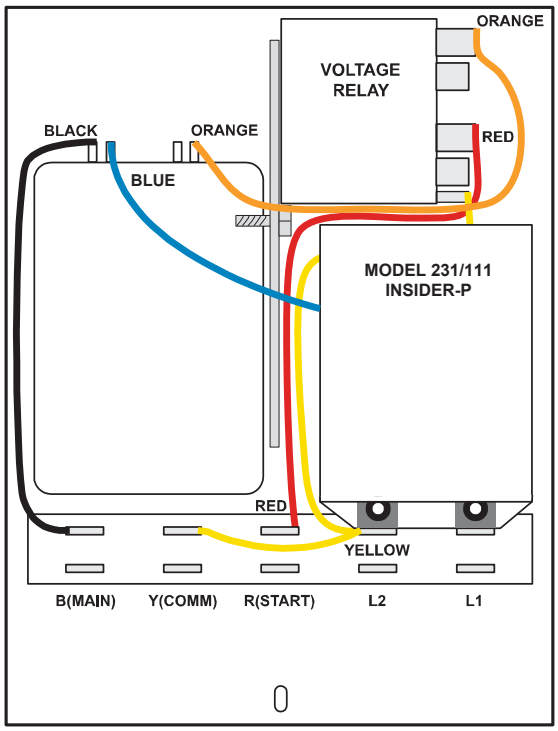
*Note: 50Hz will increase all delay timers by 20%

**The 111-Insider-P and 231-Insider-P are approved by UL for use in the Franklin™, Pentek®, and CentriPro™ type 3R control boxes when installed as described in the installation instructions. The 111-Insider-P and 231-Insider-P are not intended to provide overload protection, and should be used with thermally or impedance protected motors only.

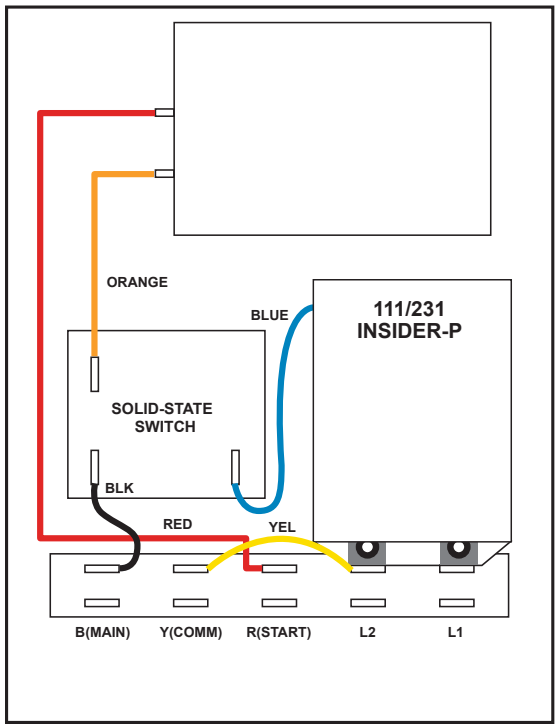
***Grundfos control boxes manufactured after mid 2014.

Wiring Diagrams

PENTEK® CONTROL BOX WIRING DIAGRAM



FRANKLIN™ CONTROL BOX WIRING DIAGRAM



7

MOTOR & PUMP PROTECTION

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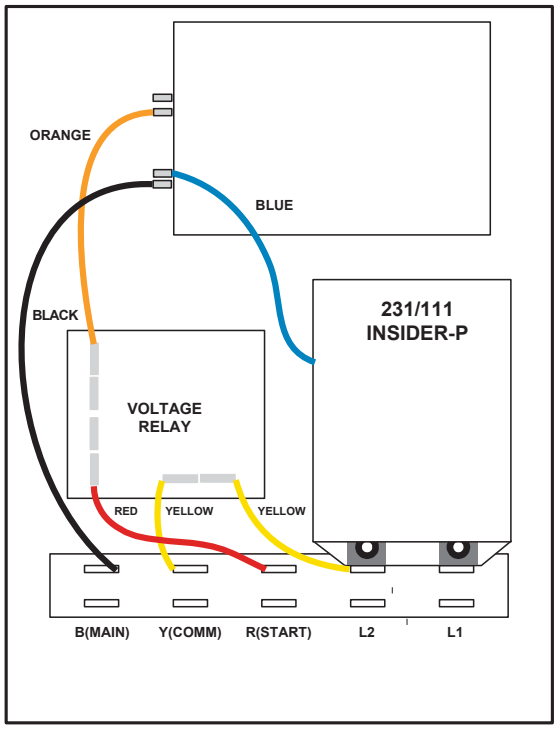
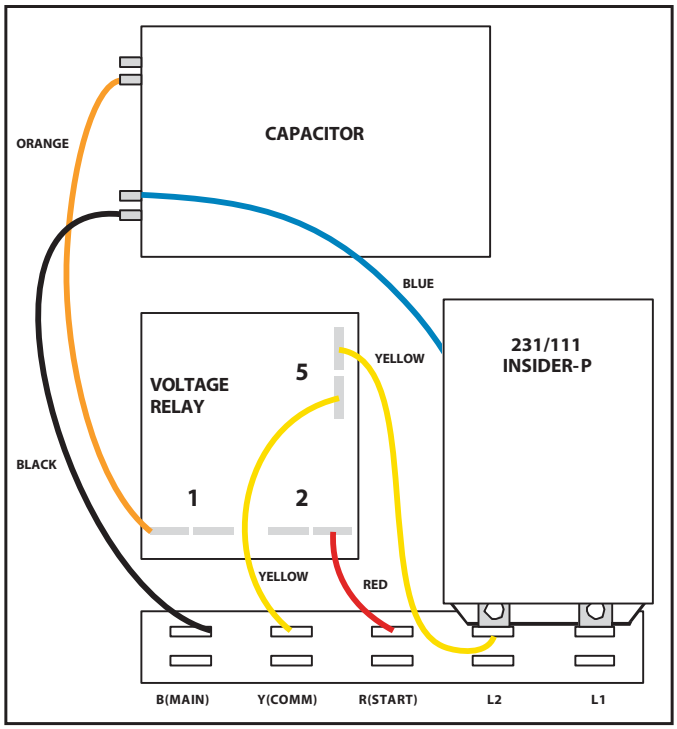
111-INSIDER-P / 231-INSIDER-P

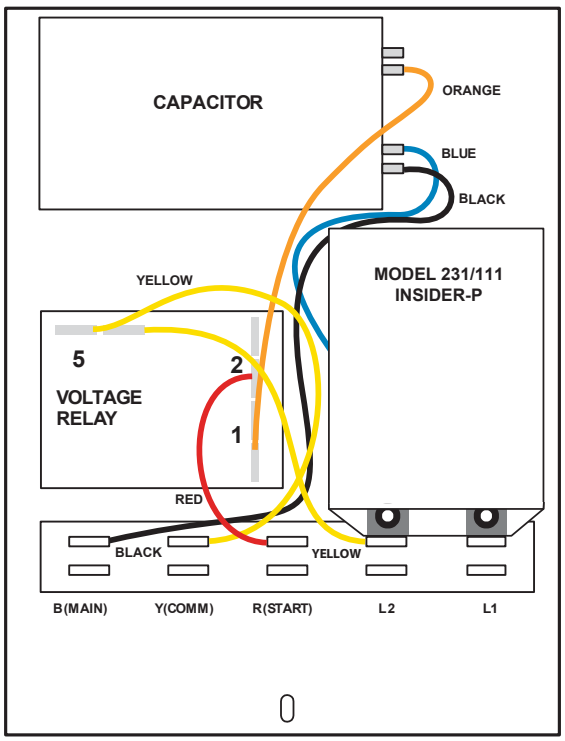
CENTRIPRO™ CONTROL BOX WIRING DIAGRAM



FLINT AND WALLING™ CONTROL BOX WIRING DIAGRAM



GRUNDFOS® CONTROL BOX* WIRING DIAGRAM



For installation instructions see the Fresh Water Pumping Catalog at www.Littelfuse.com/PumpProtection

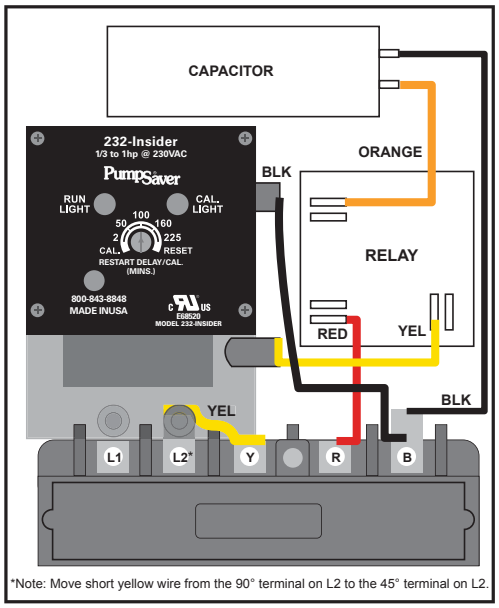
** For boxes manufactured in mid 2014 or later.*
See 232-INSIDER on next page for boxes manufactured prior to mid 2014.

232-INSIDER

Single-Phase Pump Monitor

Wiring Diagram

232-INSIDER CONNECTIONS IN GRUNDFOS® CONTROL BOX



*Note: Move short yellow wire from the 90° terminal on L2 to the 45° terminal on L2.

For installation instructions see the Install Bulletin.

Description

The Model 232-Insider single-phase PumpSaver® fits inside ⅓, ½, ¾, and 1hp, 230V Grundfos control boxes manufactured prior to mid 2014. The PumpSaver® Model 232-Insider is a pump monitor designed to protect single-phase pumps from dry-well, dead-head, jammed impeller, overvoltage and undervoltage conditions. Typical applications include residential water wells, commercial water wells, irrigation wells, and golf course systems.

A calibration adjustment allows the 232-Insider to be calibrated to your specific pumping application, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the 232-Insider deactivates its output relay and directly disconnects the pump motor. The 232-Insider then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the 232-Insider reactivates its output relay and turns the pump back on. By leaving the restart delay knob in the reset position, the 232-Insider will operate in manual reset mode.

The Insider communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults. This is valuable for troubleshooting the pump while it is running.

Note: The use of flow restrictors or unusually high head pressures at the time of calibration may interfere with the detection of dead-head conditions. Contact Littelfuse for information on a product to fit these applications.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed impeller, and voltage faults
Adjustable restart delay	Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset
Built in IR communications link	Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it's running
LED indication	Provides status and diagnostics for troubleshooting

Accessories

Informer
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system.

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232-INSIDER

Specifications

Functional

Adjustments/Settings	
Overcurrent	125% of calibration point
Underload (dry-well)	Approx. 80% of calibration point
Underload (dry well) with high sensitivity jumper removed	Approx. 87% of calibration point
Overvoltage	265VAC
Undervoltage	190VAC
Trip Delay Times	
Overcurrent	5 seconds
Dry-well	4 seconds
Restart Delay Times	
Over/undervoltage	2 seconds
All other faults (dry-well recovery timer)	Manual, 2-225 minutes

Input Characteristics

Supply Voltage	230VAC
Load Range	⅓ – 1 hp
Frequency	50*/60Hz

Output Characteristics

Output Contact Rating-SPST	1hp@240VAC (17 amps max.)

General Characteristics

Operating Temperature	-40° to 60° C (-40° to 140° F)
Maximum Input Power	5 W
Safety Marks	
UL	UL508
CSA	C22.2 No. 14
Weight	10 oz.
Mounting Methods	Grundfos® Control Box manufactured prior to mid 2014

*Note: 50 Hz will increase all delay timers by 20%

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111P / 233P / 233P-1.5 SERIES

Single-Phase PumpSaver®

Description

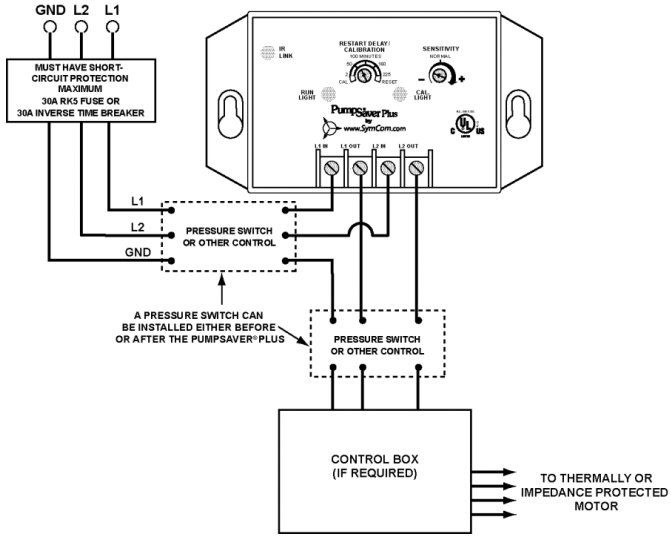
The Littelfuse Models 111P (115 volt, ⅓ to 1hp); 233P-1.5 (230 volt, ⅓ to 1.5hp); and 233P (230 volt, ⅓ to 3hp) protect pumps from dry-well, dead-head, jammed impeller, overvoltage/ undervoltage conditions and now rapid-cycle protection whether the pressure switch is mounted before or after our unit.

A calibration adjustment allows the unit to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the unit deactivates its output relay and directly disconnects the pump motor. The unit then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the unit reactivates its output relay and turns the pump back on.

The infrared LED communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults.

Special considerations for pump cables larger than #10 AWG: In some cases where larger motors are installed with deep set pumps, pump cables are used that exceed the relay's terminal size. In these conditions, a short splice of #10 AWG or #12 AWG may be a solution at the control box. **Note:** All local, state and national electric codes should be followed when applying this solution.

Wiring Diagram



For dimensional drawing see: Appendix page 511, Figure 15.

NOTE: The 111P/233P/233P-1.5 models have a sensitivity adjustment for the dry-well trip point. After calibration is done, you can adjust the sensitivity for the dry-well/dead-head trip point from 70-90% of the full load. This makes the unit even more adaptable to varying pumping applications. If you have a very low producing well, you increase the sensitivity closer to the 90% mark, or if you have a very heavy producing well, you would decrease the sensitivity around the 70% mark.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
111P	115VAC	Load Range: ⅓ - 1hp
111P-ENCL	115VAC	111P with NEMA3R enclosure
233P	230VAC	Load Range: ⅓ - 3hp
233P-ENCL	230VAC	233P with NEMA3R enclosure
233P-1.5	230VAC	Load Range: ⅓ - 1.5hp
233P-1.5-ENCL	230VAC	233P-1.5 with NEMA3R enclosure

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage, power factor, current for reliable pump protection
Onboard calibration process	Calibrates unit to your specific individual pumping application and reduces nuisance tripping
Onboard sensitivity adjustment	User adjustable sensitivity knob makes the unit more adaptable to varying pumping applications

Accessories

Informer
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system.

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111P / 233P / 233P-1.5 SERIES

Specifications

Functional Specifications

Adjustments/Settings	
Overcurrent	125% of calibration point
Underload (dry-well)	Adjustable (70 to 90% of calibrated run power)
Overvoltage	
111P	132.5VAC
233P, 233P-1.5	265VAC
Undervoltage	
111P	95VAC
233P, 233P-1.5	190VAC
Number of restarts allowed in a 60-sec. period (rapid-cycling)	4
Trip Delay Times	
Overcurrent	5 seconds
Dry-well	4 seconds
Restart Delay Times	
Over/undervoltage	2 seconds
All other faults	Manual, 2-225 Minutes

Input Characteristics

Supply Voltage	
111P	115VAC
233P-1.5, 233P	230VAC
Load Range:	
111P	⅓ – 1 hp
233P-1.5	⅓ – 1.5 hp
233P	⅓ – 3 hp
Frequency	50*/60Hz

Output Characteristics

Output Contact Rating-SPST	
111P	1hp@120VAC (16 amps max.)
233P-1.5	1.5hp@240VAC (10 amps max.)
233P	3hp@240VAC (17 amps max.)

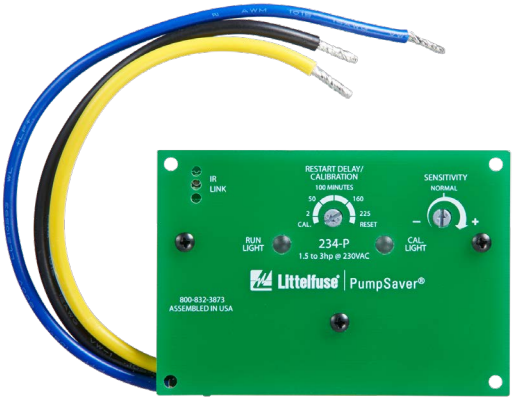
General Characteristics

Operating Temperature	-40° to 60° C (-40° to 140° F)
Maximum Input Power	5 W
Wire Gauge	Solid or Stranded 10 - 22AWG
Terminal Torque	13 in.-lbs.
Safety Marks	
cUL Listed	UL508, C22.2 No. 14
Dimensions	**H** 73.66 mm (2.9"); **W** 133.35 mm (5.25"); **D** 73.99 mm (2.913")
Weight	14 oz.
Mounting Methods	#8 screws

*Note: 50Hz will increase all delay timers by 20%

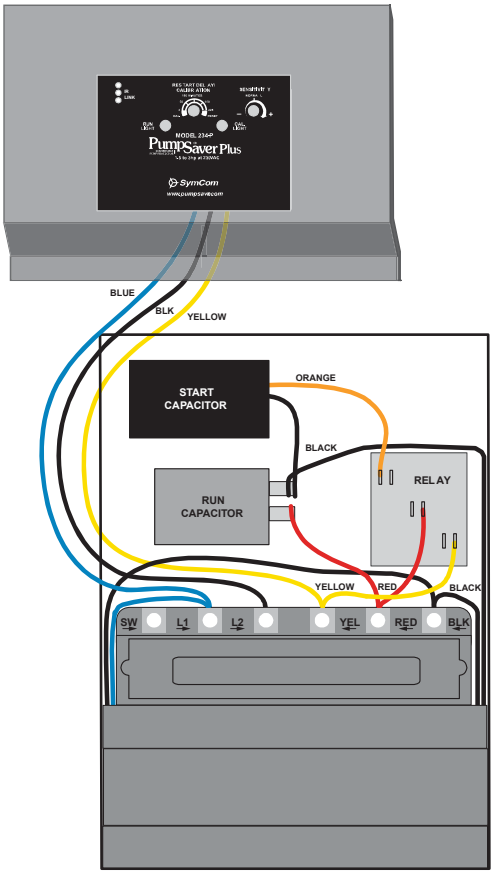
234-P

Single-Phase Pump Monitor



Wiring Diagram

234-P CONNECTIONS IN GRUNDFOS® CONTROL BOX



For installation instructions see the Install Bulletin.

Description

The PumpSaver® Model 234-P is designed to be mounted inside a Grundfos® control box to protect 1/3 – 3hp, 2- or 3-wire, 230V pumps.

The Model 234-P protects single-phase pumps from dry-well, dead-head, rapid-cycle, jammed-impeller, and over/undervoltage conditions. Typical applications include residential waterwells, commercial waterwells, irrigation wells, and golf course and other sprinkler systems.

A calibration adjustment allows the 234-P to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations, overcurrent, and undercurrent. When an abnormality, such as loss of suction is detected, the 234-P deactivates its output relay and directly disconnects the pump motor. The 234-P then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the 234-P reactivates its output relay and turns the pump back on. By leaving the restart delay knob in the reset position, the 234-P will operate in manual reset mode.

The 234-P communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults. An IR Kit-12 (12" fiber optic kit) allows the Informer to access these parameters even when the 234-P is enclosed in a control box. This is valuable for troubleshooting the pump while it is running.

NOTE: The PumpSaver® models have a sensitivity adjustment for the dry-well trip point. After calibration is done, you can adjust the sensitivity for the dry-well/dead-head trip point from 70-90% of the full load. This makes the unit even more adaptable to varying pumping applications. If you have a very low producing well, you increase the sensitivity closer to the 90% mark, or if you have a very heavy producing well, you would decrease the sensitivity around the 70% mark.

The Model 234-P is not recommended for use with the Grundfos® Deluxe Control Box.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed impeller, rapid cycling, and voltage faults
Onboard sensitivity adjustment	Allows user to adjust the current sensitivity for the dry-well / dead-head trip point from 70% - 90% of the full load.
Adjustable restart delay	Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset
Built in IR communications link	Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it's running
LED indication	Provides status and diagnostics for troubleshooting

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Accessories

Informer
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system. Includes the Informer IR Kit-12

Informer IR Kit-12
12" infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel. Included with the Informer

Specifications

Functional Specifications

Adjustments/Settings	
Overcurrent	125% of calibration point
Underload (dry-well)	Adjustable (70 - 90% of calibrated run power)
Overvoltage	265VAC
Undervoltage	190VAC
Number of restarts allowed in a 60-second period (rapid-cycling)	4
Trip Delay Times	
Overcurrent	5 seconds
Dry-well	4 seconds
Restart Delay Times	
Over/undervoltage	2 seconds
All other faults (dry-well recovery timer)	Manual, 2-225 Minutes

Input Characteristics

Supply Voltage	230VAC
Load Range	⅓ – 3 hp
Frequency	50*/60Hz

Output Characteristics

Output Contact Rating (SPST)	3 hp @ 240VAC (17 amps max.)

General Characteristics

Operating Temperature	-40° to 60° C (-40° to 140° F)
Maximum Input Power	5W
Dimensions	Fitted to Grundfos® Control Box
Weight	14 oz.
Mounting Methods	Grundfos® Control Box

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 2, 4kV contact, 6kV air

*Note: 50 Hz will increase all delay timers by 20%

235P

Single-Phase Pump Monitor

Description

The Littelfuse 235P is designed to protect 5-15hp, 230V, single-phase pumps from dry-well, dead-head, jammed impeller and overvoltage and undervoltage conditions.

A calibration adjustment allows the 235P to be calibrated to your specific pumping applications, thereby reducing the possibility of false or nuisance tripping. A unique microcontroller-based voltage and current-sensing circuit constantly monitors the incoming power for fluctuations causing overcurrent and undercurrent. When an abnormality, such as loss of suction is detected, the 235P deactivates its output relay and directly disconnects the pump motor. The unit then begins its user-selectable restart delay (dry-well recovery) timer. When the timer counts to zero or power is removed and reapplied, the unit reactivates its output relay and turns the pump back on.

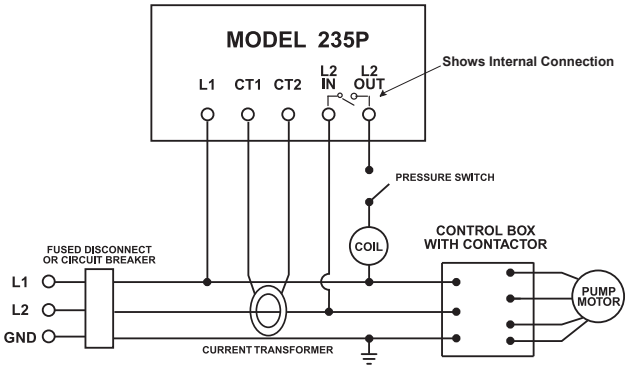
The 235P communicates with a hand-held diagnostics tool called the Informer (sold separately). The Informer displays parameters including calibration points, trip points, run time and last faults.

An external current transformer is required for operation (sold separately).

Special considerations for pump cables larger than #10 AWG: In some cases where larger motors are installed with deep set pumps, pump cables are used that exceed the relay's terminal size. In these conditions, a short splice of #10 AWG or #12 AWG may be a solution at the control box. **Note:** All local, state and national electric codes should be followed when applying this solution.

NOTE: The 235P model has a sensitivity adjustment for the dry-well trip point. After calibration is done, you can adjust the sensitivity for the dry-well/dead-head trip point from 70-90% of the full load. This makes the unit even more adaptable to varying pumping applications. If you have a very low producing well, you increase the sensitivity closer to the 90% mark, or if you have a very heavy producing well, you would decrease the sensitivity around the 70% mark.

Wiring Diagram



For dimensional drawing see: Appendix page 511, Figure 15.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
235P	230VAC	5 - 15hp
235P-ENCL	230VAC	233P with NEMA3R enclosure

PART*	SIZE	CURRENT (A)	CT CURRENT RATIO
CT-0050-D10	5 - 7.5hp	27.5 - 42.1	50:5
CT-0075-D10	10hp	51	75:5
CT-0100-D10	15hp	75	100:5

* Current transformer sold separately

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage and current protects pumps from dry-well, dead-head, jammed impeller, rapid cycling, and voltage faults
Onboard sensitivity adjustment	Allows user to adjust the current sensitivity for the dry-well / dead-head trip point from 70% - 90% of the full load.
Adjustable restart delay	Allows user to select well recovery time delay after a dry-well condition occurs, or to select manual reset
Built in IR communications link	Used with the Informer, allows user to see stored faults, run time, and also troubleshoot the pump while it's running
LED indication	Provides status and diagnostics for troubleshooting

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Accessories

Informer
A hand-held diagnostic tool that uses an infrared receiver to access information which can be helpful for troubleshooting the system. Includes the Informer IR Kit-12

Specifications

Functional Specifications

Adjustments/Settings	
Overcurrent	125% of calibration point
Underload (dry-well)	Adjustable (70 to 90% of calibrated run power)
Overvoltage	265VAC
Undervoltage	190VAC
Number of restarts allowed in a 60-sec. period (rapid-cycling)	4
Trip Delay Times	
Overcurrent	5 seconds
Dry-well	4 seconds
Restart Delay Times	
Over/undervoltage	2 seconds
All other faults	Manual, 2-225 Minutes

Input Characteristics

Supply Voltage	230VAC
Load Range	5 - 15 hp
Frequency	50*/60Hz

Output Characteristics

Output Contact Rating-SPST	A300, 720A @240VAC (10 amps max.)

General Characteristics

Operating Temperature	-40° to 60° C (-40° to 140° F)
Maximum Input Power	5 W
Wire Gauge	Solid or Stranded 10 - 22AWG
Terminal Torque	13 in.-lbs.
Safety Marks	
cUL Listed	UL508, C22.2 No. 14
Dimensions	**H** 73.66 mm (2.9"); **W** 133.35 mm (5.25"); **D** 73.99 mm (2.913")
Weight	14 oz.
Mounting Methods	#8 screws

*Note: 50Hz will increase all delay timers by 20%)

Dimensions	**H** 73.66 mm (2.9"); **W** 133.35 mm (5.25"); **D** 73.99 mm (2.913")
Weight	14 oz.
Mounting Methods	#8 screws

MP8000

Bluetooth Overload Relay

Patent Pending

Description

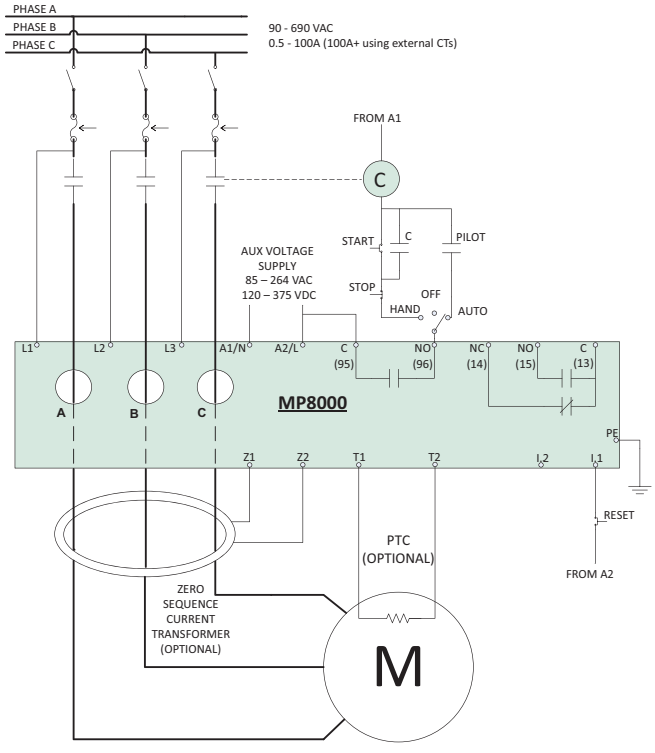
The MP8000 is an advanced motor protection electronic overload relay that is fully programmable via Bluetooth* using the Littelfuse app on an Android* or iPhone* mobile device. It is easy to use and arc-flash safety is increased because the app allows settings to be modified and real-time operational information viewed. Viewing operational information and faults on the app does not require the user to open the control panel.

The MP8000 protects any motor drawing 0.5-1,000 full load Amps (external CTs are required above 100 amperes). It is designed for single or 3-phase systems with operating voltages of 90-690 VAC (use of external potential transformers can extend upper voltage range above 690 VAC). Common applications include conveyor systems, HVAC equipment, saws and grinders, fan motors, and almost any pumping application.

Protection is unsurpassed by combining overload, voltage, phase loss and reversal, voltage and current unbalance, power monitoring, and underload in one package. For standalone applications, the Bluetooth interface can be used when paired with a smartphone or tablet. The units also feature an Ethernet communications port that can be used to form an Ethernet Modbus TCP/IP network or Ethernet/IP. Units can be remotely monitored and controlled from a PC, or SCADA system, and data logging through a PC with the optional Solutions software or other software program using the MP8000 memory map. This capability allows for a simple cost-effective way to further enhance arc-flash safety.

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR 3-PHASE

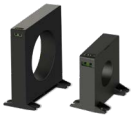


For dimensional drawing see: Appendix page 516, Figure 50.

Features & Benefits

FEATURES	BENEFITS
Bluetooth interface	Visual indication for programming, viewing real-time voltage or current, and last fault information (date and time stamped)
Programmable voltage and current settings	Allows usage on wide range of systems
3 selectable restart options	Choose from automatic, semi-automatic, or manual to best meet individual application needs
4 programmable delay timers	Program separate delay times for power up, rapid cycle protection, motor cool down, and underload restarting
Flexible reset	Reset can be done through pushbutton on panel, remotely via the network
Network communications capability	Compatible with Ethernet Modbus TCP/IP and Ethernet/IP

Accessories



ZSCT Series Current Transformer
Used with Littelfuse relays to detect low levels of earth-leakage current.

Ordering Information

MODEL	LINE VOLTAGE	MOTOR FULL AMP RANGE	DESCRIPTION
MP8000	90-690VAC (use of external potential transformers can extend upper voltage range above 690VAC)	0.5-1,000A+ (external CTs required above 100A)	Provides remote wired communication via Ethernet Modbus TCP/IP

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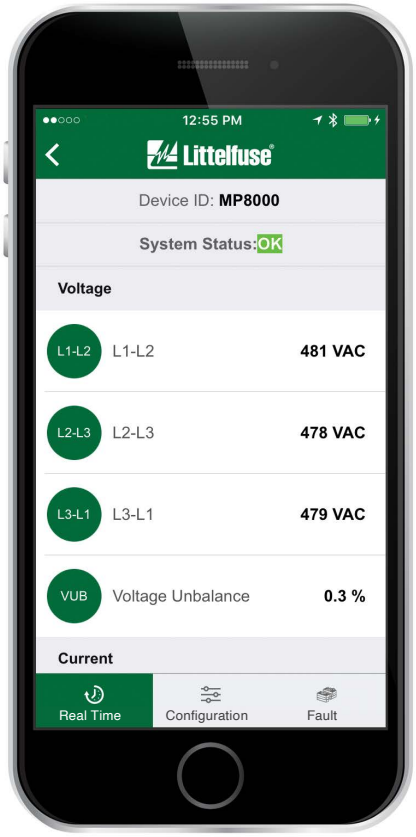
MP8000

Advanced Features

- Overload/Overpower (49)
- Underload/Underpower (37P)
- Overcurrent (51)/Jam
- Undercurrent (37)
- Current Unbalance/Phase Loss (46)
- Phase Reversal (47)
- Overvoltage (59)
- Undervoltage (27)
- Voltage Unbalance (47)
- Rapid Cycling/Jog
- Contactor Failure
- Zero-Sequence Ground Fault (50Ns)
- PTC Motor Overtemperature (49)

Littelfuse Mobile App



MP8000
Littelfuse App icon

Available on the App Store

GET IT ON Google Play

Specifications

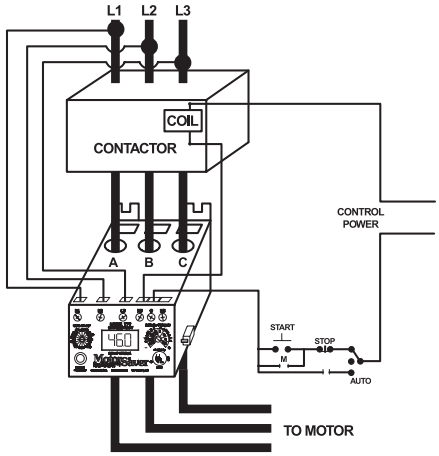
Functional Characteristics	
Frequency	50/60Hz
TC- Overcurrent Trip Class	Trip class 02-60 or linear
Output Characteristics	
Output Contact Rating	
Control relay	SPST - Form A
Auxiliary relay	SPDT - Form C
Pilot Duty Rating	B300
General Purpose	5A @ 240VAC
General Characteristics	
Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 85°C (-40° to 185°F)
Accuracy	
Voltage	±1% of reading ±0.5 V
Current	±2% (2 to 100 amperes direct)
Timing	+/-0.5% of setting +/- 1second
GF Current	±5%
Repeatability	
Voltage	±0.5%
Current	±1% (2 to 100 amps direct)
Power Consumption	<5 W
Pollution Degree	3 (conformal coating standard)
Class of Protection	IP20
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque (depluggable terminal blocks)	5.5 in.-lbs.
Terminal Torque (Earth Ground)	7.9 in.-lbs.
Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Conducted	IEC 61000-4-6, Level 3 10V/m
Radio Frequency Immunity (RFI), Radiated	IEC 61000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power
Surge	IEC 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
FCC Rating	Part 15.107 for emissions, Part 15.247 for intentional radiators
Short Circuit Withstand Rating	100kA symmetrical at 690VAC
Hi-Potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Safety Marks	
cULus	UL60947, UL1053, C22.2 (File #E68520)
CE	IEC 60947 Edition 5.2, IEC 60947-8
Maximum Conductor Size (with insulation)	0.63"
Dimensions	**H** 74.42 mm (2.93"); **W** 103.63 mm (4.08"); **D** 121.67 mm (4.79")
Weight	0.85 lbs (13.6 oz, 385.6 g)
Mounting Method	Surface mount (4 - #8 screws) or DIN-rail mount

777 SERIES

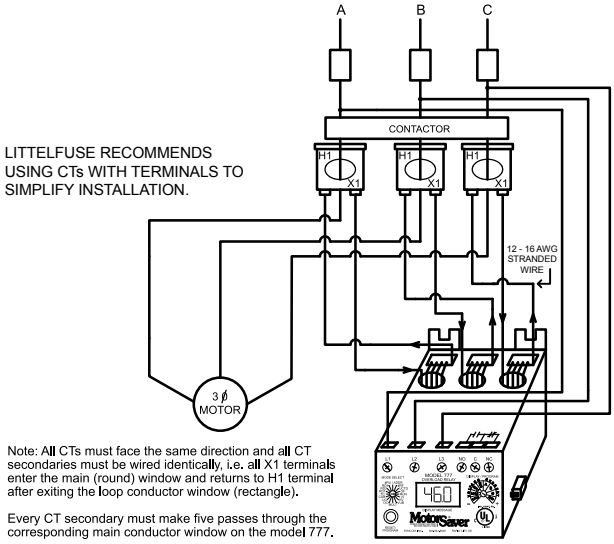
3-Phase Current & Voltage Monitor

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR MODEL 777 (2 to 90 amps)



CURRENT TRANSFORMER WIRING DIAGRAM FOR MODEL 777 (80 to 800 amps)



LITTELFUSE RECOMMENDS USING CTs WITH TERMINALS TO SIMPLIFY INSTALLATION.

Note: All CTs must face the same direction and all CT secondaries must be wired identically, i.e. all X1 terminals enter the main (round) window and returns to H1 terminal after exiting the loop conductor window (rectangle).

Every CT secondary must make five passes through the corresponding main conductor window on the model 777.

Every CT secondary must make a single pass through the corresponding main conductor window on the LR versions of the 777 Plus Series.

Description

The 777 is a fully programmable electronic overload relay designed to protect any motor drawing 2-800 full load amps (external CTs are required above 90 amps). The 777 (family of products) is for 3-phase 200-480VAC applications, with several specialized units for other voltage ranges and unique applications. Common applications include conveyor systems, HVAC equipment, saws and grinders, fan motors, and almost any pumping application. Some unique applications include use with a Subtrol® equipped Franklin submersible motor to detect high motor temperatures and applications where a fast linear trip is required.

All of the overload relays provide unsurpassed protection by combining overload, voltage, phase loss and reversal, voltage and current unbalance, power monitoring, and underload based on current in one package. For standalone applications, the units incorporate a 3-digit LED display that is used for programming, providing real-time operational information and displaying diagnostic codes to aid in troubleshooting a fault condition. The units also feature a communications port that can be used with communication modules listed in the 777 accessories section to form a Modbus, DeviceNet™, Profibus, or Ethernet network. Up to 99 units can be remotely monitored and controlled from a PC, PLC, or SCADA system, and data logging through a PC with the optional Solutions software. This capability allows for a simple, cost-effective way to meet new requirements for arc-flash safety.

Features & Benefits

FEATURES	BENEFITS
Built-in display	Visual indication for programming, viewing real-time voltage or current, and last fault code
Programmable voltage and current settings	Allows usage on wide range of systems
3 selectable restart options	Choose from automatic, semi-automatic, or manual to best meet individual application needs
3 programmable restart delay timers	Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery
Remote display compatibility	Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations
Flexible reset	Reset can be done through pushbutton on relay or remotely with optional 777-MRSW or OL-RESET remote reset kit
Network communications capability	Compatible with Modbus, DeviceNet™, Profibus, or Ethernet using optional communications module

Ordering Information

See next page.

For dimensional drawing see: Appendix page 507, Figure 1.

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777 SERIES

Ordering Information

MODEL	LINE VOLTAGE	MOTOR FULL AMP RANGE	DESCRIPTION
777-P2	200-480VAC	2-800A (external CTs required above 90A)	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts
777-LR-P2	200-480VAC	1-800A (external CTs required above 9A)	Protects low range motors when wired directly or with 10-800 FLA with use of external CTs
777-HVR-P2	340-480VAC	2-800A (external CTs required above 90A)	Provides low and high power trip*, linear overcurrent trip, and 470VA @ 600VAC output SPDT relay contacts. Required when a control power transformer (CPT) is not used with a 480V system
777-HVR-LR-P2	340-480VAC	1-800A (external CTs required above 9A)	Provides low and high power trip*, linear overcurrent trip, and 470VA @ 600VAC output SPDT relay contacts. Required when a control power transformer (CPT) is not used with a 480V system
777-575-P2	500-600VAC	2-800A (external CTs required above 90A)	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common
777-575-LR-P2	500-600VAC	1-800A (external CTs required above 9A)	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common
777-MV-P2	100-240VAC	10-800A with external CTs	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Designed for Medium Voltage applications where both PTs and CTs are used. Has built in multipliers for 25.5, 50.5, 100.5 CTs. The voltage unbalance, single-phase and reverse phase protection can be disabled for applications where only the PTs are used
777-HRG-P2	200-480VAC	2-90A only	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Designed for high resistance grounding systems that incorporate an external zero-sequence CT that correspond with the built in multipliers to detect ground faults
777-LR-HRG-P2	200-480VAC	10-800A (external CTs required, external	Overload relays designed for high resistance grounding systems that incorporate an external zero-sequence CTs that correspond with the built in multipliers to detect ground faults
777-575-HRG-P2	500-600VAC	2-90A only	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common. Designed for high resistance grounding systems that incorporate an external zero-sequence CT that correspond with the built in multipliers to detect ground faults
777-575-LR-HRG-P2	500-600VAC	10-800A with external CTs	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common. Designed for high resistance grounding systems that incorporate an external zero-sequence CT that correspond with the built in multipliers to detect ground faults
777-FT	200-480VAC	2-800A (external CTs required above 90A)	Provides linear overcurrent trip and 480VA @ 240VAC output SPDT relay contacts. Also known as shock relay, it is designed for fast linear trip applications. Overcurrent trip delay can be set ranging from less than 500ms - 70 seconds. Low trip delay is ideal in chain drive and drive linkage applications to prevent breaking in overload or jam situations. Other applications include sewage clarifiers, mixers, augers, and conveyors. Longer trip delay is ideal for motor test panels in rewind shops. Also includes adjustable motor acceleration time and overcurrent trip delay time when the faster linear trip mode is used
777-TS	200-480VAC	2-800A (external CTs required above 90A)	Provides 480VA @ 240VAC output SPDT relay contacts. For use with Subtrol® equipped Franklin submersible motors to detect high motor temperatures
777-LR-TS	200-480VAC	1-9A only	Provides 480VA @ 240VAC output SPDT relay contacts. For use with Subtrol® equipped Franklin submersible motors to detect high motor temperatures
777-575-TS	500-600VAC	2-800A (external CTs required above 90A)	Provides 480VA @ 240VAC output SPDT relay contacts. For use with Subtrol® equipped Franklin submersible motors with nominal 500-600VAC range to detect high motor temperatures
777VA-02	200-480VAC	2-800A (external CTs required above 90A)	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. Has restart delay 1 setpoints of 2-500 minutes and undercurrent trip delay setpoints of 2-60 minutes.
777VA-03	200-480VAC	2-800A (external CTs required above 90A)	Provides low and high power trip*, linear overcurrent trip, and 480VA @ 240VAC output SPDT relay contacts. For use with static and rotary single to 3-phase converters. High and low voltage trip feature only applies to the utility supplied power. Works well with unloaded phase converters because the relay ignores severely unbalanced voltages

* Network programmable only

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Accessories

RS485MS-2W Communication Module
Required to enable the Modbus communications function on Model 77X-type products.

CIO-MB/CIO-120-MB Communication Module
Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network.

CIO-DN-P/CIO-120-DN-P Communication Module
DeviceNet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet™ network.

CIO-777-PR Communication Module
Profibus interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profibus network.

CIO-EN (non-POE) Communication Module
Modbus-TCP and Modbus-RTU interface capable of providing discrete control and monitoring of an overload relay over a Modbus network.

Communication Adapters
- **RS485-RS232–Converter with cable & plug**
- **RS485-USB–Converter with cable & plug**
- **RS232-USB–Converter**

Specifications match industry standard.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.

777-MRSW Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

OL-RESET Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

Specifications

Functional Characteristics

Frequency	50/60Hz
TC- Overcurrent Trip Class (777 Plus Series units)	02-60, J02-J60, L00-L60 or Off
TC- Overcurrent Trip Class (77C, 777 non-Plus Series units)	5, 10, 15, 20, 30 (J prefix enables jam protection feature)

Output Characteristics

Output Contact Rating (SPDT - Form C)	
Pilot duty rating	480VA @ 240VAC, B300
General purpose	10A @ 240VAC
Pilot duty rating for HVR models	470VA @ 600VAC, B600

General Characteristics

Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Accuracy	
Voltage	±1%
Current	±3%(<100 amps direct)
GF Current	±15%
Timing (777 Plus Series units)	±0.5 second
Timing (77C, 777 non-Plus Series units)	5% +1 second
Repeatability	
Voltage	±0.5% of nominal voltage
Current	±1% (<100 amps direct)
Maximum Input Power	10 W
Pollution Degree	3
Class of Protection	IP20
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	7 in.-lbs.

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Conducted	IEC 61000-4-6, Level 3 10V/m
Radio Frequency Immunity (RFI), Radiated	IEC 61000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power
Short Circuit	100kA

Surge

IEC	61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse

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777 SERIES

Safety Marks

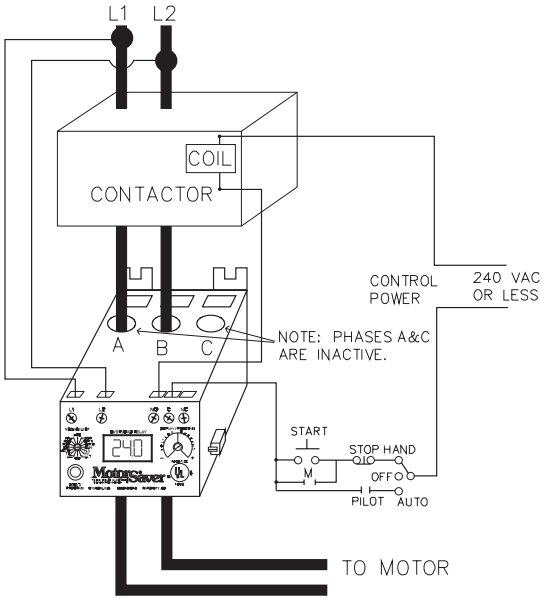
UL	UL508, UL1053 (File #E68520)
CE	IEC 60947-1, IEC 60947-5-1
CSA	C22.2 No. 14
Maximum Conductor Size (with insulation) through 777/77C	0.65"
Dimensions	**H** 77.47 mm (3.05"); **W** 97.79 mm (3.85"); **D** 128.27 mm (5.05")
Weight	1.56 lbs. (24.96 oz., 707.6 g)
Mounting Method	Surface mount (4 - #8 screws) or DIN rail mount

777 / 77C SERIES

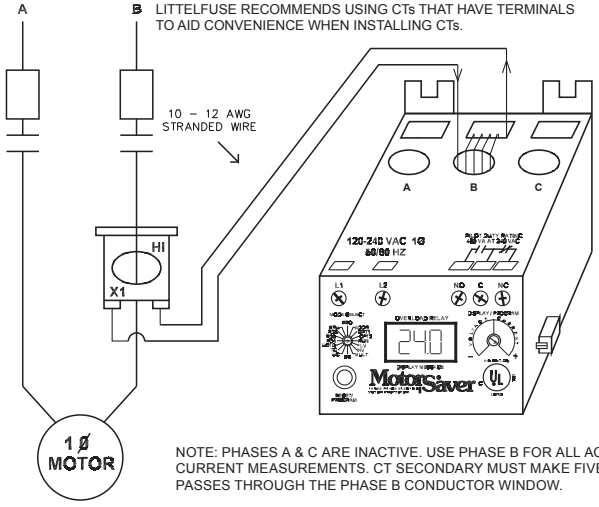
Single-Phase Current & Voltage Monitor

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR MODEL 77C WITH MOTOR CONTROL



TYPICAL WIRING DIAGRAM FOR MODEL 77C WITH EXTERNAL CT



For dimensional drawing see: Appendix page 507, Figure 1.

Description

The 777/ 77C Series is a fully programmable electronic overload relay designed to protect any motor drawing 2-800 full load amps (external CTs are required above 90 amps). Common applications include conveyor systems, HVAC equipment, saws and grinders, fan motors, and almost any pumping application.

All of the overload relays provide unsurpassed protection by combining overload, underload, and voltage in one package. For standalone applications, the units incorporate a 3-digit LED display that is used for programming, providing real-time operational information and displaying diagnostic codes to aid in troubleshooting a fault condition. The units also feature a communications port that can be used with communication modules listed in the 777 accessories section to form a Modbus, DeviceNet™, Profibus, or Ethernet network. Up to 99 units can be remotely monitored and controlled from a PC, PLC, or SCADA system, and data logging through a PC with the optional Solutions software. This capability allows for a simple, cost-effective way to meet new requirements for arc-flash safety.

Features & Benefits

FEATURES	BENEFITS
Built-in display	Visual indication for programming, viewing real-time voltage or current, and last fault code
Programmable voltage and current settings	Allows usage on wide range of systems
3 selectable restart options	Choose from automatic, semi-automatic, or manual to best meet individual application needs
3 programmable restart delay timers	Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery
Remote display compatibility	Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations
Flexible reset	Reset can be done through pushbutton on relay or remotely with optional 777-MRSW or OL-RESET remote reset kit
Network communications capability	Compatible with Modbus, DeviceNet™, Profibus, or Ethernet using optional communications module

Ordering Information

MODEL	LINE VOLTAGE	MOTOR FULL AMP RANGE	DESCRIPTION
77C	100-240VAC	2-800A (external CTs required above 90A)	Provides 480VA @ 240VAC output SPDT relay contacts
77C-LR	100-240VAC	1-9A only	Provides 480VA @ 240VAC output SPDT relay contacts
777-HVR-SP	340-480VAC	2-800A (external CTs required above 90A)	Provides 470VA @ 600VAC output SPDT relay contacts. For systems with no control power transformer

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777 / 77C SERIES

Accessories

RS485MS-2W Communication Module
Required to enable the Modbus communications function on Model 77X-type products.

Communication Adapters
- **RS485-RS232**–Converter with cable & plug
- **RS485-USB**–Converter with cable & plug
- **RS232-USB**–Converter

Specifications match industry standard.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.

777-MRSW Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

OL-RESET Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

Specifications

Frequency	50/60Hz
Functional Characteristics	
TC- Overcurrent Trip Class (77C, 777 non-Plus Series units)	5, 10, 15, 20, 30 (J prefix enables jam protection feature)
Output Characteristics	
Output Contact Rating (SPDT - Form C)	
Pilot duty rating	480VA @ 240VAC, B300
General purpose	10A @ 240VAC
Pilot duty rating for HVR models	470VA @ 600VAC, B600
General Characteristics	
Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Accuracy	
Voltage	±1%
Current	±3%(<100 amps direct)
GF Current	±15%
Timing (77C, 777 non-Plus Series units)	5% +1 second
Repeatability	
Voltage	±0.5% of nominal voltage
Current	±1% (<100 amps direct)
Maximum Input Power	10 W
Pollution Degree	3
Class of Protection	IP20
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	7 in.-lbs.
Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Conducted	IEC 61000-4-6, Level 3 10V/m
Radio Frequency Immunity (RFI), Radiated	IEC 61000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power
Short Circuit	100kA
Surge	
IEC	61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse
Safety Marks	
UL	UL508, UL1053 (File #E68520)
CE	IEC 60947-1, IEC 60947-5-1
CSA	C22.2
Maximum Conductor Size (with insulation) through 777/77C	0.65"
Dimensions	**H** 77.47 mm (3.05"); **W** 97.79 mm (3.85"); **D** 128.27 mm (5.05")
Weight	1.56 lbs. (24.96 oz., 707.6 g)
Mounting Method	Surface mount (4 - #8 screws) or DIN rail mount

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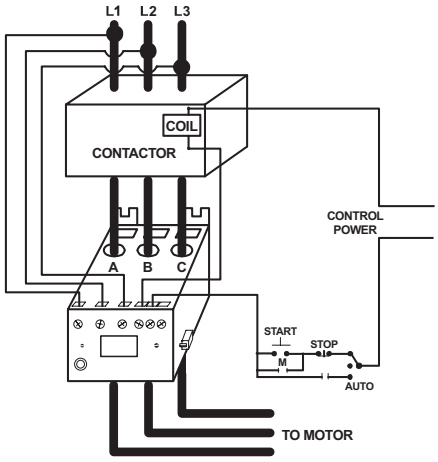
777-KW/HP-P2 SERIES

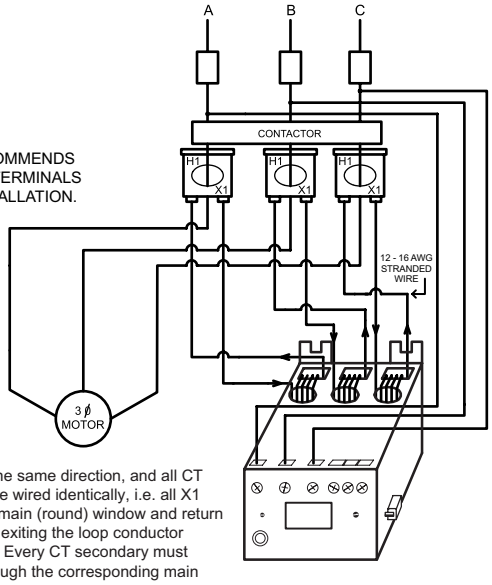
3-Phase Current & Voltage Monitor

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR 777-KW/HP-P2 SERIES



CURRENT TRANSFORMER WIRING DIAGRAM FOR 777-KW/HP-P2 SERIES



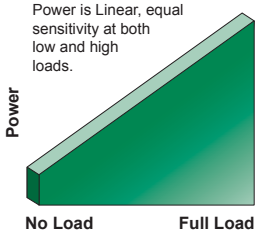
LITTELFUSE RECOMMENDS USING CTs WITH TERMINALS TO SIMPLIFY INSTALLATION.

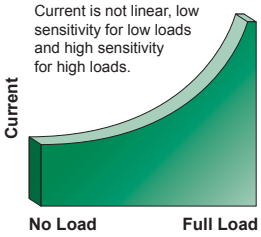
All CTs must face the same direction, and all CT secondaries must be wired identically, i.e. all X1 terminals enter the main (round) window and return to H1 terminal after exiting the loop conductor window (rectangle). Every CT secondary must make 5 passes through the corresponding main conductor window.

For dimensional drawing see: Appendix page 507, Figure 1.

Description

The 777-KW/HP-P2 Series has the overload, voltage, phase loss and reversal, voltage and current unbalance, current and power monitoring*, and underload trip based on power in one package. The underpower trip feature is desirable anytime the current vs. load characteristic is non-linear or has little change. In general terms, smaller motors and slow-speed motors have little change in current over the normal load range. Larger motors that are running light loads will also show small current changes over the operating load range. For standalone applications, the units incorporate a 3-digit LED display that is used for programming, providing real-time operational information and displaying diagnostic codes to aid in troubleshooting a fault condition.





The units also feature a communications port that can be used with communication modules listed in the 777 accessories section to form a Modbus, DeviceNet™, Profibus, or Ethernet network. Up to 99 units can be remotely monitored and controlled from a PC, PLC, or SCADA system, and data logging through a PC with the optional Solutions software.

* Low current trip and high power trip are network programmable only

Features & Benefits

FEATURES	BENEFITS
Low and High Power Protection	Increases reliability for non-linear motors where the load characteristic has little change
Built-in Display	Visual indication for programming, viewing real-time voltage, current, kilowatts, or horsepower, and last fault code
Programmable voltage and current settings	Allows usage on wide range of systems
3 selectable restart options	Choose from automatic, semi-automatic, or manual to best meet individual application needs
3 programmable restart delay timers	Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery
Remote display compatibility	Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations
Flexible reset	Reset can be done through pushbutton on relay or remotely with optional 777-MRSW or OL-RESET remote reset kit
Network communications capability	Compatible with Modbus, DeviceNet™, Profibus, or Ethernet using optional communications module

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777-KW/HP-P2 SERIES

Ordering Information

MODEL	LINE VOLTAGE	MOTOR FULL AMP RANGE	DESCRIPTION
777-KW/HP-P2	200-480VAC (3-phase)	2-800A (external CTs required above 90A)	Provides 480VA @ 240VAC output SPDT relay contacts
777-LR-KW/HP-P2	200-480VAC (3-phase)	1-800A (external CTs required above 9A)	Provides 480VA @ 240VAC output SPDT relay contacts
777-HVR-KW/HP-P2	340-480VAC (3-phase)	2-800A (external CTs required above 90A)	Provides 470VA @ 600VAC output SPDT relay contacts. Required when a CPT (control power transformer) is not used on a 480V system. Commonly used in pumping applications to save the cost and extra wiring associated with a CPT
777-575-KW/HP-P2	500-600VAC (3-phase)	2-800A (external CTs required above 90A)	Provides 480VA @ 240VAC output SPDT relay contacts. Used in Canada and NE USA where 575V utility power services are common
777-MLR-KW/HP-P2	200-480VAC (3-phase)	0.5-21A and 40-740A with external CTs	Provides 480VA @ 240VAC output SPDT relay contacts. It is wired directly without the need to loop conductors for 5-21 amps (under 5 amps requires looping of conductors), and can be used with external CTs for 40-740 amps

Accessories

RS485MS-2W Communication Module
Required to enable the Modbus communications function on Model 77X-type products.

CIO-MB/CIO-120-MB Communication Module
Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network.

CIO-DN-P/CIO-120-DN-P Communication Module
DeviceNet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet™ network.

CIO-777-PR Communication Module
Profibus interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profibus network.

CIO-EN (non-POE) Communication Module
Modbus-TCP and Modbus-RTU interface capable of providing discrete control and monitoring of an overload relay over a Modbus network.

Communication Adapters
- **RS485-RS232**–Converter with cable & plug
- **RS485-USB**–Converter with cable & plug
- **RS232-USB**–Converter

Specifications match industry standard.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.

777-MRSW Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

OL-RESET Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

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777-KW/HP-P2 SERIES

Specifications

Frequency	50/60Hz
Functional Characteristics	
TC-Overcurrent Trip Class	02-60, J02-J60, L00-L60 or OFF
Output Characteristics	
Output Contact Rating (SPDT - Form C)	
Pilot duty rating	480VA @ 240VAC, B300
General purpose	10A @ 240VAC
Pilot duty rating for HVR model	470VA @ 600VAC, B600
General Characteristics	
Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Accuracy	
Voltage	±1%
Current	±3% (<100 amps direct)
Power	±4% (<100 amps direct)
GF Current	±15%
Timing	±0.5 second
Repeatability	
Voltage	±0.5% of nominal voltage
Current	±1% (<100 amps direct)
Power	±2%
Maximum Input Power	10 W
Pollution Degree	3
Class of Protection	IP20
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	7 in.-lbs.
Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Conducted	IEC 61000-4-6, Level 3 10V/m
Radio Frequency Immunity (RFI), Radiated	IEC 61000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5 kV input power
Short Circuit Rating	100kA
Surge	
IEC	61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse
Safety Marks	
UL	UL508, UL1053 (File #E68520)
CE	IEC 60947-1, IEC 60947-5-1
CSA	C22.2 No. 14
Maximum Conductor Size (with insulation) through 777	0.65"
Dimensions	**H** 77.47 mm (3.05"); **W** 97.79 mm (3.85"); **D** 128.27 mm (5.05")
Weight	1.56 lbs. (24.96 oz., 707.6 g)
Mounting Method	Surface mount (4 - #8 screws) or DIN rail mount

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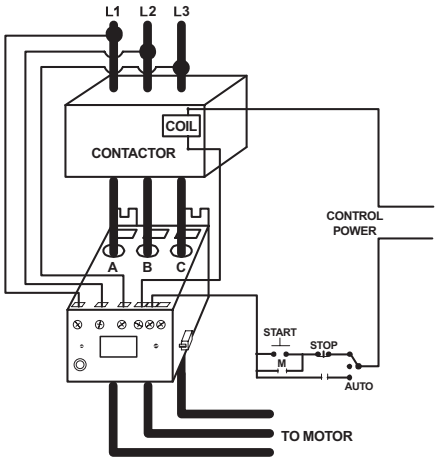
777-ACCUPOWER

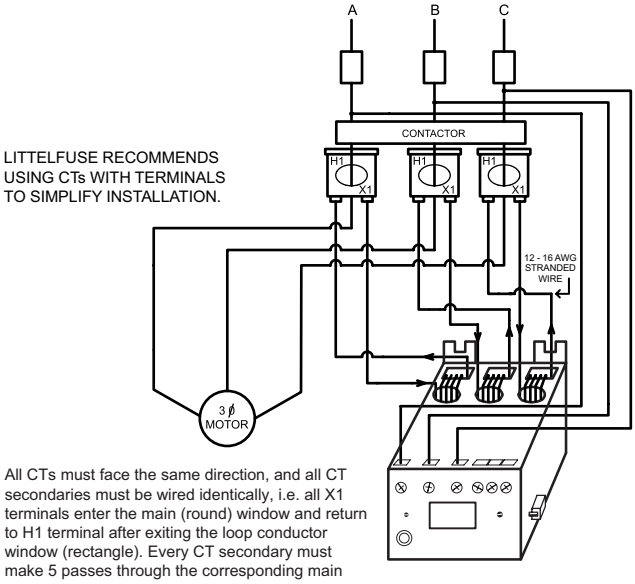
3-Phase Current & Voltage Monitor

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR MODEL 777-ACCUPOWER



CURRENT TRANSFORMER WIRING DIAGRAM OR MODEL 777-ACCUPOWER



All CTs must face the same direction, and all CT secondaries must be wired identically, i.e. all X1 terminals enter the main (round) window and return to H1 terminal after exiting the loop conductor window (rectangle). Every CT secondary must make 5 passes through the corresponding main conductor window.

For dimensional drawing see: Appendix page 507, Figure 1.

Description

The 777-AccuPower is a fully-programmable 3-phase motor and pump protection relay. It allows motor hp rating, full load amps, efficiency and power factor to be entered and will accurately calculate motor output power. This is most useful with mag-drive pumps or process applications where the process power is desired over the utility power. Voltage, current and power measurements can be displayed as well as fault information and setpoints. The built-in display simplifies troubleshooting and allows the user to easily and precisely configure setpoints. The 777-AccuPower can be used with the optional COM 4-20 output module to give an analog signal proportional to output shaft power, the RS485MS-2W (for limited Modbus capabilities, and for use with the RM1000/RM2000) remote displays listed in the 777 accessories section.

Features & Benefits

FEATURES	BENEFITS
Motor output power measurement	Allows use of process power over utility power
3 programmable restart delay timers	Program separate restart delay time for rapid cycle protection, motor cool down, and dry-well recovery
Built-in Display	Visual indication for programming, viewing real-time voltage or current, and last fault code
Remote display compatibility	Increases safety through remote display of run-hour meter, last four fault codes, without the need to open the cabinet. Aids with arc flash safety regulations
Network communications capability	Limited Modbus capabilities using RS485MS-2W communication module

Accessories

RS485MS-2W Communication Module
Required to enable the Modbus communications function on Model 77X-type products.

COM 4-20 Output Communication Module
This module allows communication to a PLC with an analog input and no Modbus input.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

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777-ACCUPOWER

Specifications

Input Characteristics

Line Voltage	200-480VAC
Frequency	50/60Hz
Motor Full Load Amp Range	2-800A (external CTs required over 90A)

Functional Characteristics

TC- Overcurrent Trip Class	5, 10, 15, 20, 30 (J prefix enables jam protection feature)

Output Characteristics

Output Contact Rating (SPDT - Form C)	
Pilot duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics

Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Accuracy	
Measured Horsepower/ Kilowatt	
Typical	±3%*
Voltage	±1%
Current	±3%(<100 amps direct)
GF Current	±15%
Timing	5% ±1 second
Repeatability	
Voltage	±0.5% of nominal voltage
Current	±1% (<100 amps direct)
Maximum Input Power	10 W
Pollution Degree	3
Class of Protection	IP20, NEMA 1 (finger safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	7 in.-lbs.

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Conducted	IEC 61000-4-6, Level 3 10V/m
Radio Frequency Immunity (RFI), Radiated	IEC 61000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5 kV input power
Short Circuit Rating	100kA

Surge

IEC	61000-4-5 Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-Potential Test	Meets UL508 (2 x rated V + 1000V for 1 min.)
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hrs, 3 axis
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse

Safety Marks

UL	UL508, UL1053
CE	IEC 60947-1, IEC 60947-5-1
CSA	C22.2
Max. Conductor Size through 777	0.65" with insulation
Dimensions	**H** 77.47 mm (3.05"); **W** 97.79 mm (3.85"); **D** 128.27 mm (5.05")
Weight	1.3 lbs. (20.8 oz., 589.67 g)
Mounting Method	Surface mount (4 - #8 screws) or DIN rail mount

*On a well balanced system within recommended current range.

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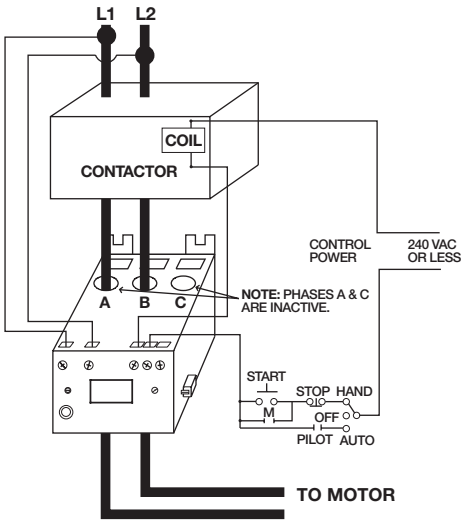
77C-KW/HP SERIES

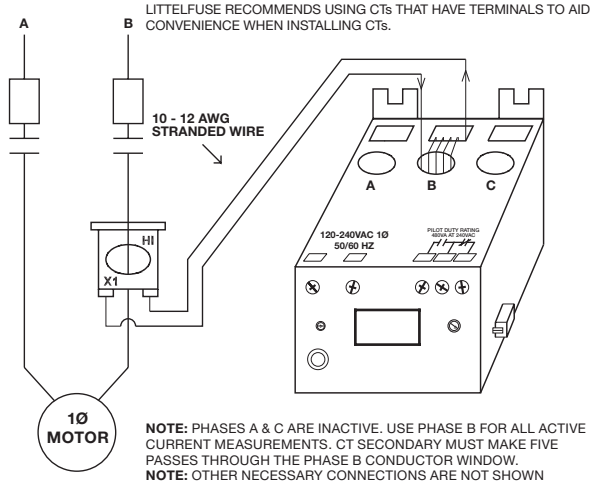
Single-Phase Current & Voltage Monitor

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR MODEL 77C-KW/HP WITH MOTOR CONTROL



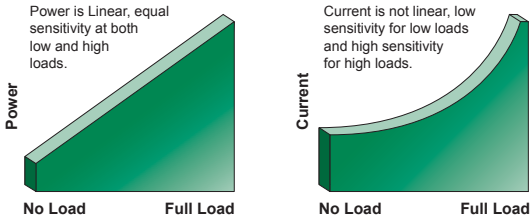
TYPICAL WIRING DIAGRAM FOR MODEL 77C-KW/HP WITH EXTERNAL CT



For dimensional drawing see: Appendix page 507, Figure 1.

Description

The 77C-KW/HP and 77C-LR-KW/HP are fully programmable pump protection relays which will monitor the voltage and current for high or low voltage, overload and underload conditions based on power, in one package. The underpower trip feature is desirable anytime the current vs.load characteristic is non-linear or has little change. In general terms, smaller motors and slow-speed motors have little change in current over the normal load range. Larger motors that are running light loads will also show small current changes over the operating load range. Common uses include pumping applications where motors run slower than around 3400 rpm and usually have small current vs load changes; such as slow speed mixer or agitator motors up to 50 hp, and magdrive or can pumps.



The Littelfuse PumpSaver relay provides the high sensivity of a power monitor to protect pump motors from dry run and dead-head conditions.

Features & Benefits

FEATURES	BENEFITS
Underload protection	Increases reliability for non-linear motors where the load characteristic has little change
Built-in display	Visual indication for programming, viewing real-time voltage, current, kilowatts or horsepower, and last fault code
15 programmable criteria settings	Allows user flexibility to fine-tune the relay for maximum protection in any application.
Last fault memory	Provides instant troubleshooting diagnostics
Remote display compatibility	Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations.
Flexible reset	Reset options: automatic, manual using pushbutton on relay, or remotely with optional 777-MRSW or OL-RESET remote reset kit.
Network communications capability	Compatible with Modbus using optional communications module (RS485MS-2W)

Ordering Information

MODEL	LINE VOLTAGE	MOTOR FULL AMP RANGE	DESCRIPTION
77C-KW/HP	100-240VAC	2-90A (external CTs required above 90A)	Provides 480VA @ 240VAC output SPDT (Form C) relay contacts
77C-LR-KW/HP	100-240VAC	1-9A (external CTs required above 9A)	Provides 480VA @ 240VAC output SPDT (Form C) relay contacts

77C-KW/HP SERIES

Accessories

RS485MS-2W Communication Module
Required to enable the Modbus communications function on Model 77X-type products.

Communication Adapters
- **RS485-RS232**–Converter with cable & plug
- **RS485-USB**–Converter with cable & plug
- **RS232-USB**–Converter

Specifications match industry standard.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.

777-MRSW Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

OL-RESET Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

Specifications

Input Characteristics

Supplt Voltage	100-240 VAC, 1Ø
Frequency	50-60 Hz
Motor Full Load Amp Range	
77C-KW/HP	2-25 Amps (Loops Required) 26-90 Amps (Direct) 91-800 Amps (External CT's)
77C-LR-KW/HP	1.0 Amps - 2.0 Amps (additional Loop) 2.0 Amps - 9.0 Amps (Direct)
Short Circuit Withstand Rating	100kA per UL and CSA
Power Consumption	5W (Maximum)
Output Contact Rating SPDT (Form C)	Pilot duty rating: 480 VA @ 240 VAC General purpose: 10A @ 240 VAC
Expected Life	
Mechanical	1 x 10^6 operations
Electrical	1 x 10^5 operations at rated load
Accuracy at 25° C (77° F)	
Voltage	±1%
Current	±3% (Direct, No External CTs)
Timing	5% ± 1 second
Repeatability	
Voltage	± 0.5% of nominal voltage
Current	± 1% (Direct, No External CTs)
Safety Marks	
UL	UL508, UL1053
CE	IEC 60947-1, IEC 60947-5-1
CSA	C22.2 No. 14

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Conducted	IEC 61000-4-6, Level 3 10V/m
Radio Frequency Immunity (RFI), Radiated	IEC 61000-4-3, Level 3 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power

Surge

IEC	IEC 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 min.)
Vibration	IEC 68-2-6, 10-55Hz, 1mm peak-to-peak, 2 hours, 3 axis
Shock	IEC 68-2-27, 30g, 3 axis, 11ms duration, half-sine pulse

Mechanical

Dimensions	**H** 77.47 mm (3.05"); **W** 97.79 mm (3.85"); **D** 128.27 mm (5.05")
Maximum conductor size through holes	0.65" (with insulation)
Terminal Torque	7 in.-lbs.
Enclosure Material	polycarbonate
Weight	1.2 lbs
Mounting Methods	35mm DIN rail or surface mount

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77C-KW/HP SERIES

Environmental

Temperature Range	
Ambient Operating	-20° - 70° C (-4° - 158°F)
Ambient Storage	-40° - 80° C (-40° - 176°F)
Pollution Degree	3
Class of Protection	IP20, NEMA 1
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Programmable	
Operating Points	Range
LV- Low Voltage Threshold	85V - HV Setting
HV- High Voltage Threshold	LV Setting - 264V
MULT- # of Conductors or	
CT Ratio (XXX:5)	
77C:	1-10 Conductors or 100-800 Ratio
77C-LR:	1 or 2
OC- Overcurrent Threshold	(20-100A) ÷ MULT or 80-120% of CT Primary
TC- Overcurrent Trip Class *	5, J5, 10, J10, 15, J15, 20, J20, 30, J30, or LIn (linear)
RD1- Rapid Cycle Timer	0, 2 - 500 Seconds
RD2- Restart Delay After All	
Faults Except Undercurrent	
(motor cool down timer)**	2 - 500 Minutes/Seconds
RD3- Restart Delay	
After Undercurrent	
(dry well recovery timer)	2 - 500 Minutes/Seconds
#RU- Number of Restarts	
After Undercurrent	0, 1, 2, 3, 4, A (Automatic)
ADDR- RS485 Address	A01- A99
#RO-Number of Restarts	
After Overcurrent	0, 1, 2, 3, 4, A (Automatic)
LP/PWS (PWS = LP Range)	**1** = 0.01 - 0.99 KW **5** = 0.01 - 1.30 HP **2** = 1.00 - 9.95 KW **6** = 1.34 - 13.3 HP **3** = 10.0 - 99.5 KW **8** = 13.4 - 133 HP **4** = 100 - 650 KW **9** = 134 - 871 HP

* If J Prefix is displayed in trip class setting, jam protection is enabled. If programmed to LIn position, overcurrent trip delays are fixed linear-type delays set in OPT1 position.

** RD2 & RD3 can be changed from minutes to seconds under program position OPT2.

SETTING	RD2	RD3		SETTING	RD2	RD3
0	Minutes	Minutes		2	Seconds	Minutes
1	Minutes	Seconds		3	Seconds	Seconds

SIO-RTD-02-00

Temperature Input Monitor

Description

The SIO-RTD is a microprocessor-based data-acquisition system for measuring temperatures accurately with resistance temperature detectors (RTDs) and for monitoring 4-20 mA analog-output devices in industrial environments. RTD inputs are noise-filtered and automatically calibrated for lead-length compensation, ambient temperature, and other factors providing accurate readings through the specified temperature range for several types of RTD devices.

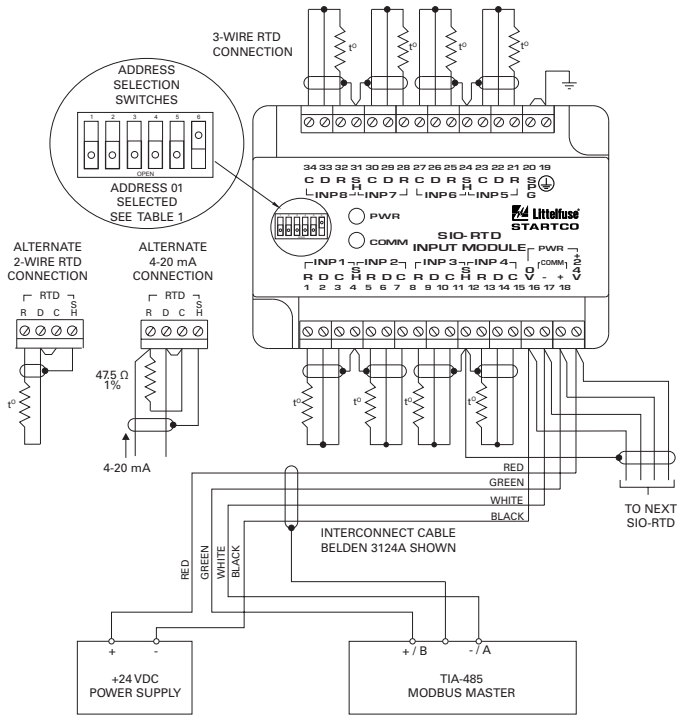
Features & Benefits

FEATURES	BENEFITS
8 inputs	Single module can collect multiple data points
CSA Class 1 Zone 2 Hazardous-location Certified	Can be mounted in hazardous areas
Individually-selectable input type	Flexible; can be used with Pt100, Ni100, Ni120, Cu10 RTD or 4-20 mA inputs
Conformal coating	Protects circuit boards against corrosion and moisture
Remote monitoring	Up to 1.2 km away from network master
Notch filter	Rejects noise from motor monitoring applications

Specifications

Input Voltage	18 to 32 Vdc, 2W
RTD Types	Pt100 (default), Ni100, Ni120, Cu10
RTD Range	-40 to 200° C with open and short detection
Analog Range	4-20 mA
Accuracy	
(Pt100, Ni100, Ni120)	1° C
(Cu10)	3° C
(4-20 mA)	0.1 mA
Lead Compensation	Up to 20 Ω
Communications	Modbus RTU®
Conformally Coated	Standard feature
Approvals	cCSAus
Dimensions	**H** 87 mm (3.43"); **W** 112.5 mm (4.43"); **D** 56 mm (2.2")
Warranty	5 years
Mounting	DIN, Surface

Wiring Diagram



For dimensional drawing see: Appendix page 515, Figure 49.

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PUMP CONTROLS & LIQUID LEVEL CONTROLS

Protect and disable a pump if a hazardous condition arises. PumpSaver® offers a wide variety of controls for both single phase and three phase applications. Intrinsically safe relays are specifically designed to interface between hazardous and non-hazardous areas.

ACBC-120 Series	Alarm Controller/Battery Charging Unit	146
PC-102 Series	Dual Channel Switch	148
PC-105	5-Channel Pump Controller	149
PC-XXX-LLC-CZ Series	Liquid Level Control Relays	150
PC-XXX-LLC-GM Series	Liquid Level Control Relays	150
201-100-SLD	Single-Channel Seal-Leak Detector	152
460-15-100-LLS	Single-Channel Liquid Level Sensor	153
460-15-100-SLD	Single-Channel Seal-Leak Detector	155
LLC1 Series	Open Board Liquid Level Control	157
LLC2 Series	Open Board Liquid Level Control	159
LLC4 Series	Octal Plug-In Liquid Level Control	161
LLC5 Series	Liquid Level Control	163
LLC6 Series	Low Level Cutoff Liquid Level Control	165
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Alternating Relays

ALT Series	8-pin Plug-in Alternating Relays	169
ALT-XXX-1-SW / ALT-XXX-3-SW Series	Alternating Relays	171
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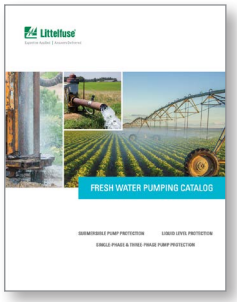
Intrinsically Safe Relays

ISS-100	Intrinsically Safe Switch	176
ISS-101	Intrinsically Safe Switch	177
ISS-102 Series	Two-Channel Intrinsically Safe Switch	179
ISS-105 Series	Five-Channel Intrinsically Safe Switch	181



For More Information…
and to download our Fresh Water Pumping Catalog, visit
Littelfuse.com/PumpProtection

ACBC-120 SERIES

Alarm Controller and Battery Charger for pump control panels

Description

The ACBC-120 Series is a dual purpose alarm controller/battery charging unit. When there is a loss of 120VAC power, the ACBC-120's primary function as an alarm controller activates. When this power loss occurs, input power is switched to a 12VDC, lead-acid, rechargeable backup battery and a 12VDC alarm consisting of a strobe light and/or a horn is activated. The horn follows a 2 second on/2 second off pattern with a "horn silence" option to turn the sound off. An LED indicator on the unit also signals that the device has entered the alarm mode.

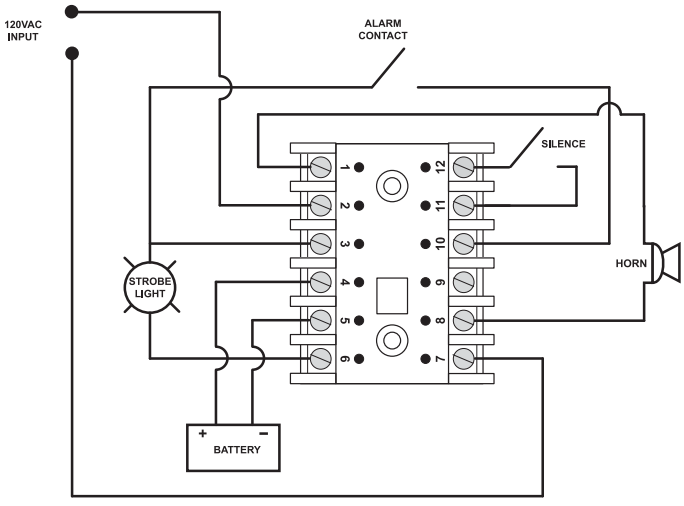
When 120VAC input is present the alarm circuit can be tested and the unit's secondary function as a 12VDC backup battery charger is activated. In fast charge mode, the unit has the capability to source up to 100mA of charging current. However, the device normally charges at a current of 14mA in maintenance mode. The alarm circuit can be tested by pressing the "test" button located on the front of the unit or by activating an external switch via the "alarm contact" pin.

The device has the ability to signal low battery voltage if the voltage drops below 10.5VDC. The device can also detect if no battery is present or if the battery is connected backwards. In either of these cases, the ACBC-120 will signal a battery error and will not attempt to charge.

Must use Model SD12-PC socket for UL Rating!

*Note: Manufacturer's recommended screw terminal torque for the SD Series Sockets is 12 in.-lbs.

Wiring Diagram



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Controls 12VDC alarm circuit	Activates strobe and/or horn when power loss occurs
Selectable fast charge mode	Unit sources higher charging current up to 100mA (normal mode is 14mA)
Trip delay timer	Prevents nuisance tripping
Battery fault detection and reverse polarity protection	Signals if battery voltage drops below 10.5VDC and can detect if no battery is present or if the battery is connected backwards
LED indication	Visual indication of unit status or trip
Test button	Preventative maintenance check of the alarm circuit by pressing the test button on the unit or externally through alarm contact connection

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION
ACBC-120	120VAC	Does not include SD12-PC socket for mounting
ACBC-120-SD	120VAC	Includes SD12-PC socket for mounting

Accessories

SD12-PC 12-pin Rectangle Socket
Rectangle Socket for the ACBC-120.
12-pin surface mountable.

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ACBC-120 SERIES

Specifications

Input Characteristics

Supply Voltage	
AC Input Voltage	120V +/-10%
Frequency	50/60Hz
AC Input Current	0.018A (max.) 0.003 (typical)
AC Input Power	2.4W (max.) fast charge current 0.4W (typical) maint. charge current

Functional Characteristics

Battery Charging Characteristics	
Acceptable Battery Type	12V lead-acid rechargeable
Fast Charge Current	100mA +/-10%
Maintenance Charge Current	14mA +/-50%
Low Battery Alert Level	10.5V

Output Characteristics

Strobe Light Alarm Output	12VDC@1A (max.)
Horn Alarm Output	12VDC@1A (max.)

General Characteristics

Temperature Range	-40° to 60°C (-40° to 140°F)

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency, Radiated	150MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 4, 4kV input lines; 4kV signal lines
Safety Marks	
UL	
(SD12-PC socket required)	UL508 (File #E68520)
Dimensions	**H** 44.45 mm (1.75"); **W** 60.325 mm (2.375"); **D** 104.775 mm (4.125") (with socket)
Weight	0.7 lb. (11.2 oz., 317.51 g)
Mounting Method	Surface mount with #8 or #10 screws (plug into SD12-PC socket)
Socket Available	Model SD12-PC (UL Rating 600V) The 600V socket can be surface mounted

PC-102 SERIES

Dual Seal-Leak Detector or Seal-Leak & Over-Temperature Detector

Description

The PC-102 is a dual-channel switch that provides dual protection against seal failures and over-temperature in submersible pumping applications.

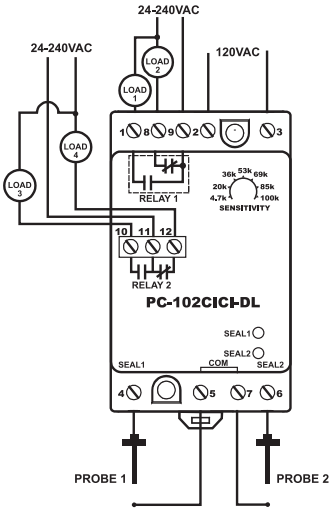
Both units have two form-C isolated output relays and two LEDs, which illuminate when each associated output relay is energized.

The sensitivity adjustment (4.7k-100kOhms) allows you to define the input impedance at which the output relays will change state. The sensitivity for the over-temperature detector can be set to 4k Ohms with use of the DIP switches.

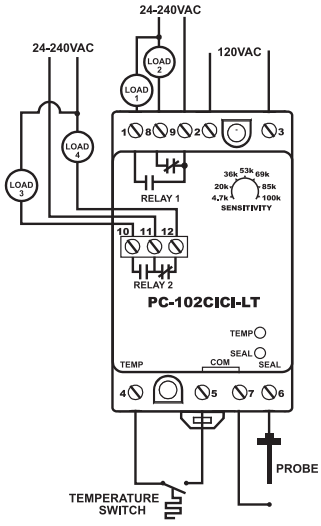
This unit may not be compatible with Flygt pumps.

Wiring Diagram

PC-102CICI-DL



PC-102CICI-LT



For dimensional drawing see: Appendix, page 510, Figure 10.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
PC-102CICI-DL	120VAC nominal	Dual seal-leak detector uses inputs to sense seal failures and energize the output relay. Input logic direct or inverted is DIP switch selectable
PC-102CICI-LT	120VAC nominal	Seal-leak and over-temperature detector uses one input to sense seal failures and the temperature input to detect motor overheating. Configurable to suit various probes. Seal input logic direct or inverted, plus over-temperature trip reset automatic or manual, is DIP switch selectable

Features & Benefits

FEATURES	BENEFITS
Finger-safe terminals	Meets IEC 61000 safety requirements
Compact design for DIN rail or surface mount	Allows flexiblility in panel installation
LED Status Indicator	Visual indication of relay engagement
Two input channels	Flexibility for pump-up/pump-down or two-channel switch applications

Specifications

Input Characteristics

Frequency	50/60Hz

Functional Characteristics

Probe Sense Voltage	5vdc pulsed
Sensitivity	4.7k-100kΩ
Sensitivity (for temp)	Selectable 4kΩ with DIP switches
Input Logic	Direct or inverted
Debounce Time Delay	0.5 or 2 seconds

Output Characteristics

Relay Output Rating (2 Form C isolated)	
Pilot Duty	180VA @ 120VAC, C150
General Purpose	5A @ 240VAC

General Characteristics

Temperature Range	-20° to 55°C (-4° to 131°F)
Maximum Input Power	2 W
Depluggable Connector	Phoenix Contact-Series MSTB plugs
Output Relay Status Indicators	LEDs
Terminal Torque	4.5 in.-lbs.
Wire range	12-20 AWG

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
Radio Frequency Immunity (RFI)	IEC 61000-4-3, Level 3, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 4kV input power 2kV inputs/outputs

Safety Marks

UL	UL508 (File #E68520)
Dimensions	**H** 88.9 mm (3.5"); **W** 52.93 mm (2.08"); **D** 59.69 mm (2.35")
Weight	0.9 lb. (14.4 oz., 408.23 g)
Mounting Method	35mm DIN rail or Surface Mount (#6 or #8 screws)

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PC-105

Pump controller with duplex, triplex or quadplex functionality or 5-channel relay

Description

The PC-105 is a 5-channel pump controller designed to handle multiple pump applications. Alternatively, it can operate as a 5-channel switch.

The PC-105's control functions support all of the popular industry-standard multi-pump, pump-up and pump-down configurations.

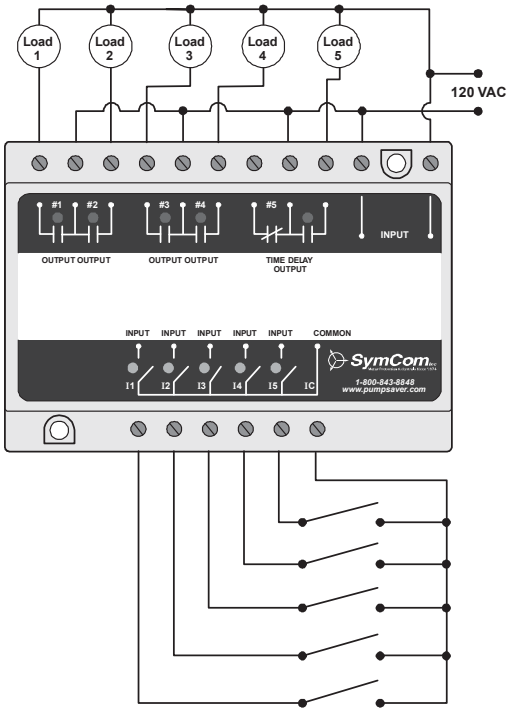
It can indicate low, high and out-of-sequence alarms and use alternating and non-alternating pump control. The non-alternating pump can be used as a jockey pump or emergency pump.

Using the built-in DIP switches, individual pumps can be disabled when taken out of service for repair or maintenance.

Features

- Compact design
- Low, high and out-of-sequence alarms
- Variable time delay/lag pump delay from 2-255 seconds
- Duplex SPS (separate pump stop) pump control
- Duplex, triplex or quadplex pump control
- Pump-up or pump-down functions
- External silence, reset and alternation configuration
- Five-channel relay configuration
- DIN rail or surface mountable

Wiring Diagram



For dimensional drawing see: Appendix, page 511, Figure 12.

Specifications

Input Characteristics

Supply Voltage	120VAC
Frequency	50*/60Hz

Functional Characteristics

Probe Sense Voltage	5vdc continuous

Output Characteristics

Relay Output Rating:	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	7A @ 240VAC

General Characteristics

Temperature Range	-20° to 55°C (-4° to 131°F)
Maximum Input Power	4 W
Wire range	12 to 20 AWG
Terminal Torque	4.5 in.-lbs. (max.)
Pump In-rush delay	2 seconds

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
Radio Frequency Immunity (RFI)	IEC 61000-4-3, Level 3, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 4kV input power 2kV inputs/outputs

Safety Marks

UL	UL508 (File #E68520)
Dimensions	**H** 94.06 mm (3.703"); **W** 127.64 mm (5.025"); **D** 59.69 mm (2.35")
Weight	1.2 lbs. (19.2 oz., 544.31 g)
Mounting Method	35 mm DIN rail or Surface Mount (#6 or #8 screws)

*Note: 50Hz will increase all delay timers by 20%.

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PC-XXX-LLC-CZ / PC-XXX-LLC-GM SERIES

Liquid Level Control

Description

The PC-xxx-LLC-CZ and PC-xxx-LLC-GM Series are liquid level control relays used to control conductive liquid pumping operations in a pump-up or pump-down application. The units come in two different voltage ranges (see specs below).

The units have an adjustable sensitivity knob (4.7k to 100k ohms) that is set according to the resistance level at which you want the probes (sold separately) to sense the conductive liquid. The units have a built-in debounce time delay that prevents the relay from energizing if the probe resistance momentarily goes above or below the sensitivity setpoint (due to liquid splashing in the tank).

The units operate their internal relay based on inputs from a high and low probe and a common reference (when a conductive tank is used) or common probe (when a non-conductive tank is used).

PC-xxx-LLC-CZ

- Compatible with Crouzet's PNR & PNRU series liquid level control

PC-xxx-LLC-GM

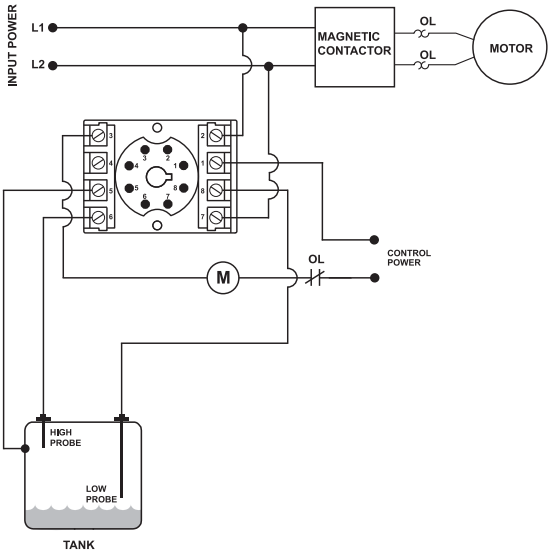
- Compatible with Gems' Series 16M general purpose control

Must use Model OT08PC or P1011-6 socket for UL Rating!

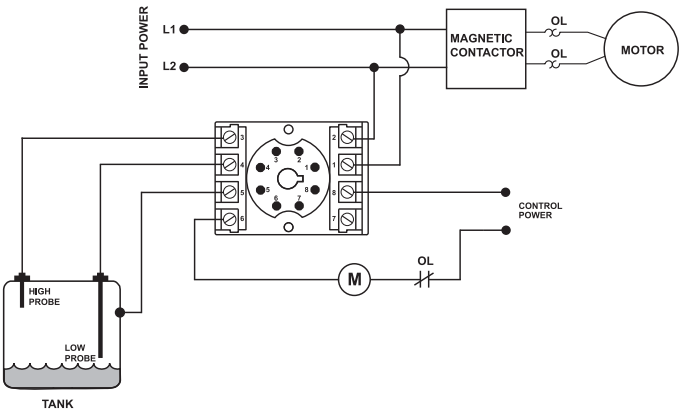
Note: Manufacturer's recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR PC-XXX-LLC-CZ



TYPICAL WIRING DIAGRAM FOR PC-XXX-LLC-GM



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Debounce time delay (2 seconds)	Prevents rapid cycling of the pump due to turbulance in the tank
Adjustable sensitivity (4.7 to 100Kohms)	Allows user to fine tune the sensing resistance to prevent false tripping due to foam or debris
Dual probe design (plus a common)	Allows user the ability to set the level differential required

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION
PC-100-LLC-CZ	95-120VAC	Compatible with Crouzet's PNR & PNRU Series liquid level control
PC-200-LLC-CZ	190-240VAC	Compatible with Crouzet's PNR & PNRU Series liquid level control
PC-100-LLC-GM	95-120VAC	Compatible with Gems' Series 16M liquid level control
PC-200-LLC-GM	190-240VAC	Compatible with Gems' Series 16M liquid level control

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PC-XXX-LLC-CZ / PC-XXX-LLC-GM SERIES

Accessories

OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Specifications

Input Characteristics

Supply Voltage	
PC-100-LLC-CZ	95-120VAC
PC-100-LLC-GM	95-120VAC
PC-200-LLC-CZ	190-240VAC
PC-200-LLC-GM	190-240VAC
Frequency	50/60Hz

Functional Characteristics

Probe Sense Voltage	5VDC pulsed
Debounce Time Delay	2 seconds
Probe Sensitivity	4.7k to 100k Adjustable

Output Characteristics

Output Contact Rating	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @240VAC

General Characteristics

Temperature Range	-40° to 70°C (-40° to 158°F)
Maximum Input Power	5 W

Sandards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
Radio Frequency Immunity (RFI)	150MHz, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 2kV input power and controls
Safety Marks	
UL (OT08PC octal socket required)	UL508 (File #E68520)
CE	IEC60947-6-2
Dimensions (when installed in socket base)	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.375"); **D** 104.78 mm (4.125")
Weight	0.65 lb. (10.4 oz., 294.84 g)
Mounting Method	DIN rail or surface mount (plug into OT08PC socket)
Socket Available	Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

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201-100-SLD

Single-Channel Seal-Leak Detector

UL listed when used in combination with OT08PC socket only.

Description

The model 201-100-SLD is an 8-pin plug-in style seal-leak detector to sense seal failures on submersible pumps. A microcontroller-based relay that monitors the shaft seal of a submersible pump motor. A resistive probe is installed in the seal cavity. If water leaks into the pump, the resistance measured by the probe decreases. When the resistance drops below the sensitivity setpoint, the unit will trip and the relay contacts will change state. The unit will automatically reset when a fault is cleared.

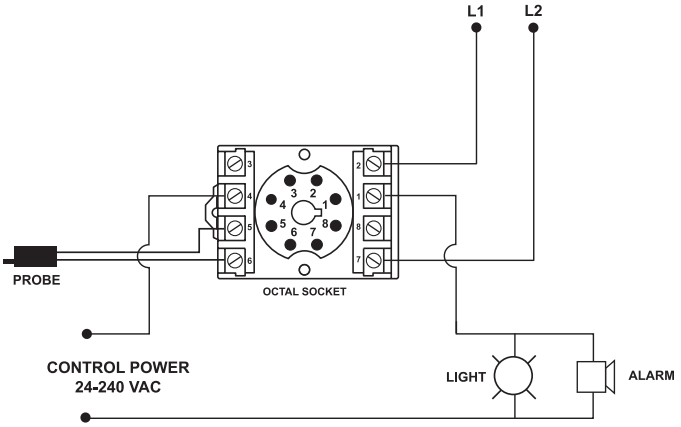
Features & Benefits

- LED status indicator
- Compact plug-in design
- DIN rail or surface mountable via octal base

Accessories

OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Wiring Diagram



For dimensional drawing see: Appendix, page 509, Figure 8.

Note: Manufacturer's recommended screw terminal torque for the RB Series and OT Series Octal Sockets is 12 in.-lbs.

Specifications

Control Voltage	110/120VAC nominal
Frequency	50/60Hz
Sensitivity	4.7k-100kΩ
Probe Sense Voltage	5vdc pulsed
Output contact Rating	SPDT
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC
Operating Temperature	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	5 W
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls
IEC	IEC 61000-4-5, Level 3, 4kV line-to-line; level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-Potential Test	Meets UL508 (2 x rated V + 1000V for 1 min.)
UL*	UL508 (File #E68520)
CE	IEC 60947-6-2
Enclosure	Polycarbonate
Dimensions	**H** 44.45 mm (1.75"); **W** 60.325 mm (2.375"); **D** (with socket) 104.78 mm (4.125")
Weight	0.7 lb. (11.2 oz., 317.51 g)
Mounting Method	DIN rail or surface mount (plug into OT08PC socket)
Socket Available	Model OT08PC (UL Rating 600V)
Approvals	UL, CE

*Must use Model OT08PC socket for UL Rating!
The 600V socket can be surface mounted or installed on DIN Rail.

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460-15-100-LLS

Single-Channel Liquid Level Sensor

Description

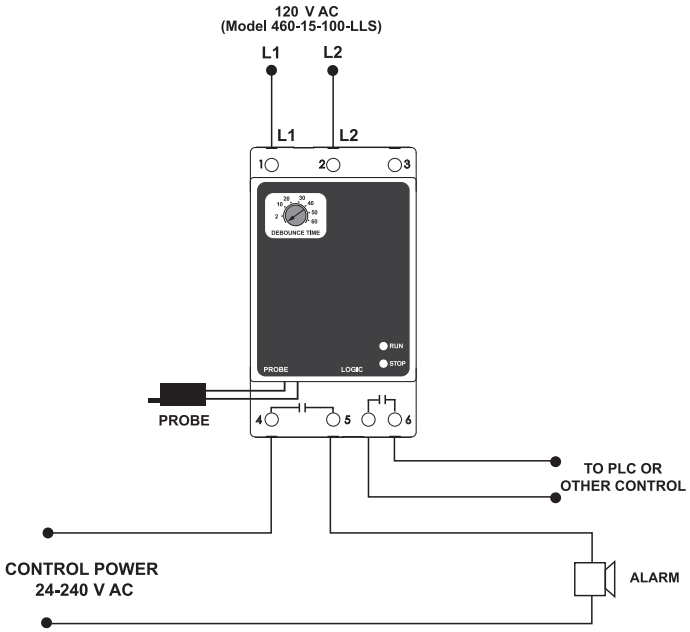
The 460-15-100-LLS is a liquid level sensor to detect the presence of conductive liquids. A probe is mounted at the desired tank level and connected to the PumpSaver®. When the probe is submersed, the relay's output contacts will change state as soon as the debounce time expires. The adjustable debounce timer is intended to prevent nuisance actuating due to waves or splashing in the tank.

Relay logic can be inverted so the relay's output contacts change state when the probe is no longer submersed. This makes the unit versatile for use in pump-up and pump-down applications.

Features & Benefits

FEATURES	BENEFITS
Unique Probe Protection	Probes are protected from scale build up through pulsed DC signal between the probes
Invertible relay logic	Allows flexibility to be used in pump-up and pump-down applications
Adjustable debounce timer	Prevents nuisance actuating caused by waves or splashing in the tank
LED status indicators	Provides visual indication of the relay status

Wiring Diagram



For dimensional drawing see: Appendix, page 510, Figure 10.

Specifications

Input Characteristics

Control Voltage	110/120VAC nominal
Frequency	50/60Hz *(Note: 50Hz will increase all delay timers by 20%)*
Sensitivity	100kΩ

Functional Characteristics

Probe Sense Voltage	5vdc pulsed
Debounce Time Delay	2-60 seconds

Output Characteristics

Output contact Rating – (Two Form A - SPST)	
Pilot Duty	360VA @ 240VAC
General Purpose	8A @ 240VAC

General Characteristics

Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	2 W
Class of Protection	IP20, NEMA 1 (finger safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	4.5 in.-lbs.
Wire	12-20 AWG

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150MHz, 10 V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls

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460-15-100-LLS

Surge

IEC	IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-Potential Test	Meets UL508 (2 x rated V + 1000 V for 1 min.)

Safety Marks

UL	UL508 (File #E68520)
CE	IEC 60947
Enclosure	Polycarbonate
Dimensions	**H** 88.9 mm (3.5"); **W** 52.93 mm (2.08"); **D** 59.69mm **(**2.35")
Weight	1 lb. (16 oz., 453.59 g)
Mounting Method	35mm DIN rail or Surface Mount (#6 or #8 screws)

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460-15-100-SLD

Single-Channel Seal-Leak Detector

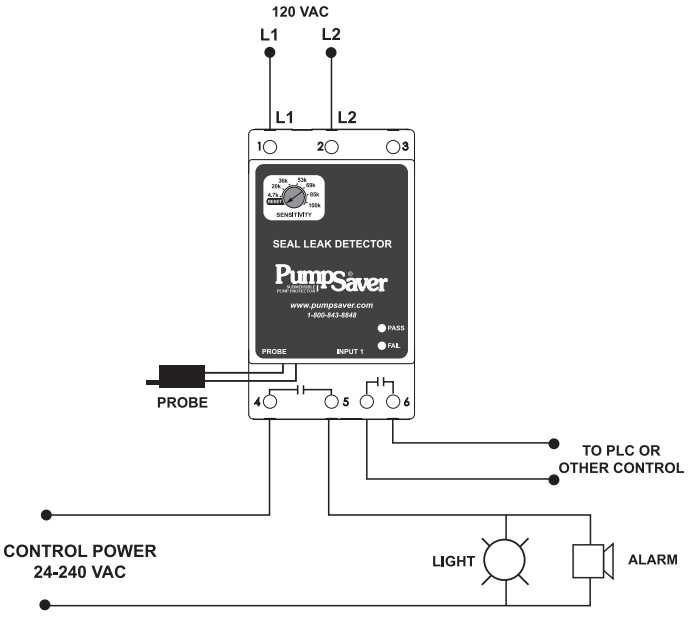
Description

The 460-15-100-SLD is a seal-leak detector to sense seal failures on submersible pumps. A microcontroller-based relay monitors the shaft seal of a submersible pump motor. A resistive probe is installed in the seal cavity. If water leaks into the pump, the resistance measured by the probe decreases. When the resistance drops below the sensitivity setpoint, the unit will trip and the relay contacts will change state. Output relay logic can be reversed by removing an external jumper. The unit will automatically reset when a fault is cleared.

Features & Benefits

FEATURES	BENEFITS
Unique probe protection logic	Probes are protected from scale build up through pulsed DC signal between the probes
Invertible relay logic	Allows flexibility to be used in pump-up and pump-down applications
LED status indicators	Provides visual indication of the relay status
2 relay contacts	Control independent loads on different circuits

Wiring Diagram



For dimensional drawing see: Appendix, page 510, Figure 10.

Specifications

Input Characteristics

Control Voltage	110/120VAC nominal
Frequency	50/60Hz (Note: 50Hz will increase all delay timers by 20%)

Functional Characteristics

Sensitivity	4.7k-100kΩ
Probe Sense Voltage	5vdc pulsed

Output Characteristics

Output contact Rating – (Two Form A - SPST)	
Pilot Duty	360VA @ 240VAC
General Purpose	8A @ 240VAC

General Characteristics

Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	2 W
Class of Protection	IP20, NEMA 1 (finger safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	4.5 in.-lbs.
Wire	AWG 12-20 AWG

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150MHz, 10 V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls

460-15-100-SLD

Surge

IEC	IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-Potential Test	Meets UL508 (2 x rated V + 1000 V for 1 min.)

Safety Marks

UL	UL508 (File #E68520)
CE	IEC 60947
Enclosure	Polycarbonate
Dimensions	**H** 88.9 mm (3.5"); **W** 52.93 mm (2.08"); **D** 59.69 mm (2.35")
Weight	1 lb. (16 oz., 453.59 g)
Mounting Method	35mm DIN rail or Surface Mount (#6 or #8 screws)

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LLC1 SERIES

Open Board Liquid Level Controls

Description

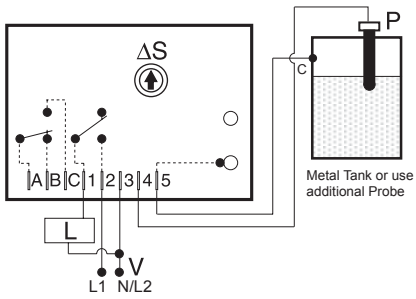
The LLC1 Series is a single probe conductive liquid level control designed for OEM equipment and commercial appliances. This unit may be ordered with fixed fill or fixed drain operation. A time delay (1-60s) prevents rapid cycling of the output relay. On adjustable units, the sensitivity adjustment allows accurate level sensing while ignoring foaming agents and floating debris. Isolated AC voltage is provided at the probe to prevent electrolysis. A trickle current of less than 1mA determines the presence or absence of liquid between the probe and common. The LLC1 Series printed circuit board is conformal coated to resist moisture and corrosion.

Operation

Drain (Pump-Down Mode): When the liquid level rises and touches the probe, a fixed time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level falls below the probe. The output relay then de-energizes and remains de-energized until the liquid again touches the probe.

Fill (Pump-Up Mode): When the liquid level falls below the probe, a fixed time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energizes and remains energized until the liquid level rises and touches the probe. The output relay then de-energizes and remains de-energized until the liquid level again falls below the probe.

Wiring Diagram



P = Probe
L = Load
V = Voltage
ΔS = Sensitivity Adjustment

Contacts A, B & C are isolated.

Connect common to conductive tank or an additional probe as required.

For dimensional drawing see: Appendix, page 514, Figure 40.

Features & Benefits

FEATURES	BENEFITS
Isolated AC voltage on probe	Prevents scale buildup on the probe
Open PCB design	Cost effective design for OEM equipment and commercial appliances
Conformally coated PCB	Protects against moisture and corrosion
Sensitivity adjustment	Provides accurate level sensing while ignoring foam or floating debris

Ordering Information

MODEL	INPUT VOLTAGE	OPERATION	TIME DELAY	SENSE RESISTANCE	MOUNTING
LLC14A1AX	120VAC	Drain	1s	Adjustable	0.5 in nylon standoffs (3)
LLC14A5AX	120VAC	Drain	5s	Adjustable	0.5 in nylon standoffs (3)
LLC14B15AX	120VAC	Fill	15s	Adjustable	0.5 in nylon standoffs (3)
LLC14B1AX	120VAC	Fill	1s	Adjustable	0.5 in nylon standoffs (3)
LLC14B60AX	120VAC	Fill	60s	Adjustable	0.5 in nylon standoffs (3)
LLC16A25AX	230VAC	Drain	25s	Adjustable	0.5 in nylon standoffs (3)
LLC16A3AX	230VAC	Drain	3s	Adjustable	0.5 in nylon standoffs (3)

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LLC1 SERIES

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

PHST-38QTN Electrode
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

LLP-24 Threaded Probe (24")
Threaded stainless steel probe measuring 24" (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

Specifications

Control	
Type	ON/OFF (single level) resistance sensor with built-in time delay to prevent rapid cycling
Sense Voltage	Low voltage AC between probe & common. Isolated from input & output.
Sense Resistance	Fixed or adjustable to 250KΩ
Sense Resistance Tolerance	Adjustable - guaranteed range Factory fixed ±10%
Time Delay	
Range	Fixed 1 - 60s in 1s increments
Input	
Voltage	24, 120, or 230VAC
Tolerance	
24VAC	-15% - 20%
120 & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Output	
Type	Electromechanical relay
Form	Non-isolated, SPST & Isolated, SPDT contacts
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^5
Protection	
Surge	IEEE C62.41-1991 Level A
Isolation Voltage	≥ 1500V RMS between input, output & probe
Mechanical	
Mounting	Surface mount to probe common with two #6 (M3.5 x 0.6) screws or 0.50 in. (12.7 mm) nylon standoffs with three #6 (M3.5 x 0.6) screws (use Terminal 5 for probe common)
Termination	0.25 in. (6.35 mm) male quick connect terminals
Dimensions (Open Board)	**H** 88.9 mm (3.5"); **W** 69.9 mm (2.75"); **D** 50.8 mm (2.0")
Environmental	
Operating/Storage Temperature	-20° to 55°C/-40° to 80°C
Coating	Printed circuit board is conformal coated to resist moisture and corrosion
Weight	≅ 8.7 oz (247 g)

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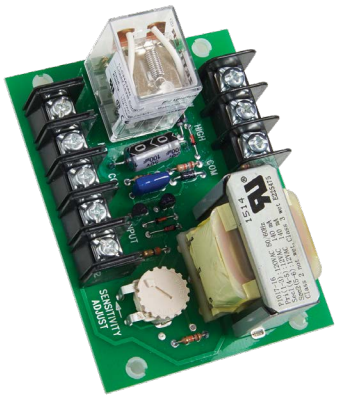
LLC2 SERIES

Open Board Liquid Level Controls



Description

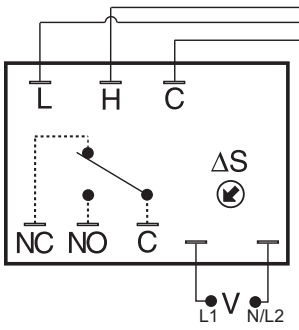
The LLC2 Series is a dual-probe conductive liquid level control designed for OEM equipment and commercial appliance applications. Models are available for fill or drain operation. Transformer isolated 12VAC is provided at the probes to prevent electrolysis. A trickle current of less than 1mA determines the presence or absence of liquid between the probes and common. On adjustable units, the sensitivity adjustment allows accurate level sensing while ignoring foaming agents and floating debris. The LLC2 Series printed circuit board is conformal coated to resist moisture and corrosion.

Operation

Drain (Pump-Down Mode): When the liquid level rises and touches the high probe, the output relay energizes and remains energized until the liquid level falls below the low probe. The output relay then de-energizes and remains de-energized until the liquid again touches the high probe.

Fill (Pump-Up Mode): When the liquid level falls below the low probe, the output relay energizes and remains energized until the liquid level rises and touches the high probe. The output relay then de-energizes and remains de-energized until the liquid level again falls below the low probe.

Wiring Diagram



V = Voltage
L = Low Probe
H = High Probe
C = Probe Common
P = Probe
ΔS = Sensitivity Adjustment
NC = Normally Closed
NO = Normally Open

Connect common to conductive tank. Additional probe is necessary for non-conductive or insulated tanks.

For dimensional drawing see: Appendix, page 514, Figure 41.

Features & Benefits

FEATURES	BENEFITS
Isolated 12VAC probes	Prevents scale buildup on the probes
Open PCB design	Cost effective design for OEM equipment and commercial appliances
Conformally coated PCB	Protects against moisture and corrosion
Sensitivity adjustment	Provides accurate level sensing while ignoring foam or floating debris

Ordering Information

MODEL	INPUT VOLTAGE	OPERATION	TERMINATION	SENSE RESISTANCE
LLC24A2AN	120VAC	Drain	Terminal block	Adjustable to 100kΩ
LLC24A2F50N	120VAC	Drain	Terminal block	Fixed 50kΩ
LLC24B1AC	120VAC	Fill	0.25" Quick connect	Adjustable to 100kΩ
LLC24B1F26C	120VAC	Fill	0.25" Quick connect	Fixed 26kΩ
LLC24B2F50N	120VAC	Fill	Terminal block	Fixed 50kΩ
LLC26A1F25C	230VAC	Drain	0.25" Quick connect	Fixed 25kΩ

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Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

PHST-38QTN Electrode
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

LLP-24 Threaded Probe (24")
Threaded stainless steel probe measuring 24" (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

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LLC2 SERIES

Specifications

Control

Type	Resistance sensing for high & low level detection of conductive liquids
Sense Voltage	12VAC at probe terminals
Sense Resistance	Fixed or adjustable to 100KΩ
Sense Resistance Tolerance	Adjustable: guaranteed range Fixed: ±10%

Input

Voltage	24, 120, or 230VAC
Tolerance	
24VAC	-15% - 20%
120 & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz

Output

Type	Electromechanical relay
Form	Isolated, SPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Isolation Voltage	≥ 1500V RMS between input, output, & probe

Mechanical

Mounting	Surface mount with two or four #6 (M3.5 x 0.6) screws
Termination	0.25 in. (6.35 mm) duplex male quick connect terminals. Terminal blocks for up to #14 AWG 2.5 mm^2) wire
Dimensions (Open Board)	**H** 101.6 mm (4.0"); **W** 76.2 mm (3.0"); **D** 50.8 mm (2.0")

Environmental

Operating/Storage Temperature	-20° to 55°C / -40° to 80°C
Coating	Printed circuit board is conformal coated to resist moisture and corrosion
Weight	≅ 9 oz (255 g)

Mounting Dimensions

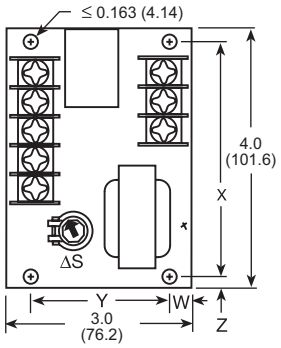

DIAGRAM KEY	MODEL NUMBERS ENDING IN:	
	N	C
W	0.440" (11.176 mm)	0.250" (6.350 mm)
X	3.620" (91.948 mm)	3.500" (88.900 mm)
Y	2.120" (53.848 mm)	2.500" (63.500 mm)
Z	0.190" (4.826 mm)	0.250" (6.350 mm)

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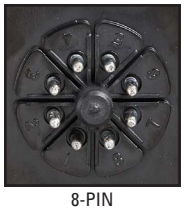
LLC4 SERIES

Octal Plug-In Liquid Level Controls



8-PIN

Description

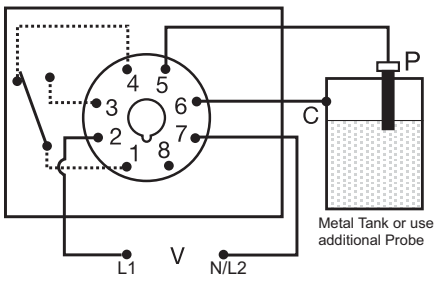
The LLC4 combines resistance sensing circuitry with solid-state timing to provide single probe level maintenance. On adjustable units, the sensitivity adjustment allows accurate level sensing while ignoring foaming agents and floating debris. Isolated 12VAC is provided at the probe to prevent electrolysis. A trickle current of less than 1mA determines the presence or absence of conductive liquid between the probe and common. The LLC4 Series can be used with many types of low voltage (resistance changing) transducers to perform other control functions like temperature limit control, photo limit control, condensation sensing, and ice sensing.

Operation

Drain (Pump-Down Mode): When the liquid level rises and touches the probe, the time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energize and remain energized until the liquid level falls below the probe level. The output relay de-energize and remain de-energized until the liquid rises and touches the probe.

Fill (Pump-Up Mode): When the liquid level falls below the probe, the time delay begins. This time delay prevents rapid cycling of the output relay and its load. At the end of the time delay, the output relay energize and remain energized until the liquid level rises and touches the probe. The output relay then de-energize and remain de-energized until the liquid level again falls below the probe level.

Wiring Diagram



P = Probe
C = Probe Common
V = Voltage

Relay contacts are isolated.

Connect common to conductive tank. Additional probe is necessary for non-conductive or insulated tanks.

For dimensional drawing see: Appendix, page 513, Figure 33.

Features & Benefits

FEATURES	BENEFITS
Isolated 12VAC probes	Prevents scale buildup on probe
Industry standard 8-pin octal plug connection	Eliminates need for special connectors
Sensitivity adjustment	Provides accurate level sensing while ignoring foam or floating debris

Ordering Information

MODEL	INPUT VOLTAGE	OPERATION	TIME DELAY	SENSE RESISTANCE	MODEL	INPUT VOLTAGE	OPERATION	TIME DELAY	SENSE RESISTANCE
LLC42A10A	24VAC	Drain	10s	Adjustable 1 - 250kΩ	LLC44B1A	24VAC	Fill		Adjustable 1 - 250kΩ
LLC42A1A	24VAC	Drain	1s	Adjustable 1 - 250kΩ	LLC44A60A	120VAC	Drain	60s	Adjustable 1 - 250kΩ
LLC42B15A	24VAC	Fill	15s	Adjustable 1 - 250kΩ	LLC44B20A	120VAC	Fill	20s	Adjustable 1 - 250kΩ
LLC44A10A	120VAC	Drain	10s	Adjustable 1 - 250kΩ	LLC44B2A	120VAC	Fill	2s	Adjustable 1 - 250kΩ
LLC44A15A	120VAC	Drain	15s	Adjustable 1 - 250kΩ	LLC44B30A	120VAC	Fill	30s	Adjustable 1 - 250kΩ
LLC44A1A	120VAC	Drain	1s	Adjustable 1 - 250kΩ	LLC44B4A	120VAC	Fill	4s	Adjustable 1 - 250kΩ
LLC44A2A	120VAC	Drain	2s	Adjustable 1 - 250kΩ	LLC44B5A	120VAC	Fill	5s	Adjustable 1 - 250kΩ
LLC44A4A	120VAC	Drain	4s	Adjustable 1 - 250kΩ	LLC44B5F100	120VAC	Fill	5s	Fixed 100kΩ
LLC44A5A	120VAC	Drain	5s	Adjustable 1 - 250kΩ					

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LLC4 SERIES

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

PSC8 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use with NDS-8 Octal Socket. Sold in pairs.

PHST-38QTN Electrode
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

LLP-24 Threaded Probe (24")
Threaded stainless steel probe measuring 24" (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

Specifications

Control

Type	ON/OFF (single level) resistance sensor with built-in time delay to prevent rapid cycling
Sensing Voltage	12VAC
Sensing Resistance	Fixed or adjustable to 250KΩ
Sensing Resistance Tolerance	Adjustable: 1K ±500Ω at low end; 250K ±25% at high end Factory fixed: ±10% or 500Ω, whichever is greater

Input

Voltage	24, 120, or 230VAC
Tolerance	
24VAC	-15%, +20%
120 & 230VAC	-20%, +10%
AC Line Frequency	50/60 Hz

Output

Type	Electromechanical relay
Form	Isolated, SPDT
Rating	4A resistive @ 240VAC; 1/10 hp @ 240VAC

Protection

Surge	IEEE C62.41-1991 Level A
Isolation Voltage	≥ 1500V RMS between input, output & probe

Mechanical

Mounting	Plug-in socket
Termination	Octal 8-pin plug-in
Dimensions	**H** 73.9 mm (2.91"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")

Environmental

Operating/Storage Temperature	-20° to 60°C/-40° to 80°C
Weight	≅ 6 oz (170 g)

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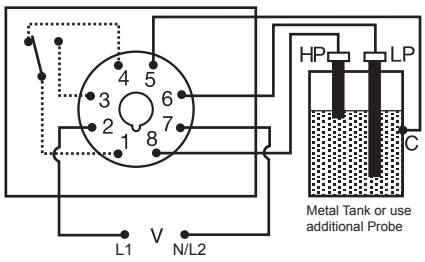
LLC5 SERIES

Liquid Level Controls

8-PIN

Wiring Diagram



HP = HIGH LEVEL PROBE
LP = LOW LEVEL PROBE
C = PROBE COMMON
V = VOLTAGE

Relay contacts are isolated. Connect common to conductive tank. Additional probe is necessary for non-conductive or insulated tanks.

For dimensional drawing see: Appendix, page 514, Figure 43.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
LLC52AA	24VAC	For Drain (pump-down) operation with adjustable sense resistance
LLC52BA	24VAC	For Fill (pump-up) operation with adjustable sense resistance
LLC54AA	120VAC	For Drain (pump-down) operation with adjustable sense resistance
LLC54AAS	120VAC	For Drain (pump-down) operation with adjustable sense resistance and reverse connection (#8 low, #6 high)
LLC54AF10	120VAC	For Drain (pump-down) operation with fixed sense resistance of 10 kΩ
LLC54BA	120VAC	For Fill (pump-up) operation with adjustable sense resistance
LLC54BAS	120VAC	For Fill (pump-up) operation with adjustable sense resistance and reverse connection (#8 low, #6 high)
LLC56AA	230 VAC	For Drain (pump-down) operation with adjustable sense resistance

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Description

The LLC5 provides dual probe conductive liquid level control in a convenient octal plug-in package. Models are available for fixed fill or drain operation. Isolated, pulsed DC voltage on the probes prevents electrolytic plating. Less than 1 mA of current is used to sense the presence of conductive liquid between the probes and common. On adjustable units, the sensitivity adjustment eliminates false tripping caused by floating debris and foaming agents.

Operation

Drain (Pump-Down Mode): When the liquid level rises and touches the high level probe, the output relay and LED energize and remain energized until the liquid level falls below the low level probe. The output relay and LED de-energize and remain de-energized until the liquid rises and touches the high level probe.

Fill (Pump-Up Mode): When the liquid level falls below the low level probe, the output relay and LED energize and remain energized until the liquid level rises and touches the high level probe. The output relay and LED de-energize and remain de-energized until the liquid level again falls below the low level probe.

Features & Benefits

FEATURES	BENEFITS
Unique Probe Protection logic	Probes are protected from scale build up through pulsed DC signal between the probes.
LED status indicator	Visual indication of relay engagement in pump-up or pump-down activity
Isolated 5A SPDT contacts	Allows control of loads for AC voltage

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

PSC8 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use with NDS-8 Octal Socket. Sold in pairs.

Note: use of the PSC8 clips partley covers the LED window of the LLC5 unit. Use of alternative socket base P1011-6 with its corresponding hold down clips PSCRB8 do not cover up the LED window, but the socket base is not DIN rail mountable.

LLC5 SERIES

Accessories

PHST-38QTN Electrode
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

LLP-24 Threaded Probe (24")
Threaded stainless steel probe measuring 24" (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

Specifications

Control	
Type	Resistance sensing for high & low level detection of conductive liquids
Sensing Voltage	Pulsed DC at probe terminals
Sensing Resistance	Factory fixed or adjustable to 100KΩ
Sensing Resistance Tolerance	Adjustable: 1K ±500Ω at low end; 100KΩ ±25%, 0% at high end Factory fixed: ±10% or 500Ω whichever is greater
Response Time	Debounce time delay <1s
Input	
Tolerance	
24VAC	-15%, +20%
120 & 230VAC	-20%, +10%
AC Line Frequency	50/60 Hz
Output	
Type	Electromechanical relay
Form	Isolated, SPDT
Rating	5A resistive @ 240VAC, 1/10 hp @ 240VAC
Protection	
Isolation Voltage	≥ 1500V RMS between input, output, & probe
Mechanical	
Mounting	Plug-in socket
Dimensions	**H** 60.7 mm (2.39"); **W** 45.2 mm (1.78"); **D** 76.5 mm (3.01")
Termination	Octal 8-pin plug-in
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 80°C
Weight	6 oz (170 g) approx.

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LLC6 SERIES

Low Level Cutoff Liquid Level Controls

11-PIN

Description

The LLC6 Series is a plug-in, single-probe conductive liquid level control designed for low liquid level cutoff protection. It offers a factory fixed time delay of 1 - 60s and is available in input voltages of 24, 120, or 230VAC. LED indicator illuminates whenever the LLC6's 10A, SPDT output relay is energized. Available with automatic/manual reset or a special manual reset with power outage feature, which auto resets the unit when power is restored and the water level is acceptable. 24VAC and 120VAC units are recognized as limit switches under UL353 (230VAC units are UL508) and CSA certified under Standard 14.

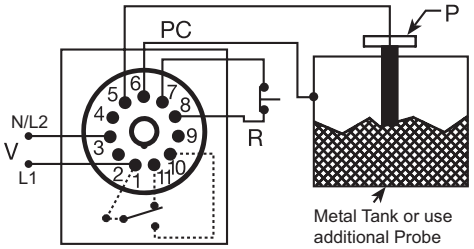
Operation

Automatic Reset (Reset terminals not connected): When liquid rises to the low level cutoff probe, the output relay and the LED indicator energize. When the liquid falls below low level cutoff probe, the output relay and the LED indicator de-energize after a fixed time delay.

Manual Reset (Reset switch connected): When the liquid level falls below the low level probe, the output relay and LED de-energize after a fixed time delay. When the liquid level rises to the low level probe, the output relay and LED indicator remain de-energized until the manual reset switch is opened; then they energize immediately.

Power Outage Manual Reset (Reset switch connected): A power outage causes the output relay and LED indicator to de-energize. Upon restoration of power, if the liquid level is above the low level probe, the output relay and LED indicator will re-energize. If the liquid level is below the low level probe, the output relay and LED indicator remain de-energized until the Normally Closed (NC) reset switch is opened.

Wiring Diagram



PC = Probe Common
P = Probe
V = Voltage
R = Optional NC Reset Switch

Connect common to conductive tank. Additional probe is necessary for non-conductive or insulated tanks.

For dimensional drawing see: Appendix, page 513, Figure 33.

Features & Benefits

FEATURES	BENEFITS
Isolated 12VAC on probe	Prevents electrolysis
Industry standard 11-pin octal plug connection	Eliminates need for special connectors
LED indication	Visual indication output relay is energized
Power outage protection (see ordering table for models)	Automatically resets the unit when power is restored and the water level is acceptable

Ordering Information

MODEL	INPUT VOLTAGE	TIME DELAY (FIXED)	SENSE RESISTANCE	RESET
LLC6210F10M	24VAC	10s	10kΩ	Manual/Automatic
LLC6410F10M	120VAC	10s	10kΩ	Manual/Automatic
LLC643F26M	120VAC	3s	26kΩ	Manual/Automatic
LLC6610F5P	230VAC	10s	5kΩ	Power Outage Manual Reset

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LLC6 SERIES

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-11 11-pin Socket
11-pin 35mm DIN rail or surface mount. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

PSC11 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use with NDS-11 Socket. Sold in pairs.

PHST-38QTN Electrode
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

LLP-24 Threaded Probe (24")
Threaded stainless steel probe measuring 24" (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

Specifications

Control	
Type	ON/OFF (single level) resistance sensor with built-in time delay to prevent rapid cycling
Sense Voltage	12VAC nominal at probe terminals
Sense Resistance	Fixed 5K - 250KΩ
Sense Resistance Tolerance	Fixed ±10%
Time Delay	
Range	1 - 60s in 1s increments
Tolerance	±20%
Repeat Accuracy	±10%
Time Delay vs Temp. & Voltage	±10%
Power Outage Reset Delay	≤ 1s
Input	
Voltage	24, 120, or 230VAC
Tolerance	
24VAC	+20% to -15%
120 or 230VAC	+10% to -20%
AC Line Frequency	50/60 Hz
Output	
Type	Electromechanical relay
Form	Non-isolated, SPDT
Rating	10A resistive @ 240VAC; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Protection	
Surge	IEEE C62.41-1991 Level A
Isolation Voltage	≥ 2500V RMS between input & output terminals
Mechanical	
Mounting	Plug-in socket
Termination	11-pin relay type
Dimensions	**H** 73.9 mm (2.91"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 80°C
Humidity	95% relative, non-condensing
Weight	≅ 7.3 oz (207 g)

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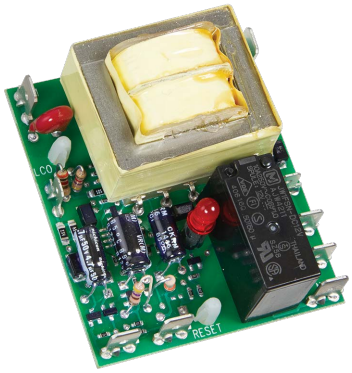
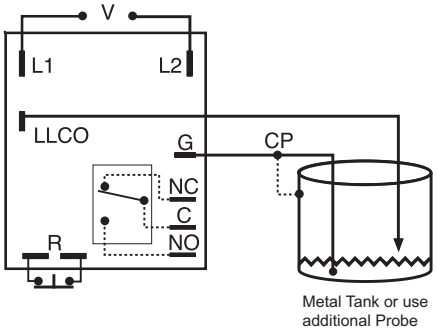
LLC8 SERIES

Low Level Cutoff Liquid Level Controls



Wiring Diagram



V = Voltage
LLCO = Low Level Probe
G, CP = Ground or Common (Reference) Probe
R = Optional NC Reset Switch (not included)
NO = Normally Open
NC = Normally Closed
C = Common or Transfer Contact

Relay contacts are isolated. Connect common to conductive tank. Additional probe is necessary for non-conductive or insulated tanks.

For dimensional drawing see: Appendix, page 514, Figure 42.

Ordering Information

MODEL	INPUT VOLTAGE	TIME DELAY (FIXED)	SENSE RESISTANCE	RESET
LLC825F5M	24VAC	5s	5kΩ	Manual/automatic
LLC842F103M	120VAC	2s	10kΩ	Manual/automatic
LLC843F10M	120VAC	3s	10kΩ	Manual/automatic
LLC843F10P	120VAC	3s	10kΩ	Power outage manual reset
LLC843F26M	120VAC	3s	26kΩ	Manual/automatic
LLC843F26P	120VAC	3s	26kΩ	Power outage manual reset
LLC845F25P	120VAC	5s	25kΩ	Power outage manual reset
LLC8430F250P	120VAC	30s	250kΩ	Power outage manual reset
LLC8430F26P	120VAC	30s	26kΩ	Power outage manual reset
LLC8610F12M	230VAC	10s	12kΩ	Manual/automatic
LLC863F26P	230VAC	3s	26kΩ	Power outage manual reset

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Description

The LLC8 Series is a low cost, single-probe conductive liquid level control designed for low liquid level cutoff protection. It offers a factory fixed time delay of 1 - 60s and is available for input voltages of 24, 120, or 230VAC. LED indicator illuminates whenever the LLC8's isolated, 10A, SPDT output relay is energized. Sense resistance is fixed from 5K - 250KΩ. Available with manual/automatic reset or a special manual reset with a power outage feature that auto resets the unit when power is restored and the water level is acceptable. 24 and 120VAC units are UL recognized as limit switches under UL353 (230VAC units are UL 508) and CSA certified under Standard 14.

Operation

Automatic Reset (Reset switch not connected): When liquid rises to low level cutoff probe, output relay and LED indicator energize. When liquid falls below the low level cutoff probe, the output relay and LED indicator de-energize after a fixed time delay.

Manual Reset (Reset switch connected): When the liquid level falls below low level probe, the output relay and LED de-energize after a fixed time delay. When the liquid level rises to low level probe, the output relay and LED indicator remain de-energized until the NC manual reset switch is opened; then they energize immediately.

Power Outage Manual Reset (Reset switch connected): A power outage causes the output relay and LED indicator to de-energize. Upon restoration of power, if the liquid is touching the low level probe, the output relay and LED indicator will re-energize. If the liquid level is below the low level probe, the output relay and LED indicator remain de-energized until the NC reset switch is opened.

Features & Benefits

FEATURES	BENEFITS
Isolated 12VAC probes	Prevents scale buildup on probe
Open PCB design	Cost effective design for OEM low liquid level cutoff protection
Conformally coated PCB	Protects against moisture and corrosion
LED indication	Visual indication output relay is energized
Power outage protection (see ordering table for models)	Automatically resets the unit when power is restored and the water level is acceptable
24VAC & 120VAC models meet UL353	Required for use as a low level limit switch

LLC8 SERIES

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

PHST-38QTN Electrode
Designed for a maximum steam pressure of 240 PSI; 400° F. UL353 Recognized.

LLP-24 Threaded Probe (24")
Threaded stainless steel probe measuring 24" (61 cm) long. For use with PHST-38QTN liquid level control electrodes.

Specifications

Control	
Type	Resistance sensing for conductive liquids with time delay
Sense Voltage	12VAC nominal at probe terminals
Sense Resistance	Fixed 5K - 250KΩ
Sense Resistance Tolerance	±10%
Time Delay	
Tolerance	±20%
Repeat Accuracy	±10%
Time Delay vs Temp. & Voltage	±10%
Power Outage Reset Delay	≤1s
Input	
Voltage	24, 120, or 230VAC
Tolerance	
24VAC	-15% - 20%
120 or 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Output	
Type	Electromechanical relay
Form	Isolated SPDT
Rating	10A resistive @ 120/240VAC; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Protection	
Surge	IEEE C62.41-1991 Level A
Isolation Voltage	≥ 2500V RMS input to output terminals
Mechanical	
Mounting	0.5 in. (12.7 mm) x .187 (4.76 mm) dia. nylon standoffs (3)
Termination	
Dimensions	**H** 63.5 mm (2.5"); **W** 55.6 mm (2.19"); **D** 47.8 mm (1.88")
Electrical	0.25 in. (6.35 mm) male quick connect terminals
Reset Switch & Probe(s)	0.187 x 0.03 in. (4.75 x 0.76 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 80°C
Coating	Printed circuit board is conformal coated to resist moisture & corrosion
Humidity	95% relative, non-condensing
Weight	≅ 5 oz (141.7 g)

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ALT SERIES

8-pin Plug-in Alternating Relay

Description

The ALT alternating relays are used to alternate between two loads. The ALT is commonly used in duplex pumping applications to balance the runtime of both pumps.

The **ALT-S** is used in single high-level float applications. When the float switch opens, the alternating relay changes state, forcing the other pump to run the next time the float closes. All ALT relays have a built-in debounce feature that prevents the relay from changing state if the switch or float contact bounces momentarily.

The **ALT-X** has an internal cross-connected relay and is used in dual high-level float applications. These floats are commonly referred to as lead and lag floats.

The pumps alternate as in the ALT-S version but the cross-connected relay configuration allows both pumps to run simultaneously when both the lead and lag floats are closed.

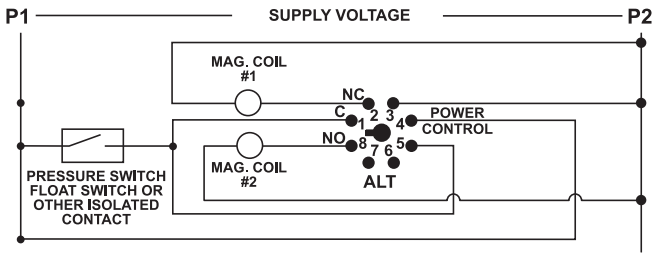
These relays are also available with a built-in switch (SW option) that is used to manually force one of the pumps to run every time the float switch is closed. This is helpful when a pump has been removed for repair or for test purposes. In the case of the **ALT-X-SW,** the switch essentially forces one pump to be the lead pump, while still allowing the second to run when both floats are closed.

Must use the OT08PC socket for UL Rating!

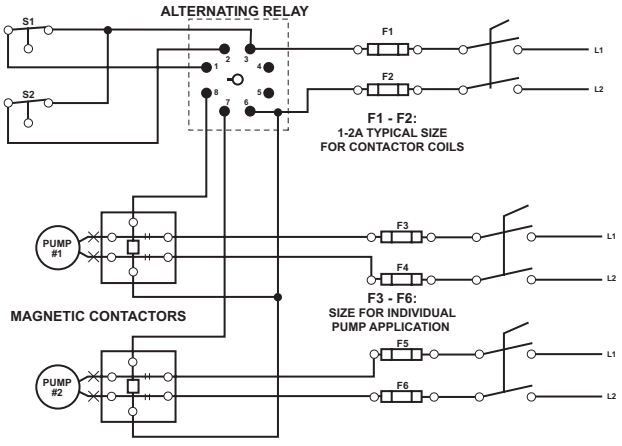
*Note: Manufacturer's recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR THE ALT-S



TYPICAL WIRING DIAGRAM FOR THE ALT-X (CROSS CONNECTED)



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Debounce time delay	Prevents nuisance actuating causes by waves or spashing in the tank
Built-in manual/ auto switch	Force lead pump operation when a pump is removed for repair or testing (on select models)

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
ALT024-S†	20-26VAC or VDC	For single high-level float applications
ALT024-S-SW†	20-26VAC or VDC	For single high-level float applications with built in manual switch
ALT115-S	95-125VAC	For single high-level float applications
ALT115-S-SW	95-125VAC	For single high-level float applications with built in manual switch
ALT115-X	95-125VAC	For dual high-level (lead and lag) float applications
ALT115-X-SW	95-125VAC	For dual high-level (lead and lag) float applications with built in manual switch
ALT230-S	195-250VAC	For single high-level float applications
ALT230-S-SW	195-250VAC	For single high-level float applications with built in manual switch
ALT230-X	195-250VAC	For dual high-level (lead and lag) float applications
ALT230-X-SW	195-250VAC	For dual high-level (lead and lag) float applications with built in manual switch

Accessories

OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

†ALT024-S and ALT024-S-SW are not UL Listed

ALT SERIES

Specifications

Input Characteristics

Supply Current	40mA

Functional Characteristics

Debounce Time Delay	0.5 second
Control Input Impedance (min)	
24	10kΩ
115	56kΩ
230	100kΩ

Output Characteristics

Output Contact Rating	480VA @ 240VAC

General Characteristics

Temperature Range	-40° to 50°C (-40° to 122°F)
Maximum Input Power	5 W

Safety Marks

UL (OT08PC octal socket required)	UL508 (File #E68520)
CSA	C22.2 No. 14 (File #46510)
Dimensions (with socket)	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.375"); **D** 104.78 mm (4.125")
Weight	0.38 lb. (6.08 oz., 172.67 g)
Mounting Method	DIN rail or surface mount (plug into OT08PC socket)
Socket Available	OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

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ALT-XXX-1-SW / ALT-XXX-3-SW SERIES

Alternating Relay

Description

The ALT-xxx-1-SW/ALT-xxx-3-SW Series are used to alternate between two loads and are commonly used in duplex pump-up and pump-down applications to balance the runtime of both pumps.

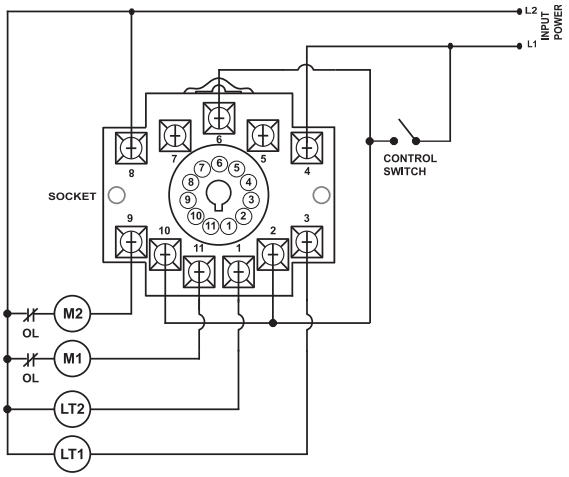
The ALT relays have a built-in debounce time delay that prevents the relay from changing state if the float momentarily bounces, and they have a built-in switch to manually force a specific load (pump) to operate each time the input float closes. This is helpful when performing periodic maintenance or pump repair.

Must use the OT08PC socket for the 8-pin models, and the OT11PC socket for the 11-pin models, for UL Rating!

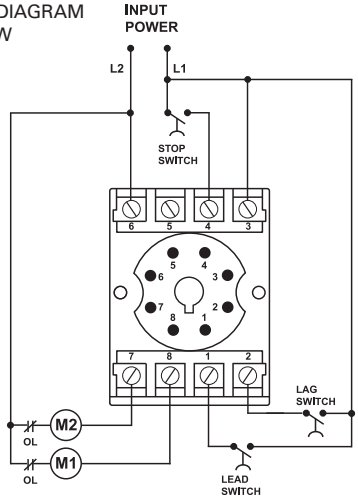
*Note: Manufacturer's recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR ALT-XXX-1-SW



TYPICAL WIRING DIAGRAM FOR ALT-XXX-3-SW



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Debounce time delay	Prevents rapid cycling caused by waves or splashing in the tank
LED indicators	Visual indication of load operation in duplex application
Built-in manual switch to force load operation	Helpful to control load operation when performing periodic maintenance or pump repair
ALT-xxx-3-SW offers duplexing	Allows lag pump to energize if lead pump can't handle current demand

Accessories

OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

OT11PC 11-pin Magnal Socket
11-pin surface & DIN rail mountable. Rated for 10A @ 300VAC

Ordering Information

MODEL	LINE VOTAGE	MOUNTING	DESCRIPTION
ALT-100-1-SW	95-120VAC	11-pin magnal	Single float input, two isolated Form C relays (DPDT), 2 LEDs for load indication
ALT-100-3-SW	95-120VAC	8-pin octal	Three float inputs (lead, lag, stop floats), actuating latching relays on lead/lag floats, 2 LEDs for load indication
ALT-200-3-SW	190-240VAC	8-pin octal	Three float inputs (lead, lag, stop floats), actuating latching relays on lead/lag floats, 2 LEDs for load indication

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ALT-XXX-1-SW / ALT-XXX-3-SW SERIES

Specifications

Input Characteristics

Supply Voltage	
ALT-100-1-SW, ALT-100-3-SW	95-120VAC
ALT-200-3-SW	190-240VAC
Frequency	50/60Hz

Functional Characteristics

Debounce Time Delay	
ALT-100-1-SW,	1 second
ALT-100-3-SW, ALT-200-3-SW	5 seconds

Output Characteristics

Output Relay (DPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics

Temperature Range	-40° to 70°C (-40° to 158°F)
Maximum Input Power	5 W

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency, Radiated	150MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls
Safety Marks	
UL (OT08PC or OT11PC octal socket required)	UL508 (File #E68520)
CE	IEC 60947-6-2
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.375"); **D** 104.78 mm (4.125") (with socket)
Weight	0.65 lb. (10.4 oz., 294.84 g)
Mounting Method	DIN rail or surface mount (plug into OT08PC or OT11PC socket)
Sockets Available	
Model OT08PC	UL Rating 600V
Model OT11PC	UL Rating 300V

The sockets can be surface mounted or installed on DIN Rail.

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ARP SERIES

Alternating Relay

8-PIN

11-PIN

Description

The ARP Series is used in systems where equal run time for two motors is desirable. The selector switch allows selection of alternation or for continuous operation of either load. LED's indicate the status of the output relay. This versatile series may be front panel mounted (BZ1 accessory required) or 35 mm DIN rail mounted with an accessory socket.

Operation

Alternating: When the rotary switch is in the "alternate" position, alternating operation of Load A and Load B occurs upon the opening of the control switch S1. To terminate alternating operation and cause only the selected load to operate, rotate the switch to position "A" to lock Load A or position "B" to lock Load B. The LEDs indicate the status of the internal relay and which load is selected to operate.

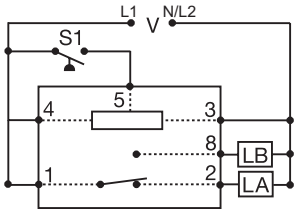
Note: Input voltage must be applied at all times for proper alternation. The use of a solid-state control switch for S1 may not initiate alternation correctly. S1 voltage must be from the same supply as the unit's input voltage (see connection diagrams). Loss of input voltage resets the unit; Load A becomes the lead load for the next operation.

Duplexing (Cross-Wired): Duplexing models operate the same as alternating relays and when both the Control (S1) and Lag Load (S2) Switches are closed, Load A and Load B energize simultaneously.

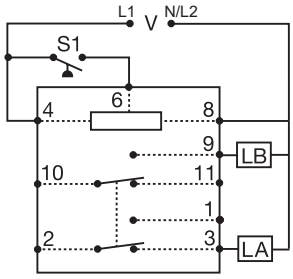
The DPDT 8-pin, cross-wired option, allows extra system load capacity through simultaneous operation of both motors when needed. Relay contacts are not isolated.

Wiring Diagram

SPDT 8-PIN

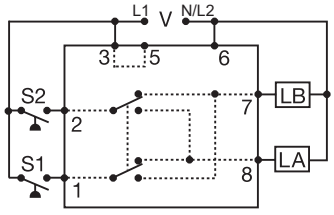


DPDT 11-PIN



Relay contacts in above are isolated.

DPDT 8-PIN CROSS WIRED



V = VOLTAGE
LA = LOAD A
LB = LOAD B
S1 = PRIMARY CONTROL SWITCH
S2 = LAG LOAD SWITCH

For dimensional drawing see: Appendix, page 514, Figure 46.

Features & Benefits

FEATURES	BENEFITS
Alternating or electrically locked operation	Flexibility to run unit alternating between the two loads as normal or lock the relay to one specific load.
Low profile selector switch	Prevents accidental actuation
LED status indication	Visual indication of which load is engaged
Industry standard base connection	Flexibility to use in many applications

Ordering Information

MODEL	LINE VOLTAGE	OUTPUT FORM	DESCRIPTION
AR120A-3095	120VAC	SPDT	8-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.
ARP23S	24VAC	DPDT	8-pin cross-wired for duplexing applications. Rotary switch allows user to lock internal relay to one specific load.
ARP41	120VAC	SPDT	8-pin for alternating applications.
ARP41S	120VAC	SPDT	8-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.
ARP42S	120VAC	DPDT	11-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.
ARP43	120VAC	DPDT	8-pin cross-wired for duplexing applications.
ARP43S	120VAC	DPDT	8-pin cross-wired for duplexing applications. Rotary switch allows user to lock internal relay to one specific load.
ARP61S	230VAC	SPDT	8-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.
ARP62S	230VAC	DPDT	11-pin for alternating applications. Rotary switch allows user to lock internal relay to one specific load.
ARP63S	230VAC	DPDT	8-pin cross-wired for duplexing applications. Rotary switch allows user to lock internal relay to one specific load.

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ARP SERIES

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

NDS-11 11-pin Socket
1-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

PSC8 or PSC11 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in pairs.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Specifications

Input	
Tolerance	
24VAC	-15% to 20%
120 & 230VAC	-20% to 10%
AC Line Frequency	50/60Hz
Output	
Type	Electromechanical relay
Form	SPDT, DPDT, or cross-wired DPDT
Rating	10A resistive @ 120/240VAC & 28 VDC; 1/3 hp @ 120/240VAC
Maximum Voltage	250VAC
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6
Protection	
Isolation Voltage	≥ 1500V RMS input to output
Mechanical	
Mounting	Plug-in socket
Dimensions	H 60.7 mm (2.39"); W 45.2 mm (1.78"); D 81.3 mm (3.2")
Termination	Octal 8-pin or magnal 11-pin
Environmental	
Operating/Storage Temperature	-20° to 60°C / -30° to 85°C
Weight	5.6 oz (159 g) approx.

NOTE: Unit does not have debounce time delay.

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50R-400-ALT

480VAC Application, Panel Mount

Description

The 50R-400-ALT alternating relays are used to alternate between two loads, most commonly in duplex pumping and compressor applications to balance the runtime of both loads.

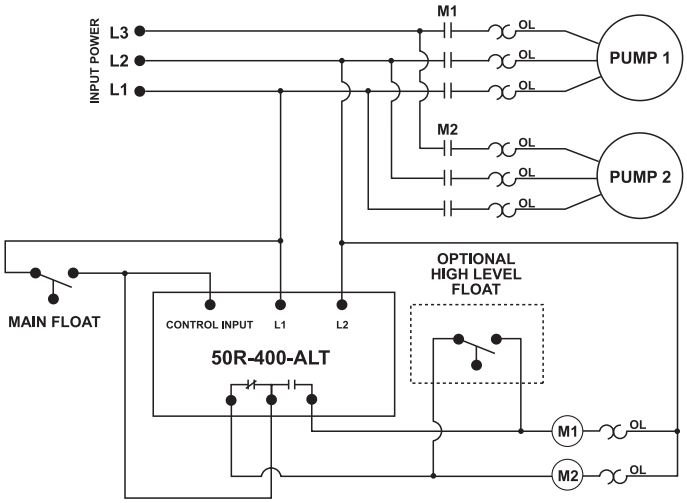
When used in single float applications, the alternating relay changes state after the float switch opens*, forcing the other pump to run the next time the float closes. When used in dual float applications, the alternating relay will allow both pumps to run simultaneously when the lead and lag floats are both closed.

An adjustment knob provides the option to force one pump to run every time the float switch is closed. This is helpful when one pump has been removed for repair or for test purposes.

A built-in debounce feature prevents the alternating relay from changing state if the float contact bounces momentarily.

*The alternating relay will not switch states while current is flowing. Switching will only occur after current has been sensed, followed by loss of current for the duration of the debounce time delay.

Wiring Diagram



For dimensional drawing see: Appendix, page 509, Figure 6.

Features & Benefits

FEATURES	BENEFITS
Debounce time delay	Prevents rapid cycling caused by waves or splashing in the tank
LED indicators	Visual indication of load operation in duplex application
Built-in manual switch to force load operation	Helpful to control load operation when performing periodic maintenance or pump repair
Operates from 380 - 480VAC	No transformer required to provide 120 - 240V for control circuit

Specifications

Input Characteristics

Supply Voltage	380-480VAC
Supply Current	40mA

Functional Characteristics

Control Input Impedance (min)	1MΩ

Output Characteristics

Output Contact Rating	
Pilot Duty	470VA @ 600VAC
General Purpose	10A
Debounce Time Delay	1 second

General Characteristics

Maximum Input Power	5 W
Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947
Dimensions	**H** 74.4 mm (2.93"); **W** 133.9 mm (5.27"); **D** 74.9 mm (2.95")
Weight	0.98 lb. (15.68 oz., 444.52 g)
Mounting Method	#8 screws

ISS-100

Single-Channel Intrinsically Safe Switch

Description

The ISS-100 switches are UL 913 listed as an associated apparatus for interfacing between hazardous and non-hazardous areas. These units must be installed in a non-hazardous area.

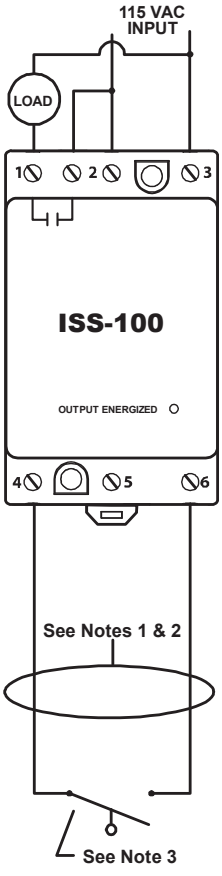
Features & Benefits

FEATURES	BENEFITS
Finger-safe terminals	Meets IEC 61000 safety requirements
Compact design for DIN rail or surface mount	Allows flexiblility in panel installation
LED Status Indicator	Visual indication of relay engagement
Isolated output relay	Allows connection to PLC or control voltage

Specifications

Input Characteristics	
Supply Voltage	90-120VAC
Functional Characteristics	
Probe Sense Voltage	5vdc continuous
Output Characteristics	
Output Contact Rating	
Pilot Duty	180VA @120VAC, C300
General Purpose	8A @120VAC
Relay Contact Life (Electrical)	100,000 cycles min. @ rated load
Relay Contact Life (Mechanical)	10,000,000 cycles
General Characteristics	
Temperature Range	-20° to 55°C (-4° to 131°F)
Maximum Input Power	1.5 W
Wire range	12 to 20 AWG
Terminal Torque	3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)
Provides Intrinsically-Safe Circuits in the following locations:	Division 1 and 2 Class I, Groups A,B,C,D; Class II, Groups E,F,G; and Class III
Entity Parameters	V_{oc} = 16.8V Po=$\frac{Voc*Isc}{4}$ I_{sc} = 1.2mA L_a = 100mH C_a= 0.39uF
Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI)	IEC 61000-4-3, Level 3, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 4kV input power
Safety Mark	
UL	UL913 Sixth Edition (File #E233355)
Dimensions	**H** 88.9 mm (3.5"); **W** 52.93 mm (2.08"); **D** 59.69 mm (2.35")
Weight	0.5 lb. (8 oz., 226.8 g)
Mounting Method	35mm DIN rail or Surface Mount (#6 or #8 screws)

Wiring Diagram



1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically safe wiring shall be separated from intrinsically safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.

For dimensional drawing see: Appendix, page 510, Figure 10.

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ISS-101

Single-Channel Intrinsically Safe Switch

Description

The ISS-101 switches are UL 913 listed as an associated apparatus for interfacing between hazardous and non-hazardous areas. These units must be installed in a non-hazardous area.

Must use Model OT08PC socket for UL Rating!

Note: Manufacturer's recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Features & Benefits

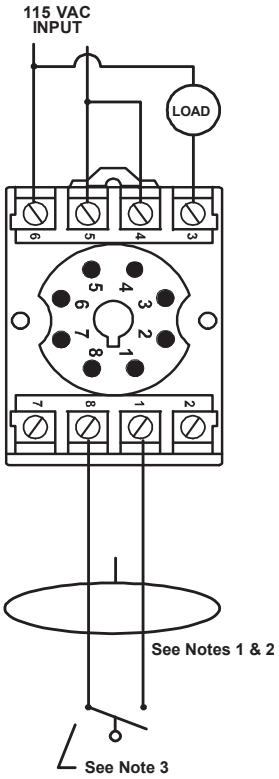
FEATURES	BENEFITS
Compact design for DIN rail or surface mount via octal base	Allows flexibility in panel installation
LED status indicator	Visual indication of relay engagement
Isolated output relay	Allows connection to PLC or control voltage
Standard 8-pin socket	Pop-in replacement for other manufacturers' parts

Accessories (included)

OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Wiring Diagram

CONTROL DRAWING ISS-101



NOTES:
1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically safe wiring shall be separated from intrinsically safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.

See Install Bulletin for full instructions and Hazardous Location information.

Specifications

Input Characteristics	
Supply Voltage	90-120VAC
Functional Characteristics	
Probe Sense Voltage	5VDC continuous
Output Characteristics	
Output Contact Rating	
Pilot Duty	180VA @120VAC, C300
General Purpose	8A @120VAC
Relay Contact Life (Electrical)	100,000 cycles min. @ rated load
Relay Contact Life (Mechanical)	10,000,000 cycles
General Characteristics	
Temperature Range	-20° to 55°C (-4° to 131°F)
Maximum Input Power	1.5 W
Wire range	12 to 20 AWG
Terminal Torque	3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)
Provides Intrinsically-Safe Circuits in the following locations:	Division 1 and 2 Class I, Groups A,B,C,D; Class II, Groups E,F,G; and Class III
Entity Parameters	V_{OC} = 16.8V Po=$\frac{Voc*Isc}{4}$ I_{SC} = 1.2mA L_a = 100mH C_a= 0.39uF

For dimensional drawing see: Appendix, page 509, Figure 8.

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ISS-101

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI)	IEC 61000-4-3, Level 3, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 4kV input power
Safety Mark	
UL	UL913 Sixth Edition (File #E233355)
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.375"); **D** 104.78 mm (4.125")
Weight	0.5 lb. (8 oz., 226.8 g)
Mounting Method	DIN rail or surface mount (plug into OT08PC socket)

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ISS-102 SERIES

Two-Channel Intrinsically Safe Switch

Description

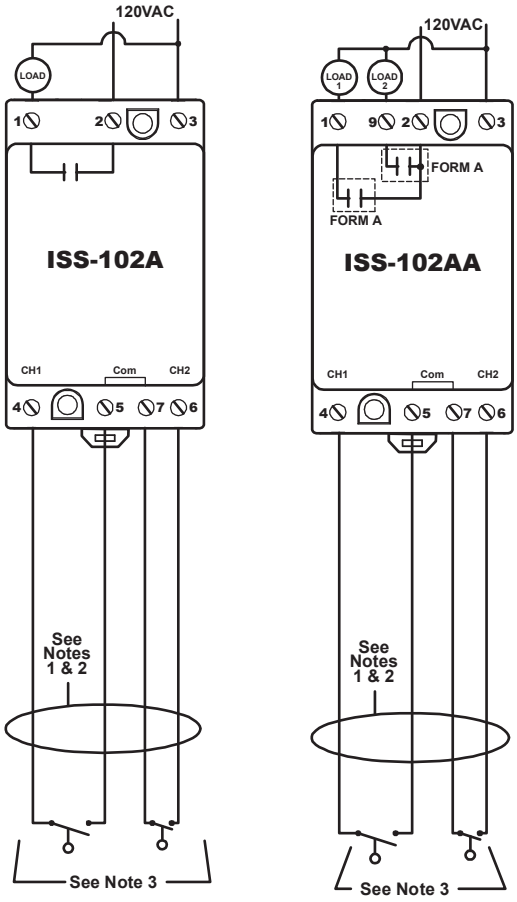
The ISS-102 is a two-channel, intrinsically-safe switch designed for multiple uses including a pump-up/pump-down (latching) controller or two-channel switch. LEDs indicate the state of the intrinsically-safe inputs and output relays and user-selectable options are available including a variable resistance threshold for float inputs. The ISS-102 enclosure is surface or DIN rail mountable.

-LC Each input channel is active when the corresponding switch is closed. When the lag input (CH2) is activated, the output closes. Applying latching logic, the output contact remains closed until the lead (CH1) and the lag (CH2) inputs are deactivated. Sensitivity is fixed at 100kOhms with a debounce time delay of 2 seconds.

-DCS This dual-channel switch has two Form A output relays. Two LEDs illuminate the output state of their respective Form A relay. Resistance probes or switches can be used on its inputs. Sensitivity is fixed at 100kOhms with a debounce time delay of 0.5 seconds.

-MC By selecting the proper functionality through the DIP switches, you can define a pump-up or pump-down, single or dual channel non-latching switch. The sensitivity adjustment (4.7k-100kOhms) allows you to define the input impedance at which the output relays (one Form A & one Form C) will change state, with a debounce time delay of 0.5 or 2 seconds.

Wiring Diagrams



For more wiring diagrams and notes, see next page.

For dimensional drawing see: Appendix, page 510, Figure 10.

Features & Benefits

FEATURES	BENEFITS
Finger-safe terminals	Meets IEC 61000 safety requirements
Compact design for DIN rail or surface mount	Allows flexiblility in panel installation
LED status indicator	Visual indication of relay engagement
Two input channels	Flexibility for pump up/pump down latching controller or two-channel switch applications

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
ISS-102A-LC	120VAC	Latching Controller
ISS-102AA-DCS	120VAC	Dual Channel Switch
ISS-102ACI-MC	120VAC	Multi-function Controller
ISS-102C-M-LC	120VAC	MSHA* evaluated
ISS-102CCI-M-MC	120VAC	MSHA* evaluated

* Mine Safety and Health Administration

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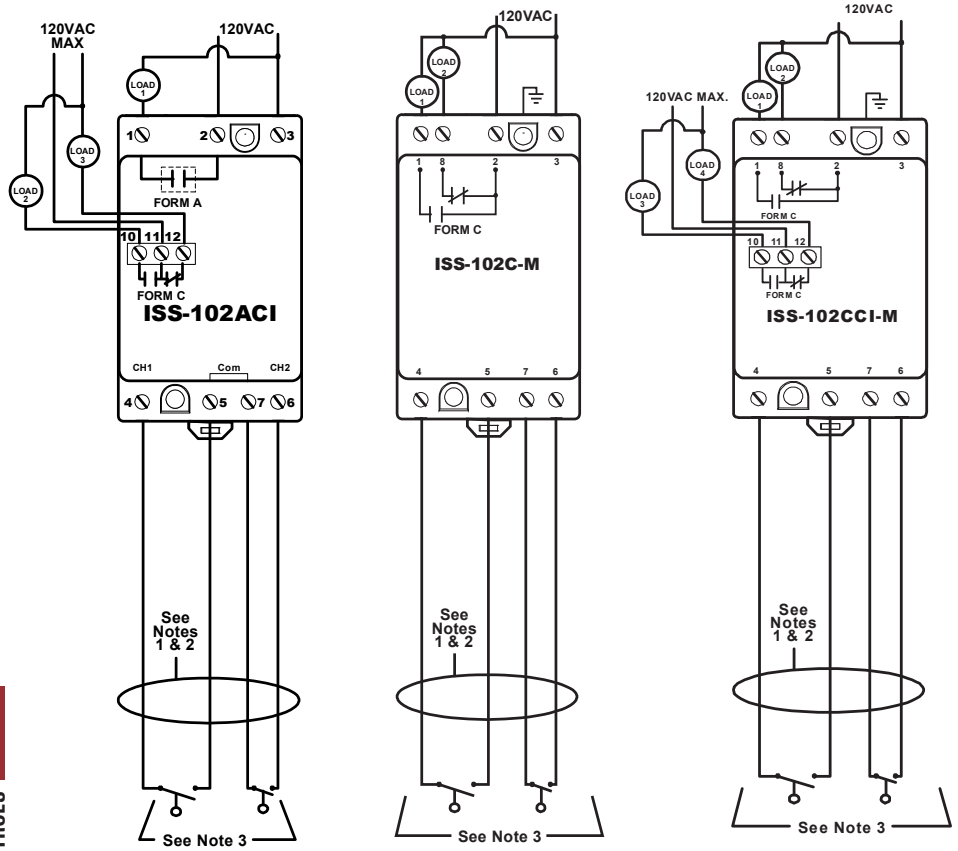
ISS-102 SERIES

Wiring Diagrams (continued)



NOTES:

1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically-safe wiring shall be separated from intrinsically-safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically-Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.

Specifications

Functional Characteristics

Debounce Time	0.5 or 2 seconds
Probe Sense Voltage	5vdc pulsed

Output Characteristics

Output Contact Rating	
Pilot Duty	180VA @120VAC, C150
General Purpose	5A @120VAC
Relay Contact Life (Electrical)	100,000 cycles min. @ rated load
Relay Contact Life (Mechanical)	10,000,000 cycles
Output Relay Type	
ISS-102A-LC	One Form A
ISS-102AA-DCS	Two Form A
ISS-102ACI-MC	One Form A & One isolated Form C
ISS-102C-M-LC	One Form C
ISS-102CCI-M-MC	Two Form C (one isolated)

General Characteristics

Temperature Range	-20° to 55°C (-4° to 131°F)
Maximum Input Power	2 W
Wire Range	12 to 20 AWG
Terminal Torque	3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)

Provides Intrinsically-Safe Circuits in the following locations:

Division 1 and 2
Class I, Groups A,B,C,D;
Class II, Groups E,F,G;
Class III

Entity Parameters

V_{oc} = 16.8V
I_{sc} = 1.2mA
L_a = 100mH
C_a = 0.39uF

$Po = \frac{Voc * Isc}{4}$

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
Radio Frequency Immunity (RFI)	IEC 61000-4-3, Level 3, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 4kV input power

Safety Mark

UL	UL913 Sixth Edition (File #E233355) (except Models ISS-102C-M-LC & ISS-102CCI-M-MC which have been evaluated by MSHA)
Dimensions	**H** 88.9 mm (3.5"); **W** 52.93 mm (2.08"); **D** 59.69 mm (2.35")
Weight	0.7 lb. (11.2 oz., 317.51 g)
Mounting Method	35mm DIN rail or Surface Mount (#6 or #8 screws)

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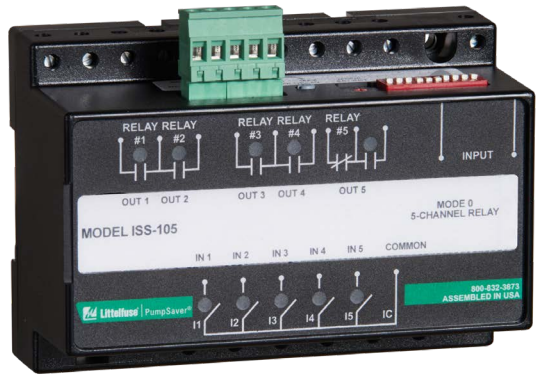
ISS-105 SERIES

Five-Channel Intrinsically Safe Switch



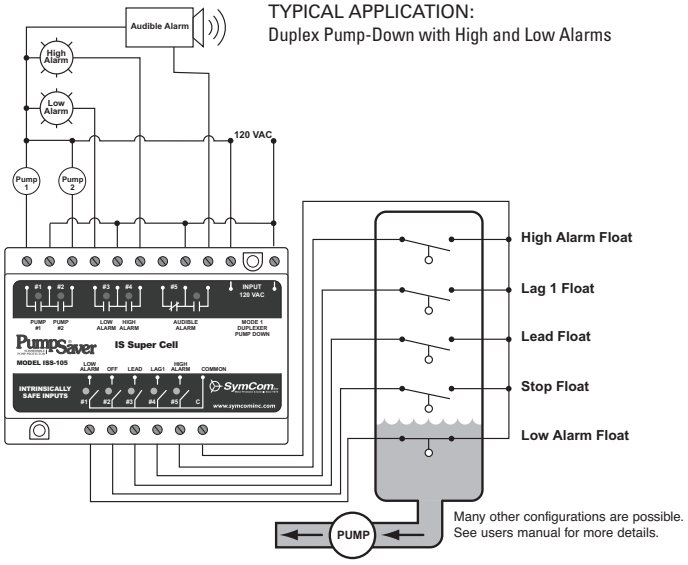
Description

The ISS-105 is a "smart" five-channel intrinsically safe relay and pump controller. The ISS-105 can be configured for pump-up or pump-down applications or as a five-channel relay covering a wide variety of applications.

The ISS-105 has a long list of features that are needed for multiple pump applications and can indicate low, high and out-of-sequence alarms. If an out-of-sequence alarm occurs, the skipped pump(s) will be started as intended.

The Model ISS-105 can be set-up to do non-alternating control, alternating control and alternating control with one non-alternating pump. The non-alternating pump is intended for use with an emergency or jockey pump. The ISS-105 can start an emergency pump once every 50 cycles to keep it working freely. Using the built-in DIP switches, individual pumps can be disabled when taken out of service for repair or maintenance.

Wiring Diagram



For dimensional drawing see: Appendix, page 511, Figure 12.

Features & Benefits

- 5 intrinsically-safe input channels meeting UL913 Sixth Edition
- 4 normally open output relays and 1 SPDT output relay
- Field selectable pump control options
- Monitors float sequencing and sends signal to alarm if out-of-sequence condition occurs
- High and/or low alarm options depending on the number of pumps and settings
- Output contacts for audible alarm
- Meets IEC EMC standards for Electrical Fast Transients (EFT), Electrostatic Discharge (ESD) and Radio Frequency Immunity (RFI)
- DIN rail or surface mountable allows flexibility in panel installation
- User-selectable alternator/non-alternator option
- Non-alternating pump option for emergency or jockey applications
- Pump disable switches make it easy to disable individual pumps when they are out for service or repair
- Adjustable lag pump delay for all pumping modes
- Adjustable delay-on-make/break timer in five-channel relay mode
- Finger-safe terminals meet IEC 61000 safety requirements

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
ISS-105	120VAC	Intrinsically-Safe & Pump Controller
ISS-105-ISO	120VAC	Intrinsically-Safe Only
ISS-105-ISO-3	120VAC	3-Channel Intrinsically-Safe Only
ISS-105-ISO-4	120VAC	4-Channel Intrinsically-Safe Only
ISS-105-ISO-F	120VAC	ISO with Fast Trip Relays

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ISS-105

Specifications

Input Characteristics

Supply Voltage	120VAC
Frequency	50*/60Hz

Functional Characteristics

Probe Sense Voltage	5vdc continuous

Output Characteristics

Relay Output Rating	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	7A @ 240VAC
Relay Contact Life (Electrical)	100,000 cycles min. @ rated load
Relay Contact Life (Mechanical)	10,000,000 cycles

General Characteristics

Temperature Range	-40° to 55°C (-40° to 131°F)
Maximum Input Power	5 W
Wire range	12 to 20 AWG
Recommended Terminal Torque	3.5 to 4.5 in.-lbs. (max. 4.5 in.-lbs.)
Provides Intrinsically-Safe Circuits in the following locations:	Division 1 and 2 Class I, Groups A,B,C,D; Class II, Groups E,F,G; and Class III
Entity Parameters	V_{oc} = 16.8V I_{sc} = 1.2mA L_a = 100mH C_a = 0.39uF

$$Po = \frac{Voc * Isc}{4}$$

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air.
Radio Frequency Immunity (RFI)	IEC 61000-4-3, Level 3, 10V/m
Fast Transients	IEC 61000-4-4, Level 3, 4kV input power 2kV inputs/outputs

Safety Marks

UL	UL913 Sixth Edition (File #E233355)
Dimensions	**H** 94.06 mm (3.703"); **W** 127.64 mm (5.025"); **D** 59.69 mm (2.350")
Weight	1.2 lbs. (19.2 oz., 544.31 g)
Mounting Method	35 mm DIN rail or Surface Mount (#6 or #8 screws)

*Note: 50Hz will increase all delay timers by 20%.

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AC SYSTEM MONITORS/LOAD SENSORS

Current monitors provide protection against both supply line and load side faults when the motor is running. They protect against single-phasing and current unbalance problems that can be caused by voltage supply problems, bad contactors, loose wiring, bad wires, or damaged motors. They also provide very reliable overload and underload protection.

Littelfuse voltage monitors are microcontroller based and factory calibrated for highly accurate and precise voltage measurements providing high sensitivity while minimizing nuisance tripping. This precise operation can detect a single-phase condition or voltage unbalance even with regenerated voltages present.

Current Monitoring Relays and Transducers

CP5 Series	Single-Phase Current Monitor	184
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Voltage Monitoring Relays

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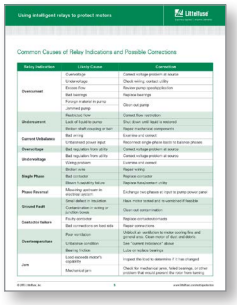

Using intelligent relays to protect motors

Common Causes of Relay Indications and Possible Corrections

For More Information…
on common faults and how to fix them, visit
Littelfuse.com/MotorProtection

CP5 SERIES

Single-Phase Current Monitor

Description

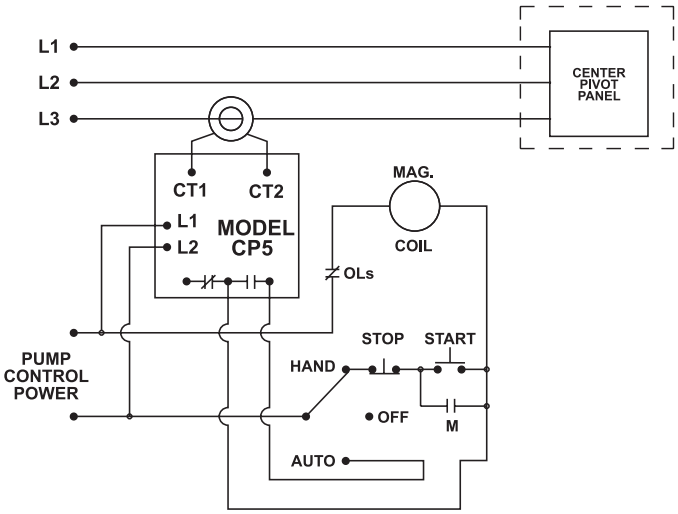
The CP5 Series are undercurrent monitors designed to monitor one leg of a 3-phase system. It is commonly used as a tower monitor on center pivot irrigation systems to detect stalled or jammed towers to prevent over watering.

The CP5 Series has both an adjustable trip level and an adjustable trip delay timer. When the current is sensed, the CP5 Series activates its output relay, thus starting the motor/pump. When the current in the monitored power line falls below the user-selectable trip point, the unit goes through a trip delay timer and then deactivates the output relay if the monitored current does not recover first.

Features & Benefits

FEATURES	BENEFITS
Adjustable trip level (0-5A)	Provides ability to precisely set the current trip point for any application
Adjustable trip delay (0-10m)	Prevents nuisance tripping due to power line fluctuations
600V rated relay contacts available on CP5-460 model	Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit

Wiring Diagram



For dimensional drawing see: Appendix page 509, Figure 6.

Specifications

Input Characteristics

Nominal Input Voltage	
CP5115	115VAC
CP5460	460VAC
Frequency	50*/60Hz

Functional Characteristics

Operating Points	
Trip Level	0-5 Amps
Trip Delay	0-10 minutes
Restart	1 second

Output Characteristics

Output Contact Rating (SPDT)	
Pilot Duty	
CP5115	480VA @ 240VAC
CP5460	470VA @ 600VAC

General Characteristics

Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG
Safety Marks	
UL	UL508 (File #E68520)
Dimensions	**H** 74.4 mm (2.93"); **W** 133.9 mm (5.27"); **D** 74.9 mm (2.95")
Weight	1 lb. (16 oz., 453.59 g)
Mounting Method	#8 screws

*Note: 50Hz will increase all delay timers by 20%

Ordering Information

MODEL	LINE VOLTAGE
CP5115	115VAC
CP5460	460VAC

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LSR-0

Self-Powered Load Sensor/Low-Cost Proof Relay

Description

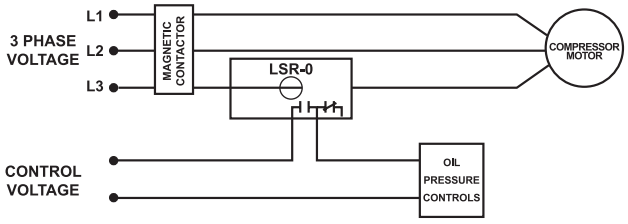
The LSR-0 is a self-powered load sensor intended for use as a proof relay. It is used to verify that current is flowing as intended. It has a guaranteed 15A pull-in current and 2.5A drop-out current. Proof relays are typically used to interlock fans, compressors, motors, heating elements and other devices. The LSR-0 is self-powered, that is, it draws its power from the wire being monitored so it does not require separate control power wiring.

Features

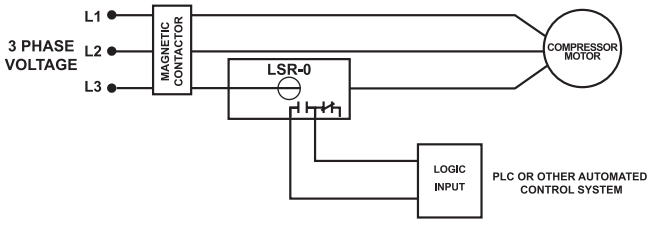
- Self-powered
- Low cost proof relay
- Can monitor up to 135A loads

Wiring Diagram

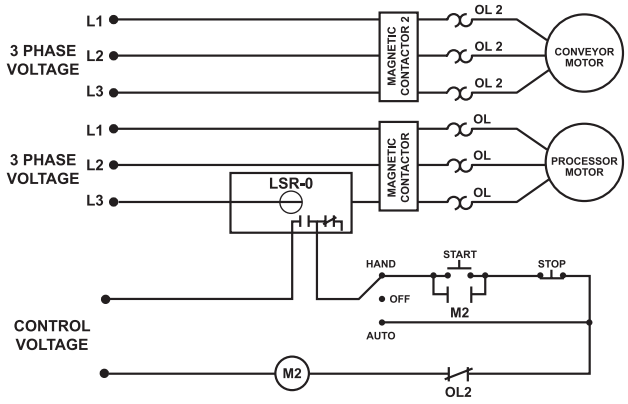
TYPICAL WIRING DIAGRAM FOR REFRIGERATION AND OIL FAILURE CONTROL



TYPICAL WIRING DIAGRAM FOR BUILDING AUTOMATION



TYPICAL WIRING DIAGRAM FOR BUILDING AUTOMATION



For dimensional drawing see: Appendix, page 511, Figure 14.

Specifications

Max Current Ratings	135A continuous
Functional Characteristics	
Turn-on Threshold	Fixed, 15A (max.)*
Turn-off Threshold	2.5A (min.)
Power	Induced from conductor
Isolation	600VAC rms
Output Characteristics	
Relay Output Rating:	
Pilot Duty	480VA @ 240VAC
General Purpose	10A
General Characteristics	
Temperature Range	-20° to 70°C (-4° to 158°F)
Wire Size	#12-24AWG
Hole Size	0.725" diameter
Terminal Torque	7 in.-lbs.
Safety Marks	
CSA, CSA-NRTL/C	(File #46510)
CE	
Dimensions	**H** 42.42 mm (1.67"); **W** 58.42 mm (2.3"); **D** 90.43 mm (3.56")
Weight	0.35 lb. (5.6 oz., 158.76 g)
Mounting Method	Four #6 screws 3/4" in length

*Conductors may be looped for smaller motor applications.

Caution: This product should not be relied upon solely for safety of life or safety applications.

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LSR-XXX SERIES

Load Sensor

Description

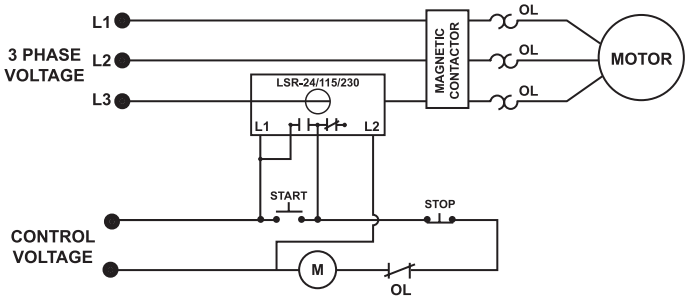
The LSR-xxx Series load sensors use current levels to determine feed rates, tool wear, loss of prime on pumps, mixer viscosity and all types of overload and underload conditions. They may also be used to stage pump motors, chillers and other machinery. These devices combine a current transformer (CT) with Form C (SPDT) relay contacts to switch alarm circuits, contactors or any resistive or inductive load. One simple screwdriver adjustment will calibrate the sensor for all single-phase or 3-phase applications up to 100hp.

Features

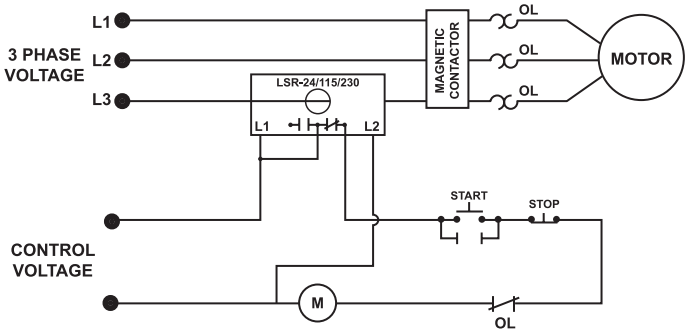
- Can monitor current of motors up to 100Hp
- Fine adjustment with 20-turn pot
- Status LEDs

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR LOAD LOSS DETECTION



TYPICAL WIRING DIAGRAM FOR OVERLOAD DETECTION



For dimensional drawing see: Appendix, page 511, Figure 14.

Specifications

Functional Characteristics

Isolation	600VAC rms
Current Adjustment Range (Typical)	2-100A
Current Adjustment Range (Min-Max)	0.5-135A
Trip Setpoint	Adjustable to ±1% range

Input Characteristics

Control Power:	
LSR-24	24VAC
LSR-115	115VAC
LSR-230	230VAC
Max Current Ratings	135A max. continuous

Output Characteristics

Output Contact Rating (SPDT):	
Pilot Duty	480VA @ 240VAC
General Purpose	10A

General Characteristics

Temperature Range	-20° to 70°C (-4° to 158°F)
Wire Size	#12-24AWG
Hole Size	0.725" diameter
Terminal Torque	7 in.-lbs.
Safety Marks	
CSA, CSA-NRTL/C	(File #46510)
CE	IEC 60947
Dimensions	**H** 42.42 mm (1.67"); **W** 58.42 mm (2.3"); **D** 90.43 mm (3.56")
Weight	0.4 lb. (6.4 oz., 181.44 g)
Mounting Method	Four #6 screws 3/4" in length

Caution: This product should not be relied upon solely for safety of life or safety applications.

Ordering Information

MODEL	LINE VOTAGE
LSR-24	24VAC
LSR-115	115VAC
LSR-230	230VAC

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LSRU SERIES

Load Sensor

Description

The LSRU Series is a microcontroller-based family of load sensors. The LSRU family of products employ three basic types of control logic: motor control logic, alarm logic and feed control logic.

Motor Control Logic

Several combinations of functions are available in the LSRU, including overcurrent and undercurrent or either overcurrent or undercurrent with variable trip, restart or extended restart delay settings. These various versions of the LSRU trip on the respective fault and then automatically reset after the restart delay expires, in preparation for the next motor start. LSRUs do not trip on undercurrent when the load turns off, this is recognized as a normal condition.

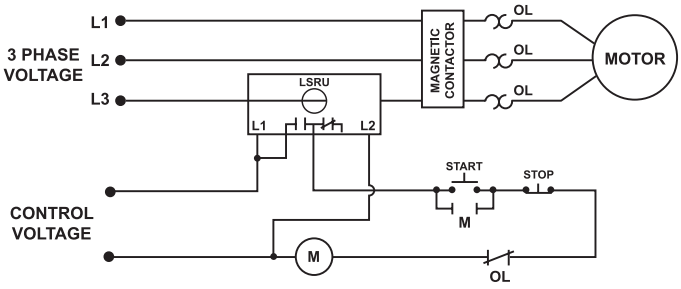
Alarm Logic

The LSRU-AL simply indicates whether the current is between the setpoints or outside of the setpoints. This product is best used with a PLC or other controller where status indication is desired.

Feed Control

The LSRU-FC is a load monitor intended to control feeder mechanisms in a variety of applications. It stops the feeder when the grinder, chipper, saw, auger, etc. nears overload. When the load is reduced to a preset level, the feeder is restarted.

Wiring Diagram



For dimensional drawing see: Appendix, page 511, Figure 14.

Features & Benefits

FEATURES	BENEFITS
LED indicator	Visual indication of relay status
Built in current sensor	Eliminates the need for a stand alone current transformer and also provides isolation between the monitored and control circuits
Adjustable current sensing range	Provides ability to precisely set the current trip point for any application

Ordering Information

See next page.

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LSRU SERIES

Ordering Information

MODEL	LINE VOTAGE	CURRENT RANGE	DESCRIPTION
LSRU-024-AL-2	24VAC	5-25A	Alarm logic
LSRU-024-AL-3	24VAC	25-100A	Alarm logic
LSRU-115-AL-1.5	115VAC	0-10A	Alarm logic
LSRU-115-AL-2	115VAC	5-25A	Alarm logic
LSRU-115-AL-3	115VAC	25-100A	Alarm logic
LSRU-115-FC-1.5	115VAC	0-10A	Feed control logic
LSRU-115-OT-1.5	115VAC	0-10A	Motor control logic with overcurrent trip, adj trip delay (0.5-60s)
LSRU-115-OT-2	115VAC	5-25A	Motor control logic with overcurrent trip, adj trip delay (0.5-60s)
LSRU-115-OT-3	115VAC	25-100A	Motor control logic with overcurrent trip, adj trip delay (0.5-60s)
LSRU-115-OR-1.5	115VAC	0-10A	Motor control logic with overcurrent trip, adj restart delay (0.5-300s, manual)
LSRU-115-OR-2	115VAC	5-25A	Motor control logic with overcurrent trip, adj restart delay (0.5-300s, manual)
LSRU-115-UE-2	115VAC	5-25A	Motor control logic with undercurrent trip, adj ext restart delay (2-300m, manual)
LSRU-115-UT-2	115VAC	5-25A	Motor control logic with undercurrent trip, adj trip delay (0.5-60s)
LSRU-115-UT-3	115VAC	25-100A	Motor control logic with undercurrent trip, adj trip delay (0.5-60s)
LSRU-115-UR-2	115VAC	5-25A	Motor control logic with undercurrent trip, adj restart delay (0.5-300s, manual)
LSRU-115-OU-1.5	115VAC	0-10A	Motor control logic with overcurrent and undercurrent trip
LSRU-115-OU-2	115VAC	5-25A	Motor control logic with overcurrent and undercurrent trip
LSRU-115-OU-3	115VAC	25-100A	Motor control logic with overcurrent and undercurrent trip

PART # KEY

O = Overcurrent Trip
U = Undercurrent Trip
T = Adj. Trip Delay (0.5-60 seconds)
R = Adj. Restart Delay (0.5-300 seconds, Manual)
E = Adj. Extended Restart Delay (2-300 minutes, Manual)

1.5 = 0-10 Amps
2 = 5-25 Amps
3 = 25-100 Amps

Specifications

Functional Characteristics

Isolation	600VAC rms
Power	2 Watts
Motor Acceleration Time	2 seconds
When not selected as an option:	
Fixed Trip Delay	0.5 second
(-AL, -FC)	1 second
Fixed Restart Delay	1 second
(-AL only)	as soon as current is within limits
(-FC only)	0.5 second

Input Characteristics

Control Power	24VAC or 115VAC

Output Characteristics

Output Contact Rating (SPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics

Temperature Range	-40° to 70°C (-40° to 158°F)
Wire Size	#12-24AWG
Hole Size	0.725" diameter
Terminal Torque	7 in.-lbs.
Safety Marks	
CSA, CSA-NRTL/C	(File #46510)
CE	
Dimensions	**H** 42.42 mm (1.67"); **W** 58.42 mm (2.3"); **D** 90.43 mm (3.56")
Weight	0.5 lb. (8 oz., 226.8 g)
Mounting Method	Four #6 screws 3/4" in length

Caution: This product should not be relied upon solely for safety of life or safety applications.

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LSRX / LSRX-C SERIES

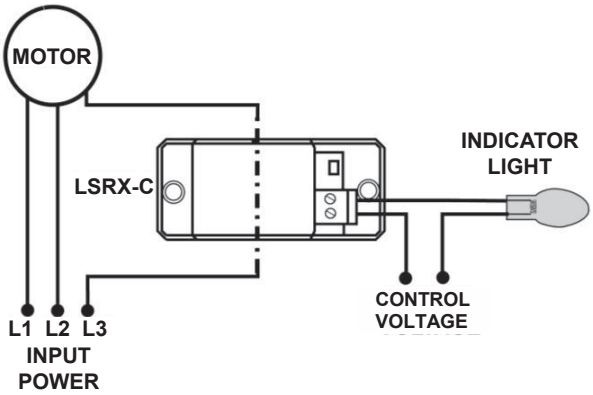
Self-Powered Load Sensor, Low-Cost Proof Relay

Description

The LSRX/LSRX-C Series are AC current sensors designed to energize the output contact whenever 4.5 Amps or greater is present. The LSRX/LSRX-C Series is used commonly as an AC current proof relay to indicate if a motor is operating. It can also be used to interlock fans, compressors and motors; to indicate equipment status such as feed rates, tool wear, loss of prime on pumps, mixer viscosity and all types of current sensing conditions or to stage pump motors, chillers, or other machinery.

This device combines a current transformer (CT), transducer and high current output relay together to switch alarm circuits, contactors and most resistive or inductive loads. The LSRX/LSRX-C Series can perform the function of an auxiliary contact, yet has the advantages of universal application and isolation.

Wiring Diagram



For dimensional drawing see: Appendix, page 511, Figure 13.

Features & Benefits

FEATURES	BENEFITS
Self-powered	Eliminates need for separate control voltage. Draws power from wire being monitored
Quick-connect terminals	Saves time at installation
LED indication	Visual indication of relay status
Built in current sensor will monitor up to 200A loads	Eliminates the need for a stand alone current transformer and also provides isolation between the monitored and control circuits

Accessories

Informer IR Kit-36 (36" infrared adapter cable)
Attaches to the face of the unit to provide remote diagnostics without opening the panel.

Specifications

Input Characteristics

Operating Current	5-200A Continuous
Minimum Pull-in Current	4.5A (typical), 7.0A (max)*
Power	Induced from AC conductor

Output Characteristics

Relay Output Rating (SPST - Form A)	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	5A @ 240VAC
Electrical Life	$1x10^5$
Mechanical Life	$1x10^7$
Maximum Conductor Diameter	0.7 in.
Output Terminals	
LSRX	0.25" quick-connect fast-ons
LSRX-C	depluggable screw terminals
Torque Rating	3.0 in.-lbs.

Ordering Information

MODEL	DESCRIPTION
LSRX	Fast-on terminal
LSRX-C	Depluggable screw terminals
LSRX-OEM	Fast-on terminals, 10 pack

LSRX / LSRX-C SERIES

General Characteristics

Temperature Range:	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Hole Size	0.72" diameter
Wire Size	12-26 AWG
Output Relay Status Indicator	LED
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 2, 4kV contact, 4kV air
Fast Transient Burst	IEC 61000-4-4, Level 3, 2kV power, 1kV input/output
Surge	
IEC	61000-4-5, Level 3, 2kV line-to-line; 2kV line-to-ground
Safety Marks	
UL	UL508 Recognized (File #E68520)
CE	IEC 60947
Dimensions	**H** 68.58 mm (2.7"); **W** 28.7 mm (1.13"); **D** 63.5 mm (2.5")
Weight	0.3 lb. (4.8 oz., 136.08 g)
Mounting Method	Surface Mount

*Conductors may be looped for smaller motor applications.

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ECS SERIES

Current Sensors

Description

The ECS Series of single-phase AC current sensors is a universal, overcurrent or undercurrent sensing control. Its built-in toroidal sensor eliminates the inconvenience of installing a stand-alone current transformer. Includes onboard adjustments for current sensing mode, trip point, and trip delay. Detects over or undercurrent events like locked rotor, loss of load, an open heater or lamp load, or proves an operation is taking place or has ended.

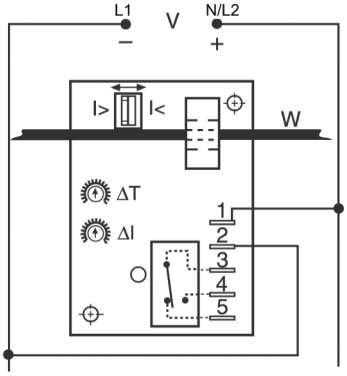
Operation

Input voltage must be supplied at all times for proper operation. When a fault is sensed throughout the trip delay, the output relay is energized. When the current returns to the normal run condition or zero, the output and the delay are reset. If a fault is sensed and then corrected before the trip delay is completed, the relay will not energize and the trip delay is reset to zero.

Adjustment

Select the desired function, over or under current sensing. Set the trip point and trip delay to approximate settings. Apply power to the ECS and the monitored load. Turn adjustment and watch the LED. LED will light; turn slightly in opposite direction until LED is off. Adjustment can be done while connected to the control circuitry if the trip delay is set at maximum. To increase sensitivity, multiple turns may be made through the ECS's toroidal sensor. The appropriate trip point range is determined by multiplying the amperage load by the number of turns/passes through the toroidal sensor. When using an external CT, select a 2VA, 0-5A output CT rated for the current to be monitored. Select ECS adjustment range 0. Pass one secondary wire lead through the ECS toroid and connect the secondary leads together.

Wiring Diagram



V = Voltage
I> = Overcurrent
I< = Undercurrent
W = Insulated Wire Carrying Monitored Current

Relay contacts are isolated. Arrow on the toroid points toward the load.

For dimensional drawing see: Appendix, page 513, Figure 34.

Features & Benefits

FEATURES	BENEFITS
Built-in toroidal current sensing	Eliminates need to install stand-alone current transformer and provides isolation from monitored circuit
Encapsulated	Protects against shock, vibration, and humidity
Adjustable mode, trip point and trip delay	Provides flexibility for use in many applications
10A, SPDT isolated relay output	Allows control of AC voltage loads

Ordering Information

See next page.

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect** These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

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ECS SERIES

Ordering Information

MODEL	SENSING	INPUT VOLTAGE	TRIP POINT ADJUSTABLE	TRIP DELAY	SENSING DELAY ON STARTUP
ECS20BC	Selectable, over or undercurrent	24VAC	0.5 - 5A	0.5 - 50s	1s
ECS21BC	Selectable, over or undercurrent	24VAC	2 - 20A	0.5 - 50s	1s
ECS2HBC	Selectable, over or undercurrent	24VAC	5 - 50A	0.5 - 50s	1s
ECS30AC	Selectable, over or undercurrent	24VDC	0.5 - 5A	0.150 - 7s	1s
ECS40A	Selectable, over or undercurrent	120VAC	0.5 - 5A	0.150 - 7s	0s
ECS40AC	Selectable, over or undercurrent	120VAC	0.5 - 5A	0.150 - 7s	1s
ECS40BC	Selectable, over or undercurrent	120VAC	0.5 - 5A	0.5 - 50s	1s
ECS41A	Selectable, over or undercurrent	120VAC	2 - 20A	0.150 - 7s	0s
ECS41AC	Selectable, over or undercurrent	120VAC	2 - 20A	0.150 - 7s	1s
ECS41BC	Selectable, over or undercurrent	120VAC	2 - 20A	0.5 - 50s	1s
ECS41BD	Selectable, over or undercurrent	120VAC	2 - 20A	0.5 - 50s	2s
ECS41BH	Selectable, over or undercurrent	120VAC	2 - 20A	0.5 - 50s	6s
ECS4HBC	Selectable, over or undercurrent	120VAC	5 - 50A	0.5 - 50s	1s
ECS4HBH	Selectable, over or undercurrent	120VAC	5 - 50A	0.5 - 50s	6s
ECS60AH	Selectable, over or undercurrent	230VAC	0.5 - 5A	0.150 - 7s	6s
ECS60BC	Selectable, over or undercurrent	230VAC	0.5 - 5A	0.5 - 50s	1s
ECS61BC	Selectable, over or undercurrent	230VAC	2 - 20A	0.5 - 50s	1s
ECS6HAH	Selectable, over or undercurrent	230VAC	5 - 50A	0.150 - 7s	6s
ECSH21F2.5C	Overcurrent	24VAC	2 - 20A	2.5s	1s
ECSH30AC	Overcurrent	24VDC	0.5 - 5A	0.150 - 7s	1s
ECSH31AD	Overcurrent	24VDC	2 - 20A	0.150 - 7s	2s
ECSH31F.08D	Overcurrent	24VDC	2 - 20A	0.08s	2s
ECSH3HF0.08D	Overcurrent	24VDC	5 - 50A	0.08s	2s
ECSH34F.08C	Overcurrent	24VDC	4A non-adjustable	0.08s	1s
ECSH40A	Overcurrent	120VAC	0.5 - 5A	0.150 - 7s	0s
ECSH40AC	Overcurrent	120VAC	0.5 - 5A	0.150 - 7s	1s
ECSH40AD	Overcurrent	120VAC	0.5 - 5A	0.150 - 7s	2s
ECSH41AC	Overcurrent	120VAC	2 - 20A	0.150 - 7s	1s
ECSH41AD	Overcurrent	120VAC	2 - 20A	0.150 - 7s	2s
ECSH41BC	Overcurrent	120VAC	2 - 20A	0.5 - 50s	1s
ECSH41F.08D	Overcurrent	120VAC	2 - 20A	0.08s	2s
ECSH4HAD	Overcurrent	120VAC	5 - 50A	0.150 - 7s	2s
ECSH4HF.08D	Overcurrent	120VAC	5 - 50A	0.08s	2s
ECSH61AD	Overcurrent	230VAC	2 - 20A	0.150 - 7s	2s
ECSL31A	Undercurrent	24VDC	2 - 20A	0.150 - 7s	0s
ECSL40AC	Undercurrent	120VAC	0.5 - 5A	0.150 - 7s	1s
ECSL40B	Undercurrent	120VAC	0.5 - 5A	0.5 - 50s	0s
ECSL40BH	Undercurrent	120VAC	0.5 - 5A	0.5 - 50s	6s
ECSL41A	Undercurrent	120VAC	2 - 20A	0.150 - 7s	0s
ECSL41AD	Undercurrent	120VAC	2 - 20A	0.150 - 7s	2s
ECSH4HAD	Overcurrent	120VAC	5 - 50A	0.150 - 7s	2s
ECSL41AH	Undercurrent	120VAC	2 - 20A	0.150 - 7s	6s
ECSL4HAC	Undercurrent	120VAC	5 - 50A	0.150 - 7s	1s
ECSL4HBH	Undercurrent	120VAC	5 - 50A	0.5 - 50s	6s
ECSL61AH	Undercurrent	230VAC	2 - 20A	0.150 - 7s	6s
ECSL6HAC	Undercurrent	230VAC	5 - 50A	0.150 - 7s	1s

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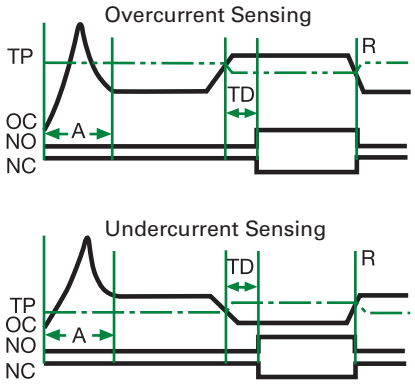
ECS SERIES

Specifications

Sensor	
Type	Toroidal through hole wiring
Mode	Over or undercurrent, switch selectable on the unit or factory fixed
Trip Point Range	0.5 - 50A in 3 adjustable ranges or fixed
Tolerance	
Adjustable	Guaranteed range
Fixed	0.5 - 25A: 0.5A or ±5% whichever is less; 26 - 50A: ±2.5%
Maximum Allowable Current	Steady – 50A turns; Inrush – 300A turns for 10s
Trip Point Hysteresis	≅ ±5%
Trip Point vs. Temperature	±5%
Response Time	≤ 75ms
Frequency	45/500 Hz
Type of Detection	Peak detection
Trip Delay	
Type	Analog
Range	
Adjustable	0.150 - 7s; 0.5 - 50s (guaranteed ranges)
Factory Fixed	+/- 10%
Delay vs. Temperature	±15%
Sensing Delay on Startup	Factory fixed 0 - 6s: +40%, -0%
Input	
Voltage	24 , 120, or 230VAC; 12 or 24VDC
Tolerance	
12VDC & 24VDC/AC	-15 - 20%
120 & 230VAC	-20 - 10%
AC Line Frequency	50/60 Hz
Output	
Type	Electromechanical relay
Form	Isolated, SPDT
Rating	10A resistive @ 240VAC; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Life	Mechanical – 1 x 10^6 ; Electrical – 1 x 10^5
Protection	
Circuitry	Encapsulated
Isolation Voltage	≥ 2500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with two #6 (M3.5 x 0.6) screws
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 44.5 mm (1.75")
Termination	0.25 in. (6.35 mm) male quick connect terminals (5)
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 6.4 oz (181 g)

Function Diagrams



NO = Normally Open Contact
NC = Normally Closed Contact
A = Sensing Delay On Start Up
TD = Trip Delay
TP = Trip Point
R = Reset
OC = Monitored Current

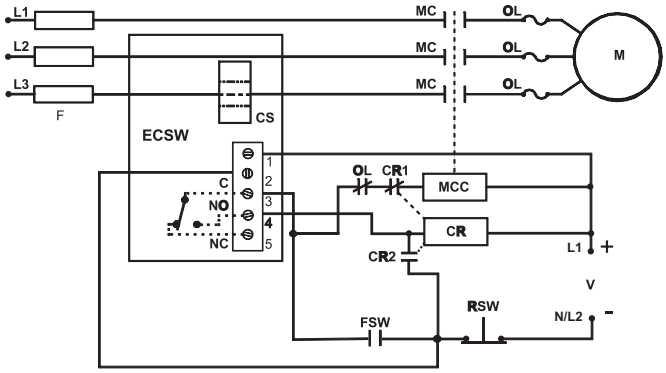
ECSW SERIES

Current Sensors

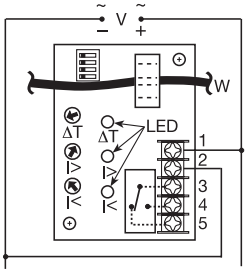
Description

The ECSW Series of single-phase, AC window, current sensors includes adjustable overcurrent and undercurrent trip points. Detects locked rotor, jam, loss of load, an open heater or lamp load, a broken belt, or loss of suction. LED's aid in trip point adjustment and provide fault indication. The built-in toroidal sensor eliminates the need for an external current transformer. The output can be electrically latched after a fault, or automatically reset. Remote resetting of a latched output by removing input voltage. The unit includes switch selectable zero current detection and normally de-energized or energized output operation. Time delays are included to improve operation and eliminate nuisance tripping.

Wiring Diagram



MC = Motor Contactor
M = Motor
F = Fuses
OL = Overload
RSW = Reset Switch
FSW = Fan or Float Contacts
CR = Control Relay
CS = Current Sensor
MCC = Motor Contactor Coil



V = Voltage
I> = Adjustable Overcurrent
I< = Adjustable Undercurrent
W = Monitored Wire
ΔT - Adjustable Trip Delay

For dimensional drawing see: Appendix, page 513, Figure 34.

Features & Benefits

FEATURES	BENEFITS
Built-in toroidal current sensing	Eliminates need to install stand alone current transformer and provides isolation from monitored circuit
Encapsulated	Protects against shock, vibration, and humidity
LED indication	Visual indication for trip point adjustment and fault indication
Multiple switch selectable features	User selectable zero current detection, latched, normally de-energized, or energized output adds application flexibility
Adjustable trip delay	Eliminates nuisance tripping and prevents rapid cycling
Isolated 10A, SPDT output contacts	Allows control of loads for AC or DC voltages

Operation

When the input voltage is applied, sensing delay on startup begins and the output transfers (if normally energized is selected). Upon completion of the startup delay, sensing of the monitored current begins. As long as current is above undercurrent trip point and below the overcurrent trip point (inside the window), the output relay remains in its normal operating condition and both red LED's are OFF. The green LED glows when the output is energized. If current varies outside the window, the associated red LED glows, and the trip delay begins. If the current remains outside the window for the full

Ordering Information

MODEL	INPUT VOLTAGE	TRIP POINT ADJUST.	TRIP DELAY	SENSING DELAY ON STARTUP	CONNECT.
ECSW3LABT	24VDC	0.5 - 5A	0.150 - 7s	0.1s	Terminal blocks
ECSW4HBHT	120VAC	5 - 50A	0.5 - 50s	6s	Terminal blocks
ECSW4LADT	120VAC	0.5 - 5A	0.150 - 7s	2s	Terminal blocks
ECSW4LBHT	120VAC	0.5 - 5A	0.5 - 50s	6s	Terminal blocks
ECSW4MACT	120VAC	2 - 20A	0.150 - 7s	1s	Terminal blocks
ECSW4MBHT	120VAC	2 - 20A	0.5 - 50s	6s	Terminal blocks
ECSW4MBGT	120VAC	2 - 20A	0.5 - 50s	5s	Terminal blocks
ECSW6MBHT	230VAC	2 - 20A	0.5 - 50s	6s	Terminal blocks

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trip delay, the relay transfers to fault condition state. If the current returns to normal levels (inside the window) during the trip delay, the red LED goes OFF, the trip delay is reset, and the output remains in the normal condition.

Reset: Remove input voltage or open latch switch. If zero current detection is selected, the unit will reset as soon as zero current is detected.

Operation With Zero Current Detection Enabled: If the current decreases to zero within the trip delay period, then zero current is viewed as an acceptable current level. The unit's output remains in its normal operating state. This allows the monitored load to cycle ON and OFF without nuisance tripping the ECSW. Zero current is defined as current flow of less than 250 milliamp-turns.

Note: When zero current detect is selected, the latching operation of switch SW2 is canceled; the output will not latch after a fault trip.

Notes on Operation

1. There is no hysteresis on the trip points. The overcurrent and undercurrent trip points should be adjusted to provide adequate protection against short cycling.
2. If the upper setpoint is set below the lower setpoint, both red LED's will glow indicating a setting error.
3. If zero current detection is selected (SW2 ON), and the system is wired to disconnect the monitored load, the system may short cycle. After the unit trips, the load de-energizes, and zero current is detected. The ECSW resets, and the load energizes again immediately and may be short cycled.
4. The sensing delay on start up only occurs when input voltage is applied. When zero current detection is selected, the trip delay must be longer than the duration of the inrush current or the unit will trip on the inrush current.

Typical Pump or Fan Protection Circuit Operation

Window Current Sensing: With the ECSW connected as shown in the diagram, a load may be monitored and controlled for over and undercurrent. The ECSW Series' on board CT (CS) may be placed on the line or load side of the contactor. The ECSW selection switches are set for zero current sensing (see Selector Switch SW2) and the output selection is normally de-energized (see Selector Switch SW3). The input voltage (V) is applied to the ECSW continually. As the control switch (FSW) is closed, the input voltage (V) is applied to the motor contactor coil (MCC), and the motor (M) energizes. As long as the current remains below the overcurrent and above the undercurrent trip points, the ECSW's output contacts remain de-energized. If the load current should rise above or fall below a trip point, for the full trip delay, the normally open (NO) contact will close, energizing the control relay (CR) coil. The CR normally closed contact (CR1) opens and the MCC de-energizes and CR latches on through its normally open contacts (CR2). Reset is accomplished by momentarily opening the normally closed reset switch (RSW).

Note: If the current falls to zero within the trip delay, the ECSW remains de-energized. The sensing delay on startup occurs when input voltage is applied therefore trip delay must be longer than the duration of the motor's inrush current. The external latching relay CR2 is required in this system to prevent rapid cycling. A timer can be added to provide an automatic reset.

Selector Switch

ON ↔ OFF

	Not Used
SW1	Latched
SW2	Zero I
SW3	Output - Normally Energized

Mode Selection Switches

SW1 = Latched or Auto reset selector
OFF - Automatic reset after a fault
ON - Output relay latches after a fault trips the unit
SW2 = Zero current detection (below 250 mA)
OFF - Zero current detection disabled
ON - Zero current detection enabled
SW3 = Output during normal operation
OFF - Output relay de-energized
ON - Output relay energized

ECSW SERIES

Specifications

Sensor

Type	Toroid, through hole wiring for up to #4 AWG (21.1 mm^2) THHN wire
Mode	Over & undercurrent trip points (window current sensing)
Trip Point Range	0.5 - 50A in 3 adjustable ranges
Tolerance	Guaranteed range
Maximum Allowable Current	Steady - 50A turns; Inrush - 300A turns for 10s
Time Point vs Temp. & Voltage	±5%
Response Time	≤ 75ms
Frequency	45/500 Hz
Type of Detection	Peak detection
Zero Current Detection	< 250mA turns typical

Time Delay

Range	0.15 - 50s in 2 adjustable ranges or 0.1 - 50s fixed
Tolerance	Adjustable: guaranteed range; Fixed: ±10%
Sensing Delay On Start Up	Fixed ≅ 0.1 - 6s in 1s increments
Tolerance	+40% -0%
Delay vs. Temp. & Voltage	±15%

Input

Voltage	24, 120, or 230VAC; 12 or 24VDC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
120 & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz

Output

Type	Electromechanical relay
Mode: Switch Selectable	
ON	Energized during normal operation, de-energized after a fault
OFF	De-energized during normal operation, energizes during a fault
Form	Isolated, SPDT
Rating	10A resistive @ 240VAC; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Life	Mechanical - 1 x 10^6; Electrical - 1 x 10^5
Latch	
Type	Electrical
Reset	Remove input voltage
Function	Switch selectable latching function

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Isolation Voltage	≥ 2500V RMS input to output
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with two #6 (M3.5 x 0.6) screws
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 44.5 mm (1.75")
Termination	0.197 in. (5 mm) terminal blocks for up to #12 (3.2 mm^2) AWG wire

Environmental

Operating/Storage Temperature	-40° to 60° C/-40° to 85° C
Humidity	95% relative, non-condensing
Weight	≅ 6.4 oz (181 g)

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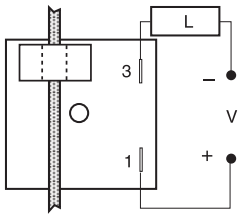
TCS SERIES

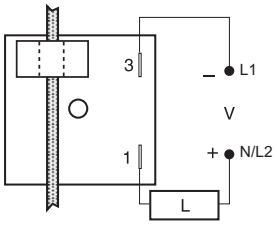
Current Sensor

Wiring Diagram

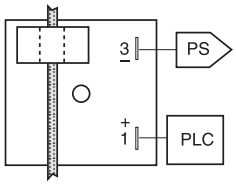
POSITIVE SWITCHING



NEGATIVE SWITCHING

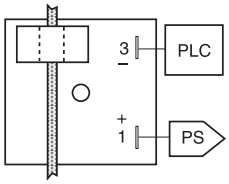


SINKING



L = Load
V = Voltage
PS = Power Supply
PLC = PLC Digital Input Module

SOURCING



Monitored AC conductor must be insulated.

For dimensional drawing see: Appendix, page 513, Figure 35.

Description

The TCS Series is a low cost method of go/no go current detection. It includes a solid-state output to sink or source current when connected directly to a standard PLC digital input module. Its normally open or normally closed output can also be used to control relays, lamps, valves, and small heaters rated up to 1A steady, 10A inrush. The TCS is self-powered (no external power required to operate the unit) and available with an adjustable actuation range of 2 - 20A or factory fixed actuation points from 2 - 45A.

Operation

Normally Open: When a current equal to or greater than the actuate current is passed through the toroidal sensor, the output closes. When the current is reduced to 95% of the actuate current or less, the output opens.

Normally Closed: When the current through the toroid is equal to or greater than the actuate current, the output opens. When the current is reduced below 95% of the actuate current, the output closes. To increase sensitivity, multiple turns may be made through the TCS's toroidal sensor. The trip point range is divided by the number of turns through the toroidal sensor to create a new range. When using an external CT, select a 2VA, 0-20A output CT rated for the current to be monitored. Select TCS adjustment range 0. Pass one secondary wire lead through the TCS' toroid and connect the secondary leads together.

Features & Benefits

FEATURES	BENEFITS
Self powered	No control voltage is required to operate the unit
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Can connect directly to PLC	Solid state output to sink or source current can be connected directly to a standard PLC digital input module
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions
Complete isolation between sensed current and control circuit	Allows you to monitor a load in a separate lectrical system

Ordering Information

MODEL	OUTPUT VOLTAGE	ACTUATE CURRENT	OUTPUT FORM		MODEL	OUTPUT VOLTAGE	ACTUATE CURRENT	OUTPUT FORM
TCSG2A	3 to 50VDC	Fixed, 2A	Normally open		TCSH2B	24 to 240VAC	Fixed, 2A	Normally closed
TCSGAA	3 to 50VDC	2-20A adjustable	Normally open		TCSH5B	24 to 240VAC	Fixed, 5A	Normally closed
TCSGAB	3 to 50VDC	2-20A adjustable	Normally closed		TCSHAA	24 to 240VAC	2-20A adjustable	Normally open
TCSH2A	24 to 240VAC	Fixed, 2A	Normally open		TCSHAB	24 to 240VAC	2-20A adjustable	Normally closed

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TCS SERIES

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

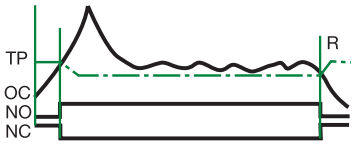
P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Function Diagram



TP = Trip Point
OC = Monitored Current
NO = Normally Open Output
NC = Normally Closed Output
R = Reset

Specifications

Sensor

Type	Toroid, through hole wiring, alternating current, monitored wire must be properly insulated
Current to Actuate	Adjustable: - 2 - 20A, guaranteed range Fixed: - 2 - 45A, +0/-20%
Reset Current	≅ 95% of the actuate current
Maximum Allowable Current	Steady - 50A turns Inrush - 300A turns for 10s
Actuate Current vs. Temp. & Voltage	≤ ±5%
Response Times	Overcurrent - ≤ 200ms Undercurrent - ≤ 1s
Burden	< 0.5VA

Output

Type	Solid state
Form	NO or NC
Rating	1A steady, 10A inrush
Voltage	AC - 24 to 240VAC +10/-20% DC - 3 to 50VDC
Voltage Drop	AC NO & NC - ≅ 2.5V DC NO & NC - ≅ 1.2V

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 44.5 mm (1.75")
Termination	0.25 in. (6.35 mm) male quick connect terminals (2)
Sensor Hole	0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm2) THHN wire

Environmental

Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

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TCSA SERIES

Current Transducers

Description

The TCSA Series is a loop-powered, linear output current transducer that provides an output that is directly proportional to the RMS AC current passing through the onboard toroid. The TCSA provides a 4 - 20mA output over a power supply range of 10 - 30VDC. Each unit is factory calibrated for monitoring in one of four ranges; 0-5, 0-10, 0-20, or 0-50A. The 0 - 5A range allows the use of external current transformers so loads up to 1200AC amps can be monitored.

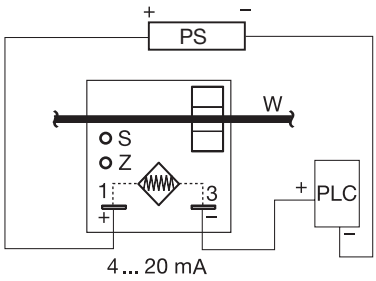
Operation

The TCSA varies the effective resistance of its output in direct proportion to the current flowing in the monitored conductor. The unit is factory calibrated so that 0 amps provides a 4mA output and full span provides a 20mA output. Zero and span adjustments are provided for minor calibration adjustments in the field (if required).

Using an External Current Transformer (CT)

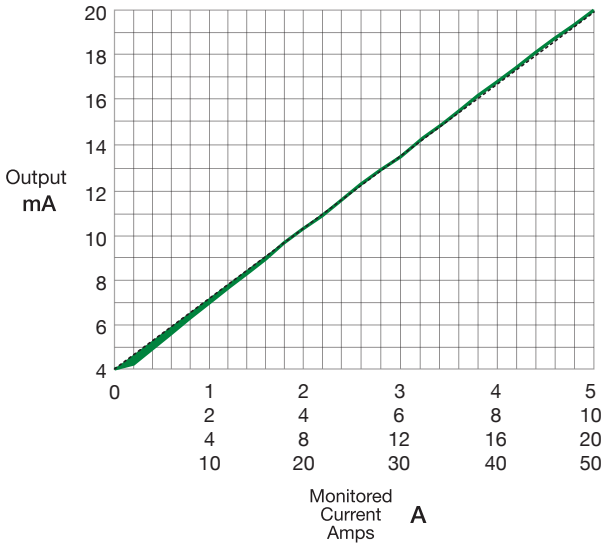
Select a 2VA, 0 to 5A output CT, rated for the current to be monitored. Select TCSA5. Pass one of the CT's secondary wire leads through the TCSA's toroid. Connect the CT's secondary leads together.

Wiring Diagram



PS = Power Supply
Z = Zero Adjust
S = Span Adjust
W = Insulated Wire Carrying Monitored Current
PLC = PLC Analog Input or Meter Input

For dimensional drawing see: Appendix, page 513, Figure 35.



Ordering Information

MODEL	CURRENT RANGE
TCSA5	0-5A
TCSA10	0-10A
TCSA20	0-20A
TCSA50	0-50A

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Features

- Monitors 0 - 50A in 4 ranges
- Loop powered from 10 to 30VDC
- Linear output from 4 - 20mA
- Zero & span adjustments
- Complete isolation between sensed current & control circuit

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TCSA SERIES

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Specifications

Sensor

Type	Toroid, through hole wiring, alternating current, monitored conductor must be properly insulated
Monitored AC Current Ranges	0 - 50A
4 Factory Calibrated Ranges	0 - 5A, 0 - 10A, 0 - 20A, or 0 - 50A
Factory Calibration	≤±2% of full scale
Maximum Allowable Current	Steady – 50A turns; Inrush – 300A turns for 10s
Repeat Accuracy	≤±0.25% of full scale under fixed conditions
Response Time	≅ 300ms
Burden	≤ 0.5VA
AC Line Frequency	
0 - 20A / 21 - 50A	20 - 100Hz / 30 - 100Hz
Temperature Coefficient	±0.05%/°C

Output

Type: Series Connection	Current directly proportional to monitored current
Range	4 - 20mA
Sensor Supply Voltage*	10 to 30VDC
Momentary Voltage	40VDC for 1m
Zero Adjust	≅ 3.75 - 4.25mA
Span Adjust	18mA - 22mA
Adjustment	Mini-screw, 25-turn potentiometer

Protection

Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	Units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 44.5 mm (1.75")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Sensor Hole	0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm^2) THHN wire

Environmental

Operating/Storage Temperature	-30° to 60°C/-40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

*Minimum loop-power supply voltage equals the minimum sensor voltage 10VDC plus the voltage drop developed across all the other loop devices at 20mA.

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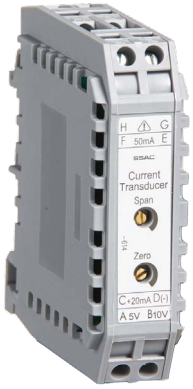
DCSA SERIES

Current Transducers



Description

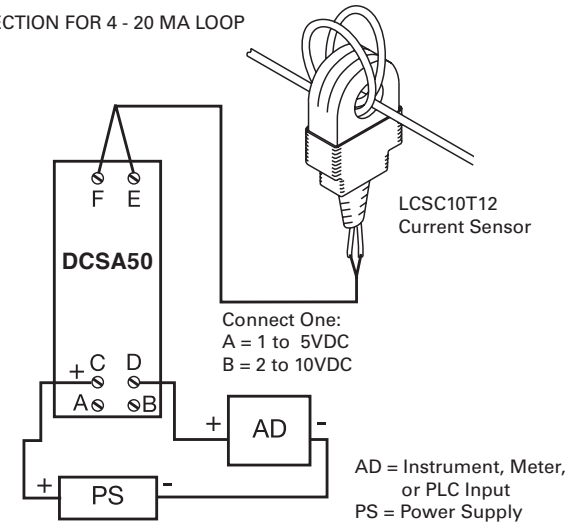
The DCSA Series is a loop-powered, linear output current transducer that provides an output that is directly proportional to the RMS AC current passing through the LCSC10T12 sensor. The DCSA Series provides either an analog current or voltage: 4-20 mA, 1 to 5VDC, or 2 to 10VDC. Each unit is factory calibrated for monitoring (with the LCSC10T12 connected) in one of four ranges; 0-5, 0-10, 0-20, or 0-50A. Zero and span adjustments allow field calibration if needed. The DCSA Series mounts on both DIN 1 and DIN 3 rails.

Operation

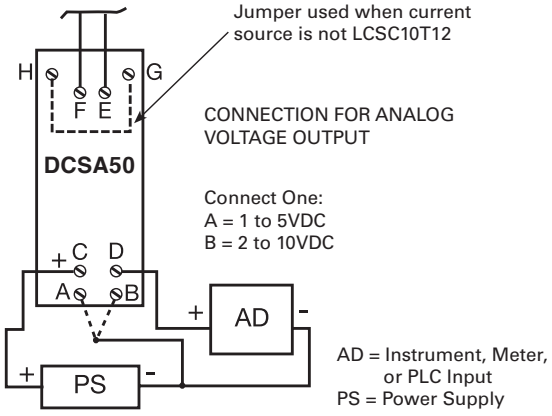
The DCSA Series varies the effective resistance of its output in direct proportion to the current flowing in the conductor monitored by the LCSC10T12. Connecting the power supply to terminals C & D provides a 4 to 20mA DC current. Connect the power supply to terminals C & A to get 1 to 5VDC at terminal D. Connect the power supply to terminals C & B to get 2 to 10VDC at terminal D.

Wiring Diagram

CONNECTION FOR 4 - 20 MA LOOP



To LCSC10T12 Current Sensor



For dimensional drawing see: Appendix, page 513, Figure 36.

Features

- Mounts on DIN 1 or DIN 3 rail
- 0-50A in 4 ranges using LCSC10T12 sensor
- Loop powered from 10 to 30VDC
- Linear output from 4-20mA, 1-10VDC
- Zero & span adjustments
- Separate sensor & control unit

Accessories

LCSC10T12 Toroidal Current Sensor
Remote monitoring of currents up to 50A.

Ordering Information

MODEL	CURRENT RANGE WITH LCSC10T12	INPUT RANGE (F TO E)
DCSA5	0-5A	0-5mA AC
DCSA20	0-20A	0-20mA AC
DCSA50	0-50A	0-50mA AC

If you don't find the part you need, call us for a custom product 800-843-8848

DCSA SERIES

Specifications

Input

Ranges (without LCSC10T12 connected)	
4 factory calibrated ranges in mA AC	0 - 5mA, 0 - 10mA, 0 - 20mA, or 0 - 50mA AC
Factory calibration	±0.5% of full scale
Repeat Accuracy	±0.25% of full scale under fixed conditions
Response Time	≅ 300ms
Temperature Coefficient	±0.05%/°C
Input to Output	Not isolated

Output

Type	
Analog	Current directly proportional to input current
Range	4 - 20mA, or 1 to 5VDC or 2 to 10VDC
Supply Voltage*	10 to 30VDC
Momentary Voltage	40VDC for 1m
Zero Adjust	≅ 3.75 - 4.25mA
Span Adjust	18mA - 22mA
Adjustment	Mini-screw, multi-turn potentiometer

Protection

Dielectric Breakdown	≥ 2500V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	Units are reverse polarity protected

Mechanical

Mounting	DIN 1 & DIN 3 rail mounting
Termination	
Wire clamp	For 22 - 14AWG (.336 mm^2 ... 2.5 mm^2)

Environmental

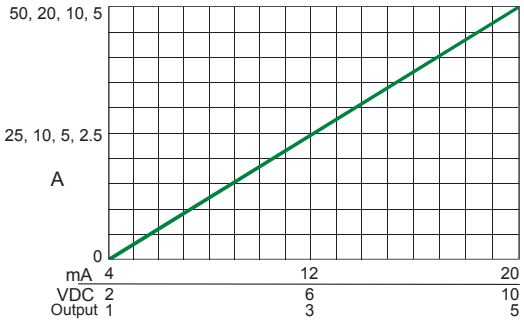
Operating/Storage Temperature	-30° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 1.6 oz (45.4 g)

Accessory - LCSC10T12 Toroidal Sensor

Number of Turns	1000
Nominal Output Current Full Range	0 - 50 mA
Maximum Allowable Current	Steady 50A turns; Inrush 300A turns for 10s
Burden	≤ 0.5 VA
Frequency 0 - 20A / 21 - 50A	20/100 Hz / 30/100 Hz
Sensor Hole	0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm^2) THHN wire
Weight	≅ 1 oz (28.3 g)

*Minimum loop-power supply voltage equals the minimum sensor voltage 10VDC plus the voltage drop developed across all the other loop devices at 20mA.

Monitored Current Amps Diagram



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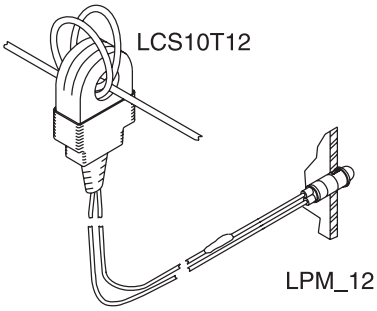
LCS10T12 / LPM SERIES

Current Indicators

Wiring Diagram



Wire Length: 500 ft. (152.4m) max. (Customer Supplied)

CAUTION: The LCS10T12 must be connected to the LPM12 or LPMG12 before current flows to prevent damage or shock hazard. Monitored wires must be properly insulated.

For dimensional drawing see: Appendix, page 513, Figure 37 and 38.

Ordering Information

MODEL	DESCRIPTION
LCS10T12	AC Current Sensor
LPM12	Red LED Indicator
LPMG12	Green LED Indicator

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Description

The LCS10T12 connected to the LPM12 or LPMG12 indicator is a low cost, easy to use, go/no-go indication system for the remote monitoring of current flow. The LCS10T12 is installed on an adequately insulated wire of the monitored load. Its 12in. (30.4cm) leads are connected to the LPM12 or LPMG12 panel mount indicator directly or via customer supplied wires up to 500 feet (152.4m) long.

Operation

When the monitored current is 5A turns, the panel mount LPM indicator will glow. The LCS10T12 is designed to maximize the light output of the panel mount indicator. It can be used to monitor current flow of less than 5A by passing the monitored conductor 2 or more times through the sensor.

CAUTION: The LCS10T12 must be connected to the LPM12 or LPMG12 before current flows to prevent damage or a shock hazard. Monitored wires must be properly insulated.

Panel mount indicator designed to match the output of the LCS10T12. The LPM12 and LPMG12 come with 12 in. (30.4 cm) wires and a one piece mounting clip. Both devices install quickly in a 0.25 in. (6.35 mm) hole in panels from 0.031 - 0.062 in. (0.79 - 1.6 mm) thick.

Features

- Low cost go/no go indication
- May be connected to wires up to 500 feet (152.4 m) long
- Remote monitoring of currents up to 50A
- Green or red LED indicator available

Specifications

Monitored Current

Current Range 2 - 50A AC

Wire Passes	Min. Current	Max. Current	Max. Inrush	Max. Wire Dia.
1	5A	50A	120A	0.355 in. (9.0 mm)
2	2.5A	25A	60A	0.187 in. (4.7 mm)
3	1.7A	16.6A	40A	0.15 in. (3.8 mm)
4	1.3A	12.5A	30A	0.125 in. (3.2 mm)
5	5/X	50/X	120/X	

Maximum Current 50A turns continuous
AC Line Frequency 50/60Hz
DC Resistance of Current Limiter 65 Ω

Mechanical

Sensor Hole 0.36 in. (9.14 mm) for up to #4 AWG (21.1 mm^2) THHN wire
Termination 12 in. (30.4 cm) wire leads

Environmental

Operating/Storage Temperature -40° to 60°C/-40° to 85°C
Weight LCS: ≅ 0.8 oz (23 g)
LPM: ≅ 0.2 oz (6 g)

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50R SERIES

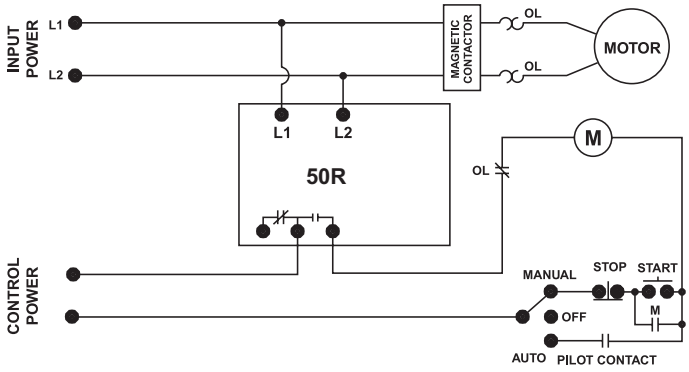
Single-Phase Voltage Monitor

Description

The 50R Series single-phase voltage monitor has a voltage-sensing circuit which constantly monitors the single-phase power for a low voltage condition. Single-phase motors on fans, compressors, air conditioners, heat pumps, well pumps, sump pumps and small conveyor motors are all applicable to the 50R Series.

When a harmful condition is detected, the MotorSaver's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Wiring Diagram



For dimensional drawing see: Appendix page 509, Figure 6.

Features & Benefits

FEATURES	BENEFITS
Proprietary voltage sensing circuitry	Constant monitoring of single-phase power for a low voltage condition
Adjustable trip delay (-3 models) and restart delay (-2 models) settings	Prevent nuisance tripping due to rapidly fluctuating power line conditions and allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition
High voltage detection (-9 models)	Trips and resets at a fixed percentage of the setpoint: trip 110%, reset 107%.
600V rated relay contacts available on some models	Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION
50R-100	95-120VAC	Fixed trip and restart delay
50R-100-2	95-120VAC	Fixed trip and variable restart delay (manual, 2-300s)
50R200	190-240VAC	Fixed trip and restart delay
50R2002	190-240VAC	Fixed trip and variable restart delay (manual, 2-300s)
50R2003	190-240VAC	Fixed restart and variable trip delay (2-30s)
50R20029	190-240VAC	Fixed trip and variable restart delay (manual, 2-300s) plus high voltage detection
50R400	380-480VAC	Fixed trip and restart delay
50R4002	380-480VAC	Fixed trip and variable restart delay (manual, 2-300s)
50R4003	380-480VAC	Fixed restart and variable trip delay (2-30s)
50R40029	380-480VAC	Fixed trip and variable restart delay (manual, 2-300s) plus high voltage detection

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50R SERIES

Specifications

Input Characteristics

Line Voltage	
50R-100	95-120VAC
50R200	190-240VAC
50R400	380-480VAC
Frequency	50*/60Hz

Functional Characteristics

Low Voltage:	
Trip (% of setpoint)	90%
Reset (% of setpoint)	93%
Delay Time (Nominal)	
Trip	4 seconds
Restart (low voltage)	2 seconds
Restart (complete power loss)	2 seconds

Output Characteristics

Output Contact Rating (SPDT - 1 Form C)	
50R-100, 50R200	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC
50R400	
Pilot Duty	470VA @ 600VAC

General Characteristics

Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	5 W
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls
Transient Protection (Internal)	IEC 61000-4-5; 1995 ±6kV
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947-6-2
Dimensions	**H** 74.4 mm (2.93"); **W** 133.9 mm (5.27"); **D** 74.9 mm (2.95")
Weight	0.98 lb. (15.68 oz., 444.52 g)
Mounting Method	#8 screws

Special Options

Opt. 2: Variable Restart Delay	Manual, 2-300 seconds
Opt. 3: Variable Trip Delay	2-30 seconds
Opt. 9: High Voltage Detection Operating Points	
Trip (% of Setpoint)	110%
Reset (% of Setpoint)	107%

*Note: 50Hz will increase all delay timers by 20%

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201-XXX-SP SERIES

Single-Phase Voltage/Phase Monitor

Description

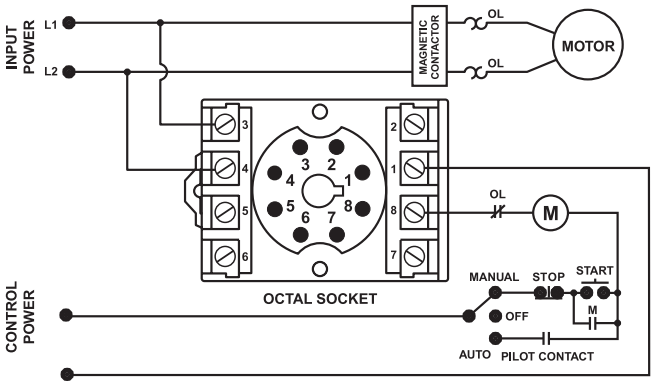
The 201-xxx-SP Series is an 8-pin octal-base, plug-in voltage monitor designed to protect single-phase motors regardless of size. The 201-100-SP is used on 95-120VAC, 50/60Hz motors to prevent damage caused by low voltage. The 201-200-SP is used on 190-240VAC, 50/60Hz motors. The 201-200-SP-T-9 is a pin-for-pin replacement for a Time Mark® #260 Series voltage monitor. High voltage protection is included in the 201-200-SP-T-9.

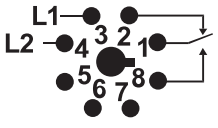
The unique microcontroller-based voltage and voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Must use Model OT08PC socket for UL Rating!

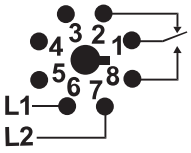
Note: Manufacturer's recommended screw terminal torque for the RB Series and OT Series Octal Sockets is 12 in.-lbs.

Wiring Diagram





PIN-OUT 1 (201-XXX-SP)
(view of socket)



PIN-OUT 2 (201-200-SP-T-9)
(view of socket)

For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage to detect harmful power line conditions, even before the motor starts
Fixed trip delay 4s	Prevents nuisance tripping due to rapidly fluctuating power line conditions
Advanced LED indication	Provides diagnostics which can be used for troubleshooting and to determine relay status
Compact design for 8-pin; DIN rail or surface mount	Allows flexibility in panel installation

Accessories

OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION
201-100-SP	95-120VAC	SPDT, protects single phase motors
201-200-SP	190-240VAC	SPDT, protects single phase motors
201-200-SP-T-9	190-240VAC	SPDT, direct replacement for Time Mark® #260 series

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201-XXX-SP SERIES

Specifications

Input Characteristics

Line Voltage:	
201-100-SP	95-120VAC
201-200-SP, 201-200-SP-T-9	190-240VAC
Frequency	50/60Hz

Functional Characteristics

Low Voltage (% of setpoint)	
Trip	90%
Reset	93%
For 201-200-SP-T-9 only:	
High Voltage (% of setpoint)	
Trip	110%
Reset	107%
Trip Delay Time:	
High/Low Voltage Fault	4 seconds
Restart Delay Time:	
After a Fault	2 seconds
After a Complete Power Loss	2 seconds

Output Characteristics

Output Contact Rating (SPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics

Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	5 W
Transient Protection (Internal)	2500V for 10 ms
Safety Marks	
UL (OT08PC octal socket required)	UL508 (File #E68520)
CE	IEC 60947-6-2
Dimensions	**H** 44.45 mm (1.75"); **W** 60.325 mm (2.375"); **D** 104.775 mm (4.125") (with socket)
Weight	0.8 lb. (12.8 oz., 362.87 g)
Mounting Method	DIN rail or surface mount (plug in to OT08PC socket)
Socket Available	Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

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201-XXX-SP-DPDT SERIES

Single-Phase Voltage/Phase Monitor

Description

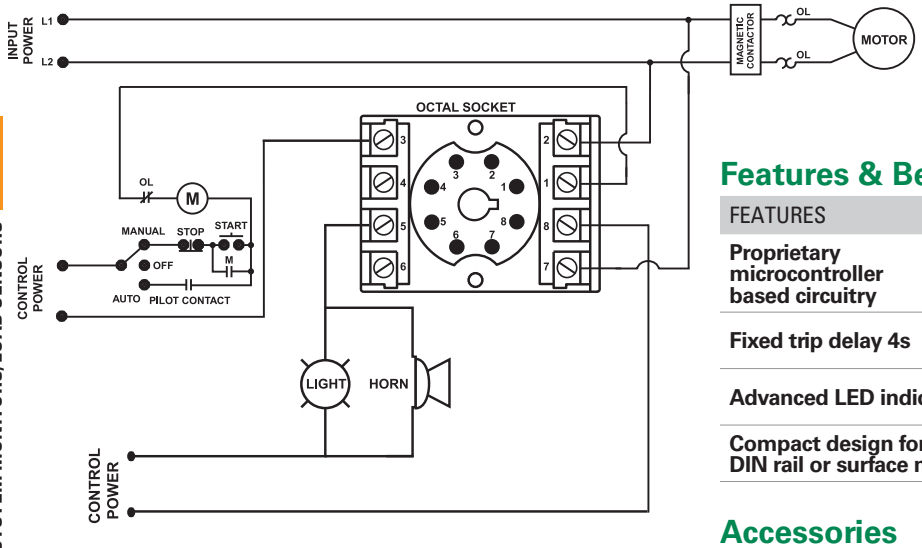
The 201-xxx-SP-DPDT Series is an 8-pin octal-base, plug-in voltage monitor designed to protect single-phase motors regardless of size. The 201-100-SP-DPDT is used on 95-120VAC, 50/60Hz motors to prevent damage caused by low voltage. The 201-200-SP-DPDT is used on 190-240VAC, 50/60Hz motors. The units feature two isolated sets of contacts that are ideal for use with two control circuits with different voltages.

The unique microcontroller-based voltage and voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver's output relays are deactivated after a specified trip delay. The output relays reactivate after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Must use Model OT08PC socket for UL Rating!

Note: Manufacturer's recommended screw terminal torque for the RB Series and OT Series Octal Sockets is 12 in.-lbs.

Wiring Diagram



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage to detect harmful power line conditions, even before the motor starts
Fixed trip delay 4s	Prevents nuisance tripping due to rapidly fluctuating power line conditions
Advanced LED indication	Provides diagnostics which can be used for troubleshooting and to determine relay status
Compact design for 8-pin; DIN rail or surface mount	Allows flexibility in panel installation

Accessories

OT08PC 8-pin Octal Socket
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10A @ 600VAC.

Ordering Information

MODEL	INPUT VOTAGE	DESCRIPTION
201-100-SP-DPDT	95-120VAC	Two isolated Form C relays
201-200-SP-DPDT	190-240VAC	Two isolated Form C relays

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201-XXX-SP-DPDT SERIES

Specifications

Input Characteristics

Line Voltage:	
201-100-SP-DPDT	95-120VAC
201-200-SP-DPDT	190-240VAC
Frequency	50/60Hz

Functional Characteristics

Low Voltage (% of setpoint):	
Trip	90% +/-1%
Reset	93% +/-1%
Trip Delay Times:	
Low Voltage	4 seconds
Restart Delay Times:	
After a Fault or Complete Power Loss	2 seconds

Output Characteristics

Output Contact Rating (DPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics

Ambient Temperature Range:	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	5 W
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls
Safety Marks	
UL (OT08PC octal socket required)	UL508 (File #E68520)
CE	IEC 60947-6-2
Dimensions	**H** 44.45 mm (1.75"); **W** 60.325 mm (2.375"); **D** 104.775 mm (4.125") (with socket)
Weight	0.65 lb. (10.4 oz., 294.84 g)
Mounting Method	DIN rail or surface mount (plug in to OT08PC socket)
Socket Available	Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail

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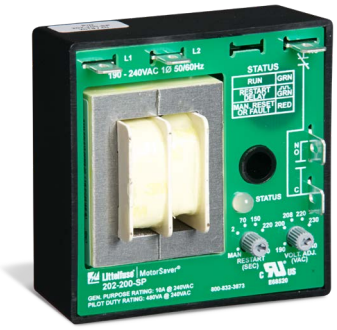
202-200-SP SERIES

Single-Phase Voltage Monitor



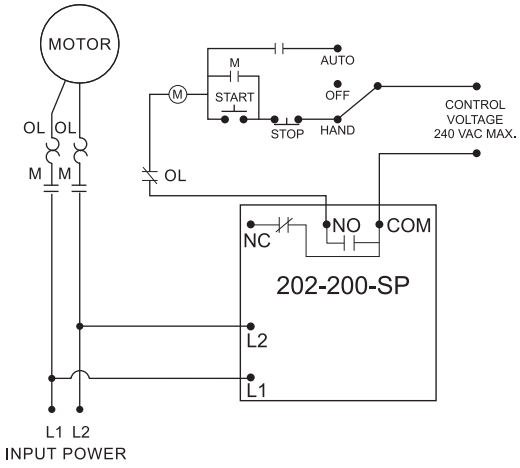
Description

The 202-200-SP Series voltage monitor is designed to protect single-phase motors regardless of size. It can be used with 190V-240VAC, 50/60Hz motors to prevent damage caused by incoming power problems.

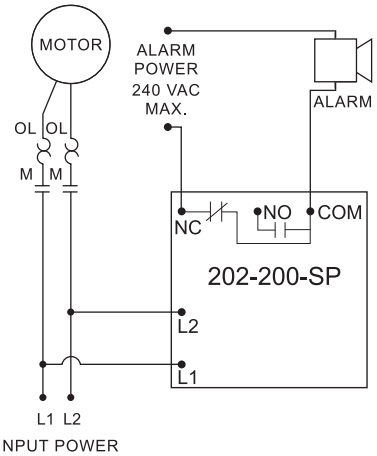
A unique microcontroller-based voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR MODEL 202-200-SP WITH MOTOR CONTROL



TYPICAL WIRING DIAGRAM FOR MODEL 202-200-SP WITH ALARM CONTROL



For dimensional drawing see: Appendix, page 509, Figure 7.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage to detect harmful power line conditions, even before a motor starts
Fixed trip delay 4s	Prevents nuisance tripping due to rapidly fluctuating power line conditions
Adjustable restart delay (Manual, 2-300s)	Allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition
Advanced LED indication	Provides diagnostics which can be used for troubleshooting and to determine relay status
One screw mounting and standard 1/4" quick connect terminals	Fast installation and compact size perfect for panel assembly or OEM applications

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION
202-200-SP	190-240VAC	SPDT, high and low voltage protection
202-200-SP-NHV	190-240VAC	SPDT, low voltage protection only

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202-200-SP SERIES

Specifications

Input Characteristics

Line Voltage:	
202-200-SP, 202-200-SP-NHV	190-240VAC
Frequency	50*/60Hz

Functional Characteristics

Low Voltage (% of setpoint)	
Trip	90%
Reset	93%
High Voltage (% of setpoint) (not available on -NHV model)	
Trip	110%
Reset	107%
Trip Delay Time:	
High and Low Voltage	4 seconds
Restart Delay Time:	
After a Fault or Complete Power Loss	Manual, 2-300 seconds adj.

Output Characteristics

Output Contact Rating (SPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics

Temperature Range	-40° to 70°C (-40° to 158°F)
Trip & Reset Accuracy	±1%
Repeatability	±0.5%
Input to Output Dielectric	1480 Vrms (min.)
Termination	0.25" male quick connect
Maximum Input Power	5 W
Relative Humidity	95%, non-condensing
Transient Protection	IEC 61000-4-5, ±4kV
Safety Marks	
UL, UL Recognized	UL508 (File #E68520)
Dimensions	**H** 63.5 mm (2.5"); **W** 63.5 mm (2.5"); **D** 35.56 mm (1.4")
Weight	0.5 lb. (8 oz., 226.8 g)
Mounting Method	1/4" socket head cap screw (customer supplied)

*Note: 50Hz will increase all delay timers by 20%.

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460-XXX-SP SERIES

Single-Phase Voltage Monitor

Description

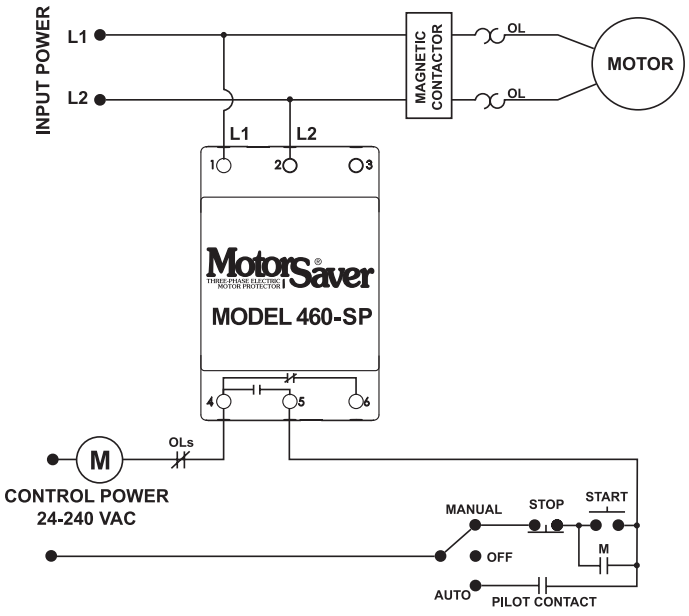
The 460-100-SP is used on 95-120VAC, 50*/60Hz single-phase motors and the 460-200-SP is used on 190-240VAC, 50*/60Hz single-phase motors to protect them from damaging high and low voltage conditions. An adjustment knob allows the user to set a 1-500 second restart delay. The variable restart delay is also a power-up delay and can be utilized to stagger-start motors on the same system.

A unique microcontroller-based, voltage-sensing circuit constantly monitors the voltage to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of voltage to detect harmful power line conditions, even before a motor starts
Fixed trip delay 4s	Prevents nuisance tripping due to rapidly fluctuating power line conditions
Adjustable restart delay (1-500s)	Allows staggered start up of multiple motors on the same system to prevent a low voltage condition
Advanced LED indication	Provides diagnostics which can be used for troubleshooting and to determine relay status
DIN rail or surface mountable	Allows flexibility for panel assembly

Wiring Diagram



For dimensional drawing see: Appendix, page 510, Figure 10.

Ordering Information

MODEL	LINE VOTAGE
460-100-SP	95-120VAC
460-200-SP	190-240VAC

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460-XXX-SP SERIES

Specifications

Input Characteristics

Line Voltage	
460-100-SP	95-120VAC
460-200-SP	190-240VAC
Frequency	50*/60Hz

Functional Characteristics

Low Voltage (% of setpoint):	
Trip	90% ±1%
Reset	93% ±1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Trip Delay Time	
Low or High Voltage	4 seconds fixed
Restart Delay Time	
After a Fault	1-500 seconds adjustable
After a Complete Power Loss	1-500 seconds adjustable

Output Characteristics

Output Contact Rating (1 Form C)	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	10A @ 240VAC

General Characteristics

Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	6 W
Class of Protection	IP20, NEMA 1 (finger safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	4.5 in.-lbs.
Wire Type	Stranded or solid 12-20 AWG, one per terminal

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5 kV input power and controls
Surge	
IEC	IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 min)
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947-6-2
Enclosure	Polycarbonate
Dimensions	**H** 88.9 mm (3.5"); **W** 52.93 mm (2.084"); **D** 59.69 mm (2.35")
Weight	0.9 lb. (14.4 oz., 408.23 g)
Mounting Method	35mm DIN rail or Surface Mount (#6 or #8 screws)

*Note: 50 Hz will increase all delay timers by 20%

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102A SERIES

3-Phase Voltage/Phase Monitor

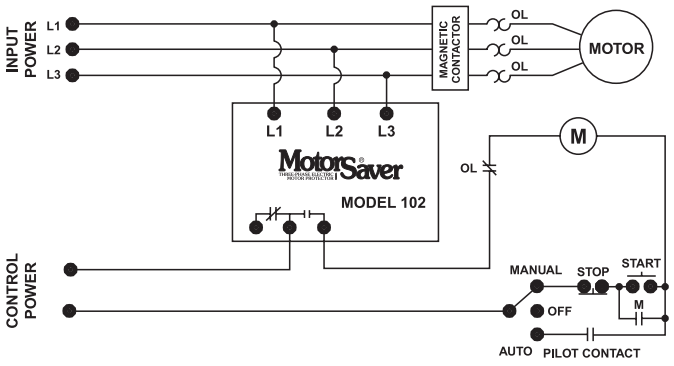
Description

The 102A is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range.

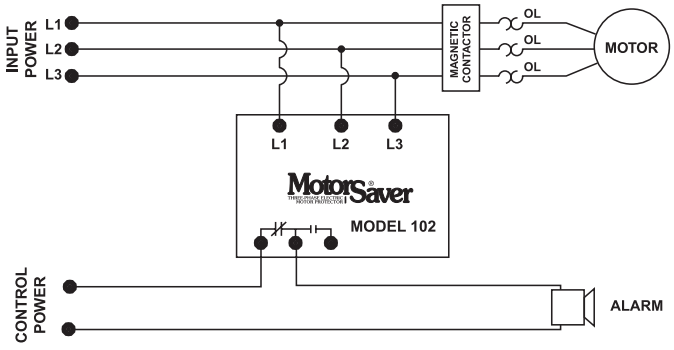
A unique microcontroller-based voltage and phase-sensing circuit constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels. The Model 102A includes advanced single LED diagnostics. Five different light patterns distinguish between faults and normal conditions.

Wiring Diagram

102 WITH MOTOR CONTROL



102 WITH ALARM CONTROL



For dimensional drawing see: Appendix page 509, Figure 6.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of single-phase, low voltage, high voltage (102A-9), voltage unbalance, phase reversal, harmful power line conditions.
Auto-sensing wide voltage range	Automatically senses system voltage between 190 - 480VAC. Saves setup time.
Advanced LED diagnostics	Quick visual indicator for cause of trip. LED indications include: normal operation, power-up restart delay, reverse-phase trip, unbalance/ single-phase trip, high or low voltage trip
Adjustable trip delay (102A2)	Prevent nuisance tripping due to rapidly fluctuating power line conditions.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
102A	190-480VAC	Fixed low voltage trip delay (4 sec), fixed restart delay (2 sec)
102A2	190-480VAC	Has variable restart delay (manual or adjustable 2-300 seconds)
102A3	190-480VAC	Has adjustable trip delay at 2-30 seconds (unbalance and phasing trip delays remain at 2 seconds).
102A-9	190-480VAC	Has high voltage protection. High Voltage Trip is 110% of setpoint, Reset is 107% of setpoint.
102600	475-600VAC	Fixed low voltage trip delay (4 sec), fixed restart delay (2 sec)

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102A SERIES

Specifications

Frequency	50*/60Hz
Functional Characteristics	
Low Voltage (% of setpoint)	
Trip	90%
Reset	93%
Voltage Unbalance (NEMA)	
Trip	6%
Reset	4.5%
Trip Delay Time	
Low/High Voltage	4 seconds (standard)
Unbalance & Phasing Faults	2 seconds
Restart Delay Time	
After a Fault	2 seconds (standard)
After a Complete Power Loss	2 seconds (standard)
Output Characteristics	
Output Contact Rating (SPDT - 1 Form C)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics	
Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Trip & Reset Accuracy	±1%
Maximum Input Power	5 W
Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG
Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Fast Transient Burst	IEC 61000-4-4, Level 3, 4kV input, 2kV input/output
Transient Protection (Internal)	IEC 61000-4-5; 1995 ±6kV
Safety Marks	
UL	UL508 (File #E68520)
CSA	22.2 No. 14 (File #46510)
CE	IEC 60947-6-2
Dimensions	**H** 74.4 mm (2.93"); **W** 133.9 mm (5.27"); **D** 74.9 mm (2.95")
Weight	1.05 lbs. (16.8 oz., 476.27 g)
Mounting Method	#8 screws

*Note: 50Hz will increase all delay timers by 20%.

201A SERIES

3-Phase Voltage/Phase Monitor

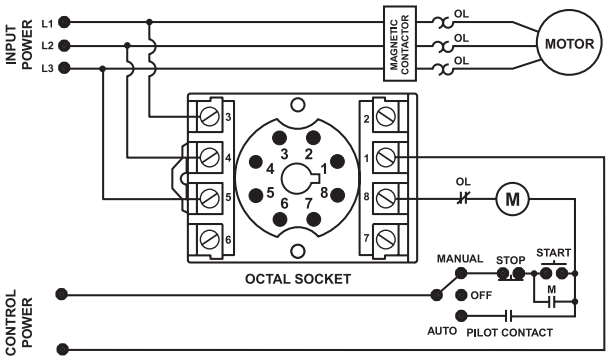
Description

The 201A is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range. The 201A includes advanced single LED diagnostics, where color and light patterns distinguish between faults and normal conditions.

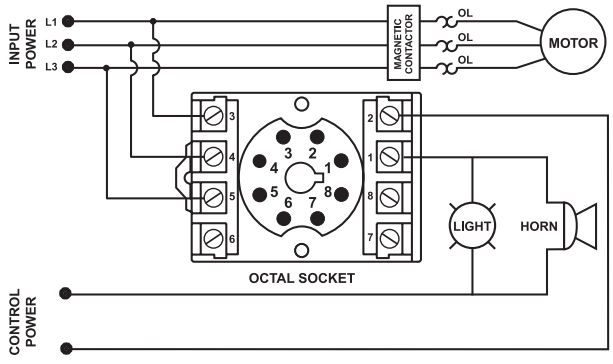
This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the 201A's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels for a specified restart delay time.

Wiring Diagram

201A WITH MOTOR CONTROL



201A WITH ALARM CONTROL



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of single-phase, low voltage, voltage unbalance, phase reversal, harmful power line conditions. High voltage monitoring optional.
Compact design for 8-pin; DIN rail or surface mount	Allows flexiblility in panel installation
Auto-sensing wide voltage range	Automatically senses system voltage between 190 - 480VAC. Saves setup time.
Advanced LED diagnostics	Quick visual indicator for cause of trip. LED indications include: normal operation, power-up restart delay, reverse-phase trip, unbalance/ single-phase trip, high/low voltage trip

Accessories

OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
201A	190-480VAC	DIN rail or surface mountable
201A-9	190-480VAC	Includes high voltage detection. DIN rail or surface mountable

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201A SERIES

Specifications

Frequency	50/60Hz
Functional Characteristics	
Low Voltage (% of setpoint)	
Trip	90% ±1%
Reset	93% ±1%
Voltage Unbalance (NEMA)	
Trip	6%
Reset	4.5%
Optional High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Trip Delay Time	
High/Low Voltage Fault	4 seconds
Unbalance & Phasing Faults	2 seconds
Restart Delay Time	
After a Fault	2 seconds
After a Complete Power Loss	2 seconds
Output Characteristics	
Output Contact Rating (SPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC
General Characteristics	
Temperature Range	-20° to 70°C (-4° to 158°F)
Trip & Reset Accuracy	±1%
Maximum Input Power	5 W
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	12 in.-lbs. (for OT08-PC socket)
Wire Gauge	12-22 AWG solid or stranded
Transient Protection (Internal)	2500V for 10 ms

Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity (RFI), Radiated	150MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power & controls
Surge	
Immunity IEC	IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V + 1000V for 1 min.)
Safety Marks	
UL (OT08PC octal socket required)	UL508 (File #E68520)
CE	IEC 60947-6-2
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")
Weight	0.7 lbs. (11.2 oz., 317.51 g)
Mounting Method	DIN rail or surface mount (plug in to OT08PC socket)
Socket Available	Model OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

Note: Manufacturer's recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Must use Model OT08PC socket for UL Rating!

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201A-AU SERIES

3-Phase Voltage/Phase Monitor

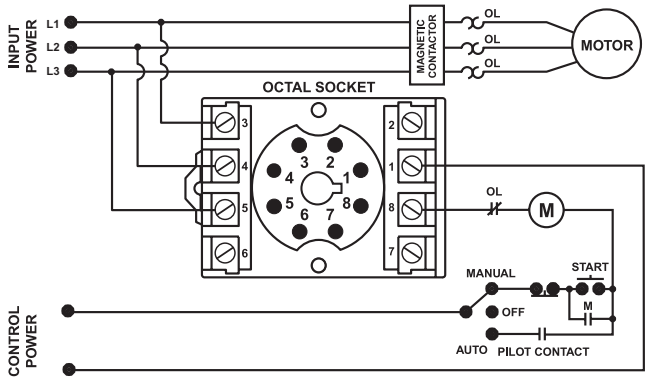
Description

The 201A-AU is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range. Additional adjustment knobs allow the user to set a 1-30 second trip delay, a manual restart or 1-500 second restart delay and a 2-8% voltage unbalance trip point. The Model 201A-AU includes advanced single LED diagnostics, where color and light patterns distinguish between faults and normal conditions.

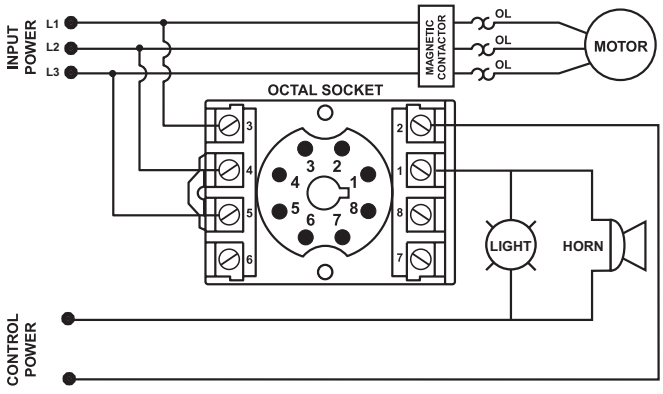
This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the 201A-AU's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels for a specified amount or restart delay time (or manual reset).

Wiring Diagram

201A-AU WITH MOTOR CONTROL



201A-AU WITH ALARM CONTROL



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of loss of any phase, low voltage, high voltage, voltage unbalance, phase reversal, rapid cycling, harmful power line conditions
Compact design for 8-pin; DIN rail or surface mount	Allows flexiblility in panel installation
Auto-sensing wide voltage range	Automatically senses system voltage between 190 - 480VAC. Saves setup time.
Advanced LED diagnostics	Quick visual indicator for cause of trip.
Adjustable voltage unbalance trip setting	Allows compatibility with a variety of motors and reduces nuisance tripping.
Adjustable trip & restart delay settings	Prevent nuisance tripping due to rapidly fluctuating power line conditions.

Accessories

OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
201A-AU	190-480VAC	DIN rail or surface mountable
201575-AU	475-600VAC	DIN rail or surface mountable
201A-AU-OT	190-480VAC	Sold with OT08PC socket
201-575-AU-OT	475-600VAC	Sold with OT08PC socket

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201A-AU SERIES

Specifications

Frequency	50/60Hz
Functional Characteristics	
Low Voltage (% of setpoint)	
Trip	90% ±1%
Reset	93% ±1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2-8% adjustable
Reset	Trip Setting Minus 1% (5-8%) Trip Setting Minus 0.5% (2-4%)
Trip Delay Time	
High, Low and Unbalanced Voltage	1-30 seconds adjustable
Single-Phasing Faults	1 second fixed
Restart Delay Time	
After a Fault	Manual, 1-500 seconds adj.
After a Complete Power Loss	Manual, 1-500 seconds adj.
Output Characteristics	
Output Contact Rating (1-Form C)	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	10A @ 240VAC
General Characteristics	
Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Trip & Reset Accuracy	±1%
Maximum Input Power	5 W
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	12 in.-lbs. (for OT08-PC socket)
Wire Gauge	12-22 AWG solid or stranded

Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls
Surge	
IEC	IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 min.)
Safety Marks	
UL (OT08PC octal socket required)	UL508 (File #E68520)
CE	IEC 60947-6-2
Enclosure	Polycarbonate
Dimensions	**H** 44.45 mm (1.75"); **W** 60.325 mm (2.375"); **D** 104.775 mm (4.125") (with socket)
Weight	0.7 lb. (11.2 oz., 317.51 g)
Mounting Method	DIN rail or surface mount (plug in to OT08PC socket)
Socket Available	OT08PC (UL Rating 600V)

The 600V socket can be surface mounted or installed on DIN Rail.

Note: Manufacturer's recommended screw terminal torque for the OT Series Octal Sockets is 12 in.-lbs.

Must use Model OT08PC socket for UL Rating!

201-XXX-DPDT SERIES

3-Phase Voltage/Phase Monitor

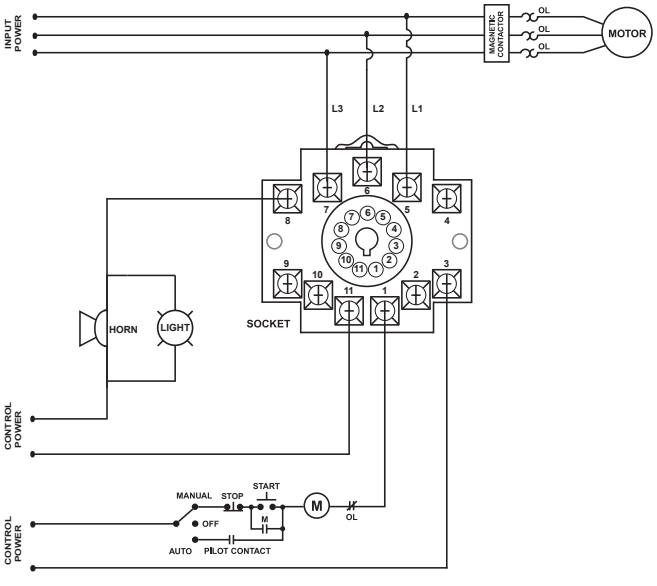
Description

The 201-xxx-DPDT Series is an 11-pin octal base plug-in voltage monitor designed to protect 3-phase motors regardless of size. The 201-100-DPDT is used on 95-120VAC, 50/60Hz motors and the 201-200-DPDT is used on 190-240VAC, 50/60Hz motors to prevent damage caused by incoming voltage problems. The units feature two isolated sets of contacts that are ideal for use with two control circuits with different voltages.

The unique microcontroller-based voltage and phase-sensing circuit constantly monitors the voltages to detect harmful power line conditions When a harmful condition is detected, the MotorSaver's output relays are deactivated after a specified trip delay. The output relays reactivate after power line conditions return to an acceptable level and a specified amount of time has elapsed (restart delay). The trip delay prevents nuisance tripping due to rapidly fluctuating power line conditions.

This unit is also available with a shorter trip delay and faster restart delay. The 201-xxx-DPDT-60mS has a trip delay of 0.5 seconds and a restart delay of 60 milliseconds.

Wiring Diagram



For dimensional drawing see: Appendix, page 509, Figure 8.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constantly monitors 3 phase voltage to protect against harmful line conditions, even before the motor is started
Compact design for 11-pin; DIN rail or surface mount	Allows flexibility in panel installation
Advanced LED indication	Provides diagnostics which can be used for troubleshooting and to determine relay status
Two isolated Form C relays (DPDT)	Ideal for use in systems which have two control circuits with different voltages

Accessories

OT11PC Octal Socket
11-pin surface & DIN rail mountable. Rated for 10A @ 300VAC

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION
201-100-DPDT	95-120VAC	Fixed unbalance, trip delay 4s for low voltage fault and 2s for unbalance and phase loss, restart delay 2s
201-200-DPDT	190-240VAC	Fixed unbalance, trip delay 4s for low voltage fault and 2s for unbalance and phase loss, restart delay 2s
201-100-DPDT-60mS	95-120VAC	Fixed unbalance, trip delay 0.5s, restart delay 60mS

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201-XXX-DPDT SERIES

Specifications

Input Characteristics

Line Voltage	
201-100-DPDT, 201-100-DPDT-60mS	95-120VAC
201-200-DPDT, 201-200-DPDT-60mS	190-240VAC
Frequency	50/60Hz

Functional Characteristics

Low Voltage (% of setpoint)	
Trip	90% +/-1%
Reset	93% +/-1%
Voltage Unbalance	
Trip	6%
Reset.	4.5%
Trip Delay Times	
Low Voltage	4 seconds
Unbalance, Phasing Faults	2 seconds
Models with -60ms option	0.5 second
Restart Delay Times	
After a Fault or Complete Power Loss	2 seconds
Models with -60mS option	60 milliseconds

Output Characteristics

Output Contact Rating (DPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC

General Characteristics

Temperature Range	-40° to 70°C (-40° to 158°F)
Maximum Input Power	5 W

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 2.5kV input power
Safety Marks	
UL (OT11PC octal socket required)	UL508 (File #E68520)
CE	IEC 60947-6-2
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** 104.78 mm (4.125")
Weight	0.65 lb. (10.4 oz., 294.84 g)
Mounting Method	DIN rail or surface mount (plug in to OT11PC socket)
Socket Available	Model OT11PC (UL Rated 300V)

The 300V socket can be surface mounted or installed on DIN Rail.

Must use Model OT11PC socket for UL Rating!

*Note: Manufacturer's recommended screw terminal torque for the RB Series and OT Series Octal Sockets is 12 in.-lbs.

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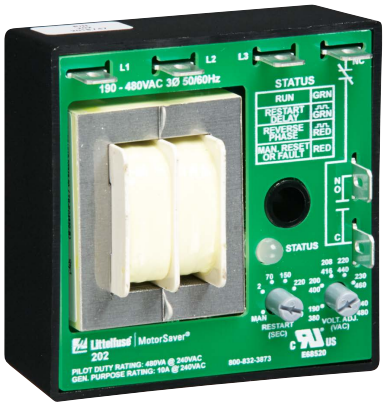
202 SERIES

3-Phase Voltage/Phase Monitor



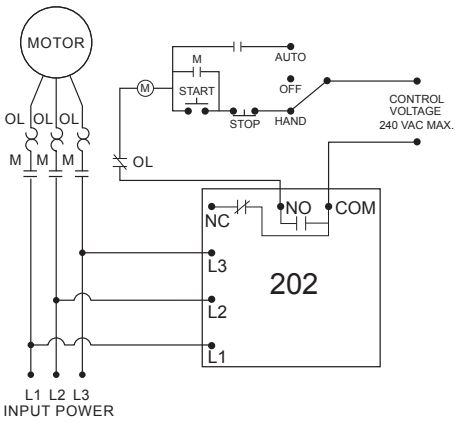
Description

The 202 Series is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50*/60Hz motors regardless of size. The 202-RP (and the 202-575-RP for 475-600VAC) monitors the phase rotation of 3-phase systems and trips on reverse-phase only. Critical applications include fan motors, scroll compressors, grinders, conveyor systems, elevators and escalators. Both products provide a user selectable nominal voltage setpoint and automatically select between the 200V and 400V range.

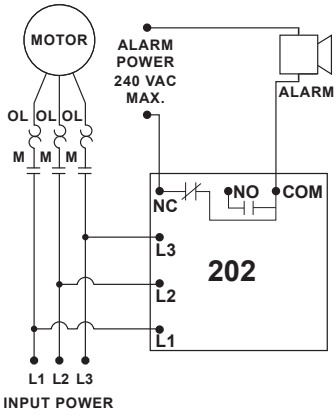
This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the MotorSaver's output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels for a specified amount of restart delay time (or a manual reset). The 202 Series includes advanced single LED diagnostics. Five different light patterns distinguish between faults and normal conditions. The status light turns green and the relay is activated when rotation is correct.

Wiring Diagram

202 WITH MOTOR CONTROL



202 WITH ALARM CIRCUIT



For dimensional drawing see: Appendix, page 509, Figure 7.

Features & Benefits

FEATURES	BENEFITS
Compact, quick mounting design	1-screw mounting saves time and space. Small footprint ideal for assembly into panels.
Proprietary microcontroller based circuitry	Constant monitoring of single-phase, low voltage, high voltage, voltage unbalance, phase reversal, harmful power line conditions.
Auto-sensing wide voltage range (202 & 202-RP	Automatically senses system voltage between 90 - 480VAC. Saves setup time.
Advanced LED diagnostics	Quick visual indicator for cause of trip. LED indications include: normal operation, restart delay, reverse-phase trip, fault
Adjustable trip delay (202)	Prevent nuisance tripping due to rapidly fluctuating power line conditions.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
202	190-480VAC	Standard protection with low/high voltage trip, voltage unbalance
202-RP	190-480VAC	Trips on reverse-phase only
202-575-RP	475-600VAC	Designed for higher voltage systems and trips on reverse-phase only

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202 SERIES

Specifications

Frequency	50*/60Hz
Functional Characteristics	
Phase Sequence	ABC
Low Voltage (% of setpoint)	
Trip	90%
Reset	93%
High Voltage (% of setpoint)	
Trip	110%
Reset	107%
Voltage Unbalance (NEMA)	
Trip	6%
Reset	4.5%
Trip Delay Time	
High and Low Voltage	4 seconds
Unbalance & Phasing Faults	2 seconds
Restart Delay Time	
After a Fault	Manual, 2-300 seconds adj.
After a Complete Power Loss	Manual, 2-300 seconds adj.

Output Characteristics	
Output Contact Rating (SPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC
General Characteristics	
Temperature Range	-40° to 70°C (-40° to 158°F)
Trip & Reset Accuracy	±1%
Repeatability	±0.5%
Maximum Input Power	5 W
Relative Humidity	95%, non-condensing
Transient Protection	IEC 61000-4-5, ±4kV
Hi-potential Test	Meets UL508 (2x rated V+1000V for 1 minute)
Termination	0.25" male quick connect
Safety Marks	
UL Recognized	UL508 (File #E68520)
Dimensions	**H** 63.5 mm (2.5"); **W** 63.5 mm (2.5"); **D** 35.56 mm (1.4")
Weight	0.5 lb. (8 oz., 226.8 g)
Mounting Method	1/4" socket head cap screw (customer supplied)

*Note: 50Hz will increase all delay timers by 20%. CE Pending

250A SERIES

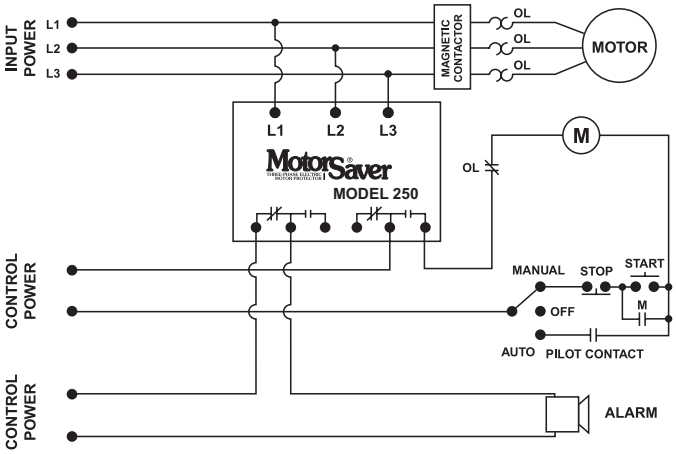
3-Phase Voltage/Phase Monitor

Description

The 250A is a 3-phase, auto-ranging, dual-range voltage monitor that protects 190-480VAC, 50/60Hz motors regardless of size from low and high voltage, unbalance/single-phase, and reverse-phase. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically selects between the 200V and 400V range. The 250A also features adjustable or manual restart delay.

This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions. When a harmful condition is detected, the output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to acceptable levels. The Model 250A includes advanced single LED diagnostics. Five different light patterns distinguish between faults and normal conditions.

Wiring Diagram



For dimensional drawing see: Appendix page 509, Figure 6.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring of single-phase, low voltage, voltage unbalance, phase reversal, harmful power line conditions.
Auto-sensing wide voltage range	Automatically senses system voltage between 190 - 480VAC. Saves setup time.
Advanced LED diagnostics	Quick visual indicator for cause of trip. LED indications include: normal operation, power-up restart delay, reverse-phase trip, unbalance/ single-phase trip, high or low voltage trip
DPDT relay output	Allows for versitility to meet wide application needs
Manual Reset	Allows for inspection of equipment before system is re-energized

Ordering Information

MODEL	LINE VOLTAGE	% OF SETPOINT				DESCRIPTION
		LOW VOLTAGE TRIP	LOW VOLTAGE RESET	HIGH VOLTAGE TRIP	HIGH VOLTAGE RESET	
250A	190-480VAC	90%	93%	110%	107%	Provides high and low voltage protection at fixed percentage of nominal voltage.
250600	475-600VAC	90%	93%	110%	107%	Provides high and low voltage protection at fixed percentage of nominal voltage.
250A-MET	190-480VAC	85%	88%	N/A	N/A	Designed for use with Fire Control Panels. Has 2 Form C contacts that operate independently. Left Form C energizes when voltage conditions are good and de-energize when a fault condition is detected. Right Form C only energizes during a reverse-phase condition. No high voltage protection.
250-100-MET	95-120VAC	85%	88%	N/A	N/A	Designed for use with Fire Control Panels. Has 2 Form C contacts that operate independently. Left Form C energizes when voltage conditions are good and de-energize when a fault condition is detected. Right Form C only energizes during a reverse-phase condition. No high voltage protection.

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250A SERIES

Specifications

Frequency	50*/60Hz Low Voltage
Functional Characteristics	
Voltage Unbalance (NEMA)	
Trip	6%
Reset	4.5%
Trip Delay Time	
Low Voltage, High Voltage	4 seconds
Unbalance, Phasing Faults	2 seconds
Restart Delay Time	
After a Fault or Complete Power Loss	Manual, 2-300 seconds adj.
Output Characteristics	
Output Contact Rating (DPDT - 2 Form C)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC
Temperature Range	-40° to 70°C (-40° to 158°F)
Trip & Reset Accuracy	±1%
Maximum Input Power	5 W
Relative Humidity	Up to 95% non-condensing per IEC 68-2-3
Terminal Torque	7 in.-lbs.
Wire Size	12-18AWG
Transient Protection (Internal)	IEC 61000-4-5;1995 ±6kV
Approvals	
UL	UL508 (File #E68520)
CSA	CSA 22.2 No. 14 (File#46510)
CE	CE IEC 60947-6-2
Dimensions	**H** 74.4 mm (2.93"); **W** 133.9 mm (5.27"); **D** 74.9 mm (2.95")
Weight	1.02 lb. (16.32 oz., 462.66 g)
Mounting Method	#8 screws

*Note: 50Hz will increase all delay timers by 20%.

350 SERIES

3-Phase Voltage/Phase Monitor

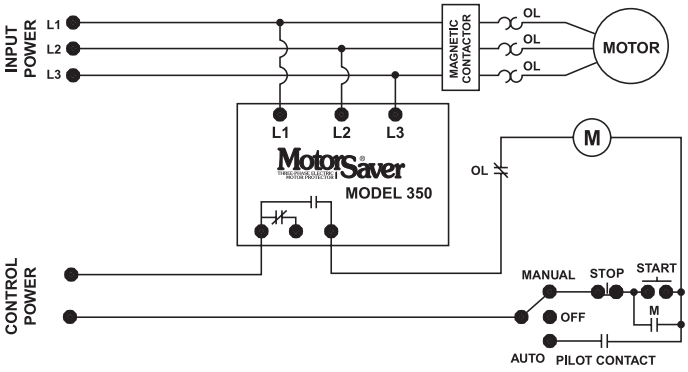
Description

The 350 Series is a heavy-duty voltage monitor. This product should be used when high current relays or dual contacts are required, or 480V controls are used. Since the 350 Series uses heavy-duty relays, it comes in fixed voltage range models rather than a dual auto-ranging version like the Model 250.

The 350200 has a 15A general purpose contact. The 350400 provides a SPDT (Form C) relay rated to switch up to 600V, allowing the use of 480V controls, eliminating the need for a control power transformer to step the voltage down to 120-240V. Several DPDT (two Form C contacts) relay models are also available.

The 350 microcontroller-based family of products are low cost yet highly advanced solutions to heavy-duty problems. The 350 includes advanced single LED diagnostics. Five different light patterns distinguish faults and normal operating conditions. Other options such as high voltage trip and adjustable restart delay are available.

Wiring Diagram



For dimensional drawing see: Appendix page 509, Figure 6.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constantly monitors 3 phase voltage to protect against harmful line conditions, even before the motor is started
Advanced LED indication	Provides diagnostics which can be used for troubleshooting and to determine relay status
Adjustable restart delay (-2 models) settings	Allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition
600V rated relay contacts available on some models	Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION	MODEL	LINE VOTAGE	DESCRIPTION
350200	190-240VAC	SPDT, fixed trip and restart delay	35040026	380-480VAC	DPDT, 2 relays (1)10a. (1) 15A; fixed trip and variable restart delay (manual, 2-300s)
3502002	190-240VAC	SPDT, fixed trip and variable restart delay (manual, 2-300s)	35040028**	380-480VAC	DPDT, 2 relays 15A; variable restart delay (no manual reset)
35020026	190-240VAC	DPDT, 2 relays (1)10a. (1) 15A; fixed trip and variable restart delay (manual, 2-300s)	35040029	380-480VAC	SPDT, fixed trip and variable restart delay (manual, 2-300s), plus high voltage detection
35020028**	190-240VAC	DPDT, 2 relays 15A; variable restart delay (no manual reset)	350600	475-600VAC	SPDT, fixed trip and restart delay
35020029	190-240VAC	SPDT, fixed trip and variable restart delay (manual, 2-300s), plus high voltage detection	3506002	475-600VAC	SPDT, fixed trip and restart delay (manual, 2-300s)
350400	380-480VAC	SPDT, fixed trip and restart delay	35060026	475-600VAC	DPDT, 2 relays (1)10a. (1) 15A; fixed trip and variable restart delay (manual, 2-300s)
3504002	380-480VAC	SPDT, fixed trip and variable restart delay (manual, 2-300s)	35060028**	475-600VAC	DPDT, 2 relays 15A; variable restart delay (no manual reset)
35040025	380-480VAC	DPDT, fixed trip and variable restart delay (manual, 2-300s)	35060029	475-600VAC	SPDT, fixed trip and variable restart delay (manual, 2-300s), plus high voltage detection

** These units are not equipped with Manual Reset.

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350 SERIES

Specifications

Input Characteristics

Line Voltage	
350200	190-240VAC
350400	380-480VAC
350600	475-600VAC
Frequency	50*/60Hz

Functional Characteristics

Low Voltage (% of setpoint)	
Trip	90%
Reset	93%
Voltage Unbalance (NEMA)	
Trip	6%
Reset	4.5%
Trip Delay Time:	
Low Voltage	4 seconds
Unbalance & Phasing Faults	2 seconds
Restart Delay Time	
After a Fault	2 seconds
After a Complete Power Loss	2 seconds

Output Characteristics

Output Contact Rating	
SPDT (350200)	
Pilot Duty	480VA @ 240VAC
General Purpose	15A
SPDT (350-400, 350-600)	470VA @ 600VAC
DPDT (-6 Option)	1-10A General Purpose 480VA @ 240VAC Pilot Duty 1-15A General Purpose 480VA @ 240VAC Pilot Duty 1hp @ 240VAC
DPDT (-8 Option)	2-15A General Purpose 480VA @ 240VAC Pilot Duty 1hp @ 240VAC

General Characteristics

Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Trip & Reset Accuracy	±1%
Maximum Input Power	5 W
Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG
Transient Protection (Internal)	IEC 61000-4-5;1995 ±6kV
Safety Marks	
UL	UL508 (File #E68520)
CSA	22.2 No. 14 (File #46510)
CE	IEC 60947-6-2
Dimensions	**H** 74.42 mm (2.93"); **W** 133.86 mm (5.27"); **D** 74.93 mm (2.95")
Weight	1.05 lbs. (16.8 oz., 476.27 g)
Mounting Method	#8 screws

Special Options

Opt. 2: Variable Restart Delay	Manual, 2-300 seconds adj.
Opt. 5: DPDT Relay	
Opt. 6: 2 Relays (1) 10A, (1) 15A	
Opt. 8: 2 Relays (2) 15A	
Opt. 9: High Voltage (% of setpoint)	
Trip	110%
Reset	107%

*Note: 50Hz will increase all delay timers by 20%.

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355 SERIES

3-Phase Voltage/Phase Monitor

Description

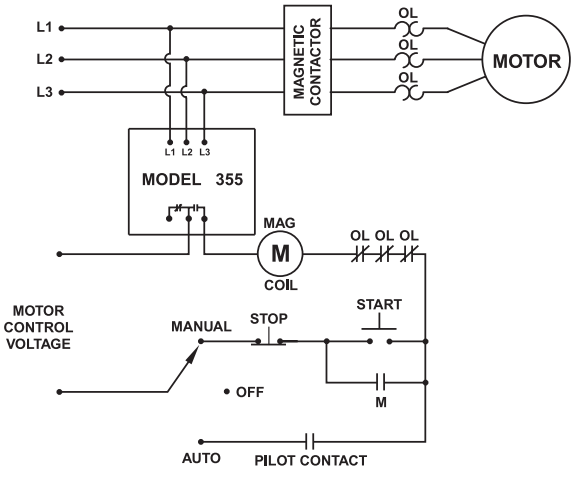
The 355 Series is a 3-phase voltage monitor with adjustable trip and restart delay, adjustable voltage unbalance and multiple diagnostic lights. It is perfect for heavy-duty applications that need both protection and simple user-friendly diagnostics. Applications include pump panels, commercial HVAC, oil rigs and others.

The 355 Series uses microcontroller technology to monitor incoming voltage and de-energize its output relay if power problems exist. The 355 Series can protect motors from damage caused by single-phasing, high and low voltage, phase reversal and voltage unbalance. It has four diagnostic LEDs that clearly show overvoltage, undervoltage, voltage unbalance, reverse-phase and normal conditions.

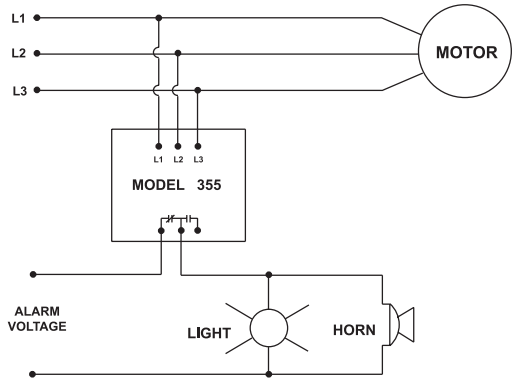
The 355200 is equipped with a heavy-duty 10A general purpose SPDT relay. The 355400 and 355600 are equipped with a 470VA @ 600VAC pilot duty SPDT relay. A high voltage (600V) DPDT relay output option is available with the 400V model.

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR MODEL 355 WITH MOTOR CONTROL



TYPICAL WIRING DIAGRAM FOR MODEL 355 WITH ALARM CONTROL



For dimensional drawing see: Appendix page 509, Figure 6.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constantly monitors 3 phase voltage to protect against harmful line conditions, even before the motor is started
Advanced LED indication	Provides diagnostics which can be used for troubleshooting and to determine relay status
Adjustable trip and restart delay settings	Prevent nuisance tripping due to rapidly fluctuating power line conditions and allows staggered start up of multiple motors, after a fault, to prevent a low voltage condition
Combines protection and diagnostics	Perfect for heavy duty applications: pump panels, commercial HVAC, and oil rigs
600V rated relay contacts available on some models	Eliminates the need for a control transformer to step voltage down to 120 - 240V for a control circuit

Ordering Information

MODEL	LINE VOTAGE	DESCRIPTION
355200	190-240VAC	SPDT
355400	380-480VAC	SPDT
3554005	380-480VAC	DPDT
355600	475-600VAC	SPDT

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355 SERIES

Specifications

Input Characteristics

Line Voltage	
355200	190-240VAC
355400	380-480VAC
355600	475-600VAC
(Specify voltage range)	
Frequency	50*/60Hz

Functional Characteristics

Low Voltage (% of setpoint)	
Trip	90% ±1%
Reset	93% ±1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2-8% adjustable
Reset	Trip setting minus 1%
Trip Delay Time:	
Low & High Voltage and Unbalance	2-30 seconds adjustable
Single-phasing Faults (>25% UB)	2 seconds
Restart Delay Time	
After a Fault or Power Loss	Manual, 2-300 seconds adj.

Output Characteristics

Output Contact Rating	
SPDT (355200)	
Pilot Duty	480VA at 240VAC
General Purpose	10A
SPDT (355400, 355600)	
Pilot Duty	470VA @ 600VAC
DPDT (-5 Option)	
Pilot Duty	470VA @ 600VAC

General Characteristics

Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Repeat Accuracy	
Fixed Conditions	±0.1%
Maximum Input Power	6 W
Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG
Transient Protection (Internal)	2500V for 10 ms
Safety Marks	
UL	UL508 (File #E68520)
Dimensions	**H** 74.42 mm (2.93"); **W** 133.86 mm (5.27"); **D** 74.93 mm (2.95")
Weight	0.94 lb. (15.04 oz., 426.38 g)
Mounting Method	#8 screws

Special Options

Option 5 - DPDT Relay

*Note: 50Hz will increase all delay times by 20%.

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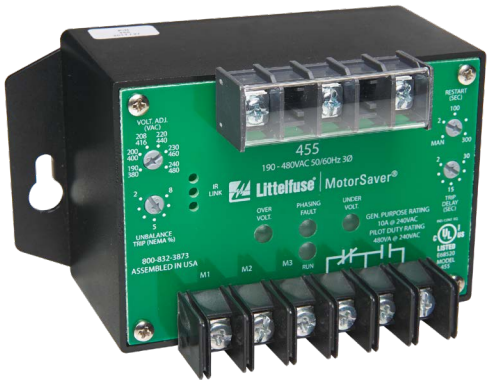
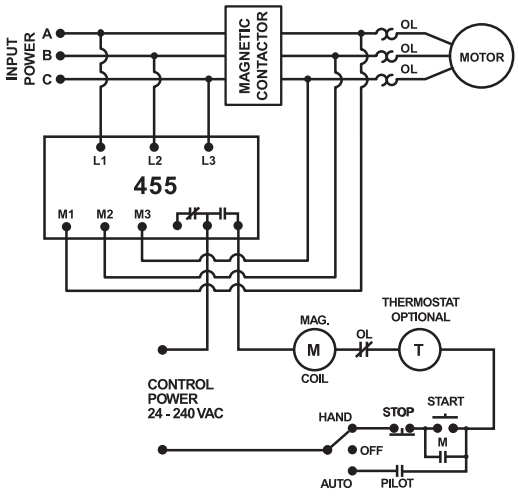
455 SERIES

3-Phase Voltage/Phase Monitor

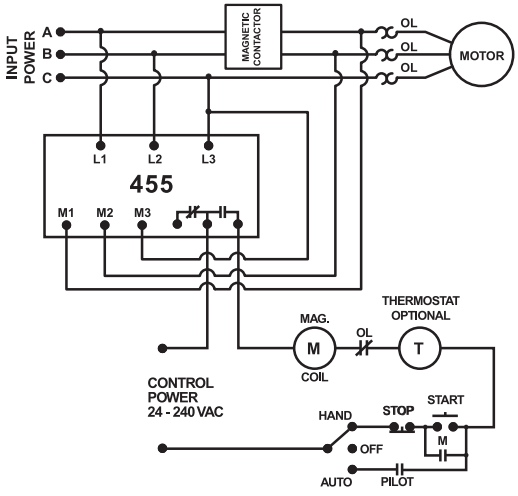


Wiring Diagram

MODEL 455 WITH MOTOR CONTROL USING A 3-POLE CONTACTOR



MODEL 455 WITH MOTOR CONTROL USING A 2-POLE CONTACTOR



For dimensional drawing see: Appendix page 509, Figure 6.

Description

The 455 Series are 3-phase voltage monitors that combine load and line side monitoring to offer complete protection. Monitoring the load side will alert the user of contactor failure or impending contactor failure. Line side monitoring will also protect the motor from damaging fault conditions that may be present prior to the motor starting. With other line/load side monitors, the motor must be started before a voltage fault is detected. With the 455, your motor is fully protected at all times.

The 455 Series are 3-phase, dual range voltage monitors that protect 190-480VAC, 50*/60Hz motors, regardless of their size. It automatically selects between the 200V and 400V range when the user selects the nominal voltage setpoint. Other adjustments include a 2-30 second trip delay, a 2-300 second restart delay (and manual restart) and a voltage unbalance trip point of 2-8%. The voltage monitor's circuitry is powered through the line side connections, so there is no need for separate control power, making it easy to install.

Equipped with an infrared LED, the 455 Sereies can communicate to the optional hand-held diagnostic tool, Informer-MS to obtain valuable information such as real-time voltage, voltage unbalance on both line and load sides, motor run hours, last 20 faults, last 32 motor starts, high and low voltage trip points, voltage unbalance trip point, restart and trip delay settings, LED status and more.

Features & Benefits

FEATURES	BENEFITS
Load side monitoring of contactor	Protects motor from contactor failure or worn contacts.
Monitors contactor or starter	Prevents rapid cycling
Infrared LED Capable	Increases personnel safety line of sight monitoring using optional Informer-MS

Accessories

Informer-MS
A hand-held diagnostic tool designed for use with Littelfuse® 455 equipped with an infrared LED transmitter

Informer IR Kit-36
36" infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
455	190-480VAC	Universal line and load side monitor
455480R	380-480VAC	Used in high voltage applications with pilot duty 470VA @ 600VAC
455575	475-600VAC	For use in Canada or NE USA where 575V utility power services are common.

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455 SERIES

Specifications

Frequency	50*/60Hz
Low Voltage (% of setpoint)	
Trip	90% ±1%
Reset	93% ±1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2-8% adjustable
Reset	Trip setting minus 1%
Trip Delay Time	
Low & High Voltage and Unbalance	2-30 seconds adjustable
Single-phasing Faults (>25% UB)	2 seconds fixed
Restart Delay Time	
After a Fault	Manual, 2-300 seconds adj.
After a Complete Power Loss	Manual, 2-300 seconds adj.
After a Motor Shut-down	Manual, 2-300 seconds adj.
Output Characteristics	
Output Contact Rating (SPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A
High Voltage Relay (-480R)	
Pilot Duty	470VA @ 600VAC

General Characteristics	
Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Repeat Accuracy	
Fixed Conditions	±0.1%
Maximum Input Power	6 W
Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG
Transient Protection (Internal)	IEC 61000-4-5;1995 ±6kV
Safety Marks	
UL	UL508 (File #E68520)
CSA	C22.2 No. 14 (File #46510)
CE	IEC 60947-6-2
Dimensions	**H** 74.4 mm (2.93"); **W** 133.9 mm (5.27"); **D** 74.9 mm (2.95")
Weight	1.1 lbs. (17.6 oz., 498.95 g)
Mounting Method	#8 screws

*Note: 50Hz will increase all delay times by 20%.

460 SERIES

3-Phase Voltage Monitor

Description

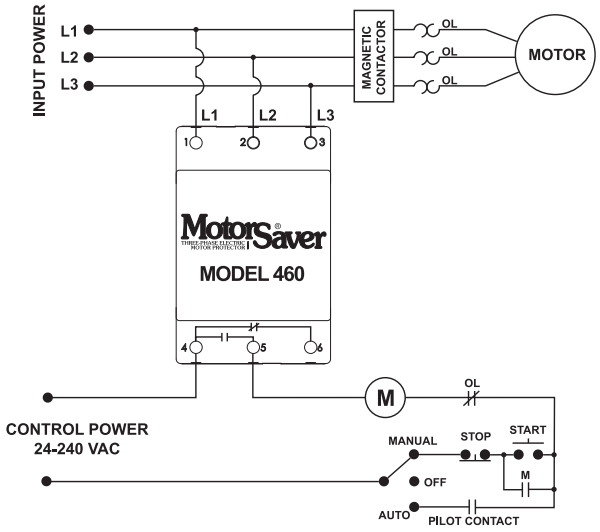
The 460 is a 3-phase voltage monitor that protects 190-480VAC or 475-600V, 50/60Hz motors regardless of size. The product provides a user selectable nominal voltage setpoint and the voltage monitor automatically senses line voltage.

This unique microcontroller-based voltage and phase-sensing device constantly monitors the 3-phase voltages to detect harmful power line conditions such as low, high, and unbalanced voltage, loss of any phase, and phase reversal. When a harmful condition is detected, the MotorSaver® output relay is deactivated after a specified trip delay. The output relay reactivates after power line conditions return to an acceptable level for a specified amount of time (restart delay). The trip and restart delays prevent nuisance tripping due to rapidly fluctuating power line conditions.

All 460 models feature adjustable 1-30 second trip delay, 1-500 second restart delay, 2-8% voltage unbalance trip point, and one form C contact except where noted below.

Wiring Diagram

TYPICAL WIRING DIAGRAM FOR MODEL 460 WITH MOTOR CONTROL



For dimensional drawing see: Appendix, page 510, Figure 10.

Features & Benefits

FEATURES	BENEFITS
Auto-sensing wide voltage range	Automatically senses system voltage between 190 - 480VAC or 475-600VAC. Saves set-up time
Adjustable trip & restart delay settings	Prevent nuisance tripping due to rapidly fluctuating power line conditions
Microcontroller based circuitry	Improved accuracy and higher reliability
Advanced LED diagnostics	Quick visual indicator for cause of trip and relay status
Adjustable voltage unbalance trip setting	Provides reliable protection when regenerative voltage is present

Ordering Information

MODEL	VOLTAGE	DESCRIPTION
460	190-480VAC	Automatically senses line voltage, adjustable 1-30 second trip delay, 1-500 second restart delay, and 2-8% voltage unbalance trip point
460-L	190-480VAC	Fixed 4 second trip delay and 1 second for single-phase faults, and fixed 6% voltage unbalance trip point
460-14	190-480VAC	Equipped with 2 sets of contacts: Form A (NO) and Form B (NC). Used for applications requiring 2 different voltages such as 5VDC for a PLC input and 115VAC for an alarm
460-575	475-600VAC	Commonly used in Eastern Canada and on generator units that generate 600 VAC power
460-575-14	475-600VAC	Commonly used in Eastern Canada and on generator units that generate 600 VAC power. Equipped with 2 sets of contacts: Form A and Form B
460-15	190-480VAC	Equipped with 2 sets of Form A (NO) contacts. Used on applications where two different units are to be controlled at once such as a unit that has separate contacts for a compressor and a fan
460-MR	190-480VAC	Equipped with a 2-prong connection for a normally open push button mounted outside the panel. Used in applications requiring an external manual reset button
460-VBM	190-480VAC	Fixed 6% voltage unbalance trip point. User adjustable low and high voltage trip points
460-400HZ	190-480VAC	For use with 400Hz power supply
460-OEM	190-480VAC	Bulk package of 460, 20 units
460L-OEM	190-480VAC	Bulk package of 460-L, 20 units

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460 SERIES

Specifications

Frequency	50/60Hz
Low Voltage (% of setpoint)	
Trip	90% ±1%
Reset	93% ±1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2-8% adjustable
Reset	Trip setting minus 1% (5-8%) Trip setting minus 0.5% (2-4%)
460L	6% UB fixed (4.5% reset)
Trip Delay Time	
Low, High and Unbalanced Voltage	1-30 seconds adjustable
460L	4 seconds fixed
Single-Phase Faults (>15% UB)	1 second fixed
Restart Delay Time	
After a Fault	1-500 seconds adjustable
After a Complete Power Loss	1-500 seconds adjustable
Output Contact Rating	
Form C	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	10A @ 240VAC
Form A & Form B	
Pilot Duty	360VA @ 240VAC, B300
General Purpose	8A @ 240VAC

Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	6 W
Class of Protection	IP20, NEMA 1 (finger safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	4.5 in.-lbs.
Wire Type	Stranded or solid 12-20 AWG, one per terminal
Standards Passed	
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
RFI, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power and controls
Surge	
IEC	IEC 61000-4-5, Level 3, 4kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947-6-2
Enclosure	Polycarbonate
Dimensions	**H** 88.9 mm (3.5"); **W** 52.9 mm (2.08"); **D** 59.69 mm (2.35")
Weight	0.7 lb. (11.2 oz., 317.51 g)
Mounting Method	35 mm DIN rail or Surface Mount (#6 or #8 screws)
460-MR (manual reset)	External NO pushbutton required.

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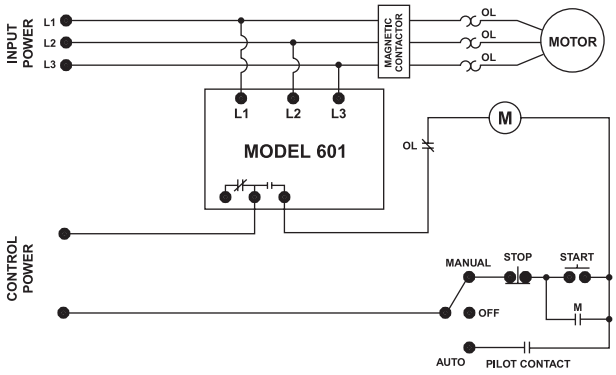
601 SERIES

3-Phase Voltage & Frequency Monitor

Wiring Diagram

MODEL 601 WITH MOTOR CONTROL



For dimensional drawing see: Appendix page 507, Figure 1.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
601	190-480VAC	Universal 3-Phase Voltage & Frequency Monitor
601575	500-600VAC	Used primarily in Canada and NE USA where 575V utility power services are common

Description

The Model 601 is a fully-programmable voltage monitor designed to protect 3-phase motors from loss of any phase (single-phasing), phase reversal, low or high voltage, voltage unbalance, low or high frequency, and rapid cycling. It can be used as a stand-alone product or networked with an RM1000, RM2000, PLC, computer or SCADA system.

When a harmful condition is detected, the 601's output relay is deactivated after the specified trip delay. The output relay reactivates after power line conditions return to an acceptable level for the programmed restart delay (RD2).

Eleven (11) setpoints are viewable with the 3-digit LED display or from a networked device:

- low voltage
- high voltage
- voltage unbalance
- low frequency
- high frequency
- RS485 address
- trip delay for voltage/ frequency faults
- trip delay for single-phase faults
- rapid-cycle timer (RD1)
- restart delay after all faults (RD2)
- type of restart after all faults (manual or automatic)

Six (6) parameters are viewable while the motor is running:

- L1-L2 voltage
- L2-L3 voltage
- L1-L3 voltage
- average voltage
- voltage unbalance (%)
- frequency

When used with the RS485MS-2W communications module, the 601 can communicate with most Modbus RTU master devices. Voltage conditions can be monitored and setpoints can be changed remotely using Solutions software, an RM1000, RM2000 or other device.

Features & Benefits

FEATURES	BENEFITS
Built-in display	Provides real time information and diagnostics to help with troubleshooting
Programmable voltage and frequency settings	Allows usage on wide range of systems
2 programmable restart delay timers	Program separate restart delay time for rapid cycle protection and motor cool down
2 programmable trip delay timers	1 trip delay specifically for Phase Loss/Single-Phase fault condition, 1 trip delay for all other fault conditions
Programmable restart control	Choose between an adjustable automatic or manual restart to best meet individual application needs
Flexible reset	Reset options include pushbutton on relay or remote reset with optional 777-MRSW or OL-RESET remote reset kit
Remote display compatibility	Increases safety through remote display of real-time data and fault history, without the need to open the cabinet. Aids with arc flash safety regulations
Network communications capability	Compatible with RS-485 Modbus communications module

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601 SERIES

Accessories

RS485MS-2W Communication Module
(for limited Modbus capabilities) Required to enable the Modbus communications function on Model 77X-type products.

RM1000 Remote Monitor
The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring for up to 16 devices.

RM2000 Remote Monitor
The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring with event storage and real-time clock for date and time stamp.

777-MRSW Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

OL-RESET Manual Remote Reset Kit
Allows the 777 line of MotorSaver® and PumpSaver® products to be manually reset without opening the panel door.

Specifications

Input Characteristics	
Frequency	50/60Hz
Functional Characteristics	
Programmable Operating Points	
LV - Low Voltage Threshold	170V (450V*) - HV Setting
HV- High Voltage Threshold	LV Setting - 528V (660V*)
VUB - Voltage Unbalance Threshold	2-15% or off
LF - Low Frequency Threshold	35Hz - HF Setting
HF - High Frequency Threshold	LF Setting - 75Hz
TD1 - Trip Delay for Voltage/Unbalance/ Frequency Faults	1-50 seconds
TD2 - Trip Delay for Single-Phase Faults	1-50 seconds
RD1 - Rapid-Cycle Timer	0, 2-500 seconds
RD2 - Restart Delay After All Faults	2-500 seconds
#RF - Type of Restart	Manual or Automatic
ADDR - RS-485 Address	A01-A99
Fixed Reset Points	
Overvoltage Reset	97% of HV Setting
Low Voltage Reset	103% of LV Setting
Voltage Unbalance Reset	UB Setting -1%
Low Frequency Reset	LF Setting +0.6Hz
High Frequency Reset	HF Setting -0.6Hz
Output Characteristics	
Output Contact Rating	
Pilot Duty	480VA @ 240VAC
General Characteristics	
Temperature Range	-20° to 70°C (-4° to 158°F)
Accuracy	
Voltage	±1%
Timing	5% ±1 second
Repeatability	
Voltage	±0.5%
Maximum Input Power	5 W
Transient Protection (Internal)	2500 V for 10 ms
Safety Marks	
UL	UL508 (File #E68520)
CSA	C22.2 No. 14 (File #46510)
CE	IEC 60947-6-2
Dimensions	**H** 77.47 mm (3.05"); **W** 97.79 mm (3.85"); **D** 128.27 mm (5.05")
Weight	1.2 lbs. (19.2 oz., 544.31 g)
Mounting Method	Surface mount (4 - #8 screws) or DIN rail mount

The 601 can be preprogrammed prior to installation by applying at least 120V to the L1 and L2 terminals.

*575V Model

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601-CS-D-P1

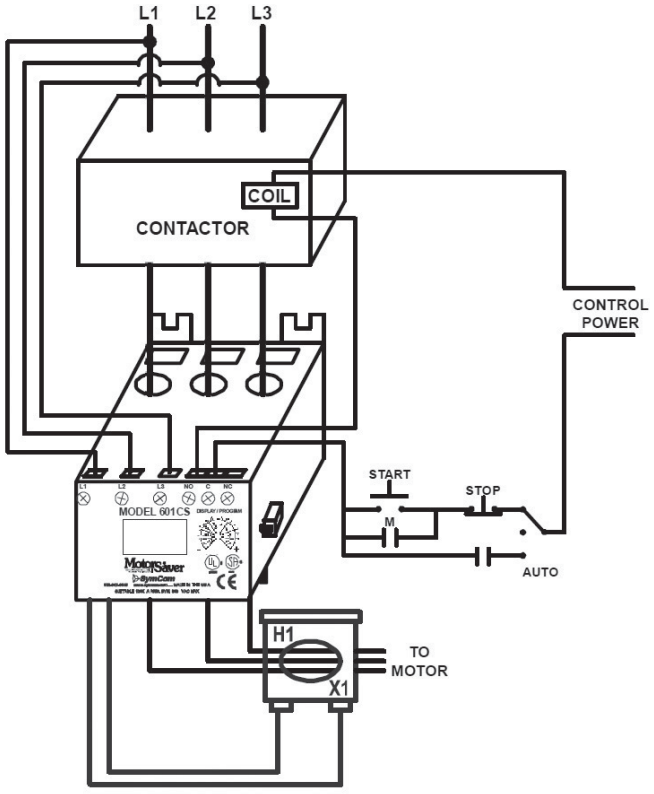
3-Phase Power Monitor

Description

The 601-CS-D-P1 3-phase power monitor is a fully programmable electronic power monitor designed to monitor 3-phase systems. The 601-CS-D-P1 has a single relay that can be configured as a general purpose network output or to trip on ground faults. The 601-CS-D-P1 monitors ground fault current, phase currents, phase voltages, power factor and frequency. The RS485MS-2W communications module allows the 601-CS-D-P1 to communicate using the Modbus RTU protocol. The Modbus connection can be used to monitor power parameters, setup the device or control the fault relay. A DeviceNet™ communications I/O module (CIO-601CS-DN-P1) is available as well. This CIO module only works with the 601-CS-D-P1 unit. It is used for sending the information from the 601-CS-D-P1 over a DeviceNet™ network. It also provides I/O capabilities and the ability to set the parameters of the 601-CS-D-P1.

Note: This product must be used with an external Zero-Sequence CT for proper operation (not included).

Wiring Diagram



For dimensional drawing see: Appendix page 507, Figure 1.

Features & Benefits

FEATURES	BENEFITS
Built-in display	Visual indication for programming and viewing real-time parameters for nominal voltage, voltage unbalance, current, current unbalance, ground fault warning, ground fault trip, and ground fault motor acceleration
15 Programmable parameters to control the device operation	Allows the user to customize the protection required for their system
2 programmable trip delay timers	Program separate trip delay time for motor acceleration and ground fault
Network communications capability	Compatible with Modbus RTU and DeviceNet™ protocols with the use of separate communications module

Accessories

CIO-601CS-DN-P1 Module
Convenient, cost-effective DeviceNet™ interface device capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet™ network.

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601-CS-D-P1

Specifications

Input Characteristics

Line Voltage	200-480VAC
Frequency	50/60Hz
Motor Full Load Amp Range	0.5-175A (direct) 176-800A (CTs required)
Input Ground Fault Current	0.5-10A

Output Characteristics

Output Contact Rating (SPDT)	
Pilot Duty	480VA @ 240VAC
General Purpose	10A @ 240VAC
Expected Life	
Mechanical	1 x 10^6 operations
Electrical	1 x 10^5 operations at rated load

General Characteristics

Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Accuracy at 25° C (77° F)	
Voltage	+/-1%
Current	+/-3% (<175A direct)
GF Current	+/-3%
Repeatability	
Voltage	+/-0.5% of nominal voltage
Current	+/-1% (<175A direct)
Maximum Input Power	10 W
Pollution Degree	3
Class of Protection	IP20
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Terminal Torque	7in.-lbs.

Standards Passed

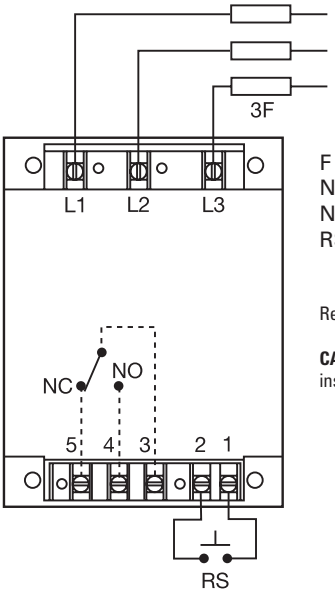
Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Conducted	IEC 61000-4-6, Level 3 10V
Radio Frequency Immunity, Radiated	IEC 61000-4-3, Level 3, 10 V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 3.5kV input power
Short Circuit Rating	100kA rms, SYM, 600VAC max.
Surge Immunity IEC	IEC 61000-4-5, Level 3, 2kV line-to-line; Level 4, 4kV line-to-ground
ANSI/IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kV line-to-line
High Potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947-1, IEC 60947-5-1
Max Conductor Size (with insulation)	0.65"
Dimensions	**H** 77.47 mm (3.05"); **W** 97.79 mm (3.85"); **D** 128.27 mm (5.05")
Weight	1.2 lbs. (19.2 oz., 544.31 g)
Mounting Method	Surface mount (4 - #8 screws) or DIN rail mount

WVM SERIES

Description

The WVM Series provides protection against premature equipment (motor) failure caused by voltage faults on the 3-phase line. The WVM's microcontroller design provides reliable protection even if regenerated voltages are present. It combines dependable fault sensing with a 10 fault memory and a 6 LED status display. Part instrument, part control, the WVM protects your equipment when you're not there and displays what happened when you return. The WVM is fully adjustable and includes time delays to prevent nuisance tripping and improve system operation. Time delays include a 0.25 to 30s adjustable trip delay, an adjustable 0.25 to 64m (in 3 ranges) restart delay, plus a unique 3 to 15s true random start delay. The random start delay prevents voltage sags caused by simultaneous restarting of numerous motor loads after a power outage.

Wiring Diagram



F = Fuses
NO = Normally Open
NC = Normally Closed
RS = Optional Remote Reset Switch

Relay contacts are isolated.

CAUTION: 2 amp max fast acting fuses must be installed externally in series with each input. (3)

For dimensional drawing see: Appendix, page 513, Figure 29.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring to protect against phase loss, phase reversal, over voltage, under voltage, unbalance, and short cycling
Fault memory	Stores the 10 most recent faults, which provides diagnostics for troubleshooting
LED indication	Provides visual indictation of existing relay/fault status or faults stored in memory.
Switch selectable automatic restart, delayed automatic restart, and manual reset	Allows user adjustment to handle unique application requirements
Random start delay	Prevents voltage sags caused by simultaneous restarting of multiple motor loads after a power outage

Operation

The output relay is energized when all conditions are acceptable and the WVM is reset. A restart and/or random start delay may occur before the output relay is energized.

Field Adjustment: Select the line voltage listed on the motor's name plate. This automatically sets the over and undervoltage trip points. No further adjustment should be required to achieve maximum equipment protection.

Ordering Information

MODEL	LINE VOLTAGE	UNBALANCE	TRIP DELAY	SWITCH SELECTABLE RESET METHOD	RESTART DELAY
WVM011AL	500 to 600VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	0.25 - 64s
WVM611AH	200 to 240VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	0.25 - 64m
WVM611AL	200 to 240VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	0.25 - 64s
WVM611RL	200 to 240VAC	2 - 10%	0.25 - 30s	Auto restart upon fault correction	0.25 - 64s
WVM811AH	355 to 425VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	0.25 - 64m
WVM811RL	355 to 425VAC	2 - 10%	0.25 - 30s	Auto restart upon fault correction	0.25 - 64s
WVM911AH	400 to 480VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	0.25 - 64m
WVM911AL	400 to 480VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	0.25 - 64s
WVM911AL-60	400 to 480VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	0.25 - 64s, no random start delay
WVM911AN	400 to 480VAC	2 - 10%	0.25 - 30s	Auto restart upon fault trip	6 - 300s
WVM911RH	400 to 480VAC	2 - 10%	0.25 - 30s	Auto restart upon fault correction	0.25 - 64m
WVM911RL	400 to 480VAC	2 - 10%	0.25 - 30s	Auto restart upon fault correction	0.25 - 64s
WVM911RN-60	400 to 480VAC	2 - 10%	0.25 - 30s	Auto restart upon fault correction	6 - 300s, no random start delay

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WVM SERIES

Read Memory: Fault(s) stored in the memory are indicated when the yellow LED is flashing, up to 10 faults are noted.

Memory Reset: To clear the memory of all faults stored, rotate selector to Clear Memory for 5 seconds. The yellow LED will turn off.

Memory Overload: Only the 10 most recent faults are retained.

Random Start Delay: A new 3 to 15s random start delay is selected by the microcontroller when a fault is corrected and when the operating voltage (L1, L2, L3) is applied to the WVM. A random start delay does not occur when the reset is manual.

Automatic Restart: Upon fault correction, the output will re-energize after a random start delay.

Automatic Restart Upon Fault Trip: When a fault is sensed for the full trip delay, the output de- energizes and a restart delay is initiated. This delay locks out the output for the delay period. Should the fault be corrected by the end of the restart delay, the output will re-energize after a random start delay. A restart delay will also occur when operating voltage (L1, L2, L3) is applied to the WVM.

Manual Reset: After a fault condition is corrected, the WVM can be manually reset. There are two methods; a customer supplied remote switch, or the onboard selector switch.

Manual Reset (Onboard): Rotate selector switch from the Manual Reset position to Auto Restart w/Delay then back again to Manual Reset within 3 seconds. The output will immediately energize.

Remote Reset: Reset (Restart) is accomplished by a momentary contact closure across terminals 1 & 2. The output will immediately energize. Remote switch requirements are ≥10mA @ 20VDC and the reset terminals are not isolated from line voltage. A resistance of ≤20KΩ across terminals 1 & 2 will cause immediate automatic restart.

Automatic Restart Upon Fault Correction: (P/N includes an R) When a fault is sensed for the full trip delay, the output relay de-energizes. Upon correction of the fault, a restart delay begins. At the end of this delay, the output will re-energize after a random start delay. If a fault occurs during restart timing, the restart time delay will be reset to zero, and the output will not energize until the restart delay is completed.

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Specifications

Line Voltage		
Type	3-phase delta or wye with no connection to neutral	
Operating Voltage	**Model**	**Adj. Line Voltage Range**
	240	200-240VAC
	380	355-425VAC
	480	400-480VAC
	600	500-600VAC
AC Line Frequency	50/60 Hz	
Overvoltage, Undervoltage, & Voltage Unbalance		
Overvoltage Trip Point	109-113% of adjusted voltage	
Reset Voltage	-2% of trip point	
Undervoltage Trip Point	88-92% of adjusted voltage	
Reset Voltage	+2% of trip point	
Voltage Unbalance	Adjustable from 2-10%*	
Trip Delay	Adjustable from 0.25 - 30s ±15%	
Phase Loss	≥ 15% unbalance	
Response Time	≤ 200 ms	
Random Start Delay Range	3 - 15s	
Reset (Restart) Delay		
Low Range	0.25-64s ±15%	
Normal Range	6-300s ±15%	
High Range	0.25-64m ±15%	
Fault Memory		
Type	Nonvolatile RAM	
Capacity	Stores last 10 faults	
Status Indicators	6 LEDs provide existing status & memory readout *Note: 50% of operating line voltage must be applied to L1 & L2 for operation of status indicators*	
Output		
Type	Electromechanical relay	
Form	Isolated, SPDT	
Rating	10A resistive @ 250VAC; 6A inductive (0.4 PF) @ 250VAC	
Life	Mechanical - 1 x 10^7	
Protection		
Phase Reversal/Failure	ASME A17.1 Rule 210.6	
Motors and Generators	NEMA MG1 14:30, 14:35	
Surge	IEEE 62.41-1991 Level B	
Isolation Voltage	≥ 2500V RMS input to output	
Mechanical		
Mounting	Surface with 2 or 4 #8 (M4 x 0.7) screws	
Dimensions	**H** 175.3 mm (6.9"); **W** 111.8 mm (4.4"); **D** 61.0 mm (2.4")	
Termination	Screw terminals with captive wire clamps for up to #12 AWG (3.2 mm^2) wire	
Environmental		
Operating/Storage Temperature	-40° to 65°C / -40° to 85°C	
Weight	≅ 25 oz (709 g)	

* Unbalance reset is 90% of the unbalance setting (i.e. VUB at 5% reset is 4.5%)

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DLMU SERIES

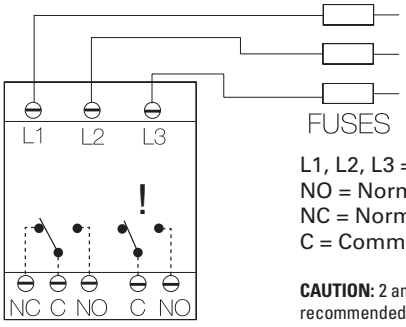
Description

The DLMU Series is a universal voltage, 3-phase voltage monitor. It continuously measures the voltage of each of the three phases with microcontroller accuracy and compares the value to preset trip points. It separately senses phase reversal and loss; over, under and unbalanced voltages; and over or under frequency. Protection is assured during periods of large average voltage fluctuations or when regenerated voltages are present. The unit trips within 200ms when phase loss is detected. Adjustable time delays are included to prevent nuisance tripping and short cycling of sensitive equipment. The isolated, 10A, SPDT and 2A alarm output relay contacts trip when a phase voltage exceeds the trip limits for the trip delay. Nominal line voltage, voltage unbalance, and time delays are knob adjustable. The phase loss setpoint and the acceptable frequency range are fixed. Both delta and wye systems can be monitored; no connection to neutral is required.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring to protect against phase loss, phase reversal, over voltage, under voltage, unbalance, short cycling and over/under frequency
Universal line voltage range	Flexibility to work in 200 to 480VAC or 500 to 600VAC applications
DIN rail (35mm) or surface mounting	Installation flexibility
LED indication	Provides diagnostics of relay, fault and time delay status
User adjustable time delays	Prevents nuisance tripping and short cycling of sensitive equipment

Wiring Diagram



L1, L2, L3 = Line Voltage Input
NO = Normally Open Contact
NC = Normally Closed Contact
C = Common, Transfer Contact

CAUTION: 2 amp max. fast acting fuses are recommended to protect the equipment's wiring. They are not required to protect the DLMU.

! = Select alarm contact connection as N.O. or N.C. when ordering; N.O. Shown.

For dimensional drawing see: Appendix, page 513, Figure 30.

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Ordering Information

MODEL	LINE VOLTAGE	OUTPUT	RESTART FUNCTION	VOLTAGE UNBALANCE	TRIP DELAY	RESTART DELAY
DLMHBRAAA	500 to 600VAC	SPDT & NO	Staggered restart	Adjustable 2 - 10%	Adjustable 1 - 30s	Adjustable 0.6 - 300S
DLMUBLAAA	200 to 480VAC	SPDT & NO	Lockout, min off time	Adjustable 2 - 10%	Adjustable 1 - 30s	Adjustable 0.6 - 300S
DLMUBNAAN	200 to 480VAC	SPDT & NO	No restart delay	Adjustable 2 - 10%	Adjustable 1 - 30s	None
DLMUBRAAA	200 to 480VAC	SPDT & NO	Staggered restart	Adjustable 2 - 10%	Adjustable 1 - 30s	Adjustable 0.6 - 300S

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DLMU SERIES

Operation

Upon application of line voltage, the output is de-energized and the restart delay begins. If all the 3-phase voltages are within the acceptable range, the output energizes at the end of the restart delay. The microcontroller circuitry automatically senses the voltage range, and selects the correct operating frequency (50 or 60Hz). The over and undervoltage trip points are set automatically. When the measured value of any phase voltage exceeds the acceptable range limits (lower or upper) the trip delay begins. At the end of the trip delay the output relay de-energizes. If the phase voltage returns to an acceptable value before the trip delay expires, the trip delay is reset and the output remains energized. Under, over, and unbalanced voltages plus over or under frequency must be sensed for the complete trip delay before the unit trips. The unit trips in 200ms when phase loss or reversal are sensed. The unit will not energize if a fault is sensed as the line voltage is applied.

Reset: Reset is automatic upon correction of the voltage or frequency fault or phase sequence.

Restart Delay Options

L = Lockout or minimum OFF time. The restart delay begins when the output trips. The unit cannot be re-energized until the restart delay is complete. This provides a minimum off time or lockout time to allow equipment sensitive to short cycling, time to reset. If the fault is corrected after the restart delay is complete the output energizes immediately. The restart delay also occurs when line voltage is applied/reapplied.

R = Restart Delay on fault correction. The restart delay begins when line voltage is reapplied or when a voltage fault is corrected. This option is normally selected when staggered restarting of multiple motors on a power system is required.

N = No Restart Delay. 0.6 second initialization delay on application of line voltage applies.

Restart Notes: All restart options remain reset when the following conditions are detected:

1. Phase loss (phase unbalance greater than 25%)
2. Average line voltage less than 120VAC
3. Phase reversal

The restart delay begins when the condition is corrected.

LED Operation

The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed. If a fault is sensed during the restart delay, the LED will glow red during that portion or the full restart delay.

Specifications

Line Voltage

Type — 3-phase delta or wye with no connection to neutral

Operating Voltage

200-480VAC

Range	Voltage Adj.Range	Line Frequency	Line Voltage Max.
240	200-240VAC	50/60Hz	
380	340-420VAC	50Hz	
480	400-480VAC	60Hz	550VAC
600	500-600VAC	50/60Hz	600VAC

600VAC

AC Line Frequency — 50/60 Hz automatically detected
Phase Loss — ≥ 25% unbalance
Response Time — ≤200ms

Undervoltage & Voltage Unbalance

Type — Voltage detection with delayed trip & automatic reset

Overvoltage
TripVoltage — 109 - 113% of the adjusted line voltage
Reset Voltage — ≅ -3% of the trip voltage

Undervoltage
Trip Voltage — 88 - 92% of the adjusted line voltage
Reset Voltage — ≅ +3% of the trip voltage
Voltage Unbalance — Adjustable 2 - 10% or specify fixed unbalance of 2 - 10% in 1% increments
Reset on balance — ≅ -0.7% unbalance

Trip Delay
Active On — Over/undervoltage, voltage unbalance, over/under frequency
Range — Adjustable from 1 - 30s or specify fixed delay 1 - 30s in 1s increments
Tolerance — ± 15%

Restart Delay
Range — Adjustable from 0.6 - 300s; if no restart delay is selected a 0.6s initialization delay applies
Tolerance — ± 15%
Over/Under Frequency — ±4%; Reset ±3%; 50/60 Hz
Phase Sequence — A, B, C, L1, L2, L3
Response Time -Phase Reversal & Phase Loss — ≤200 ms
Reset — Automatic

Output
Type — Isolated Electromechanical Relay
Form C — Isolated, SPDT
Form C Rating — 10A resistive @ 240VAC; 8A resistive @ 277VAC; NO-1/4 hp @ 120VAC; 1/3 hp @ 240VAC

Form A — Isolated, NO, SPST
Form A Rating — 2A @ 277VAC
Life — Mechanical - 1 x 10^6; Electrical - 1 x 30^3

DLMU SERIES

Protection	
Phase Reversal/Failure	ASME A17.1 Rule 210.6
Motors and Generators	NEMA MG1 14:30, 14:35
Surge	IEEE C62.41-1991 Level B
Isolation Voltage	≥ 2500V RMS input to output
Mechanical	
Mounting	Surface mount with 2 #8 (M4 x 0.7) screw or snap on 35mm DIN Rail *Note: 0.25 in.(6.35 mm) spacing between units or other devices is required*
Dimensions	**H** 110 mm (4.33"); **W** 75 mm (2.95"); **D** 50 mm (1.97")
Termination	Screw terminals with captive wire clamps for up to #14 AWG (2.5 mm^2) wire
Terminal Torque	4.4 in.-lbs.
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 8.6 oz (244 g)

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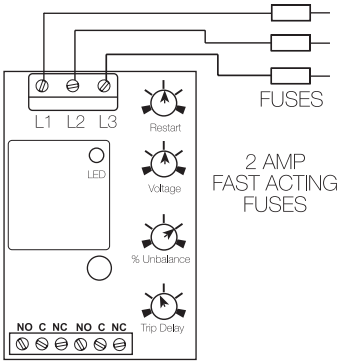
HLMU SERIES

Description

The HLMU Series is a universal voltage, encapsulated, 3-phase voltage monitor. It continuously measures the voltage of each of the three phases with microcontroller accuracy and compares the value to preset trip points. It separately senses phase reversal and loss; over, under and unbalanced voltages; and over or under frequency. Protection is assured during periods of large average voltage fluctuations, or when regenerated voltages are present. The unit trips within 200ms when phase loss is detected. Adjustable time delays are included to prevent nuisance tripping and short cycling of sensitive equipment. The isolated, 10A, DPDT relay contacts trip when a phase voltage exceeds the trip limits for the trip delay. Nominal line voltage, voltage unbalance, and time delays are knob adjustable. The phase loss setpoint and the acceptable frequency range are fixed. Both delta and wye systems can be monitored; no connection to neutral is required.

Wiring Diagram



L1, L2, L3 = Line Voltage Input
NO = Normally Open Contact
NC = Normally Closed Contact
C = Common, Transfer Contact

CAUTION: 2 amp max. fast acting fuses are recommended to protect the equipment's wiring. They are not required to protect the HLMU.

NOTE: Relay contacts are isolated, 277VAC max.

For dimensional drawing see: Appendix, page 513, Figure 31.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring to protect against phase loss, phase reversal; over, under, and unbalanced voltage; over and under frequency
Universal line voltage range	Flexibility to work in 200 to 480VAC applications
DIN rail (35mm) or surface mounting	Installation flexibility
LED indication	Provides diagnostics of relay, fault and time delay status
Encapsulated	Protects against shock, vibration, and humidity
Finger-safe terminal blocks	Meets IEC 61000 safety requirements

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 VAC/500 VDC

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	OUTPUT	RESTART FUNCTION	VOLTAGE UNBALANCE	TRIP DELAY	RESTART DELAY
HLMUDLAAA	DPDT	Lockout, min off time	Adjust. 2 - 10%	Adjust. 1 - 30s	Adjust. 0.6 - 300s
HLMUDN0405N	DPDT	No restart delay	Fixed, 4%	Fixed, 5s	None
HLMUDNAAN	DPDT	No restart delay	Adjust. 2 - 10%	Adjust. 1 - 30s	None
HLMUDRAAA	DPDT	Staggered restart	Adjust. 2 - 10%	Adjust. 1 - 30s	Adjust. 0.6 - 300s

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HLMU SERIES

Operation

Upon application of line voltage, the output is de-energized and the restart delay begins. If all the three-phase voltages are within the acceptable range, the output energizes at the end of the restart delay. The microcontroller circuitry automatically senses the voltage range, and selects the correct operating frequency (50 or 60Hz). The over and under voltage trip points are set at ± 10% of the adjusted line voltage. When the measured value of any phase voltage exceeds the acceptable range limits (lower or upper) the trip delay begins. At the end of the trip delay the output relay de-energizes. If the phase voltage returns to an acceptable value before the trip delay expires, the trip delay is reset and the output remains energized. Under, over, and unbalanced voltages plus over or under frequency must be sensed for the complete trip delay before the unit trips. The unit trips in 200ms when phase loss or reversal are sensed. The unit will not energize if a fault is sensed as the line voltage is applied.

Reset: Reset is automatic upon correction of the voltage or frequency fault or phase sequence.

Restart Delay Options

L = Lockout or minimum OFF time. The restart delay begins when the output trips. The unit cannot be re-energized until the restart delay is complete. This provides a minimum off time or lockout time to allow equipment sensitive to short cycling, time to reset. If the fault is corrected after the restart delay is complete, the output energizes immediately. The restart delay also occurs when line voltage is applied/reapplied.

R = Restart Delay on fault correction. The restart delay begins when line voltage is reapplied or when a voltage fault is corrected. This option is normally selected when staggered restarting of multiple motors on a power system is required.

N = No Restart Delay. 0.6 second initialization delay on application of line voltage applies.

Restart Notes: All restart options remain reset when the following conditions are detected:

1. Phase loss (phase unbalance greater than 25%)
2. Average line voltage less than 120VAC
3. Phase reversal

The restart delay begins when the condition is corrected.

LED Operation

The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed. If a fault is sensed during the restart delay, the LED will glow red during that portion or the full restart delay.

Specifications

Line Voltage

Type	3-phase delta or wye with no connection to neutral
Operating Voltage	
200 - 480VAC	

Range	Voltage Adj. Range	Frequency
240	200-240VAC	50 or 60Hz
380	340-420VAC	50Hz
480	400-480VAC	60Hz

Line Voltage Max.	550VAC
AC Line Frequency	50/60 Hz automatically detected
Phase Loss	≥ 25% unbalance
Response Time	≤200ms

Undervoltage & Voltage Unbalance

Type	Voltage detection with delayed trip & automatic reset
Overvoltage	
Trip Voltage	109 - 113% of the adjusted line voltage
Reset Voltage	≅ -3% of the trip voltage
Undervoltage	
Trip Voltage	88 - 92% of the adjusted line voltage
Reset Voltage	≅ +3% of the trip voltage
Voltage Unbalance	
Trip Setpoint	Adjustable 2 - 10% or specify fixed unbalance of 2 - 10% in 1% increments
Reset on Balance	≅ -0.7% unbalance
Trip Delay	
Active On	Over/undervoltage, voltage unbalance, over/under frequency
Range	Adjustable from 1 - 30s or specify fixed delay 1 - 30s in 1s increments
Tolerance	± 15%
Restart Delay	
Range	Adjustable from 0.6 - 300s; if no restart delay is selected a 0.6s initialization delay applies
Tolerance	± 15%
Over/Under Frequency	±4%; Reset ±3%; 50/60 Hz
Phase Sequence	A, B, C, L1, L2, L3
Response Time-Phase Reversal & Phase Loss	≤200 ms
Reset	Automatic

Output

Type	Isolated Electromechanical Relay
Form	DPDT
Rating	10A resistive @ 240VAC; 8A resistive @ 277VAC; NO-1/4 hp @ 120VAC; 1/3 hp @ 240VAC
Life	Mechanical - 1 x 10^6 Electrical (at 10A) - DPDT - 1 x 30^3

Protection

Phase Reversal/Failure	ASME A17.1 Rule 210.6
Motors and Generators	NEMA MG1 14:30, 14:35
Surge	IEEE C62.41-1991 Level B
Isolation Voltage	≥ 2500V RMS input to output
Circuitry	Encapsulated

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.7) screw *Note: 0.25 in.(6.35 mm) spacing between units or other devices is required*
Dimensions	**H** 76.7 mm (3.0"); **W** 50.8 mm (2.0"); **D** 41.7 mm (1.64")
Termination	Screw terminal connection up to 12 AWG (3.3 mm^2) wire

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

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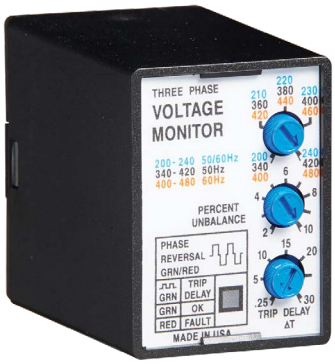
PLMU11

Voltage Monitor



8-PIN

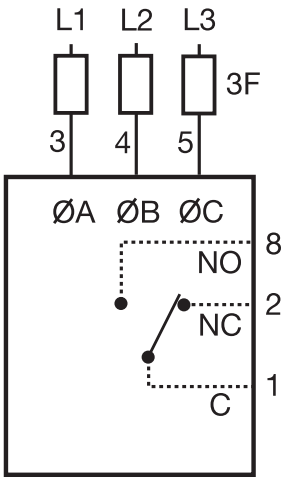
Description

The PLMU11 continuously measures the voltage of each of the three phases to provide protection for 3-phase motors and sensitive loads. Its microcontroller senses under and overvoltage, voltage unbalance, phase loss, and phase reversal. Protection is provided even when regenerated voltages are present. Universal voltage operation and standard base connection allows the PLMU11 to replace hundreds of competitive part numbers.

Operation

Upon application of power, a 0.6s random start delay begins and the PLMU11 measures the voltage levels and line frequency and selects the voltage range. The output relay is energized and the LED glows green when all voltages are acceptable and the phase sequence is correct. LED flashes green during trip delay, glows red when output de-energizes. Undervoltage, overvoltage, and voltage unbalance must be sensed for continuous trip delay before the relay de-energizes. Re-energization is automatic upon fault correction. The output relay will not energize if a fault condition is sensed as 3-phase input voltage is applied. The LED alternately flashes red/green when phase reversal is sensed. Line voltage is selected with the knob, setting the over and under voltage trip points. Voltage range is automatically selected by the microcontroller.

Wiring Diagram



F = Fuses
ØA = Phase A = L1
ØB = Phase B = L2
ØC = Phase C = L3
NO = Normally Open
NC = Normally Closed

2A fast acting fuses recommended for safety (not required).

Relay contacts are isolated

For dimensional drawing see: Appendix, page 513, Figure 32.

LED Indicator	
Steady Green	Energized
Steady Red	De-engergized (tripped on fault)
Flashing Green	Trip Delay
Alternate Flashing Red/Green	Phase Reversal

Features & Benefits

FEATURES	BENEFITS
Quick octal 8-pin mounting	Small footprint with universal mounting: ideal replacement for hundreds of competitive part numbers.
Proprietary microcontroller based circuitry	Constant monitoring of single-phase, low voltage, high voltage, voltage unbalance, phase reversal.
LED diagnostics	Quick visual indicator for cause of trip. LED indications include: normal operation, trip delay, phase reversal, fault
Isolated, 10A, SPDT output contacts	Allows control of loads for AC voltages
Simple 3-wire connection for delta or wye systems	Allows flexibility across wide range of systems
ASME A17.1 Rule 210.6	Complies with safety codes for elevators, escalators, moving walkways
NEMA MG1 14:30, 14:35	Complies with safety codes for motors and generators
IEEE C62.41-1991 Level B	Complies with safety codes for surge and voltage protection

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PLMU11

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8-pin or 11-pin plug-in timers, flashers, and other controls.

OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Specifications

Line Voltage

Type	3-phase delta or wye with no connection to neutral
Line Voltage	200 to 480VAC ±15%, 50/60 Hz ±2 Hz
Adjustable Voltage Ranges (Automatic Range Selection)	200 to 240VAC, 50/60 Hz 340 to 420VAC, 50 Hz 400 to 480VAC, 60 Hz
Maximum Voltage	552VAC
Phase Sequence	ABC
Power Consumption	≤ 5W

Overvoltage, Undervoltage, & Voltage Unbalance

Type	Voltage detection with delayed trip and automatic reset
Overvoltage & Undervoltage	
Undervoltage Trip Point	88 - 92% of adjusted line voltage
Reset Voltage	+2% of trip voltage
Overvoltage Trip Point	109 - 113% of adjusted line voltage
Reset Voltage	-2% of trip voltage
Voltage Unbalance Trip Point	Adjustable from 2 - 10%
Reset on Balance (%)	

Selected Unbalance	2	3	4	5	6	7	8	9	10
Reset	1.5	2.5	3.5	4.5	5.4	6.3	7.2	8.1	9

Trip Delay Range	Adjustable from 0.25 - 30s
Severe Unbalance - 2X Selected Unbalance	0.25 - 2s; disabled when the trip delay is less than 2s
Random Start Delay	≅ 0.6s
Phase Reversal & Phase Loss Trip Time	≤ 150ms
Phase Loss Setpoint	≥ 15% unbalance
Reset Type	Automatic
Output Type	Energized when voltages are acceptable
Type	Electromechanical relay
Form	Isolated, SPDT
Rating	10A resistive @ 240VAC; 1/4 hp @ 125VAC; 1/3 hp @ 250VAC; max. 277VAC
Life	Mechanical - 1 x 10^6 ; Electrical - 1 x 10^5

Protection

Surge	IEEE C62.41-1991 Level B
Isolation Voltage	≥ 2500V RMS input to output

Mechanical

Mounting*	Plug-in socket rated 600VAC
Termination	Octal 8-pin plug-in
Dimensions	**H** 77.0 mm (3.03"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Weight	≅ 8.6 oz (244 g)

*CAUTION: Select an octal socket rated for 600VAC operation.

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PLM SERIES

Voltage Monitor

8-PIN

Description

The PLM Series is a 3-phase voltage monitor that continuously monitors each of the three phases. Monitors both delta and wye systems and no connection to neutral is required. The microcontroller circuit design protects against undervoltage, voltage unbalance, phase loss and phase reversal. Protection is assured when regenerated voltages are present.

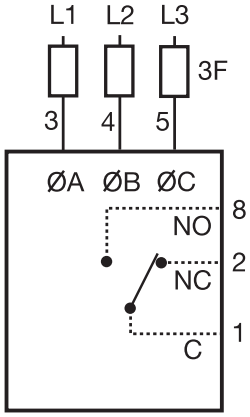
Operation

The output relay is energized and the LED glows green when all voltages are acceptable and the phase sequence is correct. Under and unbalanced voltages must be sensed for a continuous trip delay period before the relay de-energizes. Reset is automatic upon correction of the fault condition. The output relay will not energize if a fault condition is sensed as power is applied. The LED flashes red during the trip delay, then glows red when the output de-energizes. The LED flashes green/red if phase reversal is sensed.

Field Adjustment

Set voltage adjustment knob at the desired operating line voltage for the equipment. This adjustment automatically sets the undervoltage trip point. Apply power. If the PLM fails to energize, (LED glows red) check wiring of all three phases, voltage, and phase sequence. If phase sequence is incorrect, the LED flashes green/red. To correct this, swap any two line voltage connections at the mounting socket. No further adjustment should be required.

Wiring Diagram



F = Fuses
ØA = Phase A = L1
ØB = Phase B = L2
ØC = Phase C = L3
NO = Normally Open
NC = Normally Closed

2A fast acting fuses recommended for safety (not required).

Relay contacts are isolated

For dimensional drawing see: Appendix, page 512, Figure 23.

Ordering Information

MODEL	LINE VOLTAGE	VOLTAGE UNBALANCE (FIXED)	TRIP DELAY (FIXED)
PLM6405	240VAC	4%	5 sec
PLM6502	240VAC	5%	2 sec
PLM6805	240VAC	8%	5 sec
PLM8405	380VAC	4%	5 sec
PLM9405	480VAC	4%	5 sec
PLM9502	480VAC	5%	2 sec
PLM9805	480VAC	8%	5 sec

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Features & Benefits

FEATURES	BENEFITS
Quick octal 8-pin mounting	Small footprint with universal mounting: ideal replacement for hundreds of competitive part numbers.
Proprietary microcontroller based circuitry	Constant monitoring of single-phase, low voltage, high voltage, voltage unbalance, phase reversal.
LED diagnostics	Quick visual indicator for trip versus normal operation.
Isolated, 10A, SPDT output contacts	Allows control of loads for AC voltages
Adjustable nominal voltage set point	Allows setting for specific application voltage to optimize protection
Simple 3-wire connection for delta or wye systems	Allows flexibility across wide range of systems
ASME A17.1 Rule 210.6	Complies with safety codes for elevators, escalators, moving walkways
NEMA MG1 14:30, 14:35	Complies with safety codes for motors and generators
IEEE C62.41-1991 Level B	Complies with safety codes for surge and voltage protection

PLM SERIES

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- pin or 11-pin plug-in timers, flashers, and other controls.

OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Specifications

Line Voltage

Type: 3-phase delta or wye with no connection to neutral

Operating Voltage

Model	Adj. Line Voltage Range	Line Voltage Max
240	200-240VAC	270VAC
380	360-430VAC	480VAC
480	400-480VAC	530VAC

AC Line Frequency: 50/100 Hz
Phase Sequence: ABC
Power Consumption: ≅ 2W for 240V units
≅ 3W for 380 - 480V units

Low Voltage & Voltage Unbalance

Type: Voltage detection with delayed trip & automatic reset

Low Voltage
Trip: 88 - 92% of adjusted line voltage
Reset Voltage: Plus 3% of trip voltage

Voltage Unbalance
Trip: Factory fixed from 4 - 8%
Reset on Balance: -0.7% unbalance typical

Trip Delay
Range: Factory fixed from 2 - 20s
Tolerance: ±15%

Phase Reversal & Phase Loss

Response Time: ≤ 200ms
Phase Loss: > 35% unbalance
Reset: Automatic

Output

Type: Electromechanical relay
Form: Isolated, SPDT
Rating: 10A resistive @ 240VAC, 277VAC max; 1/2 Hp @ 240VAC; 1/4 Hp @ 120VAC
Life: Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Surge: IEEE C62.41-1991 Level B
Isolation Voltage: ≥ 2500V RMS input to output

Mechanical

Mounting*: 8-pin plug-in socket rated 600VAC
Dimensions: **H** 81.3 mm (3.2"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")

Environmental

Operating/Storage Temperature: -40° to 60°C / -40° to 85°C
Weight: ≅ 4.4 oz (125 g)

*CAUTION: Select an octal socket rated for 600VAC operation.

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TVW SERIES

Description

The TVW Series Provides protection for motors and other sensitive loads. Continuously measures the voltage of each of the three phases using a microcontroller circuit design that senses under and overvoltage, voltage unbalance, phase loss, and phase reversal. Protection is provided even when regenerated voltages are present. Includes a trip delay to prevent nuisance tripping and a restart delay to prevent short cycling after a momentary power outage.

Operation

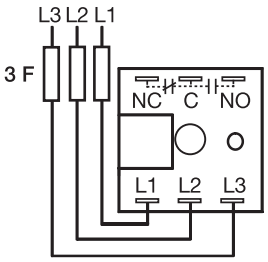
Upon application of line voltage, the restart delay begins. The output is de-energized during restart delay. Under normal conditions, the output energizes after the restart delay. Undervoltage, overvoltage, and voltage unbalance must be sensed for the complete trip delay period before the output de-energizes. The restart delay begins as soon as the output de-energizes. If the restart delay is completed when a fault is corrected, the output energizes immediately. The output will not energize if a fault is sensed as the input voltage is applied. If the voltage selector is set between two voltage marks (i.e. between 220 and 230V), the LED will flash red rapidly. The TVW provides fault protection at the lower of the two line voltages (i.e. 220V).

Reset: Reset is automatic upon correction of a fault.

LED Operation

The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed. If the voltage selector knob is between settings, it rapidly flashes red.

Wiring Diagram



L1 = Phase A
L2 = Phase B
L3 = Phase C
NO = Normally Open
NC = Normally Closed
C = Common, Transfer Contact

Relay contacts are isolated.

F = 2A Fast acting fuses are recommended, but not required

For dimensional drawing see: Appendix, page 514, Figure 44.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring to protect against phase loss, phase reversal; over, under, and unbalanced voltage; short cycling
Compact design measures 2 in. (50.8mm) square	Perfect for OEM applications where cost, size and ease of installation are important
LED indication	Provides diagnostics of relay, fault and time delay status
Encapsulated	Protects against shock, vibration and humidity

Ordering Information

MODEL	LINE VOLTAGE	VOLTAGE UNBALANCE	TRIP DELAY	RESTART DELAY
TVW5103S5S	208 to 240VAC Selectable	Fixed, 10%	Fixed, 3s	Fixed, 5s
TVW575S1M	208 to 240VAC Selectable	Fixed, 7%	Fixed, 5s	Fixed, 1m
TVW6510S0.4S	208, 220, 230, 240VAC	Fixed, 5%	Fixed, 10s	Fixed, 0.4s
TVW8510S0.4S	380, 400 & 415VAC	Fixed, 5%	Fixed, 10s	Fixed, 0.4s
TVW9510S0.4S	430, 440, 460, 480VAC	Fixed, 5%	Fixed, 10s	Fixed, 0.4s

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TVW SERIES

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VRM6048 Voltage Reduction Module
Allows the voltage monitor to monitor a 3-phase 550 to 600VAC Line.

Specifications

Line Voltage

Type	3-phase delta or wye with no connection to neutral
Input Voltage/Tolerance	208 to 480VAC in 4 ranges/-30% - 20%
AC Line Frequency	50 - 100 Hz
Phase Sequence	ABC
Power Consumption	Approx. 2W for 240V units Approx. 3W for 480V units

Overvoltage, Undervoltage, & Voltage Unbalance

Overvoltage & Undervoltage	Voltage detection with delay trip & automatic reset
Undervoltage Trip Point	88 - 92% of the selected line voltage
Reset Voltage	≅ +3% of trip voltage
Overvoltage Trip Point	109 - 113% of the selected line voltage
Reset Voltage	≅ -3% of trip voltage
Trip Variation vs Temperature	≤ ±2%
Voltage Unbalance	Factory fixed, from 4 - 10%
Reset On Balance	≅ -0.7% unbalance
Trip Delay Range	Fixed from 0.2 - 100s ±15% or ±0.1s, whichever is greater
Restart Delay Range	Fixed from 0.4s - 999m ±15% or ±0.2s, whichever is greater
Phase Reversal & Phase Loss Response	≤ 200ms; automatic reset
Phase Loss	≥ 25% unbalance

Output

Type	Isolated, SPDT
Rating	
208 to 240VAC (55°C)	10A resistive @ 125VAC, 5A @ 250VAC, 1/4 hp @ 125VAC
380 to 480VAC	10A resistive @ 240VAC, 1/4 hp @ 125VAC, 1/3 hp @ 250VAC, max. voltage 277VAC
Life	Mechanical - 1 x 10^6; Electrical - 1 x 10^5

Protection

Phase Reversal/Failure	ASME A17.1 Rule 210.6
Motors and Generators	NEMA MG1 14:30, 14:35
Surge	IEEE C62.41-1991 Level B
Dielectric Breakdown	
208 to 240VAC	≥ 1500V RMS input to output terminals
380 to 480VAC	≥ 2500V RMS input to output terminals

Mechanical

Mounting	Surface mount with one #8 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 31.75 mm (1.25")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 55°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.8 oz (79 g)

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TVM SERIES

Description

The TVM Series Provides protection for motors and other sensitive loads. Continuously measures the voltage of each of the three phases using a microcomputer circuit design that senses under and overvoltage, voltage unbalance, phase loss, and phase reversal. Protection is provided even when regenerated voltages are present. Includes a trip delay to prevent nuisance tripping and a restart delay to prevent short cycling after a momentary power outage.

Operation

Upon application of line voltage, the restart delay begins. The output relay is de-energized during restart delay. Under normal conditions, the output energizes after restart delay. Undervoltage, overvoltage, and voltage unbalance must be sensed for continuous trip delay period before the output is de-energized. The output will not de-energize if a fault is corrected during the trip delay. The restart delay begins as soon as the output relay de-energizes. If the restart delay is completed when the fault is corrected, the output relay will energize immediately.

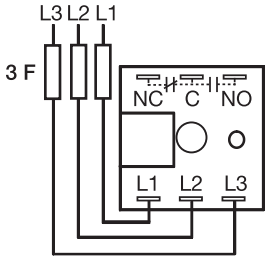
The output relay will not energize if a fault or phase reversal is sensed as 3-phase input voltage is applied.

Reset: Reset is automatic upon correction of a fault.

LED Operation

The LED flashes green during the restart delay, then glows green when the output energizes. It flashes red during the trip delay then glows red when the output de-energizes. It flashes red/green if phase reversal is sensed.

Wiring Diagram



L1 = Phase A
L2 = Phase B
L3 = Phase C
NO = Normally Open
NC = Normally Closed
C = Common, Transfer Contact

Relay contacts are isolated.

F = 2A Fast acting fuses are recommended, but not required

For dimensional drawing see: Appendix, page 514, Figure 44.

Features & Benefits

FEATURES	BENEFITS
Proprietary microcontroller based circuitry	Constant monitoring to protect against phase loss, phase reversal; over, under, and unbalanced voltage; short cycling
Compact design measures 2 in. (50.8mm) square	Perfect for OEM applications where cost, size and ease of installation are important
LED indication	Provides diagnostics of relay, fault and time delay status
Encapsulated	Protects against shock, vibration and humidity

Ordering Information

MODEL	LINE VOLTAGE	VOLTAGE UNBALANCE	TRIP DELAY	RESTART DELAY
TVM208A100.5S3S	208VAC	10%	0.5s	3s
TVM230A101S1S	230VAC	10%	1s	1s
TVM460A41S5M	460VAC	4%	1s	5m
TVM460A75S2M	460VAC	7%	5s	2m
TVM480A45S5S	480VAC	4%	5s	5s
TVM480A100.5S3S	480VAC	10%	0.5s	3s

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TVM SERIES

Accessories

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VRM6048 Voltage Reduction Module
Allows the voltage monitor to monitor a 3-phase 550 to 600VAC Line.

Specifications

Line Voltage	
Type	3-phase delta or wye with no connection to neutral
Input Voltage	208 to 480VAC
AC Line Frequency	50 - 100 Hz
Phase Sequence	ABC
Power Consumption	Approx. 2W for 240V units Approx. 3W for 480V units
Overvoltage, Undervoltage, & Voltage Unbalance	
Overvoltage & Undervoltage	Voltage detection with delay trip & automatic reset
Undervoltage Trip Point	88 - 92% of the selected line voltage
Reset Voltage	≅ +3% of trip voltage
Overvoltage Trip Point	109 - 113% of the selected line voltage
Reset Voltage	≅ -3% of trip voltage
Trip Variation vs Temperature	≤ ±2%
Voltage Unbalance	Factory fixed from 4 - 10%
Reset On Balance	≅ -0.7% unbalance
Trip Delay Range	Fixed from 0.2 - 100s ±15% or ±0.1s, whichever is greater
Restart Delay Range	Fixed from 0.5s - 999m ±15% or ±0.2s, whichever is greater
Phase Reversal & Phase Loss Response	≤ 200ms; automatic reset
Phase Loss	≥ 25% unbalance
Output	
Type	Isolated SPDT relay contacts
Rating	
208 to 240VAC (55°C)	10A resistive @ 125VAC, 5A @ 250VAC, 1/4 hp @ 125VAC
380 to 480VAC	10A resistive @ 240VAC, 1/4 hp @ 125VAC, 1/3 hp @ 250VAC, max. voltage 277VAC
Life	Mechanical - 1 x 10^6; Electrical - 1 x 10^5
Protection	
Phase Reversal/Failure	ASME A17.1 Rule 210.6
Motors and Generators	NEMA MG1 14:30, 14:35
Surge	IEEE C62.41-1991 Level B
Dielectric Breakdown	
208 to 240VAC	≥ 1500V RMS input to output terminals
380 to 480VAC	≥ 2500V RMS input to output terminals
Mechanical	
Mounting	Surface mount with one #8 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 31.75 mm (1.25")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 55°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.8 oz (79 g)

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PLR SERIES

8-PIN

Description

The PLR Series provides a cost effective means of preventing 3-phase motor startup during adverse voltage conditions. Proper A-B-C sequence must occur in order for the PLR's output contacts to energize. In addition, the relay will not energize when an undervoltage or phase loss condition is present. The PLR Series protects a motor against undervoltage operation. The adjustment knob sets the undervoltage trip point.

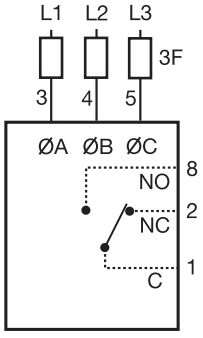
Operation

The output relay is energized and the LED glows when all voltages are acceptable and the phase sequence is correct. Undervoltage must be sensed for a continuous dropout delay period before the relay de-energizes. Reset is automatic upon correction of the fault condition. The output relay will not energize if a fault condition is sensed as power is applied.

Field Adjustment: Turn the adjustment knob fully counterclockwise and apply three-phase power. The LED should be ON. Increase adjustment until the LED goes OFF. Decrease adjustment until LED glows again. If nuisance tripping occurs, decrease the adjustment slightly.

NOTE: When properly adjusted and operating in an average system, a voltage unbalance of 10% or more is required for phase loss detection. When a phase is lost while the motor is running, a voltage will be induced into the open phase nearly equal in magnitude to the normal phase-to-phase voltage. This condition is known as regeneration. When regenerated voltages are present, the voltage unbalance during single phasing may not exceed 10% for some motors. The PLR Series may not provide protection under this condition. For systems that require superior phase loss protection, select the PLMU Series.

Wiring Diagram



F = Fuses
ØA = Phase A = L1
ØB = Phase B = L2
ØC = Phase C = L3
NO = Normally Open
NC = Normally Closed

Relay contacts are isolated

2A fast acting fuses recommended for safety (not required).

For dimensional drawing see: Appendix, page 512, Figure 23.

Features & Benefits

FEATURES	BENEFITS
Continuous monitoring	Prevents 3-phase motor startup when undervoltage or phase loss condition is present
Industry standard 8-pin octal plug connection	Eliminates need for special connectors
LED indication	Quick visual indication of output status and correct phase sequence

Ordering Information

MODEL	LINE VOLTAGE
PLR120A	95 to 140VAC
PLR240A	190 to 270VAC
PLR380A	340 to 450VAC
PLR480A	380 to 500VAC

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PLR SERIES

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

OT08PC Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 600VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Specifications

Line Voltage

Type	3-phase delta or wye with no connection to neutral

Nominal Voltage	**Undervoltage Dropout Adj. Range**	**Line Voltage Max.**
120VAC	85 to 130VAC	143VAC
240VAC	170 to 240VAC	270VAC
380VAC	310 to 410VAC	480VAC
480VAC	350 to 480VAC	530VAC

AC Line Frequency	50/60Hz
Phase Sequence	ABC
Response Times	
Pull-in	≤ 400ms
Drop-out	≤ 100ms
Hysterisis	
Pull-in/Drop-out	≅ 2%
Output	
Type	Electromechanical relay, energized when all voltages are acceptable
Form	SPDT
Rating	5A resistive @ 240VAC, 1/4 Hp @ 120VAC
Maximum Voltage	250VAC
Protection	
Phase Reversal/Failure	ASME A17.1 Rule 210.6
Motors and Generators	NEMA MG1 14:30, 14:35
Surge	IEEE C62.41-1991 Level B
Isolation Voltage	
120 & 240VAC	≥ 1500V RMS input to output
380 & 480VAC	≥ 2500V RMS input to output
Mechanical	
Dimensions	**H** 81.3 mm (3.2"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")
Mounting*	Plug-in socket
Termination	Octal 8-pin, plug-in
Environmental	
Operating/Storage Temperature	0° to 55°C / -40° to 85°C
Weight	≅ 6 oz (170 g)

*CAUTION: Select an octal socket rated for 600VAC operation.

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PLS SERIES

8-PIN

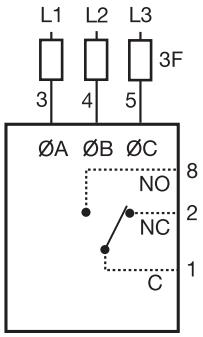
Description

The PLS Series is a low cost phase sensitive control that provides an isolated contact closure when the proper A-B-C phase sequence is applied. Protects sensitive 3-phase equipment and equipment operators from reverse rotation. Designed to be compatible with motor overloads or other 3-phase equipment protection devices. Protection for equipment control centers where frequent reconnection or electrical code makes reverse rotation protection essential. Examples include: mobile refrigerated containers, construction equipment, hoists, pumps, conveyors, elevators and escalators.

Operation

The internal relay and LED are energized when the phase sequence is correct. The output relay will not energize if the phases are reversed. Reset is automatic upon correction of the fault.

Wiring Diagram



F = Fuses
ØA = Phase A = L1
ØB = Phase B = L2
ØC = Phase C = L3
NO = Normally Open
NC = Normally Closed

Relay contacts are isolated

2A fast acting fuses recommended for safety (not required).

For dimensional drawing see: Appendix, page 513, Figure 33.

Features & Benefits

FEATURES	BENEFITS
Continuous monitoring	Cost effective protection of 3-phase equipment and operators from reverse rotation. Meets reverse rotation protection code requirements.
Universal motor compatibility	Designed to be compatible with motor overloads or other 3-phase equipment protection devices
Industry standard 8-pin octal plug connection	Eliminates need for special connectors
Factory calibrated	Easy to install. No field adjustment needed
LED indicator	Provides visual indication of relay status

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 6 00VAC. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

LPSM003ZXID (Indicating), LPSM003Z (Non-indicating) Fuse Holders
Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 VAC/DC

0KLK002.T Midget Fuse (2 Amp)
10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 Vac/500 Vdc

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Ordering Information

MODEL	LINE VOLTAGE
PLS120A	120VAC
PLS240A	208/240VAC
PLS480A	440/480VAC

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PLS SERIES

Specifications

Line Voltage

Type 3-phase delta or wye with no connection to neutral

Nominal Voltage	Minimum Voltage	Maximum Voltage
120VAC	95VAC	135VAC
208/240VAC	175VAC	255VAC
380/415VAC	310VAC	430VAC
440/480VAC	380VAC	500VAC

AC Line Frequency 50/60Hz
Phase Sequence ABC

Response Times

Pull-in ≤ 300ms
Drop-out ≤ 50ms

Output

Type Electromechanical relay, energized when the phase sequence is correct
Form Isolated SPDT
Rating
120 & 240VAC 10A resistive @ 240VAC
380 & 480VAC 8A resistive @ 240VAC
Maximum Voltage 250VAC

Protection

Isolation Voltage
120 & 240VAC ≥ 1500V RMS input to output
380 & 480VAC ≥ 2500V RMS input to output

Mechanical

Mounting* Plug-in socket
Dimensions **H** 81.3 mm (3.2"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")
Termination Octal 8-pin plug-in

Environmental

Operating/Storage Temperature -40°to 55°C / -40° to 85°C
Weight ≅ 6 oz (170 g)

*CAUTION: Select an octal socket rated for 600VAC operation.

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HLVA6I23

Single-Phase Monitor

Description

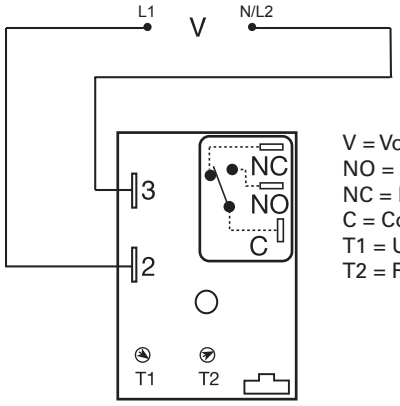
The HLVA6I23 is a single-phase undervoltage monitor designed to protect sensitive equipment from brownout or undervoltage conditions. Time delays are included to prevent nuisance tripping and short cycling. The 30A, 1hp rated, SPDT relay contacts allow direct control of motors, solenoids and valves. The output relay can be ordered with isolated SPDT contact to allow monitoring of one voltage and switching a separate voltage. Two undervoltage trip point ranges allow monitoring of 110 to 120VAC or 208 to 240VAC systems.

Operation

Upon application of input voltage the output relay remains de-energized. When the input voltage value is above the pull-in voltage, the restart delay begins. At the end of the restart delay, the output relay energizes. When the input voltage falls below the trip point, the trip delay begins. If the input voltage remains below the pull-in voltage for the entire trip delay the relay de-energizes. If the input voltage returns to a value above the pull-in voltage, during the trip delay, the trip delay is reset and the relay remains energized. If the input voltage falls below the trip point voltage during the restart delay, the delay is reset and the relay remains de-energized. Reset is automatic upon correction of an undervoltage fault.

Reset: Removing input voltage resets the output relay and the time delays.

Wiring Diagram



V = Voltage
NO = Normally Open
NC = Normally Closed
C = Common
T1 = Undervoltage Trip Point
T2 = Restart Delay

For dimensional drawing see: Appendix, page 512, Figure 17.

Features

- 30A, SPDT, NO output contacts
- 100 to 240VAC input voltage
- 70 to 220VAC adjustable undervoltage trip point in 2 ranges
- Restart delays from 3 - 300s
- Trip delay 1 - 20s fixed
- Isolated or non-isolated relay contacts

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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HLVA6I23

Specifications

Input

Min & Max RMS Voltage	70 to 264VAC
AC Line Frequency	50/60 Hz
Power Consumption	AC ≤ 4VA

Undervoltage Sensing

Type	Peak voltage sensing
Ranges	
(4)	70 to 120VAC
(6)	170 to 220VAC
Pull-In Voltage	105% or trip point voltage
Trip Point Accuracy	± 3% of trip point

Time Delay

Restart Delays	3 - 300s adjustable
Trip Delay	1 - 20s fixed in 1s increments
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	±5%
Reset Time	≤ 150ms
Time Delay vs. Temp. & Voltage	≤ ±10%

Output

Type	Electromechanical relay		
Form	SPDT		
Ratings		**SPDT-NO**	**SPDT-NC**
General Purpose	125/240VAC	30A	15A
Resistive	125/240VAC	30A	15A
	28VDC	20A	10A
Motor Load	125VAC	1 hp*	1/4 hp**
	240VAC	2 hp**	1 hp**
Life	Mechanical - 1 x 10^6		
	Electrical - 1 x 10^5, *3 x10^4, **6,000		

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output; isolated units
Insulation Resistance	≥ 100 MΩ

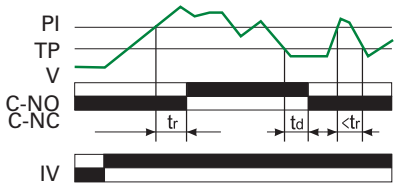
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 51.3 mm (2"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connects

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

Function Diagram



tr = Restart Delay
td = Trip Delay
PI = Pull-in 105% or trip point
TP = Trip Point
V = Monitored Voltage
IV = Input voltage
C-NO = Normally Open Contacts
C-NC = Normally Closed Contacts

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KVM SERIES

Description

The KVM Series is a single-phase undervoltage monitor designed to protect sensitive equipment against brownout undervoltage conditions. The compact design and encapsulated construction make the KVM Series an excellent choice for OEM equipment.

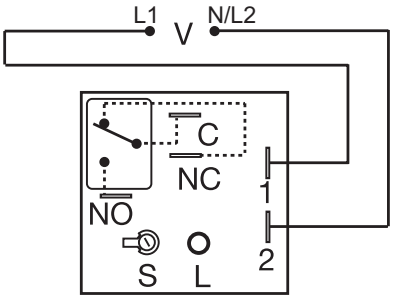
Operation

The output relay is energized and the LED glows green when the input voltage is above the reset voltage threshold. If the input voltage drops below the undervoltage setpoint, the output relay and LED will de-energize. The output relay will remain de-energized as long as the input voltage is below the reset voltage. Reset is automatic when the input voltage returns to a normal range.

Features & Benefits

FEATURES	BENEFITS
Continuous monitoring	Low cost single-phase undervoltage (brownout) protection
Compact design measures 2 in. (50.8mm) square	Perfect for OEM applications where, cost, size and ease of installation are important
LED indication	Quick visual indication of output status
Encapsulated	Protects against shock, vibration, and humidity

Wiring Diagram



V = Voltage
L = LED
S = Undervoltage Setpoint
NO = Normally Open
NC = Normally Closed
C = Common, Transfer Contact

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	MAXIMUM LINE VOLTAGE	UNDERVOLTAGE SETPOINT
KVM4	132VAC	Adjustable, 78 to 99VAC
KVM6	264VAC	Adjustable, 156 to 199VAC

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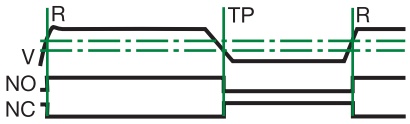
KVM SERIES

Specifications

Line Voltage	
Type	Single phase
Input Voltage	110 to 120VAC or 220 to 240VAC
AC Line Frequency	50/60 Hz
Power Consumption	2.5W @ 132VAC; 4.5W @ 264VAC
Power Off Reset Time	≤ 150ms
Undervoltage Detection	
Undervoltage Setpoint	
KVM4	78 to 99VAC
KVM6	156 to 199VAC
Undervoltage Reset Point	
KVM4	Fixed at 104VAC
KVM6	Fixed at 209VAC
Repeatability	± 0.5% under fixed conditions ±1% over temperature range
Voltage Sensing Accuracy	±2% at 25°C
Output	
Type	Electromechanical relay
Form	SPDT
Rating	8A resistive @ 120VAC, 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^6; Electrical - 1x10^5
LED Indicator	Glows green when output is energized
Protection	
Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ minimum
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating /Storage Temperature	-25 to 55°C / -40 to 85°C
Humidity	95% relative, non-condensing
Weight	2.6 oz (74 g)

Function Diagram



TP = Undervoltage Setpoint
R = Reset Point

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REMOTE INDICATION & MONITORING

Improve safety for service and operations personnel by allowing control and monitoring of the relay without opening the electrical cabinet.

RM1000 Series	Remote Monitor	262
RM2000 Series	Remote Monitor	264
Informer	Remote Diagnostics Tool	266
Informer-MS	Remote Diagnostics Tool	268

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RM1000 SERIES

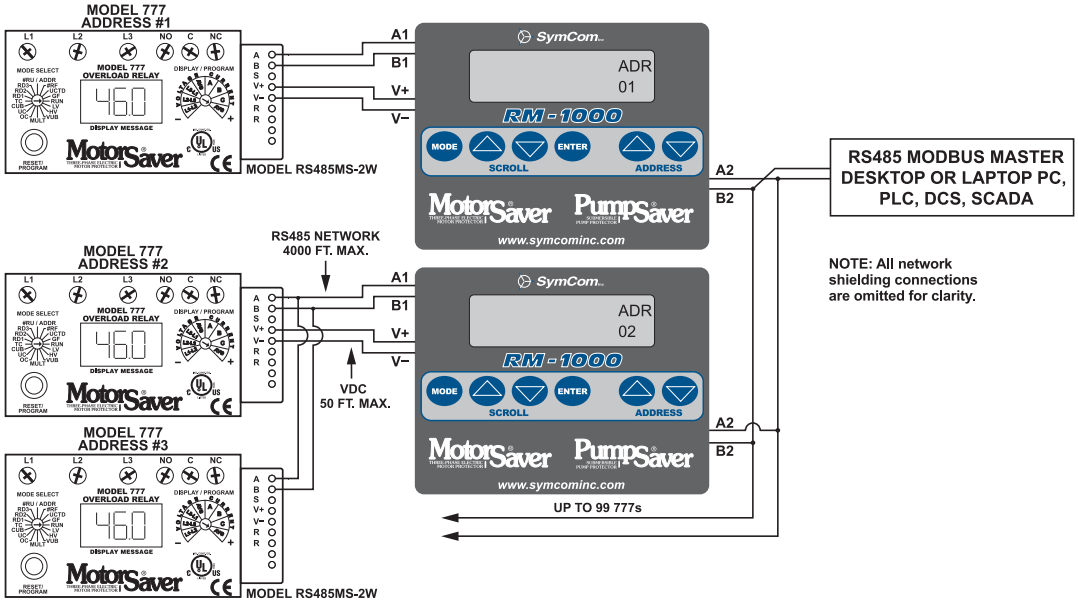
Remote Monitor

Description

The RM1000 Series is a motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products and the 601 voltage monitors, via Modbus protocol with a communications module. The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring.

The RM1000 Series can monitor up to 16 MotorSaver® and/or PumpSaver® units through an RS-485 network using Modbus RTU protocol. A second communication port allows monitoring and control of up to 99 MotorSaver® and/or PumpSaver® units from a computer, PLC, DCS or SCADA system and can be accessed from the host computer or PLC with the RM1000 acting as a repeater for any of its motor protectors. In addition to the monitoring functions, the RM1000 can be used to reset a tripped MotorSaver® or PumpSaver®.

Wiring Diagram



For dimensional drawing see: Appendix, page 508, Figure 4.

Ordering Information

MODEL	DESCRIPTION
RM1000	NEMA 3R and/or UL Type 12
RM1000-3R	NEMA 3R
RM1000 NEMA 4	NEMA 4X

The RM1000 Series is easily mounted remotely and improves safety for service and operations personnel by allowing them to control and monitor the device without opening the electrical cabinet. Using the RM1000 is a simple, cost-effective method for aiding compliance with arc flash safety regulations. The enclosure and keypad assembly is water and ultraviolet light resistant. The enclosure is NEMA 3R or NEMA 4X (optional) rated. The RM1000 and RM1000 NEMA 4 also carry a UL Type 12 rating, whereas the RM1000-3R does not carry the UL Type 12 rating due to added weep holes. The added weep holes in the RM1000-3R make it suitable for applications subjected to condensing moisture/humidity.

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RM1000 SERIES

Features

Displays:

- Individual line currents and average current
- Current and voltage unbalance
- Individual phase voltages and average voltage
- Displays last four faults, trip reason, and restart timer status
- MotorSaver® and/or PumpSaver® setpoints
- Run-hours on each motor
- Warning of pending (imminent) faults

Controls:

- Reset run-hour meter
- Reset MotorSaver® or PumpSaver®
- Change setpoints from the RM1000

Convenience:

- Power from RS485MS-2W communications module
- Monitor up to 16 777s with one display
- NEMA 3R outdoor rated
- Secondary steel enclosure available

Accessories

RS485-RS232 Converter with cable & plug
Allows RS485 devices to be connected to a PC via the RS232 (serial) port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

RS485-USB Converter with cable & plug/RS232:USB
Allows RS485 devices to be connected to a PC via the USB port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

RM1000 ENCL
Steel enclosure for protecting the RM1000 remote communications monitor from adverse affects of weather and vandalism, while allowing normal communications connections to the RM1000 unit.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.

Specifications

Input Characteristics

Control Power	12-24VDC (Supplied by RS485MS-2W)

Functional Characteristics

	Port #1 for 777(s)	**Port #2 for PC, PLC, etc.**
Communication		
Baud Rate	1200-28800	1200-28800
Setup	None, Odd, or Even Parity 1 or 2 Stop Bits	None, Odd, or Even Parity 1 or 2 Stop Bits
Protocol	Modbus RTU	Modbus RTU
Serial Interface	RS-485	RS-485
Available Addresses	1-99 addresses (max 16 per RM1000)	Responds to all port #1
Mechanical Life	100,000 actuations	
Overlay Material	Polyester	
UV Exposure w/o degradation	2000 hrs	
Terminal Torque (depluggable terminal block)	3 in.-lbs.	
Panel Thickness	0.03" min, 0.12" max	

General Characteristics

Ambient Temperature Range	
Operating	-40° to 70°C (-40° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Maximum Input Power	100mA
Class of Protection	
RM1000, RM1000 NEMA 4	NEMA 3R and/or UL Type12, NEMA 4X (optional)
RM1000-3R	NEMA 3R only
Relative Humidity	Up to 85%, non-condensing
Safety Marks	
UL	UL508 (File #E68520)
CSA	22.2 No. 14 (File #46510)
CE	IEC 60947-6-2
Enclosure Material	Black polycarbonate
Display	Liquid Crystal with extended temp. range
Size	2 rows x 16 characters
Keypad	Six 0.5" stainless steel dome buttons for tactile feedback
Dimensions	**H** 91.92 mm (3.62"); **W** 115.42 mm (4.54"); **D** 22.86 mm (0.9")
Weight	1.5 lbs. (24 oz., 680.39 g)
Mounting Method	Surface mountable on backplane using 4 screws

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RM2000 SERIES

Remote Monitor

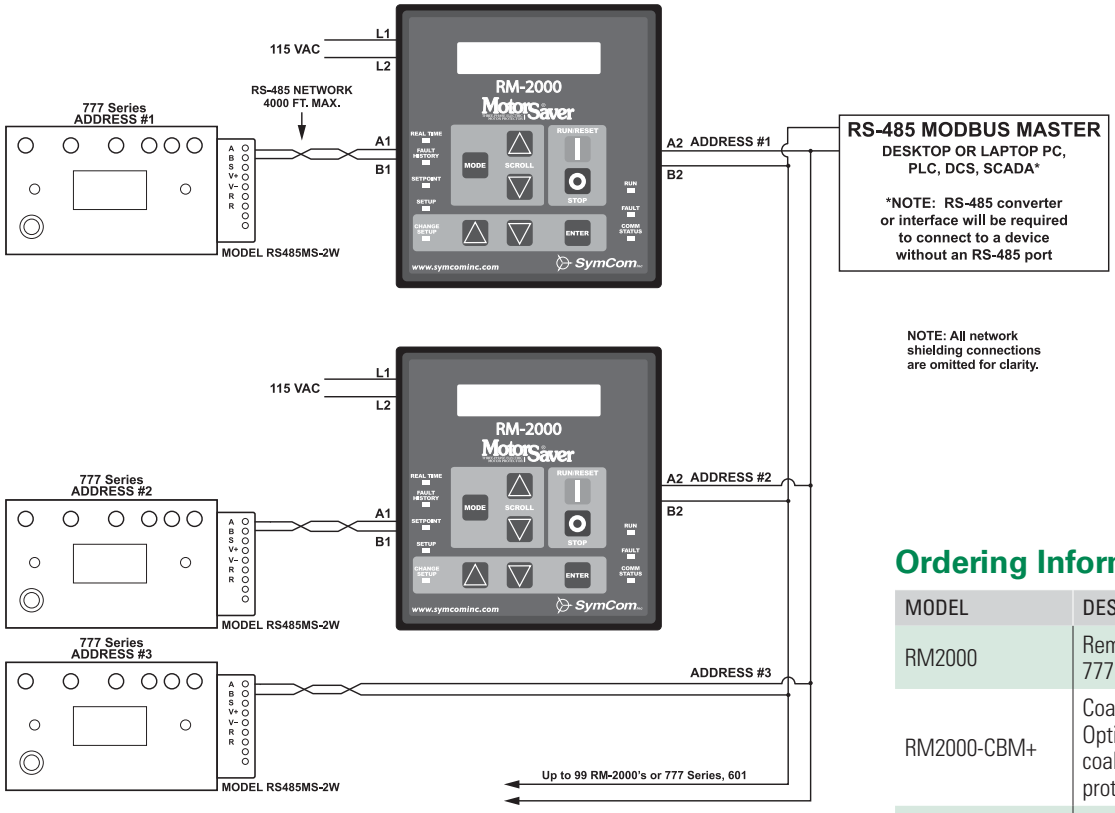
Description

The RM2000 Series is a motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products and the Model 601 voltage monitors, via Modbus protocol with a communications module. The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring.

The RM2000 has membrane keypad controls which allow both monitoring and control of a 777 MotorSaver® through an RS-485 network using Modbus RTU protocol. A second communication port allows monitoring and control of up to 99 RM2000 devices from a PLC, DCS, or SCADA system or a PC with Solutions software installed. The RM2000 will act as a repeater for its motor protector when accessed from the host computer or PLC. In addition to the monitoring functions, the RM2000 can be used to reset a tripped MotorSaver® or PumpSaver®.

The RM2000 is easily mounted remotely and improves safety for service and operations personnel by allowing them to control and monitor the device without opening the electrical cabinet. Using the RM2000 is a simple, cost-effective method for aiding compliance with arc flash safety regulations. The enclosure and keypad assembly is water and ultraviolet light resistant.

Wiring Diagram



For dimensional drawing see: Appendix, page 508, Figure 5.

Ordering Information

MODEL	DESCRIPTION
RM2000	Remote display monitor for 777 family relays
RM2000-CBM+	Coal Bed Methane Special. Optimizes gas production from coal bed methane wells while protecting submersible pump
RM2000-RTDW	Includes additional input for ground-fault module

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RM2000 SERIES

Features

Displays:

- Average current, individual line currents and current unbalance
- Current to ground
- Average voltage, line-line voltages and voltage unbalance
- Instantaneous power
- Power factor
- Last four faults
- All parameters programmed into 777 MotorSaver®
- Remaining restart delay times

Controls:

- Start and stop buttons
- Key lock input to prevent setpoint changes
- Change 777 setpoints from keypad

The RM2000 is also equipped with a real-time clock, which allows access to the following motor management information (most readings can be reset):

- Total motor run-time
- Time and date of last four faults, along with voltage and current at time of trip
- Time and date of last 10 motor starts
- Total number of motor restarts
- Minimum time between any two starts with time and date
- Run-time since last start
- kWh consumed
- kVARs consumed

Accessories

RS485-RS232 Converter with cable & plug
Allows RS485 devices to be connected to a PC via the RS232 (serial) port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

RS485-USB
Converter with cable & plug/RS232:USB
Allows RS485 devices to be connected to a PC via the USB port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

Solutions Software: Solutions-M
Software features include data logging, real-time data monitoring and fault and event monitoring.

Specifications

Input Characteristics		
Control Voltage	115VAC ±10%; 50/60Hz	
Transient Protection (Internal)	2500V for 10ms	
Functional Characteristics		
Communication	**Port #1 for 777**	**Port #2 for PC, PLC, etc.**
Baud Rate	1200-28800	1200-28800
Setup	Even Parity 1 Stop Bit	None, Odd, or Even Parity 1 or 2 Stop Bits
Protocol	Modbus RTU	Modbus RTU
Serial Interface	RS-485	RS-485
Available Addresses	01	A01-A99
Real-time Clock		
Battery Back-up Life	10 years @ 25°C without external power	
Last fault memory	Stores up to 4 faults with time and date stamp, includes voltages and currents at time of trip	
Configuration	Two independent electro-mechanical Form C (SPDT)	
Contact Material	Silver/Tin Oxide	
Output Characteristics (RM2000-RTDW version only)		
Pilot Duty Rating	240VA @ 120VAC	
General Purpose Rating	5A @ 120VAC	
General Characteristics		
Ambient Temperature Range		
Operating	-20° to 70°C (-4° to 158°F)	
Storage	-30° to 70°C (-22° to 158°F)	
Maximum Input Power	3 W	
Class of Protection	NEMA 3R and/or UL Type 12	
Relative Humidity	Up to 85%, non-condensing	
Safety Marks		
UL	UL508 (File #E68520)	
CSA	C22.2 No. 14 (File #46510)	
CE	IEC 60947-6-2	
Enclosure		
Material	Black polycarbonate	
Display	Liquid crystal with extended temp. range	
Size	2 rows x 20 characters	
Lighting	LED Backlight	
Keypad	Eight 0.5" stainless steel dome buttons for tactile feedback	
Mechanical Life	100,000 actuations	
Overlay Material	Polyester	
UV Exposure w/o degradation	2000 hrs.	
Terminal Torque (depluggable terminal block)	3 in.-lbs.	
Dimensions	**H** 162.56 mm (6.4"); **W** 154.94 mm (6.1"); **D** 27.94mm (1.1")	
Weight	1.2 lbs. (19.2 oz., 544.31 g)	
Mounting Method	Surface mountable on backplane using 4 screws	

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INFORMER

Remote Diagnostic Tool for use with Single-Phase Pump Relays

For dimensional drawing see: Appendix, page 510, Figure 9.

Description

The Informer is a hand-held diagnostic tool designed for use with single-phase models equipped with infrared LED transmitters (111-Insider-P; 231-Insider-P; 232-Insider; 111P; 233P; 233P-1.5; 234-P and 235P).

The Informer uses an infrared receiver to access information sent from the relay which can be helpful for troubleshooting the system.

Each Littelfuse single-phase model listed above is equipped with an infrared LED that transmits valuable information from the device. To retrieve this information, the Informer's receiver must be directed toward the unit's LED transmitter and be within 8 feet of the unit. The green COMM STATUS light indicates when the Informer is receiving data from the unit. If communication is lost, the Informer will display the last values it received. The Informer will automatically shut off after 2 minutes of non-use.

An infrared adapter (IR Kit-12) is included with all new and updated Informers. This adapter allows communication with the unit without opening the panel door (for select models).

Features & Benefits

The Informer displays:

- Model number
- Real-time voltage, current, and power
- Drywell and overload trip points
- Calibration voltage
- Restart delay setpoint and restart delay time remaining
- CT size (if applicable)
- Number of pump starts
- Total run-time
- Fault history for last 20, most recent, faults
- Voltage, current, power, and run-time for each fault at time of the fault
- Highest and lowest voltage and current since last calibration

Accessories

Informer IR Kit-12
12" infrared adapter cable attaches to the face of the unit to provide remote diagnostics without opening the panel. Included with the Informer

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INFORMER

Specifications

Functional Characteristics

Power	
Input	9 Volts DC (requires one 9-volt alkaline battery)
Auto Shut-off	2 minutes

Communication

Signal	Infrared
Range	1-8 ft. (approx. 0.25 ft. when using IR Kit)
Data Update	4 seconds

General Characteristics

Temperature Range	0 to 60°C (32° to 140°F)

Accuracy

Voltage	±2%
Current	±2%
Power	±4%
Maximum Input	0.25 W

Resolution

Voltage	1.0VAC
Display	Liquid crystal
Size	2 rows x 16 characters
Keypad	Three 0.5" diameter buttons
Mechanical Life	100,000 actuations min.
Overlay Material	Polyester

Enclosure

Dimensions	**H** 139.70 mm (5.50"); **W** 91.44 mm (3.60"); **D** 28.70 mm (1.13")
Weight	0.375 lb. (6 oz., 170.10 g) (w/out battery); 0.70 lb. (11.2 oz., 317.51 g) (total package)
Material	Black ABS 94HB

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INFORMER-MS

Remote Diagnostic Tool for use with the 455 3-Phase, Dual-Range Voltage Monitor

For dimensional drawing see: Appendix, page 510, Figure 9.

Specifications

Functional Characteristics

Power

Input	9 Volts DC (requires one 9-volt alkaline battery)
Consumption	0.25 Watt (max.)
Auto Shut-off	2 minutes

Communication

Signal	Infrared
Range	1-8 ft. (approx. 0.25 ft. when using IR Kit)
Data Update	4 seconds

General Characteristics

Temperature Range	0 to 60°C (32° to 140°F)

Accuracy

Voltage	±2%
Maximum Input	0.25 W

Resolution

Voltage	1.0VAC
Voltage Unbalance	1%
Time	1 minute increments
Trip Delay	2 second increments
Restart Delay	2 second increments

Display (liquid crystal)

Size	2 rows x 16 characters

Keypad (three 0.5" dia. buttons)

Mechanical Life	100,000 actuations min.
Overlay Material	Polyester

Enclosure

Dimensions	**H** 139.70 mm (5.50"); **W** 91.44 mm (3.60"); **D** 28.70 mm (1.13")
Weight	0.375 lb. (6 oz., 170.10 g) (w/out battery); 0.70 lb. (11.2 oz., 317.51 g) (total package)
Material	Black ABS 94HB

Description

The Informer-MS is a hand-held diagnostic tool designed for use with the Littelfuse 455.*

The Informer-MS uses an infrared receiver to read valuable information transmitted from the 455*, which can be helpful for troubleshooting the system. A green communication status light indicates the Informer-MS is receiving data from the 455. If communication is lost, the Informer-MS will display the last values it received.

*Model 455s manufactured after 03/01/06 are equipped with the infrared LED transmitter. Models manufactured prior to this date are not compatible with the Informer-MS.

An infrared adapter (IR Kit-36) can be purchased to allow communication with the Model 455 without opening the panel door.

Features

The Informer-MS displays:

- Real-time, line and load side voltage
- Real-time, line and load side voltage unbalance
- Motor run hours
- Last 20 faults
- Last 32 motor starts
- High and low voltage trip points
- Voltage unbalance trip point
- Restart and trip delay settings
- Voltage at last fault
- Communication status LED
- Auto shut off
- Last fault with trip conditions

Accessories

Informer IR Kit-36
36" infrared adapter cable attaches to the face of the model 455 to provide remote diagnostics without opening the panel.

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COMMUNICATION MODULES

RS485MS-2W	Communication Module	270
CIO-MB/CIO-120-MB	Communication Module	271
CIO-DN-P/ CIO-120-DN-P	Devicenet™ Interface	273
CIO-777-PR	Profibus Interface	275
CIO-EN	Modbus-TCP and Modbus-RTU Interface	276
COM 4-20	Output Module for use with Model 777-AccuPower	277

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RS485MS-2W

Communication Module

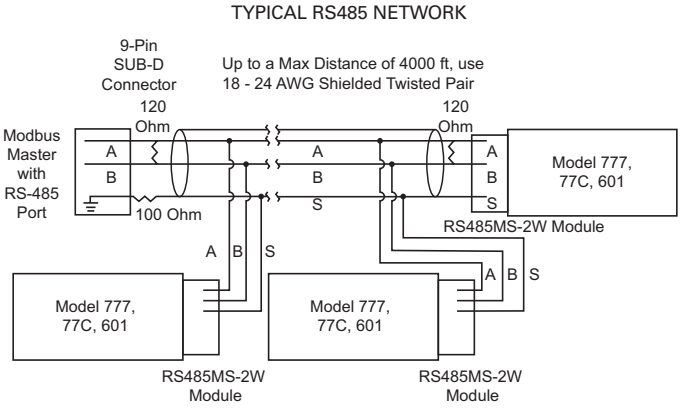
Description

The RS485MS-2W is required to enable the Modbus communications function on Model 77x-type products. This module is required when the RM1000, RM2000 or other Modbus capable device is used with 77x-type products.

Features

- Optical isolation from line potentials
- Powered by the 77x product
- RS-485 compliant bus drive capability
- Remote reset input connection
- Power connection for the Model RM1000

Wiring Diagram



Refer to the manual for basic and extended network diagrams.

For dimensional drawing see: Appendix, page 507, Figure 2.

Accessories

RS485-RS232 Converter with cable & plug
Allows RS485 devices to be connected to a PC via the RS232 (serial) port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

RS485-USB
Converter with cable & plug/RS232:USB
Allows RS485 devices to be connected to a PC via the USB port. Provides convenient terminal blocks for making signal and DC power supply connections. Pre-wired.

Specifications

Functional Specifications

Remote Reset (for optional use with 777 Series)	Normally open pushbutton rated 24VDC, 10mA (min.)

General Characteristics

Ambient Operating Temperature	-20° to 50°C (-4° to 122°F)
Terminal (depluggable terminal block)	
Torque	3 in.-lbs. (max.)
Wire AWG	12-20 AWG
Class of Protection	IP20
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 4kV input power
Hi-Potential Test	Meets UL508 (2 x rated V + 1000V for 1 min)

Surge

Input Power	IEC 61000-4-5, Level 1
Inputs/Data Lines	IEC 61000-4-5, Level 2
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947
Enclosure	Polycarbonate
Dimensions	**H** 52.83 mm (2.08"); **W** 73.66 mm (2.9"); **D** 19.56 mm (.77")
Weight	0.26 lb. (4.16oz., 117.93 g)
Mounting Method	9-pin D-Sub connector on the side of a 777-Series

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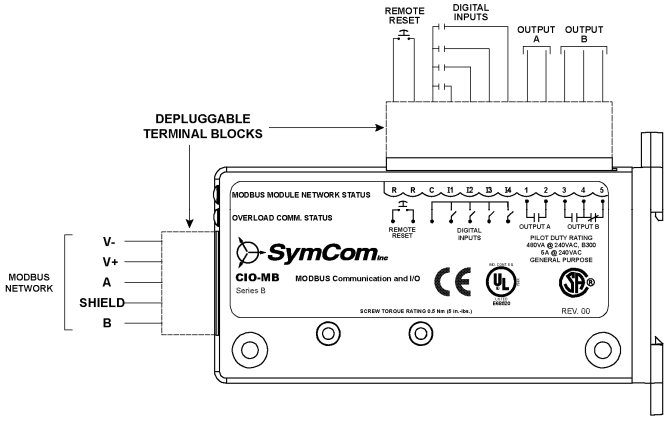
CIO-MB / CIO-120-MB

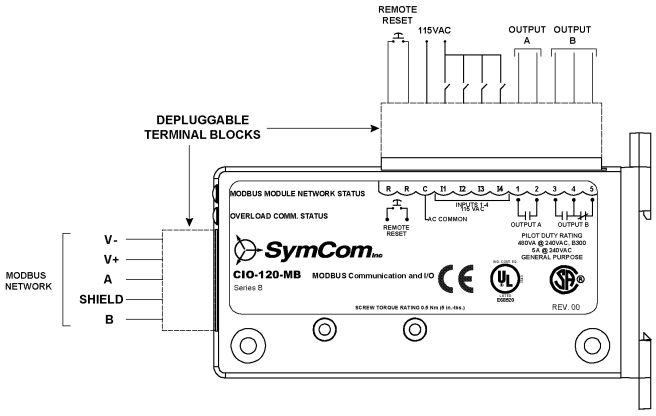
Communication Link to PLC/SCADA/ Monitoring Systems

Wiring Diagram

TYPICAL WIRING FOR CIO-MB



TYPICAL WIRING FOR CIO-120-MB



For dimensional drawing see: Appendix, page 507, Figure 3.

Ordering Information

MODEL	LINE VOTAGE
CIO-MB	12 to 24VDC
CIO-120-MB	90 to 130VAC

Description

The CIO-MB/CIO-120-MB Modules are convenient and cost-effective Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network.

Features & Benefits

FEATURES	BENEFITS
Compact size 3.46" H x 1.0" W x 5.0" D	Easily adapts to existing as well as new applications
Flexible addressing standard allows function as stand-alone interface or in conjunction with 777 series overload relay	Provides flexibility for control and monitoring
Remote reset option	Additional remote reset input allows user to reset 777 series relays without opening the panel
DIN rail or surface mountable	Allows installation flexibility
Unpluggable terminal block connections	Allows user to wire terminal blocks before installing the module and reduces field wiring

Specifications

Functional Specifications

Remote Reset (for use with optional 777 Series)	Normally open pushbutton rated 24VDC, 10mA (min.)
Power Requirements:	
Voltage	24VDC +10%
Current	95mA (max.) 70mA (typical)
Power	2.28 W (max.) 1.7 W (typical)
Ethernet Controller Capability	IEEE 802.3 10Base-T

Input Characteristics

General Purpose (4)

Voltage Range:	
CIO-MB	12-24VDC
CIO-120-MB	90-130VAC
Current	2mA (typical)

Output Characteristics

SPDT (1), SPST (1)	
Pilot Duty	480VA & 240VAC, B300
General Purpose	5A @ 240VAC

General Characteristics

Ambient Operating Temperature	-20° to 70°C (-4° to 158°F)
Terminal (depluggable terminal block)	
Torque	3 in.-lbs. (max.)
Wire AWG	12-20 AWG
Class of Protection	IP20, NEMA 1 (finger safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

CIO-MB / CIO-120-MB

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 4kV input power
Hi-Potential Test	Meets UL508 (2 x rated V + 1000V for 1 min)
Surge	
Input Power	IEC 61000-4-5, Level 1
Inputs/Data Lines	IEC 61000-4-5, Level 2
Safety Marks	
UL	UL508 (File #E68520)
CSA	C22.2 (File #46510)
CE	IEC 60947-6-2
Enclosure	Polycarbonate
Dimensions	**H** 86.36 mm (3.40"); **W** 25.40 mm (1.00"); **D** 138.68 mm (5.46") (w/depluggable connectors)
Weight	0.25 lb. (4 oz., 113.4 g)
Mounting Methods	DIN Rail or surface mount (w/two #8 screws)

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CIO-DN-P / CIO-120-DN-P

Communication Link to PLC/SCADA/ Monitoring Systems

Description

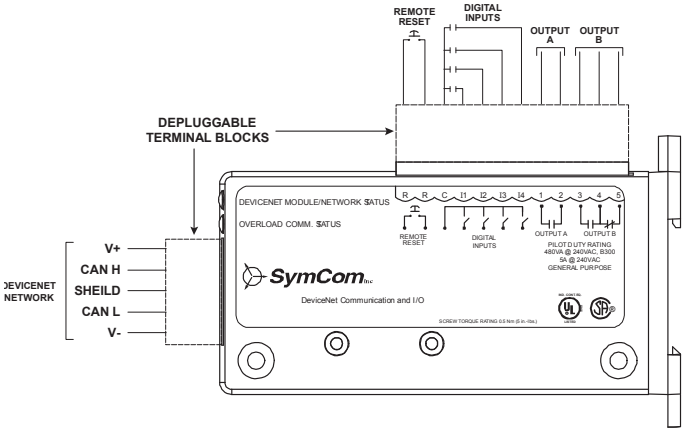
The CIO-DN-P/CIO-120-DN-P are convenient and cost-effective Devicenet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a Devicenet™ network.

Features & Benefits

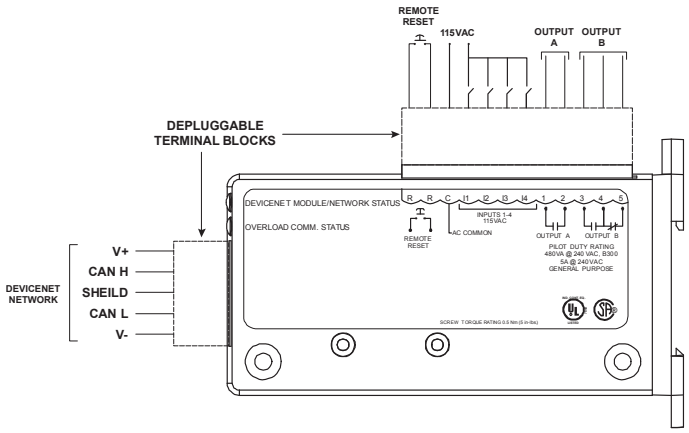
FEATURES	BENEFITS
Compact size 3.4" H x 1.0" W x 5.46" D	Easily adapts to existing as well as new applications
Flexible addressing standard allows function as stand-alone interface or in conjunction with 777 series overload relay	Provides flexibility for control and monitoring
Remote reset option	Additional remote reset input allows user to reset 777 series relays without opening the panel
DIN rail or surface mountable	Allows installation flexibility
Unpluggable terminal block connections	Allows user to wire terminal blocks before installing the module and reduces field wiring

Wiring Diagram

TYPICAL WIRING FOR CIO-DN-P



TYPICAL WIRING FOR CIO-120-DN-P



For dimensional drawing see: Appendix, page 507, Figure 3.

Ordering Information

MODEL	LINE VOTAGE
CIO-DN-P	12 to 24VAC
CIO-120-DN-P	90 to 130VAC

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CIO-DN-P / CIO-120-DN-P

Specifications

Input Characteristics

Power Requirements	
Voltage (nominal)	24VDC
Current	137mA (max.)
Power	3.28 W (max.)

Digital Inputs

Voltage Range	
CIO-DN-P	12-24 VAC
CIO-120-DN-P	90-130VAC
Frequency	50/60Hz
Maximum Current	2mA (typical)
Remote Reset	24VDC, 10mA (min.), NO pushbutton

Output Characteristics

Form A & Form C Contactors	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	5A @ 240VAC

General Characteristics

Temperature Range	-20° to 70°C (-4° to 158°F)
Relative Humidity	10-95%, non-condensing
Wire Gauge	Solid or stranded, 12-20 AWG
Terminal Torque	3 in.-lbs.
Hi-Potential Test (relays to other circuits)	(2 x rated V + 1000V for 1 minute)

EMC Standards

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 4kV input power
Safety Marks	
UL, ULC Listed, CSA	UL508 (File #E68520), C22.2 (File #46510)
Enclosure	Polycarbonate
Dimensions	**H** 86.36 mm (3.4"); **W** 25.4 mm (1.0"); **D** 138.68 mm (5.46") (w/depluggable connectors)
Weight	0.25 lb. (4 oz., 113.4 g) (w/depluggable connectors)
Mounting Methods	DIN Rail or surface mount (w/two #8 screws)

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CIO-777-PR

Communication Link to PLC/SCADA/ Monitoring Systems

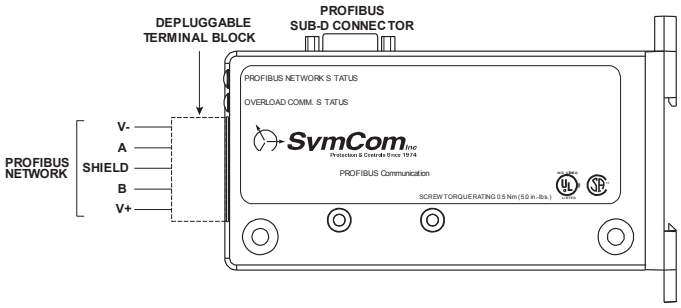
Description

The CIO-777-PR Module is a convenient and cost-effective Profibus interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profibus network.

Features & Benefits

FEATURES	BENEFITS
Compact size 3.4" H x 1.0" W x 5.46" D	Easily adapts to existing as well as new applications
Flexible addressing standard allows function as stand-alone interface or in conjunction with 777 series overload relay	Provides flexibility for control and monitoring
Remote reset option	Additional remote reset input allows user to reset 777 series relays without opening the panel
DIN rail or surface mountable	Allows installation flexibility
Built in sub-D connector	Provides a quick and easy connection to a network and reduces field wiring

Wiring Diagram



For dimensional drawing see: Appendix, page 507, Figure 3.

Specifications

Input Characteristics

Power Requirements	
Voltage (nominal)	12-24VDC
Current	150mA (max.)
Power	3.6 W (max.)
Digital Inputs	
Voltage Range	12-24VAC
Maximum Current	2mA (typical)
Remote Reset	24VDC, 10mA, (min.), NO pushbutton

Output Characteristics

Form A & Form C Contactors	
Pilot Duty	480VA @ 240VAC, B300
General Purpose	5A @ 240VAC

General Characteristics

Ambient Temperature Range	
Operating	-20° to 70°C (-4° to 158°F)
Storage	-40° to 80°C (-40° to 176°F)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3
Wire Gauge	Solid or stranded, 12-20 AWG
Terminal Torque	3 in.-lbs.
Hi-Potential Test (relays to other circuits)	Meets UL508 (2 x rated V + 1000V for 1 min.)

EMC Standards

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 4kV input power
Safety Marks	
UL, ULC Listed	UL508 (File #E68520)
CSA	C22.2 (File #46510)
Enclosure	Polycarbonate
Dimensions	**H** 86.36 mm (3.4"); **W** 25.4 mm (1.0"); **D** 138.68 mm (5.46") (w/depluggable connectors)
Weight	0.25 lb. (4 oz., 113.4 g) (w/depluggable connectors)
Mounting Methods	DIN Rail or surface mount (w/ two #8 screws)

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CIO-EN

Communication Link to PLC/SCADA/ Monitoring Systems

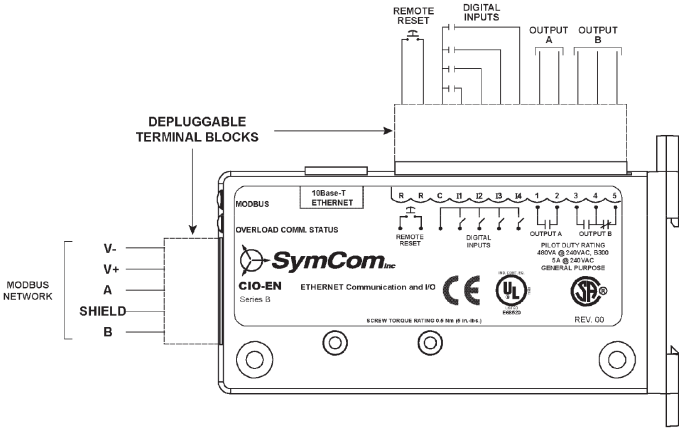
Description

The CIO-EN Module (non-POE) is a convenient and cost-effective Modbus-TCP and Modbus-RTU interface capable of providing discrete control and monitoring of an overload relay over a Modbus network.

Features & Benefits

FEATURES	BENEFITS
Compact size 3.4" H x 1.0" W x 5.46" D	Easily adapts to existing as well as new applications
Flexible addressing standard allows function as stand-alone interface or in conjunction with 777 series overload relay	Provides flexibility for control and monitoring
Remote reset option	Additional remote reset input allows user to reset 777 series relays without opening the panel
DIN rail or surface mountable	Allows installation flexibility
Built in Ethernet jack	Reduces field wiring

Wiring Diagram



For dimensional drawing see: Appendix, page 507, Figure 3.

Specifications

Input Characteristics

Power Requirements:	
Voltage	24VDC +10%
Current	95mA (max.) 70mA (typical)
Power	2.28 W (max.) 1.7 W (typical)
Digital Inputs	
General Purpose (4)	
Voltage Range	12-24VDC
Current	2mA (typical)

Functional Specifications

Remote Reset (for use with optional 777 Series)	Normally open pushbutton rated 24VDC, 10mA (min.)
Ethernet Controller Capability	IEEE 802.3 10Base-T

Output Characteristics

SPDT (1), SPST (1)	
Pilot Duty	480VA & 240VAC, B300
General Purpose	5A @ 240VAC

General Characteristics

Ambient Operating Temperature	-20° to 70°C (-4° to 158°F)

Terminal (depluggable terminal block)

Torque	3 in.-lbs. (max.)
Wire AWG	12-20 AWG
Class of Protection	IP20, NEMA 1 (finger safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

Standards Passed

Electrostatic Discharge (ESD)	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 4kV input power
Hi-Potential Test	Meets UL508 (2 x rated V + 1000V for 1 min)
Surge	
Input Power	IEC 61000-4-5, Level 1
Inputs/Data Lines	IEC 61000-4-5, Level 2
Safety Marks	
UL	UL508 (File #E68520)
CSA	C22.2 (File #46510)
CE	IEC 60947-6-2
Enclosure	Polycarbonate
Dimensions	**H** 86.36 mm (3.4"); **W** 25.4 mm (1.0"); **D** 138.68 mm (5.46")
Weight	0.25 lb. (4 oz., 113.4 g)
Mounting Methods	DIN Rail or surface mount (w/two #8 screws)

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COM 4-20

Communication Link to PLC/SCADA/ Monitoring Systems

Description

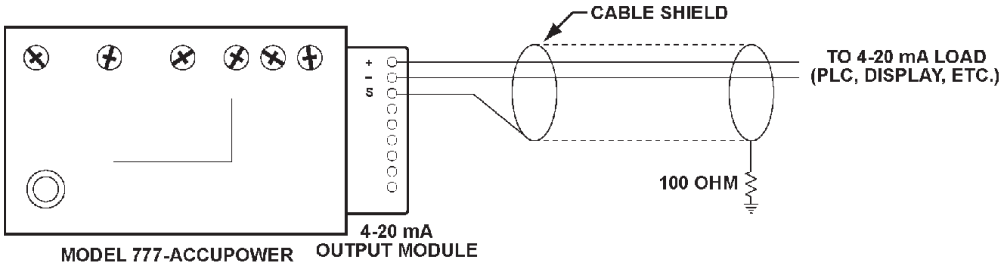
The COM 4-20 Output Module is intended for use with ONLY the Model 777-AccuPower output power monitor. The module will send a 4-20mA signal proportional to the output power. It can also be used to send the input power by setting the efficiency setting on the 777-AccuPower monitor to one. This module allows communication to a PLC with an analog input and no Modbus input.

Features

- Powered by the 777-AccuPower
- Scalable 4-20mA output proportional to Hp or kW
- Signal can be used for displays, controllers, or PLCs

Wiring Diagram

4-20mA OUTPUT MODULE



For dimensional drawing see: Appendix, page 507, Figure 2.

Specifications

Output Characteristics

Current	4-20mA

General Characteristics

Temperature Range	-20° to 50°C (-4° to 122°F)
Terminal (depluggable terminal block)	
Torque	3 in.-lbs. (max.)
Wire AWG	12-20 AWG
Class of Protection	IP20
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

Standards Passed

Electrostatic Discharge	IEC 61000-4-2, Level 3, 6kV contact, 8kV air
Radio Frequency Immunity, Radiated	150 MHz, 10V/m
Fast Transient Burst	IEC 61000-4-4, Level 3, 4kV input power
Hi-Potential Test	Meets UL508 (2 x rated V + 1000V for 1 min)
Surge	
Input Power	IEC 61000-4-5, Level 1
Inputs/Data Lines	IEC 61000-4-5, Level 2
Safety Marks	
UL	UL508 (File #E68520)
CE	IEC 60947
Enclosure	Polycarbonate
Dimensions	**H** 52.83 mm (2.08"); **W** 73.66 mm (2.9"); **D** 19.56 mm (0.77")
Weight	0.25 lb. (4 oz., 113.4 g)
Mounting Method	#8 screws; mount to side of 777-AccuPower unit

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TIME DELAY RELAYS

The largest selection of time delay relays known since 1968 for its reliable designs that provide long service lives with low maintenance costs. Versatile multifunction time delay relays give you the option of choosing among functions and time delay ranges to ensure that you receive the perfect timer to fit your needs. Electromechanical relay-output time delay relays are available with a number of different functions and assure isolation between input and output, as well as no voltage drop across output contact. Solid-state time delay relays have no moving parts to arc and wear out over time, giving them a lifespan of up to 100x that of a relay-output timer. In addition, all solid state time delay relays are fully encapsulated to protect against shock, vibration, humidity, etc.

Timer Function Guide 280

Multifunction

TRDU Series 281
TRU Series 283
ASQU / ASTU Series 286
DSQU / DSTU Series 288

Dedicated

On Delay

T10 SERIES 290

Delay-on-Make

ERDM Series 291
HRDM Series 293
KRDM Series 295
KRPS Series 297
KSD1 Series 300
KSDU Series 302
KSPS Series 304
MSM Series 307
ORM Series 309
PRLM Series 311
TDM / TDMH / TDML Series 313
TDU / TDUH / TDUL Series 315
TH1 Series 317
THD1B410.5S 319
TMV8000 / TSU2000 Series 321
TRM Series 323
TS1 Series 325
TSD1 Series 327

Delay-on-Make, Normally Closed

TS441165 329

Delay-on-Break

HRDB Series 331
HRPS / HRIS Series 333
KRDB Series 335
KSDB Series 337
ORB Series 339
TDB / TDBH / TDBL Series 341
TDUB Series 343
THDB Series 345
TRB Series 347
TSB Series 349
TSDB Series 351

Single Shot

HRDS Series 353
HSPZA22SL 355
KRDS Series 357
KSDS Series 359
ORS Series 361
PRS65 363
TDS / TDSH / TDSL Series 365
TDUS Series 366
THC / THS Series 368
THDS Series 370
TRS Series 372
TSDS Series 374
TSS Series 376

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Interval

ERDI Series 378
HRDI Series 380
KRDI Series 382
KSD2 Series 384
KSPU Series 386
TDI / TDIH / TDIL Series 388
TDUI / TDUIH / TDUIL Series 390
THD2 Series 392
THD7 Series 394
TS2 / TS6 Series 396
TSD2 Series 398
TSD6 Series 400
TSD7 Series 402

Retriggerable Single Shot

KRD9 Series 404
TSD94110SB 406

Recyle

ERD3425A 407
ESDR Series 409
HRDR Series 412
KRD3 Series 414
KRDR Series 416
KSD3 Series 418
KSDR Series 420
KSPD Series 422
RS Series 424
TDR Series 426
THD3C42A0 428
TSD3411S 430
TSDR Series 432

Percentage

PTHF4900DK 434

Dual Function

TDMB Series 436
ESD52233 438
KRPD Series 440

HVAC

CT Series 442
T2D120A15M 444
TA Series 446
TAC1 Series 448
TL Series 450
TSA141300 452

Coin Vending

HRV Series 453

For More Information…
and to download our HVAC Timer Application Guide, visit
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TIMER FUNCTION GUIDE

Selecting a Timer's Function

Selecting one of the five most common timing functions can be as easy as answering three questions on the chart below. If you have trouble answering these questions, try drawing a connection diagram that shows how the timer and load are connected. Time diagrams and written descriptions of the five most popular functions, plus other common functions. Instantaneous contacts, accumulation, pause timing functions, and flashing LED's are included in some units to expand the versatility of the timer. These expanded operations are explained on the product's catalog page. Time diagrams are used on these pages along with text and international symbols for functions.

Function Selection Guide

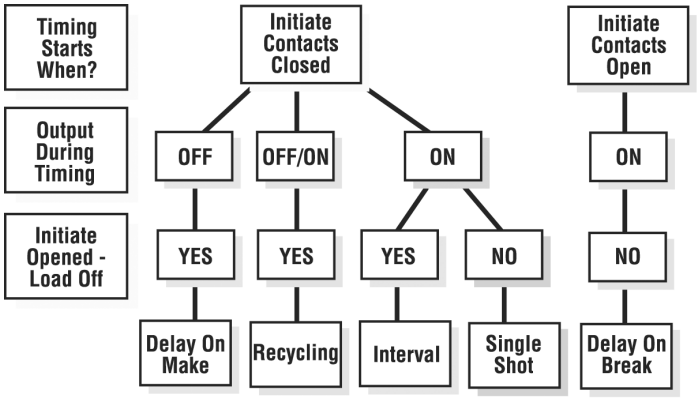
Selection Questions

1) The timing starts when the initiate (starting) contacts are:
A) Closed **B)** Opened

2) What is the status of the output (or load) during timing?
A) On **B)** Off **C)** On/Off

3) Will the load de-energize (or remain de-energized) if the initiate (starting) contacts are opened during timing?
A) Yes **B)** No

THE FIVE MOST USED FUNCTIONS

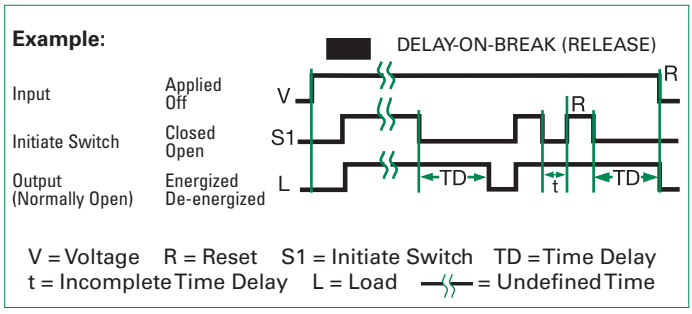


Understanding Time Diagrams

Time diagrams are used to show the relative operation of switches, controls, and loads as time progresses. Time begins at the first vertical boundary. There may be a line indicating the start of the operation or it may just begin with the transition of the device that starts the operation. Each row in the time diagram represents a separate component. These rows will be labeled with the name of the device or its terminal connection numbers. In a bistable or digital system, the switches, controls, or loads can only be ON or OFF. The time lines are drawn to represent these two possible conditions. Vertical lines are used to define important starting or ending points in the operation.

The example to the right is the most common type of time diagram in use in North America. It shows the energizing of loads, and the closing of switches and contacts by an ascending vertical transition of the time line. Opening switches or contacts or de-energizing loads are represented by descending vertical transitions.

TIME DIAGRAM



International Timing Function Symbols

- = Delay-on-Make; ON-delay
- = Delay-on-Break; OFF-delay
- = Delay-on-Make and Break; ON and OFF-delay
- 1 = Interval; Impulse-ON
- 1 = Trailing Edge Interval; Impulse-OFF
- = Single Shot; Pulse Former
- = Flasher - ON Time First; Recycling Equal Times - ON First
- = Flasher - OFF Time First; Recycling Equal Times - OFF First
- = Recycling - Unequal Times; Pulse Generator
- = Recycling - Unequal Times Starting with ON or OFF
- = Delay-on-Make and Interval; Single Pulse Generator

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TRDU SERIES

8-PIN

11-PIN

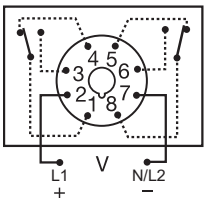
Description

The TRDU Series is a versatile universal time delay relay with 21 selectable single and dual functions. The dual functions replace up to three timers required to accomplish the same function. Both the function and the timing range are selectable with switches located on the face of the unit. Two LED's indicate input voltage and output status. This device offers full 10A isolated relay output contacts in either SPDT or DPDT. The TRDU replaces hundreds of part numbers, thereby, reducing your stock inventory requirements.

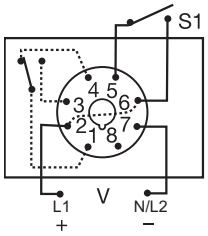
21 Functions

Five switches are provided to set one of 10 single or 11 dual modes of operation.

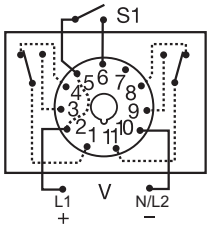
Wiring Diagram



8-PIN DPDT



8-PIN SPDT



11-PIN DPDT

V = Voltage
S1 = Initiate Switch

For dimensional drawing see: Appendix, page 512, Figure 20.

Ordering Information

MODEL	INPUT VOLTAGE	BASE CONNECTION
TRDU120A1	120VAC	8-pin, DPDT*
TRDU120A2	120VAC	8-pin, SPDT
TRDU120A3	120VAC	11-pin, DPDT
TRDU12D1	12VDC	8-pin, DPDT*
TRDU12D2	12VDC	8-pin, SPDT
TRDU230A2	230VAC	8-pin, SPDT
TRDU24A1	24VAC/DC	8-pin, DPDT*
TRDU24A2	24VAC/DC	8-pin, SPDT
TRDU24A3	24VAC/DC	11-pin, DPDT

If you don't find the part you need, call us for a custom product 800-843-8848

*Limited to 9 operating functions in 8-pin DPDT units.

Features & Benefits

FEATURES	BENEFITS
21 timing functions	Replace hundreds of parts and reduce stocking requirements
Microcontroller based	Repeat Accuracy + / - 0.1%
User selectable time delay	Timing settings are switch selectable 0.1s - 1,705h in eight ranges for added flexibility
Isolated 10A, SPDT or DPDT output contacts	Allows control of loads for AC or DC voltages
LED indicators	Provides visual indication of input voltage and relay status

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

NDS-11 11-pin Socket
11-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

PSC8 or PSC11 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in sets of two.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

TRDU SERIES

Specifications

Time Delay

Type	Microcontroller
Range: Switch Selectable**	Single Functions: 0.1s - 1,705h in 8 ranges Dual Functions: 0.1s - 3,100m each in 8 ranges
Adjustments	Multiplier: 3 position DIP switches select 0.1, 1, 10, or 100 in s or m
Setting Accuracy	±1% or 50ms, whichever is greater
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Timing Functions	Five switches are provided to set one of twenty-one single or dual functions
Reset Time	≤ 50ms
Initiate Time	120VAC: 75ms
Time Delay vs Temp. & Voltage	±1%

Indication

Two LEDs indicate	**1)** Input voltage applied **2)** Output relay status

Input

Voltage	12VDC, 24VAC/DC, 120VAC, or 230VAC
Tolerance	
12VDC & 24VAC/DC	-15% - 20%
120 & 230VAC	-20% - 10%
AC Line Frequency	50/60Hz
Power Consumption	24 to 230V ≤ 3W; 12VDC ≤ 2W

Output

Type	Electromechanical relay
Form	SPDT or DPDT
Rating	10A resistive @ 120/240VAC & 28 VDC; 1/3 hp @ 120/240VAC
Life	Mechanical – 1 x 10^7; Electrical – 1 x 10^6

Protection

Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

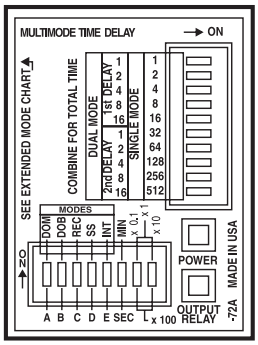
Mechanical

Mounting	Plug-in socket
Dimensions	**H** 76.7 mm (3.1"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")
Termination	Octal 8-pin plug-in or magnal 11-pin plug-in

Environmental

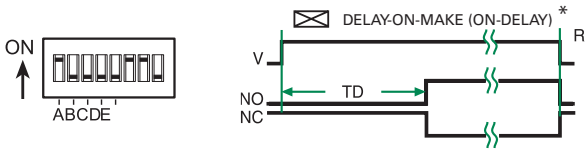
Operating/Storage Temperature	-20° to 65°C / -40° to 85°C
Weight	≅ 5.8 oz (164 g)

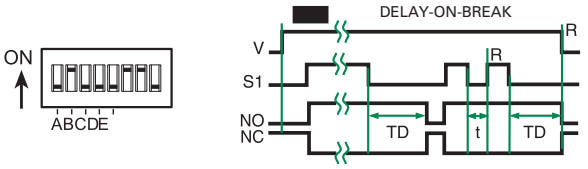
**For CE approved applications, power must be removed from the unit when a switch position is changed.

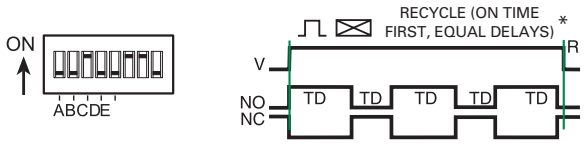


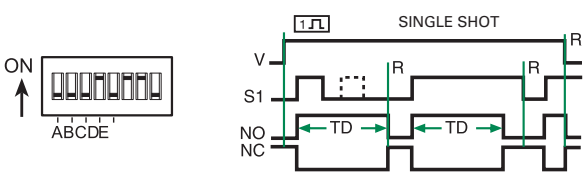
Function Diagrams

Single Functions

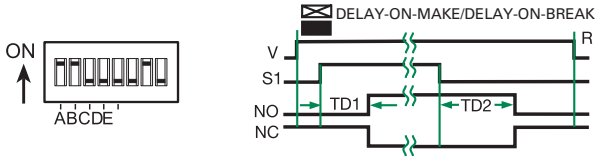


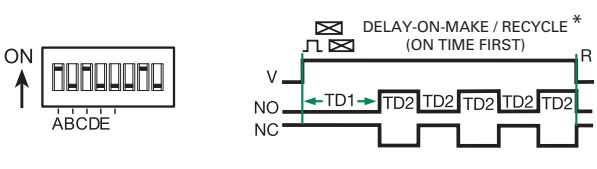


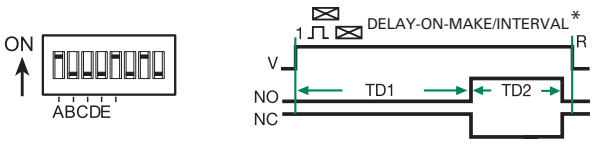


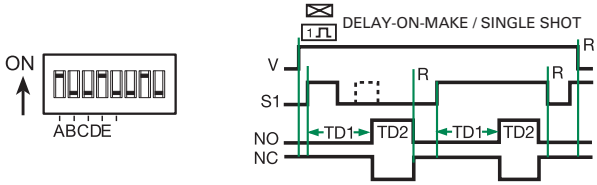


Dual Functions









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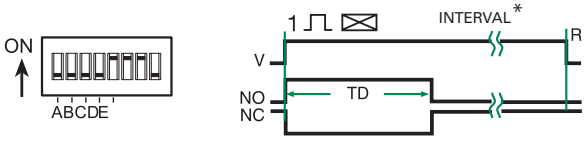
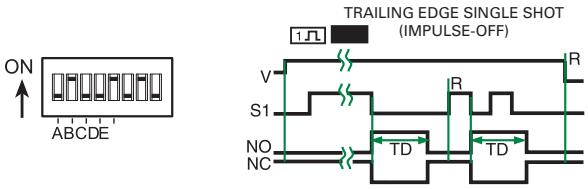
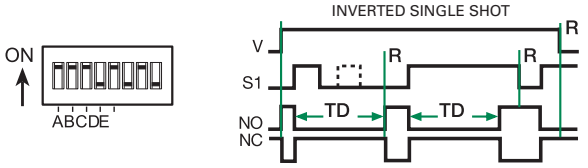
Expertise Applied | Answers Delivered

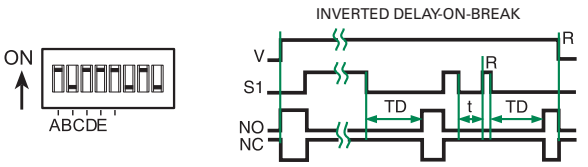
TRDU SERIES

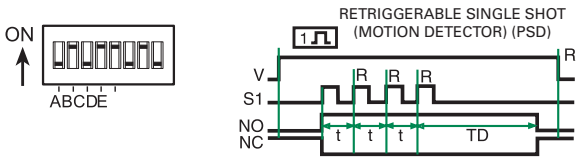
Single Functions

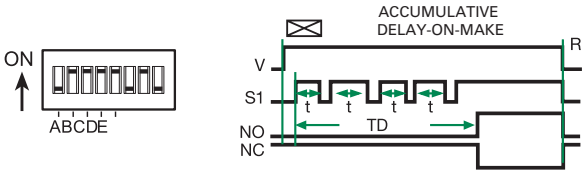




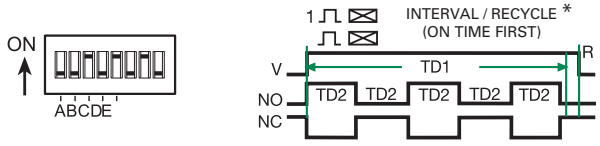


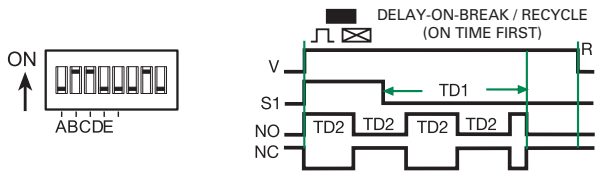


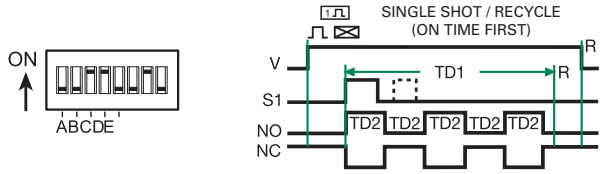


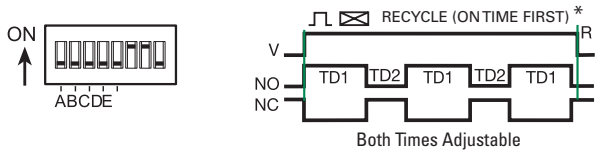


Dual Functions

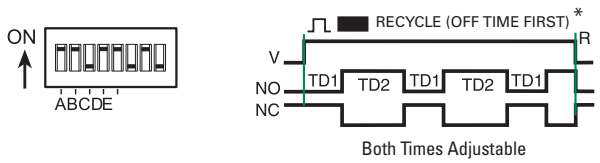




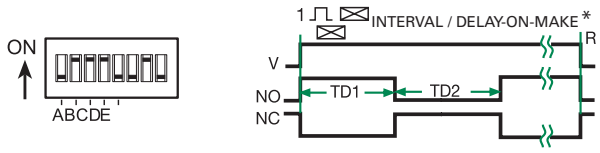


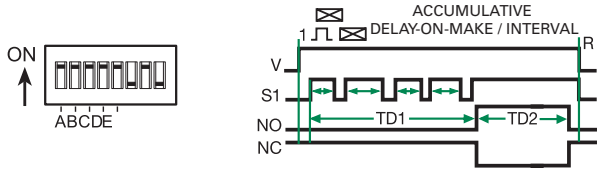


Both Times Adjustable



Both Times Adjustable





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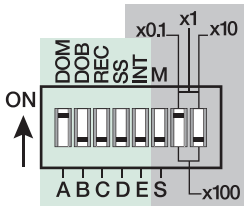


5 Switches for Function Selection

3 Switches for Time Delay Range

LEGEND

V = Voltage
R = Reset
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD,TD1,TD2 = Complete Time Delay
t = Partial Time Delay
DOM = Delay-on-Make
DOB = Delay-on-Break
REC = Recycle
SS = Single Shot
INT = Interval
M = Minutes
S = Seconds
—⫽— = Undefined time

NOTE: The time delay range is the same for both functions when dual functions are selected.

* 9 Functions included in the 8 pin DPDT models

12
TIME DELAY RELAYS

TRU SERIES

Knob Adjustable Universal Time Delay Relay

8-PIN

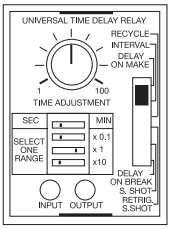
11-PIN

Description

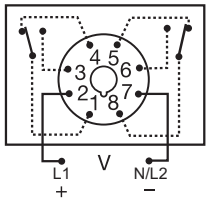
The TRU Series is a multifunction, knob adjustable, Universal Time Delay Relay. It includes six of the most popular timing functions selected by a slide switch. The time delay is knob adjustable and the time delay range is switch selectable. The repeat accuracy is + 0.1%. Both function and time range can be selected on the top face of the unit. In addition to multifunctioning and multiple time ranges, the TRU Series features universal input voltage; 19 to 264VAC and 19 to 30VDC and full 10A output relay. The TRU Series can directly replace up to 1000 competitive time delay relay models.

Operation

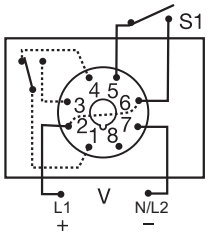
A six position slide switch selects delay-on-make, interval, single shot, recycling (ON time first, equal recycle delays), delay-on-break, and retriggerable single shot. 8-pin DPDT base wiring is limited to delay-on-make, interval, and recycling functions. All six functions are available in the 8-pin SPDT and 11-pin DPDT versions.



Wiring Diagram



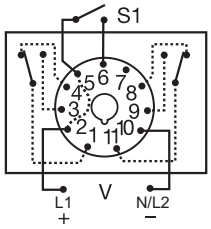
8-PIN DPDT
Delay-on-Make
Interval
Recycling



8-PIN SPDT
Delay-on-Make
Interval
Single Shot
Recycling
(ON Time First, Equal Recycle Delays)
Delay-on-Break
Retriggerable Single Shot

V = Voltage
S1 = Initiate Switch

Relay contacts are isolated



11-PIN DPDT
Delay-on-Make
Interval
Single Shot
Recycling
(ON Time First, Equal Recycle Delays)
Delay-on-Break
Retriggerable Single Shot

For dimensional drawing see: Appendix, page 512, Figure 21.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1% or + / - 20ms, whichever is greater
6 time ranges (0.1s to 1,000m)	Broad range will satisfy most requirements
Knob adjustable time delay	Allows user to fine tune time delay based on application needs
Universal input voltage	Makes it versatile for use in most applications
Multifunction	Provides the most common standard timing functions
LED Indicators	Provide visual indication of input voltage and relay status
10A isolated output contacts	Allows control of loads for AC or DC voltages

Ordering Information

MODEL	INPUT VOLTAGE	BASE WIRING	FUNCTIONS
TRU1	19 to 264VAC; 19 to 30VDC	8-pin DPDT	3
TRU2	19 to 264VAC; 19 to 30VDC	8-pin SPDT	6
TRU3	19 to 264VAC; 19 to 30VDC	11-pin DPDT	6

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TRU SERIES

Accessories

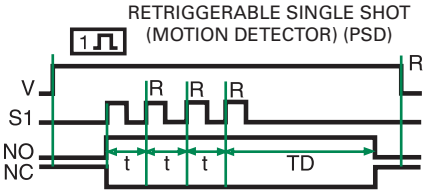
BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

NDS-11 11-pin Socket
11-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

PSC8 or PSC11 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in pairs.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
t = Incomplete Time Delay
TD = Time Delay
R = Reset

Specifications

Time Delay	
Type	Digital integrated circuitry
Range	
Switch Selectable	0.1s - 1000m in 6 ranges: **1)** 0.1 - 10s **2)** 1 - 100s **3)** 10 - 1000s **4)** 0.1 - 10m **5)** 1 - 100m **6)** 10 - 1000m
Adjustments	
Multiplier	4 position DIP switch selects x0.1, x1, x10, and sec. or min.
Time Setting	Onboard knob adjustment with 1 - 100 reference dial
Two LEDs indicate	**1)** Input voltage applied **2)** Output relay status
Repeat Accuracy	±0.1% or ±20ms, whichever is greater
Reset Time	≤ 300ms
Time Delay vs Temp. & Voltage	±2%
Input	
Voltage - Universal Input Range	19 to 264VAC and 19 to 30VDC
AC Line Frequency	50/60Hz
Output	
Type	Electromechanical relay
Form	SPDT or DPDT, isolated
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6
Protection	
Transient	38 joules
Isolation Voltage	≥ 1500V RMS input to output
Polarity	DC units are reversed polarity protected
Mechanical	
Mounting	Plug-in socket
Dimensions	**H** 87.3 mm (3.44"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")
Termination	Octal 8-pin plug-in or magnal 11-pin plug-in
Environmental	
Operating/Storage Temperature	-20° to 65°C / -30° to 85°C
Weight	≅ 6 oz (170 g)

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ASQU / ASTU SERIES

Description

The ASQU and ASTU Series of 17.5 mm, knob adjustable, universal solid-state timers offer multiple functions, voltages, and time delay ranges. Choose one of 5 functions and 4 time delay ranges via 4 selection switches located on face of the unit. Adjustment through the time range is accomplished by an onboard knob.

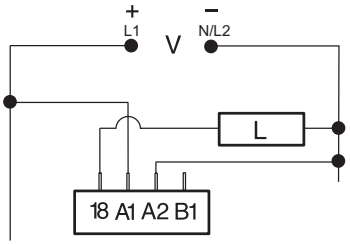
The ASQU Series has quick connect terminals and the ASTU Series has terminal blocks.

Features & Benefits

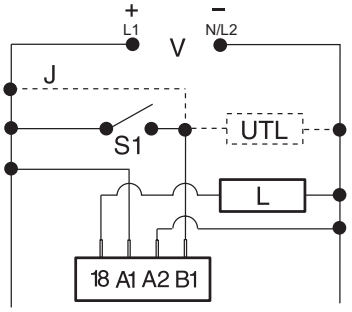
FEATURES	BENEFITS
Universal AC or DC voltage	Choose from 24 to 240VAC or 9 to 110VDC models
Compact 17.5mm size	Allows for high rail density
Microcontroller based	Repeat Accuracy + / -1%
Multifunction: 5 timing functions	Reduce stocking requirements
Knob Adjustable Time Delay	Field adjustable delay ranging from 0.1s - 100m
0.7A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Mounting fasteners lincluded	Each unit ships with both surface and DIN rail quick mount adapters
Watchdog circuitry	Self monitoring and self correcting for improved performance

Wiring & Adjustment Diagrams

DELAY-ON-MAKE & RECYCLING



SINGLE SHOT, INTERVAL & DELAY-ON-BREAK



V = Voltage
L = Load
J= Wire Required for Interval Operation
S1= Initiate Switch
UTL = Optional Untimed Load

ADJUSTMENTS

DOM	A B
SS	A B
R	A B
DOB	A B

DOM = Delay-on-Make
SS = Single Shot/Interval
R = Recycling
DOB = Delay-on-Break

R	M	S
0.1-10s	X1s	C E D F
1-100s	X10s	C E D F
10-1000s	X100s	C E D F
1-100m	X10m	C E D F

R = Range
M = Multiplier
S = Setting

For dimensional drawing see: Appendix, page 512, Figure 22.

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P0500-178 Surface Mount Adapter
P0500-179 DIN Rail Mount Adapter
For use with the ASxx/DSxx Series timers.

Ordering Information

MODEL	INPUT VOLTAGE	CONNECTION
ASQUA3	24 to 240VAC	Quick Connects
ASQUD3	9 to 110VDC	Quick Connects
ASTUA3	24 to 240VAC	Terminal Blocks
ASTUD3	9 to 110VDC	Terminal Blocks

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ASQU / ASTU SERIES

Specifications

Time Delay

Type	Microcontroller based with ceramic resonator and watchdog circuitry
Adjustment	Knob with dial; 2 switches select 1 of 4 multipliers
Range*	0.1 - 10s, 1 - 100s, 10 - 1000s, 1 - 100m
Repeat Accuracy	±1% or ±50ms, whicheer is greater
Tolerance (Factory Calibration)	±2% or ±50ms, whichever is greater
Reset Time	≤ 300ms
Initiate Time	Single Shot & Delay-on-Break: ≤ 32ms
Time Delay vs Temp. & Voltage	±2%, or ±50ms, whichever is greater

Input

Voltage	AC: 24 to 240VAC; -20% - 10% DC: 9 to 110VDC; -0% - 20% @ -25°C 9.4 to 110VDC; -0% - 20% @ -40°C
AC Line Frequency/DC Ripple	50/60Hz / ≤ 10%

Output

Type	Solid state
Form	NO
Rating	0.7A steady state, 10A inrush
Voltage Drop	AC ≅ 2.5V @ 0.7A; DC ≅ 1.5V @ 0.7A

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Two base adaptors are available
DIN Rail	Snap on to 32 mm DIN 1 & 35 mm DIN 3 rail
Surface	Two #6 (M3.5 x 0.6) screws or quick mount fasteners
Dimensions	**H** 76.2 mm (3.0"); **W** 17.52 mm (0.69"); **D** 61.2 mm (2.41")
Termination	
ASQU	0.25 in. (6.35 mm) male quick connect terminals
ASTU	0.197 in. (5 mm) push-on terminal blocks for up to #14 AWG (2.5 mm²) wire

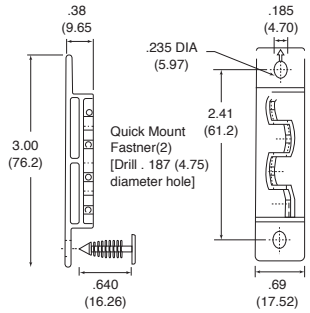
Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 4 oz (113 g)

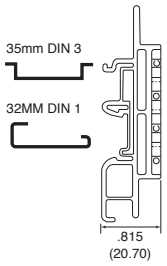
*For CE approved applications, power must be removed from the unit when a switch position is changed.

Mounting Diagrams

P0500-178
SURFACE MOUNT
Inches (Millimeters)



P0500-179
DIN RAIL MOUNT
Inches (Millimeters)



DSQU / DSTU SERIES

Description

The DSQU and DSTU Series of 17.5 mm, DIP switch adjustable, universal solid-state timers offer multiple functions, voltages, and time delay ranges. Choose one of 5 functions and 4 time delay ranges via 4 selection switches located on face of the unit. Six switches adjust the time delay through the selected range.

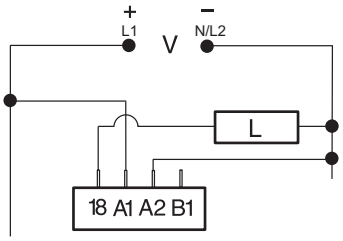
The DSQU Series has quick connect terminals and the DSTU Series has terminal blocks.

Features & Benefits

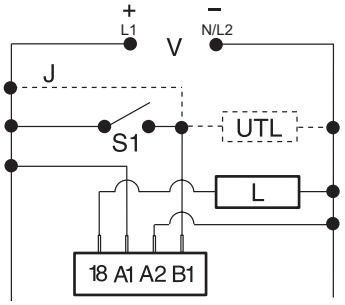
FEATURES	BENEFITS
Universal AC or DC voltage	Choose from 24 to 240VAC or 9 to 110VDC models
Compact 17.5mm size	Allows for high rail density
Microcontroller based	Repeat Accuracy + / -1%
Multifunction: 5 timing functions	Reduce stocking requirements
DIP switch adjustable time delay	Field adjustable delay ranging from 0.1s - 63m
0.7A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Mounting fasteners included	Each unit ships with both surface and DIN rail quick mount adapters
Watchdog circuitry	Self monitoring and self correcting for improved performance

Wiring & Adjustment Diagrams

DELAY-ON-MAKE & RECYCLING



SINGLE SHOT, INTERVAL & DELAY-ON-BREAK



V = Voltage
L = Load
J= Wire Required for Interval Operation
S1= Initiate Switch
UTL = Optional Untimed Load

ADJUSTMENTS

DOM	A B
SS	A B
R	A B
DOB	A B

DOM = Delay-on-Make
SS = Single Shot/Interval
R = Recycling
DOB = Delay-on-Break

R	M	S	I
0.1-6.3s	X0.1s	C E D F	0.1s
1-63s	X1s	C E D F	1s
10-630s	X10s	C E D F	10s
1-63m	X1m	C E D F	1m

R = Range
M = Multiplier
S = Setting
I = Increments of time

Add switches in ON position
TD = 2+8+16=26

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P0500-178 Surface Mount Adapter
P0500-179 DIN Rail Mount Adapter
For use with the ASxx/DSxx Series timers.

Ordering Information

MODEL	INPUT VOLTAGE	CONNECTION
DSQUA3	24 - 240VAC	Quick Connects
DSQUD3	9 - 110VDC	Quick Connects
DSTUA3	24 - 240VAC	Terminal Blocks
DSTUD3	9 - 110VDC	Terminal Blocks

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For dimensional drawing see: Appendix, page 512, Figure 22.

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DSQU / DSTU SERIES

Specifications

Time Delay

Type	Microcontroller based with ceramic resonator and watchdog circuitry
Adjustment	6 switches adjust the time delay; 2 switches select 1 of 4 multipliers
Range*	x0.1s = 0.1 - 6.3s in 0.1s increments x1s = 1 - 63s in 1s increments x10s = 10 - 630s in 10s increments x1m = 1 - 63m in 1m increments
Repeat Accuracy	±0.1% or ±20ms, whichever is greater
Setting Accuracy	±2% or ±50ms, whichever is greater
Reset Time	≤ 300ms
Initiate Time	Single Shot & Delay-on-Break: ≤ 32ms
Time Delay vs Temp. & Voltage	±2% or ±50ms, whichever is greater

Input

Voltage	AC: 24 to 240VAC; -20% - 10% DC: 9 to 110VDC; -0% - 20% @ -25°C 9.4 to 110VDC; -0% - 20% @ -40°C
AC Line Frequency/DC Ripple	50/60Hz / ≤ 10%

Output

Type	Solid state
Form	NO
Rating	0.7A steady state, 10A inrush
Voltage Drop	AC ≅ 2.5V @ 0.7A; DC ≅ 1.5V @ 0.7A

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Two base adaptors are available
DIN Rail	Snap on to 32 mm DIN 1 & 35 mm DIN 3 rail
Surface	Two #6 (M3.5 x 0.6) screws or quick mount fasteners
Dimensions	**H** 76.2 mm (3.0"); **W** 17.52 mm (0.69"); **D** 61.2 mm (2.41")
Termination	
DSQU	0.25 in. (6.35 mm) male quick connect terminals
DSTU	0.197 in. (5 mm) push-on terminal blocks for up to #14 AWG (2.5 mm^2) wire

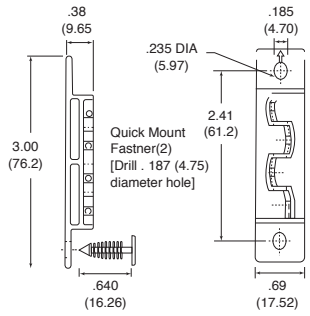
Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 4.2 oz (119 g)

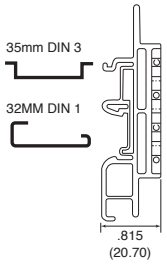
*For CE approved applications, power must be removed from the unit when a switch position is changed.

Mounting Diagrams

P0500-178
SURFACE MOUNT
Inches (Millimeters)



P0500-179
DIN RAIL MOUNT
Inches (Millimeters)



T10 SERIES

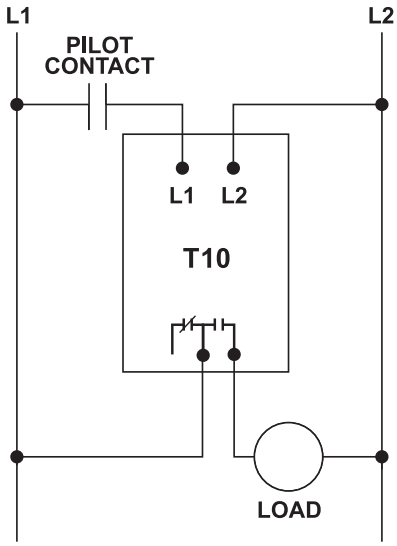
Solid-State On-Delay Timer

Description

The T10 Series on-delay timer is a solid-state electronic device that provides accurate and reliable timing for control circuits up to 460VAC. The T10 features a user-selectable time delay from 6 seconds to 10 minutes (0.5 to 12 seconds on the T10S400 model) and SPDT output contacts. When power is applied to the T10, it immediately begins its timing cycle. During this time, the indicator LED alternates between red and green and the output contacts remain inactive. When the timing cycle is complete, the indicator LED turns solid green and the output contacts are activated. The output contacts will remain activated until power is removed from the T10.

The SPDT contact ratings are 480V @ 240VAC on the 115V and 230V models, and 470VA @ 600VAC on the 460V model.

Wiring Diagram



For dimensional drawing see: Appendix page 509, Figure 6.

Features & Benefits

- Status LED
- 600V control relay on 460V models

Specifications

Input Characteristics

Frequency	50*/60Hz

Functional Characteristics

Timing Range	
T10100, T10200, T10400	6 seconds to 10 minutes
T10S400	0.5 seconds to 12 seconds
Repeat Accuracy	
Fixed Condition	±1%

Output Characteristics

Output Contact Rating (SPDT)	
Pilot Duty	
T10100, T10200	480VA @ 240VAC
T10400, T10S400	470VA @ 600VAC

General Characteristics

Maximum Input Power	5 W
Terminal	
Torque	7 in.-lbs.
Wire Size	12-18AWG

Safety Marks

UL	UL508 (File #E68520)
Dimensions	**H** 74.4 mm (2.93"); **W** 133.9 mm (5.27"); **D** 74.9 mm (2.95")
Weight	0.94 lb. (15.04 oz., 426.38 g)
Mounting Method	#8 screws

*Note: 50Hz will increase all delay timers by 20%.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
T10120	115VAC	0.1 to 10 minute range, 240 VAC rated output contacts
T10200	230VAC	0.1 to 10 minute range, 240 VAC rated output contacts
T10400	460VAC	0.1 to 10 minute range, 600 VAC rated output contacts
T10S400	460VAC	0.5 to 12 second range, 600 VAC rated output contacts

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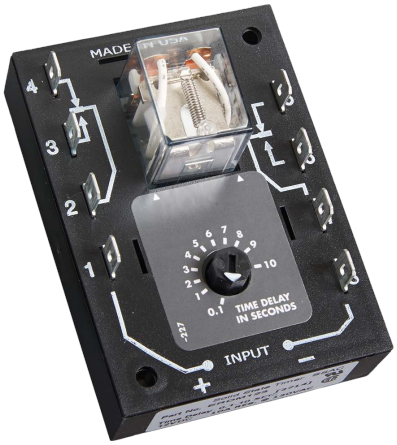
ERDM SERIES



Description

The ERDM Series is a combination of digital electronics and a reliable electromechanical relay. These devices offer a DPDT relay output for relay logic circuits, and isolation of input to output voltages. Cost effective for OEM applications, such as random starting, sequencing ON, switch de-bouncing, anti-short cycling, and other common delay-on-make applications.

Operation (Delay-on-Make)

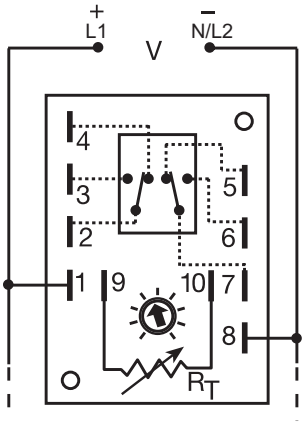
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

FEATURES	BENEFITS
Digital integrated circuitry with electromechanical relay	Repeat Accuracy + / - 0.5%
Isolated 10A, DPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Protects against shock, vibration, and humidity

Wiring Diagram



V = Voltage

A knob, or terminals 9 & 10 are only included on adjustable units. Relay contacts are isolated.

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 25.

Accessories

P1004-16, P1004-16-XVersa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1015-64 (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
ERDM123	12VDC	Onboard knob	0.1 - 10s	ERDM422	120VAC	Onboard knob	0.1 - 5s
ERDM126	12VDC	Onboard knob	0.6 - 60s	ERDM423	120VAC	Onboard knob	0.1 - 10s
ERDM128	12VDC	Onboard knob	0.1 - 10m	ERDM425	120VAC	Onboard knob	0.3 - 30s
ERDM222	24VAC	Onboard knob	0.1 - 5s	ERDM427	120VAC	Onboard knob	0.1 - 5m
ERDM4130S	120VAC	Fixed	30s	ERDM429	120VAC	Onboard knob	0.2 - 15m
ERDM4210	120VAC	Onboard knob	1 - 100m				

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ERDM SERIES

Specifications

Time Delay	
Type	Digital integrated circuitry
Range	0.1s - 500m in 11 adjustable ranges or 0.1s - 1000m fixed
Adjustment	Fixed, onboard or external adjust
Repeat Accuracy	±0.5%
Tolerance (Factory Calibration)	≤ ±10%
Recycle Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%
Input	
Voltage	12, 24, or 120VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
120VAC/DC & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Output	
Type	Isolated relay contacts
Form	DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^7; Full Load - 1 x 10^6
Protection	
Isolation Voltage	≥1500V RMS input to output
Insulation Resistance	≥100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mount with two #6 (M3.5 x 0.6) screws
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 43.2 mm (1.7")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 65°C / -40° to 85°C
Weight	≅ 5.7 oz (162 g)

Selection Guides

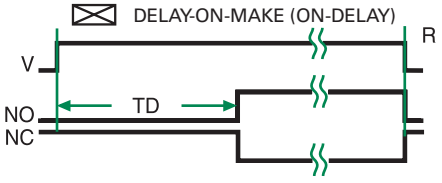
R_T Selection Chart						
Desired Time Delay* Seconds						R_T
1	2	3	4	5	6	Megohm
0.1	0.1	0.1	0.2	0.3	0.6	0.0
0.19	0.6	1	1.7	3	6	0.1
0.28	1.1	2	3.2	6	12	0.2
0.37	1.6	3	4.7	9	18	0.3
0.46	2.1	4	6.2	12	24	0.4
0.55	2.6	5	7.7	15	30	0.5
0.64	3.0	6	9.2	18	36	0.6
0.73	3.5	7	10.7	21	42	0.7
0.82	4.0	8	12.2	24	48	0.8
0.91	4.5	9	13.7	27	54	0.9
1.0	5.0	10	15	30	60	1.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

R_T Selection Chart					
Desired Time Delay* Minutes					R_T
7	8	9	10	11	Megohm
0.1	0.1	0.2	1	10	0.0
0.6	1	1.7	10	50	0.1
1.1	2	3.2	20	100	0.2
1.6	3	4.7	30	150	0.3
2.1	4	6.2	40	200	0.4
2.6	5	7.7	50	250	0.5
3.0	6	9.2	60	300	0.6
3.5	7	10.7	70	350	0.7
4.0	8	12.2	80	400	0.8
4.5	9	13.7	90	450	0.9
5.0	10	15	100	500	1.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
—⌇— = Undefined Time

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HRDM SERIES

Delay-on-Make Timer

Description

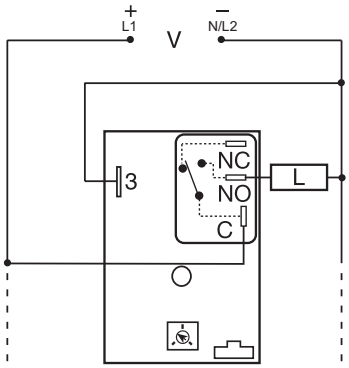
The HRDM Series combines an electromechanical relay output with microcontroller timing circuitry. It offers 12 to 230V operation in five ranges and factory fixed, onboard, or external adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. This series is ideal for OEM applications where cost is a factor.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



NO = Normally Open
L = Load
C = Common, Transfer Contact

NOTE: A knob, or terminals 4 & 5 are only included on adjustable units. R_T is used when external adjustment is ordered. Relay contacts are not isolated.

For dimensional drawing see: Appendix, page 512, Figure 17.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact, low cost design	Allows flexibility for OEM applications
Isolated, 30A, SPDT, NO output contacts	Allows direct operation of heavy loads: compressors, pumps, blower moters, heaters.
Encapsulated	Protects against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
HRDM120	12VDC	Onboard	0.1 - 10s
HRDM3112S	24VDC	Fixed	12s
HRDM413M	120VAC	Fixed	3m
HRDM415M	120VAC	Fixed	5m

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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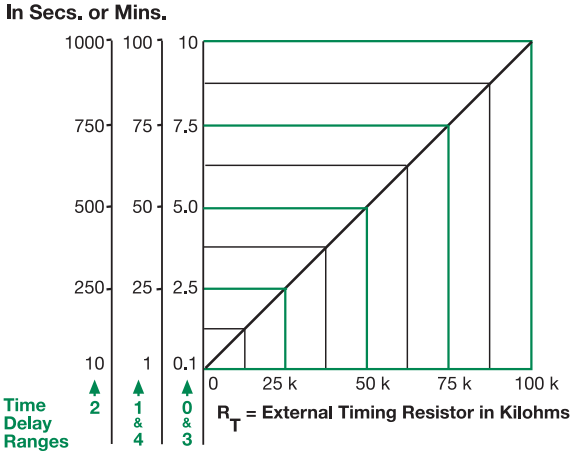
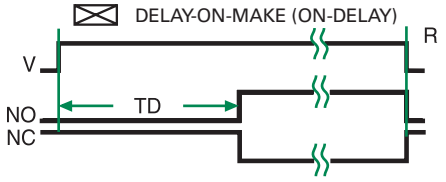
HRDM SERIES

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Type	Microcontroller circuitry
Range	0.1s - 100m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20 ms, whichever is greater
Tolerance (Factory Calibration)	±1%, ±5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	±2%

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC	-15% - 20%
24 to 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Power Consumption	AC ≤ 4VA; DC ≤ 2W

Output

Type	Electromechanical relay
Form	Non-isolated, SPDT

Ratings		**SPDT-NO**	**SPDT-NC**
General Purpose	**125/240VAC**	30A	15A
Resistive	**125/240VAC**	30A	15A
	28VDC	20A	10A
Motor Load	**125VAC**	1 hp*	1/4 hp**
	240VAC	2 hp**	1 hp**

Life	Mechanical - 1 x 10^6; Electrical - 1 x 10^5, *3 x 10^4, **6,000

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	3 x 2 x 1.5 in. (76.7 x 51.3 x 38.1mm)
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

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KRDM SERIES

Description

The KRDM Series is a compact time delay relay measuring only 2 in. (50.8 mm) square. Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDM Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Delay-on-Make)

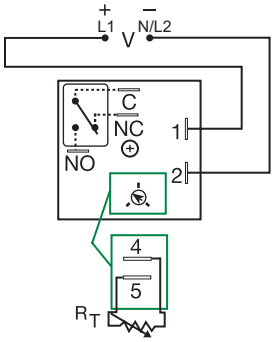
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact, low cost design	Allows flexibility for OEM applications
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Protects against shock, vibration, and humidity

Wiring Diagram



V = Voltage
C = Common, Transfer Contact
NO = Normally Open
NC = Normally Closed

A knob is supplied for adjustable units, or R_T terminals 4 & 5 for external adjust. See external adjustment vs time delay chart. Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
KRDM1110S	12VDC	Fixed	10s	KRDM4110M	120VAC	Fixed	10m
KRDM1130S	12VDC	Fixed	30s	KRDM4110S	120VAC	Fixed	10s
KRDM120	12VDC	Onboard knob	0.1 - 10s	KRDM4145S	120VAC	Fixed	45s
KRDM121	12VDC	Onboard knob	1 - 100s	KRDM420	120VAC	Onboard knob	0.1 - 10s
KRDM2110M	24VAC/DC	Fixed	10m	KRDM421	120VAC	Onboard knob	1 - 100s
KRDM215M	24VAC/DC	Fixed	5m	KRDM424	120VAC	Onboard knob	1 - 100m
KRDM220	24VAC/DC	Onboard knob	0.1 - 10s	KRDM430	120VAC	External	0.1 - 10s
KRDM221	24VAC/DC	Onboard knob	1 - 100s	KRDM433	120VAC	External	0.1 - 10m
KRDM223	24VAC/DC	Onboard knob	0.1 - 10m	KRDM6115M	230VAC	Fixed	15m
KRDM310.2S	24VDC	Fixed	0.2s				

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KRDM SERIES

Accessories

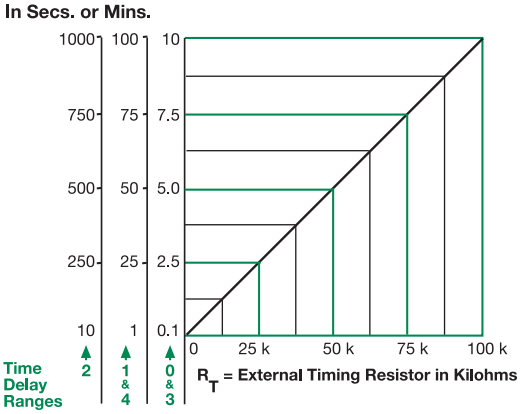
P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

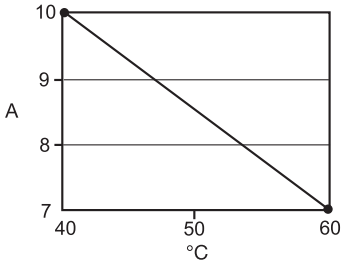
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Output Current/Ambient Temperature



Specifications

Time Delay

Range	0.1s - 100m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Recycle Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±5%

Input

Voltage	12, 24 or 110VDC; 24, 120 or 230VAC
Tolerance	
12VDC & 24VAC/DC	-15% - 20%
110VDC 120 & 230VAC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

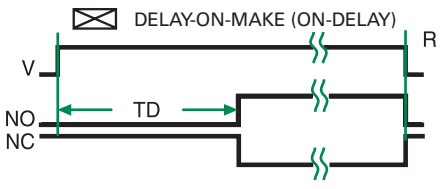
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
—⌇— = Undefined Time

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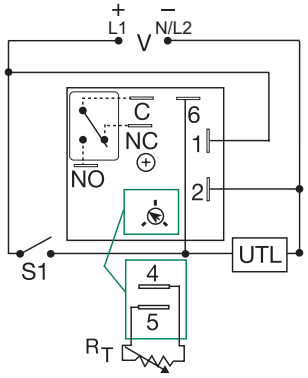
KRPS SERIES

Description

The KRPS Series is a factory programmed time delay relay available with 1 of 15 functions and measures only 2 inches square. The KRPS offers a wide range of fixed, onboard, or externally adjustable time delays. The output relay contacts offer a full 10A rating with complete isolation. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRPS Series is a cost effective approach for OEM applications that require small size, isolation, accuracy, and long life. Special time ranges and functions are available.

Wiring Diagram



V = Voltage
C = Common, Transfer Contact
NC = Normally Closed
NO = Normally Open
S1 = Initiate Switch
UTL = Untimed Load

A knob is supplied for adjustable units, or R_T terminals 4 & 5 for external adjust. See external adjustment vs. time delay chart. The untimed load is optional. S1 is not used for some functions.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact design	Allows flexibility for OEM applications
Isolated, SPDT, 10A output	Allows control of loads for AC or DC voltages
Encapsulated	Encapsulated to protect against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUST.	TIME DELAY	FUNCTION
KRPS4160MM	120VAC	Fixed	60m	Delay-on-Make
KRPS913MB	230VAC	Fixed	3m	Delay-on-Break
KRPSA10.1SFT	24 - 240VAC/DC	Fixed	0.1s	Alternating
KRPSA21RE	24 - 240VAC/DC	Onboard	0.1 - 10s	Recycling, On Time First
KRPSA22B	24 - 240VAC/DC	Onboard	1 - 100s	Delay-on-Break
KRPSA24M	24 - 240VAC/DC	Onboard	0.1 - 10m	Delay-on-Make
KRPSD10.1SF	12 to 48VDC	Fixed	0.1s	Leading Edge Flip-Flop
KRPSD21B	12 to 48VDC	Onboard	0.1 - 10s	Delay-on-Break
KRPSD21M	12 to 48VDC	Onboard	0.1 - 10s	Delay-on-Make
KRPSD22M	12 to 48VDC	Onboard	1 - 100s	Delay-on-Make
KRPSD22S	12 to 48VDC	Onboard	1 - 100s	Single Shot
KRPSD25S	12 to 48VDC	Onboard	1 - 100m	Single Shot

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KRPS SERIES

Specifications

Time Delay

Type	Microcontroller circuitry
Range	0.1s - 1000h in 9 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±2%
Reset Time	≤ 150ms
Initiate Time	≤ 40ms; ≤ 750 operations per minute
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	12 to 48VDC; 24 to 240VAC/DC
Tolerance	
12 to 48VDC	-15% - 20%
24 to 240VAC/DC	-20% - 10%
AC Line Frequency/DC Ripple	50/60Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC 5A resistive @ 230VAC & 28VDC 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

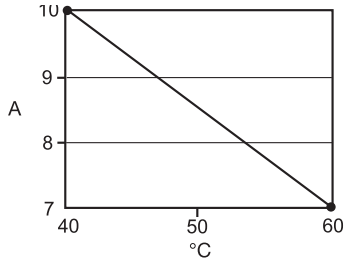
Mechanical

Mounting	Surface mt. with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connects

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

Output Current/Ambient Temperature



Timer Functions

Operation (Delay-on-Make)

Upon application of the input voltage, the dime delay begins. The output relay is de-energized before and during the time delay. At the end of the time delay, the put energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Operation (Delay-on-Break)

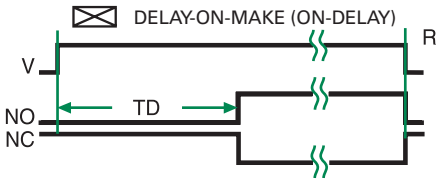
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

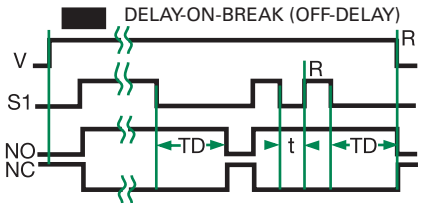
Reset: Re-closing the initiate switch during timing resets the time delay. Removing input voltage resets the time delay and output.

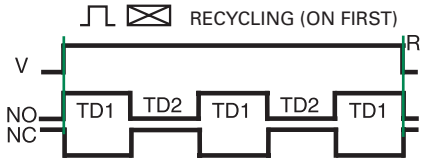
Operation (Recycling)

Upon application of input voltage, the output relay energizes and the ON time begins. At the end of the ON time, the output de-energizes and the OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.







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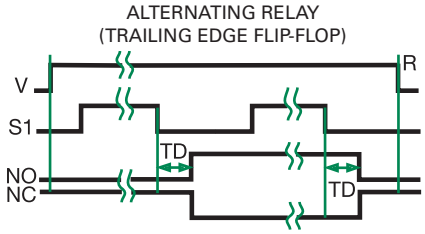
KRPS SERIES

Operation (Alternating)

Input voltage must be applied at all times for proper operation. The operation begins with the output relay de-energized. Closing S1 enables the next alternating operation. When S1 opens (trailing edge triggered), the time delay begins. At the end of the time delay, the output energizes and remains energized until S1 is (re-closed and) re-opened. Then the output relay de-energizes and remains until S1 opens again. Each time S1 opens the time delay occurs and the output transfers.

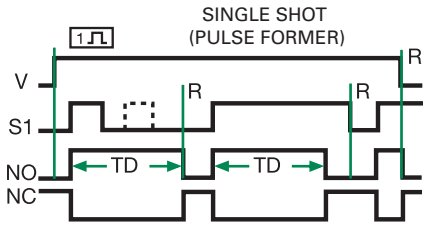
Reset: Removing input voltage resets the output and the time delay.



Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output (relay or solid state) energizes and the time delay begins. At the end of the delay, the output de-energizes. Opening or re-closing the initiate switch during timing has no effect on the time delay. Note (for most single shot timers): If the initiate switch is closed when input voltage is applied, the output energizes and the time delay begins.

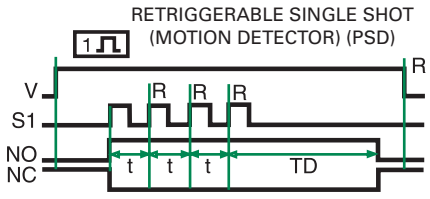
Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Removing input voltage resets the time delay and output.



Operation (Retriggerable Single Shot, Motion Detector)

Input voltage must be applied prior to and during timing. The output relay is de-energized. When the initiate switch S1 closes momentarily or maintained, the output energizes and the time delay begins. Upon completion of the delay, the output de-energizes.

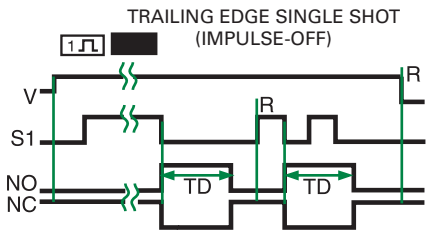
Reset: Re-closing S1 resets the time delay and restarts timing. Removing input voltage resets the time delay and output.



Operation (Trailing Edge Single Shot, Impulse-OFF)

Input voltage must be applied before and during timing. When the initiate switch S1 opens, the output relay energizes. At the end of the time delay, the output de-energizes. Re-closing and opening S1 during timing has no affect on the time delay. The output will not energize if S1 is open when input voltage is applied.

Reset: Reset occurs when the time delay is complete and S1 is closed. Removing input voltage resets the time delay and output.



LEGEND

V = Voltage
R = Reset
T1 = ON Time
T2 = OFF Time
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
t = Incomplete Time Delay
TD, TD1, TD2 = Time Delay
C = Count
P = Pulse Duration
—⁄⁄— = Undefined Time

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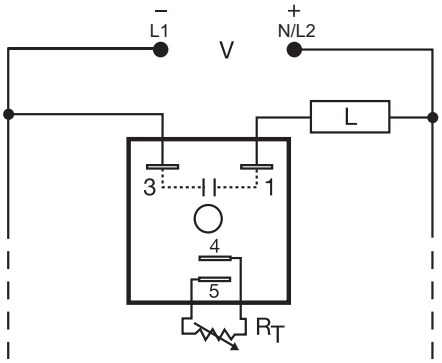
KSD1 SERIES

Delay-on-Make Timer

Wiring Diagram



Load may be connected to terminal 3 or 1.

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Description

The KSD1 Series features two-terminal, series-connection with the load. The KSD1 Series is an ideal choice for delay-on-make timing applications. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for popular AC and DC voltages. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, + / -5% time delay accuracy
Compact, low cost design	Allows flexibility for OEM applications
1A Steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
KSD11120S	12VDC	Fixed	20s
KSD1123	12VDC	External	0.1 - 10m
KSD1230	24VAC	Onboard	0.1 - 10s
KSD1320	24VDC	External	0.1 - 10s
KSD1412S	120VAC	Fixed	2s
KSD14130S	120VAC	Fixed	30s
KSD1420	120VAC	External	0.1 - 10s
KSD16130S	230VAC	Fixed	30s

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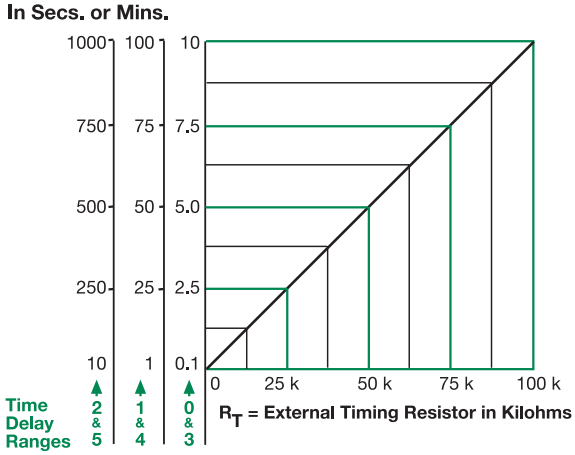
KSD1 SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

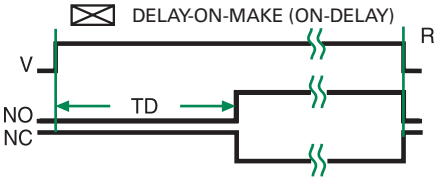


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
⌇ = Undefined Time

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Recycle Time	≤ 150ms
Time Delay vs. Temperature & Voltage	≤ ±10%

Input

Voltage	24, 120, or 230VAC; 12 or 24VDC
Tolerance	±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid state
Form	NO, open during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Minimum Holding Current	≤ 40mA
OFF State Leakage Current	≅ 7mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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KSDU SERIES

Description

The KSDU Series are encapsulated solid-state, delay-on-make timers that combine digital timing circuitry with universal voltage operation. The KSDU Series is factory fixed from 0.1s to 10,230s and does not include the DIP switch. These series are excellent choices for process control systems and OEM equipment.

Operation (Delay-on-Make)

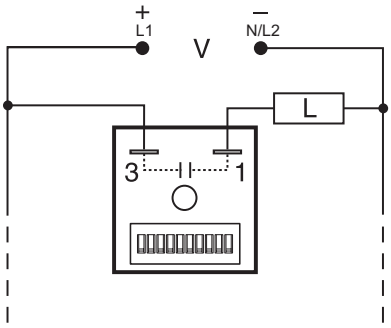
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Features & Benefits

FEATURES	BENEFITS
Universal Voltage	24 to 240VAC/DC in 2 ranges
Digital Integrated Circuitry	Repeat accuracy + / - 5%
1A Steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
2 terminal design	Provides series connection for easy installation

Wiring Diagram



V = Voltage
L = Load

Load may be connected to terminal 3 or 1.

KSDU is fixed.

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
KSDU8120	24 to 120VAC/DC	Fixed	20s
KSDU811200	24 to 120VAC/DC	Fixed	1200s

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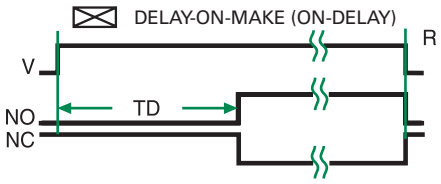
KSDU SERIES

Specifications

Time Delay	
Type	Digital integrated circuitry
Range*	
Fixed	Fixed from 0.1s - 10230s
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	±10%
Recycle Time	≤150ms
Time Delay vs Temp. & Voltage	±5%
Input	
Voltage	24 to 120VAC/DC; 100 to 240VAC/DC
AC Line Frequency	50/60 Hz
Tolerance	±20%
Output	
Type	Solid state
Form	NO, open during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Minimum Holding Current	40mA
Voltage Drop	≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

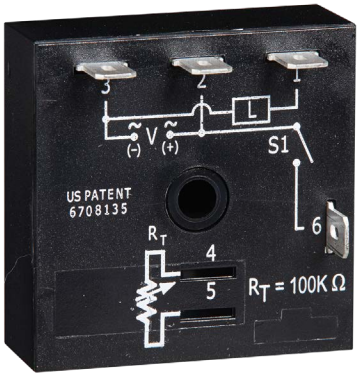
* For CE approved applications, power must be removed from the unit when a switch position is changed.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

KSPS SERIES



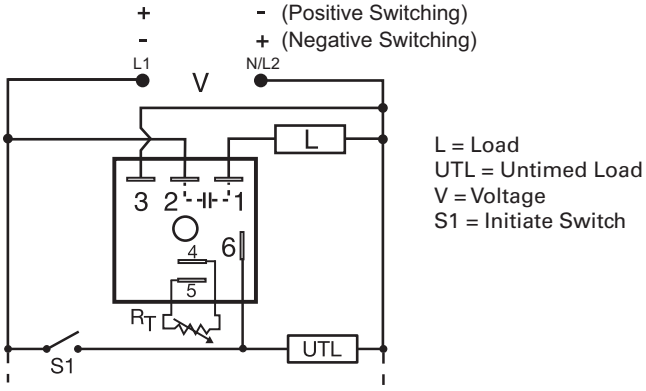
Description

The KSPS Series is a factory programmed module available in any 1 of 14 standard functions. The KSPS Series offers a single, fixed, externally or onboard adjustable time delay. The 1A steady, 10A inrush rated solid-state output provides 100 million operations typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KSPS Series is a cost effective approach for OEM applications that require small size and solid state reliability.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact design	Allows flexibility for OEM applications
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Wiring Diagram



L = Load
UTL = Untimed Load
V = Voltage
S1 = Initiate Switch

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	FUNCTION
KSPS2180SB	24VAC	Fixed	80s	Delay-on-Break
KSPSA21FT	24 - 240VAC, positive switching	Onboard	0.1 - 10s	Recycling, On Time First
KSPSN13MI	12 - 120VDC, negative switching	Fixed	3m	Interval
KSPSN21B	12 - 120VDC, negative switching	Onboard	0.1 - 10s	Delay-on-Break
KSPSP145SM	12 - 120VDC, positive switching	Fixed	45s	Delay-on-Make
KSPSP22B	12 - 120VDC, positive switching	Onboard	1 - 100s	Delay-on-Break
KSPSP35PSD	12 - 120VDC, positive switching	External	1 - 100m	Retriggerable Single Shot

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KSPS SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Specifications

Time Delay

Type	Microcontroller circuitry
Range	0.1s - 1000h in 9 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±2%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms; ≤ 1500 operations per minute
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	12 to 120VDC; 24 to 240VAC
Tolerance	≤ ±15%
AC Line Frequency/DC Ripple	50/60Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid-state output
Rating	1A steady, 10A inrush for 16ms
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
OFF State Leakage Current	AC ≅ 5mA @ 240VAC, DC≅ 1mA

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mt. with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connects

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

Timer Functions

Operation (Delay-on-Make)

Upon application of the input voltage, the dime delay begins. The output relay is de-energized before and during the time delay. At the end of the time delay, the put energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Operation (Delay-on-Break)

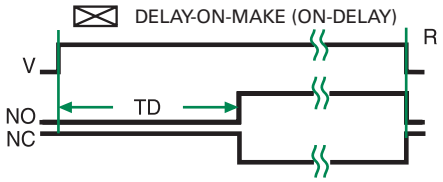
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

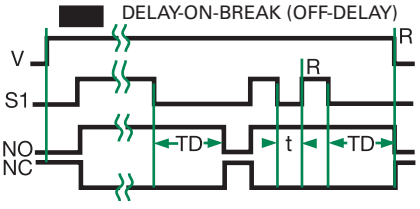
Reset: Re-closing the initiate switch during timing resets the time delay. Removing input voltage resets the time delay and output.

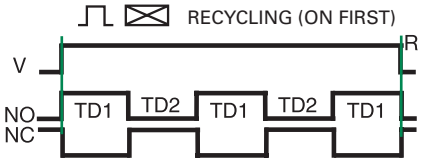
Operation (Recycling)

Upon application of input voltage, the output relay energizes and the ON time begins. At the end of the ON time, the output de-energizes and the OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.







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KSPS SERIES

Operation (Alternating)

Input voltage must be applied at all times for proper operation. The operation begins with the output relay de-energized. Closing S1 enables the next alternating operation. When S1 opens (trailing edge triggered), the time delay begins. At the end of the time delay, the output energizes and remains energized until S1 is (re-closed and) re-opened. Then the output relay de-energizes and remains until S1 opens again. Each time S1 opens the time delay occurs and the output transfers.

Reset: Removing input voltage resets the output and the time delay.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output (relay or solid state) energizes and the time delay begins. At the end of the delay, the output de-energizes. Opening or re-closing the initiate switch during timing has no effect on the time delay. Note (for most single shot timers): If the initiate switch is closed when input voltage is applied, the output energizes and the time delay begins.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Removing input voltage resets the time delay and output.

Operation (Trailing Edge Single Shot, Impulse-OFF)

Input voltage must be applied before and during timing. When the initiate switch S1 opens, the output relay energizes. At the end of the time delay, the output de-energizes. Re-closing and opening S1 during timing has no affect on the time delay. The output will not energize if S1 is open when input voltage is applied.

Reset: Reset occurs when the time delay is complete and S1 is closed. Removing input voltage resets the time delay and output.

Operation (Inverted Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch S1, the output relay de-energizes. At the end of the time delay, the output energizes. Opening or re-closing S1 during timing has no affect on the time delay. The output will remain de-energized if S1 is closed when input voltage is applied.

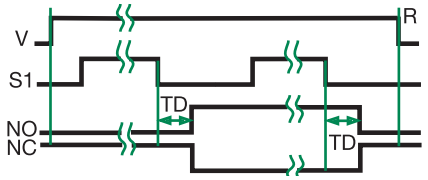
Reset: Reset occurs when the time delay is complete and S1 is open. Removing input voltage resets the time delay and output.

Operation (Interval)

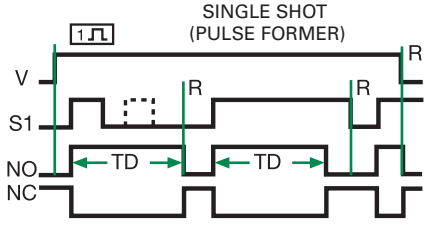
Upon application of input voltage, the time delay begins. The output (relay or solid state) energizes during the time delay. At the end of time delay the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

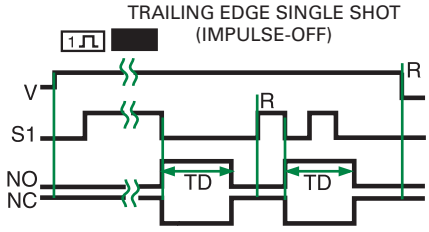
ALTERNATING RELAY
(TRAILING EDGE FLIP-FLOP)



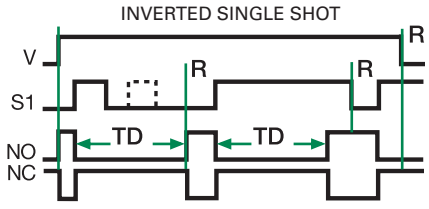
SINGLE SHOT
(PULSE FORMER)



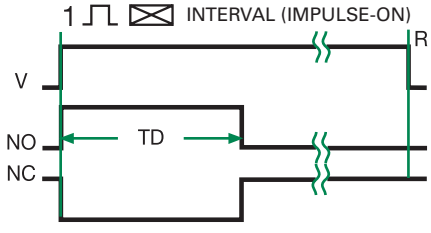
TRAILING EDGE SINGLE SHOT
(IMPULSE-OFF)



INVERTED SINGLE SHOT



1 INTERVAL (IMPULSE-ON)



LEGEND

V = Voltage
R = Reset
T1 = ON Time
T2 = OFF Time
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
t = Incomplete Time Delay
TD, TD1, TD2 = Time Delay
C = Count
P = Pulse Duration
= Undefined Time

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MSM SERIES

Description

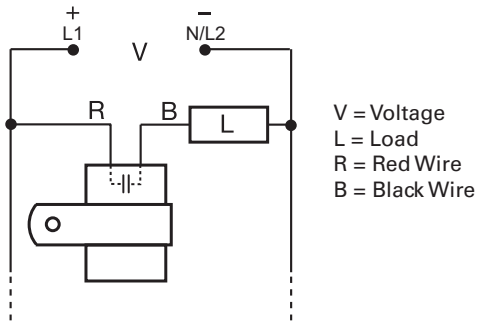
The MSM Series replaces bi-metal type timing with reliable solid-state circuitry. There are no moving parts to arc or wear. It is a cost effective solution for OEM designers. It is available for printed circuit board mounting or surface mounting with a removable bracket and wire leads. The MSM Series offers immediate reset on removal of power.

Operation (Delay-on-Make)

The time delay begins upon application of input voltage. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
L = Load
R = Red Wire
B = Black Wire

For dimensional drawing see: Appendix, page 514, Figure 39.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat Accuracy + / - 5%, Factory calibration + / - 15%
Compact, low cost design	Allows flexibility for OEM applications
Long life	No moving parts to arc or wear
PCB or wire harness	Offers design and installation flexibility
Immediate reset	Occurs on removal of power
Totally Encapsulated	Protects against shock, vibration and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	WIRE TYPE	WIRE LENGTH inches (mm)
MSM10.5W6	12VDC	Fixed	0.5s	Standard Lead	6.0 (152.4)
MSM10.7W6	12VDC	Fixed	0.7s	Standard Lead	6.0 (152.4)
MSM11W6	12VDC	Fixed	1s	Standard Lead	6.0 (152.4)
MSM110W6	12VDC	Fixed	10s	Standard Lead	6.0 (152.4)
MSM130W9	12VDC	Fixed	30s	Standard Lead	9.0 (228.6)
MSM190W6	12VDC	Fixed	90s	Standard Lead	6.0 (152.4)
MSM20.15W9	24VAC	Fixed	0.15s	Standard Lead	9.0 (228.6)
MSM210P3	24VAC	Fixed	10s	PC Mount	0.5 (12.7)
MSM25W9	24VAC	Fixed	5s	Standard Lead	9.0 (228.6)
MSM30.7W6	24VDC	Fixed	0.7s	Standard Lead	6.0 (152.4)
MSM42W6	120VAC	Fixed	2s	Standard Lead	6.0 (152.4)
MSM43W6	120VAC	Fixed	3s	Standard Lead	6.0 (152.4)
MSM420W6	120VAC	Fixed	20s	Standard Lead	6.0 (152.4)
MSM450W6	120VAC	Fixed	50s	Standard Lead	6.0 (152.4)

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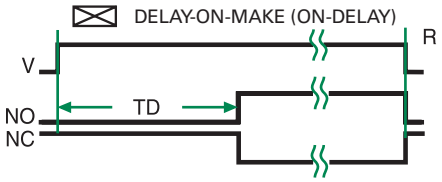
MSM SERIES

Specifications

Time Delay	
Type	Analog Circuitry
Range	0.05 - 180s fixed
Repeat Accuracy	±5%
Tolerance (Factory Calibration)	±15%
Recycle Time	≤ 75ms
Time Delay vs Temp. & Voltage	±15%
Input	
Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	±10%
AC Line Frequency	50/60 Hz
Output	
Type	Solid State
Form	NO, open during timing
Maximum Load Current	0.5A steady state 25°C; 0.25A steady state 60°C
Minimum Holding Current	40mA
Voltage Drop	≅ 2.5V @ 0.5A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS input to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	**A.)** PC mount 14 AWG (2.087mm²) wires (Can be inserted in AMP Miniature Spring Socket #645980-1) **B.)** Stranded 18 AWG wire leads (0.933 mm²) with mounting bracket
Environmental	
Operation/Storage Temperature	-20° to 60°C / -30° to 85°C
Humidity	95% relative, non-condensing
Weight	P: ≅ 1.1 oz (31.2 g) W: ≅ 1.2 oz (34 g)

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
—⌇— = Undefined Time

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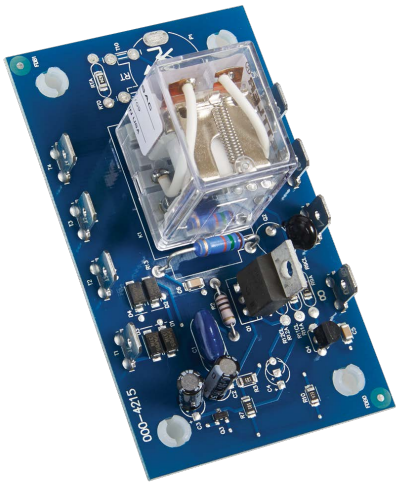
ORM SERIES



Description

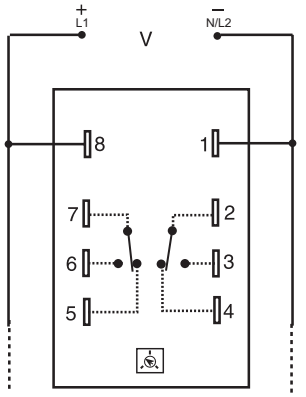
The ORM Series features open PC board construction for reduced cost. It has isolated, 10A, DPDT relay contacts and all connections are 0.25 in (6.35 mm) male quick connect terminals. The time delay may be ordered as factory fixed, onboard knob, or external adjustment. Time delays from 0.05 - 300 seconds.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



V = Voltage

R_T is used when external adjustment is ordered.
Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 26.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry with electromechanical relay	Repeat Accuracy + / - 2%
Isolated 10A, DPDT output contacts	Allows control of loads for AC or DC voltages
Open PCB contruction	Reduces cost for OEM applications

Accessories

P1004-12, P1004-12-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
ORM120A17	120VAC	Fixed	7s
ORM120A25	120VAC	Onboard knob	3 - 300s
ORM230A17	230VAC	Fixed	7s
ORM24D13.5	24VDC/28VDC	Fixed	3.5s
ORM24D22	24VDC	Onboard knob	0.5 - 30s

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ORM SERIES

Specifications

Time Delay

Type	Analog circuitry
Range	0.05 - 300s in 5 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance	Adjustable: guaranteed range Fixed: ±10%
Recycle Time	After timing - ≤ 16ms; During timing - 0.1% of max. time delay or 75ms, whichever is greater
Time Delay vs Temp. & Voltage	≤ ±10%

Input

Voltage	24 or 110VDC; 24, 120, or 230VAC
Tolerance	
24VDC/AC	-15% - 20%
110 to 230VAC/DC	-20% - 10%
AC Line Frequency	50/60 Hz
Power Consumption	2.25W

Output

Type	Electromechanical relay
Form	DPDT, Isolated
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - $1x10^7$; Electrical - $1x10^6$

Protection

Polarity	DC units are reverse polarity protected
Isolation Voltage	≥1500V RMS input to output

Mechanical

Mounting	Surface mount with four #6 (M3.5 x 0.6) screws
Dimensions	**H** 53.8 mm (2.12"); **W** 93.7 mm (3.69"); **D** 47.8 mm (1.88")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

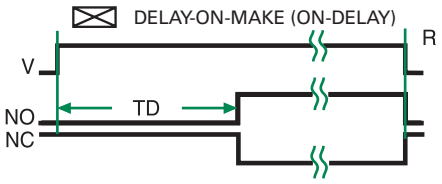
Operating/Storage Temperature	-20° to 65°C / -30° to 85°C
Weight	≅ 2.7 oz (77 g)

Selection Guide

R_T Selection Chart					
Desired Time Delay*					R_T
Seconds					
1	2	3	4	5	Megohm
0.05	0.5	0.6	1.2	3.0	0.0
0.5	5.0	10	20	50	0.5
1.0	10	20	40	100	1.0
1.5	15	30	60	150	1.5
2.0	20	40	80	200	2.0
2.5	25	50	100	250	2.5
3.0	30	60	120	300	3.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

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PRLM SERIES

Description

The PRLM series is designed for use in non-critical timing applications. It offers low cost, knob adjustable timing control, full 10 A relay output, and onboard LED indication. The knob adjustment provides a guaranteed time range of up to 10 minutes in 6 ranges. The onboard LED indicates whether or not the unit is timing (flashing LED) as well as the status of the output.

Operation (Delay-on-Make)

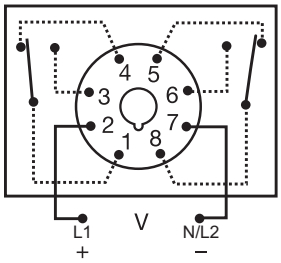
The time delay is initiated when input voltage is applied. LED flashes during timing. At the end of the delay period, the output contacts energize. LED is on steady after the unit times out.

Reset: Reset is accomplished by removal of input voltage. There is no false output when reset during timing.

Features & Benefits

FEATURES	BENEFITS
Electronic circuitry with electromechanical relay	Repeat Accuracy + / - 2 %
Knob adjustable time delay	Guaranteed time range of up to 10 mins in 6 ranges
Isolated 10 A, DPDT output contacts	Allows control of loads for ac or dc voltages
LED indication	Provides relay status both during and after timing
Industry standard octal plug connection	Eliminates need for special connectors

Wiring Diagram



8-pin octal DPDT

For dimensional drawing see: Appendix B, page 512, Figure 24

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
PRLM41180	120 V ac	Fixed	180 s
PRLM423	120 V ac	Adjustable	1–60 s

Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac

P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rate 10 A @ 600 V ac.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

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PRLM SERIES

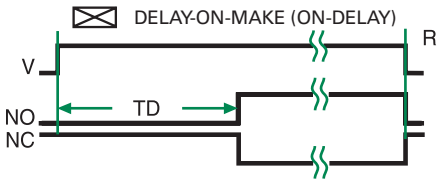
Specifications

Time Delay	
Type	Digital circuitry
Range	See "Ordering Information" table
Repeat Accuracy	±2 %
Fixed Time Tolerance & Setting Accuracy	+/- 5 %
Reset Time	≤ 50 ms
Recycle Time	After timing: ≤ 20 ms During timing: 0.1% of max. time delay or 75 ms, whichever is greater
Time Delay vs Temp. & Voltage	≤ ± 5 %
Input	
Voltage	120 V ac
Tolerance	
120 V ac	-20 %–10 %
AC Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W
Output	
Type	Electromechanical relay
Form	Isolated, DPDT
Rating	10 A resistive @ 240 V ac; 1/3 hp @ 120/240 V ac
Life	Mechanical - $1x10^7$; Electrical - $1x10^6$
Protection	
Surge	IEEE C62.41-1991 Level A
Isolation Voltage	≥ 1500 V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	Dc units are reverse polarity protected
Indication	
Type	LED
Operation	During timing - flashing Output energized - on steady
Mechanical	
Mounting	Plug-in socket
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")
Termination	Octal 8-pin plug-in
Environmental	
Operating/Storage Temperature	-20° to 65 °C / -30° to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT series sockets is 12 in-lbs.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
—⌇— = Undefined Time

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TDM / TDMH / TDML SERIES

Delay-on-Make Timer

Description

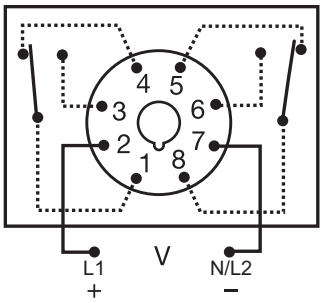
The TDM/TDMH/TDML series is a delay-on-make timer that combines accurate digital circuitry with isolated, DPDT relay contacts in an industry standard 8-pin plug-in package. DIP switch adjustment allows precise selection of the time delay over the full time delay range. The TDM/TDMH/TDML series is the product of choice for custom control panel and OEM designers.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 23.

Features & Benefits

FEATURES	BENEFITS
Wide delay range (0.1 s to 2.8 h)	User selectable via DIP switches for fine tuning to individual applications.
Microcontroller based	Repeat Accuracy +/- 0.1 %
Dip switch adjustment	Provides first time setting accuracy of +/- 2 %
Setting accuracy +/- 2 %	Provides flexibility for use in most applications
LED indication	Provides visual indication of time delay status
Isolated 10 A, DPDT output contacts	Allows control of loads for ac or cc voltages

Ordering Information

MODEL	INPUT VOLTAGE	DELAY RANGE
TDM120AL	120 V ac	1–1023 s in 1 s increments
TDM12DL	12 V dc	1–1023 s in 1 s increments
TDM230AL	230 V ac	1–1023 s in 1 s increments
TDM24AL	24 V ac	1–1023 s in 1 s increments
TDM24DL	24 V dc/28 V dc	1–1023 s in 1 s increments
TDMH120AL	120 V ac	10 –10230 s in 10 s increments
TDMH24AL	24 V ac	10 –10230 s in 10 s increments
TDML110DL	110 V dc	0.1 –102.3 s in 0.1 s increments
TDML120AL	120 V ac	0.1 –102.3 s in 0.1 s increments
TDML12DL	12 V dc	0.1 –102.3 s in 0.1 s increments
TDML24DL	24 V dc/28 V dc	0.1 –102.3 s in 0.1 s increments

Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac

P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

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TDM / TDMH / TDML SERIES

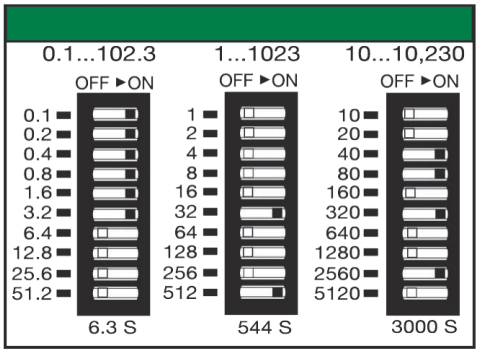
Specifications

Time Delay	
Type	Digital integrated circuitry
Range	0.1–102.3 s in 0.1 s increments 1–1023 s in 1 s increments 10–10,230 s in 10 s increments
Repeat Accuracy	±0.1 %
Setting Accuracy	±2 %
Reset Time	≤ 150 ms
Time Delay vs. Temperature & Voltage	±5 %
Indicator	LED glows during timing; relay is de-energized
Input	
Voltage	12, 24, or 110 V dc; 24, 120, or 230 V ac
Tolerance	
12 V dc & 24 Vdc/ac	-15 %–20 %
110 V ac/dc to 230 V ac	-20 %–10 %
Ac Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W
Output	
Type	Electromechanical relay
Form	DPDT
Rating	10 A resistive @ 120/240 V ac; 1/3 hp @ 120/240 V ac
Life	Mechanical - 1 x10^7; Electrical - 1 x 10^6
Protection	
Polarity	Dc units are reverse polarity protected
Isolation Voltage	≥ 1500 V RMS input to output
Mechanical	
Mounting	Plug-in socket
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")
Termination	Octal 8-pin plug-in
Environmental	
Operating/Storage Temperature	-20 °C to 65 °C / -30 °C to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	UL 508 (E57310)

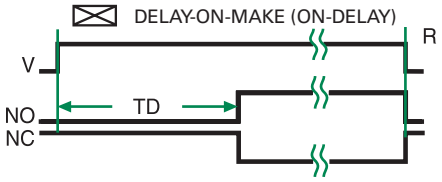
*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT Series sockets is 12 in-lbs.

Binary Switch Operation



Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
⊣⌇⊢ = Undefined Time

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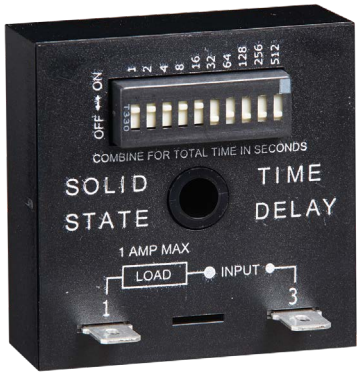
TDU / TDUH / TDUL SERIES

Encapsulated Solid-State, Delay-on-Make Timers



Description

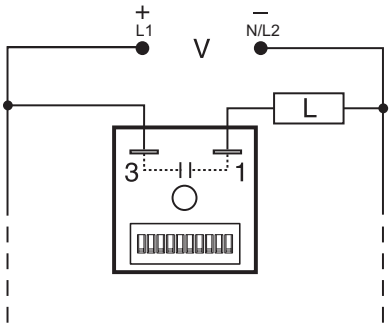
The TDU Series are encapsulated solid-state, delay-on-make timers that combine digital timing circuitry with universal voltage operation. The TDU offers DIP switch adjustment allowing accurate selection of the time delay over the full time delay range. This series is an excellent choice for process control systems and OEM equipment.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



Load may be connected to terminal 3 or 1.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Universal input voltage	Meets wide application needs
Microcontroller based	Repeat Accuracy +/- 0.5% or 20ms, whichever is greater
Totally solid state and encapsulated	No moving parts to arc and wear out over time, and encapsulated to protect against shock, vibration, and humidity
3 time ranges available (0.1s to 2.8h)	Makes it versatile for use in many applications
DIP switch adjustment	Provides first time setting accuracy

Ordering Information

MODEL	INPUT VOLTAGE	TIME RANGE (SEC)
TDUL3000A	24 to 120VAC/DC	0.1-102.3
TDUL3001A	100 to 240VAC/DC	0.1-102.3
TDU3000A	24 to 120VAC/DC	1-1023
TDU3001A	100 to 240VAC/DC	1-1023
TDU3003A	120 to 277VC/DC	1-1023
TDUH3000A	24 to 120VAC/DC	10-10230
TDUH3001A	100 to 240VAC/DC	10-10230

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Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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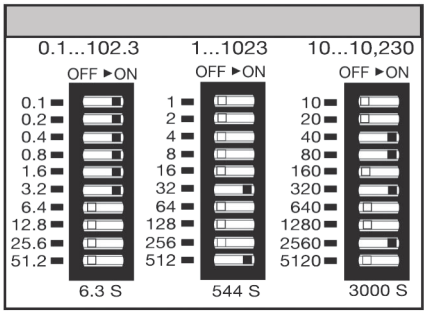
TDU / TDUH / TDUL SERIES

Specifications

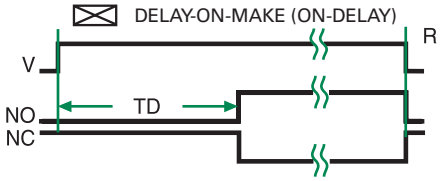
Time Delay	
Type	Digital integrated circuitry
Range*	0.1 - 102.3s in 0.1s increments 1 - 1,023s in 1s increments 10 - 10,230s in 10s increments
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	±10%
Recycle Time	≤ 150ms
Time Delay vs Temp. & Voltage	±5%
Input	
Voltage	24 to 120VAC/DC; 100 to 240VAC/DC
AC Line Frequency	50/60 Hz
Tolerance	±20%
Output	
Type	Solid state
Form	NO, open during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Minimum Holding Current	40mA
Voltage Drop	≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

Binary Switch Operation



*For CE approved applications, power must be removed from the unit when a switch position is changed.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
—⌇— = Undefined Time

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TH1 SERIES

Description

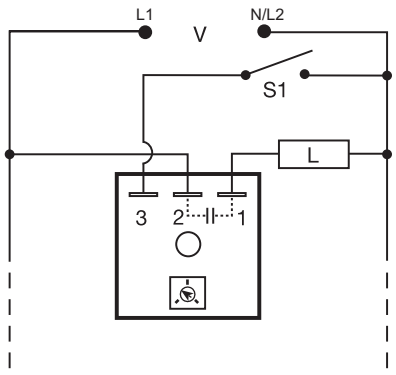
The TH1 Series is a solid-state relay and timer combined into one compact, easy-to-use control. This highly reliable device eliminates the need for a separate solid-state relay. When mounted to a metal surface, it can switch load currents up to 20A steady state, and 200A inrush.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Optional Low Current Initiate Switch
L = Load

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 2%, Factory calibration + / - 5%
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and component costs
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps, and heaters directly without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer for high current applications

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	OUTPUT RATING	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TH1B633	10A	230VAC	Onboard	2 - 180s
TH1C415	20A	120VAC	Fixed	5s
TH1C621	20A	230VAC	External	0.1 - 3s

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TH1 SERIES

Specifications

Time Delay

Range	0.1 - 600s in 4 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ± 5%
Time Delay vs Temp. & Voltage	≤ ±10%
Recycle Time	≤ 150ms

Input

Voltage	24, 120, or 230VAC
Tolerance	±15%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, open during timing

Maximum Load Currents

Output	Steady State	Inrush**
A	6A	60A
B	10A	100A
C	20A	200A

Minimum Load Current	100mA
Voltage Drop	≅ 2.5V at rated current
OFF State Leakage Current	≅ 5mA @ 230VAC

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

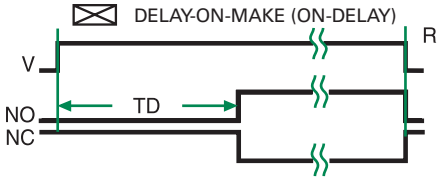
**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

Selection Guide

R_T Selection Chart				
Desired Time Delay* Seconds				R_T
1	2	3	4	Kohms
0.1	0.5	2	5	0
0.3	6	20	60	10
0.6	12	38	120	20
0.9	18	55	180	30
1.2	24	73	240	40
1.5	30	90	300	50
1.8	36	108	360	60
2.1	42	126	420	70
2.4	48	144	480	80
2.7	54	162	540	90
3.0	60	180	600	100

* When selecting an external R_T add at least 15% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
⊣⌇⊢ = Undefined Time

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THD1B410.5S

Description

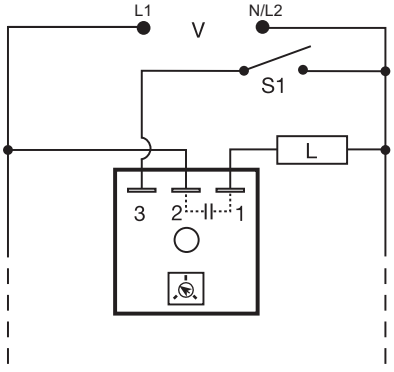
The THD1B410.5S combines accurate timing circuitry with high power solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, timers.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Optional Low Current Initiate Switch
L = Load

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration + / - 1%
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and component costs
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps, and heaters directly without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer for high current applications

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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THD1B410.5S

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Recycle Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, open during timing

Maximum Load Current

Output	Steady State	Inrush**
A	6A	60A
B	10A	100A
C	20A	200A

Minimum Load Current	100mA
Voltage Drop	≅ 2.5V @ rated current
OFF State Leakage Current	≅ 5mA @ 230VAC

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

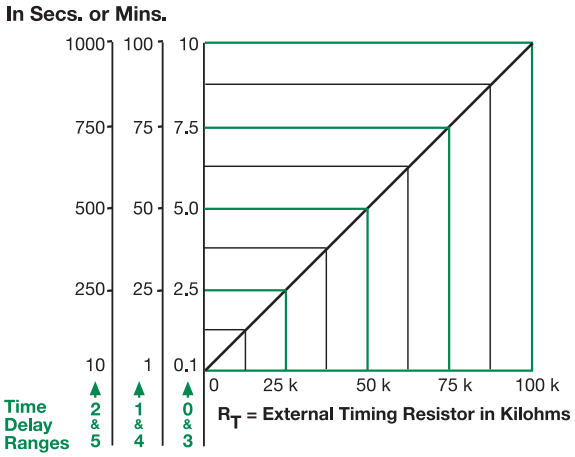
Mounting **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

External Resistance vs. Time Delay

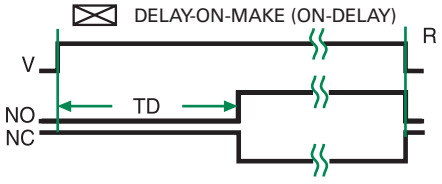


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
—⌇— = Undefined Time

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TMV8000 / TSU2000 SERIES

Universal Voltage Delay-on-Make Timer

TMV8000

TSU2000

Description

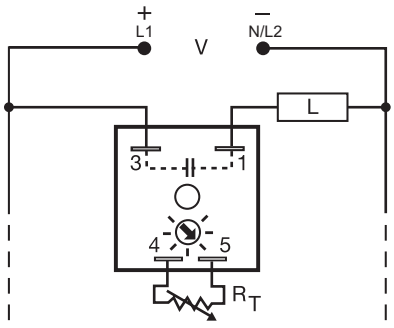
The TMV and TSU Series are universal voltage delay-on-make timers. Two models cover all the popular voltages and time delays. Available with knob or external adjust time delay. Its simple two terminals can easily be connected in series with a relay coil, contactor coil, solenoid, lamps, small motor, etc., to delay their energization, prevent short cycling or to sequence on various loads.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



Load may be connected to terminal 3 or 1.

TMV has knob adjustment.

TSU has external adjustment terminals 4 & 5.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Universal AC/DC operating voltage	Provides flexibility for use in all systems
Totally solid-state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Two terminal series connection with the load	Provides quick and easy installation for new or existing systems
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TMV8000	24 to 240VAC/DC	Onboard	0.1 - 8m
TSU2000	24 to 240VAC/DC	External	5 - 480s

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TMV8000 / TSU2000 SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

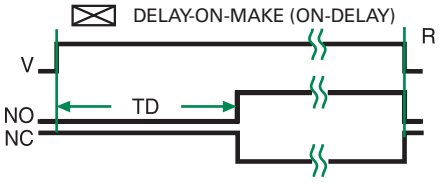
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Selection Guide

R_T Selection Chart	
Time Delay*	
Seconds	R_T Megohm
5	0.0
85	0.5
163	1.0
240	1.5
320	2.0
400	2.5
480	3.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Type	Analog circuitry
Range	5 - 480s (TSU2000) 0.1 - 8m (TMV8000)
Repeat Accuracy	±2%
Tolerance (Factory Calibration)	≤ ±10%
Reset Time	≤ 100ms

Input

Voltage	24 to 240VAC/DC ±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid State
Form	NO, open during timing
Maximum Load Current	1A steady state, 10A inrush at 55°C
Minimum Holding Current	≤ 40mA
Voltage Drop	≅ 2.5V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-20° to 70°C / -30° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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TRM SERIES

Description

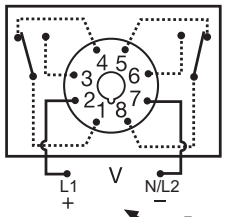
The TRM series is a combination of digital electronic circuitry and electromechanical relay output. It provides input to output isolation with a wide variety of input voltages and time ranges. Standard plug-in base wiring, fast reset, rugged enclosure, and good repeat accuracy make the TRM a select choice in any OEM application.

Operation (Delay-on-Make)

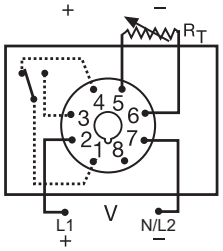
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



8-pin octal DPDT



8-pin octal SPDT

V = Voltage

R_T is used when external adjustment is ordered. Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 24.

Features & Benefits

FEATURES	BENEFITS
Electronic circuitry with electromechanical relay	Repeat Accuracy +/- 2 %
Isolated 10 A, SPDT or DPDT output contacts	Allows control of loads for ac or dc voltages.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	OUTPUT	TIME TOLERANCE	TIME DELAY
TRM120A2X30	120 V ac	Knob	Octal, DPDT	+/- 20%	1–30 s
TRM120A2Y120	120 V ac	Knob	Octal, DPDT	+/- 10%	2–120 s
TRM120A2Y180	120 V ac	Knob	Octal, DPDT	+/- 10%	2–180 s
TRM24A8Y5	24 V ac	External	Octal, SPDT without potentiometer	+/- 10%	0.1–5 s
TRM24D1X10	24 V dc/28 V dc	Fixed	Octal, DPDT	+/- 20%	10 s
TRM24D1X2	24 V dc/28 V dc	Fixed	Octal, DPDT	+/- 20%	2 s

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TRM SERIES

Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

OT11PC Octal Socket for UL listing*
11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac

P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

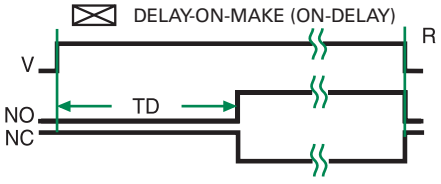
C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Selection Guides

External R_T P/N Selection Table	
VALUE	PART NUMBER*
100K ohm	P1004-95
100K ohm	P1004-95-X

*Externally adjustable potentiometers. Numbers with additional "-X" include two pre-soldered 8" wire leads with 1/4" female quick-connect terminals (for clockwise increase).

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Type	Digital circuitry
Range	See "Ordering Information" table
Repeat Accuracy	± 2 %
Fixed Time Tolerance & Setting Accuracy	± 5, 10, or 20 %
Reset Time	≤ 50 ms
Recycle Time	After timing: ≤ 20 ms During timing: 0.1 % of max. time delay or 75 ms, whichever is greater
Time Delay vs Temp. & Voltage	≤± 5 %
Indicator	LED glows after time delay; relay is energized

Input

Voltage	24 V dc; 24, 120 V ac
Tolerance	
24 V dc/ac	-15 %–20 %
120 V ac	-20 %–10 %
AC Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W

Output

Type	Electromechanical relay
Form	Isolated DPDT or SPDT
Rating	10 A resistive @ 120/240 V ac; 1/3 hp @ 120/240 V ac
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6

Protection

Isolation Voltage	≥ 1500 V RMS between input & output terminals
Insulation Resistance	≥ 100 MΩ
Polarity	Dc units are reverse polarity protected

Mechanical

Mounting	Plug-in socket
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")
Termination	Octal 8-pin or 11-pin plug-in

Environmental

Operating/Storage Temperature	-20 °C to 65 °C / -30 °C to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT series sockets is 12 in-lbs.

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TS1 SERIES

Delay-on-Make Timer

Description

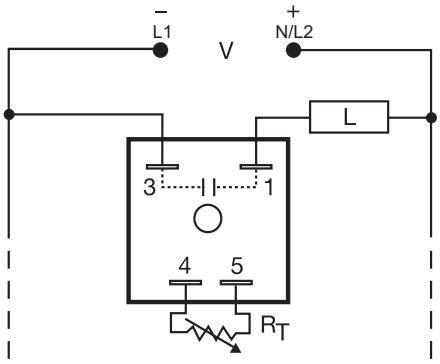
The TS1 Series offers proven reliability and performance with years of use in OEM equipment and commercial applications. This encapsulated general use timing module is capable of controlling load currents ranging from 5mA to 1A. May be connected in series with contactors, relays, valves, solenoids, small motors, and lamps.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



Load may be connected to terminal 3 or 1. R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat Accuracy +/- 2%
Fixed or external adjustable time delay	External time delay settings are adjustable from 0.05s - 10m in 8 ranges for added flexibility
5mA to 1A load current range	Minimum holding current of 5mA ensures proper operation with the lightest of loads
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Two terminal series load connections	Allows connection in series with contactors, relays, valves, solenoids, small motors and lamps. Provides quick and easy installation for new or existing systems

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TS1211.5	24VAC	Fixed	1.5s	TS1412	120VAC	Fixed	2s
TS121150	24VAC	Fixed	150s	TS14120	120VAC	Fixed	20s
TS12130	24VAC	Fixed	30s	TS14130	120VAC	Fixed	30s
TS1214	24VAC	Fixed	4s	TS1415	120VAC	Fixed	5s
TS12190	24VAC	Fixed	90s	TS1416	120VAC	Fixed	6s
TS1221	24VAC	External	0.05 - 3s	TS1421	120VAC	External	0.05 - 3s
TS1222	24VAC	External	0.5 - 60s	TS1422	120VAC	External	0.5 - 60s
TS1224	24VAC	External	5 - 600S	TS1423	120VAC	External	2 - 180s
TS13115	24VDC	Fixed	15s	TS1424	120VAC	External	5 - 600s
TS1321	24VDC	External	0.05 - 3s	TS1612	230VAC	Fixed	2s
TS1410.25	120VAC	Fixed	0.25s	TS1615	230VAC	Fixed	5s
TS14110	120VAC	Fixed	10s	TS1621	230VAC	External	0.05 - 3s
TS141180	120VAC	Fixed	180s	TS1622	230VAC	External	0.5 - 60s

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TS1 SERIES

Accessories

P1004-XX, P1004-XX-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

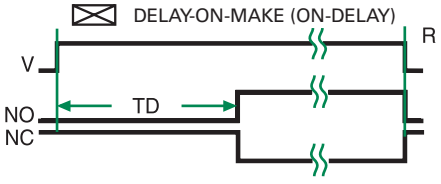
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

All Other Voltages		12VDC	
Time Delay	VTP P/N	Time Delay	VTP P/N
1 - 0.05-3s	VTP4B	1 - 0.05-1s	VTP2A
2 - 0.5-60s	VTP4F	2 - 0.5-20s	VTP2E
3 - 2-180s	VTP4J	3 - 2-60s	VTP2F
4 - 5-600s	VTP5N	4 - 5-120s	VTP2H

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Type	Analog circuitry
Range	
12VDC	0.05 - 120s in 4 adjustable ranges or fixed (1 MΩ max. R_T)
Other Voltages	0.05 - 600s in 4 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±10%
Recycle Time	After timing – ≤ 16ms During timing – 0.1% of time delay or 75ms, whichever is greater
Time Delay vs. Temperature & Voltage	≤ ±10%

Input

Voltage	12, 24 or 120VDC; 24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid state
Form	NO, open during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Minimum Holding Current	5mA
Voltage Drop	≅ 2.5V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 80°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

Selection Chart

R_T Selection Chart				
Desired Time Delay*				R_T
Seconds				
1	2	3	4	Megohm
0.05	0.5	2	5	0.0
0.5	10	30	60	0.5
1.0	20	60	120	1.0
▼ 24VDC or AC ONLY† ▼				
1.5	30	90	180	1.5
2.0	40	120	240	2.0
2.5	50	150	300	2.5
3.0	60	180	360	3.0
			420	3.5
			480	4.0
			540	4.5
			600	5.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.
† 1 Megohm max for 12 VDC Units

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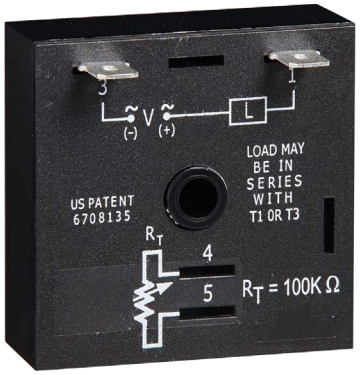
TSD1 SERIES

Delay-on-Make Timer



Description

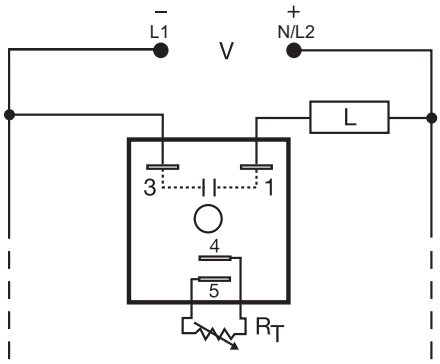
The TSD1 Series is designed for more demanding commercial and industrial applications where small size and accurate performance is required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD1 Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



Load may be connected to terminal 3 or 1.

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1%, + / -1% time delay accuracy
Extended temperature range	Rated to 75°C operating temperature to withstand high heat applications.
Compact, low cost design	Allows flexibility for OEM applications
1A Steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TSD1311.2S	24VDC	Fixed	1.2s
TSD1321	24VDC	External	1 - 100s
TSD1424	120VAC	External	1 - 100m

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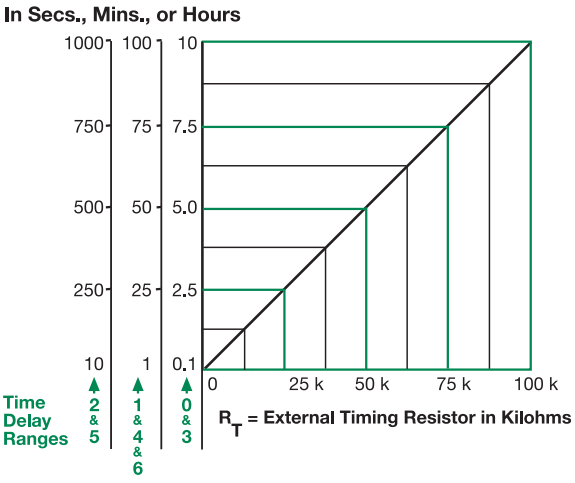
TSD1 SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

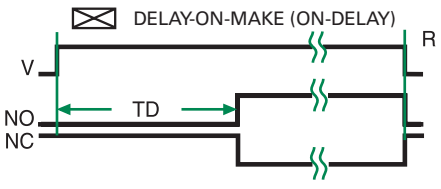


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Specifications

Time Delay	
Range	0.1s - 100h in 7 adjustable ranges or fixed
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Recycle Time	≤ 150ms
Time Delay vs. Temperature & Voltage	≤ ±1%
Input	
Voltage	12, 24, 120VDC; 24, 120, 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Output	
Type	Solid state
Form	NO, open during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Minimum Holding Current	≤ 40mA
Off State Leakage Current	≅ 7mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

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TS441165

Description

The TS441165 is an analog delay-on-make timer with a normally closed solid-state output. Unlike an interval timer, the load is energized prior to and during the time delay period. It can be used as a faster starting interval time delay when S1 is closed upon application of input voltage.

Operation (Delay-on-Make NC)

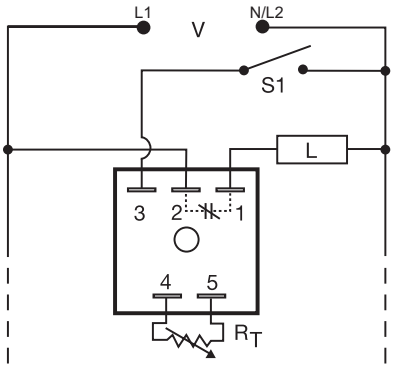
Upon application of input voltage, the load is energized immediately. When the initiate switch is closed, the time delay begins. At the end of the time delay, the load de-energizes.

Reset: When the initiate switch is reopened, the load again energizes and the time delay is reset. Removing input voltage resets the time delay and output.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat Accuracy + / - 2%
Compact, low cost design	Allows flexibility for OEM applications
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Load energized prior to and during time delay	Faster operation
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Normally closed output	Can be used as a faster starting interval time delay

Wiring Diagram



V = Voltage
S1 = Initiate Switch
L = Load

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-XX, P1004-XX-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

TS441165

Accessories

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

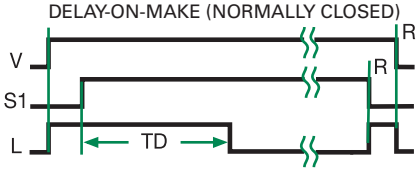
Time Delay	VTP P/N
1 - 0.05-3s	VTP4B
2 - 0.5-60s	VTP4F
3 - 2-180s	VTP4J
4 - 5-600s	VTP5N

Selection Guide

R_T Selection Chart				
Desired Time Delay* Seconds				R_T
1	2	3	4	Megohm
0.05	0.5	2	5	0.0
0.5	10	30	60	0.5
1.0	20	60	120	1.0
1.5	30	90	180	1.5
2.0	40	120	240	2.0
2.5	50	150	300	2.5
3.0	60	180	360	3.0
			420	3.5
			480	4.0
			540	4.5
			600	5.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
L = Load
TD = Time Delay
R = Reset
—⟨⟩— = Undefined Time

Specifications

Time Delay

Type	Analog circuitry
Range	165s
Adjustment	Fixed
Repeat Accuracy	±2% or 20ms, whichever is greater; under fixed conditions
Tolerance (Factory Calibration)	≤ ±10%
Time Delay vs Temp. & Voltage	≤ ±10%
Recycle Time	≤ 150ms

Input

Voltage	120VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid state
Form	NC, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Voltage Drop	≅ 2.5V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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HRDB SERIES

Delay-on-Break Timer

Description

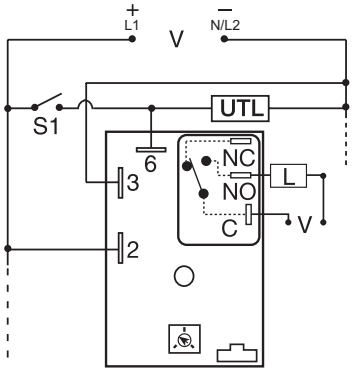
The HRDB Series combines an electromechanical, relay output with microcontroller timing circuitry. The HRDB offers 12 to 230V operation in five options and factory fixed, external, or onboard adjustable time delays with a repeat accuracy of ±0.5%. The isolated output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. The HRDB is ideal for OEM applications where cost is a factor.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
L = Timed Load
UTL = Untimed Load (optional)
NO = Normally Open
C = Common, Transfer Contact

NOTE: A knob, or terminals 4 & 5 are only included on adjustable units. R_T is used when external adjustment is ordered. Relay contacts are isolated. Dashed lines are internal connections. The untimed load is optional.

For dimensional drawing see: Appendix, page 512, Figure 17.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact, low cost design	Allows flexibility for OEM applications
Isolated, 30A, SPDT, NO output contacts	Allows direct operation of heavy loads: compressors, pumps, blower moters, heaters.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME TOLERANCE	TIME DELAY		MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME TOLERANCE	TIME DELAY
HRDB1110M	12VDC	Fixed	+ / -5%	10m		HRDB223	24VAC	Onboard	+ / -5%	0.1 - 10m
HRDB117S	12VDC	Fixed	+ / -5%	7s		HRDB321	24VDC	Onboard	+ / -5%	1 - 100s
HRDB120	12VDC	Onboard	+ / -5%	0.1 - 10s		HRDB324	24VDC	Onboard	+ / -5%	1 - 100m
HRDB121	12VDC	Onboard	+ / -5%	1 - 100s		HRDB423	120VAC	Onboard	+ / -5%	0.1 - 10m
HRDB124	12VDC	Onboard	+ / -5%	1 - 100m		HRDB623	230VAC	Onboard	+ / -5%	0.1 - 10m
HRDB21A65M	24VAC	Fixed	+ / -1%	65m						

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HRDB SERIES

Accessories

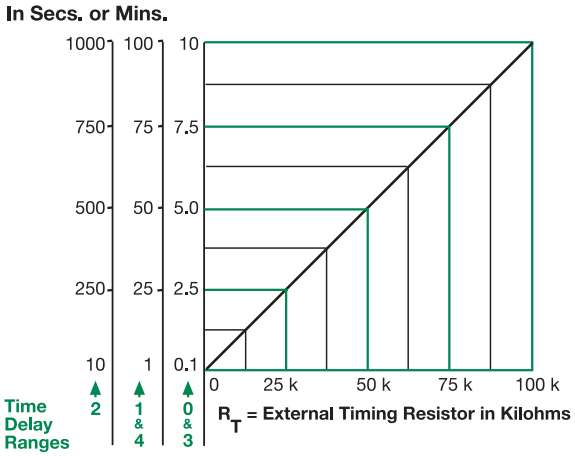
P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

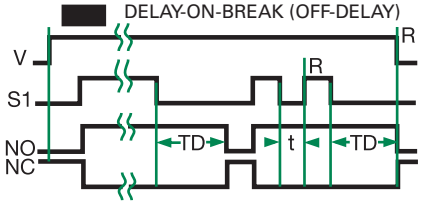
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
—⌇— = Undefined Time

Specifications

Time Delay			
Type	Microcontroller circuitry		
Range	0.1s - 100m in 5 adjustable ranges or fixed		
Repeat Accuracy	±0.5 % or 20ms, whichever is greater		
Tolerance (Factory Calibration)	±1%, ±5%		
Reset Time	≤ 150ms		
Initiate Time	≤ 20ms		
Time Delay vs Temp. & Voltage	±2%		
Input			
Voltage	12 or 24VDC; 24, 120, or 230VAC		
Tolerance			
12VDC & 24VDC	-15% - 20%		
24 to 230VAC	-20% - 10%		
AC Line Frequency	50/60 Hz		
Power Consumption	AC ≤ 4VA; DC ≤ 2W		
Output			
Type	Electromechanical relay		
Form	Isolated, SPDT		
Ratings		**SPDT-NO**	**SPDT-NC**
General Purpose	125/240VAC	30A	15A
Resistive	125/240VAC	30A	15A
	28VDC	20A	10A
Motor Load	125VAC	1 hp*	1/4 hp**
	240VAC	2 hp**	1 hp**
Life	Mechanical - 1 x 10^6; Electrical - 1 x 10^5, *3 x 10^4, **6,000		
Protection			
Surge	IEEE C62.41-1991 Level A		
Circuitry	Encapsulated		
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface		
Insulation Resistance	≥ 100 MΩ		
Polarity	DC units are reverse polarity protected		
Mechanical			
Mounting	Surface mount with one #10 (M5 x 0.8) screw		
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.1 mm (1.51")		
Termination	0.25 in. (6.35 mm) male quick connect terminals		
Environmental			
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C		
Humidity	95% relative, non-condensing		
Weight	≅ 3.9 oz (111 g)		

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HRPS / HRIS SERIES

Description

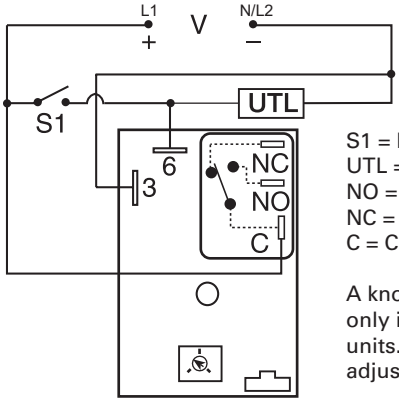
The HRPS/HRIS Series combines an electromechanical relay output with microcontroller timing circuitry. It is a factory programmed module available in any 1 of 13 standard functions. It offers 12 to 240V operation in two universal ranges and factory fixed, onboard, or external adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. This series is ideal for OEM applications where cost is a factor. The HRPS has non-isolated SPDT relay contacts, and the HRIS has isolated SPDT relay contacts. Both offer the most popular timer functions in the industry.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output (relay or solid state) energizes during the time delay. At the end of time delay the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram

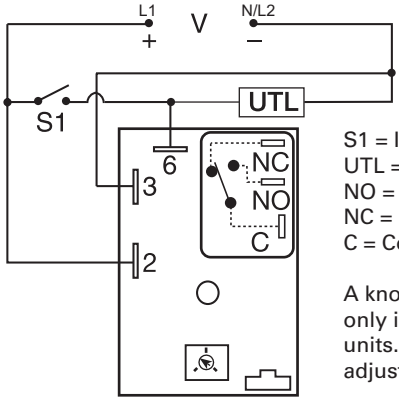


HRPS

Relay contacts are non-isolated.

S1 = Initiate Switch
UTL = Untimed Load (optional)
NO = Normally Open
NC = Normally Closed
C = Common

A knob, or terminals 4 & 5 are only included on adjustable units. R_T is used when external adjustment is ordered.



HRIS

Relay contacts are isolated.

S1 = Initiate Switch
UTL = Untimed Load (optional)
NO = Normally Open
NC = Normally Closed
C = Common

A knob, or terminals 4 & 5 are only included on adjustable units. R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 17.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5% , factory calibration +/- 2%
Compact design	Allows flexibility for OEM applications
30A, SPDT, Normally Open output contacts	Allows for direct operation of heavy loads
Encapsulated	Protects against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUST.	TIME DELAY	FUNCTION
HRISW21FT	24 - 240VAC/24 - 110VDC	Onboard	0.1 - 10s	Alternating
HRISW27I	24 - 240VAC/24 - 110VDC	Onboard	0.1 - 10h	Interval
HRPSD12HI	12 - 48VDC	Fixed	2h	Interval
HRISW25B	24 - 240VAC/24 - 110VDC	Onboard	1 - 100m	Delay on break

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HRPS / HRIS SERIES

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

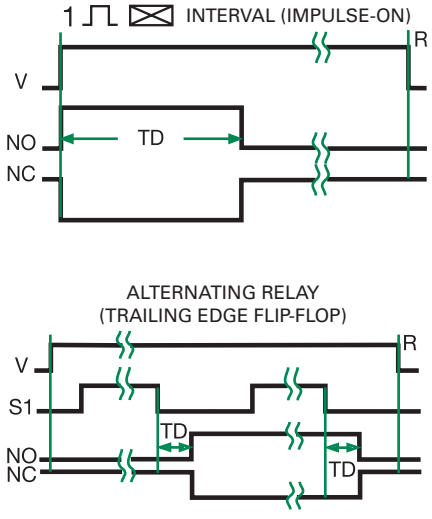
P1015-64 (AWG 14/16), **P1015-13** (AWG 10/12) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Function Diagrams



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
—⫴— = Undefined Time

Specifications

Time Delay	
Type	Microcontroller circuitry
Range	0.1s - 1000h in 9 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	±2%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	±2%
Input	
Voltage	12 to 48VDC; 24 to 240VAC/24 to 110VDC
Tolerance	
12 to 48VDC	-15% - 20%
24 to 110VDC/240VAC	-20% - 10%
AC Line Frequency	50/60Hz
Power Consumption	AC ≤ 4VA; DC ≤ 2W
Output	
Type	Electromechanical relay
Form	SPDT

Ratings	**SPDT-NO**	**SPDT-NC**
General Purpose		
125/240VAC	30A	15A
Resistive		
125/240VAC	30A	15A
28VDC	20A	10A
Motor Load		
125VAC	1 hp*	1/4 hp**
240VAC	2 hp**	1 hp**

Life	Mechanical - 1 x 10^6 Electrical - 1 x 10^5, *3 x 10^4, **6,000
Protection	
Surge Circuitry	IEEE C62.41-1991 Level A Encapsulated
Isolation Voltage	≥ 1500V RMS input to output; isolated units
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mt. with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.2 mm (3.0"); **W** 50.8 mm (2.0"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connects
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

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KRDB SERIES

Description

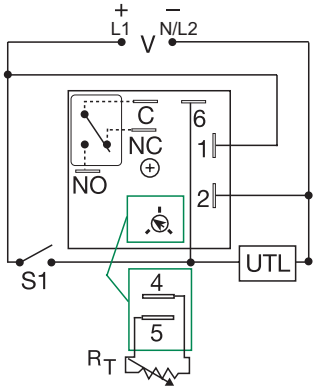
The KRDB Series is a compact time delay relay measuring only 2 in. (50.8 mm) square. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDB Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
C = Common, Transfer Contact
NO = Normally Open
NC = Normally Closed
UTL = Untimed Load (optional)

A knob is supplied for adjustable units. The untimed load is optional. Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat accuracy + / - 0.5%, Factory calibration + / - 5%
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	To protect against shock, vibration, and humidity
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
KRDB110.1S	12VDC	Fixed	0.1s	KRDB31120S	24VDC	Fixed	20s
KRDB112.5S	12VDC	Fixed	2.5s	KRDB415S	120VAC	Fixed	5s
KRDB1120M	12VDC	Fixed	20m	KRDB4160S	120VAC	Fixed	60s
KRDB115M	12VDC	Fixed	5m	KRDB420	120VAC	Onboard	0.1 - 10s
KRDB120	12VDC	Onboard	0.1 - 10s	KRDB421	120VAC	Onboard	1 - 100s
KRDB124	12VDC	Onboard	1 - 100m	KRDB422	120VAC	Onboard	10 - 1000s
KRDB21180S	24VAC/DC	Fixed	180s	KRDB423	120VAC	Onboard	0.1 - 10m
KRDB217S	24VAC/DC	Fixed	7s	KRDB424	120VAC	Onboard	1 - 100m

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KRDB SERIES

Accessories

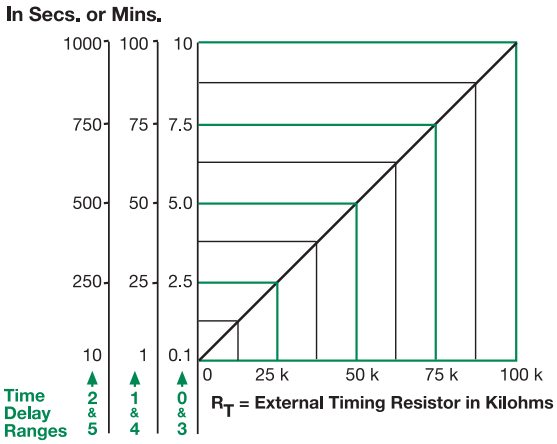
P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

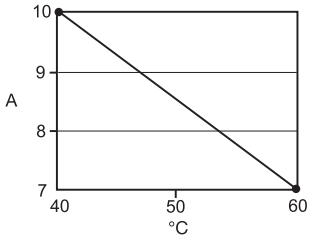


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Output Current/Ambient Temperature



Specifications

Time Delay

Type	Microcontroller with watchdog circuitry
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Recycle Time	≤ 150ms
Initiate Time	≤ 40ms
Time Delay vs Temp. & Voltage	≤ ±5%

Input

Voltage	12, 24, 110VDC; 24, 120 or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
110VDC, 120 or 230VAC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

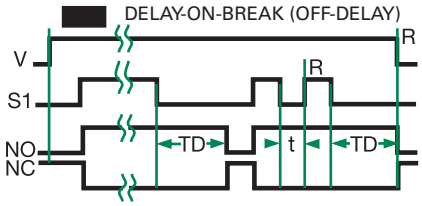
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
—⌇— = Undefined Time

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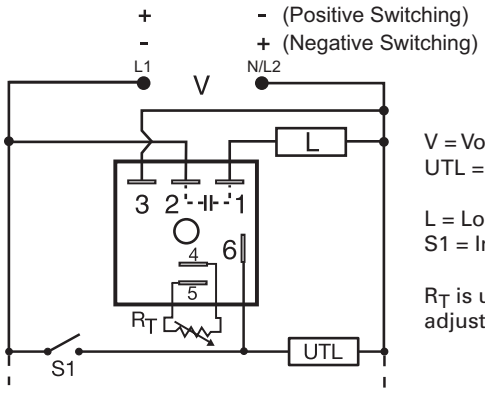
KSDB SERIES

Wiring Diagram



V = Voltage
UTL = Optional Untimed Load
L = Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Description

The KSDB Series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for popular AC and DC voltages. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output energizes if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat accuracy + / - 0.5%, Factory calibration + / - 5%
1A Steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Compact, low cost design	Allows flexibility for OEM applications

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE	MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE
KSDB1110MP	12VDC	Fixed	10m	Positive	KSDB314SP	24VDC	Fixed	4s	Positive
KSDB1115SP	12VDC	Fixed	15s	Positive	KSDB315SP	24VDC	Fixed	5s	Positive
KSDB1120SP	12VDC	Fixed	20s	Positive	KSDB324N	24VDC	External	1 - 100m	Negative
KSDB113MP	12VDC	Fixed	3m	Positive	KSDB330N	24VDC	Onboard	0.1 - 10s	Negative
KSDB113SP	12VDC	Fixed	3s	Positive	KSDB4120M	120VAC	Fixed	20m	n/a
KSDB120P	12VDC	External	0.1 - 10s	Positive	KSDB4160S	120VAC	Fixed	60s	n/a
KSDB134P	12VDC	Onboard	1 - 100m	Positive	KSDB4190M	120VAC	Fixed	90m	n/a
KSDB2115S	24VAC	Fixed	15s	n/a	KSDB431	120VAC	Onboard	1 - 100s	n/a
KSDB220	24VAC	External	0.1 - 10s	n/a	KSDB61150S	230VAC	Fixed	150s	n/a
KSDB231	24VAC	Onboard	1 - 100s	n/a	KSDB631	230VAC	Onboard	1 - 100s	n/a

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KSDB SERIES

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

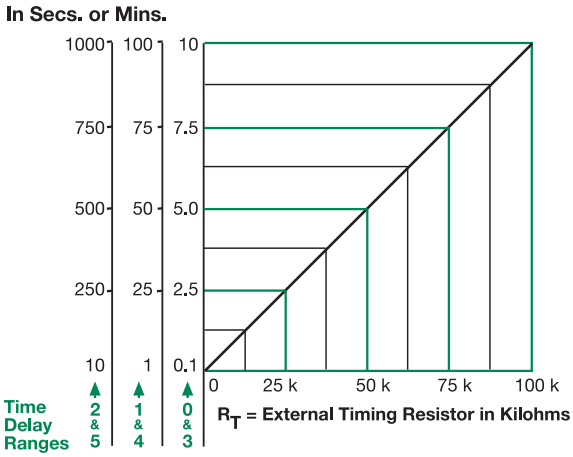
P1015-64 (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

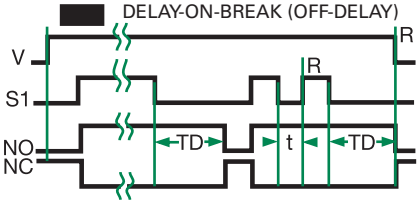
When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Specifications

Time Delay	
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5 % or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±10%
Input	
Voltage	12, 24, or 120VDC; 24, 120, or 230VAC
Tolerance	±20%
Power Consumption	AC ≤ 2VA; DC ≤ 2W
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10 %
Output	
Type	Solid state
Form	NO, closed before & during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
OFF State Leakage Current	AC≅ 5mA @ 230VAC; DC ≅ 1mA
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
DC Operation	Positive or negative switching
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 80°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
—⌇— = Undefined Time

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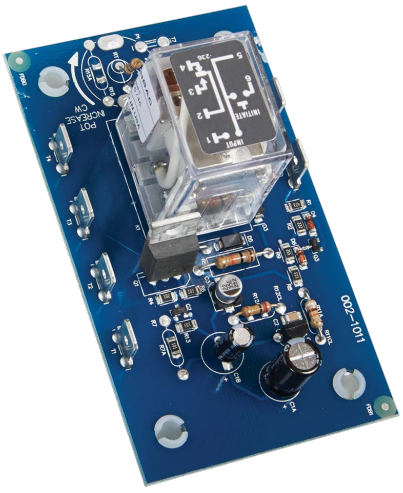
ORB SERIES



Description

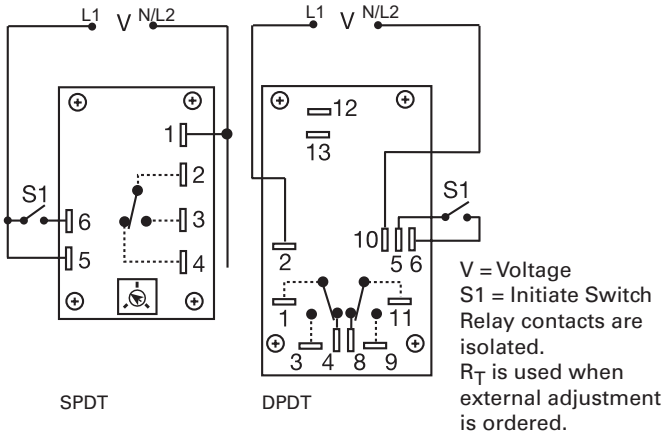
The ORB Series' open PCB construction offers the user good economy without sacrificing performance and reliability. The output relay is available in isolated, 10A, DPDT or SPDT forms. The time delay may be ordered as factory fixed, onboard knob, or external adjustment. All connections are 0.25 in. (6.35 mm) male quick connect terminals.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Wiring Diagram



For dimensional drawing see: Appendix, page 512, Figure 26.

Features & Benefits

FEATURES	BENEFITS
Open PCB construction	Reduces cost for OEM applications
Analog circuitry	Repeat accuracy + / - 2%, Factory calibration + / - 10%
Isolated, 10A, SPDT or DPDT output contacts	Allows control of loads for AC or DC voltages
Line voltage initiation	Separate control voltage is not required for operation

Accessories

P1004-12, P1004-12-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OUTPUT FORM
ORB120A160	120VAC	Fixed	60s	SPDT
ORB120A25	120VAC	Onboard	3 - 300s	SPDT
ORB24A11D	24VAC	Fixed	1s	DPDT
ORB24A21D	24VAC	Onboard	0.05 - 3s	DPDT
ORB24A25	24VAC	Onboard	3 - 300s	SPDT

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ORB SERIES

Specifications

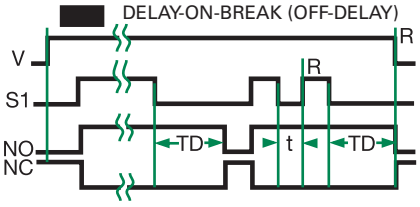
Time Delay	
Type	Analog circuitry
Range	0.05 - 300s in 5 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	Adjustable: guaranteed range Fixed: ±10%
Reset Time	≤ 50ms
Initiate Time	≤ 70ms
Time Delay vs Temp. & Voltage	≤ ±10%
Input	
Voltage	24, 120, or 230VAC
Tolerance	
24VAC	-15% - 20%
120 & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Power Consumption	2.25W
Output	
Type	Electromechanical relay
Form	Isolated, SPDT or DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - $1x10^7$; Electrical - $1x10^6$
Protection	
Isolation Voltage	≥1500V RMS input to output
Mechanical	
Mounting	Surface mount with four #6 (M3.5 x 0.6) screws
Dimensions	**H** 53.8 mm (2.12"); **W** 93.7 mm (3.69"); **D** 47.8 mm (1.88")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-20° to 65°C / -30°to 85°C
Weight	≅ 2.7 oz (77 g)

Selection Guides

R_T Selection Chart					
Desired Time Delay* Seconds					R_T
1	2	3	4	5	Megohm
0.05	0.5	0.6	1.2	3.0	0.0
0.5	5.0	10	20	50	0.5
1.0	10	20	40	100	1.0
1.5	15	30	60	150	1.5
2.0	20	40	80	200	2.0
2.5	25	50	100	250	2.5
3.0	30	60	120	300	3.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
—⌇— = Undefined Time

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TDB / TDBH / TDBL SERIES

Relay Output, Delay-on-Break

Description

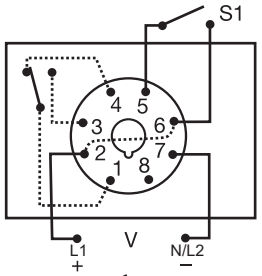
The TDB series combines accurate digital circuitry with isolated, 10 A, DPDT or SPDT contacts in an 8-pin or 11-pin plug-in package. The TDB series features DIP switch selectable time delays ranging from 0.1–10,230 seconds in three ranges. The TDB series is the product of choice for custom control panel and OEM designers.

Operation (Delay-on-Break)

Input voltage must be applied to the input before and during timing. Upon closure of the initiate switch, the output relay is energized. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

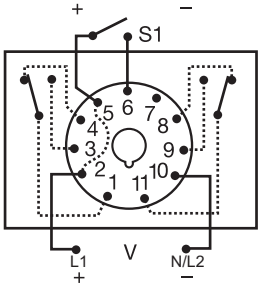
Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Wiring Diagram



8-PIN OCTAL SPDT

S1 = Initiate Switch
Relay contacts are isolated



11-PIN DPDT

For dimensional drawing see: Appendix, page 512, Figure 23.

Features & Benefits

FEATURES	BENEFITS
3 time ranges available (0.1 s to 2.8 h)	Makes it versatile for use in many applications
Microcontroller based	Repeat Accuracy + / - 0.1 % or 20 ms, whichever is greater; Setting Accuracy + / - 2 % or 50 ms, whichever is greater
LED indication (select models)	Provides visual indication of relay status
DIP switch adjustment	Provides first time setting accuracy
Isolated output contacts	Allows control of loads for ac or dc voltages

Ordering Information

MODEL	INPUT VOLTAGE	DELAY RANGE (SEC)	LED	TYPE PLUG/OUTPUT FORM
TDB120AL	120 V ac	1–1023 in 1 s increments	X	Octal (8-pin) plug, SPDT
TDB120ALD	120 V ac	1–1023 in 1 s increments	X	11-pin plug, DPDT
TDB12D	12 V dc	1–1023 in 1 s increments		Octal (8-pin) plug, SPDT
TDB230AL	230 V ac	1–1023 in 1 s increments	X	Octal (8-pin) plug, SPDT
TDB24AL	24 V ac	1–1023 in 1 s increments	X	Octal (8-pin) plug, SPDT
TDB24DL	24 V dc/ 28 V dc	1–1023 in 1s increments	X	Octal (8-pin) plug, SPDT
TDBH120AL	120 V ac	10–10230 in 10 s increments	X	Octal (8-pin) plug, SPDT
TDBH120ALD	120 V ac	10–10230 in 10 s increments	X	11-pin plug, DPDT
TDBL120AL	120 V ac	0.1–102.3 in 0.1 s increments	X	Octal (8-pin) plug, SPDT
TDBL120ALD	120 V ac	0.1–102.3 in 0.1 s increments	X	11-pin plug, DPDT
TDBL24DL	24 V dc/ 28 V dc	0.1–102.3 in 0.1 s increments	X	Octal (8-pin) plug, SPDT

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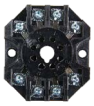
TDB / TDBH / TDBL SERIES

Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

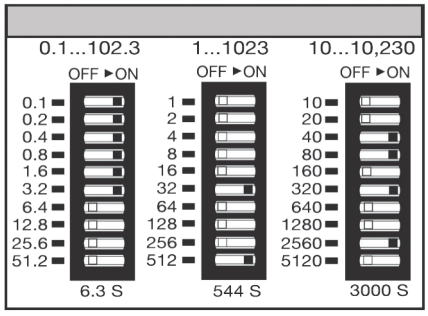
OT11PC Octal Socket for UL listing*
11-pin surface & DIN-rail mountable. Rated for 10 A @ 300 V ac



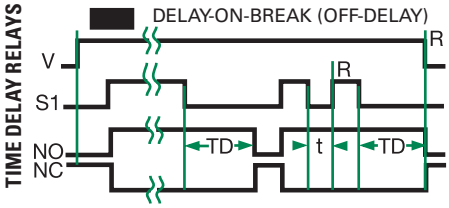
P1011-6 Octal Socket for UL listing
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Digi-Set Binary Switch Operation



Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
—⟋— = Undefined Time

Specifications

Time Delay

Type	Digital integrated circuitry
Range	0.1–102.3 s in 0.1 s increments 1–1023 s in 1 s increments 10–10,230 s in 10 s increments
Repeat Accuracy	±0.1 %
Setting Accuracy	±2 %
Reset Time	≤ 150 ms
Time Delay vs Temp. & Voltage	±5 %
Indicator	LED indicates relay is energized
Initiate Time	≤ 60 ms

Input

Voltage	12, 24/28 V dc; 24, 120, or 230 V ac
Tolerance	
12 V dc & 24 V dc/ac	-15 %–20 %
120 to 230 V ac/dc	-20 %–10 %
AC Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W

Output

Type	Electromechanical relay
Form	SPDT or DPDT
Rating	10 A resistive @ 120/240 V ac; 1/3 hp @ 120/240 V ac
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6
Protection	
Isolation Voltage	≥ 1500 V RMS input to output
Polarity	Dc units reverse polarity protected

Mechanical

Mounting	Plug-in socket
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")
Termination	Octal 8-pin plug-in or 11-pin plug-in

Environmental

Operating/Storage Temperature	-20 °C to 65 °C / -30 °C to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT series sockets is 12 in-lbs.

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TDUB SERIES

Delay-on-Break Timer

Description

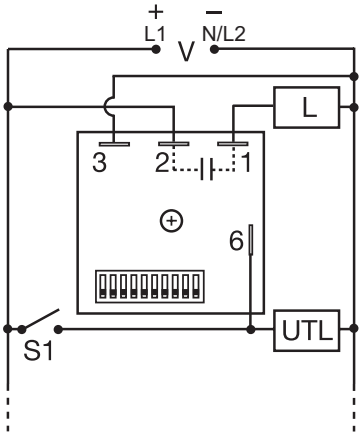
The TDUB Series combines digital timing circuitry with universal voltage operation. Voltages of 24 to 240VAC and 12 to 24VDC are available in three ranges. The TDUB Series offers DIP switch selectable time delays ranging from 0.1 seconds to 102.3 minutes in three ranges. Its 1A rated output, ability to operate on multiple voltages, and wide range of switch selectable time delays make the TDUB Series an excellent choice for process control systems and OEM equipment.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
UTL = Optional Untimed Load
S1 = Initiate Switch
L = Timed Load

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
DIP switch timing adjustment	Provides setting accuracy of +/-2%
User selectable time delay	Timing settings are switch selectable 0.1s - 102.3m in three ranges for added flexibility
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity.

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE RANGE	TIME RANGE
TDUB3000A	24 to 120VAC	1-1023s
TDUB3002A	12 to 24VDC	1-1023s
TDUBH3002A	12 to 24VDC	0.1-102.3m
TDUBH3001A	100 to 240VAC	0.1-102.3m
TDUBL3002A	12 to 24VDC	0.1-102.3s

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TDUB SERIES

Specifications

Time Delay

Range*	0.1 - 102.3s in 0.1s increments 1 - 1023s in 1s increments 0.1 - 102.3m in 0.1m increments
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Setting Accuracy	≤ ±2% or 20ms, whichever is greater
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs. Temperature & Voltage	≤ ±5%

Input

Voltage/Tolerance	24 to 240VAC, 12 to 24VDC /±20%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid state
Form	NO, closed before and during timing
Rating	1A steady state, 10A inrush at 60°C
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
Off State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1mA

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

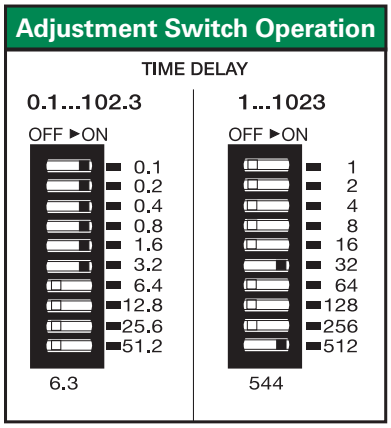
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C /-40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

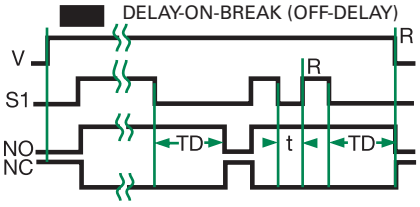
*For CE approved applications, power must be removed from the unit when a switch position is changed.

Adjustment Switch Operation



Add the value of switches in the ON position for the total time delay.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
—⟋— = Undefined Time

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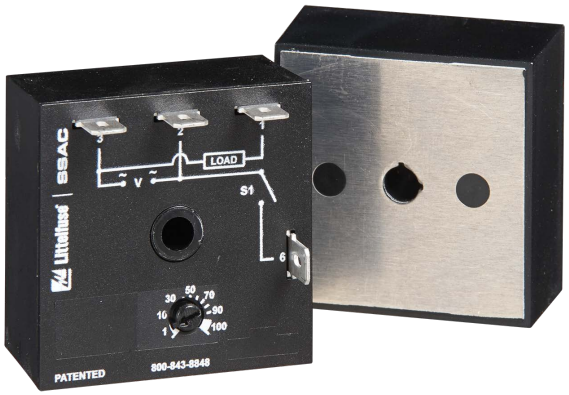
THDB SERIES



Description

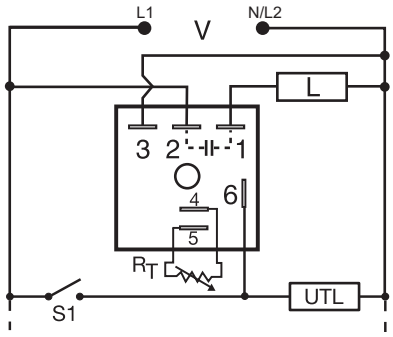
The THDB Series combines accurate timing circuitry with high power, solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, timers.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output energizes if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
UTL = Optional Untimed Load
L = Timed Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat accuracy + / - 0.5%, Factory calibration + / - 1%
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps and heaters without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and components costs

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OUTPUT RATING
THDB421A	120VAC	External	1 - 100s	6A
THDB434C	120VAC	Onboard	1 - 100m	20A

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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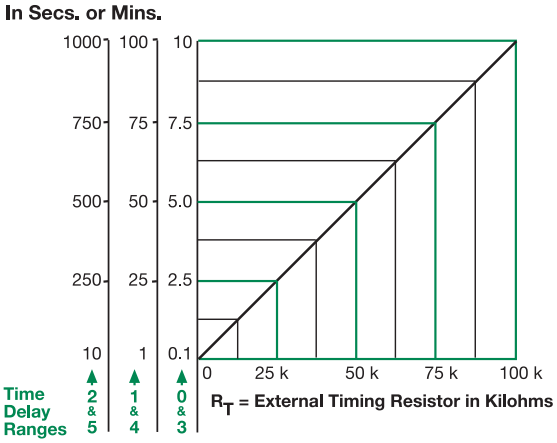
THDB SERIES

External Resistance vs. Time Delay

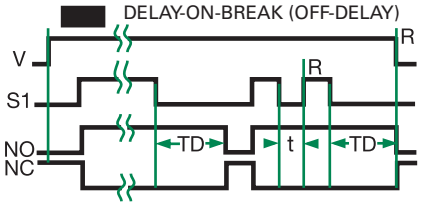


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
—⌇— = Undefined Time

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, closed before & during timing

Maximum Load Current

Output	Steady State	Inrush**
A	6A	60A
B	10A	100A
C	20A	200A

Voltage Drop	≅ 2.5V @ rated current
Off State Leakage Current	≅ 5mA @ 230VAC
Minimum Load Current	100mA

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

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TRB SERIES

*8-pin models UL listed when used in combination with P1011-6 socket only.

Description

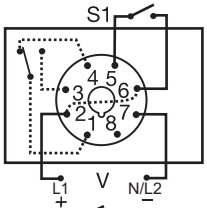
The TRB series combines an isolated, 10 A electromechanical relay output with digital timing circuitry. False trigger of the TRB by a transient is unlikely because of the complete isolation of the circuit from the line prior to initiation. The initiate contact is common to one side of the line and may be utilized to operate other loads. Installation is easy due to the TRB's industry standard 8- or 11-pin plug-in base wiring.

Operation (Delay-on-Break)

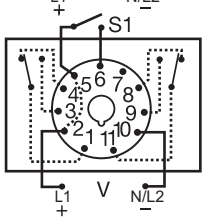
Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output relay energizes. The time delay begins when the initiate switch is opened (trailing edge triggered). The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Wiring Diagram



8-pin octal SPDT



11-pin DPDT

Features & Benefits

FEATURES	BENEFITS
Complete isolation of circuit from line	No false trip due to transients
Industry standard 8 or 11-pin connection	Provides easy installation and field replacement
Isolated, 10 A, SPDT or DPDT output contacts	Allows control of loads for ac or dc voltages
Digital circuitry	Repeat accuracy +/- 2 %

For dimensional drawing see: Appendix, page 512, Figure 24.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	OUTPUT FORM	TIME TOLERANCE	TIME DELAY
TRB120A2Y30	120 V ac	Onboard	Octal, SPDT	+/- 10 %	1–30 s
TRB120A3X600	120 V ac	Lock shaft	Octal, SPDT	+/- 20 %	7–600 s
TRB120A4Y120	120 V ac	Onboard	11-pin, DPDT	+/- 10 %	2–120 s
TRB24D10Y10	24 V dc/28 V dc	Fixed	11-pin, DPDT	+/- 10 %	10 s

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TRB SERIES

Accessories

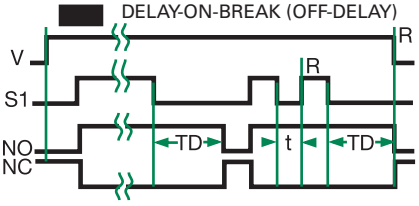
OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10 A @ 600 V ac.

OT11PC Octal Socket for UL listing*
11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac

P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
⊣⌇⊢ = Undefined Time

Specifications

Time Delay	
Type	Digital circuitry
Range	See "Ordering Information" table
Repeat Accuracy	±2 %
Fixed Time Tolerance & Setting Accuracy	±5, 10, or 20 %
Initiate Time	≤ 70 ms
Reset Time	≤ 75 ms
Recycle Time	≤ 250 ms
Time Delay vs Temp. & Voltage	≤±5 %
Input	
Voltage	24/28 V dc; 120 V ac
Indicator	LED indicates relay is energized
Tolerance	
24V dc/ac	-15 %–20 %
120 V ac	-20 %–10 %
AC Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W
Output	
Type	Electromechanical relay
Form	Isolated SPDT or DPDT
Rating	10 A resistive @ 120/240 V ac 1/3 hp @ 120/240 V ac
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6
Protection	
Insulation Resistance	≥ 100 MΩ
Isolation Voltage	≥ 1500 V RMS between input to output
Polarity	Dc units are reverse polarity protected
Mechanical	
Mounting	Plug-in socket
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")
Termination	Octal 8-pin plug-in or 11-pin plug-in
Environmental	
Operating/Storage Temperature	-20 °C to 65 °C / -30 °C to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT series sockets is 12 in-lbs.

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TSB SERIES

Description

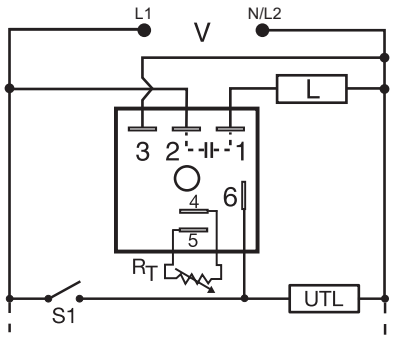
The TSB Series is a totally solid-state, delay-on-break timing module. The TSB Series is available with a fixed, external, or onboard adjustable time delay. Time Delays from 0.05 to 600 seconds, in 4 standard ranges, cover over 90% of all OEM and commercial appliance timing applications. The repeat accuracy is ±2%. Operating voltages of 24, 120, or 230VAC are available. The TSB's 1A steady state, 10A rated, solid-state output is perfect for direct control of solenoids, contactors, relays, lamps, buzzers, and small heaters. The TSB Series can be surface mounted with a single screw, or snapped on a 35 mm DIN rail using the P1023-20 adaptor.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch opens. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the output and the time delay.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
UTL = Optional Untimed Load
L = Load

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat accuracy + / - 2%, Factory calibration + / - 5%
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Wide time delay range	Meets almost all OEM and commercial appliance timing applications
1A steady, 10A inrush solid state output	Provides 100 million operations in typical conditions

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TSB2190	24VAC	Fixed	90s	TSB434	120VAC	Onboard	5 - 600s
TSB222	24VAC	External	0.5 - 60s	TSB632	230VAC	Onboard	0.5 - 60s
TSB41300	120VAC	Fixed	300s	TSB634	230VAC	Onboard	5 - 600s
TSB422	120VAC	External	0.5 - 60s				

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TSB SERIES

Accessories

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

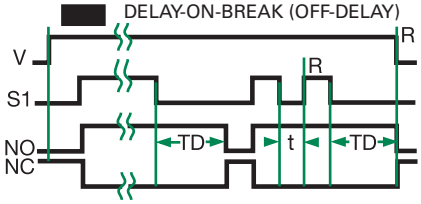
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Selection Guide

R_T Selection Chart				
Desired Time Delay* Seconds				R_T
1	2	3	4	Kohms
0.05	0.5	2	5	0
0.3	6	20	60	10
0.6	12	38	120	20
0.9	18	55	180	30
1.2	24	73	240	40
1.5	30	90	300	50
1.8	36	108	360	60
2.1	42	126	420	70
2.4	48	144	480	80
2.7	54	162	540	90
3.0	60	180	600	100

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
⟋⟍ = Undefined Time

Specifications

Time Delay	
Range	0.05s - 600s in 4 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Time Delay vs Temp. & Voltage	≤ ±10%
Reset Time	≤ 150ms
Input	
Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA
Output	
Type	Solid state
Form	NO, closed before & during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Off State Leakage Current	≅ 5mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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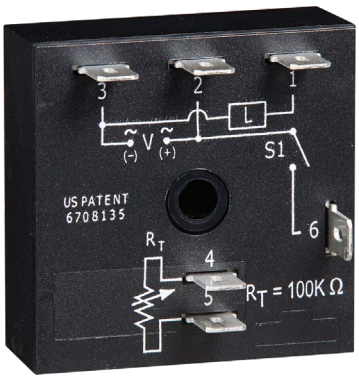
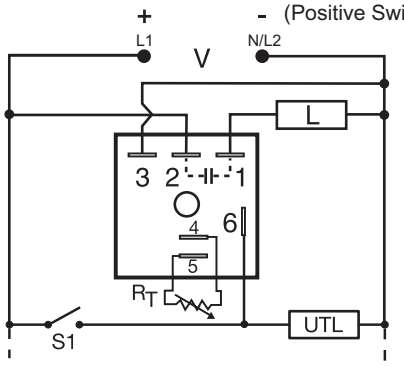
TSDB SERIES



Wiring Diagram



V = Voltage
UTL = Optional Untimed Load
L = Timed Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE
TSDB320P	24VDC	External	0.1 - 10s	Positive
TSDB421	120VAC	External	1 - 100s	n/a
TSDB431	120VAC	Onboard	1 - 100s	n/a

If you don't find the part you need, call us for a custom product 800-843-8848

Description

The TSDB Series is designed for more demanding commercial and industrial applications where small size, and accurate performance are required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the time delay.

The TSDB Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 1000 minutes are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Delay-on-Break)

Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reclosing the initiate switch during timing resets the time delay. Loss of input voltage resets the time delay and output.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat accuracy + / - 0.5%, Factory calibration + / - 1%
Compact design	Allows flexibility for OEM applications
1A Steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Wide temperature range: -40° to 75°C	Reliable in demanding commercial and industrial applications

Accessories

P1004-13, P1004-13-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

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TSDB SERIES

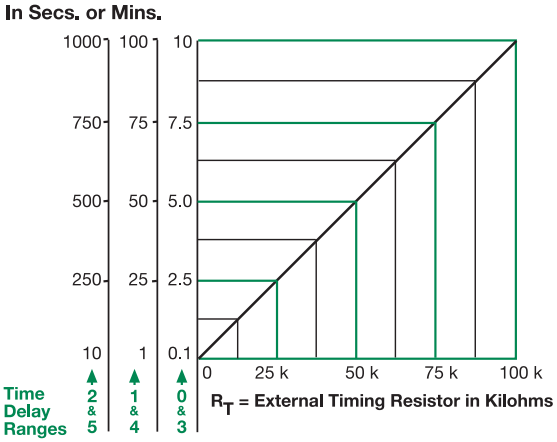
Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

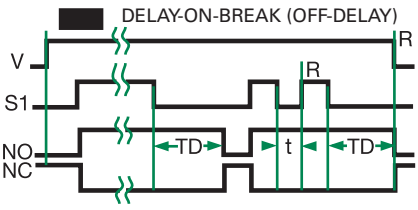


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
t = Incomplete Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5 % or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	±15%
Power Consumption	AC ≤ 2VA; DC ≤ 1W
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10 %

Output

Type	Solid state
Form	NO, closed before & during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Off State Leakage Current	≅ 5mA @ 230VAC; DC ≅ 1mA
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
DC Operation	Positive or negative switching

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 75°F / -40° to 85°F
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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HRDS SERIES

Single Shot Timer

Description

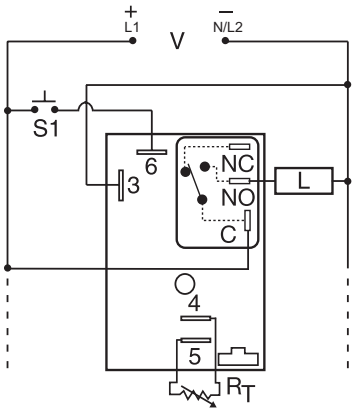
The HRDS Series combines an electromechanical relay output with microcontroller timing circuitry. It offers 12 to 230V operation in five options and factory fixed, onboard or external adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. This series is ideal for OEM applications where cost is a factor.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output relay energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



NO = Normally Open
S1 = Initiate Switch
L = Load
C = Common, Transfer Contact

NOTE: A knob, or terminals 4 & 5 are only included on adjustable units. R_T is used when external adjustment is ordered. Relay contacts are not isolated.

For dimensional drawing see: Appendix, page 512, Figure 17.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact, low cost design	Allows flexibility for OEM applications
Isolated, 30A, SPDT, NO output contacts	Allows direct operation of heavy loads: compressors, pumps, blower moters, heaters.
Encapsulated	Protects against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
HRDS120	12VDC	Onboard	0.1 - 10s
HRDS313M	24VDC	Fixed	3m
HRDS321	24VDC	Onboard	1 - 100s
HRDS421	120VAC	Onboard	1 - 100s
HRDS430	120VAC	External	0.1 - 10s

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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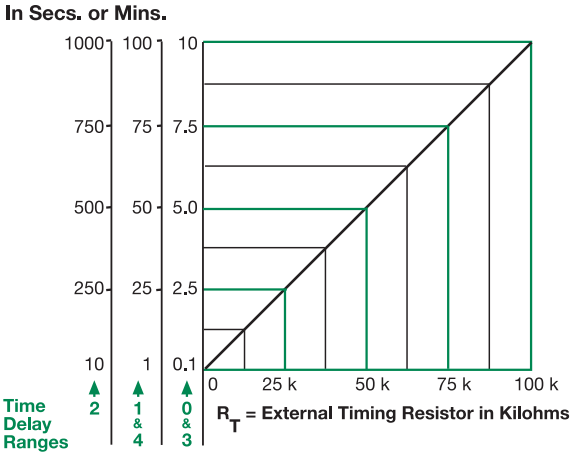
Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

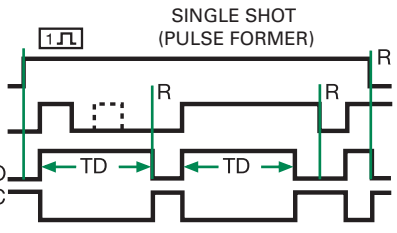
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Type	Microcontroller circuitry
Range	0.1s - 100m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20 ms, whichever is greater
Tolerance (Factory Calibration)	±1%, ±5%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	±2%

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC	-15% - 20%
24 to 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Power Consumption	AC ≤ 4VA; DC ≤ 2W

Output

Type		Electromechanical relay	
Form		SPDT, non-isolated	
Ratings		**SPDT-NO**	**SPDT-NC**
General Purpose	**125/240VAC**	30A	15A
Resistive	**125/240VAC**	30A	15A
	28VDC	20A	10A
Motor Load	**125VAC**	1 hp*	1/4 hp**
	240VAC	2 hp**	1 hp**
Life		Mechanical - 1 x 10^6; Electrical - 1 x 10^5, *3 x 10^4, **6,000	

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 51.3 mm (2"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C/-40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

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HSPZA22SL

Description

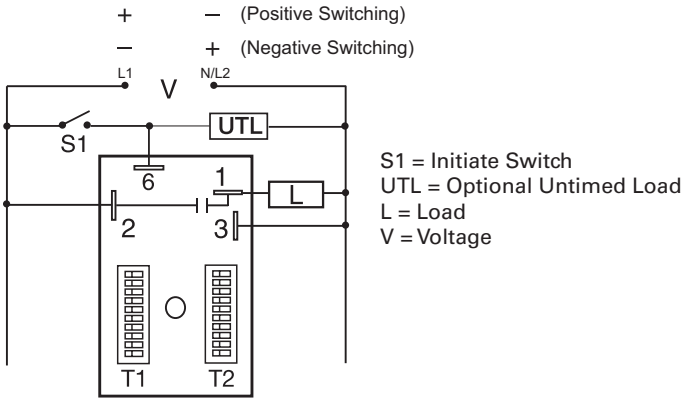
The HSPZA22SL is a factory programmed module available in any 1 of 13 standard functions. The HSPZA22SL offers dual switch adjustable timer or counter functions. Switch adjustment allows accurate selection of the time delay or number of counts the first time and every time. The 1A steady, 10A inrush rated solid-state output provides 100 million operations, typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The HSPZA22SL is a cost effective approach for OEM applications that require small size, solid state reliability, and accurate switch adjustment.

Operation (Single Shot Lockout)

Upon application of input voltage and momentary or maintained closure of S1, the output relay energizes and TD1 single shot time delay begins. The output relay de-energizes at the end of TD1 and the TD2 lockout time delay begins. During TD2 (and TD1) closing switch S1 has no effect on the operation. After TD2 is complete, closing S1 starts another operation. If S1 is closed when input voltage is applied, the output energizes and the TD1 time delay begins.

Reset: Removing input voltage resets the time delays and the output and returns the cycle to the first delay.

Wiring Diagram



S1 = Initiate Switch
UTL = Optional Untimed Load
L = Load
V = Voltage

For dimensional drawing see: Appendix, page 512, Figure 18.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1%
User selectable time delay	Timing settings are switch selectable 0.1s - 1023h in a dual switch timer function for added flexibility
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid-state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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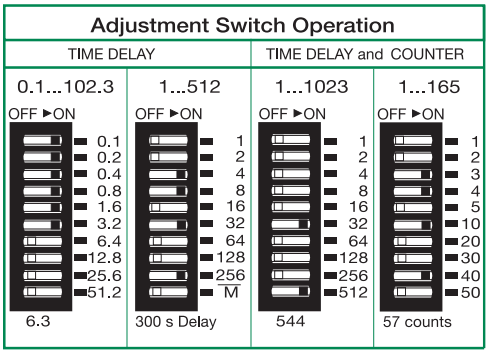
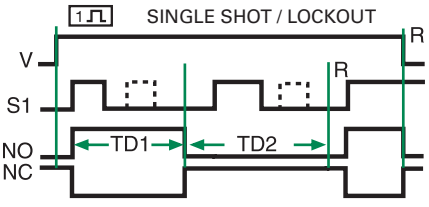
HSPZA22SL

Switch Adjustment



Function Diagrams



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD1,TD2 = Time Delay
R = Reset

Specifications

Time Delay

Type	Microcontroller circuitry
Range	1-1023s, m or h in 1s, m or h increments
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Setting Accuracy	≤ ±1% or 20ms, whichever is greater
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±2%
Count Range	1 - 1023 in 2 ranges
Count Rate	≤ 25 counts per second

Input

Voltage	24 to 240VAC
Tolerance	≤ ±15%
AC Line Frequency/ DC Ripple	50/60Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid-state output
Rating	1A steady, 10A inrush for 16ms
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
OFF State Leakage Current	AC ≅ 5mA @ 240VAC; DC ≅ 1mA
Counter Output	Output pulse width: 300ms ±20%

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.2 mm (3.0"); **W** 50.8 mm (2.0"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connects

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

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KRDS SERIES

Single Shot

Description

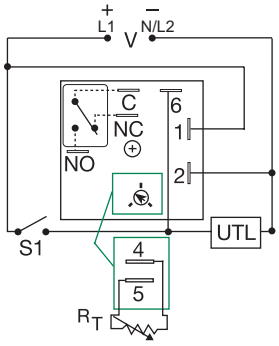
The KRDS Series is a compact time delay relay measuring only 2 in. (50.8 mm) square. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDS Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output relay energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
C = Common, Transfer Contact
NO = Normally Open
NC = Normally Closed
UTL = Untimed Load

R_T is used when external adjustment is ordered.
A knob is supplied for adjustable units. The untimed load is optional.
Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications
Microcontroller based	Repeat Accuracy + / -0.5%, Factory calibration + / - 5%
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	To protect against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
KRDS1135M	12VDC	Fixed	35m
KRDS120	12VDC	Onboard	0.1 - 10s
KRDS221	24VAC/DC	Onboard	1 - 100s
KRDS420	120VAC	Onboard	0.1 - 10s
KRDS421	120VAC	Onboard	1 - 100s
KRDS424	120VAC	Onboard	1 - 100m
KRDS430	120VAC	External	0.1 - 10s

If desired part number is not listed, please call us to see if it is technically possible to build.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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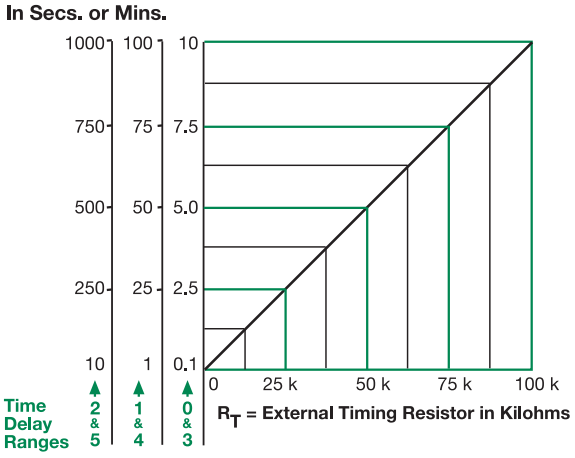
KRDS SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

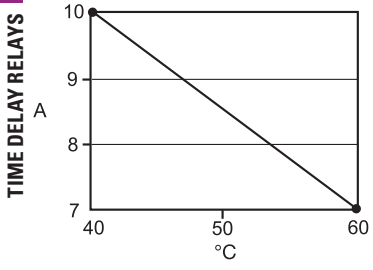


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Output Current/Ambient Temperature



Specifications

Time Delay

Type	Microcontroller with watchdog circuitry
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Initiate Time	≤ 40ms
Time Delay vs Temp. & Voltage	≤ ±5%

Input

Voltage	12, 24 or 110VDC; 24, 120 or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
110VDC, 120VAC or 230VAC	-20%- 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

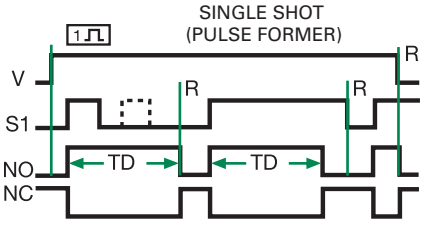
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C/-40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

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KSDS SERIES

Description

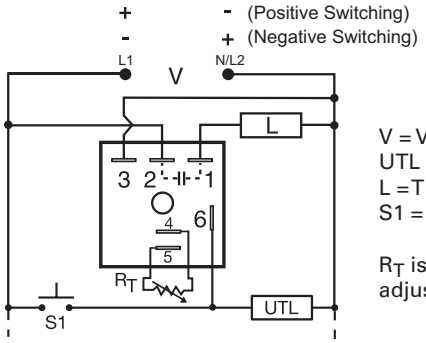
The KSDS Series is ideal for applications that require momentary start interval timing including dispensing, exposure timing, or pulse shaping. This series is available for both AC and DC voltages. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will not energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
UTL = Optional Untimed Load
L = Timed Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration +/- 5%
1A Steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Compact, low cost design	Allows flexibility for OEM applications

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE
KSDS1115SP	12VDC	Fixed	15s	Positive
KSDS230	24VAC	Onboard	0.1 - 10s	n/a
KSDS320P	24VAC	External	0.1 - 10s	Positive
KSDS415M	120VAC	Fixed	5m	n/a
KSDS420	120VAC	External	0.1 - 10s	n/a

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

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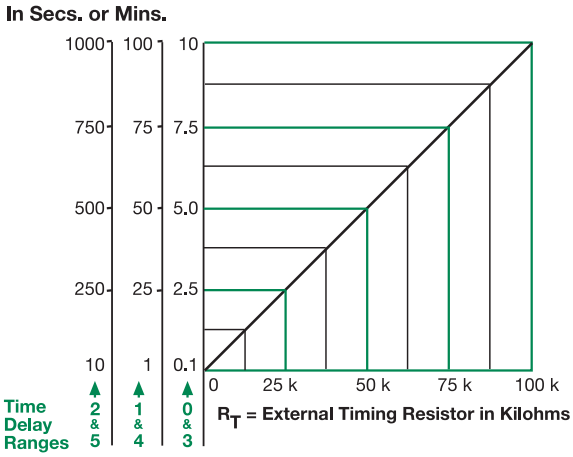
Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

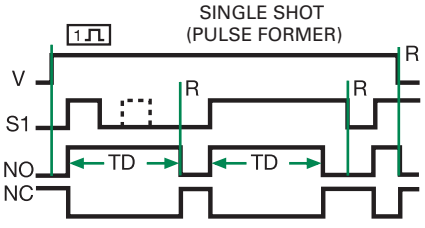


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay	
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5 % or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±10%
Input	
Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10 %
Power Consumption	AC ≤ 2VA; DC ≤ 1W
Output	
Type	Solid state
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
OFF State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1mA
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
DC Operation	Positive or negative switching
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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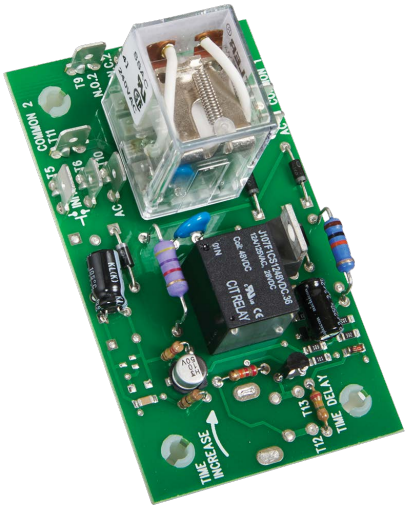
ORS SERIES



Description

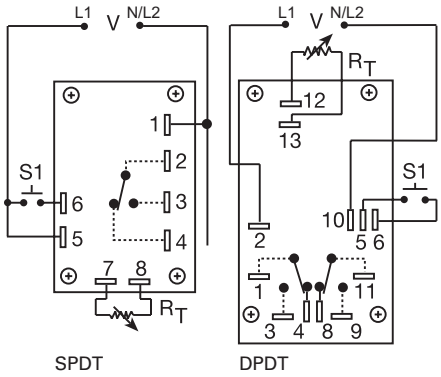
The ORS Series' open PCB construction offers the user good economy without sacrificing performance and reliability. The output relay is available in isolated, 10A, DPDT or SPDT forms. The time delay may be ordered as factory fixed, onboard knob, or external adjustment. All connections are 0.25 in. (6.35 mm) male quick connect terminals.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output relay energizes for a measured interval of time. At the end of the time delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Initiate Switch

Relay contacts are isolated.

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 26.

Features & Benefits

FEATURES	BENEFITS
Open PCB construction	Reduces cost without sacrificing performance and reliability
Analog circuitry	Repeat accuracy + / - 2%, Factory calibration + / - 10%
Isolated, 10A, SPDT or DPDT output contacts	Allows control of loads for AC or DC voltages
Line voltage initiation	Separate control voltage is not required for operation

Accessories

P1004-12, P1004-12-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OUTPUT FORM
ORS120A150SD	120VAC	Fixed	50s	DPDT
ORS230A150SD	230VAC	Fixed	50s	DPDT

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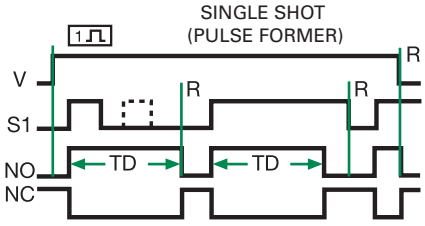
ORS SERIES

Selection Guide

R_T Selection Chart					
Desired Time Delay* Seconds					R_T
1	2	3	4	5	Megohm
0.05	0.5	0.6	1.2	3.0	0.0
0.5	5.0	10	20	50	0.5
1.0	10	20	40	100	1.0
1.5	15	30	60	150	1.5
2.0	20	40	80	200	2.0
2.5	25	50	100	250	2.5
3.0	30	60	120	300	3.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Type	Analog circuitry
Range	0.05 - 300s in 5 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	Adjustable: guaranteed range Fixed: ±10%
Reset Time	≤ 50ms
Initiate Time	≤ 70ms
Time Delay vs Temp. & Voltage	≤ ±10%

Input

Voltage	24, 120, or 230VAC
Tolerance	
24VAC	-15% - 20%
120 & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Power Consumption	2.25W

Output

Type	Electromechanical relay
Form	Isolated, SPDT or DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - $1x10^7$; Electrical - $1x10^6$

Protection

Isolation Voltage	≥1500V RMS input to output

Mechanical

Mounting	Surface mount with four #6 (M3.5 x 0.6) screws
Dimensions	**H** 53.8 mm (2.12"); **W** 93.7 mm (3.69"); **D** 47.8 mm (1.88")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-20° to 65°C / -30° to 85°C
Weight	≅ 2.7 oz (77 g)

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PRS65

Single Shot Timer

8-PIN

Description

The PRS65 is a single shot time delay relay for use on non-critical timing applications. The knob adjustable time delay carries a guaranteed time range of up to 8 minutes.

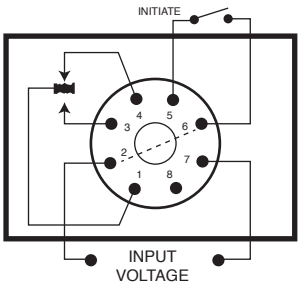
Operation

Power must be applied to the input at all times prior to and during timing. Upon closure of the initiate switch (momentary or maintained) the output contacts transfer and the time delay is initiated. At the end of the delay interval, the output contacts revert to their original position. If the initiate switch is reclosed during timing, the time delay will not be affected.

Features & Benefits

- Electronic Circuit with Electromechanical Relay
- Popular Operating Voltages
- Octal Plug-in
- Hold Down Clamps Available

Wiring Diagram



OCTAL, SPDT

For dimensional drawing see: Appendix, page 515, Figure 48.

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

Specifications

Time Delay

Type	Analog circuitry
Range	7 to 480 seconds
Repeat Accuracy	±2% under fixed conditions
Tolerance	Knob adjustable: guaranteed range
Reset Time	80ms max.
Recycle Time	
After Timing	16ms max.
During Timing	0.1% of max. time delay or 75ms, whichever is greater
Time Delay vs. Temp. & Voltage	15% max.

Input

Voltage	230VAC, nominal
Tolerance	±15% of nominal
AC Line Frequency	50/60 Hz

Output

Type	Relay
Form	Single Pole, Double Throw
Rating	10 amperes resistive at 240VAC

Protection

Transient	±1500 volts for 150 microseconds
Dielectric Breakdown	≥1500 V rms min. at 60 Hz between input and output terminals

Mechanical

Mounting	Plug in (hold-down clips for panel mounting also available)
Termination	Standard Octal Plug-in
Dimensions	**H** 92.2 mm (3.63"); **W** 60.45 mm (2.38"); **D** 44.45 mm (1.75")

Environmental

Operating/Storage Temperature	-20° to 65°C / -30° to 85°C
Humidity	95% relative, non-condensing
Weight	Approx. 6 oz (170 g)

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TDS / TDSH / TDSL SERIES

Relay Output, Single Shot Time Delay Relay

Description

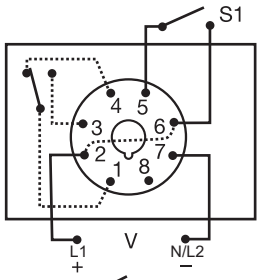
The TDS series combines accurate digital circuitry with isolated, 10 A rated, DPDT or SPDT relay contacts in an 8-pin or 11-pin plug-in package. The TDS series features DIP switch selectable time delays ranging from 0.1s to 10,230 s in three ranges. The TDS series is the product of choice for custom control panel and OEM designers.

Operation (Single Shot)

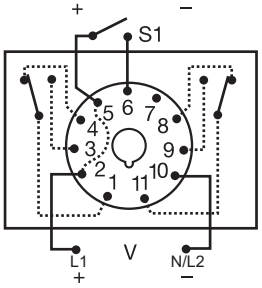
Input voltage must be applied to the input before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output relay energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



8-PIN OCTAL SPDT



S1 = Initiate Switch
Relay contacts are isolated.

11-PIN DPDT

For dimensional drawing see: Appendix, page 512, Figure 23.

Features & Benefits

FEATURES	BENEFITS
3 time ranges available (0.1 s to 2.8 h)	Makes it versatile for use in many applications
Microcontroller based	Repeat Accuracy +/- 0.1 % or 20 ms, whichever is greater; Setting Accuracy +/- 2 % or 50 ms, whichever is greater
LED indication (select models)	Provides visual indication of relay status
DIP switch adjustment	Provides first time setting accuracy
Isolated output contacts	Allows control of loads for ac or dc voltages

Ordering Information

MODEL	INPUT VOLTAGE	DELAY RANGE (SEC)	LED	PLUG TYPE/OUTPUT FORM
TDS120AL	120 V ac	1–1023 in 1 s increments	X	Octal (8-pin) plug, SPDT
TDS120ALD	120 V ac	1–1023 in 1 s increments	X	11-pin plug, DPDT
TDS12D	12 V dc	1–1023 in 1 s increments		Octal (8-pin) plug, SPDT
TDS230AL	230 V ac	1–1023 in 1 s increments	X	Octal (8-pin) plug, SPDT
TDS24AL	24 V ac	1–1023 in 1 s increments	X	Octal (8-pin) plug, SPDT
TDSH120AL	120 V ac	10–10230 in 10 s increments	X	Octal (8-pin) plug, SPDT
TDSL120AL	120 V ac	0.1–102.3 in 0.1 s increments	X	Octal (8-pin) plug, SPDT

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TDS / TDSH / TDSL SERIES

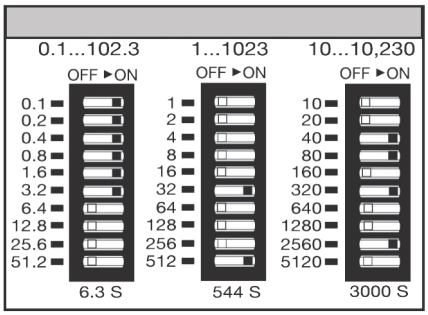
Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN rail mountable. Rated for 10 A @ 600 V ac.

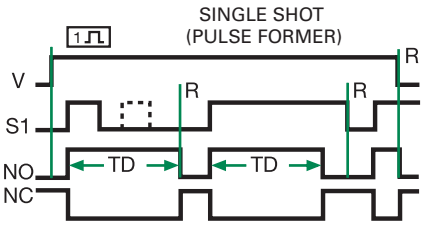
OT11PC Octal Socket for UL listing*
11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac

P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

Digi-Set Binary Switch Operation



Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Type	Digital integrated circuitry
Range	0.1–102.3 s in 0.1 s increments 1–1023 s in 1 s increments 10–10,230 s in 10 s increments
Repeat Accuracy	± 0.1 %
Setting Accuracy	± 2 %
Reset Time	≤ 150 ms
Time Delay vs Temp. & Voltage	± 5 %
Indicator	LED glows during timing; relay is energized
Initiate Time	≤ 60 ms

Input

Voltage	12 V dc; 24, 120, or 230 V ac
Tolerance	
12 V dc & 24 V dc/ac	-15 %–20 %
110 to 230 V dc/ac	-20 %–10 %
AC Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W

Output

Type	Electromechanical relay
Form	SPDT or DPDT
Rating	10 A resistive @ 120/240 V ac 1/3 hp @ 120/240 V ac
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6

Protection

Isolation Voltage	≥ 1500 V RMS input to output
Polarity	Dc units are reverse polarity protected

Mechanical

Mounting	Plug-in socket
Termination	Octal 8-pin plug-in or 11-pin plug-in
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")

Environmental

Operating/Storage Temperature	-20 °C to 65 °C/-30 °C to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	UL 508 (E57310)

*UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT Series sockets is 12 in-lbs.

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TDUS SERIES

Single Shot Timer

Description

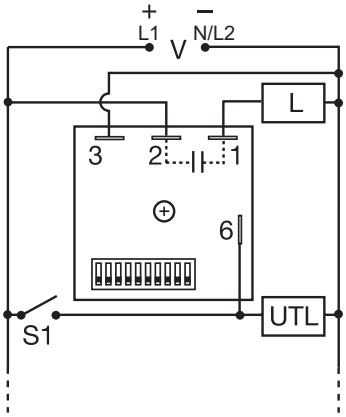
The TDUS Series combines digital timing circuitry with universal voltage operation. Voltages of 24 to 240VAC and 12 to 24VDC are available in three ranges. The TDUS Series offers DIP switch selectable time delays ranging from 0.1 seconds to 102.3 minutes in three ranges. Its 1A rated output, ability to operate on multiple voltages, and wide range of switch selectable time delays make the TDUS Series an excellent choice for process control systems and OEM equipment.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
UTL = Optional Untimed Load
S1 = Initiate Switch
L = Timed Load

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1%
Compact design	Allows flexibility for OEM applications
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE	TIME RANGE
TDUS3000A	24 to 120VAC	1 - 1023s
TDUS3001A	100 to 240VAC	1 - 1023s
TDUS3002A	12 to 24VDC	1 - 1023s
TDUSH3001A	100 to 240VAC	0.1 - 102.3m
TDUSL3000A	24 to 120VAC	0.1 - 102.3s

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TDUS SERIES

Specifications

Time Delay

Range*	0.1 - 102.3s in 0.1s increments 1 - 1023s in 1s increments 0.1 - 102.3m in 0.1m increments
Repeat Accuracy	±0.5% or 20 ms, whichever is greater
Setting Accuracy	≤ ±2% or 20 ms, whichever is greater
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs. Temperature & Voltage	≤ ±5%

Input

Voltage/Tolerance	24 to 240VAC, 12 to 24VDC /±20%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid state
Form	NO, closed during timing
Rating	1A steady state, 10A inrush at 60°C
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
Off State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1 mA

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

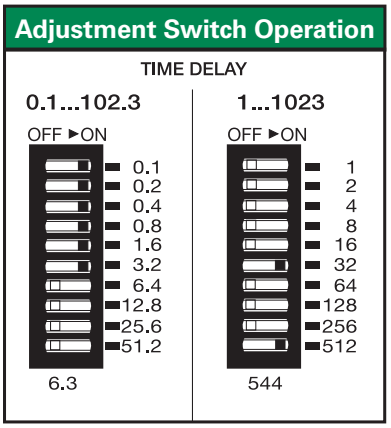
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

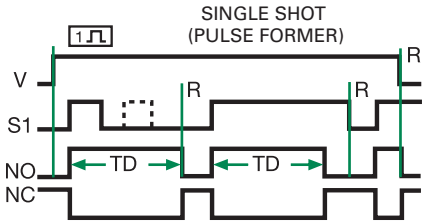
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

Adjustment Switch Operation



Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

THC / THS SERIES

Description

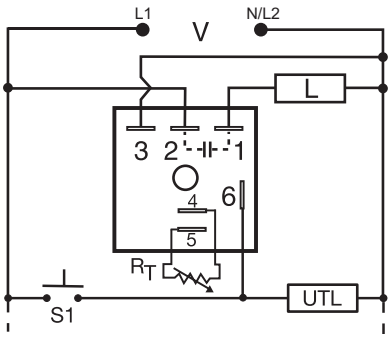
The THC/THS Series is a solid-state relay and timer combined into one compact, easy-to-use control. When mounted to a metal surface, the THC/THS Series may be used to directly control lamp or heater loads of up to 20A steady, 200A inrush. Its single shot function can perform dispensing and pulse shaping operations. The initiate switch can be a momentary or maintained type of switch. Time delays can be selected from 0.1 - 600 seconds in 4 ranges. The THC/THS Series is used for coin vending applications where fast initiate response is required.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch opens. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
L = Timed Load
UTL = Optional Untimed Load

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat accuracy + / - 2%, Factory calibration + / - 5%
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and component costs
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps, and heaters directly without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OUTPUT RATING
THC421C	120VAC	External	0.1 - 3s	20A
THS422B	120VAC	External	0.5 - 60s	10A
THS422C	120VAC	External	0.5 - 60s	20A

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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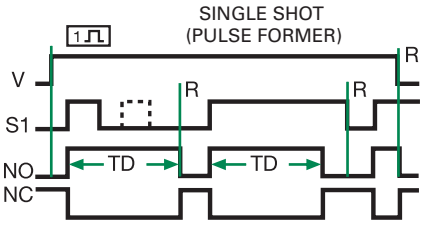
THC / THS SERIES

Selection Guide

R_T Selection Chart				
Desired Time Delay* Seconds				R_T
1	2	3	4	Kohms
0.1	0.5	2	5	0
0.3	6	20	60	10
0.6	12	38	120	20
0.9	18	55	180	30
1.2	24	73	240	40
1.5	30	90	300	50
1.8	36	108	360	60
2.1	42	126	420	70
2.4	48	144	480	80
2.7	54	162	540	90
3.0	60	180	600	100

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Range	0.1 - 600s in 4 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ± 5%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±10%

Input

Voltage	24, 120, or 230VAC
Tolerance	±15%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, closed during timing

Maximum Load Currents

Output	Steady State	Inrush**
A	6A	60A
B	10A	100A
C	20A	200A

Minimum Load Current	100mA
Voltage Drop	≅ 2.5V at rated current
OFF State Leakage Current	≅ 5mA @ 230VAC

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥100 MΩ

Mechanical

Mounting **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

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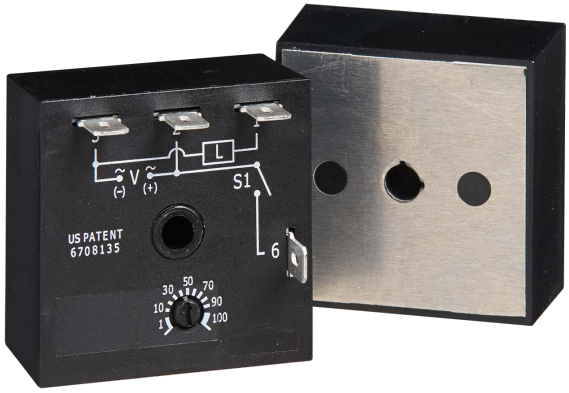
THDS SERIES



Description

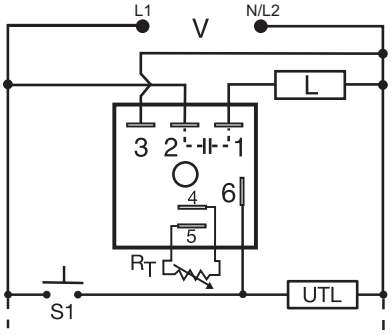
The THDS Series combines accurate timing circuitry with high power solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, timers.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output energizes if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
UTL = Optional Untimed Load
L = Timed Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration +/- 1%
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps and heaters without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and component costs

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OUTPUT RATING
THDS410.25SA	120VAC	Fixed	0.25s	6A
THDS431C	120VAC	Onboard	1 - 100s	20A
THDS610.25SA	230VAC	Fixed	0.25s	6A

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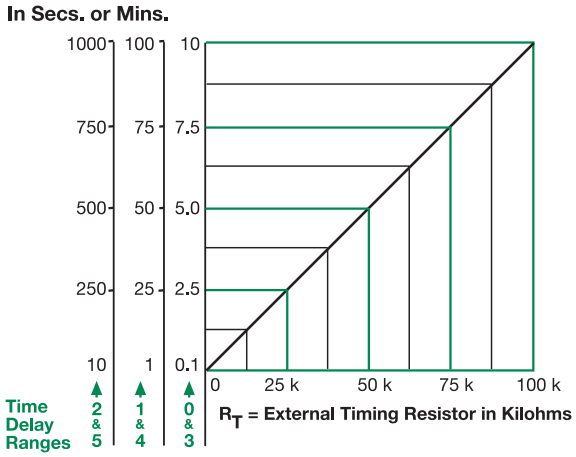
THDS SERIES

External Resistance vs. Time Delay

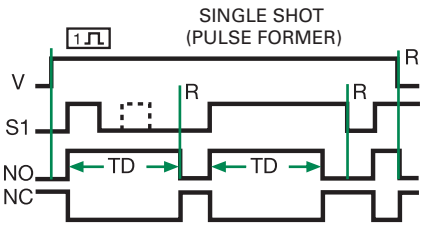


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, closed during timing

Maximum Load Current

Output	Steady State	Inrush**
A	6A	60A
B	10A	100A
C	20A	200A

Voltage Drop	≅ 2.5V @ rated current
Off State Leakage Current	≅ 5mA @ 230VAC
Minimum Load Current	100mA

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

**Mounting ** **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

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TRS SERIES

Description

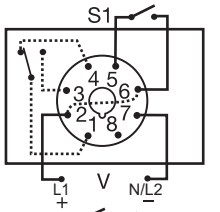
The TRS series combines an isolated, 10 A electromechanical, relay output with digital timing circuitry. False trigger of the TRS series by a transient is unlikely because of the complete isolation of the circuit from the line prior to initiation. The initiate contact is common to one side of the line and may be utilized to operate other loads. Installation is easy due to the TRS's industry standard 8 or 11-pin plug-in base wiring.

Operation (Single Shot)

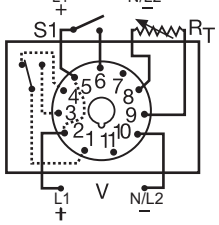
Input voltage must be applied to the input before and during timing. Upon momentary or maintained closure of the initiate switch (leading edge triggered), the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. Applying input voltage with the initiate switch closed will energize the load and begin the time delay.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



8-PIN OCTAL SPDT



11-PIN SPDT

Features & Benefits

FEATURES	BENEFITS
Complete isolation of circuit from line	No false trip due to transients
Industry standard octal plug connection	Eliminates need for special connectors
Isolated, 10 A, SPDT or DPDT output contacts	Allows control of loads for ac or dc voltages
Digital circuitry	Repeat accuracy +/- 2 %

For dimensional drawing see: Appendix, page 512, Figure 24.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	OUTPUT FORM	TIME TOLERANCE	TIME DELAY
TRS120A2X300	120 V ac	Knob	8-Pin, Octal, SPDT	+/- 20 %	7–300s
TRS120A2Y10	120 V ac	Knob	8-Pin, Octal, SPDT	+/- 10 %	0.1–10s
TRS24D7Z10	24 V dc/28 V dc	External	11-Pin, SPDT no potentiometer	+/- 5 %	0.1–10s

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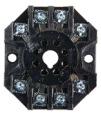
TRS SERIES

Accessories



P1011-6 Octal Socket for UL listing*
8-pin surface mount socket with binder head screw terminals. Rated 10 A @ 600 V ac.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

OT11PC Octal Socket for UL listing*
11-pin surface & DIN rail mountable. Rated for 10 A @ 300 V ac

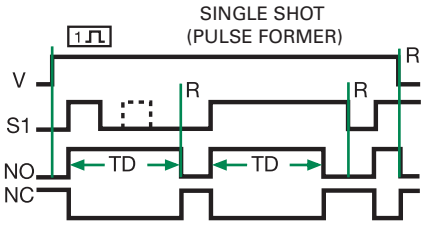
C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Selection Guides

External R_T P/N Selection Table	
VALUE	PART NUMBER*
100K ohm	P1004-95
100K ohm	P1004-95-X

* Externally adjustable potentiometers. Numbers with additional "-X" include two pre-soldered 8" wire leads with ¼" female quick-connect terminals (for clockwise increase).

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Type	Digital circuitry
Range	See "Ordering Information" table
Repeat Accuracy	± 2 %
Fixed Time Tolerance & Setting Accuracy	± 5, 10, or 20 %
Initiate Time	≤ 70 ms
Reset Time	≤ 75 ms
Recycle Time	≤ 250 ms
Time Delay vs Temp. & Voltage	≤± 5 %

Input

Voltage	24/28 V dc; 24, 120 V ac
Tolerance	
24 V dc/ac	-15 %–20 %
120 V ac	-20 %–10 %
AC Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W

Output

Type	Electromechanical relay
Form	Isolated SPDT or DPDT
Rating	10 A resistive @ 120/240 V ac & 28 V dc; 1/3 hp @ 120/240 V ac
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6

Protection

Insulation Resistance	≥ 100 MΩ
Isolation Voltage	≥ 1500 V RMS between input & output terminals
Polarity	Dc units are reverse polarity protected

Mechanical

Mounting	Plug-in socket
Termination	Octal 8-pin plug-in or 11-pin plug-in
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")

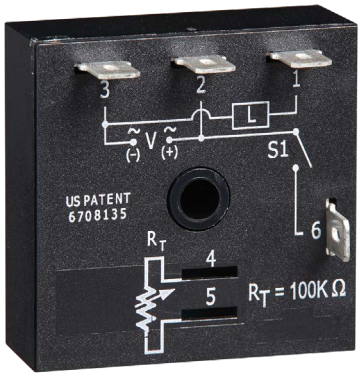
Environmental

Operating/Storage Temperature	-20 °C to 65 °C/-30 °C to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	4 oz (113 g)

*UL Listed when used with Part Number OT08-PC, RB08-PC, OT11-PC, or RB11-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT series sockets is 12 in-lbs.

TSDS SERIES



Description

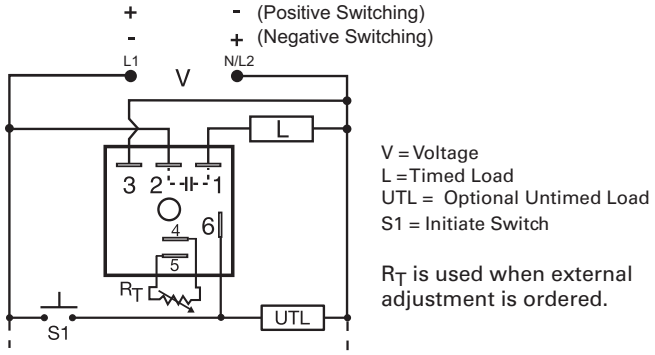
The TSDS Series is designed for more demanding commercial and industrial applications where small size and accurate performance are required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the time delay. The TSDS Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 1000 minutes are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry. This product is suitable for many applications, including dispensing, welding, and exposure timing.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will not energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch is opened. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
L = Timed Load
UTL = Optional Untimed Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration + / - 1%
1A Steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Wide temperature range: -40° to 75°C	Reliable in demanding commercial and industrial applications

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE
TSDS2110S	24VAC	Fixed	10s	n/a
TSDS320N	24VDC	External	0.1 - 10s	Negative
TSDS321P	24VDC	External	1 - 100s	Positive
TSDS421	120VAC	External	1 - 100s	n/a

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

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TSDS SERIES

Accessories

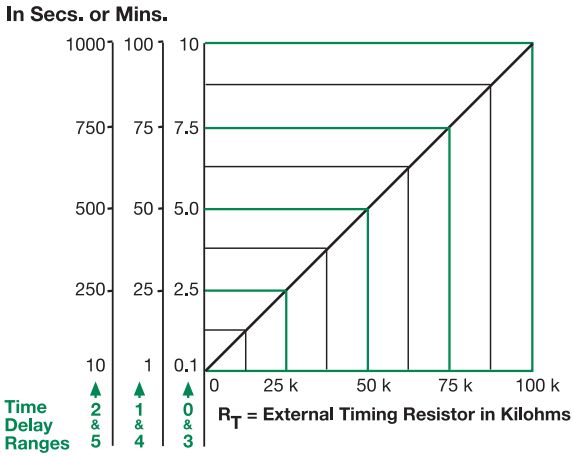
P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

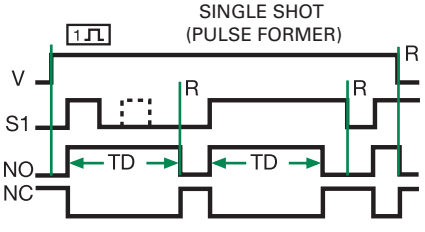


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	±15%
Power Consumption	AC ≤ 2VA; DC ≤ 1W
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%

Output

Type	Solid state
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
Off State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1mA
DC Operation	Positive or negative switching

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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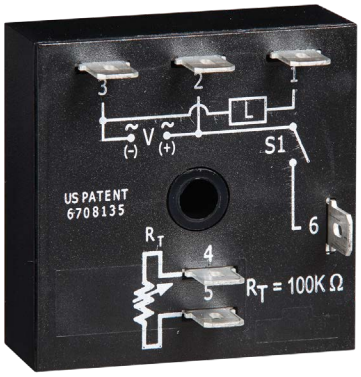
TSS SERIES



Description

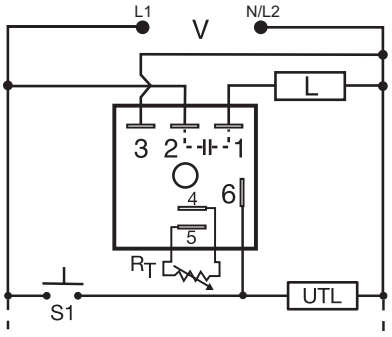
The TSS Series is a totally solid-state timing module. Its 1A rated, solid-state output provides an excellent method of time control for exposures, dispensing, or for increasing or decreasing a switch closure. Time delays from 0.05 to 600 seconds, in 4 ranges, cover 90% of all OEM applications. Factory calibration of fixed delays is ±5% and the repeat accuracy is ±2%. The TSS Series can be surface mounted with a single screw, or snapped on a 35mm DIN rail using the P1023-20 accessory adaptor.

Operation (Single Shot)

Voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output energizes for a measured interval of time. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no affect on the time delay. The output will energize if the initiate switch is closed when input voltage is applied.

Reset: Reset occurs when the time delay is complete and the initiate switch opens. Loss of input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
L = Timed Load
UTL = Optional Untimed Load

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat accuracy + / - 2%, Factory calibration + / - 5%
Compact, low cost design	Allows flexibility for OEM applications
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Surface or DIN rail mounting	Provides flexibility for installation

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TSS410.5	120VAC	Fixed	0.5s
TSS421	120VAC	External	0.05 - 3s
TSS422	120VAC	External	0.5 - 60s
TSS424	120VAC	External	5 - 600s
TSS622	230VAC	External	0.5 - 60s
TSS624	230VAC	External	5 - 600s

If desired part number is not listed, please call us to see if it is technically possible to build.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

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TSS SERIES

Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

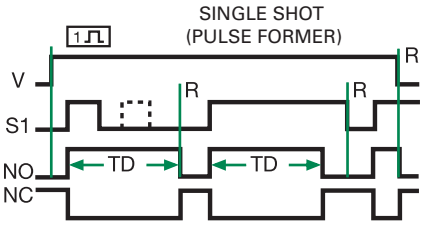
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Selection Guide

R_T Selection Chart				
Desired Time Delay* Seconds				R_T
1	2	3	4	Kohms
0.05	0.5	2	5	0
0.3	6	20	60	10
0.6	12	38	120	20
0.9	18	55	180	30
1.2	24	73	240	40
1.5	30	90	300	50
1.8	36	108	360	60
2.1	42	126	420	70
2.4	48	144	480	80
2.7	54	162	540	90
3.0	60	180	600	100

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Range	0.05s - 600s in 4 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs Temp. & Voltage	≤ ±10%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Off State Leakage Current	≅ 5mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	- 40° to 75°C / - 40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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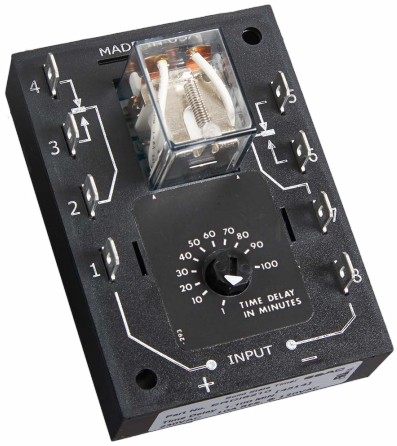
ERDI SERIES



Description

Econo-Timers are a combination of digital electronics and an electromechanical relay. DPDT relay output for relay logic circuits, and isolation of input to output voltages. For applications, such as interval on, pulse shaping, minimum run time, etc. The ERD Series is encapsulated to protect the circuitry from shock, vibration and humidity.

Operation (Interval)

Upon application of input voltage, time delay begins, and output relay energizes. At the end of time delay, output de-energizes until input voltage is removed.

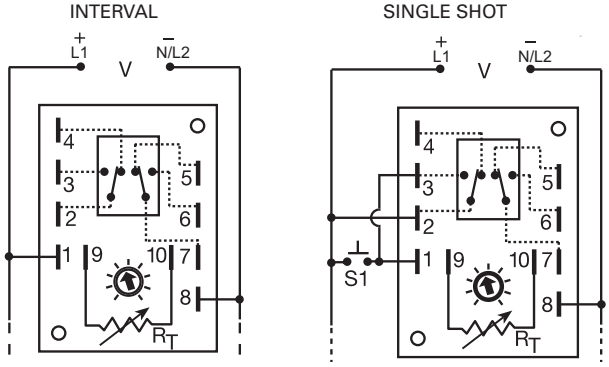
Reset: Removing input voltage resets the time delay and the output.

Operation (Single Shot)

Input voltage must be applied before and during timing. Upon momentary or maintained closure of initiate switch, output relay energizes for time delay. At the end of the delay, output de-energizes. Opening or reclosing initiate switch during timing has no affect on time delay. Output will energize if initiate switch is closed when input voltage is applied.

Reset: Reset occurs when time delay is complete & initiate switch is opened. Loss of input voltage resets time delay and output.

Wiring Diagram



2-3 & 7-6 are Normally Open Contacts (NO)

2-4 & 7-5 are Normally Closed Contacts (NC)

For dimensional drawing see: Appendix, page 512, Figure 25.

Features & Benefits

FEATURES	BENEFITS
Digital integrated circuitry	Repeat Accuracy + / - 0.5%, Factory calibration +/ - 10%
Isolated, 10A, DPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Protects against shock, vibration, and humidity

Accessories

P1004-16, P1004-16-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
ERDI436	120VAC	External	0.6 - 60s
ERDI6210	230VAC	Onboard	1 - 100m

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ERDI SERIES

Selection Guides

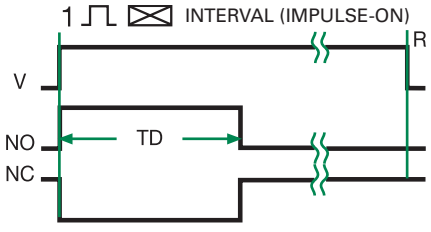
R_T Selection Chart						
Desired Time Delay* Seconds						R_T
1	2	3	4	5	6	Megohm
0.1	0.1	0.1	0.2	0.3	0.6	0.0
0.19	0.6	1	1.7	3	6	0.1
0.28	1.1	2	3.2	6	12	0.2
0.37	1.6	3	4.7	9	18	0.3
0.46	2.1	4	6.2	12	24	0.4
0.55	2.6	5	7.7	15	30	0.5
0.64	3.0	6	9.2	18	36	0.6
0.73	3.5	7	10.7	21	42	0.7
0.82	4.0	8	12.2	24	48	0.8
0.91	4.5	9	13.7	27	54	0.9
1.0	5.0	10	15	30	60	1.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

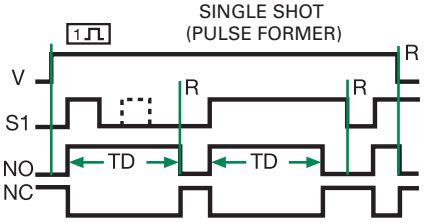
R_T Selection Chart					
Desired Time Delay* Minutes					R_T
7	8	9	10	11	Megohm
0.1	0.1	0.2	1	10	0.0
0.6	1	1.7	10	50	0.1
1.1	2	3.2	20	100	0.2
1.6	3	4.7	30	150	0.3
2.1	4	6.2	40	200	0.4
2.6	5	7.7	50	250	0.5
3.0	6	9.2	60	300	0.6
3.5	7	10.7	70	350	0.7
4.0	8	12.2	80	400	0.8
4.5	9	13.7	90	450	0.9
5.0	10	15	100	500	1.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagrams



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset

Specifications

Time Delay

Type	Digital integrated circuitry
Range	0.1s - 500m in 11 adjustable ranges, 0.1s - 1000m fixed
Adjustment	External adjust or onboard
Repeat Accuracy	±0.5%
Tolerance (Factory Calibration)	≤ ±10%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	120VAC or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
120VDC/AC & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz

Output

Type	Isolated relay contacts
Form	DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6

Protection

Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting screws	Surface mount with two #6 (M3.5 x 0.6)
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 43.2 mm (1.7")
Termination terminals	0.25 in. (6.35 mm) male quick connect

Environmental

Operating/Storage Temperature	-40° to 65°C / -40° to 85°C
Weight	≅ 5.7 oz (162 g)

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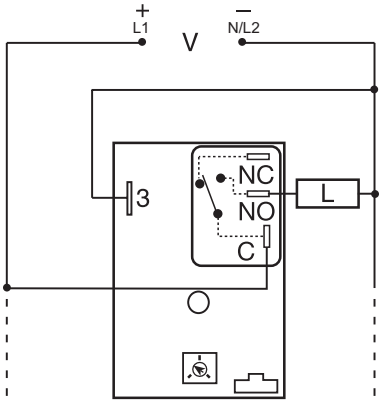
HRDI SERIES

Interval Timer

Wiring Diagram



C = Common, Transfer Contact
NO = Normally Open
L = Load

NOTE: A knob, or terminals 4 & 5 are only included on adjustable units. R_T is used when external adjustment is ordered. Relay contacts are not isolated.

For dimensional drawing see: Appendix, page 512, Figure 17.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
HRDI117S	12VDC	Fixed	7s
HRDI421	120VAC	Onboard	1 - 100s
HRDI422	120VAC	Onboard	10 - 1000s

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Description

The HRDI Series combines an electromechanical relay output with microcontroller timing circuitry. It offers 12 to 230V operation in five ranges and factory fixed, external, or onboard adjustable time delays with a repeat accuracy of ±0.5%. The output contact rating allows for direct operation of heavy loads, such as compressors, pumps, blower motors, heaters, etc. This series is ideal for OEM applications where cost is a factor.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output relay is energized during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy +/- 0.5%
Compact, low cost design	Allows flexibility for OEM applications
Isolated, 30A, SPDT, NO output contacts	Allows direct operation of heavy loads: compressors, pumps, blower moters, heaters.
Encapsulated	Protects against shock, vibration, and humidity.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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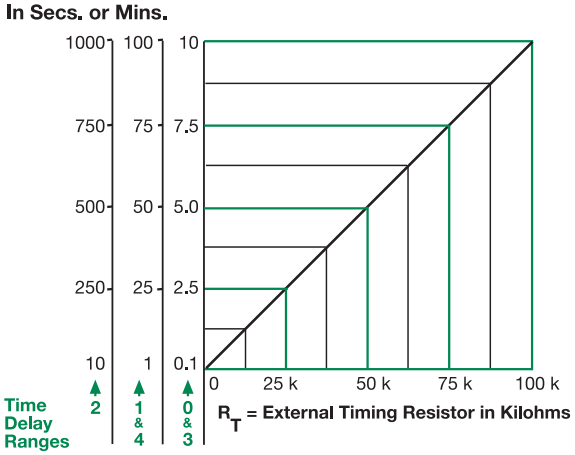
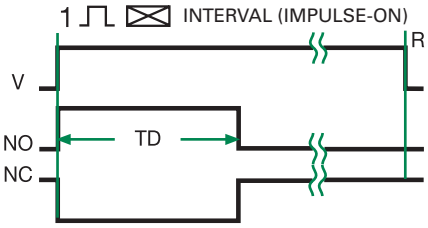
HRDI SERIES

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Type	Microcontroller circuitry
Range	0.1s - 100m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5 % or 20ms, whichever is greater
Tolerance (Factory Calibration)	±1%, ±5%
Recycle Time	≤ 150ms
Time Delay vs Temp. & Voltage	±2%

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC	-15% - 20%
24 to 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Power Consumption	AC ≤ 4VA; DC ≤ 2W

Output

Type		Electromechanical relay	
Form		SPDT, non-isolated	
Ratings		**SPDT-NO**	**SPDT-NC**
General Purpose	**125/240VAC**	30A	15A
Resistive	**125/240VAC**	30A	15A
	28VDC	20A	10A
Motor Load	**125VAC**	1 hp*	1/4 hp**
	240VAC	2 hp**	1 hp**
Life		Mechanical - 1 x 10^6; Electrical - 1 x 105, *3 x 104, **6,000	

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 51.3 mm (2"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

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KRDI SERIES

Description

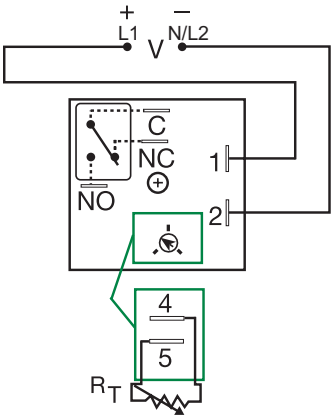
The KRDI Series is a compact time-delay relay measuring only 2 in. (50.8 mm) square. Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDI Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output relay energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Wiring Diagram



V = Voltage
C = Common, Transfer Contact
NO = Normally Open
NC = Normally Closed

A knob is supplied for adjustable units, or R_T terminals 4 & 5 for external adjust. See external adjustment vs time delay chart.

Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration + / - 5%
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Protects against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
KRDI120	12VDC	Onboard knob	0.1 - 10s
KRDI121	12VDC	Onboard knob	1 - 100s
KRDI122	12VDC	Onboard knob	10 - 1000s
KRDI2110S	24VAC/VDC	Fixed	10s
KRDI2160S	24VAC/VDC	Fixed	60s
KRDI220	24VAC/VDC	Onboard knob	0.1 - 10s
KRDI320	24VDC	Onboard knob	0.1 - 10s
KRDI420	120VAC	Onboard knob	0.1 - 10s
KRDI424	120VAC	Onboard knob	1 - 100m

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KRDI SERIES

Accessories

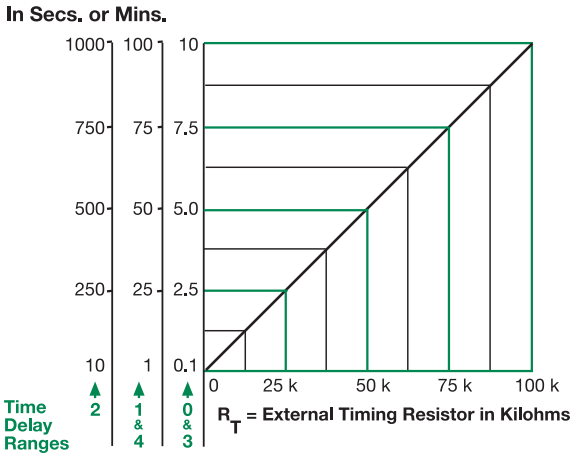
C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Specifications

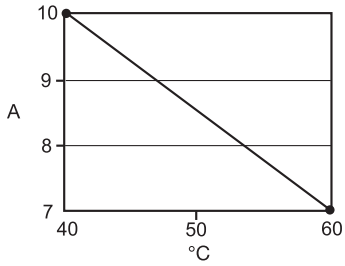
Time Delay	
Range	0.1s - 100m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ± 5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±5%
Input	
Voltage	12, 24 or 110VDC; 24, 120 or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
110VDC, 120VAC or 230VAC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W
Output	
Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5
Protection	
Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

External Resistance vs. Time Delay

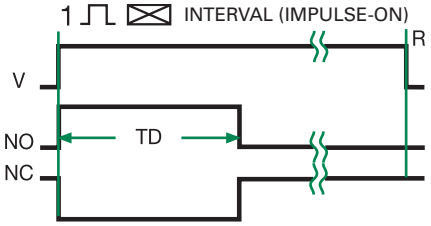


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Output Current/Ambient Temperature



Function Diagram

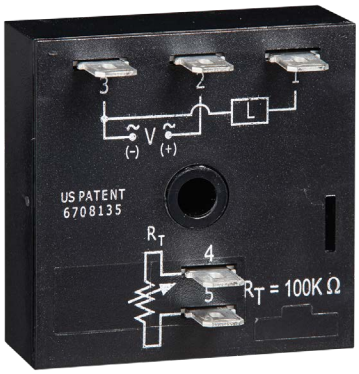


V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

12
TIME DELAY RELAYS

KSD2 SERIES

Interval Timer



Description

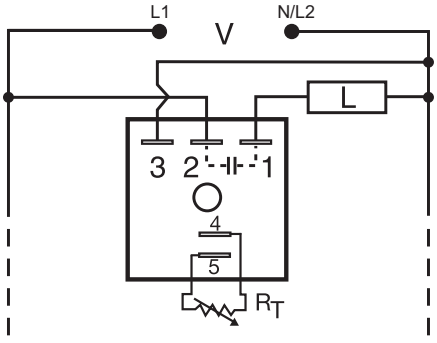
The KSD2 Series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for input voltages of 24, 120 or 230VAC. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry. An excellent choice for most OEM pulse shaping, maximum run time, and other process control applications.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Wiring Diagram



R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, + / -5% time delay accuracy
Compact, low cost design	Allows flexibility for OEM applications
1A Steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

Ordering Information

MODEL	INPUT VOLTAGE VAC	ADJUSTMENT	TIME DELAY
KSD2221	24	External	1 - 100s
KSD2413M	120	Fixed	3m
KSD2420	120	External	0.1 - 10s

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KSD2 SERIES

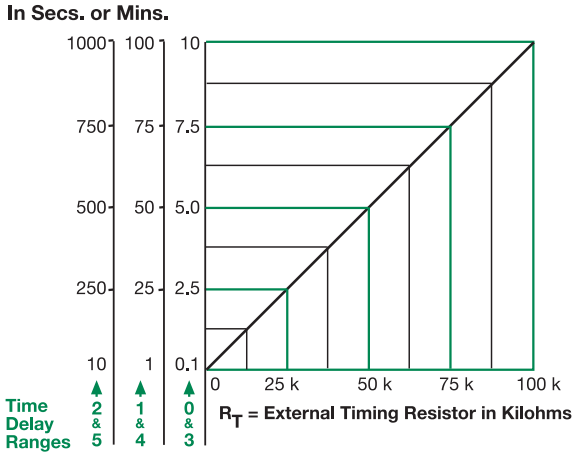
Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

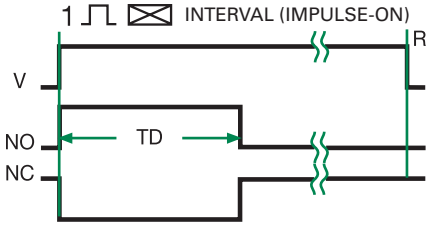


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Time Delay vs. Temperature & Voltage	≤ ±10%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
OFF State Leakage Current	≅ 5mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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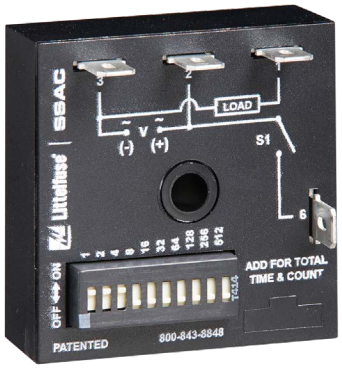
KSPU SERIES



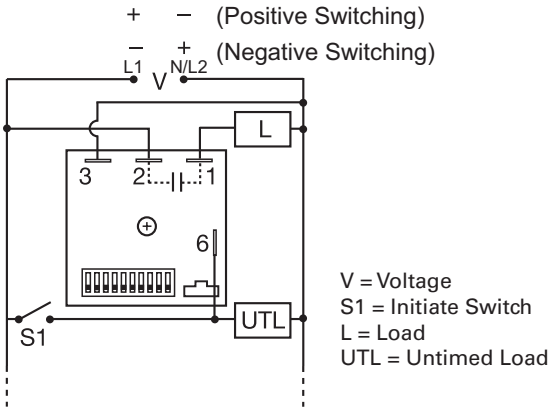
Description

The KSPU Series is a factory programmed module available in any 1 of 14 standard functions. The KSPU offers a single adjustable timer or counter function. Switch adjustment allows accurate selection of the time delay or number of counts the first time and every time. The 1A steady, 10A inrush rated solid-state output provides 100 million operations, typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KSPU Series is a cost effective approach for OEM applications that require small size, solid state reliability, and accurate switch adjustment.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1%
Compact design	Allows flexibility for OEM applications
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Wiring Diagram



For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1015-64 (AWG 14/16), **P1015-14** (AWG 18/22)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE	TIME DELAY/COUNTS	FUNCTION
KSPUA2I	24 to 240VAC	1 - 1023s	Interval
KSPUA8C	24 to 240VAC	1 - 1023 counts (binary) with pulsed output	Counter with pulsed output

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KSPU SERIES

Specifications

Time Delay

Range*	0.1 - 102.3s, m or h in 0.1s, m or h increments 1 - 1023s, m or h in 1s, m or h increments 1 - 63s or m in 1s or m increments
Repeat Accuracy	±0.1% or 20 ms, whichever is greater
Setting Accuracy	≤ ±1% or 20 ms, whichever is greater
Reset Time	≤ 150ms
Initiate Time	≤ 20ms
Time Delay vs. Temperature & Voltage	≤ ±2%

Input

Voltage/Tolerance	24 to 240VAC, 12 to 120VDC/≤ ±15%
AC Line Frequency/DC Ripple	50/60 Hz/≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid state
Form	NO, SPST-NO
Rating	1A steady state, 10A inrush for 16ms
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
Off State Leakage Current	AC ≅ 5mA @ 240VAC; DC ≅ 1 mA
Counter Output	Output pulse width: 300ms ±20% Time Delay/Counts Variable 7 & 8

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

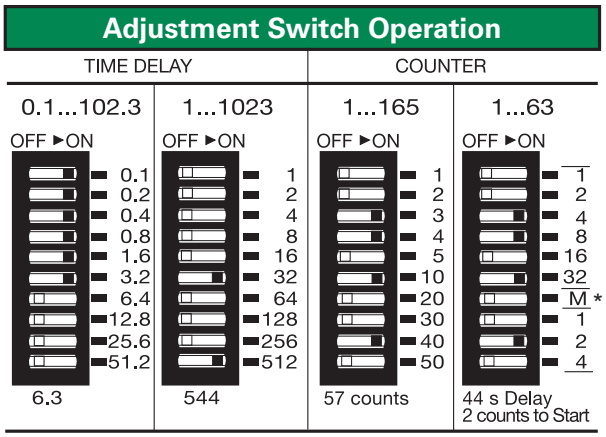
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

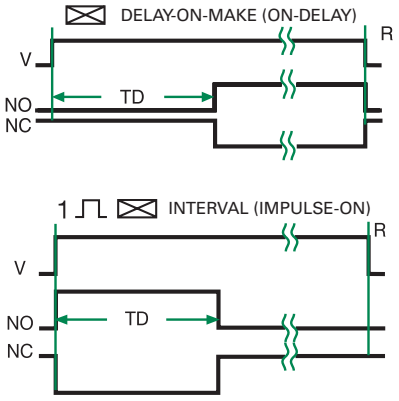
*For CE approved applications, power must be removed from the unit when a switch position is changed.

Adjustment Switch Operation



* for selecting time in minutes or seconds

Function Diagrams



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
⌇ = Undefined Time

TDI / TDIH / TDIL SERIES

Description

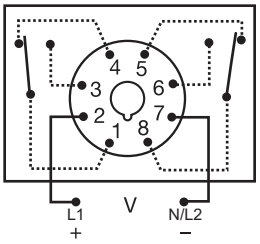
The TDI series is an interval timer that combines accurate digital circuitry with isolated, 10 A rated, DPDT relay contacts in an 8-pin plug-in package. The TDI series features DIP switch selectable time delays ranging from 0.1 to 10,230 seconds in three ranges. The TDI series is the product of choice for custom control panel and OEM designers.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output relay is energized during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Wiring Diagram



Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 23.

Features & Benefits

FEATURES	BENEFITS
Digital circuitry	Repeat Accuracy + / - 0.1 %, Setting accuracy + / - 2 %
Isolated, 10 A, DPDT output contacts	Allows control of loads for ac or dc voltages
DIP switch adjustment	Provides first time setting accuracy
Industry standard octal plug connection	Eliminates need for special connectors
LED indication (select models)	Provides visual indication of timing and output status

Ordering Information

MODEL	INPUT VOLTAGE	TIME DELAY	LED
TDI120AL	120 V ac	1–1023 s in 1 s increments	Yes
TDI12D	12 V dc	1–1023 s in 1 s increments	No
TDIH24AL	24 V ac	10–10,230 s in 10 s increments	Yes
TDIL120AL	120 V ac	0.1–102.3 s in 0.1 s increments	Yes
TDIL24DL	24 V dc/28 V dc	0.1–102.3 s in 0.1 s increments	Yes

Accessories

OT08PC 8-pin Octal Socket for UL listing*
Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable. Rated for 10 A @ 600 V ac.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

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TDI / TDIH / TDIL SERIES

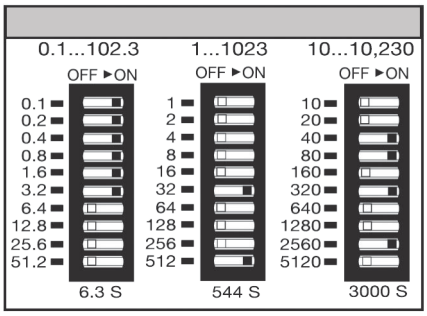
Specifications

Time Delay	
Type	Digital integrated circuitry
Range	0.1–102.3 s in 0.1 s increments 1–1023 s in 1 s increments 10 – 10,230 s in 10 s increments
Repeat Accuracy	±0.1 %
Setting Accuracy	±2 %
Reset Time	≤ 150 ms
Time Delay vs Temp. & Voltage	±5 %
Indicator	LED glows during timing; relay is energized
Input	
Voltage	12, 24 V dc; 24, 120 V ac
Tolerance	
12 V dc & 24 V dc/Ac	-15 %–+20 %
120 V ac	-20 %–+10 %
AC Line Frequency	50/60 Hz
Power Consumption	≤ 3.25W
Output	
Type	Electromechanical relay
Form	DPDT
Rating	10 A resistive @ 120/240 V ac; 1/3 hp @ 120/240 V ac
Life	Mechanical - 1 x10^7; Electrical - 1 x 10^6
Protection	
Polarity	Dc units are reverse polarity protected
Isolation Voltage	≥ 1500 V RMS input to output
Mechanical	
Mounting	Plug-in socket
Dimensions	**H** 44.45 mm (1.75"); **W** 60.33 mm (2.38"); **D** (with socket) 104.78 mm (4.13")
Termination	Octal 8-pin plug-in
Environmental	
Operating/Storage Temperature	-20 °C to 65 °C / -30 °C to 85 °C
Weight	≅ 4 oz (113 g)
Safety Marks	
UL (socket required)*	UL 508 (E57310)

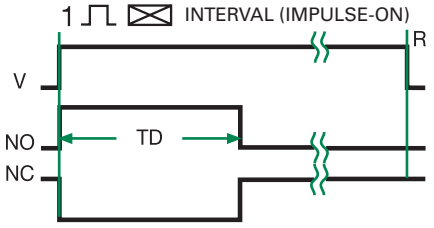
*UL Listed when used with Part Number OT08-PC or RB08-PC manufactured by Custom Connector Corp.

Note: Manufacturer's recommended screw terminal torque for the OT Series sockets is 12 in-lbs.

Digi-Set Binary Switch Operation



Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

TDUI / TDUIH / TDUIL SERIES

Description

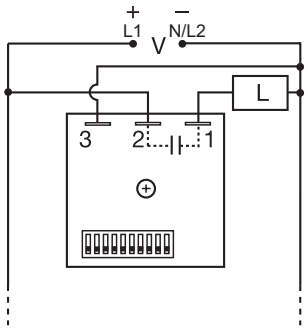
The TDUI Series combines digital timing circuitry with universal voltage operation. Voltages of 24 to 240VAC and 12 to 24VDC are available in three ranges. The TDUI Series offers DIP switch selectable time delays ranging from 0.1 seconds to 102.3 minutes in three ranges. Its 1A rated output, ability to operate on multiple voltages, and wide range of switch selectable time delays make the TDUI Series an excellent choice for process control systems and OEM equipment.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Wiring Diagram



V = Voltage
L = Load

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, Setting accuracy + / - 2%
Compact design	Allows flexibility for OEM applications
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Wide voltage ranges	Flexibility to handle multiple voltages found in control systems and OEM applications
DIP switch Adjustment	Provides first time setting accuracy

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE	TIME DELAY
TDUI3000A	24 to 120VAC	1 - 1023s
TDUIH3002A	12 to 24VDC	0.1 - 102.3m
TDUIL3001A	100 to 240VAC	0.1 - 102.3s
TDUIL3002A	12 to 24VDC	0.1 - 102.3s

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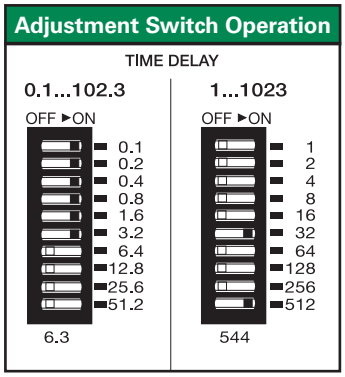
TDUI / TDUIH / TDUIL SERIES

Specifications

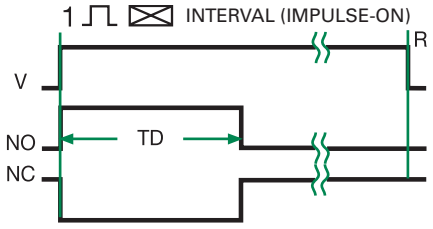
Time Delay	
Range*	0.1 - 102.3s in 0.1s increments 1 - 1023s in 1s increments 0.1 - 102.3m in 0.1m increments
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Setting Accuracy	≤ ±2% or 20ms, whichever is greater
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±5%
Input	
Voltage	24 to 240VAC, 12 to 24VDC ±20%
AC Line Frequency	50/60 Hz
Power Consumption	AC ≤ 2VA; DC ≤ 1W
DC Ripple	≤ 10%
Output	
Type	Solid state
Form	NO, closed during timing
Rating	1A steady state, 10A inrush at 60°C
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
OFF State Leakage Current	AC ≅ 5mA @ 230VAC; DC≅ 1mA
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

Switch Operation



Function Diagram

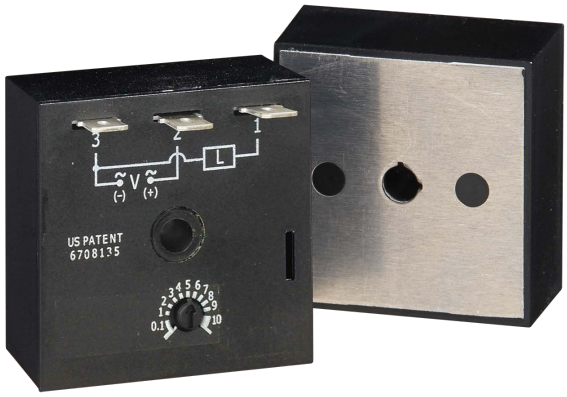


V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

12

TIME DELAY RELAYS

THD2 SERIES



Description

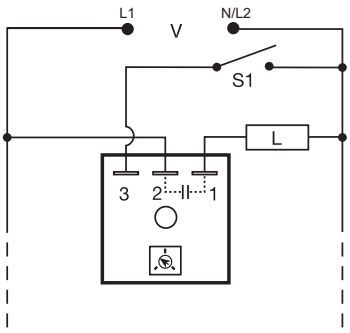
The THD2 Series combines accurate timing circuitry with high power solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, Digi-Power timers.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Wiring Diagram



V = Voltage
L = Load
S1 = Optional Low Current Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration + / - 1%
High load currents up to 20A, 200A inrush	Allows direct control of motors, lamps and heaters without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and components costs

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	OUTPUT RATING	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
THD2C420	20A	120VAC	External	0.1 - 10s
THD2C423	20A	120VAC	External	0.1 - 10m
THD2C433	20A	120VAC	Onboard	0.1 - 10m
THD2C620	20A	230VAC	External	0.1 - 10s
THD2C633	20A	230VAC	Onboard	0.1 - 10m

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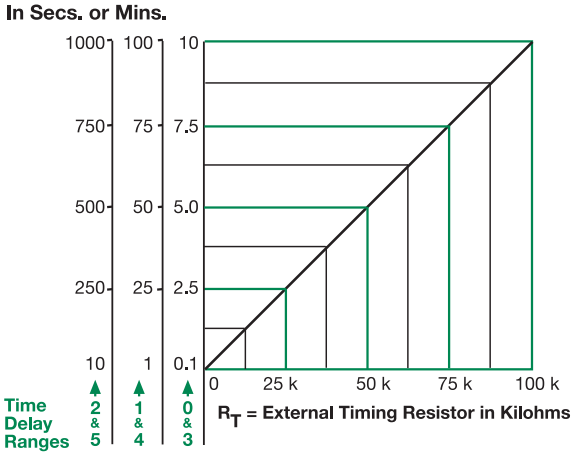
THD2 SERIES

External Resistance vs. Time Delay

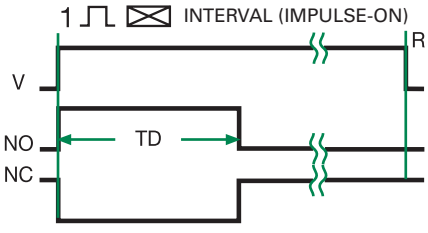


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid state
Form	NO, closed during timing

Maximum Load Current

Output	Steady State	Inrush**
A	6A	60A
B	10A	100A
C	20A	200A

Minimum Load Current	100mA
Voltage Drop	≅ 2.5V at rated current
OFF State Leakage Current	≅ 5mA @ 230VAC

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

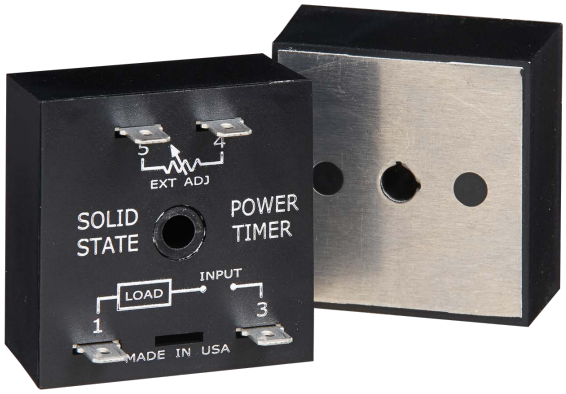
**Mounting ** **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

THD7 SERIES



Description

The THD7 Series utilizes only two terminals connected in series with the load. Interval timing mode is achieved by using a small portion of the AC sine wave allowing sufficient voltage for circuit operation. The THD7 Series can be used for interval or delay-on-break timing. It is designed to operate large loads directly, such as motors, heater elements, and motor starters.

Operation (Interval)

Upon application of input voltage, the output energizes and the time delay begins. The output remains energized throughout the time delay. At the end of the time delay the output de-energizes and remains de-energized until power is removed.

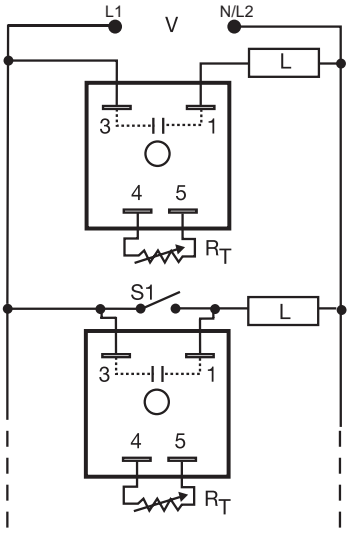
Reset: Removing input voltage resets the time delay and the output.

Operation (Delay-on-Break)

Upon closure of SW1, the load energizes and the timer is reset (zero voltage across its input terminals). Opening SW1 re-applies input voltage to the timer, the load remains energized and the time delay begins. At the end of the time delay the output de-energizes. If SW1 is open when power is applied, the load will energize for the time delay then de-energize.

Reset: Reclosing SW1 resets the timer.

Wiring Diagram



INTERVAL

V = Voltage
L = Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

DELAY-ON-BREAK

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Digital integrated circuitry	Repeat Accuracy + / - 0.5%
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps and heaters without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and component costs

Accessories

P1004-13, P1004-13-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OUTPUT RATING
THD7421A	120VAC	External	1 - 100s	6A
THD7621C	230VAC	External	1 - 100s	20A

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THD7 SERIES

Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

Time Delay	VTP P/N
1 - 1-100s	VTP5G
2 - 10-1000s	VTP5K
3 - 0.1-10m	VTP5N
4 - 1-100m	VTP5P
5 - 10-1000m	VTP5R

Selection Guide

R_T Selection Chart					
Desired Time Delay*					R_T
Seconds		Minutes			
1	2	3	4	5	Megohm
1	10	0.1	1	10	0.0
10	100	1	10	100	0.5
20	200	2	20	200	1.0
30	300	3	30	300	1.5
40	400	4	40	400	2.0
50	500	5	50	500	2.5
60	600	6	60	600	3.0
70	700	7	70	700	3.5
80	800	8	80	800	4.0
90	900	9	90	900	4.5
100	1000	10	100	1000	5.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Specifications

Time Delay

Type	Digital integrated circuitry
Range	1s - 1000m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±10%
Recycle Time	After timing: ≤150ms; During timing: ≤ 350ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid state
Form	NO, closed during timing

Rating

Output	Steady State	Inrush**
A	6A	60A
B	10A	100A
C	20A	200A

Effective Voltage Drop (VLine-VLoad)

Input	Effective Drop
24VAC	≤ 3V
120VAC	≤ 3V
230VAC	≤ 5V

Minimum Load Current	100mA

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

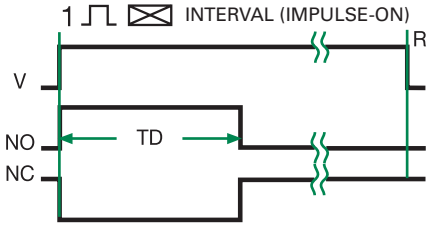
**Mounting ** **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

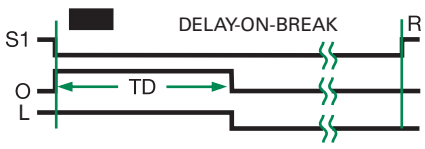
Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

Function Diagrams



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time



S1 = Initiate Switch
O = Output
L = Load
TD = Time Delay
R = Reset
= Undefined Time

TS2 / TS6 SERIES

TS2

TS6

Description

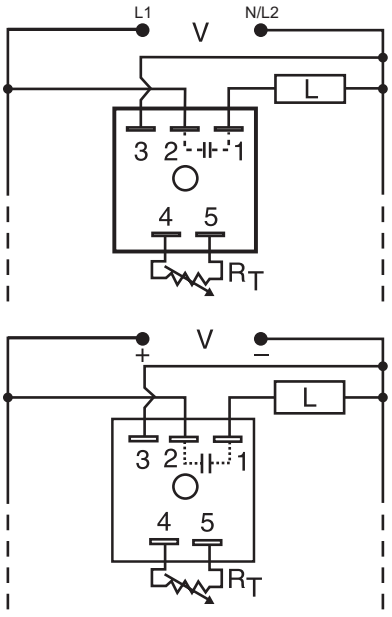
The TS2 Series is designed for 24, 120 or 230VAC and the TS6 Series is designed for 12 or 24VDC. These series are capable of controlling load currents of up to 1A steady state, 10A inrush. Encapsulated circuitry and the reliability of a ±2% repeat accuracy make the TS2 and TS6 ideal for cost sensitive applications.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Wiring Diagram



V = Voltage
L = Load

R_T is used when external adjustment is ordered.

Note: TS6 is not reverse polarity protected.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat accuracy + / - 2%, Factory calibration + / - 10%
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions
Rated for operation up to 75°C	Can be used in the harshest environments

Accessories

P1004-XX (fig. A), **P1004-XX-X** (fig. B) **Versa-Pot**
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE		MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE
TS22120	24VAC	Fixed	20s	n/a		TS2424	120VAC	External	5 - 600s	n/a
TS2223	24VAC	External	2 - 180s	n/a		TS6116P	12VDC	Fixed	6s	Positive
TS2412	120VAC	Fixed	2s	n/a		TS6122P	12VDC	External	0.5 - 20s	Positive
TS24130	120VAC	Fixed	30s	n/a		TS6123P	12VDC	External	2 - 60s	Positive
TS2421	120VAC	External	0.05 - 3s	n/a		TS6321P	24VDC	External	0.05 - 3s	Positive
TS2422	120VAC	External	0.5 - 60s	n/a		TS6323P	24VDC	External	2 - 180s	Positive
TS2423	120VAC	External	2 - 180s	n/a						

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TS2 / TS6 SERIES

Accessories

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

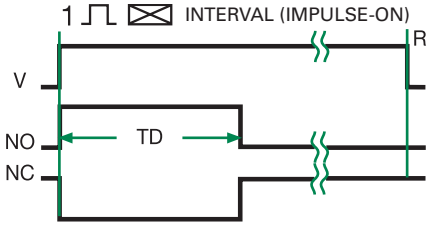
VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

TS6 12VDC			
Time Delay	VTP P/N	Versa-Pot (potentiometer)	
		Fig. A P/N	Fig. B P/N
1 - 0.05-1s	VTP2A	P1004-16	P1004-16-X
2 - 0.5-20s	VTP2E	P1004-16	P1004-16-X
3 - 2-60s	VTP2F	P1004-16	P1004-16-X
4 - 5-120s	VTP2H	P1004-16	P1004-16-X

TS2 & TS6 All Other Voltages			
Time Delay	VTP P/N	Versa-Pot (potentiometer)	
		Fig. A P/N	Fig. B P/N
1 - 0.05-3s	VTP4B	P1004-12	P1004-12-X
2 - 0.5-60s	VTP4F	P1004-12	P1004-12-X
3 - 2-180s	VTP4J	P1004-12	P1004-12-X
4 - 5-600s	VTP5N	P1004-13	P1004-13-X

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Selection Guide

R_T Selection Chart				
Desired Time Delay*				R_T
Seconds				
1	2	3	4	Megohm
0.05	0.5	2	5	0.0
0.5	10	30	60	0.5
1.0	20	60	120	1.0
▼	24VDC or AC ONLY†			▼
1.5	30	90	180	1.5
2.0	40	120	240	2.0
2.5	50	150	300	2.5
3.0	60	180	360	3.0
			420	3.5
			480	4.0
			540	4.5
			600	5.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.
† 1 Megohm max for 12 VDC Units

Specifications

Time Delay

Type	Analog circuitry
Range	
12VDC	0.05 - 120s in 4 adjustable ranges or fixed (1 MΩ max. R_T)
Other Voltages	0.05 - 600s in 4 adjustable ranges or fixed
Repeat Accuracy	±2% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±10%
Time Delay vs Temp. & Voltage	≤ ±10%
Reset Time	≤ 150ms
Input	
Voltage	12 or 24VDC; 24 or20VAC
Tolerance	±15%
DC Ripple	10%
Power Consumption	DC ≤ 1W; AC ≤ 2VA
Output	
Type	Solid state
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Voltage Drop	DC ≅ 1.0V @ 1A; AC ≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Polarity	TS6 is not reverse polarity protected
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

TSD2 SERIES

Interval Timer

Description

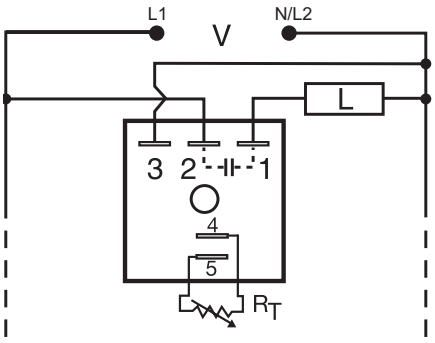
The TSD2 Series is designed for more demanding commercial and industrial applications where small size and accurate performance are required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output is energized during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1%, + / -1% time delay accuracy
Extended temperature range	Rated to 75°C operating temperature to withstand high heat applications.
Compact, low cost design	Allows flexibility for OEM applications
1A Steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TSD2411S	120VAC	Fixed	1s
TSD24145S	120VAC	Fixed	45s
TSD241600S	120VAC	Fixed	600s
TSD2434	120VAC	Onboard	1 - 100m

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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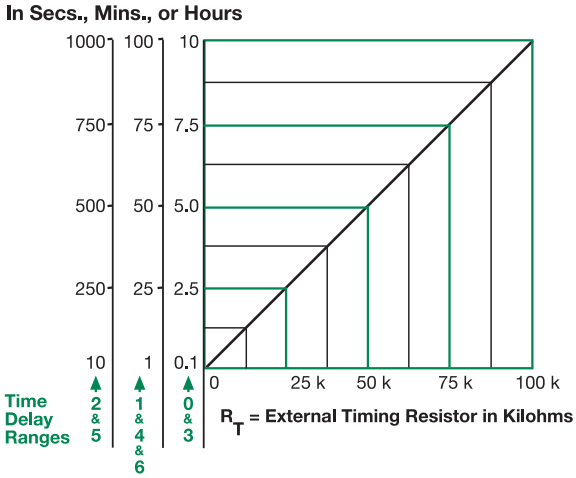
TSD2 SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

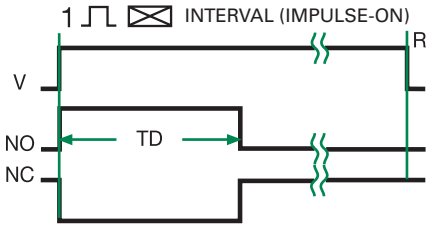
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Range	0.1s - 100h in 7 adjustable ranges or fixed
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Time Delay vs. Temperature & Voltage	≤ ±1%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Off State Leakage Current	≅ 5mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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TSD6 SERIES

Interval Timer

Description

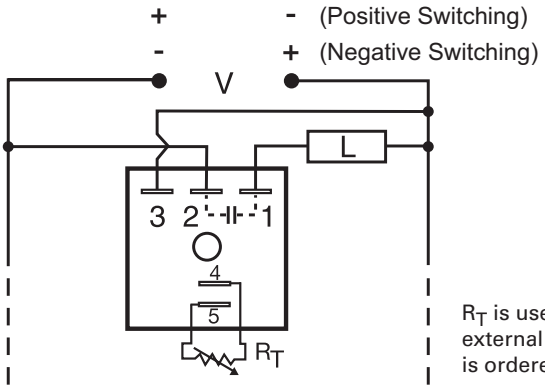
The TSD6 Series offers total solid-state, interval timing for 12 or 24VDC applications. This series provides either negative or positive switching. The TSD6 Series is designed for more demanding commercial and industrial applications where small size and accurate performance is required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD6 Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Interval)

Upon application of input voltage, the time delay begins. The output energizes during the time delay. At the end of the time delay, the output de-energizes and remains de-energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and the output.

Wiring Diagram



R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1%, + / -1% time delay accuracy
Extended temperature range	Rated to 75°C operating temperature to withstand high heat applications.
Compact, low cost design	Allows flexibility for OEM applications
1A Steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	SWITCHING MODE
TSD6113SP	12VDC	Fixed	3s	Positive
TSD61115SP	12VDC	Fixed	15s	Positive
TSD6113SN	12VDC	Fixed	3s	Negative
TSD6310.8SN	24VDC	Fixed	0.8s	Negative
TSD631380SP	24VDC	Fixed	380s	Positive
TSD6320P	24VDC	External	0.1 - 10s	Positive

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

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TSD6 SERIES

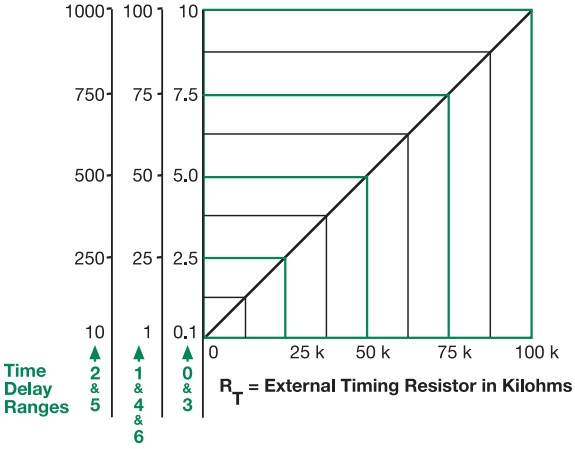
Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

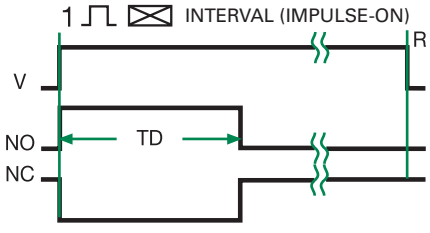
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Range	0.1s - 100h in 7 adjustable ranges or fixed
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Time Delay vs. Temperature & Voltage	≤ ±1%

Input

Voltage	12 or 24VDC
Tolerance	±15%
DC Ripple	±10%
Power Consumption	≤ 1W

Output

Type	Solid state, positive or negative switching
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 60°C
Off State Leakage Current	≅ 1mA
Voltage Drop	≅ 1.0V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	Units are reverse polarity protected
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

TSD7 SERIES

Interval/Delay-on-Break Timer

Description

The TSD7 Series utilizes only two terminals connected in series with the load. Interval timing mode period is achieved by using a small portion of the AC sine wave allowing sufficient voltage for circuit operation. It can be used as an interval timer to control or pulse shape the operation of contactors, solenoids, relays, and lamp loads. The TSD7 Series can be wired to delay on the break of a switch for energy saving fan delays.

Operation (Interval)

Upon application of input voltage, the output energizes and the time delay begins. The output remains energized throughout the time delay. At the end of the time delay, the output de-energizes and remains de-energized until power is removed.

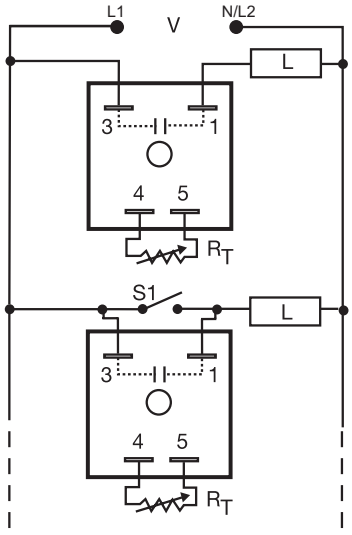
Reset: Removing input voltage resets the time delay and the output.

Operation (Delay-on-Break)

Upon closure of SW1, the load is energized and the timer is reset (zero volts across its input terminals). Opening SW1 re-applies input voltage to the timer, the load remains energized and the time delay begins. At the end of the time delay, the output de-energizes. If SW1 is open when power is applied, the load will energize for the time delay then de-energize.

Reset: Reclosing SW1 resets the timer.

Wiring Diagram



Interval

Delay-on- Break

V = Voltage
L = Load
S1 = Initiate Switch
R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, + / -1% time delay accuracy
Extended temperature range	Rated to 75°C operating temperature to withstand high heat applications
Compact, low cost design	Allows flexibility for OEM applications
1A steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Two terminal series load connections	Provides quick and easy installation for new or existing systems

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TSD7412S	120VAC	Fixed	2s	TSD761120S	230VAC	Fixed	120s
TSD7414M	120VAC	Fixed	4m	TSD761180S	230VAC	Fixed	180s
TSD7421	120VAC	External	1 - 100s	TSD7611S	230VAC	Fixed	1s
TSD7423	120VAC	External	0.1 - 10m	TSD7621	230VAC	External	1 - 100s
TSD7424	120VAC	External	1 - 100m				

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TSD7 SERIES

Accessories

P1004-13, P1004-13-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting Bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

Time Delay	VTP P/N	Time Delay	VTP P/N
1 - 1-100s	VTP5G	**4** - 1-100m	VTP5P
2 - 10-1000s	VTP5K	**5** - 10-1000m	VTP5R
3 - 0.1-10m	VTP5N		

Selection Guide

R_T Selection Chart					
Desired Time Delay*					R_T
Seconds		Minutes			
1	2	3	4	5	Megohm
1	10	0.1	1	10	0.0
10	100	1	10	100	0.5
20	200	2	20	200	1.0
30	300	3	30	300	1.5
40	400	4	40	400	2.0
50	500	5	50	500	2.5
60	600	6	60	600	3.0
70	700	7	70	700	3.5
80	800	8	80	800	4.0
90	900	9	90	900	4.5
100	1000	10	100	1000	5.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Specifications

Time Delay

Type	Digital integrated circuitry
Range	1s - 1000m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±10%
Recycle Time	≤ 400ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid state
Form	NO, closed during timing
Maximum Load Current	1A steady state, 10A inrush at 45°C
Minimum Load Current	40mA
Effective Voltage Drop (VLine-VLoad)	

Input	Effective Drop
24VAC	3V
120VAC	4V
230VAC	6V

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

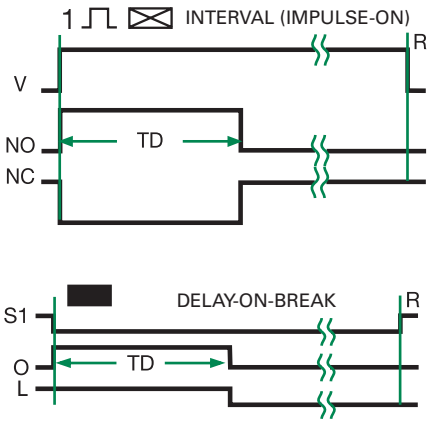
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

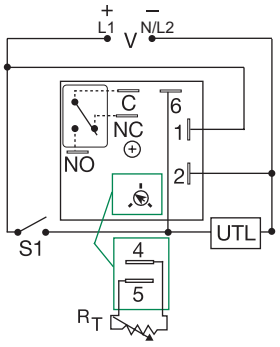
Function Diagrams



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
O = Output
L = Load
TD = Time Delay
R = Reset
⌇⌇ = Undefined Time

KRD9 SERIES

Wiring Diagram



V = Voltage
S1 = Initiate Switch C = Common, Transfer Contact
UTL = Untimed Load (optional)

A knob is supplied for adjustable units, or R_T terminals 4 & 5 for external adjust. See external adjustment vs time delay chart. The untimed load is optional. Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 16.

Description

The KRD9 Series microcontroller timing circuit provides excellent repeat accuracy and stability. Cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Retriggerable Single Shot)

Function Type A (Output Initially De-energized): Input voltage must be applied prior to and during timing. When the initiate switch is closed, (momentary or maintained) the output energizes and the time delay starts. On completion of the delay, the output de-energizes. The unit will time out if S1 remains in the open or closed position for the full time delay. Reclosing the initiate switch resets the time delay and restarts timing; the output remains energized. The output will not energize if the initiate switch is closed when input voltage is applied.

Function Type B (Output Initially Energized): Upon application of input voltage, the output energizes and the time delay starts. At the end of the time delay, the load de-energizes. The unit will time out if S1 remains in the open or closed position for the full time delay. Closing (re-closing) the initiate switch resets the time delay and restarts timing; the output remains energized.

Reset: The time delay and the output are reset when input voltage is removed.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration + / - 5%
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and component costs
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated circuitry	Protects against shock, vibration, and humidity

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TIME DELAY RELAYS

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	FUNCTION TYPE
KRD9120B	12VDC	Onboard	0.1 - 10s	Energized
KRD92115MA	24VAC/DC	Fixed	15m	De-energized
KRD92115MB	24VAC/DC	Fixed	15m	Energized
KRD9220B	24VAC/DC	Onboard	0.1 - 10s	Energized
KRD93115MA	24VDC	Fixed	15m	De-energized
KRD9423B	120VAC	Onboard	0.1 - 10m	Energized

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

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KRD9 SERIES

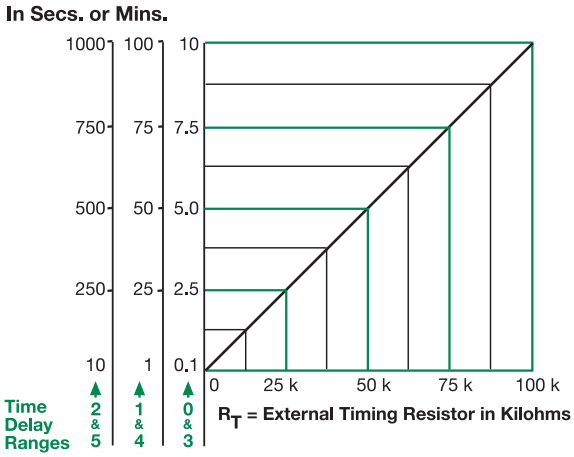
Accessories

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

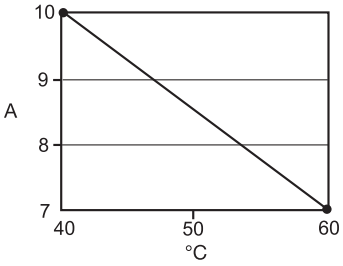


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Output Current/Ambient Temperature



Specifications

Time Delay

Type	Microcontroller based with watchdog circuitry
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Initiate Time	≤ 40ms; ≤ 750 operations per minute
Time Delay vs Temp. & Voltage	≤ ±5%

Input

Voltage	12, 24 or 110VDC; 24, 120 or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - +20%
110VDC, 120 or 230VAC	-20% - +10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7 ; Electrical - 1 x 10^5

Protection

Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reversed polarity protected

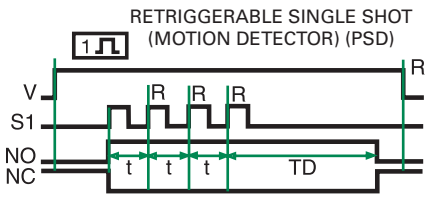
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2.0"); **W** 50.8 mm (2.0"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40°to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

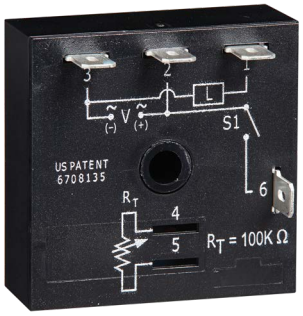
Function Diagram



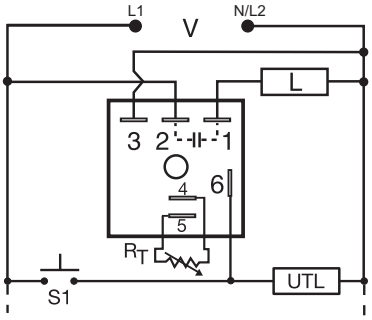
V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
t = Incomplete Time Delay
TD = Time Delay
R = Reset

TSD94110SB

Retriggerable Single-Shot Timer



Wiring Diagram



V = Voltage
L = Timed Load
UTL = Optional Untimed Load
S1 = Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Description

The TSD94110SB retriggerable single-shot timer is designed for a variety of appllcations. Its digital circuit provides long or short delays with accuracy and stability over a wide voltage and temperature range. It is the ideal timer for pulse-train monitoring of programmable controllers, or any system requiring motion detection.

Operation A Type

Power must be applied to input at all times prior to and during timing. Upon closure of initiate switch (momentary or maintained) the load is energized and the time delay is started. On completion of the delay period the load is de-energized. Should the initiate switch be reclosed during timing, the delay will be reset to zero and restarted.

Operation B Type

Upon application of input power, the load is energized and a time delay is started. At the end of the time delay, the load is de-energized. Should the initiate switch be closed or reclosed during timing, the delay is reset to zero and restarted.

Features & Benefits

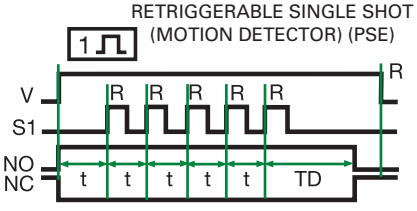
- Excellent Pulse Train Monitor
- Totally Solid State and Encapsulated
- Microcontroller Circuitry
- Fast Reset to Zero During Timing
- Excellent Accuracy and Reliability
- DC Units are Reverse Polarity Protected

Specifications

Time Delay	
Type	Microcontroller circuitry
Range	Factory fixed 10s
Repeat Accuracy	±0.5%
Tolerance (Factory Calibration)	±1%
Recycle Time	300ms max.
Time Delay vs. Temp. & Voltage	±2%
Initiate Timing	16ms max. AC
Input	
Operating Voltage	120 volts AC
Tolerance	±15%
Output	
Type	Solid State
Form	Normally open
Rating	1 ampere steady state, 10 amperes inrush at 55°C
Voltage Drop	AC 2.5 volts typical at 1 ampere
Protection	
Transient	Protected
Dielectric	1500 volts RMS
Insulation Resistance	100 megohms minimum 4.4

Mechanical	
Mounting	Surface mount with one #8 or #10 screw
Termination	0.25 in. (6.35 mm) male quick connect terminals
Package	Molded housing with encapsulated circuitry
Dimensions	**H** 50.80 mm (2.00"); **W** 50.80 mm (2.00"); **D** 30.70 mm (1.21")
Environmental	
Operating/Storage Temperature	-40°C to 60°C / -40°C to 85°C
Humidity	95% relative, non-condensing
Weight	Approx. 2.4 oz (68 g)

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
t = Incomplete Time Delay
TD = Time Delay
R = Reset

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ERD3425A

Description

Econo-Timers are a combination of digital electronics and a reliable electromechanical relay. DPDT relay output for relay logic circuits, and isolation of input to output voltages. Cost effective for OEM applications, such as duty cycling, drying, washing, signaling, and flashing.

Operation (Recycling - ON Time First)

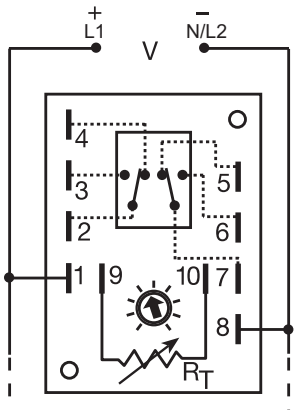
Upon application of input voltage, the output relay energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

Features & Benefits

FEATURES	BENEFITS
Digital integrated circuitry	Repeat Accuracy + / - 0.5%, Factory calibration + / - 10%
Isolated, 10A, DPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Protects against shock, vibration, and humidity

Wiring Diagram



A knob, or terminals 9 &10 are only included on adjustable units.

Relay contacts are isolated.

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 25.

Accessories

P1004-16, P1004-16-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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ERD3425A

Selection Guides

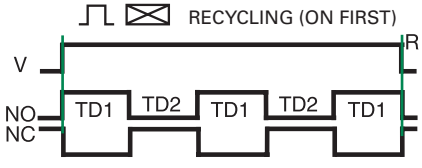
R_T Selection Chart						
Desired Time Delay* Seconds						R_T
1	2	3	4	5	6	Megohm
0.1	0.1	0.1	0.2	0.3	0.6	0.0
0.19	0.6	1	1.7	3	6	0.1
0.28	1.1	2	3.2	6	12	0.2
0.37	1.6	3	4.7	9	18	0.3
0.46	2.1	4	6.2	12	24	0.4
0.55	2.6	5	7.7	15	30	0.5
0.64	3.0	6	9.2	18	36	0.6
0.73	3.5	7	10.7	21	42	0.7
0.82	4.0	8	12.2	24	48	0.8
0.91	4.5	9	13.7	27	54	0.9
1.0	5.0	10	15	30	60	1.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

R_T Selection Chart					
Desired Time Delay* Minutes					R_T
7	8	9	10	11	Megohm
0.1	0.1	0.2	1	10	0.0
0.6	1	1.7	10	50	0.1
1.1	2	3.2	20	100	0.2
1.6	3	4.7	30	150	0.3
2.1	4	6.2	40	200	0.4
2.6	5	7.7	50	250	0.5
3.0	6	9.2	60	300	0.6
3.5	7	10.7	70	350	0.7
4.0	8	12.2	80	400	0.8
4.5	9	13.7	90	450	0.9
5.0	10	15	100	500	1.0

* When selecting an external R_T add at least 20% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Specifications

Time Delay

Type	Digital integrated circuitry
Range	0.1s - 500m in 11 adjustable ranges 0.1s - 1000m fixed
Adjustment	Knob, external adjust, or fixed
Repeat Accuracy	±0.5%
Tolerance (Factory Calibration)	≤ ±10%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	12, 24, or 120VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
120VAC/DC & 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz

Output

Type	Isolated relay contacts
Form	DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6

Protection

Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with two #6 (M3.5 x 0.6) screws
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 43.2 mm (1.7")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 65°C / -40° to 85°C
Weight	≅ 5.7 oz (162 g)

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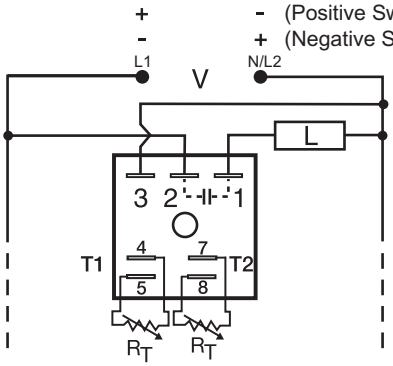
ESDR SERIES

Wiring Diagram



V = Voltage
L = Load
T1 = ON Time
T2 = OFF Time

R_T is used when external adjustment is ordered. A knob is supplied for adjustment on the unit; terminals for external adjustment.

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Description

The ESDR Series offers independent time adjustment of both delay periods. Adjustment options include fixed, onboard or external adjust. The ESDR is recommended for air drying, automatic oiling, life testing, chemical metering and automatic duty cycling. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is <±5%. The repeat accuracy, under stable conditions, is 0.1% of the selected time delay. This series is designed for input voltages of 12VDC to 230VAC in five ranges. Time delays of 0.1 seconds to 1000 minutes are available in six ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2, OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / -0.1%, Factory calibration + / - 5%
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
ON/OFF recycling with independent adjustment of both time periods	Separate on and off timing settings are knob adjustable for added flexibility
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications

Ordering Information

See next page.

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ESDR SERIES

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	T1 ON TIME	FIRST DELAY	T2 OFF TIME	SWITCHING MODE
ESDR120A0P	12VDC	Onboard	0.1 - 10s	On time	0.1 - 10s	Positive
ESDR120B3P	12VDC	Onboard	0.1 - 10s	Off time	0.1 - 10m	Positive
ESDR123B4P	12VDC	Onboard	0.1 - 10m	Off time	1 - 100m	Positive
ESDR125A5P	12VDC	Onboard	10 - 1000m	On time	10 - 1000m	Positive
ESDR221A2	24VAC	Onboard	1 - 100s	On time	10 - 1000s	n/a
ESDR320A0P	24VDC	Onboard	0.1 - 10s	On time	0.1 - 10s	Postitive
ESDR320A3P	24VDC	Onboard	0.1 - 10s	On time	0.1 - 10m	Positive
ESDR420A0	120VAC	Onboard	0.1 - 10s	On time	0.1 - 10s	n/a
ESDR420A1	120VAC	Onboard	0.1 - 10s	On time	1 - 100s	n/a
ESDR420A4	120VAC	Onboard	0.1 - 10s	On time	1 - 100m	n/a
ESDR420B1	120VAC	Onboard	0.1 - 10s	Off time	1 - 100s	n/a
ESDR420B4	120VAC	Onboard	0.1 - 10s	Off time	1 - 100m	n/a
ESDR421A1	120VAC	Onboard	1 - 100s	On time	1 - 100s	n/a
ESDR421A4	120VAC	Onboard	1 - 100s	On time	1 - 100m	n/a
ESDR423A3	120VAC	Onboard	0.1 - 10m	On time	0.1 - 10m	n/a
ESDR423A4	120VAC	Onboard	0.1 - 10m	On time	1 - 100m	n/a
ESDR424A1	120VAC	Onboard	1 - 100m	On time	1 - 100s	n/a
ESDR450A1	120VAC	External	0.1 - 10s	On time	1 - 100s	n/a

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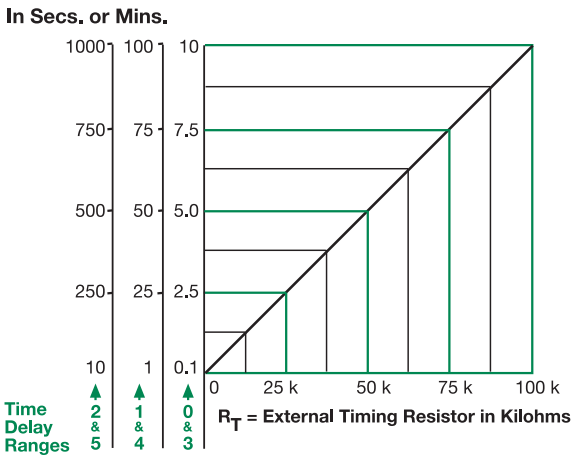
External Resistance vs. Time Delay

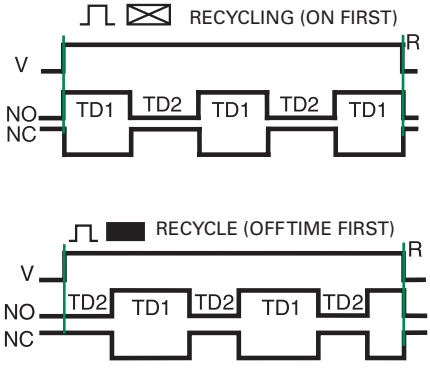


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagrams



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

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TIME DELAY RELAYS

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ESDR SERIES

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ± 5%
Time Delay vs Temp. & Voltage	≤ ±2%
Reset Time	≤ 150ms

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	±20%
Power Consumption	AC ≤ 2VA; DC ≤ 1W
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%

Output

Type	Solid state
Maximum Load Current	1A steady state , 10A inrush at 60°C
OFF State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1mA
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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HRDR SERIES

Recycling Timer

Description

The HRDR Series combines an electromechanical relay and microcontroller timing circuitry. It offers 12 to 230V operation in five ranges and factory fixed, onboard or externally adjustable time delays with a repeat accuracy of ±0.5%. The high switching capacity of the output contacts allow for direct control of heavy loads like compressors, pumps, motors, heaters and lighting. A bypass/reset switch option allows operator to interrupt normal recycling sequence and energize output relay. An excellent choice for OEM applications.

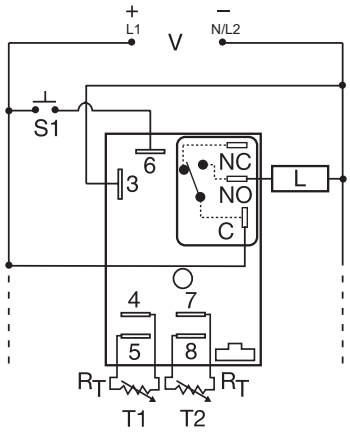
Operation (Recycling with Reset Switch)

Upon application of input voltage, the ON time T1 begins and output relay energizes. At the end of the ON time, the output relay de-energizes and the OFF time T2 begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied. Some recycling timers have the OFF time as the first delay.

Reset: Removing input voltage resets output and time delays, and returns sequence to the first delay.

Bypass/Reset Switch: Closing the normally open bypass/reset switch energizes the output relay and resets the time delays. Opening the switch restarts recycling operation with the first delay.

Wiring Diagram



NO = Normally Open
S1 = Reset Switch
C = Common, Transfer Contact
L = Load

Terminals 4 & 5 and/or 7 & 8 are only included on externally adjustable units. Relay contacts are non-isolated. R_T is included when external adjustment is ordered. Terminal 6 is included when Bypass/Reset is selected.

For dimensional drawing see: Appendix, page 512, Figure 17.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact, low cost design	Allows flexibility for OEM applications
Isolated, 30A, SPDT, NO output contacts	Allows direct operation of heavy loads: compressors, pumps, blower moters, heaters.
Encapsulated	Protects against shock, vibration, and humidity
Independent adjustment of On and Off delays	Provides greater flexibility of timing options
Bypass/Reset switch option	Allows operator to interrupt the timing sequence and energize the output relay

Ordering Information

MODEL	INPUT VOLTAGE	EXTERNAL ADJUSTMENT	T1 ON TIME	OPERATING SEQUENCE	T2 OFF TIME	BYPASS / RESET OPTION
HRDR121A4R	12VDC	Both time onboard adj	1 - 100s	On time first	1 - 100m	Yes
HRDR321A4R	24VDC	Both time onboard adj	1 - 100s	On time first	1 - 100m	Yes
HRDR322B2R	24VDC	Both time onboard adj	10 - 1000S	Off time first	10 - 1000S	Yes
HRDR330A0R	24VDC	Both time external adj	0.1 - 10s	On time first	0.1 - 10s	Yes
HRDR331A1	24VDC	Both time external adj	1 - 100s	On time first	1 - 100s	No
HRDR411SB30MR	120VAC	Both times fixed	1s	Off time first	30m	Yes
HRDR431A1R	120VAC	Both times external adj	0.1 - 100s	On time first	0.1 - 100s	Yes

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HRDR SERIES

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

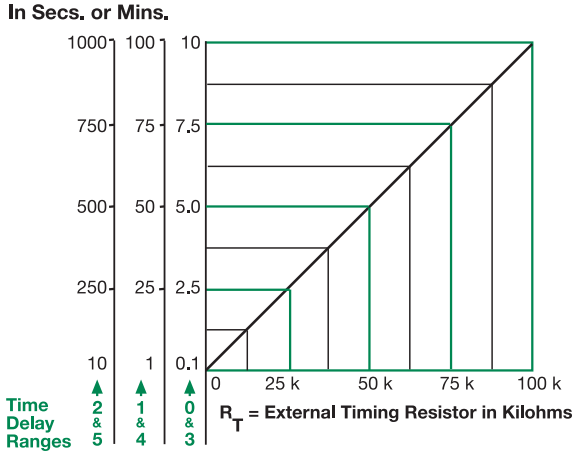
P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Specifications

Time Delay

Range	100ms - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	±5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC	-15% - 20%
24 to 230VAC	-20% - 10%
AC Line Frequency	50/60 Hz
Power Consumption	AC ≤ 4VA; DC ≤ 2W

Output

Type		Electromechanical relay	
Form		SPDT, non-isolated	
Ratings		**SPDT-NO**	**SPDT-NC**
General Purpose	**125/240VAC**	30A	15A
Resistive	**125/240VAC**	30A	15A
	28VDC	20A	10A
Motor Load	**125VAC**	1 hp*	1/4 hp**
	240VAC	2 hp**	1 hp**
Life		Mechanical - 1 x 10^6; Electrical - 1 x 10^5, *3 x 10^4, **6,000	

Protection

Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

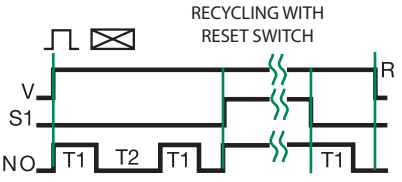
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 51.3 mm (2"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative non-condensing
Weight	≅ 3.9 oz (111 g)

Function Diagram



S1 = Reset Switch

KRD3 SERIES

Description

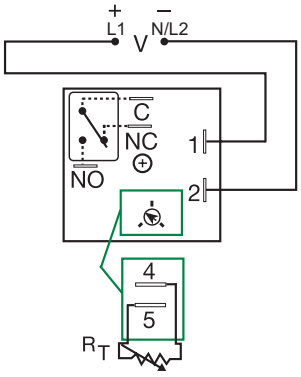
The KRD3 Series measures only 2 in. (50.8 mm) square.Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRD3 Series is a cost effective approach for OEM applications that require small size, isolation, reliability, and long life.

Operation (Recycling Flasher - ON Time First)

Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to T1 ON time.

Wiring Diagram



V = Voltage
C = Common, Transfer Contact
NO = Normally Open
NC = Normally Closed

A knob is supplied for adjustable units, or R_T terminals 4 & 5 for external adjust. See external adjustment vs time delay chart.

Relay contacts are isolated.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Compact, low cost design measuring 2 in. (50.8mm) square	Provides greater flexibility for OEM applications and reduces component and labor costs
Microcontroller based	Repeat Accuracy + / -0.5%, Factory calibration + / - 5%
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Protects against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OPERATING SEQUENCE
KRD3420A	120VAC	Onboard knob	0.1 - 10s	On time first
KRD3421A	120VAC	Onboard knob	1 - 100s	On time first
KRD3434A	120VAC	External	1 - 100m	On time first

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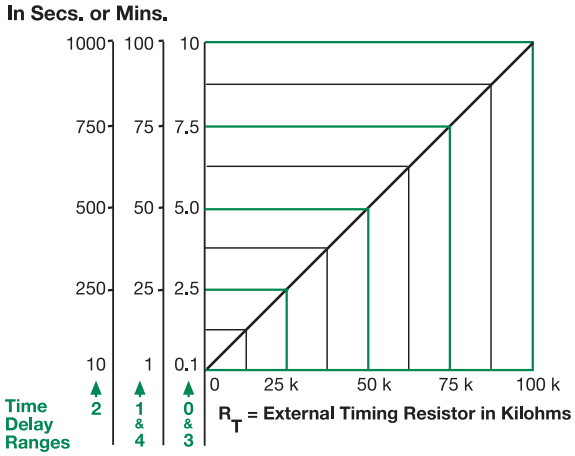
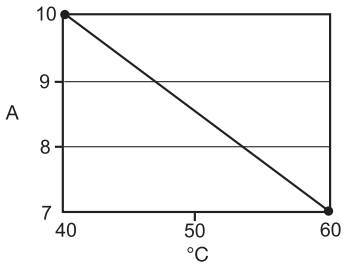
KRD3 SERIES

External Resistance vs. Time Delay

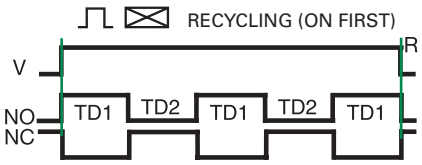


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Output Current/Ambient Temperature



Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Specifications

Time Delay

Range	0.1s - 100m in 5 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ± 5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±5%

Input

Voltage	12, 24 or 110VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
110VDC, 120 or 230VAC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

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KRDR SERIES

Description

The KRDR Series is a compact time-delay relay measuring only 2 in. (50.8 mm) square. Its solid-state timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRDR Series is a cost effective recycling timer for OEM applications that require small size, isolation, reliability, and long life.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output relay energizes and the T2 ON time begins. At the end of the ON time, the output de-energizes and the T1 OFF time begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied

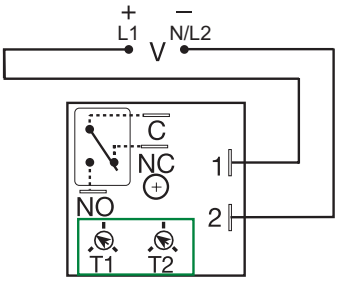
Reset: Removing input voltage resets the output and the time delays, and returns the sequence to the ON time.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the T1 OFF time begins. At the end of the OFF time, the T2 ON time begins and the load energizes. At the end of the ON time the load de-energizes, and the cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to the OFF time.

Wiring Diagram



V = Voltage
C = Common
NO = Normally Open
NC = Normally Closed
T1 = OFF Time
T2 = ON Time

A knob is supplied for adjustable units.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Compact design and independent adjustment of ON and OFF times	Provides greater flexibility for OEM applications and reduces component and labor costs
Microcontroller based	Repeat Accuracy + / - 0.5%, Factory calibration + / - 5%
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Protects against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLT.	ADJUST.	T2 ON TIME	FIRST DELAY	T1 OFF TIME
KRDR115MB25M	12VDC	Fixed	5m	Off time	25m
KRDR120A0	12VDC	Adjustable	0.1 - 10s	On time	0.1 - 10s
KRDR121A1	12VDC	Adjustable	1 - 100s	On time	1 - 100s
KRDR320B0	24VDC	Adjustable	0.1 - 10s	Off time	0.1 - 10s
KRDR321A4	24VDC	Adjustable	1 - 100s	On time	1 - 100m
KRDR321B4	24VDC	Adjustable	1 - 100s	Off time	1 - 100m
KRDR420A3	120VAC	Adjustable	0.1 - 10s	On time	0.1 - 10m
KRDR421A4	120VAC	Adjustable	1 - 100s	On time	1 - 100m
KRDR424A0	120VAC	Adjustable	1 - 100m	On time	0.1 - 10s
KRDR424A4	120VAC	Adjustable	1 - 100m	On time	1 - 100m
KRDR440.5SA0	120VAC	On time fixed	0.5s	On time	0.1 - 10s

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Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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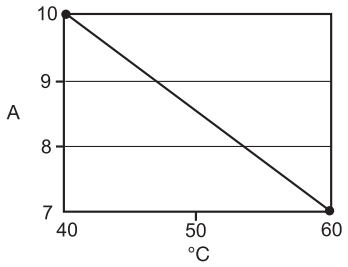
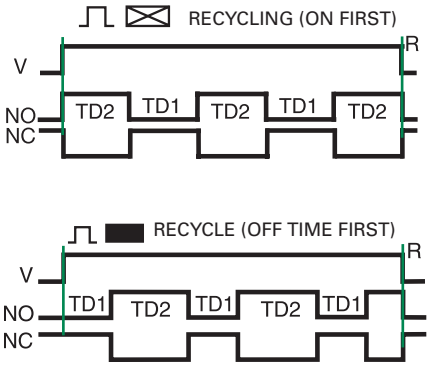
KRDR SERIES

Output Current/Ambient Temperature



Function Diagrams



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
T1 = OFF Time
T2 = ON Time
R = Reset

Specifications

Time Delay	
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5 % or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±5%
Input	
Voltage	12, 24 or 110VDC; 24, 120 or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
110VDC & 120 or 230VAC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W
Output	
Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC; 5A resistive @ 230VAC & 28VDC; 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5
Protection	
Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

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KSD3 SERIES

Recycling Flasher

Description

The KSD3 Series Digi-Timer is a cost effective approach for ON/OFF recycling applications. The on time is equal to the off time. An adjustment of the R_T will change the time delays of both on and off times. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is within 5% of the target time delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for popular AC and DC voltages. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Recycling Flasher - ON Time First)

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

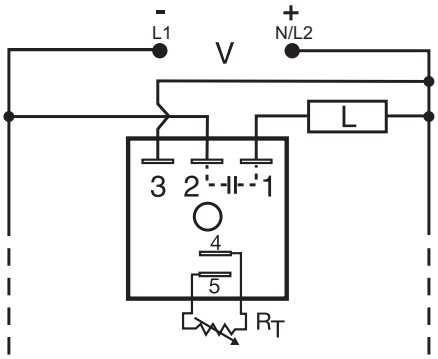
Reset: Removing input voltage resets the output and time delays, and returns the sequence to the ON time.

Operation (Recycling Flasher - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of the ON time the load de-energizes, and the cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and time delays and the sequence to the OFF time.

Wiring Diagram



V = Voltage
L = Load
R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%, + / -5% time delay accuracy
Compact, low cost design	Allows flexibility for OEM applications
1A Steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY	OPERATING SEQUENCE
KSD3120A	12VDC	External	0.1 - 10s	ON time first
KSD3310.1SA	24VDC	Fixed	0.1s	ON time first
KSD3415MA	120VAC	Fixed	5m	ON time first
KSD3432A	120VAC	Onboard	10 - 1000s	ON time first

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Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

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KSD3 SERIES

Accessories

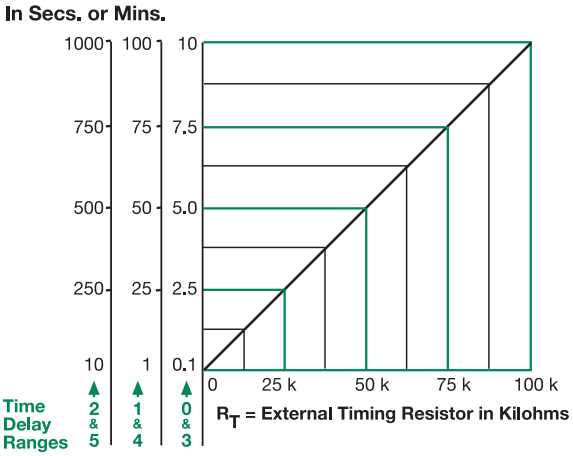
P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ± 5%
Reset Time	≤ 150ms
Time Delay vs. Temperature & Voltage	≤ ±10%

Input

Voltage	24 or 120VAC; 12 or 24VDC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid state
Maximum Load Current	1A steady state, 10A inrush at 60°C
OFF State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1mA
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
DC Operation	Negative switching only

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

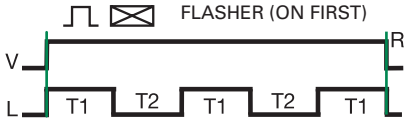
Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

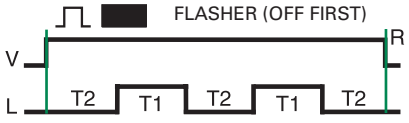
Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

Function Diagrams



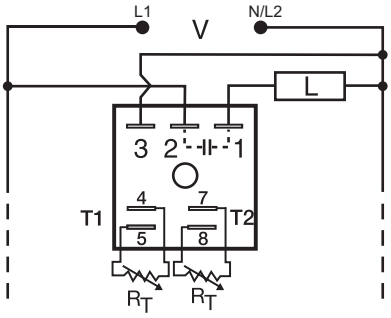
ON time plus OFF time equals one complete flash.



V = Voltage
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2
R = Reset

KSDR SERIES

Wiring Diagram



V = Voltage
L = Load

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Description

The KSDR Series offers independent time adjustment of both delay periods. The KSDR Series is recommended for air drying, automatic oiling, life testing, chemical metering, and automatic duty cycling. This series is designed for general purpose commercial and industrial applications where a small, cost effective, reliable, solid-state timer is required. The factory calibration for fixed time delays is within ± 5% of the target delay. The repeat accuracy, under stable conditions, is 0.5% of the selected time delay. This series is designed for input voltages of 24, 120 or 230VAC. Time delays of 0.1 seconds to 1000 minutes are available in 6 ranges. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2, OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to T1 ON time.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2 OFF time.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / -0.5%, Factory calibration + / - 5%
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Wide operating temperature range: -40° to 75°C	Reliable in demanding commercial and industrial applications
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications

Ordering Information

MODEL	INPUT VOLTAGE	T1 ON TIME	FIRST DELAY	T2 OFF TIME
KSDR40A0	120VAC	0.1 - 10s	On time	0.1 - 10s
KSDR42A4	120VAC	10 - 1000s	On time	1 - 100m

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KSDR SERIES

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

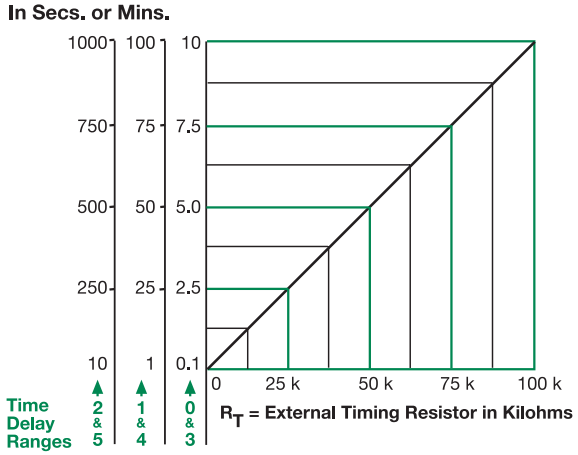
P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

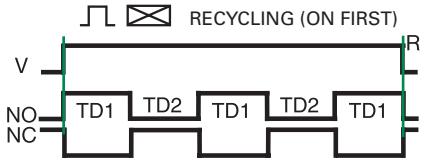


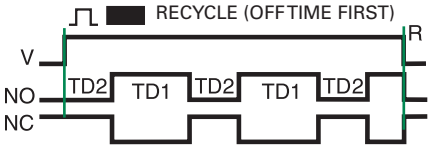
This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagrams





V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Specifications

Time Delay	
Range	0.1s - 1000m in 6 ranges
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±10%
Input	
Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA
Output	
Type	Solid state
Rating	1A steady state, 10A inrush at 60°C
Voltage Drop	≅ 2.5V @ 1A
OFF State Leakage Current	≅ 5mA @ 230VAC
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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KSPD SERIES

Solid State Timer

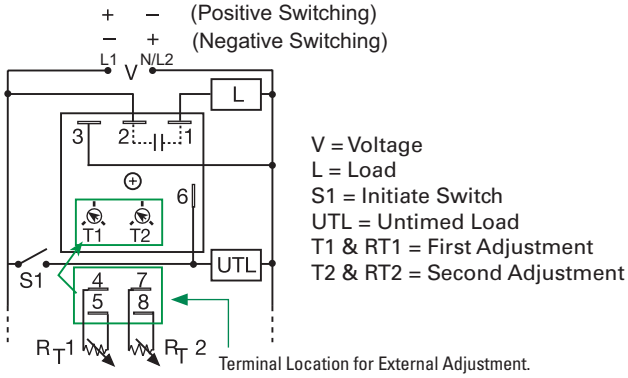
Description

The KSPD Series is a factory programmed module available with 1 of 12 standard dual functions. The time delays can be factory fixed, externally or onboard adjustable, or a combination of fixed and adjustable. The 1A steady, 10A inrush rated solid-state output provides 100 million operations, typical. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KSPD Series is a cost effective approach for OEM applications that require small size and long life.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact design	Allows flexibility for OEM applications
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Wiring Diagram



For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT	ADJUSTMENT 1	TIME DELAY 1	ADJUSTMENT 2	TIME DELAY 2	FUNCTION
KSPDA2222RXE	24 to 240VAC	Onboard	1-100s	Onboard	1-100s	Recycling/On Time First
KSPDP110M18SRXE	12 to 120VDC positive switching	Fixed	10 mins	Fixed	8s	Recycling/On Time First

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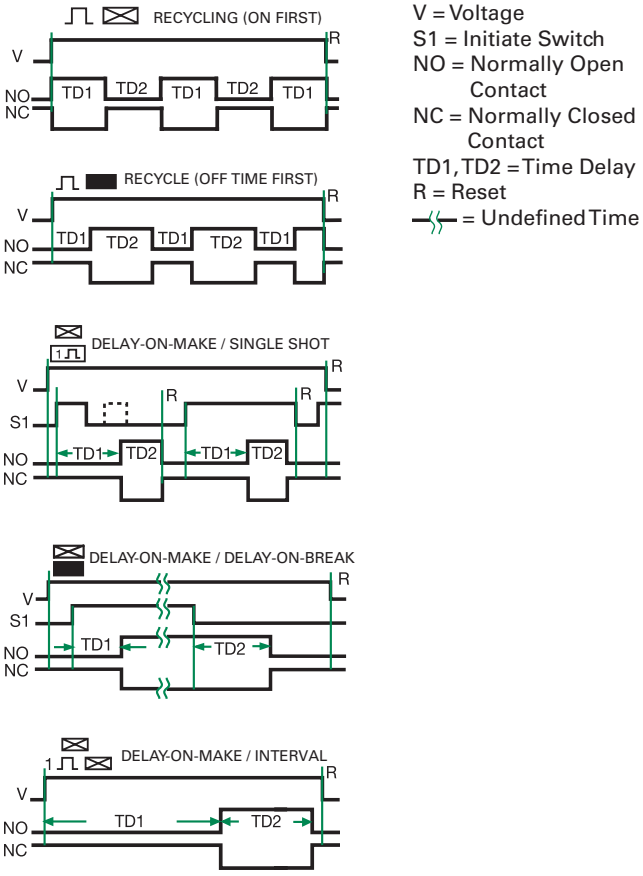
KSPD SERIES

Function Diagrams



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset
⟋⟋ = Undefined Time

Specifications

Time Delay

Type	Microcontroller circuitry
Range	0.1s - 1000h in 9 adjustable ranges or fixed (to 999)
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±2%
Reset Time	≤ 150ms
Initiate Time	≤ 20ms; ≤ 1500 operations per minute
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	12 to 120VDC; 24 to 240VAC
Tolerance	≤ ±15%
AC Line Frequency/DC Ripple	50/60Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid-state output
Rating	1A steady, 10A inrush for 16ms
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A
OFF State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1mA

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V rms terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mt. with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connects

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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RS SERIES

Description

The RS Series is a solid-state, encapsulated, recycling timer designed for tough industrial environments. It is used by many testing labs as a life cycle tester; by others as a cycle controller. The RS Series has separate DIP switch adjustments for the on delay and the off delay. These make accurate adjustment possible the first time, every time. Time delays of 0.1 seconds to 1023 hours are available in 4 ranges.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

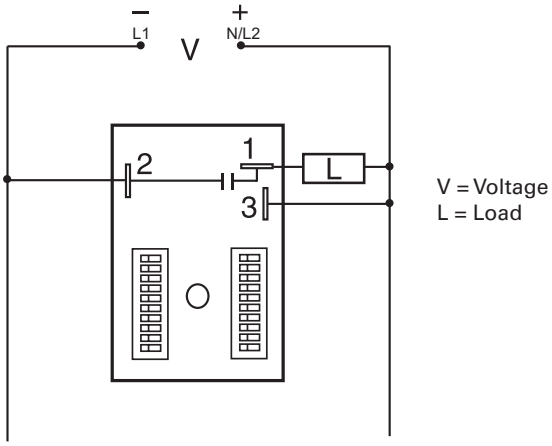
Reset: Removing input voltage resets the output and time delays, and returns the sequence to the ON time.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the OFF time.

Wiring Diagram



V = Voltage
L = Load

For dimensional drawing see: Appendix, page 512, Figure 17.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / -0.1%, Setting accuracy + / - 2%
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
ON and OFF time delay settings	Independent adjustment provides greater timing flexibility
DIP switch adjustment	Provides first time setting accuracy

Ordering Information

MODEL	INPUT VOLTAGE	FIRST DELAY	T1 ON TIME	T2 OFF TIME	MODEL	INPUT VOLTAGE	FIRST DELAY	T1 ON TIME	T2 OFF TIME
RS1A11	12VDC	On time	0.1 - 102.3s in 0.1s increments	0.1 - 102.3s in 0.1s increments	RS4A22	120VAC	On time	0.1 - 102.3m in 0.1m increments	0.1 - 102.3m in 0.1m increments
RS2B44	24VAC	Off time	1 - 1023h in 1h increments	1 - 1023h in 1h increments	RS4A24	120VAC	On time	0.1 - 102.3m in 0.1m increments	1 - 1023h in 1h increments
RS4A11	120VAC	On time	0.1 - 102.3s in 0.1s increments	0.1 - 102.3s in 0.1s increments	RS4A33	120VAC	On time	1 - 1023m in 1m increments	1 - 1023m in 1m increments
RS4A12	120VAC	On time	0.1 - 102.3s in 0.1s increments	0.1 - 102.3m in 0.1m increments	RS4B12	120VAC	Off time	0.1 - 102.3s in 0.1s increments	0.1 - 102.3m in 0.1m increments
RS4A13	120VAC	On time	0.1 - 102.3s in 0.1s increments	1 - 1023m in 1m increments	RS6A13	230VAC	On time	0.1 - 102.3s in 0.1s increments	1 - 1023m in 1m increments

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RS SERIES

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

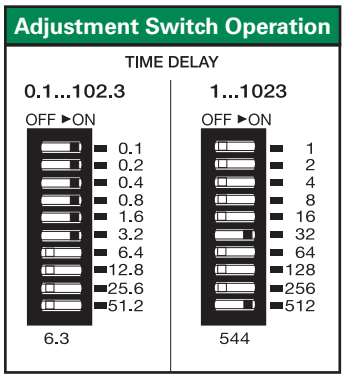
P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

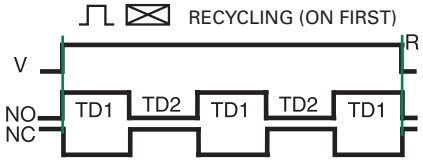
C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

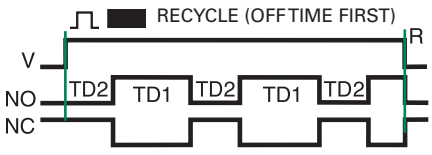
P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Adjustment Switch Operation



Function Diagrams





V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Specifications

Time Delay

Range*	0.1 - 102.3s in 0.1s increments 0.1 - 102.3m in 0.1m increments 1 - 1023m in 1m increments 1 - 1023h in 1h increments
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Setting Accuracy	≤ ±2% or 20ms, whichever is greater
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ± 2%

Input

Voltage	12, or 24VDC; 24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ ±10%
Power Consumption	AC ≤ 2VA; DC ≤ 1W

Output

Type	Solid state
Maximum Load Current	1A steady state, 10A inrush at 60°C
OFF State Leakage Current	AC ≅ 5mA @ 230VAC; DC ≅ 1mA
Voltage Drop	AC ≅ 2.5V @ 1A; DC ≅ 1V @ 1A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 50.8 mm (2"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

TDR SERIES

Relay Output, Recycling Time Delay Relay

8-PIN

Description

The TDR Series of time-delay relays are comprised of digital circuitry and an isolated, 10A relay output. The ON and OFF delays are selected by means of two, ten position binary switches, which allow the setting of the desired delay to be precise every time.

Operation (Recycling - ON Time First)

Upon application of input voltage, the green LED glows, the output relay is energized, the red LED glows, and the T1 ON time begins. At the end of the ON time, the output de-energizes, the red LED turns OFF and the T2, OFF time begins. At the end of the OFF time, the output relay energizes and the cycle repeats as long as input voltage is applied.

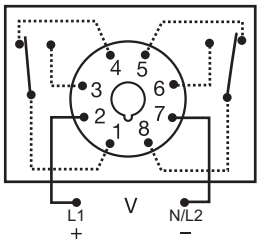
Reset: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the green LED glows, the T1 OFF time begins, the load is OFF. At the end of the OFF time, the T2 ON time begins, the load energizes, and the red LED glows. At the end of the ON time the load de-energizes and the red LED turns OFF. The cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to the OFF time.

Wiring Diagram



Relay contacts are isolated

For dimensional drawing see: Appendix, page 512, Figure 23.

Features & Benefits

FEATURES	BENEFITS
ON & OFF time delay settings	Independent adjustment allows for greater flexibility
3 Time Ranges Available (0.1s to 2.8h)	Makes it versatile for use in many applications
Microcontroller based	Repeat Accuracy + / - 0.1% or 20 ms, whichever is greater; Setting Accuracy + / - 2% or 50 ms, whichever is greater
DIP switch adjustment	Provides first time setting accuracy
Isolated output contacts	Allows control of loads for AC or DC voltages
LED indication (select models)	Provides visual indication of relay status

Ordering Information

MODEL	INPUT VOLTAGE	LED	SEQUENCE	ON TIME (SEC)	OFF TIME (SEC)
TDR1A22	12VDC		ON time first	1-1023 in 1s increments	1-1023 in 1s increments
TDR2A23	24VAC	X	ON time first	1-1023 in 1s increments	10-10230 in 10s increments
TDR4A11	120VAC	X	ON time first	0.1-102.3 in 0.1s increments	0.1-102.3 in 0.1s increments
TDR4A12	120VAC	X	ON time first	0.1-102.3 in 0.1s increments	1-1023 in 1s increments
TDR4A13	120VAC	X	ON time first	0.1-102.3 in 0.1s increments	10-10230 in 10s increments
TDR4A22	120VAC	X	ON time first	1-1023 in 1s increments	1-1023 in 1s increments
TDR4A23	120VAC	X	ON time first	1-1023 in 1s increments	10-10230 in 10s increments
TDR4A33	120VAC	X	ON time first	10-10230 in 10s increments	10-10230 in 10s increments
TDR4B22	120VAC	X	OFF time first	1-1023 in 1s increments	1-1023 in 1s increments
TDR4B23	120VAC	X	OFF time first	1-1023 in 1s increments	10-10230 in 10s increments
TDR6A22	230VAC	X	ON time first	1-1023 in 1s increments	1-1023 in 1s increments

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TDR SERIES

Accessories

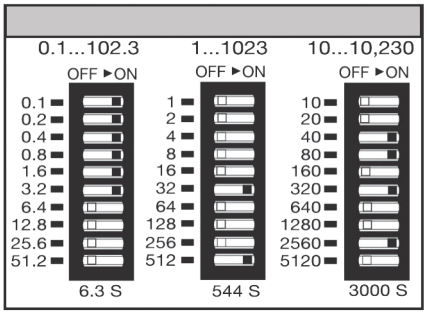
BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Rated at 10A @ 300VAC. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

PSC8 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use with NDS-8 Octal Socket. Sold in pairs.

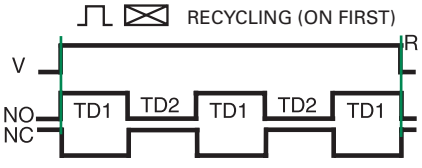
C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

Binary Switch Operation



** For CE approved applications, power must be removed from the unit when a switch position is changed.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Specifications

Time Delay

Type	Digital integrated circuitry
Range**	0.1 - 102.3s in 0.1s increments 1 - 1023s in 1s increments 10 - 10,230s in 10s increments
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Setting Accuracy	±2% or 50ms, whichever is greater
Reset Time	≤ 50ms
Recycle Time	≤ 150ms
Time Delay vs Temp. & Voltage	±5%

Input

Voltage	12, 24/28, or 110VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
110 to 230VAC/DC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz/<=10%
Power Consumption	≤ 3.25W
Input LED Indicator	Green; on when input voltage is applied

Output

Type	Electromechanical relay
Form	DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life	Mechanical - 1 x 10^7; Electrical - 1 x 10^6
Max. Switching Voltage	250VAC
Relay LED Indicator	Red; ON when output relay energizes

Protection

Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units reverse polarity protected

Mechanical

Mounting	Plug-in socket
Dimensions	**H** 81.3 mm (3.2"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")
Termination	Octal 8-pin plug-in

Environmental

Operating/Storage Temperature	-20° to 65°C/-30° to 85°C
Weight	≅ 6 oz (170 g)

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THD3C42A0

Description

The THD3C42A0 combines accurate timing circuitry with high power, solid-state switching. It can switch motors, lamps, and heaters directly without a contactor. The THD3C42A0 has equal on and off time delays. A single R_T sets both time delays. You can reduce labor, component cost, and increase reliability with these small, easy-to-use, Digi-Power timers.

Operation (Recycling Flasher - ON Time First)

Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

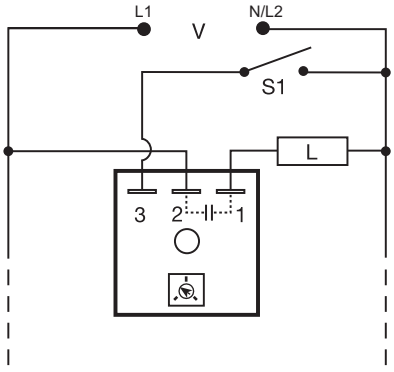
Reset: Removing input voltage resets the output and time delays, and returns the sequence to T1 ON time.

Operation (Recycling Flasher - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2 OFF time.

Wiring Diagram



V = Voltage
L = Load
S1 = Optional Low Current Initiate Switch

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / -0.5%, Factory calibration + / - 1%
Compact, low cost design	Allows flexibility for OEM applications and reduces labor and component costs
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps, and heaters without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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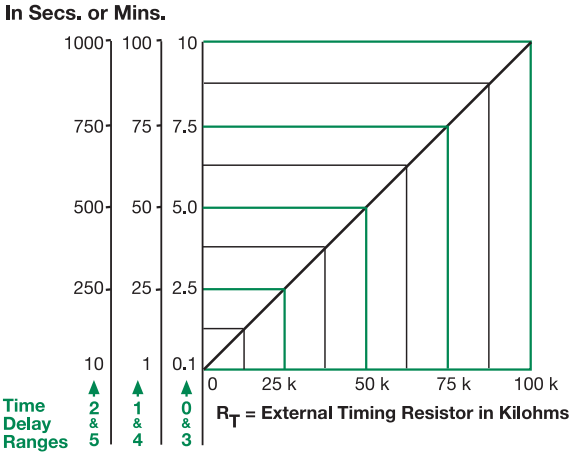
THD3C42A0

External Resistance vs. Time Delay

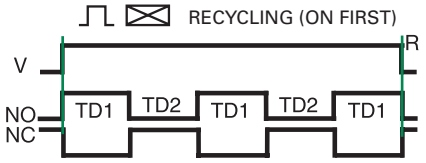


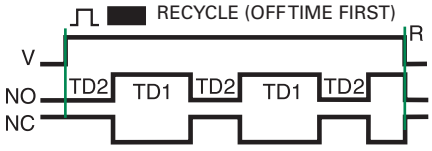
This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagrams





V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Specifications

Time Delay

Range	0.1s - 1000m in 6 adjustable ranges or fixed
Adjustment	Single variable resistor changes both the on & off times equally
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state
Maximum Load Current	**Steady State** 20A **Inrush**** 200A
Minimum Load Current	100mA
Voltage Drop	≅ 2.5V at rated current
OFF State Leakage Current	≅ 5mA @ 230VAC

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting **	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

**Must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

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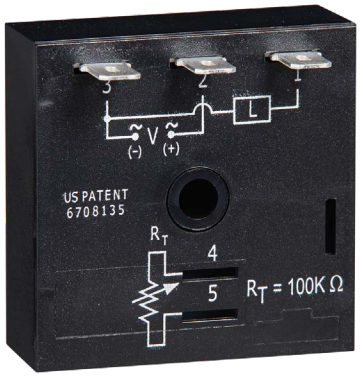
TSD3411S

Recycling Timer



Description

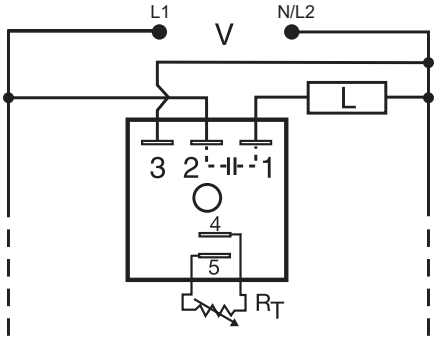
The TSD3411S is a solid-state ON/OFF recycling timer with the on time always equal to the off time. When time delay is changed by the R_T, both the ON and the OFF periods are changed. The TSD Series is designed for more demanding commercial and industrial applications where small size, and accurate performance is required. The factory calibration for fixed time delays is within 1% of the target time delay. The repeat accuracy, under stable conditions, is 0.1% of the time delay. The TSD3411S is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 100 hours are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Recycling Flasher - ON Time First)

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the T1 ON time.

Wiring Diagram



R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.1%, + / -1% time delay accuracy
Extended temperature range	Rated to 75°C operating temperature to withstand high heat applications.
Compact, low cost design	Allows flexibility for OEM applications
1A Steady solid-state output, 10A inrush	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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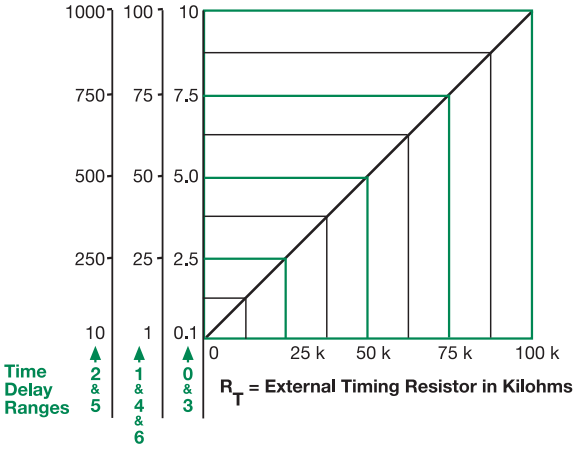
TSD3411S

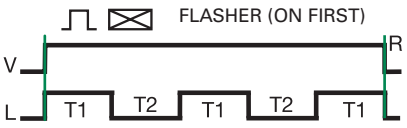
External Resistance vs. Time Delay

In Secs., Mins., or Hours



This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the RT terminals; as the resistance increases the time delay increases.
When selecting an external RT, add the tolerances of the timer and the RT for the full time range adjustment.
Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohm RT. For 1 to 100 S use a 100 K ohm RT.

Function Diagram



V = Voltage
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2
R = Reset

ON time plus OFF time equals one complete flash.

Specifications

Time Delay	
Range	0.1s - 100h in 7 adjustable ranges
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±1%
Reset Time	≤ 150ms
Time Delay vs. Temperature & Voltage	≤ ±1%
Input	
Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA
Output	
Type	Solid state
Maximum Load Current	1A steady state, 10A inrush at 60°C
Off State Leakage Current	≅ 5mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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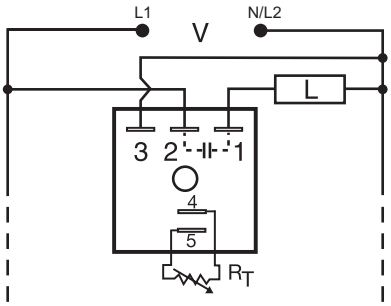
TSDR SERIES

Wiring Diagram



V = Voltage
L = Load

R_T is used when external adjustment is ordered. An onboard adjustment, or terminals 4 & 5 are only included on adjustable units.

For dimensional drawing see: Appendix, page 512, Figure 16.

Description

The TSDR Series is an ON/OFF or OFF/ON recycling timing module designed to control metering pumps, chemical valves, flash lamps, or use in energy saving or duty cycling applications. The TSDR Series is designed for more demanding commercial and industrial applications where small size and accurate performance are required. The factory calibration for fixed time delays is < ±5%. The repeat accuracy, under stable conditions, is 0.5% of the time delay. The TSDR Series is rated to operate over an extended temperature range. Time delays of 0.1 seconds to 1000 minutes are available. The output is rated 1A steady and 10A inrush. The modules are totally solid state and encapsulated to protect the electronic circuitry.

Operation (Recycling - ON Time First)

Upon application of input voltage, the output energizes and the T1, ON time begins. At the end of the ON time, the output de-energizes and the T2, OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the T1 ON time.

Operation (Recycling - OFF Time First)

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of the T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2 OFF time.

Ordering Information

MODEL	INPUT VOLT.	ADJUST.	T1 ON TIME	FIRST DELAY	T2 OFF TIME
TSDR215SB18M	24VAC	Fixed	5s	Off time	18m
TSDR415SB18M	120VAC	Fixed	5s	Off time	18m
TSDR4412SA1	120VAC	On time fixed, off external	12s	On time	1 - 100s
TSDR442MA2	120VAC	On time fixed, off external	2m	On time	10 - 1000s
TSDR4430SA2	120VAC	On time fixed, off external	30s	On time	10 - 1000s
TSDR610.2SA0.2S	230VAC	Fixed	0.2s	On time	0.2s
TSDR6110SA30S	230VAC	Fixed	10s	On time	30s
TSDR612.5SA4.5S	230VAC	Fixed	2.5s	On time	4.5s
TSDR615SB18M	230VAC	Fixed	5s	Off time	18m
TSDR6412SA1	230VAC	On time fixed, off external	12s	On time	1 - 100s

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Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat accuracy +/- 0.5%, Factory calibration +/- 5%
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Wide operating temperature range: -40° to 75°C	Reliable in demanding commercial and industrial applications
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

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TSDR SERIES

Accessories

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

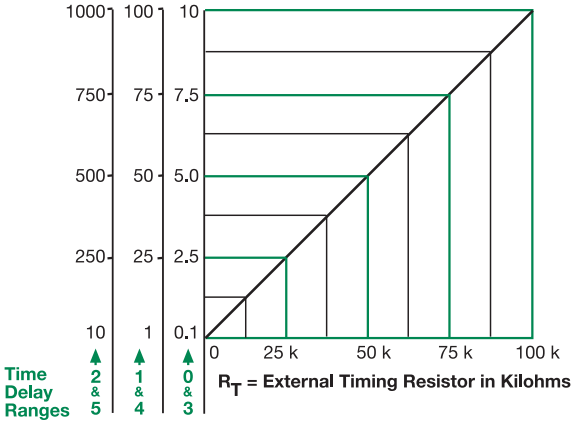
P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

External Resistance vs. Time Delay

In Secs. or Mins.

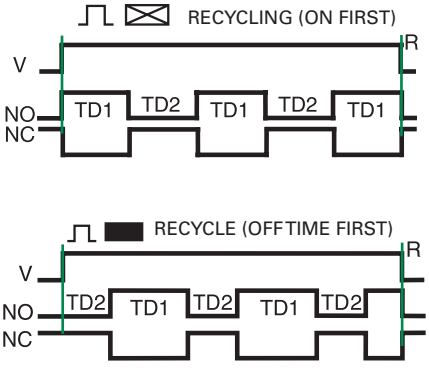


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagrams



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset

Specifications

Time Delay	
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±5%
Input	
Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA
Output	
Type	Solid state
Maximum Load Current	1A steady state, 10A inrush at 60°C
Off State Leakage Current	≅ 5mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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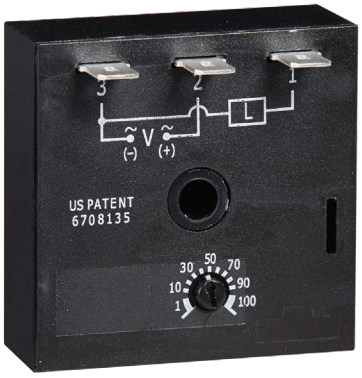
PTHF4900DK



Description

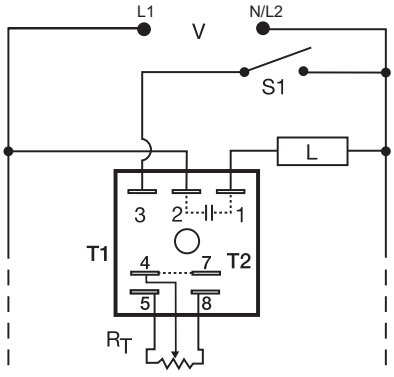
The PTHF4900DK can be used for a variety of applications from chemical metering, to temperature regulating, to energy management. The infinite adjustability from 1 to 99% provides accurate percentage on control over a wide factory fixed cycle period. When mounted on a metal surface, it can be used to drive solenoids, contactors, relays, or lamps, up to 20A steady, 200A inrush. The PTHF4900DK is the suggested replacement for the PT Series.

Operation (Percentage)

Upon application of input voltage, the output energizes and the T1 ON time begins. At the end of the ON time, the output de-energizes and the T2 OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied. Increasing the ON time decreases the OFF time. The total cycle period is equal to the ON time plus the OFF time. The total cycle period is factory fixed. ON time range is 1 to 99 percent of cycle period.

Reset: Removing input voltage resets the output and time delays, and returns the sequence to the T1 ON time.

Wiring Diagram



V = Voltage
L = Load
S1 = Optional
Low Current
Initiate Switch
T1 = ON Time
T2 = OFF Time
R_T = 100 KΩ

R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat accuracy + / -0.5%, Factory calibration + / - 5%
ON/OFF recycling percentage control 1 to 99%	Accurate control over a wide factory fixed cycle period
Compact, low cost design	Allows flexibility for OEM applications and reduces component and labor costs
High load currents up to 20A, 200A inrush	Allows direct operation of motors, lamps, and heaters without a contactor
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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PTHF4900DK

Specifications

Time Delay

Type	External or onboard knob
Range/External Adjustment Resistance	Adjustable from 1 - 99% / R_T = 100 KΩ
Cycle Period	Fixed from 10s - 1000m
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Cycle Period Tolerance (Factory Calibration)	≤ ± 5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±10%

Input

Voltage	120 or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA

Output

Type	Solid state	
Maximum Load Currents	**Steady State**	**Inrush***
	1A	10A
Voltage Drop	≅ 2.5V at rated current	
OFF State Leakage Current	≅ 5mA @ 230VAC	

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

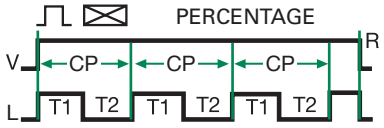
Mounting *	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
	6, 10, 20A units: ≅ 3.9 oz (111 g)

*Units rated ≥ 6A must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C. Inrush: Non-repetitive for 16ms.

Function Diagram



V = Input Voltage
CP = Cycle Period
L = Load
T1 = ON Time
T2 = OFF Time
R = Reset

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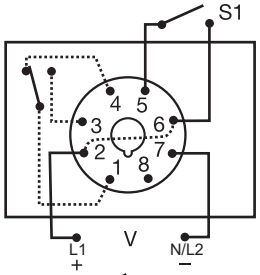
TDMB SERIES

Delay-on-Make/Delay-on-Break

8-PIN

11-PIN

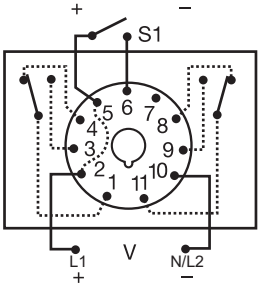
Wiring Diagram



8-PIN OCTAL SPDT

V = Voltage
S1 = Initiate Switch or Thermostat

Relay contacts are isolated.



11-PIN DPDT
(P/N ends with D)

For dimensional drawing see: Appendix, page 512, Figure 23.

Ordering Information

MODEL	INPUT VOLTAGE	DELAY-ON-MAKE	DELAY-ON-BREAK	PLUG TYPE
TDMB411	120VAC	0.1 - 102.3s in 0.1s increments	0.1 - 102.3s in 0.1s increments	Octal (8-pin) SPDT
TDMB413D	120VAC	0.1 - 102.3s in 0.1s increments	10 - 10230s in 10s increments	11-pin DPDT
TDMB422	120VAC	1 - 1023s in 1s increments	1 - 1023s in 1s increments	Octal (8-pin) SPDT
TDMB422D	120VAC	1 - 1023s in 1s increments	1 - 1023s in 1s increments	11-pin DPDT
TDMB622	230VAC	1 - 1023s in 1s increments	1 - 1023s in 1s increments	Octal (8-pin) SPDT

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Description

The TDMB combines both delay-on-make and delay-on-break functions into one plug-in package. Selection of the time period is accomplished with dual switches, one for the on delay and the other for the off delay. SPDT or DPDT output options provide isolated, 10A switching capability.

Operation (Delay-on-Make/Delay-on-Break)

Input voltage must be applied at all times. The output relay is de-energized. Upon closure of the initiate switch, the green LED glows and the delay-on-make time delay (T1) begins. At the end of T1, the output relay energizes and the red LED glows. When the initiate switch opens, the green LED turns OFF and the delay-on-break time delay (T2) begins. At the end of T2, the output relay de-energizes and the red LED turns OFF.

Reset: Removing input voltage resets time delay and output. Opening the initiate switch during the delay-on-make delay, resets T1. Closing the initiate switch during the delay-on-break delay, resets T2.

Features & Benefits

FEATURES	BENEFITS
Digital circuitry	Repeat Accuracy + / - 0.1%, Setting accuracy + / - 2%
Isolated, 10A, SPDT or DPDT output contacts	Allows control of loads for AC or DC voltages
User selectable Delay-on-Make and Delay-on-Break time delay	Timing settings are independently adjustable for added flexibility
Industry standard octal plug connection	Eliminates need for special connectors
LED Indication	Provides visual indication of initiate, timing, and relay output status
DIP switch adjustment	Provides first time setting accuracy

Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

NDS-11 11-pin Socket
11-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC11 hold-down clips.

PSC8 or PSC11 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use PSC8 with NDS-8 Octal Socket or PSC11 with NDS-11 Socket. Sold in sets of two.

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TDMB SERIES

Specifications

Time Delay

Type	Microcontroller circuitry
Range**	0.1 - 102.3s in 0.1s increments 1 - 1023s in 1s increments 10 - 10,230s in 10s increments
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Setting Accuracy	≤ ±2% or 50ms, whichever is greater
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%
Control LED Indicator	Green; on when the initiate switch is closed

Input

Voltage	12 or 24VDC; 24, 120, or 230VAC; 24 to 240VAC/DC; 12 to 48VDC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
110 to 230VAC/DC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Electromechanical relay
Form	SPDT or DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 230VAC
Life	Mechanical - 1 x10^7; Electrical - 1 x 10^5
Max. Switching Voltage	250VAC
Relay LED Indicator	Red; on when output relay energizes (not included on 12VDC units)

Protection

Insulation Resistance	≥ 100M
Polarity	DC units are reverse polarity protected
Isolation Voltage	≥ 1500V RMS input to output

Mechanical

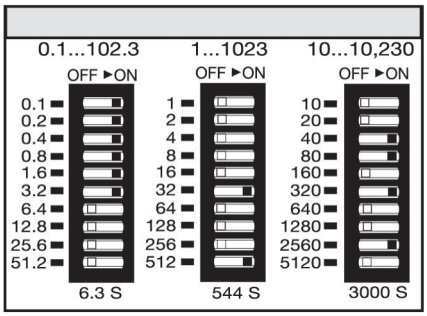
Mounting	Plug-in socket
Dimensions	**H** 81.3 mm (3.2"); **W** 60.7 mm (2.4"); **D** 45.2 mm (1.8")
Termination	Octal 8-pin plug-in, magnal 11-pin plug-in

Environmental

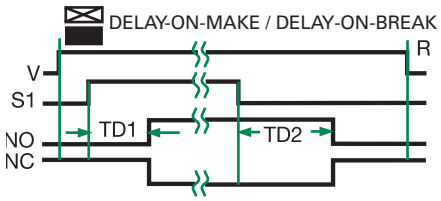
Operating/Storage Temperature	-20° to 60°C / -30° to 85°C
Weight	≅ 6 oz (170 g)

** For CE approved applications, power must be removed from the unit when a switch position is changed.

Digi-Set Binary Switch Operation



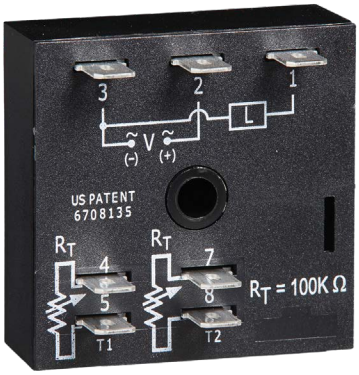
Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD1,TD2 = Time Delay
R = Reset
= Undefined Time

ESD52233

Delay-on-Make/Interval



Description

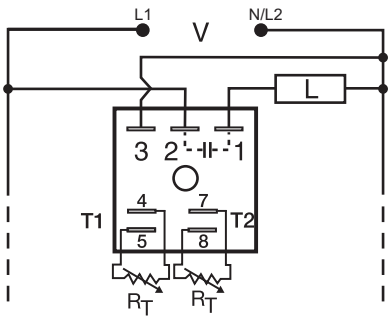
The ESD5 Series is an accurate, solid-state, delayed interval timer. It offers a 1A steady, 10A inrush output and is available with adjustable or fixed time delays of 0.1 seconds to 1000 minutes in six ranges. Input voltages of 24, 120, or 230VAC are available. Encapsulation offers protection against shock and vibration. Adjustment options are factory fixed, onboard or externally adjustable. The repeat accuracy, under stable conditions, is 0.1%. The factory calibration of the time delay is ±5%.

Operation (Delayed Interval)

Upon application of input voltage, the T1 delay-on-make time delay begins and the output remains de-energized. At the end of this delay, the output energizes and the T2 interval delay begins. At the end of the interval delay period, the output de-energizes.

Reset: Removing input voltage resets the output and the time delays, and returns the sequence to the first delay.

Wiring Diagram



V = Voltage
L = Load
T1 = Delay-on-Make time
T2 = Interval delay time

R_T is the external adjustment component.

Note: Terminals 4, 5 and/or 7, 8 are included when external adjustment is ordered. A knob is included when onboard adjust is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Compact, low cost design measuring 2 in. (50.8mm) square	Allows flexibility for OEM applications and reduces component and labor costs
Microcontroller based	Repeat Accuracy + / - 0.1%, Factory calibration + / - 5%
1A steady, 10A inrush solid-state output	Provides 100 million operations in typical conditions.
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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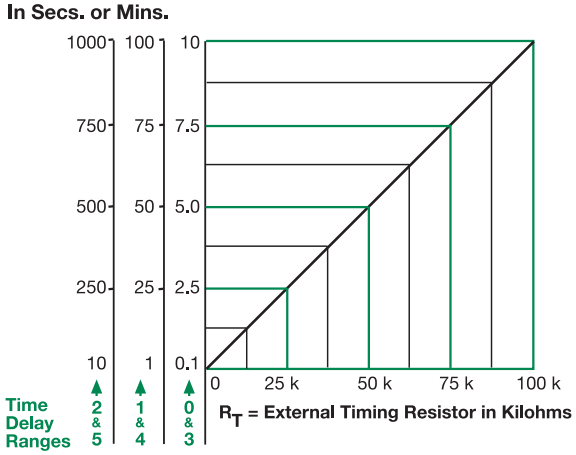
ESD52233

External Resistance vs. Time Delay

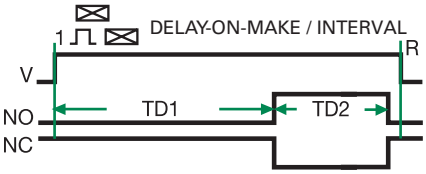


This chart applies to externally adjustable part numbers.
The time delay is adjustable over the time delay range selected by varying the resistance across the R_T terminals; as the resistance increases the tie delay increases.

When selecting an external R_T, add the tolerances of the timer and the R_T for the full time range adjustment.

Examples: 1 to 50 S adjustable time delay, select time delay range 1 and a 50 K ohn R_T. For 1 to 100 S use a 100 K ohm R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD1,TD2 = Time Delay
R = Reset

Specifications

Time Delay	
Range	0.1s - 1000m in 6 adjustable ranges or fixed
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±5%
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%
Input	
Voltage	24VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz
Power Consumption	≤ 2VA
Output	
Type	Solid state
Rating	1A steady state, 10A inrush at 60°C
OFF State Leakage Current	≅ 5mA @ 230VAC
Voltage Drop	≅ 2.5V @ 1A
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 75°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68g)

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KRPD SERIES

Relay Output Timer

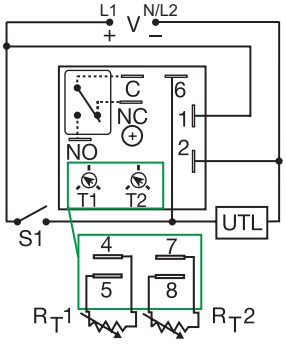
Description

The KRPD Series is a factory programmed time delay relay available with 1 of 12 standard dual functions. The time delays can be factory fixed, onboard or externally adjustable or a combination of fixed and adjustable. The SPDT output relay contacts offer a full 10A rating with complete isolation. Its microcontroller timing circuit provides excellent repeat accuracy and stability. Encapsulation protects against shock, vibration, and humidity. The KRPD Series is a cost effective approach for OEM applications that require small size, isolation, accuracy and long life.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat Accuracy + / - 0.5%
Compact design	Allows flexibility for OEM applications
Isolated, 10A, SPDT output contacts	Allows control of loads for AC or DC voltages
Encapsulated	Encapsulated to protect against shock, vibration, and humidity

Wiring Diagram



V = Voltage
C = Common, Transfer Contact
NC = Normally Closed
NO = Normally Open
S1 = Initiate Switch
UTL = Untimed Load

A knob is supplied for adjustable units or R_T terminals for external adjust. The untimed load is optional. S1 is not used for some functions.

For dimensional drawing see: Appendix, page 512, Figure 16.

Accessories

P1004-95, P1004-95-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT	ADJUSTMENT 1	TIME DELAY 1	ADJUSTMENT 2	TIME DELAY 2	FUNCTION
KRPD215S190SMB	24VAC	Fixed	5s	Fixed	90s	Delay-on-Make/Delay-on-Break
KRPD417M113MRXD	120VAC	Fixed	7m	Fixed	13m	Recycling/Off Time First
KRPDA175S130SMI	24 to 240VAC/DC	Fixed	75s	Fixed	30s	Delay-on-Make/Interval
KRPDA2129RXE	24 to 240VAC/DC	Onboard	0.1 - 10s	Onboard	10 - 1000h	Recycling
KRPDD2121MB	12 to 48VDC	Onboard	0.1-10s	Onboard	0.1-10s	Delay-on-Make/Delay-on-Break

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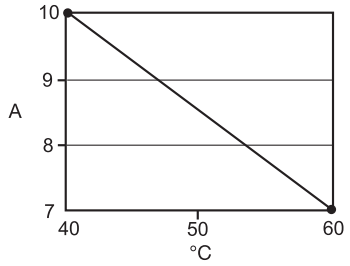
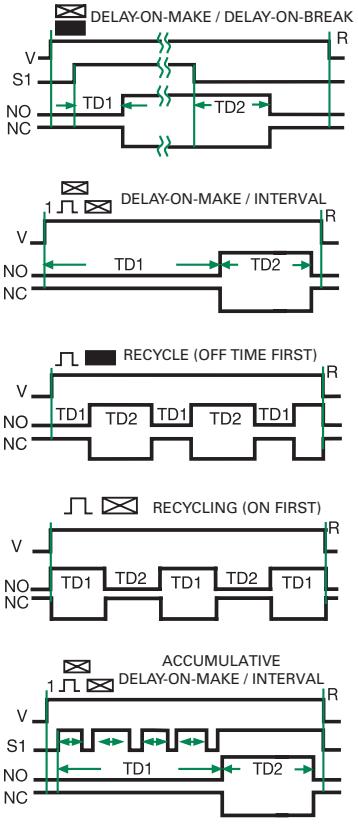
KRPD SERIES

Output Current/Ambient Temperature



Function Diagrams



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
TD1, TD2 = Time Delay
R = Reset
⌇ = Undefined Time

Specifications

Time Delay

Type	Microcontroller circuitry
Range	0.1s - 1000h in 9 adjustable ranges or fixed (to 999)
Repeat Accuracy	±0.5% or 20ms, whichever is greater
Tolerance (Factory Calibration)	≤ ±2%
Reset Time	≤ 150ms
Initiate Time	≤ 40ms; 750 operations per minute
Time Delay vs. Temperature & Voltage	≤ ±2%

Input

Voltage	12 to 48VDC; 24 to 240VAC/DC
Tolerance	
12 to 48VDC	-15% - 20%
24 to 240VAC/DC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 2VA; DC ≤ 2W

Output

Type	Isolated relay contacts
Form	SPDT
Rating (at 40°C)	10A resistive @ 125VAC 5A resistive @ 230VAC & 28VDC 1/4 hp @ 125VAC
Max. Switching Voltage	250VAC
Life (Operations)	Mechanical - 1 x 10^7; Electrical - 1 x 10^5

Protection

Circuitry	Encapsulated
Isolation Voltage	≥ 1500V RMS input to output
Insulation Resistance	≥ 100 MΩ
Polarity	DC units are reverse polarity protected

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connects

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.6 oz (74 g)

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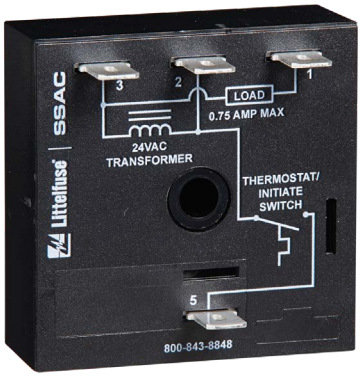
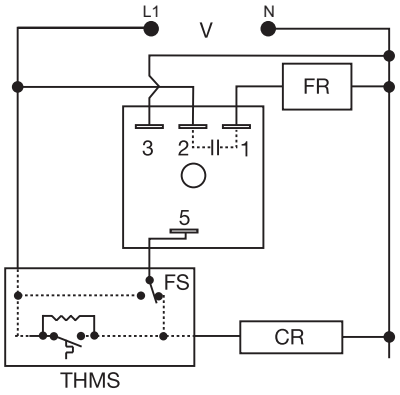
CT SERIES

Delay-on-Make/Delay-on-Break Timer



Wiring Diagram



V = Voltage
FR = Fan Relay
FS = Fan Switch
CR = Compressor Relay
THMS = Wall Thermostat

For dimensional drawing see: Appendix, page 512, Figure 16.

12

TIME DELAY RELAYS

Ordering Information

MODEL	DELAY-ON-MAKE (FIXED SECONDS)	DELAY-ON-BREAK (FIXED SECONDS)
CT1S30	1	30
CT1S45	1	45
CT1S8	1	8
CT1S90	1	90
CT30S1	30	1
CT45S45	45	45
CT5S300	5	300

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Description

The CT Series combines a delay-on-make and delay-on-break time delay into one unit and may be used to control fan delays in heating and/or cooling equipment. The CT includes bypass circuitry to allow it to operate with cooling anticipators ≥ 3000 ohms. It is designed to operate in 24VAC control circuits. Several CT modules may be combined to provide sequencing of any number of loads and sequencing off of the same loads, such as electric heating elements.

Operation (Delay-on-Make/Delay-on-Break)

Forced Air Heating or Air Conditioning (as shown): When the thermostat closes, the compressor relay is immediately energized. At the end of a fixed delay-on-make delay (T1), the fan relay is energized. When the thermostat opens, the compressor relay is de-energized and the delay-on-break delay is initiated. On completion of the fixed delay-on- break delay (T2) the fan relay is de-energized. If the thermostat is reclosed during the delay-on-break delay, the delay-on-break delay is reset and the fan relay remains energized. If the thermostat is closed when input voltage is applied, the delay-on-make delay (T1) begins as normal.

Reset: Removing input voltage resets the output and time delays.

Features & Benefits

FEATURES	BENEFITS
Delay-on-Make and Delay-on-Break in one unit	Simplifies wiring and installation, and optimizes efficiency of heating and cooling systems
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
Interconnectability with other CT modules	Combine modules to provide sequencing on of a number of loads and sequencing off of the same loads

Accessories

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

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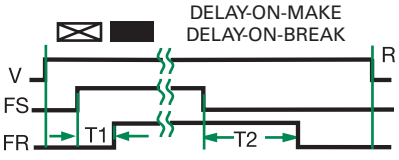
CT SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Function Diagram



V = Voltage
FS = Fan Switch
FR = Fan Relay
T1 = Delay-on-Make
T2 = Delay-on-Break
R = Reset
—⟋— = Undefined Time

Specifications

Time Delay	
Type	Microcontroller
Range	1 - 600s
Repeat Accuracy	±5%
Tolerance (Factory Calibration)	±20%
Recycle Time	≤ 300ms
Input	
Voltage	24VAC
Tolerance	±15%
AC Line Frequency	50/60 Hz
Output	
Type	Solid state
Form	NO
Rating	0.75A steady state, 5A inrush at 55°C
Voltage Drop	≅ 1.25V
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V rms terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 70°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)
Thermostat	Anticipator Resistor: ≥ 3000 Ω

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T2D120A15M

Lockout

Description

The T2D provides protection against short cycling of compressors and other motors. At the end of each operation, a lockout delay prevents restarting the compressor or motor until the delay is completed. 24VAC models can be used with thermostats that include a cooling anticipator resistor. It can be connected in series with the load for delay-on-make operation.

Operation (Lockout with Random Start)

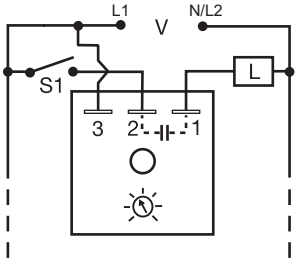
Connection #1: Upon application of input voltage, a random start time delay begins. At the end of this time delay, the output is energized.

Lockout Delay: Input voltage must be applied prior to and during timing. When the thermostat or initiate switch opens, the output de-energizes and the lockout time delay begins. At the end of the lockout delay, the output is energized allowing the load to immediately energize when the initiate switch or thermostat closes.

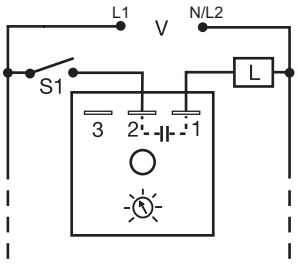
Connection #2: Upon application of input voltage and closure of initiate switch, the time delay begins. At the end of the time delay, the output is energized and remains energized until power is removed.

Reset: Removing power resets the output and the time delay.

Wiring Diagram



RANDOM START PLUS LOCKOUT



DELAY-ON-MAKE

V = Voltage
L = Load
S1 = Initiate Switch or Thermostat

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Lockout delay	Prevents rapid cycling of compressor
Random start delay	Prevents low voltage starting
Analog circuitry	Repeat Accuracy + / - 1%
Compact design	Allows flexibility for OEM applications
1A steady, 10A inrush output	Provides 100 million operations in typical conditions.
Totally solid state and fully encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration and humidity

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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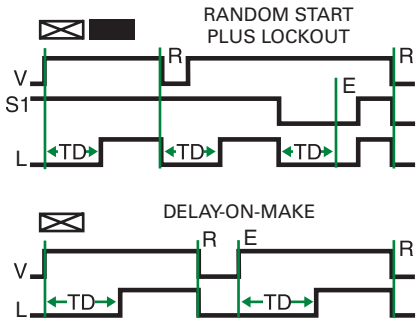
T2D120A15M

Specifications

Input	
Voltage	120/230VAC in 2 ranges
Tolerance	±20%
AC Line Frequency	50/60 Hz
Output	
Minimum Load Current	24VAC - 100mA; 120/230VAC - 40mA
Rating	1A steady state, 10A inrush at 60°C
Voltage Drop	≅ 2.5V @ 1A
Time Delay	
Initiate Time	After timing - 16ms
Type	Analog circuitry
Lockout & Random Start Delays	1s - 100m in 4 adjustable ranges or fixed Note: The lockout & random start delays are the same length.
Tolerance	Adjustable: ±30%; factory fixed: ±30%
Repeat Accuracy	±1% or 20ms, whichever is greater
Reset Time	After timing - ≤ 16ms; During timing - ≤ 200ms
Protection	
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)
Cooling Anticipator (24VAC Units Only)	
Minimum Cooling Anticipator	≥ 3,000 Ω

Function Diagram



V = Voltage
S1 = Initiate Switch
L = Load (CR)
E = Ready
TD = Time Delay
R = Reset

TA SERIES

Lockout

Description

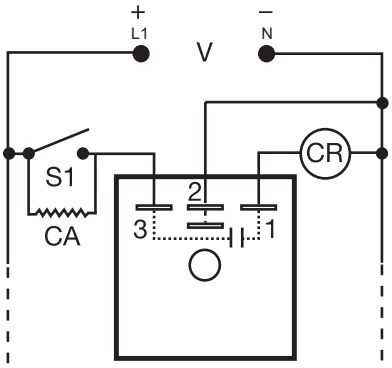
The TA Series prevents rapid recycling of a compressor. A lockout delay is started when the thermostat opens, or input voltage is lost. Eliminates tripped circuit breakers or blown fuses caused by a locked rotor during short cycling. The TA will not allow the compressor to start when the line voltage is low. Chatter of the compressor relay is eliminated. Because of the fast initiate time, bounce of the thermostat will not be transmitted to the compressor relay coil. A 30 second delay provides anti-reversing protection for scroll compressors.

Operation (Lockout)

On initial closure of the S1, the compressor relay energizes immediately. When S1 opens or input voltage is interrupted, a lockout time delay is initiated. During this lockout time delay, the compressor relay cannot be energized. The low voltage (brownout) protection prevents energization of the compressor when the line voltage is low.

Reset: The lockout time delay cannot be reset. After the time delay is completed, the unit automatically resets.

Wiring Diagram



V = Voltage
S1 = Initiate Switch, Contact, or Thermostat
CR = Compressor Relay (Load)
CA = Optional Cooling Anticipator

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Lockout delay	Prevents rapid cycling of compressor and eliminates nuisance service calls due to blown fuse or tripped breaker by locked rotor during short cycling
Anti-reversing protection for scroll compressors	Extends life of equipment
Brownout protection	Timer will not allow the compressor to start during low line voltage conditions
Encapsulated	Protects against shock, vibration, and humidity
1A solid state output	No moving parts to arc and wear out. Provides up to 100 million operations under typical conditions

Ordering Information

MODEL	INPUT VOLTAGE	TIME DELAY
TA12D1	12VDC	1m
TA12D2	12VDC	2m
TA24A0.5	24VAC	30s
TA24A3	24VAC	3m
TA24A5	24VAC	5m

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Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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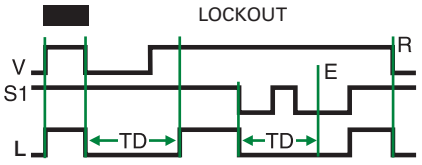
TA SERIES

Specifications

Input	
Voltage	12 or 24VDC; 24VAC
AC Line Frequency	50/60 Hz
Impedance	450 Ω (anticipator by-pass)
Output	
Minimum Load Current	75mA
Maximum Load Current	1A at 60°C
Voltage Drop	≤ 1.25V
Time Delay	
Initiate Time	≅ 16ms
Lockout Time	Fixed 0.5, 1, 2, 3, or 5m
Tolerance	-15% - 35%
Protection	
Circuitry	Encapsulated
Low Voltage Protection	≅ 20V: 24VAC/DC; ≅ 9V: 12VDC
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 70°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)
Thermostat	
Cooling Anticipator Resistor	≥ 1800 Ω

Function Diagram



V = Voltage
S1 = Initiate Switch
L = Load (CR)
E = Ready
TD = Time Delay
R = Reset

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TAC1 SERIES

Delay-on-Make

Description

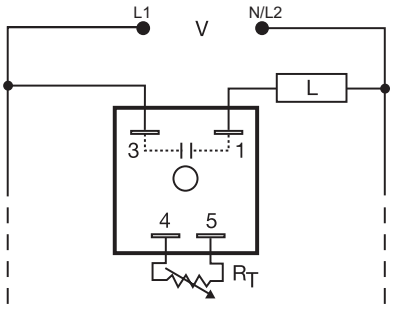
The TAC1 Series was designed to delay the operation of a compressor relay. It eliminates the possibility of relay chatter due to half-wave failure of the output. It connects in series with the load relay coil and provides a delay-on-make time delay each time input voltage is applied. It can be used for random start, anti-short cycling, sequencing, and many other applications. It is an excellent choice for all air conditioning and refrigeration equipment.

Operation (Delay-on-Make)

Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.

Reset: Removing input voltage resets the time delay and output.

Wiring Diagram



V = Voltage
L = Load

Load may be connected to terminals 3 or 1.
R_T is used when external adjustment is ordered.

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Analog circuitry	Repeat accuracy + / - 2%, Factory calibration + / - 20%
0.5A steady state, 10A inrush	Provides 100 million operations in typical conditions.
Connects in series with load relay coil	Fail-safe design eliminates contactor chatter
Meets UL 873	UL Recognized for air conditioning and refrigeration equipment
Fully encapsulated	Protects against shock, vibration and humidity

Accessories

P1004-XX, P1004-XX-X Versa-Pot
Panel mountable, industrial potentiometer recommended for remote time delay adjustment.

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P0700-7 Versa-Knob
Designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	ADJUSTMENT	TIME DELAY
TAC1223	24VAC	External	2 - 180s
TAC1411	120VAC	Fixed	1s
TAC1412	120VAC	Fixed	2s
TAC1413	120VAC	Fixed	3s
TAC14164	120VAC	Fixed	64s

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TAC1 SERIES

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

VTP(X)(X) Plug-on Adjustment Module
Mounts on modules with in-line adjustment terminals. Rated at 0.25W at 55°C. Available in resistance values from 5KΩ to 5MΩ.

Selection Table for VTP Plug-on Adjustment Accessory

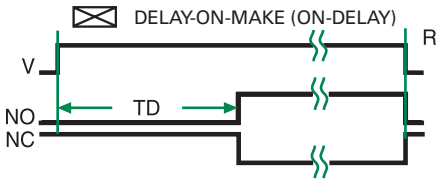
Time Delay	VTP P/N
1 - 0.05-3s	VTP4B
2 - 0.5-60s	VTP4F
3 - 2-180s	VTP4J
4 - 5-600s	VTP5N

Selection Guide

R_T Selection Chart				
Desired Time Delay* Seconds				R_T
1	2	3	4	Megohm
0.05	0.5	2	5	0.0
0.5	10	30	60	0.5
1.0	20	60	120	1.0
1.5	30	90	180	1.5
2.0	40	120	240	2.0
2.5	50	150	300	2.5
3.0	60	180	360	3.0
			420	3.5
			480	4.0
			540	4.5
			600	5.0

* When selecting an external R_T add at least 30% for tolerance of unit and the R_T.

Function Diagram



V = Voltage
NO = Normally Open Contact
NC = Normally Closed Contact
TD = Time Delay
R = Reset
= Undefined Time

Specifications

Time Delay

Type	Analog circuitry
Range	0.05 - 600s in 4 adjustable ranges or fixed
Repeat Accuracy	±2%
Tolerance (Factory Calibration)	±20%
Recycle Time	≤ 20ms after timing, during timing - 0.1% of time delay or 75ms, whichever is greater
Time Delay vs Temp. & Voltage	≤ ±10%

Input

Voltage	24, 120, or 230VAC
Tolerance	±20%
AC Line Frequency	50/60 Hz

Output

Type	Solid state
Form	NO, open during timing
Rating	0.5A steady state, 10A inrush at 60°C
Voltage Drop	120 & 230VAC: ≅ 4.2V @ 0.5A 24VAC: ≅ 2.5V @ 0.5A

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

Environmental

Operating/Storage Temperature	-40° to 80°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

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TL SERIES

Lockout

Description

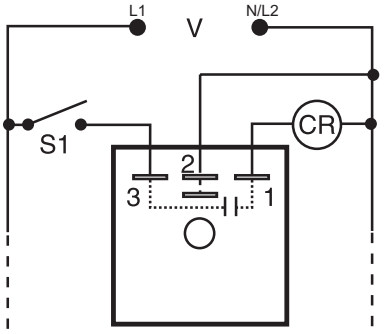
The TL Series provides protection against short cycling of a compressor. At the end of each operation, or whenever power is lost, a lockout delay is initiated. This lockout delay prevents restarting of the compressor until the head pressure has equalized. Compressor relay chatter due to thermostat bounce is eliminated by use of optional one second delay-on-make. The TL Series should not be used with cooling anticipator resistors or solid-state switches. (See the TA Series).

Operation (Lockout)

Lockout: On initial closure of S1, the compressor relay energizes immediately (or after an optional 1s delay). When the S1 opens or input voltage is interrupted, the output opens and remains open for the lockout time delay. During this lockout time delay period, the compressor relay cannot be re-energized.

Reset: The lockout time delay cannot be reset. After the time delay is completed, the unit automatically resets.

Wiring Diagram



V = Voltage
S1 = Initiate Switch
CR = Compressor or Control Relay

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Lockout delay	Prevents rapid cycling of compressor and eliminates nuisance service calls due to blown fuse or tripped breaker by locked rotor during short cycling.
One second Delay-on-Make (models ending in T)	Eliminates contactor chatter due to thermostat bounce
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
1A steady, 10A inrush, solid state output	Provides 100 million operations in typical conditions

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT VOLTAGE	LOCKOUT TIME	DELAY-ON-MAKE
TL120A5T	120VAC	5m	1s
TL230A5	230VAC	5m	No delay
TL24A5T	24VAC	5m	1s

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TL SERIES

Specifications

Input

Voltage	24, 120, or 230VAC
AC Line Frequency	50/60 Hz
Tolerance	±20%

Output

Minimum Load Current	≤ 40mA
Maximum Load Current	1A @ 24VAC; 0.5A @ 120 & 230VAC at 60°C
Inrush Current	10A at 60°C
Voltage Drop	24VAC - 2.5V @ 1A 120 & 230VAC - 4.2V @ 0.5A

Time Delay

Initiate Time	≅ 8ms
Lockout Time*	Fixed 2, 3, or 5m
Tolerance	-15% - 35%
Option	1s delay-on-make eliminates contactor chatter due to thermostat bounce

Protection

Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ

Mechanical

Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals

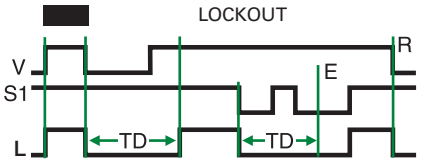
Environmental

Operating/Storage Temperature	-40° to 70°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.4 oz (68 g)

*Power must be applied for at least 15 s to achieve a full lockout delay. Less than 15 s will result in proportionally shorter delay periods.

NOTE: Cooling anticipator resistor or leakage may cause erratic operation. See TA Series for use with 24VAC systems that include anticipator resistors or use solid-state switches.

Function Diagram

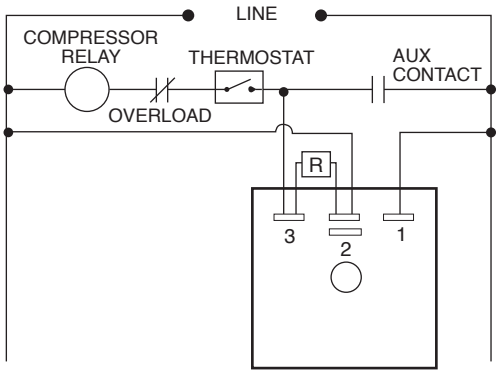


V = Voltage
S1 = Initiate Switch
L = Load (CR)
E = Ready
TD = Time Delay
R = Reset

TSA141300

Anti-Short Cycle, Solid State Timer

Wiring Diagram



For dimensional drawing see: Appendix, page 512, Figure 16.

Description

The TSA141300 utilizes unique circuitry to provide random start and lockout delay in one small, rugged, inexpensive package. When connected as shown, the TSA141300 in a multiple unit situation, prevents all units from starting at one time with its random start feature. The TSA141300 also prevents the compressor from recycling rapidly which could result in a lock rotor condition. This lockout delay is initiated at the end of each operation of the compressor. A momentary loss of power would also initiate the lockout delay.

Operation

Random Start: With the thermostat closed, when line voltage is applied to system, a time delay is initiated. At the end of this delay, the compressor relay will be energized. (Random Start delay is equal to lockout delay.)

Anti-Short Cycle: At the end of each cycle, when the thermostat opens, a lockout delay is initiated which prevents re-energization of the compressor relay during this period. If the thermostat is closed after the time delay is completed, the compressor relay will energize Immediately.

Loss of Power: If there is a momentary loss of power, the lockout will again be initiated preventing the compressor relay from energizing for the duration of the delay.

Features & Benefits

- Lockout Delay—prevents rapid recycling of compressor in air conditioning, refrigeration, and heat pump equipment
- Random Start Delay—provides staggered start up of multiple units
- Fast response time
- All Solid State with Encapsulated Circuitry

Specifications

Time Delay

Type	Factory fixed 5 minutes
Repeat Accuracy	± 5% under fixed conditions
Tolerance	Factory calibration: ± 15%
Time Delay vs. Temperature	± 10% max.

Input

Voltage	120 volts AC
Tolerance	± 20% of nominal
AC Line Frequency	50/60 Hz

Output

Type	Solid State
Maximum Load Current	1 ampere steady state, 10 amperes inrush at 60°C
Voltage Drop	2.5 volts typical at 1 ampere

Protection

Transient	Protected
Dielectric Breakdown	Greater than 1500 volts RMS
Insulation Resistance	100 megohms min.

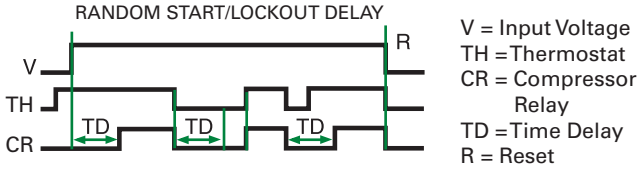
Mechanical

Mounting	Surface mount with one #8 or #10 screw
Package	Molded housing with encapsulated circuitry
Termination	0.25 in. (6.35 mm) male quick connect terminals
Dimensions	**H** 50.80 mm (2.0"); **W** 50.80 mm (2.0"); **D** 30.70 mm (1.21")

Environmental

Operating/Storage Temperature	-40°C to +80°C/-40°C to +85°C
Humidity	95% relative, non-condensing

Function Diagram



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HRV SERIES

Coin Counter

Description

The HRV combines the accuracy of microcontroller based circuitry with an electromechanical relay output. The HRV's switching capacity allows direct control of loads like compressors, pumps, motors, heaters, and lighting. The HRV "S" version provides a vend time after the selected number of initiate switch closures to start is reached. The HRV "A" version includes all of the "S" features and allows the total vend time to be extended for each additional initiate switch closure. The HRV is ideal for cost sensitive single coin or token vending machines. The electronic circuitry is encapsulated to protect against humidity and vibration.

Operation

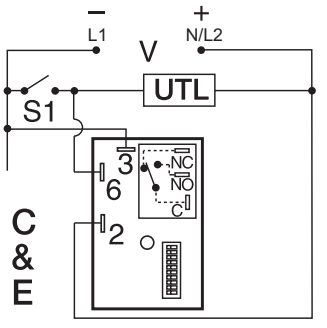
Coin Totalizer & Vending Timer ("S" Version):
Input voltage must be applied prior to & during operation. When the total number of S1 initiate switch closures equals the number to start set on the lower 3 DIP switches, the load energizes and the vending time set on the upper 7 DIP switches begins. At the end of the vending time, the load de-energizes and the vending time is reset. Closing the initiate switch during vend timing will have no affect on vend time delay.

Accumulating Vending Timer ("A" Version):
Input voltage must be applied prior to and during operation. When the total number of S1 initiate switch closures equals the number to start set on the lower 3 DIP switches, the load energizes and the vending time starts. For every initiate switch closure, the HRV unit adds one time per coin period, as set on the upper 7 DIP switches, to the total vending time.

Operation Note: If S1 is closed when input voltage is applied, the output remains de-energized and the S1 counter remains at zero closures. At least one "vend time" and one "closures to start" DIP switch must be in the "ON" position for proper operation.

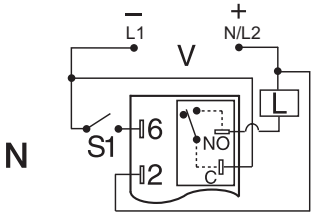
Reset: Removing input voltage resets the vend time delay, the S1 closure counter, and de-energizes the output relay.

Wiring Diagram



ISOLATED OUTPUT

V = Voltage
S1 = Initiate Switch
L = Load
UTL = Optional Untimed Load



NON-ISOLATED OUTPUT

For dimensional drawing see: Appendix, page 512, Figure 17.

Features & Benefits

FEATURES	BENEFITS
Microcontroller based	Repeat accuracy + / - 0.1%, Setting accuracy 0 - 2%, or 50ms
Encapsulated	Protects against shock, vibration, and humidity
30A , 1Hp at 125VAC, normally open contacts	Allows direct control of loads like compressors, pumps, motors, and heaters without a contactor
Switch selectable coin start	Allows user flexibility to select the number of coins to start vending cycle
Coin switch can be connected to a counter	Provides user with accurate count of total number of coins collected

Ordering Information

MODEL	INPUT VOLTAGE	VEND TIME	MODE OF OPERATION	OUTPUT FORM & RATING
HRV11SC	12VDC	1 - 127s	Coin totalizer	30A SPDT, NO (isolated)
HRV24AC	24VAC	0.25 - 31.75m	Accumulating	30A SPDT, NO (isolated)
HRV41AE	120VAC	1 - 127s	Accumulating	30A SPDT, NO (isolated)
HRV41SE	120VAC	1 - 127s	Coin totalizer	30A SPDT, NO (isolated)
HRV42SE	120VAC	5 - 635s	Coin totalizer	30A SPDT, NO (isolated)
HRV43AE	120VAC	0.1 - 12.7m	Accumulating	30A SPDT, NO (isolated)
HRV43AN	120VAC	0.1 - 12.7m	Accumulating	30A SPDT, NO (non-isolated)
HRV43SE	120VAC	0.1 - 12.7m	Coin totalizer	30A SPDT, NO (isolated)

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HRV SERIES

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

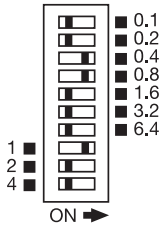
P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

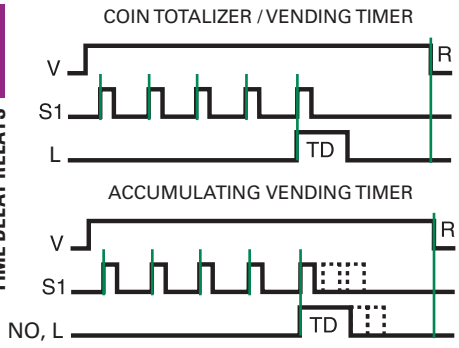
Switch Adjustment



Combine upper seven switches in "ON" position for vend time in minutes.

Combine lower three switches in "ON" position for number of closures to start.

Function Diagram



V = Voltage
S1 = Initiate Switch
NO = Normally Open Contact
L = Load
TD = Time Delay
R = Reset

Specifications

Count Functions/ Switch Type	Mechanical (counts on switch closure)
Minimum Switch Closure Time	≥ 20ms
Minimum Switch Open (between closures) Time	≥ 20ms
Count Range to Start	1 - 7 counts
Maximum Counts ("A" Version)	250
Time Delay/Range ***	Adjustable 1s - 31.75m in 4 ranges
Adjustment	7 of a 10 position DIP switch
Setting Accuracy	0% to +2% or 50ms, whichever is greater
Repeat Accuracy	±0.1% or 20ms, whichever is greater
Reset Time	≤ 150ms
Time Delay vs Temp. & Voltage	≤ ±2%
Input	
Voltage	12 or 24VDC; 24, 120, or 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
120 & 230 VAC	-20% - 10%
AC Line Frequency/DC Ripple	50/60 Hz / ≤ 10%
Power Consumption	AC ≤ 4VA; DC ≤ 2W
Output	
Type	Electromechanical relay
Form	Isolated, SPDT or non-isolated, SPDT

Ratings	**SPDT-NO**	**SPDT-NC**
General Purpose		
125/240VAC	30A	15A
Resistive		
125/240VAC	30A	15A
28VDC	20A	10A
Motor Load		
125VAC	1 hp*	1/4 hp**
240VAC	2 hp**	1 hp**

Life	Mechanical - 1 x 10^6; Electrical - 1 x 10^5, *3 x 104, ** 6,000
Protection	
Surge	IEEE C62.41-1991 Level A
Circuitry	Encapsulated
Dielectric Breakdown	≥ 1500V RMS input to output on isolated units
Insulation Resistance	≥ 100 MΩ
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 50.8 mm (2"); **D** 38.1 mm (1.5")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Environmental	
Operating/Storage Temperature	-40° to 70°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

***For CE approved applications, voltage must be removed when a switch position is changed.

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FLASHERS & TOWER LIGHTING CONTROLS

Flashers for incandescent or LED lighting used with both alternating and non-alternating applications in the signaling, communications, and advertising industries. FAA approved versions for obstruction lighting control are available. Tower lighting illuminates communications towers, tall buildings, and bridges as required by FA regulation. Designs are also available for powered AM and FM towers.

Flashers

FSU1000 Series		456
FS100 Series	Low Current Flasher	458
FS100 Series	Med Power Flasher	460
FS200 Series		462
FS300 Series		464
FS491		466
FS500 Series		467
SC3 / SC4 Series	Sequencing Controls	469

Tower and Obstruction Lighting Controls

FA / FS Series		471
FB Series	Flasher & Incandescent Beacon Alarm Relay	472
SCR490D	Obstruction Lamp Alarm Relay	474
SCR Series	Universal Lamp Alarm Relay	475
FB9L	Universal Lamp Alarm Relay	477
SCR9L	Universal Lamp Alarm Relay	479
PCR Series	Photo Control	481

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FSU1000 SERIES

Description

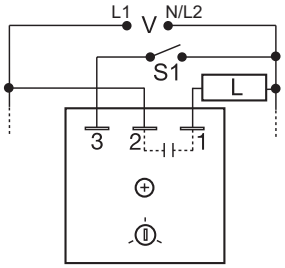
The FSU1000 incorporates an onboard adjustable flash rate of 10 to 100 FPM and a universal input voltage in one device. Its circuitry is encapsulated and is capable of controlling loads of up to 20A. The versatility of the FSU1000 makes it ideal for applications where various flash rates and operating voltages are required.

Operation

When input voltage is applied to terminal 2 and the load (lamp), the load energizes steadily. When input voltage is applied to terminal 3, the output flashes.

Optional Low Current Switch (S1): This low current switch could be a limit switch or contact. While open, the operator sees the load (lamp) ON and operating. When the limit switch closes, the load (lamp) flashes to attract attention.

Wiring Diagram



V = Voltage
S1 = Optional low current switch
L = Load

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Universal input voltage 24 to 240VAC	Allows flexibility for a wide range of applications with one part
Onboard adjustable flash rate	Provides flexibility for user to select flash rate between 10 - 100 FPM
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
High output rating up to 20A, 200A inrush	Allows direct operation of high current loads without a contactor

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect** These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INRUSH RATING	LOAD RATING
FSU1000	10A	1A
FSU1003	60A	6A
FSU1004	100A	10A
FSU1005	200A	20A

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FSU1000 SERIES

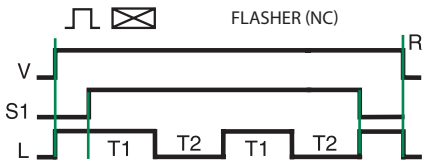
Specifications

Technical Data

Operation	ON/OFF recycling solid-state flasher (continuous duty)
Flash Rate	Adjustable 10 - 100 FPM
ON/OFF Ratio	≅ 50%
Input	
Range/Frequency	24 to 240VAC / 50/60Hz
Output	
Load Type	Inductive, resistive, or incandescent
Maximum Load Rating	1, 6, 10, or 20A steady state
Inrush	10 times steady state current
Mechanical	
Mounting*	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	
FSU1000	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
FSU1003, FSU1004	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Protection	
Circuitry	Encapsulated
Environmental	
Operating/Storage Temperature	-20° to 60°C (240VAC +50°C) / -40° to 85°C
Weight	1A units: ≅ 2.4 oz (68 g) ≥ 6A units: ≅ 3.9 oz (111 g)

*Units rated > 6A must be bolted to a metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C.

Flasher Function Diagram



V = Voltage
S1 = Initiate Switch
L = Load
R = Reset
T1 = ON Time
T2 = OFF Time
T1 ≅ T2

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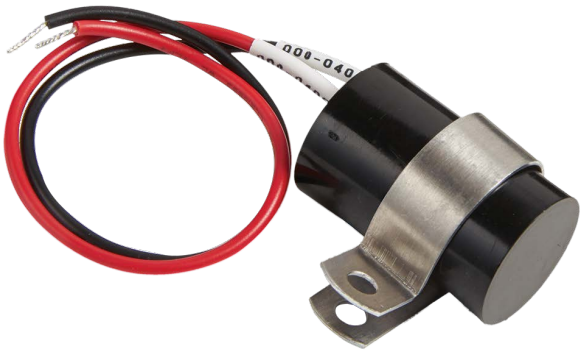
FS100 SERIES

Low Current Flasher



Description

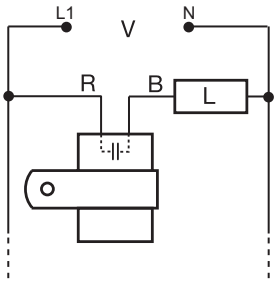
The FS100 Series (low current) may be used to control inductive, incandescent or resistive loads. This series offers a 1A (fullwave) or a 2A (halfwave) steady state, 10A inrush solid-state output and may be ordered with an input voltage of 24 or 120VAC. The FS100 Series offers a factory fixed flash rate of 75 FPM or may be ordered with a fixed, custom flash rate ranging from 45 to 150 FPM. Ideal for OEM applications where cost is a factor.

Operation

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2.

Wiring Diagram



V = Voltage
L = Load
R = Red Wire
B = Black Wire

For dimensional drawing see: Appendix, page 512, Figure 25.

Features & Benefits

FEATURES	BENEFITS
Compact Size: 38 x 23.9mm (1.5" x 0.94")	Ideal for OEM applications
Custom Flash Rates Available	Tailor to specific application: custom rates range from 45 to 150 FPM

Accessories

P1023-2 "P" Clamp
Mounting Bracket Alum. 15/16

Ordering Information

MODEL	INPUT VAC	OUTPUT RATING A	OUTPUT TYPE AC	LOAD TYPE	FLASH RATE
FS126	120	1	Fullwave	Incandescent & Resistive	75 FPM
FS126-45	120	1	Fullwave	Incandescent & Resistive	45 FPM
FS126-60	120	1	Fullwave	Incandescent & Resistive	60 FPM
FS126RC	120	1	Fullwave	Incandescent, Resistive, & Inductive	75 FPM
FS126RC-45	120	1	Fullwave	Incandescent, Resistive, & Inductive	45 FPM
FS127	120	2	Halfwave	Incandescent & Resistive	75 FPM
FS146	24	1	Fullwave	Incandescent & Resistive	75 FPM
FS146RC	24	1	Fullwave	Incandescent, Resistive, & Inductive	75 FPM

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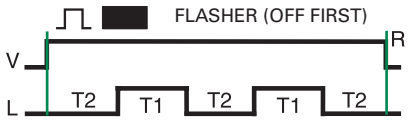
FS100 SERIES

Low Current Flasher

Specifications

Technical Data	
Operation	OFF/ON solid-state flasher (continuous duty)
Flash Rate	Factory fixed at 75 FPM ±20%
Custom Flash Rates Available	From 45-150 FPM ±20%
ON/OFF Ratio	≅ 50%
Input	
Voltage	24, 120VAC, ±15%
AC Line Frequency	50/60Hz
Output	
Output	Fullwave AC or Halfwave rectified AC
Load Type	Incandescent, resistive, or inductive (Choose RC suffix for inductive loads)
Maximum Load Rating	Fullwave: 1A steady state Halfwave: 2A steady state
Inrush	10A
Mechanical	
Mounting	Removable mounting bracket, use one #8 (M4 x 0.7) screw
Connection/Wires	18 AWG (0.82mm2) wires 6 in. (15.2cm)
Dimensions	**H** 38.1 mm (1.5"); **W** 23.9 mm (0.94")
Protection	
Circuitry	Encapsulated
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 1.1 oz (31 g)

Flasher Function Diagram



V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2

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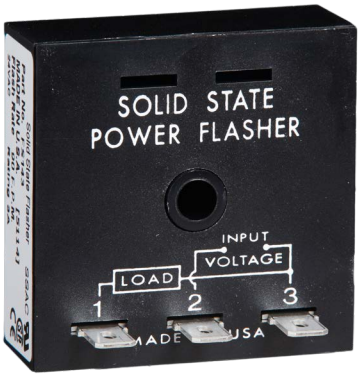
FS100 SERIES

Medium Power Flasher



Description

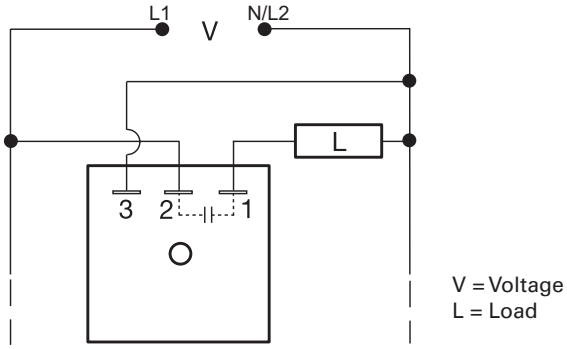
The FS100 Series (medium power) may be used to control inductive, incandescent, or resistive loads. Input voltages of 24, 120, or 230VAC are available. Fixed flash rates in stock range from 30, 50, 60, and 90 FPM, with custom flash rates ranging from 10 to 300 FPM. Encapsulation provides protection against shock, vibration, and humidity. This group of solid-state flashers has proven reliability with years of use throughout the world.

Operation

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2.

Wiring Diagram



For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
3A steady, 30A inrush current	Provides direct control of inductive, incandescent, or resistive loads
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT	FLASH RATE
FS143	24VAC	90 FPM
FS152	120VAC	90 FPM
FS152-30	120VAC	30 FPM
FS152-60	120VAC	60 FPM
FS162	230VAC	90 FPM
FS162-30	230VAC	30 FPM

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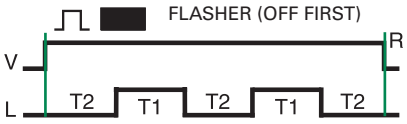
FS100 SERIES

Medium Power Flasher

Specifications

Technical Data	
Operation	OFF/ON solid-state flasher (continuous duty)
Flash Rate	Fixed at 90 FPM ±10%
Custom Flash Rates	10 - 300 FPM ±10%
ON/OFF Ratio	≅ 50%
Input	
Voltage/Frequency	24, 120, or 230VAC ±15% / 50/60 Hz
Output	
Load Type	Inductive, resistive, or incandescent
Output	Fullwave AC, solid state, SPST
Maximum Load Rating	3A steady state
Inrush	10 times steady state current
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6 .35 mm) male quick connect terminals
Protection	
Circuitry	Encapsulated
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Weight	≅ 2.2 oz (62 g)

Flasher Function Diagram



V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2

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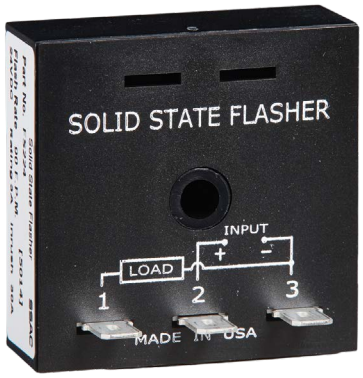
FS200 SERIES



Description

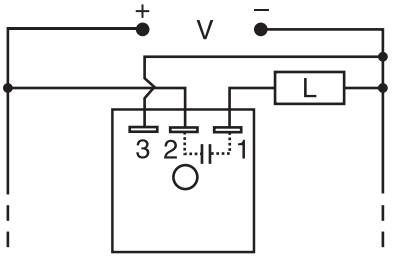
The FS200 Series may be used to control inductive, incandescent, or resistive loads. Factory fixed flash rate of 45 or 90 FPM or may be ordered with a fixed custom flash rate ranging from 10 to 180 FPM. Encapsulation provides protection against shock, vibration, and humidity. Uniform performance, high inrush current capability, and low RFI, make this series ideal for general industrial applications.

Operation

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2.

Wiring Diagram



V = Voltage
L = Load

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
3A steady, 30A inrush, SPST output contact	Provides direct control of inductive, incandescent, or resistive loads
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
High inrush current capability and low RFI	Ideal for general industrial applications

Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

Ordering Information

MODEL	INPUT	RATING	FLASH RATE
FS219-45	12VDC ± 20%	3A	45 FPM
FS224	24VDC ± 20%	3A	90 FPM

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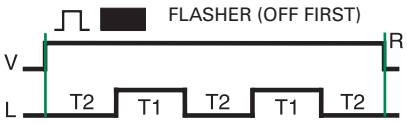
FS200 SERIES

Specifications

Technical Data	
Operation	OFF/ON solid-state flasher (continuous duty)
Flash Rate	Fixed at 90 FPM ±10%
Custom Flash Rate	10 - 180 FPM
ON/OFF Ratio	≅ 50%
Input	
Voltage	12, 24, 36, 48, or 110VDC
Output	
Load Type	Inductive, resistive, or incandescent
Maximum Load Rating	0.25 - 3A steady state
OFF State Leakage Current 12 & 24VDC	≤ 250 µA
Inrush	10 times steady state current
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Protection	
Circuitry	Encapsulated
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Weight	≅ 2.2 oz (62 g)

Flasher Function Diagram



V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2

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FS300 SERIES

Description

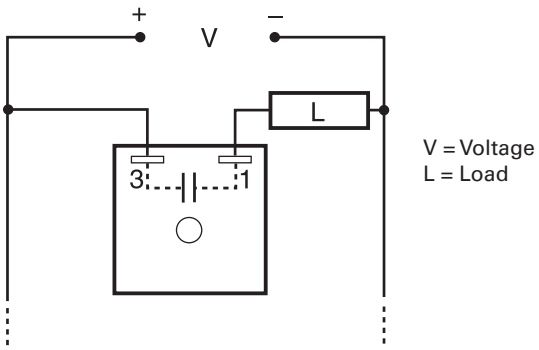
The FS300 Series of solid-state flashers were specifically designed to operate lamp loads. Their two-terminal series connection feature makes installation easy. The high immunity to line noise and transients makes the FS300 Series ideal for moving vehicle applications. All solid-state construction means reliability and long life. The FS300 Series offers a factory fixed flash rate of 75 FPM or may be ordered with a fixed, custom flash rate ranging from 60 to 150 FPM.

Operation

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until input voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2.

Wiring Diagram



V = Voltage
L = Load

For dimensional drawing see: Appendix, page 512, Figure 16.

Features & Benefits

FEATURES	BENEFITS
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
High immunity to line noise and transients	Designed specifically for moving vehicle applications
High surge current capability (10 times steady state)	Direct operation of incandescent lamp loads
Two terminal series connection	Provides quick and easy installation for new or existing applications

Ordering Information

MODEL	INPUT	MAXIMUM CURRENT LOAD
FS312	12VDC ± 20%	2.5A
FS324	24VDC ± 20%	1.5A

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Accessories

P1023-6 Mounting bracket
The 90° orientation of mounting slots makes installation/removal of modules quick and easy.

P1015-64 (AWG 14/16)
Female Quick Connect
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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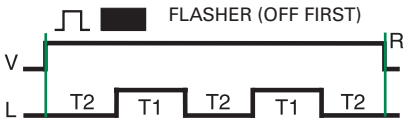
FS300 SERIES

Specifications

Technical Data

Operation	OFF/ON recycling solid-state flasher (continuous duty)
Flash Rate	Fixed at 75 FPM ±10%
Custom Flash Rates	60 - 150 FPM
ON/OFF Ratio	≅ 50%
Input	
Voltage	12, 24, 36, 48, 72, & 110VDC
Output	
Load Type	Incandescent or resistive
Maximum Load Rating	0.25 - 2.5A steady state
Inrush	10 times steady state current
Mechanical	
Mounting	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 30.7 mm (1.21")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Protection	
Circuitry	Encapsulated
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 2.2 oz (62 g)

Flasher Function Diagram



V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2

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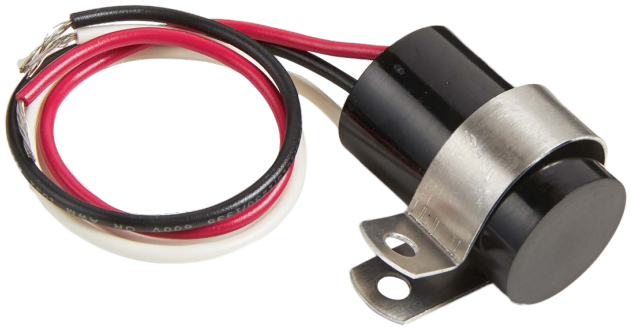
FS491



Description

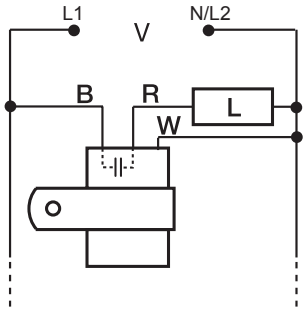
The FS491 is a low leakage AC flasher designed to control LED, or resistive loads. This product offers a solid-state output and accepts an input voltage of 120VAC to 240VAC. It offers a factory fixed flash rate of 75 FPM. The FS491 is the perfect solution for LED lamp flashing.

Operation

Upon application of input voltage, the output energizes and the ON time begins. At the end of the ON time, the output de-energizes and the OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and the flash sequence.

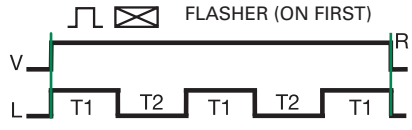
Wiring Diagram



V = Voltage
L = Load
R = Red Wire
B = Black Wire
W = White Wire

For dimensional drawing see: Appendix, page 512, Figure 25.

Function Diagram



ON time plus OFF time equals one complete flash.

V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2

Features & Benefits

FEATURES	BENEFITS
Totally solid state	No moving parts to arc and wear out, up to 100 million operations under typical conditions
Fully encapsulated	Protects circuitry from shock, vibration and humidity
Extremely low leakage current	Ideal for use in LED lighting applications

Specifications

Technical Data

Operation	ON/OFF solid-state flasher (continuous duty)
Flash Rate	Fixed at 75 FPM ±20%
ON/OFF Ratio	≅ 50%

Input

Voltage	120 - 240VAC
Tolerance	± 15%
AC Line Frequency	50/60Hz

Output

Load Type	LED or resistive
Output	Bridge Rectifier & FET
Maximum Load Rating	
120VAC to 240VAC	0.5A steady state; 5A inrush
Max. Load Leakage Current	250µA
Voltage Drop	2V typical

Mechanical

Mounting	Surface mount with one #8 (M4 x 0.7) screw
Dimensions	**Dia.** 23.9 mm (0.94"); **L** 38.1 mm (1.5")

Protection

Surge	IEEE C62.41 - 1991 Level A
Circuitry	Encapsulated

Environmental

Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 1.1 oz (31 g)

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FS500 SERIES

*(some models)

8-PIN

Description

The FS500 Series flash rate is adjustable from 10 to 100 FPM. A locknut is provided to hold selected flash rate. The long-life electronic circuit combined with a quality electromechanical relay provides flexibility and reliability in most applications.

Operation

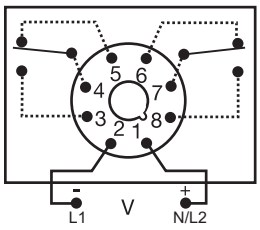
Upon application of input voltage, the output relay is energized and the ON time begins. At the end of the ON time, the output relay de-energizes and the OFF time begins. At the end of the OFF time, the output is energized and the cycle repeats as long as input voltage is applied.

Reset: Removing input voltage resets the output and the sequence.

Features & Benefits

FEATURES	BENEFITS
Solid-state circuitry with electromechanical relay	Long life circuitry at a reliable low cost
Industry standard octal plug connection	Eliminates need for special connectors
Adjustable flash rate	Provides flexibility for user to select flash rate between 10 - 100 FPM
10A, DPDT isolated output contacts	Allows control of loads for AC or DC voltages

Wiring Diagram



V = Voltage

For dimensional drawing see: Appendix, page 512, Figure 24.

Ordering Information

MODEL	INPUT VOLTAGE
FS512	12VDC
FS524	24VAC/DC
FS590	120VAC/DC

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Accessories

BZ1 Front Panel Mount Kit
Provides an easy method of through-the-panel mounting of 8- or 11-pin plug-in timers, flashers, and other controls.

NDS-8 Octal 8-pin Socket
8-pin 35mm DIN rail or surface mount. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail. Uses PSC8 hold-down clips.

PSC8 Hold-down Clips
Securely mounts plug-in controls in any position. Provides protection against vibration. Use with NDS-8 Octal Socket. Sold in pairs.

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

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FS500 SERIES

Specifications

Technical Data

Operation	ON/OFF recycling flasher with adjustable flash rate
Flash Rate	Adjustable from 10 - 100 operations per minute (guaranteed range)
ON/OFF Ratio	≅ 50%

Input

Input Voltage	12VDC, 24VAC/DC, 120VAC/DC, 230VAC
Tolerance	
12VDC & 24VDC/AC	-15% - 20%
120VAC/VDC & 230VAC	-20% - 10%
AC Line Frequency	50/60Hz

Output

Load Type	Electromechanical relay
Form	DPDT
Rating	10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/ 240VAC

Mechanical

Mounting	Plug-in socket
Dimensions	**H** 91.6 mm (3.62"); **W** 60.7 mm (2.39"); **D** 45.2 mm (1.78")
Termination	Octal 8-pin plug-in

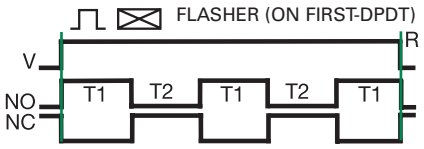
Protection

Isolation Voltage	≥ 1500V RMS input to output
Polarity	DC units are reverse polarity protected

Environmental

Operating/Storage Temperature	-20° to 60°C / -30° to 85°C
Weight	≅ 5.8 oz (164 g)

Flasher Function Diagram



V = Voltage
R = Reset
T1 = ON Time
T2 = OFF Time
NO = Normally Open
NC = Normally Closed

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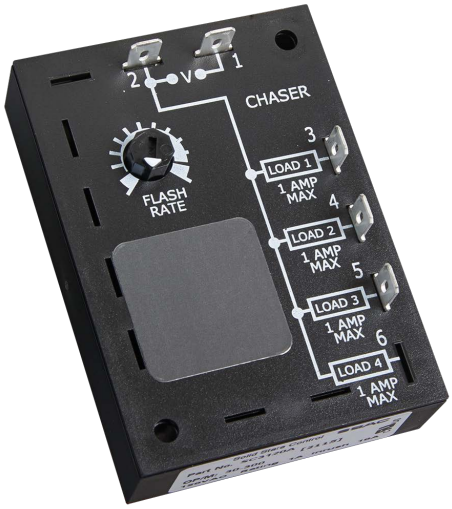
SC3 / SC4 SERIES

Chaser



Description

The SC3/SC4 Series are solid-state 3 or 4 channel chasers designed for sequential three circuit flashing of incandescent lamp loads. Unlike electromechanical chasers, there are no contacts to arc, wear, and eventually fail.

Operation

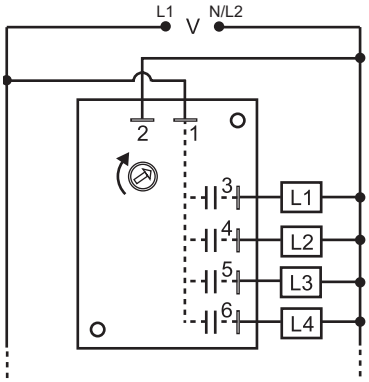
Sequential 3 or 4 circuit flashing of incandescent loads with equal time delays for each load. Upon application of input voltage, Load 1 is energized. At the end of the time delay, Load 1 de-energizes and Load 2 energizes. At the end of the time delay, Load 2 de-energizes and Load 3 energizes. This cycle continues until input voltage is removed. The set time delay (rate) is the timing for the *whole cycle*, for all 3 loads (output contacts).

Reset: Removing input voltage resets the unit and cycle.

Features & Benefits

FEATURES	BENEFITS
Totally solid state and encapsulated	No moving parts to arc and wear out over time and encapsulated to protect against shock, vibration, and humidity
1A steady solid state output	Provides 100 million operations in typical conditions.

Wiring Diagram



V = Voltage
L1 = Load 1
L2 = Load 2
L3 = Load 3
L4 = Load 4

SC4 shown. For SC3, terminal 6 and load L4 are eliminated.

For dimensional drawing see: Appendix, page 513, Figure 28.

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect** These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	RATING	CHANNEL	FLASH RATE
SC3120A	120VAC	1A	3 Sequential	Adjustable 30 - 30FPM
SC4120A	120VAC	1A	4 Sequential	Adjustable 30 - 30FPM

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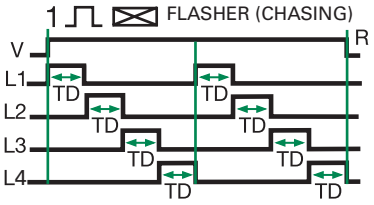
SC3 / SC4 SERIES

Specifications

Technical Data

Operation	Sequential 3 circuit flashing of incandescent lamp loads. Fixed rate. *For sequential 4 circuit and adjustable rates, please contact the factory.*
Rate	Fixed: 30 operations per minute (±10%)
Input	
Voltage	120VAC ±15%
AC Line Frequency	50/60 Hz
Output	
Type	Solid state
Rating	1A steady state per output
Mechanical	
Mounting	Surface mount with two #6 (M3.5 x 0.6) screws
Termination	0.25 in. (6.35 mm) male quick connect terminals
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 31 mm (1.22")
Protection	
Circuitry	Encapsulated
Dielectric Breakdown	≥ 2000V RMS terminals to mounting surface
Insulation Resistance	≥ 100 MΩ
Environmental	
Operating/Storage Temperature	-20° to 60°C / -40° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 5.4 oz (153 g)

Flasher Function Diagram



V = Voltage
R = Reset
L1, L2, L3, L4 = Lamps
TD = Time Delay
(all are equal)

SC4 shown.
For SC3, L4 is eliminated and L1 TD begins as soon as L3 TD is completed.

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FA / FS SERIES

FA155

FS165-30T

*(FS155 & FA155 models only)

Description

The FA/FS Series have proven their reliability through years of use on communication towers, smoke stacks, cooling towers, tall buildings, bridges and utility towers. The highest quality components are encapsulated in a rugged plastic housing with a molded-in heat transfer plate. The flash rate, ratio, and fail-safe design meet FAA regulations. Zero voltage switching can increase lamp life up to ten times. The FS155-30RF includes superior RF filtering circuitry for use in high RF installations, including AM hot towers.

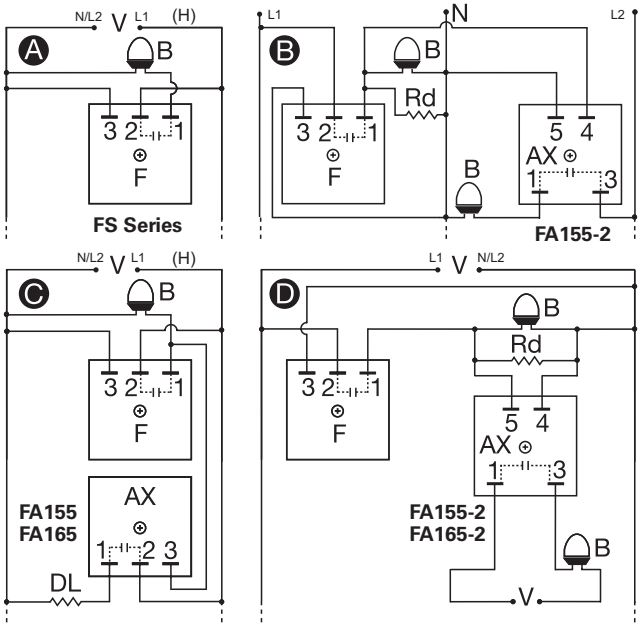
Operation

FS Series - Flasher (OFF First)
FA Series - Auxiliary Modules

Upon application of input voltage, the T2 OFF time begins. At the end of the OFF time, the T1 ON time begins and the load energizes. At the end of T1, T2 begins and the load de-energizes. This cycle repeats until voltage is removed.

Reset: Removing input voltage resets the output and the sequence to T2.

Wiring Diagram



V = Voltage N = Neutral B = Beacon
DL = Dummy Load for Constant Line Loading
Rd = 3.3 KΩ @ 5W for 120VAC; 8.5 KΩ @ 5W for 230VAC
F = Flasher (FS155-30T, FS155-30RF, FS165-30T)
AX = Auxiliary Unit (FA155, FA155-2, FA165, FA156-2)

For dimensional drawing see: Appendix, page 512, Figure 19.

Features & Benefits

FEATURES	BENEFITS
Zero voltage switching	Delivers up to 10 times longer lamp life
Encapsulated	Protects against shock, vibration, and humidity
Metalized mounting surface	Facilitates heat transfer in high current applications
Superior RF filtering circuitry (RF models only)	Ideal for AM hot towers and other high RF installations
High inrush capability up to 200A	Will withstand the repetitive inrush current of incandescent beacons

Accessories

P1015-13 (AWG 10/12), **P1015-64** (AWG 14/16), **P1015-14** (AWG 18/22) **Female Quick Connect**
These 0.25 in. (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.

P1015-18 Quick Connect to Screw Adapter
Screw adapter terminal designed for use with all modules with 0.25 in. (6.35 mm) male quick connect terminals.

Ordering Information

MODEL	INPUT VOLTAGE	WATTAGE	INRUSH RATING	DESCRIPTION
FA155	120VAC	2500W	200A	Auxiliary unit to provide constant line loading
FA155-2	120VAC	2500W	200A	Auxiliary unit for synchronized operating of additional beacons. Synchronized flashing of additional beacons on a 3 wire system
FA165	230VAC	5000W	200A	Auxiliary unit to provide constant line loading
FA165-2	230VAC	5000W	200A	Auxiliary unit for synchronized operating of additional beacons. Synchronized flashing of additional beacons on a 2 wire system
FS155-30RF	120VAC	2500W	200A	For high RF interference locations including AM hot towers
FS155-30T	120VAC	2500W	200A	Standard beacon flasher
FS165-30T	230VAC	5000W	200A	Standard beacon flasher

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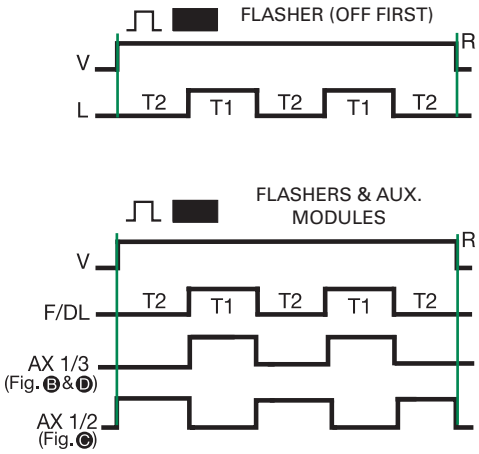
FA / FS SERIES

Flasher Function Diagrams



V = Voltage
R = Reset
L = Load
T1 = ON Time
T2 = OFF Time
T1 ≅ T2
F = Flasher
DL = Dummy Load
AX = Auxillary Module

Specifications

Operation	Single & multiple beacon flashing with auxiliary modules
Flash Rate (FS Series Only)	30 ±10 FPM
ON/OFF Ratio (FS Series Only)	50 - 67% ON time; 33 - 50% OFF time
Voltage	120 or 230VAC ±20%
AC Line Frequency	50/60Hz
Output Rating (Zero Voltage Switching)	2500W @ 120VAC; 5000W @ 230VAC
Inrush Current	200A peak for 1 cycle of AC line
Mounting*	Surface mount with one #10 (M5 x 0.8) screw
Dimensions	**H** 50.8 mm (2"); **W** 50.8 mm (2"); **D** 38.4 mm (1.51")
Termination	0.25 in. (6.35 mm) male quick connect terminals
Circuitry	Encapsulated
Operating/Storage Temperature	-55° to 65°C / -55° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 3.9 oz (111 g)

* Note: Must be mounted to metal surface using the included heat sink compound. The maximum mounting surface temperature is 90°C.

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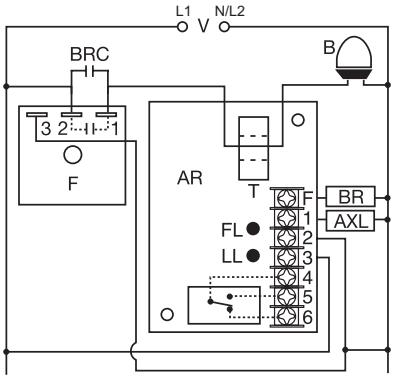
FB SERIES

Flasher & Incandescent Beacon Alarm Relay

Wiring Diagram



V = Voltage
B = Beacon
F = Flasher
T = Toroid
BRC = Flasher Bypass Relay Contacts
AR = FB Alarm Relay
BR = Bypass Relay Coil
FL = Flasher Failure LED
LL = Lamp Failure LED
AXL = Lamp Alarm Relay Coil

NOTE: Flasher module may be located on either the line or load side of the toroidal sensor.

For dimensional drawing see: Appendix, page 514, Figure 47.

Ordering Information

MODEL	LINE VOTAGE	LAMP TYPE
FB120A	120VAC	Incandescent Beacon
FB230A	230VAC	Incandescent Beacon

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Description

The FB Series is used to monitor the operation of one two-lamp incandescent beacon and one beacon flasher (or auxiliary module). The flasher and lamps are monitored by sensing the flow of current in the circuit. If the lamp(s) or the flasher fail to operate properly, a solid-state output and an isolated SPDT relay energize. When connected to a site monitoring system, this unit provides the remote beacon monitoring protection required by the FAA/FCC. On a multiple beacon structure, one unit is required for each two-lamp incandescent beacon (one unit per beacon for LED beacons).

Operation

If one lamp in an incandescent beacon fails, the relay and solid-state lamp failure outputs energize after 10s. If the flasher fails in the ON or OFF condition, the relay and the solid-state flasher failure output energizes after 6s. If both failures occur, all three outputs energize after their trip delays.

Note: If both incandescent lamps fail, all three outputs will energize. The relay and solid-state flasher failure output energizes after 6s, and the solid-state lamp failure output energizes after 10s.

Features & Benefits

FEATURES	BENEFITS
Toroidal current sensing	Reliable low cost monitoring of the flasher and lamps through built-in CT and provides isolatio n from the monitored circuit
Failsafe beacon monitoring	Alarm monitors for failed incandescent lamps in addition to flasher function
One isolated, 5A, SPDT alarm output plus two, 1A, solid-state line voltage alarm outputs	When connected to a site monitoring system, it provides the remote beacon monitoring protection required by the FAA / FCC.
Fixed trip delays for flasher (6s) and lamp (10s) failures	Prevents nuisance alarms

Specifications

Input Voltage

FB120A	120VAC ±15%
FB230A	230VAC ±15%
AC Line Frequency	50/60Hz
Lamp Socket Voltage	±10%; 50/60Hz

Alarm Outputs

Type	3 total - 1 relay, 2 solid state; One isolated SPDT relay rated 5A resistive Two solid-state line voltage outputs rated 0.5A steady, 5A inrush

Lamp Failure Detection

FB120A	For two 620W or 700W lamps
FB230A	For two 500W or 700W lamps

Trip Delays

Flasher Failure	Fixed at 6s; -0/+40%
Lamp Failure	Fixed at 10s; -0/+40%

LEDs

Lamp Failure (Red)	Glows when one or both lamps fail
Flasher Failure (Red)	Glows when the flasher fails

Protection

Circuitry	Encapsulated
Mounting	Surface mount with two #6 (M3.5 x 0.6) screws
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 44.5 mm (1.75")
Termination	7 position barrier block for 20 AWG (0.5 mm^2) to 14 AWG (2.5 mm^2) wire

Environmental

Operating/Storage Temperature	-55° to 60°C / -55° to 85°C
Weight	≅ 7 oz (198 g)

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SCR490D

Obstruction Lamp Alarm Relay

Description

The SCR490D is used to provide remote monitoring of steady burning incandescent marker and obstruction lighting. Four onboard switches allow operator programming for lighting systems with two through nine lamps on a single AC circuit. The SCR490D uses a toroidal sensor and electronic circuitry to sense the failure of one or more lamps.

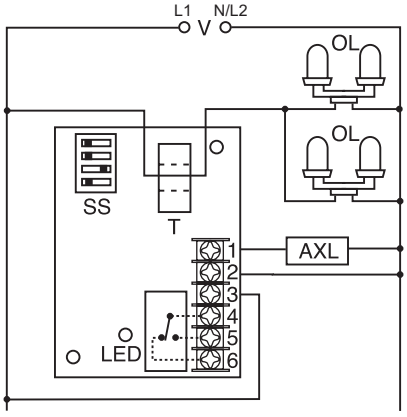
Operation

When a lamp fails, the SCR490D senses a decrease in current flow. Then, after a fixed time delay, it transfers to its alarm mode. In alarm mode, the LED indicator, the output relay (SPDT isolated contacts), and a non-isolated solid-state output are energized. Replacement of the failed lamps resets the alarm outputs and the LED indicator. To prevent false alarm signals, power must be applied to the SCR490D at the same time that lamps are energized.

Features & Benefits

FEATURES	BENEFITS
Toroidal current sensing	Reliable low cost monitoring of incandescent marker and obstruction lighting through built-in CT which also provides isolation from the lighting circuit
Monitors 2 - 9 lamps	Senses failed obstruction lamps on a single AC circuit
Isolated, 10A, SPDT alarm output plus one 1A, solid-state line voltage alarm output	Provide alarm indication and can also be used for remote monitoring of the lighting system
Fixed trip delay (6s)	Prevents nuisance alarms

Wiring Diagram



V = Voltage
OL = Obstruction Lamps
T = Toroid
SS = Selector Switch
AXL = Auxiliary Load/Alarm

Relay contacts are isolated.

For dimensional drawing see: Appendix, page 514, Figure 47.

Specifications

Operation

Number of Lamps	2 - 9 (selectable)
Lamp Wattage	116W, incandescent lamps
Rated Lamp Voltage	120 or 130VAC (selectable)
Monitored Voltage	120VAC ±3%
Trip Delay	≅ 6s fixed
Voltage	120VAC
AC Line Frequency Tolerance	50/60Hz
120VAC Line Voltage Output (Solid State Rated)	- 20% - 10% ≤ 125W to operate a spare lamp or alarm
Isolated Alarm Output	10A @ 120VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Mounting	Surface mount with two #6 (M3.5 x 0.6) screws
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 44.5 mm (1.75")
Termination	Screws with captive clamps for up to 14 AWG (2.45 mm^2) wire
Circuitry	Encapsulated
Operating/Storage Temperature	-55° to 65°C / -55° to 85°C
Humidity	95% relative, non-condensing
Weight	≅ 6.8 oz (193 g)

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SCR SERIES

Universal Lamp Alarm Relay

(SCR430T only)

Description

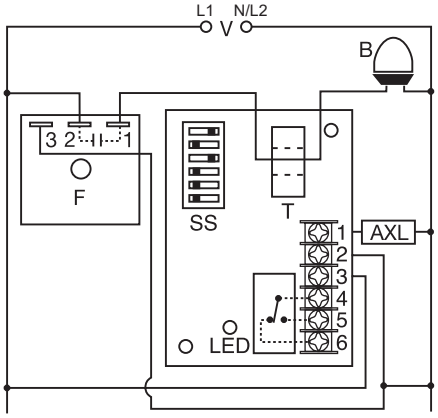
The SCR series is a universal lamp alarm relay designed to sense the failure of flashing or steady incandescent beacon lamps or steady side lights. The toroidal current sensor provides isolation and allows monitoring of more than one line at a time. The SCR Series energizes when one or more lamps fail. It will monitor the operation of one to four side lights and up to four beacon lamps.

Operation

When a lamp fails, the SCR Series senses a decrease in current flow. After a fixed time delay, the LED glows and the two alarm outputs energize. The outputs and the LED are reset when the failed lamps are replaced and the current returns to the nominal setting, or when the input voltage is removed. The SCR will sense an open flasher, it will not sense a continuously ON flasher (see FB Series).

Wiring Diagram

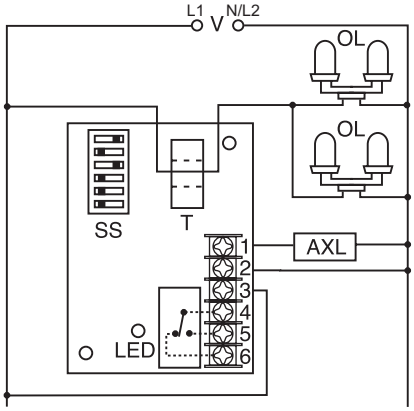
BEACON LAMP CONNECTION DIAGRAM



V = Voltage
B = Beacon Lamps
SS = Selector Switch
T = Toroid
F = Flasher
AXL = Auxiliary Load/Alarm

Relay contacts are isolated.

OBSTRUCTION LAMP CONNECTION DIAGRAM



V = Voltage
SS = Selector Switch
T = Toroid
AXL = Auxiliary Load/Alarm
OL = Obstruction Lamps

Relay contacts are isolated.

For dimensional drawing see: Appendix, page 514, Figure 47.

Features & Benefits

FEATURES	BENEFITS
Toroidal current sensing	Provides isolation from the lighting circuit and allows monitoring of multiple lines simultaneously
Monitors 1-4 side lights or up to 4 beacon lamps	Senses failed incandescent flashing beacon or steady obstruction lamps
Isolated, 10A, SPDT alarm output plus one 1A, solid-state line voltage alarm output	Provides alarm indication and can also be used for remote monitoring of the lighting system
Fixed trip delay (6s)	Prevents nuisance alarms
Switch selectable number, voltage, and wattage of lamps	User selectable to meet wide application needs with one relay

Ordering Information

MODEL	INPUT	LAMP TYPE
SCR430T	120VAC	Incandescent
SCR630T	230VAC	Incandescent

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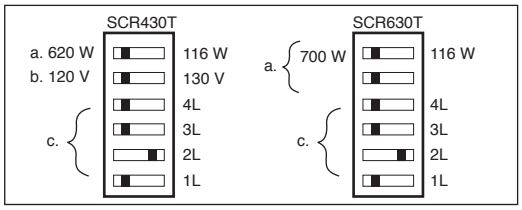
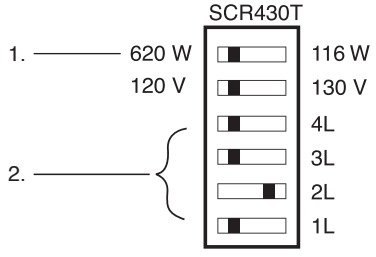
SCR SERIES

Selection Range



a. Lamp Wattage - Select the lamp wattage of the lamps in use.
b. Lamp Voltage - Select the lamp voltage shown on the lamp (SCR430T)
c. Lamps ON - Select the number of lamps on during normal operation. Only one lamp switch at a time may be transferred to the right.

Programming Example



Example Shown: SCR430T-620 watts at 120 VAC lamps, two lamps are ON during normal operation.

STEP
1. Select lamp wattage: 116 or 620 watts
2. Select the number of lamps ON (1 thru 4) during normal operation. Only one lamp switch may be ON (RIGHT) at any time.

Specifications

Operation

Lamp Monitoring				
Capacity (in lamps)	**100W**	**116W**	**620W**	**700W**
SCR430T 120VAC Lamps	4	4	4	n/a
SCR630T 230VAC Lamps	n/a	4	n/a	4

Time Delay

Trip Delay	Factory fixed ≅ 6s

Input

Input Voltage/Tolerance	SCR430T - 120VAC ±10% SCR630T - 230VAC ±10%
AC Line Frequency	50/60Hz

Output

To operate a spare lamp or alarm	
Line Voltage Output (Solid-state Rated)	≤ 125W @ 120VAC ≤ 250W @ 240VAC
Isolated Alarm Output (SPDT)	10A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC

Mechanical

Mounting	Two #6 (M3.5 x 0.6) screws
Dimensions	**H** 88.9 mm (3.5"); **W** 63.5 mm (2.5"); **D** 44.5 mm (1.75")
Termination	Screws with captive clamps for up to 14 AWG (2.45 mm^2) wire

Protection

Circuitry	Encapsulated

Environmental

Operating Temperature	-55° to 65°C
Weight	≅ 6.8 oz (193 g)

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FB9L

Universal Lamp Alarm Relay

Description

The FB9L is a universal lamp alarm relay designed to sense the failure of flashing LED beacon lamps. It will monitor the operation of one to eight beacons connected to a single flasher and/or auxiliary modules and the operation of the flasher. The FB9L output relay energizes when one or more lamps fail. All monitored lamps must be the same wattage and voltage. The 0.5A solid-state output energizes when a flasher failure is sensed.

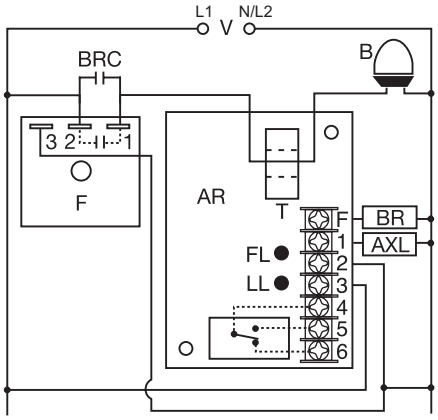
Operation

When a LED beacon lamp fails, the FB9L senses a decrease in current flow. After a 10s lamp failure trip delay, the isolated SPDT (4-5-6) and non-isolated SPNO (3-1) relay contacts energize. These contacts are used to indicate a beacon failure has occurred. The "L" onboard LED indicator flashes green during the trip delay and glows red after the output relay energizes. Connected to a site monitoring system, it provides remote beacon monitoring required by FAA-AC No: 150/5345-43E.

The FB9L also monitors the operation of the flasher. If the flasher remains in the ON or OFF condition for more than 6s the solid-state output energizes and the "F" flasher failure, onboard LED glows red. This output is normally used to energize an external flasher bypass relay. The contacts of the bypass relay are used to route voltage around the failed flasher and to indicate an alarm condition.

Note: In a single flasher, single beacon system, if the beacon lamp fails, zero current flow is detected. This will cause the flasher failure output to energize after 6s and then the beacon failure outputs after 10s. This is normal operation and can be expected anytime zero current is flowing through the monitored conductor.

Wiring Diagram



V = Voltage
B = Beacon
F = Flasher
BRC = Flasher Bypass Relay Contacts
T = Toroid
AR = FB Alarm Relay
BR = Bypass Relay Coil
FL = Flasher Failure LED
LL = Lamp Failure LED
AXL = Lamp Alarm Relay Coil

NOTE: Flasher module may be located on either the line or load side of the toroidal sensor.

For dimensional drawing see: Appendix, page 513, Figure 31.

Features & Benefits

FEATURES	BENEFITS
Self calibrating	Saves time at installation. No fine adjustment required.
Failsafe beacon monitoring	Alarm monitors for failed LED lamps in addition to flasher function
Number of beacons monitored is switch selectable for up to 8	User selection allows quick set up and easy adaption to multiple applications
Universal voltage 120 to 230VAC	Meets wide application requirements
Isolated, 10A, SPDT alarm output contacts	Provides remote beacon monitoring when connected to a site monitoring system, which is required by the FAA

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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Specifications

Sensors

Calibration Range (total all Lamps)	150mA - 8.0A
Absolute Max Current (total all Lamps)	15A max. (may not calibrate above 8A)
Single Lamp Current	150mA - 8.0A (total all lamps ≤ 8.0A)
Trip Delay	
Flasher Failure	Fixed at 6s; -0/+40%
Lamp Failure	Fixed at 10s; -0/+40%

Input

Input Voltage/Tolerance	120 to 230VAC / ±15%
AC Line Frequency	50/60Hz
Output	To operate a spare lamp or alarm
Line Voltage Output (SPNO)	5A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Isolated Alarm Output (SPDT)	10A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Solid-State Line Voltage Output (F)	0.5A steady; 5A inrush

Mechanical

Mounting	One #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 50.8 mm (2"); **D** 41.7 mm (1.64")
Termination	IP20 screw terminals for up to 14 AWG (2.45 mm^2) wire or two 16 AWG (1.3 mm^2) wires

LEDs

Power/Timing/Lamp Failure (Bi-color)	Glows red when one or more lamps fail
Flasher Failure (Red)	Glows red when the flasher fails

Protection

Circuitry	Encapsulated

Environmental

Operating/Storage Temperature	-40° to 60°C / -40° to 85°C
Weight	≅ 3.9 oz (111 g)
FAA-AC No.	150/5345-43E

Indicator Table

L	Green	Input ON & Calibrated
L	Green Flashing	Trip Delay
L	Red	Lamp Failure
L	Red/Green Flashing	Calibrating
L	Red Flashing	Not Calibrated
F	Red	Flasher Failure

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SCR9L

Universal Lamp Alarm Relay

Description

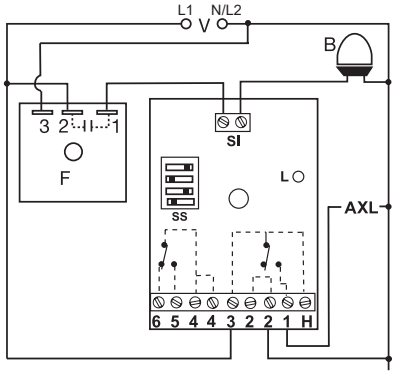
The SCR9L is a universal lamp alarm relay designed to sense the failure of flashing or steady LED beacon lamps or obstruction lamps. The SCR9L energizes when one or more lamps fail. It will monitor the operation of one to eight beacon or obstruction lamps. All monitored lamps must be the same wattage and voltage. When connected to a site monitoring system, it provides the remote lamp monitoring protection required by the FAA-AC No: 150/5345-43E.

Operation

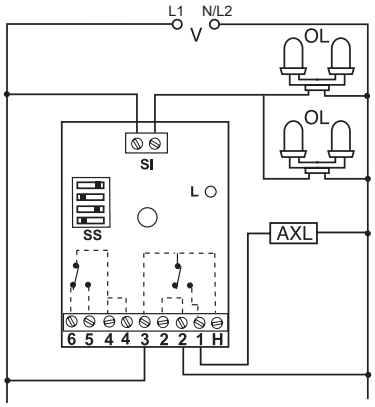
When a lamp fails, the SCR9L senses a decrease in current flow. After a 10s trip delay, the onboard LED glows and the two alarm outputs energize. The outputs and the LED are reset when the failed lamps are replaced and the unit is recalibrated. The SCR9L will sense an open flasher, it will not sense a continuously ON flasher (see FB Series). Removing input voltage de-energizes the output and the LED's. It does not change the calibration.

Wiring Diagram

BEACON LAMP CONNECTION DIAGRAM



OBSTRUCTION LAMP CONNECTION DIAGRAM



V = Voltage
B = Beacon Lamps
SS = Selector Switch
L = LED Indicator
F = Flasher
AXL = Auxiliary Load/Alarm
OL = Obstruction Lamps
SI = Sensor Input
H = "3" Spare AC Hot Connection (2A max.)

For dimensional drawing see: Appendix, page 513, Figure 31.

Features & Benefits

FEATURES	BENEFITS
Self calibrating	Designed for use with all types of LED beacon and obstruction lamps
Failsafe beacon monitoring	Relay will also provide an alarm signal on a failed flasher (open)
Number of lamps monitored is switch selectable up to 8	User selection allows quick set up and easy adaption to multiple applications
Universal voltage 120 to 230VAC	Designed for use in most applications
Isolated, 10A, SPDT alarm output contacts	Provides remote beacon monitoring when connected to a site monitoring system, as is required by the FAA
LED indication	Provides visual relay status of operation, alarm, trip delay, and calibration
Fully encapsulated	Protects against shock, vibration, and humidity

Accessories

C103PM (AL) DIN Rail
35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.

P1023-20 DIN Rail Adapter
Allows module to be mounted on a 35 mm DIN type rail with two #10 screws.

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SCR9L

CE

Calibration

Alarm relays must be calibrated at initial installation and when LED lamps are replaced. Due to LED lamp aging, recalibration is recommended every 12 months.

1. Remove input voltage
2. Move calibration switch to off position
3. Re-apply input voltage
4. LED will flash red to indicate the unit is ready for calibration
5. Visually inspect structure's lighting to make sure all lamps and flashers (if used) are operating properly
6. Remove input voltage
7. Adjust lamp selector switches for the correct number of lamps to be monitored (see adjustment diagram below)
8. Re-apply input voltage
9. LED should flash red
10. Move calibrate switch to ON position
11. The LED will alternate flashing red and green
12. LED will glow steady green within 30 secs. Calibration is complete

Calibration Failed

If the LED double blinks red, calibration failed. Remove input voltage and repeat steps 6-8.

Notes:

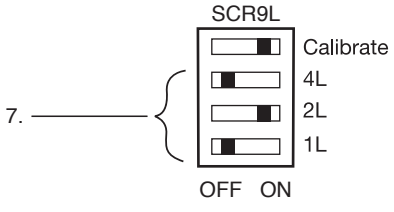
a. Monitoring a mixture of LED beacons and LED obstruction lamps is not possible with the SCR9L.

b. This alarm relay is not designed to monitor incandescent lamps.

c. Applying input voltage when the calibrate switch is in the OFF position, erases the previous calibration settings. The LED will flash Red. The output relays are OFF and the unit will not sense lamp failures.

d. Only one temperature compensated LED beacon can be monitored with this product. A combination of temperature compensated and standard LED beacons cannot be monitored.

Adjustment Example



Example Shown: SCR9L two lamps are ON during normal operation.

Indicator Table

L	Green	Input ON & Calibrated
L	Green Flashing	Trip Delay
L	Red	Lamp Failure
L	Red/Green Flashing	Calibrating
L	Red Flashing	Not Calibrated

Specifications

Sensors

Calibration Range (total all Lamps)	150mA - 8.0A
Absolute Max Current (total all Lamps)	15A max. (may not calibrate above 8A)
Single Lamp Current	150mA - 8.0A (total all lamps < 8.0A)

Time Delay

Trip Delay	Factory fixed ≅10s

Input

Input Voltage/Tolerance	120 to 230VAC ±15%
AC Line Frequency	50/60Hz

Output

	To operate a spare lamp or alarm
Line Voltage Output (SPNO)	5A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Isolated Alarm Output (SPDT)	10A @ 240VAC or 30VDC resistive; 1/4 hp @ 125VAC; 1/2 hp @ 250VAC
Auxilliary Input Voltage (H)	≤ 2A @ 230VAC

Mechanical

Mounting	One #10 (M5 x 0.8) screw
Dimensions	**H** 76.7 mm (3"); **W** 51.3 mm (2.02"); **D** 41.7 mm (1.64")
Termination	IP20 screw terminals for up to 14 AWG (2.45 mm^2) wire or two 16 AWG (1.3 mm^2) wires

Protection

Circuitry	Encapsulated

Environmental

Operating / Storage Temperature	-40° to 60°C / - 40° to 85°C
Weight	≅ 3.9 oz (111 g)

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PCR SERIES

Photo Control

Description

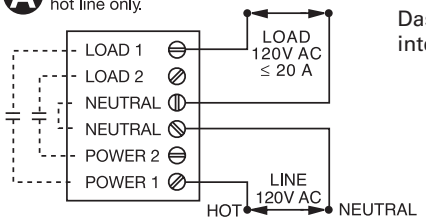
The PCR Series of photo controls is a combination of precision electronic circuitry, electromechanical output, and unique molded plastic housing. Designed and built to meet the demands of the most rigorous requirement of tower and obstruction lighting control, each unit is factory calibrated to meet FAA and FCC specifications. Electronic circuit, output contactor, and terminal block are all contained within front plastic housing. Edge support molded into the bottom edge of housing allows easy wiring of new and existing installations. Available with or without cast aluminum junction box.

Operation

When the amount of light sensed falls below the actuation level for energization, the output relay energizes. Conversely, when the amount rises above the actuation level for de-energization, the output relay de-energizes.

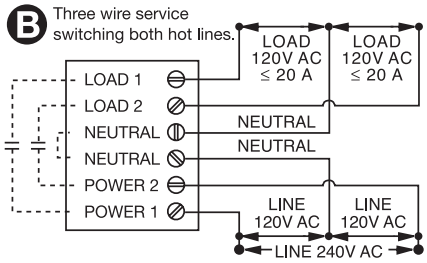
Wiring Diagram

A Two wire service switching hot line only.

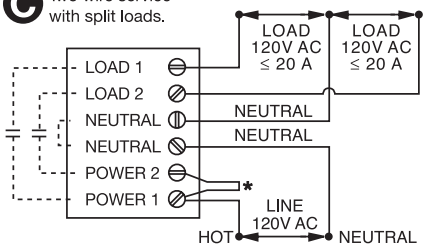


Dashed lines are internal connections.

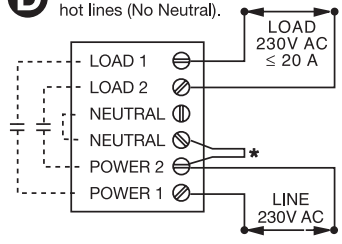
B Three wire service switching both hot lines.



C Two wire service with split loads.



D Two wire service switching both hot lines (No Neutral).



*Customer Supplied Jumper

For dimensional drawing see: Appendix, page 514, Figure 45.

Features & Benefits

FEATURES	BENEFITS
ABS plastic housing with gasket seal	Withstands outdoor environmental hazards and protects circuitry from moisture damage
Two 20A relay contacts	Allows direct control of a lighting circuit without a separate contactor
Fixed time delay	Eliminates contact chatter
Reliable photo sensor	Provides automatic lighting circuit operation from dusk to dawn

Ordering Information

MODEL	INPUT	DESCRIPTION	REPLACES	
			Hughey & Phillips	Crouse Hinds
PCR10	120VAC	Photo Control without aluminum box	n/a	n/a
PCR11	120VAC	Photo Control without aluminum box	PC800 120V	PEC52010
PCR12	230VAC	Photo Control with aluminum box	n/a	n/a
PCR13	230VAC	Photo Control with aluminum box	PC800 240V	PEC52010-1

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PCR SERIES

Specifications

Indication	LED indicates power is applied
Light Actuation Levels (Factory Calibrated)	Energized: ≤ 35 fc De-energized: ≥ 60 fc
Voltage	120VAC or 230VAC
AC Line Frequency Tolerance	50/60Hz
120 & 230VAC	-20% - 10%
Output Rating	Two SPST NO 20A contacts 1 hp @ 120VAC 2.5 hp @ 240VAC
Termination	Screw terminals for up to #8 (M4 x 0.7) AWG wire
Dimensions	**H** 159.51 mm (6.28"); **W** 127 mm (5.0"); **D** 131.75 mm (5.19")
Mounting	ABS plastic housing with gasket seal. Multiple knockout holes for optional mounting to Crouse Hinds or Hughey & Phillips cast aluminum electrical boxes.
Operating/Storage Temperature	-40° to 60°C / -55° to 85°C

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ACCESSORIES

Software 484
Electrical 485
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Littelfuse.com/relayaccessories

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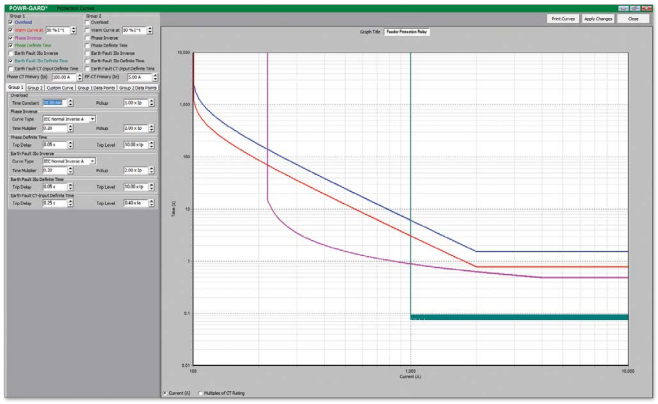
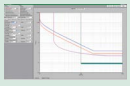
SOFTWARE



Protection Relays and Alarm Systems are supplied with free software. The software simplifies programming and allows the user to save setpoint files and reuse them for similar applications.

The software gives the ability to change parameters and see the impact on the protection time current curves. It also allows another device curve to be entered to view simple coordination.

SOFTWARE		
Product	Features	Accessory For
Solutions-M Relay Interface Software	Provides the ability to configure and monitor Modbus networks. The features include data logging, real-time data monitoring and fault and event monitoring. Devices can be added and configured manually or the software can scan an existing network to identify devices which can be used as is or reconfigured by the user. Setpoints for each device can be uploaded and downloaded for easy monitoring and reconfiguration.	**RS485** **TCP/IP networks** **MotorSaver and PumpSaver Devices**
SE-COMM-RIS Relay Interface Software 	Provides remote access to metering, control, data logging, and programming features. Setpoints can be accessed individually, downloaded as a file, and protective curves can be plotted. Metered data can be observed or logged for later study.	**FPU-32** **FPS** **MPS** **MPU-32**
SE-FLASH Firmware Update Utility	Used to update relay firmware to add new features.	**FPU-32** **FPS** **MPS** **MPU-32** **EL731**
SE-MON330 Relay Interface Software	Used to receive data from the SE-330. It displays relay set points and measured values, and features data logging of information at a selectable interval.	**SE-330** **SE-330AU** **SE-330HV**
VMPU Virtual Motor Protection Relay	Allows the user to scroll through the MPU-32 Motor Protection Relay menu.	**MPU-32**
VMPS Virtual Motor Protection System	Allows the user to scroll through the MPS Motor Protection System menu.	**MPS**
VFPU Virtual Feeder Protection Relay	Allows the user to scroll through the FPU-32 Feeder Protection Relay menu.	**FPU-32**
MPU-32 Tutorial MPU-32 Online Self-Training Tutorial	Online Self-Training tutorial for MPU-32 programming.	**MPU-32**

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ELECTRICAL

ELECTRICAL ACCESSORIES

Product	Features	Accessory For
PGA-1100.0010 Diode Logic Unit	Used in installations with more than one breaker and more than one Littelfuse Arc-Flash Relay. It separates the trip paths, so the breakers can be tripped independently from each other. **For full datasheet, see pg. 81**	**PGR-8800** **AF0500** **AF0100** **D0920** **D1000**
P1004-XX-(X) Versa-Pot	Panel mountable, industrial potentiometer recommended for remote time delay adjustment. The shaft is slotted for screwdriver adjustment and serrated for slip-proof finger adjustment. Accepts Versa-Knob or Lock Shaft. May be ordered with two 8 in (20.3 cm) wires soldered to pot (clockwise increase) and female quick connect terminals on other ends by adding suffix -X to end of part number.	P1004-95 & P1004-95-X: **Consult individual datasheet for compatibility** P1004-174 & P1004-175: **PHS Series** P1004-16 & P1004-16-X: **Series: ERDM ERDI ERD3 TRB TRM TRS TS1 TS6** P1004-15, P1004-14, P1004-13, P1004-12, & P1004-12-X: **Series: ORB ORM ORS TAC1 THD7 TRB TRM TRS TS1 TS2 TS4 TS6 TSD7 TSU2000**
P0700-7 Versa-Knob	Versa-Knob is designed for 0.25 in (6.35 mm) shaft of Versa-Pot. Semi-gloss industrial black finish.	**P1004-XX-(X)**
P0700-8 Lock Shaft	Fits 0.25 in (6.35 mm) potentiometer shafts. Locks by tightening nut onto four tapered/slotted fingers. Pressure on the shaft locks control against mis-adjustment. Nickel plated brass finish.	**P1004-XX-(X)**
P1004-9 **P1004-10** **P1004-31** Mini-Pot	A high quality, industrial potentiometer for remote time delay adjustment. The shaft extends through the timer's center hole for easy panel mounting. Use mini-mount bracket for standup mounting of timer. Adjustment by screwdriver or mini-knob. May be ordered with two 3 in (7.6 cm) wires soldered to pot (clockwise increase) and female quick connect terminals on other ends by adding suffix -X to end of part number.	**Series: TAC1 TS1 TS2 TS4 TS6 TSD7 TSU2000**
P0700-21 Mini-Knob	Mini-Knob is designed for 0.125 in (3.2 mm) shaft of Mini-Pot. Semi-gloss industrial black finish.	**P1004-9** **P1004-10** **P1004-31**

PART NUMBER	WITH WIRE LEADS	VALUE
P1004-199		50 kΩ
P1004-174		100 kΩ
P1004-175		200 kΩ
P1004-95	P1004-95-X	100 kΩ
P1004-17		500 kΩ
P1004-16	P1004-16-X	1M Ω
P1004-15		1.5M Ω
P1004-14		2M Ω
P1004-12	P1004-12-X	3M Ω
P1004-13		5M Ω

Specifications

Rating	0.25 W at 55 °C
Taper	Linear
Shaft Rotation	300° ±5°
Tolerance	±10 %
Shaft Diameter	0.25 in

PART NUMBER	VALUE
P1004-9	500kΩ
P1004-10	1MΩ
P1004-31	3MΩ

Specifications

Rating	0.25 W at 55 °C
Taper	Linear
Shaft Rotation	300° ±5°
Tolerance	±10 %
Shaft Diameter	0.125 in (3.2 mm)

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ELECTRICAL

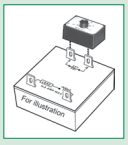
ELECTRICAL ACCESSORIES

Product	Features	Accessory For
P0200-19 Heat Sink Compound 2 grams **P0200-20** Heat Sink Compound 100 grams	Single package/container of heat sink compound consisting of primarily zinc oxide and having a 12 month shelf life (EOD date on the label). P0200-19 mounts one high current, plated 2 x 2 in (50.8 x 50.8 mm) timer or flasher. P0200-20 mounts 50+ units.	**Any 2 x 2 in (50.8 x 50.8 mm) plated timer or flasher.**
P1015-18 Quick Connect Screw Adaptor	Screw adaptor terminal designed for use with all modules with 0.25 in (6.35 mm) male quick connect terminals. Screw terminal accepts ring or spade terminals.	**Modules with 0.25 in (6.35 mm) male quick connect terminals. Consult the individual datasheet to determine compatibility.**
P1015-13 **P1015-64** **P1015-14** Female Quick Connect Terminals	These 0.25 in (6.35 mm) female terminals are constructed with an insulator barrel to provide strain relief.	**Consult individual datasheet to determine compatibility.**
P0400 Time Adjustment Dials	Dials for use with remote Versa-Pot and panel mounted Mini-Pot. Reverse screen printed on clear plastic to avoid damage to printed image.	**P1004-9** **P1004-10** **P1004-12** **P1004-13** **P1004-16** **P1004-31** **P1004-95**

PART NUMBER	RANGE	INCREMENTS
P0400-12	0.05 - 1 s	0.1 s
P0400-86	0.1 - 10 m	1 m
P0400-82	0.1 - 10 s	1 s
P0400-17	1 - 30 s	5 s
P0400-83	1 - 60 s	10 s
P0400-27	0 - 10	MRD*

*Multiplier Reference Dial

VTPXX
VTP



The VTP Series mounts on modules with in-line adjustment terminals. Rated at 0.25 W at 55 °C. Available in resistance values from 5 kΩ to 5 MΩ

Series: TAC1 THD7 THDM TS1 TS2 TS4 TS6 TSD7

PART NUMBER	R_T VALUE	RANGE	PART NUMBER	R_T VALUE	RANGE
VTP0E	250 kΩ	0.5–20s	VTP3L	2 MΩ	0.1–4 m
VTP1B	0.5 MΩ	0.05–3s	VTP4B	3 MΩ	0.05–3 s
VTP1C	0.5 MΩ	0.1–10s	VTP4F	3 MΩ	0.5–60 s
VTP1D	0.5 MΩ	0.5–10s	VTP4J	3 MΩ	2–180 s
VTP2A	1 MΩ	0.05–1s	VTP4P	3 MΩ	1–100 m
VTP2C	1 MΩ	0.1–10s	VTP5G	5 MΩ	1–100 s
VTP2E	1 MΩ	0.5–20s	VTP5K	5 MΩ	10–1000 s
VTP2F	1 MΩ	0.5–60s	VTP5N	5 MΩ	0.1–10 m
VTP2J	1 MΩ	2–180s	VTP5P	5 MΩ	1–100 m
VTP2P	1 MΩ	1–100m	VTPDF	50 kΩ	0.5–60 s
VTP3B	2 MΩ	0.05–3s			

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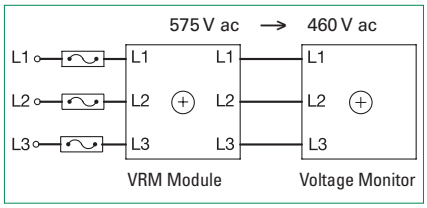
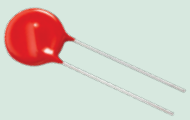
ELECTRICAL

ELECTRICAL ACCESSORIES

Product	Features	Accessory For
LPSM003ZXID Indicating Fuse Holder **LPSM003Z** Non-indicating Fuse Holder	Littelfuse POWR-SAFE Dead Front holders provide optimum protection to personnel for Class CC and Midget-Style fuses. 600 V ac/dc	**Class CC and Midget-Style fuses**
0KLK002.T Midget Fuse (2 Amp)	10 x 38 fast acting, high-interrupting capacity, current-limiting type fuse. 600 V ac/500 V dc	**FH3P** **LPSM003ZXID** **LPSM003Z**
VRM6048 Voltage Monitor Accessory Module 	The VRM6048 accessory module allows the voltage monitor to monitor a 3-phase 550 to 600 V ac Line. **Adjustment** If the measured line voltage is 575 V ac, connect as shown and adjust/select the voltage monitor for 460 V ac operation. **Package** Molded housing with encapsulated circuitry **Mounting** Surface mount with one #10 (M5 x 0.8) plastic screw. May be DIN-rail mounted using P1023-20 Adaptor. **Termination** Screw terminals with captive wire clamps for up to No.12 AWG wire. **Operating** -40 °C to 70 °C **Storage** -40 °C to 85 °C **Humidity** 95 % relative, non-condensing **Voltage** **Input** 600 V ac, 575 V ac, 550 V ac **Output*** 480 V ac, 460 V ac, 440 V ac *The VRM6048 must be connected as shown. If the voltage monitor is disconnected, the VRM output voltage equals the input voltage.	**Series:** **PLM** **PLR** **PLS** **TVM** **TVW** **(manufactured after December 2003)**
V150LA10AP LA Varistor 	The V150LA10AP, a transient voltage surge suppressor, is a radial leaded varistors (MOVs) that is designed to be operated continuously across ac power lines. This UL Recognized varistor requires very little mounting space.	**Any of our products that operate below 150 V ac or 200 V dc.**

PRODUCT	MAX. OPERATING VOLTAGE		MAX IMPULSE CURRENT 80.20 µs CURRENT WAVE (A)	VARISTOR VOLTAGE AT 1MA DC TEST CURRENT		PEAK CLAMPING VOLTAGE WITH 80.20 µs WAVE		CAPACITANCE	DISC DIAMETER SIZE (MM)
	AC (V)	DC (V)		MIN. (V)	MAX. (V)	V_C (V)	1_{PK} (A)		
V150LA10AP	150	200	4500	216	264	395	50	800	14

GR MODULES, HIGH-TENSION COUPLERS, & RELAY TESTERS

GROUND-REFERENCE MODULES

Product	Features	Accessory For
SE-GRM024 Ground Reference Module	Connects the SE-601 relay to an ungrounded 24 V dc bus.	**SE-601**
SE-GRM048 Ground Reference Module	Connects the SE-601 relay to an ungrounded 48 V dc bus.	**SE-601**
SE-GRM125 Ground Reference Module	Connects the SE-601 relay to an ungrounded 125 V dc bus.	**SE-601**
SE-GRM250 Ground Reference Module	Connects the SE-601 relay to an ungrounded 250 V dc bus.	**SE-601**
SE-GRM500 Ground Reference Module	Connects the SE-601 relay to an ungrounded 500 V dc bus.	**SE-601**
SE-GRM780 Ground Reference Module	Connects the SE-601 relay to an ungrounded 780 V dc bus.	**SE-601**
SE-GRM1000 Ground Reference Module	Connects the SE-601 relay to an ungrounded 1000 V dc bus.	**SE-601**

HIGH-TENSION COUPLERS

Product	Features	Accessory For
PGH-5000 High Tension Couplers	Allows 5 kV systems to be connected to relay.	**PGR-6100** **PGR-3200**
PGH-6000 High Tension Couplers	Allows 6 kV systems to be connected to relay.	**PGR-6100** **PGR-3200**

PROTECTION RELAY TESTERS

Product	Features	Accessory For
SE-100T c SP us Ground-Fault Relay Tester	Tests the current pickup level ground-fault protection. Tests the entire ground-fault circuit.	**Any Relay on Substations, MCCs, Central Distribution Panels, Switchboards, and Test Benches**
SE-400 Ground-Fault-Relay Test Unit	Tests the current pickup level, time delay and coordination of ground-fault protection. Tests the entire ground-fault circuit.	**Any Relay on Substations, MCCs, Central Distribution Panels, Switchboards, and Test Benches**

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INPUT MODULES & METERS

INPUT MODULES			
Product		Features	Accessory For
MPS-RTD Temperature Input Module		Provides 8 programmable inputs to connect Pt100, Ni100, Ni120, and Cu10 RTDs.	**MPU-32** **MPS**
MPS-DIF Differential Current Module		Adds motor differential protection, compatible with core balance and summation current transformer connections.	**MPU-32** **MPS**
MPU-CIM Current Input Module		Interface between current transformers and MPU-32 or FPU-32 series relays. Reduces potential for open CT hazard.	**MPU-32** **FPU-32**
PGA-LS10 Point Sensor		Line-of-sight light sensor detects an arc as small as 3 kA within a 2 m half-sphere. Local LED continually displays sensor health or trip state.	**PGR-8800** **AF0500** **AF0100**
PGA-LS20 Fiber-Optic Sensor		Used to detect light and coordinate with current detection to eliminate nuisance tripping. 8 m (26.2 ft) active; 10 m (32.8 ft) total.	**PGR-8800** **AF0500** **AF0100**
PGA-LS30 Fiber-Optic Sensor		Used to detect light and coordinate with current detection to eliminate nuisance tripping. 18 m (59 ft) active; 20 m (66 ft) total	**PGR-8800** **AF0500** **AF0100**
A0200/A0300 Light Sensor		Line-of-sight light sensor detects an arc as small as 3 kA within a 2 m halfsphere. Available in both 180° and 360°.	**D0920**
A0220 Arc Detecting Point Sensor		Line-of-sight light sensor detects an arc as small as 3 kA within a 2 m half-sphere. Available with 10 or 15 m cable. **For full datasheet and ordering information, see pg. 80**	**PGR-8800** **AF0500** **AF0100** **D0920** **D1000**
LCSC10T12 Toroidal Current Sensor		Remote monitoring of currents up to 50 A. Inner diameter 9.14 mm (0.36")	**DCSA Series**

REMOTE INDICATION & METERS			
Product		Features	Accessory For
RK-105 Remote Indication and Reset Assembly		Panel-mounted remote indication and reset with NEMA 1 rating.	**SE-105** **SE-107**
RK-105I Remote Indication Assembly		Panel-mounted remote indication with NEMA 1 rating.	**SE-105** **SE-107**
RK-102 Industrial Remote Indication and Reset Kit		Panel-mounted remote indication and reset, standard 22 mm mounting, with NEMA 4 and NEMA 13 rating.	**SE-105** **SE-107**
RK-132 Industrial Remote Indication and Reset Kit		Panel-mounted remote indication and reset, standard 22 mm mounting, with NEMA 4 and NEMA 13 rating.	**SE-134C** **SE-135** **SE-145**
RK-325 Remote Indication and Reset Assembly		Panel-mounted remote indication and reset with NEMA 1 rating.	**SE-325**

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METERS & SENSING RESISTORS

REMOTE INDICATION & METERS		
Product	Features	Accessory For
RK-325I Remote Indication Assembly	Panel-mounted remote indication with NEMA 1 rating.	**SE-325**
RK-302 Remote Indication and Reset Kit	Panel-mounted remote indication and reset, standard 22 mm mounting with NEMA 4 and NEMA 13 rating.	**SE-325**
RK-332 Remote Indication and Reset Kit	Panel-mounted remote indication and reset, standard 22 mm mounting with NEMA 4 and NEMA 13 rating.	**SE-330** **SE-330AU** **SE-330HV**
PGA-0500 Analog % Current Meter	Panel-mounted analog meter displays ground-fault current as a percentage of the set point.	**SE-601** **SE-701** **PGR-4300** **SE-703** **PGR-6100** **SE-704**
PGA-0510 Analog Ohm Meter	Panel-mounted analog ohmmeter displays insulation resistance from 0 Ω to infinity.	**PGR-3200** **PGR-6100** **PGR-6101-120**

SENSING RESISTORS		
Product	Features	Accessory For
ER-600VC (PGE-600V) Sensing Resistor	Used on systems up to 1 kV. (Continuous duty)	**SE-330** **SE-325** **SE-330AU**
SE-MRE-600 Enclosure	Used in outdoor enclosures. (ER-600 VC ordered separately)	**ER-600VC**
ER-5KV (PGE-05KV) Sensing Resistor	Used on systems up to 5 kV. (Continuous duty)	**SE-330** **SE-325** **SE-330AU**
ER-5WP (PGE-05WV) Sensing Resistor	Used on systems up to 5 kV, includes weather-protected terminals for use in outdoor enclosures. (Continuous duty)	**SE-330** **SE-325** **SE-330AU**
ER-15KV (PGE-15KV) Sensing Resistor	Used on systems up to 15 kV. (Non-continuous duty)	**SE-330** **SE-325** **SE-330AU** **SE-330HV**
ER-25KV (PGE-25KV) Sensing Resistor	Used on systems up to 25 kV. (Non-continuous duty)	**SE-330** **SE-325** **SE-330AU** **SE-330HV**
ER-35KV (PGE-35KV) Sensing Resistor	Used on systems up to 35 kV. (Non-continuous duty)	**SE-330** **SE-330AU** **SE-330HV**
ER-72KV (PGE-72KV) Sensing Resistor	Used on systems up to 72 kV. (Non-continuous duty)	**SE-330HV**

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REMOTE INDICATION & MONITORING

REMOTE INDICATORS & MONITORS

Product	Features	Accessory For
RM1000 **RM1000-3R** **RM1000 NEMA 4** Motor-monitoring Device	Motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products, and the 601 voltage monitors, via Modbus protocol with a communications module. The RM1000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring. **For full datasheet, see pg. 246**	**777 series** **77C series** **601 series**
RM2000 **RM2000CBM+** **RM2000-RTDW** Motor-monitoring Device	Motor-monitoring device to be used in conjunction with the 777 family of products (excluding the P1 Series), 77C family of products and the Model 601 voltage monitors, via Modbus protocol with a communications module. The RM2000/777 motor management system combines unsurpassed electronic motor protection and critical, user-friendly, motor monitoring. **For full datasheet, see pg. 248**	**777 series** **77C series** **601 series**
INFORMER Remote diagnostic tool	Hand-held diagnostic tool designed for use with single-phase pump relays. The Informer uses an infrared receiver to access information sent from the relay which can be helpful for troubleshooting the system. Comes with IR Kit-12 (12" long). **For full datasheet, see pg. 250**	**111P** **111-Insider-P** **111P-ENCL** **231-Insider-P** **232-Insider** **233P-1.5** **233P-ENCL** **233P-1.5-ENCL** **234-P** **235P** **235P-ENCL**
IR Kit-36 (36" long) Informer Fiber Optic Kit	Use with the Informer. Simply attaches to the face of the unit to provide remote diagnostics without opening the panel.	**LSRX1** **111-Insider-P** **455** **LSRX-C** **231-Insider-P**
INFORMER-MS Remote diagnostic tool	Hand-held diagnostic tool designed for use with the Littelfuse 455 series. The Informer-MS uses an infrared receiver to read valuable information transmitted from the 455, which can be helpful for troubleshooting the system **For full datasheet, see pg. 252**	**455 series**
OL-RESET Remote Reset Module	Allows the 777 line of motor and pump relay products to be manually reset without opening the panel door. Simply connect the module to the 777 communication port, connect a wire to each of the two applicable pins on the OL-RESET and to a normally-open push-button switch (sold separately). Mount the push-button switch in a convenient location.	**777 series**
777-MRSW Manual Remote Reset Kit (24" long)	Allows the 777 line of motor and pump relay products to be manually reset without opening the panel door. Simply connect the 9-pin adapter to the 777 communication port and mount the push-button switch in a convenient location.	**777 series**
M500 Electronic Megohmmeter	Automatic, portable, battery-powered insulation tester. This unit is specifically designed as an inexpensive alternative to costly swing needle megohmmeters. The M500 measures insulation resistance values of motors, generators and transformers up to 1000 megohms at 500 V ac, indicating the condition of insulation on the zone scale. Its compact design and ease of use makes the M500 a great diagnostic tool for motor rewind shops, electrical maintenance personnel and pump installers.	

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COMMUNICATION ADAPTERS & MODULES

COMMUNICATION ADAPTERS

Product	Features	Accessory For
RS485-RS232 Converter with cable & plug	Allows RS485 devices to be connected to a PC via the RS232 (serial) port. The converter provides convenient terminal blocks for making signal and dc power supply connections. An optional power supply may be required for laptops or other computers with low power serial ports, or for very large networks. Pre-wired for easy installation on the RS485MS-2W module.	**RS485MS-2W**
RS485-USB Converter with cable & plug/RS232:USB	Allows RS485 devices to be connected to a PC via the USB port. The converter provides convenient terminal blocks for making signal and dc power supply connections. An optional power supply may be required for laptops or other computers with low power serial ports, or for very large networks. Pre-wired for easy installation on the RS485MS-2W module.	**RS485MS-2W**
AC700-CUA Communications Adapter	Optical network-interface and firmware-upgrade communication adapter. Field-installed.	**EL731**

COMMUNICATION MODULES

Product	Features	Accessory For
RS485MS-2W Communication Module	This module is required when the RM1000, RM2000 or other Modbus capable device is used with 77X-type products. **For full datasheet, see pg. 254**	**Series: RM1000 77X RM2000**
CIO-DN-P **CIO-120-DN-P** Communication link to PLC/ SCADA/monitoring systems	Convenient and cost-effective Devicenet™ interfaces capable of providing discrete control and monitoring of motor starters, drives and other devices over a Devicenet network. **For full datasheet, see pg. 257**	**777 series**
CIO-EN Communication link to PLC/ SCADA/monitoring systems	The CIO-EN Module (non-POE) is a convenient and cost-effective Modbus-TCP and Modbus-RTU interface capable of providing discrete control and monitoring of an overload relay over a Modbus network. **For full datasheet, see pg. 260**	**777 series**
CIO-MB **CIO-120-MB** Communication link to PLC/ SCADA/monitoring systems	Convenient and cost-effective Modbus-RTU interfaces capable of providing discrete control and monitoring of an overload relay over a Modbus network. **For full datasheet, see pg. 255**	**777 series**
CIO-777-PR Communication link to PLC/ SCADA/monitoring systems	Convenient and cost-effective Profibus interface capable of providing discrete control and monitoring of motor starters, drives and other devices over a Profibus network. **For full datasheet, see pg. 259**	**777 series ending in P, -P, or -P2**
CIO-601CS-DN-P1	Convenient and cost-effective DeviceNet device capable of providing discrete control and monitoring of motor starters, drives and other devices over a DeviceNet network.	**601-CS-D-P1**
COM 4-20 Communication link to PLC/ SCADA/monitoring systems	Send a 4-20 mA signal proportional to the output power. It can also be used to send the input power by setting the efficiency setting on the 777-AccuPower monitor to one. This module allows communication to a PLC with an analog input and no Modbus input. **For full datasheet, see pg. 261**	**777-AccuPower**

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TERMINATIONS & ADAPTERS

TERMINATIONS & ADAPTERS		
Product	Features	Accessory For
1N5339B Termination Device	5 W axial-lead ground-check termination. Included with SE-105 and SE-107.	**SE-105** **SE-107**
SE-TA6-SM Stud-Mount Termination Assembly	50 W ground-check termination that is robust and compact for submersible pumps. Wire lead simplifies installation. (Replacement for 1N4553B)	**SE-105** **SE-107**
SE-TA6 Termination Assembly	50 W ground-check termination with convenient mounting holes and screw terminals.	**SE-105** **SE-107**
SE-TA6A **(PGA-0T6A)** Termination Assembly	Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.	**SE-105** **SE-107** **SE-134C**
SE-TA6A-WL Termination Assembly	Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.	**SE-105** **SE-107** **SE-134C**
SE-TA6ASF-WL Small-Format Termination Assembly with Wire Leads	Temperature compensated 12 W ground-check termination, ideal for use in cable-coupler end caps and submersible pumps. Mounting holes and wire leads.	**SE-105** **SE-107** **SE-134C**
SE-TA12A Termination Assembly	Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.	**SE-135** **SE-145**
SE-TA12ASF-WL Small-Format Termination Assembly with Wire Leads	Temperature compensated 12 W ground-check termination, ideal for use in cable-coupler end caps and submersible pumps. Mounting holes and wire leads.	**SE-135** **SE-145**
SE-TA12A-WL Termination Assembly	Temperature compensated 50 W ground-check termination with convenient mounting holes and screw terminals.	**SE-135** **SE-145**
SE-TA12A **SE-TA12B** Termination Assemblies	Used together to allow an SE-134C to monitor a splitter box and two cables.	**SE-134C**
PPI-600V Parallel Path Isolator	Parallel ground-path rejection for ground-check monitors. Eliminates intermachine arcing and prevents stray dc currents from flowing in a monitored ground wire.	**SE-105** **SE-107** **SE-134C** **SE-135**
RK-13 Relay Interface Module	Separate ground-fault and ground-check indication contacts for the SE-105, and separate ground-fault and resistor-fault contacts for the SE-325. Used to provide output to a PLC and operate standard pilot lights. Complete with conformally coated circuit boards.	**SE-105** **SE-107** **SE-325**
SE-485-DIN Industrial RS-485 to RS-232 Converter	Industrial network quality RS-485 to RS-233 serial converter. DIN-rail mounted, 24 V dc required.	**MPS** **FPS**
SE-485-PP Port-Powered Serial Converter	Converts an RS-485 signal to an RS-232 signal. Used for set-point programming and updating flash memory. 115.2 kbit/s maximum transfer rate.	**MPU-32** **MPS** **FPU-32** **FPS**
CA-945 Serial Connector Adapter Kit	Connects an RJ45 to a 9-pin serial connector. Includes 1.5 m cable and plug-in adapter.	**MPU-32** **FPU-32**
SE-ICUSB232 USB to RS-232 Converter	Connects a 9-pin serial cable to a USB port.	**SE-330** **CA-945** **SE-330AU** **SE-330HV** **SE-485-PP** **SE-485-DIN**

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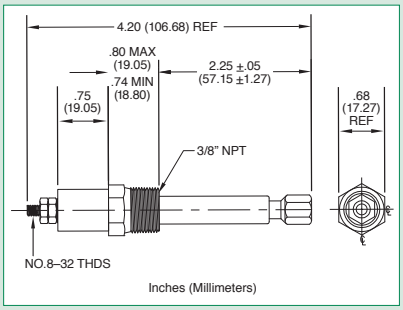
LIQUID LEVEL PROBES & PROBE HOLDERS

LIQUID LEVEL CONTROL ELECTRODES		
Product	Features	Accessory For
LLP-24 Liquid Level Probe	Threaded stainless steel probe measuring 24 in (61 cm) long. Designed for use with PHST-38QTN liquid level control electrodes.	**PHST-38QTN**
PHST-38QTN Probe Holder **P0700-409** Protective Boot 	Designed for use with all conductive liquid level controls. Composed of insulators and metal parts made of number 300 series stainless steel. These internally conductive probe holders are designed for a maximum steam pressure of 240 PSI; 400 °F maximum. Maximum voltage from electrode to ground. PHST-38QTN is UL 353 Recognized.	**Series:** **LLC1** **LLC2** **LLC4** **LLC5** **LLC6** **LLC8** **PC-XXX-LLC-CZ** **PC-XXX-LLC-GM** **460-15-100-LLS**

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CT SELECTION GUIDE

	PRODUCT	GROUND-FAULT CT	GROUND-FAULT TRIP LEVEL (or insulation level)	PHASE CTS	PAGE #
GROUND-FAULT PROTECTION	SE-601	No CTs required	1–20 mA	N/A	–
	PGR-3100	No CTs required	Indication only	N/A	–
	PGR-3200	No CTs required	Warnings at 30 kΩ & 50 kΩ Alarm at 10 kΩ	N/A	–
	SE-701/SE-703	CT200 series	10–198 A	N/A	480
		EFCT series	50 mA–4.95 A		480
		SE-CS30 series	300 mA–29.7 A		480
	SE-704	SE-CS30 series	10 mA–5 A	N/A	480
	EL731	EFCT series	30–5,000 mA ac and dc	N/A	480
GROUND-CONDUCTOR MONITORING	SE-105/SE-107	CT200 series	0.5–4 A	N/A	480
	SE-134C/SE-135	SE-CS10 series	0.5–12.5 A	N/A	480
RESISTANCE GROUNDING	SE-330	CT200 series	12–200 A	N/A	480
		EFCT series	100 mA–5 A		480
		SE-CS30 series	600 mA–30 A		480
	SE-325	CT200 series	0.5–4 A	N/A	480
MOTOR & PUMP PROTECTION	MPU-32*	CT200 series	10–200 A	N/A	480
		EFCT series	50 mA–5 A		480
		SE-CS30 series	300 mA–30 A		480
	MPS*	CT200	10–200 A	1-A, 5-A Secondary CTs	480
		EFCT series (5-A Primary)	50 mA–5 A		480
		SE-CS30 series (30-A Primary)	300 mA–30 A		480
	MPU-32-X69X-PMA16	Existing CTs can be used or same as MPU-32.			480
	MPS-469X-PMA24	Existing CTs can be used or same as MPS.			480
FEEDER PROTECTION	FPU-32*	CT200 series	10–200 A	1-A, 5-A Secondary CTs	480
		EFCT series	50 mA–5 A		480
		SE-CS30 series	300 mA–30 A		480
	FPS*	CT200	10–200 A	1-A, 5-A Secondary CTs	480
		EFCT series (5-A Primary)	50 mA–5 A		480
		SE-CS30 series (30-A Primary)	300 mA–30 A		480
ARC-FLASH PROTECTION	PGR-8800‡	N/A	N/A	5-A Secondary CTs (optional)	480

Note: See page 502 for additional information on CT selection. See page 482 for CT sizing chart.

*Phase CTs should be selected with a primary rating of 100—300 % of rated current to maintain specified accuracy.
‡Select a CT with a primary rating approximately equal to the system's rated current.

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CURRENT TRANSFORMERS

CURRENT TRANSFORMERS			
Product	Features	Inner Diameter	Accessory For
CT200 (PGC-2056) Current Transformer	Detects phase current or ground-fault current (200-A primary)	56 mm (2.20")	**FPS, FPU-32, MPS, MPU-32, PGR-8800, SE-105/107, SE-330, SE-325, SE-701**
CT200L (PGC-2089) Current Transformer	Detects phase current or ground-fault current (200-A primary)	89 mm (3.50")	**FPS, FPU-32, MPS, MPU-32, PGR-8800, SE-105, SE-107, SE-701**
EFCT-26 (PGC-3026) Ground-Fault Current Transformer	Sensitive current transformer used to detect ground-fault current (5-A primary)	26 mm (1.02")	**EL731, FPS, FPU-32, MPS, MPU-32, SE-330, SE-701**
EFCT-1 (PGC-3082) Ground-Fault Current Transformer	Sensitive current transformer used to detect ground-fault current (5-A primary)	82 mm (3.23")	**EL731, FPS, FPU-32, MPS, MPU-32, SE-330, SE-701**
EFCT-2 (PGC-3140) Ground-Fault Current Transformer	Sensitive current transformer used to detect ground-fault current (5-A primary)	140 mm (5.50")	**EL731, FPS, FPU-32, MPS, MPU-32, SE-701**
EFCT-1FC (PGC-31FC) Flux Conditioner	Fits in the EFCT-1 window to reduce saturation and prevent false operation due to large surge currents	70 mm (2.75")	**EFCT-1**
SE-CS10-2.5 (PGC-4064) Current Sensor	Detects ground-fault current	64 mm (2.50")	**SE-134C, SE-135, SE-145**
SE-CS10-4 (PGC-4108) Current Sensor	Detects ground-fault current	108 mm (4.25")	**SE-134C, SE-135, SE-145**
SE-CS10-6 (PGC-4160) Current Sensor	Detects ground-fault current	160 mm (6.31")	**SE-134C, SE-135, SE-145**
SE-CS10-8 (PGC-4210) Current Sensor	Detects ground-fault current	210 mm (8.25")	**SE-134C, SE-135, SE-145**
SE-CS30-26 (PGC-5025) Ground-Fault Current Transformer	Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)	25 mm (0.98")	**FPS, FPU-32, MPS, MPU-32, PGR-6100, PGR-6101, SE-330, SE-701, SE-704**
SE-CS30-70 (PGC-5060) Ground-Fault Current Transformer	Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)	60 mm (2.36")	**FPS, FPU-32, MPS, MPU-32, PGR-6100, PGR-6101, SE-330, SE-701, SE-704**
SE-CS30-4 (PGC-5095) Ground-Fault Current Transformer	Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)	95 mm (3.74")	**FPS, FPU-32, MPS, MPU-32, PGR-6100, PGR-6101, SE-330, SE-701, SE-704**
SE-CS30-5 (PGC-5130) Ground-Fault Current Transformer	Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)	130 mm (5.12")	**FPS, FPU-32, MPS, MPU-32, PGR-6100, PGR-6101, SE-330, SE-701, SE-704**
SE-CS30-8 (PGC-5200) Ground-Fault Current Transformer	Current Transformer for low-level ground faults, flux conditioner is standard (30-A primary)	200 mm (7.87")	**FPS, FPU-32, MPS, MPU-32, PGR-6100, PGR-6101, SE-330, SE-701, SE-704**
SE-CS40-6 Current Sensor	Detects ground-fault current	160 mm (6.31")	**SE-135, SE-145**

NOTE: Contact factory for additional CT offerings.

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INSTRUMENTATION & METERING TRANSFORMERS

Donut Style **Foot Mounted**

Description

Littelfuse offers a wide array of instrument rated current transformers in 1–3 inch diameter opening.

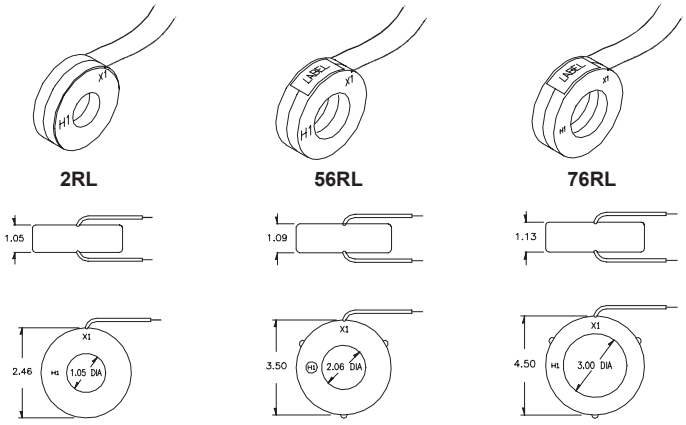
Voltage class: 600 V

BIL rating: 10 kV

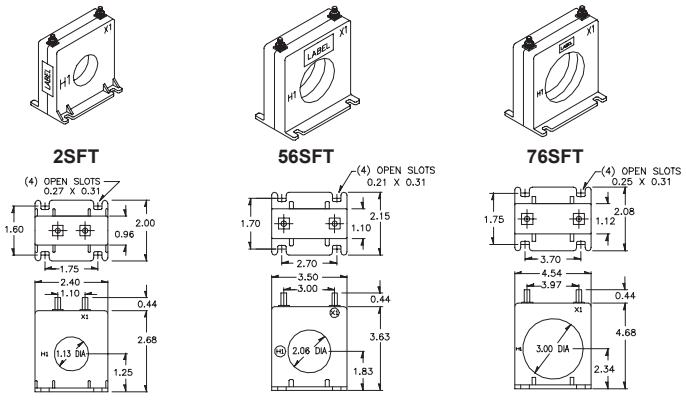
Certification: cRUus (WICC File E100575)

Dimensional Drawing

DONUT STYLE



FOOT MOUNTED WITH BRASS TERMINALS



Ordering Information

DONUT MODEL	WINDOW	CURRENT RATIO
CT-0050-D10	1.0"	50:5
CT-0075-D10	1.0"	75:5
CT-0100-D10	1.0"	100:5
CT-0150-D10	1.0"	150:5
CT-0200-D10	1.0"	200:5
CT-0300-D10	1.0"	300:5
CT-0200-D20	2.0"	200:5
CT-0300-D20	2.0"	300:5
CT-0400-D20	2.0"	400:5
CT-0500-D20	2.0"	500:5

FOOTED MODEL	WINDOW	CURRENT RATIO
CT-0050-F10	1.0"	50:5
CT-0100-F10	1.0"	100:5
CT-0150-F10	1.0"	150:5
CT-0200-F10	1.0"	200:5
CT-0300-F10	1.0"	300:5
CT-1200-F15	1.5"	1200:5
CT-0150-F20	2.0"	150:5
CT-0200-F20	2.0"	200:5
CT-0300-F20	2.0"	300:5
CT-0400-F20	2.0"	400:5
CT-0600-F20	2.0"	600:5
CT-0400-F30	3.0"	400:5
CT-0800-F30	3.0"	800:5

Part Numbering System

CT - xxx - D10

Series

Current Ratio
xxx:5 current ratio

Window Size
10 = 1.0 inch
15 = 1.5 inches
20 = 2.0 inches
30 = 3.0 inches

Style
D = Donut Style
F = Footed Style

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INSTRUMENTATION & METERING TRANSFORMERS

INSTRUMENTATION AND METERING TRANSFORMERS			
Product	Features	Inner Diameter	Accessory For
CT-XXXX-DXX Series Donut Style Transformer	Littelfuse offers a wide array of instrument rated current transformers in 1–3 inch diameter opening. **For full datasheet and ordering information, see page 481.**	25.4 - 76.2 mm (1 - 3")	**Series:** **777 DCSA ECS** **ECSW LSR-0 LSR-XX** **LSRU LSRX TCS** **TCSA LCSC10T12**
CT-XXXX-FXX Series Footed Style Transformer	Littelfuse offers a wide array of instrument rated current transformers in 1–3 inch diameter opening. **For full datasheet and ordering information, see page 481.**	25.4 - 76.2 mm (1 - 3")	**Series:** **777 DCSA ECS** **ECSW LSR-0 LSR-XX** **LSRU LSRX TCS** **TCSA LCSC10T12**

Current Transformer Sizing Chart

Conductor Size (AWG/kcmil)	Minimum CT Window Size (Inner Diameter in mm)					
	Number of Conductors					
	1	3	4	6	8	12
12	4	8	9	11	13	15
10	6	10	11	14	16	19
8	7	12	14	17	20	24
6	9	15	18	22	25	31
4	11	19	22	28	32	39
3	13	22	25	31	36	44
2	14	25	28	35	40	49
1	16	28	32	39	45	55
1/0	18	31	36	44	51	62
2/0	20	35	40	49	57	69
3/0	23	39	45	55	64	78
4/0	25	44	51	62	72	88
250	28	48	55	67	78	95
350	33	56	65	80	92	113
500	39	67	78	95	110	135
750	48	82	95	117	135	165
1000	55	95	110	135	156	191

Installation Instructions:

When installing the Zero-Sequence CTs, ensure the following:

1. Only the load carrying conductors pass through the center of the CT. This means L1 + N for 1-phase and L1+ L2 + L3 for 3-phase.
2. The power conductors pass through the center of the CT and are preferably bound together to keep the conductors uniformly spaced.
3. The power conductors pass perpendicular to the CT and, where practical, continue perpendicular to the CT on both sides of the CT for 3".
4. The power conductors should not be installed in a way that allows them to run along the side edges of the CT.
5. Where practical, locate the CT away from noise-generating devices such as transformers, frequency converters, etc.

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ELCT SERIES

Current Transformer

Description

The ELCT series is a sensitive current transformer with integrated flux conditioner used with Littelfuse relays to detect low levels of earth-leakage current.

Accessories

CBLTP
Twisted-pair wire for connection to CT.
Order in desired length in meters.

Specifications

Current Rating	**ELCT5:** 5:0.05 A **ELCT30:** 30:0.05 A
Accuracy	**ELCT5**: 3 % @ 0.01 VA **ELCT30**: 3 % @ 0.06 VA
Frequency	50 to 400 Hz
Insulation Level	600 V
Operating Temperature	-40 °C to 55 °C (-40 °F to 131 °F)
Application	SE-701
Wire Gauge	0.05–3.3 mm² (12–30 AWG)
Tightening Torque	0.5 N-m
Certification	UL, cUL, CE
Compliance	RoHS, IEC 61869-2, ANSI/IEEE C57.13

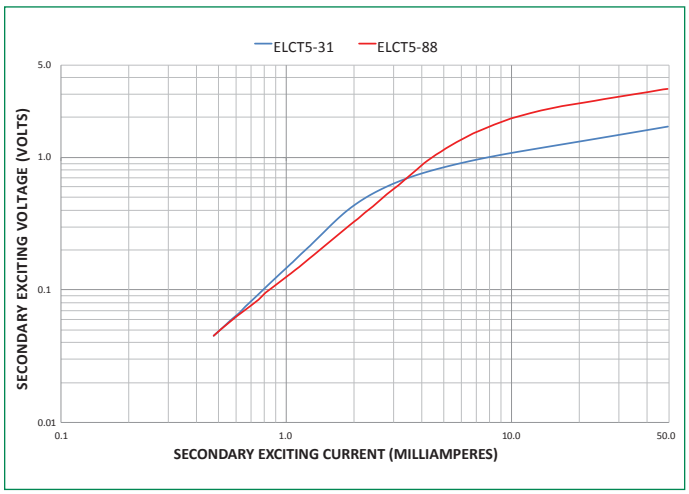
Note: One frequency response may be extended for specific product families

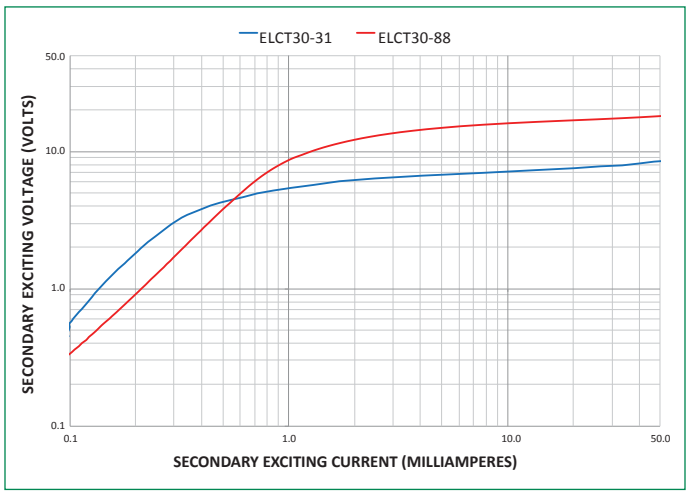
Ordering Information

ORDERING NUMBER	TURNS RATIO	WINDOW SIZE, ID	WEIGHT
ELCT5-31	100:1	31 mm (1.22 in)	127.0 g (0.28 lbs)
ELCT5-88	100:1	88 mm (3.46 in)	635.0 g (1.40 lbs)
ELCT30-31	600:1	31 mm (1.22 in)	131.5 g (0.29 lbs)
ELCT30-88	600:1	88 mm (3.46 in)	680.4 g (1.50 lbs)

Recommended Relay

Series: SE-330
SE-704 (ELCT30-series)

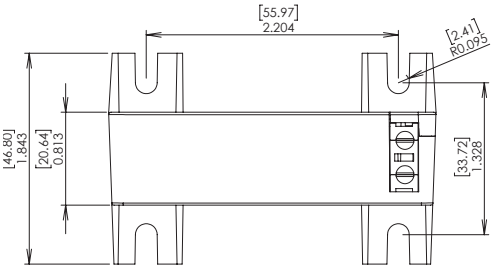


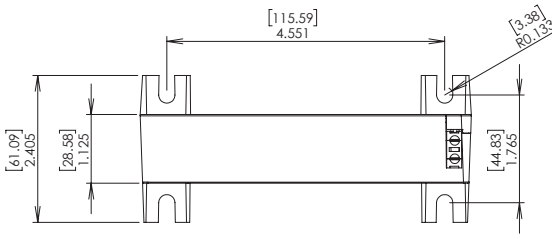


Dimensions and Mounting Diagram

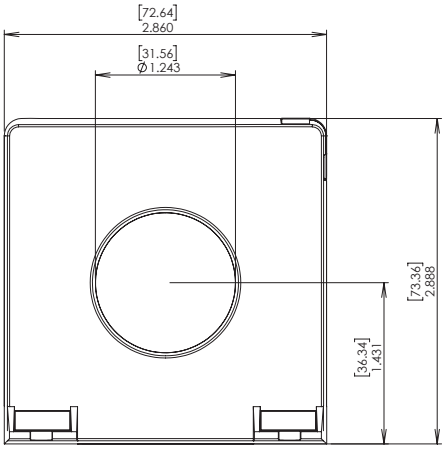
Inches [millimeters]

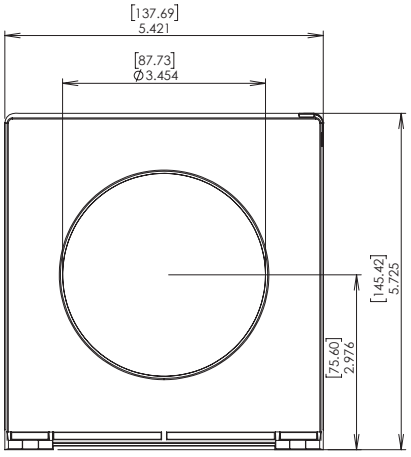
Mount the ELCT5-31 and ELCT30-31 using M5 or #10 screws.
Mount the ELCT5-88 and ELCT30-88 using M6 or ¼" screws.



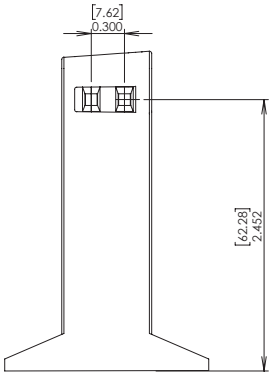


TOP VIEW AND MOUNTING DETAIL



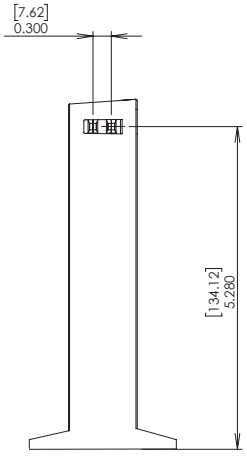


FRONT VIEW



ELCT5-31 and ELCT30-31

SIDE VIEW



ELCT5-88 and ELCT30-88

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ZSCT SERIES

Current Transformer

Description

The ZSCT series is a current transformer used with Littelfuse relays to detect low levels of earth-leakage current.

Accessories

CBLTP
Twisted-pair wire for connection to CT.
Order in desired length in meters.

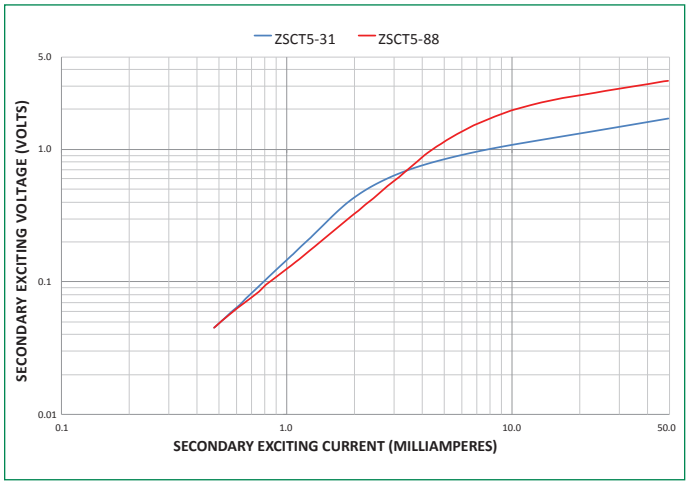
Specifications

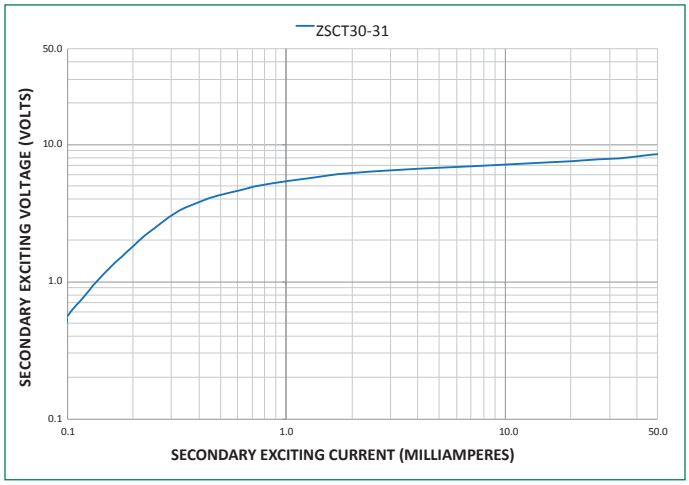
Current Rating	**ZSCT5:** 5:0.05 A **ZSCT30:** 30:0.05 A
Accuracy	**ZSCT5:** 3 % @ 0.01 VA **ZSCT30:** 3 % @ 0.06 VA
Frequency	50 to 400 Hz
Insulation Level	600 V
Operating Temperature	-40 °C to 55 °C (-40 °F to 131 °F)
Application	MP8000
Wire Gauge	0.05-3.3 mm² (12–30 AWG)
Tightening Torque	0.5 N-m
Certification	UL, cUL, CE
Compliance	RoHS, IEC 61869-2, ANSI/IEEE C57.13

Note: One frequency response may be extended for specific product families

Ordering Information

ORDERING NUMBER	TURNS RATIO	WINDOW SIZE, ID	WEIGHT
ZSCT5-31	100:1	31 mm (1.22 in)	117.9 g (0.26 lbs)
ZSCT5-88	100:1	88 mm (3.46 in)	499.0 g (1.10 lbs)
ZSCT30-31	600:1	31 mm (1.22 in)	113.4 g (0.25 lbs)





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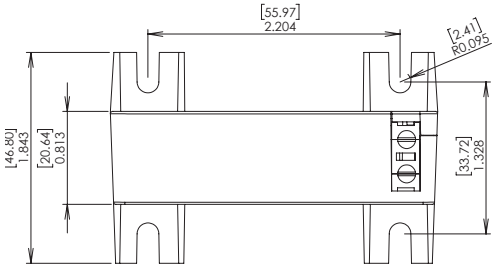
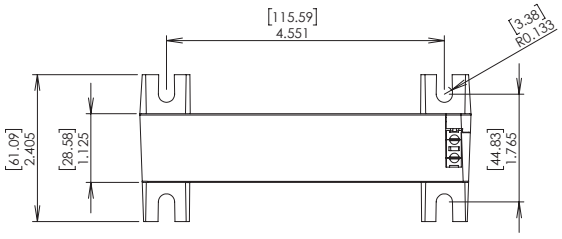
ZSCT SERIES

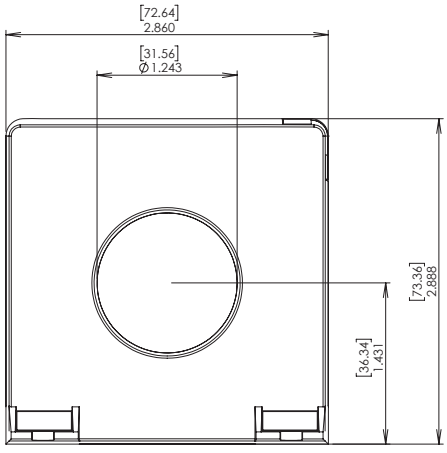
Dimensions and Mounting Diagram
Inches [millimeters]

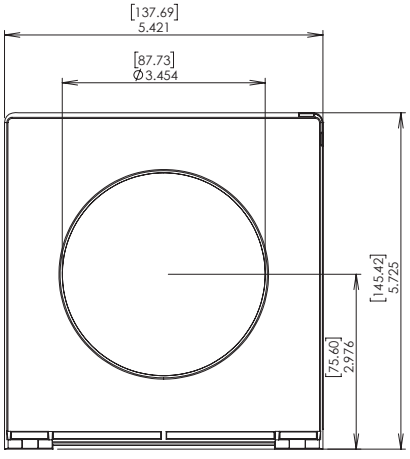
Mount the ZSCT5-31 and ZSCT30-31 using M5 or #10 screws.
Mount the ZSCT5-88 using M6 or ¼" screws.



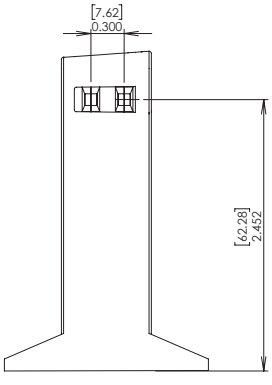


TOP VIEW AND MOUNTING DETAIL



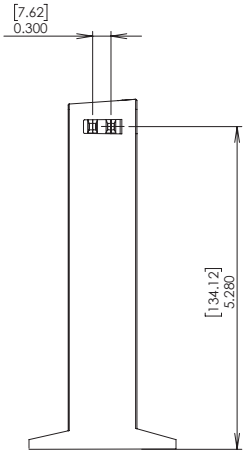


FRONT VIEW



ZSCT5-31 and ZSCT30-31

SIDE VIEW



ZSCT5-88

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PMA SERIES

Panel Mount Adapters — Retrofits

Example Shown: PMA-3

Example of a panel mount adapter (PMA-3). Relay is for illustrative purposes only and must be purchased separately from adapter plate. For more information on our complete offering of panel mount adapters see the following page.

Description

A variety of protection relay retrofit adapter plates are available for the products listed below. These adapter plates simplify the process of updating electromechanical or poorly functioning existing relays. Consult factory if you have a specific product to replace that is not featured. Adapters are available in either plate style for panel mounting or drawout style depending on the relay being replaced.

Motor, feeder and ground-fault protection upgrades are available for electromechanical or solid state relays that are nearing the end of their life.

Features & Benefits

FEATURES	BENEFITS
Mounting	Fits in existing mounting holes and panel openings
Multiple adapter sizes	Plate style or drawout style adapters are available to fit various outdated relays

Adapter Plates

RELAY TO REPLACE	PANEL MOUNT	NEW RELAY
AB BULLETIN 1406	PMA-14	MPS
FPL-GFRM	PMA-6	SE-701/SE-704
GE S1	PMA-9	MPU-32/FPU-32
GE LODTRAK III	PMA-10	MPU-32
GE MULTILIN 169, 269, or 369	PMA-13	MPS
	PMA-16	MPU-32
	PMA-16	FPU-32
GE MULTILIN 469	PMA-24	MPS
GE MULTILIN P4A	PMA-15	MPU-32/FPU-32
GEC/MCGG	PMA-3	SE-701/SE-704
GE & WESTINGHOUSE FT-11	PMA-12	MPU-32
P & B GOLDS	Contact Factory	FPU-32
WESTINGHOUSE CO9 & CO11	Contact Factory	FPU-32

For a complete list of the Littelfuse Panel Mount Adapter Plates please see next page.

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PANEL-MOUNT ADAPTERS

PANEL MOUNT ADAPTERS		
Product	Features	Accessory For
PMA-2 Adapter Plate	Used when replacing the AB Bulletin 1406.	**MPU-32**
PMA-3 Adapter Plate	Used when replacing GEC/MCGG ground-fault relays. Requires PMA-55 or PMA-60.	**SE-704** **SE-701**
PMA-4 Adapter Plate	Used when replacing the Multilin 139/239.	**MPU-32**
PMA-6 Adapter Plate	Used when replacing FPL-GFRM ground-fault relays. Requires PMA-55 or PMA-60.	**SE-701**
PMA-7 Adapter Plate	Used when replacing the GE Lodtrak II.	**MPU-32**
PMA-8 Adapter Plate	Used when replacing an Atkinson Omser II with an SE-130-Series Monitor.	**SE-134C** **SE-135**
PMA-9 Adapter Plate	Used when replacing relays in the GE S1 Case. Requires PMA-55 or PMA-60.	**MPU-32** **FPU-32**
PMA-10 Adapter Plate	Used when replacing the GE Lodtrak III.	**MPU-32**
PMA-12 Adapter Plate	Used when replacing GE and Westinghouse FT-11 relays.	**MPU-32**
PMA-13 Adapter Plate	Used when replacing the GE Multilin 169, 269, or 369.	**MPS**
PMA-14 Adapter Plate	Used for rough cutouts and when replacing the AB Bulletin 1406.	**MPS**
PMA-15 Adapter Plate	Used for rough cutouts and when replacing the GE Multilin P4A.	**MPU-32** **FPU-32**
PMA-16 Adapter Plate **PMA-16-RTDB** Mounting Bracket	The PMA-16 mounting plate is used when replacing the GE Multilin 169, 269, and 369 relays. The PMA-16-RTDB is a mounting bracket for the optional MPS-RTD Temperature Input Module.	**MPU-32** **FPU-32**
PMA-17 Adapter Plate	Used when replacing Sprecher & Schuh Cet 4.	**MPU-32**
PMA-18 Adapter Plate	Used when replacing Sprecher & Schuh Cet 3.	**MPU-32**
PMA-21 Adapter Plate	Used when replacing an ABB RACIF.	**FPU-32**
PMA-23 Adapter Plate	Custom mounting plate for FPU-32 to replace 3 Westinghouse C0 relays.	**FPU-32**
PMA-24 Adapter Plate	Used when replacing the GE Multilin 469.	**MPS**
PMA-55 Adapter Plate	Used to panel mount the SE-601 and SE-701.	**SE-601** **SE-701** **PGR-4300** **SE-704**
PMA-60 Adapter Plate	Used to panel mount the relay; IP 53 and NEMA 3 rating, tamper resistant.	**SE-601** **SE-701** **PGR-4300** **SE-704**
MPU-32-SMK Surface-Mount Kit	Used to surface mount the MPU-32 or FPU-32.	**MPU-32** **FPU-32**

Note: Relays are not included with the PMA-Series Panel Mount Adapters.

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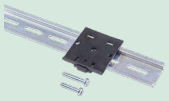
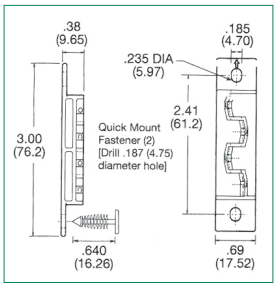
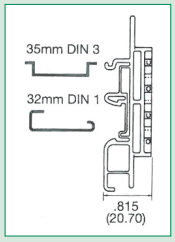
DIN RAIL & MOUNTING ADAPTERS

DIN RAIL & MOUNTING ADAPTERS		
Product	Features	Accessory For
C103PM (Al) DIN Rail	Industry standard 35 mm aluminum or steel DIN rail. C103PM aluminum rail is available in a 36 in. (91.4 cm) length.	**Can be used with all DIN-rail compatible units.**
AC700-SMK Mount Adapter	DIN-rail and Surface-mount adapter for back-plane mounting.	**EL731**
D0050 DIN-Rail Adapter Clip	Plastic clip allowing DIN-rail mounting of the PGR-8800 and AF0500 Arc-Flash Relay.	**AF0500** **PGR-8800**
P1023-20 DIN Rail Mount Adaptor 	Allows any 2 x 2 in (50.8 x 50.8 mm) or 2 x 3 in (50.8 x 76.2 mm) module to be mounted on a 35 mm DIN type rail. Comes complete with mounting hardware (one #10 - 24 x 1.00 screw and one #10 - 24 x 1.25 screw) for 0.75 in (19 mm) and 1 in (25.4 mm) thick modules.	**Consult the individual datasheet to determine part compatibility.**
P0500-178 Surface Mount Adapter  Inches (Millimeters)	P0500-178 is surface mountable with 2 Quick Mount Fasteners.	**ASXX/DSXX Series Timers**
P0500-179 DIN Rail Mount Adapter  Inches (Millimeters)	P0500-179 snaps onto DIN rail.	**ASXX/DSXX Series Timers**

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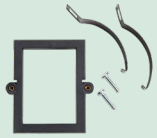
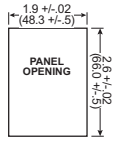
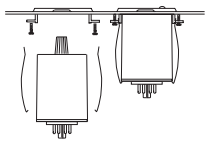
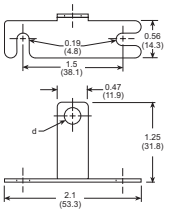
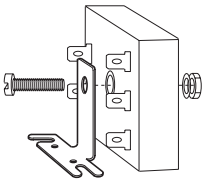
BRACKETS & CLIPS

BRACKETS & CLIPS

Product	Features	Accessory For
BZ1 Front Panel Mount Kit   Inches (Millimeters)  Illustrates panel opening size required to mount BZ1.	Provides an easy method of through-the-panel mounting of 8-pin or 11-pin plug-in timers, flashers, and other controls. May be mounted in panels up to 0.125 in (3.2 mm) thick. Includes two clamps and two screws.	**Series:** **ARP FS500 LLC4 LLC5 LLC6** **PLM PLMU PLR PLS PRLM** **TDB TDBH TDBL TDI TDIH** **TDIL TDM TDMB TDMH TDML** **TDR TDS TDSH TDSL TRB** **TRDU TRM TRS TRU**
P1023-6 **P1023-7** Mounting Brackets   Inches (Millimeters)	Provides a convenient method of mounting modules. The 90 ° orientation of mounting slots makes installation/removal of modules quick and easy. Made from steel with a cadmium surface finish. PART NUMBER / MOUNTING HOLE SIZE / MOUNTING METHOD P1023-6 / 0.19 in (4.8 mm) / #8 (M4 x 0.7) screw P1023-7 / 0.25 in (6.35 mm) / Mini-Pot	**Used on many 2" x 2" timers. Refer to individual series datasheet to determine if this accessory is compatible.**
PSCRB8 Hold-down Brackets 	Designed for use with P1011-6 socket. Securely mounts 8-pin plug-in controls in any position, and provides protection against vibration. Sold in pairs.	**P1011-6**
PSC8 **PSC11** Hold-down Clips 	Securely mounts plug in controls in any position. Also provides protection against vibration. Select the PSC8 for use with NDS-8, or the PSC11 for use with NDS-11 sockets. Sold in pairs.	**NDS-8 Socket** **NDS-11 Socket**
P1023-2 P Clamp 	Removable P clamp bracket for mounting MSM series timers and FS100 and FS400 series flashers.	**Timers series:** **MSM** **Flasher series:** **FS100** **FS400**

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ENCLOSURES & WATERTIGHT COVERS

ENCLOSURES		
Product	Features	Accessory For
NGRM-ENC NGR Monitor Control Panel	NEMA 4 painted steel control panel, complete with the SE-325 or SE-330, and a fused 600/480:120 V PT for relay control power. Suitable for indoor or outdoor mounting, CSA certified. When NGR Monitor is back-plane mounted, 22 mm NEMA 4 indicators and reset button are included. Please contact factory for additional information. **For full datasheet and ordering information, see pg. 67**	**SE-325** **SE-330**
NEMA-3R-L A Enclosure	Metal NEMA-3R electrical box with lenses for viewing the single-phase PumpSaver® status lights. **H** 6.0" x **W** 6.0" x **D** 4.0"	**Single-Phase PumpSaver**
RM-1000-ENCL Enclosure	Steel enclosure for protecting the RM1000 from weather and vandalism. Protects from UV, hail, and it seals to keep rain from contacting the RM1000 connections. The enclosure also features a built-in padlock tab (padlock not included). **H** 6.4" x **W** 6.3" x **D** 1.7"	**RM1000**

WATERTIGHT COVERS		
Product	Features	Accessory For
MPU-16A-Y92A-96N Watertight Cover	Watertight cover for outdoor applications.	**MPU-32** **FPU-32**
SE-IP65CVR-G Watertight Cover	Watertight cover. Tamper-resistant. IP65 protection.	**SE-134C** **SE-135** **SE-330** **SE-330AU** **SE-330HV** **SE-400**
SE-IP65CVR-M Watertight Cover	Watertight cover. Tamper-resistant. IP65 protection.	**MPS** **FPS**
SE-MRE-600 Moisture-Resistant Enclosure Kit	Protects the connection terminals from snow and rain in outdoor applications.	**ER-600VC** **ER-1000HV**

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SOCKETS

SOCKETS		
Product	Features	Accessory For
OT08PC Octal Socket 8-Pin	8-pin 35 mm DIN-rail or surface mount octal socket. Rated at 10 A @ 600 V ac and has pressure clamp terminals.	**AWG 12 to 22 (3.2 to 0.33 mm²) wire sizes. Consult individual datasheet for compatibility**
NDS-8 Octal Socket 8-Pin Screw terminals with captive wire clamps	8-pin 35 mm DIN-rail or surface mount octal socket. Rated at 10 A @ 300 V ac. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. A spring mechanism allows easy removal. Uses PSC8 hold-down clips.	**Up to two #14 AWG (2.45 mm²) wire size** **Series:** **ARP FS500 LLC4 LLC5** **PRLM TDB TDBH TDBL** **TDI TDIH TDIL TDM** **TDMB TDMH TDML TDR** **TDS TDSH TDSL TRDU** **TRM TRS TRU**
P1011-6 Octal Socket 8-Pin	8-pin surface mount socket with binder head screw terminals. Rated at 10 A @ 600 V ac. UL Listed combination when used with TDM, TDB, TDS series timers. Uses PSCRB8 hold-down brackets.	**Series:** **ARP FS500 LLC4 LLC5** **PRLM TDB TDM TDMB** **TDR TDS TRB TRDU** **TRM TRS TRU**
OT11PC Magnal Socket 11-Pin	Magnal Sockets are for plug-in units	**11-pin Plug-in units** **Series:** **ARP LLC6 TDB TDBH** **TDBL TDMB TDS TDSH** **TDSL TRB TRDU TRM** **TRS TRU**
SD12-PC Rectangle Socket 12-pin	12-pin surface Rectangle Socket.	**ACBC-120**
NDS-11 11-pin Magnal Socket Screw terminals with captive wire clamps	11 pin 35 mm DIN-rail or surface mount socket. Rated at 10 A @ 300 V ac. Surface mounted with two #6 (M 3.5 x 0.6) screws or snaps onto a 35 mm DIN rail. A spring mechanism allows easy removal. Uses PSC11 hold-down clips.	**AWG 12 to 22 (3.2 to 0.33 mm²) wire sizes** **Series:** **ARP LLC6 TDB TDBH** **TDBL TDMB TDS TDSH** **TDSL TRB TRDU TRM** **TRS TRU**

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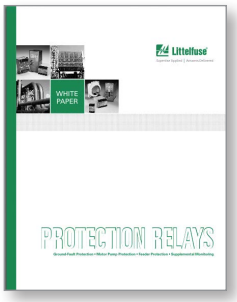

For More Information...
and to download our
Protection Relay Overview, visit
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Active Power–Measured in kW. In a diesel generator application, it is the power produced by the engine.

Alarm Level–A setting on a protection relay at which an LED or output contact operates.

Alarm Relay Contact–An output of a relay that acts as a switch and is typically connected to a visual or audible alarm.

Analog Output–A discrete, continually variable 0-1 mA, 4-20 mA, or 0-5 Vdc signal from a protection relay used to pass information to a device or controller.

Apparent Power–The vector sum of the active and reactive power.

Arc Flash Hazard–A dangerous condition associated with the possible release of energy caused by an electric arc.

Arc Flash Risk Assessment–A study investigating a worker's potential exposure to arc flash energy, conducted for the purpose of injury prevention and to determine safe work practices, arc flash boundary, and the necessary types of personal protective equipment (PPE).

Arc Flash Suit–A complete arc-rated clothing and equipment system covering the entire body, except for hands and feet.

Arc Flash Boundary–When an arc flash hazard exists, the boundary is an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

Arc Rating–The value attributed to materials that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of break open threshold (EBT) (Should a material system exhibit a break open response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value.^

Asynchronous Motor–A motor in which the speed of the rotor is not the same as the connected system frequency.

Charging Current–System charging current is the current that will flow into the grounding connection when one phase of an ungrounded system is faulted to ground. Although not physically connected to ground, electrical conductors and the windings of all components are capacitively connected to ground. Consequently, a small current will flow to ground from each phase. This current does not occur at any particular location; rather, it is distributed throughout the system just as the capacitance to ground is distributed throughout the system.

Conformal Coating–A Silicone coating used to protect circuit boards from pollutants, corrosion, mildew, etc.

Core-Balance Current Transformer–See Earth-Fault Current Transformer.

Current Transformer (CT)–A transformer that produces a current in its secondary circuit in a known proportion to current in its primary circuit.

CT Verification–A continuous check of CT continuity to verify connection.

CT Saturation–A condition that occurs when a CT cannot maintain a secondary current proportional to a relatively large primary current.

CT Local Saturation–A condition where the magnetic flux is not evenly distributed throughout the CT. A resulting secondary current could be induced when no ground fault is present; it may lead to the false operation of a protective relay. This could occur if conductors are not centered in a CT window.

CT Saturation Compensation–A feature in which a protective relay can recognize that a CT is saturated and compensate for the condition in order to maintain service.

Data Logging–Collecting and storing information in a format that can be reviewed for trending, troubleshooting, and reporting.

De-energized–Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.

DFT–See Discrete Fourier Transform.

Differential Module–An accessory for the MPU-32 Motor Protection Relay and MPS Motor Protection System to add phase-differential protection.

Digital Harmonic Filter–The use of digital signal-processing techniques such as a discrete Fourier Transform to eliminate the measurement of harmonic components. With regard to ground-fault detection, this allows for a setting below the background noise level.

Discrete Fourier Transform–A mathematical algorithm used to extract a single frequency, such as the fundamental frequency, from a signal.

Earth Leakage–See Leakage Current.

Earth-Fault Current Transformer–A current transformer used to measure low-level ground-fault current.

Electrical Hazard–A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

Electrical Safety–Recognizing hazards associated with the use of electrical energy and taking precautions so hazards do not cause injury or death.

Electrically Safe Work Condition–An electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Fail-Safe Mode (also known as Undervoltage or UV)–An output relay is energized during normal (not tripped) operation. If the protection relay loses supply voltage, the system will trip or alarm. (Also see Non-Fail-Safe.)

Fault Current–A current that flows when a phase conductor is faulted to another phase or ground.

Feeder–All circuit conductors between the service equipment or other power-supply source and the load or branch-circuit overcurrent device.

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Feeder Protection–Overcurrent or overvoltage devices installed on a feeder circuit to interrupt the supply in the event of a fault.

Flux Conditioner–A ring of magnetically permeable material inserted in an earth-fault current transformer window; used to reduce local saturation.

Fundamental Frequency–In an alternating-current power system, the frequency of the generated voltage. In North America this is typically 60 Hz (60 cycles per second).

Ground Check Conductor–An insulated conductor in a trailing cable used to assist in monitoring continuity of the ground conductor. Typically designed to be the smallest conductor, it is the first to break connection when cable couplers are disconnected.

Ground-Check Loop–A circuit that includes a ground-check conductor, a ground-check termination device, and a ground conductor.

Ground-Check Termination–A device installed at the load end of a ground-check loop.

Ground-Continuity Monitor–A protection relay that continuously monitors a ground-check loop and trips if the loop opens or shorts.

Ground Fault–An unintentional contact between a phase conductor and ground or equipment frame. The words "ground" and "earth" are used interchangeably.

Ground-Fault Current–A current that returns to the supply neutral through a ground-fault and ground-return path.

Ground-Fault Current Transformer–See Earth-Fault Current Transformer.

Ground-Fault Relay–A protection relay designed to detect a phase-to-ground fault on a system and trip or alarm when the condition exceeds its pickup setting for longer than its time delay.

Ground-Fault Protection–The use of a ground-fault relay or indication system in order to interrupt the supply or alarm personnel in the event of a ground fault.

Ground Reference Module–A resistor network that limits ground-fault current and provides a system reference for a DC ground-fault relay.

Harmonic Filter–A device or method to remove or ignore non-fundamental frequency components of a signal.

Harmonic Frequency–Harmonic-frequency components (voltage and current) are multiples of the fundamental frequency and, in a power system, can be considered noise. Harmonic-frequency components are often present with the use of adjustable-speed drives.

High-Resistance Grounding–Using a neutral-grounding resistor to limit the current to a low level. Typically, High-Resistance Grounding limits ground-fault current to 25 A or lower. (Also see Low-Resistance Grounding.)

High Tension Coupler–An accessory used to isolate system voltage from a protective relay.

I^2t (I squared t)–Thermal capacity, or used thermal capacity. With regard to motor protection, thermal capacity is used to measure and describe motor heating in terms of current (I). This method is more accurate than temperature sensing because of temperature-sensor placement and the time delay inherent in temperature measurement.

IEEE Device Numbers–The devices in switching equipment are referred to by numbers, according to the functions they perform. These numbers are based on a system which has been adopted as standard for automatic switchgear by the IEEE. This numbering system is used on connection diagrams, in instruction literature, and in specifications.

Incident Energy–The amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. One of the units used to measure incident energy is calories per centimeter squared (cal/cm2).

Incident Energy Analysis–Used to predict the incident energy of an arc flash for a specified set of conditions.

Insulation Monitoring–Monitoring the resistance from phase to ground to detect insulation breakdown on a system.

Insulation Resistance–A measurement of the ability of an insulator, such as a cable jacket, to prevent current flow when a voltage is applied; typically measured in megaohms (MΩ). Insulation resistance change can be monitored to predict failure.

Inverse-Time Overcurrent Protection–A method by which time-to-trip of a protective device, such as an overcurrent or ground-fault relay, decreases as the magnitude of the fault increases.

Leakage Current–Low-level ground-fault current, typically measured in milliamperes (mA).

Low-Resistance Grounding–A Resistance-Grounding System that allows high currents to flow during a ground fault. Typically, 100 A and higher is considered Low-Resistance Grounding. (Also see High-Resistance Grounding.)

LSIG Protection–An acronym for **L**ong-time, **S**hort-time, **I**nstantaneous overcurrent, and **G**round-fault protection; a term often used to describe protection required for a power-distribution feeder, or a protection relay with these functions.

Motor Protection–Technology designed to ensure that a motor operates within its rated thermal capacity in order to maximize its service life.

Neutral-Grounding Resistor (NGR)–A current-limiting resistor connecting the power-system neutral to ground.

N.C. Contact (Normally Closed Contact)–A relay contact that is closed when the relay is not energized.

N.O. Contact (Normally Open Contact)–A relay contact that is open when the relay is not energized.

Non-Fail-Safe Mode (also known as Shunt Trip or SH)–An output relay is energized and contacts change state when a trip occurs. If the protective device loses supply voltage, the system can continue to operate but will not be protected. (Also see Fail-Safe Mode.)

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Non-Volatile Memory–Data is retained when power is removed.

Nuisance Trip–A false operation of a protective relay.

Phase Current–Current present in a phase conductor.

Phase-Current Transformer–A current transformer installed so that current from one phase conductor flows in its primary winding. With regard to motor protection, feeder protection, and metering in a three-phase system, three current transformers are typically used to measure phase currents.

Phase-Differential Protection–Protection designed to detect low-level winding-to-winding and winding-to-ground failures in an AC motor.

Phase Voltage–The voltage measured between a phase conductor and ground, or another phase.

Power factor (cosϕ)–The relation between the active power [kW] and apparent power [kVA].

Primary Rating (for CTs)–The current rating of the primary side of a current transformer. For example, the first number in the ratio 500:5 is the primary rating. 500 A of primary current flowing through the CT will produce 5 A of current out of the secondary terminals.

Pulsing Ground-Fault Systems–Modulating the ground-fault current on a resistance-grounded system using a contactor to short out part of the NGR elements (or to open one of two NGRs connected in parallel). This technique is used to locate ground faults by tracing the pulsing ground-fault current to the source of the fault.

Online or Offline Monitoring–Monitoring system parameters such as insulation integrity when the system is energized or de-energized, respectively.

Open-CT Hazard–An open-circuited CT secondary which can develop a dangerously high voltage when primary current is present.

Reactive Power–Measured in kVAR. The power used for magnetization of asynchronous alternators, motors and transformers, coils etc. The amount of reactive power has no effect on the torque of the prime mover (e.g. diesel engine). Therefore the reactive power has no effect on the engine. It is however very important for the alternator, as the total load on he alternator is the vector sum of active and reactive load.

Relay (1)–An electrical switch that opens and closes a contact (or contacts) under the control of another circuit. Typically an electromagnet.

Relay (2)–A device that receives inputs, compares them to set points, and provides outputs based upon that comparison.

Relay Operating Mode–Method of operation used for undervoltage or shunt-trip breakers. (Also see **Fail-Safe Mode, Non-Fail-Safe Mode**.)

Resistance-Grounded System–An electrical system in which the transformer or generator neutral is connected to ground through a current-limiting resistor. (Also see **Solidly Grounded System, Ungrounded System**.)

Reverse Power–An active power [kW] fed into a generator that thus is working as an electric motor, turning the prime mover. As this would damage the prime mover (e.g. an internal combustion engine), reverse power relays are used in applications where generators run in parallel with each other or with the utility. These relays detect the amount and direction of the power, and in case of excessive reverse power, disconnect the generator breaker.

Ride-Through Time–The amount of time a protection relay can maintain operation during a supply voltage loss.

RTD (Resistance Temperature Detector)–A device that experiences a linear change in resistance with a change in temperature. It is used to provide temperature metering. Common RTDs are 100 Ω platinum, 100 Ω nickel, 120 Ω nickel, and 10 Ω copper.

Sensitive Ground-Fault Protection–Protection designed to accurately detect low-level ground-fault current.

Shock Hazard–A dangerous condition associated with possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

Solidly Grounded System–An electrical system in which the neutral point of a wye-connected supply transformer is connected directly to ground. (Also see **Resistance-Grounded System, Ungrounded System**.)

Switchgear, Arc-Resistant–Equipment designed to withstand the effects of an internal arcing fault and that directs the internally released energy away from the employee.

Time Delay–A setting on a protection relay that determines the time between the fault detection and relay operation.

Trailing Cable–A power cable used to supply electrical power to mobile equipment. They typically contain three phase conductors, two ground conductors, and a pilot wire (also known as a ground-check conductor).

Trip Level–A setting on a protection relay at which an LED or output contact operates.

Trip Relay Contact–An output of a relay that acts as a switch and is typically connected to an undervoltage-release or shunt-trip coil of a circuit breaker.

Trip State–The state of the output contact during a relay trip.

True RMS–"Root-Mean-Square" calculation used to derive an average current or voltage value in a waveform.

Ungrounded System–An electrical system in which no point of the system is intentionally grounded, such as a delta-connected supply transformer.

Zero-Sequence Current Transformer–See **Earth-Fault Current Transformer.**

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I. INTRO TO PROTECTION RELAYS

What is a protection relay?

- Inputs and Settings
- Processes
- Outputs

How do protection relays solve electrical problems?

- Stage 1 – Early stages of a failure
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I. INTRODUCTION TO PROTECTION RELAYS

What is a Protection Relay?

A protection relay is a smart device that receives inputs, compares them to set points, and provides outputs. Inputs can include current, voltage, resistance, or temperature. Outputs can include visual feedback in the form of indicator lights and/or an alphanumeric display, communications, control warnings, alarms, and turning power off and on. A diagram is shown below.

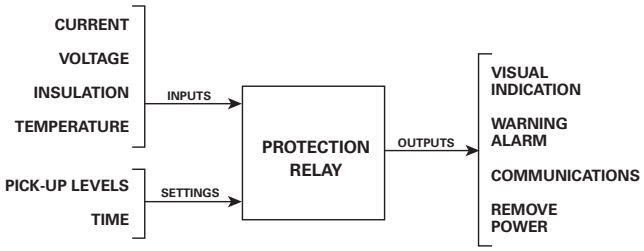

FIGURE 1

Protection relays can be either electromechanical or electronic/microprocessor-based. Electromechanical relays consist of mechanical parts that require routine calibration to stay within intended tolerances. Microprocessor-based or electronic relays provide quick, reliable, accurate, and repeatable outputs. Using an electronic or microprocessor-based relay instead of an electromechanical design provides numerous advantages including improved accuracy, additional functions, reduced maintenance, smaller space requirements and lower life-cycle costs.

Inputs

A relay needs information from the system to make a decision. These inputs can be collected in a variety of ways. In some cases, the wires in the field can be connected directly to the relay. In other applications, additional devices are needed to convert the measured parameters to a format that the relay can process. These additional devices can be current transformers, potential transformers, high-tension couplers, RTDs, or other devices.

Settings

Many protection relays have adjustable settings. The user selects settings (pick-up levels) that allow the relay to make a decision. The relay compares the inputs to these settings and responds accordingly.

Processes

Once the inputs are connected and the settings are made, the relay compares these values and makes a decision. Depending on the need, different types of relays are available for different functions.

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Outputs

A relay can have several ways of communicating that a decision has been made. Typically the relay will operate a switch (relay contact) to indicate that an input has surpassed a setting, or the relay can provide notification through visual feedback such as a meter or LED. One advantage of many electronic or microprocessor-based relays is an ability to communicate with a network or a PLC.

As an example, a thermostat can be evaluated using the diagram in *Figure 1*. The input that is measured is temperature and the input device is the temperature sensor. The user sets the desired temperature setting (pick-up level). The relay measures the existing air temperature and compares it to the setting. The outputs can be used to provide controls (turning an air conditioner or furnace on and off) and visual indication on the thermostat display.

How Do Protection Relays Solve Electrical Problems?

Similar to how the thermostat solves the problem of automating the control of the air conditioner or furnace in a home, protection relays can solve electrical problems.

The purpose of the protection relay is to detect a problem, ideally during its initial stage, and to either eliminate or significantly reduce damage to personnel and/or equipment.

The following stages illustrate how an electrical problem develops:

Stage 1: When conductors with good insulation are exposed to fault initiators such as moisture, dust, chemicals, persistent overloading, vibration or just normal wear, the insulation will slowly deteriorate. Such small changes will not be immediately obvious until the damage is severe enough to cause an electrical fault. Relays can detect that a problem is developing by identifying slight deviations in current, voltage, resistance, or temperature. Due to the small magnitude in change, only a sophisticated device such as a sensitive protection relay or a monitor can detect these conditions and indicate that a problem may be developing, before any further damage occurs.

Stage 2: As the problem becomes more severe, further changes take place such as insulation breakdown, overheating, or overvoltage. Since the change from normal to abnormal is great, traditional devices can be used to interrupt power. Protection relays can also be used to provide additional protection by detecting the fault contributors (overheating, overvoltage, etc.) not possible with fuses and circuit breakers.

Stage 3: At this point, the problem has occurred and caused damage. Different types of protection relays and monitors can reduce or eliminate damage because they detect problems in advance of traditional devices.

As an example, if a facility is continually resetting circuit breakers, replacing fuses, or repairing equipment and cannot locate the problem, they may be experiencing overcurrents. If this is the case, the user can install a protection relay that has an overcurrent feature. The relay measures the current (input) and allows the user to program limits (settings). The settings typically are more sensitive than the fuses or circuit breakers. Once these limits are exceeded, the relay will operate an internal switch (relay contacts). The user has the option to use the switch to turn on a light (alarm indication) or remove power (trip) before greater problems occur. The user can use the alarm indication to help identify the faulty equipment prior to the traditional fuse or circuit breaker clearing the fault.

II. RELAY APPLICATION

Ground-Fault Protection

The primary purpose of grounding electrical systems is to provide protection against electrical faults. However, this was not common practice until the 1970's. Until then, most commercial and industrial systems were ungrounded. Although ungrounded systems do not cause significant damage during the first ground fault, the numerous disadvantages associated with ground faults resulted in a change to the grounding philosophy. There are other advantages for a grounded system, such as reduction of shock hazards and protection against lightning.

Electrical faults can be divided into two categories: phase-to-phase faults and ground faults. Studies have shown that 98% of all electrical faults are ground faults (Source: Woodham, Jack, P.E. " The Basics of Grounding Systems" May 1, 2003 <http://www.ecmweb.com/mag/electric_basics_grounding_systems_2/index.html>). While fuses can protect against phase-to-phase faults, additional protection, such as protection relays, are typically required to protect against ground faults.

Definition of Ground Fault

A ground fault is an inadvertent contact between an energized conductor and ground or the equipment frame. The return path of the fault current is through the grounding system and any equipment or personnel that becomes part of that system. Ground faults are frequently the result of insulation breakdown. It's important to note that damp, wet, and dusty environments require extra diligence in design and maintenance. Since contaminated water is conductive, it exposes degradation of insulation and increases the potential for hazards to develop.

Table 1 shows the leading initiators of electrical faults.

LEADING INITIATORS OF FAULTS	% OF ALL FAULTS
Exposure to moisture	22.5%
Shorting by tools, rodents, etc.	18.0%
Exposure to dust	14.5%
Other mechanical damage	12.1%
Exposure to chemicals	9.0%
Normal deterioration from age	7.0%

TABLE 1

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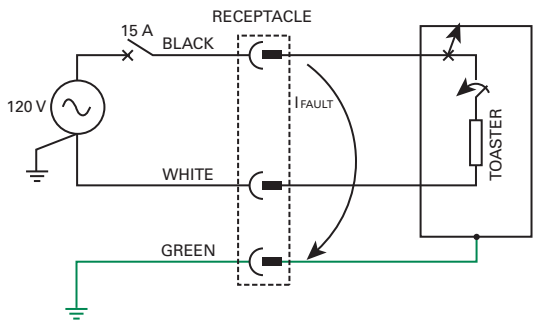

FIGURE 2

As an example, in the toaster circuit above, the black or hot wire is shorted to the metal casing of the toaster. When the circuit closes, all or part of the current is channeled through the toaster frame and then through the green ground wire. When sufficient current flows (typically 6 x 15 A = 90 A), the circuit breaker will open. A protection relay could be installed to detect currents as low as 10 mA, which would open the circuit breaker at a significantly lower level, hence, much quicker than the traditional circuit breaker.

Although the example above shows a solidly grounded single-phase circuit, the philosophy is the same on three-phase circuits discussed later. Relays and monitors are specifically designed to look for the leading initiators shown in *Table 1* by detecting low-level changes in current, voltage, resistance or temperature.

DC Systems

Direct current (DC) systems have positive and negative buses. If either bus is intentionally grounded, then it is referred to as a grounded system. If neither bus is grounded, then it is referred to as an ungrounded DC system. A ground fault on a DC system may cause damage to the source as well as in the field.

If the system is ungrounded, then it is possible to use a ground-fault relay by installing a ground-reference module between the two buses to establish a neutral point (see *Figure 3*). The ground-fault relay uses this neutral point as a reference to detect low-level ground faults.

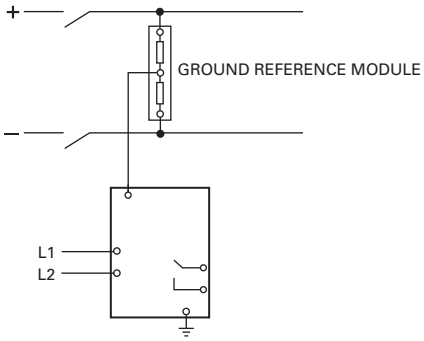

FIGURE 3

Ungrounded AC Systems

Ungrounded AC systems, as shown in *Figure 4*, were used where continuity of power was critical. For example, chemical plants or refineries involving processes that cannot be interrupted without extensive dollar or product loss may have an ungrounded system. However, experience has proven that these systems are problematic and are being replaced with resistance grounded systems. Two major problems with ungrounded systems are transient overvoltages and difficulty locating ground faults.

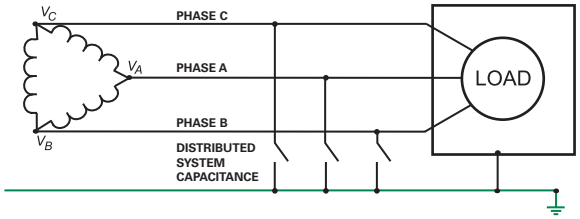

FIGURE 4

- An ungrounded system has no point in the system that is intentionally grounded (other than the normal bonding which is always present to connect the non-current-carrying metal parts to ground). Grounding occurs only through system capacitance to ground (as shown in *Figure 4*).
- Continuity of operation occurs because the system can operate with one phase faulted to ground.
- An intermittent or arcing fault can produce high transient overvoltages to ground. These voltages are impressed on the phase conductors throughout the system until the insulation at the weakest point breaks down. This breakdown can occur at any point in the electrical system, causing a phase-to-ground-to-phase fault.
- Although a ground fault can be detected or alarmed on the system, it is difficult to determine the location of the fault.

There are two methods used to detect ground faults on ungrounded systems. One method is to monitor the voltages between the phases and ground. As a ground fault develops, the faulted phase will collapse to ground potential, causing an indicator light to dim. The indicator lights on the unfaulted phases become brighter.

A second method to detect a ground fault is to measure the insulation resistance. As the insulation deteriorates, a relay continuously monitoring the insulation resistance can alarm at different levels for predictive maintenance. A visual indicator or meter can also be used.

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Solidly Grounded Systems

Due to the problem of ungrounded systems, a shift in philosophy occurred and designs moved from ungrounded to grounded systems. In most cases, the type of grounding system chosen was solidly grounded. A solidly grounded system is a system of conductors in which at least one conductor or point is intentionally grounded (usually the neutral point of transformer or generator windings). The problem with the direct connection is that ground-fault current can be excessive, causing Arc-Flash hazards, extensive equipment damage, and possible injury to personnel. A solidly grounded system cannot continue to operate with a ground fault.

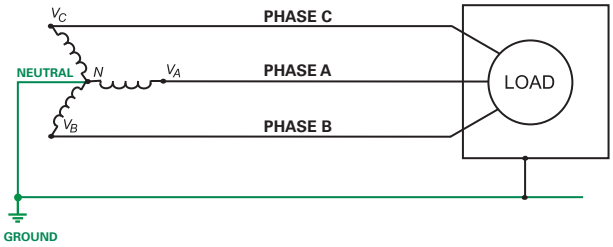

FIGURE 5

- In a solidly grounded system, the wye point (or neutral) of the power source is connected solidly to ground and offers a very stable system that maintains a fixed phase-to-ground voltage.
- The high ground-fault current is easy to detect with fuses, circuit breakers, or protection relays, allowing for selective tripping (tripping the faulted feeder and not the main feeder).
- When a ground fault occurs, high point-of-fault damage can quickly result since the energy available to the ground fault is only limited by the system impedance (which is typically very low).
- Due to excessive ground-fault current and Arc-Flash Hazards, the faulted feeder must be removed from service. This does not allow for continuous operation during a ground fault.

Figure 6 illustrates an example of the dangers associated with solidly grounded systems. In this example, a ground fault occurs and the overcurrent protection is set at 600 A.

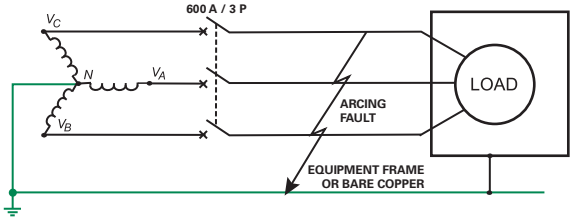

FIGURE 6

Assume that this ground-fault is not a bolted fault, but an arcing fault due to an insulation breakdown or a partial reduction of clearances between the line and ground.

- Because of the arc resistance, fault current may be as low as 38% of the bolted-fault level. This can be in the range of a normal load or a slight overload.
- The fault current may be low enough that the overcurrent device (600-A circuit breaker) does not sense a fault, or may pick it up but not trip for a long time.
- The energy being supplied by the source is concentrated at the arc and could cause severe equipment damage very quickly. This energy release could cause a fire that in turn, could damage the premises and present an extreme hazard to personnel.

Aside from converting this solidly grounded system to resistance grounding, the best way to prevent damage is to detect low-level ground leakage prior to it becoming a ground fault. In order to accomplish this, the protection relay must be able to sense a low-level ground leakage without nuisance tripping.

In modern facilities, equipment often generates noise or harmonics that can interfere with a protection relay's ability to function properly. For example, the noise or harmonics may be higher than the desired ground-fault relay settings, causing the relay to falsely operate when there is no fault on the system. The protection relay must be able to filter out noise or harmonics to provide reliable protection.

Resistance-Grounded Systems

Resistance grounding solves the problems commonly associated with both ungrounded systems and solidly grounded systems. The name is derived from the addition of a resistor between the system neutral and ground (as shown in *Figure 7*). The specifications of the resistor are user-determined to achieve a desired ground-fault current, which must be greater than the system capacitive charging current (explained later in this section).

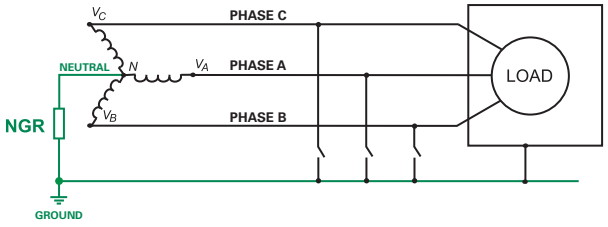

FIGURE 7

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- Transient overvoltages can be eliminated by correctly sizing the neutral-grounding resistor (NGR) to provide an adequate discharge path for the system capacitance.
- Continuity of operation with one ground fault is typically allowable when ground-fault current is ≤10 A.
- The NGR limits the available ground-fault current. This eliminates or minimizes point-of-fault damage (Arc-Flash Hazards) and controls the ground-fault voltage.
- Pulsing current can be used to locate ground faults when ground-fault current is ≤10 A. Pulsing current is created by using a shorting contactor to short out half of the resistance, causing the ground-fault current to double (usually one cycle per second). A hand-held zero-sequence meter is used to detect the fluctuating ground-fault current, and locate the ground fault.
- The only disadvantage of resistance grounding is that if the resistor fails, the system will become ungrounded. Resistor monitoring is recommended to protect against this.

A protection relay for resistance-grounded systems is used to detect a ground fault and to monitor the neutral-to-ground connection. It can be used to provide alarms or to trip the feeder from service upon the detection of a ground fault. The relay can provide a pulsing circuit that can be used to locate the ground fault. The relay can also alarm or trip if the neutral-to-ground path fails. For systems 5 kV and less, high-resistance grounding can be used. High-resistance grounding typically limits the resistor current to 10 A or less. By doing so, the ground fault can remain on the system, given that the system is rated for the voltage shift.

For systems above 5 kV, neutral-grounding resistors are typically rated for 25 A or more, and ground-fault current is cleared within 10 s.

System Capacitive Charging Current

Although not physically connected to ground, electrical conductors and the windings of all components are capacitively connected to ground. Consequently, a small current will flow to ground from each phase. This current does not occur at any particular location; rather, it is distributed throughout the system just as the capacitance to ground is distributed throughout the system. For analysis, it is convenient to consider the distributed capacitance as lumped capacitance, as shown in *Figures 5, 6, 7, and 8*.

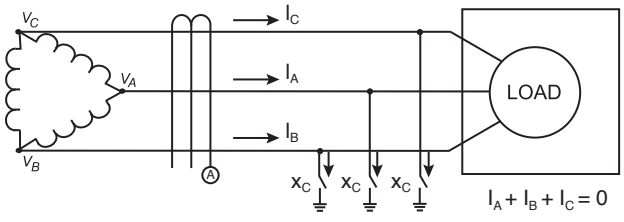

FIGURE 8

Even if the distributed capacitance is not balanced, the ammeter will read zero because all the current flowing through the CT window must return through the CT window.

System charging current is the current that will flow into the grounding connection when one phase of an ungrounded system is faulted to ground (see *Figure 9*). It can be measured as shown below if appropriate precautions are taken:

- If the fault occurs on the supply side of the CT, the sum of the currents in the CT window is not zero.
- Ammeter A will read the sum of the capacitive currents in the unfaulted phases. This value is the charging current of all the equipment on the load side of the CT.

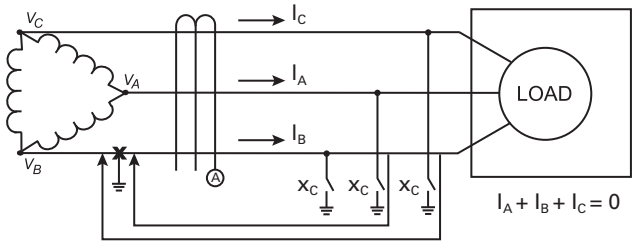

FIGURE 9

A single-line diagram of a three-feeder, resistance-grounded system with a fault on feeder 3 is shown in *Figure 10*.

- A CT (A1 and A2) on unfaulted feeders will detect the charging current of that feeder.
- A CT (A3) on a faulted feeder will detect the sum of the resistor current (I_R) and the charging currents ($I_1 + I_2$) of the unfaulted feeders.

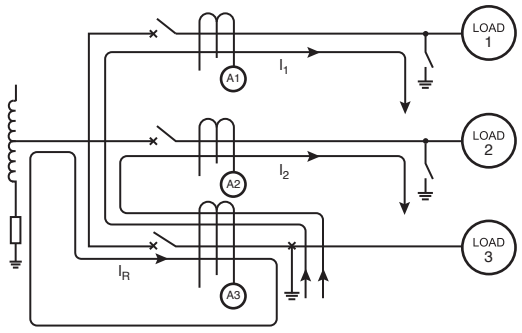

FIGURE 10

Selective coordination in a resistance-grounded system can be achieved if the pick-up setting of each ground-fault relay is greater than the charging current of the feeder it is protecting. If the pick-up setting of a ground-fault relay is less than the charging current of the feeder it is protecting, it will trip when a ground fault occurs elsewhere in the system. This is known as sympathetic tripping. Sympathetic tripping can be avoided by choosing a relay pickup setting larger than the charging current from the largest feeder. If the relative size of the feeders can change, or if the advantage of using one operating value for all ground-fault relays in a system is recognized, then it is prudent to select a pick-up setting for all ground-fault relays that is larger than the system charging current.

In order to eliminate transient overvoltages associated with an ungrounded system, it is necessary to use a grounding resistor with a let-through current equal to or larger than the system charging current.

What is the minimum acceptable NGR current? Select a pick-up setting for the ground-fault relays that exceeds the largest feeder charging current and multiply the operating value by an acceptable tripping ratio. Use the greater of this value or system charging current and select the next-largest available standard let-through current rating.

Resistor Monitors

As discussed in the resistance-grounded systems section, a failure in the neutral-to-ground path will lead to a dangerous situation. Some examples of failure are stolen wires, loose connections, corrosion, and broken resistor elements. The resistor monitor continuously monitors the path from system neutral to ground for a problem. When a problem occurs, the monitor provides an alarm.

Ground-Continuity Monitors

Ground-check monitors are used to detect problems in equipment ground conductors. The cable powering mobile equipment typically has an extra wire, or pilot wire, routed with the phase conductors. A monitor uses this pilot wire to send a signal to a terminating device in the equipment, where the signal is sent back on the cable ground conductor to the monitor. The monitor continuously monitors this loop for open or short circuits, indicating that a problem has occurred. The monitor provides an alarm for this condition.

As an example, portable loads are grounded via single or multiple conductors in a trailing cable. A ground fault on a portable load will cause fault current to flow through the ground conductors and all other ground-return paths. A hazardous touch voltage can develop when the ground conductor opens and a ground fault develops, assuming there is not enough current to trip a ground-fault relay. If the portable equipment has rubber tires or is not in good contact with earth, then a person who touches the equipment under fault conditions will become part of the ground-return path.

Motor Protection

Overview

Motors are a significant investment and often run critical processes. Motor protection relays are used to protect the windings from damage due to electrical faults and thermal overloads. Adequate motor protection not only prevents motor damage, but also ensures optimal process efficiency and minimal interruption. Cost recovery for protection is achieved by extending the life of the motor, preventing motor rewinds and reducing downtime.

Common Motor Problems

Overload and Overtemperature

Insulation breakdown is a common reason for motor failure. Windings in the motor are insulated with organic materials including epoxy and paper. Insulation degradation occurs when winding temperature exceeds its rating. The National Electrical Manufacturers Association (NEMA) states that the time-to-failure of organic insulation is halved for each 8 to 10°C rise above the motor insulation-class rating. This point is illustrated in *Figure 11*.

Solution: An I^2t Thermal Model provides thermal-overload protection of motor windings during all phases of operation. By integrating the square of the current over time, a thermal model can predict motor temperature and react much quicker than embedded temperature devices. A thermal model takes into consideration the motor service factor, full-load current and class. A dynamic thermal model adjusts the time-to-trip depending on how much motor thermal capacity has been used. *Figure 12* illustrates the adjustment in trip time for different current levels at different levels of used thermal capacity (I^2t).

A dynamic thermal model allows accurate protection of a motor and allows operations to get the maximum work out of a motor without sacrificing available life. If the motor is hot (high % used thermal capacity) it will trip more rapidly during an overload than if the motor is cold (0% used thermal capacity). In the event of a stall condition, when available motor torque is lower than the torque required by the load, the motor can be de-energized before it overheats.

Many old-technology electronic thermal overloads do not take into consideration the values of load current below the full-load current (FLA) pick-up value. Modern overload relays should model currents above and below the FLA pick-up current to achieve maximum output of the motor and maximum life of insulation.

On larger induction motors, blockage or loss of ventilation can cause motor hot spots that current-based protection cannot detect without the use of temperature sensors. Resistance temperature detectors (RTDs) are inexpensive devices installed between the stator windings during manufacturing and may be included on motor-end bearings.

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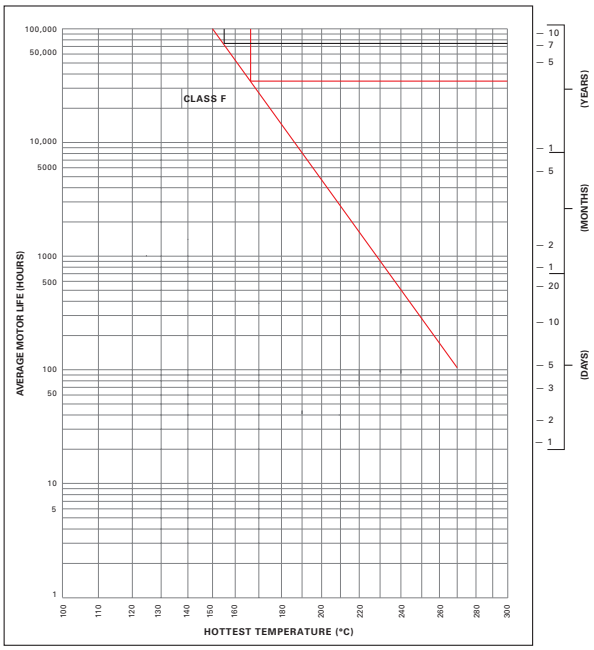

FIGURE 11

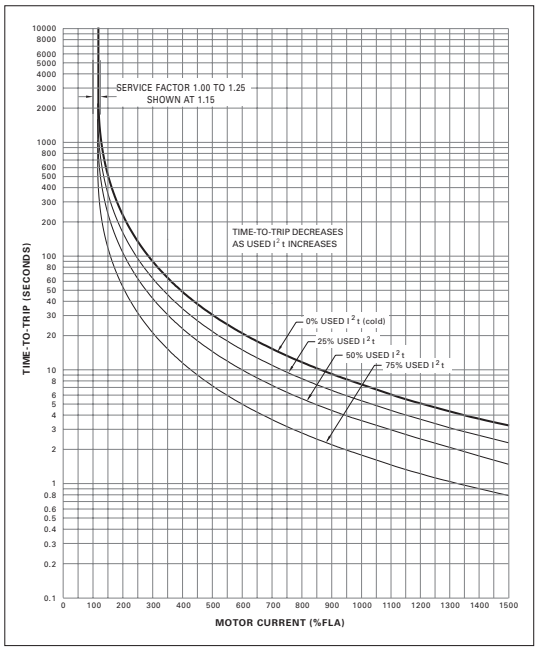

FIGURE 12

An RTD has a linear change in resistance over its rated temperature range. Using information from an RTD, motor-protection relays can provide protection for loss-of-ventilation, loss-of-cooling, or high-ambient-temperature.

The RTD temperature reading can also be used as an input to the thermal model to improve protection. When hot-motor compensation is enabled, the maximum stator-RTD temperature is used to bias the thermal model by increasing used I^2t when the RTD temperature is greater than the thermal-model temperature.

Overcurrent, Jam and Undercurrent

Overcurrent faults, also referred to as short circuits, can cause catastrophic motor failures and fires. Overcurrents can be caused by phase-to-phase, phase-to-ground, and phase-to-ground-to-phase faults.

A mechanical jam, such as a failed bearing or load, can cause stalling and locked-rotor current to be drawn by the motor, resulting in overheating.

Undercurrent protection is loss-of-load protection and is required by some codes as a safety measure. A water pump that cavitates can be dangerous. The water typically provides pump cooling. Without the cooling water, case temperature can reach an extremely high value. If valves are opened under these conditions and cold water is allowed to reach red-hot metal parts, the resulting steam pressures can destroy the pump and pose a serious personnel hazard.

Solution: A multifunction motor protection relay has multiple trip and alarm settings for current protection. Overcurrent protection is typically set above locked rotor current and has a minimal delay time. Overcurrent protection may be used to trip a breaker instead of a starter due to the high fault levels. Jam protection is set below overcurrent and has a slightly longer delay time. Jam protection prevents motor heating that would otherwise lead to an overload trip. Jam protection is enabled after the motor is running to avoid tripping on starting current. Undercurrent is set below full-load current to detect loss of load.

Under and Overvoltage

Overvoltages cause insulation stress and premature breakdown. Undervoltages, such as those caused by brownouts, can lead to increased motor heating. Torque developed by an electric motor changes as the square of the applied voltage. A 10% reduction in voltage results in a 19% reduction in torque. If the motor load is not reduced, the motor will be overloaded.

Solution: Under and overvoltage protection are features found in higher-end motor protection relays. Voltage protection can be used pro-actively to inhibit a start.

Ground Faults

Ground faults are the most common fault and can lead to more serious problems. Ground-fault protection, described elsewhere in this text, is an important consideration in motor loads.

Solution: The motor protection relay should be able to detect low-level ground-fault current when used on a resistance-grounded system.

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High-Resistance Winding Faults

Winding-to-winding and winding-to-ground failures inside the motor are difficult to detect using the phase and ground-fault CTs due to low magnitudes of current.

Solution: Differential protection in high-end motor protection relays use multiple CTs to compare the current entering and leaving the winding. If there is a difference in currents then leakage is occurring. This sensitive protection is used on very large or critical motors.

Current and Voltage Imbalance, Phase Loss, Phase Reverse

Older motor protection devices did not consider current imbalance and today it is often overlooked. Imbalance increases negative-sequence current which causes additional rotor heating.

Phase loss is also referred to as single phasing. When a phase loss occurs, negative-sequence current is equal to the positive-sequence current and imbalance is 100%. In this condition, one motor winding attempts to do the work of three, inevitably leading to overheating.

Phase reversal causes the negative-sequence current and voltage to be greater than the positive-sequence current and voltage. Voltage-based protection is advantageous to prevent a start with incorrect sequence. In some applications attempting to spin the motor backwards will result in damage to the load. An example of this is certain impeller designs in downhole pumps.

Solution: Modern motor protection relays use digital signal analysis to measure true-sequence components. These sequence components are used for thermal model calculations and take the extra heating into consideration. Voltage imbalance which drives current imbalance can be used as a start inhibit. Sequence components are also used for calculating imbalance, phase loss and phase reversal.

Motor Jogging

NEMA-designed motors are rated for two starts from cold and one start from hot per hour. Motor jogging refers to excessive starts and can cause overheating. The motor may not get up to full speed and the forced air cooling is not effective.

Solution: Since the thermal model accurately tracks the motor's used thermal capacity at all times, including during starts and between starts, the starts-per-hour feature may not be required.

It is included for compatibility with protection relays that do not have dynamic thermal-modeling capability.

Motor Protection and the NEC

The NEC® requires the motor to be protected by overload devices against excessive heating due to overload and failure to start (Article 430 Section III). Article 430, Section IV also specifies the use of devices to protect against overcurrents such as short circuits and grounds. Both of these NEC® requirements and many additional functions can be met with the use of a multifunction motor protection relay.

Article 430.32 (A)(4) requires the use of a protection device having embedded temperature detectors that cause current to the motor to be interrupted when the motor attains a temperature rise greater than marked on the nameplate in an ambient temperature of 40°C for motors larger than 1500 hp.

The NEC defines minimum requirements and is intended to provide protection from fire. Protection relays can provide many enhancements above simple fire protection.

Communications

Network communications can be added to a motor protection relay to allow remote metering of currents, voltages and temperatures. Data logging is a useful feature for troubleshooting and comparing event sequences with process stages. Analysis of information can often show operational issues.

Arc-Flash Protection

The Consequences of Arc Flash

Arcing and arc flashes are uncontrolled, intense, luminous discharges of electrical energy that occur when electric current flows across what is normally an insulating medium. The most common cause of arc faults is insulation failure. These failures may be caused by defective or aging insulation material, poor or incorrect maintenance, dust, moisture, vermin, and human error (touching a test probe to the wrong surface or a tool slipping and touching live conductors).

Arc-Flash events are dangerous, and potentially fatal, to personnel. According to OSHA, industrial Arc-Flash events cause about 80% of electrically-related accidents and fatalities among qualified electrical workers. Even if personnel injuries are avoided, Arc Flash can destroy equipment, resulting in costly replacement and downtime.

Arc-Flash Safety Standards

NFPA 70E, Handbook for Electrical Safety in the Workplace. outlines the practices and standards that companies should follow to protect workers and equipment from Arc Flash and other electrical hazards. It specifies practices designed to make sure that an electrically safe work condition exists. In Canada, CSA Z462, Workplace electrical safety, specifies safe workplace practices. There are also various provincial regulations pertaining to electrical safety.

The NFPA 70E and the CSA Z462 hold both employers and their employees responsible for creating a workplace for electrical workers that is not just safe but puts in place the best possible processes and procedures that are fully understood, practiced and enforced for optimal results. Using Arc-Flash relays is one way to protect the functional reliability of the distribution board and at the same time comply with the requirements of NFPA 70E and CSA Z462.

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Arc-Flash Mitigation

NFPA 70E goes into great detail on procedures to avoid electrical shock and Arc-Flash events. Sometimes, though, it's necessary to work on live circuits. For these cases, NPFA 70E specifies approach distances and use of personal protection equipment (PPE).

Current limiting fuses or current-limiting circuit breakers help protect against arc flashes. They allow only a certain amount of energy to pass before they open a circuit. Because an Arc Flash can draw a fraction of bolted-fault current, circuit breakers cannot be relied upon to distinguish between the arcing current and a typical inrush current.

High-resistance grounding (HRG) is another technique for protecting against arc flashes. If a phase faults to ground, then the resistance limits current to just a few amps; not enough to cause downtime by tripping the overcurrent protection device, and not enough to allow an Arc Flash. It is important to remember that while resistance grounding prevents Arc Flash from phase-to-ground shorts, it has no effect on phase-to-phase shorts.

Another way to mitigate the dangers of arc flashing is by redesigning the switchgear. Switchgear cabinets can be designed to contain and channel energy away from personnel during an Arc Flash.

Arc-Flash relays

Arc-Flash relays are microprocessor-based devices that use optical sensors to detect the onset of a flash. The sensors are strategically placed in various cubicles or drawers inside the switchboard.

Installing an Arc-Flash relay to rapidly detect developing arc flashes greatly reduces the total clearing time and the amount of energy released through an arcing fault. In turn, there is less damage to equipment and fewer and less severe injuries to nearby personnel.

Arc-Flash Relay Selection Criteria

When selecting an Arc-Flash relay, there are six important criteria:
1. Reaction time
2. Trip reliability
3. Avoidance of nuisance tripping
4. Sensor design and installation
5. Ease of use

Reaction Time

Since light is the earliest detectable indication that an Arc Flash is occurring, Arc-Flash relays use optical light sensors to detect the arc that is forming. The output of the light sensor is hard-wired to the Arc-Flash relay, which trips a circuit that interrupts the energy supply in the Arc.

The response time of an Arc-Flash relay is approximately 1-5 ms at light intensities of about 10,000 lux or higher. Within that time frame, the optical sensor output can actuate a switch or circuit breaker to cut off current feeding the arc. The overall current clearing time depends on the protection strategy used and the performance of the external switch or circuit breaker used. The breaker will typically take an additional 35-50 ms to open, depending on the type of breaker and how well it is maintained.

The electronic output to turn on is a function of the type of output relay used. Solid-state outputs (for example, insulated gate bipolar transistors (IGBTs)) are much faster than electromechanical relays and can operate within 200 microseconds.

Trip Reliability

Reliable tripping is the most important characteristic of an Arc-Flash relay, because this ensures mitigation of an arcing fault. Two aspects of reliability should be considered: trip redundancy and system-health monitoring.

Redundant Tripping. Arc-Flash relays should offer a redundant tripping feature, which means it has both primary and secondary trip path logic. The primary path is controlled by the internal microprocessor and its embedded software, and works by activating the coil of the primary trip relay.

The redundant path typically uses a discrete solid-state device that does not go through the microprocessor. Any failure in the primary (microprocessor) path will cause the unit to automatically switch to its redundant path, which activates a shunt-trip relay without delay when a sensor input is above the light detection threshold.

An often overlooked advantage of a solid-state trip path compared to a microprocessor-based circuit is the reaction time when the relay is first powered up. Wiring mistakes, tools left in hazardous locations, and the regular stresses of powering up all contribute to the risk of an Arc Flash on power up. A microprocessor can require 200 ms or more before it is able to start scanning the optical sensors. However, a solid-state trip path can detect an Arc and send a trip signal in as little as 2 ms. In addition, there are fail- safe features that alert operators when, for example, the microprocessor fails.

Health monitoring. Health monitoring makes sure the system is in good operating condition and should extend from the light sensors to the output of the Arc-Flash relay trip circuitry. Health monitoring starts on the sensors. A signal is sent from the relay to the light sensors, where a test light is detected by the sensor and sent back to the relay. In the case of a fiber-optic sensor, this also verifies the entire length of the fiber is not pinched or broken. On-sensor health indication is critical in preventing maintenance work on equipment where protection is not working. It also has the added benefit of providing rapid fault location.

Following the path of a trip signal from the sensor, internal monitoring must also include the primary and redundant trip circuit. Low voltage across the IGBT indicates a wiring fault or an error in the trip coil, and a high voltage is a sign of an error in the IGBT switch, both of which are also reported and logged. The IGBT is also thermally protected against overloads, and will turn off if it overheats. However, the thermal protection has a 100 ms delay before acting, meaning that even a dangerously overheated coil will attempt to signal a trip before resuming thermal protection.

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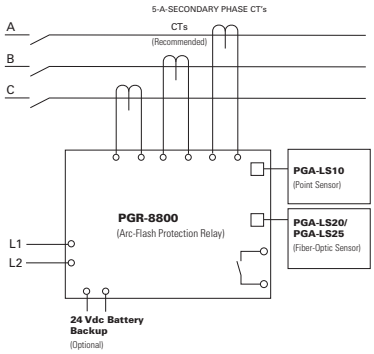
Avoidance of Nuisance Tripping

A typical Arc-Flash Relay system has an integrated three-phase current measurement function that detects and reacts to short circuit and overcurrent conditions. Although this is not a requirement for the system to operate, this option will increase the reliability of the system (minimize unwanted tripping).

If the microprocessor logic receives an input from a light sensor, it checks for a rapidly rising input from the current transformers. Two conditions need to be fulfilled before the trip is sent to the circuit breaker: a certain current flow that exceeds the normal operating current of the system (the threshold level is adjustable from 10-1000% of the full load current) and a signal from the arc-flash sensor, implying that the sensor has reacted to a high-intensity light source.

Sensor Design and Installation

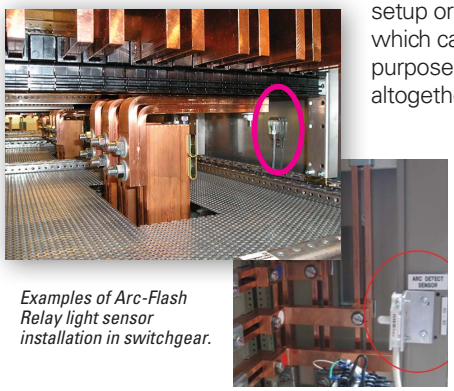
Arc-Flash relay installations utilize multiple fixed-point light sensors near vertical and horizontal bus bars where arcing faults are apt to occur in feeder switchgear cabinets. Sufficient numbers of sensors should be installed to cover all accessible areas, even if policy is to only work on de-energized systems. At least one sensor should have visibility to an arc fault if a person blocks another sensor's field of view. Light sensors may also be installed in other electrical cabinets and on panels that are subject to routine maintenance and repairs.



A fiber-optic sensor, which have a 360° field of view for detecting light, allows more flexible positioning of the light sensing locations, as the fiber-optic strands can be looped throughout an enclosure or panel to cover challenging component layouts.

Easy to Use Hardware and Software

Another important factor to consider is ease of use. Some relays may require field assembly, calibration, or advanced configuration before installing. It is critical to consider those extra steps and the capabilities of the operators who will be using the devices. Often, very complicated devices can be misused because of incorrect setup or configuration, which can defeat the purpose of the device altogether. A few Arc-Flash Relays have software that provides event logging. To make troubleshooting easier, this software should record the specific sensor that initiated the fault in the data records.



Examples of Arc-Flash Relay light sensor installation in switchgear.

III. CT APPLICATION

Current Transformers (CTs)

A current transformer is defined as a transformer that produces a current in its secondary circuit that is in proportion to current in its primary circuit.

Although there are other types of CTs, only the window (or ring) type will be discussed here. Window-type CTs get their name from their design that consists of a ring-shaped core. This core is formed by a single length of strip ferromagnetic material tightly wound to form the ring-shaped core.

A CT operates on a principle of flux balance, as shown in *Figure 1*. If the primary winding is energized with the secondary circuit open-circuited, the transformer becomes an iron-cored inductor. The primary current generates a magnetic flux in the core as shown (flux direction can be determined by the right-hand rule). When the secondary winding is connected to a burden or is short circuited, current flows through the secondary winding creating magnetic flux in the core in opposition to the magnetizing flux created by the primary current. If losses are ignored, the secondary flux balances exactly to the primary flux. This phenomenon is known as Lenz's Law.

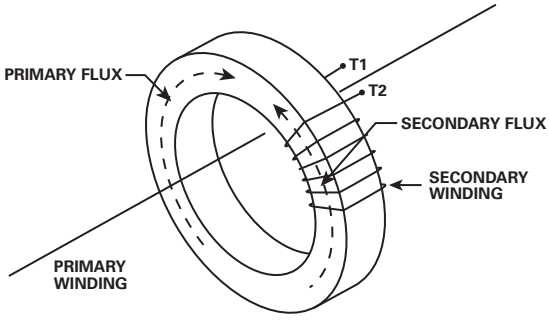


FIGURE 1

Lead Length

The secondary lead resistance of CTs cannot be ignored, particularly with low Volt-Amperes (VA) CTs. For example, let's look at an electronic overload relay.

The relay's CT input impedance or burden (Z_B) = 0.01 Ω

The maximum current (I) = 10 A

The CT rating (P) = 5 VA

Now let's solve for the maximum length of #14 AWG leads that will result in a rated accuracy for a 10 A secondary current. Solving for maximum total impedance (Z_T):

$P = I^2Z_T$

$Z_T = P / I^2 = 5 / 10^2 = 0.05\ \Omega$

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Solving for the maximum lead resistance (Z_W):

$Z_T = Z_W + Z_B$

$Z_W = 0.05\text{-}0.01 = 0.04\ \Omega$

If we look up the #14 AWG resistance we find it equals 2.6 ohms/1000 ft

Therefore, lead length = Z_W / #14 AWG resistance

Maximum lead length = (0.04 x 1000) / 2.6 = 15.4 ft

CT Installation

A CT should not be operated with its secondary open-circuited. If the secondary is opened when primary current is flowing, the secondary current will attempt to continue to flow so as to maintain the flux balance. As the secondary circuit impedance increases from a low value to a high value the voltage across the secondary winding will rise to the voltage required to maintain current flow. If the secondary voltage reaches the breakdown voltage of the secondary winding, the insulation will fail and the CT will be damaged. Furthermore, this situation presents a personnel shock hazard.

When a ring-type CT is used to monitor a single conductor or multiple conductors, the conductors should be centered in the CT window, as shown below in *Figure 2*, and should be perpendicular to the CT opening.

In some applications it is difficult or impossible to install the primary conductor through the CT window (example: existing bus bar structure). For these applications a split core CT is sometimes used. Performance of split core CTs may be less than that of solid core CTs.

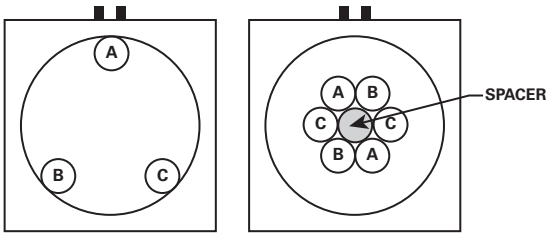


FIGURE 2

CT characteristics are normally specified at a single frequency such as 50 or 60 Hz. Therefore the question arises: What happens when CTs are used with variable frequency drives (VFDs)? For CTs that are linear to approximately 10x rated primary current at 60 Hz, the Volts/Hertz ratio is approximately constant. That is, for all other conditions held the same at 6 Hz, the CT will be linear to only 1x rated current and at 30 Hz the CT will be linear to 5x rated current. For a standard silicon-steel-core CT, the upper bandwidth frequency is approximately 5 kHz.

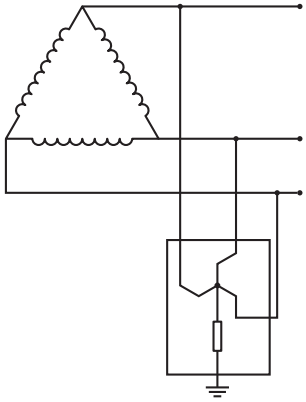
IV. RESISTANCE-GROUNDING CONVERSION

Convert Ungrounded to Resistance-Grounded Systems

Resistance grounding protects a system against transient overvoltages caused by intermittent ground faults and it provides a method to locate ground faults. (Transient overvoltages and inability to locate ground faults are the most common safety issues with ungrounded systems.)

Conversion of delta-connected or wye-connected sources with inaccessible neutrals require a zigzag transformer to derive an accessible neutral for connection to a neutral grounding resistor (NGR). The neutral is only used for the NGR and not for distribution. During normal operation the only current that flows in the zigzag transformer is an extremely small magnetizing current. When one phase is grounded, the NGR and the zigzag transformer provide a path for ground-fault current to flow.

Figure 1



Design Note 1: A zigzag conversion requires a three-phase connection to the existing power system, typically at the main transformer or switchgear. See *Figure 1*.

Design Note 2: The resistor let-through current must be greater than the system capacitive charging current *(see Section I).*

Design Note 3: Protection, coordination, and annunciation systems depend on the integrity of the NGR. NGR monitoring with an SE-330 or SE-325 is recommended.

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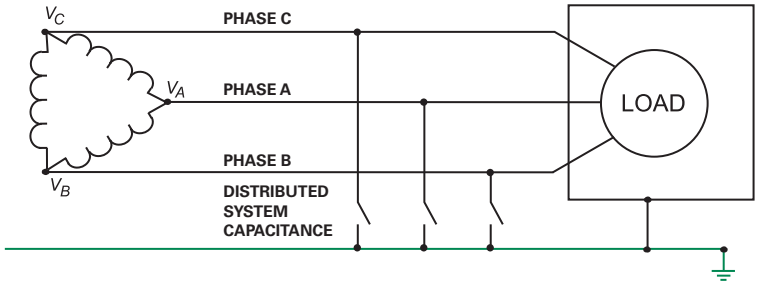
UNGROUNDED SYSTEM

Advantages

- Operation possible with one faulted phase

Disadvantages

- Ground faults are difficult to locate
- Transient overvoltages damage equipment



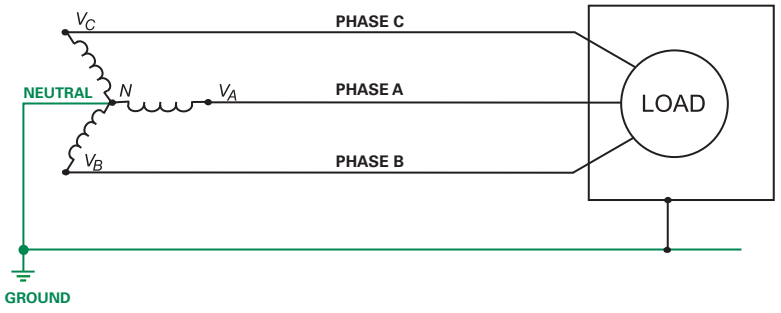
SOLIDLY GROUNDED SYSTEM

Advantages

- Eliminates transient overvoltages
- Selective tripping possible

Disadvantages

- Costly point-of-fault damage
- Cannot operate with a ground fault
- Ground-fault Arc-Flash hazard
- Increased Arc-Flash risk



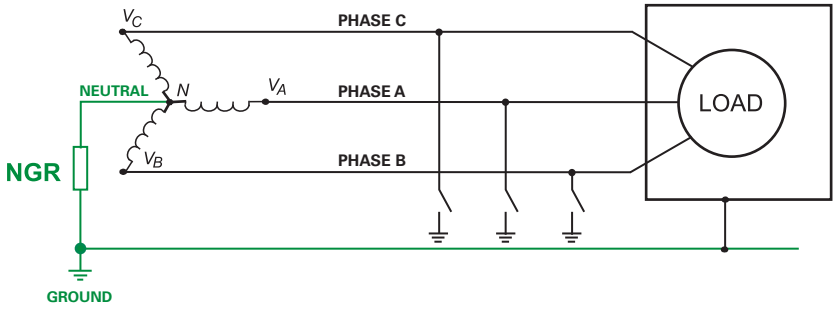
RESISTANCE-GROUNDED SYSTEM

Advantages

- Reduced point-of-fault damage and Arc-Flash risk
- Eliminates transient overvoltages
- Simplifies ground-fault location
- Continuous operation with a ground fault
- Selective tripping possible
- No ground-fault Arc-Flash hazard

Disadvantages

- Failure of the neutral-grounding resistor renders current-sensing ground-fault protection inoperative



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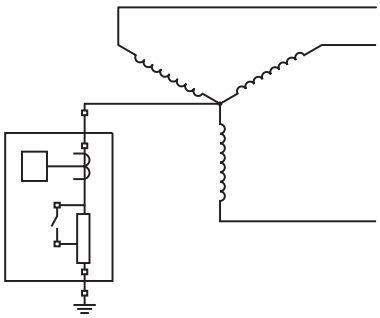
Convert Solidly Grounded to Resistance-Grounded Systems

Resistance grounding protects a system against Arc-Flash Hazards caused by ground faults and provides a method for continuous operation or an orderly shutdown procedure. (Ground faults are estimated to be 98% of all electrical faults.)

Since the neutral point of the power source is available, the solid connection between neutral and ground is replaced with a grounding resistor. This resistor limits ground fault current to a predetermined value, typically 5 A for 480 V systems (the system capacitive charging current is usually less than 3 A). By limiting the ground-fault current to 5 A or less, there are no Arc-Flash Hazards associated with ground faults. This allows for continuous operation during the first ground fault.

During a ground fault on a resistance-grounded (RG) system, a voltage shift occurs (the same shift experienced on ungrounded systems). The faulted phase collapses to ~0 V, the non-faulted phases rise to line-to-line voltage with respect to ground, and the neutral point rises to line-to-neutral voltage with respect to ground.

Figure 2



Design Note 1: An NGR conversion for a solidly grounded system requires a neutral connection to the existing power system, typically at the main transformer or switchgear. See *Figure 2*.

Design Note 2: The voltage shift requires equipment to be fully rated at line-to-line voltage with respect to ground. This may require TVSSs, VFDs, meters, etc. to be reconfigured or replaced.

Design Note 3: The voltage shift also restricts neutral distribution. The neutral typically cannot be distributed due to its potential rise during ground faults. Single-phase line-to-neutral-voltage loads must be served by a 1:1 isolation transformer or converted to line-to-line loads.

Design Note 4: The resistor let-through current must be greater than the system capacitive charging current (*see Section I).*

Design Note 5: Protection, coordination, and annunciation systems depend on the integrity of the NGR. Monitoring with an SE-330 or SE-325 NGR Monitor is recommended.

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IEEE DEVICE NUMBERS

1 - Master Element
2 - Time Delay Starting or Closing Relay
3 - Checking or Interlocking Relay
4 - Master Contactor
5 - Stopping Device
6 - Starting Circuit Breaker
7 - Rate of Change Relay
8 - Control Power Disconnecting Device
9 - Reversing Device
10 - Unit Sequence Switch
11 - Multi-function Device
12 - Overspeed Device
13 - Synchronous-speed Device
14 - Underspeed Device
15 - Speed - or Frequency, Matching Device
16 - Data Communications Device
17 - Shunting or Discharge Switch
18 - Accelerating or Decelerating Device
19 - Starting to Running Transition Contactor
20 - Electrically Operated Valve
21 - Distance Relay
22 - Equalizer Circuit Breaker
23 - Temperature Control Device
24 - Volts Per Hertz Relay
25 - Synchronizing or Synchronism-Check Device
26 - Apparatus Thermal Device
27 - Undervoltage Relay
28 - Flame Detector
29 - Isolating Contactor or Switch
30 - Annunciator Relay
31 - Separate Excitation Device
32 - Directional Power Relay
33 - Position Switch
34 - Master Sequence Device
35 - Brush-Operating or Slip-Ring Short-Circuiting Device
36 - Polarity or Polarizing Voltage Devices
37 - Undercurrent or Underpower Relay
38 - Bearing Protective Device
39 - Mechanical Condition Monitor
40 - Field (over/under excitation) Relay
41 - Field Circuit Breaker
42 - Running Circuit Breaker
43 - Manual Transfer or Selector Device
44 - Unit Sequence Starting Relay
45 - Abnormal Atmospheric Condition Monitor
46 - Reverse-phase or Phase-Balance Current Relay
47 - Phase-Sequence or Phase-Balance Voltage Relay
48 - Incomplete Sequence Relay
49 - Machine or Transformer, Thermal Relay
50 - Instantaneous Overcurrent Relay
51 - AC Inverse Time Overcurrent Relay
52 - AC Circuit Breaker
53 - Exciter or DC Generator Relay
54 - Turning Gear Engaging Device
55 - Power Factor Relay
56 - Field Application Relay
57 - Short-Circuiting or Grounding (Earthing) Device
58 - Rectification Failure Relay
59 - Overvoltage Relay
60 - Voltage or Current Balance Relay
61 - Density Switch or Sensor
62 - Time-Delay Stopping or Opening Relay
63 - Pressure Switch
64 - Ground (Earth) Detector Relay
65 - Governor
66 - Notching or Jogging Device
67 - AC Directional Overcurrent Relay
68 - Blocking or "Out-of-Step" Relay
69 - Permissive Control Device
70 - Rheostat
71 - Liquid Level Switch
72 - DC Circuit Breaker
73 - Load-Resistor Contactor
74 - Alarm Relay
75 - Position Changing Mechanism
76 - DC Overcurrent Relay
77 - Telemetering Device
78 - Phase-Angle Measuring Relay
79 - AC Reclosing Relay
80 - Flow Switch
81 - Frequency Relay
82 - DC Reclosing Relay
83 - Automatic Selective Control or Transfer Relay
84 - Operating Mechanism
85 - Communications, Carrier or Pilot-Wire Relay
86 - Lockout Relay
87 - Differential Protective Relay
88 - Auxiliary Motor or Motor Generator
89 - Line Switch
90 - Regulating Device
91 - Voltage Directional Relay
92 - Voltage and Power Directional Relay
93 - Field Changing Contactor
94 - Tripping or Trip-Free Relay

ANSI DEVICE NUMBERS

AFD - Arc Flash Detector
CLK - Clock or Timing Source
DDR - Dynamic Disturbance Recorder
DFR - Digital Fault Recorder
ENV - Environmental Data
HIZ - High Impedance Fault Detector
HMI - Human Machine Interface
HST - Historian
LGC - Scheme Logic
MET - Substation Metering
PDC - Phasor Data Concentrator
PMU - Phasor Measurement Unit
PQM - Power Quality Monitor
RIO - Remote Input/Output Device
RTU - Remote Terminal Unit/Data Concentrator
SER - Sequence of Events Recorder
TCM - Trip Circuit Monitor
SOTF - Switch On To Fault

TYPICAL SUFFIXES

A - Alarm/Auxiliary Power
AC - Alternating Current
B - Battery/Blower/Bus
BT - Bus Tie
C - Capacitor/Condenser/Compensator/ Carrier Current/Case/Compressor
DC - Direct Current
E - Exciter
F - Feeder/Field/Filament/ Filter/Fan
G - Generator/Ground*
M - Motor/Metering
N - Network/Neutral*
P - Pump/Phase Comparison
R - Reactor/Rectifier/Room
S - Synchronizing/Secondary/Stainer/Sump/ Suction (Valve)
T - Transformer/Thyratron
TH - Transformer (High-voltage Side)
TL - Transformer (Low-voltage Side)
TT - Transformer (Tertiary-voltage Side)
U - Unit

Note: Descriptions per IEEE Std C37.2-1996
*Suffix N is preferred when the device is connected in the residual of a polyphase circuit, is connected across broken delta, or is internally derived from the polyphase current or voltage quantities. The suffix G is preferred where the measured quantity is in the path of ground or, in the case of ground fault detectors, is the current flowing to ground.

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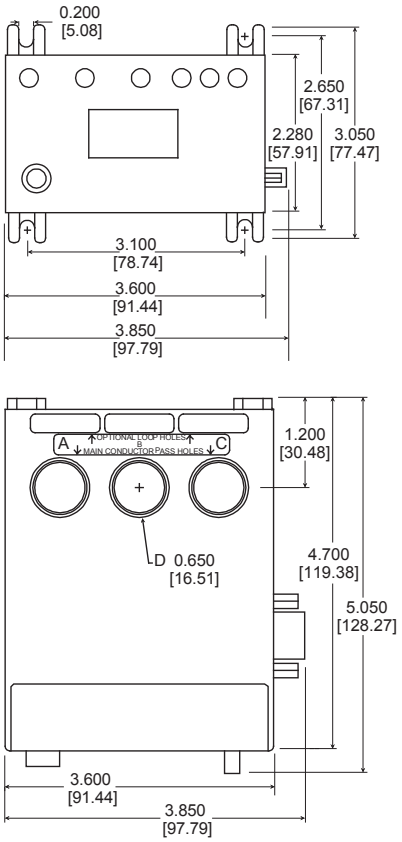
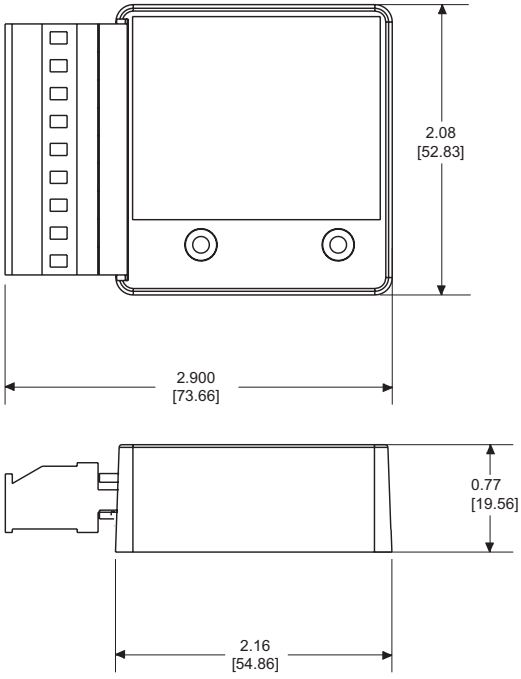
DIMENSIONAL DRAWINGS

Figure 1



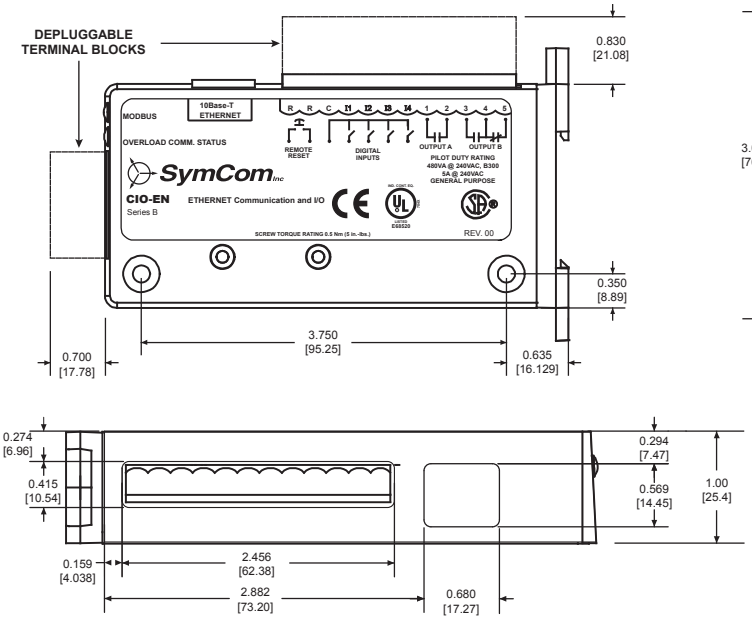
601; 601-CS-D-P1; 777; 777-ACCUPOWER; 777-KW/HP-P2; 77C; 77C-KW/HP

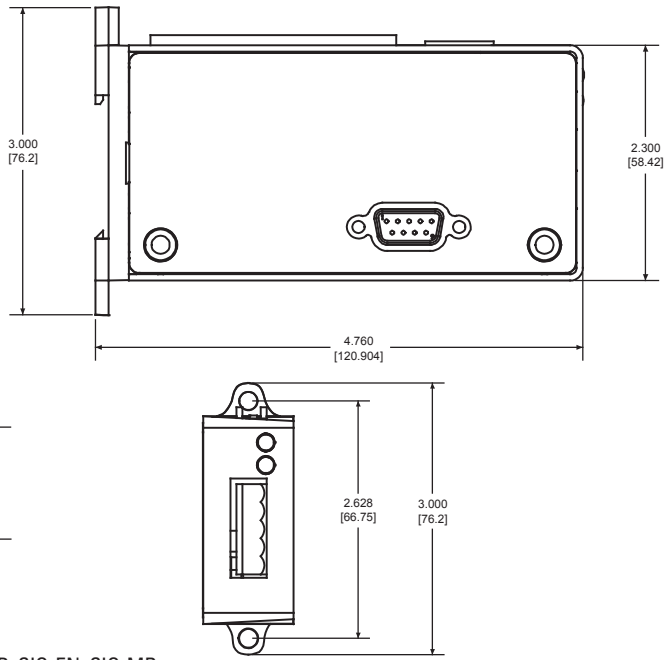
Figure 2



RS485MS-2W; COM 4-20

Figure 3



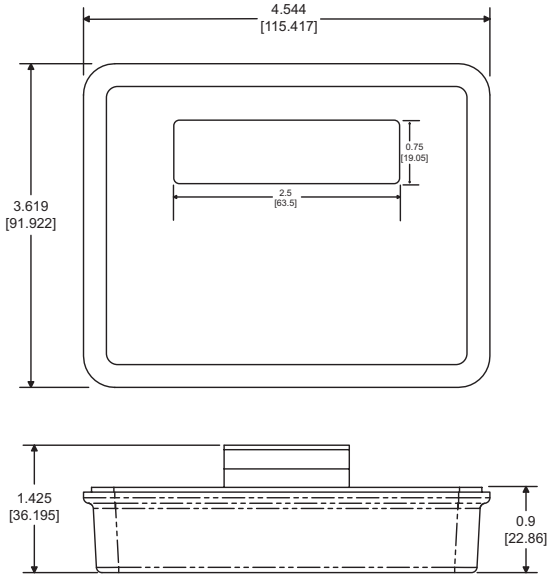


CIO-120-DN-P; CIO-DN-P; CIO-EN; CIO-MB;
CIO-120-MB; CIO-777-PR

Measurements: inches (millimeters)

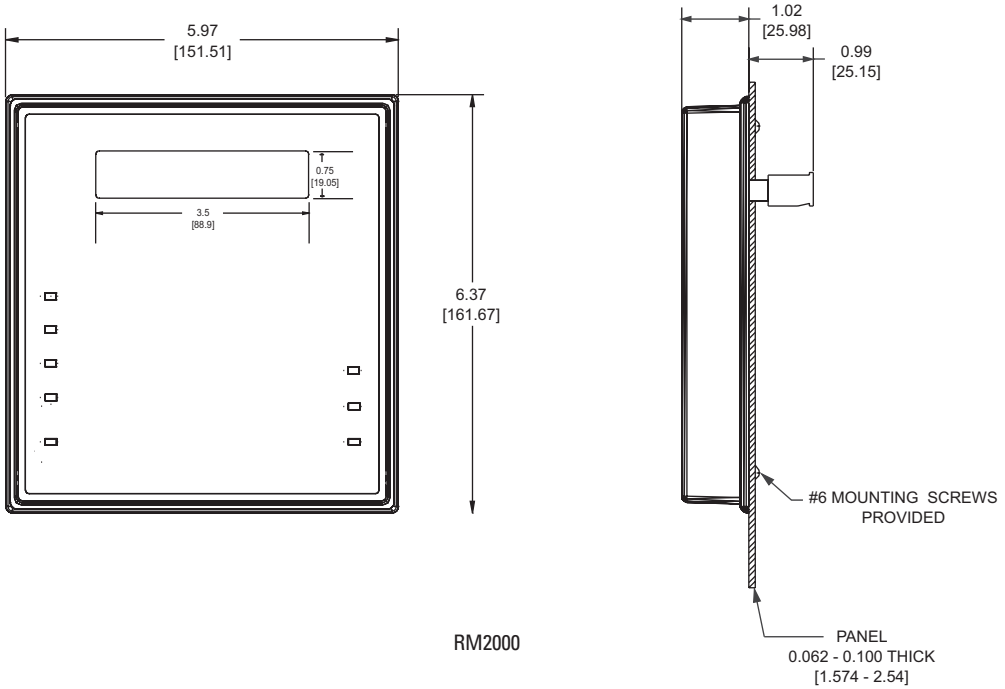
DIMENSIONAL DRAWINGS

Figure 4



RM1000

Figure 5



RM2000

Measurements: inches (millimeters)

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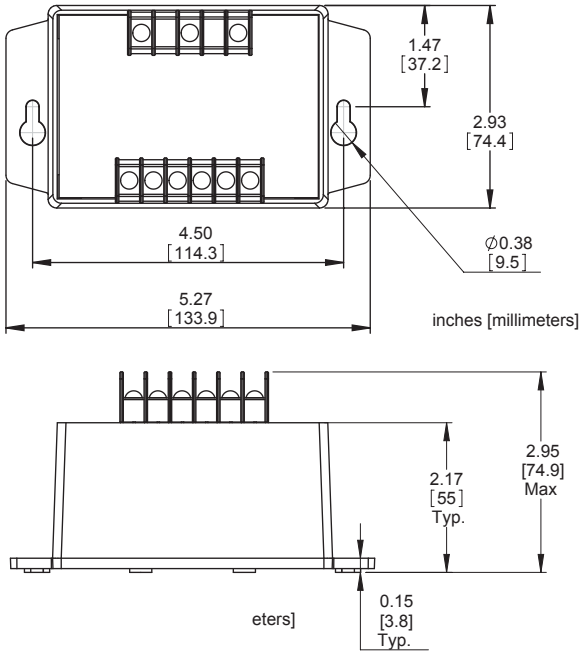
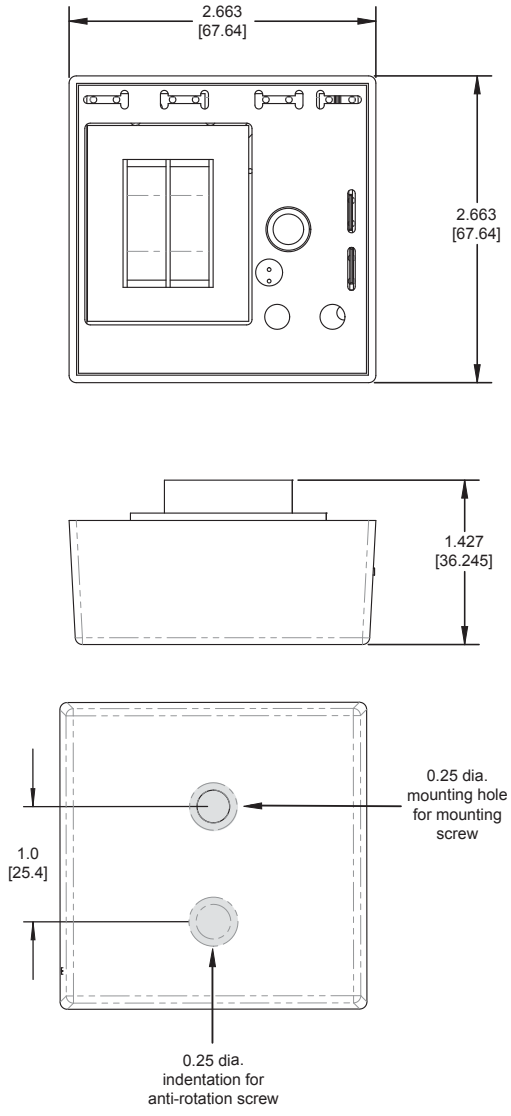
DIMENSIONAL DRAWINGS

Figure 6



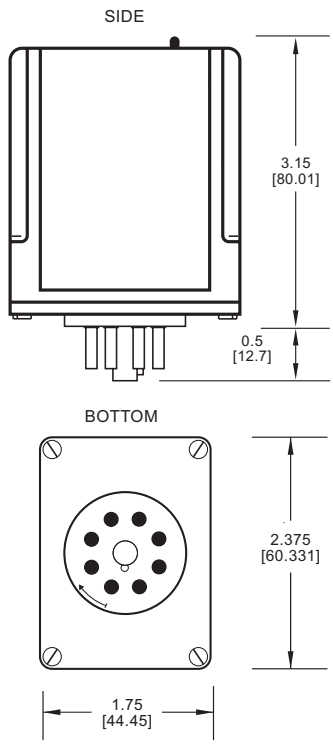
102A; 250A; 350; 355; 455; 50R; 50R-400-ALT; CP5; T10

Figure 7



202; 202-200-SP

Figure 8

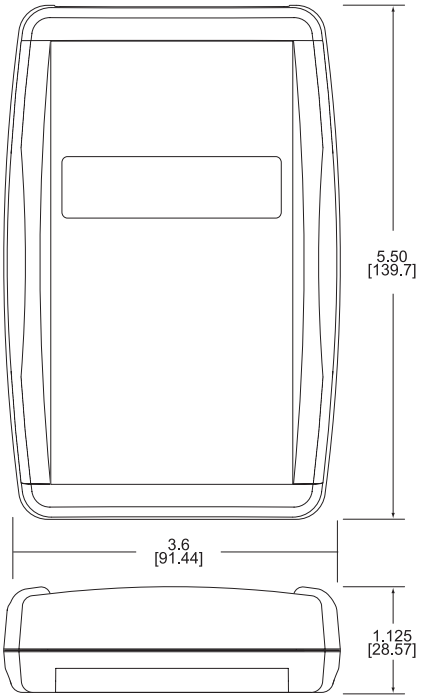


ACBC-120; ALT; ALT-XXX-X-SW; ISS-101; PC-XXX-LLC; 201-100-SLD; 201A; 201A-AU; 201A-9; 201-XXX-SP; 201-XXX-DPDT; 201-XXX-SP-DPDT

Measurements: inches (millimeters)

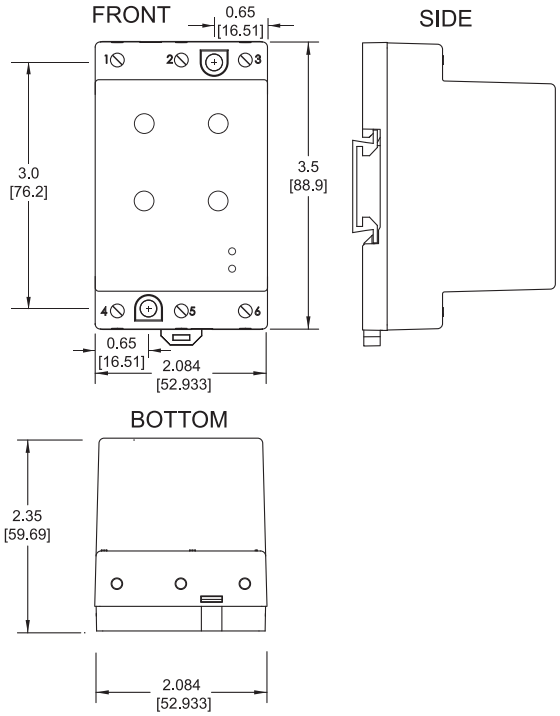
DIMENSIONAL DRAWINGS

Figure 9



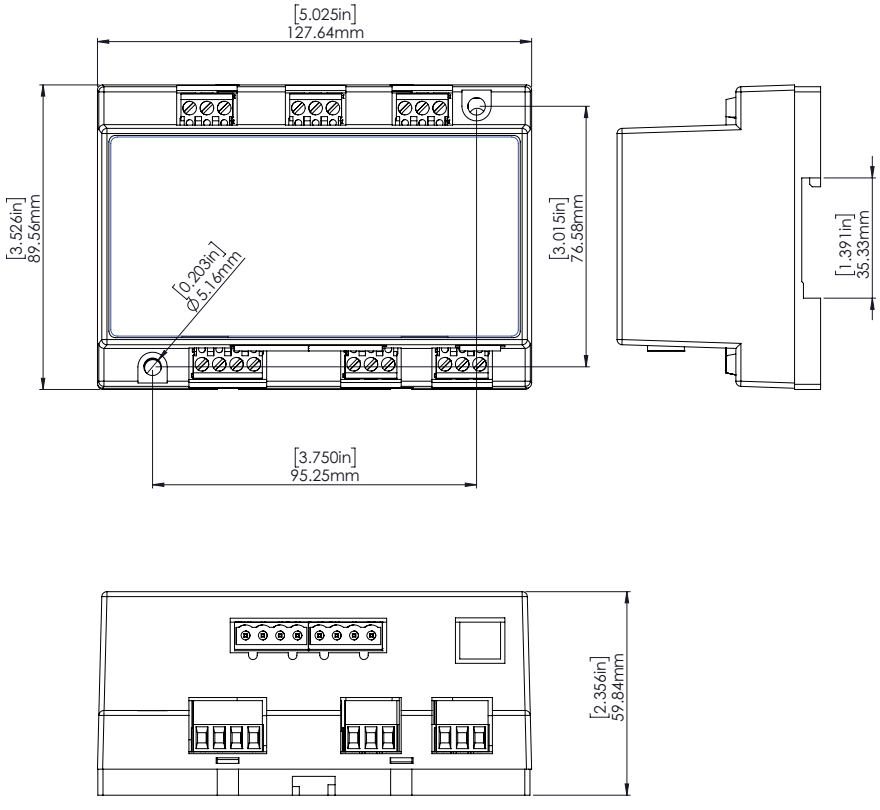
Informer; Informer-MS

Figure 10



460; 460-15-100-XXX; 460-XXX-SP; ISS-100; ISS-102; PC-102

Figure 11



AF0100

Measurements: inches (millimeters)

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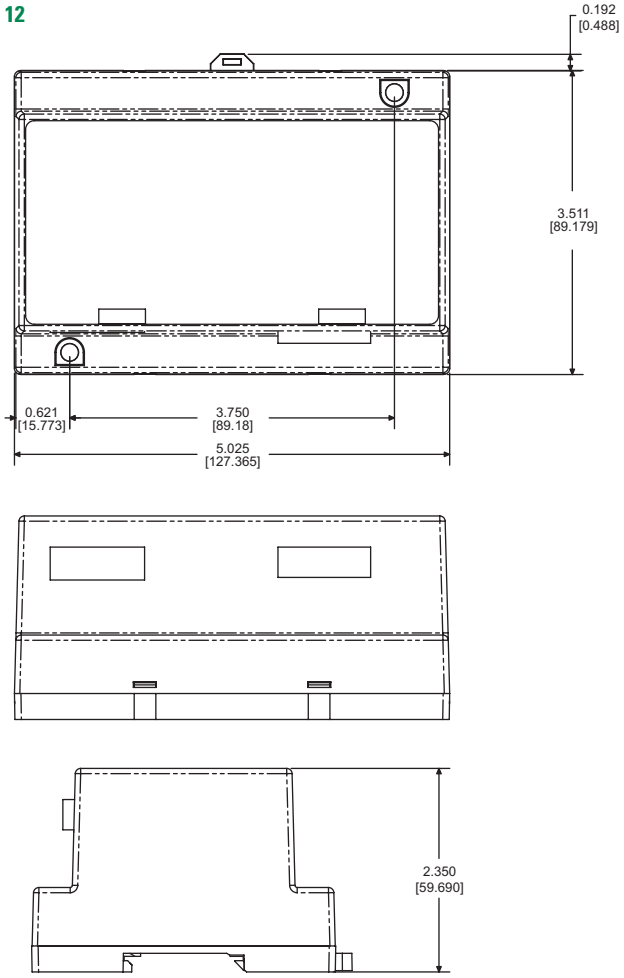
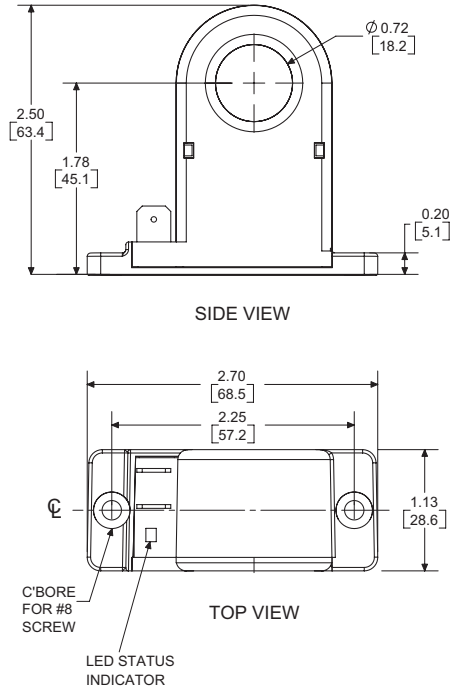
DIMENSIONAL DRAWINGS

Figure 12



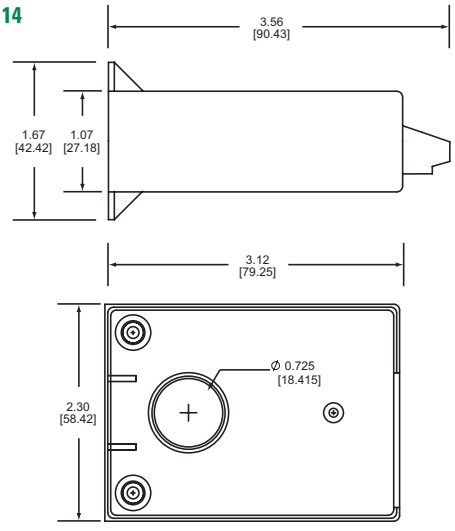
ISS-105; PC-105

Figure 13



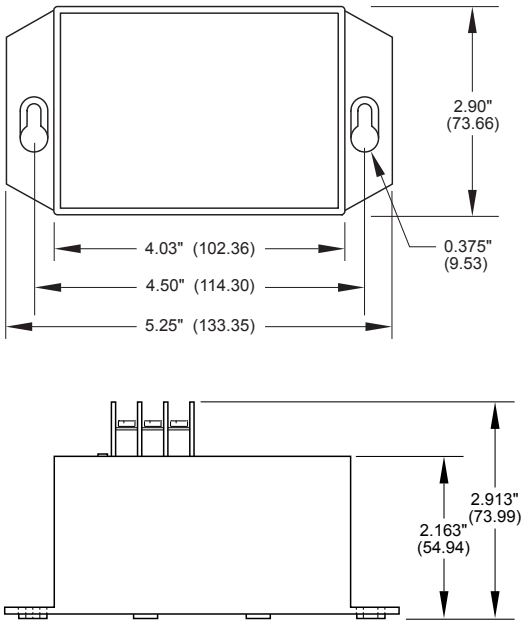
LSRX; LSRX-C

Figure 14



LSR-0; LSR-XXX; LSRU

Figure 15

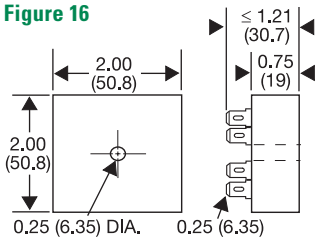


111P; 233P; 233P-1.5; 235P

Measurements: inches (millimeters)

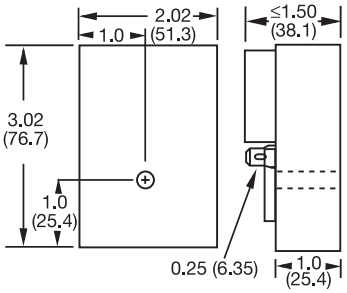
DIMENSIONAL DRAWINGS

Figure 16



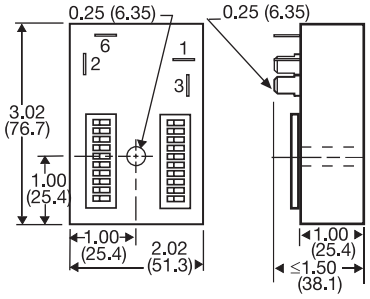
CT; ESD52233; ESDR; FS100 (medium power); FS200; FS300; KRD3; KRD9; KRDB; KRDI; KRDM; KRDR; KRDS; KRPD; KRPS; KSD1; KSD2; KSD3; KSDB; KSDR; KSDS; KSDU; KSPD; KSPS; KSPU; KVM; T2D120A15M; TA; TAC1; TDU; TDUB; TDUI; TDUS; TL; TMV8000; TS1; TS2; TS441165; TS6; TSA141300; TSB; TSD1; TSD2; TSD3411S; TSD6; TSD7; TSD94110SB; TSDB; TSDR; TSDS; TSS; TSU2000

Figure 17



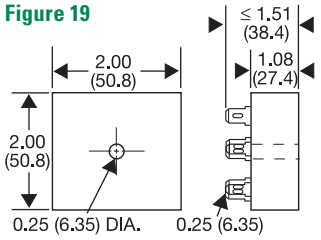
HLVA6I23; HRDB; HRDI; HRDM; HRDR; HRDS; HRIS; HRPS; HRV; RS

Figure 18



HSPZA22SL

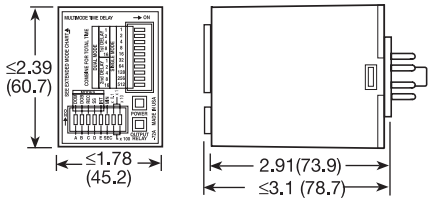
Figure 19



FA; FS; FSU1000*; PHS*; PTHF4900DK*; SIR1; SIR2; SLR1*; TH1; THC; TCR9C; THD1B410.5S; THD2; THD3C42A0; THD7; THDB; THDS; THS

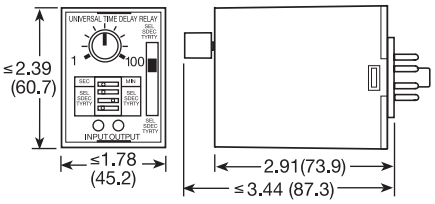
*If unit is rated @ 1A, see Figure 16

Figure 20



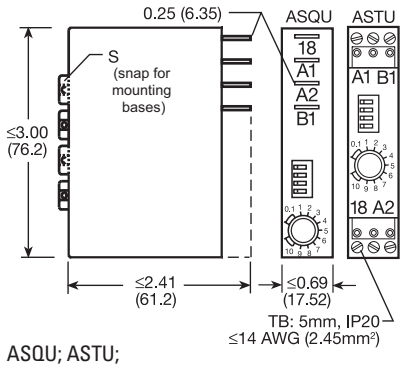
TRDU

Figure 21



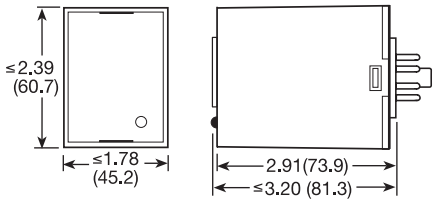
TRU

Figure 22



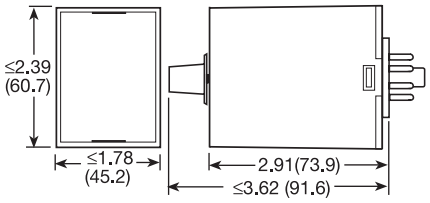
ASQU; ASTU;
DSQU; DSTU

Figure 23



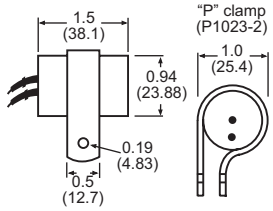
PLM; PLR; TDB; TDBH; TDBL; TDI; TDIH; TDIL; TDM; TDMB; TDMH; TDML; TDR; TDS; TDSH; TDSL

Figure 24



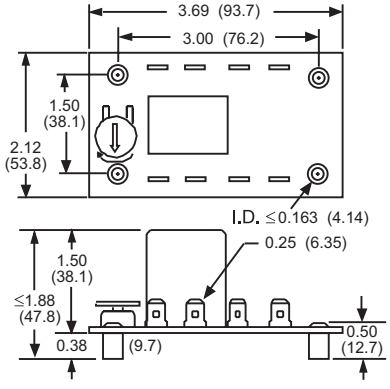
FS500; PRLM; TRB; TRM; TRS

Figure 25



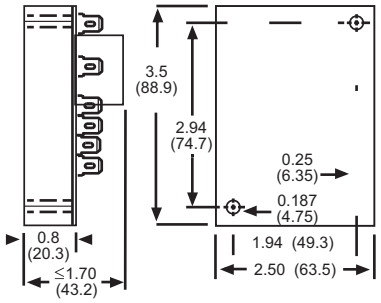
FS100 (low current flasher); FS491

Figure 26



ORB; ORM; ORS

Figure 27



ERD3425A; ERDI; ERDM

Measurements: inches (millimeters)

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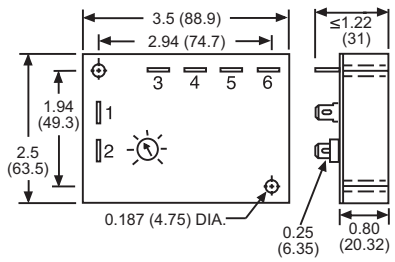
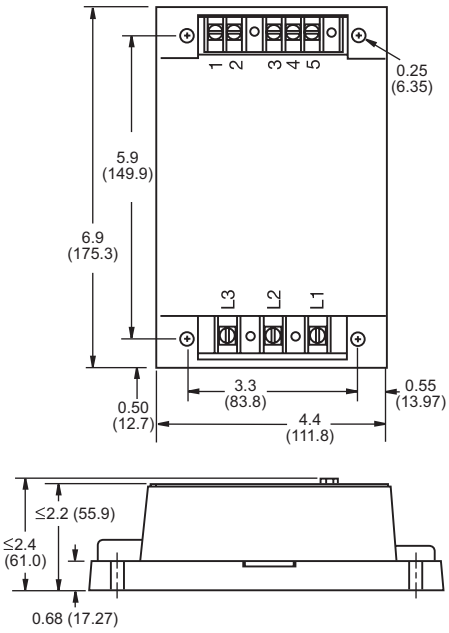
DIMENSIONAL DRAWINGS

Figure 28



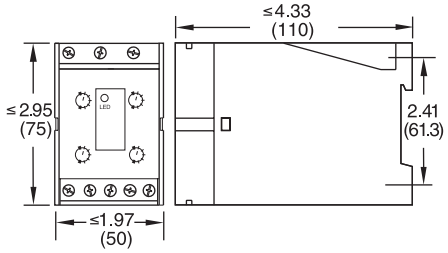
SC3; SC4

Figure 29



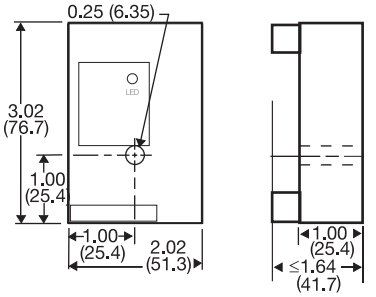
WVM

Figure 30



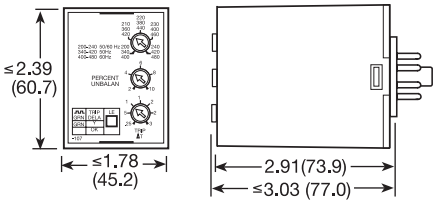
DLMU

Figure 31



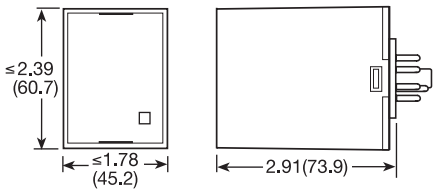
FB9L; HLMU; SCR9L

Figure 32



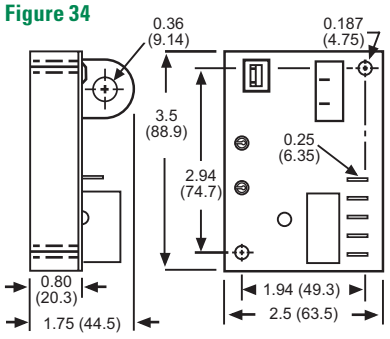
PLMU11

Figure 33



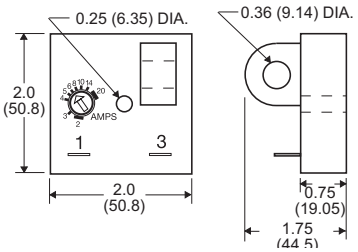
LLC4; LLC6; PLS

Figure 34



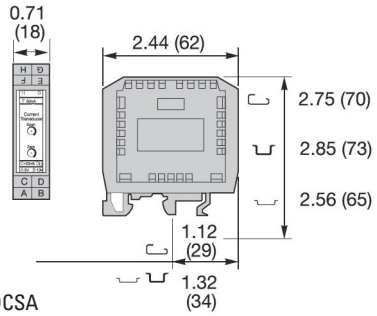
ECS; ECSW
(ECS has spade connectors and ECSW has terminal board)

Figure 35



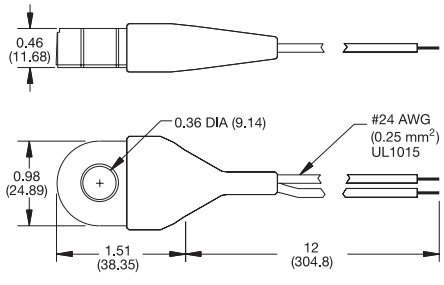
TCS; TCSA

Figure 36



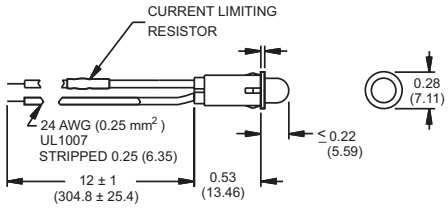
DCSA

Figure 37



LCS10T12

Figure 38



LPM

Measurements: inches (millimeters)

Measurements: inches (millimeters)

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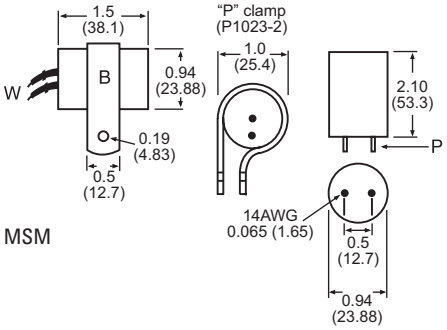
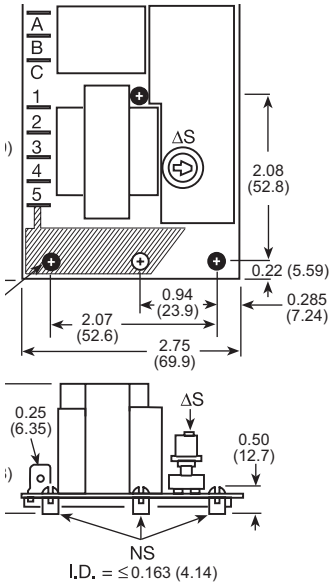
DIMENSIONAL DRAWINGS

Figure 39



MSM

Figure 40

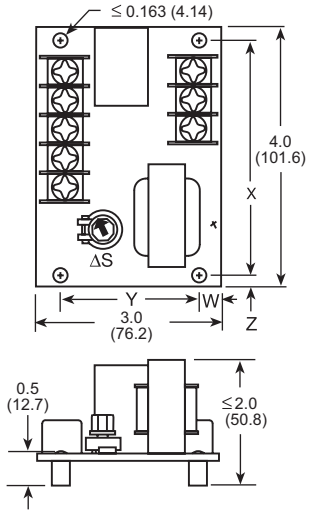


I.D. = ≤0.163 (4.14)

LLC1

NS = Nylon Standoffs

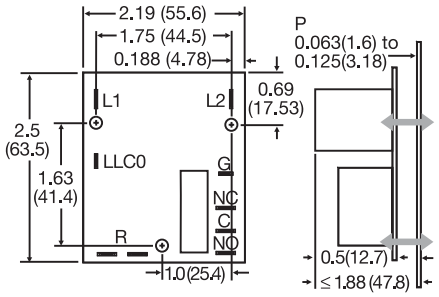
Figure 41



LLC2

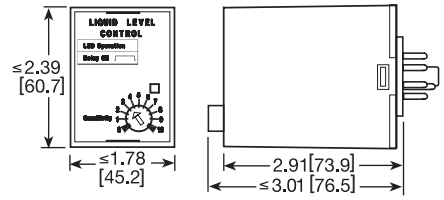
KEY	MODEL NUMBERS ENDING IN:	
	N	C
W	0.440" (11.176 mm)	0.250" (6.350 mm)
X	3.620" (91.948 mm)	3.500" (88.900 mm)
Y	2.120" (53.848 mm)	2.500" (63.500 mm)
Z	0.190" (4.826 mm)	0.250" (6.350 mm)

Figure 42



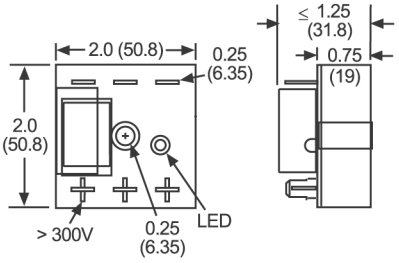
LLC8

Figure 43



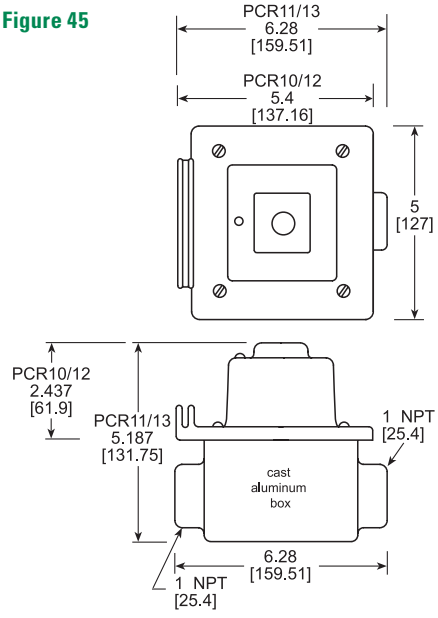
LLC5

Figure 44



TVM; TVW

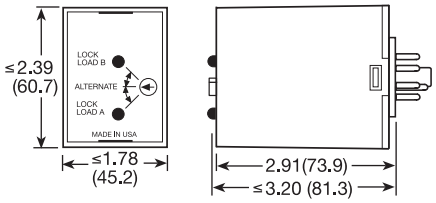
Figure 45



NPT = National Pipe Thread

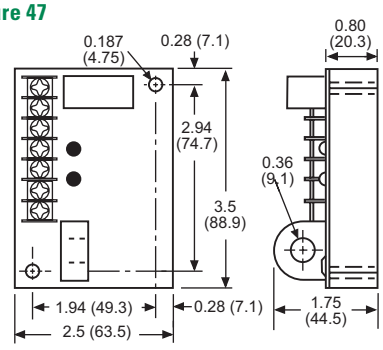
PCR

Figure 46



ARP

Figure 47



FB; SCR

Measurements: inches (millimeters)

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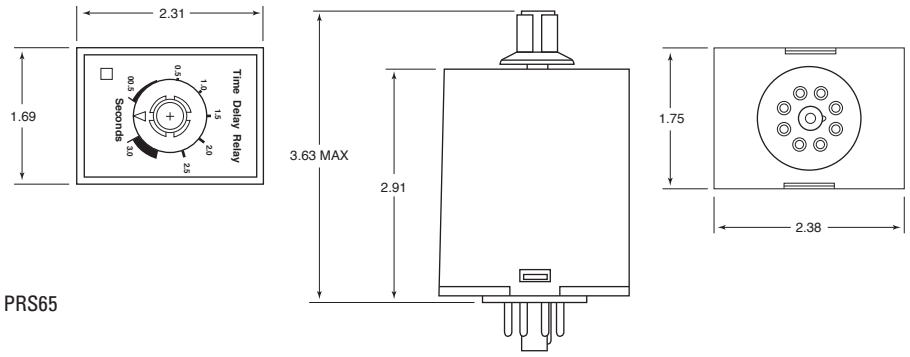
DIMENSIONAL DRAWINGS

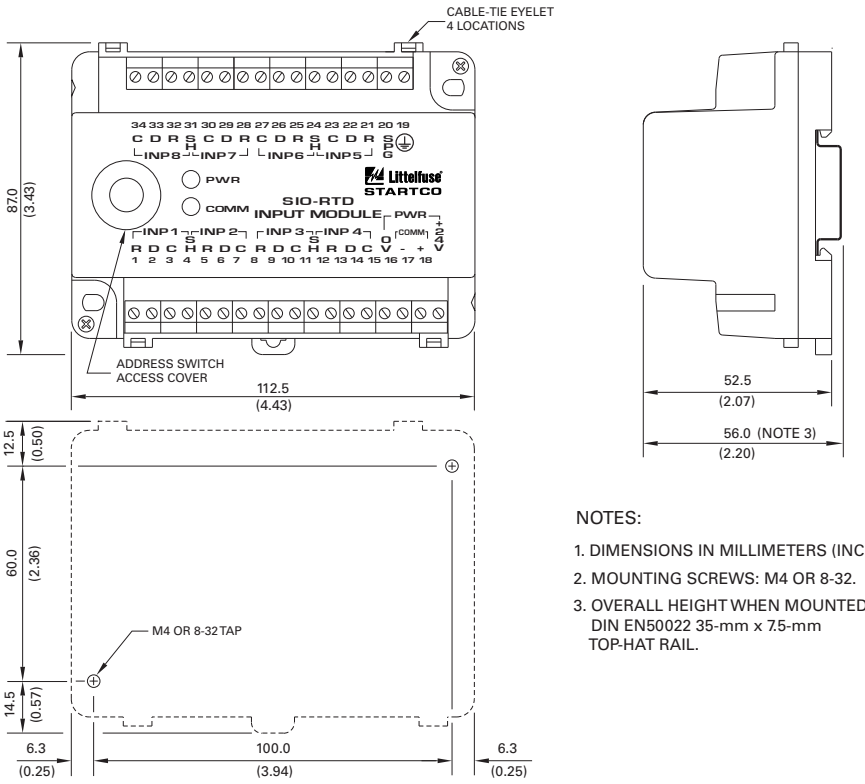
Figure 48



PRS65

Measurements: inches

Figure 49



NOTES:

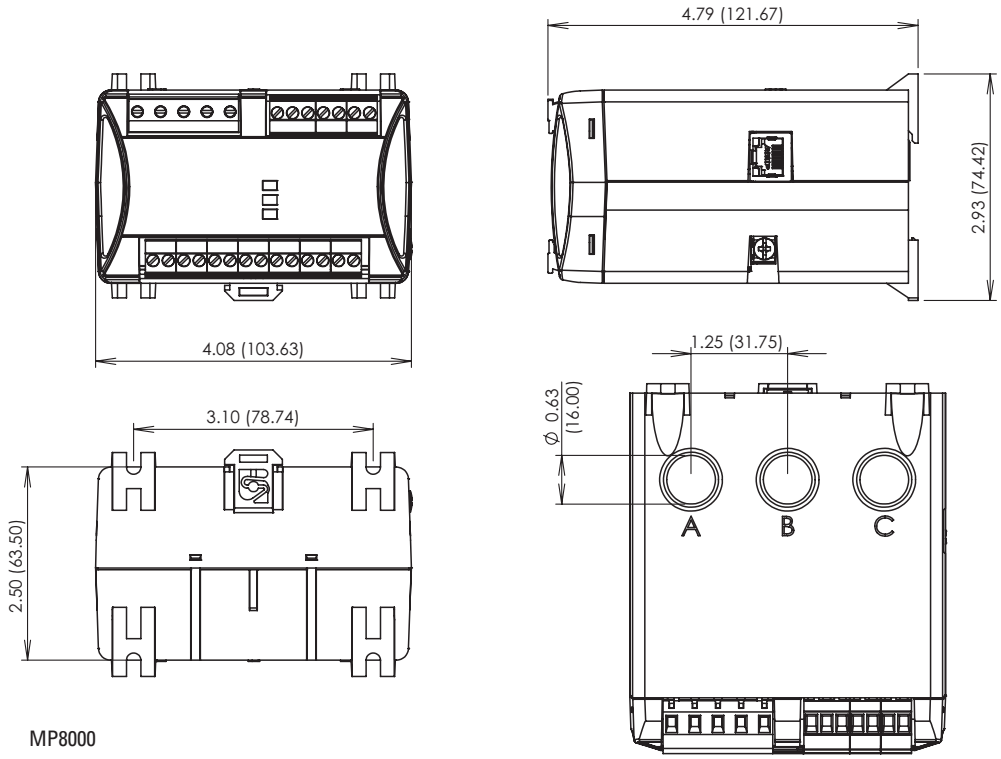
1. DIMENSIONS IN MILLIMETERS (INCHES).
2. MOUNTING SCREWS: M4 OR 8-32.
3. OVERALL HEIGHT WHEN MOUNTED ON DIN EN50022 35-mm x 7.5-mm TOP-HAT RAIL.

SIO-RTD-02-00

Measurements: inches (millimeters)

DIMENSIONAL DRAWINGS

Figure 50



MP8000

Measurements: inches (millimeters)

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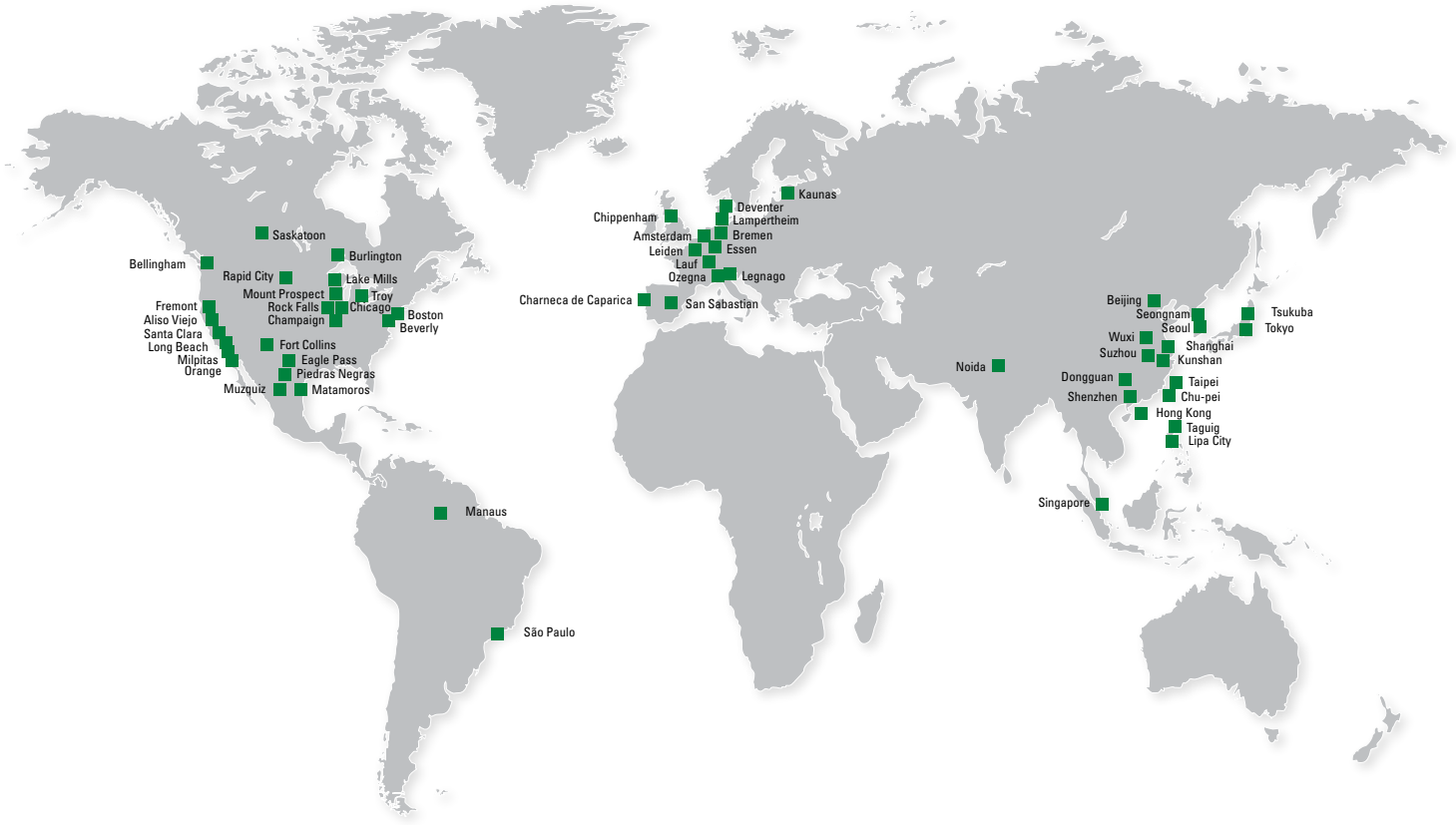

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