



Expertise Applied | Answers Delivered

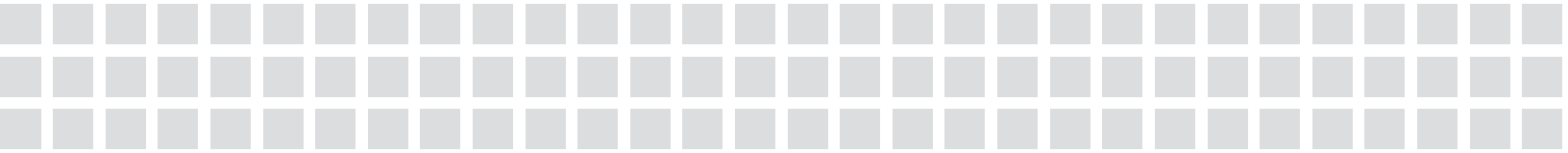


FRESH WATER PUMPING CATALOG

SUBMERSIBLE PUMP PROTECTION

LIQUID LEVEL PROTECTION

SINGLE-PHASE & THREE-PHASE PUMP PROTECTION



We Improve Electrical Safety and Increase Productivity

The Industrial Business Unit of Littelfuse delivers vital products to address customer needs for protection, safe control and distribution of electrical power in industrial applications. Our electrical safety product portfolio includes a comprehensive line of fuses, fuse holders, protection relays, and custom-engineered electrical products to minimize electrical safety hazards, limit equipment damage, improve productivity, and safeguard personnel from injury due to electrical faults.

Technically speaking, professionals in construction, manufacturing, mining, oil & gas, solar, and many more industries rely on Littelfuse for rugged, lasting protection for their designs.



Safety

- Shock Hazard
- Injury to Personnel
- Arc-Flash Hazards
- Open-CT Hazards
- Failed Resistors



Cost

- Fault Damage
- Equipment Replacement
- Calibration Costs
- Compliance Citations
- Motor Rewinds



Downtime

- Replacement Time
- Nuisance Tripping
- Intermittent Faults
- Unreliable Protection
- Calibration Time

For All Types of Environments

- Mining
- Petrochemical, Oil and Gas
- Power Generation
- Pipelines and Transportation
- Aggregate and Cement
- Pulp and Paper
- Water and Wastewater
- Shore-to-Ship Power
- Data Centers
- Semiconductor Equipment
- Hospitals
- Alternative Energy
- Manufacturing

SUBMERSIBLE PUMPS - OPTIMIZED PROTECTION

111-Insider-P / 231-Insider-P with Control Box	2
Single-Phase Pump Monitor	
111P / 233P / 233P-1.5	5
Single-Phase Pump Monitor	
235P	7
Single-Phase Pump Monitor	
Abbreviated Installation Instructions	9
111P / 233P / 233P-1.5 / 235P in Enclosure	11
Single-Phase Pump Monitor in a NEMA box	

SINGLE-PHASE & THREE-PHASE PUMP PROTECTION

MP8000	12
Bluetooth* Overload Relay	

SINGLE-PHASE PUMP PROTECTION

77C-KW/HP (2-800 A)	16
Programmable	
77C-LR-KW/HP (1-9 A)	16
Low-Range Programmable	

THREE-PHASE PUMP PROTECTION

777-P2 Series	21
Fully Programmable Electronic Overload Relay	
777-KW/HP-P2 Series	23
Programmable Electronic Power Monitor	

LIQUID LEVEL PROTECTION

460-15-100-LLS	32
Liquid Level Sensor Relay (DIN-rail or surface mount)	
PC-XXX-LLC-CZ / PC-XXX-LLC-GM Series	34
Liquid Level Control Relays (8-pin plug-in)	

TIMERS AND ALTERNATING RELAYS

T10	38
Solid-State On-Delay Timer	
ALT	39
Alternating Relay Series	
50R-400-ALT	41
Alternating Relay	

ACCESSORIES

NEMA-3R-L Enclosure	42
Metal Electric Box	
Informer	43
Hand-Held Diagnostic Tool	

*Bluetooth is a trademark of its respective owner.

Submersible Pumps – Optimized Protection

111-INSIDER-P / 231-INSIDER-P

Single-Phase Pump Monitor

for use with the Pentek*, Franklin*, CentriPro*, Grundfos*, Flowise Pro*, or Flint and Walling* Control Box



Description

The Littelfuse 111-Insider-P single-phase products fit inside 1/3 and 1/2 hp, 115 V control boxes and the 231-Insider-P fits inside 1/3, 1/2, 3/4, and 1 hp, 230 V 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.

Ordering Information

MODEL	VOLTAGE	DESCRIPTION
111-Insider-P	115 V ac	1/3 - 1/2 hp, includes IR Kit-12
231-Insider-P	230 V ac	1/3 - 1 hp, includes IR Kit-12

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.

Accessories



Informer

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



Informer IR Kit-12

Attaches to the face of the unit to provide remote diagnostics without opening the panel. (12" fiber optic cable)

*Pentek, Franklin, Grundfos, Flowise Pro, and Flint and Walling are trademarks of their respective owners.

Submersible Pumps – Optimized Protection

111-INSIDER-P / 231-INSIDER-P

Specifications

Functional Specifications

Adjustments/Settings

Overcurrent Underload (dry-well) 125 % of calibration point
Adjustable (70 to 90 % of calibrated run power)

Overvoltage
111-Insider-P 132.5 V ac
231-Insider-P 265 V ac

Undervoltage
111-Insider-P 95 V ac
231-Insider-P 190 V ac

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 2 seconds
Over/Undervoltage Manual, 2-225 minutes
All other faults

Input Characteristics

Supply Voltage

111-Insider-P 115 V ac
231-Insider-P 230 V ac

Load Range

111-Insider-P 1/3 – 1/2 hp
231-Insider-P 1/3 – 1 hp

Frequency

50/60 Hz (*Note: 50 Hz will increase all delay timers by 20 %*)

Output Characteristics

Output Contact Rating-SPST

111-Insider-P 1/2 hp @ 120 V ac (17 A max.)
231-Insider-P 1 hp @ 240 V ac (17 A max.)

General Characteristics

Operating Temperature -40 °C to 60 °C (-40 °F to 140 °F)
Maximum Input Power 5 W

Safety Marks

cURus**
Weight 10 oz.

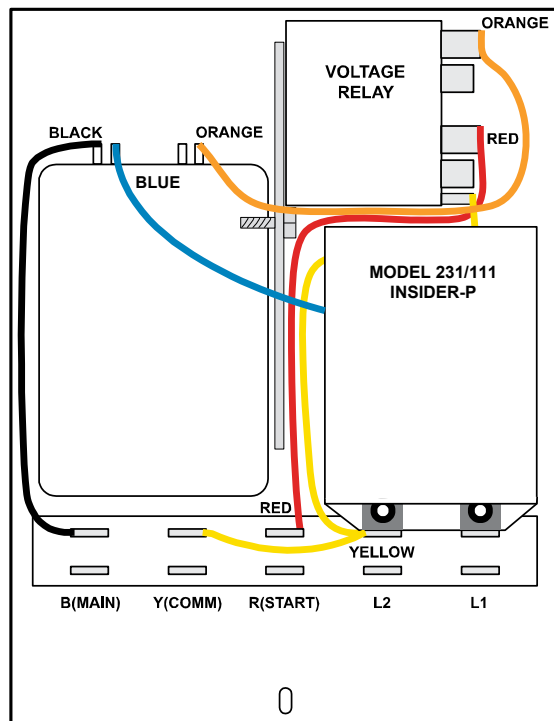
Mounting Methods

Inside a Grundfos* (mfg after mid-2014),
Flowise Pro* and Flint and Walling*
control box

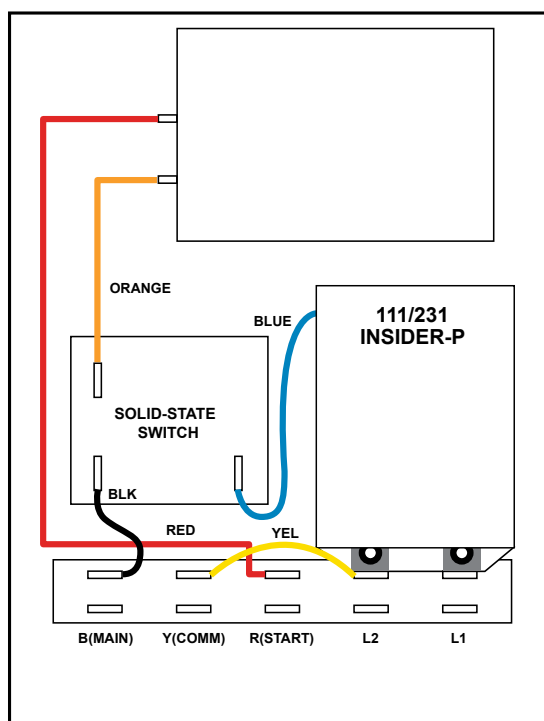
**The 111-Insider-P and 231-Insider-P are agency approved type 3R control boxes when installed as described in the installation instructions. The 111-Insider-P and 231-Insider-P are not intended to provide overload protection, and should be used with thermally or impedance protected motors only.

Installation Instructions

PENTEK* CONTROL BOX WIRING DIAGRAM



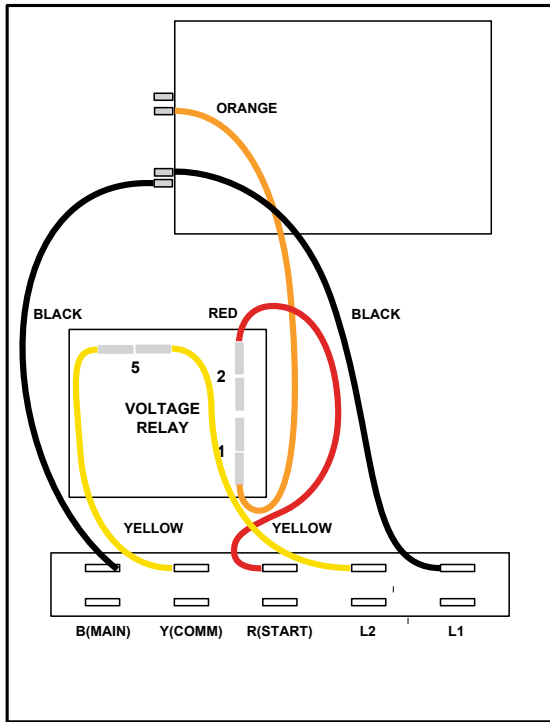
FRANKLIN* CONTROL BOX WIRING DIAGRAM



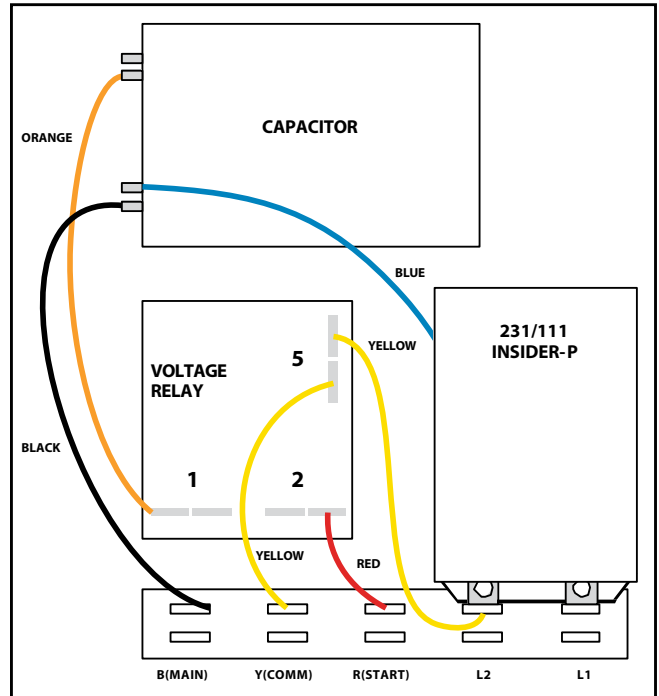
Submersible Pumps – Optimized Protection

111-INSIDER-P / 231-INSIDER-P

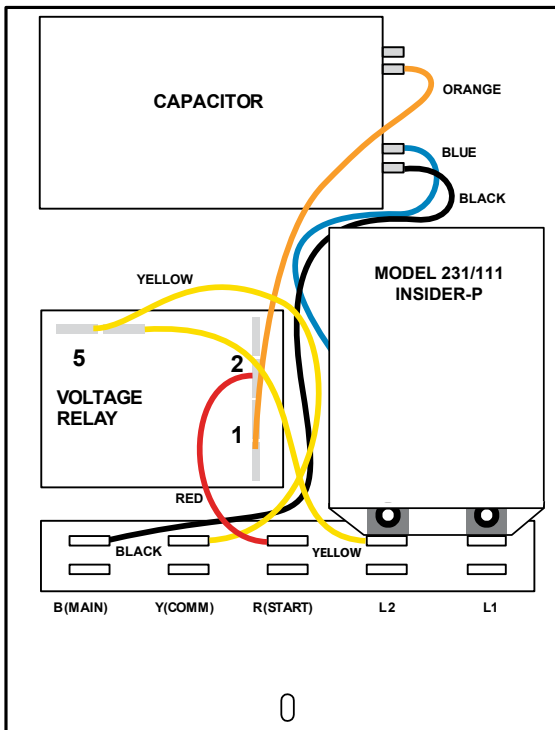
CENTRIPRO* CONTROL BOX WIRING DIAGRAM



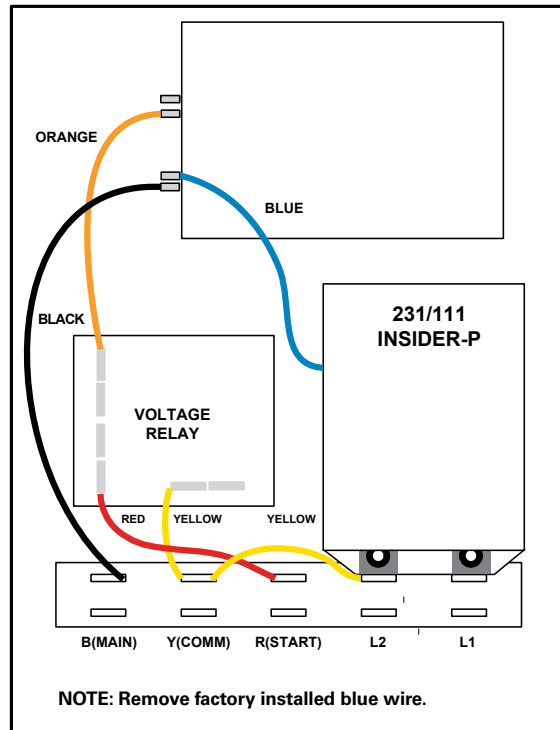
FLINT AND WALLING* CONTROL BOX WIRING DIAGRAM



GRUNDFOS** CONTROL BOX WIRING DIAGRAM



FLOWISE PRO* CONTROL BOX WIRING DIAGRAM



**For boxes manufactured in mid 2014 or later.
See 232-INSIDER page 6 for boxes manufactured prior to mid 2014.

*Pentek, Franklin, Grundfos, Flowise Pro, and Flint and Walling are trademarks of their respective owners.

Submersible Pumps – Optimized Protection

111P / 233P / 233P-1.5

Single-Phase Pump Monitor



Description

The Littelfuse Models 111P (115 V, 1/3 to 1 hp); 233P-1.5 (230 V, 1/3 to 1.5 hp); and 233P (230 V, 1/3 to 3 hp) protect pumps from dry-well, dead-head, jammed impeller, overvoltage/undervoltage conditions, and 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.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
111P	115 V ac	1/3 - 1 hp
233P	230 V ac	1/3 - 3 hp
233P-1.5	230 V ac	1/3 - 1.5 hp

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.

vNote: All local, state and national electric codes should be followed when applying this solution.

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.

Accessories



Informer

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

Submersible Pumps – Optimized Protection

111P / 233P / 233P-1.5

Specifications

Functional Specifications

Adjustments/Settings

Overcurrent Underload (dry-well) 125 % of calibration point
Adjustable
(70 to 90 % of calibrated run power)

Overvoltage

111P 132.5 V ac
233P, 233P-1.5 265 V ac

Undervoltage

111P 95 V ac
233P, 233P-1.5 190 V ac

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 115 V ac
233P-1.5, 233P 230 V ac

Load Range:

111P 1/3 – 1 hp
233P-1.5 1/3 – 1.5 hp
233P 1/3 – 3 hp

Frequency

50*/60 Hz

Output Characteristics

Output Contact Rating-SPST

111P 1 hp @ 120 V ac (16 A max.)
233P-1.5 1.5 hp @ 240 V ac (10 A max.)
233P 3 hp @ 240 V ac (17 A max.)

General Characteristics

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

Maximum Input Power 5 W

Wire Gauge Solid or Stranded 10 - 22 AWG

Terminal Torque 13 in.-lbs.

Safety Marks

cULus Listed UL 508, C22.2 No. 14

Dimensions **H** 73.66 mm (2.9"); **W** 133.35 mm (5.25");

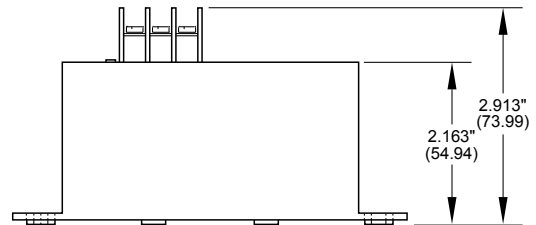
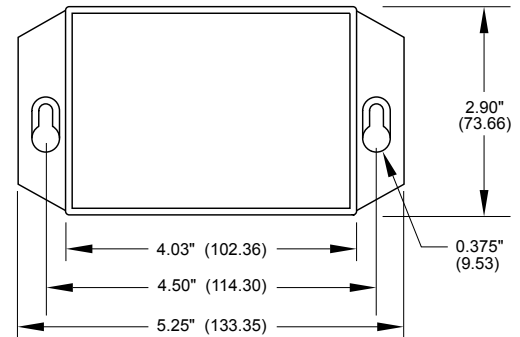
D 73.99 mm (2.913")

Weight 14 oz.

Mounting Methods #8 screws

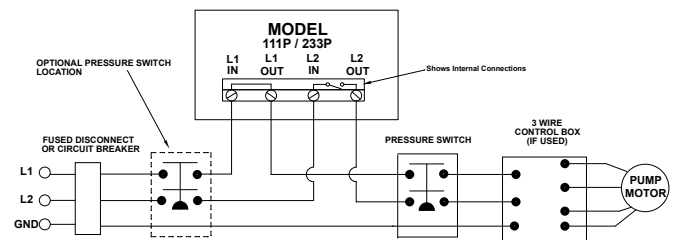
*Note: 50 Hz will increase all delay timers by 20 %

Dimensions



Installation Instructions

TYPICAL WIRING DIAGRAM FOR 111P / 233P / 233P-1.5



Submersible Pumps – Optimized Protection

235P

Single-Phase Pump Monitor



Description

The Littelfuse 235P is designed to protect 5-15 hp, 230 V, single-phase pumps from dry-well, dead-head, rapid-cycle, 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.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
235P	230 V ac	5 - 15 hp

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

* Current transformer sold separately

Accessories



Informer

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

Submersible Pumps – Optimized Protection

235P

Specifications

Functional Specifications

Adjustments/Settings

Overcurrent 125 % of calibration point
Underload (dry-well) Adjustable
 (70 to 90 % of calibrated run power)

Overvoltage 265 V ac
Undervoltage 190 V ac

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 230 V ac
Load Range 5 - 15 hp
Frequency 50*/60 Hz

Output Characteristics

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

General Characteristics

Operating Temperature -40 °C to 60 °C (-40 °F to 140 °F)
Maximum Input Power 5 W
Wire Gauge Solid or Stranded 10 - 22 AWG
Terminal Torque 13 in.-lbs.

Safety Marks

cULus Listed UL 508, C22.2 No. 14

Dimensions

H 73.66 mm (2.9"); **W** 133.35 mm (5.25");
D 73.99 mm (2.913")

Weight

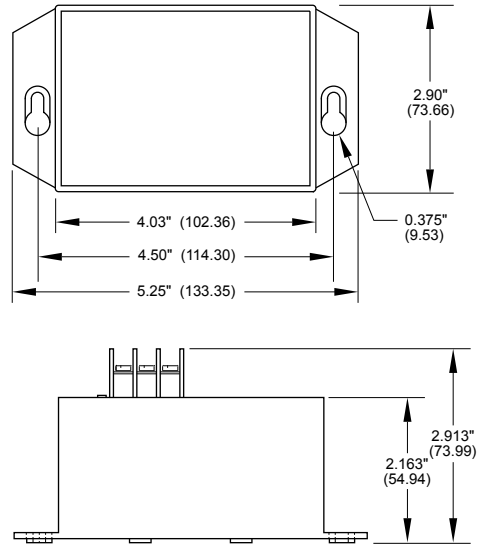
14 oz.

Mounting Methods

#8 screws

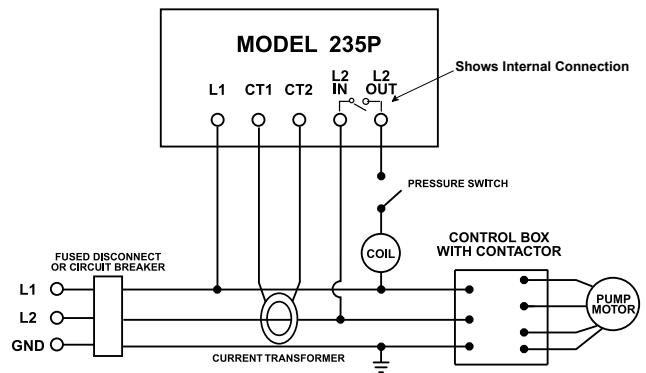
*Note: 50 Hz will increase all delay timers by 20 %

Dimensions



Installation Instructions

TYPICAL WIRING DIAGRAM FOR 235P



Submersible Pumps – Optimized Protection

ABBREVIATED INSTALLATION INSTRUCTIONS

Mounting (111P/233P/235P only)

Use in conjunction with UL listed or recognized thermal or solid-state overload relays only.

1. Mount the Model 111P/233P/235P in a convenient location in or near the pump control box. If the location is wet or dusty, a NEMA 3R, 4 or 12 enclosure should be used.

Calibration/Restart Delay

Note: All models should be calibrated during normal pumping conditions. There must be a “call for water”; ensure the pressure or float switch is fully closed.

INSIDER Models

1. Turn RESTART DELAY/CALIBRATION to the CAL position and close the control box cover.
2. Apply power to the system. The pump should run for approximately 10 seconds and then shut off—this indicates the INSIDER has calibrated.
3. Remove power from the system. Open the control box and set the appropriate dry-well recovery time with the RESTART DELAY/CALIBRATION knob.
4. Shut the control box and re-apply power to the system.

111P/233P/235P Models

1. Turn the RESTART DELAY/CALIBRATION knob fully counter-clockwise to the CAL position.
2. Apply power. The pump will run for approximately 10 seconds then shut off.
3. Set the RESTART DELAY/CALIBRATION knob to the desired restart delay (dry-well recovery time). The pump will turn on.

Note: If the Model 235P immediately trips out upon completion of the calibration process, the current transformer may be installed incorrectly. Switch the CT1 and CT2 connections at the unit, then repeat the calibration process.

Calibrating While Pumping

The 111P/233P/235P can also be calibrated while the pump is running. Turn the RESTART DELAY/CALIBRATION knob to CAL while pumping. Wait for the pump to turn off (approximately 10 seconds), then adjust the RESTART DELAY/CALIBRATION knob to the desired restart delay setting.

Manual Reset Mode (111P/233P/235P only)

Set the RESTART DELAY/CALIBRATION knob to RESET for manual reset mode. If the 111P/233P/235P trips off due to a voltage or load problem, the RESTART DELAY/CALIBRATION knob must be rotated out of the RESET position to restart the pump, and then can be placed back in the RESET position for subsequent manual reset mode.

Note: Any restart delay can be bypassed by rotating the RESTART DELAY/CALIBRATION knob to the RESET position and back to the desired restart delay setting.

Note: The restart delay can be changed at any time. The next trip will follow the new restart delay setting.

Operation

The Littelfuse Pump Protection units monitor pump loads in amperes and kilowatts. When the current (amperes) exceeds approximately 125 % of calibrated current, or power (kW) drops below the adjustable underload trip point, the units—after the trip delay—will turn off the pump. The units will automatically restart the pump after the selected restart delay time (unless in the manual reset mode).

The calibration is stored in permanent memory. The units do not need to be re-calibrated if power is lost.

Sensitivity

The Littelfuse Pump Protection units have an adjustment knob to set the underload trip sensitivity. Setting SENSITIVITY to the middle position (straight up) is equivalent to Littelfuse’s standard underload trip level. Adjust the SENSITIVITY knob to increase/decrease underload sensitivity up to approximately ± 10 % of the standard trip. It may be necessary to increase the sensitivity if the unit does not trip on dry-run or dead-head or it is known that the water level in the well is very low relative to the pump’s capabilities.

WARNING: Decreasing the SENSITIVITY may compromise the unit’s ability to detect dry-run and/or dead-head conditions.

Run Hours

The Littelfuse Pump Protection units record pump run hours. Run hours can be displayed by a Littelfuse Informer. Run hours can be reset on the units. Please read the instructions fully before performing the procedure.

Note: Turn the SENSITIVITY knob *completely* to the left (counter-clockwise) or *completely* to the right (clockwise) when directed.

WARNING: Ensure power is applied to the INSIDER models in a safe manner when performing the following procedure.

To Reset Run Hours:

1. Remove power to the units.
2. Set the RESTART DELAY/CALIBRATION knob to RESET and the SENSITIVITY knob to the middle (12:00) position.
3. Apply power to the unit—the CAL LIGHT will turn on.
4. Turn the SENSITIVITY knob to the right—the CAL LIGHT will turn off and the RUN LIGHT will turn on.
5. Turn the SENSITIVITY knob to the left—both lights will turn on.
6. Turn the SENSITIVITY knob to the right.
7. After 10 seconds, the CAL and RUN LIGHTS will blink twice indicating the run hours have successfully been reset.

Submersible Pumps – Optimized Protection

ABBREVIATED INSTALLATION INSTRUCTIONS

Rapid Cycling

Rapid cycling is defined as more than 4 restarts in a 60-second period. The units are capable of detecting a rapid-cycle condition whether a control device, such as a pressure switch, is installed before or after it. Upon detecting either form of rapid cycling, the unit will lock-out, preventing damage to the pump. To reset the unit, remove and re-apply power.

RAPID CYCLING (Line Side/Upstream)

Rapid cycling of the line side of the units may be caused by several naturally occurring conditions which are indistinguishable from true rapid cycling. For this reason, once tripped, the units will wait 30 minutes and restart for protection. If any restart is successful (pump runs for more than 1 minute), the rapid cycle counter will reset to zero. If the unit encounters rapid cycle 4 times without a successful restart, the unit will lock-out and require a manual reset. To reset, remove and re-apply power.

Note: Turn the SENSITIVITY knob *completely* to the left (counter-clockwise) or *completely* to the right (clockwise) when directed.

To Enable Line-Side Rapid-Cycle Protection: (to disable, follow the same procedure and replace the jumper on the unit) (Insider models only)

1. Locate the Rapid-Cycle Jumper in the upper-right corner behind the faceplate of the unit.
2. Remove the Rapid-Cycle Jumper. The jumper may be removed before or after initial installation.
3. Save the removed jumper.
4. If the unit is not already installed, install as described in the CONNECTIONS section of the unit's install manual.
5. Re-apply power.

To Enable Rapid-Cycle Protection when a Control Device is Installed BEFORE the unit: (to disable, follow the same procedure)

1. Remove power to the unit.
2. Set the RESTART DELAY/CALIBRATION knob to RESET and the SENSITIVITY knob to the middle (12:00) position.
3. Apply power to the unit—the CAL LIGHT will turn on.
4. Turn the SENSITIVITY knob to the right—the CAL LIGHT will turn off, RUN LIGHT will turn on.
5. Turn the SENSITIVITY knob to the left—both lights will turn on.
6. Turn the SENSITIVITY knob right—left—right—left—right, in a quick and smooth manner.
7. After 2 seconds, the CAL and RUN LIGHTS will blink once indicating line side rapid-cycle protection has been enabled.

RAPID CYCLING (Load Side/Downstream)

Load side rapid cycling of the pump will immediately result in a manual lock-out. The pump will not restart automatically. To reset, remove and re-apply power.

Note: Protection against rapid cycling of a control device installed after the unit is always enabled. Disabling line side detection will not disable load side detection.

Submersible Pumps – Optimized Protection

111P-ENCL / 233P-ENCL / 233P-1.5-ENCL / 235P-ENCL

Single-Phase Pump Monitor in NEMA Box



Enclosure



Enclosure with 233P mounted

Description

The ENCL enclosure is a metal electrical box that meets the National Electrical Manufacturers Association's and Underwriter Laboratory's standard for a 3R rating. The ENCL box can house one of several single-phase Littelfuse Pump Protection products. It has three clear lenses on the cover for viewing the LEDs on the units, allowing the customer to determine the units operational status and to provide access to the IR signal for use with the Informer diagnostic tool.

The ENCL enclosure is sold ONLY in conjunction with the single-phase 111P, 233P, 233P-1.5, and 235P models.

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 unit'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.

An external current transformer is required for operation of the Model 235P (sold separately).

Specifications (Enclosure)

Functional Specifications

Classification	NEMA 3R
Grounding	Two separate ground tabs
General Characteristics	
Dimensions (with cover on)	H 210.82 mm (8.3"); W 139.70 mm (5.5"); D 93.47 mm (3.68")
Front Cover	Secured by one capture screw. Cover contains three clear lenses, two for viewing the diagnostic LED's on PumpSaver® and one for access to IR Signal for Informer
Weight	2.20 lbs.
Mounting Method	Surface mount (2 concave mounting holes)
Knock-outs (seven)	½" (1 each side and 2 in bottom) ¾" (1 each side and 1 in bottom)

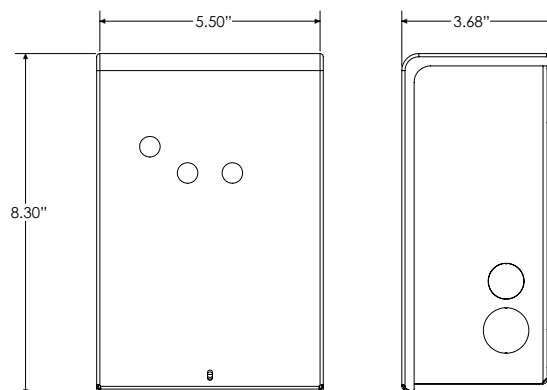
Ordering Information

MODEL	DESCRIPTION
111P-ENCL	Enclosure with 111P mounted
233P-ENCL	Enclosure with 233P mounted
233P-1.5-ENCL	Enclosure with 233P-1.5 mounted
235P-ENCL	Enclosure with 235P mounted

PART*	SIZE	CURRENT (A)	CT CURRENT RATIO
CT-0050-D10	5 - 7½ hp	27.5 - 42.1	50:5
CT-0075-D10	10 hp	51	75:5
CT-0100-D10	15 hp	75	100:5

* Current transformer sold separately

Dimensions (Enclosure with cover on)



Single-Phase & Three-Phase Pump Protection

MP8000

Bluetooth* Overload Relay



Patent Pending

Description

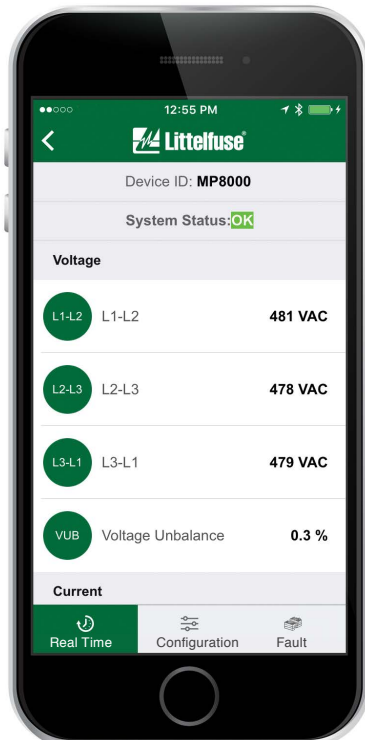
The MP8000 is an advanced motor protection electronic overload relay, fully programmable via Bluetooth* using an iPhone* or Android* smartphone or tablet with the Littelfuse App. It is easy to use and arc-flash safety is increased because the app allows settings to be modified and real-time operational 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 amperes (external CTs are required above 100 A). It is designed for single or 3-phase systems with operating voltages of 90-690 V ac (use of external potential transformers can extend upper voltage range above 690 V ac). The unit requires 85-264 V ac control power, so applications on 480-600 V ac systems must have a control power transformer in the panel to step the voltage down to a lower control voltage. Common applications include protecting motors on pumps for water, wastewater, oil and chemicals, as well as motors running fans, compressors, and other industrial equipment.

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 or Ethernet/IP network. Units can be remotely monitored and controlled from a PC, or SCADA system, and data logging through a PC with the optional MP8000 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.

Ordering Information

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



MP8000

Littelfuse App icon



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)

*Bluetooth, iPhone, and Android are trademarks of their respective owners.

Single-Phase & Three-Phase Pump Protection

MP8000

Specifications

Functional Characteristics

Frequency 50/60 Hz
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 5 A @ 240 V ac

General Characteristics

Ambient Temperature Range
Operating -40 °C to 70 °C (-40 °F to 158 °F)
Storage -40 °C to 85 °C (-40 °F to 185 °F)

Accuracy

Voltage ±1 % of reading ±0.5 V_{RMS}
Current ±2 % of reading ±0.05 A_{RMS}
 (2 to 100 A direct)
Timing ±0.5 % of setting ±1 second
GF Current +/- 5 %

Repeatability

Voltage ±0.5 %
Current ±1 % (2 to 100 A direct)
Power Consumption <5 W
Pollution Degree 3 (conformal coating standard)
Class of Protection IP20
Relative Humidity 5-95 %, 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, 6 kV contact, 8 kV air

Radio Frequency Immunity (RFI), Conducted

IEC 61000-4-6, Level 3 10 V/m

Radio Frequency Immunity (RFI), Radiated

IEC 61000-4-3, Level 3 10 V/m

Fast Transient Burst Surge

IEC 61000-4-4, Level 3, 3.5 kV input power
 IEC 61000-4-5, Level 3, 2 kV line-to-line;
 Level 4, 4 kV line-to-ground
 Part 15.107 for emissions,
 Part 15.247 for intentional radiators

FCC Rating

Short Circuit Withstand Rating

100 kA symmetrical at 690 V ac

Hi-Potential Test

Meets UL 508 (2 x rated V +1000 V for 1 minute)

Safety Marks

cULus UL 60947, UL 1053, 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")

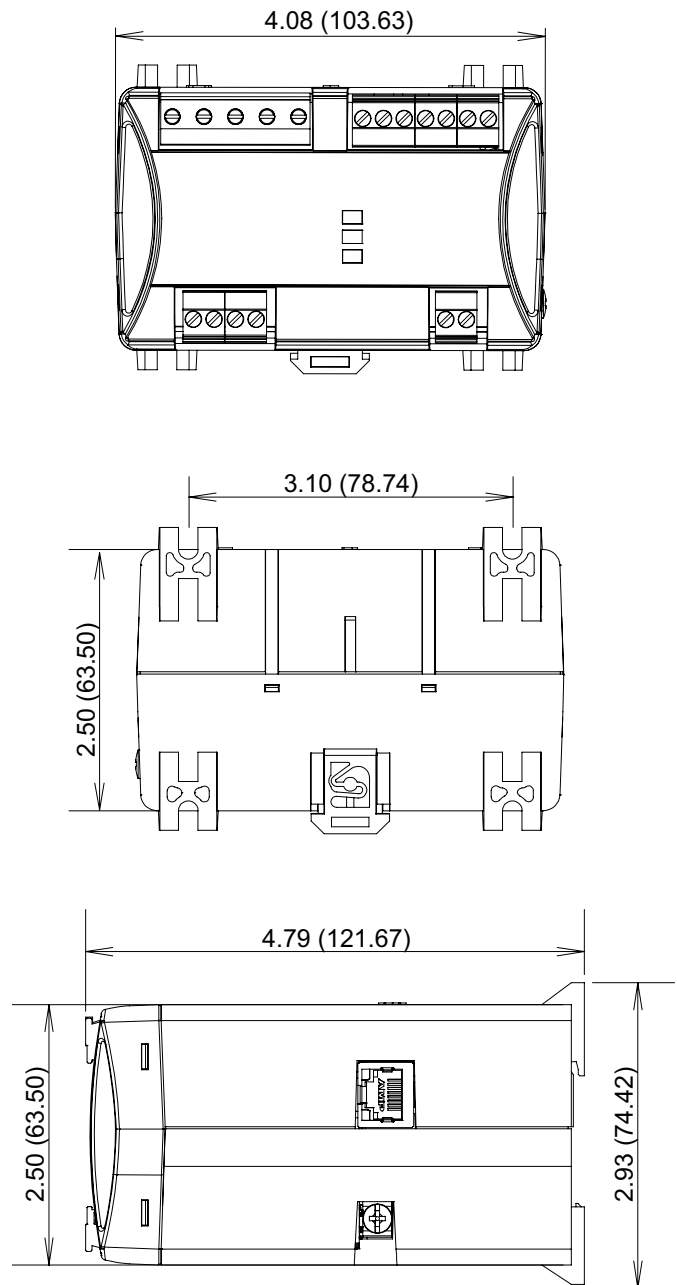
Weight

0.85 lbs (13.6 oz, 385.6 g)

Mounting Method

Surface mount (4 - #8 screws)
 or DIN-rail mount

Dimensions

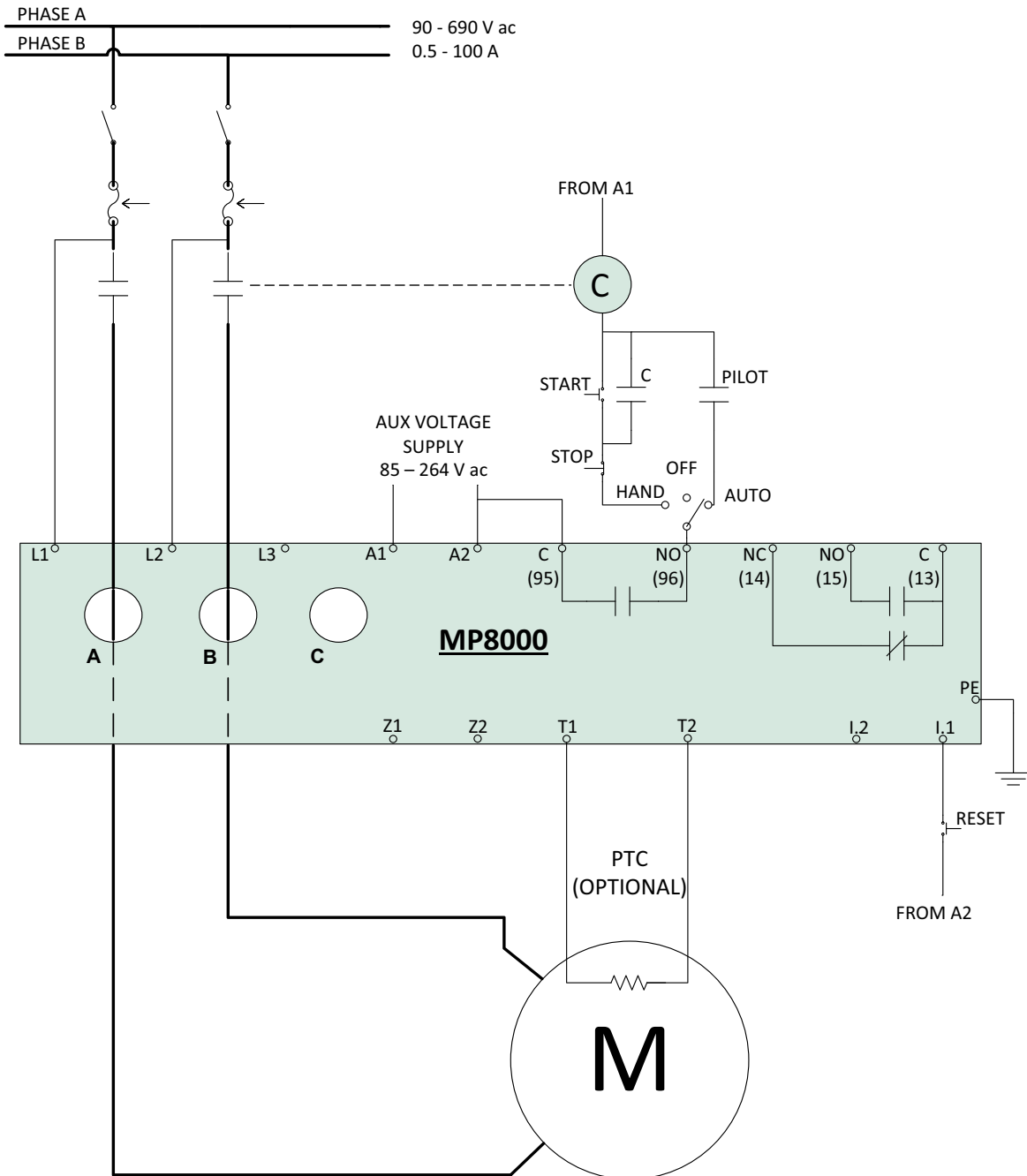


Single-Phase & Three-Phase Pump Protection

MP8000

Installation Instructions

TYPICAL WIRING DIAGRAM FOR SINGLE-PHASE

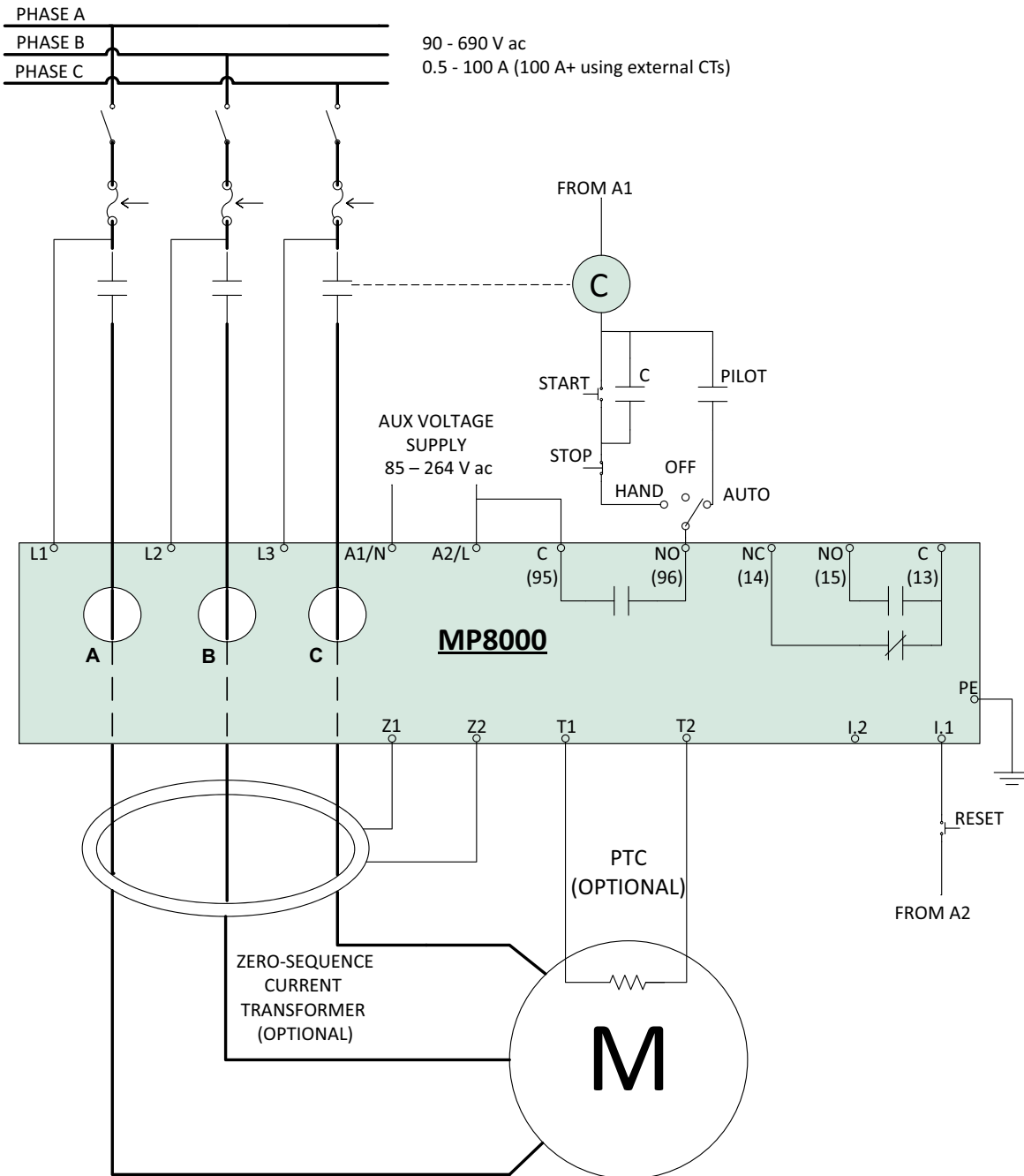


Single-Phase & Three-Phase Pump Protection

MP8000

Installation Instructions

TYPICAL WIRING DIAGRAM FOR 3-PHASE



Single-Phase Pump Protection

77C-KW/HP / 77C-LR-KW/HP

Programmable and Low-Range Programmable Power Monitor/Overload Relay



Description

The 77C-KW/HP is a programmable solid-state power monitor/overload relay that protects single-phase, 100-240 V ac, 2-800 A pumps (external CTs are required for 91-800 A) from dry-well, dead-head, jammed impeller and other voltage and current conditions. The LR version is designed for easier installation at a lower 1-9 full load amperes.

This Littelfuse 77C-KW/HP is programmable to your specific pumping application and provides a digital display of real-time data of the pump's operation and fault conditions. The programmability allows the user to set trip points, trip delays and restart delays, to include protection from successive power outages and short-cycling/rapid-cycling caused by other motor controls, and delays for motor cool-down time and dry-well recovery time.

The 77C-KW/HP can be programmed and monitored through network communications, as well as hooked to a remote display unit to program and monitor the pump protection from an alternate location, or outside the electrical panel to avoid potential arc flash (arc flash is a serious hazard that can happen when opening an electrical panel).

Specifications

Functional Specifications

Programmable Operating Points

LV-Low Voltage Threshold
HV-High Voltage Threshold
MULT-# of Conductors or CT Ratio (xxx:5)

85 V - HV Setting
 264 V - LV Setting

77C-KW/HP: 1-10 Conductors or 100-800 Ratio
 77C-LR-KW/HP: 1 or 2 conductors
 (20-100 A)/MULT or 80-120 % of CT Primary
 See PWS below or 0=off
 5, J5, 10, J10, 15, J15, 20, J20, 30, J30 or Lin (linear)

OC-Overcurrent Threshold
LP-Low Power Threshold
TC-Overcurrent Trip Class

1=0.01-0.99 kW **5**=0.01-1.33 hp
2=1.00-9.95 kW **6**=1.34-13.3 hp
3=10.0-99.5 kW **7**=13.4-133 hp
4=100-650 kW **8**=134-871 hp

RD1-Rapid-Cycle Timer
RD2-Restart Delay after all faults except underload (motor cool down timer)
RD3-Restart Delay after undercurrent (dry-well recovery timer)
#RU-Number of restarts after underload

0, 2-500 Seconds
 2-500 Minutes/Seconds
 2-500 Minutes/Seconds
 0, 1, 2, 3, 4, A (automatic)

Ordering Information

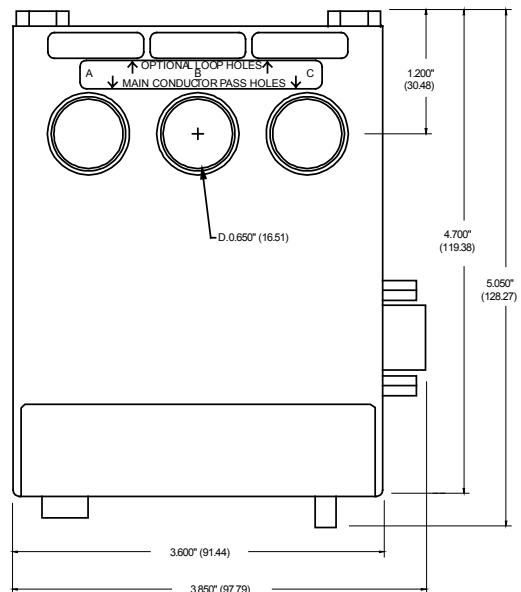
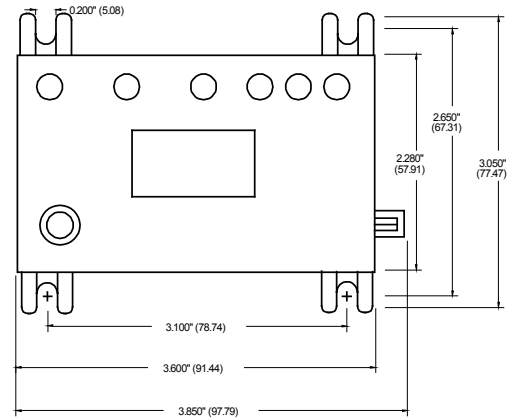
MODEL	DESCRIPTION
77C-KW/HP	Programmable Pump Protection
77C-LR-KW/HP	Low-Range Programmable Pump Protection

Single-Phase Pump Protection

77C-KW/HP / 77C-LR-KW/HP

#RO-Number of restarts after overload	0, 1, 2, 3, 4, A (automatic)
ADDR-RS485 Address	A01-A99
OPT1-To set linear OC trip delay when TC is set to Lin	2-60 seconds
OPT2-To set RD2 & RD3 in either seconds or minutes	0, 1, 2, 3
Input Characteristics	
Supply Voltage	100-240 V ac
Frequency	50/60 Hz
Motor Full Load Amp Range	2-25 A (Loops Required); 26-90 A (Direct); 91-800 A (External CTs)
77C-KW/HP	2-25 A (Loops Required); 26-90 A (Direct); 91-800 A (External CTs)
77C-LR-KW/HP	1-2 A (1 Loop Required); 2.1-9 A (Direct)
Output Characteristics	
Output Contact Rating-SPDT (Form C)	480 V ac @ 240 V ac (Pilot Duty) 10 A @ 240 V ac (General Purpose)
Expected Life:	
Mechanical	1 x 10 ⁶ operations
Electrical	1 x 10 ⁵ operations at rated load
General Characteristics	
Operating Temperature	
Ambient Operating	-20 °C to 70 °C (-4 °F to 158 °F)
Ambient Storage	-40 °C to 80 °C (-40 °F to 176 °F)
Accuracy	
Voltage	+/- 1 %
Current	+/- 3 % (Direct, No External CTs)
Timing	5 % +/- 1 second
Power	+/- 10 %
Repeatability	
Voltage	+/- 0.5 % of nominal voltage
Current	+/- 1 % (Direct, No External CTs)
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
Safety Marks	
UL	UL 508, UL 1053
CE	IEC 60947-1, IEC 60947-5-1
CSA	C22.2 No. 14
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)
Weight	1.2 lbs.
Mounting Methods	35mm DIN rail or surface mount

Dimensions



Single-Phase Pump Protection

77C-KW/HP / 77C-LR-KW/HP

Installation Instructions

TYPICAL WIRING DIAGRAM FOR 77C-KW/HP & 77C-LR-KW/HP SERIES

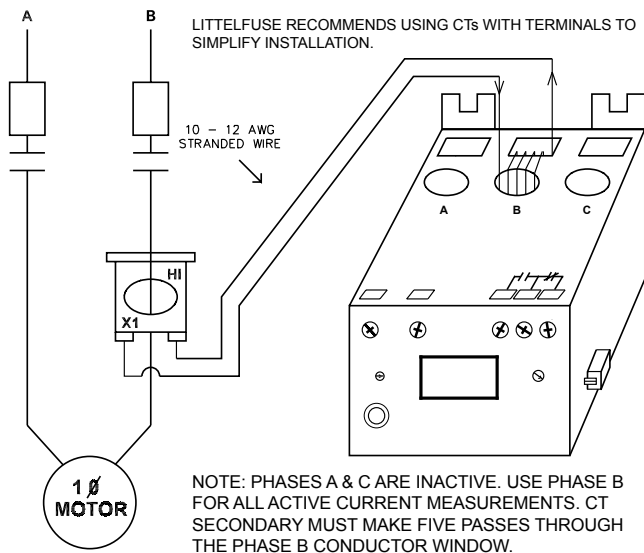
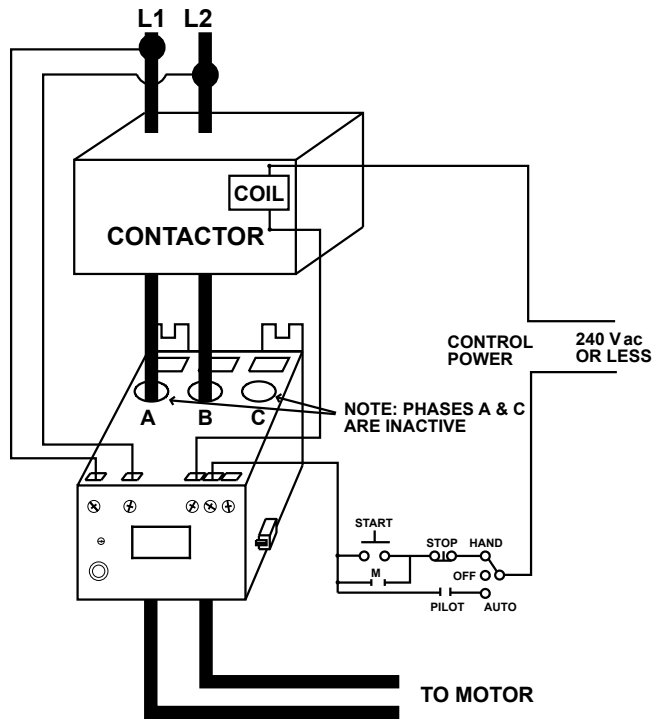


Table 1: Wiring configuration for 77C-KW/HP based on motor amperes.

FULL LOAD AMPERES	# OF CONDUCTORS THROUGH B	MULT TO PROGRAM (CT RATIO)
2.0 - 2.5	10	10
2.6 - 3.0	9	9
3.1 - 3.5	8	8
3.6 - 4.0	7	7
4.1 - 5.0	6	6
5.1 - 6.0	5	5
6.1 - 8.0	4	4
8.1 - 12	3	3
13 - 25	2	2
26 - 90	1	1
EXTERNAL CTS REQUIRED. SEE WIRING DIAGRAM FOR EXTERNAL CTS.		
91 - 110	5	100 (100:5)
111 - 160	5	150 (150:5)
161 - 220	5	200 (200:5)
221 - 320	5	300 (300:5)
321 - 420	5	400 (400:5)
421 - 520	5	500 (500:5)
521 - 620	5	600 (600:5)
621 - 800	5	800 (800:5)

Table 2: Wiring configuration for 77C-LR-KW/HP based on motor amperes.

FULL LOAD AMPERES	# OF CONDUCTORS THROUGH WINDOW B	MULT
1.0 - 2.0	2	2
2.1 - 9.0	1	1

Programming

1. Rotate the MODE SELECT switch to the parameter to be programmed. It is recommended that PWS be programmed first on the KW/HP versions.
2. Press and hold the RESET/PROGRAM button.
3. While holding the RESET/PROGRAM button, rotate the DISPLAY/PROGRAM knob until the proper setting for the parameter that is being programmed is displayed.
4. Release the RESET/PROGRAM button. This stores the new parameter in the nonvolatile memory. If the number changes back to what it was before programming, then the tamper guard is on and will need to be unlocked before programming can be completed.
5. Continue steps 1-4 until all parameters are programmed.

Single-Phase Pump Protection

77C-KW/HP / 77C-LR-KW/HP

Suggested Settings

(Consult the Motor Manufacturer for their recommendations.)

LV/HV - The recommended settings for LV (low voltage) and HV (high voltage) depend on many factors such as motor usage, motor size, environmental factors and tolerance of the motor. The motor manufacturer should be consulted for HV and LV settings. However, the NEMA MG1 standard recommends that LV and HV be set to no more than $\pm 10\%$ of the motor's nameplate voltage. The setting can be determined by multiplying the motor's nameplate voltage by the recommended percent over and under voltage. (e.g., The motor nameplate voltage is 230 V, set LV to $0.9 \times 230 = 207$, set HV to $1.10 \times 230 = 253$) LV can not be set higher than HV, so HV may have to be adjusted higher before the proper LV setting can be programmed.

MULT - The multiplication factor for determining true current settings and represents the number of conductors passing through the main current window marked B, or current transformer ratio of external CTs. The appropriate number can be determined from Table 1 (Table 2 for -LR version) on page 18. MULT must be correctly programmed in order to accurately program the current settings.

OC - Represents the motor's maximum service factor amperage. The OC (overcurrent) setting depends on many factors such as motor usage, motor size, environmental factors and tolerance of the motor. The motor manufacturer should be consulted for OC settings. However, OC is typically between 110 % and 125 % of full load amperage (FLA) and may be referred to as maximum amperes or service factor amperes.

LP - (Low power setting) is used to shut down the motor or pump on an underload condition. Setting LP to 0 disables the underload trip feature. LP is set in either kilowatts (kW) or horsepower (hp) depending on the PWS setting.

NOTE: PWS must be set before setting LP

TC - Designates the trip class for overload protection. The trip class defines the trip delay when an overload is detected. Trip class is determined by the type of motor and application. Your motor manufacturer should be consulted for the proper setting. Table 4 shows the trip class and a general description of the applications and Table 5 shows the trip class curves.

RD1 - is the rapid-cycle timer. It will engage when the motor is first powered-up or after the motor controls shut down the motor. An RD1 setting of 20-30 seconds will generally protect the motor from rapid, successive power outages or short cycling caused by the motor controls. A setting of 0 seconds will allow the motor to start immediately after power-up or after a normal shutdown.

RD2 - is the restart delay after the overload relay trips on overcurrent. This delay allows the motor to cool down after experiencing an overcurrent. It is also known as a motor cool

down timer. Your motor manufacturer should be contacted to determine this setting. Under normal circumstances, a setting of 5-10 minutes will give the motor enough time to cool down between faults.

RD3 - is the restart delay after an underload. It is also known as a dry well recovery timer and is usually used in submersible pumping applications. The setting of RD3 depends on the recovery time of the water well and varies widely from application to application.

#RU - is the number of successive restart attempts allowed after an underload fault, before the overload relay requires manual reset. The following settings are available: 0, 1, 2, 3, 4 and A. A setting of "0" is manual reset and a setting of A is continuously automatic reset.

ADDR - is the address setting for RS485 communications. Available settings are from A01- A99. You may ignore this setting if RS485 communications are not used.

#RO - is the number of successive restart attempts allowed after an overcurrent fault. The following settings are available: 0, 1, 2, 3, 4 and A. A setting of "0" is manual reset and a setting of "A" is continuously automatic reset.

PWS - (power scale) is the range setting for the LP setting.

- 1 = 0.01 - 0.99 kW
- 2 = 1.00 - 9.95 kW
- 3 = 10.0 - 99.5 kW
- 4 = 100 - 650 kW
- 5 = 0.01 - 1.33 hp
- 6 = 1.34 - 13.3 hp
- 7 = 13.4 - 133.0 hp
- 8 = 134 - 871 hp

Settings 1-4 will allow the LP setting to display in KW. Settings 5-8 will allow the LP setting to display in hp.

OPT1 - Linear overcurrent trip delay (2-60 seconds). This programming position is used only if the TC position is set to LIn. This setting will determine the period of time that will expire before tripping on overcurrent, after the amperage exceeds the OC setting.

OPT2 - RD2 & RD3 time units programming. This position sets the time units used by the RD2 and RD3 timers. (e.g., RD2 = 10, RD3 = 20; OPT2 = 2 from Table 3 below, RD2 = 10 seconds and RD3 = 20 minutes.)

Table 3: OPT2 Settings

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

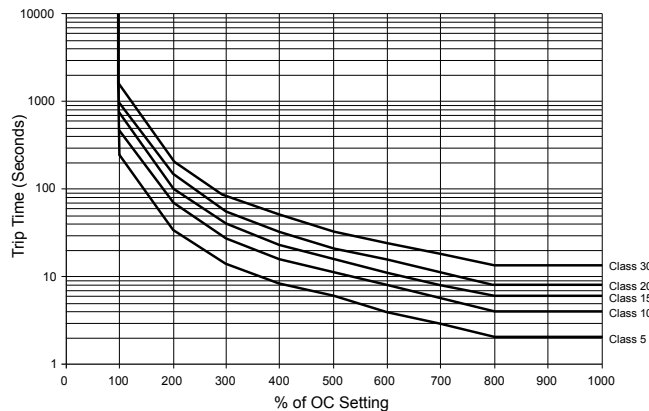
Single-Phase Pump Protection

77C-KW/HP / 77C-LR-KW/HP

Table 4: Trip Class Table

TRIP CLASS	APPLICATION DESCRIPTION
5	Small fractional horsepower motors where acceleration times are almost instantaneous or where extremely quick trip times are required.
10	(Fast Trip) Hermetic refrigerant motors, compressors, submersible pumps and general purpose motors that reach rated speed in less than 4 seconds.
15	Specialized applications.
20	(Standard Trip) Most NEMA-rated general purpose motors will be protected by this setting.
30	(Slow Trip) Motors with long acceleration times (>10 seconds) or high inertia loads.
J Prefix	Programming any of the trip classes with the J Prefix will enable jam protection. This additional protection is enabled 1 minute after the motor starts and provides a 2 second trip time for motors exceeding 400 % of the OC setting, regardless of trip class.
LIn	Programming the trip class to LIn disables the normal trip classes shown above and enables a linear trip delay on overcurrent. The linear trip delay is set in program position OPT1.

Table 5: Overload Trip Curves



Multi-Function System Display

The output display shows various system operating parameters (L1-L2 Voltage, L2 Current (B), kilowatts, and horsepower).

When MODE SELECT is in the RUN position, the LED will display one of the above operating parameters. To select or change the displayed parameter, turn the DISPLAY/PROGRAM knob to the desired position as shown on its label.

The multifunction display is used for programming purposes and also announces system faults such as low voltage and high voltage. Any time MODE SELECT is in the RUN

position, the RESET/PROGRAM button may be pushed to view the last fault which occurred. Table 6 below shows the possible messages.

Table 6: Output Displays

DISPLAYED MESSAGE	MEANING
oc	Tripped on Overcurrent
LPR	Tripped on Low Power
HI	High Voltage (won't allow the motor to start)
Lo	Low Voltage (won't allow the motor to start)
oFF	A stop command was issued from a remote source.

Operation

Once the power monitor has been programmed, turn the MODE SELECT to the RUN position. The LED display will flash RUN alternatively with a number representing the parameter indicated by the DISPLAY/PROGRAM knob. After the period of time programmed into RD1, the output contacts will close and the value of the parameter indicated by the DISPLAY/PROGRAM knob will appear on the LED display. If a message other than those indicated above is shown on the LED display, see Troubleshooting Chart in Table 7 to diagnose the problem.

Table 7: Troubleshooting Chart

PROBLEM	SOLUTION
The unit will not start. Display alternates "HI" or "Lo" with the DISPLAY/PROGRAM knob parameter value.	The incoming voltage is not within the limits programmed in the HV and LV settings. Adjust the DISPLAY/PROGRAM knob to read the incoming line voltage value. Correct the incoming power problem and check programmed limits to verify they are correct.
Display alternates "oc" with RUN.	The overload relay has tripped on overcurrent and is timing down RD2 before restarting.
Display alternates LPr with RUN.	The overload relay has tripped on low power and is timing down RD3 before restarting.
Display is showing a solid "oc."	The unit has tripped on overcurrent and manual reset is required because of the programmed setting in #R0. Check the system for problems (like a jam) that would produce the overload fault.
Display is showing the solid "LPr."	The unit has tripped on low power and a manual reset is required because of the programmed setting in #RU. Check the system for problems that would produce an underload condition like a dead-head or a lack of liquid to the pump.
Unable to change parameters.	See Tamper Guard.

Three-Phase Pump Protection

777-P2 SERIES

Fully Programmable Electronic Overload Relay



Description

The 777-P2 Series is a family of fully programmable electronic overload relays. They are designed to monitor and protect any 3-phase 200-480 V ac motor drawing 2-800 full load amperes (external CTs are required above 90 A). They provide unsurpassed protection from faulty voltage, underload and overload conditions. The 777-P2 can be used in a variety of 3-phase applications and features an undercurrent trip point (adjustable on the unit) that is favorable anytime there is a notable difference between a load and no-load condition. The overload relay displays voltage and current on the face of the unit. The LR version is designed for easier installation at a lower range of 1-9 full load amperes. The HVR version is designed with a high voltage relay for control circuits operating at 480 V ac.

The 777-P2 Series 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 unit's many features include enhanced trip classes beyond the NEMA standard trip classes. The settable trip class range is 2-60, with or without jam protection, and a secondary linear trip delay can be set with a range of 0-60 seconds. If both trip class and linear trip delay are set, the 777-P2 will follow the faster trip time. Another feature is the automatic dry-well recovery timer that allows the unit to automatically select a restart delay based on the last cycle's run time. This allows the 777-P2 to optimize restart delay times.

Network communications: compatible with Modbus, DeviceNet™, Profibus, or Ethernet using optional communications module.

Ordering Information

MODEL	LINE VOLTAGE	MOTOR FULL AMP RANGE	DESCRIPTION
777-P2	200-480 V ac (3-phase)	2-800 A (external CTs required above 90 A)	Provides low and high power trip*, linear overcurrent trip, and 480 VA @ 240 V ac output SPDT relay contacts
777-LR-P2	200-480 V ac (3-phase)	1-800 A (external CTs required above 90 A)	Protects low range motors when wired directly or with 10-800 FLA with use of external CTs
777-HVR-P2	340-480 V ac (3-phase)	2-800 A (external CTs required above 90 A)	Provides low and high power trip*, linear overcurrent trip, and 470 VA @ 600 V ac output SPDT relay contacts. Required when a control power transformer (CPT) is not used with a 480 V system

* Network programmable only

Specifications

Functional Specifications

Programmable Operating Points

LV-Low Voltage Threshold 170-524 V

HV-High Voltage Threshold 172-528 V

VUB-Voltage Unbalance Threshold 2-25 % or 999 (disable)

MULT-# of Conductors or CT Ratio (xxx:5) 1-10, 100, 150, 200, 300, 400, 500, 600, 700, 800

OC-Overcurrent Threshold (20-100 A) ÷ MULT or 80-140 % of CT Primary

UC-Undercurrent Threshold 0, (10-98 A) ÷ MULT or 40-140 % of CT Primary

CUB-Current Unbalance Threshold 2-50 % or 999 (disable)

TC-Overcurrent Trip Class 2-60, J2-J60, L00-L60, oFF

RD1-Rapid-Cycle Timer 0-999 seconds

RD2-Restart Delay after all faults except undercurrent (motor cool down timer) 2-500 minutes

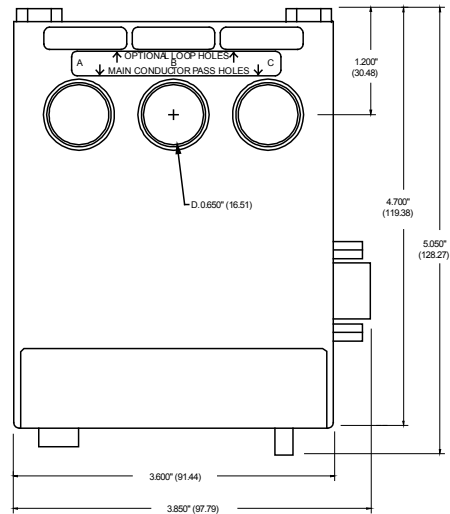
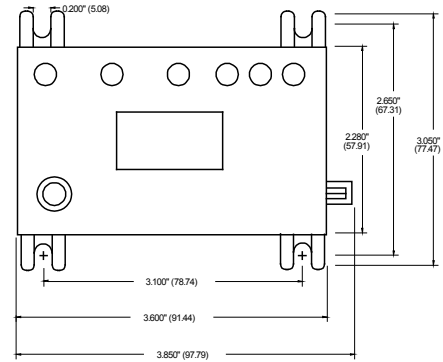
RD3-Restart Delay after undercurrent (dry-well recovery timer) 2-500 minutes, A (automatic)

Three-Phase Pump Protection

777-P2 SERIES

#RU-Number of restarts after undercurrent	0, 1, 2, 3, 4, A (automatic)
ADDR-RS485 Address	A01-A99
#RF-Number of Restarts after all faults except undercurrent	0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, ocA (automatic)
COM-Communication Setting	C00-C07
UCTD-Undercurrent Trip Delay	2-999 seconds
GF-Ground Fault Current Threshold	(3-20 A) ÷ MULT or 12-40 % of CT Primary or OFF
Input Characteristics	
Supply Voltage	200-480 V ac
777-P2, 777-LR-P2	340-480 V ac
777-HVR-P2	50/60 Hz
Frequency	
Motor Full Load Amp Range	2-20 A (Loops Required); 20-90 A (Direct); 80-800 A (External CTs)
777-P2, 777-HVR-P2	1-2 A (1 Loop Required); 2.1-9 A (Direct); 10-800 A (External CTs)
777-LR-P2	
Output Characteristics	
Output Contact Rating-SPDT (Form C)	480 VA @ 240 V ac (Pilot Duty), 10 A @ 240 V ac (General Purpose)
777-P2, 777-LR-P2	470 VA @ 600 V ac
777-HVR-P2	
Expected Life	1 x 10 ⁶ operations
Mechanical	
Electrical	1 x 10 ⁵ operations at rated load
General Characteristics	
Operating Temperature	
Ambient Operating	-20 °C to 70 °C (-4 °F to 158 °F)
Ambient Storage	-40 °C to 80 °C (-40 °F to 176 °F)
Accuracy	
Voltage	± 1 %
Current	± 3 % (<100 A direct)
Timing	± 0.5 % second
Power	± 10 %
Repeatability	
Voltage	± 0.5 % of nominal voltage
Current	± 1 % (<100 A 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
Safety Marks	
UL	UL 508, UL 1053
CE	IEC 60947-1, IEC 60947-5-1
CSA	C22.2 No. 14
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)
Weight	1.2 lbs.
Mounting Methods	35mm DIN rail or surface mount

Dimensions



Three-Phase Pump Protection

777-KW/HP-P2 SERIES

Fully Programmable Electronic Power Monitors



Description

The Model 777-KW/HP-P2 Series is a family of fully programmable electronic power monitors. They are designed to monitor and protect any 3-phase 200-480 V ac motor drawing 2-800 full load amperes (external CTs are required above 90 A). They provide unsurpassed protection from faulty voltage, underload and overload conditions. The 777-KW/HP-P2 can be used in a variety of 3-phase applications and features a low power trip point (adjustable on the unit) that is desirable any time the current vs. load characteristic is non-linear or has little change. In general, this applies to small slow speed motors, small centrifugal motors and fractional horsepower motors. Low power protection can be used any time in place of undercurrent protection. The power monitor displays voltage, current, kilowatts and horsepower on the face of the unit. The LR version is designed for easier installation at a lower range of 1-9 full load amperes. The HVR version is designed with a high voltage relay for control circuits operating at 480 V ac.

The 777-KW/HP-P2 Series 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 unit's many features include enhanced trip classes beyond the NEMA standard trip classes. The settable trip class range is 2-60, with or without jam protection, and a secondary linear trip delay can be set with a range of 0-60 seconds. If both trip class and linear trip delay are set, the 777-KW/HP-P2 will follow the faster trip time. Another feature is the automatic dry-well recovery timer that allows the unit to automatically select a restart delay based on the last cycle's run time. This allows the 777-KW-HP-P2 to optimize restart delay times.

Network communications: compatible with Modbus, DeviceNet™, Profibus, or Ethernet using optional communications module.

Specifications

Functional Specifications

Programmable Operating Points (on face of the units)

LV-Low Voltage Threshold 170-524 V

HV-High Voltage Threshold 172-528 V

VUB-Voltage Unbalance Threshold 2-25 % or 999 (disable)

MULT-# of Conductors or CT Ratio (xxx:5) 1-10, 100, 150, 200, 300, 400, 500, 600, 700, 800

(20-100 A) ÷ MULT or 80-140 % of CT Primary

OC-Overcurrent Threshold **1**=0.01-0.99 kW **5**=0.01-1.33 hp

PWS-Power Scale **2**=1.00-9.95 kW **6**=1.34-13.3 hp

3=10.0-99.5 kW **7**=13.4-133 hp

4=100-650 kW **8**=134-871 hp

Ordering Information

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

Three-Phase Pump Protection

777-KW/HP-P2 SERIES

LP-Low Power 0.01-650 kW or 0.01-871 hp or 0 (off); LP setting is dependent on PWS setting. PWS setpoint must be programmed prior to LP or setpoint setting

CUB-Current Unbalance Threshold 2-50 % or 999 (disable)
TC-Overcurrent Trip Class 2-60, J2-J60, L00-L60, off
RD1-Rapid-cycle Timer 0-999 seconds

RD2- Restart Delay after all faults except underload motor cool-down timer) 2-500 minutes

RD3-Restart Delay after underload (dry-well recovery timer) 2-500 minutes, A (automatic)

#RU-Number of Restarts after underload 0, 1, 2, 3, 4, A (automatic)

ADDR-RS485 Address A01-A99

#RF-Number of Restarts after all faults except underload 0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, ocA (automatic)
COM-Communication Setting C00-C07

GF-Ground Fault Current Threshold (3-20 A) ÷ MULT of 12-40 % of CT Primary or off

Input Characteristics

Supply Voltage
777-KW/HP-P2,
777-LR-KW/HP-P2,
777-MLR-KW/HP-P2 200-480 V ac
777-HVR-KW/HP-P2 340-480 V ac
Frequency 50/60 Hz

Motor Full Load Amp Range
777-KW/HP-P2,
777-HVR-KW/HP-P2 2-20 A (Loops Required); 20-90 A (Direct); 80-800 A (External CTs)

777-LR-KW/HP-P2 1-2 A (1 Loop Required); 2.1-9 A (Direct); 10-800 A (External CTs)

777-MLR-KW/HP-P2 0.5-10.5 A (Loops Required), 5-21 (Direct), 40-740 (External CTs)

Output Characteristics

Output Contact Rating-SPDT (Form C)
777-KW/HP-P2, 7
77-LR-KW/HP-P2,
77-MLR-KW/HP-P2 480 VA @ 240 V ac (Pilot Duty)
777-HVR-KW/HP-P2 10 A @ 240 V ac (General Purpose)
 470 VA @ 600 V ac

Expected Life 1 x 10⁶ operations
Mechanical 1 x 10⁵ operations at rated load
Electrical

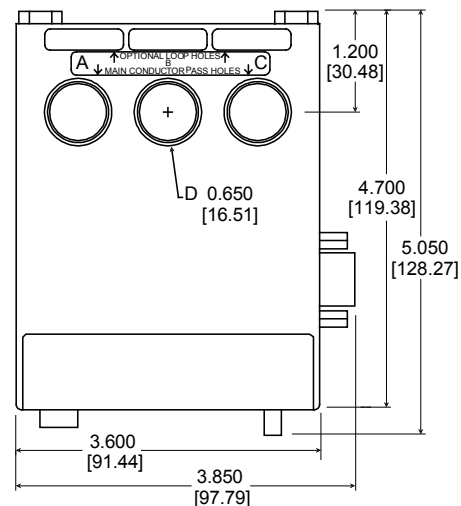
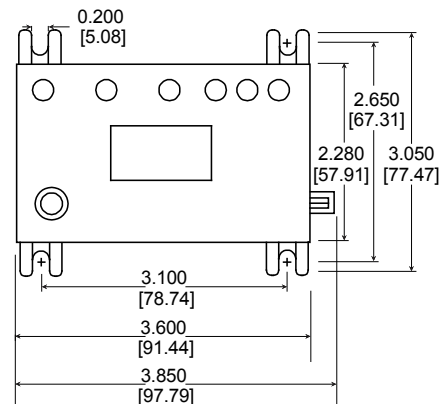
General Characteristics

Operating Temperature -20 °C to 70 °C (-4 °F to 158 °F)
Ambient Operating
Ambient Storage -40 °C to 80 °C (-40 °F to 176 °F)

Accuracy
Voltage ± 1 %
Current ± 3 % (<100 A direct)
Timing ± 0.5 % second
Power ± 10 %

Repeatability ± 0.5 % of nominal voltage
Voltage
Current ± 1 % (<100 A 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
Safety Marks
UL UL 508, UL 1053
CE IEC 60947-1, IEC 60947-5-1
CSA C22.2 No. 14
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)
Weight 1.2 lbs.
Mounting Methods 35mm DIN rail or surface mount

Dimensions

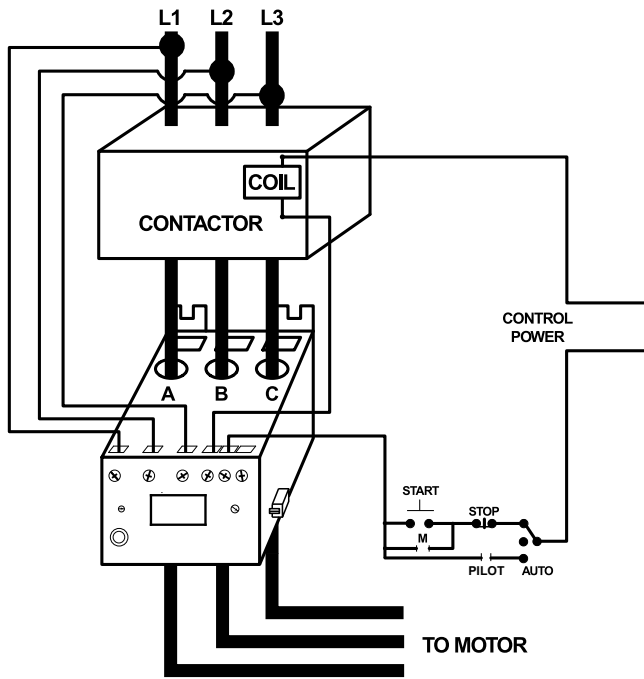


Three-Phase Pump Protection

777-P2 / 777-KW/HP-P2 SERIES INSTALLATION INSTRUCTIONS

Installation Instructions

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



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

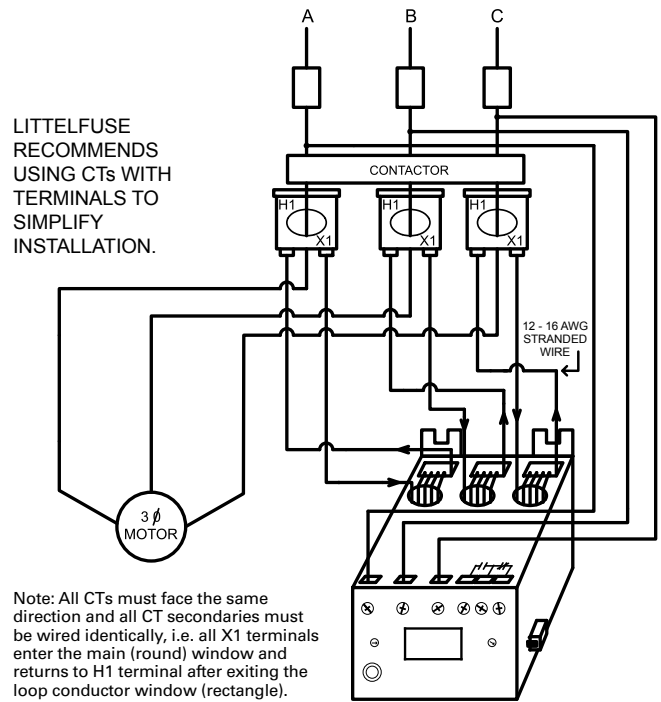


Table 8: Wiring Configuration for 777-P2 & 777-KW/HP-P2 Based on Motor Full Load Amperes

RECOMMENDED FULL LOAD AMPERES	OC RANGE (AMPERES)	UC RANGE (AMPERES)	# OF PASSES THROUGH EACH WINDOW	MULT (CT RATIO)
2-2.5	2-10	0, 1-9.8	10	10
2.5-3	2.2-11.1	0, 1.1-10.8	9	9
3-3.5	2.5-12.5	0, 1.2-12.2	8	8
3.5-4	2.8-14.3	0, 1.4-14	7	7
4-5	3.3-16.7	0, 1.6-16.3	6	6
5-6	4-20.1	0, 2-19.6	5	5
6-8	5-25.1	0, 2.5-24.5	4	4
8-12	6.6-33.5	0, 3.3-32.6	3	3
12-20	10-50.3	0, 5-49	2	2
20-90	20-100	0, 10-98	1	1
80-110	80-140	0, 40-140	5	100 (100:5)
110-160	120-210	0, 60-210	5	150 (150:5)
160-220	160-280	0, 80-280	5	200 (200:5)
220-320	240-420	0, 120-420	5	300 (300:5)
320-420	320-560	0, 160-560	5	400 (400:5)
400-520	400-700	0, 200-700	5	500 (500:5)
480-600	480-840	0, 240-840	5	600 (600:5)
540-700	560-980	0, 280-980	5	700 (700:5)
560-800	640-992/FFF	0, 320-992/FFF	5	800 (800:5)

Three-Phase Pump Protection

777-P2 / 777-KW/HP-P2 SERIES INSTALLATION INSTRUCTIONS

Table 9: Wiring Configuration for 777-LR-P2 & 777-LR-KW/HP-P2 Based on Motor Full Load Amperes

RECOMMENDED FULL LOAD (AMPERES)	OC RANGE (AMPERES)	UC RANGE (AMPERES)	# OF PASSES THROUGH EACH WINDOW	MULT (CT RATIO)
1.0-2.0	1.0-5.0	0, 0.5-4.9	2	2
2.1-9.0	2.0-10.0	0, 1-9.8	1	1
10-25	10-50	0, 5-49	2	25 (50:5)
20-50	20-100	0, 10-98	1	50 (50:5)
30-75	30-150	0, 15-147	1	75 (75:5)
40-100	40-200	0, 20-196	1	100 (100:5)
60-150	60-300	0, 30-294	1	150 (150:5)
80-200	80-400	0, 40-392	1	200 (200:5)
120-300	120-600	0, 60-588	1	300 (300:5)
160-400	160-800	0, 80-784	1	400 (400:5)
200-500	200-999	0, 100-980	1	500 (500:5)
240-600	240-999	0, 120-999	1	600 (600:5)
280-700	280-999	0, 140-999	1	700 (700:5)
320-800	320-999	0, 160-999	1	800 (800:5)

Table 10: Wiring Configuration for 777-MLR-KW/HP-P2 Based on Motor Full Load Amperes

RECOMMENDED FULL LOAD (AMPERES)	OC RANGE (AMPERES)	# OF PASSES THROUGH EACH WINDOW	MULT (CT RATIO)
0.5-2.10	0.5-2.7	10	10
0.5-2.3	0.5-3	9	9
0.6-2.6	0.6-3.3	8	8
0.7-3	0.7-3.8	7	7
0.8-3.5	0.8-4.5	6	6
1-4.25	1-5.4	5	5
1.2-5.25	1.2-6.7	4	4
1.6-7	1.6-9	3	3
2.5-10.5	2.5-13.5	2	2
5-21	5-27	1	1
40-90	20-108	5	100 (100:5)
60-135	30-162	5	150 (150:5)
80-180	40-216	5	200 (200:5)
120-270	60-324	5	300 (300:5)
160-360	80-432	5	400 (400:5)
200-450	100-540	5	500 (500:5)
240-540	120-648	5	600 (600:5)
270-630	140-756	5	700 (700:5)
320-740	160-864	5	800 (800:5)

Three-Phase Pump Protection

777-P2 / 777-KW/HP-P2 SERIES INSTALLATION INSTRUCTIONS

Programming

To program prior to installation, connect the 9-V battery cable to the pins on the left side of the unit (when looking at the display), and then attach a standard 9-V battery to the cable. The 9-V battery cable is keyed for proper installation. If the cable is connected improperly, the unit will not power its display. DO NOT connect the battery when line voltage is present. The unit cannot be tested for proper operation or communications using a 9-V battery. For testing purposes, 3-phase power must be used with a minimum voltage of 200 V ac. Follow all safety warnings when dealing with hazardous voltages.

1. Rotate the MODE SELECT switch to the parameter to be programmed. It is recommended that PWS be programmed first on the KW/HP versions.
2. Press and hold the RESET/PROGRAM button.
3. While holding the RESET/PROGRAM button, rotate the DISPLAY/PROGRAM knob until the proper setting for the parameter that is being programmed is displayed.
4. Release the RESET/PROGRAM button. This stores the new parameter in the nonvolatile memory. If the number changes back to what it was before programming, then the tamper guard is on and will need to be unlocked before programming can be completed. (See Tamper Guard section in the install manual if necessary.)
5. Continue steps 1-4 until all parameters are programmed.

Programmable Parameters

The following settings MUST be programmed by the user in order to provide proper protection for the application. Settings vary by situation and application and should be selected and tested for each unique installation. All parameters are actual values except for the VUB and CUB settings; these are programmed as percentages. The range each parameter can be programmed is found in the electrical specifications table. Failure to program all setpoints could result in nuisance tripping or prevent the device from protecting the motor. Always use the proper CTs for the motor full-load amperage (FLA).

LV/HV - Low Voltage/High Voltage. The recommended settings for LV (low voltage) and HV (high voltage) according to the NEMA MG1 standard are $\pm 10\%$ of the motor's nameplate voltage. Generally, the motor manufacturer should be contacted to verify these limits. High and low voltage trips are based on average voltage measured. Never set LV higher than HV.

Example: Nameplate voltage = 230 V
LV = $90\% \times 230 = 207\text{ V}$
HV = $110\% \times 230 = 253\text{ V}$

VUB - Voltage Unbalance. The NEMA MG1 standard says a motor should not be operated above a 1% voltage unbalance without derating the motor. Most utility supplied power sources have a difficult time sustaining a 1% VUB. The motor manufacturer should be consulted for an exact VUB setting. Setting VUB to 999 will disable voltage unbalance protection, but will not disable voltage single-phase protection. Voltage unbalance is calculated as follows:

$$\% \text{ Voltage Unbalance} = \left[\frac{\text{Maximum deviation from the average}}{\text{Average}} \right] \times 100 \%$$

Example: Measured line-line voltages = 203, 210, and 212. The average = $(203+210+212)/3 = 208.3$. The maximum deviation from the average is the greatest difference between the average voltage (208.3) and any one voltage reading: $212-208.3 = 3.7$, $210-208.3 = 1.7$ and $208.3-203 = 5.3$. The maximum deviation from the average is 5.3, thus voltage unbalance = $5.3/208.3 \times 100 = 2.5\%$.

MULT - (multiplier) setting is found in Table 8 (Table 9 for -LR version, Table 10 for -MLR version). The MULT setting is determined by the number of passes of the motor leads or the size of external CTs and the full-load amperes of the motor the unit will be monitoring. MULT sets the trip point range for overcurrent and ground fault current faults. Set MULT first, then set OC and GF.

OC - Overcurrent. Is typically set to the service-factor amperage (SFA) of the motor or 100-135 % of motor full-load amperes (FLA), which are determined by the motor manufacturer. If any one leg exceeds the OC setting, the unit will trip according to the Trip Class (TC) settings.

NOTE: When using external CTs, do not set OC greater than the thermal rating of the CTs

UC - Undercurrent (for non-KW/HP versions). Is most commonly set to 80 % of the full-load amperage (FLA) of the motor. This is usually adequate for protection of loss of load for many pumps and motors, including submersibles. If the motor is drawing less than full-load amperage, then the UC may be set lower than 80 % of FLA for adequate protection. Centrifugal/booster pumps may have to be set to something higher than 80 % of FLA for adequate protection. UC can be set to 0 if UC protection is not desired. The unit examines average current to determine if an undercurrent trip condition exists. The value must be lower than OC.

Three-Phase Pump Protection

777-P2 / 777-KW/HP-P2 SERIES INSTALLATION INSTRUCTIONS

LP - Low Power (for KW/HP versions) setting is used to shut down the motor or pump on an underload condition (that is based on power instead of solely on current). LP can be set in either kilowatts (kW) or horsepower (hp) as determined by the PWS setting. Setting LP to 0 disables the underload trip feature.

NOTE: PWS must be set before setting LP.

CUB - Current Unbalance. Littelfuse recommends contacting the motor manufacturer for a specific setting. Current unbalance is calculated the same way voltage unbalance is calculated (see formula under VUB).

Setting CUB to 999 will disable current unbalance and current single-phase protection.

TC - Trip Class. Determines how quickly the unit will trip when an overcurrent (overload) condition is detected. TC is a dual-function setting—both a thermal trip class (NEMA standard) and a linear trip delay (in seconds) can be set.

While the standard trip classes are 5, 10, 15, 20, and 30, TC can be set from 2–60, with or without jam protection. The trip class setpoint is the time in seconds that the device will take to trip when any phase current is greater than or equal to 600 % of the OC setpoint. These additional “non-standard” trip classes allow the unit to follow a trip curve in-between the “standard” trip class curves shown in Table 11.

Trip classes 2–60 can be set from approximately the 7 o'clock to 10 o'clock position with the DISPLAY/ PROGRAM knob. Trip classes J02–J60, which include jam protection, can be set from approximately the 10 o'clock to 1 o'clock position. This additional jam protection feature, when enabled, is initiated 1 minute after the motor starts and provides a 2-second trip delay for motors exceeding 400 % of the OC setting.

The linear overcurrent trip delay can be set from approximately the 1 o'clock to 5 o'clock position from 0–60 seconds (L00–L60) or to “OFF”. If TC is set to L00, the unit will trip off within 1 second after motor current reaches the OC setpoint. If both trip class and linear trip delay settings are programmed, the unit will follow the faster trip time. For example, TC is set to J15 and L20, and the amperage is 200 % of the OC setting. Following the trip class 15 curve, the unit will trip off in approximately 100 seconds. Thus the unit will follow the linear trip delay setting, because it is faster, and will trip off in 20 seconds.

The motor manufacturer should be contacted for an exact TC setting. Table 11 describes the trip classes, and Table 5 (page 20) shows the trip class curves.

Table 11: Trip Classes

TRIP CLASS	APPLICATION DESCRIPTION
5	Small fractional horsepower motors where acceleration times are almost instantaneous or where extremely quick trip times are required.
10	(Fast Trip) Hermetic refrigerant motors, compressors, submersible pumps and general purpose motors that reach rated speed in less than 4 seconds.
15	Specialized applications.
20	(Standard Trip) Most NEMA-rated general purpose motors will be protected by this setting.
30	(Slow Trip) Motors with long acceleration times (>10 seconds) or high inertia loads.
J Prefix	Programming any of the trip classes with the J Prefix will enable jam protection. This additional protection is enabled 1 minute after the motor starts and provides a 2 second trip time for motors exceeding 400 % of the OC setting, regardless of trip class.
Non-Standard Trip Classes	Trip time in seconds when any phase current is 600 % of OC. Time is approximately 90 % of the TC setting

RD1 - Restart Delay One. Rapid-cycle timer, in seconds (default). The purpose of this timer is to provide protection against short cycling and to allow adequate cool-down time between motor starts. This timer is initiated when power is first applied to the unit. If no voltage fault conditions exists, the output relay will energize (the NO will close and the NC will open) as soon as RD1 timer expires. In most cases, this is set to 20-30 seconds. This should provide adequate protection for successive power outages or short cycling caused by other motor controls. This timer is also initiated when motor current goes to zero. Setting RD1 to zero will turn off this feature and ensure that when an alarm circuit is used, an alarm will sound only when there is a fault or power to the unit is lost.

RD2 - Restart Delay Two. Referred to as a motor cool-down timer, in minutes (default). RD2 is used to restart the motor after a trip due to a current unbalance, current single-phasing, or an overcurrent condition. A setting of 5-10 minutes will give most motors adequate time to cool down after an overcurrent condition. The motor manufacturer should be contacted for an exact value.

RD3 - Restart Delay Three. This timer, in minutes (default), only initiates after an undercurrent/low power trip and is referred to as a dry-well recovery timer in pumping applications. This is set according to the time it takes for the well to recharge after pumping dry. This setting varies widely by application and there is no typical setting. RD3 can be set from 2-500 minutes or to A to enable the automatic Dry-Well Recovery Calculator. The Automatic Dry-Well Recovery

Three-Phase Pump Protection

777-P2 / 777-KW/HP-P2 SERIES INSTALLATION INSTRUCTIONS

Calculator allows the unit to automatically select a restart delay based on the run time of the last run cycle before tripping on an undercurrent/low power fault. Table 12 shows the next restart delay vs. run time. In general, a longer run time produces a shorter restart delay. This feature allows the unit to optimize running and rest times automatically.

Table 12: Automatic Dry-Well Recovery Timer

RUN TIME	NEXT RESTART DELAY (MINUTES)	STARTS/HR
> 1hr	6	10
30 min. - 59.99 min.	15	4
15 min. - 29.99 min.	30	2
< 15 min.	60	1

#RU/ADDR - Restart Attempts (Undercurrent/Underload)/Address. The #RU/ADDR is a dual-function setting. #RU settings are displayed and selected by turning the DISPLAY/PROGRAM knob from approximately the 7 o'clock to 12 o'clock position. ADDR settings are displayed and selected by turning the DISPLAY/PROGRAM knob from approximately the 12 o'clock to 5 o'clock position.

#RU is the number of restarts the unit will attempt after undercurrent/low power fault before the unit locks out and requires a manual reset. #RU can be set to 0, 1, 2, 3, 4, or A. This counter is cleared one minute after restarting if the unit does not trip again on undercurrent/low power.

If #RU is set to "0", the unit will require manual resetting after all undercurrent/low power faults.

If #RU is set to "A", the unit will always automatically restart after undercurrent/low power faults, once the RD3 timer expires.

ADDR is the RS-485 address of the unit and is only used when communicating with any external communication device. The address can be set from A01–A99.

#RF/COM - Restart Attempts (other faults)/Communications Settings. The #RF settings are displayed and selected by turning the DISPLAY/PROGRAM dial from approximately the 7 o'clock to 12 o'clock position. COM settings are displayed and selected by turning the DISPLAY/PROGRAM dial from approximately the 12 o'clock to 5 o'clock position.

#RF is the number of restarts the unit will attempt after current unbalance or current single-phase faults before the unit locks out and requires a manual reset. This counter will be cleared one minute after restarting if the unit does not trip again for the same fault condition. Available settings are 0, 1, 2, 3, 4 and A, or to include overcurrent faults, #RF can be set to oc1, oc2, oc3, oc4 or ocA.

If #RF is set to "0", the unit will require manual resetting after all current unbalance, current single-phase and overcurrent faults.

If #RF is set to "A", the unit will always restart automatically after current unbalance and current single-phase faults, once the RD2 timer expires. Overcurrent faults will require a manual reset.

If #RF is set to "ocA", the unit will always restart automatically after current unbalance, current single-phase and overcurrent faults, once the RD2 timer expires.

COM determines the baud rate, even/odd/no parity, and stop bit. COM can be set to C00-C07. C00 and C04 are duplicates provided for backward compatibility.

- C00 = 9600 baud, No parity, and 1 stop bit
- C01 = 9600 baud, Odd parity, and 1 stop bit
- C02 = 9600 baud, No parity, and 1 stop bit
- C03 = 9600 baud, Even parity, and 1 stop bit
- C04 = 19200 baud, No parity, and 1 stop bit
- C05 = 19200 baud, Odd parity, and 1 stop bit
- C06 = 19200 baud, No parity, and 1 stop bit
- C07 = 19200 baud, Even parity, and 1 stop bit

PWS - Power Scale (for KW/HP versions). The PWS setting for the respective LP range is shown in Table 13 below. Settings 1-4 will allow the LP setting to display in kW. Settings 5-8 will allow the LP setting to display in hp.

Table 13: PWS

PWS SETTING	LP RANGE
1	0.01 - 0.99 kW
2	1.00 - 9.95 kW
3	10.0 - 99.5 kW
4	100 - 650 kW
5	0.01 - 1.33 hp
6	1.34 - 13.3 hp
7	13.4 - 133.0 hp
8	134 - 871 hp

Three-Phase Pump Protection

777-P2 / 777-KW/HP-P2 SERIES INSTALLATION INSTRUCTIONS

UCTD - Undercurrent Trip Delay (for non-KW/HP version). The length of time, in seconds (default), the unit will allow the motor to run in an undercurrent situation before de-energizing its relay. Typically, UCTD is set to 2-4 seconds to allow for motor to reach full load.

GF - Ground Fault. The maximum allowable current that can flow to ground before the unit de-energizes its relay. This is a residual, class II ground fault system and should not be used for personnel safety. A typical setting for GF is 10-20 % of motor FLA (in amperes). GF may be set to OFF if this feature is not desired. The GF test procedure in the installation instruction manual must be conducted before the device is brought online.

Operation

The relay operation of the units are designed to be fail-safe. This means when the voltage is within the programmed limits, the relay will energize—the NO contact will close and the NC contact will open. When the unit loses power or senses a fault condition, the relay will de-energize and contacts will return to their original state. Once the unit has been installed and programmed, the unit is ready to operate.

Turn MODE SELECT to the RUN position. The display will show “run” alternating with a number (the number displayed will be the number corresponding to where the DISPLAY/PROGRAM knob is pointed). It will do this for the restart delay time programmed into RD1. Once the timer expires, the relay will energize—the NO contact will close and the NC contact will open if the voltage is within the set parameters. If something other than this is displayed, see the troubleshooting section on page 31 for more information. If MODE SELECT is taken out of RUN, the unit’s relay will de-energize.

System Display

On power up, the unit will show the current software revision. For example if the software revision is 33.04, the unit will show 033 followed by 004.

The output display can show one of the following parameters when MODE SELECT is in RUN: L1-L2, L2-L3, and L3-L1 line voltage; %VUB; A, B, and C phase current; %CUB; measured GF current, and KW and HP on KW/HP version. The display is used for programming the operating parameters of the device and also identifies what caused the unit to de-energize its relay or what is keeping the unit from energizing its relay, and under normal operating conditions, what the last fault was. The last fault can be displayed by pressing and holding the RESET/PROGRAM button while MODE SELECT is in RUN. When the unit trips off or is holding the motor off, the current fault condition will be

shown in the display without pressing the button (CAUTION: pressing the reset button at this time will reset the unit). Table 14 lists the fault codes the unit could display.

Table 14: Fault Codes

DISPLAYED MESSAGE	MEANING
oc	Tripped on overcurrent
SP	Tripped on current single-phasing or unit won't start because the voltage is single-phased
ub	Tripped on current unbalance or unit won't start because the voltage is unbalanced
uc	Tripped on undercurrent
CF	Tripped on contactor failure (due to faulty contacts or connections on the load side)
GrF	Tripped on ground fault
HI	A high voltage condition exists (won't allow motor to start)
Lo	A low voltage condition exists (won't allow motor to start)
rP	Incoming phases have been reversed, the motor may run backwards if started
oFF	A stop command was issued from a remote source
HPr	Tripped on high power
LPr	Tripped on low power
CLo	Tripped on low control voltage
clr	No previous faults
Pro	Shown when programming using the battery in the RUN position
FFF	Displayed value is greater than 999 (can be due to incorrect MULT setting)

Three-Phase Pump Protection

777-P2 / 777-KW/HP-P2 SERIES INSTALLATION INSTRUCTIONS

Troubleshooting

The unit will display a fault code alternating with a number or with “run” when it has tripped. If the unit is showing a fault code alternating with “run,” it is timing down the restart delay. If the fault code is alternating with a number (voltage reading or zero), the unit will not allow the motor to start because there is a problem with the incoming voltage. If the display is

showing just a fault code, the unit is in a manual reset mode. This could be because the number of restarts (#RF, #RU) has expired or is not allowed. If the display reads “oFF,” a stop command was issued through the communications network or a remote monitor.

Table 15: Troubleshooting Chart

PROBLEM	SOLUTION
The unit will not start. Display alternates “rP” with the DISPLAY/PROGRAM parameter value.	The voltage inputs are reverse-phased. If this is the initial start-up, swap any two of the leads connected to L1, L2, or L3 on the unit to correct the problem. If the unit has been previously running, the power system has been reverse-phased. Check the phase sequence of the incoming power lines. Note: L1 must be tapped from conductor Phase A, L2 from B, and L3 from C for correct power factor measurements on remote communications.
The unit will not start. Display alternates “SP”, “ub”, “HI”, or “Lo” with the DISPLAY/PROGRAM parameter value.	The incoming voltage is not within the limits programmed in the VUB, HV, and LV settings. Turn the DISPLAY/PROGRAM knob to read each incoming line voltage value. Correct the incoming power problem and check programmed limits by turning the MODE SELECT knob. Compare incoming values for HV, LV, and VUB to setpoints to verify they are correct.
Display alternates “SP”, “ub”, or “oc” with “run”	The unit has tripped on the fault shown on the display and is timing down RD2 before restarting. No further action is required.
Display alternates “uc” with “run”	The unit has tripped on undercurrent and is counting down RD3 before restarting. If undercurrent is not a normal condition for this application, check for broken shafts, belts, or closed valves or loss of liquid.
Display is showing a solid “SP”, “ub”, or “oc”	The unit has tripped on the fault shown and a manual reset is required because of the programmed setting in #RF. Check the system for problems that would produce the single-phase, overcurrent or current unbalance fault, such as a jam.
Display is showing a solid “uc”	The unit has tripped on undercurrent and a manual reset is required because of the setting in #RU. Check the system for problems that would produce an undercurrent condition like a dead-head or a lack of liquid to the pump.
Display is showing a solid “CF”	The unit has tripped on current single-phasing, but was not single-phased by the incoming voltage. Check for damaged contacts or loose or corroded wiring connections.
Display is showing a solid “GrF”	A ground fault current greater than the programmed GF value has been detected. Check the motor for insulation breakdown. A manual reset is required to clear this message. Press the RESET/PROGRAM button to perform a manual reset.
Display alternates “LPr” with “RUN”	The unit has tripped on low power (LPr) and is timing down RD3 before restarting. If LPr is not a normal condition for this application, check for broken shafts, belts, or closed valves or loss of liquid.
Display is showing a solid “LPr”	The unit has tripped on low power and a manual reset is required because of the setting in #RU. Check the system for problems that would produce a loss of load or a pump is out of liquid. Press the RESET/PROGRAM button to perform a manual reset.
Display alternates “HPr” with “RUN”	The unit has tripped on high power and is timing down RD2. Check for a high power condition.
Display is showing solid “HPr”	The unit has tripped on high power and requires a manual reset because of the setting in #RF. Press the RESET/PROGRAM button to perform a manual reset.
Display alternates “CLo” with “RUN”	The unit has tripped on low control voltage (CLo) and is timing down RD2 before restarting.
Display is showing solid “CLo”	The unit has tripped on low control voltage (CLo) and a manual reset is required because of the setting in #RF. Verify system voltage is correct. Press the RESET/PROGRAM button to perform a manual reset.

Liquid Level Protection

460-15-100-LLS

Liquid Level Sensor



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	Quick visual indicator of relay status of trip

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 Littelfuse Pump Protection Relay. 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.

Specifications

Input Characteristics

Control Voltage 110/120 V ac nominal
Frequency 50*/60 Hz
Sensitivity 100 kΩ

Functional Characteristics

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

Output Characteristics

Output contact Rating
– (Two Form A - SPST)

Pilot Duty 360 VA @ 240 V ac
General Purpose 8 A @ 240 V ac

General Characteristics

Ambient Temperature Range

Operating -20 °C to 70 °C (-4 °F to 158 °F)
Storage -40 °C to 80 °C (-40 °F 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, 6 kV contact, 8 kV air

Radio Frequency Immunity, Radiated

150M Hz, 10 V/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, 4 kV line-to-line;

ANSI/IEEE

Level 4, 4 kV line-to-ground

Hi-Potential Test

C62.41 Surge and Ring Wave Compliance to a level of 6 kV line-to-line

Safety Marks

Meets UL 508 (2 x rated V + 1000 V for 1 min.)

cULus

UL 508 (File #E68520)

CE

IEC 60947

Enclosure

Polycarbonate

Dimensions

H 88.9 mm (3.5"); **W** 52.93 mm (2.08");

Weight

D 59.69mm (2.35")
1 lb. (16 oz., 453.59 g)

Mounting Method

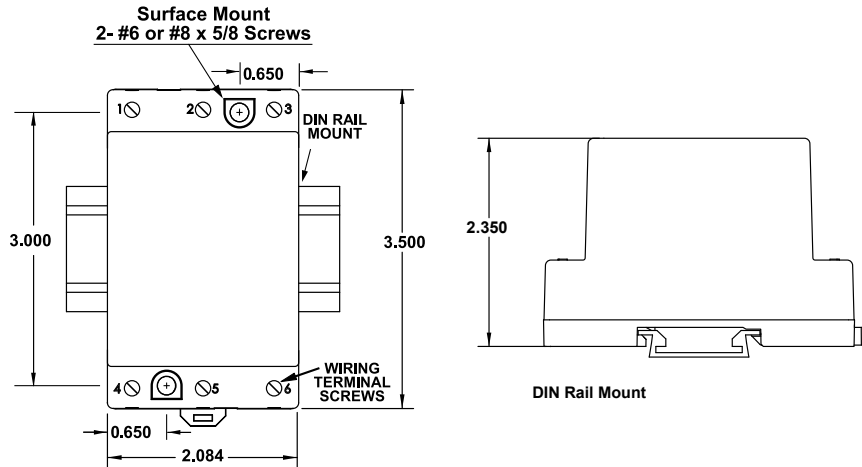
35mm DIN rail or Surface Mount
(#6 or #8 screws)

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

Liquid Level Protection

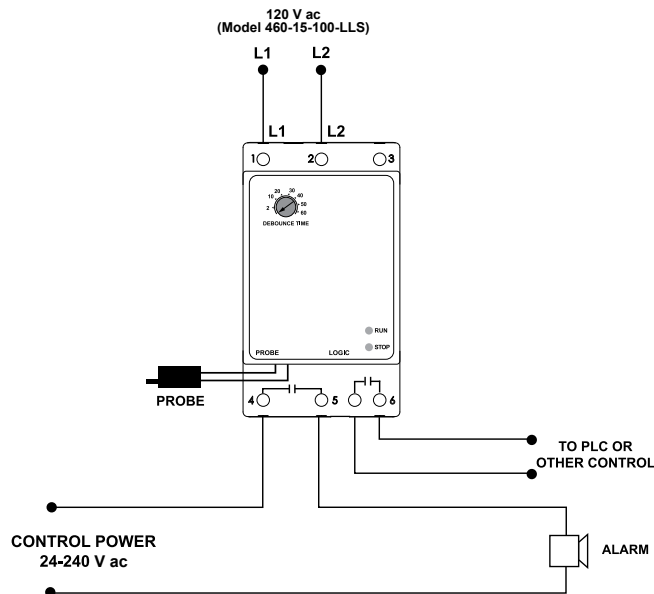
460-15-100-LLS

Dimensional Drawing



Installation Instructions

TYPICAL WIRING DIAGRAM FOR 460-15-100-LLS



Operation

When a conductive liquid makes contact with the probe it will cause the relay to change state after the debounce time is satisfied. The Run LED indicates that liquid is not present, and the Stop LED indicates that liquid is present.

Settings

1. Debounce Adjustment:

This adjusts the amount of time that a conductive liquid is in contact with the probe before the relay changes state. **Note:** If the time dial is changed, the new setting will take effect immediately, minus any time that has already elapsed.

2. Logic Jumper:

Logic Jumper Installed: Relay closes when conductive liquid is in contact with the probe.

Logic Jumper Removed: Relay opens when conductive liquid is in contact with the probe.

Liquid Level Protection

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

Liquid Level Control Relays



Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
PC-100-LLC-CZ	95 to 120 V ac	Compatible with Crouzet PNR & PNRU series
PC-200-LLC-CZ	190 to 240 V ac	Compatible with Crouzet PNR & PNRU series
PC-100-LLC-GM	95 to 120 V ac	Compatible with Gems' series 16M
PC-200-LLC-GM	190 to 240 V ac	Compatible with Gems' series 16M

Description

The PC-XXX-LLC-CZ & PC-XXX-LLC-GM 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 on adjacent page).

The units have an adjustable sensitivity knob (4.7 k to 100 k ohms) that is set according to the resistance level at which you want the (user supplied) probes 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

(Direct replacement for Crouzet models: PNR110A, PNR220A, PNRU110A, PNRU220A)

PC-XXX-LLC-GM

- Compatible with Gems' Series 16M general purpose control

(Direct replacement for GEMS models: 16MA1A0, 16MB1A0, 16MC1A0, 16MD1A0, 16ME1A0, 16MA2A0, 16MB2A0, 16MC2A0, 16MD2A0, 16ME2A0, 16MK1A0, 16ML1A0, 16MM1A0, 16MN1A0, 16MP1A0, 16MK2A0, 16MM2A0, 16MN2A0, 16MP2A0)

Must use Model OT08-PC socket for UL Rating!

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

Accessories



8-pin Octal Socket (P/N: OT08-PC)

Octal Socket for plug-in units. 8-pin surface & DIN-rail mountable

Liquid Level Protection

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

Specifications

Input Characteristics

Supply Voltage:

PC-100-LLC-CZ 95-120 V ac

PC-100-LLC-GM 95-120 V ac

PC-200-LLC-CZ 190-240 V ac

PC-200-LLC-GM 190-240 V ac

Frequency

50/60 Hz

Functional Characteristics

Probe Sense Voltage

5 V dc pulsed

Debounce Time Delay

2 seconds

Probe Sensitivity

4.7 k to 100 k Adjustable

Output Characteristics

Output Contact Rating:

480 VA @ 240 V ac

Pilot Duty

10 A @ 240 V ac

General Purpose

General Characteristics

Temperature Range

-40 °C to 70 °C (-40 °F to 158 °F)

Maximum Input Power

5 W

Standards Passed

Electrostatic Discharge (ESD) IEC 61000-4-2, Level 3, 6 kV contact, 8 kV air.

Radio Frequency

Immunity (RFI)

150M Hz, 10 V/m

Fast Transients

IEC 61000-4-4, Level 3, 2 kV input power and controls

Safety Marks

cULus (OT08-PC octal socket required)

UL 508 (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

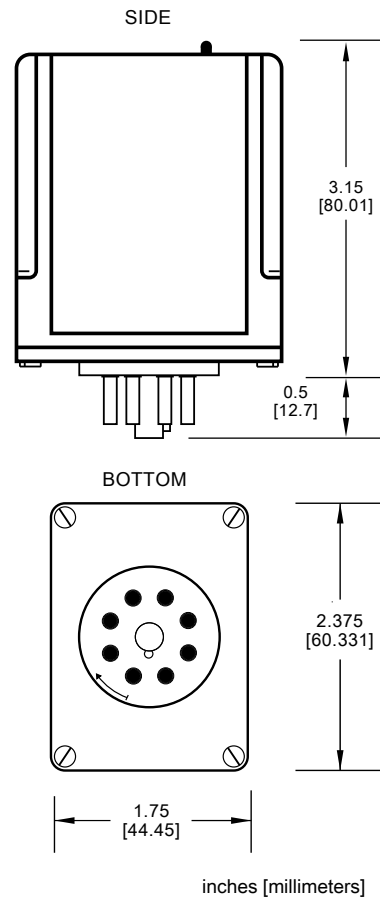
DIN rail or surface mount
(plug into OT08-PC socket)

Socket Available

Model OT08-PC (UL Rating 600 V)

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

Dimensional Drawing

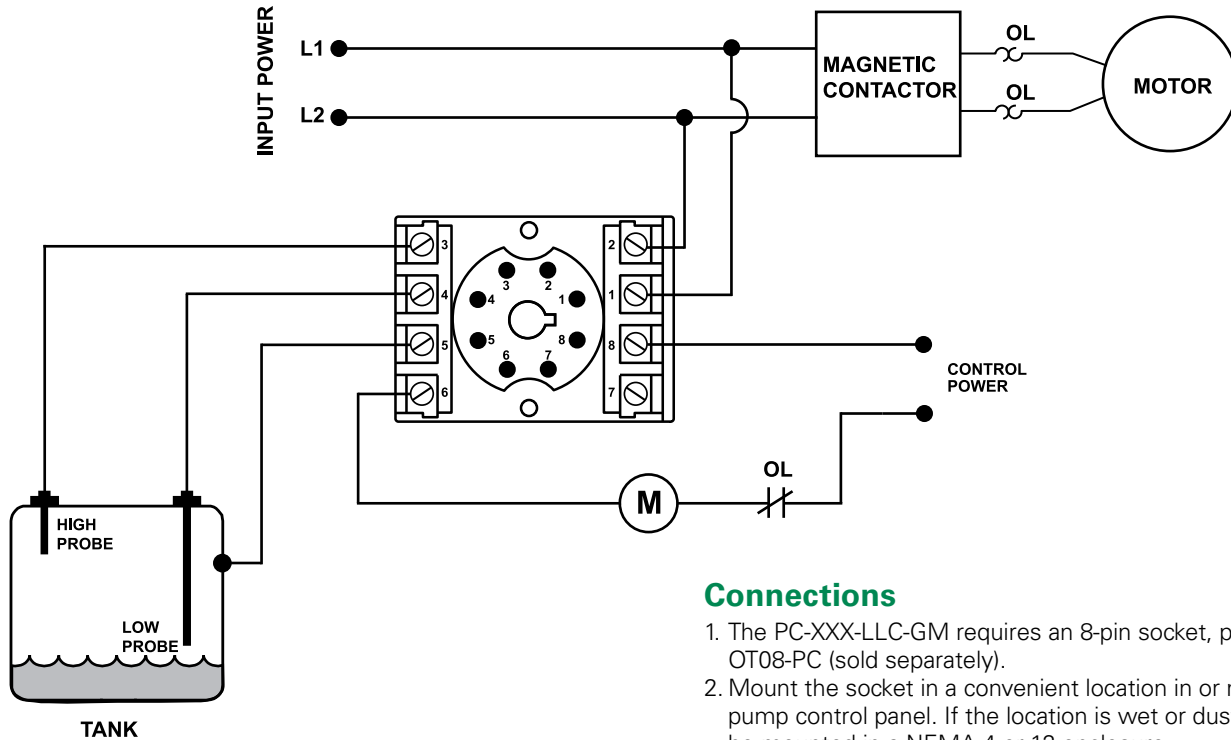


Liquid Level Protection

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

PC-XXX-LLC-GM Installation Instructions

TYPICAL WIRING DIAGRAM FOR PC-XXX-LLC-GM SERIES



Connections

1. The PC-XXX-LLC-GM requires an 8-pin socket, part number OT08-PC (sold separately).
2. Mount the socket in a convenient location in or near the pump control panel. If the location is wet or dusty, it should be mounted in a NEMA 4 or 12 enclosure.
3. For pump motor control, connect the normally open contact, socket terminal 6, and common, socket terminal 8, in series with the motor's magnetic contactor coil (M).
4. Connect the power supply L1 to socket terminal 1 and power supply L2 to socket terminal 2.
5. Connect high level probe to socket terminal 3.*
6. Connect low level probe to socket terminal 4.
7. If the tank is conductive, connect a probe common wire between the tank and socket terminal 5. If the tank is not conductive, a wire must be connected between a reference, or common, probe and socket terminal 5.
8. Plug the unit into the socket.

Note: The PC-XXX-LLC-GM uses a 5 V dc pulse to check the resistance of each probe, so the probes must be isolated from other voltage sources.

** For single probe applications, connect the single probe between socket terminals 3 and 5. The single probe must be connected to the high probe input and the low probe input must be left open.*

Timers & Alternating Relays

T10 SERIES

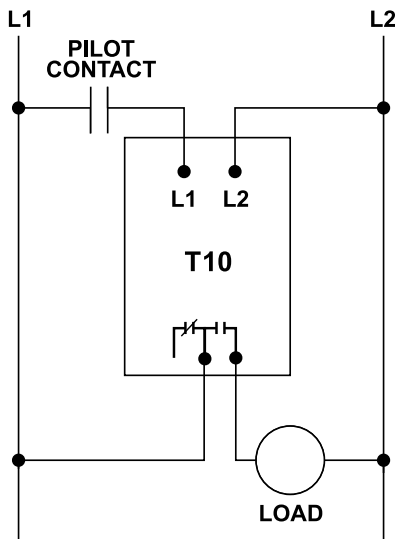
Solid-State On-Delay Timer



Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
T10120	115 V ac	0.1 to 10 minute range, 240 V ac rated output contacts
T10200	230 V ac	0.1 to 10 minute range, 240 V ac rated output contacts
T10400	460 V ac	0.1 to 10 minute range, 600 V ac rated output contacts
T10S400	460 V ac	0.5 to 12 second range, 600 V ac rated output contacts

Installation Instructions



Description

The T10 Series on-delay timer is a solid-state electronic device that provides accurate and reliable timing for control circuits up to 460 V ac. 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 480 V @ 240 V ac on the 115 V and 230 V models, and 470 VA @ 600 V ac on the 460 V model.

Specifications

Input Characteristics

Frequency 50*/60 Hz

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 480 VA @ 240 V ac
T10400, T10S400 470 VA @ 600 V ac

General Characteristics

Maximum Input Power

5 W

Terminal

Torque 7 in.-lbs.
Wire Size 12-18 AWG

Safety Marks

UL

UL 508 (File #E68520)
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: 50 Hz will increase all delay timers by 20 %.

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.

Ordering Information

MODEL	LINE VOLTAGE	DESCRIPTION
ALT024-S [†]	20-26 V ac or V dc	For single high-level float applications
ALT024-S-SW [†]	20-26 V ac or V dc	For single high-level float applications with built in manual switch
ALT115-S	95-125 V ac	For single high-level float applications
ALT115-S-SW	95-125 V ac	For single high-level float applications with built in manual switch
ALT115-X	95-125 V ac	For dual high-level (lead and lag) float applications
ALT115-X-SW	95-125 V ac	For dual high-level (lead and lag) float applications with built in manual switch
ALT230-S	195-250 V ac	For single high-level float applications
ALT230-S-SW	195-250 V ac	For single high-level float applications with built in manual switch
ALT230-X	195-250 V ac	For dual high-level (lead and lag) float applications
ALT230-X-SW	195-250 V ac	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 10 A @ 600 V ac. Surface mounted with two #6 screws or snaps onto a 35 mm DIN rail.

[†]ALT024-S and ALT024-S-SW are not UL Listed

Timers & Alternating Relays

ALT SERIES

Specifications

Input Characteristics

Supply Current 40 mA

Functional Characteristics

Debounce Time Delay 0.5 second

Control Input Impedance (min)

24 10 kΩ

115 56 kΩ

230 100 kΩ

Output Characteristics

Output Contact Rating 480 VA @ 240 V ac

General Characteristics

Temperature Range -40 °C to 50 °C (-40 °F to 122 °F)

Maximum Input Power 5 W

Safety Marks

UL (OT08PC octal

socket required) UL 508 (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)

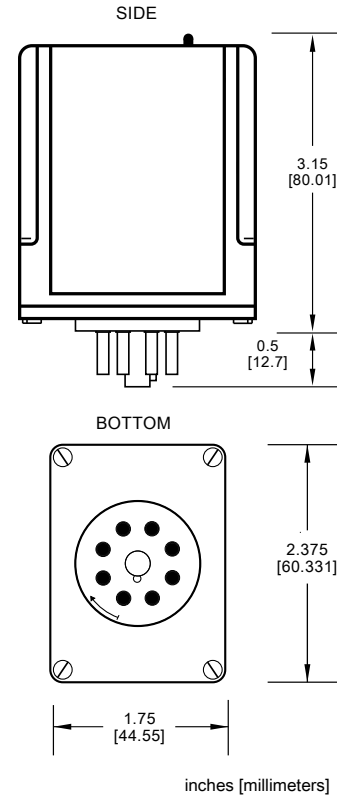
Mounting Method DIN rail or surface mount

(plug into OT08PC socket)

Socket Available OT08PC (UL Rating 600 V)

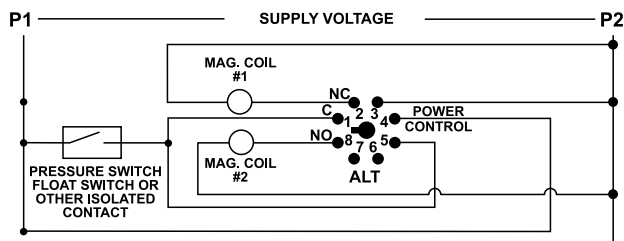
The 600 V socket can be surface mounted or installed on DIN rail.

Dimensional Drawing

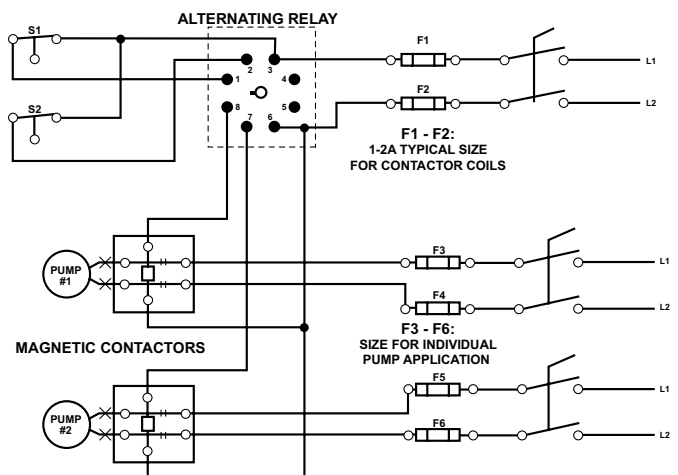


Installation Instructions

TYPICAL WIRING DIAGRAM FOR THE ALT-S



TYPICAL WIRING DIAGRAM FOR THE ALT-X (CROSS CONNECTED)



Timers & Alternating Relays

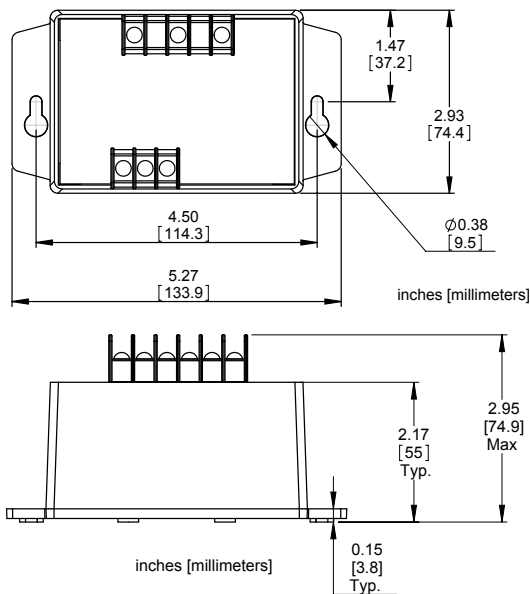
50R-400-ALT



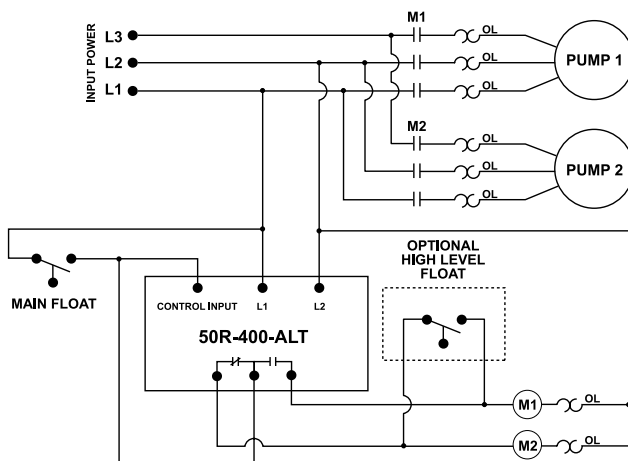
480 V ac, Panel Mount Alternating Relay



Dimensions



Installation Instructions



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.

Specifications

Input Characteristics

Supply Voltage 380-480 V ac
Supply Current 40 mA

Functional Characteristics

Control Input Impedance (min) 1MΩ

Output Characteristics

Output Contact Rating
Pilot Duty 470 VA @ 600 V ac
General Purpose 10 A
Debounce Time Delay 1 second

General Characteristics

Maximum Input Power 5 W

Terminal

Torque 7 in.-lbs.
Wire Size 12-18 AWG

Safety Marks

UL UL 508 (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

Metal Electrical Box



Description

The NEMA-3R-L enclosure is a metal electrical box that meets the National Electrical Manufacturers Association's standard for a 3R enclosure (rain proof). The NEMA-3R-L box can house several different single-phase Littelfuse models. It has two clear lenses on the cover for viewing the LEDs on the unit, allowing the customer to determine the units operational status.

The NEMA-3R-L is sold separately.

Specifications

Functional Specifications

Classification

NEMA 3R standard (rain proof)

Grounding

12" long 12-gauge wire secured by ground screw

General Characteristics

Dimensions

H 156.46 mm (6.16");

W 159.26 mm (6.27");

D 117.35 mm (4.62");

Inside Depth 101.6 mm (4.0")

Front Cover

Secured by two machine screws, contains two clear lenses for viewing LED lights on the relay

Weight

3.30 lbs.

Mounting Method

Surface mount (four pre-drilled concave holes)

Knock-outs (four)

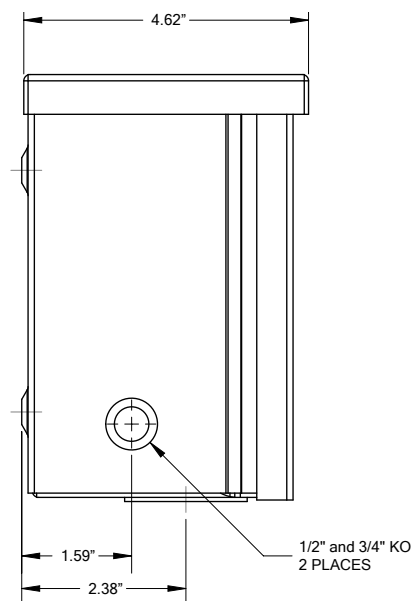
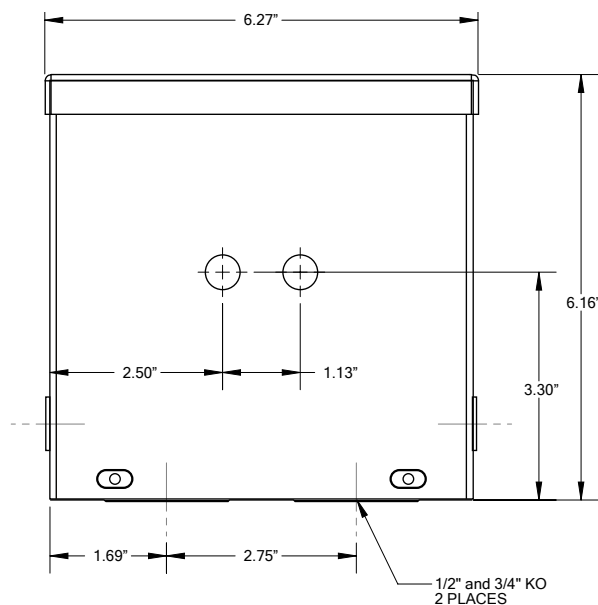
1/2" (1 each side and 2 in bottom) or

3/4" (1 each side and 2 in bottom)

Security

Padlock tab

Dimensions



Hand-held diagnostic tool



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.

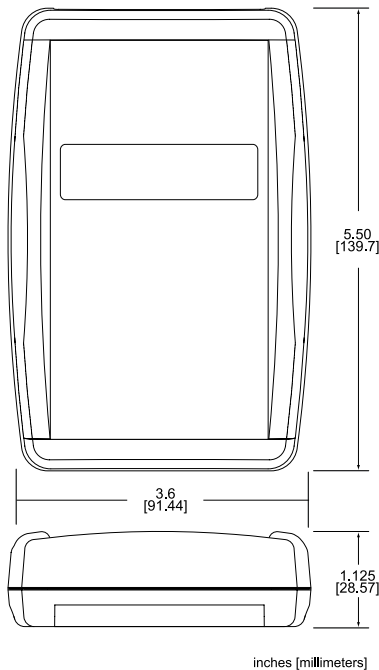
Each Littelfuse single-phase model listed above is equipped with an infrared LED that transmits valuable information from the device. To retrieve this information, the Informer's receiver must be directed toward the unit's LED transmitter and be within 8 feet of the unit. The green COMM STATUS light 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).

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

Dimensions



Accessories



Informer IR Kit-12

Attaches to the face of the unit to provide remote diagnostics without opening the panel. (12" infrared adapter cable)

Specifications

Functional Characteristics

Power

Input

9 V dc
(requires one 9-V 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 °C to 60 °C (32 °F to 140 °F)

Accuracy

Voltage

± 2 %

Current

± 2 %

Power

± 4 %

Maximum Input

0.25 W

Resolution

Voltage

1.0 V ac

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)

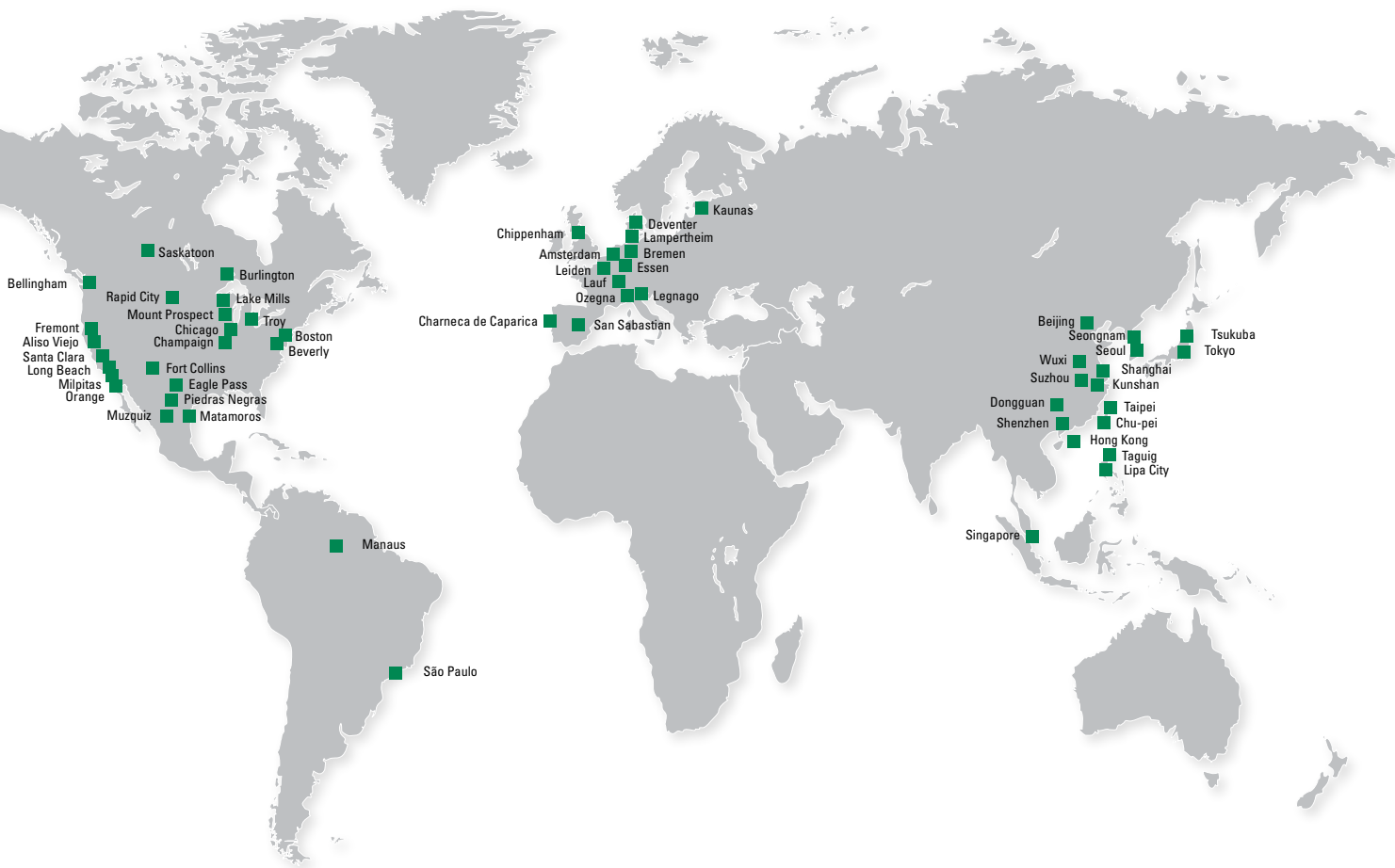
Material

Black ABS 94HB

Troubleshooting Guide

PROBLEM	SOLUTION
The Informer does not activate when the ON button is pressed.	Battery Polarity Reversed – Verify the + and – terminals on the battery match the markings inside the battery compartment.
	Low Battery – Replace the battery.
The COMM STATUS light is off and all display values remain at zero.	Weak Signal – Ensure the Informer is aimed directly at the unit's infrared LED and is within the operating distance.
	Unit Not Transmitting – Verify the unit is energized and the green RUN light is illuminated.
	Sunlight – Verify the sun is not shining directly onto the Informer's infrared receiver or the unit's infrared LED.
The COMM STATUS light is blinking.	Weak Signal – Ensure the Informer is aimed directly at the unit's infrared LED and is within the operating distance.
	If using an older Informer (version 1.XX or earlier), this is a normal condition.
The displayed values fluctuate radically.	Weak Signal – Ensure the Informer is aimed directly at the unit's infrared LED and is within the operating distance.
The Informer displays values even after communication is lost.	This is Normal – The Informer holds the last values it received before communication was lost (until the auto shut off).

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