Littelfuse®

Expertise Applied | Answers Delivered

SOLAR
PRODUCTS
CATALOG

SOLAR PRODUCTS

1000 Vdc Protection • Full-Range Protection • Remote Notification • Overvoltage Protection

Safety and Productivity for Solar Applications

For over 80 years, Littelfuse has provided reliable circuit-protection products for electronic, automotive and industrial applications.

This catalog highlights products designed specifically for the growing solar industry. We offer a wide variety of circuit-protection products designed to meet the needs of original equipment manufacturers, photovoltaic (PV) engineers and other solar industry professionals. Inside you will find technical product information, online resources and ideas on how to improve solar circuit protection.

As industry standards are shifting and 1000 Vdc protection is becoming more common, Littelfuse continues to develop fuses and fuseholders that meet this requirement at both high and low amperages. In addition, we offer a broad selection of overvoltage suppression products to protect against transients, ground-fault relays to detect ground faults, and other products that can easily combine solar strings within a combiner box.

For more information about Littelfuse circuit-protection products visit www.littelfuse.com

A Broad Offering of Circuit-Protection Products to Safeguard Against Common Threats

FUSES AND FUSEHOLDERS
PROTECTION RELAYS
PTCs
VARISTORS
GDTs
THYRISTORS
SIDACtor® DEVICES
TVS DIODES
SPA™ SILICON PROTECTION ARRAYS
PulseGuard® ESD SUPPRESSORS

As the global leader in circuit protection, Littelfuse is the only company to offer all pertinent circuit-protection technologies. Our products protect virtually any application that uses electrical energy.

In addition to a wide portfolio of circuit protection products, Littelfuse offers decades of design experience to help you address application challenges and achieve regulatory compliance. Littelfuse's products can help:

- Improve end-product uptime, sustainability and reliability
- Minimize fire and shock risks and limit damage potential
- Minimize operating dangers and potential liabilities

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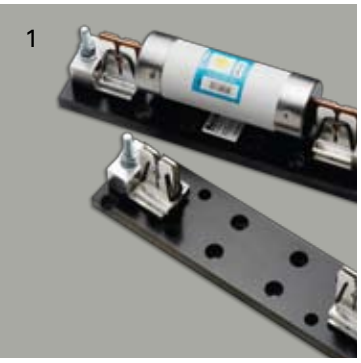

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SOLAR-RATED PRODUCTS

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11

1. SPFR Solar Fuse and Fuseholder—UL Recognized, full-range, fast-acting 1000 Vdc fuse. Self-certified, RoHS compliant and lead (Pb) free fuseholder. Both are offered in 250, 300, 350 and 400 A **(Page 3)**.

2. SPF Solar Rated Fuse—UL Recognized, fast-acting 1000 Vdc 10x38 mm midget fuse with full range performance 15-30 A. RoHS compliant and Pb free. **(Page 5)**.

3. LPHV/LPSM Touch-Safe Fuseholders—UL Recognized, RoHS compliant and Pb free DIN-Rail 10x38 mm midget fuseholder **(Page 6)**.

4. IDSR/LDC Fuse and Fuseholder—UL Listed indicating fuses with a full range performance. Available in 1/10–2,000 A **(Page 7)**.

5. KLKD Midget Fuse—UL Listed, fast-acting 10x38 mm midget fuse. Available up to 30 A. RoHS compliant and Pb free **(Page 9)**.

6. PGR-2601 DC Ground-Fault Relay—Ground-fault protection up to 1000 Vdc with trip settings from 1 mA to 20 mA. For use in ungrounded systems **(Page 10)**.

7. Busbar for LPSM/LPSC Fuseholder—UL Recognized accessory with maximum voltage of 600 Vac/dc. RoHS compliant and Pb free **(Page 11)**.

8. Up-LINK™ Remote Indication Fuseholder—UL Recognized touch-safe holder with remote fuse status indication up to 30 A and 600 Vdc **(Page 13)**.

9. TVS Diodes—Overvoltage protection, up to 3,500 Vdc with maximum energy 10,000 J and maximum peak current 70,000 A. Most series are UL Recognized **(Page 15)**.

10. Varistor Products—Overvoltage protection that diverts transient currents away from sensitive components. Most series are UL Recognized **(Page 16)**.

11. Power Distribution Blocks—UL Recognized, 600 Vac/dc power distribution blocks with multiple-wire rated terminals **(Page 17)**.

SPFR SERIES 1000 VDC SOLAR FUSE

The SPFR series was designed to meet the growing needs of the solar industry with higher amperage and voltage requirements. It was developed specifically for solar applications, ranging from low-amperage (1 A) SPF products to 400 A SPFR fuses and fuseholders. Please contact factory for time current curves.

Applications

- Solar Inverters
- High-amperage combiner boxes

Features/Benefits

- DC Voltage rating meets European system requirements and North American utility scale requirements
- Multiple amperage ratings
- RoHS compliant
- UL Class H Dimensions
- Full Range Protection

Specifications

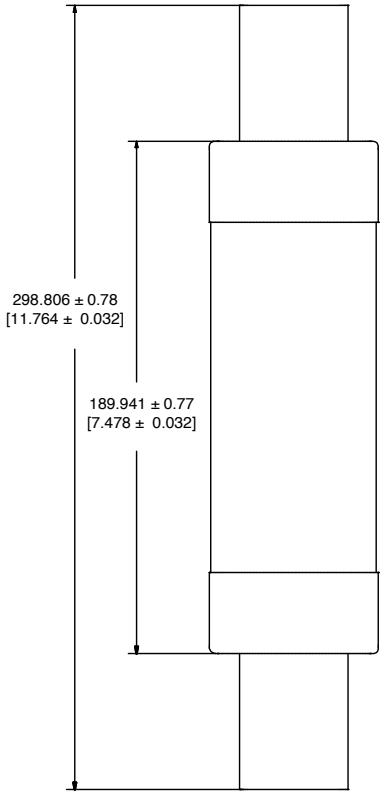
Voltage Rating: 1000 Vdc
Ampere Rating: 250, 300, 350 and 400 A
Interrupting Rating: 10,000 A; Time Constant less than 1ms
Fuse Type: Fast-acting
Approvals: UL Recognized 1000 Vdc UL 248 (UL File No. 71611)
CSA (File No. 29862)
Fuseholder: SPFRHD Series

Ordering Information

FUSE PART#	SYSTEM #	AMPERAGE
SPFR 250	SPFR250.X	250
SPFR 300	SPFR300.X	300
SPFR 350	SPFR350.X	350
SPFR 400	SPFR400.X	400

Dimensions: mm [inches]

CAD drawings available for download at www.littelfuse.com



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SPFRHD SERIES 1000 VDC SOLAR FUSEHOLDER

Specifications

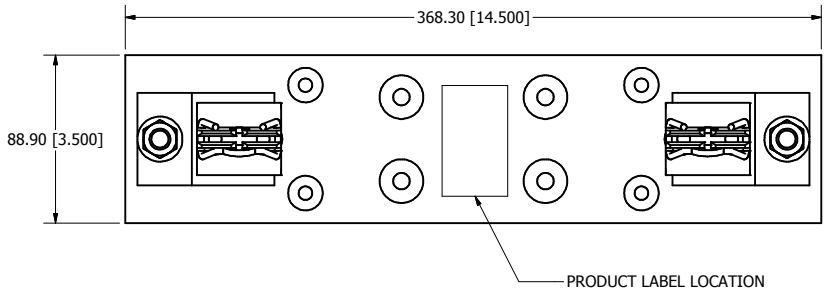
Voltage Rating: 1000 Vdc
Ampere Rating: 400 A
Approvals: UL Recognized 600 Vdc UL 4248 (UL File No. E14721)
1,000 V Self-certified
CSA (File No. 29862)
Fuse Type: SPFR Series

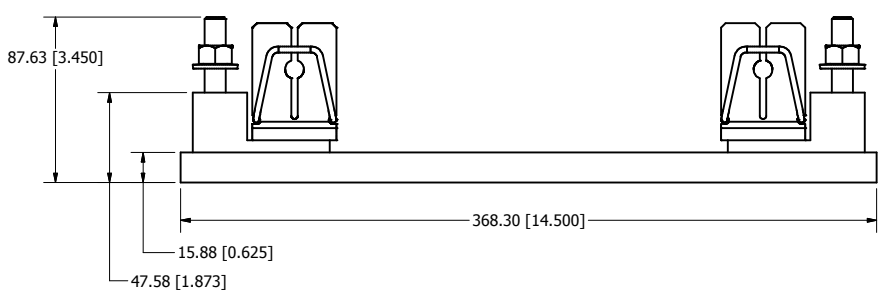
HOLDER PART#	HOLDER SYSTEM #	AMPERAGE
SPFRHD4001ST	SPFRHD4001ST	250–400

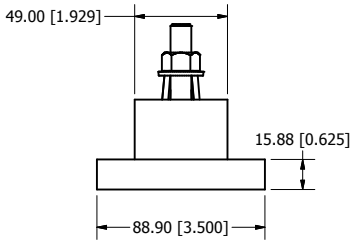
The SPFRHD series fuseholders are specifically designed for 1000 Vdc SPFR fuses up to 400 A. The SPFRHD is self-certified to 1000 V and UL Recognized to 600 V (UL File No. E14721).

Dimensions: mm [inches]

CAD drawings available for download at www.littelfuse.com







SPF SERIES 1000 VDC SOLAR FUSE

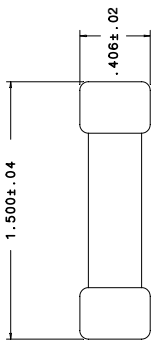
The SPF Solar Protection Fuse series has been specifically designed for photovoltaic (PV) systems. This family of midget fuses (10x38mm) can safely protect PV modules and their conductors from reverse overcurrent conditions despite the associated challenges of DC power.

As PV systems have grown in size, so have the corresponding voltage requirements. This increase in system voltage has typically been intended to minimize power loss associated with long conductor runs. With design voltages growing upwards of 1000 Vdc, 10x38 mm standard midget fuses were not designed to meet the newest protection requirements. However, the SPF series is UL Recognized to safely interrupt circuits up to this demanding voltage level.

Littelfuse offers thirteen ampere ratings to match designers' specific requirements in applications including combiner boxes, inverters and battery charge controllers.

Dimensions: inches

CAD Drawings available for download at www.littelfuse.com



Product Features

- UL Recognized 1000 Vdc maximum
- 13 ampere ratings for flexible design
- 20,000 A interrupting rating
- High performance in compact 10x38 mm midget size
- RoHS compliant and lead free
- Touch safe DIN rail holder available
- PCB leaded version available

Specifications

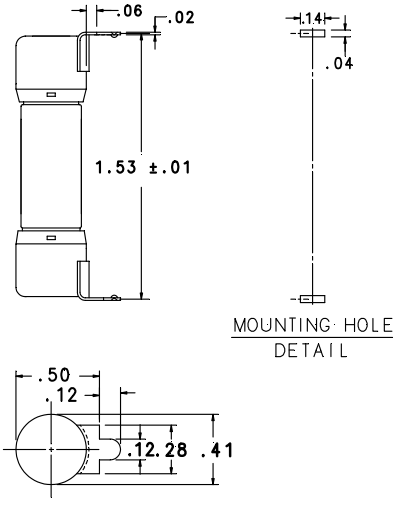
Voltage Rating:	1000 Vdc
Amperage Ratings:	1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 25, 30
Max. Interrupt Rating:	20,000 A; Time Constant less than 2ms
Min. Interrupt Rating:	1–12 amperes, 2x Current Rating 15–30 amperes, 1.35x Current Rating
Approvals:	UL Recognized (File No. E71611) CSA (File No. 29862)
Fuseholder:	LPHV series

Ordering Examples

PART#	SYSTEM #	AMPERAGE
SPF002	SPF002.T	2
SPF008	SPF008.T	8
SPF030	SPF030.T	30
SPF030R	SPF030.HXR	30 (with PCB tabs)

Dimensions: inches - PCB Version

CAD Drawings available for download at www.littelfuse.com



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LPHV/LPSM SERIES TOUCH-SAFE HOLDERS

Specifications

Voltage Rating:	LPHV: 1000 Vac/dc LPSM: 600 Vac/dc
Amperage Rating:	30 A
SCCR Rating:	200,000 Aac 20,000 Adc
Wire Range:	#6–#14 CU 75°C
Terminal Type:	Pressure Plate
Terminal Torque:	17.7 in-lbs
Fuse Type:	LPHV: SPF Series LPSM: KLKD Series
Approvals:	LPHV: 1000 Vdc Self-certified LPHV and LPSM: 600 Vdc UL Recognized (UL file# E14721) CSA (File No. 7316)

The LPHV and LPSM 10x38 mm midget fuseholders have a touch-safe design to protect personnel from contact with live parts when installing and removing fuses. The compact fuseholder mounts quickly onto 35 mm DIN-rail, decreasing panel layout and assembly time. The LPHV is self-certified to stringent Littelfuse standards for applications up to 1000 Vdc when used with the Littelfuse SPF 10x38 mm midget fuse series.

The LPHV and LPSM fuseholders are available in 1, 2, 3 and 4 pole configurations or can be connected together with an assembly kit. Applications include combiner boxes and inverters.

LPHV (1000 VDC)		
POLES	PART# (NON-ID)	SYSTEM# (NON-ID)
One	LPHV001	LPHV001Z
Two	LPHV002	LPHV002Z
Three	LPHV003	LPHV003Z
Four	LPHV004	LPHV004Z

LPSM (600 VDC)				
POLES	PART# (NON-ID)	PART# (INDICATOR)	SYSTEM# (NON-ID)	SYSTEM# (INDICATOR)
One	LPSM001	LPSM001ID	LPSM001Z	LPSM001ZXID
Two	LPSM002	LPSM002ID	LPSM002Z	LPSM002ZXID
Three	LPSM003	LPSM003ID	LPSM003Z	LPSM003ZXID
Four	LPSM004	LPSM004ID	LPSM004Z	LPSM004ZXID

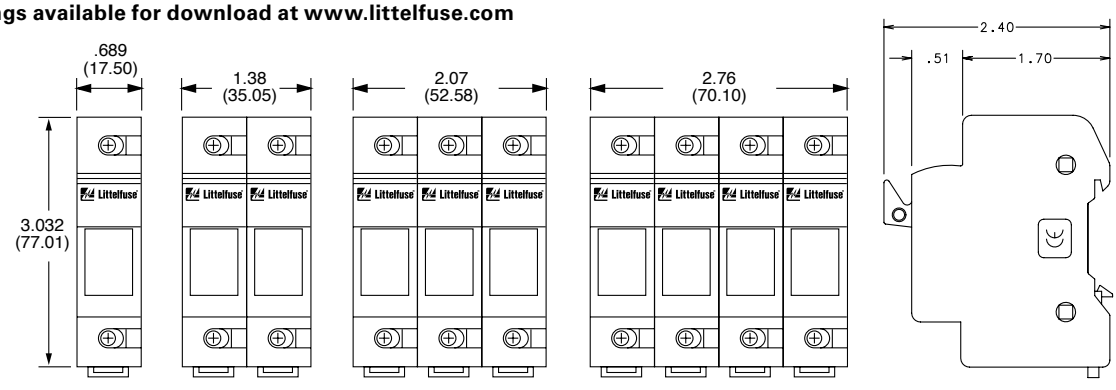
Multi-pole Assembly Kit: CYHP001 (Kit allows up to 10 holders to be connected)

Features/Benefits

- LPHV is self-certified to 1000 Vdc
- LPSM and LPHV are UL Recognized to 600 Vdc
- Mountable on 35mm Din Rail
- Safe and easy installation and removal of fuses
- RoHS compliant and Pb free
- Indication available on LPSM

Dimensions: inches (mm)

CAD Drawings available for download at www.littelfuse.com



IDSR AND LDC 600VDC FUSES

IDSR Series Class RK5 Indicator® Fuse

The design of the IDSR features a 600 Vac/dc rating, making it ideal for DC applications such as solar photovoltaic systems.

Specifications

Voltage Ratings: 600 Vac/dc
Interrupting Ratings: AC: 200,000 A rms symmetrical
300,000 A rms symmetrical
(Littelfuse self-certified)
DC: 20,000 A
Ampere Range: 1/10 – 600 A
Approvals: Standard 248–12, Class RK5
UL Listed (File No: E81895)
CSA Certified (File No: LR29862)
Fuseholder: LR60 Series

AMPERE RATING							
1/10	6/10	1 8/10	4	8	30	80	225
1/8	8/10	2	4 1/2	9	35	90	250
15/100	1	2 1/4	5	10	40	100	300
2/10	1 1/8	2 1/2	5 6/10	12	45	110	350
1/4	1 1/4	2 8/10	6	15	50	125	400
3/10	1 4/10	3	6 1/4	17 1/2	60	150	450
4/10	1 1/2	3 2/10	7	20	70	175	500
1/2	1 6/10	3 1/2	7 1/2	25	75	200	600

Note: All fuses rated 1 amp and above are Indicator® fuses.

Ordering Example

PART#	SYSTEM #	AMPERAGE
IDSR030	IDSR030.T	30

LDC Series Class L

The 600 Vac/dc rating of the LDC series can be used on either the AC or DC side of a photovoltaic system.

Specifications

Voltage Ratings: 600 Vac/dc
Interrupting Ratings: AC: 200,000 A rms symmetrical
DC: 50,000 A
Ampere Range: 150–2000 A
Approvals: Standard 248–10, Class L
UL Listed 601–2000 A (File No: E81895)
UL Recognized 150–600 A (File No: E71611)
CSA Certified 150–2000 A (File No: LR29862)

AMPERE RATING				
150	450	750	1,300	1,900
200	500	800	1,350	2,000
250	600	900	1,400	
300	601	1,000	1,500	
350	650	1,100	1,600	
400	700	1,200	1,800	

Ordering Example

PART#	SYSTEM #	AMPERAGE
LDC150	0LDC150.X	150

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CLASS R FUSEBLOCKS

Features/Benefits

- Class R fuseblocks incorporate a rejection electrical contact.
- Reinforcing clips are standard on all Class R fuseblocks and minimize heat rise.
- Protective covers are available. Visit www.littelfuse.com for more information.

Specifications

Voltage Rating: 600 V
Ampere Ratings: 0–600 A
Approvals: UL Listed (File No. E14721)
CSA Certified
(File No. LR73091)

Ordering Information

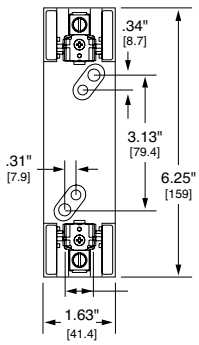
CLASS R 600 V (BOX LUG TERMINALS)				
AMP RATING	NO. OF POLES	PART #	SYSTEM #	MAXIMUM WIRE SIZE
30	1	LR60030-1CR*	LR600301CR	C=#6 CU-AL
30	2	LR60030-2CR*	LR600302CR	
30	3	LR60030-3CR*	LR600303CR	
60	1	LR60060-1CR	LR600601CR	C=#2 CU-AL
60	2	LR60060-2CR	LR600602CR	
60	3	LR60060-3CR	LR600603CR	
100	1	LR60100-1C	LR601001C	#2/0 CU-AL
100	2	LR60100-2C	LR601002C	
100	3	LR60100-3C	LR601003C	
200	1	LR60200-1C	LR602001C	250MCM CU-AL
200	3	LR60200-3C	LR602003C	
400	1	LR60400-1CR	LR604001CR	(2) 350MCM CU-AL
400	3	LR60400-3CR	LR604003CR	
600	1	LR60600-1C	LR606001C	(2) 500MCM CU-AL
600	3	LR60600-3C	LR606003C	

Note: Reinforcing springs standard on all Class R fuseblocks.
* 30 A Fuseblocks are also available with screw or pressure plate terminals. To order, replace suffix CR with SR for screw or PR for pressure plate.

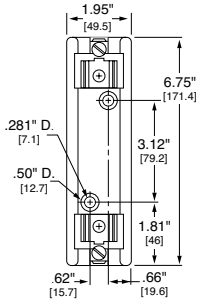
Dimensions: inches [mm]

CAD Drawings available for download at www.littelfuse.com

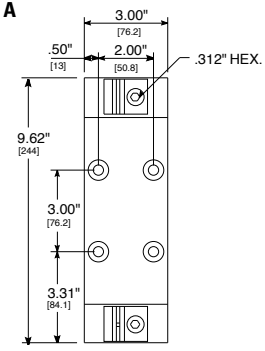
600 V 30 A



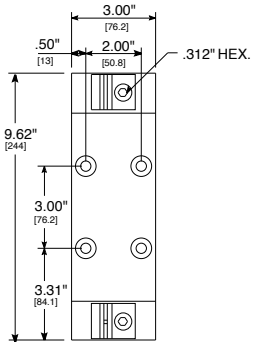
600 V 60 A



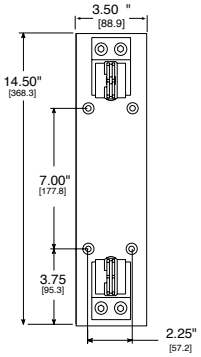
600 V 100 A



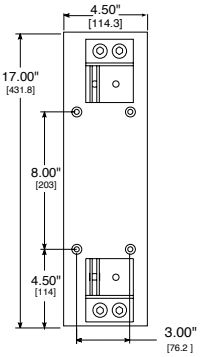
600 V 200 A



600 V 400 A



600 V 600 A



KLKD 10X38 MM MIDGET FUSE

The KLKD series is a fast acting, high interrupting capacity, current limiting type fuse. It is perfect for 600 Vdc applications such as photovoltaic systems.

Specifications

Voltage Rating: 600 Vac/dc
Interrupting Rating: AC: 100,000 A rms symmetrical; DC: 50,000A
Dimensions: 13/32" x 1½" (10x38 mm)
Approvals: Standard 248–14
UL Listed 3/10-30 A (File No: E10480)
CSA Certified 3/10-30 A (File No: LR29862)

Product Features

- UL Listed 600 Vdc maximum
- 50,000 Adc interrupting rating
- High performance in compact 10x38 mm midget size
- RoHS compliant and Pb free
- Touch-safe DIN-rail mount holder available
- PCB leaded version available in select amperages (Contact factory for availability)

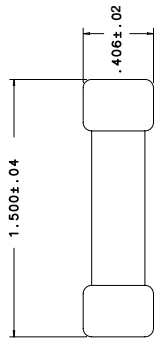
AMPERE RATING			
1/10	1	5	15
1/8	1½	6	20
2/10	2	7	25
¼	2½	8	30
3/10	3	9	
½	3½	10	
¾	4	12	

Ordering Examples:

PART#	SYSTEM #	AMPERAGE
KLKD.300	KLKD.300T	3/10
KLKD002	KLKD002.T	2
KLKD030	KLKD030.T	30
KLKD030R	KLKD030.HXR	30 (with PCB tabs)

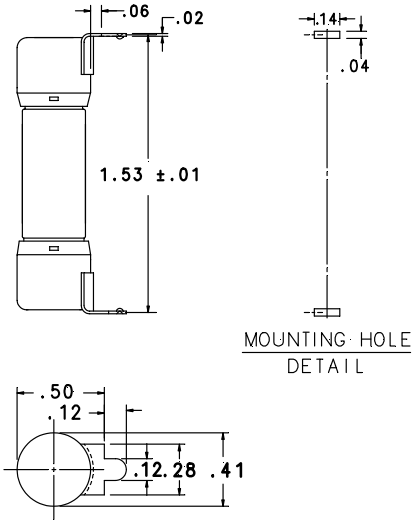
Dimensions: inches

CAD Drawings available for download at www.littelfuse.com



Dimensions: inches - PCB Version

CAD Drawings available for download at www.littelfuse.com



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PGR-2601 SERIES DC GROUND-FAULT RELAY

Description

The PGR-2601 is used to detect and limit harmful ground faults in ungrounded photovoltaic systems. This relay is typically installed in the controls enclosure of the central inverter. In addition, a PGG series Ground-Reference Module is mounted between the positive and negative DC bus inside of a central inverter.

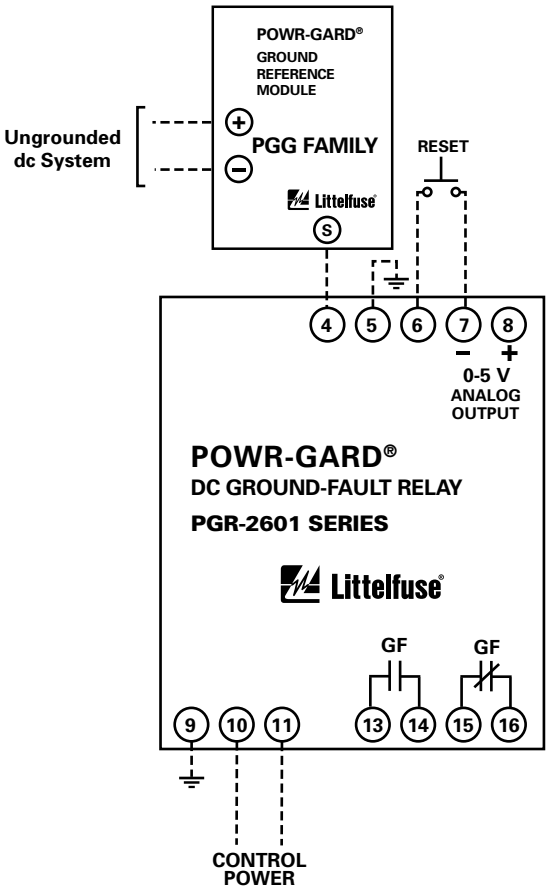
Applications

The PGR-2601 is used on ungrounded dc systems ranging from industrial 24-Vdc control circuits to 1000-Vdc photo-voltaic systems.

Features/Benefits

Sensitive 1-to 20-mA trip setting provides a wide range of low-level protection and 50-ms to 2.5-s trip delay allows coordinated protection.

- Form A and Form B ground-fault trip contacts
- Non-volatile trip memory retains trip state
- Analog output for external metering
- Selectable fail-safe or non-fail-safe operating modes
- No calibration required



Ordering Information

PART#	SYSTEM #	CONTROL POWER
PGR-2601-OD	PGR-2601-OD	9–36 Vdc
PGR-2601-OT	PGR-2601-OT	32–70 Vdc
PGR-2601-OU	PGR-2601-OU	75–275 Vac/dc 50/60 Hz

Note: The PGG1000 Ground Reference Module is a required accessory that connects the PGR-2601 to an ungrounded 1000 V bus.

Specifications

IEEE Device Numbers:	76 G
Input Voltage:	See Ordering Information
Dimensions:	**H** 75 mm (3.0"); **W** 55 mm (2.2"); **D** 115 mm (4.5")
Trip Level Settings:	1– 20 m A
Trip Time Settings:	0.05 s–2.5 s
Alarm Relay Contacts:	Isolated N.O. and N.C.
Contact Operating Mode:	Selectable fail-safe or non-fail-safe
Test Button:	Standard
Reset Button:	Standard
Communications:	Analog Output
Conformally Coated:	Optional
Warranty:	5 Year
Mounting:	DIN, Surface, Panel (optional)

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POWR-BAR™ SERIES BUS BAR SYSTEM

Safe distribution of power to multiple fuseholders in a compact design is a key objective for effective panel design. The Littelfuse UL508 bus bar system eliminates most wire terminations in a time-saving package. A power distribution block and associated conductors are no longer needed to combine multiple POWR-SAFE fuseholders. It can accommodate LPSM, LPSC and LPHV holders.

Features/Benefits

- Decreases wiring terminations
- Small footprint reduces space requirements
- Reduces assembly time
- Prevents accidental finger exposure
- Quick and safe method of changing fuse holder configurations
- Allows for future expansion
- Improves troubleshooting
- Eliminates power distribution block
- Can be cut down to optimal size
- RoHS compliant and Pb free

Specifications

Max Current:

CROSS SECTION (mm²)	18 mm²	25 mm²
End Fed	80 A	100 A
Center Fed	160 A	200 A

Max Operating Voltage: 600 Vac/dc
Conductor: Copper
Pitch: 17.8 mm
Approvals: UL508 file # E308478
Environmental: RoHS compliant and Pb free

Customization

This product is simple to integrate into AC and DC applications. It offers multiple pole configurations and amperage ratings to match the design requirements. Instructions are included for bus bar cutting for further customization.

Individual power feed lugs are available which allow termination at any point along the bus bar.

Ordering Information

3-PHASE AC, 18 mm²		DC, 25 mm²		POLES	LENGTH*
PART #	SYSTEM #	PART #	SYSTEM #		
1PH3P18MM	1PH3P18MM.V	1PH3P25MM	1PH3P25MM.V	3	50
1PH6P18MM	1PH6P18MM.V	1PH6P25MM	1PH6P25MM.V	6	104
1PH9P18MM	1PH9P18MM.V	1PH9P25MM	1PH9P25MM.V	9	155
1PH12P18MM	1PH12P18MM.V	1PH12P25MM	1PH12P25MM.V	12	208
1PH15P18MM	1PH15P18MM.V	1PH15P25MM	1PH15P25MM.V	15	270
1PH57P18MM	1PH57P18MM.V	1PH57P25MM	1PH57P25MM.V	57	1009

Note: Contact factory for 3-phase part number information.
** Length is shown in millimeters.*

Required Accessory

Power Feed Lug
Part# BB18
Ampere rating: 115 A
Wire: #10–1/0 AWG copper

Optional Accessories

Pole Protective Covers
Part# CTPT5
5 covers/bag

Endcaps
Part# EDCP42 for 1-phase
50 piece bag

Note: End caps are not needed for the DC configurations from the factory or if the copper bus is trimmed per the supplied instructions. Power feed lugs and protective covers should be ordered separately.

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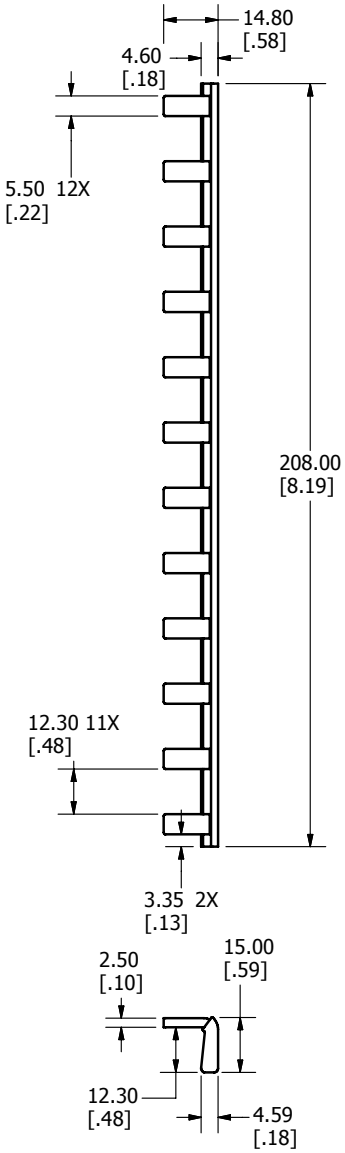
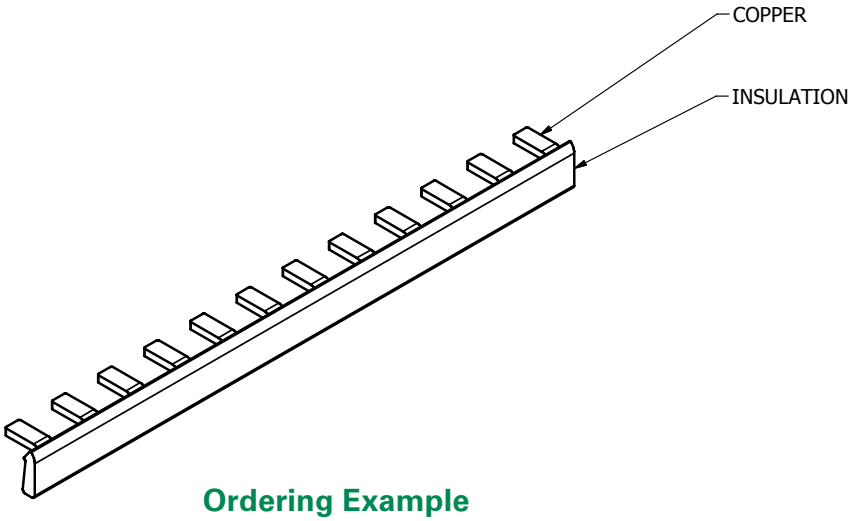
POWR-BAR™ SERIES BUS BAR SYSTEM

Only the overall length changes for each 1-phase part number. The dimensions below are for a DC application, 12-pole busbar.

Dimensions: mm [inches]

CAD Drawings available for download at www.littelfuse.com





Ordering Example

DC, 12-pole application using touch-safe fuseholders and 600 Vdc 12 A rated fuses.

QTY	PART#	DESCRIPTION
1	1PH12P25MM	Bus Bar
2	BB18	Power Feed Lug
12	LPSM001	Touch-Safe Fuseholder
12	KLKD012	600 Vdc, 12 A fuse

UP-LINK CLASS CC AND 10X38 MM MIDGET FUSEHOLDER

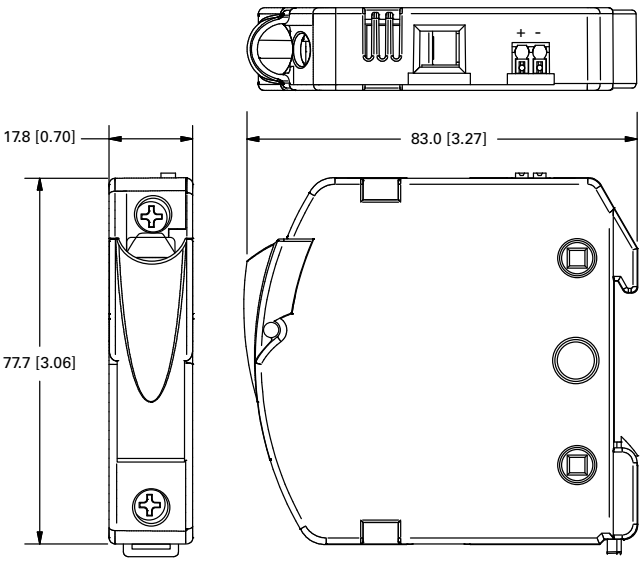
The Littelfuse Up-LINK solid-state dead-front fuseholder series provides remote fuse status functionality without the need to incorporate proprietary network protocols. It features two separate indication modes. The first mode provides remote indication for immediate notification to maintenance personnel monitoring their system. The second mode is local LED indication on the front of the holder.

Up-LINK provides fuse status notification that can be integrated with a PLC and help increase solar system efficiency by allowing for rapid deployment of maintenance personnel when necessary.

All 1, 2 and 3 pole Up-LINK holders have the same footprint as their corresponding Littelfuse LPSM, LPHV, Midget and LPSC Class CC dead-front fuseholders, making design upgrades easy in existing applications.

Dimensions: mm [inches]

CAD drawings available for download at www.littelfuse.com



Product Benefits

- Cost effective solution for remote blown-fuse indication
- Easily integrates with an existing PLC or system
- Utilizes reliable solid state circuitry
- Meets stringent IEC and UL Touch-Safe Standards to improve worker safety

Specifications

Voltage Rating:	100–600 Vac/dc
Amperage:	30 A max
SCCR:	200,000 Aac 20,000 Adc
Terminal Type:	Pressure Plate (torque 17.7 in-lbs)
Wire Range:	#8–#14 CU Stranded #10–#14 CU Solid
Flammability Rating:	UL 94V0
Approvals:	Class CC: UL Listed (File No. E14721) Midget: UL Recognized CSA

Remote Indicating Circuit

Output (open fuse):	Open Collector
Max Current Sink:	25 mA (28 Vdc Max)
Terminals:	Push In
Wire Range:	#16–#24 CU Solid/Stranded
Suggested Insulation Strip Length:	8 mm (0.31 in)

Ordering Information

CLASS CC		
POLES	PART#	SYSTEM#
One	LINK001C	LINK001C.Z
Two	LINK002C	LINK002C.Z
Three	LINK003C	LINK003C.Z

10X38 MM MIDGET		
POLES	PART#	SYSTEM#
One	LINK001M	LINK001M.Z
Two	LINK002M	LINK002M.Z
Three	LINK003M	LINK003M.Z

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QUICK-LINK I/O CONNECTORS

Littelfuse Quick-LINK connectors allow for Up-LINK daisy chaining. They reduce the number of PLC I/O ports that are required and save installation time and materials. With four different configurations, any number of Up-LINK fuseholders can quickly be connected together.

Ordering Information

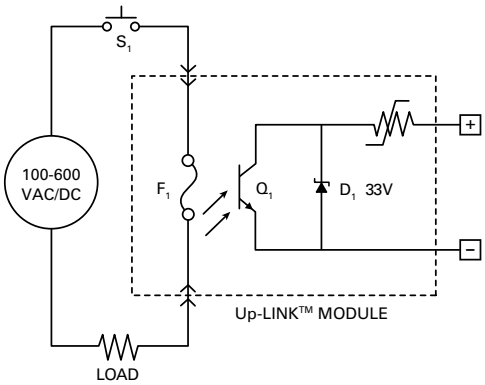
POLES	PART#	TYPE
Two	LK2M30B	Base
Two	LK2M30E	Extender
Three	LK3M30B	Base
Three	LK3M30E	Extender

QUANTITY NEEDED (BY PART NUMBERS)				
UP-LINK POLES	LK2M30B	LK3M30B	LK2M30E	LK3M30E
2	1			
3		1		
4	1		1	
5		1	1	
6		1		1
7		1	2	
8		1	2	1
9		1		2
10		1	2	1

Product Benefits

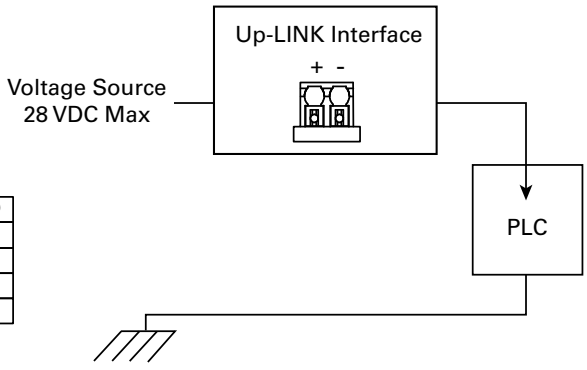
- Daisy-chain multiple Up-LINK fuseholders to a single I/O port
- Simple snap-in feature saves time and assembly costs while providing a more secure connection
- Four unique configurations allow parallel connection of any number of Up-LINK fuseholders
- Multiple wire connections have been reduced to only two
- UL Listed materials

Functional Schematics



Up-LINK Logic

S1	F1	Q1/LED
		OFF
		ON
		OFF
		OFF



TVS (TRANSIENT VOLTAGE SUPPRESSION) DIODES

What Are Voltage Transients?

Voltage transients are unwanted short duration surges of electrical energy. They may result from the sudden release of previously stored energy, and can come from internal and external sources. If the voltage magnitude of the transient is large enough, circuit component damage or malfunction of the circuit may result.

Transients can occur either repeatedly or as random impulses. Repeatable transients are frequently caused by the operation of other system components, such as motors, generators or the switching of reactive circuit components. Random transients, are often caused by lightning, electrostatic discharge (ESD), and other outdoor environment events.

SOURCE	VOLTAGE	CURRENT	RISE-TIME	DURATION
Lightning	25 kV	20 kA	10 µs	50 ms
Load Switching	600 V	500 A	50 µs	500 ms
Electromagnetic Pulse (EMP)	1 kV	300 kV	20 ns	1 ms
Electrostatic Discharge (ESD)	15 kV	30 A	1–5 ns	100 ns

Integration of Transient Voltage Suppression (TVS) components within solar system designs help to prevent the damaging effects of transient events, and assure compliance to safety and reliability standards.

TVS and Solar Inverter Protection

A PV solar system component particularly vulnerable to transient voltage effects is the power inverter. Its range of functions and direct connection to other system components enables vulnerability of transient voltage transfer. For example:

- Lightning-induced transient events may pass through the solar array and outdoor cabling to the inverter (and other sensitive electronic equipment in the path).
- Conversely, transients originating from the outside utility power grid may pass through the main circuit panel and cabling to the inverter.
- Startup of motorized equipment (such as power tools, tracking systems, fan motors) enable vulnerabilities produced by repeat load changes.
- Electrostatic discharge events generated internal and external to the system may pass between the inverter and sensitive electronic control equipment.

For these reasons, it is important to build surge withstand ability within the inverter as well at locations before damaging transients may reach sensitive equipment.

TRANSIENT VOLTAGE SUPPRESSION (TVS) DIODES

TVS Diodes are used to protect semiconductor components from high-voltage transients. Their p-n junctions have a larger cross-sectional area than those of a normal diode, allowing them to conduct large currents to ground without sustaining damage. Littelfuse supplies TVS Diodes with peak power ratings from 400W to 15kW, and reverse standoff voltages from 5V to 512V.

www.littelfuse.com/tvsdiode

Series Name[1]		Package Type	Reverse Standoff Voltage (V_R)	Peak Pulse Power Range [2] (P_{PP})	Peak Pulse Current (I_{PP} 8x20µs)	Operating Temperature	HF	RoHS
SURFACE MOUNT - STANDARD APPLICATIONS (400-5000W):								
SMAJ		DO-214AC	5.0-440	400W	Not Applicable	-85° to +302° F (-65° to +150° C)	•	•
P4SMA			5.8-495	400W			•	•
SACB		DO-214AA	5.0-50	500W			•	•
SMBJ			5.0-440	600W			•	•
P6SMB			5.8-495	600W			•	•
1KSMB			5.8-136	1000W			•	•
SMCJ		DO-214AB	5.0-440	1500W			•	•
1.5SMC			5.8-495	1500W			•	•
SMDJ			5.0-170	3000W			•	•
5.0SMDJ			12-170 (uni-directional) 12-45 (bi-directional)	5000W			•	•
AXIAL LEADED - STANDARD APPLICATIONS (400-5000W):								
P4KE		DO-41	5.8-495	400W	Not Applicable	-85° to +302° F (-55° to +175° C)	•	•
SA		DO-15	5.0-180	500W			•	•
SAC			5.0-50	500W			•	•
P6KE			5.8-512	600W			•	•
1.5KE		DO-201	5.8-495	1500W			•	•
LCE			6.5-90	1500W			•	•
3KP		P600	5.0-220	3000W			•	•
5KP			5.0-250	5000W			•	•
AXIAL LEADED - HIGH POWER:								
15KPA		P600	17-280	15000W	Not Applicable	-85° to +302° F (-55° to +175° C)	•	•
20KPA			20.0-300	20000W			•	•
30KPA			28.0-288	30000W			•	•
AK6		Radial Lead	58-430	NA	6000A	-67° to +347° F (-55° to +150° C)	•	•
AK10		Radial Lead	58-430	NA	10000A		•	•

(1) Detailed information about most product series listed here can be found on our web site by entering www.littelfuse.com/series/(Series Name).html
(2) For Maximum Clamping Voltage (V_C) please refer to electrical characteristics table within each series data sheet

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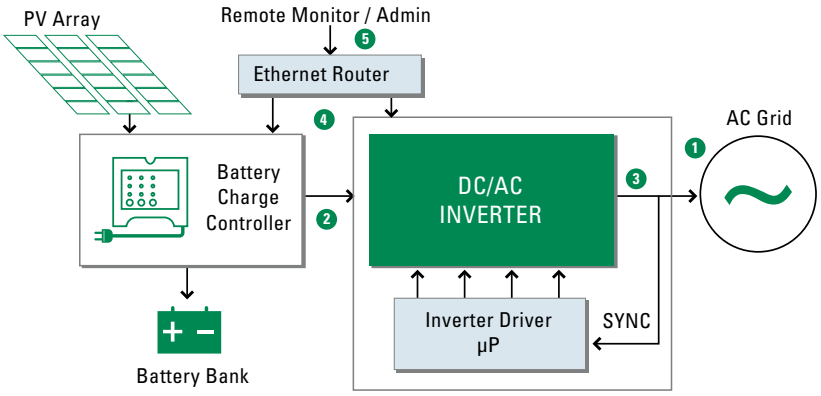
VARISTORS



Example: Grid-Connected Solar Inverter Configuration

Protection Application and Needs:

Description:
Microprocessor-controlled inverter with the AC output synchronized to the AC grid prevents over-discharging of the battery.

Threats:
- Power surges on AC or DC Input and AC Output
- Improper connections throughout, transient voltage
- ESD threats through the communication network

Solutions:
1. **AC Input:** Fuse / MOV
2. **DC Input:** DC-rated fuse / Unidirectional TVS.
3. **AC Output:** Fuse / TVS
4. **Outside Ethernet:** SEP series SIDACtor® device
5. **Local Ethernet:** MLV / SPA

Companion Solution:
- AC output may use MOV in less exposed environments

VARISTOR PRODUCTS

Varistors possess characteristics that divert transient currents away from sensitive components. Littelfuse offers a range of options including protection of higher energy applications.

www.littelfuse.com/varistor

Series Name[1]		Operating AC Voltage Range	Operating DC Voltage Range	Peak Current Range[2] (A)	Peak Energy Range (J)	Operating Temperature Range	Mount/ Form Factor	Disc Size	Agency Approvals					RoHS	Lead Free
									UL	CSA	VDE	CECC	OPL		
RADIAL LEADED MOV:															
TMOV®/ iTMOV®		115-750		6000-10000	35-480	-55 to +85°C	Radial Leaded	14, 20, 34mm	•	•	•	•		•	•
TMOV® 25S		115-750		20000	170-670			25mm	•					•	•
UltraMOV™		130-625	170-825	1750-10000	12.5-720			7, 10, 14 20, 25mm	•	•	•	•		•	•
UltraMOV™ 25S		115-750	150-970	22000	230-890			25mm	•	•	•	•		•	•
C-III		130-660		3500-9000	40-530			10, 14, 20mm	•	•	•			•	•
LA		130-1000	175-1200	1200-6500	11-360			7, 10, 14 20mm	•	•	•	•		•	•
ZA		4-460	5.5-615	50-6500	0.1-52			5, 7, 10, 14, 20mm	•		•	•		•	•
INDUSTRIAL HIGH ENERGY TERMINAL MOV:															
BA/BB		130-2800	175-3500	50000 70000	450-10000	-55 to +85°C	Screw / Clip Terminals	60mm	•					•	
DA/DB		130-750	175-970	40000	270-1050			40mm	•					•	•
HA		130-750	175-970	25000 40000	200-1050		Industrial Packaged Radial Leads	32, 40mm	•	•				•	•
TMOV34S®		115-750		40000	235-1050			34mm	•					•	•
HB34, HG34, HF34		130-750	175-970	40000	270-1050			34mm	•	•				•	•
DHB34		250-2800	330-3500	20000 70000	330-10000			34mm						•	
CA		250-2800	330-3500	20000 70000	330-10000		Bare Disc	60mm						•	

(1) Detailed information about most product series listed here can be found on www.littelfuse.com/series/(Series Name).html
(2) Not an applicable parameter for Crowbar devices

POWR-BLOKS™ DISTRIBUTION/SPLICER BLOCKS AND COVERS

POWR-BLOKS power distribution blocks offer a safe, convenient way of collecting or distributing power. The LX2xxx-xDIN series offers integral DIN-Rail mount and an optional hinged safety cover.

Applications

Typical applications in photovoltaic systems include solar string and array combiner boxes and inverters.

Connectors

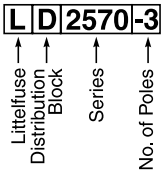
The POWR-BLOKS use box lug connectors that are designed for a single or solid class B or C stranded conductor.

Specifications

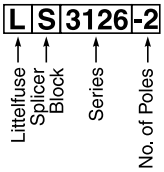
Voltage Rating:	600 V
Amperage:	Based on NEC® Table 310.16, using 75°C copper wire
Material:	Phenolic rated at 150°C and Thermoplastic rated at 125°C
Connector:	Standard: Highly conductive aluminum, tin plated Copper: Highly conductive copper, tin plated
Flammability Rating:	94 VO
Approvals:	UL Recognized (File No. E171395) CSA Certified (File No. LR700111)

Ordering Example

Distribution Block Example Part No.



Splicer Block Example Part No.

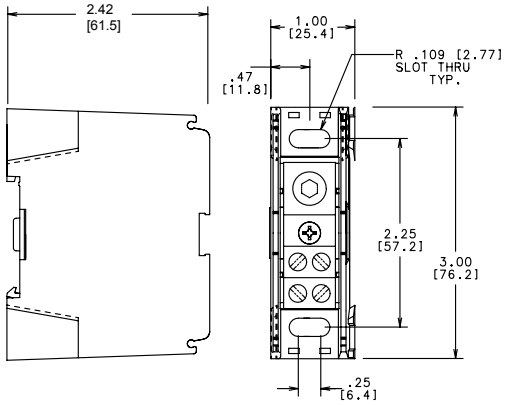


Note: Aluminum blocks can use copper or aluminum wire; copper blocks can only use copper wire.

Note: More configuration options are available online.

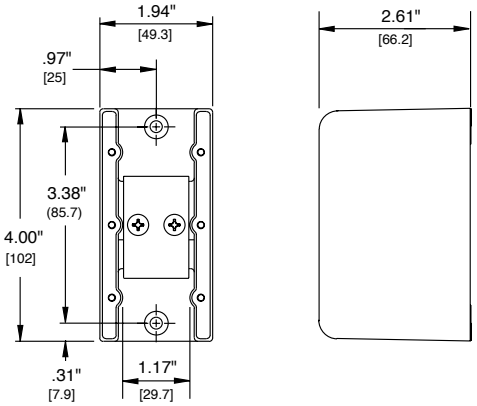
Dimensions: inches [mm]

LX2XXX-XDIN



1 POLE

LX3XXX



1 POLE

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Littelfuse's broad portfolio of circuit-protection products and services enhance the productivity and safety of electrical systems and end-user applications. Along with solar-rated products, Littelfuse offers current-limiting fuses to decrease Arc-Flash exposure, protection relays to improve productivity and safeguard equipment, and overvoltage suppression products to protect against transients.

> **Fuses and Fuseholders**

> **Protection Relays**

> **Solar-rated Products**

> **Varistors**

> **TVS Diodes**

> **Remote Indication Products**

WWW.LITTELFUSE.COM/GREEN

For over 30 years Littelfuse has helped OEM engineers, consulting engineers and end users select the right products to protect critical electrical equipment — supported by our full line of product catalogs and reference materials.

Fuses and Fuseholders Catalog Littelfuse offers a complete circuit protection portfolio of industrial power fuses, including time-saving indication products for an instant visual blown-fuse identification, even on de-energized systems.

Protection Relay Catalog The comprehensive line of electronic and microprocessor-based protection relays safeguard equipment and personnel to prevent expensive damage, downtime or injury due to electrical faults.

Up-LINK™ Product Brochure Up-LINK™ is a patented remote indication technology, incorporated in a growing number of fuseholders and other products that improve productivity by providing necessary information to monitoring sites.

Varistor Catalog Littelfuse offers industrial Metal Oxide Varistors (MOVs) to protect against transient voltage surges.

TVS Diodes Catalog Littelfuse offers silicon transient voltage suppression (TVS) devices, able to conduct large currents to ground without sustaining damage.

To view all Littelfuse product catalogs, visit our website at **www.littelfuse.com/catalogs**

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