Photovoltaic (PV)

Fuses, Holder

SET safe | SET fuse

Providing a Total Solution for High Standard Safety Circuit Protection

WHAT

CAN DO FOR YOU

MISSION

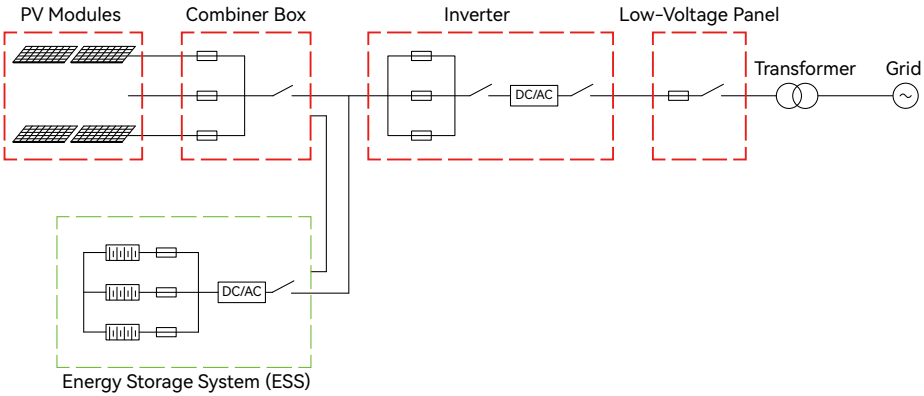
PROVIDING A TOTAL SOLUTION FOR HIGH STANDARD SAFETY CIRCUIT PROTECTION.

SETsafe | SETfuse was established in 2000 in Xiamen, China. We have a presence in more than 40 countries and regions recognising our products. Some of the world's 500 fortune companies are our valuable customers. We have pioneered, innovated & developed several products exclusively. Products are compliance with CCC, UL, cUL, VDE, TUV, PSE, KC, IATF 16949, ISO 9001, ISO 14001, ISO 45001, GB/T29490 certificates. We are in one of the core participating teams for revising and setting several national & international standards in the field of Circuit Protection.

SETsafe | SETfuse Key Markets：Telecom, Surge Protector, Power, New Energy, Lighting, Home Appliances, Mobile Devices, Medical, etc.

Photovoltaic (PV) System

The photovoltaic power system is mainly composed of PV modules, PV combiner boxes, Inverters, and transformer systems, some are equipped with energy storage systems. The early photovoltaic power systems only achieved 10% ~ 15% efficiency. Most of the system voltage is within 1000 VDC. With the advancement of technology, especially the rapid development in the past ten years, the monocrystalline silicon wafers [(p-type) + (n-type)] efficiency has been increased to 23% ~ 24%, and the main voltage of the power system is already 1500 VDC. And even higher 2000 VDC systems are being studied to continue to reduce the Levelized Cost of Energy (LCOE).



Photovoltaic + Energy Storage System DC Coupling Scheme

For system safety, IEC 62548 "Photovoltaic (PV) arrays—Design requirements" and the US NSI/NFPA 70 "National Electrical Code" and other related standards propose that the requirements of installation protectors such as DC PV fuses, etc. in front of combiner boxes and PV inverters.

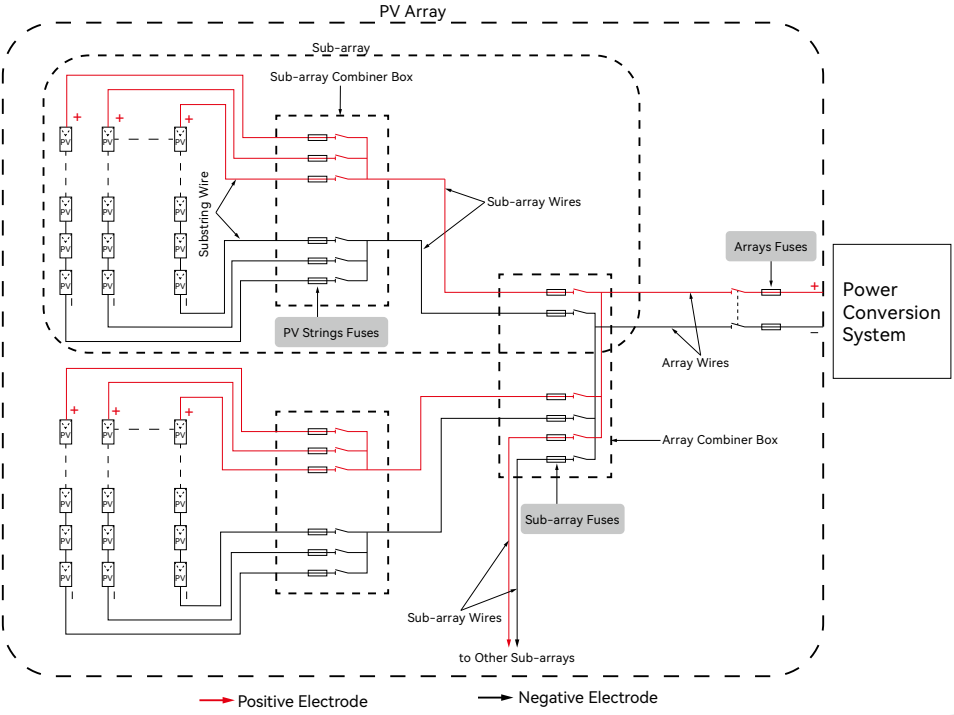
The main purpose of setting PV fuse protection in the combiner box

- ▶ Protect the short circuit between PV strings that may cause the overload fault of the wire.
- ▶ Protect the blowback current generated by the failure of inverter to harm the PV modules.
- ▶ The action of the fuse will identify the circuit fault and warn timely to request checking and handling

The main purpose of setting PV fuse protection in PV inverters, and DC panel

- ▶ Protect the short circuit between PV sub-arrays that may cause the fault current burning the PV sub-array cables and safety accidents.
- ▶ Protect the blowback current generated by the failure of inverter to harm the PV modules.
- ▶ The action of the fuse will identify the circuit fault and warn timely to request checking and handling

PV Power System Diagram



PV Fuses Selection Guide

Follow the steps below to select the rated size of the Fuse at the corresponding location.

Step 1

Confirm the fuse requirement information

1.1 PV module short circuit current $I_{SC\text{-}MOD}$

1.2 System maximum voltage U

1.3 Altitude

1.4 The maximum ambient operating temperature of the installation location

Step 2

Select the rated value range of the Fuse within 2000 meters above sea level under normal temperature conditions according to the standard requirements

2.1 For the sub-array combiner box:

Fuse rating I_n

2.1.1 PV fuses designed according to IEC 62548 standard requirements:

$1.5\ I_{SC\text{-}MOD} \le I_n \le 2.4\ I_{SC\text{-}MOD}$

2.1.2 PV fuses designed according to UL standards, according to the requirements of NASI/NFPA 70 "National Electrical Code" of "Photovoltaic System" (Chapter 690):

$I_n \ge 1.56\ I_{SC\text{-}MOD}$

2.2 For the PV array (setting in the PV inverter, DC panel, etc.)

Fuse Rating I_n

$1.25\ I_{SC\text{-}MOD} \le I_n \le 2.4\ I_{SC\text{-}MOD}$ (UL and IEC Fuses)

Step 3

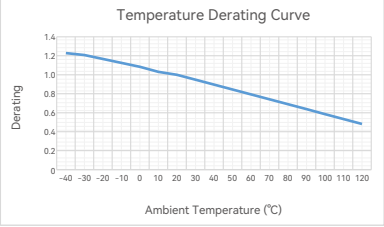
Analyze and calculate the correction factor for the rated value of the Fuse

3.1 The rated value of the fuse is determined according to standard under normal temperature conditions. In actual utilizing, its rated value needs to be corrected according to the ambient temperature and altitude:

Correction factor Y = temperature correction factor Y_1 × altitude correction factor Y_2

$$= \text{temperature correction factor } Y_1 \times \left[1 - \frac{(h-2000)}{20000}\right]$$

The temperature correction coefficient Y_1 is taken from the fuse temperature derating coefficient, which is obtained from the derating curve provided by the fuse manufacturer; the altitude correction coefficient Y_2 is calculated according to the empirical coefficient $\left[1 - \frac{(h-2000)}{20000}\right]$



Step 3

3.2 When the derating factor or derating curve is not available, the correction factor can be obtained by calculating the temperature correction function provided by the UL expert in early PV technology report:

Correction factor Y = Temperature correction factor Y_1 × Altitude correction factor Y_2

$$= (1.0997553 - 0.0026678X - 0.0000159X^2) \times [1 - \frac{(h-2000)}{20000}]$$

X: The value of the ambient temperature in degrees Celsius

h: The value of the altitude in meters

Note: The altitude correction factor Y_2 can also adopt the recommended value of the International Institute of Engineers standard IEEE C37.40-2003, see appendix.

Based on the above calculation and analysis, the correction factor of the rated value of the Fuse under the specific conditions is determined. Different correction coefficients will be obtained by taking different basic data above. In order to ensure a reliable selection, it is suggested that the coefficient obtained above is preferably used for subsequent correction.

Appendix: Altitude Correction Factor Y_2 (Institute of Electrical and Electronics Engineers IEEE C37.40-2003)

Altitude		Rated Current Correction Factor	Altitude		Rated Current Correction Factor
Meter	Feet		Meter	Feet	
1000	3300	1.00	3000	10000	0.96
1500	5000	0.99	3600	12000	0.95
2100	7000	0.98	4300	14000	0.93
2400	8000	0.97	4900	16000	0.92
2700	9000	0.96			

Step 4

Calculate the rated value range of the Fuse after considering the correction factor

For example, A-1 in step 2, the PV fuse designed according to the IEC standard, is revised according to the requirements of the IEC 62548 standard as:

$$\frac{1.5\ I_{SC\text{-}MOD}}{Y} \le I_n \le \frac{2.4\ I_{SC\text{-}MOD}}{Y}$$

Others can be calculated and determined with reference to examples.

Step 5

Select the rated specification of the Fuse

Select a fuse that meets the specifications calculated in step 4 and its rated voltage should not be lower than the system voltage.

If many fuses are installed together in a hermetic space, the selected specifications must have a sufficient margin to ensure reliable protection and meet the life requirements. If necessary, consult the supplier.

If you have any questions in the selection and application, please contact us and hope our professional experience can assist you.

Product

SETsafe | SETfuse LFP series PV fuses are specially developed for the PV systems to protect overload, short circuit and other current faults. It has low power consumption, good current cycle withstanding capacity. The operating temperature range of (-40 ~ 120) ℃, and it has good short-circuit protection and excellent current limiting ability, which can well protect related PV components and cables to improve system safety.

SETsafe | SETfuse can provide various types of PV fuses with rated voltages of 1000 VDC and 1500 VDC to meet the protection needs of PV systems at all levels. A variety of connection methods such as fuse base, bolt connection, PCB installation are all available. Welcome your inquiry.

Fuses, LFP10 Series

Specifications

Rated Voltage: 1000 VDC
Rated Current: (1 ~ 32) A
Time Constant: (1 ~ 3) ms
Breaking Capacity: 30 kA
Protection Category: gPV

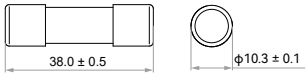
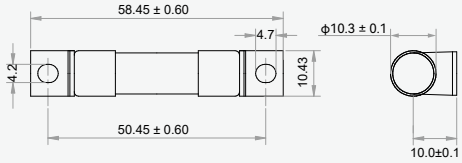
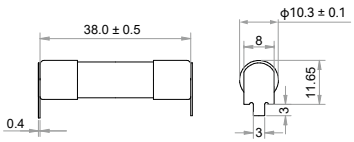
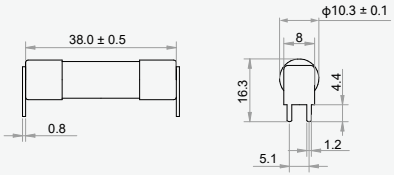
Ref. Standards

IEC60269-6
GB/T13539.6
UL248-19

Application

Combiner Boxes
Inverter
Benchtop Meter
Power Supply

Installation Size (mm)

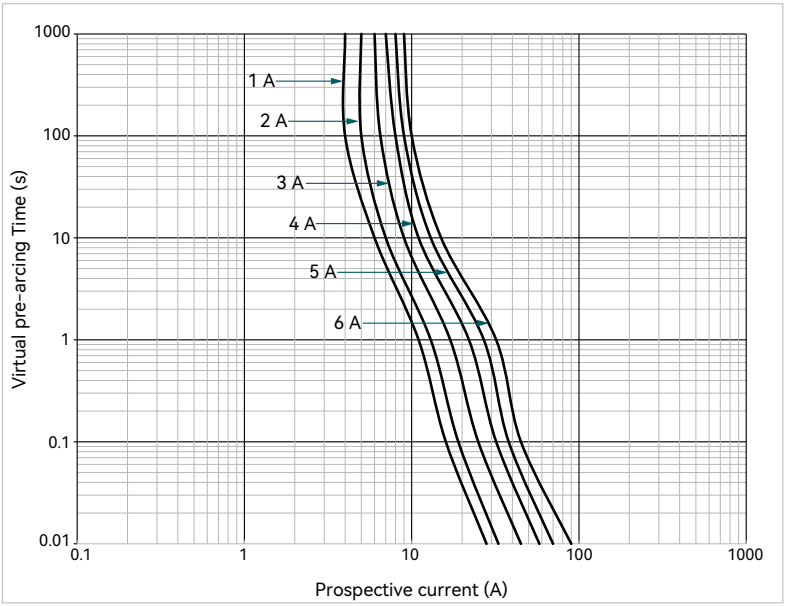
Installation Method	Schematic
CF	
BT	
PT1	
PT2	

Technical Data

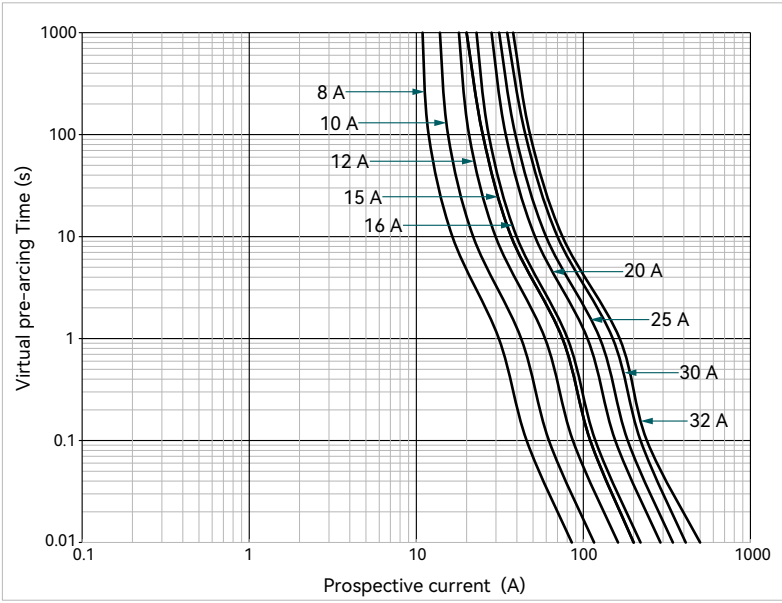
Model	Body Size (mm)	Rated Current (A)	Rated Voltage (VDC)	I^2t (A^2Sec) Pre-earcing	I^2t (A^2Sec) Total Power	I_n Watts Loss (W)	0.8 I_n Watts Loss (W)	Installation Method
LFP10-1A10	ϕ10 x 38	1	1000	0.9	1.9	0.70	0.6	CF , BT, PT1 , PT2
LFP10-2A10	ϕ10 x 38	2	1000	1.3	3.7	0.90	0.7	CF , BT, PT1 , PT2
LFP10-3A10	ϕ10 x 38	3	1000	4.4	12.1	1.78	1.4	CF , BT, PT1 , PT2
LFP10-4A10	ϕ10 x 38	4	1000	10.5	28.6	1.30	1.1	CF , BT, PT1 , PT2
LFP10-5A10	ϕ10 x 38	5	1000	20.0	55.0	1.70	1.4	CF , BT, PT1 , PT2
LFP10-6A10	ϕ10 x 38	6	1000	33.0	99.0	2.00	1.6	CF , BT, PT1 , PT2
LFP10-8A10	ϕ10 x 38	8	1000	1.9	41.0	1.70	1.4	CF , BT, PT1 , PT2
LFP10-10A10	ϕ10 x 38	10	1000	2.4	52.0	2.20	1.8	CF , BT, PT1 , PT2
LFP10-12A10	ϕ10 x 38	12	1000	4.2	93.0	2.90	2.4	CF , BT, PT1 , PT2
LFP10-15A10	ϕ10 x 38	15	1000	5.6	143.0	3.30	2.7	CF , BT, PT1 , PT2
LFP10-16A10	ϕ10 x 38	16	1000	7.4	165.0	3.80	3.1	CF , BT, PT1 , PT2
LFP10-20A10	ϕ10 x 38	20	1000	16.7	372.0	2.90	2.4	CF , BT, PT1 , PT2
LFP10-25A10	ϕ10 x 38	25	1000	33.5	747.0	5.10	4.1	CF , BT, PT1 , PT2
LFP10-30A10	ϕ10 x 38	30	1000	38.5	1129.0	4.50	3.6	CF , BT, PT1 , PT2
LFP10-32A10	ϕ10 x 38	32	1000	43.1	1038.0	6.05	4.8	CF , BT, PT1 , PT2

Example: LFP10-32A10CF means ϕ10 x 38 32 A 1000 VDC, CF Represents the terminal structure (installation mode), see the previous description for details.

LFP10 Time Current Curve (1 ~ 6) A



LFP10 Time Current Curve (8 ~ 32) A



Holder, CFH10 Series

SETsafe | SETfuse special base for CFH10 series PV fuse has the characteristics of compact structure, convenient replacement of fuses, safety protection, etc., suitable for 10 x 38 series fuse.

Specifications

Rated Voltage:	1000 VDC
Rated Current:	32 A
Max. Breaking Capacity:	1000 VDC 33 kA
Protection Class:	IP20
Copper Wire Gauge:	(0.8 ~ 8.4) mm²
Max. Acceptable Power:	3.6 W
Operating Temperature:	(-40 ~ 120) °C

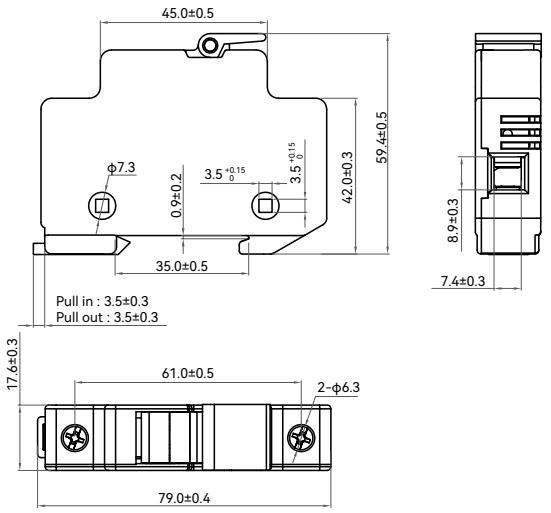
Ref. Standards

IEC60269-1
IEC60947-3
UL4248-19

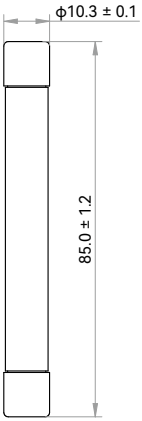
Installation Method

35 mm DIN-Rail Mounting
Wiring Torque: 2.8 Nm

Dimensions (mm)



Fuses, 10 x 85 mm 1500 VDC Series



Specifications

Rated Voltage: 1500 VDC
Rated Current: (2 ~ 32) A
Time Constant: <1.5 ms
Breaking Capacity: 30 kA
Operating Humidity: ≤75%
Protection Category: gPV

Ref. Standards

IEC60269-6
GB/T13539.6
UL248-19

Application

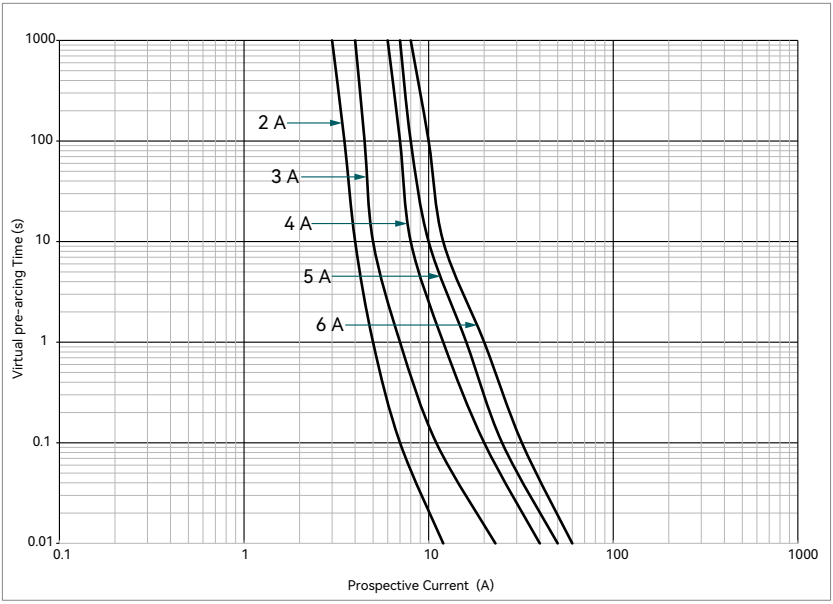
Combiner Box
Inverter
Benchtop Meter
Power Supply

Technical Data

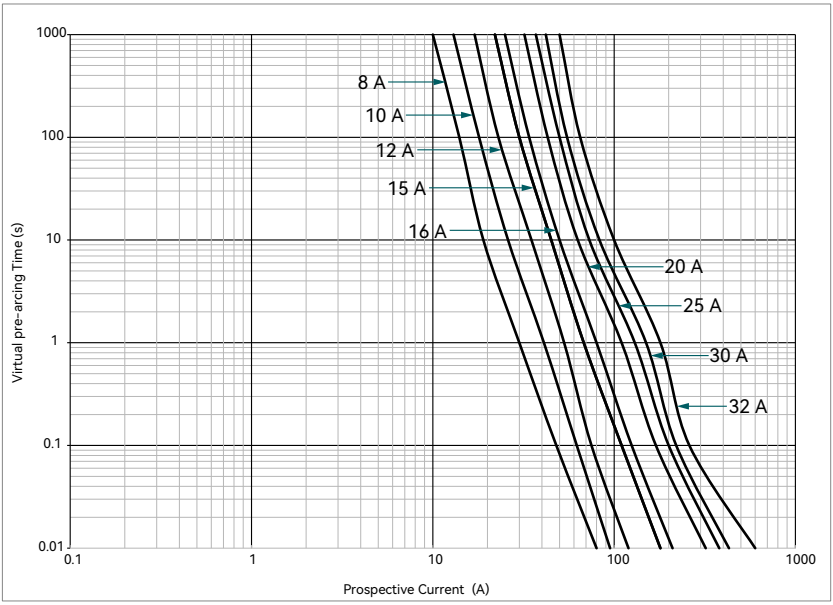
Model	Body Size (mm)	Rated Current (A)	Rated Voltage (VDC)	I^2t (A^2Sec) Pre-earcing	I^2t (A^2Sec) Total Power	I_n Watts Loss (W)	0.8 I_n Watts Loss (W)	Installation Method
LFP10L-2A15	ϕ10 x 85	2	1500	3	10	2.5	1.5	CF , BT
LFP10L-3A15	ϕ10 x 85	3	1500	8	22	2.7	1.6	CF , BT
LFP10L-4A15	ϕ10 x 85	4	1500	17	33	2.8	1.8	CF , BT
LFP10L-5A15	ϕ10 x 85	5	1500	35	63	2.9	1.85	CF , BT
LFP10L-6A15	ϕ10 x 85	6	1500	36	83	3.0	1.9	CF , BT
LFP10L-8A15	ϕ10 x 85	8	1500	39	110	3.2	2.3	CF , BT
LFP10L-10A15	ϕ10 x 85	10	1500	50	153	3.3	2.3	CF , BT
LFP10L-12A15	ϕ10 x 85	12	1500	17	226	3.5	2.1	CF , BT
LFP10L-15A15	ϕ10 x 85	15	1500	45	320	3.8	2.3	CF , BT
LFP10L-16A15	ϕ10 x 85	16	1500	50	380	4.2	2.4	CF , BT
LFP10L-20A15	ϕ10 x 85	20	1500	118	810	4.9	2.9	CF , BT
LFP10L-25A15	ϕ10 x 85	25	1500	202	1560	5.8	3.1	CF , BT
LFP10L-30A15	ϕ10 x 85	30	1500	280	1842	7.6	4.3	CF , BT
LFP10L-32A15	ϕ10 x 85	32	1500	330	2890	9.4	5.2	CF , BT

Example: LFP10L-32A15CF means ϕ10 x 85 32 A 1500 VDC, CF represents the terminal structure (installation mode), see the previous description for details.

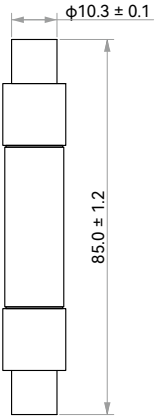
LFP10L Time Current Curve (2 ~ 6) A



LFP10L Time Current Curve (8 ~ 32) A



Fuses, 14 x 85 mm 1500 VDC Series



Specifications

Rated Voltage:	1500 VDC
Rated Current:	(2 ~ 50) A
Time Constant:	<1.5 ms
Breaking Capacity:	50 kA
Operating Humidity:	≤75%
Working Altitude:	≤3000 meter
Protection Category:	gPV

Ref. Standards

IEC60269-6
GB/T13539.6
UL248-19

Application

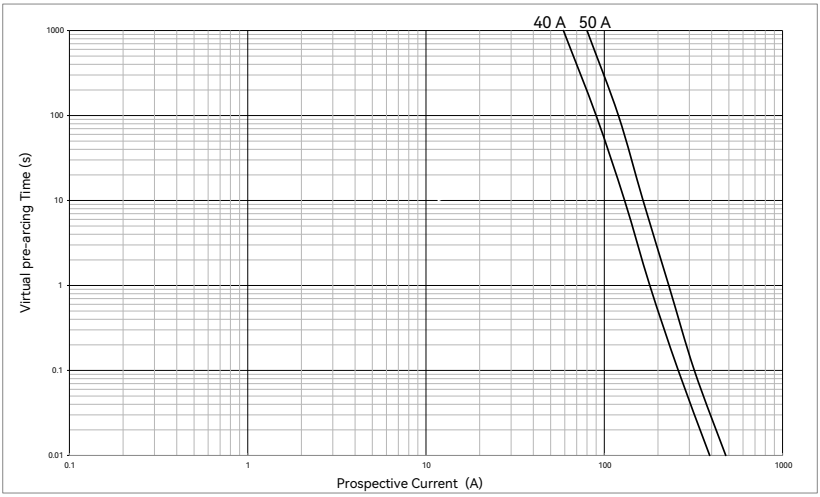
Combiner Box
Inverter
Benchtop Meter
Power Supply

Technical Data

Model	Body Size (mm)	Rated Current (A)	Rated Voltage (VDC)	I^2t (A^2Sec) Pre-earcing	I^2t (A^2Sec) Total Power	I_n Watts Loss (W)	0.8 I_n Watts Loss (W)
LFP14L-40A15	ϕ14 x 85	40	1500	235	1950	10.6	3.1
LFP14L-50A15	ϕ14 x 85	50	1500	586	4563	12.5	6.2

Example: LFP14L-50A15 means ϕ14 x 85 50 A 1500 VDC

LFP14L Time Current Curve (40 / 50 A)



Holder, CFH15 Series

SETsafe | SETfuse special base for CFH15 series PV fuse has the characteristics of compact structure, convenient replacement of fuses, safety protection, etc., suitable for 10X85 series fuse and some 14X85 series fuse such as our LFP14L series.

Specifications

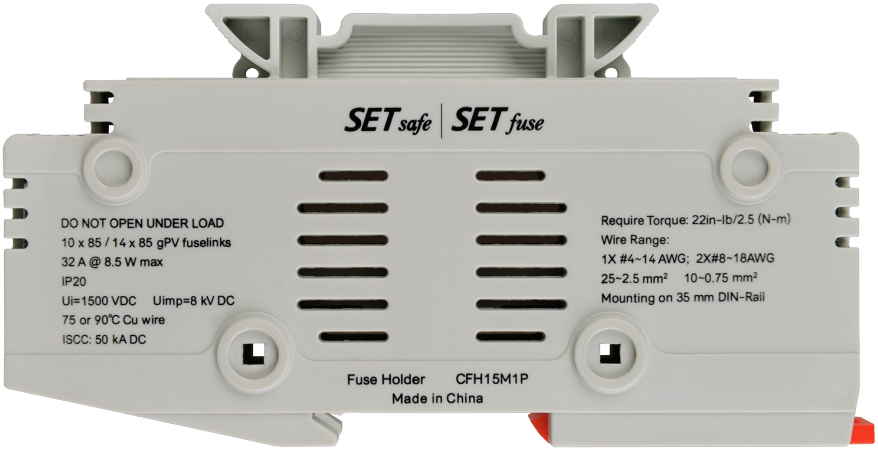
Rated Voltage:	1500 VDC
Rated Current:	32 A
Max. Breaking Capacity:	1500 VDC 50 kA
Protection Class:	IP20
Copper Wire Gauge:	(0.8 ~ 8.4) mm^2
Max. Acceptable Power:	8.5 W
Operating Temperature:	(-40 ~ 120) ℃

Ref. Standards

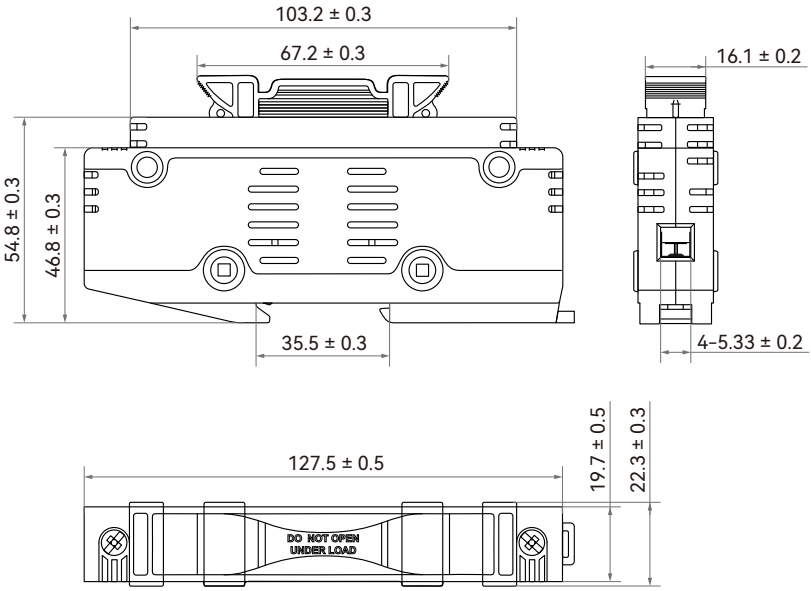
IEC60269-1
IEC60947-3
UL4248-19

Installation Method

35 mm DIN-Rail Mounting
Wiring Torque: 2.8 Nm



Dimensions (mm)



Over Temperature Protection

1 ATCO
Thermal-Link

2 DC-ATCO
Thermal-Link

3 OTCO
Thermal-Link

4 TMS
Thermal Protector

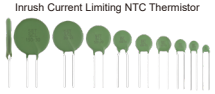
Over Current Protection

1 Mini Fuses
Miniature Fuses

2 TRXF
Thermal-Link & Fusing Resistor

3 TPR
Thermally Protected Resistor

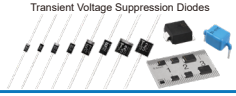
4 NTC
Inrush Current Limiting NTC Thermistor



5 LV Fuses
Low Voltage Fuses

Over Voltage Protection

1 TVS
Transient Voltage Suppression Diodes



2 GDT
Gas Discharge Tube

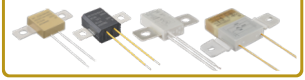
3 MOV
Metal Oxide Varistor

4 TFMOV
Thermal Fuse & MOV

5 TFMOV
Thermally Protected Varistors

Active Protection

1 iTCO
idea Thermal-Link



Over Voltage Protection

6 SPD-M
Surge Protective Device Module

7 SPD
Low-voltage Power Systems

8 SPD
PV System

9 SPD
Outdoor Lighting

10 SPD
Signaling Networks

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