

<b>ONE-PORT SURGE PROTECTOR FOR POWER SUPPLY USE</b>	MODEL <b>MAL</b>
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**BEFORE USE ....**

Thank you for choosing us. Before use, please check contents of the package you received as outlined below. If you have any problems or questions with the product, please contact our sales office or representatives.

**■ PACKAGE INCLUDES:**

Surge protector.....(1)  
Marking label.....(1) sheet

**■ MODEL NO.**

Check that model No. described on specifications matches the operational line voltage and other specifications as shown in 'PERFORMANCE' below.

**■ INSTALLATION / INSTRUCTION MANUAL**

This manual describes necessary points of caution when you use this product, including installation, connection and basic maintenance procedures.

**LIMITATION APPLICABLE TO MAL**

The MAL will protect electronics equipment from damage caused by direct or almost direct lightning by absorbing most of the surge voltages.

However, MAL may not be effective against certain extremely high voltages exceeding its discharge current capacity (25kA @10/350µsec. waveform) caused by a direct or almost direct hit by lightning.

The MAL must be installed according to this installation / instruction manual.

**PERFORMANCE**

**Response time:** ≤ 50 nanoseconds  
**Maximum discharge current:** 25kA (10/350 µsec.)

MODEL	Uc (AC) (V)	DISCHARGE VOLTAGE (V min)	Up (Vmax)
MAL-230x	255	400	1000
MAL-400A	440	650	2000

Uc = Maximum continuous operational voltage  
Up = Voltage protection level

Insulation resistance: ≥ 100MΩ with 500V DC  
(line to alarm output)  
Dielectric strength: 2000V AC @1 minute  
(line to alarm output)

**POINTS OF CAUTION**

**■ INSTALLATION**

**• DANGER!**  
MAL is an IEC 61643-1 class I product. Install the surge protector under following requirements.

- 1) When leading in the low voltage to the building which external lightning protection device such as a lightning rod and low voltage electronics equipment are connected with equipotential bonding.
- 2) In case the low voltage wiring is possible to be hit by the direct or almost direct lightning.

**• DANGER!**

- DO NOT perform an installation and wiring of the MAL during thunder storms.
- Be sure to house the MAL inside a metal enclosure for safety. Lightning is a natural phenomenon and this unit could receive surges exceeding the discharge withstand current rating. The MAL will be destroyed by such high lightning energy.
- Indoor use. We recommend to install the MAL in a position where to facilitate inspection and maintenance.
- DO NOT install the MAL where it is subjected to continuous vibration. Do not apply physical impact to the MAL.
- Environmental temperature must be within -5 to +55°C (23 to 131°F) and relative humidity within 30 to 90% RH in order to ensure adequate life span and operation.

**■ OPERATIONAL VOLTAGE**

- DO NOT connect a power source of which the operational voltage exceeds the MAL's maximum continuous operational voltage, Uc value indicated on the specification label at the front.
- Be sure that the peak voltage does not exceed 1.4 times the maximum continuous operational voltage. Distorted waveform may have extremely high peak voltage.

**■ DIELECTRIC STRENGTH TESTING**

- Conduct the dielectric strength test with all power supply wires removed. The MAL will start discharging at the described discharge voltage if a test voltage is applied with all power supply wires connected. It will result in an insulation failure.

**■ AND ....**

- We recommend that you keep spare MALs so that you can replace them quickly when necessary.

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## APPLICATIONS

- Direct lightning current captured by external lightning protection device is absorbed through the earth electrode to the ground. However, depending on the grounding resistance, the ground potential increases, destroying the insulation of low voltage electronics equipment and causing part of the direct lightning current to flow back to the power supply side. To prevent such dielectric breakdown, install the surge protector between grounding and power supply of low voltage electronics equipment to save high potential voltage applying to the low voltage electronics equipment. (For TT system, one-port SPD between neutral and protective earth (model: MALN) is required.)
- Installing to the low voltage inlet, protects the electronics equipment around the inlet from direct lightning entering to the low voltage line.
- Installing our class II surge protector (MAKF, MAKN, MAT2) at the distribution board 10 m or more away from the low voltage inlet, energy coordination is achieved.

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## FEATURES

### ■ CURRENT CAPACITY

- The one-port SPD can be used regardless of the load current.

### ■ SAFETY AND HIGH-DENSITY MOUNTING

- Using discharge tube filled with inert gas for discharge element. Sealing type, and no gas emission at operation. No safety clearance for fire prevention is needed. High-density mounting. DIN rail mounting.

### ■ HIGH DISCHARGE CURRENT CAPACITY AND LONG LIFESPAN

- The MAL is designed to withstand 25 kA surges. Low residual voltage and long lifespan design compared to class I varistor type surge protector.

### ■ PREVENTING ELECTRIC SHOCK

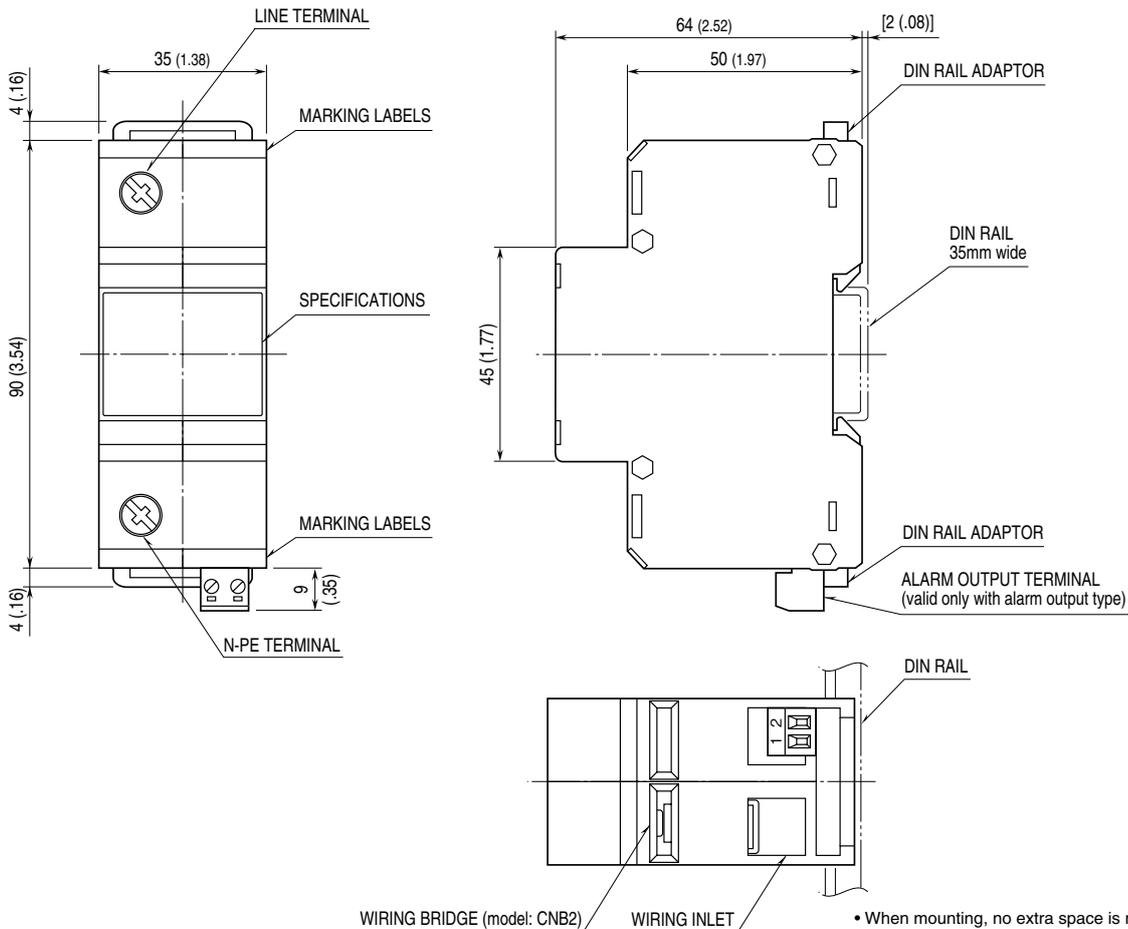
- The MAL's terminal section covered with an insulation enclosure has IP20 protection level to protect from an electric shock.
- The MAL is designed for use with press-to-screw terminals for a wide range of wire sizes from 8 to 35 mm<sup>2</sup>.

### ■ ACCESSORY

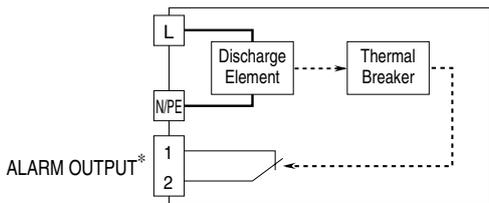
- Wiring bridge (model: CNB2) for easy cross-wiring for the neutral line is available.

## COMPONENT IDENTIFICATION & DIMENSIONS

Unit: mm (inch)



## CIRCUIT & CONNECTION DIAGRAM



\*Terminal block provided for the alarm output option.  
Schematic shows the operation in normal conditions.

## INSTALLATION

### ■ DIN RAIL MOUNTING

The MAL is mounted on a 35-mm-wide DIN rail, closely side by side. Position the upper hook on the DIN rail and push in the lower. When removing the base, push down the DIN rail adaptor utilizing a minus screwdriver and pull.

## TERMINAL CONNECTIONS

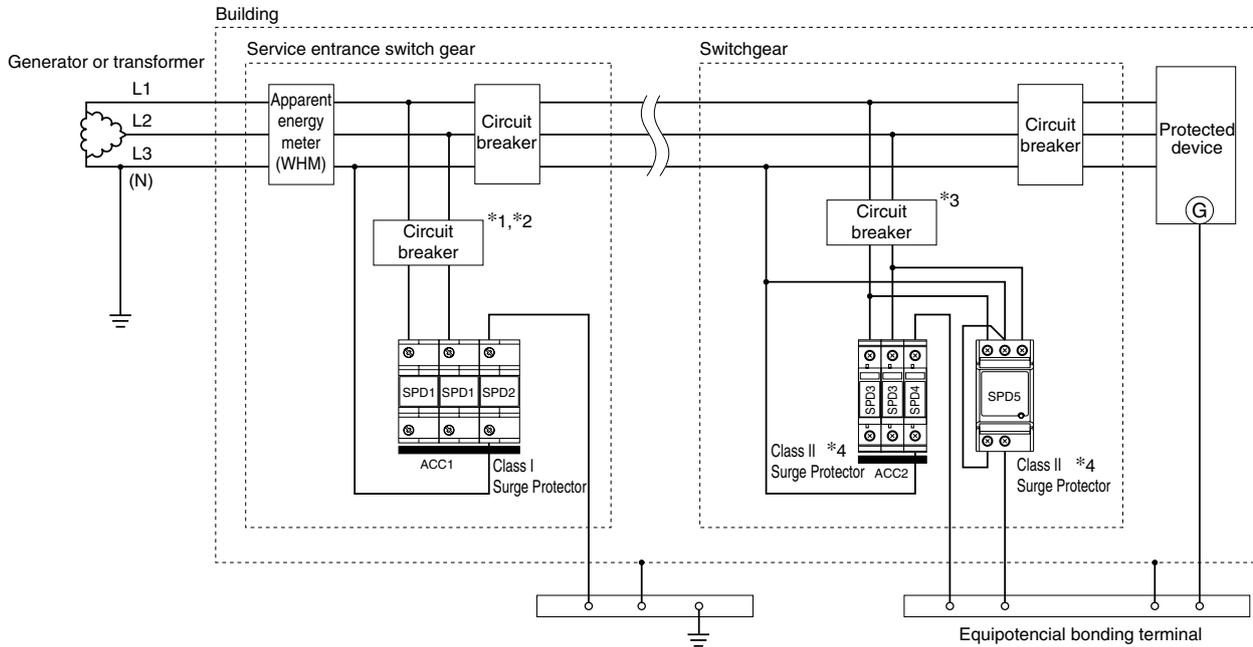
### INSTALLATION EXAMPLES: Three phase/3-wire (delta connection) TT Systems

Lightning is a natural phenomenon and this unit could receive surges exceeding the discharge withstand current rating.

Then, there is a possibility of burning out and result in short-circuits because of exceeding the processing capacity.

Upon to save a backup, the circuit breaker must be installed on the power supply side of the surge protector.

Molded-case circuit breaker (MCCB) or residual current circuit breaker with overcurrent protection (RCD) can be used.



- \*1. The circuit breaker's rating current must be of 150 A, and the rated interrupting capacity selected must be the greater between 30 kA or the highest amount of current that could be available in the circuit. For monitoring the operation of the circuit breaker we recommend also using the alarm switch (AL).
- \*2. The use of RCD with time-delay overcurrent protection is recommended upon to prevent unnecessary operation with surge current (Recommended sensitivity current rating: 30mA)
- \*3. Install an MCCB for backup saving of class II surge protector. Refer to the data sheets of the class II surge protector for details.
- \*4. If the service entrance switchgear and switchgear or protective device wiring distance is more than 10 m, install the class II surge protector on the power supply downstream. Class II surge protector is the combination of SPD3 and SPD4 or SPD5

POWER (e.g.)	Class I Surge Protector		Class II Surge Protector			ACCESSORY	
	SPD1	SPD2	SPD3	SPD4	SPD5	ACC1	ACC2
Three phase/3-wire 220V AC	MAL-230x	MALN-230	MAKF-240x	MAKN-220x	MAT2-2404xx	CNB2-5	CNB-3

■ CONNECTION EXAMPLES BY POWER SYSTEMS

POWER SYSTEM	TN Systems (common earth)				TT Systems (independent earth)			
Single-phase /2-wire								
	POWER (e.g.)	SPD1	SPD2	ACC	POWER (e.g.)	SPD1	SPD2	ACC
	Single-phase/2-wire 110V AC Single-phase/2-wire 220V AC	MAL-230x MAL-230x	- -	- -	- -	Single-phase/2-wire 110V AC Single-phase/2-wire 220V AC	MAL-230x MAL-230x	MALN-230 MALN-230
Single-phase /3-wire								
	POWER (e.g.)	SPD1	SPD2	ACC	POWER (e.g.)	SPD1	SPD2	ACC
	Single-phase /3-wire 220/110V AC	MAL-230x	-	CNB2-4	Single-phase /3-wire 220/110V AC	MAL-230x	MALN-230	CNB2-5
Three-phase /3-wire (delta connection)								
	POWER (e.g.)	SPD1	SPD2	ACC	POWER (e.g.)	SPD1	SPD2	ACC
	Three-phase/3-wire 220V AC	MAL-230x	-	CNB2-4	Three-phase/3-wire 220V AC	MAL-230x	MALN-230	CNB2-5
Three-phase /4-wire (star connection)								
	POWER (e.g.)	SPD1	SPD2	ACC	POWER (e.g.)	SPD1	SPD2	ACC
	Three-phase/4-wire 220V AC Three-phase/4-wire 400V AC	MAL-230x MAL-400A	- -	CNB2-5 CNB2-5	Three-phase/4-wire 220V AC Three-phase/4-wire 400V AC	MAL-230x MAL-400A	MALN-230 MALN-230	CNB2-7 CNB2-7

POWER SYSTEM	TN Systems (common earth)				TT Systems (independent earth)			
Three-phase /3-wire (V connection)  Three-phase /4-wire (V connection)								
	POWER (e.g.)	SPD1	SPD2	ACC	POWER (e.g.)	SPD1	SPD2	ACC
Three-phase/4-wire 220V AC	MAL-230x	-	CNB2-5	Three-phase/4-wire 220V AC	MAL-230x	MALN-230	CNB2-7	

\*1. Wiring only for three-phase/4-wire

## WIRING

### LEADWIRES

Conductor cross-section area: 8 to 35 mm<sup>2</sup> (stripped length 15 mm) for both the power and the ground lines. 14 mm<sup>2</sup> minimum is recommended.

### TORQUE

Tighten the screw terminals securely. Recommended torque is of 4.5 N·m.

### MARKING LABEL

Use the marking labels included in the product package to identify power lines. The labels are appropriate in size to be placed close to each terminal as designated in the external dimensions.

Nine labels are printed with typical markings.

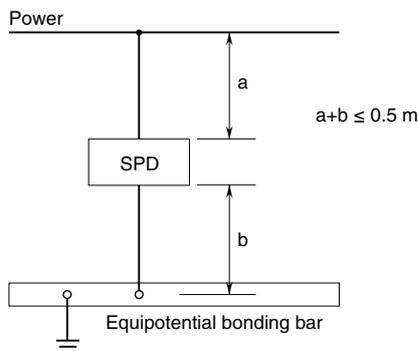
L1	L2	L3
N	E	G
PE	PEN	⏚

### WIRING BRIDGE

Wiring bridges for two units (model: CNB2-4), for three units (model: CNB2-5) and for four units (model: CNB2-7) are available for easy cross-wiring to the ground.

### WIRE LENGTH

Keep the wire length to the minimum for both the power source side and the ground side. Connect the surge protector and the protected device to the same equipotential bonding bar as following. The wire length between the branch point and the ground should ideally be less than 0.5 meters.

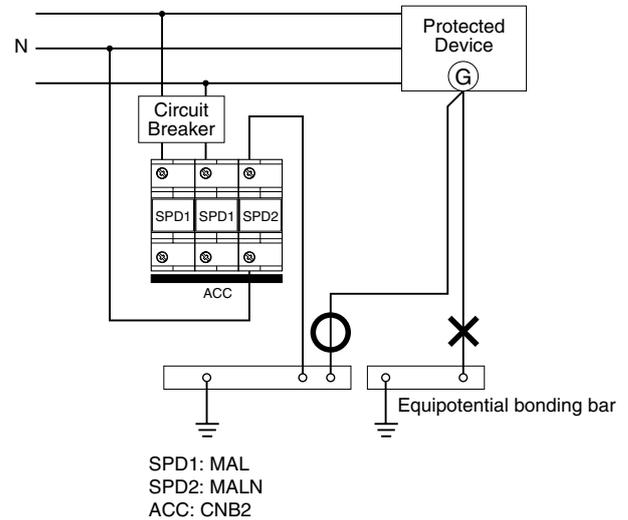


## GROUNDING

### COMMON GROUNDING WITH CROSS-OVER WIRE

Basically a common grounding with cross-wiring between the MAL and the protected device is recommended for adequate protection. Ground both the surge protector and the protected device to the same equipotentially bonding bar as following. If the protected device has no ground terminal, ground only the MAL.

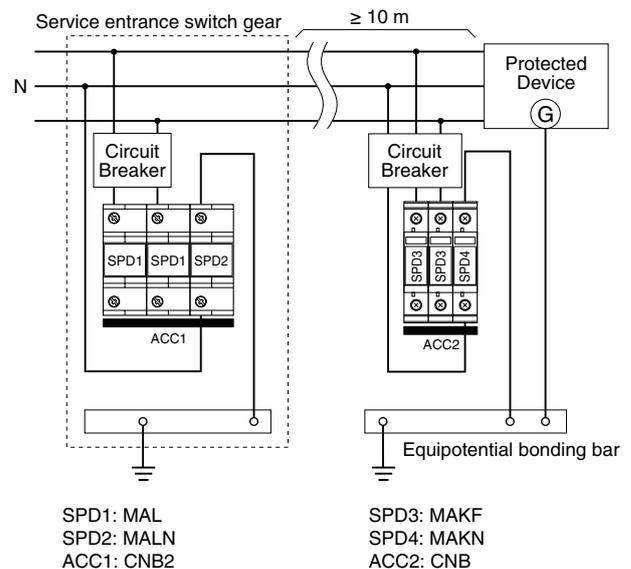
#### Single-phase/3-wire connection (TT system)



### INSTALLING THE DEVICES SEPARATELY

When installing the surge protector in a low-voltage inlet, grounding is likely to be independent if the protected device is not installed nearby. In this case, potential difference between the surge protector and the protected device lessens lightning protection function when thunder storming. When the wiring distance from the surge protector is 10 m or more, maximum surge voltage becomes high potential due to reflection. When the wiring distance exceeds 10 m, install the other class II surge protection near the protected device as following.

#### Single-phase/-wire connection (TT system)



## ALARM OUTPUT

When the MAL's discharge element gradually degrades, its increased leakage current causes high temperature. Optional alarm output is available to detect high temperature by thermal breaker and trips discrete signal. If the alarm output should be transmitted remotely via outdoor cables, a surge protector for signal line is required.

Choose a circuit breaker with an alarm output. Configure a logical addition sequence so that the alarm trips when booth or either of the MAL or the breaker alarm trips.

### ■ RELAY SPECIFICATIONS

Alarm output: Normal close relay  
 Short-circuited at normal operation  
 Open-circuited at abnormal operation  
 Rated load: 250V AC @0.5A (resistive load)

### ■ CONNECTION

Terminal: Euro type connector terminal  
 Applicable wire size: 0.2 to 1.5 mm<sup>2</sup>  
 Stripped length: 7 mm  
 Torque: 0.25 N·m

## CHECKING

### ■ WIRING

- Make sure that wiring is done as instructed in the connection diagram.
- Make sure that the Ground terminal (G) is connected to the metallic housing of protected equipment.
- Make sure that the Ground terminal (G) is grounded to earth.

## MAINTENANCE

Even lightning in remote locations could induce surges without our knowledge. Regular checking of the surge protector is important to find degradations in early stage, before and after the storm seasons, and whenever you experience a strong lightning storm.

DO NOT attempt checking or replacing the surge protector during a thunder storm for safety.

Checking procedure is as explained below:

### ■ CUTTING OFF POWER SUPPLY

Cut off the circuit breaker and confirm no power supply to prevent electric shock while maintenance.

### ■ CHECKING EXTERIOR

If discoloration or deformation is observed, replace with a new one immediately

### ■ RETIGHTENING

If the cables are loosened, retighten the terminal blocks.

### ■ CHECKING ALARM OUTPUT

Optional normal close relay output is open-circuited, replace with a new one immediately.

### ■ CHECKING OPERATION OF THE CIRCUIT BREAKER

When the circuit breaker operates repeatedly, the MAL may be degraded. Conduct following "CHECK WITH AN INSULATION TESTER".

### ■ CHECK WITH AN INSULATION TESTER

Remove all wires and check the discharging occurs across the terminals with an insulation tester. If an abnormality is proved, replace new one immediately.

#### • Checking insulation

Check insulation across the terminals to confirm no conduction.

MODEL	INSULATION RESISTANCE RANGE	DUE RESULT
MAL-230	250 V DC, 1000 MΩ	≥ 100 MΩ
MAL-400	500 V DC, 1000 MΩ	≥ 100 MΩ

#### • Checking discharging occurs

Check insulation across the terminals to confirm that the surge protector operates normally.

MODEL	INSULATION RESISTANCE RANGE	DUE RESULT
MAL-230	1000 V DC, 1000 MΩ	≤ 2 MΩ
MAL-400	1500 V DC, 1000 MΩ	≤ 2 MΩ