

# ONE-PORT SURGE PROTECTOR BETWEEN NEUTRAL AND PROTECTIVE EARTH

MODEL

**MAKN**

## BEFORE USE ....

Thank you for choosing M-System. 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 M-System's Sales Office or representatives.

The MAKN is designed for inductive surge protection, NOT for direct lightning surge exceeding the described discharge current capacity (40 kA @ 8/20  $\mu$ sec.).

### ■ PACKAGE INCLUDES:

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

### ■ MODEL NO.

Confirm Model No. marking on the product to be exactly what you ordered.

### ■ 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 M-RESTER

The M-RESTER will protect electronics equipment from damage caused by lightning by absorbing most of the surge voltages.

However, M-RESTER may not be effective against certain extremely high voltages caused by a direct or almost direct hit by lightning.

M-RESTER must be installed according to this installation / instruction manual.

## PERFORMANCE

**Response time:**  $\leq 100$  nanoseconds

**Maximum discharge current:** 40 kA (8/20  $\mu$ sec.)

**Nominal discharge current:** 20 kA (8/20  $\mu$ sec.)

**Leakage current:**  $\leq 100$   $\mu$ A at the discharge voltages listed in the table below.

MODEL	Uc (AC) (V)	DISCHARGE VOLTAGE (Vmin)	Up
			@ 6 kV (1.2/50 $\mu$ sec.), 5 kA (8/20 $\mu$ sec.) (Vmax)
MAKN-220	260	400	1500

**TOV value:** 1200 V/0.2 sec.

**Insulation resistance:**  $\geq 100$  M $\Omega$  with 500 V DC  
(N or PE to alarm output)

**Dielectric strength:** 2000 V AC @1 minute  
(N or PE to alarm output)

## POINTS OF CAUTION

### ■ INSTALLATION

#### • DANGER!

DO NOT install the MAKN at the inlet of the power source wiring or close to it. DO NOT ground the MAKN at the point common to an external lightning protection device such as a lightning rod. In both cases, the MAKN will be subject to the danger of direct lightning.

#### • DANGER!

DO NOT perform an installation and wiring of the MAKN during thunder storms.

- Be sure to house the MAKN inside a metal enclosure for safety. Even though the MAKN is capable of withstanding an induced discharge current expected in normal conditions, it is entirely possible to be hit by a certain strong lightning exceeding its designed capacity. It is also subject to a direct hit by a lightning. The MAKN will be destroyed by such high lightning energy.
- We recommend to install the MAKN in a position where the check window is clearly visible to facilitate inspection and maintenance.
- DO NOT install the MAKN where it is subjected to continuous vibration. Do not apply physical impact to the MAKN.
- 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.

### ■ HIGH TEMPERATURE

#### • DANGER!

Generally, at TT system, N (power supply side earth) and PE (equipment side earth) have equipotentiality. However, problems on power supply facility might generate potential difference. Thus may make the head element surface hot. DO NOT touch the sides of the head element module when you remove it from the base for maintenance. Hold instead the grips at the top and bottom of the module.

- Observe at least 20 mm (0.8 inch) between the MAKN and other devices in order to prevent the high temperature from affecting them.

### ■ OPERATIONAL VOLTAGE

- Please confirm the expected over-voltage between N to PE due to the earth fault at low side does not exceed the maximum working voltage of MAKN.

### ■ DIELECTRIC STRENGTH TESTING

- Remove the head element from the base before conducting a dielectric strength test. The MAKN will start discharging at the described discharge voltage if a test voltage is applied with the head module connected to the base. It will result in an insulation failure.
- Be sure to return the head element and fasten securely after the test.

### ■ AND ....

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

## APPLICATIONS

- Provides primary protection of a power supply system in a distribution switchboard.
- Protects electric devices such as isolation transformers, heaters, electromagnetic contactors, motors.
- Protects electric devices of high load current.

Low-voltage equipment such as computers, measuring instruments, transmission devices, which generally incorporates semiconductor circuitries, is especially vulnerable against lightning surges. We recommend to use combination type surge protectors incorporating serial impedance (M-System model examples: MAX, MMA, MAH)

Please use it combined with One-port surge protector for power supply (model: MAKF).

MAKN protects between N to PE of TT system. MAKF protects between L to N and L to L. (N: power supply side earth PE: equipment side earth)

## FEATURES

### ■ CURRENT CAPACITY

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

### ■ HIGH DISCHARGE CURRENT CAPACITY

- The MAKN is designed to withstand 40 kA surges twice (test waveform 8/20  $\mu$ sec.). High design standard compared to normally induced surge current level of 1 kA.

### ■ TOV-proof

- It doesn't ignite even in case of TOV (temporary over-voltage between N to PE caused by the high-voltage system's earth fault)

### ■ THERMAL BREAKER

- The failure is notified visually by the check window color change and remotely by an alarm contact.

### ■ PREVENTING ELECTRIC SHOCK

- The MAKN's terminal section covered with an insulation enclosure has IP20 protection level to protect from an electric shock.
- The MAKN is designed for use with ring shape solderless terminals for a wide range of wire sizes from 2 to 14 mm<sup>2</sup>.

### ■ KEYED PIN CONNECTION

- MAKN is made to be used with One-port surge protector for power supply (model: MAKF), however, the wrong insertion of the head element is prevented with the voltage identification key. The accident that miss-inserts the MAKN head element in the base of MAKF can be prevented.

### ■ EASY MAINTENANCE

- The pin-mounted head element can be easily separated from the base for easy regular inspection, replacement and insulation tester testing.
- The power line is not interrupted when the head element is removed.

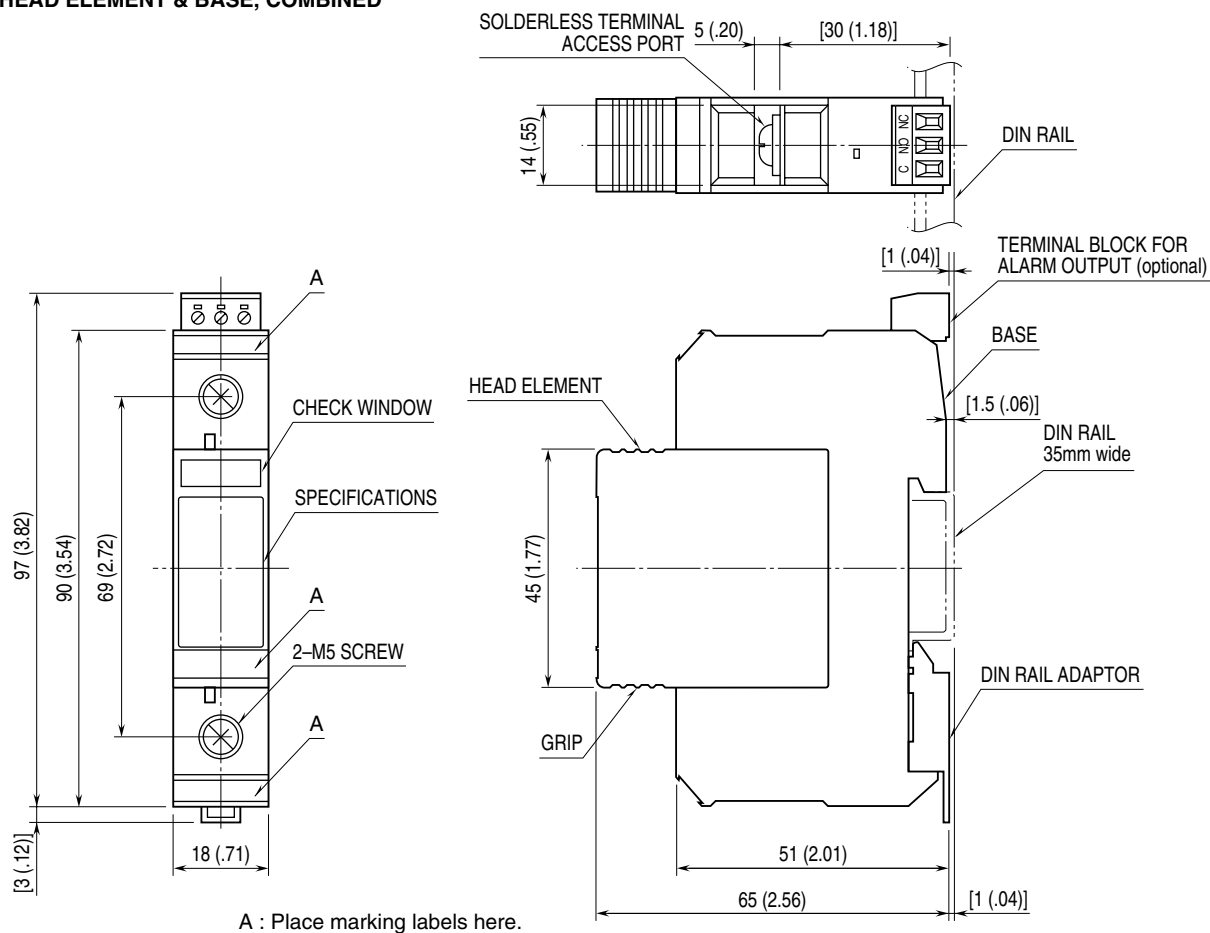
### ■ COMPACT DESIGN

- The thin and compact modules can be mounted side by side in high density on a DIN rail.
- Wiring bridge (model: CNB) is available to easily cross-wire multiple modules to the ground.
- Single mount adaptor (model: MBS) to install the MAKN on the wall is available.

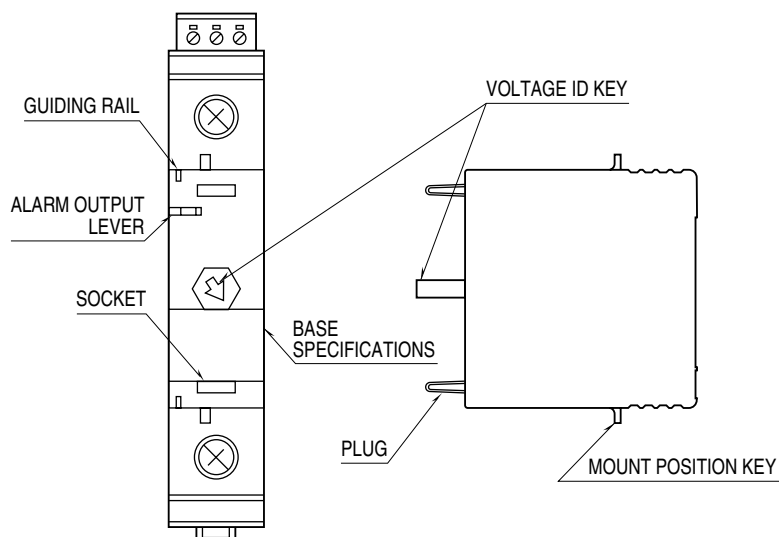
## COMPONENT IDENTIFICATION & DIMENSIONS

Unit: mm (inch)

### ■ HEAD ELEMENT & BASE, COMBINED



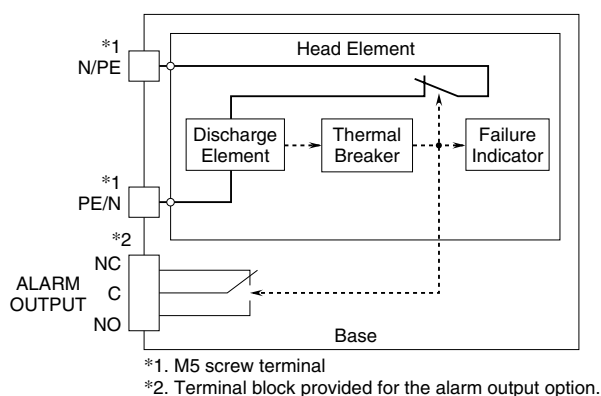
### ■ HEAD ELEMENT & BASE, SEPARATED



### ■ MARKING LABELS (terminal identifiers, tag name labels)

L1	L2	L3
N	E	G
PE		

## CIRCUIT & CONNECTION DIAGRAM



## INSTALLATION

### ■ DIN RAIL MOUNTING

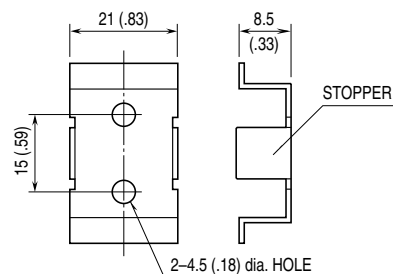
The MAKN is mounted on a 35-mm-wide DIN rail, closely side by side. Set the base so that its DIN rail adaptor is at the bottom. Position the upper hook at the rear side of base on the DIN rail and push in the lower.

If the terminal block for alarm output at the top hits the wall and blocks the upper hook to reach the DIN rail, mount the MAKN without the terminal block and then replace it. When removing the base, push down the DIN rail adaptor utilizing a minus screwdriver and pull.

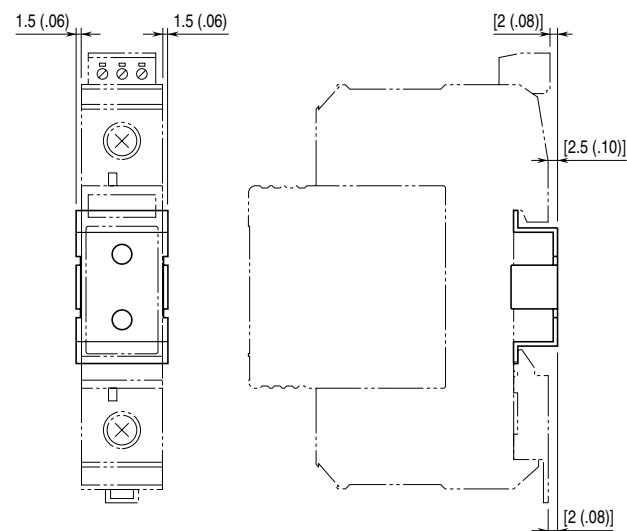
### ■ WALL MOUNTING

Wall mounting is available using the Single Mount Adaptor (model: MBS). The MAKN can be mounted to the adaptor in the same manner as to the DIN rail. Refer to the drawings below (Unit: mm (inch)) when mounting the MBS to the wall.

### ■ MBS



### ■ MBS ATTACHED TO THE MAKx



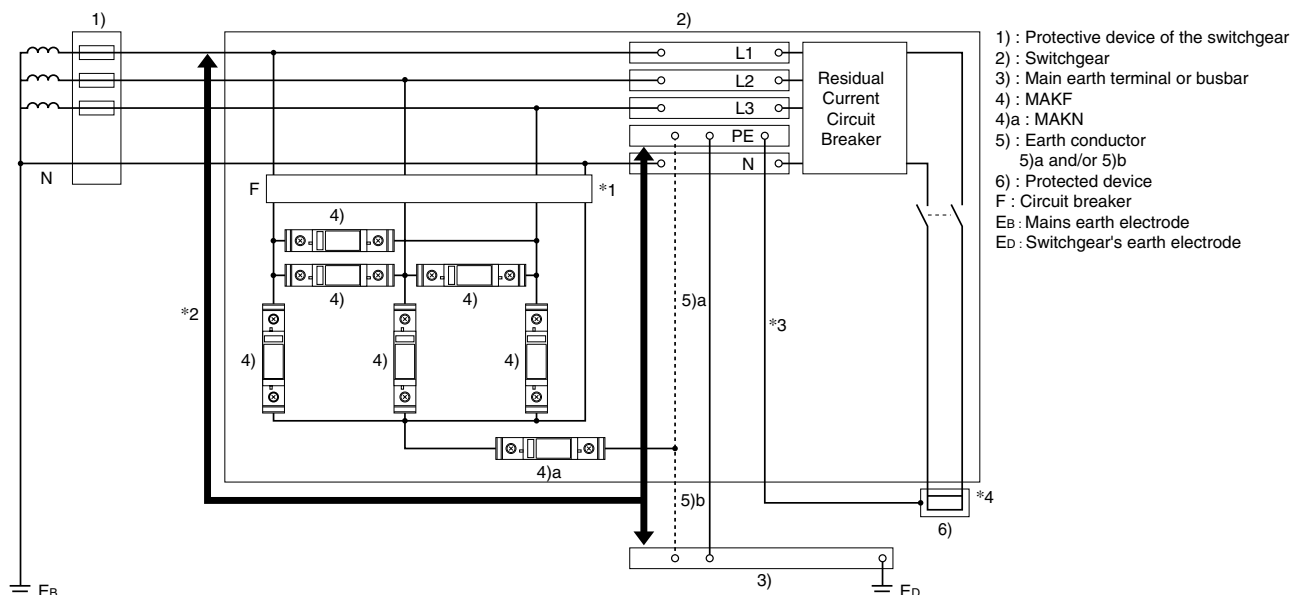
## CONNECTION PROCEDURE

### ■ INSTALLING CIRCUIT BREAKERS

The MAKN incorporates a thermal breaker, which separates the discharge element from the power line upon detecting discharge element's overheating due to problems in the power facility through a consecutive over-voltage addition of MAKN.

### ■ INSTALLATION EXAMPLES

When power supply side (N) and equipment side (PE) are earthed independently (TT system), install this unit between N and PE. Install one-port surge protector for power supply (model: MAKF) between L to L and L to N. The installation procedure of the three-phase/4-wire system is shown below as an example.



\*1. The circuit breaker must be installed. Molded-case circuit breaker (MCCB) or residual current circuit breaker with overcurrent protection (RCD) can be used.

The rated interrupting capacity of the circuit breaker must be greater than the highest amount of current that could be available in the circuit.

Install MCCB (rated current 20 – 30A) that has element for each phase. Or RCD with protection from nuisance tripping against transit voltages type or time-delay overcurrent protection type is recommended.

Recommended sensitivity current rating: 30mA

\*2. Cable length between the branch point and the earthing: 0.5 meters or less recommended

\*3. The protected device's metal enclosure must be cross-wired to the earth terminal of the MAKN. If the protected device has no earth terminal, earth only the MAKN.

\*4. In order to protect an electronic circuit such as measuring equipment or communication equipment, we recommend to use surge protectors which have serial impedance incorporated such as M-System's models MAX, MMA or MAH.

### ■ CIRCUIT BREAKER REQUIREMENTS

Additional requirements are listed below:

- Be completely sure to install an MCCB with head elements in each phase (rated current 20 to 30 A)
- The rated interrupting capacity of the MCCB must be greater than the highest amount of current that could be available in the circuit. Or RCD with protection from nuisance tripping against transit voltages type or time-delay overcurrent protection type is recommended.
- Recommended sensitivity current rating: 30 mA
- When using alarm output of MAKN and MAKF, choose the breaker with the alarm output. Please, install the logical OR between MCCB alarm output and surge protector's thermal breaker.

### ■ INSTALLATION ON THE LINES

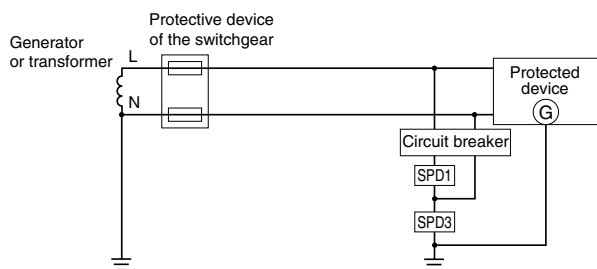
In general, lightning surges hit electric devices in common mode to the ground. As a result, transient voltage appears between the power line and the ground. The basic use of the MAKN is an installation between the power line and the ground.

However, if there is an imbalance of the power source impedance, transient voltage may appear also between the power lines.

## CONNECTION EXAMPLES BY POWER SYSTEMS

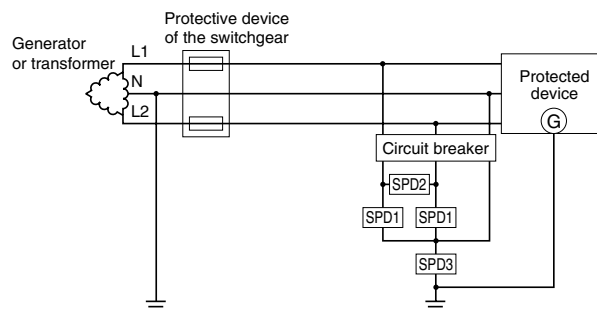
Wiring connection examples are shown below according to system configurations. For detailed explanations on circuit breakers mentioned in the diagrams, please refer to 'CIRCUIT BREAKER REQUIREMENTS' mentioned above.

### Single-phase/2-wire connection



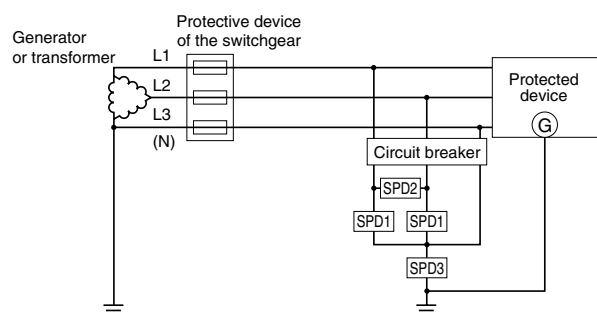
POWER SYSTEM (e.g.)	SPD1	SPD3
Single-phase/2-wire, 110V AC	MAKF-240x	MAKN-220x
Single-phase/2-wire, 220V AC	MAKF-240x	MAKN-220x

### Single-phase/2-wire (three-phase delta connection earthed in the middle of phases) or single-phase/3-wire connection



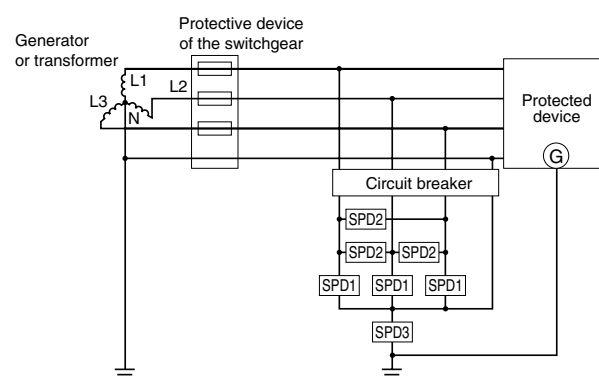
POWER SYSTEM (e.g.)	SPD1	SPD2	SPD3
Single-phase/2-wire, 110V AC	MAKF-240x	MAKF-240x	MAKN-220x
Single-phase/3-wire, 220/110V AC	MAKF-240x	MAKF-240x	MAKN-220x

### Three-phase/3-wire connection (delta)



POWER SYSTEM (e.g.)	SPD1	SPD2	SPD3
Three-phase/3-wire, 220V AC	MAKF-240x	MAKF-240x	MAKN-220x

### Three-phase/4-wire connection (star)



POWER SYSTEM (e.g.)	SPD1	SPD2	SPD3
Three-phase/4-wire, 220V AC	MAKF-240x	MAKF-240x	MAKN-220x
Three-phase/4-wire, 440V AC	MAKF-400x	MAKF-400x	MAKN-220x

## WIRING

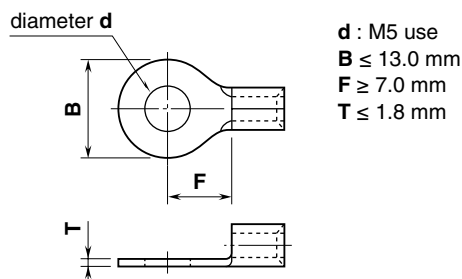
### LEADWIRES

Conductor cross-section area: 5.5 mm<sup>2</sup> minimum for both the N and PE. However, a local industrial standard requirement for wiring should take precedence.

### SOLDERLESS TERMINAL

Applicable ring tongue terminal is as indicated below. In order to ensure IP20 protection (IEC 50529) with a solderless terminal without insulation sleeve, cover the terminal with a marking tube to prevent direct touching by a hand.

#### Applicable Solderless Terminal Size



### POLARITY

Two screw terminals are provided. Connect either side to the power source side or the ground side.

### TORQUE

Tighten the screw terminals securely. Maximum allowable torque is of 2.5 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.

Seven labels are printed with typical markings, and two are blank for your own markings.

Blank labels may be used to identify the head element.

L1	L2	L3
N	E	G
PE		

### WIRING BRIDGE

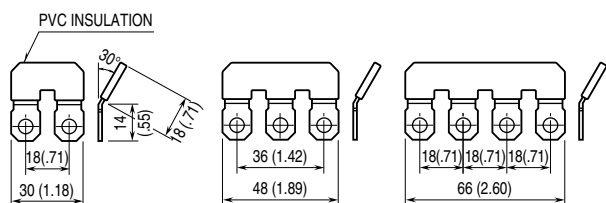
Wiring bridges for two poles (model: CNB-2), for three poles (model: CNB-3) and for four poles (model: CNB-4) are available for easy cross-wiring to the ground.

External dimensions are as shown below (Unit: mm (inch)).

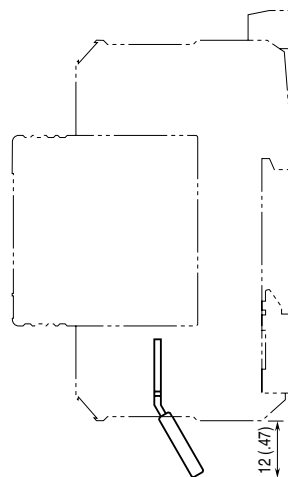
#### CNB-2

#### CNB-3

#### CNB-4



### CNB ATTACHED TO THE MAKx



### WIRE LENGTH

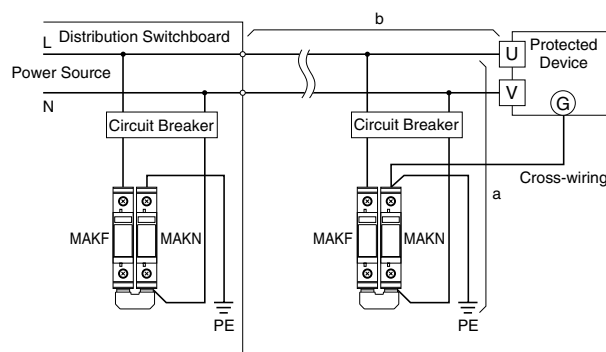
Keep the wire length to the minimum for N and PE. An example with single-phase/two-wire configuration is shown below. The wire length between the branch point and the ground ('a' in the figure) should ideally be less than 0.5 meters. Extra long wires should not be bundled in coils, but be cut to the minimum required length.

### PROTECTING LOW-VOLTAGE EQUIPMENT

The MAKN, one-port surge protector, is most suitable to protect electric devices such as isolation transformers, heaters, electromagnetic contactors, motors. On the other hand, combination type surge protectors incorporating serial impedance (M-System model examples: MAX, MMA, MAH) are suitable to protect low-voltage electric devices such as computers, measuring instruments, transmission devices.

However, when the distance between the distribution switchboard and the protected device ('b' in the figure) is longer than 20 or 30 meters, the reactance of the wires would function as serial impedance in the combination type surge protectors. In this case, the overall protection performance should be augmented by one-port surge protectors installed inside the switchboard and next to the protected device, protected device side cross-wired to the ground.

#### Single-phase/2-wire connection



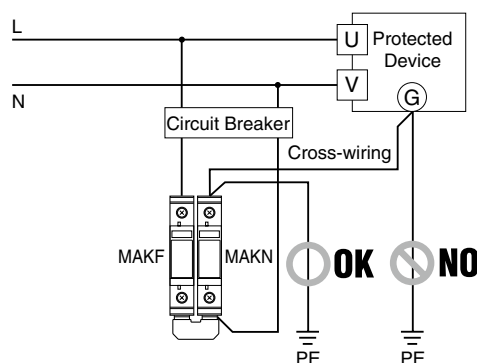
## GROUNDING

### ■ COMMON GROUNDING WITH CROSS-OVER WIRE

Basically a common grounding with cross-wiring between the MAKN and the protected device is recommended for adequate protection. Grounding resistance should be less than 100 ohms. If the protected device has no ground terminal, ground only the MAKN.

The ground point should be close to the MAKN side as shown below.

#### • Single-phase/2-wire connection



## ALARM OUTPUT

When MAKN detects the electrical discharge element of the internal unit over-heating, separates the electrical discharge element from the power supply for safety.

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 MAKN or the breaker alarm trips.

### ■ RELAY SPECIFICATIONS

Alarm output: The SPDT relay trips when the thermal breaker operates and/or the head element is removed.

Rated load: 250 V AC @ 0.5 A (resistive load)  
125 V DC @ 0.2 A (resistive load)

Minimum switching load: 5 V DC, 1 mA

### ■ CONNECTION

Terminal: Terminal block

Applicable wire size: 0.14 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.

### ■ ELEMENT-BASE CONNECTION

- Make sure that the head element is pushed into the bottom of the base and that the mount position keys are entirely inserted into the key holes.
- The alarm output will not function appropriately if the head element is not connected firmly.

## 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:

### ■ CHECK WINDOW

Green color is normal, indicating the surge protector is functioning properly. Black indicator means that the protector is in failure. Replace with a new one immediately.

### ■ DISCHARGE ELEMENT MODULE

Pull out the head element from the base.

Connect the probes of a multimeter in high-resistance range across the plugs on the head element and confirm no conduction (The meter should indicate 10 MΩ or greater).

Then connect the probes of a 1000 V DC/1000 MΩ insulation tester across the plugs and confirm discharging (The meter should indicate 20 MΩ or less).

If any of above testing proves an abnormality, replace the head element with a new one immediately.