

# High Performance Single-phase Thyristor Unit **THV-A1** Installation Manual

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IMR02D06-E3

Thank you for purchasing this RKC product. In order to achieve maximum performance and ensure proper operation of your new instrument, carefully read all the instructions in this manual. Please place the manual in a convenient location for easy reference.

This manual describes the mounting, wiring and specifications only. For the basic operations, refer to THV-A1 Quick Operation Manual (IMR02D07-ED). For the detail handling procedures and various function settings, please refer to separate THV-A1 Instruction Manual [Detailed version] (IMR02D04-ED).

The above manuals can be downloaded from the official RKC website:  
[http://www.rkcinst.com/english/manual\\_load.htm](http://www.rkcinst.com/english/manual_load.htm)

## Product Check

<b>Instruction manuals</b>	
THV-A1 Installation Manual (IMR02D06-E3)	1
THV-A1 Quick Operation Manual (IMR02D07-ED)	1
<b>Accessories (Order separately)</b>	
Setter for open loop control [potentiometer, knob and scale plate] (THVP-S01)	ordered quantity
Input connector [plug] (THVP-C01)	1
Alarm output connector [plug] (THVAP-C01)	1

## Safety Precautions



- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to instrument and equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- When the withstand voltage test or each test is performed, please contact RKC sales office or the agent. If you make a mistake in the test method, the instrument failure may result.
- RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction can occur and warranty is void under these conditions.

**High temperature caution:**  
 Do not touch the heat radiation fin while the power is turned on or just after the power is turned off as it may be at high temperatures. If touched, burning may result.

## CAUTION

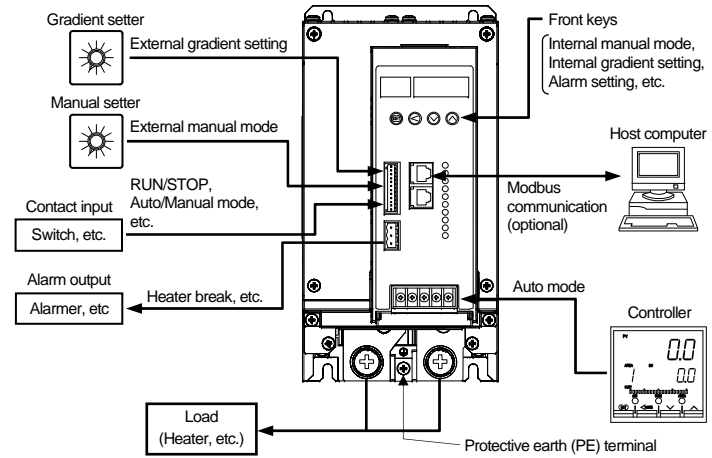
- This product is intended for use with industrial machines, test and measuring equipment. It is not designed for use with medical equipment and nuclear energy.
- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.
- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.
- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless the length.
- This product is manufactured on the assumption that it is mounted within a control panel. All high-voltage connections such as power supply terminals must be enclosed in the control panel to avoid electric shock by operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- All wiring must be in accordance with local codes and regulations.
- Always use this product at the rated power supply voltage, load current and power frequency.
- All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action.
- To prevent instrument damage or failure, protect the power line and the input/output lines with a protection device such as fuse, etc.
- If this product is used for phase control, higher harmonic noise may be generated. Therefore in this case, take such measures as separating the power line from the high-voltage line for load drive.
- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.
- Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.
- For proper operation of this instrument, provide adequate ventilation for heat dispensation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration will occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to instrument display, do not rub with an abrasive material or push front panel with a hard object.
- Do not connect modular connectors to telephone line.

## NOTICE

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for purpose of illustration.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.

## 1. OUTLINE

This instrument is a single-phase thyristor unit for power supply voltage 100 to 240 V AC. It is possible to adjust power supplied to heaters, etc. by setting the signal from the controller, setter (variable resistor) or front keys.



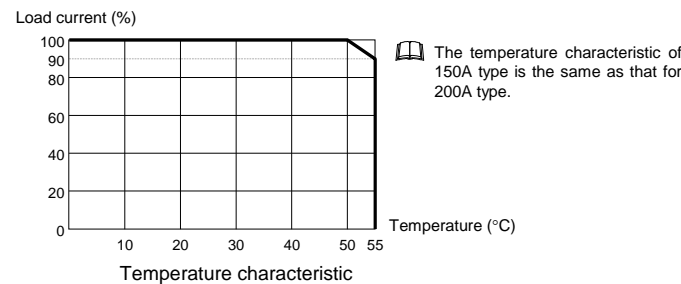
## 2. MOUNTING



In order to prevent electric shock or instrument failure, always mount or remove this instrument after power supplied to the entire system is turned off.

### 2.1 Mounting Environment

- This instrument is intended to be used under the following environmental conditions.
  - UL508, C22.2 No.14 (cUL) POLLUTION DEGREE 2
- Use this instrument within the following environment conditions.
  - Allowable ambient temperature: 0 to 50 °C.  
 (The rated current drops when the ambient temperature exceeds 50 °C.)

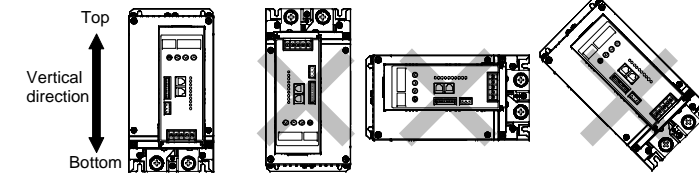


- Allowable ambient humidity: 5 to 95 % RH.  
 (Ambient humidity: MAX.W.C 29.3 g/m<sup>3</sup> dry air at 101.3 kPa)
- Avoid the following conditions when selecting the mounting location:
  - Rapid changes in ambient temperature which may cause condensation.
  - Corrosive or inflammable gases.
  - Such a place where there are inflammable materials near this instrument.
  - Direct vibration or shock to the mainframe.
  - Water, oil, chemicals, vapor or steam splashes.
  - Excessive dust, salt or iron particles.
  - Excessive induction noise, static electricity, magnetic fields or noise.
  - Exposure to direct sunlight.
  - Excessive heat accumulation.

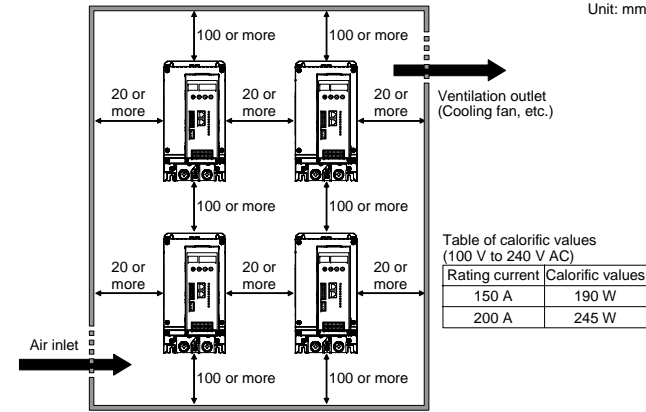
### 2.2 Mounting Cautions

Take the following points into consideration when mounting this instrument.

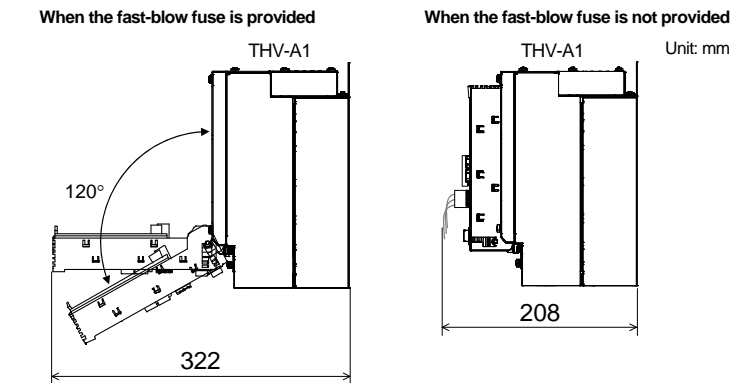
- Mount this instrument in the direction shown below.



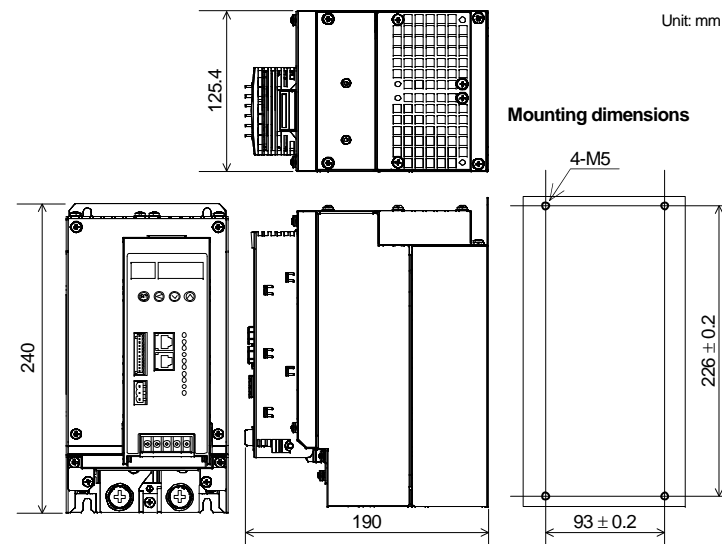
- Provide adequate heat radiation space so that heat does not build up.
- At least 20 mm is necessary on the left and right and at least 100 mm on the top and bottom.
- The temperature inside the control panel increases due to heat generation of this instrument itself. Therefore, take into account full ventilation by mounting forced ventilation fans on the panel.



- The front of the instrument can be opened to allow replacement of the fast-blow fuse. When installing the instrument, leave enough space to allow the cover to be opened. If there is no fast-blow fuse, install with enough space for the wiring when the connector plug (optional) is inserted.

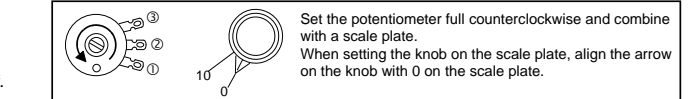
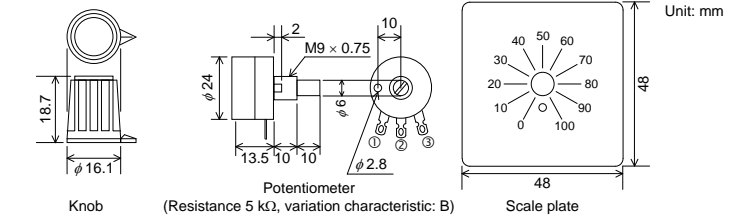


### 2.3 Dimensions



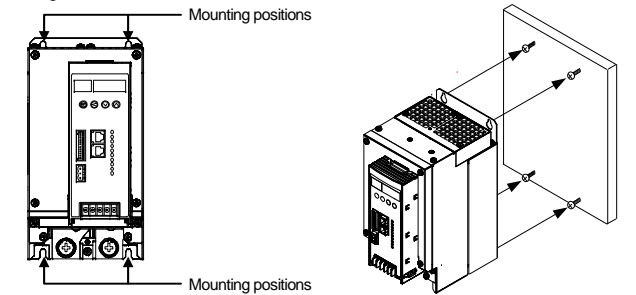
The dimension of 150 A type is the same as that for 200 A type.

### Setter (Potentiometer, Knob and Scale plate)



### 2.4 Mounting Procedures

- Prepare the holes as specified in 2.3 Dimensions.
- Insert the mounting screws into the holes. (The instrument is mounted using four screws.)
- Hook the mounting positions (4 holes) at the top and bottom of the instrument onto the partially mounting screws.



- Tighten the mounting screws with a screwdriver. (Recommended tighten torque: 3.6 N·m [36 kgf·cm])  
 Customer must provide the set of screws.  
 Screw type: Pan-head screws (Size: M5, Length: 10 mm)

## 3. WIRING



To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

### 3.1 Wiring of Main Circuit

#### CAUTION

- Always conduct wiring so that the phase of the main circuit (2T1) coincides with that of terminal No. 4 and the phase of the main circuit (1/L1), with that of terminal No. 5. Otherwise the instrument may not function properly or the load may be damaged.
- Caution for conducting control of primary side of a transformer
  - When a protection function for control of primary side of a transformer is provided: To conduct control of primary side of a transformer, make sure protection function for control of primary side of a control is set. Appropriately adjust the soft-start time for in case of secondary side breakdown depending on the operating condition.
  - When a protection function for control of primary side of a transformer is not provided: If the action of the device is influenced by excessive current (inrush current, current due to flux saturation of transformer), use a transformer 1.25 T (magnetic flux density) or less. Make sure soft-start time is appropriately set.
- For setting procedure of each function, refer to THV-A1 Instruction Manual [Detailed version] (IMR02D04-ED).
- If the secondary side of the transformer goes open due to a break in the heater, connect resistor in parallel on the primary side of the transformer to allow current flow larger than the minimum load current (0.5 A or more). (Adjust the resistance value considering the exciting current of the transformer.)
- There are neither fuses nor power switches in the power circuit of this instrument. Therefore install the fuses and switches near the instrument, if necessary.
- To avoid noise induction, keep input signal wire of controller away from instrument power line, load lines and power lines of other electric equipment. If wiring near high-voltage power is unavoidable, use shielded wires.
- For safety, always ground the protective earth (PE) terminal.
- Use wires satisfying the rated current capacity.
- Tighten the hexagon headed bolts on the main circuit terminals using a torque wrench. Always tighten each of them by contacting the diagonal surfaces of the wrench with those of each hexagon head.
- Firmly tighten each terminal hexagon headed bolt with the tightening torque specified below. Otherwise, electric shock, fire or heat generation may result.

- When using a solderless terminal lug, use ring type.

#### Solderless terminal size and tightening torque

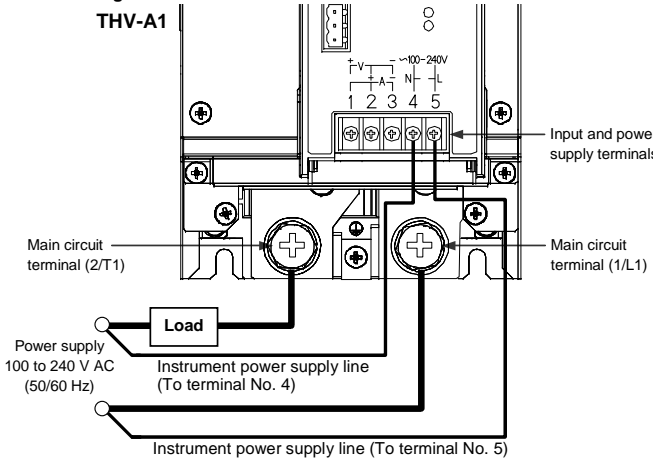


Item	Power terminals (4, 5)	Main circuit terminal (2/T1, 1/L1)
$\phi$	3.2 mm or more	10.5 mm or more
D (mm)	5.5 mm or less	28.5 mm or less
Recommended tightening torque	0.4 N·m (4 kgf·cm)	18 N·m (180 kgf·cm)

- Make sure that the any wiring such as solderless terminal is not in contact with the adjoining terminals.

#### Wiring diagram of main circuit

**Always conduct wiring so that the phase of the main circuit (2/T1) coincides with that of terminal No. 4 and the phase of the main circuit (1/L1), with that of terminal No. 5. Otherwise the instrument may not function properly or the load may be damaged.**



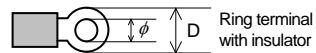
#### Terminal screws size

Main circuit terminal (2/T1, 1/L1)	M10 size
Input and power supply terminals (1 to 5)	M3 size

### 3.2 Wiring of Input Signal

When using a solderless terminal lug, use ring type.

#### Solderless terminal size and tightening torque



Item	Input terminals (1, 2, 3)
$\phi$	3.2 mm or more
D (mm)	5.5 mm or less
Recommended tightening torque	0.4 N·m (4 kgf·cm)

#### On input signal change

The input signal is set as specified when ordering at the time of being unpacked. When changing the input signal, conduct the following two settings.

- Set the type of input signal by Input signal by Input signal (IS) in Engineering mode.
- Change the position of the short bar to match the input type.

In addition, the input signal is divided into two pieces of hardware. The input signal in the same hardware is selectable but the input signal in the other hardware cannot be selected.

#### Hardware 1

Current input 0 to 20 mA DC  
Voltage input 0 to 5 V DC  
Current input 4 to 20 mA DC  
Voltage input 1 to 5 V DC  
Voltage pulse input 0/12 V DC

Cannot be selected to the input signal in the other hardware.

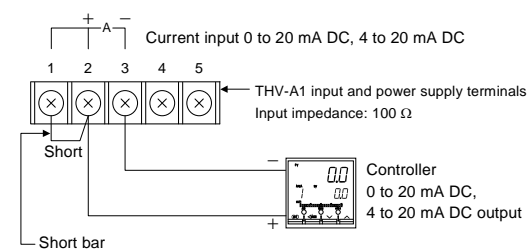
#### Hardware 2

Voltage input 0 to 10 V DC  
Voltage pulse input 0/12 V DC  
Voltage pulse input 0/24 V DC

- For the input signal (IS), refer to THV-A1 Quick Operation Manual (IMR02D07-ED).

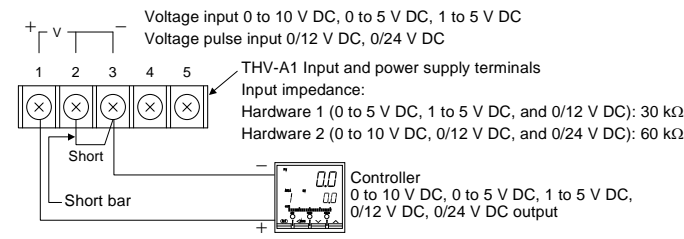
#### Wiring of the current input

For current input (0 to 20 mA DC, 4 to 20 mA DC), short terminal No.1 with terminal No.2.



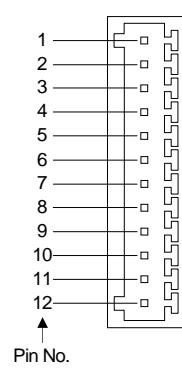
#### Wiring of the voltage input or voltage pulse input

For voltage input (0 to 5 V DC, 1 to 5 V DC or 0 to 10 V DC) or voltage pulse input (0/12 V DC, 0/24 V DC), short terminal No. 2 with terminal No. 3.



### 3.3 Wiring for External Manual Mode, External Gradient Setting and Contact Input

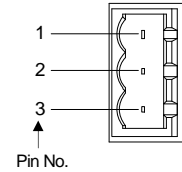
#### Input connector pin number and details



Pin No.	Details
1	+5 V (Gradient setting input)
2	0 V (Gradient setting input)
3	Gradient setting input (0 to 5 V input by the gradient setter)
4	+5 V (Manual mode input)
5	0 V (Manual mode input)
6	Manual mode input (0 to 5 V input by the manual setter)
7	Contact input 1 (DI1)
8	Contact input 2 (DI2)
9	Contact input 3 (DI3)
10*	0 V (Contact input)
11*	0 V (Contact input)
12*	0 V (Contact input)

\* As for the pins from 10 to the 12, a circuit is connected within the THV-A1.

#### Pin number and details of connector for alarm output



Pin No.	Details
1	Alarm 1 (ALM1): Digital output 1 (DO1), Relay contact output
2	Alarm 2 (ALM2): Digital output 2 (DO2), Relay contact output
3	Common (COM)

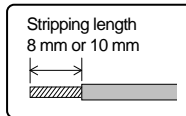
#### Caution for connector (plug) wiring

Use the stranded leadwires.

Stranded leadwires:

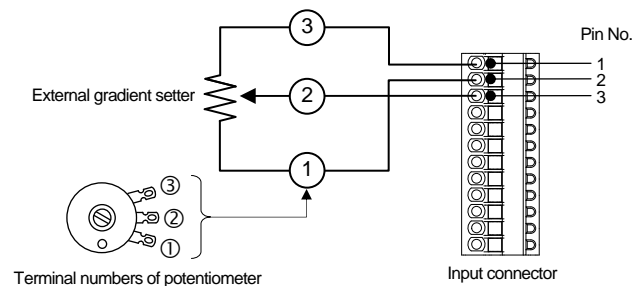
Input connector: AWG28-20 (cross-section: 0.14 to 0.5 mm<sup>2</sup>)  
Alarm output connector: AWG24-12 (cross-section: 0.2 to 2.5 mm<sup>2</sup>)

Stripping length: Input connector: 8 mm  
Alarm output connector: 10 mm

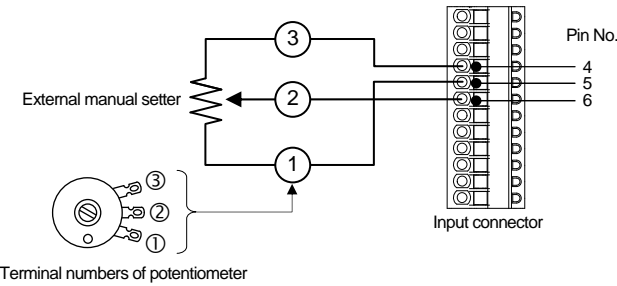


The input connector (plug), alarm output connector (plug) and setter is optional.

#### Input connector [Wiring of external gradient setter]



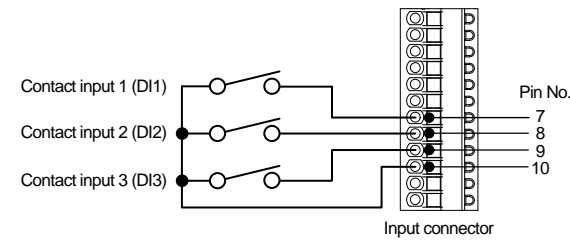
#### Input connector [Wiring of external manual setter]



To use the external manual setter, the contact input action (dA) must be set to "External manual mode (fixed)" after the wiring is completed. An alternative method is to fix external manual mode by assigning the "Auto/Manual mode" function to the contact input (DI).

- For the setting, refer to THV-A1 Quick Operation Manual (IMR02D07-ED).

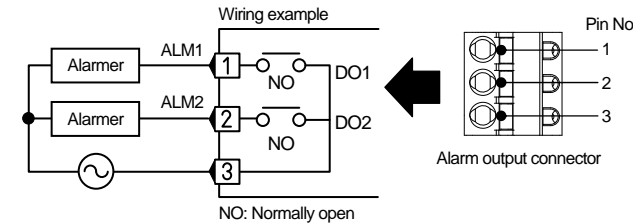
#### Input connector [Wiring of contact input (DI)]



After wiring is completed, functions must be assigned to contact inputs 1 to 3 with contact input 1 (DI1) function assignment (C1), contact input 2 (DI2) function assignment (C2), and contact input 3 (DI3) function assignment (C3).

- For the setting, refer to THV-A1 Quick Operation Manual (IMR02D07-ED).

#### Wiring of alarm output connector

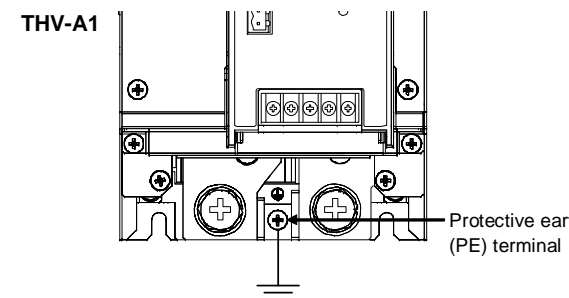


Relay contact input:  
Contact type: 1a contact  
Contact rating: 250 V AC, 1 A or less (resistive load)  
30 V DC, 1 A or less (resistive load)  
Electrical life: 300,000 times or more (250 V AC 1A, 30 V DC 1A, Switching: 10 times/min)  
Mechanical life: 2 million times or more (No-load, Switching: 300 times/min)

For alarm output, the type of alarm that is output must be selected with alarm 1 output logic (L1) or alarm 2 output logic (L2) after wiring is completed.

- For the setting, refer to THV-A1 Quick Operation Manual (IMR02D07-ED).

### 3.4 Protective Earth (PE) Terminal



- Protective earth no other devices to the location where you earth this device.
- Avoid sharing earth lines with electric motors, motorized equipment, and other equipment that uses large amounts of electricity.
- In the earth system, be careful to earth each point and not to create a earth loop.
- Connect so that the earth resistance is no greater than 100  $\Omega$ .
- Use wire of at least 2.0 mm<sup>2</sup> for earth lines.

## 4. SPECIFICATIONS

Number of phase:	Single-phase
Rated current:	150 A AC, 200 A AC
Minimum load current:	0.5 A (at 98 % output of rated voltage)
Power supply voltage:	90 to 264 V AC [Including power supply voltage variation] (Rating: 100 to 240 V AC)
Power frequency:	50/60 Hz (Automatic discriminating)
Allowable power frequency variations:	50 Hz $\pm$ 1 Hz, 60 Hz $\pm$ 1 Hz (Performance guarantee) 45 to 54.9 Hz, 55 to 64.9 Hz (Operation guarantee)
Input signal:	Hardware 1: Current input 0 to 20 mA DC, 4 to 20 mA DC (Input impedance 100 $\Omega$ ) Voltage input 0 to 5 V DC, 1 to 5 V DC (Input impedance 30 k $\Omega$ ) Voltage pulse input 0/12 V DC (Input impedance 30 k $\Omega$ ) Dry contact input Hardware 2: Voltage input 0 to 10 V DC (Input impedance 60 k $\Omega$ ) Voltage pulse input 0/12 V DC, 0/24 V DC (Input impedance 60 k $\Omega$ ) Dry contact input
Output voltage range:	0 to 98 % of rating voltage (excluding voltage drops due to fuse effects)
Applicable load:	Phase control: Resistor load (Corresponding utilization category: AC-51), Control of primary side of a transformer The magnetic flux density must be 1.25 T [12,500 Gauss] or less when the protection function for control of primary side of a transformer is not provided. Zero-cross control: Resistor load (Corresponding utilization category: AC-51)
Control method:	Phase control/Zero-cross control
Output setting range:	Internal manual set value: 0.0 to 100.0 % (Set by the THV-A1 front keys) External manual set value: 0 to 100 % (Set by the setter *) Internal gradient set value: 0.00 to 2.00 (Set by the THV-A1 front keys) External gradient set value: 0 to 100 % (Set by the setter *) Output limiter (high) set value: 0.0 to 100.0 % (Set by the THV-A1 front keys) Output limiter (low) set value: 0.0 to 100.0 % (Set by the THV-A1 front keys) Base-up set value: -10.0 to 100.0 % (Set by the THV-A1 front keys) Output limiter setting in case of a break on the secondary side of the transformer: 15.0 to 50.0 % of phase angle (Set by the THV-A1 front keys) * Sold separately
Output mode for phase control:	Standard <sup>1</sup> and Constant voltage control <sup>2</sup> Standard, constant voltage control and Constant current control <sup>3,4</sup> Standard, constant voltage control and Constant power control <sup>3,4,5</sup> <sup>1</sup> Proportional phase angle to input, Proportional voltage to input and Proportional square voltage (electric power) to input <sup>2</sup> Square wave feedback can be selected. <sup>3</sup> With heater break alarm, thyristor break-down, memory area, current limiter and over current <sup>4</sup> Constant current control or constant power control is optional. <sup>5</sup> Constant current control is available.
Power off leakage current:	90 mA AC rms or less (load voltage 200 V rms, 60 Hz, Ta = 25 °C)
Ramp (Soft-start/Soft-down) function:	Setting range: 0.0 to 100.0 seconds (Set by the THV-A1 front keys)
Soft-start function in case of a break on the secondary side of the transformer:	Setting range: 0.1 to 100.0 seconds (Set by the THV-A1 front keys)
Contact input:	Contact input (DI) can be assigned the function. Number of input points: 3 points Input type: Dry contact input Dry contact: Open state: 500 k $\Omega$ or more, Close state: 250 $\Omega$ or less
Current transformer (CT) input (optional):	Input: Current transformer (Built-in) Input range: 0.0 to Rated current $\times$ 1.35 A
Potential Transformer (PT) input:	Input: Potential Transformer (Built-in) Input range: 80 to 280 V
Current measurement (optional):	The current is calculated from the input values of CT and PT in the THV-A1. Measurement range: 0.00 to 63.36 kW
Alarm function (optional):	Number of output points: 2 points individual output (common) Output type: Relay contact output, 1a contact, 250 V AC, 1 A or less (resistor load), 30 V DC, 1 A or less (resistor load) Electrical life: 300,000 times or more (250 V AC 1A, 30 V DC 1A, Switching: 10 times/min) Mechanical life: 2 million times or more (No-load, Switching 300 times/min)
Alarm type:	FAIL alarm (FAIL) Heater break alarm 2 (HBA2) Power frequency error (FREQ) Thyristor break-down alarm (THY.B) Board error (BOARD) Over current alarm (OCR) Power supply voltage error (VOLT) Fuse break (FUSE) Heater break alarm 1 (HBA1) Heat sink temperature abnormality (HEAT)
Output limiter (high) at the time of start:	High setting: 0.0 to 100.0 % Time setting: 0.0 to 600.0 seconds
Current limiter function (optional):	Setting range: 150 A: 0.0 to 165.0 A 200 A: 0.0 to 220.0 A If a current limit value is set to its maximum value, the current limit function is deactivated.
Ambient temperature:	0 to 50 °C (Performance guarantee range) -10 to +55 °C (Operation guarantee range)
Ambient humidity:	5 to 95 %RH (Non-condensing) Absolute humidity MAX. W. C 29.3 g/m <sup>3</sup> dry air at 101.3kPa
Power consumption:	14 VA MAX. (100 V AC) Rush current 22 A or less 22 VA MAX. (240 V AC) Rush current 52 A or less
Withstand voltage:	Between main circuit and power terminals and radiation fins: 2000 V AC, 1 minute Between main circuit and power terminals and input terminals: 2000 V AC, 1 minute
Insulation resistance:	Between main circuit and power terminals and radiation fins: 20 M $\Omega$ or more, 500 V DC Between main circuit and power terminals and input terminals: 20 M $\Omega$ or more, 500 V DC
Cooling method:	Forced air cooling (built-in cooling fan)
Mounting method:	Vertical mounting
Dimensions:	125.4 (W) $\times$ 240 (H) $\times$ 190 (D) mm (150 A, 200 A)
Weight:	Approx. 4.5 kg (150 A, 200 A)
Standard:	Safety standards: UL: UL508 (file No. E177758) [POLLUTION DEGREE 2] cUL: C22.2 No.14 (file No. E177758) [POLLUTION DEGREE 2]

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