

SINGLE PHASE THYRISTOR UNIT

1()PHM TYPE INSTRUCTION MANUAL 1()ZEM TYPE INSTRUCTION MANUAL

IMX01C01-E1

Thank you for purchasing the 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 this manual in a convenient location for easy reference.

WARNING

- 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.
- 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.

CAUTION

- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation 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.
- 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 from high currents with a protection device such as fuse, circuit breaker, etc.
- 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.

NOTE

- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- 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.

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For safe operation of '1()PHM series', the following 'Signal Words' and 'Symbol Marks' are used in this manual.

<Signal Words>

WARNING : Where there are possible dangers such as electric shock, fire (burns), etc. which could cause loss of life or injury, precautions to avoid such dangers are described.

CAUTION : These describe precautions to be taken if unit damage may result if operating procedures are not strictly followed.

NOTE : Extra notes or precautions are added to operating procedures and explanations.

<Symbol Marks>



: Electrical shock



: High temperature



: This mark is used when great care is needed especially for surety.

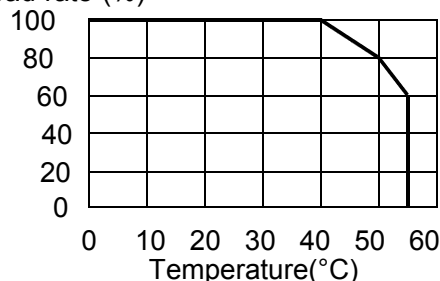
* : This mark is used to add extra notes, precautions or supplementary explanations to table and figures.

1. Caution for mounting

(Avoid the following when selecting the mounting location)

- Should be used indoors where the system is not exposed to direct sunlight.
- Ambient humidity of less than 45% or more than 85%RH. Water, oil, chemicals, vapor or steam splashes.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Excessive induction noise, static electricity, magnetic fields or noise.

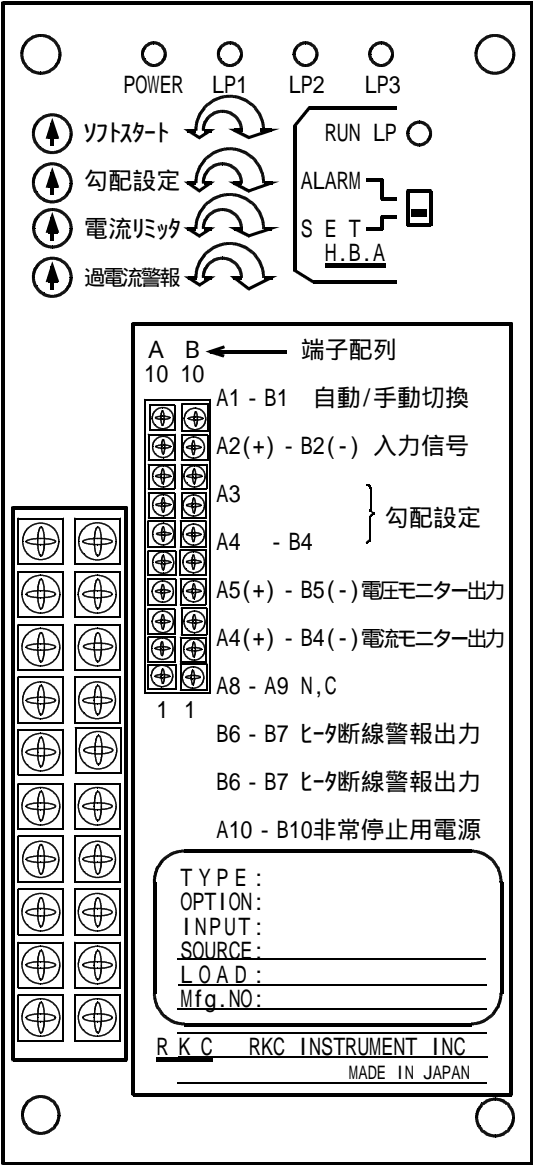
Load rate (%)



2. Model Code

1 □ □ - □ □ □ □ - □ □						CONTENTS		
Power supply voltage	1 2 3 4					Single phase 100 to 110V AC Single phase 200 to 220V AC Single phase 380V AC Single phase 400 to 440V AC		
Control method		PHM ZEM				Phase control method Zero-cross control method		
Maximum load current		020 030 050 070 100 150 200 300				Maximum load current	20A AC 30A AC 50A AC 70A AC 100A AC 150A AC 200A AC 300A AC	
Applicable load			R L			Resistance load Inductive load		
Input signal				4 6 8		0 to 5V DC 1 to 5V DC 4 to 20mA DC		
Option and special voltage				-1	Auto/Manual transfer and gradient setting	Phase control	Yes	Zero cross control
				-4	Fuse blow alarm	Yes	Yes	Yes
				-5	High-Low control	Yes	Yes	Yes
				-6	Constant voltage circuit	Yes	Yes	No
				-8	Current limiter	Yes	Yes	No
				-9	With % meter	No	No	Yes
				-A	Emergency stop	Yes	Yes	Yes
				-B	Temperature abnormality alarm	Yes	Yes	Yes
				-D	Excessive current alarm	Yes	Yes	No
				-E	Constant current circuit	Yes	Yes	No
				-G	SCR abnormality alarm	Yes	Yes	Yes
				-H	Heater break alarm	Yes	Yes	Yes
				-W	Constant power circuit	Yes	Yes	No
				-M	Load voltage & Load current monitor output	Yes	Yes	No
				-T	Special voltage (120V, 240V)	Yes	Yes	Yes

3. Panel Name Explanation



Monitor Lamp

POWER : Power lamp
LP1 to LP3 : Alarm lamp

LAMP			Contents
LP1	LP2	LP3	
ON	OFF	OFF	Heater break alarm(Option)
OFF	ON	OFF	Temperature abnormality alarm (Option)
OFF	OFF	ON	Fuse below alarm (Option)
ON	ON	OFF	Excessive current alarm (Option)
ON	OFF	ON	SCR abnormality alarm (Option)
ON	ON	ON	System abnormality

RUN LP : Load monitoring lamp
Lamp ON : Heater break
Lamp OFF : Setting mode

Select switch (Heater break alarm)

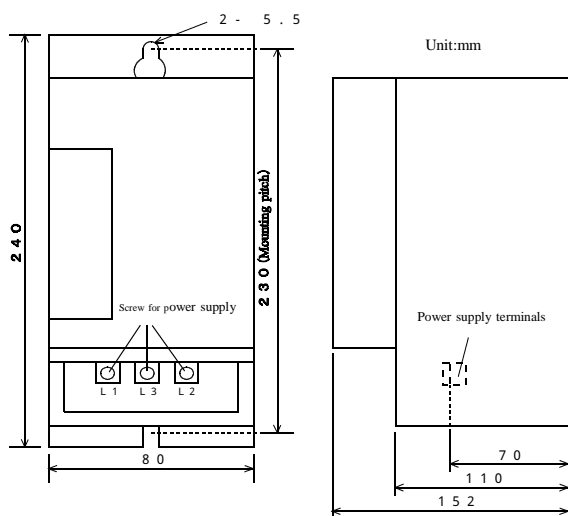
ALARM : Load break monitoring
(Auto load setting and braking monitor)
SET : Auto load setting preparation

Setting unit

ソフトスタート : Soft start time setting
0.5 to 10 sec
勾配設定 : Gradient setting
0 ~ 100 %
電流リミット設定 : Current limit setting
Approx 30 to 100 % of rated current
過電流警報設定 : Excessive current setting
Approx 50 to 100 % of rated current

4. External dimension

4.1 20A/30A



4.2 50A/70A/100A/150A/200A/300A

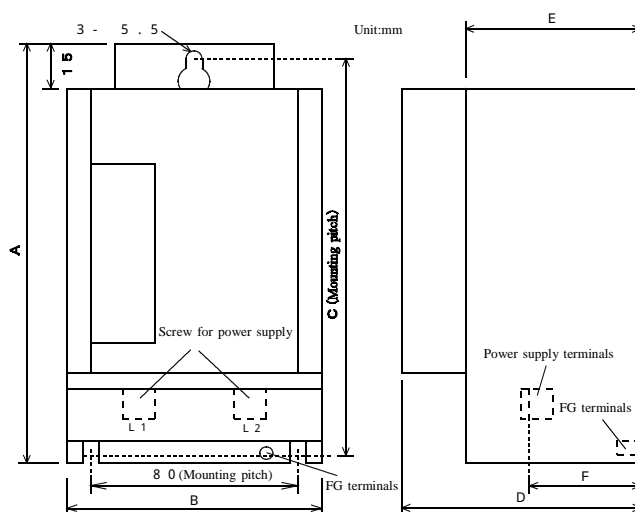


Table for heat value

	Unit rated current							
	20A	30A	50A	70A	100A	150A	200A	300A
200V type	30	43	67	95	141	208	270	397
400V type	31	45	71	101	146	214	275	397

unit:W

External dimension list

unit: mm

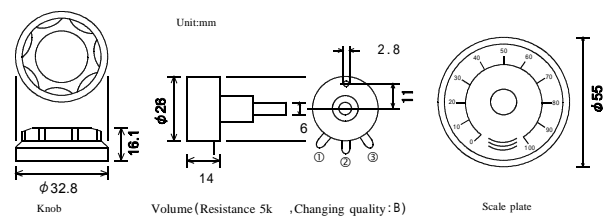
	A	B	C	D	E	F
50A	235	105	227	212	170	120
70A	285	105	277	212	170	120
100A	285	105	277	212	170	120
150A	335	140	327	265	223	170
200A	335	140	327	265	223	170
300A	335	140	327	265	223	170

4.3 Wiring terminal specification & tightening torque list of power, input signal

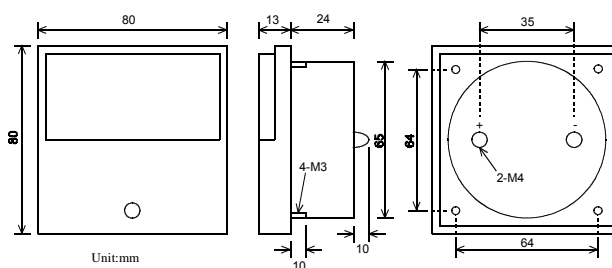
	Rated current				FG terminal	Input signal terminals
	20,30A	50A	70·100A	150·200·300A	20 to 300A	20 to 300A
Φ	4.3 or more	6.4 or more	8.4 or more	10.5 or more	4.3 or more	3.2 or more
D (mm)	10 or less	17 or less	17 or less	22 or less	10 or less	7 or less
Screw	M4	M6	M8	M10	M4	M3
Tighten torque	1.2N·m	2.4N·m	5.4N·m	9.8N·m	1.2N·m	0.5N·m

4.4 Setting volume, % meter, Monitoring meter for load voltage/load current (option)

• Setting volume



• % meter, monitoring meter



0 to 1mA input

Load resistance : 0 to 3k

5. External wiring



Make sure terminal screws are tightened with the specified torque.
Improper tightening may cause electric shock, fire or excessive heat.
(Recommended torque is described in the external dimensional drawing)

5.1 Gradient setting

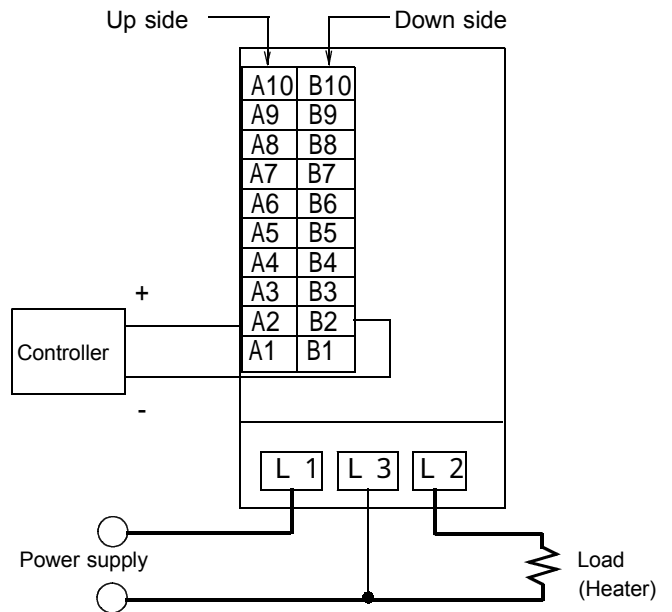
Select power cables for L1 and L2 terminals that are suitable for the load current capacity.
This unit uses L1 and L3 for the internal power supply.
Refer to the specifications (p.16) for the current that runs through the L3 terminal.

Input impedance of this unit is approximately 150 ohms for 4-20mA input type, and approximately 10K ohms for 0-5V/1-5V input type.

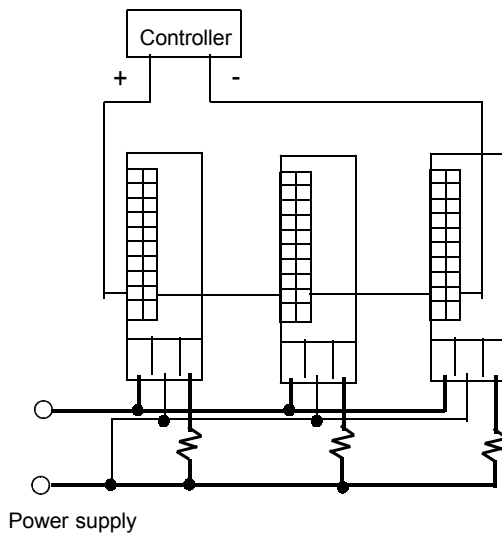
Our controller can control up to three of this unit with a single controller.

Load impedance of our controllers is 600 ohms or less for 4-20mA input type, and approximately 1K ohm or more for 0-5V/1-5V input type.

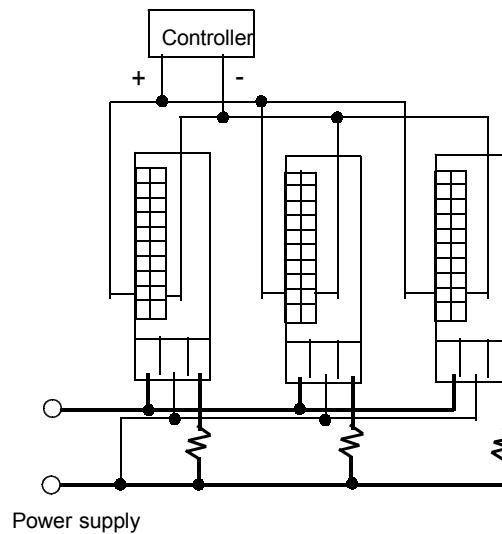
Please refer to our controller specifications for further details.



4 to 20mA DC input type
(Series connection)

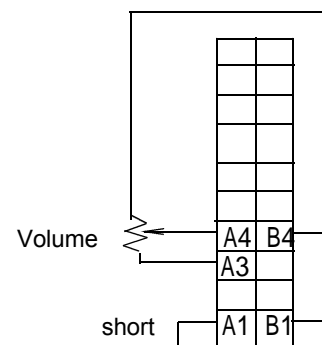


0 to 5V DC/1to 5V DC input type
(Parallel connection)



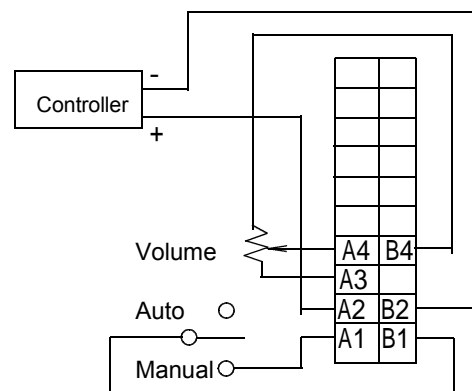
5.2 Manual mode

output can be manually adjusted by connecting the attached variable resistor. In this case, always short the A1 and B1 input terminals.



5.3 Auto/Manual transfer (option)

it is possible to switch between automatic and manual by using the attached variable resistor and a selector switch.
(Selector switch to be supplied by the user)

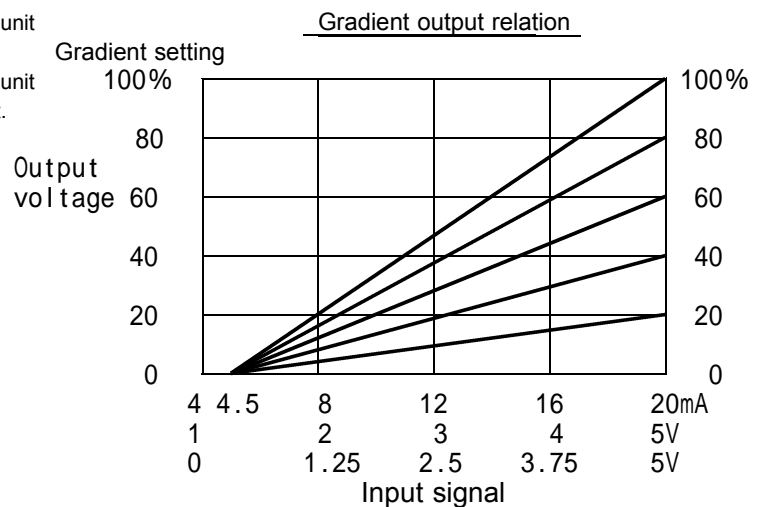


5.4. Gradient setting (option)

This is a function to adjust the relation between the automatic setting input and output voltage.
With this option, control characteristics of automatic setting input can be set in accordance with the gradient setting.

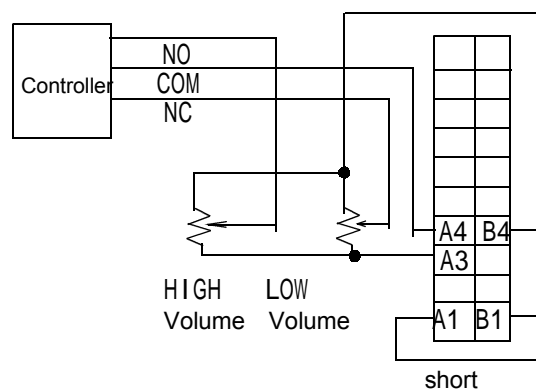
Shorting input terminals A1 and B1 makes this unit a manual setter. Making terminals between A1 and B1 open gives this unit an external gradient setting function.
A gradient setting unit is supplied as standard also inside the power unit. Setting is available from the following combinations.

Automatic setting input x external gradient setting unit
x internal gradient setting unit.
Automatic setting input x external gradient setting unit
Manual setting input x internal gradient setting unit.



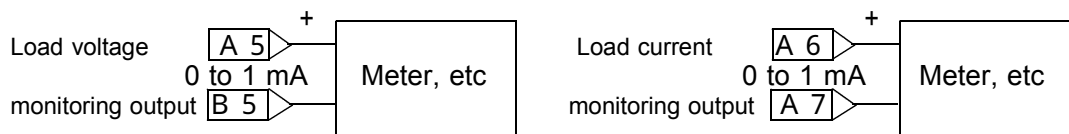
5.5 H-L control (Option)

ON/OFF control which restricts the maximum output/minimum output can be performed by selecting the variable resistor on the HIGH or LOW side by the relay contact signal.

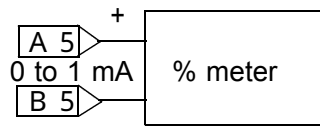


5.6 Monitoring output (Option)

Load voltage & Load current monitoring output (Phase control method)



% meter (Zero cross control method)



Meter specification

Input signal : 0 to 1 mA

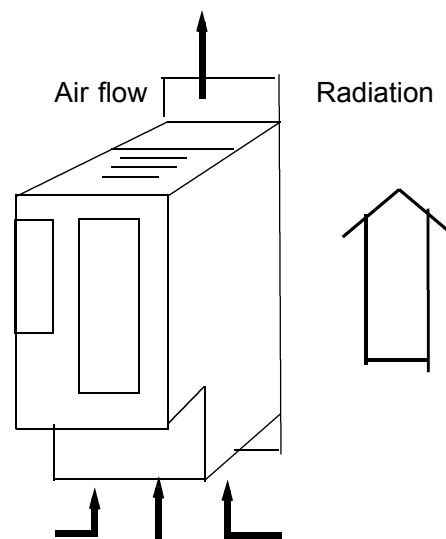
Load resistance : Less than 0 to 3 kW 以下

6. Mounting precautions

- (1) When mounting the adjuster, check its top and bottom then mount it on the wall in the specified orientation.

CAUTION

As this adjuster generates much heat, it is cooled by circulating heated air by convection. Therefore, if it is not mounted as specified such as the wrong way up or mounted on the floor, an accident or fault with the adjuster may result.

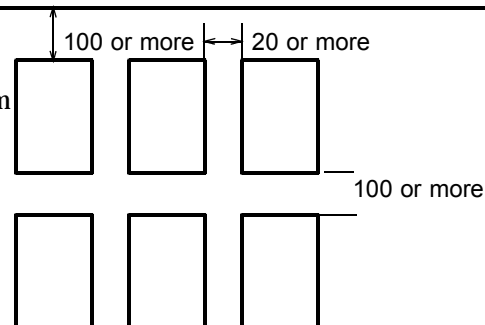


Upper side (Unit: mm)

- (2) When two or more adjusters are mounted together, make the space between each adjuster as specified in the diagram on the right. If the adjusters are closely mounted, an accident or fault may result from heat generation

CAUTION

Do not mount these adjusters too close together.



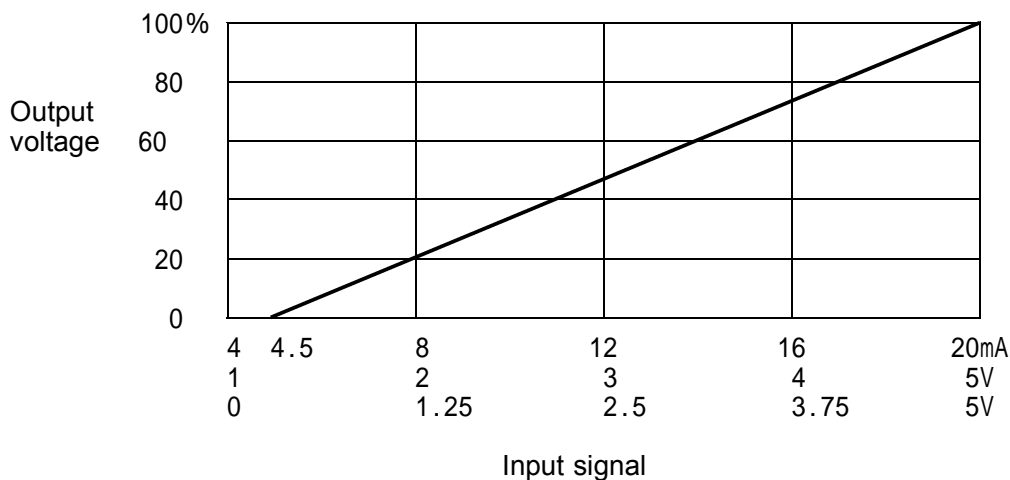
7. Function Explanation

7.1 Control method <proportional control>

Phase control method : Outputs effective value voltage proportional to the setting input.

Zero-cross method: Outputs effective value power proportional to the setting input.
However, power supply variation is not compensated.

Proportional control input/output relation



Soft-start function :

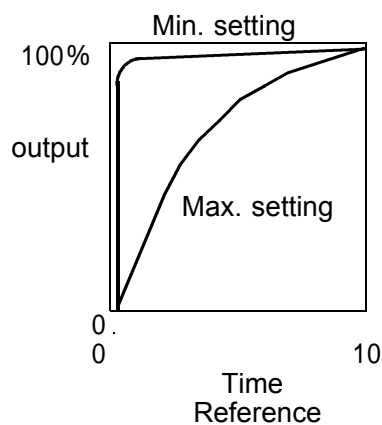
This unit is supplied with an adjustable soft-start function as standard which is adjustable from approximately 0.5 to 10 seconds.
(Default value: approximately 0.5 second).

With the soft-start function, output changes gradually to suppress inrush current even if the setting input changes abruptly.

To use a soft-start, adjust the setting knob (volume) to a desired time.



The set time shows the time at the end of which maximum output is produced on the voltage wave form.



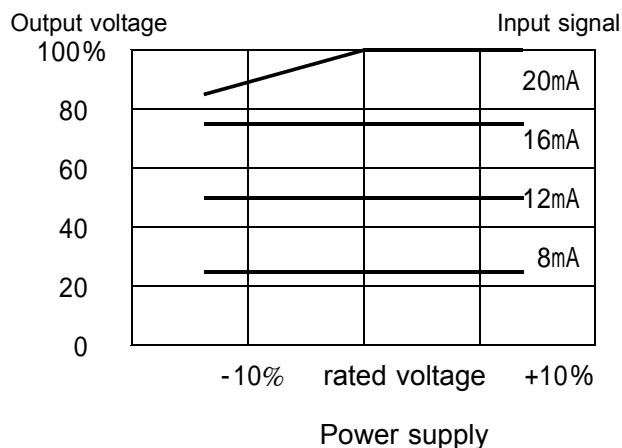
7.2 Additional functions

Constant voltage control (option)

This function compensates the power supply variation, and outputs the effective value proportional to the setting input.

Operating condition	Accuracy
Power supply variation +/- 10%	Within $\pm 1.5\%$
Load variation 10 times	

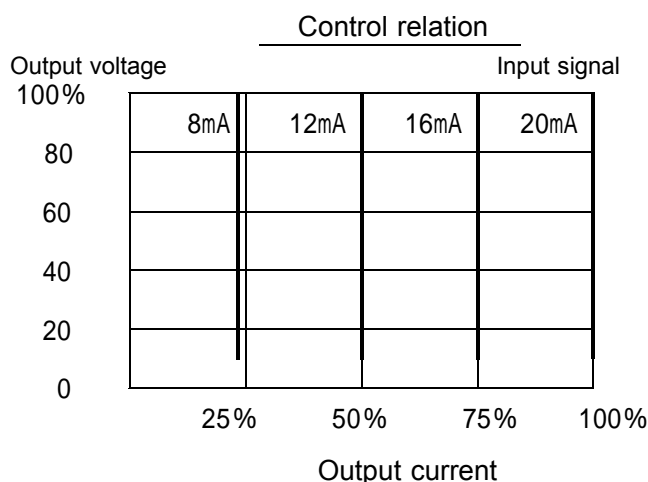
Control relation



Constant current control (option)

This function outputs the effective value current proportional to the setting input.
This function maintains the output current constant even with a load variation.

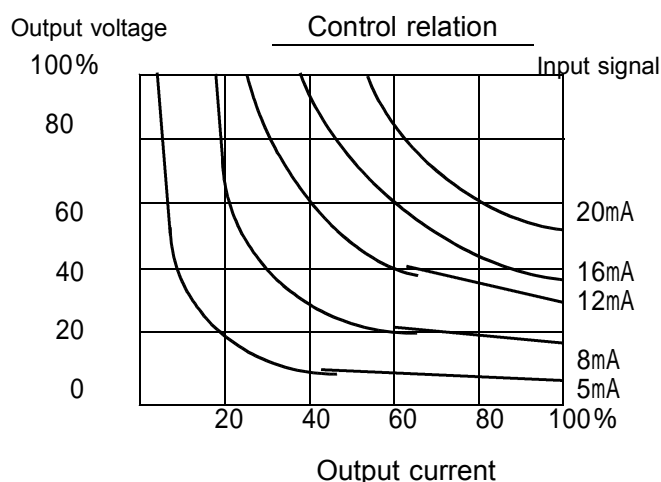
Operating condition	Accuracy
Power supply variation +/- 10%	Within $\pm 2\%$
Load variation 4 times	Within $\pm 4\%$
Load variation 10 times	Within $\pm 7\%$



Constant power control (option)

This function outputs the effective value power proportional to the setting input.
As the controllable load range is 50% of the rated output (rated voltage x rated current/2), select a power supply unit with a capacity twice as large as the load capacity.

Operating condition	Accuracy
Power supply variation +/- 10%	Within $\pm 5\%$
Load variation 4 times	



Current limiter function (option)

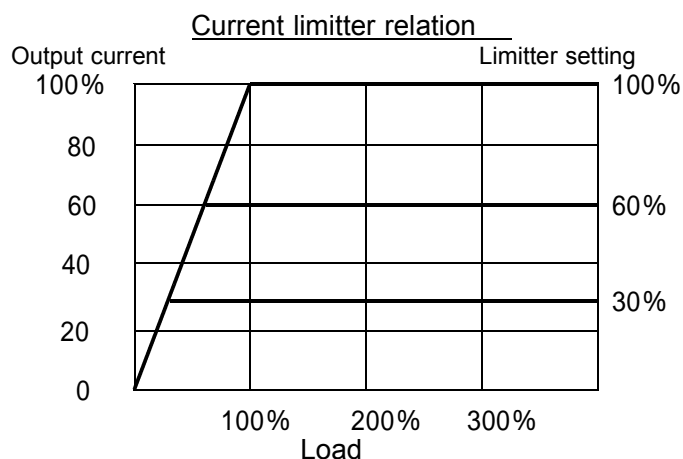
- Used for phase control -

This is a function to limit the current with the built-in current limiter setting unit (approximately 30 to 100% of rating) to prevent overcurrent.

This function provides limits to the load with a large initial inrush current to protect an SCR and a load.

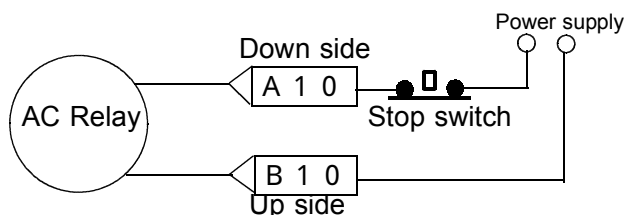
Note

Current limiter is not available for constant voltage control.



Emergency stop function (option)

Apply the voltage as strong as the unit voltage.
However, for 380 and 400-440V AC power supply types, arrange a 200V AC power supply separately.



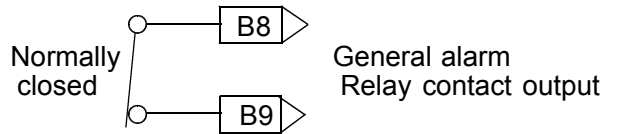
Normal state : When voltage is applied to the input terminals (between A10-B10).

Emergency stop: When no voltage is applied to the input terminals (between A10-B10).

Gate signal remains off in spite of the input signal during the emergency stop period.

7.3 General Alarm Function

The contacts of the general alarm output relay get open when system abnormality, device temperature abnormality, excess current, fuse blow, and SCR abnormality has occurred.



Alarm for system abnormality (supplied as standard)

System error occurs when a CPU abnormality and data abnormality has been detected. Monitor lamps LP1, LP2, and LP3 turn on simultaneously. System abnormality status can be reset by re-applying power.

Alarm for device temperature abnormality (option)

Device temperature abnormality is detected when a temperature inside the power unit enters the range of $65^{\circ}\text{C} \pm 3^{\circ}\text{C}$. This alarm is retained, but can be reset by re-applying power (Reset temperature: $65^{\circ}\text{C} \pm 3^{\circ}\text{C}$)

Alarm for fuse blow (option)

Fuse blow alarm is generated when a rapid blown fuse has blown. A monitor lamp LP3 lights to indicate the alarm status. The alarm status can be reset by re-applying power.

Alarm for excessive current (option)

This alarm is generated when current over the value set by the excess current alarm setter to the range of 50 to 100% of the rated current flows into the load side. Monitor lamps LP1 and LP2 turn on simultaneously.

The alarm status can be reset by re-applying power.

Alarm for SCR abnormality (option)

This alarm is generated when a thyristor element for output control is broken or shorted.

Monitor lamps LP1 and LP3 turn on when an element is shorted.

Monitor lamps LP1 and LP3 blinks when an element is broken.

7.4 Heater break alarm (option)

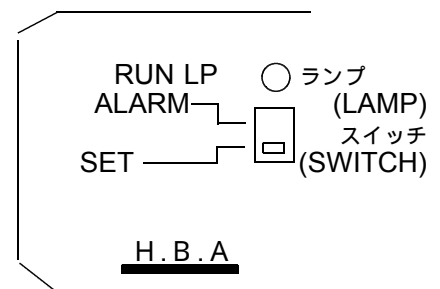
Description

Heater break alarm function monitors load voltage and excess current during the operation of the power unit.

When load current goes over/below the alarm set value (fixed to 25%), this alarm is generated to indicate that a heater might have been broken.

How to set

1. Keep the control load factor above 50% in operation mode.
2. Set the switch to the SET side (from the ALARM side).
3. RUN LP lamp starts blinking to indicate the setting status.
4. Re-set the switch to the ALARM side, and the set data is taken.
5. When the data has been taken, the RUN LP lamp lights brighter and the unit enters a heater break monitoring status.



Front panel drawing

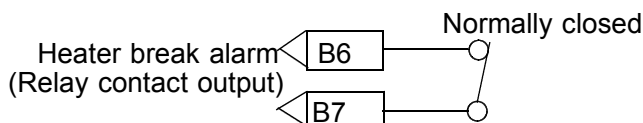
NOTE

The set data is backed up and retained even if power supply is turned off.

Alarm action

When heater current goes down more than 25% (fixed) from the load set value, the monitor lamps LP1 turns on and relay contacts get open.

When a heater status is back to normal, the alarm status is reset.



8. Inspection, maintenance and troubleshooting

In order to keep this adjuster always working in the best condition, perform the following inspection and maintenance.

8-1. Inspection

- (1) Before turning on the power after completing the wiring, re-check the load wiring.
- (2) After turning on the power, check that normal power adjustment is performed.

8-2. Maintenance

- (1) If the screws on the power connection terminals are loose, heat generation may result. First, check that the power is not applied to the adjuster, then check that the screws are not loose.
- (2) This adjuster uses parts with limited life span such as electrolytic capacitors, cooling fan, etc. Periodic inspection should be conducted every several years.

8-3. Troubleshooting

Most general adjuster faults, causes and remedies are described in the following. Please refer to these for maintenance and inspection. If you have any query concerning this adjuster, please contact our sales office or agent from where you bought it giving the Model No. and specifications.

(1) No output is generated.

- * No normal load voltage is applied. (Example: The adjuster in the 200V line is used in the 100V line.)
- * The plus (+) and minus (-) sides of the current input signal are opposite.
- * The fuse is burnt out.
- * For the Model with the optional function of '-1' or '-5', the No.A1 terminal is not shorted with the B1 terminal when the variable resistor is not used.
- * (For manual setting) : The No. M terminal is not shorted with the + terminal.
- * (For gradient setting control) : The variable resistor in the gradient setter is left set to zero.
- * (For H-L control): The variable resistor on the HIGH side is left set to zero.
- * Failure inside the adjuster (Thyristor element damage caused by load shorting) Must be repaired.

(2) Output continues to be generated

- * No load is connected to this adjuster, but it is directly connected to the power. (Incorrect wiring)
- * Manual setting continues. (When the manual setting variable resistor is set to 100%)
- * (For H-L control): The variable resistor on the LOW side is left set to 100%.
- * The input signal from the controller is left at the maximum. Controller failure
- * Failure inside the adjuster (Thyristor element damage caused by load shorting) Must be repaired.

(3) No normal output is generated.

- * No normal load voltage is applied. (No rated voltage is applied.)
- * The adjuster output does not match the controller output.
(Example: An output of 4 to 20mA is connected to an output of 1 to 5V.)
- * For gradient setting control : The variable resistor in the gradient setter is left set to zero.
- * For H-L control : The variable resistors on the HIGH and LOW sides are not correctly set.
- * The selection of resistive load (R load)/inductive load (L load) is incorrect.
- * Failure inside the adjuster caused by deteriorated parts, etc. Must be repaired.

8.4. How to replace a fuse



WARNING

1. When replacing a fuse, make sure that power supply has been disconnected. Otherwise, you may receive an electric shock.
2. The replacement must be performed by an authorized personnel who has electrical knowledge and experience.

Replace Procedure

1. When you need to replace a fuse, separate the main unit from the PWB as shown in the drawings and replace the fuse.
 - a. Remove two screws
 - b. Pull up slightly the PWB and slide it to the direction shown by
 - c. The main unit is separated from the PWB.
 - d. Remove the leadwire connector between the main unit and the PWB.
 - e. When the PWB has been removed, you will find the fuse inside. Replace the fuse with a specified one.

CAUTION

Make sure to tighten the fuse mounting screw. Loose tightening may cause internal heat and damage the unit. (See the table below)

Screws and tightening torque

Screw diameter	Torque
M6	2.4Nm or more
M8	5.4Nm or more
M10	9.8Nm or more

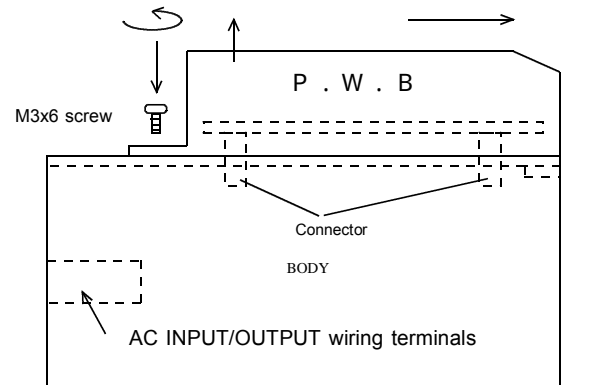


Fig.1 Unit seen from the side

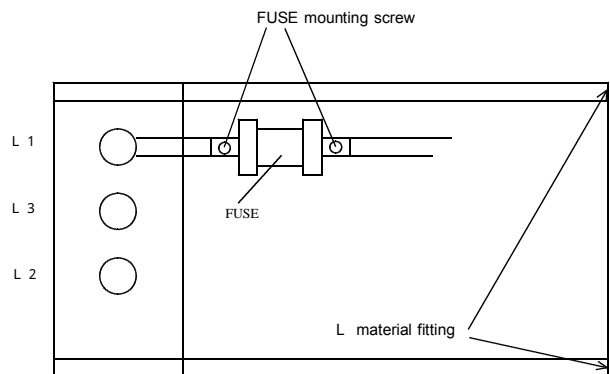
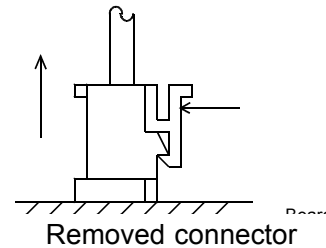


Fig.2 Unit seen from above after the PWB has been removed.

2. Assemble the parts in the reverse order of the disassemble. Insert the connector fully observing the direction.

- a. After the connector has been properly set, insert the space of (1) into the bent part of the PWB, slightly pull the PWB to the direction shown by an arrow (2) until it becomes parallel with the main unit, fit the screw holes and tighten the screws.

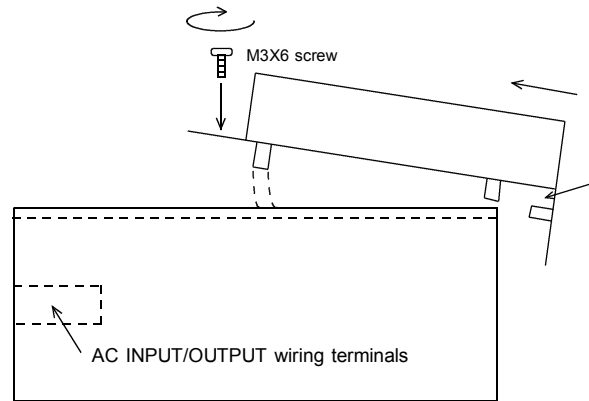


Fig.3 Unit seen from the side

9. Specifications

- Max. load current : 20A · 30A · 50A · 70A · 100A · 150A · 200A · 300A (at 40 °C)
- Control method : Phase control, Zero cross control
- Applicable load : Resistance load, Inductive load, Control of primary side of a transformer.
(Cannot be used for a capacitive load such as a capacitor).
- Load open/close element : Thyristor module
- Min. load current : 0.3A
- Output control range : 0 to 98% of primary power supply
- Start method : Soft start : 0.5 to 10sec
- Input : 4 to 20mA DC (Input impedance : 150Ω)
1 to 5V DC (Input impedance : 10kΩ)
0 to 5V (Input impedance : 10kΩ)
- Output protection : Fast fuse
- Power supply voltage : 100 to 110V AC, 200 to 220V AC, 30V AC, 400 to 440V AC
(Can meet 120V or 240V AC by option)
- Power frequency : 50Hz & 60Hz ± 1 Hz (Common use)
- Allowable voltage variation : ±10% of rated value
- Cooling method : Self-cooling (For 20A, 30A, 50A, 70A)
Forced-cooling (For 100A, 150A, 200A, 300A)
- Allowable temperature controller : -10 to +50 °C
(Maximum load current falls when the ambient temperature is more than 40 °C.)
- Allowable ambient humidity : 35 to 90% RH
- Environment : Corrosive gases, dust or vibration shall not exist.
- Insulation resistance : More than 50MΩ between power terminal and frame
(Using 500V DC megger)
- Dielectric strength : For 1 min. at 2000V AC between power terminal and frame
- Power consumption : For 20A : 4VA, For 30A : 4VA, For 50A : 4VA, For 70A : 4VA ,
For 100A : 13VA, For 150A : 15VA, For 200A : 15VA, For 300A : 17VA
- Mounting method : For vertical mounting
- Option : Auto/manual transfer and gradient setting
 - Heater break alarm
 - High - Low control
 - Current limiter
 - Constant voltage circuit
 - Constant current circuit
 - Constant power circuit
 - % meter
 - Load voltage & Load current monitor output
 - Emergency stop
 - Excessive current alarm, Fuse below alarm, other alarm function
- Weight : 20A & 30A : approx. 2.0kg , 50A : approx.3.2kg, 70A : approx.3.9kg ,
100A : approx 4.6 kg, 150A/200A : approx.7.8kg, 300A: approx.8.0kg



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