PAC18 Series

Single-Phase Thyristor Power Regulator

Instruction Manual

Thank you for purchasing a Shimaden PAC18 Series Single-Phase Thyristor Power Regulator.
After making sure the product fits the desired description, you should carefully read the instructions and get a good understanding of the contents before attempting to operate the equipment.

Request

The instruction manual should be kept in a handy place where the end user can refer to it when necessary.

Preface

The instruction manual has been prepared for those involved in setup, wiring, operation or routine maintenance of PAC18 Series equipment.
The manual provides information concerning mounting, wiring and precautions when working with PAC18 Series equipment.
You should therefore keep it in a handy place to refer to when operating and handling the equipment.
Be sure to observe all precautions and adhere to the procedures provided in the manual.
Safety rules, precautions concerning equipment damage, additional instructions and notes are written based on the following headings.

◎Matters that could result in injury or death if instructions are not followed.

⚠WARNING

◎Matters that could result in equipment damage if instructions are not followed.

⚠CAUTION

◎additional instructions and notes

Note

⚠WARNING

PAC18 Series equipment is designed to control heater power, etc., of common industrial equipment. It should not be used for nuclear power generation, traffic control, communications or medical equipment. You should either take appropriate safety measures or avoid using for control that could have a serious effect on human life. The manufacturer shall not be liable for an accident that results if used without taking appropriate safety measures.

⚠WARNING

1. The power regulator should be used so the terminal elements in the control box, etc., are not touched by human beings.
2. The power regulator should not be used as a switch.
   Even if output is zero, power is present in the capacitors and resistors of the output circuit, and could result in accident involving human life or serious bodily injury due to electrical shock.
3. Radiation fins and chassis become extremely hot. Never touch the radiation fins or chassis. Doing so could result in burn injury.
4. Do not supply power when wiring. Doing so could result in electrical shock.
5. Do not touch terminal elements or other charged parts while conducting electricity. Also, do not introduce foreign objects or matter into the equipment.
   If a foreign object or matter accidentally gets inside, be sure to turn off the power and make sure all is safe before introducing tools or your hands.

⚠CAUTION

If there is danger of damage to any peripheral device or equipment due to failure of the power regulator, you should take appropriate safety measures such as mounting a rapid fuse or overcurrent circuit breaker.

⚠CAUTION

1. Concerning the ⚠ alert symbol on the power regulator's plate, a ⚠ alert symbol is printed on the label applied to the outer surface of the device.
   The symbol is provided to prompt you to employ special care not to touch the device because doing so could result in electrical shock if parts that conduct power are touched when power is present, or could result in burn injury if touched when hot, etc.
2. Provide a switch or breaker as a means of cutting off power for external power circuit connected to the power terminal of the device.
   Mount a switch or breaker near the controller where the operator can get to it easily and label it as an electrical breaker for the device.
3. Be sure to securely fasten conductor cable connections before using.
   Failure to do so could result in burning from overheating due to contact resistance.
4. Be sure power supply voltage and frequency do not exceed the rating.
5. Do not apply voltage/current other than rated input to the input terminal.
   Doing so could shorten the life of the product or result in equipment failure.
6. Voltage/current of load connected to the output terminal should not exceed the rating.
   Using voltage/current that exceeds the rating could shorten the life of the device by raising the temperature, and could result in equipment failure.
7. Be sure to mount the terminal cover that comes with the device after wiring.
8. The user should absolutely not modify or use the device in any way other than it was intended to be used.
9. Be sure to observe the notes and precautions provided in the manual to use the device safely and maintain its reliability.

Note: Shimaden shall bear no responsibility, monetarily or otherwise, for accident or damages caused by failure to observe warnings, notes and precautions contained in the instruction manual.

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Contents

1. Specifications code check

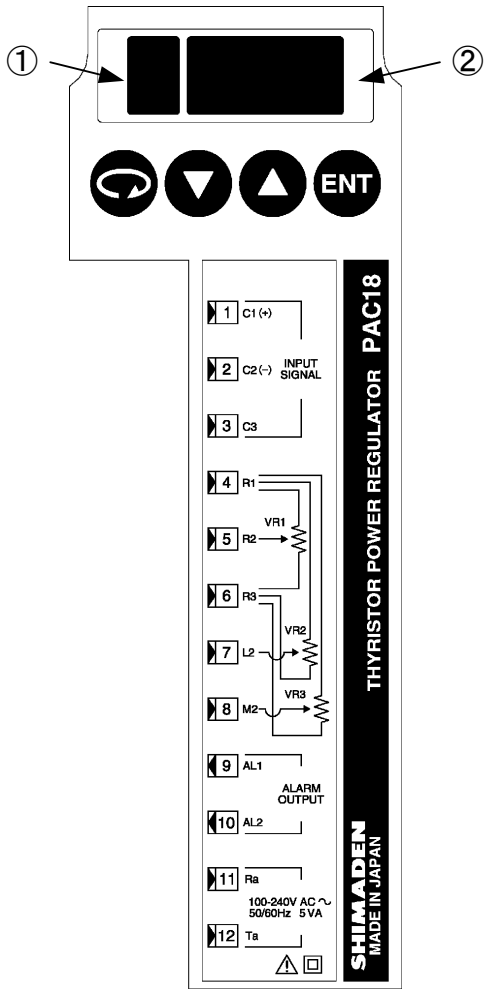
Make sure the product you have received matches the specifications of your order. If you have any questions, feel free to contact your nearest Shimaden agent.

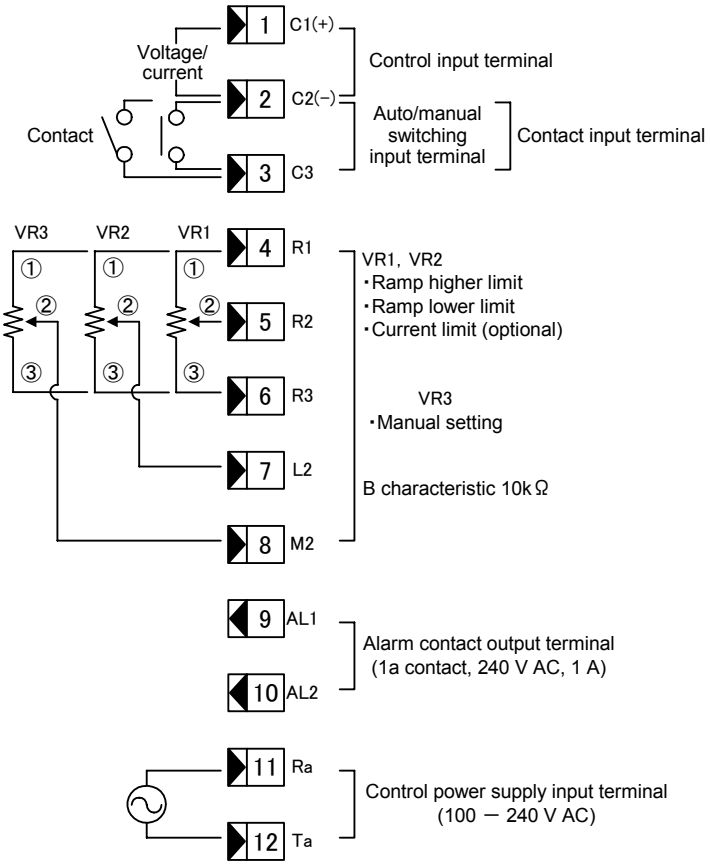
1-1. Code selection table

Item	Code	Specifications		
1. Series	PAC18	Single-Phase Thyristor Power Regulator		
2. Control Type		P0-	Phase control / phase angle proportional output	
		P1-	Phase control / voltage proportional output	
		P3-	Phase control / voltage square proportional output	
		C1-	Cycle calculation zero voltage switching control	
		X1-	Complex control	
3. Control input		3	Voltage: 1-5V DC, input resistance: 200kΩ(built-in), contact: common	
		4	Current: 4-20mA DC, receiving impedance: 100Ω(built-in), contact: common	
		6	Voltage: 0-10V DC, input resistance: 200kΩ(built-in), contact: common	
		9	Other	
4. Rated current		020-	20A	
		030-	30A	
		045-	45A	
		060-	60A	
		080-	80A	
		100-	100A	
5. Output current detection function(optional)		0	Without	
		1	With	Equipped with overcurrent protection, current limit function, alarm output function (power failure alarm, overcurrent alarm, heater break detection alarm, hardware error alarm). Alarm output: One point a-contact 240V AC, 1A (insulated from system circuit)
6. Communication(optional)		0	Without	
		1	Equipped with Parameter setting function (data communication adapter [sold separately] can be connected).	
		5	RS-485 specs, Communication protocol: MODOBUS(RTU)	
7. Remarks		0	Without	
		9	Without (please consuit before ordering)	

2. Panel part names and control terminals

2-1. Panel part names

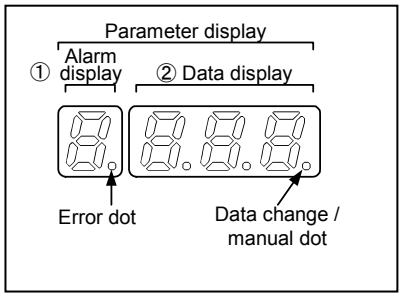




Display

① Status display (red, 1 digit): Displays parameter screen group and alarm contents.

② Parameter display (green, 3 digits): Displays parameter names and data.



Key switches

↻ : Parameter key: Primarily used for switching screen groups.

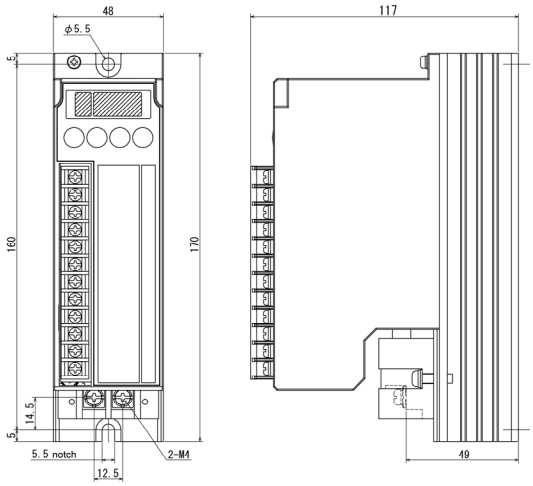
▼ : Down key: Primarily used for modifying parameter values. Decreases numerical value.

▲ : Up key: Primarily used for modifying parameter values. Increases numerical value.

ENT : Enter key: Primarily used to register parameter settings.

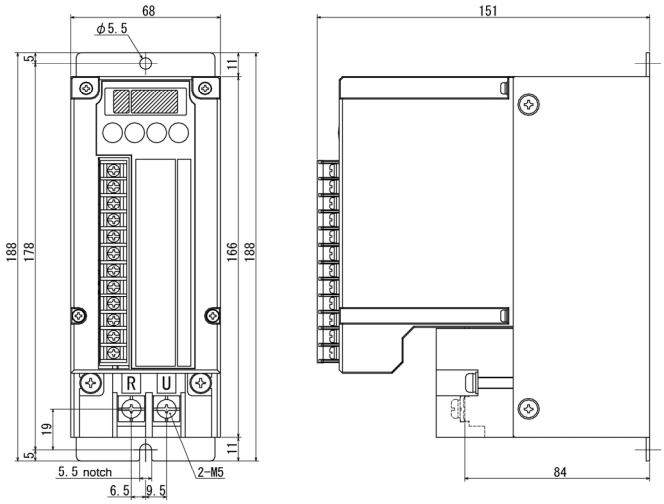
3. External dimensions / terminal dimensions / weight

20/30A, Weight: Approx. 0.8 kg



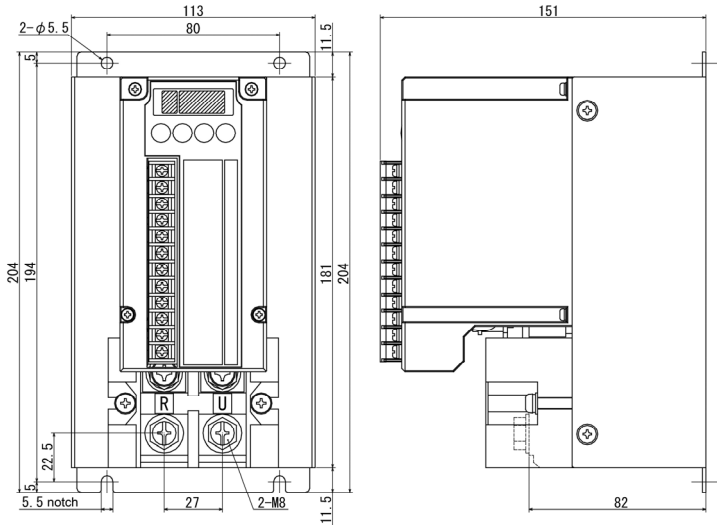
Unit: mm

45/60A, Weight: Approx. 1.8 kg



Unit: mm

80/100A, Weight: Approx. 3.0 kg



Unit: mm

4. Setup location

The device is designed to be used under the following conditions. Observe the following environmental conditions when using:

1) Indoor use
2) Elevation: Max. 2000 m (see '14-2. Ambient temperature and load current.')
3) Temperature range: -10 − 55°C (see '14-2. Ambient temperature and load current.')
4) Humidity range: Max. 90% RH Must be no dew condensation.
5) Transient overvoltage category: II
6) Pollution class: 2 (IEC 60664)

⚠ CAUTION

Do not use in the following locations. Doing so could lead to equipment failure, damage or fire.

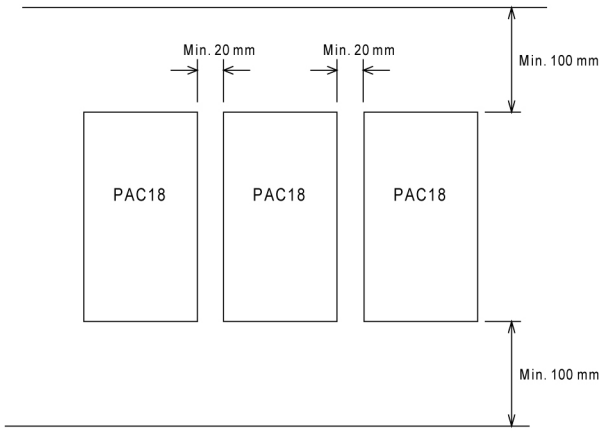
- Places exposed to flammable or corrosive gases, oil mist, or excessive dust that could cause insulation to deteriorate
- Places subject to vibration or impact
- Places exposed to water dripping or direct sunlight
- Places directly exposed to air from heater or air conditioner
- Places where maintenance cannot be performed safely

5. Mounting

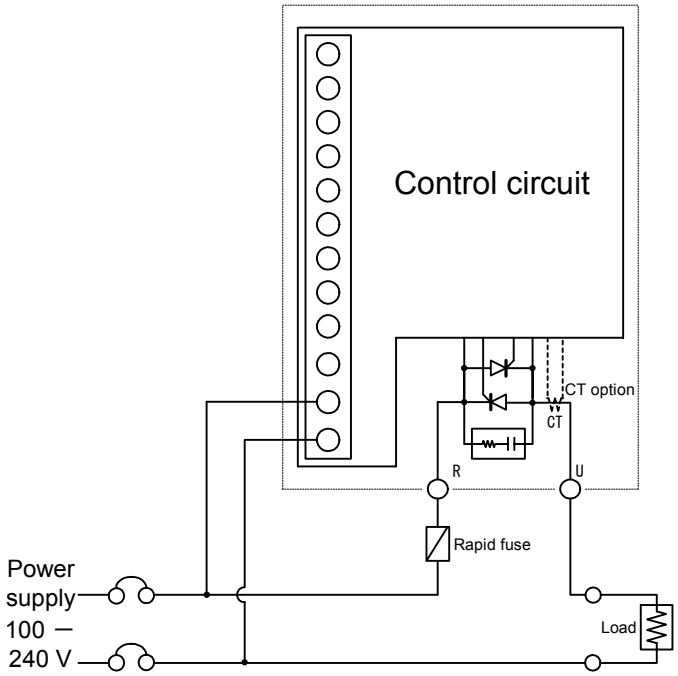
Fasten to control panel, wall, rack, etc., when using. To ensure safety, arrange so that people cannot easily come into contact with the equipment.
Be sure to mount vertically to allow heat to dissipate. Provide at least 100 mm of clearance above and below the device.
If the device has to be mounted horizontally, operate at no higher than 50% of the current capacity of this device.

5-1. Mounting method and clearance

Provide the clearance shown in the figure.



6. Circuit block diagram and terminal symbols

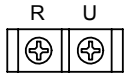


Terminal symbol

□Control terminal
No. 1 - 12

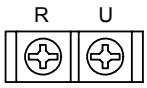
□Power supply ／ load circuit

[20/30A terminal]



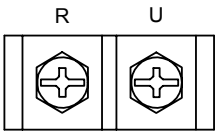
Screw diameter: 2-M4

[45/60A terminal]



Screw diameter: 2-M5

[80A/100A terminal]



Screw diameter: 2-M8

R: Power supply terminal
U: Output terminal

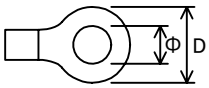
7. Power supply and load (main circuit) wiring

7-1. Wiring

Open the terminal block cover to connect wires to the terminal block.
Loosen the fastening screws mounted on the device and wire.

7-2. Power supply and load (main circuit) wiring

PAC18 employs 2-terminal wiring. The R and U terminals of 20/30A are M4, 45/60A are M5 and 80/100A are M8.
Use the proper terminal and securely fasten the screws.



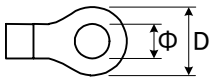
	Rated current		
	20A/30A	45A/60A	80A/100A
Φ	Min. 4	Min. 5	Min. 8
D	Max. 10	Max. 13	Max. 14
Screws	M4	M5	M8
Fastening torque (N·m)	1.2－1.4	2.0－2.4	5.5－6.6

Use wiring of material that matches rated current for R and U terminals.

8. Control input signal wiring

M3 screws are used for control signal terminals.
Use the proper terminal and securely fasten the screws.
Use wiring that conforms to crimping terminals.

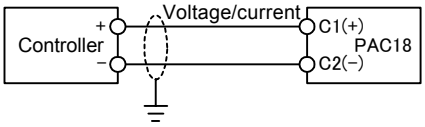
Control terminal	
Φ mm	Min. 3.0
D mm	Max. 6.2
Screws	M3
Fastening torque (N•m)	0.5—0.75



Control signal from the controller (4 – 20 mA, 1 – 5 V, 0 – 10 V, contact, etc.) enters the control input signal terminals (C1, C2, C3).
Be careful of the polarity and make sure noise from strong electric circuits does not get into the wiring.

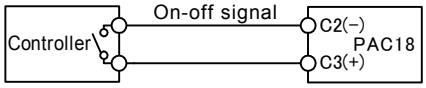
8-1. 1-to-1 connection with controller

Connection with voltage/current output controller
Adjust controller output with control signal of the PAC18.



In the case of 1-to-1 connection, connect the positive controller output terminal (+) to C1 and the negative terminal (-) to C2 as shown in the figure above.

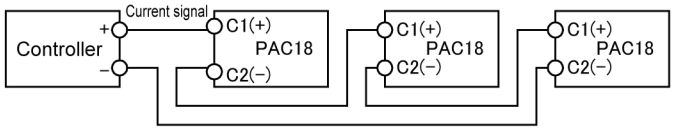
Connection with contact output controller



If connecting with on-off signal, connect between C3 and C2.

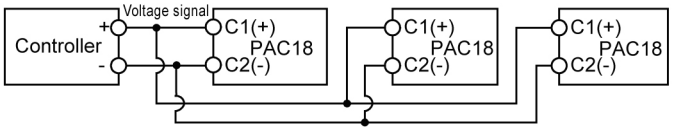
8-2. Multiple units connected to a single controller

Current input connection diagram



In the case of current input type, wire control input signals in series. Input resistance for the PAC18 is 100Ω, so if load resistance tolerance for a 4 – 20 mA output controller is 600Ω, you can connect up to 6 units.

Voltage input connection diagram



In the case of voltage input type, wire control signals in parallel. Input resistance for the PAC18 is 200kΩ, so if maximum load current for a 0 – 10 V output controller is 2 mA, you can connect up to 40 units.

9. Precautions when turning on the power

9-1. Power supply voltage

Use the device with a power supply within 100 to 240 V.
If voltage in excess of the rating is applied, internal components could be damaged. You should therefore be careful of the power supply voltage.

9-2. Power supply frequency

Power supply frequency should be 50/60 Hz.
Power supply frequency is automatically determined, but the device cannot handle sudden frequency change.
Before switching frequency, turn off the device's power.
Changing power supply frequency with the power on could result in output malfunction causing maximum output.

10. Alarm function

When the state of the device becomes abnormal, the condition is displayed by alarm code by LED digit (red) on the left side of key sequence '0-0. Output monitor (basic screen),' and the decimal point of the digit starts flashing to alert the operator. The alarm function consists of power failure, overcurrent, hardware error, heater break error and input error.
For alarms other than input error, you can select to output each of the alarm contents to alarm contact output (AL) by key sequence '1-3 to 1-6･･･alarm.' Alarms are not displayed when other than key sequence '0-0. Output monitor (basic screen)' is displayed, but the decimal point of the left side LED digit (red) flashes.

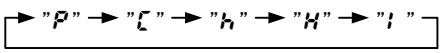
⚠ CAUTION

When an alarm occurs, we recommend you turn off the power, remove the cause, and then turn the power back on.

Alarms

Alarm types	Alarm display	Conditions	Alarm output	Corresponding action
Power failure (Power error)	"P"	Power supply frequency is outside the 40 – 70 Hz range. Power supply frequency is unstable.	Available	Stops output. Output is automatically reset if alarm conditions are eliminated.
Overcurrent (Current error)	"C"	Output current has exceeded 130% of rating.	Available	Stops output. Turn off the power, remove the cause, and then turn the power back on.
Hardware error	"h"	Output current flows when output is 0%.	Available	Stops output. If a hardware error alarm occurs when a load is connected, repair is required.
Heater break	"H"	Heater break has been detected.	Available	Control continues.
Input error	"i "	Control input is less than -10% or above 110%.	Not available	

*If multiple alarm causes occur at once, display is as follows:



The alarm function contents are indicated in the following:

10-1. Power failure (Power error)

A power failure alarm occurs when power supply frequency exceeds the 40 – 70 Hz range or when power supply frequency is unstable.
When the alarm occurs, output stops and an alarm is displayed.

At this time,  is displayed in the alarm display of the left LED digit, and  is displayed in the data display.

(Output standby status, key sequence '0-0. Output monitor [basic screen]' only displayed)
Output is automatically reset if abnormal state is eliminated.
Set key sequence '1-3. Power failure alarm' when outputting power failure alarm to optional alarm contact output (AL).

10-2. Overcurrent (Current error) / (optional)

The built-in overcurrent circuit is triggered when the output current value exceeds 130% of the rating and an overcurrent alarm occurs.
When the alarm occurs, output stops and an alarm is displayed.

At this time,  is displayed in the alarm display of the left LED digit, and  is displayed in the data display.

(Output standby status, key sequence '0-0. Output monitor [basic screen]' only displayed)
Operation remains stopped. To reboot, turn off the power once.
Set key sequence '1-4. Overcurrent alarm' when outputting an overcurrent alarm to alarm contact output (AL).

10-3. Hardware error (optional)

A hardware error alarm occurs when a thyristor error occurs (current continues to flow even if the thyristor device shorts and output is 0%).
When the alarm occurs, output stops and an alarm is displayed.

At this time,  is displayed in the alarm display of the left LED digit, and  is displayed in the data display.

(Output standby status, key sequence '0-0. Output monitor [basic screen]' only displayed)
Operation remains stopped. To reboot, turn off the power once.
Set key sequence '1-5. Hardware error alarm' when outputting hardware error alarm to alarm contact output (AL).

⚠ CAUTION

Do not apply the power to the device with no load. If a hardware error alarm occurs even if a load is connected, repair is required.
Contact your nearest Shimaden agent.

10-4. Heater break (optional)

Function that detects load heater break. A heater break alarm occurs when the current drops below the preset heater break alarm current value.
When the alarm occurs, output continues and an alarm is displayed.

At this time, H is displayed in the alarm display of the left LED digit.

Set key sequence '1-6. Heater break error alarm' when outputting heater break alarm to alarm contact output (AL).

10-5. Input error

An input error alarm occurs if control input is less than -10% or over 110% of the setting range maximum value.
Output continues even if an alarm occurs. You cannot set alarm contact output destination for input error alarm.

At this time, I is displayed in the alarm display of the left LED digit.

The key sequence '0-0. Output monitor (basic screen) ' display does not display less than 0% or more than 100%.

If control input is less than -10%, the key sequence '0-2. Control input' display displays 0.0 or LLL and output serves as the ramp lower limit value;

if control input exceeds 110%, HHH is displayed and output serves as the ramp higher limit value.

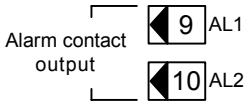
(Display differs according to type of control input.)

10-6. Alarm output (optional)

You can use contact output (relay a contact, 240 V AC / 1 A) as a function to notify alarm occurrence.
Output is on when in alarm status.
You can select whether to output an alarm for each type of alarm. (Multiple selections possible)

Alarm output type and terminal layout

Terminal block No.	Terminal symbol	Alarm	Output type
9	AL1	ALARM OUTPUT	Contact output (relay a contact)
10	AL2		



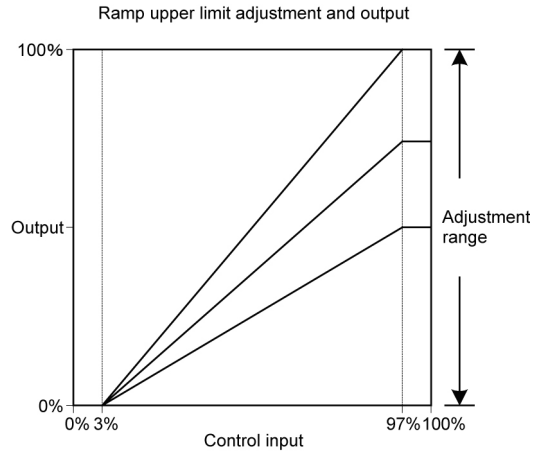
11. Output adjustment function

11-1. Ramp higher limit (high power) adjustment

Set adjustment target by key sequence '1-8. Ramp higher limit option.'
The output value for ramp higher limit can be adjusted from 0.1 to 100% when control input signal is 100%.
Because maximum output is adjusted, output ramp of the PAC18 relative to the control input signal is changed.

11-1-1. Ramp higher limit adjustment by external adjuster

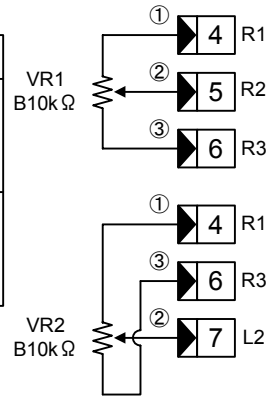
Adjustment location is allocated to VR by key sequence '1-8. Ramp higher limit option.'
If allocated to VR1, connect external adjuster B characteristics 10kΩ (VR) to terminal block No. 4-5-6.
Ramp higher limit adjustment and ramp lower limit adjustment cannot be allocated by the same external adjuster VR.



Ramp higher limit adjustment by output lower limit 0%

External adjuster terminal block layout

Allocation	Terminal block No.	Terminal symbol	Adjuster No.
VR1	4	R1	①
	5	R2	②
	6	R3	③
VR2	4	R1	①
	7	L2	②
	6	R3	③



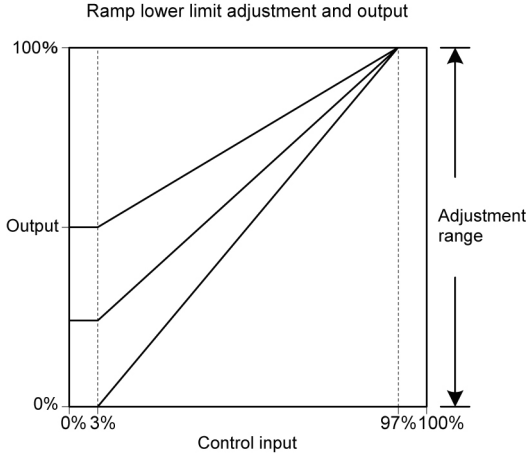
Note: For setting change of key sequence '1-8. Ramp higher limit option' and ramp adjustment by external adjuster, output cannot be changed by variation limit of key sequence '1-10. Variation limit.'

11-2. Ramp lower limit (base power) adjustment

Set adjustment target by key sequence '1-7. Ramp lower limit setting.'
The output value for ramp lower limit can be adjusted from 0 to 99.9% when control input signal is 0%.
Used when you want to output even when control input is 0%.
Because minimum output is adjusted, output ramp of the PAC18 relative to the control input signal is changed.

11-2-1. Ramp lower limit adjustment by external adjuster

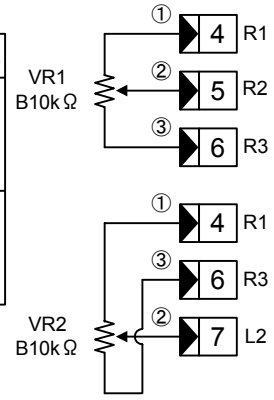
Adjustment location is allocated to VR by key sequence '1-7. Ramp lower limit setting.'
If allocated to VR2, connect external adjuster B characteristics 10kΩ (VR) to terminal block No. 4-7-6.
Ramp higher limit adjustment and ramp lower limit adjustment cannot be allocated by the same external adjuster VR.



Ramp lower limit adjustment by output higher limit 100%

External adjuster terminal block layout

Allocation	Terminal block No.	Terminal symbol	Adjuster No.
VR1	4	R1	①
	5	R2	②
	6	R3	③
VR2	4	R1	①
	7	L2	②
	6	R3	③

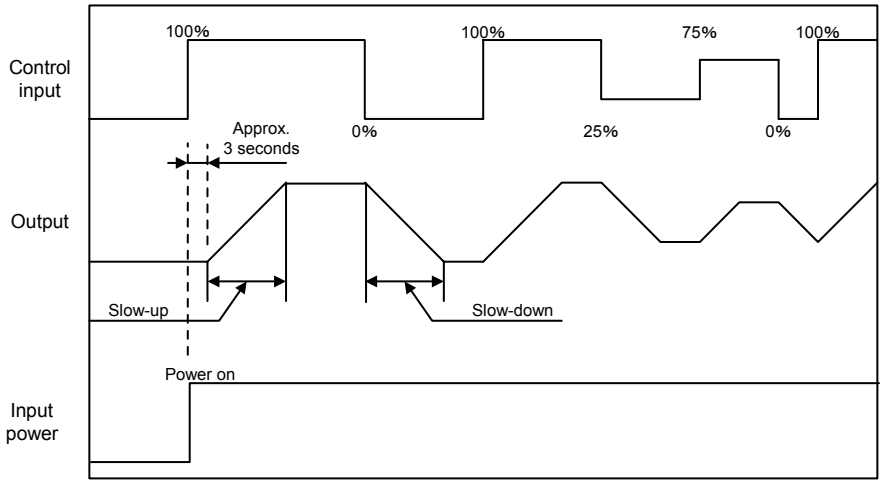


Note: For setting change of key sequence '1-7. Ramp lower limit setting' and ramp adjustment by external adjuster, output cannot be changed by variation limit of key sequence '1-10. Variation limit.'

11-3. Variation limit (slow-up / slow-down) time adjustment

The variation limit function delays PAC18 output response relative to control input signal variation.
It is effective for suppressing transient current when power is turned on, etc., and controlling heater inrush current so as not to place a burden on power equipment. Slow-up/slow-down time is the time required for output to go from 0 to 100%. Slow-up/slow-down time is set from 0.0 to 99.9 seconds by key sequence '1-10. Variation Limit.' Slow-up/slow-down time cannot be set separately.
The longer the time is set, the slower output response is. Adjust time according to characteristics of load used.
The factory setting is approximately 1 second. If time is set shorter than this, the overcurrent protection function may be triggered depending on load conditions.
For setting change of key sequence '1-7. Ramp lower limit setting' and key sequence '1-8. Ramp higher limit option,' and when conducting ramp adjustment by external adjuster, output cannot be changed by variation limit.

Operation diagram

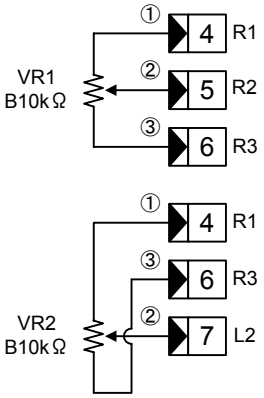


11-4. Current limit function (optional)

Function for limiting output current to within 0 – 120% of the device's rated current. Limits current and protects the thyristor if using loads with large inrush current such as pure metal heaters or lamp heaters.
Detects output current by built-in CT and produces delay time to control the control angle of the thyristor (response time 0.1 sec. or less).
Sudden change in load while conducting power therefore may not be handled.
If using external current limit setting B characteristic 10kΩ (VR), allocate by key sequence '1-11. Current limiter.'
(If allocating to VR, current limit is 100% of rated current.)
For large inrush current load, use with variation limit (slow-up/slow-down) time set to at least 2 seconds.

External adjuster terminal block layout

Allocation	Terminal block No.	Terminal symbol	Adjuster No.
VR1	4	R1	①
	5	R2	②
	6	R3	③
VR2	4	R1	①
	7	L2	②
	6	R3	③



Also, if current exceeds 130% of the rated current, the circuit inside the device is triggered to force output to 0%.; alarm display [E] is displayed and the data display displays [Stb] . (Standby display displayed for 0-0. Basic screen only) Remove the cause of the alarm and turn the power back on.

Note
- The current limit function is not activated for cycle calculation zero voltage switching control or complex control.
- The more load rate exceeds 100%, the more output power drops. (Limit current to set value by lowering output voltage.)
- If current limit setting device is removed with external current limit setting device (VR) set to key sequence '1-11. Current limiter' setting, current is limited to 0% of rated current and there is no output.

12. Fuse / heater break alarm function

12-1. Rapid fuse (sold separately)

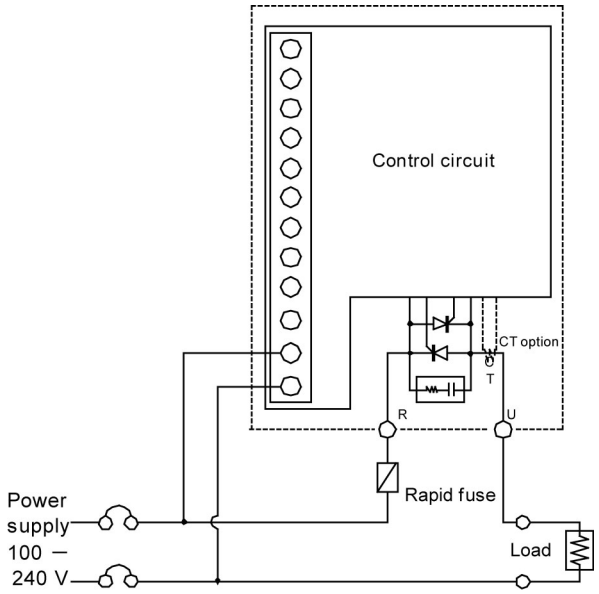
You can externally mount a rapid fuse to protect the thyristor device. The thyristor device cannot be protected by electronic protection circuit from malfunction when using a transformer or load short circuit when conducting power. It can therefore be protected by using a rapid fuse.

Recommended rapid fuses

Name		Separately sold part type
Rapid fuse	20/30A (350GH-50UL Hinode Electric Co., Ltd.)	QSF006
	45/60A (350GH-100UL Hinode Electric Co., Ltd.)	QSF007
	80/100A (CF5R06-150 Fuji Electric FA Components & Systems Co., Ltd.)	QSF008
Fuse holder	20－60A (HT4017 Hinode Electric Co., Ltd.)	QSH002
	80/100A (CMS-5 Fuji Electric FA Components & Systems Co., Ltd.)	QSH003
Rapid fuse and fuse holder set	For 20/30A (350GH-50UL + HT4017 set)	QSF01F
	For 45/60A (350GH-100UL + HT4017 set)	QSF01G
	For 80/100A (CF5R06-150 + CMS-5 set)	QSF01H

For information on rapid fuses, contact your nearest Shimaden agent.

Connection diagram



⚠CAUTION

Cut off the device's power supply before replacing the rapid fuse.

12-2. Heater break alarm function (optional)

The heater break alarm is a function whereby an alarm is given to let you know when the heater is broken.
The function is effective for preventing product defects and negative impact of insufficient power.

12-2-1. Operation overview

In ordinary operating conditions, measure the current value of the steady heater by key sequence '3-2. Setting of break judgment standard for heater break' and use as standard value.
Input the reduction rate (heater break alarm point) of the current value for the standard value by key sequence '1-12. Heater break alarm current.'
When the current is below the preset value for at least 5 seconds, the heater is judged to be broken and the heater break alarm occurs.

When the alarm occurs, the alarm display of the LED on the far left displays H and control operation output continues as is.

Alarm output is canceled as soon as heater current recovers, and the H display in the alarm display of the LED digit on the left is canceled.

If self- hold is required, an external self-hold circuit must be constructed.

12-2-2. Setting method

1) Preparation before setting

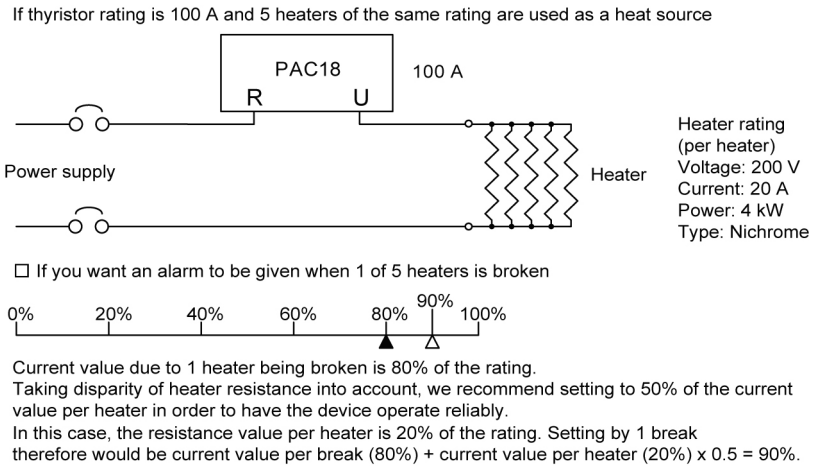
Switch to rSEt of key sequence '3-2. Setting of break judgment standard for heater break' of manual operation screen. (The dot on the right flashes.)
The heater is powered with output near that of actual usage and the heater temperature is sufficiently stabilized.
(You should however make the load current at least 25% of the rated current.)

2) Heater current value setting

When heater temperature stabilizes, press ENT and load the heater current value (standard value). (The dot on the right stops flashing.)

3) Heater break alarm point setting (HB alarm trigger point setting)

Set current for heater break in the range of 0 – 100% by key sequence '1-12. Heater break alarm current.'
(Alarm however does not occur if heater break alarm current is set to 0%.)
Example 1: Detecting break for 1 of 5 heaters
Current percentage for 1 break is 4/5 x 100 = 80%; set to about 90% between that and 100% current when operating normally.



Example 2: If using 1 heater
Set to 50% between 0% current when broken and 100% when operating normally.

12-2-3. Precautions when setting

1) When setting steady heater standard current value by key sequence '3-2. Setting of break judgment standard for heater break', do so with device output set to maximum within the output range actually used. If set outside the actually used output range or when output is small (load current is less than 25% of the rated current), the effect of detection error grows large and could result in malfunction.

2) You should set the heater break alarm point low by key sequence '1-12. Heater break alarm current.'
Depending on the type of load, detection accuracy may drop and result in malfunction.
Even in the case of constant resistance heaters, resistance value may vary according to heater temperature in some cases.
In some cases, it may be difficult to differentiate between that resistance value variation and resistance value variation due to 1 of several heaters being broken. If there are many heaters (5 or more), if you set lower than the calculation value (value between 1 break and when normal), you may be able to detect break of 1 of several heaters, but this is effective for preventing malfunction of HB alarms.

3) Variable resistance heaters can be controlled applicable load, but Heater break alarm function can not be detected rightly in some cases because the change of resistance value is too large.
With variable resistance heaters, current may become lower than the standard current value of the steady heater measured by key sequence '3-2. Setting of break judgment standard for heater break' during usage. If so, set the value lower than the drop in current percentage.
Example: Using 2 heaters. If heater resistance is large when starting and current when starting is 70% of the heater current for ordinary operation, set lower than 70% of the current when it drops.
Because current when starting is 70% and 50% when 1 heater is broken, if you set to 60% between the two, detecting break 1 of 2 heaters is possible.
If using 3 similar heaters, you cannot accurately set to a value between when the current drops to 70% and when current drops to 67% when 1 heater is broken. Detecting break of 1 of 3 heaters is therefore impossible.

4) In the case of light loads of less than 15% of the rated heater current, heater break may not be able to be detected.
With transformer loads, current detection accuracy may drop. If using with light load to prevent malfunction (30% of rating or less) or transformer load, base the heater break alarm point setting on 50% by key sequence '1-12. Heater break alarm current.'

5) To avoid malfunction, heater break alarm is not activated when output phase angle is less than 15%.

13. Manual operation

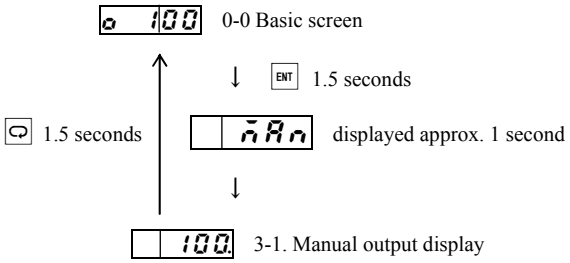
The device offers both operation by control input and manual operation.
If performing manual operation or deciding output characteristics by test operation, you can control output manually.
Operation is set to control input when shipped from the factory. When the power is turned on, the device is controlled by control input.

13-1. Manual operation

With manual operation, the desired operation amount is controlled manually.
Manual operation includes key operation and operation by external adjuster VR3.
During manual operation, the first digit dot of data display for the monitor screen group flashes.
Manual control cannot be performed if key sequence '2-1. Control input type' is contact 2-position control.
Manual control cannot be performed when communication manual output operation be enabled.

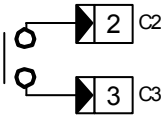
1) Manual operation by key
You can select key operation by opening C2 – C3 terminals. (Cannot be selected if C2 – C3 terminals are shorted.)

Press and hold [ENT] on the basic screen for at least 1.5 seconds.



Automatic/manual terminal blocklayout

Terminal block No.	Terminal symbol
2	C2
3	C3



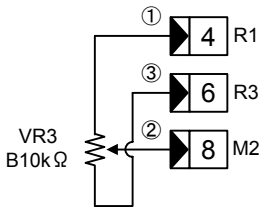
Output is up by [▲] , and down by [▼].

Manual operation can be conducted by key sequence '3-1. Manual operation.'

2) Manual operation by external adjuster VR3
Shorting the C2 – C3 terminals selects external adjuster VR3.
In this case, the manual operation group can no longer be selected by key operation.

Manual power regulator terminal block layout

Allocation	Terminal block No.	Terminal symbol	Adjuster No.
VR3	4	R1	①
	8	M2	②
	6	R3	③



If ① is broken, output is 100% output.
If ② or ③ is broken, output is 0% output.

Note
When operation is switched from control input to manual operation by key, manual operation is set from the output values before switching.
If switched from manual operation by key to control input operation, operation is executed by control input values immediately after switching. (Output value not carried over)
If operation is switched from manual operation by key to control input, output varies by key sequence '1-10. Variation limit.'

If operation is switched from control input to manual operation by external adjuster, output varies by key sequence '1-10. Variation limit.'
If operation is switched from manual operation by external adjuster VR3 to control input, output varies by key sequence '1-10. Variation limit.'

14. Characteristics

14-1. Rated current and heat value

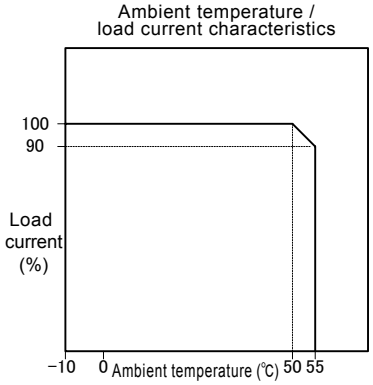
By conducting current to the thyristor, voltage (0.9－1.3 V) is gererated between terninals. Voltage between terminals and accumulation of current (W) turn into Joule heat, resulting in rise in temperature of the thyristor device. Take radiation and ventilation into account.

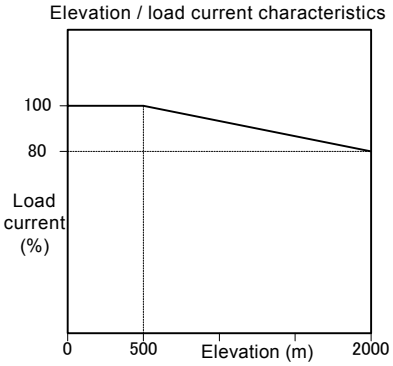
Internal heat value

Rated current	20A	30A	45A	60A	80A	100A
Heat value	22W	36W	47W	65W	77W	96W

14-2. Ambient temperature, elevation and load current

Rated current of the device assumes an environment where ambient temperature does not rise above 55°C. If ambient temperature exceeds 50°C, reduce load current as shown in the following figure.

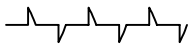
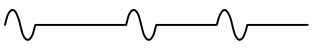
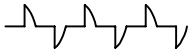
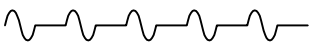
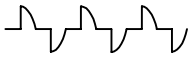
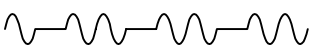
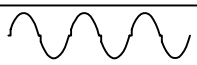
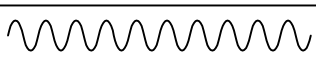




14-3. Control type and output waveform

The device includes phase control and cycle calculation zero voltage switching control types. Be sure to specify which type you require when ordering. The customer cannot change control type.

A comparison of features is provided below.

Output \ Control type	Phase control	Cycle calculation zero voltage switching control
0%		
30%		
50%		
70%		
100%		
Noise generation	Large	Small
Output	Continuous	Intermittent

14-4. Various control types

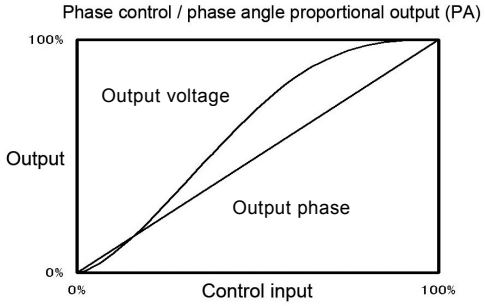
The device is equipped with various control functions (phase angle proportion, voltage proportion, voltage square proportion, cycle calculation zero voltage switching, complex).
Specify the desired control type when placing your order.

Control type

Display	Control type
PA	Phase control / phase angle proportional output
PA-V	Phase control / voltage proportional output
PA-W	Phase control / voltage square proportional output
ZC	Cycle calculation zero voltage switching control
PA-Z	Complex control

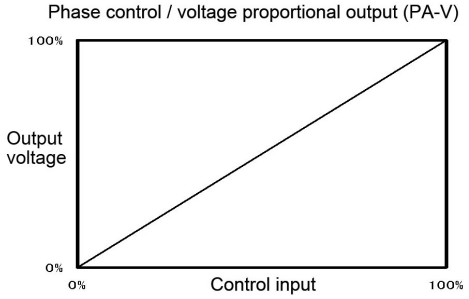
14-4-1. Phase control / phase angle proportional output PA

You can obtain phase angle output proportional to control input signal.
This function enables finer output control than cycle output control.



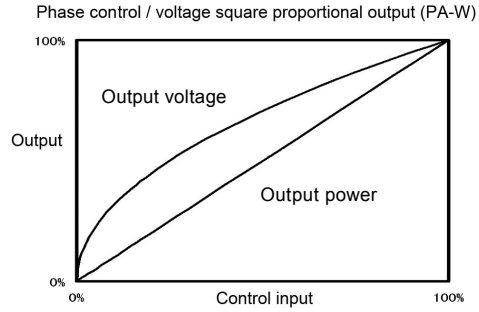
14-4-2. Phase control / voltage proportional output PA-V

You can obtain output voltage proportional to control input signal.
The current limit function is necessary for large inrush current loads.



14-4-3. Phase control / voltage square proportional output PA-W

You can obtain voltage square output proportional to control input signal.
Because power relative to constant resistance is proportional to voltage squared, you can obtain power according to control signal using constant resistance heaters such as nichrome or iron-chrome.
The current limit function is necessary for large inrush current loads.

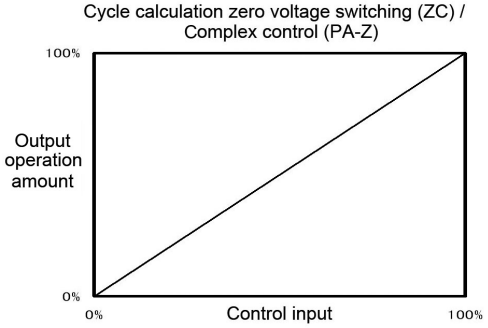


14-4-4. Cycle calculation zero voltage switching ZC

You can obtain cycle output proportional to control input.
Not as much noise is produced as with phase angle control.

14-4-5. Complex control PA-Z

Short time phase angle control is executed only when output rises from zero percent, after which operation switches to cycle output.



15. Noise countermeasures

Especially with phase control for thyristors, part of the power supply sine wave is dropped. This produces distortion in the sine wave if power supply impedance is high. Also, because power supply is switched each half cycle, switching noise is produced. The power supply distortion and noise may affect other equipment.
In the case of cycle calculation zero voltage switching, an extremely small amount of noise is produced compared with phase control due to switching near the zero cross point of the power supply.
Because some noise is produced by switching large current, however, you should use a noise filter if necessary.
Also, if power supply impedance is high, the power supply may flicker in synch with ON/OFF of the thyristor.

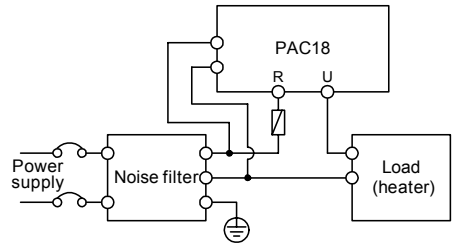
15-1. Noise filter (sold separately)

The frequency of noise produced by the thyristor is distributed in a place below several megahertz, and the noise dampening effect of common commercially available noise filters is insufficient.
Using noise filters specified by Shimaden can dampen this noise. This noise filter is specially designed for Shimaden thyristor power regulators.

Rated current	Type
20A／30A	HF2030A-XB
45A	HF2050A-XB
60A	HF2060A-XB
80A	HF2080A-XB
100A	HF2100A-XB

For information on noise filters, contact your nearest Shimaden agent.

Noise filter connection diagram

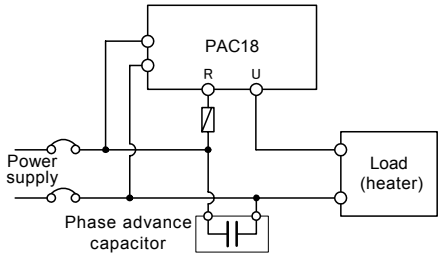


15-2. Improvement of power supply waveform by phase advance capacitor

It is effective to connect a phase advance capacitor to the main power supply for the device and load to ameliorate power supply distortion (high harmonic wave) due to thyristor phase control by enhancing power factor.
1 μF capacitor should be effective for rated current 1 A.
This is a very simple method, but you should take the following precautions.

① High harmonic wave current flows into the capacitor, so pay attention to the rated current of the capacitor and watch out for temperature rise.
② The capacitor may cause resonation with inductance of the power supply line resulting in high harmonic wave voltage; check the power supply waveform.

Phase advance capacitor connection diagram



16. Precautions for inductive load

Transformer usage objective
1) To match voltage when heater voltage differs from power supply voltage.
2) When it is necessary to insulate the heater circuit from the power supply.
3) To raise ground voltage resistance using a double winding transformer when ground insulation deteriorates like vacuum equipment.

16-1. Control type

A transformer can be used for phase control or complex control.
A transformer load cannot be used for cycle calculation zero voltage switching control.

16-2. Transformer magnetic flux density

Excessive current flows when the magnetic circuit becomes saturated when using the transformer (load is limited to transformer winding resistance) and could destroy the thyristor. With thyristor control, the thyristor is switched (OFF/ON) each half cycle. If the load becomes heavy, the output waveform tends to become unbalanced and saturated. You should therefore design the system so that magnetic flux density is lower than that of a conventional transformer. If using with complex control, proceed by key sequence '1-2. Complex control phase angle adjustment.'

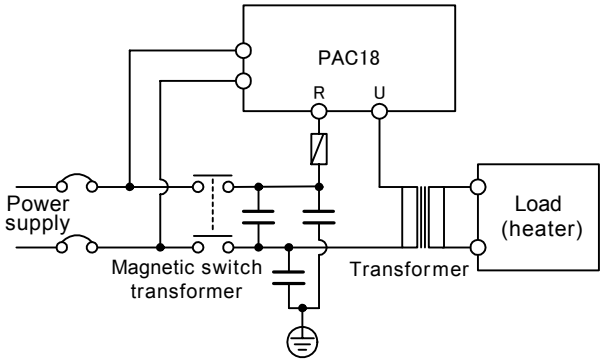
⚠CAUTION

The applicable transformer is as follows:
Applicable transformer: Isolation transformer (double winding transformer)
Inapplicable single phase transformer: Single winding transformer (slide transformer only)
The secondary side of applicable transformers must, however, be connected to resistance load (power factor 0.8 – 1.0).

Conventional transformers are designed so that saturated magnetic flux is saturated at approx. 1.0 – 1.3 tesla (10,000 – 13,000 gauss).
If using in combination with a thyristor, design so that 0.8 tesla (8000 gauss) is not exceeded.
(There is no problem with using a conventional transformer if used with a load rate that doesn't exceed 70% of the transformer rating.)
Do not connect any equipment between the device and transformer.
Cut off the power supply before replacing the tap of the transformer.

16-3. If using magnetic switch (contactor)

If using a magnetic switch (contactor) for a circuit connected to the transformer (inductive load), malfunction could result from contact bounce.
If so, you should either use the prescribed noise filter, or connect an X capacitor (0.1 – 0.5 μF) between the R and U power supply side terminals of the thyristor, or a Y capacitor (1000 – 3300 pF) between the R and U power supply side terminals and the ground to absorb the noise.



16-4. Rapid fuse usage

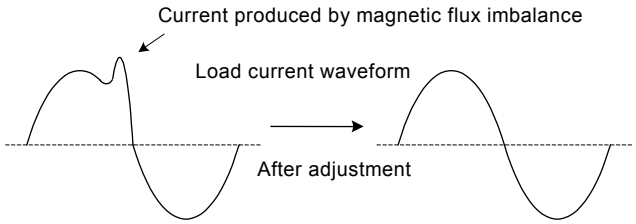
We recommend a rapid fuse to protect the thyristor device from excessive current produced when using a transformer due to high frequency wave noise or load trouble, etc.

16-5. Prohibition of operating without load

Before conducting operation whereby a load cannot be connected such as test operation, disconnect the transformer wiring and connect a dummy load such as an electric heater or light bulb. Do not operate the device with the secondary side of a transformer load open.
Do not switch loads while the device is powered. Doing so could result in excessive current due to failure of the soft start function to be triggered or the protective circuit to be triggered due to absence of a load.
Example: If using a single heater and it becomes broken, then the device would be operating without a load.

16-6. Complex control phase angle adjustment

Select complex control if you want to use a single phase transformer as a load for cycle calculation zero voltage switching control.
Phase angle adjustment is required for complex control.
With complex control, slow-up is conducted by phase control ahead of cycle calculation zero voltage switching control to cancel magnetic flux imbalance of single phase transformers.
If however a sine wave of single phase transformer primary and secondary side current that is negatively and positively symmetrical is not present, magnetic flux imbalance could be produced, resulting in excessive current.
It is therefore necessary to adjust load current so that negative and positive are symmetrical in order to cancel magnetic flux imbalance.
After presetting load conditions of the transformer actually used, adjust while monitoring load current. Phase angle is adjusted so the current waveform is a non-sine wave. Adjust by key sequence '1-2. Complex control phase angle adjustment.'
This adjustment could produce excessive current; increase load current gradually while monitoring the current waveform.



17. Parameter setting function / Communication

17-1. Parameter setting function (optional)

If the device is optionally equipped with a parameter setting function, you can connect to a computer via a separately sold data communication adapter and display various settings, control input values, output values and trend graph.

17-2. Communication (optional)

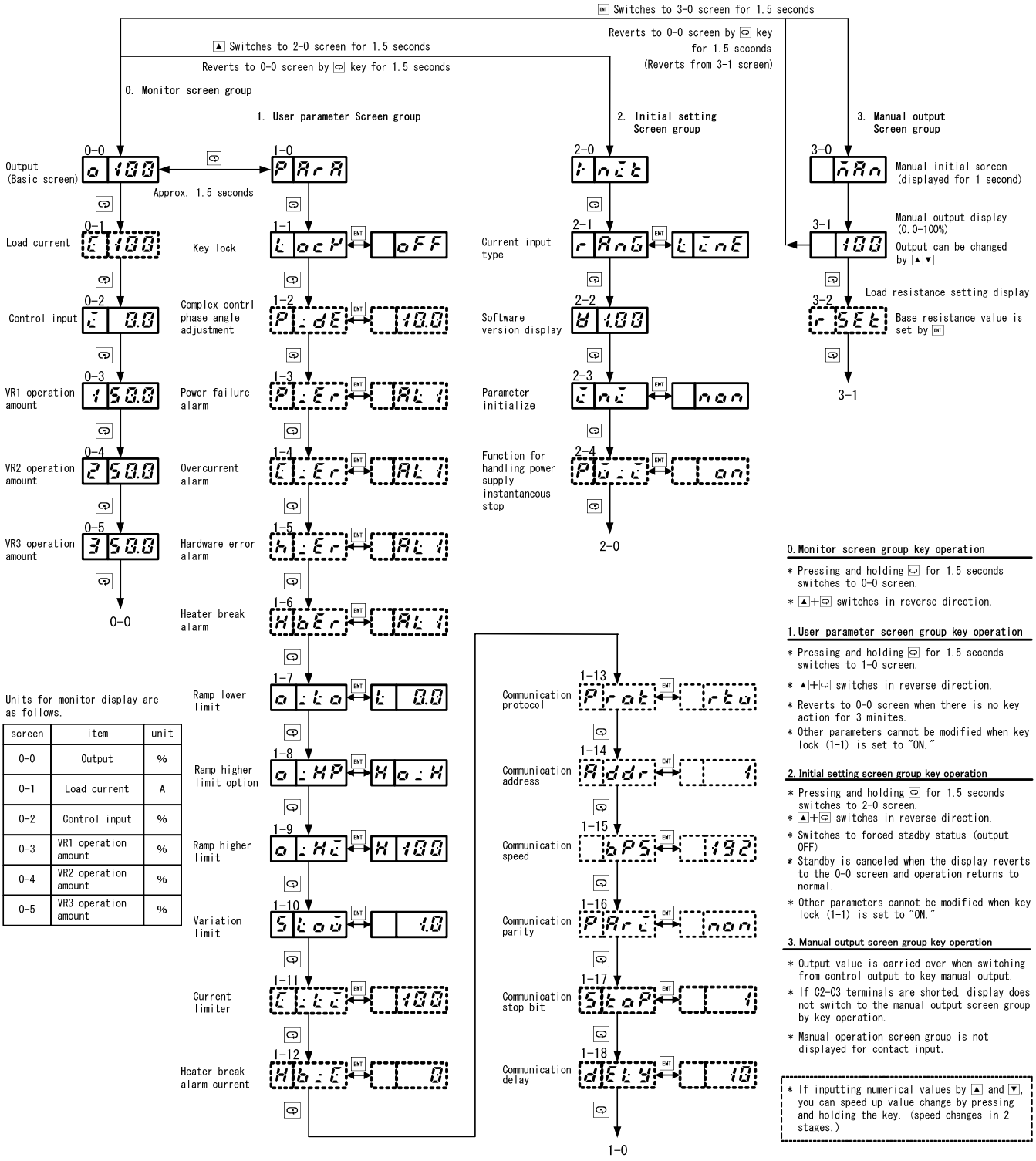
Hardware conforms to RS-485.
Communication protocol is MODBUS (RTU).
Set communication conditions by 'key sequence 1-14. Communication address,' 'key sequence 1-15. Communication speed,' 'key sequence 1-16. Communication parity,' 'key sequence 1-17. Communication Stop bit' and 'key sequence 1-18. Communication delay.'

For details, see the instruction manual for the communication interface.

18. Key sequence

18-1. Screen sequence

Standard screens are indicated by a solid line box ☐ and optional screens are indicated by a dotted line box ⬚.
Optional screens may not be displayed depending on the product specifications.



Units for monitor display are as follows.

screen	item	unit
0-0	Output	%
0-1	Load current	A
0-2	Control input	%
0-3	VR1 operation amount	%
0-4	VR2 operation amount	%
0-5	VR3 operation amount	%

Note: When changing numerical values on each screen group, use ▲ or ▼ key. Press ⇦ key to register.

0. Monitor screen group key operation

* Pressing and holding ⇦ for 1.5 seconds switches to 0-0 screen.
* ▲+⇦ switches in reverse direction.

1. User parameter screen group key operation

* Pressing and holding ⇦ for 1.5 seconds switches to 1-0 screen.
* ▲+⇦ switches in reverse direction.
* Reverts to 0-0 screen when there is no key action for 3 minites.
* Other parameters cannot be modified when key lock (1-1) is set to "ON."

2. Initial setting screen group key operation

* Pressing and holding ⇦ for 1.5 seconds switches to 2-0 screen.
* ▲+⇦ switches in reverse direction.
* Switches to forced stadby status (output OFF)
* Standby is canceled when the display reverts to the 0-0 screen and operation returns to normal.
* Other parameters cannot be modified when key lock (1-1) is set to "ON."

3. Manual output screen group key operation

* Output value is carried over when switching from control output to key manual output.
* If C2-C3 terminals are shorted, display does not switch to the manual output screen group by key operation.
* Manual operation screen group is not displayed for contact input.

* If inputting numerical values by ▲ and ▼, you can speed up value change by pressing and holding the key. (speed changes in 2 stages.)

Standard screens are indicated by a solid line box and optional screens are indicated by a dotted line box.
Optional screens may not be displayed depending on the product specifications.

0. Monitor screen group

Screen group that displays data such as voltage, current and input values of various loads

0-0. Output monitor (basic screen)

Basic screen for the device.
Displays current output.

When phase control (phase angle proportional control) is selected:	Output phase angle (%)
When phase control (voltage proportional control) is selected:	Output voltage (%)
When phase control (voltage square proportional control) is selected:	Output power (%)
When cycle calculation zero voltage switching control is selected:	Output operation amount (%)
When complex control is selected:	Output operation amount (%)

Switches from this screen to various parameter groups for checking/setting various parameter settings.

range: 0.0 – 100%

(fractional digits below decimal point not displayed for 100%)

Switches to subsequent screen → key sequence '0-1'

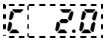
Pressing and holding 1.5 seconds switches to user parameter group → key sequence '1-0.'

Pressing and holding 1.5 seconds switches to initial setting screen group → key sequence '2-0.'

Pressing and holding 1.5 seconds switches to manual output screen group → key sequence '3-0.'

0-1. Load current (optional)

Displays load current value (A).



Range: At least 5% of rated current

(Fractional digits below decimal point not displayed for 100 A or more)

Displayed when current is below 5% of the rating.

0-2. Control input

Displays control input value.
Controls according to power supply frequency, so it can't handle faster variation.

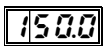
range: -10.0 – 110%

(fractional digits below decimal point not displayed for 100% or more)

0.0 or LLL is displayed if control input is less than -10%; HHH is displayed if 110% is exceeded. Differs according to type of control input.
If set to contact 2-position control (on/off control), 100 is displayed for C3-C2 terminal short and 0.0 is displayed for C3-C2 terminal open.

0-3. VR1 operation amount

Operation amount of VR1 is displayed in the range of 0 – 100%.
Set either key sequence '1-7. Ramp lower limit setting, ' key sequence '1-8. Ramp higher limit option,' or key sequence '1-11. Current limiter.'

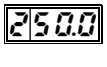


range: 0.0 – 100%

(fractional digits below decimal point not displayed for 100%)

0-4. VR2 operation amount

Operation amount of VR2 is displayed in the range of 0 – 100%.
Set either key sequence '1-7. Ramp lower limit setting, ' key sequence '1-8. Ramp higher limit option,' or key sequence '1-11. Current limiter.'

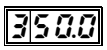


range: 0.0 – 100%

(fractional digits below decimal point not displayed for 100%)

0-5. VR3 operation amount

Operation amount of VR3 is displayed in the range of 0 – 100%.
VR3 is used for manual operation.



range: 0.0 – 100%

(fractional digits below decimal point not displayed for 100%)

Switches to key sequence '0-0. Basic screen.'

1. User parameter screen group

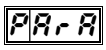
The user can modify the control operation parameters.
You can obtain safer, more reliable control characteristics by various type of alarm output settings and settings such as overcurrent limit.

The user parameter screen group is accessed by pressing and holding for at least 1.5 seconds from key sequence '0-0. Output monitor (basic screen).'

▼ ▲ Switches parameters.

ENT Enters selection.

1-0 User parameter screen

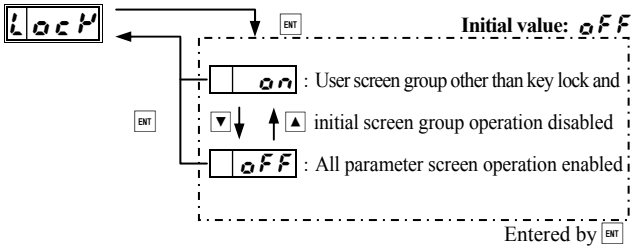


Displays the initial screen of the user parameter screen group.
Switch to this screen when returning to the basic screen from the user parameter screen group.

Switches to subsequent screen → key sequence '1-1'

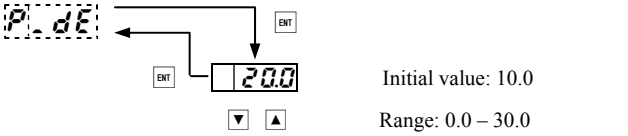
1-1. Key lock

Limits operation of parameters screens.



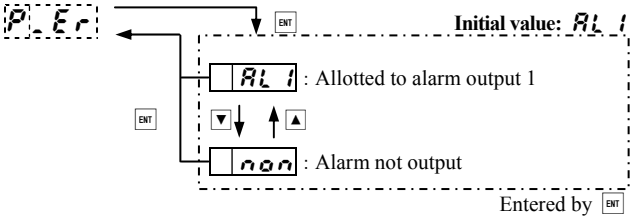
1-2. Complex control phase angle adjustment (enabled when complex control selected)

This screen is displayed when complex control is selected as a product specification.
May produce delay in current phase due to load and transformer used.
This could upset magnetic balance of the transformer, cause the transformer to become saturated, and excessive current could flow. This can be avoided by adjusting to eliminate current imbalance. Adjust while monitoring the waveform of the transformer load current with an oscilloscope, etc., using an actual load. See '16-6. Complex control phase angle adjustment.'



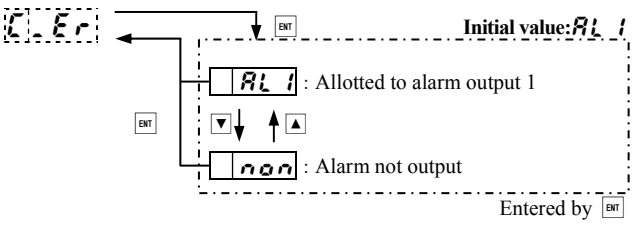
1-3. Power failure error alarm (optional)

Sets whether or not to output an alarm when a power failure occurs.



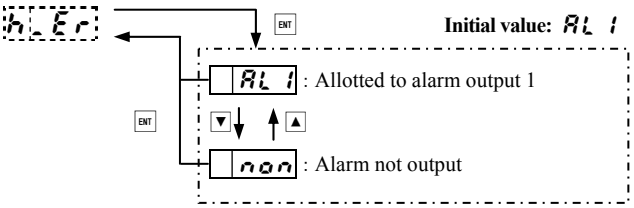
1-4. Overcurrent error alarm (optional)

Sets whether or not to output an alarm when overcurrent protection circuit is triggered.



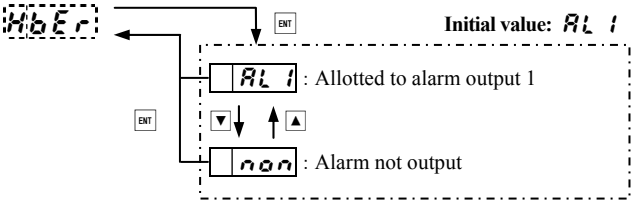
1-5. Hardware error alarm (optional)

Sets whether or not to output an alarm when thyristor failure or circuit error occurs.



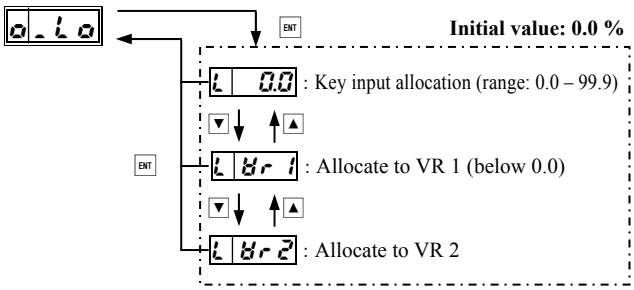
1-6. Heater break error alarm (optional)

Sets whether or not to output an alarm when heater break occurs.



1-7: Ramp lower limit

Sets allocation of output ramp limit (base power).
Lower the display to 0.0 when allocating to VR.



Note 1

Both ramp lower limit and ramp higher limit cannot be allocated to VR 1 and VR 2.
For example, if VR 1 is selected for ramp lower limit, only VR 2 can be selected for ramp higher limit.
If one VR has been selected, the other is automatically selected as well.
To change while higher or lower limit is selected, first cancel VR allocation and then change.
(VR cannot be selected while using key sequence '1-11. Current limiter.'
To allocate to ramp lower limit, cancel allocation of VR of key sequence '1-11.')

Note 2

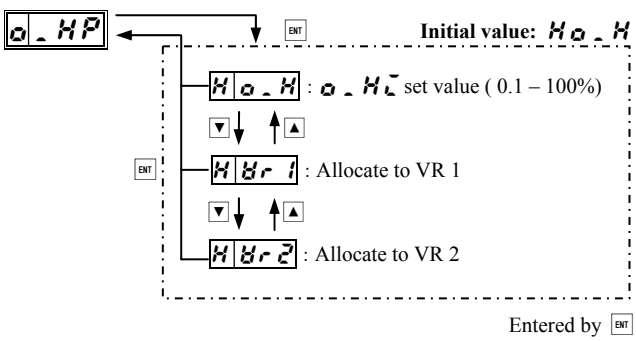
Ramp lower limit cannot be set higher than ramp higher limit. (Key setting and VR setting)
Output range is narrowed down by reducing the difference between ramp lower limit and ramp higher limit, which could produce hunting.

Note 3

Output is not modified by variation limit by changing the ramp lower limit setting.

1-8: Ramp higher limit option

Sets ramp higher limit option.



Note 1

Ramp lower limit and ramp higher limiter allocation cannot be overlapped for VR1 and VR2.
To change allocation, you must first clear the VR allocation.

Note 2

For key setting, ramp higher limit cannot be set below ramp lower limit. For VR setting, ramp lower limit drops if ramp upper limit is lower than ramp lower limit.
If the difference between ramp higher limit and ramp lower limit is small, output range is narrow, and could therefore result in hunting.

Note 3

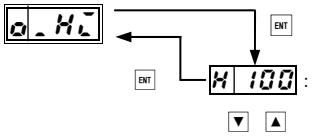
Output is not modified by variation limit by changing the ramp higher limit setting.

Note 4

When allocated to VR1/VR2, ramp higher limit would be (VR amount)*(o_HL set value). If o_HL is set to 100%, ramp higher limit would be controlled only by VR1/VR2.

1-9: Ramp higher limit

Sets allocation of ramp higher limit of output (high power).



Range: 0.1 – 100
(fractional digits below decimal point not displayed for 100%)

Note 1

Both ramp lower limit and ramp higher limit cannot be allocated to VR 1 and VR 2.
For example, if VR 1 is selected for ramp higher limit, only VR 2 can be selected for ramp lower limit.
If one VR has been selected, the other is automatically selected as well.
To change while higher or lower limit is selected, first cancel VR allocation and then change.
(VR cannot be selected while using key sequence '1-11. Current limiter.'
To allocate to ramp higher limit, cancel allocation of VR of key sequence '1-11.')

Note 2

For key setting, ramp higher limit cannot be set below ramp lower limit.
For VR setting, ramp lower limit drops if ramp higher limit is lower than ramp lower limit.
Output range is narrowed down by reducing the difference between ramp lower limit and ramp higher limit, which could produce hunting.

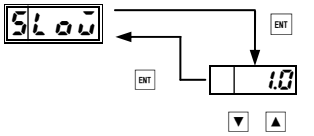
Note 3

Output is not modified by variation limit by changing the ramp higher limit setting.

1-10. Variation limit

Current may change precipitously if amount of output varies dramatically while the power is on. A variation limit is provided to control this ramp.

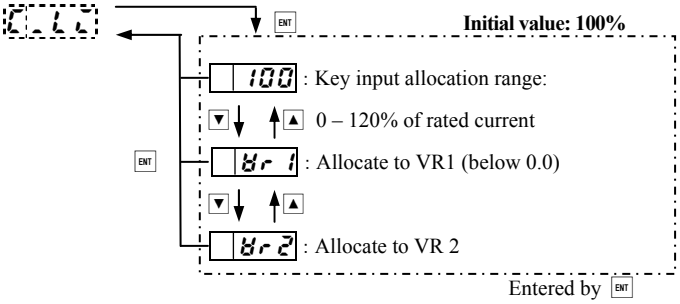
Unit: Seconds



The setting value is the time required for output to increase from 0 to 100%.

1-11. Current limiter (optional)

The current limiter limits output current value to 120% of rated current. Sets allocation of the function. Lower the display to 0 when allocating to VR. (If allocating to VR, current limit is 100% of rated current.)
This screen is not displayed for cycle calculation zero voltage switching control or complex control.

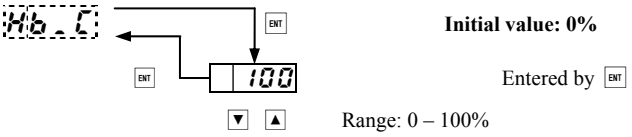


Note

VR currently being used cannot be selected by key sequence '1-7. Ramp lower limit setting' and key sequence '1-8. Ramp higher limit option.' If allocating to the current limiter, cancel VR allocation of key sequence '1-7.' or key sequence '1-8.'

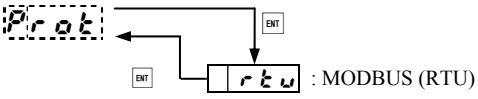
1-12. Heater break alarm current (optional)

Sets value for which alarm is to be output for heater break in percent of set standard value. (Alarm however does not occur if heater break alarm current is set to 0%.)



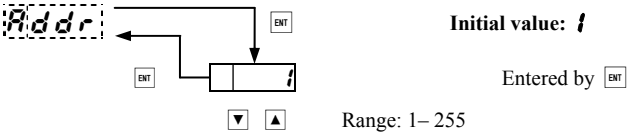
1-13. Communication protocol (optional)

This screen is displayed if you have selected communication (optional). Displays communication protocol.



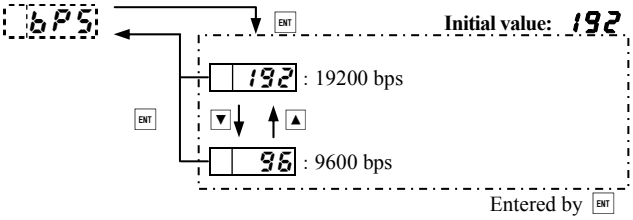
1-14. Communication address (optional)

This screen is displayed if you have selected communication (optional). Sets communication address.



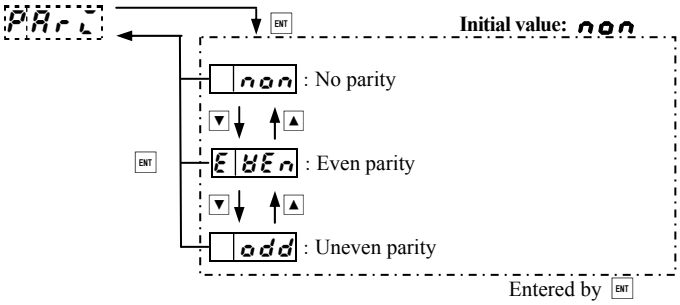
1-15. Communication speed (optional)

This screen is displayed if you have selected communication (optional). Sets communication speed.



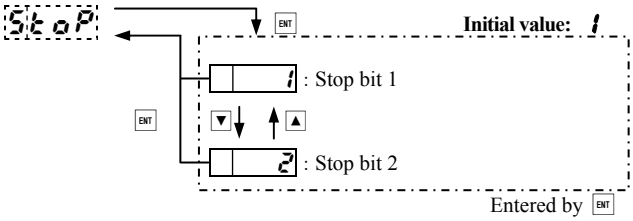
1-16. Communication parity (optional)

This screen is displayed if you have selected communication (optional). Sets communication parity.



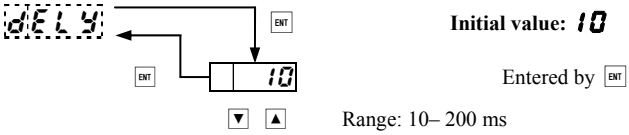
1-17. Communication Stop bit (optional)

This screen is displayed if you have selected communication (optional). Sets stop bit.



1-18. Communication delay (optional)

This screen is displayed if you have selected communication (optional). Sets communication delay.



Sets time from reception to transmission.
Sets delay time if equipment with slow response is connected.
By doing so, you can avoid collision of data in the communication line.

↺ Switches to key sequence '1-0. Initial screen.'

2. Initial setting screen group

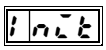
Group of screens for setting operation conditions for the device.
Must be set in advance.
The initial setting screen group is accessed by pressing and holding ▲ for at least 1.5 seconds from key sequence '0-0. Output monitor (basic screen).' Output is forced off (output OFF).
To escape for the initial setting screen, press and hold ↺ for at least 1.5 seconds from key sequence '2-0. Initial screen.' Switches to monitor screen group.

▼ ▲ Switches parameters.

ENT Enters selection.

2-0. Initial screen

Initial screen for initial setting screen group.
Switch to this screen when returning to the basic screen.

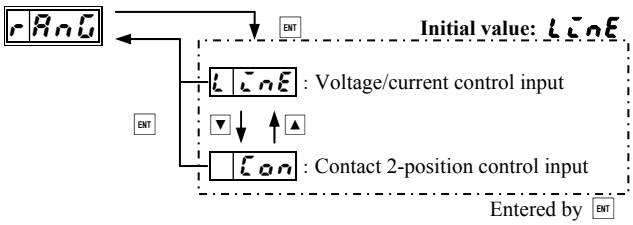


↺ Switches to subsequent screen → key sequence '2-1.'

↺ Pressing 1.5 seconds switches to monitor screen group → key sequence '0-0.'

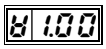
2-1. Control input type selection

Selects type of control input for the device.



2-2. Software version display

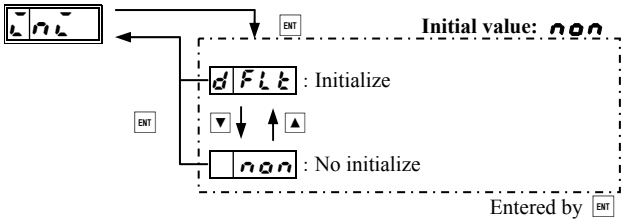
Displays software version of the device.



V1.00 is shown in this display.

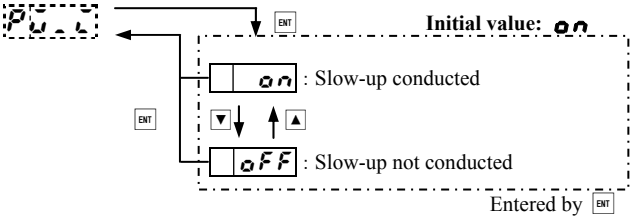
2-3. Parameter initialize

Resets initial settings screen group and user parameter group to factory settings.
Executed by ENT. (Restart after executing reset.)



2-4. Power supply instantaneous stop handling function (effective when phase control or complex control is selected)

Sets slow-up operation when power is restored after instantaneous power stop is detected.



↺ Switches to key sequence '2-0. Initial screen.'

3. Manual output screen group

To conduct manual output by key operation, open the connection between C2 and C3 terminals. (You cannot switch to this screen if the terminals are shorted.)
When communication manual output operation be enabled, the manual output screen group can not be selected by key operation.
When Contact 2-position control input be selected, the manual output screen group can not be selected by key operation.

With the heater break alarm function, there is an operation to measure resistance value of the heater.

▼ ▲ Switches parameters.

ENT Enters selection.

3-0. Switch to manual output

Pressing and holding ENT for at least 1.5 seconds switches from the '0-0. Output monitor (basic screen)' to manual output.
When manual output is switched to from the key sequence '0-0. Output monitor (basic screen),' the immediately preceding control input values are carried over.
If reverting to the key sequence '0-0. Output monitor (basic screen)' from manual output, output is in accordance with control input values at that time.

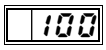
key sequence '0-0.' Basic screen

↓ ENT Press and hold for 1.5 seconds.

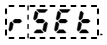
displayed approx. 1 second

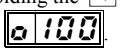
3-1. Manual output screen

Displays the manual output screen.



: Displays manual output values.

Range: 0.0 – 100% (fractional digits below decimal point not displayed for 100%)
Output is 100% for this display.
Output can be changed by ▼ ▲ key.
↺ key switches to resistance setting screen 

.
Pressing and holding the ↺ key for 1.5 seconds reverts to basic screen 

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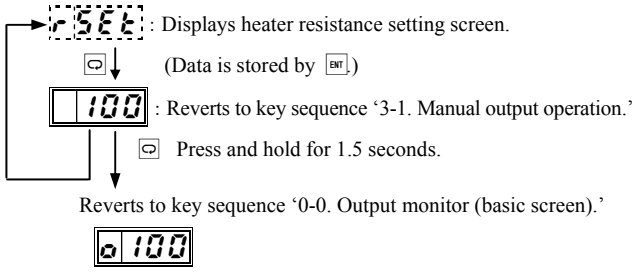
3-2. Setting of break judgment standard for heater break (optional)

Sets (loads) break judgment standard for heater break.
Set to normal state by manual output and enter the resistance value at that time.
Sets this as the judgment standard for good condition. Future deterioration percentage is set to determine when heater break has occurred.
Deterioration value input is set by key sequence '1-12. Heater break alarm current.'

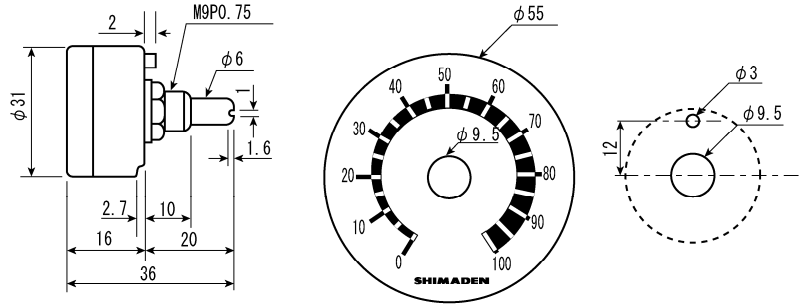


19. Accessories (sold separately)

19-1. External adjuster

- Type: QSV003
- Specifications: Variable resistor: RV30YN 20S / characteristics / resistance value: B / 10kΩ
  Lead: Vinyl lead 1 m, M3 crimp terminal
  Scale plate / knob: 1 each provided

- External dimensions and mounting method (unit: mm)

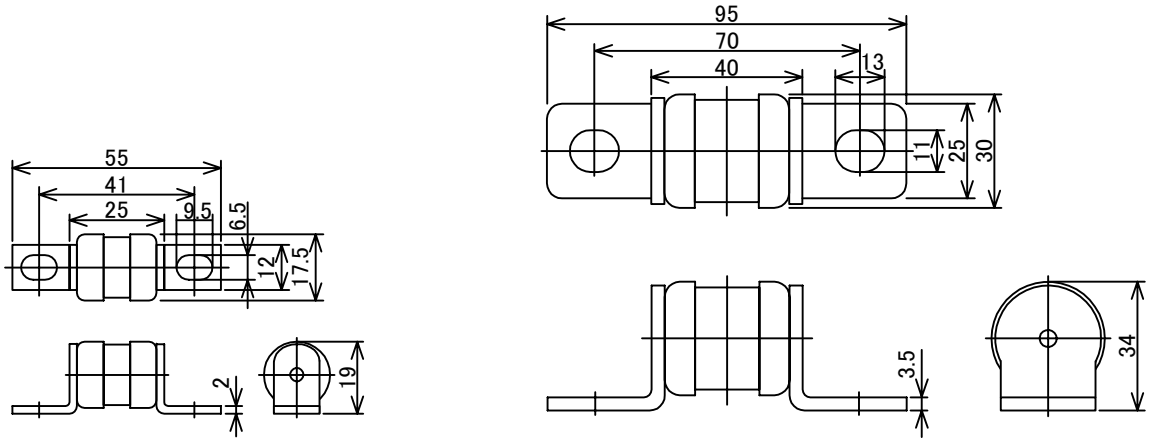


19-2. External rapid fuse

20/30A (Model: QSF006)
45/60A (Model: QSF007)

80/100A (Model: QSF008)

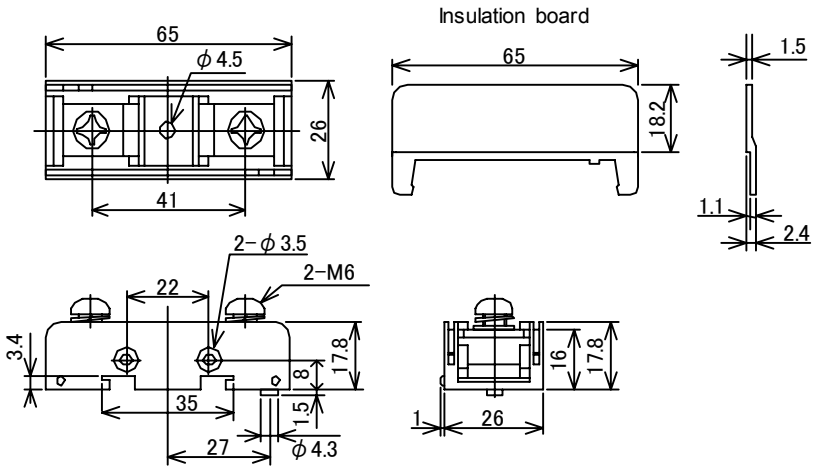
- External dimensions (unit: mm)



19-3. Fuse holder

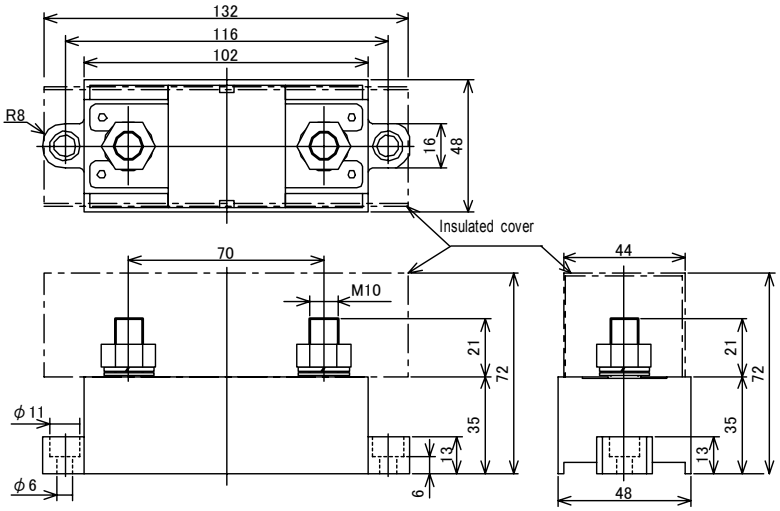
20/30A, 45/60A (Model: QSH002)

• External dimensions (unit: mm)



80/100A (Model: QSH003)

• External dimensions (unit: mm)



20. Common specifications

☐Type : PAC18
☐Control element configuration : Thyristor x 2 inverse-parallel connection
☐Main/control power supply : 100 – 240V AC, 5VA (main/control power supply used by same phase)
☐Voltage fluctuation tolerance : Max. ±10% of rated voltage
☐Rated frequency : 45 – 65Hz
☐Rated current : Any one of 6 types (20, 30, 45, 60, 80, 100A)
☐Minimum load current : 0.6A
☐Control output range : 0 – 98% or more
☐Applicable load : Resistance load or inductive load (transformer primary control: phase control or complex control)
☐Control type : Phase control, cycle calculation zero voltage switching control, complex control (specify when ordering)
(No output feedback function)
P: Phase control (specify when ordering); phase angle proportional output (P0-),
voltage proportional output (P1-) or voltage square proportion Output (P3-)
C1-: Cycle calculation zero voltage switching control
X1-: Complex control (phase control when output increases from 0%, followed by cycle calculation zero voltage switching control)
☐Cooling : Self cooling
☐Protection : 1) Electronic overcurrent gate cutoff circuit (optional); alarm output when operating, detection by current sensor (CT)
2) Rapid fuse (sold separately)
3) Hardware error detection (optional); detects short circuit or thyristor shorting when output is 0%
☐Control input : Selection of any one of 3 types (current 4 – 20mA DC [receiving impedance 100Ω] or voltage 1 – 5V,
0 – 10V DC [input resistance 200kΩ]) Contact 2-position control (on/off control)

☐Standard functions
• External adjuster : Can be allocated to ramp, current limiter, manual operation and up to 3 external adjusters (sold separately)
• Variation limit (slow-up, slow-down) : 0.0 – 99.9 sec. variable setting (set by front surface key switch)
Time required to reach 0 – 100% output time, initial value:1.0 sec.

☐Additional functions (optional)
• Output current detection function (built-in current sensor CT)
• Current limit function : Phase control only supported
Using pure metal load, etc., inrush current limitation, response time 0.1 sec. or less (initial value 100% or rated current)
0 – 100% of rated current set by external adjuster (current limiter) or 0 – 120% of rated current set by front panel key operation
• Overcurrent error alarm : Electronic overcurrent gate cutoff circuit, outputs alarm when it detects that output current value is in excess of 130% of the rating
• Hardware error alarm : Alarm is output when thyristor error (thyristor device is shorted and current flows even though output is 0%) is detected.
• Heater break alarm : Heater break is detected and alarm is output.
Heater break judgment 0 – 100% setting
[caution]: Variable resistance heaters can be controlled applicable load, but Heater break alarm function can not be detected rightly in some cases because the change of resistance value is too large.
• Alarm output : One point a-contact 240V AC, 1A (insulated from system circuit)
Power failure, overcurrent error, hardware error, heater break selection
alarm contact output; redundant selection possible
• Parameter setting function : Separately sold data communication adapter can be connected.
you can connect to a computer via a separately sold data communication adapter and display various settings, control input values, output values and trend graph.
• Communication : RS-485 specs., insulated from control input and system
Communication protocol: MODBUS protocol (RTU)
Communication speed: 19200/ 9600bps
Parity: Selection of NON / EVEN / ODD
Stop bits: 1/2 selection
Power on/off, output control, ramp setting
Operation on/off, control input, operation amount, load current, alarm status can be obtained

☐Separately sold goods
• Data communication adapter : Model: S5009－Connected to computer by USB; enables various settings, control input values display, output values display and trend graph
• External adjuster : Model: QSV003－B characteristics, 10kΩ, 3 lines
• External rapid fuse / fuse holder : Protects thyristor and power equipment from load short, etc. (For model, see '12-1. Rapid fuse.')
• Noise filter : Model
20A/30A : HF2030A-XB
45A : HF2050A-XB
60A : HF2060A-XB
80A : HF2080A-XB
100A : HF2100A-XB

☐General specifications

- Operation ambient temperature range : -10 – 55°C (current must be reduced for 50°C or higher)
- Operation ambient humidity range : 90% RH or lower (no dew condensation)
- Storage temperature : -20 – 65°C
- Applicable standards : Safety IEC61010-1
  : EMC EN61326
  The specified noise filter (sold separately) must be used.
- Insulation resistance
  Between control power supply terminals and control input terminals : 500V DC, 20MΩ min.
  Between main power supply terminals and chassis : 500V DC, 20MΩ min.
- Dielectric strength
  Between control power supply terminal and control input terminal : 2300V AC, 1 minute
  Between main power terminal and chassis : 2000V AC, 1 minute
- Plastic case material : Polycarbonate
- External dimensions/weight : 20/30A : 48 (W) x 117 (D) x 170 (H), approx. 0.8kg
  45A/60A : 68 (W) x 151 (D) x 188 (H), approx. 1.8 kg
  80A/100A : 113 (W) x 151 (D) x 204 (H), approx. 3.0kg
- Terminal cover : Standard attached

21. Troubleshooting

If a problem occurs while using the equipment, check it by using the following chart and contact your nearest Shimaden agent.

	Problem	Place to inspect	Measures to take
1.	No output.	1) Panel LED does not light.	Check power. If power is not supplied, check out the power supply side. If power is supplied, the device may be broken.
		2) h is lit in the alarm code display.	There could be something wrong with the circuit or the thyristor may have shorted.
		3) C is lit in the alarm code display.	Excessive current may have been produced for some reason. For pure metal heater or transformer load, set longer variation limit time. If the alarm lights again, turn the power off, set ramp higher limit to 0% and then turn the power back on. If no longer lit, there might be a problem on the load side. You should therefore check the load side. If lit, there may be internal failure of the device.
		4) Is the control input signal present?	Check the level by measuring between input terminals with a tester, etc. If the control input signal is not present, check the signal supply source such as the controller. (Linear control input [voltage/current control input]: Between C1 and C2 terminals; contact 2-position control: Between C2 and C3 terminals) If a normal signal is present, check settings of and connection with external adjusters. If the connections and settings are correct, the device may be faulty.
		5) Output limit is functioning.	Check ramp higher limit setting and current limiter setting. Check the value of the parameter setting screen and whether the external adjuster (VR) to which the function is allocated has been turned down.
2.	Output continues as is.	1) h is lit in the alarm code display.	The thyristor may be shorted/faulty or the circuit may be shorted.
		2) Is the load circuit open?	If the load circuit is open, the panel meter or tester will indicate high voltage. Check the load circuit.
		3) Ramp lower limit setting is high.	The minimum value for output is not set to zero for ramp lower limit function. Check the value of the parameter setting screen and position of the external adjuster (VR) to which the ramp lower limit is allocated. Check VR position on monitor screen VR1 – VR2. Remember that output is 99.9% if set to the maximum.
		4) The ramp higher limit is turned down.	The ramp higher limit function turns down output. Check the value of the parameter setting screen and position of the external adjuster (VR) to which the ramp higher limit is allocated. Check VR position on monitor screen VR1 – VR2. Remember that output is 0.1% if set to the minimum.
3.	Maximum output has dropped.	1) Check various output adjustment settings.	Check parameter setting values and external adjusters (VR). Set to '100%' and monitor output.
		2) Check control input signal.	Check if the control input signal is 100%.
		3) Current limit circuit addition.	Check current limit setting, set to 100% and check output and load current. If load current is at the maximum rated current, the current limit function is functioning. The load exceeds the rating of the device.
		4) Inspect the output voltage meter.	The reading may vary according to the type of meter. Be sure to use actual value type (True RMS) or moving-iron meter. If measuring voltage with a conventional digital or analog tester, the mean value is shown as the actual value conversion, which could result in significant pointing error. (In the case of a 200 V power supply, pointing error may be as much as 43 V.)
4.	Rapid fuse blows and overcurrent protection circuit is triggered frequently.	1) Are load capacity and device capacity appropriate?	If load rate is 100% or more, turn output down.
		2) If inrush current from pure metal heater, etc., produces a large load.	Set variation limit time longer. If this doesn't help, either add a current limit function (optional) or replace the device with one with a larger rated current.
		3) If using a transformer.	Set variation limit time longer. Also lighten load relative to transformer capacity. If malfunction due to noise is possible, either use a noise filter or connect a capacitor (at least 250 V AC, 0.1 μF) between terminals R and U.

MEMO

MEMO

The contents of this manual are subject to change without notice.

Temperature and Humidity Control Specialists

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