

°C

%RH

SHIMADEN

**SHIMADEN**

*Series PAC18*

**SINGLE-PHASE THYRISTOR POWER REGULATOR**



**CE** approved

**RoHS** compliance

### **BASIC FEATURES**

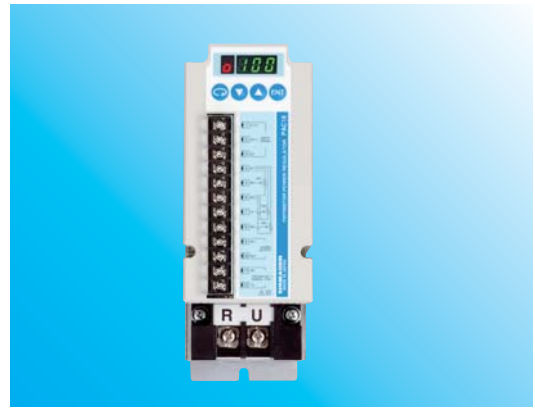
- Easy Front Key Setting***
- A 7-segment LED displays input and output values and various parameters.***
- Slow-Up, Slow-Down Function***
- Output Current Detection Function (Optional)***
- Parameter Setting Function (Optional)***
- Universal Power Supply (100 ~ 240 V AC)***
- Automatic Frequency Discerning Function (50/60 Hz)***

As a succession device for the PAC15 Series which achieved a record of long-term durability and reliance, the PAC18 Series thyristor power regulator pursues an even higher level of functionality and safety.

Corresponding **RoHS** compliance

**CE** mark

Safety standards: Safety IEC61010-1  
 : EMC EN61326  
 (The specified noise filter must be used.)



## FUNCTIONS

- Automatic detection of power frequency 50/60 Hz
- Control circuit power supply is 100 V ~ 240 V common: this corresponds to a wide power/voltage range.
- Output current detection function (optional) available, adaptable to overcurrent protection, current limit function and alarm output function (power failure, overcurrent, heater break detection and hardware error)

## CONTROL TYPE

Display	Control type
PA	Phase control/phase angle proportional output
PA-H	Phase control/voltage proportional output
PA- $\bar{U}$	Phase control/voltage square current proportional output
$\Xi$	Cycle calculation zero voltage switching control
PA- $\Xi$	Complex control

## CONTROL TYPE AND OUTPUT WAVEFORM

Item Control type	Harmonic disturbance	Flickering occurrence	Applicable load	Output waveform		
				10% output	50% output	90% output
Phase control	Possibility of occurrence	None	Constant resistive load Inductive load (transformer primary control)			
Cycle calculation zero voltage switching control	None	Possibility of occurrence	Constant resistive load			

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

## SAFETY MEASURES

- Thanks to the power supply instantaneous stop handling function and the power failure handling function, overcurrent trouble during transformer load has been eliminated and power supply variation, distortion, and noise, in comparison with the former series, have been improved.
- Detects shorting of thyristor device, gate set to off and alarm output (optional).
- Load current is detected by CT (optional), gate set to off when overcurrent occurs and alarm is output.

- Setting panel included as standard equipment

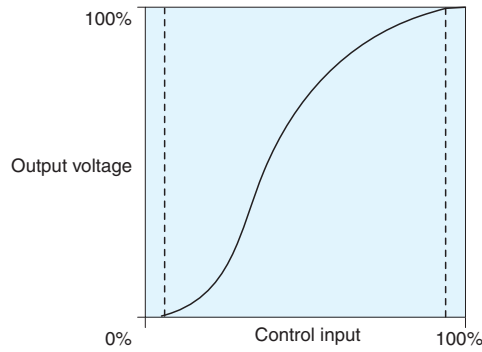
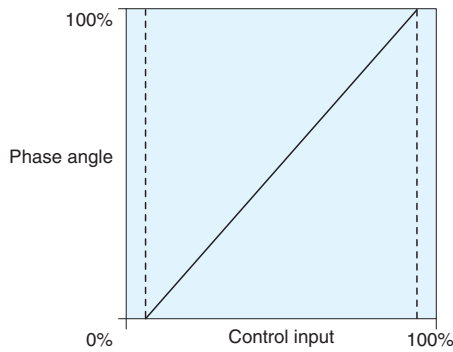
Ramp setting, variation limit setting, current limit setting and manual output setting are easily conducted by use of the front key and digital display.

Manual output setting, current limit setting, ramp upper limit setting and ramp lower limit setting are conducted with an external adjuster.

**CONTROL TYPE**

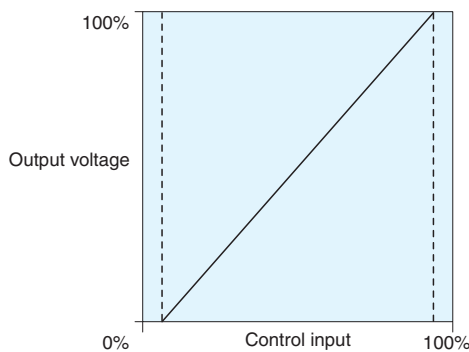
(1) Phase control/phase angle proportional output (same as PAC15P)

Phase angle output proportional to control input can be obtained.



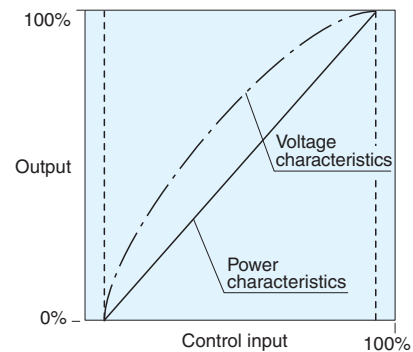
(2) Phase control/voltage proportional output

Output voltage proportional to control input signal can be obtained.



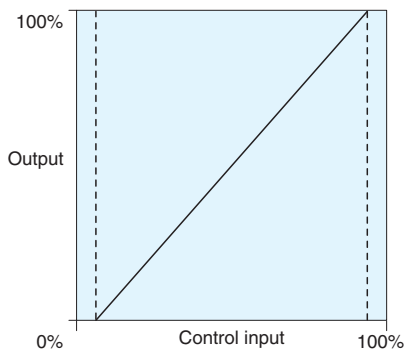
(3) Phase control/voltage square (current) proportional output

The characteristics of this function are to output power in proportion to control input. This also has constant voltage characteristics and therefore is applicable to nichrome heaters and allows controllability to be improved. In cases of manual adjustment, etc., power adjustment which is proportional to the scale of a regulator is available.



(4) Cycle calculation zero voltage switching control (same as PAC15C)

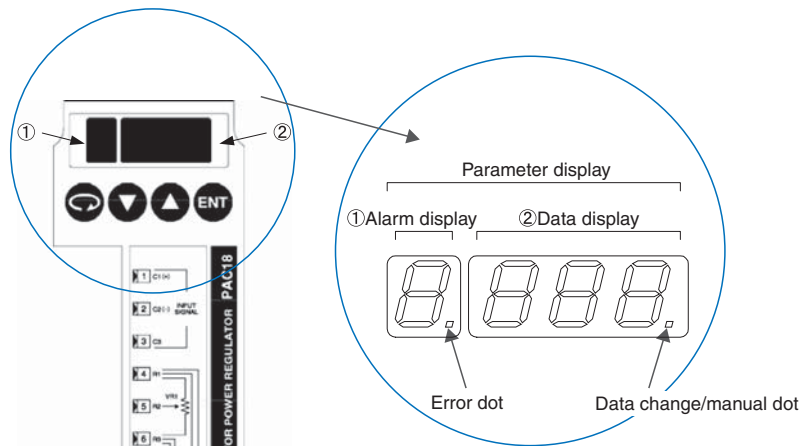
Output proportional to control input signal can be obtained.



(5) Complex control

Short time phase control is executed only when output rises from zero percent, after which operation switches to cycle control. Used for transformer primary control by cycle control.

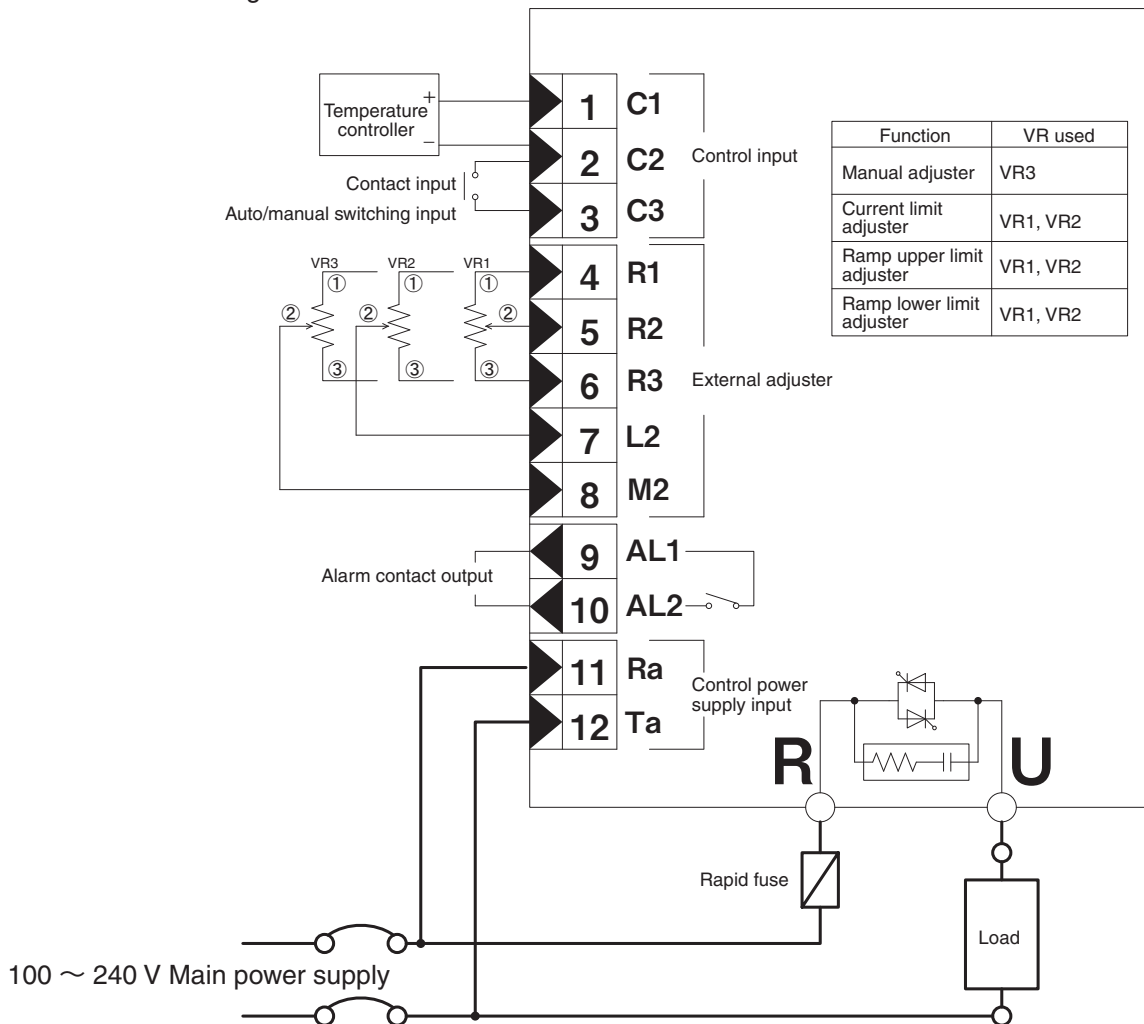
● Panel Part Names



Switches and their names

- Parameter key: Primarily used for switching screen displays.
- Down key: Primarily used for switching parameters. Decreases numerical values.
- Up key: Primarily used for switching parameters. Increases numerical values.
- Enter key: Primarily used to enter parameter settings.

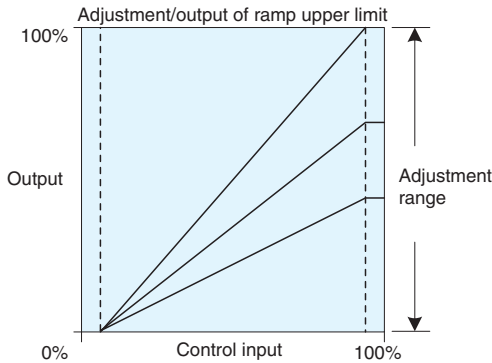
● External Connection Diagram



Note: Main power supply and control power supply should be used in the same phase.

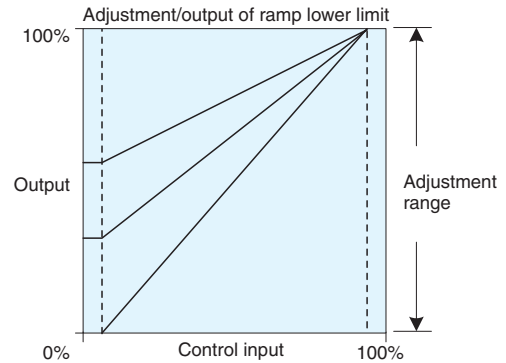
### (1) Ramp upper limit (high power) adjustment

The output value for ramp upper limit can be adjusted from 0.1 to 100.0% when the control input is 100%. Because maximum output is turned down, output ramp of the device relative to the control input signal is changed.



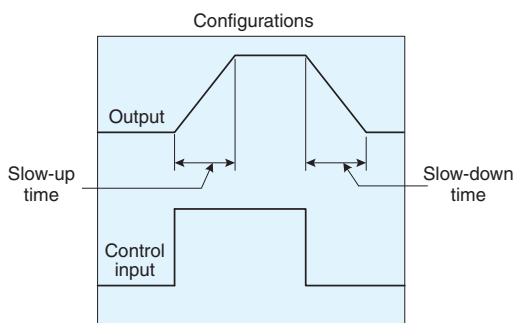
### (2) Ramp lower limit (low power) adjustment

The output value for ramp lower limit can be adjusted from 0.0 to 99.9% when the control input is 0%. It is used when you want to output even when control input is 0%. Because minimum output is adjusted, output ramp of the device relative to the control input signal is changed.



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

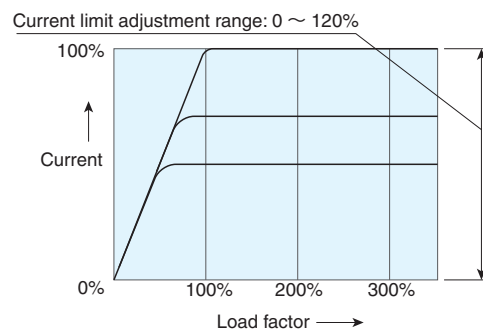
Input variation can be limited by the variation limit setting, and therefore the output variation of the device can be delayed.



### (4) Current limit: only for phase control (optional)

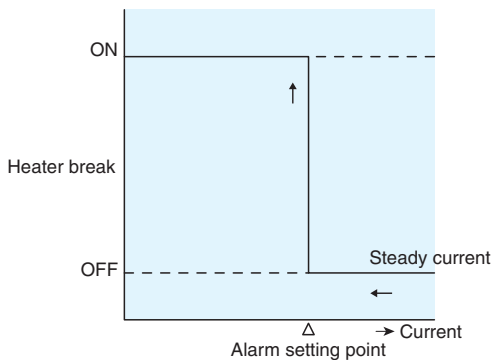
Function for limiting the current to the set current value (within 0 ~ 120% of the rated current). Selected when controlling heaters which generate primary inrush current such as platinum, molybdenum and tungsten or SiC heater.

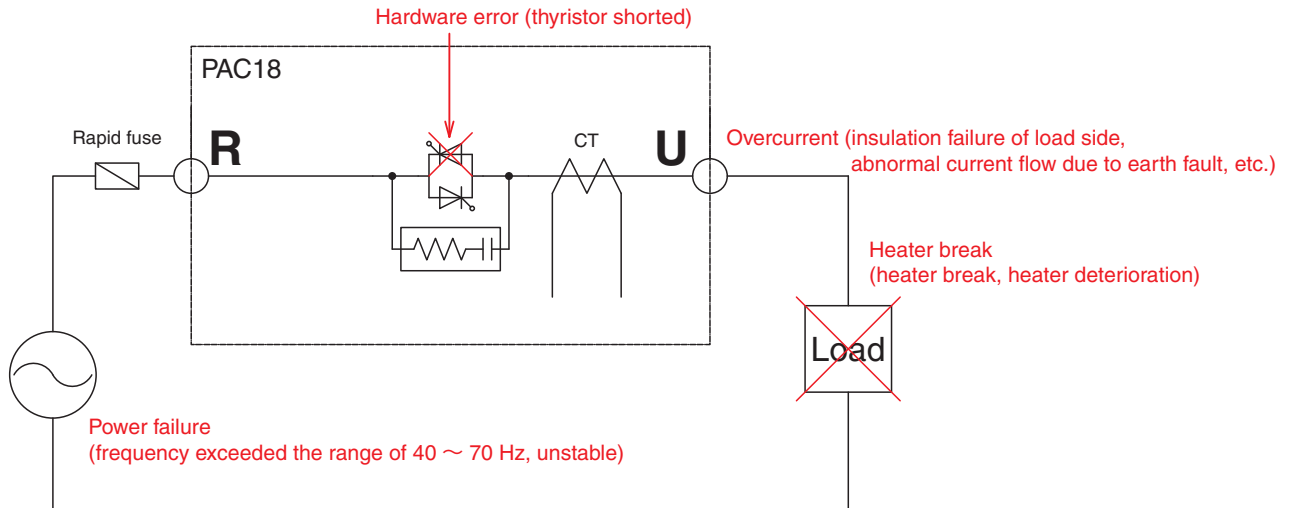
Note: The more load rate exceeds the rating, the more output power drops.



### (5) Heater break alarm (optional)

Generally, there are cases where quick detection and consequent alarm output are required such as when even one heater is broken within a heat source which consists of several heaters. Also, power down due to deterioration, such as that involving a SiC heat generator, can be detected. This can also be used as a signal for the replacement period of taps and heat generators.





Alarm types	Alarm display	Conditions	Alarm output	Corresponding action
Power failure	$P$	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 (optional)	$\square$	Output current has exceeded 130% of rating.		Stops output. Turn off the power, remove the cause, and then turn the power back on.
Hardware error (optional)	$h$	Output current flows when output is 0%.		Stops output. If a hardware error alarm occurs even if a load is connected, repair is required.
Heater break (optional)	$H$	Heater break has been detected.		Control continues.
Input error	$!$	Control input is below -10% or over 110%.	Not available	

**SPECIFICATIONS**

- Control element configuration : Thyristor x 2 inverse-parallel connection
- Main/control power supply : 100 ~ 240 V AC, 5 VA (main/control power supply used in the same phase)
- Voltage fluctuation tolerance : Max.  $\pm 10\%$  of rated voltage
- Rated frequency : 50/60 Hz
- Rated current : Any one of 6 types (20, 30, 45, 60, 80, 100 A)
- Control output range : 0 ~ 97% 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, voltage proportional output or voltage square proportional output  
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 transformer (CT)  
2) External rapid fuse (sold separately)  
3) Hardware error detection (optional); detects short circuit or thyristor shorting when output is 0%.
- Control input : Current: 4 ~ 20 mA DC [receiving impedance 100 $\Omega$ ] common with contact  
Voltage: 1 ~ 5 V, 0 ~ 10 V DC [input resistance approx. 200k $\Omega$ ] common with contact
- Standard functions
  - External adjustment function : External adjusters such as ramp lower limit, ramp upper limit, current limiter and manual can be connected. Up to 3 external adjusters can be used. B characteristics 10k $\Omega$  3 lines  
External adjusters sold separately
  - Variation limit : 0.0 ~ 99.9 sec. variable setting (set by front surface key switch)  
(slow-up, slow-down) Time required to reach 0 ~ 100% output

● Additional functions (optional)

- Output control detection function (built-in current transformer [CT])
  - Overcurrent : Electronic overcurrent gate cutoff circuit, outputs alarm when it detects that output current value is in excess of 130% of the rating.
  - 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% of 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
  - 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
  - Alarm output : 1 point, 1a contact, 240 V AC, 1A  
Power failure, overcurrent (optional), hardware error (optional), heater break (optional) selection; alarm contact output; redundant selection possible
- External adjuster : Up to 3 external adjusters can be used.  
B characteristics 10kΩ 3 lines
- Parameter setting function : Data communication adapter (sold separately) can be connected.  
By connection with a PC, various settings, control input values, output values and various setting values can be displayed.
- External rapid fuse : Protect thyristor and power equipment from load short, etc.

● General specifications

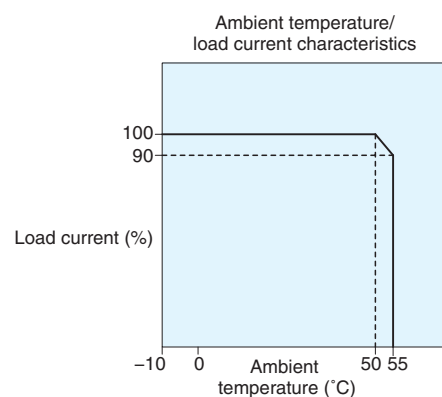
- Operating ambient temperature range : -10 ~ 55°C (current must be reduced for 50°C or higher.)
- Operating ambient humidity range : 90% RH or lower (no dew condensation)
- Operating ambient elevation range : altitude 2000 m or below
- Storage temperature : -20 ~ 65°C
- Safety standards : Safety IEC61010-1  
EMC EN61326 The specified noise filter however must be used.
  - 20/30A HF2030A-XB
  - 45A HF2050A-XB
  - 60A HF2060A-XB
  - 80A HF2080A-XB
  - 100A HF2100A-XB
- Insulation resistance : Between control power supply terminals and control input terminals: Min. 500 V DC, 20MΩ  
Between main power supply terminals and chassis: Min. 500 V DC, 20MΩ
- Dielectric strength : Between control power supply terminal and control input terminal: 2300 V AC, 1 minute  
Between main power terminal and chassis: 2000 V AC, 1 minute
- Plastic case material : Polycarbonate
- External dimensions and weight : 20/30A: 48 (W) x 117 (D) x 170 (H), approx. 0.8 kg  
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. 3.0 kg
- Terminal cover : Standard attached

## CURRENT CAPACITY AND HEAT VALUE

Voltage (0.9 ~ 1.3 V) is produced between terminals by current flowing to the thyristor. Voltage between terminals and accumulation of current (W) turn into Joule heat, resulting in a rise in temperature of the thyristor device. Take radiation and ventilation into account.

● PAC18 Internal heat value

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



ITEMS	CODE		
SERIES	PAC18		Single-Phase Thyristor Power Regulator
CONTROL TYPE	P0-		Phase control/phase angle proportional output
	P1-		Phase control/voltage proportional output
	P3-		Phase control/voltage square (current) proportional output
	C1-		Cycle calculation zero voltage switching control
	X1-		Complex control (Phase control only when output rises from zero percent, then switches to cycle control)
CONTROL INPUT	3		Voltage 1 ~ 5 V DC Input resistance: 200kΩ/contact, common
	4		Current 4 ~ 20 mA DC Receiving impedance: 100 Ω built-in/contact, common
	6		Voltage 0 ~ 10 V DC Input resistance: 200kΩ/contact, common
RATED CURRENT	020-		20A
	030-		30A
	045-		45A
	060-		60A
	080-		80A
	100-		100A
OUTPUT CURRENT DETECTION FUNCTION (OPTIONAL)	0		Without
	1		With: Overcurrent protection, current limit function, alarm output 1 point 1a contact 240 V AC 1A (Power failure alarm, overcurrent alarm, heater break detection alarm, hardware error alarm)
PARAMETER SETTING FUNCTION (OPTIONAL)	0		Without
	1		With (data communication adapter (sold separately) can be connected.)
REMARKS	0		Without
	9		With

Note: If the CE designation is required on the product, please specify this when ordering.

On the condition that the product is used with a noise filter as specified by SHIMADEN, the CE safety standard (EMC Directive) shall be satisfied.

**Rapid fuse and fuse holder**

Name	Rated current	Fuse type	Type
Rapid fuse	20A/30A	350GH-50UL	QSF006
	45A/60A	350GH-100UL	QSF007
	80A/100A	CF5R06-150	QSF008
Fuse holder	20A ~ 60A	HT4017	QSH002
	80A/100A	CMS-5	QSH003
Rapid fuse with fuse holder	20A/30A	350GH-50UL + HT4017 set	QSF01F
	45A/60A	350GH-100UL + HT4017 set	QSF01G
	80A/100A	CF5R06150 + CMS-5 set	QSF01H

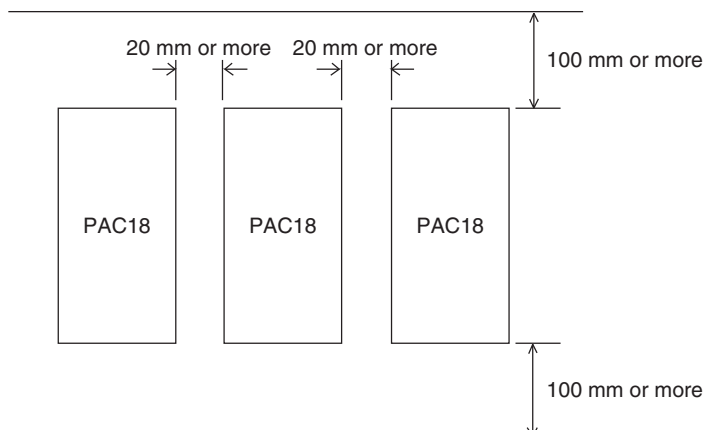
**External adjuster**

Type	
QSV003	B10kΩ

**Noise filter**

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

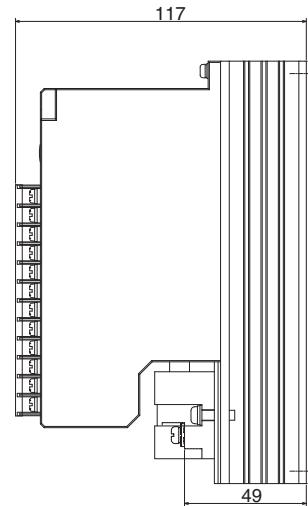
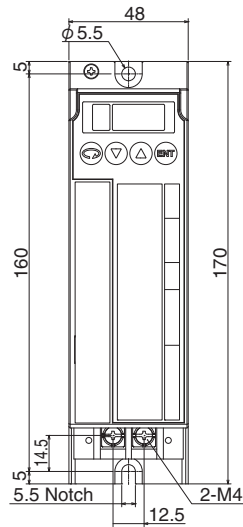
● **Mounting dimensions**





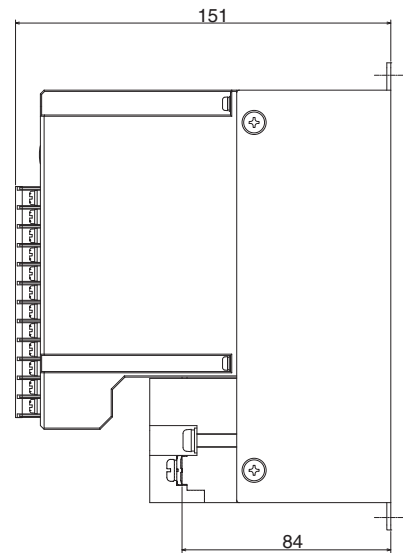
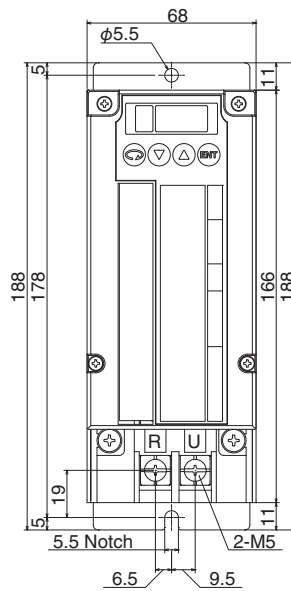
Unit: mm

- 20/30A: 48x170x117 mm/approx. 0.8 kg



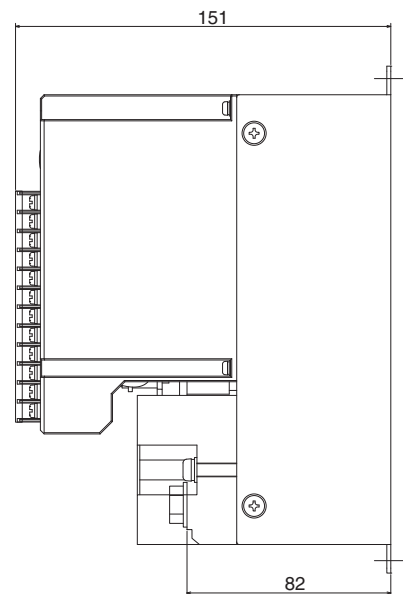
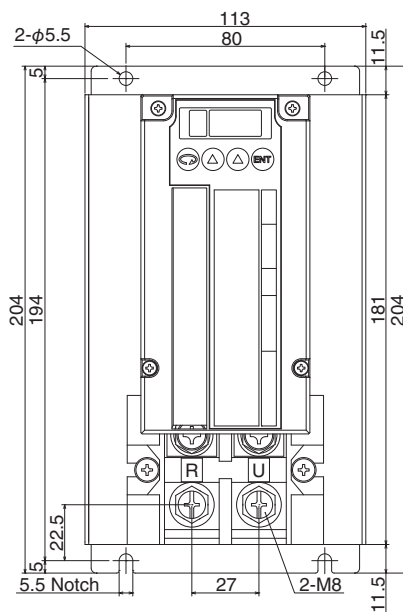
- 45/60A: 68x188x151 mm/approx. 1.8 kg

Unit: mm



- 80/100A: 113x204x151 mm/approx. 3.0 kg

Unit: mm



**■ CONDITION FOR CE MARKING**

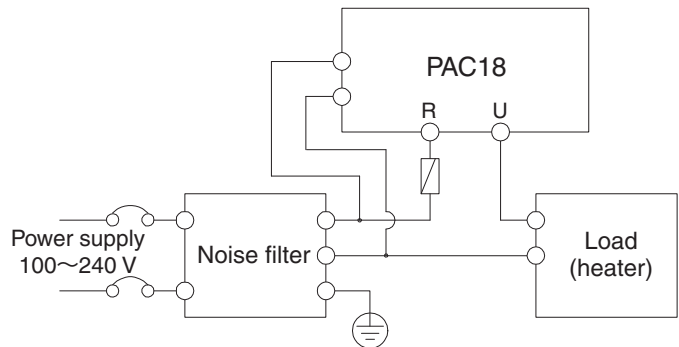
1. For dealing with EMC command

- ① Use in combination with a noise filter designated by Shimaden. Install the noise filter on the same metal plate as the PAC18. Concerning the noise filter, please ensure that it is properly grounded.
- ② The length of wiring between the noise filter and the PAC18 should be 0.5 m or less.

2. For dealing with low-voltage command

- ① When power line is wired, as a precaution against accidental shorting, make sure to install one molded case circuit breaker for each PAC18.
- ② The rated current of a molded case circuit breaker should be less than 1.3 times as high as that of the PAC18.

With phase control, part of the power supply sine wave is dropped. This produces distortion in the sine wave if the power supply impedance is high. Also, because the power supply is switched each half cycle, a 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 in comparison with phase control due to switching near the zero cross point of the power supply. However, because some noise is produced by switching to a large current, you should use a noise filter if necessary. Also, if power supply impedance is high, the power supply may flicker in synch with the ON/OFF status of the thyristor.



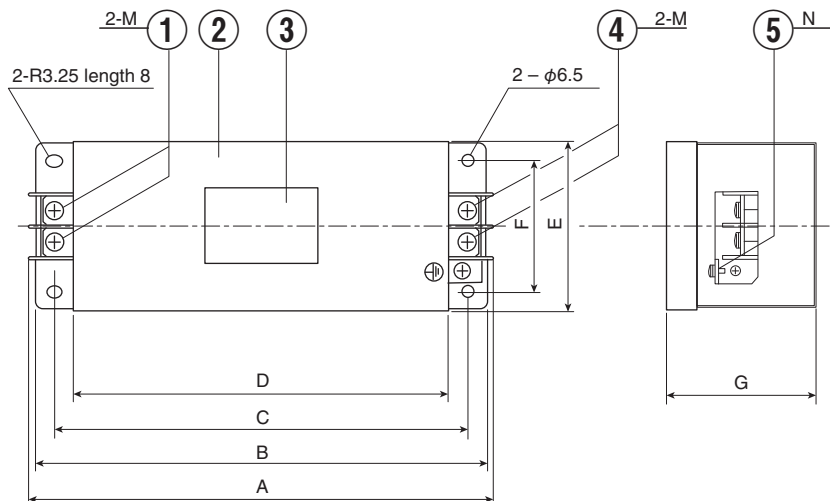
Make sure that the wiring between noise filter and PAC 18 is as short as possible.

**● Noise filter**

The frequency of noise produced by the thyristor is distributed in a place below several megahertz, and the noise dampening effect of commonly available commercial 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.

**External configuration/dimensions**

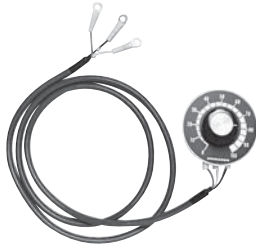
Type	Rated current	Dimensions (unit: mm)									Weight (kg)
		A	B	C	D	E	F	G	M	N	
HF2030A-XB	20A, 30A	248	240	220	200	90	70	80	M5	M4	Approx. 1.8
HF2050A-XB	45A	268	250	235	220	90	70	80	M6	M4	Approx. 2.5
HF2060A-XB	60A	268	250	235	220	90	70	80	M6	M4	Approx. 2.5
HF2080A-XB	80A	304	280	265	250	130	110	95	M8	M6	Approx. 4.5
HF2100A-XB	100A	304	280	265	250	130	110	95	M8	M6	Approx. 5.0



No.	Name
①	Input terminal
②	Metal case
③	Name plate
④	Output terminal
⑤	Grounding terminal

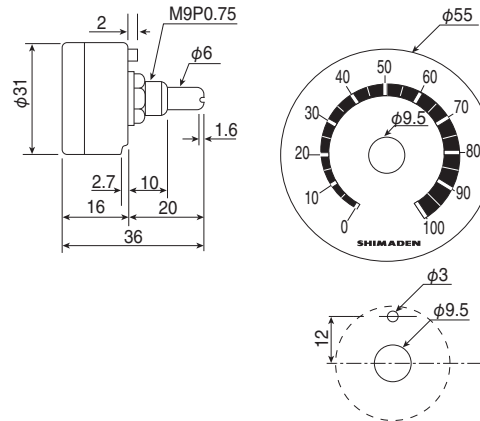
● External adjuster

Type: QSV003



- Resistance value: B10kΩ
- Lead wire length: 1 m
- With crimping terminal for M3

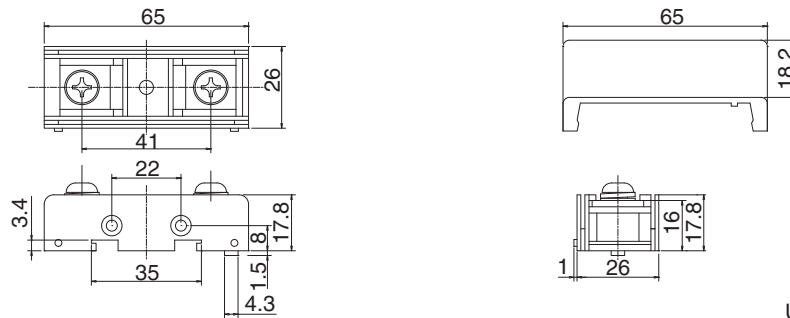
External diagram of external adjuster



Unit: mm

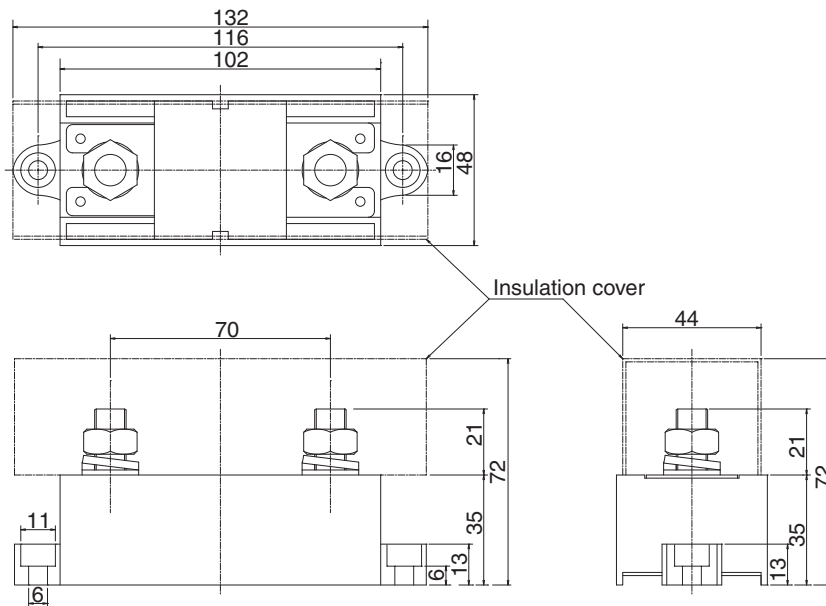
● Fuse holder

Type: QSH002  
Hinode Electric Co., Ltd.  
HT4017



Unit: mm

Type: QSH003  
Fuji Electric Co., Ltd.  
CMS-5



Unit: mm

**Warning**

- The PAC18 series is designed for the control of temperature, humidity and other physical values of general industrial equipment. (It is not to be used for any purpose which regulates the prevention of serious effects on human life or safety.)

**Caution**

- If the possibility of loss or damage to your system or property as a result of failure of any part of the process exists, proper safety measures must be made before the instrument is put into use so as to prevent the occurrence of trouble.



(The contents of this brochure are subject to change without notice.)

Temperature and Humidity Control Specialists

**SHIMADEN CO., LTD.**

Head Office: 2-30-10 Kitamachi, Nerima-Ku, Tokyo 179-0081 Japan

Phone: +81-3-3931-7891 Fax: +81-3-3931-3089

E-MAIL: exp-dept@shimaden.co.jp URL: <http://www.shimaden.co.jp>