Fuji Electric

Innovating Energy Technology

AC Power Regulators
Single-phase APR-V Series

APR-V Series

The APR-V series provides high functionality with improved functions and performance as a successor to the APR-N series.

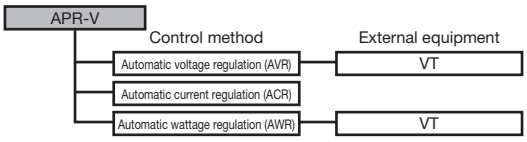
■Features

●Switch between phase control and cycle control

- Flicker prevention cycle control (staggering the power application cycle of 50 units max.) enables distributed load operation. (Optional specifications: ZAP is required.)
- Perform cycle control for loads with a large change in resistance value (e.g., pure metal) using inrush current automatic suppression control (composite control) independent of soft start time.(models with control method A only).
- Switch between phase control and cycle control during operation. (using a setting indicator or network communications).

●Built-in high-precision feedback control (except models with control method T)

Control accuracy of ±1% FS for automatic current regulator, automatic voltage regulator, and automatic watt regulator.
Built-in high accuracy control circuits improve temperature control accuracy, save space, reduce wiring, and help decrease total costs.



●Independent settings for soft start time and soft increase/decrease time

●Does not require a 400 V system operating transformer

Allows operation using a 200 V power supply, since it does not require a dedicated operating transformer for the control power input of 400 V series products.
(Can perform control even if the main circuit power supply and control power supply are not of the same phase)

●External dimensions and mounting dimensions are compatible with APR-N

External dimensions, mounting dimensions, and wiring positions are 100% compatible with those of the APR-N Series.

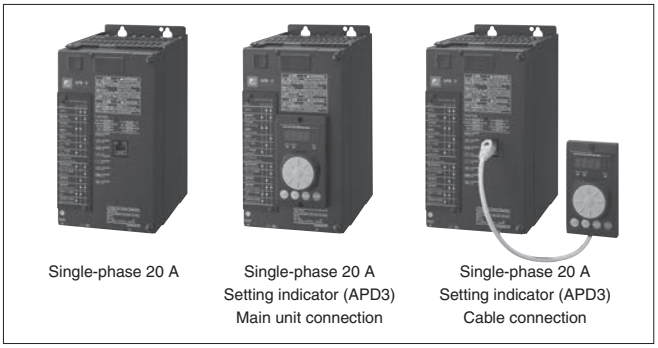
Setting indicator (APD3)

●Does not require a communication board for setting indicator (APD3) connection

Comes standard with a dedicated setting indicator connector on the front panel.
Connection can be made with a LAN cable.

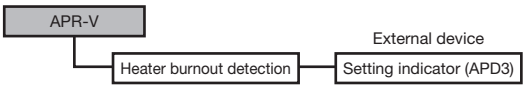
●Optional accessories

- The setting indicator (APD3) enables a variety of monitoring, high-accuracy digital settings and function settings
- Adding a communications board enables a wide range of communications specifications.
- Easily perform operation or monitoring and change settings by linking to a PLC or touch panel.
- Capable of analog output of operation status
  Can output the present operating status (output current, output voltage, etc.) using analog signals (4-20 mA DC, etc.).
- Capable of outputting a contact point for power-on confirmation
- Finger guard (IP20)



●Built-in advanced heater burnout detecting function (except models with control method T. This functionality requires setting indicator (APD3).)

Single phase can detect up to 1-wire/10-wire disconnections using the high-function heater disconnection detecting function.
Applicable to various types of heaters (alloy, pure metal, silicon carbide, etc.) of the same material and capacity.



(Note) Single phase requires one external CT.

●Enhanced error detection

A total of 12 errors, including major and minor ones, are displayed using alarm LEDs.

- Thyristor error (except models with control method T)
- Current limit detection (except models with control method T)
- External setting input not connected (burnout)

●Compliant with the revised European RoHS Directive (2011/65/EU + (EU)2015/863)

Complies with the EU Restriction of Hazardous Substances (RoHS) Directive as standard.
It is an environmentally friendly APR that limits the use of 10 hazardous substances.
<10 Hazardous Substances>
Lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE)
Phthalates (DEHP, BBP, DBP, DIBP)

●Complies with revised Chinese RoHS

All APR-V Series models are supported as standard.

●Products compliant with international standards

Complies with the new EMC Directive (2014/30/EU)
Complies with the new Low Voltage Directive (2014/35/EU)

(Note) Please contact us for information on acquisition status

■Type number nomenclature

(Note 1) In the type number, the white boxes are required items and the black boxes are optional items. For items with no specification, fill in the box with a hyphen or slash.

RPV E 2 0 2 0 – T – Z 06 / UL

APR-V Series

No. of phases

No. of phases	Code
Single-phase thyristor pure reverse parallel connection	E

Input voltage

Input voltage	Code
100-240V	2
380-480V	4
Special voltage	9

Inquire about special voltage.

Rated current

Rated current	Code
20A	020
45A	045
60A	060
100A	100
150A	150
250A	250
350A	350
450A	450
600A	600
800A	800
1000A	A00
1200A	A20
1500A	A50

Inquire about 800A, 1000A, 1200A, and 1500A

Control method

Control method	Required external devices (sold separately)	Code	Control method overview
No feedback function	—	T	No built-in CT. (Functions such as overcurrent protection and heater burnout detection are not included.) This method applies to loads with small changes in resistance, such as alloy heaters.
AC CLR	—	A	CLR = Current Limit Regulator: Output voltage is limited so that the output current does not exceed the CLR setting. This method is used for applications (such as pure metal heaters) for which the maximum current that flows to the load must be limited.
AC ACR + AC CLR	—	B	ACR = Automatic Current Regulator: Control is performed so that the output current is proportional to the set value. This method is used for applications for which the current must be constant, such as pure metal heaters or direct power application heating.
AC AVR + AC CLR	VT (type: PT-5S) single-phase: 1	C	AVR = Automatic Voltage Regulator: Control is performed so that the output voltage is proportional to the set value. This method is used for applications that require output voltage accuracy.
AC AWR + AC CLR	VT (type: PT-5S) single-phase: 1	D	AWR = Automatic Watt Regulator: Control is performed so that the output power is proportional to the set value. This method is used for applications that require heat level control, such as silicon carbide heaters or sensorless operation.
DC feedback control + AC CLR (Feedback input: 0 to 10 V DC)	Isolating converter (high-speed response)	E	This method is used for applications that require accuracy, such as the transformer secondary side or rectifier secondary side. Control is performed so that the feedback value is 10V when the set value is 100%.
Transformer primary control using cycle control	Enclosed CT (Type number: CT-5S)	P	Single-phase only. This method can be applied to isolating transformers and resistive loads (resistance value changes of 20% max.). Output will stop due to load error if the load drops below 30% of the APR rated capacity.

International safety standards

International safety standards	Code
None specified	Blank
Complies with UL, cUL, and CE marking	UL

Specification

Specification	Code
Standard	Blank
Unit optional accessories	Z (Note 2)

(Note 2) Unit optional accessories

Main optional specification name	Description	Option specification number (Note 3)
Soft start time 0.05s min.	Soft start time variable range: 0.05 to 10s/0.05 to 100s	**RPVE□□□□-□-Z06**
Built-in base load setting	Base load setting included on control printed circuit board	**RPVE□□□□-□-Z07**
Built-in gradient setting	Gradient setting included on control printed circuit board	**RPVE□□□□-□-Z43**
Printed circuit board coating process	Incorporates printed wiring board with coating applied	**RPVE□□□□-□-Z70**
Communications board: Parallel operation supported	Flicker prevention and communications board for parallel operation (Note 4)	**RPVE□□□□-□-ZAP**
Communications board: MX compatible parallel operation supported	MX and MX2-series compatible parallel operation communications board (Note 5)	**RPVE□□□□-□-ZAX**
Communications board: Modbus RTU supported	Communications board for Modbus RTU (Note 6)	**RPVE□□□□-□-ZAM**
Communications board: CC-Link supported	Communications board for CC-Link (Note 6)	**RPVE□□□□-□-ZAC**
APD3 main unit mounting (cable connection connector accessory)	Mounts APD3 on the front surface of the main unit	**RPVE□□□□-□-ZB3**
Function code change	Shipment made with the specified function code (Note 7)	**RPVE□□□□-□-ZC■**
Input voltage: Special voltage supported	TR1-70R/E1 operation transformer enclosed (Note 8)	**RPVE□□□□-□-ZE■**
Analog output board) Supports current signals	4 to 20 mA DC output Analog output board mounting (Note 9)	**RPVE□□□□-□-ZAA**
Analog output board) Supports voltage signals	0 to 10 V DC output Analog output board mounting (Note 9)	**RPVE□□□□-□-ZAB**

(Note 3) To specify multiple unit option specifications, list the specification numbers after Z. For example, the following is the order type number for a unit with the following options: Soft start time 0.05s min., communications board, parallel operation, and APD3 main unit mounting. Order type number: RPNW □□□□ - □■ -Z06APB4

(Note 4) Not compatible with the MX series and MX2 series. Also, cycle control cannot be performed using both single-phase and 3-phase. When parallel operation is used, heater burnout detection cannot be used with the setting indicator for the slave device.

(Note 5) Compatible with the MX series and MX2 series. Also, cycle control cannot be performed using both single-phase and 3-phase. When parallel operation is used, heater burnout detection cannot be used with the setting indicator for the slave device.

(Note 6) Please purchase APD3 when selecting optional specification numbers ZAM and ZAC. This is required when making settings.

(Note 7) Before shipment, settings are changed in-house using the setting indicator. A setting indicator is not enclosed at shipment. Each unit can be handled individually. Inquire for details.

(Note 8) Please contact us regarding available input voltages.

(Note 9) The output signal content can be changed using the APD3.

APR-V Series

■Specification

Item			Specification								
Type (Product code)			**RPVE**□□□□−□								
Rated current [A] (Ambient temperature 50°C)			20	45	60	100	150	250	350	450	600
Main circuit power supply		Power supply voltage	Single-phase 100 to 240 V AC, 380 to 480 V AC ±10%								
		Frequency	50/60±2.5 Hz (Automatic frequency detection and switching)								
Control circuit power supply(Note 1)		Power supply voltage	Single-phase 100 to 240 V AC±10% (However, only sine wave operation is guaranteed. Must operate in phase with the main circuit power supply.)								
		Frequency	50/60±2.5 Hz (Automatic frequency detection and switching)								
		Power supply capacity [VA]	36				40	45			
Internal heat generation [W] (at rated current)			47	74	89	124	190	320	377	510	700
Cooling method			Self-cooled				Fan-cooled				
Applicable load		Phase control	Resistive load, inductive load, transformer primary side, rectifier primary side								
		Cycle control (Note 2)	Resistive load, inductive load, transformer primary side								
Control	Waveform control method		Phase control or cycle control (intermittent) (Function selection switch SW2)								
	Output voltage adjustment range		0 to 100% (effective value) of main circuit power supply voltage (except thyristor voltage drop)								
	I/O characteristics		Effective value linear characteristics, linearity ±2% FS or less (for a resistive load and for an automatic setting signal of 10 to 90%.)								
	Power supply voltage compensation (Applicable to models with control methods T and A)		Compensation for output fluctuation to ±3% FS max. relative to ±10% fluctuation in power supply voltage (for a setting signal of 10% to 90%, applies to models with control method T or A.)								
	Setting signal	Manual setting	External variable resistor: 1 kΩ (B characteristic 1/2 W min.) HIGH-LOW (two-position control) contact signal: configured with external wiring								
		Automatic setting	Current signal: 4 to 20 mA DC (Zin = 100 Ω) Voltage signal: 0 to 5 V DC, 1 to 5 V DC (Zin = 10 kΩ) (Function selection switch SW4)								
	Gradient setting		Output magnitude can be set as desired for the setting signal [1] External variable resistor 1 kΩ (B characteristic 1/2 W or higher) (standard), [2] Built-in (optional), [3] Control circuit terminal Selectable using "5V-M0" voltage signal setting (Function selection switch SW5 off. 1 to 5 V DC only) Enables reverse gradient characteristics in combination with base load setting								
	Base load setting		0 to 100% of output voltage (Optional: built-in)								
	Soft start time and soft up/down time (Note 3)		0.5 to 10 s or 5 to 100 s (function selection switch SW1). Soft up/down time can be set to 0.5 seconds. (Function selection switch SW7 off)								
	Feedback control (Phase control method only)		AC CLR (models with control method A) AC ACR + AC CLR (models with control method B) AC AVR + AC CLR (models with control method C) AC AWR + AC CLR (models with control method D) DC feedback control + AC CLR (models with control method E) For models with control methods B, C, D, and E, priority is given to the AC CLR function. AC CLR (models with control method A) becomes selected when the function selection switch SW6 is turned off.								
	Rush current auto suppression (Note 4) (Cycle control system only)		When CLR setting is 100%, uses built-in CT to detect a load current of about 90% or more of the rated current Reduces it by switching the phase angle (Applicable only to models with control method A. Function selection switch SW6 off)								
Error detection and protection	CPU memory error		CPU memory error detected at startup; output disabled								
	Power supply abnormal		[1] Detected when the power supply frequency other than 45 to 65 Hz [2] Detects sudden frequency change of ±2.5 Hz or more								
	Undervoltage (Note 5)		Detects power supply undervoltage (100 V series: 85 V or less; 200 V series: 165 V or less; 400 V series: 315 V or less)								
	Overvoltage (Note 5)		Detects power supply overvoltage (100 V series: 140 V or higher; 200 V series: 265 V or higher; 400 V series: 535 V or higher)								
	Overcurrent		Current at approx. 120% min. of rated current detected by built-in CT (Applicable to models with control methods A, B, C, D, E, and P)								
	Rapid fuse blowout		Detected at contact welding of built-in rapid fuse. Main element protection.								
	Heater burnout (Note 6)		Uses built-in CT to detect when load current becomes less than disconnection threshold (Applicable to models with control methods A, B, C, D, and E)								
	Current limit detection		Detects load current exceeding the CLR setting values and switches the phase angle to reduce it to within the CLR setting values (Applicable to models with control methods A, B, C, D, E, and P)								
	Thyristor error		Detects short-circuit of thyristor using built-in CT (Applicable to models with control methods A, B, C, D, E, and P) Stops arc pulse. However, there are cases where it is not possible to stop output.								
	Overheat error		Detected with temperature sensor								
	Communications error (optional)		Detects transmission errors between APRs during parallel operation								
	Cooling fan service life (fan-cooled models only)		Detects 70% or less of steady-state rotation speed								
	External setting input not connected (Note 7)		Detected when 1. The current for the voltage setting signal is not connected or disconnected (4mA max. or 1V max. or 2. When the manual or gradient setting is not connected.								
	Load error (Models with control method P only)		[1] Detects when load is open[2] If the load current is delayed by more than 30°								
	Analog output current error (Optional)		Detects when the allowable load resistance is exceeded when using current signals from analog output boards								
	Alarm contact output		Relay contact: Major failure + minor failure [1a + 1a contact, 250 V AC, 1 A]								
Environment	Ambient temperature		-5 to 50°C (decrease relative to rated current if ambient temperature is between 50 and 55°C)								
	Storage temperature		-20 ～+60℃								
	Ambient humidity		30-90%RH (No condensation)								
	Others		Free from corrosive gas, dust, or vibration. Indoor use. Altitude up to 1000 m.								
Insulation	Withstand voltage (Main circuit to ground)		2000 V AC for 1 minute (100 to 240 V), 2500 V AC for 1 minute (380 to 480 V) (Note 8)								
	Insulation resistance (to ground)		10 MΩ min. (500 V DC megger)								

(Note 1) The rated voltage always operates as either 110 V or 220 V.
For use at 230 V or 240 V, adjust the maximum output voltage at the power supply voltage compensation setting (PVC setting).
(Note 2) When cycle control is used, connecting a transformer such as a VT to the output side may cause the biased magnetization phenomenon. Use after disconnecting transformers such as VTs.
"Transformer primary control using cycle control" is valid only for models with control method P.
(Note 3) For models with control methods B, C, D, and E, even if the soft start and soft up/down time are set to be short, there are cases when the time may not be shortened because priority is given to the response speed of feedback control. The time can be set longer.
(Note 4) Automatic inrush current suppression suppresses the occurrence of overcurrent through control in combination with phase control. If a transformer such as a VT is connected to the output side, please use it after disconnecting transformers such as VTs because cycle control could cause the biased magnetization phenomenon.
(Note 5) Control power supply voltage is automatically detected when power is turned on. Therefore, if the power supply voltage is slowly increased or decreased, or if a 110 V series power supply is switched with a 220 V series power supply, an "overvoltage" or "undervoltage" alarm will be detected.
(Note 6) For cycle control (models with control method A), the alarm is "load open detection".
(Note 7) It does not operate for the voltage signal 0 to 5 V DC setting (function selection switch SW4 off).
(Note 8) Since the DC power supply for the cooling fan is supplied from the secondary side of the power circuit, there is no need to unplug the cooling fan power connector during dielectric strength testing.

■ Types and Ratings

No. of phases	Type	Input voltage 〔V〕	Rated current 〔A〕	Rated load capacity [kVA] (Note 1)	Built-in rapid fuse
Single-phase	**RPVE2020-T**	100-240V	20	2-4.8	CR6L-30G/UL
	RPVE2020-A				
	RPVE2045-T		45	4.5-10.8	CR6L-75G/UL
	RPVE2045-A				
	RPVE2060-T		60	6-14.4	CR6L-100G/UL
	RPVE2060-A				
	RPVE2100-T		100	10-24	CR6L-150G/UL
	RPVE2100-A				
	RPVE2150-T		150	15-36	CR6L-200G/UL
	RPVE2150-A				
	RPVE2250-T		250	25-60	6、9URD30TTF0350
	RPVE2250-A				
	RPVE2350-T		350	35-84	6、9URD31TTF0500
	RPVE2350-A				
	RPVE2450-T		450	45-108	6、9URD31TTF0630
	RPVE2450-A				
	RPVE2600-T		600	60-144	CS5F-800/UL
	RPVE2600-A				
	RPVE2800-T, RPVE2800-A		800	80-192	(Note 4)
	RPVE2A00-T, RPVE2A00-A		1000	100-240	
	RPVE2A20-T, RPVE2A20-A		1200	120-288	
	RPVE2A50-T, RPVE2A50-A		1500	150-360	
	RPVE4020-T	380-480V	20	7.6-9.6	CR6L-30G/UL
	RPVE4020-A				
	RPVE4045-T		45	17.1-21.6	CR6L-75G/UL
	RPVE4045-A				
	RPVE4060-T		60	22.8-28.8	CR6L-100G/UL
	RPVE4060-A				
	RPVE4100-T		100	38-48	CR6L-150G/UL
	RPVE4100-A				
	RPVE4150-T		150	57-72	CR6L-200G/UL
	RPVE4150-A				
	RPVE4250-T		250	95-120	6、9URD30TTF0350
	RPVE4250-A				
	RPVE4350-T		350	133-168	6、9URD31TTF0500
	RPVE4350-A				
	RPVE4450-T		450	171-216	6、9URD31TTF0630
	RPVE4450-A				
	RPVE4600-T		600	228-288	CS5F-800/UL
	RPVE4600-A				
	RPVE4800-T, RPVE4800-A		800	304-384	(Note 4)
	RPVE4A00-T, RPVE4A00-A		1000	380-480	
	RPVE4A20-T, RPVE4A20-A		1200	456-576	
	RPVE4A50-T, RPVE4A50-A		1500	570-720	

(Note 1) The value for the rated load capacity is calculated using the following equation.
Rated load capacity (single-phase) = Rated input voltage x Output current
(Note 2) To replace only the built-in rapid fuse, use the type number that is listed. For models with a microswitch (CR6L), replace G with S.
(Note 3) Prices are for models with control methods T and A (B, C, D, and E are the same price as A) and do not include external equipment or optional specifications.
(Note 4) Please inquire about fuses for high current products.

■Cooling fan

The average life of the cooling fan is about 40,000 hours. (At an ambient temperature of 50°C and 100% output. The 600 A products have an average life of about 23,000 hours.)
Replace with a new product as soon as required in consideration of this lifespan.
An alarm will trigger when the cooling fan reaches the end of its life. (Green and yellow LED blinks)

Cooling fan, order type

APR rated current	Cooling fan, order type	Required quantity
150A	RPVE150 fan motor	1 piece / unit
250A	RPVE250 fan motor	
350 A	RPVE350 fan motor	
450 A	RPVE450 fan motor	
600 A	RPVE600 fan motor	

(Note) Please contact us for fan guard orders of cooling fans.

APR-V Series

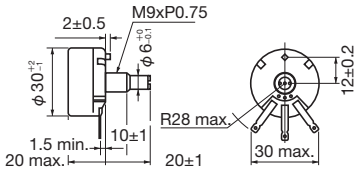
■Other optional accessories (sold separately)

●Setting device

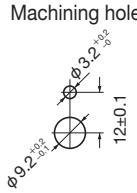
Setting device type number: RPN001	Used for setting methods, such as variable resistance setting, two-position control, and gradient control.

Rated: 1 kΩJ 2.5 W Type number: RA30Y20SB102J (Manufacturer: Tokyo Cosmos)

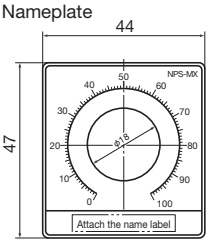
Variable resistor



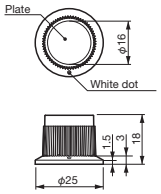
Machining holes



Nameplate



Knob



Name label sheet

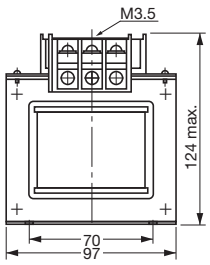
手動設定	MANUAL SET.
勾配設定	GRADE SET.
CLR設定	CLR SET.
HIGH設定	HIGH SET.
LOW設定	LOW SET.

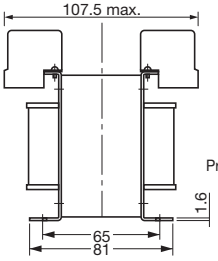
(Note) Control circuit terminal block allocation using the setting indicator (APD3) is required except for manual setting and gradient setting.

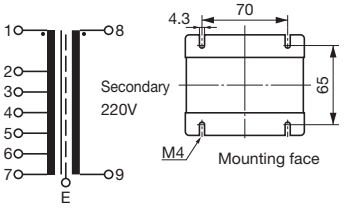
Label sheets not used by the APR-V Series are also included.

●Transformer for control power supply (UL certified products)

Operating transformer (single-phase) Type number: TR1-70R/UL







Output current	20 to 600 A
Rating	1φ, 380, 400, 415, 440, 460, 480 V/220 V 70 VA
Type	TR1-70R/UL

Primary voltage	Terminal number
380V	1-2
400V	1-3
415V	1-4
440V	1-5
460V	1-6
480V	1-7

Mass: 3.5 kg

General-purpose low-voltage operating transformers can also be used. (Not UL compliant) Catalog No. HS192
Ex.CU1F-050-A4020

●Mounting bracket for external cooling installation

Single-phase (RPV004-E□□)

Type	Description
RPV004-E02	For RPVE□020-□
RPV004-E06	For RPVE□045-□, RPVE□060-□
RPV004-E10	For RPVE□100-□
RPV004-E15	For RPVE□150-□
RPV004-E25	For RPVE□250-□
RPV004-E45	For RPVE□350-□, RPVE□450-□
RPV004-E60	For RPVE□600-□

●Finger guard

Single-phase (RPV005-E□□)

Type	Description
RPV005-E02	For RPVE□020-□
RPV005-E06	For RPVE□045-□, RPVE□060-□
RPV005-E10	For RPVE□100-□
RPV005-E15	For RPVE□150-□
RPV005-E25	For RPVE□250-□
RPV005-E45	For RPVE□350-□, RPVE□450-□
RPV005-E60	For RPVE□600-□

●Feedback control CT and VT

Product name	Type		Rated primary input	Rated secondary output, etc.
CT	CT-5S	20A/0.1A ～ 600A/0.1A	20A, 45A, 60A, 100A, 150A, 250A, 350A, 450A, 600A	0.1A 5VA and Class 1
VT	PT-5S	100V/10V	100, 110 V	10V 5VA and Class 1
	PT-5S	200V/10V	200, 220V	
	PT-5S	230V/10V	230, 254V	
	PT-5S	380V/10V	380V	
	PT-5S	400V/10V	400, 440V	
	PT-5S	415V/10V	415V	
	PT-5S	420V/10V	420, 460V	
	PT-5S	440V/10V	440, 480V	

(Note) Number of primary pass-through turns for CT-5S:
5 turns for 20A, 3 turns for 45A, 2 turns for 60A, and 1 turn otherwise.
The primary voltage of PT-5S is 2-tap input except for 380V and 415V.

●Setting indicator and connection cable for remote operation

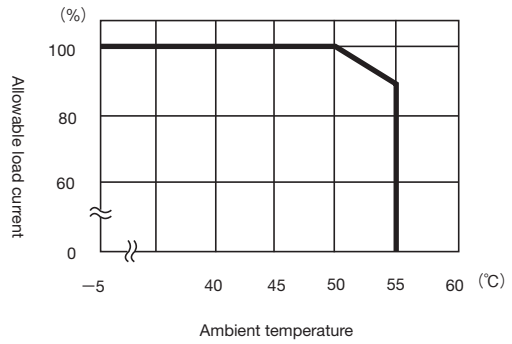
Product name	Type	Name	Specification
Setting indicator	APD3	–	–
Cable	RPN002-1	Connection cable for remote operation	Length: 1 m
	RPN002-3	Connection cable for remote operation	Length: 3 m
	RPN002-5	Connection cable for remote operation	Length: 5 m

■Important selection notes

●Allowable load current / ambient temperature characteristics

The rated current value for single-phase is based on an ambient temperature of 50°C.

If the ambient temperature is higher than this, use after reducing the load current as shown below.



●Transformer primary control

[1] If there is a risk of the transformer becoming unloaded, connect a resistor in parallel with the primary winding so that about 0.5 A (at rated voltage) flows through it.

[2] Allow enough margin for magnetic flux density to prevent biased magnetization. (1.0 to 1.2 T and less)

[3] Do not use in cycle control except for single-phase P models.

●Important notes for power cycle life expectancy

If run and stop are repeated at short-period cycles (for example, 30-minute run and 30-minute stop), a large difference in temperature occurs in the thyristor element, significantly shortening its life expectancy through thermal fatigue.

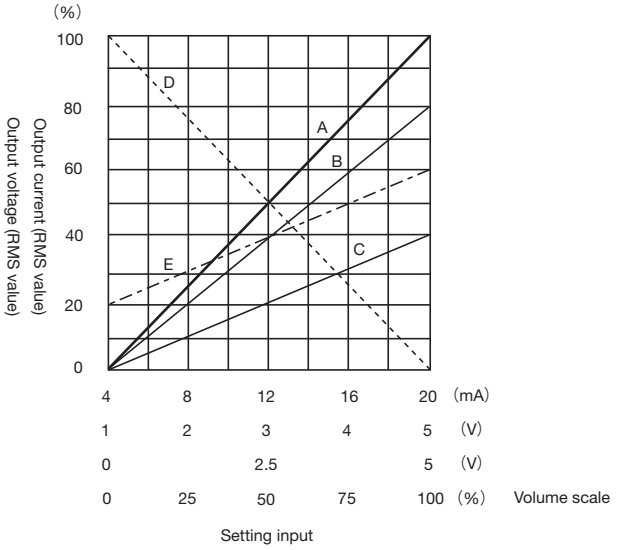
For such applications, select a capacity with a load current less than 80% of the rated current.

APR-V Series

■Control function

●I/O characteristics

・Setting signal, gradient setting, base load setting / output characteristics (for resistive load, operating principle characteristics)
The figure below shows characteristic A when the base load setting and gradient setting are not used.
Output varies linearly with various setting inputs.
By using the gradient setting and base load setting (optional) together, the I/O characteristics can be changed as desired, as shown in the example in the graph below.
It is common to phase control, cycle control, or each feedback control method.



The left graph shows examples of base load setting and gradient setting

Characteristics	Output adjustment range (%)	Base load setting (%)	Gradient setting (%)
A	0– 100	0	100
B	0– 80	0	80
C	0– 40	0	40
D	100– 0	100	0
E	20– 60	20	60

* Gradient setting: Set the output value at the maximum setting input in the I/O characteristics

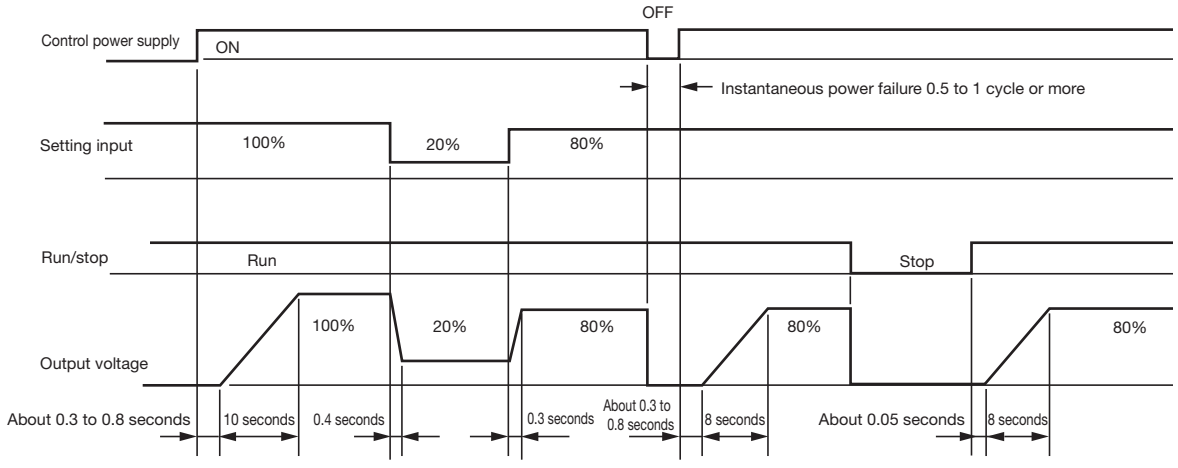
* Base load setting: Set the output value at the minimum setting input in the I/O characteristics

●Run/stop (gate on/off) function

Output is turned on by soft start when the RUN-COM terminal is "shorted" and turned off immediately when it is “open” regardless of the setting input. The figure below shows the operation timing. (When a setting indicator is connected or network communication control is used, there are cases where it will not run by only short-circuiting RUN-COM.)

●Soft start and soft up/down function

It activates and gradually changes the output when the control power is turned on, immediately after an instantaneous power failure, when the run/stop signal is turned on, or when the setting signal changes. Therefore, in the case of transformer loads, pure metal heaters or lamp loads, the inrush current can be suppressed by using it in combination with the current limiting function. The soft start time can be set as desired in the range of 0.5 to 10 seconds or 5 to 100 seconds, respectively. The variable range can be switched by changing DIP switch SW1. The figure below shows the operation timing.



Example of run/stop, soft start, and soft up/down time charts

(Soft start setting: 10 seconds; Soft up/down: 0.5-second fixed setting; Models with control methods T and A)

(Note)
・The soft start setting time is the time after RUN during which the output increases from 0% to 100%.
・The soft start setting time can be set independently of feedback control.
・The soft start setting time and soft up/down setting time can be set as desired by using the setting indicator (APD3).
(Setting time: 0 to 100 seconds)

●Feedback control

Feedback control accuracy (for resistive loads) (Ta=25℃)

Control method	Variable element	Control accuracy (Note)	Conditions
Current limit regulation (CLR)	Power supply voltage fluctuation ±10%	±1% FS	Constant load
	Load fluctuation 4 times	±2% FS	Constant power supply voltage
Automatic voltage regulation (AVR)	Power supply voltage fluctuation ±10%	±1% FS	Constant load
	Load fluctuation 4 times	±2% FS	Constant power supply voltage
Automatic current regulation (ACR)	Power supply voltage fluctuation ±10%	±1% FS	Constant load
	Load fluctuation 4 times	±2% FS	Constant power supply voltage
Automatic wattage regulation (AWR)	Power supply voltage fluctuation ±10%	±1% FS	Constant load
	Load fluctuation 4 times	±1% FS	Constant power supply voltage

(Note) ・The control accuracy is a % value of the rated output.
・The accuracy of DC feedback control depends on the accuracy of the external converter.
・Control accuracy is ±4% FS for 10 times load fluctuation.
・The rated voltage or rated current is the upper limit of feedback control.

●Waveform control

The phase control and cycle control can be selected by using the DIP switch.
For models with control method A, automatic inrush current suppression cycle control (combined control) can be selected.

Item	Phase control	Cycle control	Combined control (Models with control method A only) (Note)
Applicable load	Applicable to most loads, including resistive and inductive loads (excluding capacitor loads)	Applicable to nichrome and iron-chromium resistive loads (with low temperature coefficient of resistance)	Most resistive loads including pure metal and silicon carbide types
Transformer primary side	Possible	Not possible (for models with control method P)	Not possible
Feedback control (AVR, ACR, etc.)	Possible	Not possible	Not possible
Harmonic disturbance	Occurrence possible	No	No (except during suppression)
Occurrence of flicker	No	Occurrence possible	Occurrence possible
Responsiveness	Fast	Slow	Slow
Power factor	Bad	Good	Good (except during suppression)

(Note) During current-limiting operation, it temporarily switches to phase control to limit the current flowing to the load to 90% or less of the CLR setting.

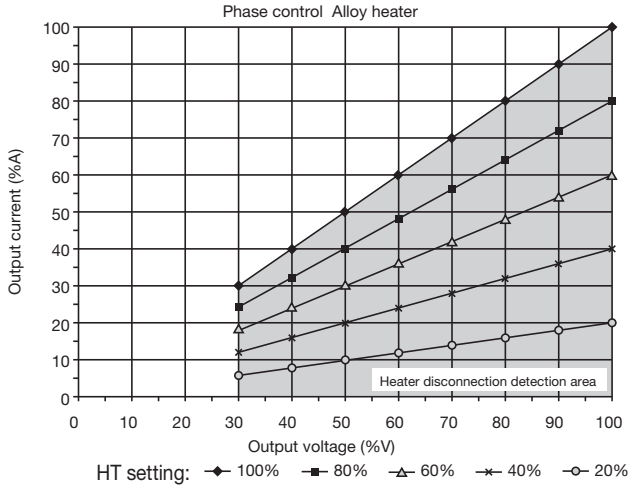
■Heater burnout detection (except for models with control method T)

In the state of standard shipment, it is set to operate only in the standard specification of single-phase.
To enable the heater burnout detecting function of the high-performance specification, the setting must be changed using the setting indicator (APD3).

●Standard specification (single-phase only)

Detects a disconnection when the load current drops below the current value set by the heater burnout determination setting volume “HT”.

・Applicable heaters
Alloy types: 3 or less in parallel
(Must be of the same material and of the same capacity)
・Applicable load capacity
A load that draws 40 to 100% of the APR rated current at 100% APR output voltage.
・Burnout determination setting volume “HT”
Less than 3% setting: Disconnection determination invalid
3% or more setting: Disconnection determination valid
・Detection range
Output setting range 30 to 100% (including gradient setting)
Output voltage range 30 to 100% V



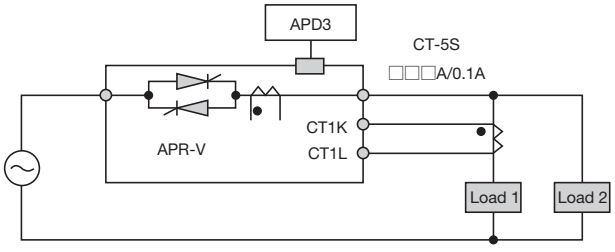
Standard specifications: Heater burnout detection characteristics via output voltage

●High-performance specifications (for single-phase)

The load is divided into two, and the currents are compared with each other to detect disconnections.

・Applicable heaters
Various heaters: 10 (5+5) lines or less in parallel
(Must be of the same material and of the same capacity)
・Applicable load capacity
A load that draws 50 to 100% of the APR rated current at 100% APR output voltage.
・Burnout determination setting
Settings (number of heaters, determination time, etc.) using setting indicator (APD3)
・Number of parallel lines and detection range

Total number	Load 1 No. of parallel lines	Load 2 No. of parallel lines	Detection range (APR output voltage)
2	1	1	30-100%
3	1	2	
4	2	2	
5	2	3	
6	3	3	
7	3	4	40-100%
8	4	4	
9	4	5	50-100%
10	5	5	



High-performance specifications External wiring diagram

APR-V Series

Setting indicator APD3

■Features

The APR-V series enables a wide variety of operations and settings.

- Fast selection and display switching using dial operation.
- Display two elements at the same time with the data display and multi-indicator.
- Perform unit diagnosis even with no data for the input signal check function.
- Error detection history display functionality.
- High-accuracy setting using digital display.
- Customize functionality by changing function codes. (For example, allocate alarm outputs or allocate the terminal block for internal adjustment functionality.)
- Function code copy functionality.
- Compliant with the revised Chinese RoHS.
- Not compatible with APD1/2.

■Specifications

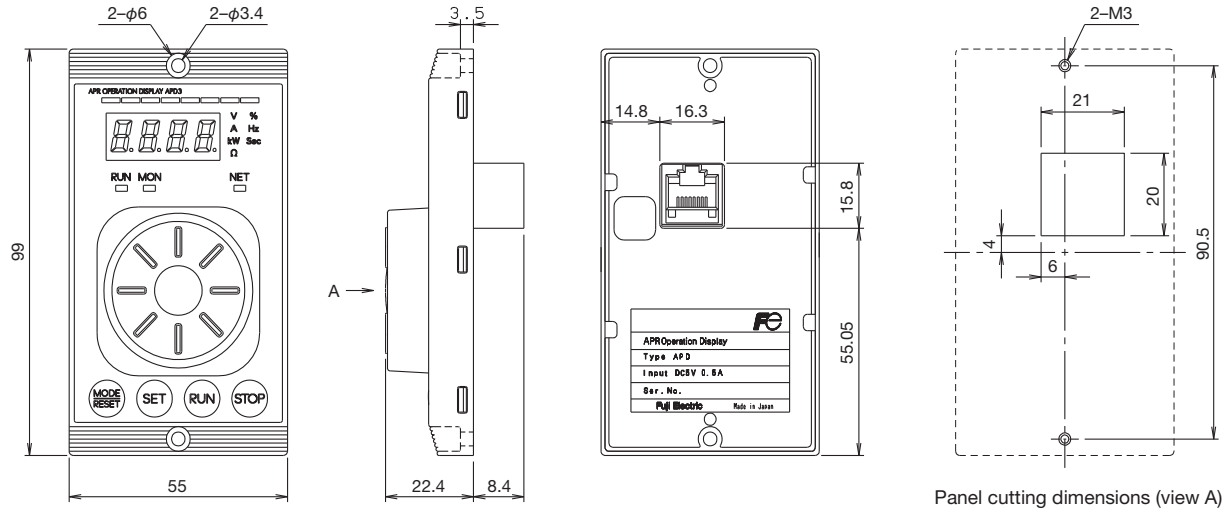
Item	Specifications
Type	APD3
Degree of protection	Panel surface: IP40, Back: (mounting surface): IP20
Operating location	Indoor
Ambient temperature	–5 to 50°C
Ambient humidity	30% to 90% RH (no condensation)
Environment	Location free from dust, corrosive gas (especially sulfidizing gas and ammonia gas), flammable gas, oil mist, water droplets, and direct sunlight. Location free from salt damage. Free from condensation due to sudden temperature changes.
Altitude	1000m max.
Ambient storage temperature	–20 to 60°C
Ambient storage humidity	30% to 90% RH (no condensation)
Installation method	Vertical installation (wall mounting)
Unit mounting tightening torque	
Mounting screws	M3 x 16
Tightening torque (±10%)	0.7N·m (7kgf·cm)
Mass	55g

■Hardware specifications

Item	Specifications
Connection cable for remote operation	Satisfies standards of U.S. ANSI, TIA, and EIA- 568A Category 5. Straight cable (straight cable for 10Base-T and 100Base-TX)
Maximum communication distance	20m (non-insulated)
External connection terminal	RJ -45 connector (modular jack connector)

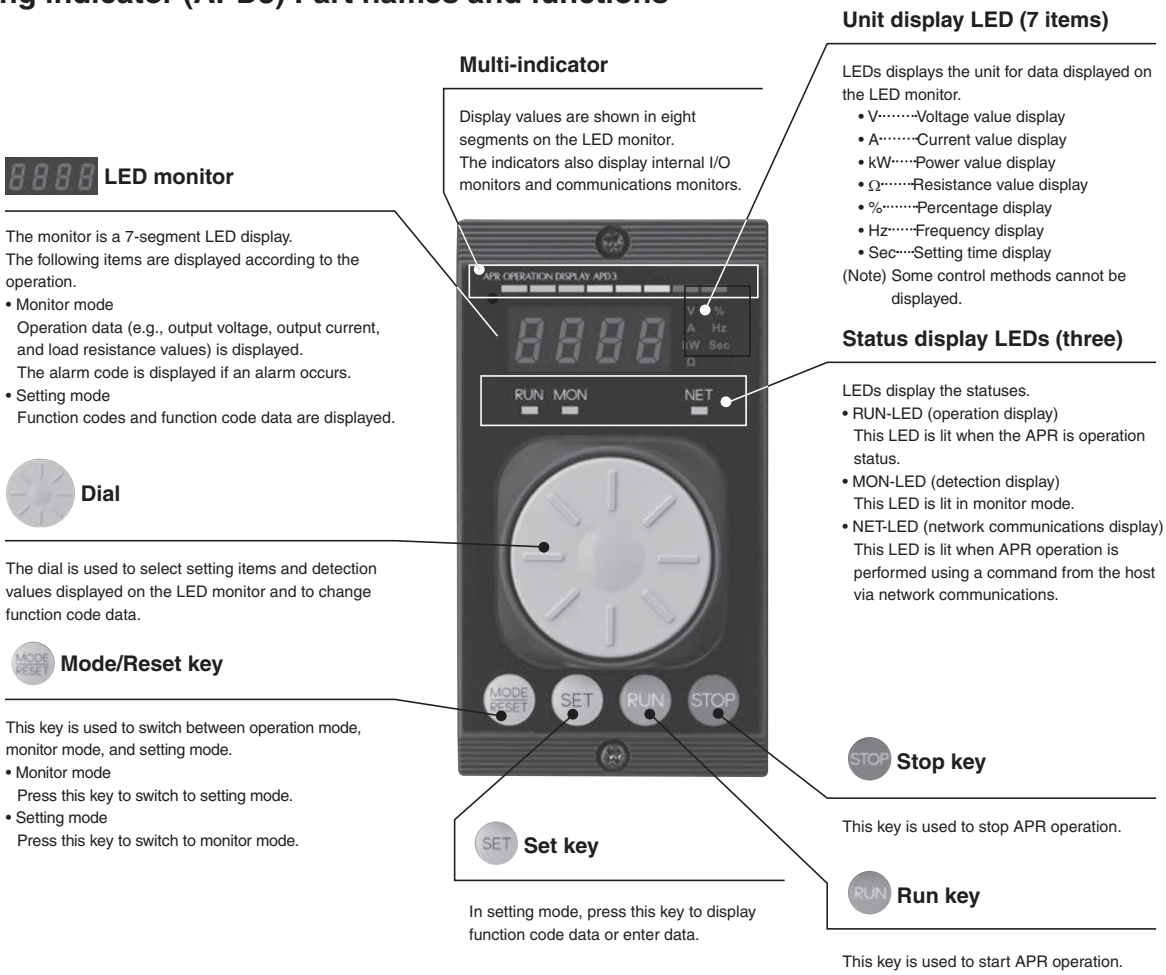
(Note 1) If a setting indicator is used, a connection cable for remote operation (RPN002-□) is required.
(Note 2) If a commercially available cable is used, do not use an STP (shielded) cable.

■Dimensions, Unit: mm



Panel cutting dimensions (view A)

■Setting indicator (APD3) Part names and functions



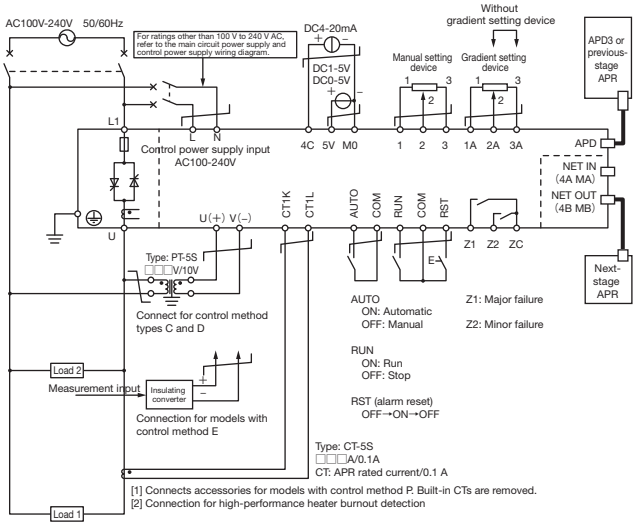
■Display and key operation

Display section and operation section		Operation mode	Setting mode		Monitor mode	
			Operation stopped	Operating	Operation stopped	Operating
Display section		Function	Displays operation data outputs for fixed display of multi-indicator.		Displays in 8 segments for operation data, internal I/O, and communication monitors.	
		Display	ON/Blinks			
		Function	Displays function codes and function code data. Displays alarm code at alarm.		Displays output voltage, output current, output power, load resistance value, and output %. Displays alarm code at alarm.	
		Display	ON			
	RUN MON NET	Function	Displays the statuses.			
		Display	●RUN-LED OFF	●RUN-LED ON	●RUN-LED OFF	●RUN-LED ON
			●MON-LED OFF		●MON-LED ON	
			●NET-LED ON when NET is selected using setting device.			
	V % A Hz kW Sec Ω	Function	Displays unit for data displayed on LED monitor.			
		Display	● V -LED Voltage display			
			● A -LED Current display			
			●kW-LED Power display			
			●Ω-LED Resistance value display			
			●%-LED Percentage display			
			●Hz-LED Frequency display			
			●Sec-LED Setting time display			
Operation section		Function	Increases and decreases function codes and function code data.		Switches display mode of operation data.	
	MODE RESET	Function	Moves to monitor mode		Moves to setting mode	
					Resets error after removing cause of error.	
	SET	Function	Displays function code data and entering data.		–	
	RUN	Function	Starting operation	–	Starting operation	–
	STOP	Function	–	Operation stopped	–	Operation stopped

APR-V Series

■External wiring

●External connections (single-phase)



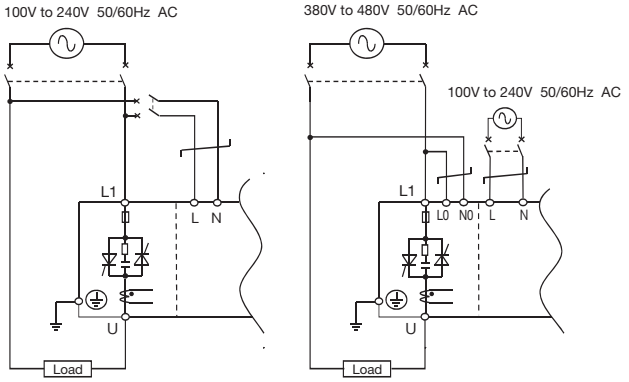
External wiring diagram (In case of full connection and no change in function allocation)

●Control terminal function when setting indicator (APD3) is available (SW8: ON)

You can make function code settings using the setting indicator (APD3) and omit external wiring or change functions using network communication.

Control terminal	Wiring	Remarks
RUN	Required	Operation is not performed when the RUN terminal is OFF. When the RUN terminal is ON, the unit will run or stop when the RUN/STOP key is pressed on the setting indicator (APD3). Operation using the RUN/STOP key on the setting indicator is recorded in non-volatile memory. If the last operation is RUN, the unit will run or stop according to the RUN terminal ON/OFF status. If the last operation is STOP, the unit will not run even if the RUN terminal is ON. *The unit will run or stop only when the RUN terminal is turned ON or OFF if function code 6.o11 is set to OFF. *The unit can be started or stopped using network communications if the RUN terminal is ON.
1, 2, 3 1 A, 2 A, 3 A	Selectable	Settings can be made using the setting indicator (APD3) or network communications, and so wiring is not required. *The functions of the CLR setting can be allocated to an external setter.
AUTO RST	Selectable	Operations can be performed using a setting indicator (APD3) or network communications, and so wiring is not required. Alarms can also be reset using the RESET key on the setting indicator. *Can be allocated to HIGH setting/LOW setting switching input for two-position control.
4C, 5V, M0	Selectable	Control can be performed using network communications if control is made using PLC output.
Z1, Z2, ZC	Selectable	Alarm codes are displayed on the setting indicator (APD3). Network communications can be used to read alarm codes and check if there are major failures or minor failures.

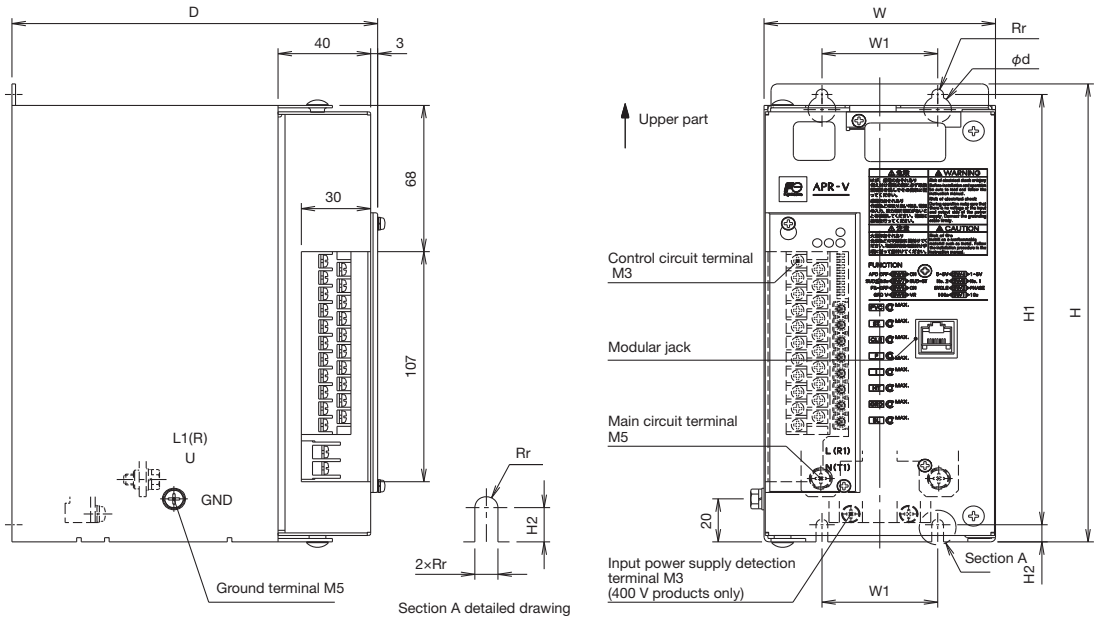
●Main circuit and control power supply wiring connection (single-phase)



***Be sure to check that the main circuit power supply and the input power supply detection terminals are in phase. The 400V system L and N terminals do not need to be in phase.**

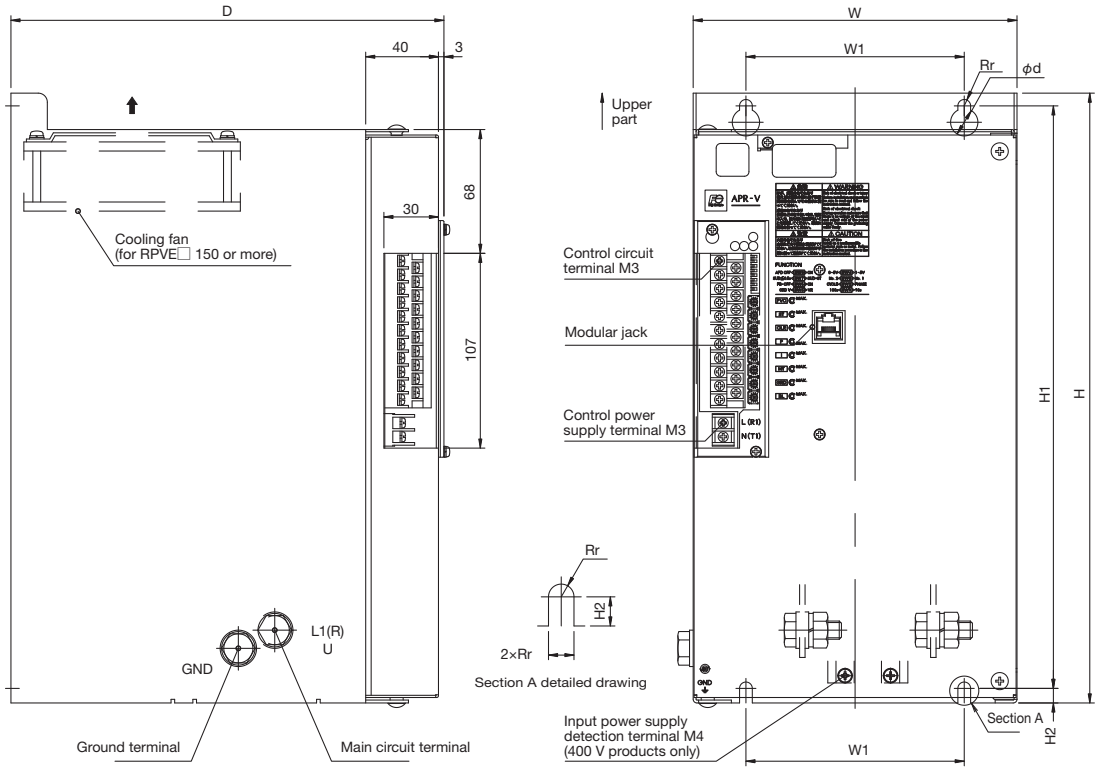
■Dimensions, mm (single-phase)

●RPVE□020, RPVE□045, RPVE□060



Type	W	H	D	W1	H1	H2	d	r	Mass [kg]
RPVE□020	100	213	158	50	200	8	12	2.5	2.6
RPVE□045	114	213	183	60	200	8	12	2.5	3.6
RPVE□060									

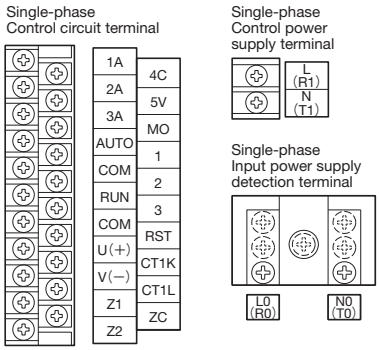
●RPVE□100, RPVE□150, RPVE□250, RPVE□350, RPVE□450, RPVE□600



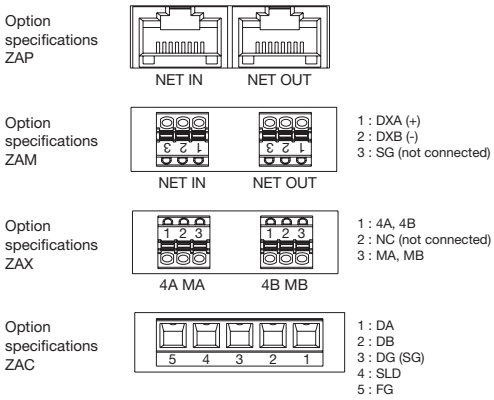
Type	W	H	D	W1	H1	H2	d	r	Mass [kg]	Main circuit terminal	Ground terminal
RPVE□100	144	224	238	90	210	8	14	3	5.3	M8	M8
RPVE□150	160	273	238	90	260	7	14	3	6.4		
RPVE□250	178	335	238	120	320	8	15	3.5	9.0	M10	M10
RPVE□350	200	345	263	150	330	8	15	3.5	10.6		
RPVE□450											
RPVE□600	207	360	288	157	345	8	15	3.5	13.7	M12	M10

APR-V Series

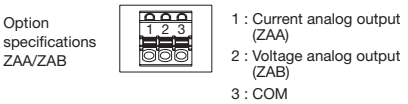
● **Terminal block detailed drawing**



● **Communication board connector diagram Wiring specifications**



● **Analog output connector diagram Wiring specifications**



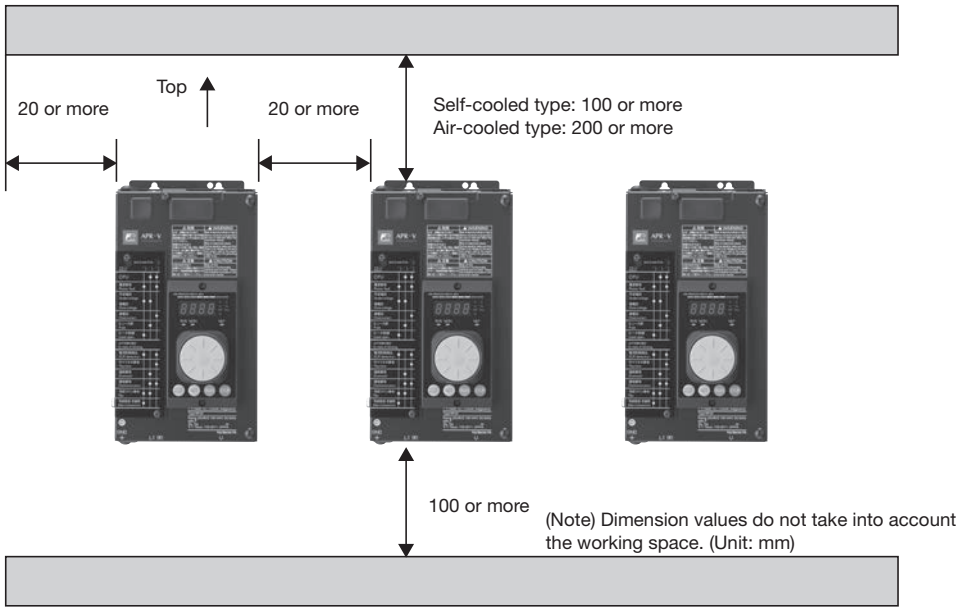
Note) One of the signal outputs is either a current analog signal or a voltage analog signal.

Classification	Name	Symbol	When not in use	Function description
Control power supply	Control power supply terminal	L (R1), N (T1)	—	Control circuit power supply Single-phase 100 V to 240 V AC input
Input power supply detection	Input power supply detection terminal (400 V products only)	L0 (R0), N0 (T0)		Input power monitored using in-phase input with main circuit power supply
Control circuit	Manual setting input	1, 2, 3	Open	Manual setting input and HIGH setting input using connection of variable resistor
	Gradient setting input	1 A, 2 A, 3 A	2A-3A short circuit	Gradient setting input and LOW setting input using connection of variable resistor
	Automatic setting input	4C, 5V, M0	Open	Voltage and current signal input of controller
	Auto/Manual changeover input	AUTO, COM	—	Automatic setting input using external contact closed
				Manual setting input using external contact open
	Run/stop input	RUN, COM	Short-circuit	RUN status using external contact closed and output OFF using external contact open
	Alarm reset	RST, COM	Open	Alarm release for closing of external contacts
	Alarm contact output	Z1, ZC		Internal contacts turn ON when alarm occurs for major failure
	Alarm contact output	Z2, ZC		Internal contacts turn ON when alarm occurs for minor failure
	External detection input	U (+), V (-)		Feedback detection input with connection of VT and DC converters
	External CT input	CT1K、CT1L		CT connection using advanced heater burnout alarm
Parallel run/ Modbus RTU/ CC-Link	APD I/O	APD		Sending and receiving setting values with connection of a setting indicator (APD3)
	Parallel run I/O	NET IN		Receiving parallel operation signals from previous-stage APR in parallel operation
		NET OUT		Sending and receiving setting values from the host in network communications
				Sending parallel operation signals to next-stage APR in parallel operation
		4A, MA		MX and MX2-series compatible input terminal
		4B, MB		MX and MX2-series compatible output terminal

(Note) The function description for the control circuit applies when there are no changes in function allocations.

●Mounting method

- To ensure heat radiation of APRs, mount the APR on a vertical metal surface, make sure the vertical mounting direction is as shown in the figure below, and provide sufficient space both vertically and horizontally. In particular, when using APRs in a dense configuration, there may be heat interference between APRs, so when mounting APRs, separate them by at least the dimensions shown below.
- The temperature inside the panel rises due to the heat generated by the APR, so please take measures to ensure ventilation, etc.
- The left and right sides and top of the APR radiate the most amount of heat, so be careful of the impact of temperature rise on nearby objects.
- Ensure sufficient space with regard to nearby objects when wiring the main circuit terminals, control power supply terminals, and control circuit terminals, as well as for tools used in replacing quick-acting fuses (removing and replacing screws on front panel) and replacing cooling fans (removing and replacing fan mounting screws on the top).



Mounting space diagram

●Wiring method

- For main circuit terminals (single-phase: L1, U), use the screws (bolts) provided. Parts with dimensions larger than the specified dimensions will lack sufficient insulation from surrounding parts. Also, use insulation caps for crimp terminals.
- To ensure safety, always connect ground terminals. Since this terminal is similar to the main circuit terminal, be careful not to mistake them. Wire the ground terminal independently and ensure that you do not wire more than one line.
- Use circuit protective circuit breakers or earth leakage circuit breakers, respectively, on the main circuit input side and control power supply input side (or on the primary side of the operating transformer) for short circuit protection and overload protection.
- The input power supply detection terminal of 400 V products monitors the main circuit power supply status. Wire the input power supply detection terminal block (single-phase: L0, N0) so that it is in-phase with the main circuit power supply.
- When wiring to control power supply terminal blocks (single-phase: L, N), input power supply detection terminal blocks, and control circuit terminal blocks (Z1, Z2, ZC terminals), use crimp terminals with sufficient insulation coating to ensure insulation with nearby terminals.
- When wiring to the signal terminals of the control circuit terminal block, in order to prevent noise, do not wire them close to the main circuit terminals (single-phase: L1, U) and control power supply terminals (single-phase: L, N), and do not wire them in the same duct. If the wires intersect, arrange them orthogonally. The wires should be twisted for each signal group (twist 4 to 7 times per 10 cm). When using a shielded wire, connect the shielded outer jacket on the receiving side to the ground terminal and leave the other terminal open.
- For contact specifications of relays used for contact input, use twin gold-plated contacts for long-term continuous energization at low currents and voltages.
- For external detection signal terminals (single-phase: U (+), V (-), CT1K, CT1L), use a CT, VT, or insulating converter to isolate the signal from the main circuit.
- When mounting the setter (type: RPN001), mount it after drilling mounting holes to prevent rotation.
- When connecting the setting indicator, secure it after taking into account the cable take-out direction so that no excessive force will be applied to the cable connector connection.

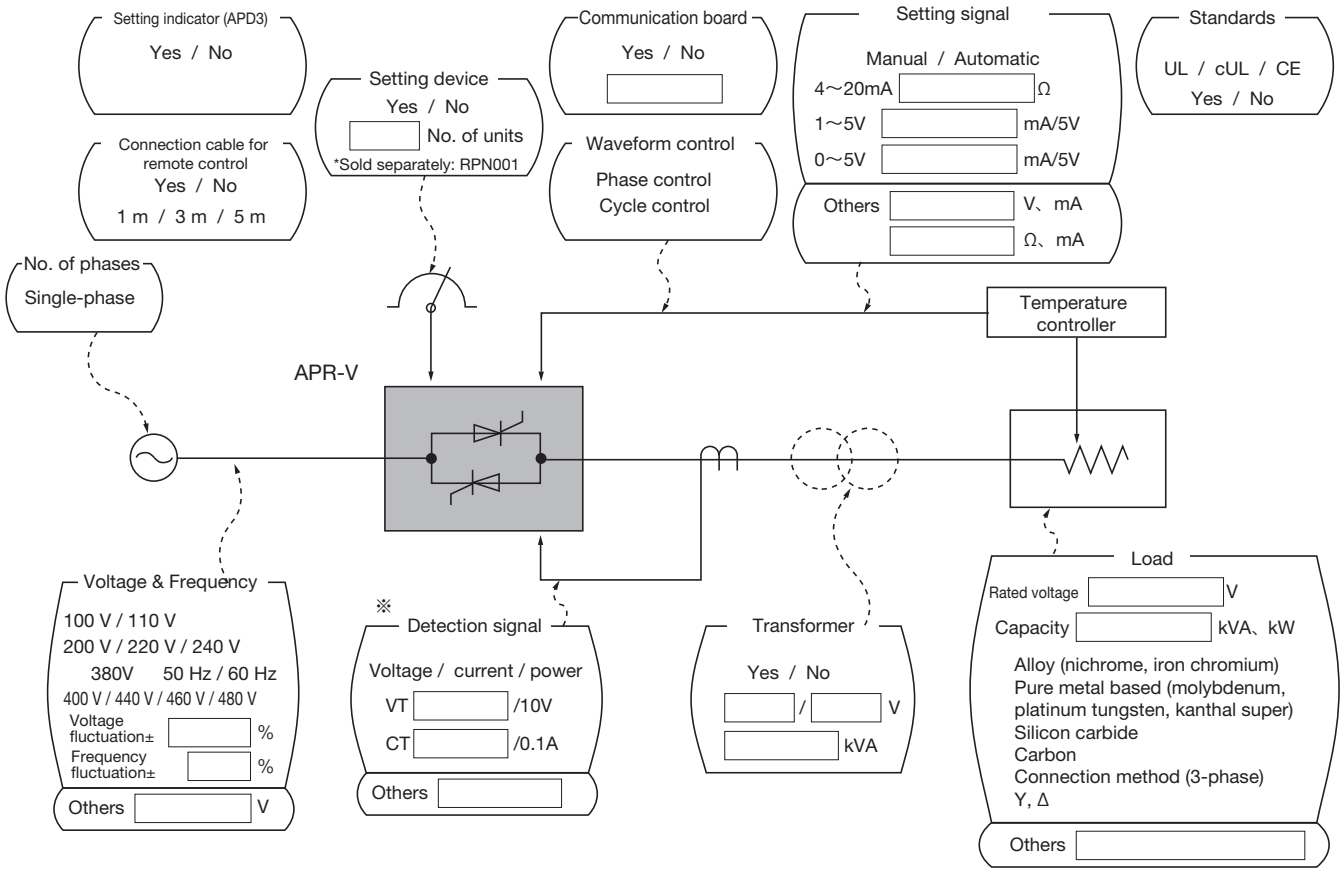
●Others

- In terms of output measurement instruments, use an RMS value type for phase control and a cycle control waveform type for cycle control. The use of other instruments will cause errors.
- No compensation will be provided for damages caused by the failure of any individual delivered product.

APR-V Series

■Inquiries

1. Please circle the appropriate content for each relevant item. Please fill in the values or details in the enclosed blank spaces.



* Select the following control method according to the detection signal.

T: No feedback function
A: AC CLR (current limit regulation)
B: AC ACR (automatic current regulation) + AC CLR (current limit regulation)
C: AC AVR (automatic voltage regulation) + AC CLR (current limit regulation)
D: AC AWR (automatic wattage regulation) + AC CLR (current limit regulation)
E: DC feedback control + AC CLR (current limit regulation)
P: Transformer primary control using cycle control

2. Surrounding temperature (panel inside temperature when stored in-panel) ☐ ～ ☐ ℃

3. Order type (= Product code)

RPV ☐☐☐☐☐ — ☐ — ☐☐☐ / ☐☐

4. No. of units: ☐ **units**

⇨**The following can be omitted depending on the specifications.**

5. Delivery date: ☐ **YYYY** ☐ **MM** ☐ **DD**

6. Company name

7. Other remarks

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- Operate (keep) in the environment specified in the operating instructions and manual. High temperature, high humidity, condensation, dust, corrosive gases, oil, organic solvents, excessive vibration or shock might cause electric shock, fire, erratic operation or failure.
- For safe operation, before using the product read the instruction manual or user manual that comes with the product carefully or consult the Fuji sales representative from which you purchased the product.
- Products introduced in this catalog have not been designed or manufactured for such applications in a system or equipment that will affect human bodies or lives.
- Customers, who want to use the products introduced in this catalog for special systems or devices such as for atomic-energy control, aerospace use, medical use, passenger vehicle, and traffic control, are requested to consult with Fuji Electric FA.
- Customers are requested to prepare safety measures when they apply the products introduced in this catalog to such systems or facilities that will affect human lives or cause severe damage to property if the products become faulty.
- For safe operation, wiring should be conducted only by qualified engineers who have sufficient technical knowledge about electrical work or wiring.
- Follow the regulations of industrial wastes when the product is to be discarded.
- For further questions, please contact your Fuji sales representative or Fuji Electric FA.

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