



# INSTRUCTION MANUAL

Single-phase APR-V

## SETTING INDICATOR

TYPE : APD3

ROM Version : V1.01

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**Note: Please make sure that this instruction manual will be handed over to the final user who is responsible for the maintenance of this instrument.**

## ***Safety design of equipment (request)***

Please take the following into consideration in designing and manufacturing equipment using the AC power regulator (hereafter called APR).

### **1. Scope of application of product**

The APR described in this manual is designed as a general-purpose product for general industry. The application of APR is off the subject in the following usage. The nuclear power, the aerospace, the medical treatment, the traffic equipment, ship, the passenger car, and systems of special application that may considerably affect the human life and property.

### **2. Failure of product**

The APR uses electronic parts that center on the semiconductor for a main circuit and the control circuit. These electronic parts break down at a certain probability. Please do the safe designs of a redundant design, fire spread preventive design, erratic operation preventive design, etc. where an accident resulting in injury or death, a fire accident, and social damage, etc. are not caused as a result of the breakdown of the device that uses APR.

### **3. Malfunctions of main circuit semiconductors**

Thyristors are used in the main circuit of the instrument. As their failure, the short-circuit may rarely occur. Although some models of the series have a function of detecting the said failure, safety design must be respected as in 2 above so that any malfunction will not entail serious damages.

## ***About the latest information***

If system designing including the APR is in progress based on the contents of our general APR brochure, general D&C brochure, and related technical documents, we recommend you to obtain the latest information from our website at the following URL.

If maintenance is to be performed for the first time in a long time since the purchase of this instrument, various pieces of information is also available at the website.

<APR Web site>

<http://www.fujielectric.co.jp/technica/products/ac-power-regulators/index.html>

<Fe Library>

<https://felib.fujielectric.co.jp/download/index.htm>

Search word : RPVE

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The specifications are subject to change without prior notice.

## INTRODUCTION

Thank you very much for purchasing Fuji's setting indicator [APD3] (Read afterward as APD3.), which is an optional item of the APR-V. Be sure to read this manual carefully to ensure safety in handling the instrument, maintain intended functions and performance of the instrument, and operate the instrument properly.

The APD3 is designed for remotely operating Fuji's APR-V.  
Connect to the Fuji APR-V with the remote control connection cable (RPN002-1, RPN002-3, RPN002-5). Remote operation from the panel, function code setting, monitoring, and copying (reading of APR function code data and writing to other APRs), data check, and data change can thus be performed.

Before using the APD3, read the instruction manual of the APR-V as well to use the instrument properly. Improper handling may prevent normal operation, or result in shortening of life or failure.

### Related documents

The following are the documents related to the APR-V. Use them in accordance with the purpose.

- Instruction manual for SINGLE-PHASE APR-V (Detailed version) : INR-MK31083
- Instruction manual for SINGLE-PHASE APR-V (Simple version) : INR-MK31084
- Instruction manual for THREE-PHASE APR-V (Detailed version) : Later
- Instruction manual for THREE-PHASE APR-V (Simple version) : Later
- Instruction manual for MODBUS RTU communication board : INR-MK31091
- Instruction manual for CC-Link communication board : INR-MK31092

The contents of these manuals are revised as needed. Obtain the latest data from our website.

## 1. SAFETY PRECAUTIONS

Be sure to read this instruction manual carefully before performing installation, wiring, operation, and maintenance/inspection.

Operate the instrument properly after obtaining knowledge on the devices, information on safety, and all the other precautions on this instrument.

This instruction manual classifies the level of safety precautions into “**WARNING**” and “**CAUTION**.”

Warning sign	Meaning
 <b>WARNING</b>	Improper handling may result in dangerous situations involving death or serious injury.
 <b>CAUTION</b>	Improper handling may result in dangerous situations involving medium or minor injury or property damage.

Even notes of CAUTIONS may involve a serious accident depending on situations.

You must follow all of them because they contain very important information.

### Operation

 <b>WARNING</b>
<ul style="list-style-type: none"> <li>• Check the installation and wiring carefully for improper wiring and poor connections.</li> <li>• Do not operate the dials and keys with wet hands. Do not allow liquids such as water to spill on the device.</li> <li>• When various alarms are triggered or you feel an abnormal smell, turn off the input power supply. If the alarm or abnormal state recurs and the cause cannot be found, be sure to contact your dealer and never leave the problem unsolved.</li> <li>• Be sure to mount the cover of the terminal block first, and then set the power to ON (close). Do not remove the cover in energized state. Even if each input is set to 0%, or the “Run/Stop” signal is set to OFF (open), electric shock may result if you touch an output terminal. Do not touch the terminals. ..... <b>Electric shock or fire may result.</b></li> <li>• If the alarm is reset with the operation signal set to ON, the instrument starts promptly. Be sure to check in advance that the operation signal is set to OFF.</li> <li>• The APD3 STOP key is enabled only when communication with the APR main unit is normal. Use the operation stop signal from the APR for emergency stop, or provide an emergency stop switch separately. If the operation stop signal from the APR is to be used for emergency stop, input the run signal from the APR, and then input the RUN key of the APD3.</li> <li>• If a data setup of a function code is performed without understanding an operation manual enough, or it mistakes, it may output to load exceeding allowable voltage. ..... <b>An accident may result.</b></li> </ul>

### Disposal

 <b>CAUTION</b>
<ul style="list-style-type: none"> <li>• When disposing of APD3, treat it as industrial waste.</li> </ul>

### Others

 <b>WARNING</b>
<ul style="list-style-type: none"> <li>• Never modify the instrument. ..... <b>Electric shock or injury may result.</b></li> </ul>

General precautions
The illustrations in this instruction manual may show the state of the instrument with the cover or safety shield removed in order to show details clearly. Before operating the instrument, be sure to mount the cover and protective shield back to the original position, and operate it according to the descriptions of the instruction manual.

## 2. BEFORE USE

### 2.1 Checking the product

Open the package and check the following:

- (1) Are the APD3 and its instruction manual (Simple version) enclosed?
- (2) Is the instrument damaged due to an accident during transportation?

If you notice anything wrong, contact your dealer or our sales representative nearest to you.

### 2.2 Target APR

This product is compatible with the APR-V series (Type: RPV□□□□□-□)

(Note) If the order code is kept blank, space is saved by including "-" or "/".

### 2.3 Transportation

The cover of this product is made of plastic.

Do not hold it in a way in which excessive power is applied to it to prevent damage.

### 2.4 Storage

#### 2.4.1 Temporary storage

- (1) Store the instrument in an environment shown by Table 2-1

Table 2-1. Storage and transportation environment

Item	Specifications
Ambient temperature for storage (Note 1)	-20 to +60°C
Ambient humidity for storage	30 to 90% (Note 2)
Atmosphere	A place not subject to dust, corrosive gas (such as sulfide gas and ammonia gas), oil mist, steam, water droplets, direct sunlight, and damage by salt. No condensation due to sudden temperature change is allowed.
Atmospheric pressure	86 to 106 kPa (During storage)
Vibration	Do not vibrate.
Altitude	1,000m or less.

(Note.1) The ambient temperature for storage assumes relatively short time of storage such as during transportation.

(Note.2) Even if the humidity satisfies the specifications, condensation or freezing may occur in a place where temperature varies widely. Avoid storing the instrument in such a place.

- (2) Do not leave the instrument directly on a floor.
- (3) If the atmosphere does not satisfy the storage environment listed by Table 2-1, seal the instrument tightly with a vinyl sheet before storage.
- (4) If there is a concern that humidity may affect the storage, place desiccant (such as silica gel) in the package, and then seal it tightly with a vinyl sheet.

#### 2.4.2 Long-term storage

If the instrument is not to be used for a long time after purchase, store it in the following state.

- (1) Satisfy the environmental conditions for temporary storage.

Note that if the storage period exceeds three months, maintain the ambient temperature within the -10 to +30°C range to prevent degradation of electrolytic capacitor due to the effect of temperature.

- (2) Pack the instrument tightly to prevent entry of moisture. Place desiccant such as silica gel in the package to keep the relative humidity within the package at 70% or lower level.
- (3) If the instrument is to be left in an environment subject to humidity or dust (such as construction site or in case it is mounted on a control panel), remove it once and store it in an environments
- (4) To keep the instrument for one year or longer

If the instrument is left unenergized for a long time, characteristics of the electrolytic capacitor degrade. Be sure to connect it to the power for 30 to 60 minutes at least once a year.

### 3. MOUNTING AND CONNECTIONS

To connect the APD3 to the APR, use the remote control connection cable (RPN002-□) or a commercially available LAN cable to connect the APD3 to the APR.

#### 3.1 Devices and parts required for connections

The following parts are required in addition to the APR.

Table 3.1. Devices and parts required for connections

Name of device and parts	Type	Note
Connection cable for remote operation (Note)	RPN002-1 RPN002-3 RPN002-5	The cable is available in three lengths (1m, 3m, and 5m). Conforms to European RoHS directive and UL standard.
Screws for mounting the APD3	M3*16	Conforms to RoHS directive. Use two screws (supplied).

(Note) If commercially available LAN cable is to be used, use a straight cable (within 20 m in length) for 10BASE-T/100BASE-TX that satisfies category 5 or category 5e of ANSI/TIA/EIA-568A.

[Do not use shielded type cable (STP cable).]

Recommended LAN cable (to comply with European RoHS directive and UL standard):

Manufacturer : Green House  
Type : GH-CBE5E-1M (Length: 1 m)

#### 3.2 Mounting procedure

Mount the APD3, following the procedure shown below.

##### Mounting procedure

- To mount it to a panel (See Fig. 3-1.)
  - [1] Cut out the panel to which the APD3 is to be mounted. (See Fig. 3-2.)
  - [2] Mount the APD3 to the surface of a panel for use on a flat surface of a type 1 enclosure (Note 2)
  - [3] Connect a cable for remote operation to the RJ-45 connector of the APD3.
  - [4] Connect the other end of the remote operation cable to the RJ-45 connector on the APR unit
  - [5] **Make function selection switch SW8 of the main body of APR (APD3 selection) turn on (right side).**

- To operate it locally

Follow the above procedures from [3] to [5].

(Note 1) If the mounting surface is made of plastic, the flame retardant grade of the mounting surface should be UL94V-1 or higher.

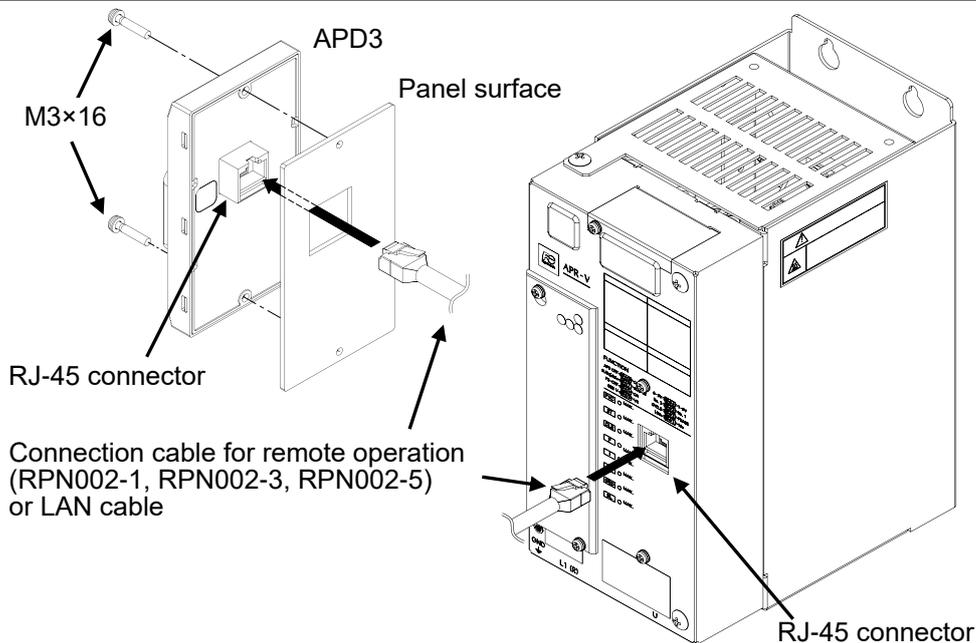


Fig. 3-1. Connecting the APD3 to the APR

(Note 2) Alarm LED (yellow and red) blinks to the main body of APR when an APD3 is detached from the main body.

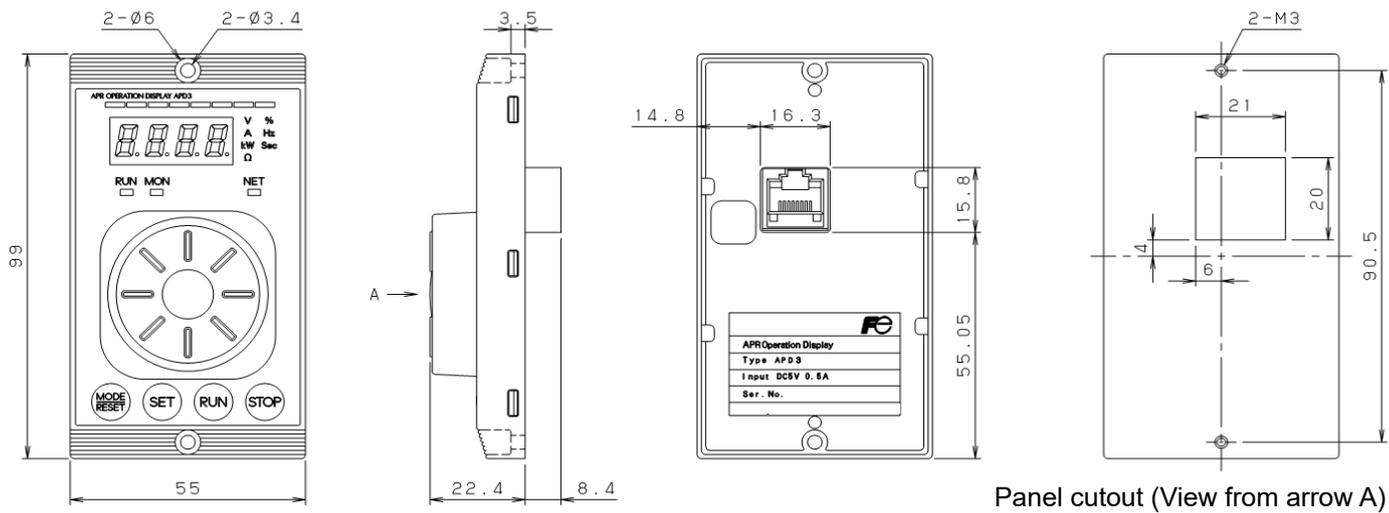


Fig. 3.2. Position of holes for mounting screws and panel cutout dimensions

#### 4. FUNCTIONS

In APD3, various control setups besides various monitoring facilities can be performed.

### ⚠ WARNING

- **Switch it on after attaching front cover by all means. During electricity, you must not take off a cover.**
- Do not operate keys with wet hand. Do not splash liquid such as water over the instrument.
- During electricity, while during the output stop or a setting indicator (APD3) turns off the light, do not touch the terminal of APR-V. (When function code 6.003 [Standby State Selection] is SUSP [Standby State Enable], the light may be put out except a status display [MON].)  
 ..... **Electric shock or fire may result.**
- If a data setup of a function code is performed without understanding an operation manual enough, or it mistakes, it may output to load exceeding allowable voltage.  
 ..... **An accident may result.**

#### 4.1 Name of each part and outline of functions

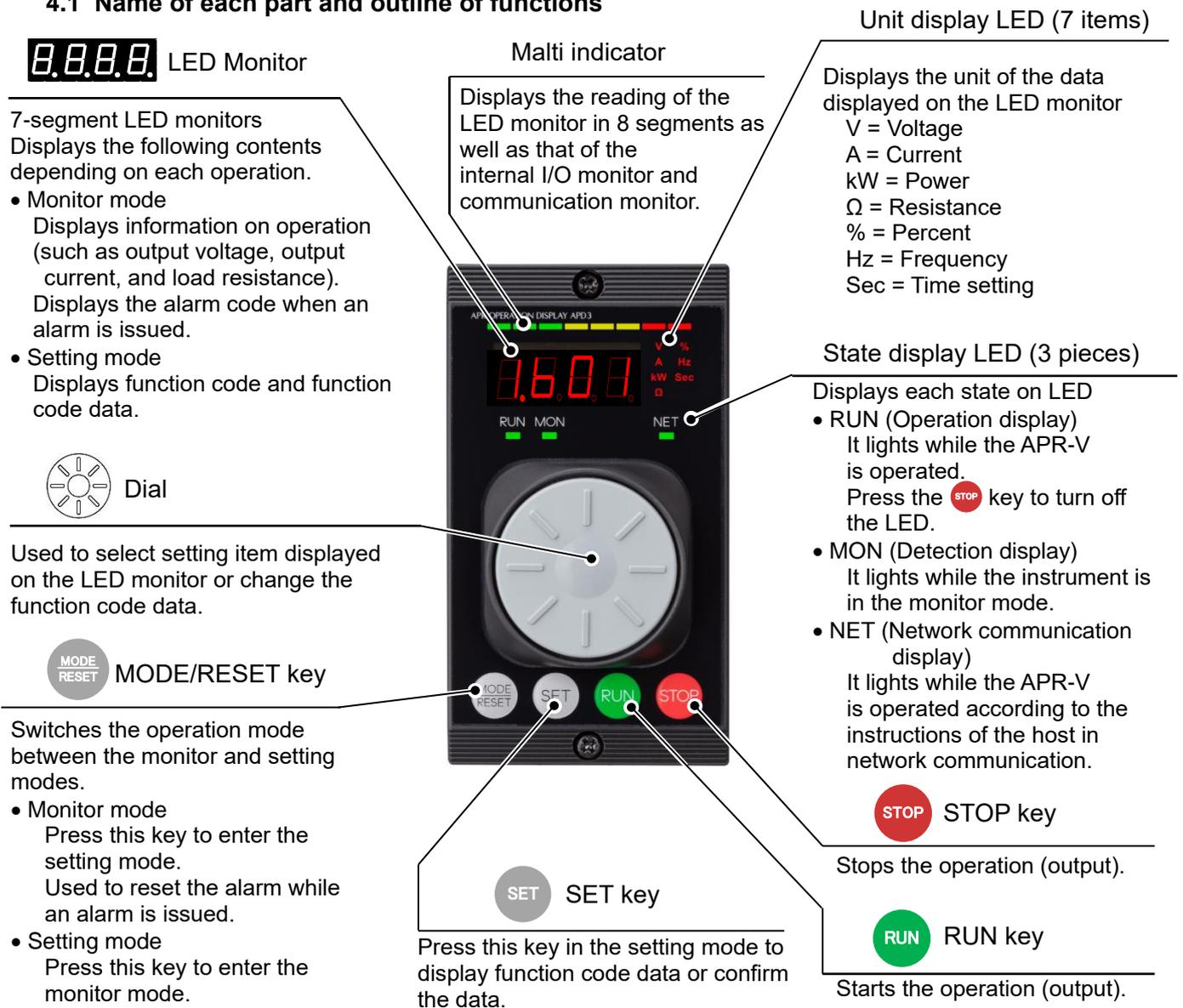


Fig. 4-1-1. The name of each part of the SETTING INDICATOR (APD3)

Table 4-1-1. Displays and key operation

Indicator/Operating unit		Operation mode		Setting mode		Monitor mode	
		Stop	Run	Stop	Run	Stop	Run
Indicator unit	Multi-Indicator		Function	Displays each operation data, internal I/O, communication monitor, etc. in 8-segment indicator, while fixed to multi-indicator display.			
			Display	ON/Blinks			
	Data Display		Function	Displays function code and function code data.		Displays output voltage, output current, output power, and output %.	
			Display	Display an alarm code when an alarm is issued.			
	Status Display		Function	Displays each state.			
			Display	RUN: OFF	RUN: ON	RUN: OFF	RUN: ON
				MON: OFF		MON: ON	
	Unit Display		Function	Displays the unit of data displayed on the LED monitor.			
			Display	V :		Voltage display	
				A :		Current display	
kW :				Power display			
Ω :				Resistance			
% :				Percent display			
Hz :				Frequency display			
Sec :		Time setting display					
Dial		Function	Displays function code and increases/decreases function code data		Switches display mode of each operation data		
Operation unit	MODE/RESET key		Function	Transfers to monitor mode.		Transfers to setting mode Resets the alarm after cause of the error is eliminated	
	SET key		Function	Displays function code data and confirms the data		A setup of a fixed display of a monitor item	
	RUN key		Function	Starts operation	-	Starts operation	-
	STOP key		Function	-	Stops operation	-	Stops operation

Table 4-1-2. Data display- alphanumeric character expression

Alphanumeric character	Display										
A		F		K		P		U		Z	
b		G		L		q		v		-	
C		H		m		r		w		-	
d		i		n		S		X		0.	
E		J		o		t		y		9.	

## 4.2 Outline of operation mode

The setting indicator can be operated in either of the following two modes.

- Monitor mode: The operation is monitored in real time.  
An alarm code is displayed when an alarm is issued.
- Setting mode: Function code data can be checked or set in this mode.

In each operation mode, APR operation/stop operation is possible with the RUN key/STOP key. The change state of the operation mode is shown in Fig. 4-2-1.

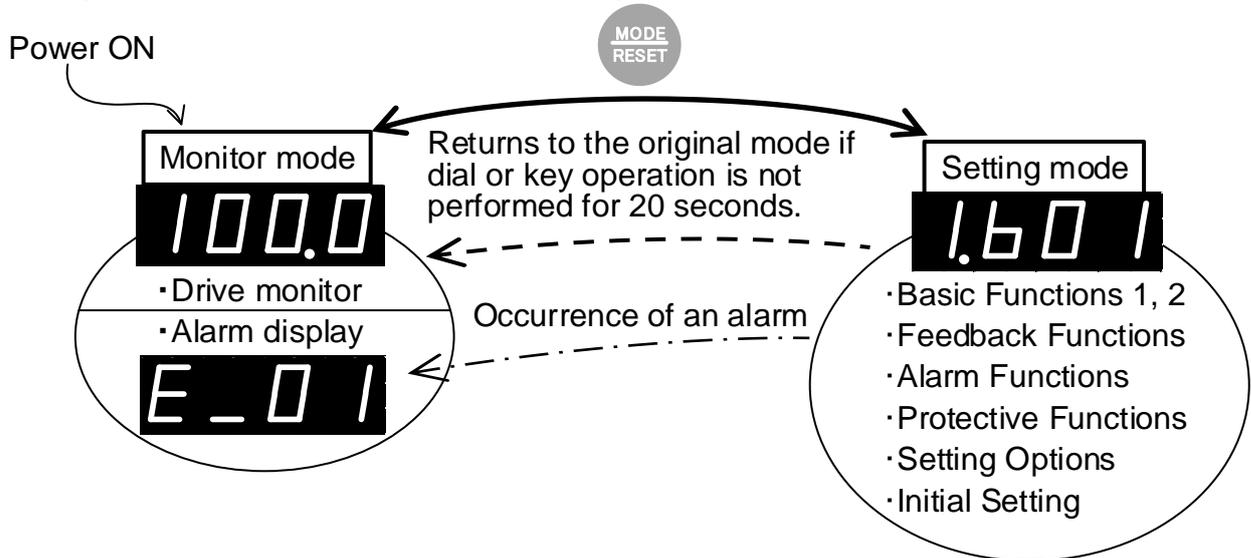


Fig. 4-2-1. Operation mode state transfer diagram

(The display on the LED monitor shown below is an example.)

### 4.2.1 RUN/STOP operation

Press the RUN key, and the state display "RUN" lights and operation is started.

Press the STOP key, and the state display "RUN" turns off and operation is stopped.

(Note.1) Before operating the instrument, set [RUN-COM] on the terminal block of the APR to ON (short-circuited).

If operation is made in the OFF (Open) state,  and then  are displayed on the LED monitor.

(Note.2) If state-indicating "RUN" lighting, the instrument is automatically restarted even if the power is turned off and then on again.

(Note.3) Disable the RUN key and STOP keys If you want to, set function code  [APD3 : RUN/STOP Key Operation Selection] to  [Disable].

### 4.2.2 Monitor mode

The state-indicating “MON” lighting and the items shown below can be monitored.

Turn on the dial to switch between items to be monitored. If an alarm issued, the alarm code is displayed.

Table 4-2-1. Monitor item table

No.	Monitor item	Display (e.g.)	Unit	Explanation of an indicated value	
1	Output reading	100.0	%	Output reading by internal calculation of the APR	
2	Output voltage	220.0	V	AC output voltage detection	
3	Output current	150.0	V	AC output current detection	
4	Output power	33.00	kW	AC output power detection	
(Note.2, 3)	5	Load resistance	1.47	Ω	AC output voltage (detection)/ AC output current detection
(Note.4)	6	Output current for CT	150.0	A	AC output current detection value at CT0/1
(Note.3, 4)	7	Load resistance for CT	1.47	Ω	Load resistance value at CT0/1
8	Power supply voltage	220v	V	Power supply voltage detection (Main circuit :Input terminal)	
9	Power supply frequency	60.0	Hz	Power supply frequency detection	
10	Output setting signal	r100	%	Setting signal detection	
11	Gradient setting signal	g100	%	Gradient setting signal detection	
12	CLR setting signal	c100	%	CLR setting detection	
13	Control circuit terminal input	T0.A.r	-	Status display of control circuit terminal	
	3 <sup>rd</sup> column: Alarm reset	0. / 1.		[RST-COM] Alarm reset terminal	
	2 <sup>nd</sup> column: Auto/manual changeover	A. / m.		[AUTO-COM] Auto/manual terminal	
	1 <sup>st</sup> column: RUN/STOP changeover	r / S		[RUN-COM] RUN/STOP terminal	
14	Rated current, Control system	20.A	A	Rated current, Control system	
15	Advanced Function Information	F0.0	-	Enable/disable the advanced setting function	
	3 <sup>rd</sup> column: Unused	—		Unused	
	2 <sup>nd</sup> column: Function selection switch	0 / 2		Enable/disable function selection switch	
16	Alarm code	E_01	-	Alarm outbreak display	

(Note.1) In order to display a monitor item on a forward direction (No.1~16~1), rotate a dial in the clockwise direction. (Fig.4-2-2)

(Note.2) It is displayed by selecting  [on] [Enable] for the function code **7.d05** [Monitor: Load Resistance Display Selection].At this time, monitor No.10 to 12 are hidden.

(Note.3) The maximum value of resistance display is 99.99Ω.  
If the maximum value is exceeded, 99.99Ω will be displayed.  
If the value is indeterminate (current is not flowing in the load, etc.), 0.0Ω is displayed.

(Note.4) It is displayed by selecting  [on] [Enable] for the function code **7.d06** [Monitor: CT Value Display Selection].

(Note.5) Press the SET key to display the items to be monitored at all times. Default display is output voltage.

(Note.6) If key or dial operation is not performed for 20 seconds in the setting mode, the display set in the monitor mode is displayed. Note that if the dial is turned after the display is fixed, the display changes, and resetting is allowed by pressing the SET key.

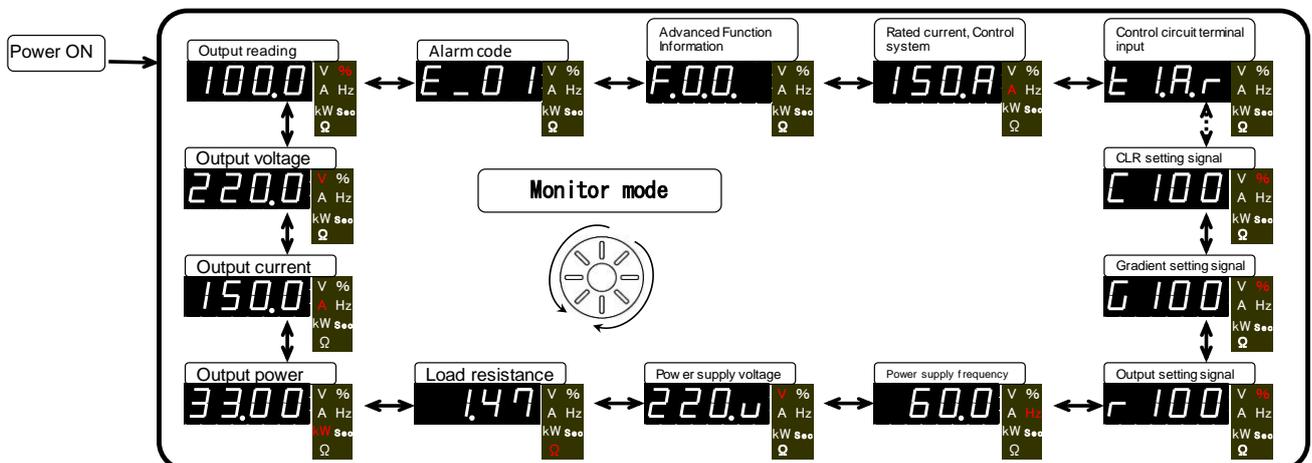


Fig. 4-2-2. Monitor item display change flow

(1) Display accuracy

The display accuracy of the monitor items is as shown in the table below.

Table 4-2-2. Items to be monitored ◎: Monitor accuracy  $\pm 2\%FS$ , ○: Monitor accuracy  $\pm 5\%FS$ , -: Not displayed

No.	Monitor item	Unit	Explanation of an indicated value	Accuracy of control system					
				T	A/B	C	D	E	P
1	Output reading	%	Output reading by internal calculation of the APR	◎	◎	◎	◎	◎	◎
2	Output voltage	V	AC output voltage detection	○	○	◎	◎	○	○
3	Output current	A	AC output current detection	-	◎	◎	◎	◎	○
4	Output power	kW	AC output power detection	-	○	○	◎	○	-
5	Load resistance	$\Omega$	AC output voltage (detection)/ AC output current detection	-	○	○	○	○	○
6	Output current for CT	A	AC output current detection value at CT0/1	-	◎			-	
7	Load resistance for CT	$\Omega$	Load resistance value at CT0/1	-	○			-	
8	Power supply voltage	V	Power supply voltage detection (Main circuit :Input terminal)	◎					
9	Power supply frequency	Hz	Power supply frequency detection	◎					
10	Output setting signal	%	Setting signal detection	◎					
11	Gradient setting signal	%	Gradient setting signal detection	◎					
12	CLR setting signal	%	CLR setting detection	◎					

- (Note.1) Regarding the display accuracy, only the heater resistance during phase control is applicable.  
An accurate output voltage cannot be displayed at the inductivity load, the first transformer control, and the first rectifier control. The output voltage display value is the referred value.
- (Note.2) The cycle control and cycle control ) Rush current auto suppression can display "Output voltage", "Output reading ", "Power supply voltage", "Power supply frequency", and "Alarm code".  
When using the cycle control with the control type C, type D and type E, disconnect the VT because the connected VT may be burnt out due to the magnetic bias phenomenon
- (Note.3) To keep the monitor accuracy of the load resistance value (balanced load) within 5%FS, the output setting must be 60% or more.

(2) Monitor with item name display

When displaying the monitor items in the table below, the item name is displayed for 1 second before the numerical value display.

Table 4-2-3. Monitor item with item name display

No.	Monitor item	Item name display	Display (e.g.)	Unit	Explanation of an indicated value
6	Output current for CT	Ct-0 / Ct-1	150.0	A	AC output current detection value at CT0/1
7	Load resistance for CT		1.47	$\Omega$	Load resistance value at CT0/1

### 4.2.3 Setting mode

The setting mode has functions such as setting/checking function codes and maintenance functions that can check the input signal.

It uses a menu system that allows easy selection of functions. Table 4-2-4 shows the menu types.

The leftmost digit (number) of the displayed code indicates the menu number, and the remaining 3 digits indicate the menu contents.

When the setting mode is entered from the second time onward, the function code at the end of the previous time is displayed.

Table 4-2-4. Setting mode menu

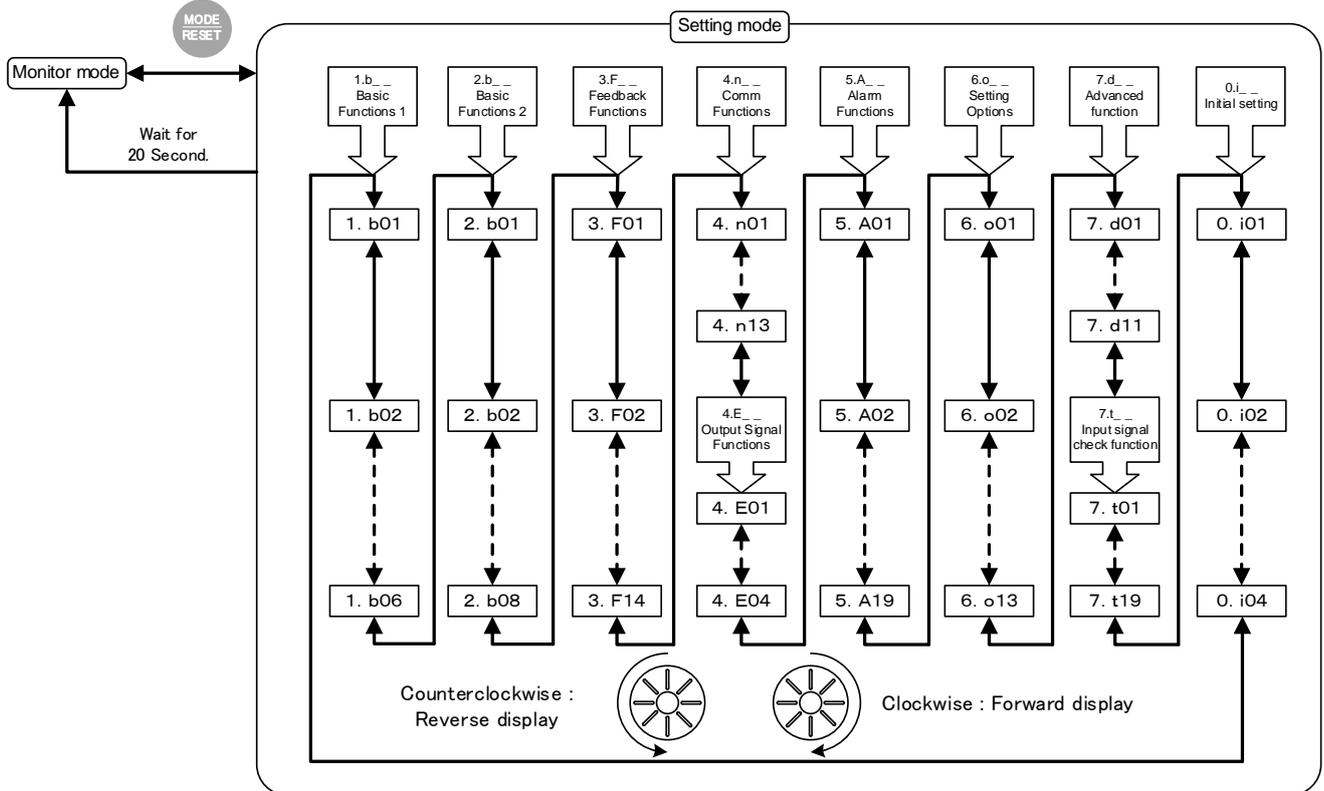
Manu	Data display unit	Major function	Description
APR control setting	1.b_ _	Basic Functions 1 b code (1.b01 - 1.b06)	Basic APR-V operations Mainly substitution of external volume
	2.b_ _	Basic Functions 2 b code (2.b01 - 2.b08)	Basic APR-V operations Mainly function selection
	3.F_ _	Feedback Functions F code (3.F01 - 3.F14)	The function corresponding to feedback form. CLR setting, Heater disconnection setting, etc.
Attachment function setting	4.n_ _	Communication Functions n code (4.n01 - 4.n13)	The function about communication
	4.E_ _	Output Signal Functions E code (4.E01 - 4.E04)	The function about an output signal
Alarm setting	5.A_ _	Alarm Functions A code (5.A01 - 5.A19)	The function about an alarm output (terminal block[Z1, Z2])
Setting option	6.o_ _	Setting Options o code (6.o01 - 6.o13)	The function code changed from a factory setting is displayed (it is possible to return function code data to reference/change/factory setting). The operation limited function of APD3.
Advanced function	7.d_ _	Advanced function d code (7.d01 - 7.d11)	Monitor display selection. (Load resistance, CT signal) Function to enable external terminal input
	7.t_ _	Input signal check function t code (7.t01 - 7.t18)	Displays the status of the setter for adjustment and terminal input signal
Initial setting	0.i_ _	Initial Setting i code (0.i01-0.i07)	"CODE SYMBOLS" setting

(1) Display menu

All the menu mode function codes can be displayed by turning the dial.

(2) Menu “Data setting”

Fig. 4-2-3. shows the procedure to switch the menu display.



Operation procedure:

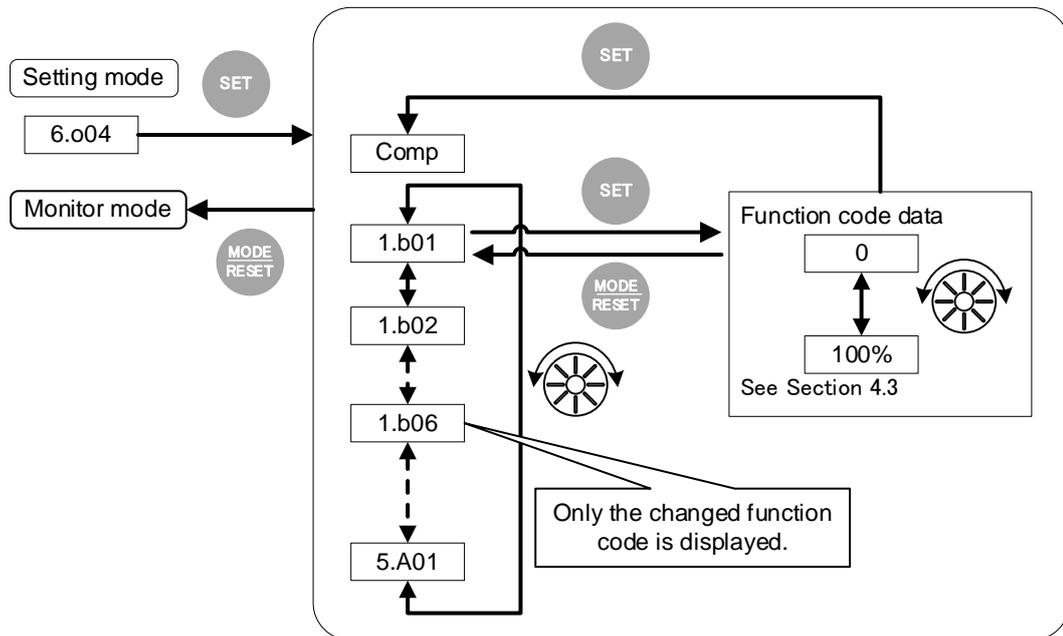
1. Press while monitor mode is displayed, and the function code is displayed.
2. Select a desired function No. by turning , and then press (for instance, 1.b01) and “Function code data” appears.
3. The initial setting is 0.0 %. If 50.0 % has been set, 50.0 % appears.
4. Turn to select a desired setting and press , and the function code data is confirmed and the next function code No. 1.b02 appears.
5. Press not to make the setting for that function code, and the display returns to 1.b01 .
6. Press to return to the monitor mode, or wait for 20 seconds, and the monitor mode is automatically restored.

Fig. 4-2-3. State transition in setting mode

(3) Menu “Data check & change”

The change of function code data can be checked or changed using the function code **6.o04** [Data Check & Change].

The function code changed from the factory setting appears on the data display unit.



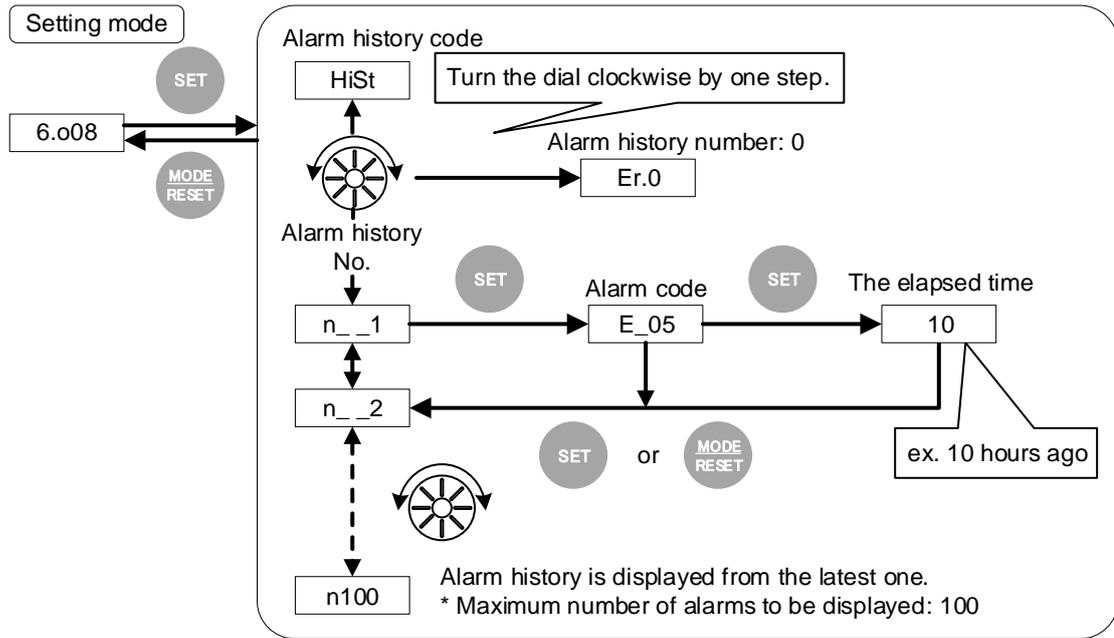
Operation procedure:

1. Select the function code **6.o04** in the setting mode, and press **SET**.
2. **ComP** appears, and the newest code (for instance, **1.b01**) in the changed function code is displayed.  
\* If there is no changed function code, **SAMe** is displayed.
3. The function code can be changed by turning .  
Select the function code, and press **SET**, the function code data can be changed.
4. Turn to select a desired function code and then press **SET**, and the function code data is confirmed. Again, after displaying **ComP** and the next function code No. that has been changed, **1.b02** appears.  
\* The function code of the correspondence (for instance, **1.b01**) disappears from the list of the changed function code when the fixed set value is the same as the factory setting.
5. Press **MODE RESET** to return to the monitor mode, or wait for 20 seconds, and the monitor mode is automatically restored.

Fig. 4-2-4. “Data check & change” operation procedure

(4) Menu “Alarm history check”

The alarm that has been issued can be checked with function code **6.o08** [Checking Of Alarm History].



Operation procedure:

1. Select function code **6.o08** in the setting mode and press **SET**, and **HiSt** appears.
2. Turn  clockwise by one step.  
Refer to procedure 3, when the number of alarm histories is zero.  
Refer to procedure 4, when the number of alarm histories is one or more.
3. **Er.0** appears. Press **SET** or **MODE RESET**, and the display returns to **6.o08**.
4. Newest alarm history No. **n\_1** is displayed. In this state, if **SET** is pressed, and an alarm code (for instance, **E\_05**) will be displayed. Once again, if **SET** is pressed, and the elapsed time (for instance, **10**) will be displayed.
5. While the newest No. **n\_1** shows, if  is turned once on the right side, the alarm history No. **n\_2** in front of one will be displayed.  
If  is turned once on the left side, the alarm history No. **n\_1** in front of one will be returned.
6. While an alarm code or the elapsed time shows, if **SET** or **MODE RESET** is pressed, it will return to the display of an alarm history No. While an alarm history No. shows, if **MODE RESET** is pressed, it will return to the function code **6.o08**.

Fig. 4-2-5. “Alarm history check” operation procedure

(5) Direct drive function

APD3 operates in the same manner as an internal setter and external setter.

As a specific example, if the dial is turned while function code data [0 to 100%] of the function code **1.b01** [Manual Digital Setting] is displayed, the display changes in the 0 to 100% range. The output of the main unit also changes accordingly in the 0 to 100% range.

Press SET key to confirm the setting, and the next function code **1.b02** [Gradient Digital Setting] appears.

If you press the MODE/RESET key before pressing the SET key, the previous set value will be restored.

See the direct drive field (Enable: ○) in "4.3.1 Function code list" for the function codes having the same functions.

(Note.1) The alarm code displays **E CL** , when entering "CLR detection" state while operating a direct drive.

(Note.2) An alarm code is displayed during direct drive operation, and if you continue to turn the dial, the LED monitor display will return to the original direct drive operation. The alarm does not reset.

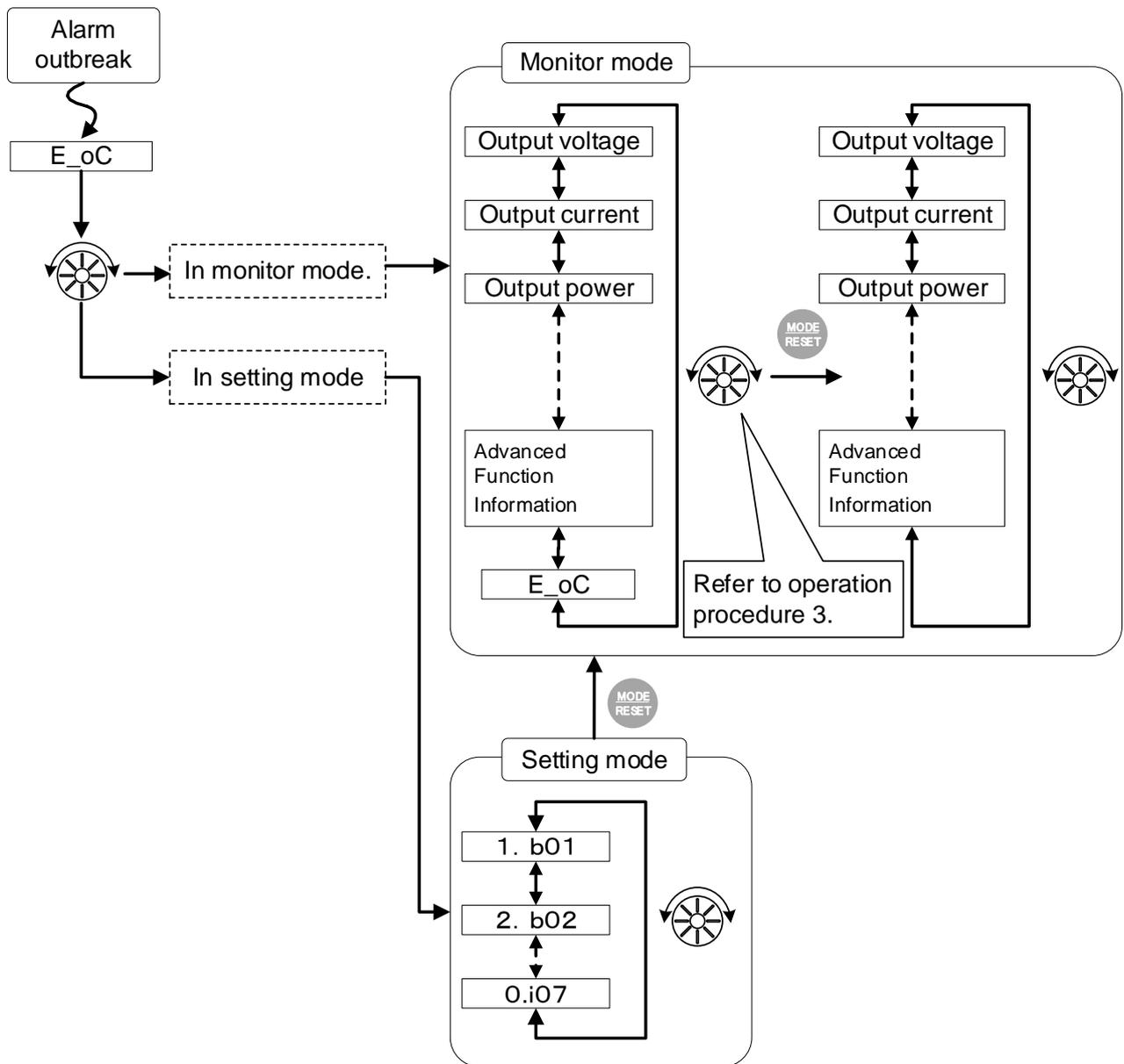
When the output is stopped by an alarm, the setting by direct drive operation is disabled.

(The status display "RUN" (operation display) turns off).

(Note.3) **If an alarm occurs during direct drive operation, the set value before the alarm code is displayed is confirmed.**

#### 4.2.4 Alarm code display

If the protective function is activated and an alarm is issued, the alarm code is displayed.



Operation procedure:

1. If an alarm occurs, an alarm code **E oC** appears (for instance, “Overcurrent” ).
2. **Output voltage** is displayed by pressing **MODE RESET** , or turning . The monitor item and alarm code is displayed by turning .

3. Alarm reset.

By pressing **MODE RESET** , the alarm codes are reset and only the monitor item is displayed.

APR-V will start an output, if output preparation is complete.

**Note:** **Remove the cause of alarm code generating before pushing alarm reset.**

Fig. 4-2-6. The operation procedure of monitor mode under alarm display

Only one alarm code is displayed. The priority of the display is major failure> minor failure> other failure. If they have the same priority, the one with the earliest occurrence is displayed. If you remove the cause of the alarm and press the MODE/RESET key, the alarms with the highest priority will be displayed first. An alarm code list is shown in Table 4-2-5. For alarm details, refer to the APR-V main unit operation manual.

Table 4-2-5. Alarm code list

Display	Name	Alarm No.	Explanation
E_oC	Overcurrent	1	Detected by internal CT when the output current exceeds the rating for several cycles.
E_tH	Thyristor error (Type A and up)	2	Short circuit of thyristor element is detected by internal CT.
E_FS	Main fuse blown	3	In case abnormal current such as insufficient insulation and short circuit should occur, the current is interrupted within half cycle to protect the main element.
E_oH	Overheating	4	Detection by temperature sensor
E_CP	CPU error	5	CPU memory error
E_Hb	Heater disconnection	7	Heater disconnection
E_LF	Power supply frequency fall	8	When power supply frequency falls within the 45 to 65 Hz range
E_LL	Under voltage	9	Detects decrease of control power supply voltage
E_Lo	Over voltage	12	Detects increased of control power supply voltage
E_Fn	End of life of cooling fan	13	Detects the end of life of cooling fan(decrease of speed) (Air-cooled type only)
E_ES	Analog output current error (Option)	31	Detects when the allowable load resistance is exceeded when using the current signal on the AO board.
E_CL	CLR detection	15	Detects load current that exceeds the CLR setting.
E_01	Communication error (Net)	6	Detects master APR transmission failure during parallel operation (ZAX, ZAP). Detects communication error during network communication (Modbus RTU, CC-Link).
E_02	Communication error (APD3)	14	Detected when there is no communication response from APR. If function code <input type="text" value="6.013"/> [APD3: Communication Disconnection Detection Selection] is set to <input type="text" value="oFF"/> [Disable], it will not be detected.
E_03	Setting input 1 disconnected	16	When setting input 1 (external volume for manual setting) is enabled, non-connection is detected. Judgment time: 10 seconds.
E_04	Setting input 2 disconnected	17	When setting input 2 (external volume for gradient setting) is enabled, non-connection is detected. Judgment time: 10 seconds.
E_05	Current/voltage setting signals disconnected	18, 19	4-20mA or 1-5V, non-connection is detected. Judgment time: 10 seconds.
E_07	Data R/W failure (APD3)	20	Detected when data cannot be saved to external memory. (APD3)
E_08	Data R/W failure (APR)	21	Detected when data cannot be saved to external memory. (APR)
E_09	Alarm history storage failure	22	Detected when the alarm history cannot be saved in the external memory. (APR)
E_10	Password error	-	Display if the password is incorrect.
E_11	APD3 operation error	-	Displayed when an incorrect operation is performed in each operation mode.
E_12	Current zero cross detection failure(Type P)	27	Detects unconnected/reverse polarity connection of external CT. Detected when the load is open.
E_13	Delay of load current by 30° or more(Type P)	28	Detects when the load current is delayed by 30° or more.

(Note.1) Cut power off when alarm is generated. Next, remove the cause of alarm.

Do not turn on the power supply again without removing the cause of alarm.

There is a possibility of displaying the same alarm again.

(Note.2) Even if the alarm is reset while the alarm is being displayed, the alarm display will continue if the cause has not been resolved.

(Note.3) Alarm is preserved in the alarm history (100 or less).

(Note.4) If an alarm is reset without turning off the power and then the same alarm occurs again, the second alarm is not recorded in the alarm history.

(Note.5) Next alarms are not saved in the alarm history. "CPU memory error , "CLR detection , "Data R/W failure , , "Alarm history storage failure , "Password error , and "APD3 operation error

(Note.6) Resetting alarm codes

The alarm can be canceled by removing the alarm factor. (Alarm code display cancellation, alarm contact cancellation)Some alarms are automatically released. (e.g., "communication error , "CLR detection )

(Note.7) When setting or running/stopping by APD3 or network device, the set value is saved (written) in the internal EEPROM. There is an upper limit (about 1 million times) to the number of times EEPROM can be written.  
 If the number of writable times exceeds the upper limit, "Data write/read failure (APR) E 08 " or "Alarm history storage failure E 09 " may be detected or the data may return to the factory default. For example, if an operation/stop command is issued from a network device at 10-minute intervals, an alarm will be detected 19 years later.

In addition, the main unit consumes the number of times of write in the EEPROM in the following cases:

[1] Storage of alarm history at the occurrence of an alarm (one time of write)

[2] Operation accumulation time preservation in every hour (one time of write)

Please note that when using the generator power supply, "Power supply frequency abnormal E LF ", "Under voltage E LL ", and restart may be repeated.

(Note.8) About the priority level  
 If multiple alarms occur at the same time, the alarm with the highest priority is displayed.  
 Refer to Table 4-2-6 for a priority level.

Table 4-2-6. Alarm code priority level

Priority level	Alarm output (Note.1)	After-detection operation
HIGH ↑↓ LOW	r1, r2	Output stop
		Output continuation
	r-	Output stop
		Output continuation

(Note.1) "Alarm Functions (5.A code)" reference

#### 4.2.5 Multi-indicator

By expressing numerical value of the data display with a multi-indicator, higher visual effect can be obtained. Table 4-2-7 (below) explains what these numbers mean.

Table 4-2-7. Multi-indicator

No.	Monitor item	Display (e.g.)	Allocation of multi-indicator
1	Output voltage	220.0V	20% 40% 50% 60% 70% 80% 90% 100% 
2	Output current	80.0A	20% 40% 50% 60% 70% 80% 90% 100% 
3	Output power	17.6kW	20% 40% 50% 60% 70% 80% 90% 100% 
4	Output reading	100.0%	20% 40% 50% 60% 70% 80% 90% 100% 

- Lighting and blinking of multi-indicator  
 When the value is transferred from 0% to 20%, the 20% LED blinks.  
   At 5%, the LED blinks, allowing the ON/OFF DT ratio to show 25%.  
   At 10%, the LED blinks, allowing the ON/OFF DT ratio to show 50%.  
   At 15%, the LED blinks, allowing the ON/OFF DT ratio to show 75%.  
   At 20%, the LED lights.  
   Other LED operates in the same manner.
- About the multi-indicator fixation display  
 A fixed display can be done by each item the multi-indicator.  
 Refer to "the function code 6.o01 [Multi-indicator Fixation Display]" of the "4.3.2 Outline of function code" for details.

## 4.3 Function code

### 4.3.1 Function code list

A function code is the code number assigned to the function of APR-V.

The function codes consist of the following 9 groups: "Basic Functions (b code)", "Feedback Functions (F code)", "Communication Functions (n code)", "Attachment Functions (E code)", "Alarm Functions (A code)", "Setting Options (o code)", "Advanced function (d code)", "Input signal check function (t code)", "Initial Setting (i code)".

#### ■ Checking and setting the function code data

In the function code data, there are a thing in which setting change is possible, and an impossible thing.

The symbol to classify these in is shown in the column of "the data processing" of the function code list.

- ◎ : Can be checked and set freely.
- : Exclusively for setting
- △ : Data is protected by password. Customers can check the data but cannot set data.
- x : Exclusively for checking
- : Data cannot be checked or set through network communication.

#### ■ Skip function

The skip conditions (a function code and a preset value) to which a function code becomes undisplayed at the column of a "skip" of a function code table are shown.

- : Displayed at all times. It is not skipped.
- Function code : It is the function code and its function code data leading to a skip.
- F\_SW□ : APR function selection switch (□: SW No.) and its setting state that cause skipping.

A list of function codes is shown on the next page.

### Basic Functions 1 (1.b code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
1.b01	Manual Digital Setting	0 to 100.0%	0.1	%	0.0%	⊙	○	○	—	○
1.b02	Gradient Digital Setting	0 to 200.0%	0.1	%	100.0%	⊙	○	○	—	○
1.b03	Base Load Setting	0 to 100.0%	0.1	%	0.0%	⊙	○	7.d04	on	○
1.b04	Soft Start Time Setting	0.5 to 100.0 sec.	0.1	Sec.	0.5 sec.	⊙	○	7.d04	on	—
1.b05	Soft Up Time Setting	0.5 to 100.0 sec.	0.1	Sec.	0.5 sec.	⊙	○	7.d04	on	—
1.b06	Soft Down Time Setting	0.5 to 100.0 sec.	0.1	Sec.	0.5 sec.	⊙	○	7.d04	on	—

### Basic Functions 2 (2.b code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
2.b01	Setting Input 1 Selection	No Selecting (APD3) : no Manual Setter : mAnU CLR Setter : CL.VL	—	—	mAnU	⊙	○	○	—	—
2.b02	Setting Input 2 Selection	No Selecting (APD3) : no Gradient Setter : Grd CLR Setter : CL.VL	—	—	Grd	⊙	○	○	—	—
2.b03	Auto Setting Selection (Voltage Signal Setting Input)	Auto Setting : 1-5v Gradient Setting : Grd CLR Setting : CL.VL	—	—	1-5v	⊙	○	○	—	—
2.b04	Auto Setting Selection (Voltage Signal)	DC1-5V : 1-5v DC0-5V : 0-5v	—	—	1-5v	⊙	○	2.b03 7.d04	Except 1-5V on	—
2.b05	2-potion Control Selection (Disable / Changeover)	Disable : oFF Auto/Manual Changeover Input Terminal : Auto APD3-HIGH Setting : AP-H APD3-LOW Setting : AP-L	—	—	oFF	⊙	○	○	—	—
2.b06	2-potion Control Selection (LOW / HIGH Selection)	L-1.b01, H-1.b02 : LA.HA L-1.b01, H-Setting Input 2 : LA.Hv L-Setting Input 1, H-1.b02 : Lv.HA L-Setting Input 1, H-Setting Input 2 : Lv.Hv	—	—	LA.HA	⊙	○	○	—	—
2.b07	Waveform Control System Selection	Phase Control : PHA1 Cycle Control : CYC1 Cycle Control : Rush Current : CYC2 Auto Suppression	—	—	PHA1	⊙	○	7.d04	on	—
2.b08	Output Characteristics Selection	Linearity : Lnr Phase Angle Proportional : Pro Square-Law Characteristics : SqU	—	—	Lnr	⊙	○	○	—	—

### Feedback Functions (3.F code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
3.F01	Operation Mode Selection	Feedback Control Enable : Fbon Feedback Control Disable : FboF	—	—	Fbon	⊙	○	2.b07 7.d04 7.d04 0.i03	CYC1 CYC2 oFF on t A P	—
3.F03	AC CLR Selection	0 to (Rated current * 1.02) (A) (For Phase Control)	0.1	A	Rated current * 1.02	⊙	○	7.d04 0.i03	on t	○
3.F05	P Control Setting	0.100 to 0.500 times	1	0.001 times	300	⊙	○	7.d04 0.i03	on t	○
3.F06	I Control Setting	0.025 to 0.125 sec.	0.001	Sec.	0.075sec.	⊙	○	7.d04 0.i03	on t	○
3.F07	Heater Disconnection : Judgment Level Setting	0 to 100.0%	0.1	%	0.0%	⊙	○	3.F11 7.d04 0.03 0.i04	Except 0.0 on t P 3P	○
3.F08	Heater Disconnection : Judgment Time Setting	0 to 60 sec.	1	Sec.	1sec.	⊙	○	2.b07 7.d04 7.d04 0.i03	CYC1 CYC2 oFF on Cycle t P	○
3.F09	Heater Disconnection : Operation State Selection	Operation Continue : rUn Operation Stop : StoP	—	—	rUn	⊙	○	0.i03	t P	—
3.F10	Heater Disconnection : Detection Selection	Disable : oFF.H Enable : on.H	—	—	oFF.H	⊙	○	0.i03	t P	—
3.F11	Heater Disconnection : Number Of Heaters Setting	0.0 to 5.5 (1Phase)	*.1	—	0.0	⊙	○	0.i03	t P	—
3.F14	Type P : Magnetic Deviation Preventive Phase Setting	0 to 100.0%	0.1	%	0.0%	⊙	○	7.d04 0.i03	on Except P	○

### Network Functions (4.n code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
4.n01	Communication Method Selection	Parallel Operation (Type ZAX) : rPA Modbus RTU : rmbS CC-Link : rCC_L Parallel Operation (Type ZAP) : rZAP	—	—	zAP	⊙●	○	○	—	—
4.n11	Parallel Operation: Master Slave Selection	Master : rno.1 Slave : rno.2-	—	—	no.1	⊙●	○	4.n01	rmbS	—
								7.d04	on	

Refer to the following for an instruction manual about communication (network).

- Instruction manual for CC-Link : INR-MK31092
- Instruction manual for MODBUS RTU : INR-MK31091

### Attachment Functions (4.E code)

Refer to the following for an instruction manual about analog output function.

- Instruction manual for APR-V Analog output board : INR-MK31089

### Alarm Functions (5. A code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
5.A01	Communication error (Net)	No Selecting : r-	—	—	r2	⊙	○	○	—	—
5.A02	Heater Disconnection Selection	Serious Breakdown : r1	—	—	r2	⊙	○	0.i03	t	—
		Minor Breakdown : r2							P	
5.A03	Power Supply Frequency Selection		—	—	r-	⊙	○	○	—	—
5.A04	Undervoltage Selection		—	—	r-	⊙	○	○	—	—
5.A05	Overvoltage Selection		—	—	r-	⊙	○	○	—	—
5.A06	End Of Life Of Cooling Fan Selection		—	—	r-	⊙	○	0.i02	Except 100	—
5.A07	Communication Error (APD3) Selection		—	—	r2	⊙	○	○	—	—
5.A08	CLR Detection Selection		—	—	r-	⊙	○	0.i03	t	—
5.A09	Setting Input Disconnected Selection		—	—	r-	⊙	○	○	—	—
5.A11	Data R/W Failure (APR) Selection		—	—	r-	⊙	○	○	—	—
5.A12	Alarm History Storage Failure Selection		—	—	r-	⊙	○	○	—	—
5.A13	Analog Output Current Error Selection		—	—	r-	⊙	○	○	—	—
5.A14	Type P : Current Zero Cross Detection Failure Selection		—	—	r-	⊙	○	0.i03	Except P	—
5.A15	Type P : Delay Of Load Current By 30° Or More Selection		—	—	r-	⊙	○	0.i03	Except P	—
5.A18	Power ON Check Contact Selection	No Selecting : r- Serious Breakdown : r2	—	—	r-	⊙	○	5.A19	r2	—
5.A19	Output Check Contact Selection		—	—	r-	⊙	○	2.b07	CYC1	—
								7.d04	oFF	
								5.A18	r2	
								7.d04	on	
								F_SW2	Cycle	

(Note) When **r2** is selected for **5.A18** and **5.A19**, **r2** cannot be selected for other function codes.

## Setting Options (6.o code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
6.o01	Multi Indicator Fixation Display Selection	Normal Display : br_0 Output Voltage(Single, Three-UV) : br_1 Output Voltage(Three-WV) : br_2 Output Voltage(Three-WU) : br_3 Output Current(Single, Three-U) : br_4 Output Current(Three-V) : br_5 Output Current(Three-W) : br_6 Output Power : br_7 Output Reading : br_8 Transmission Status + Alarm Output : br_9	-	-	br_0	⊙●	x	○	-	-
6.o02	Operation Limit Selection	Enable : Limit Disable : no	-	-	no	⊙●	x	○	-	-
6.o03	Standby State Selection	Enable : SUSP Disable : ACTi	-	-	SUSP	⊙●	x	○	-	-
6.o04	Data Check & Change	Comp: Check Start ⇒ SAmE: Factory Setting ⇒ Function Code: Code Changed.	-	-	-	○●	x	○	-	-
6.o05	Factory Setting Selection	yES: Factory Setting ⇒ End: Normal End ⇒ Er.07, Er.08: Error	-	-	-	○●	x	○	-	-
6.o06	Data Write	CoPy: Data Write ⇒ End: Normal End ⇒ Er.07, Er.08: Error	-	-	-	○●	x	○	-	-
6.o07	Data Read	LoAd: Data Read ⇒ End: Normal End ⇒ Er.07, Er.08: Error	-	-	-	○●	x	○	-	-
6.o08	Alarm History Check	Check start ⇒ HiSt: Normal End ⇒ Er.0: No Alarm ⇒ 1 to Max 100 Alarm	-	-	-	x●	x	○	-	-
6.o09	Alarm History Clear	CL: Clear ⇒ End: Normal End	-	-	-	○△●	x	○	-	-
6.o10	APD3 : Operation After Communication Error Selection	Immediate Stop : SP-0 Communication Retry : SP-1 Continue Operation : SP-2	-	-	SP-2	⊙	○	○	-	-
6.o11	APD3 : RUN / STOP Key Operation Selection	Enable : on.r Disable : oFF.r	-	-	on.r	⊙	○	○	-	-
6.o13	APD3 : Communication Error Detect Selection	Enable : on Disable : oFF	-	-	on	⊙	○	○	-	-

## Advanced function (7.d code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
7.d01	Advanced Function Display Selection	Hidden : oFF.d Display : on.d	-	-	oFF.d	⊙●	x	○	-	-
7.d02	Auto / Manual Operation Signal Selection	Terminal / Auto / Manual : no Manual Setting : mAnU Auto Setting (4-20mA) : 4-20 Auto Setting (1-5V) : 1-5	-	-	no	⊙	○	7.d01	oFF.d	-
7.d03	Reset Terminal : Waveform Control System Change Selection	Disable : oFF Enable : on	-	-	oFF	⊙	○			-
7.d04	Function Select SW & Setter For ADJ Selection	Disable : oFF Enable : on	-	-	oFF	⊙	○			-
7.d05	Monitor : Load Resistance Display Selection	Hidden : oFF Display : on	-	-	oFF	⊙	○			-
7.d06	Monitor : CT Value Display Selection	Hidden : oFF Display : on	-	-	oFF	⊙●	x			-
7.d11	Maintenance Data Display Selection	Disable : oFF Enable : on	-	-	oFF	⊙	○			-

### Input signal check function (7.t code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
7.t01	Terminal : Manual Setting	0 - 5.00V	0.01	V	—	x	x	7.d01	oFF.d	—
7.t02	Terminal : Gradient Setting		0.01	V	—	x	x			—
7.t03	Terminal : Current Setting Signal		0.01	V	—	x	x			—
7.t04	Terminal : Voltage Setting Signal		0.01	V	—	x	x			—
7.t05	Terminal : CT0 (CT – U phase)		0.01	V	—	x	x			—
7.t06	Terminal : CT1 (CT – V phase)		0.01	V	—	x	x			—
7.t07	Terminal : CT0 RMS (CT – W phase)		0.01	V	—	x	x			—
7.t08	Terminal : VT1 RMS (VT – U phase)		0.01	V	—	x	x			—
7.t09	Terminal : VT2 (VT – V phase)		0.01	V	—	x	x			—
7.t10	Terminal : Input Of DC		0.01	V	—	x	x			—
7.t11	Setter : PVC Setting		0.01	V	—	x	x			—
7.t12	Setter : Soft Start Time Setting		0.01	V	—	x	x			—
7.t13	Setter : CLR Setting		0.01	V	—	x	x			—
7.t14	Setter : P Control		0.01	V	—	x	x			—
7.t15	Setter : I Control		0.01	V	—	x	x			—
7.t16	Setter : HT Setting		0.01	V	—	x	x			—
7.t17	Setter : BL Setting		0.01	V	—	x	x			—
7.t18	Setter : IT Setting		0.01	V	—	x	x			—

### Initial setting (0.i code)

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
0.i01	Rated Voltage Setting	100V System : 100 to 127V 200V System : 200 to 240V 400V System : 380 to 480V	1	V	220v	⊙	○	○	—	—
0.i02	Rated Current Display	Rated Current (A)	—	A	Rated current	△●	x	○	—	—
0.i03	Control System Display	No Feedback Control : t AC CLR : A AC ACR + AC CLR : b AC AVR + AC CLR : C AC AWR + AC CLR : d DC (ACR / AVR) + AC CLR : E Transformer Primary Control : P Based On Cycle Control	—	—	Displays type of APR	△●	x	○	—	—
0.i04	Number Of Phase Display	Single-Phase : 1P Three-Phase : 3P	—	—	Displays phase of APR	△●	x	○	—	—
0.i06	ROM Version (APD3) Display	v **. **	—	—	v *. **	x●	x	○	—	—
0.i07	ROM Version (APR) Display	v **. **	—	—	v *. **	x	x	○	—	—

### 4.3.2 Outline of function code

#### 1.b01 Manual Digital Setting

It functions as substitution of the external variable resistor for manual setting.

In function code **2.b01** [Setting Input 1 Selection], when **no** [No Selecting] is chosen, this function code data becomes enable.

Moreover, in function code **2.b06** [2-potion Control Selection (LOW/HIGH Selection)], when a LOW Setting is assigned to APD3 ( **LA.HA** or **LA.Hv** ), this function code functions as LOW Setting.

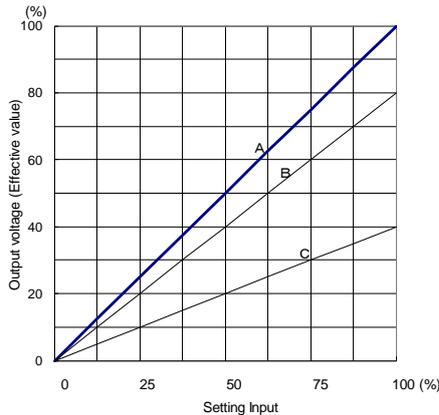
#### 1.b02 Gradient Digital Setting

It functions as substitution of the external variable resistor for gradient setting.

In function code **2.b02** [Setting Input 1 Selection], when **no** [No Selecting] is chosen, this function code data becomes enable.

Moreover, in function code **2.b06** [2-potion Control Selection (LOW/HIGH Selection)], when a LOW Setting is assigned to APD3 ( **LA.HA** or **Lv.HA** ), this function code functions as HIGH Setting.

A gradient setting sets up inclination of an output characteristic arbitrarily to a setting signal.



Gradient setting: Output characteristic (%)

Graph	Output adjustment range	Base Load Setting	Gradient Setting
A	0 - 100	0	100
B	0 - 80	0	80
C	0 - 40	0	40

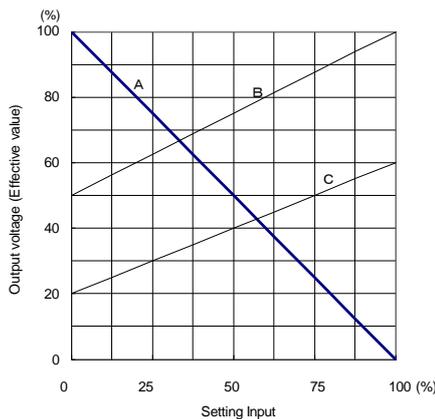
(Note) The left graph is an example of the output voltage (effective value) to a setting input.

Fig. 4-3-1. Gradient Setting characteristic

(Note) The maximum of output voltage is a main circuit power-supply-voltage value.

#### 1.b03 Base Load Setting

The output value of 0% of a setting signal can be set up arbitrarily.



Base load setting: Output characteristic (%)

Graph	Output adjustment range	Base Load Setting	Gradient Setting
A	100 - 0	100	0
B	50 - 100	50	100
C	20 - 60	20	60

(Note) The left graph is an example of the output voltage (effective value) to a setting input.

Fig. 4-3-2. Base Load Setting characteristic

1.b04	Soft Start Time Setting
1.b05	Soft Up Time Setting
1.b06	Soft Down Time Setting

The soft start and soft up/down time is the time when the output increases (or decreases) from 0% to 100% (or 100% to 0%) when the control power is turned on (Type: 400V Both control power and main circuit power are on), momentary blackout, or the setting signal changes.

Type 200V : Control power supply

Type 400V : Control power supply  
+ Main power supply

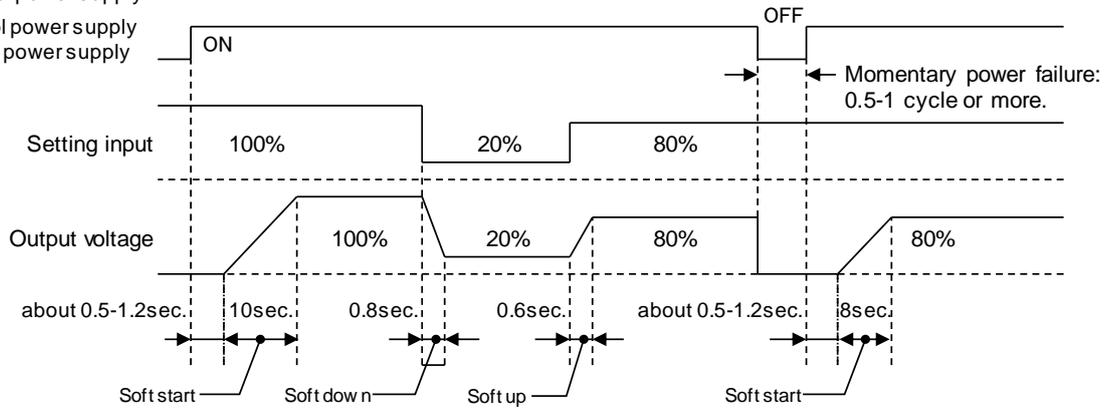


Fig. 4-3-3. The example of Soft Start, Soft Up, and Soft Down time chart  
(Soft Start Time Setting-10 sec., Soft Up and Soft Down Time Setting-1.0 sec.)

(Note) With the control method P, the minimum setting value is 0.5 seconds.

## 2.b01 Setting Input 1 Selection

Select the setting device of the control circuit terminal [1-2-3] (setting input 1) from the following items.

- no : No Selecting (APD3) (Function code  1.b01 [Manual Digital Setting])
- mAnU : Manual Setter (External variable resistor)
- CL.vL : CLR Setter (External variable resistor)

<Function code data Skip condition>

Function code data (settable range)		Skip		Skip		Skip	
		Function code	Setting	Function code	Setting	Function code	Setting
No Selecting (APD3)	: no	○	—	○	—	○	—
Manual Setter	: mAnU	○	—	○	—	○	—
CLR Setter	: CL.vL	2.b06	LA.Hv or Lv.Hv	2.b02	CL.vL	2.b03	CL.vL

(Note) When  CL.vL is selected, the manual setting is assigned to function code  1.b01 [Manual Digital Setting].

## 2.b02 Setting Input 2 Selection

Select the setting device of the control circuit terminal [1A-2A-3A] (setting input 2) from the following items.

- no : No Selecting (APD3) (Function code  1.b02 [Setting Input 2 Selection])
- Grd : Gradient Setter (External variable resistor)
- CL.vL : CLR Setter (External variable resistor)

<Function code data Skip condition>

Function code data (settable range)		Skip		Skip		Skip	
		Function code	Setting	Function code	Setting	Function code	Setting
No Selecting (APD3)	: no	○	—	○	—	○	—
Gradient Setter	: Grd	○	—	○	—	○	—
CLR Setter	: CL.vL	2.b06	Lv.HA or Lv.Hv	2.b01	CL.vL	2.b03	CL.vL

(Note) When  CL.vL is selected, the manual setting is assigned to function code  1.b02 [Gradient Digital Setting].

## 2.b03 Auto Setting (Voltage Signal Setting Input) Selection

The setting input to voltage signal DC1-5V input is chosen from the following item.

- 1-5v : Auto Setting
- Grd : Gradient Setting
- CL.vL : CLR Setting

<Function code data Skip condition>

Function code data (settable range)		Skip		Skip	
		Function code	Setting	Function code	Setting
Auto Setting	: 1-5v	○	—	○	—
Gradient Setting	: Grd	○	—	○	—
CLR Setting	: CL.vL	2.b01	CL.vL	2.b02	CL.vL

(Note) If a value other than  1-5v [Auto Setting 1-5V] is selected, the automatic setting works only for 4-20mA.

## 2.b04 Auto Setting (Voltage Signal) Selection

The “Voltage Signal” of an “Auto Setting” is chosen from the following item.

- 1-5v : DC1-5V
- 0-5v : DC0-5V

**2.b05 2-potion Control (Disable/Changeover) Selection**

“2-position Control” function is disable or it chooses from the following item as change apparatus of a LOW/HIGH setting.

- OFF : Disable the two-position control function.
- Auto : LOW/HIGH setting is switched with a control circuit terminal "AUTO, COM."  
 “AUTO, COM” opens: LOW Setting, “AUTO, COM” closes: HIGH Setting
- AP-H : HIGH Setting (Gradient Digital Setting or Setting Input 2) is chosen.
- AP-L : LOW Setting (Manual Digital Setting or Setting Input 1) is chosen.

(Note) To enable the 2-position control function, select  Auto ,  AP-H , or  AP-L .

**2.b06 2-potion Control (LOW/HIGH Selection) Selection**

The setting apparatus of a LOW setting and a HIGH setting is chosen from the following item.

- LA.HA : LOW Setting-  1.b01 , HIGH Setting-  1.b02
- LA.Hv : LOW Setting-  1.b01 , HIGH Setting- Setting Input 2
- Lv.HA : LOW Setting- Setting Input 1, HIGH Setting-  1.b02
- Lv.Hv : LOW Setting- Setting Input 1, HIGH Setting- Setting Input 2

<Function code data Skip condition>

Function code data (settable range)	Skip		Skip	
	Function code	Setting	Function code	Setting
L-1.b01, H-1.b02 : LA.HA	○	—	○	—
L-1.b01, H-Setting Input 2 : LA.Hv	2.b01	CL.vL	—	—
L-Setting Input 1, H-1.b02 : Lv.HA	—	—	2.b02	CL.vL
L-Setting Input 1, H-Setting Input 2 : Lv.Hv	2.b01	CL.vL	2.b02	CL.vL

Select the waveform control method from the following items.

- PHA1 : Phase control  
 CYC1 : Cycle control  
 CYC2 : Cycle control)Rush current auto suppression

●Phase control

It is a method to control 0-100% in the voltage that joins the load by controlling fire angle  $\alpha$  at a power supply frequency half cycle.

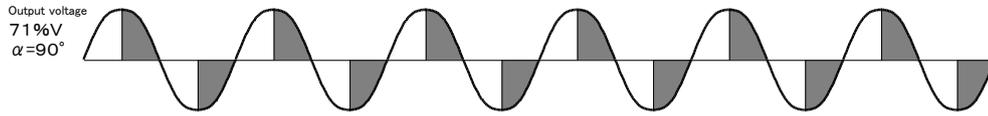


Fig. 4-3-4. Phase control output voltage waveform

●Cycle control (Note)

This is a method to control the voltage applied to the load by 0-100% by controlling the on/off period ratio of one cycle of the power supply voltage.

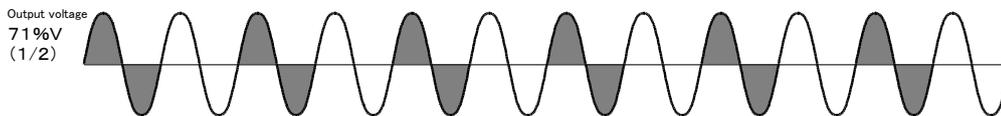


Fig. 4-3-5. Cycle control output voltage waveform

●Cycle control)Rush current auto suppression (Note)

In order to suppress overcurrent generation, combined control of cycle control and phase control is performed.

(Note) For control method B-E, set function code  3.F01 [Operation Mode Selection] to  FboF [Feedback Control Disable] before selecting.

<Function code data Skip condition>

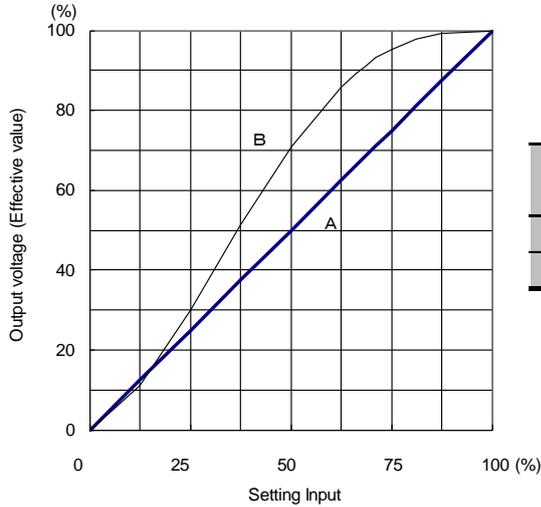
Function code data (settable range)	Skip		Skip		Skip	
	Function code	Setting	Function code	Setting	Function code	Setting
Phase Control	0	—	0	—	0	—
Cycle Control	—	—	2.b08	Pro SqU	3.F01 0.i01	Fbon B - E (Excluding P)
Cycle Control : Rush Current Auto Suppression	0.i03	t P	2.b08	Pro SqU	3.F01 0.i01	Fbon B - E (Excluding P)

Select the output characteristic of APR from the following items.

- Lnr : Linearity
- Pro : Phase angle proportional
- SqU : Square-law characteristics

●Phase angle proportional

The phase angle  $\alpha$  is controlled in proportion to the set signal.

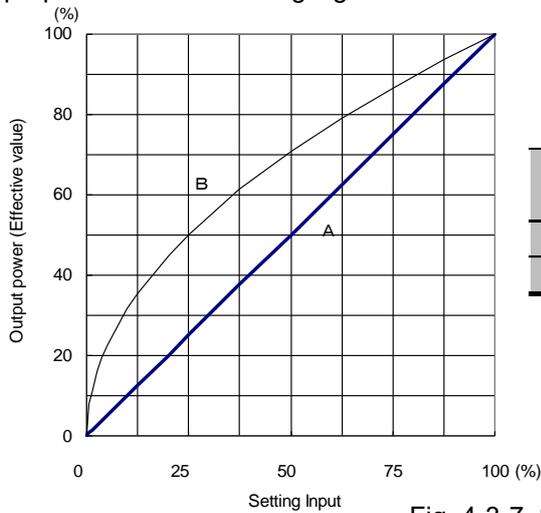


Graph	Output characteristics
A	Linearity
B	Phase angle proportional

Fig. 4-3-6. Phase angle proportional Output characteristics

●Square-law characteristics

The output voltage is squared according to the set signal. The output power can obtain the characteristic proportional to the setting signal.



Graph	Output characteristics
A	Square-law characteristics
B	Linearity

Fig. 4-3-7. Square-law Output characteristics

<Function code data Skip condition>

Function code data (settable range)	Skip		Skip		Skip	
	Function code	Setting	Function code	Setting	Function code	Setting
Linearity	0	—	0	—	0	—
Phase Angle Proportional	0.i03	B - E (Excluding P)	2.b07	CYC1 CYC2	7.d04	on
Square-law Characteristics	0.i03	B - E (Excluding P)	2.b07	CYC1 CYC2	7.d04	on

3.F01	Operation Mode Selection
-------	--------------------------

Select the operation mode for feedback control from the following items.

- Fbon : Feedback Control (Type: B - E) Enable
- FboF : Feedback Control (Type: B - E) Disable (= Type A)

3.F03	AC CLR Selection
-------	------------------

The output is controlled so that the output current does not exceed the AC CLR setting value.

(Note) The setting range changes under the following conditions.

Condition		AC CLR Selection range
Function code	Function code data	
<input type="checkbox"/> 2.b07 [Waveform Control System Selection]	<input type="checkbox"/> CYC2 [Cycle Control : Rush Current Auto Suppression]	0 - (Rated current * 0.918) (A)

3.F05	P Control Setting
-------	-------------------

P adjustment in feedback control.

3.F06	I Control Setting
-------	-------------------

I adjustment in feedback control.

3.F07	Heater Disconnection : Judgment Level Setting
-------	---

When output current becomes in less than a Heater Disconnection Judgment Level, Heater Disconnection is judged.

3.F08	Heater Disconnection : Judgment Time Setting
-------	--

It is the time from disconnection generating to alarm sending out.

During this time, unless a disconnection state continues, heater disconnection is not detected.

3.F09	Heater Disconnection : Operation State Selection
-------	--

Select the operation from the following items after the heater disconnection is detected.

- rUn : Operation Continue
- StoP : Operation Stop

3.F10	Heater Disconnection : Detection Selection
-------	--

Select from the following items to enable/disable the disconnection detection.

- on.H : Heater Disconnection Enable
- off.H : Heater Disconnection Disable

3.F11	Heater Disconnection : Number of Heaters Setting
-------	--

Set the number of heaters for the load.

Refer to "4.4 Heater disconnection function" for details.

3.F14	Type P : Magnetic deviation preventive phase setting
-------	--

For preventing transformer bias magnetism. The phase angle is controlled during cycle control to prevent magnetic bias.

Since it has been adjusted at the factory, **no setting is required**.

4.n01

Communication Method Selection

Select the communication method from the following items.

Since it has been adjusted at the factory, **no setting is required.**

PArA : Parallel operation (Type ZAX)

mdbS : Modbus RTU

CC\_L : CC-Link

zAP : Parallel operation (Type ZAP)

4.n11

Parallel Operation : Master Slave Selection

In the parallel operation method (ZAP, ZAX), select the master unit or slave unit from the items below.

no.1 : Master

no.2- : Slave

**5.A01 - 17 Alarm Selection**

Each alarm is chosen in  r- (No Selecting),  r1 (Serious Breakdown), and  r2 (Minor Breakdown).

- r- : No Selecting
- r2 : Serious Breakdown
- r1 : Minor Breakdown

**5.A18 Power ON Check Contact Selection**

Set the power-on confirmation contact [Z2 (Minor Failure)] or select from the following items.

- r- : No Selecting
- r2 : Power ON Check Contact  r2 (Minor Breakdown),  
Other warnings will be  r- (No Selecting)

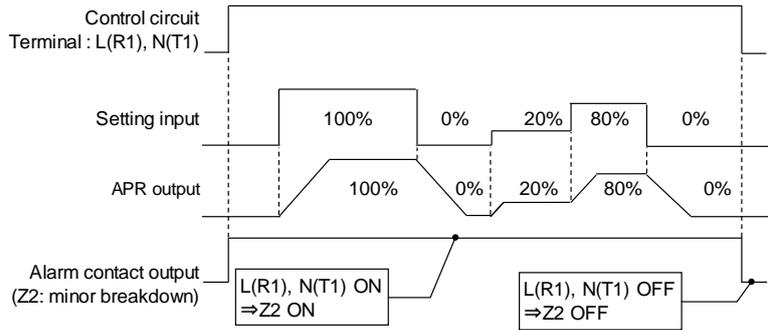


Fig. 4-3-8. Alarm for a Power ON Check Contact Time chart

**5.A19 Output Check Contact Selection**

Set the contact for output confirmation [Z2 (Minor Failure)] or select from the following items.

- r- : No Selecting
- r2 : Power ON Check Contact  r2 (Minor Breakdown),  
Other warnings will be  r- (No Selecting)

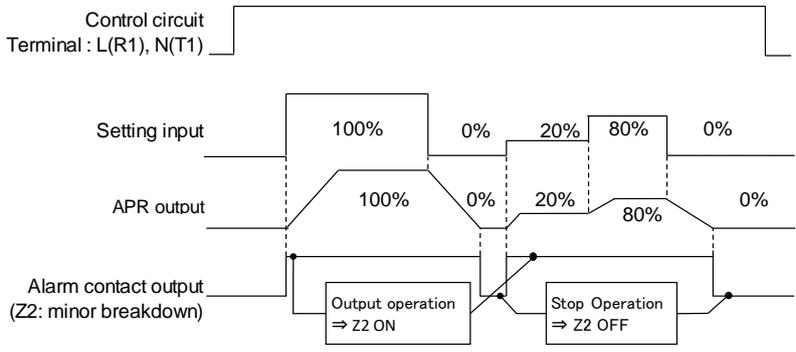
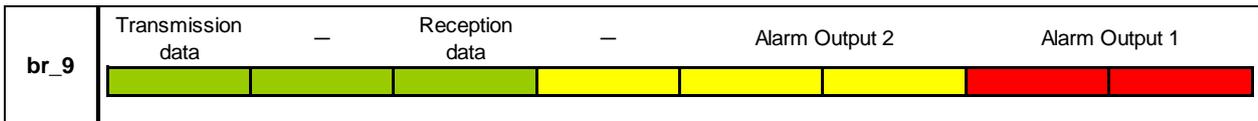


Fig. 4-3-9. Alarm for an Output Check Contact Time chart

6.o01	Multi Indicator Fixation Display Selection
-------	--

The monitor item of “Multi Indicator Fixation Display” is chosen from the following item.

- br\_0 : Normal Display = Display each item of monitor mode
- br\_1 : Output Voltage(Single, Three-UV)
- br\_2 : Output Voltage(Three-VW)
- br\_3 : Output Voltage(Three-WU)
- br\_4 : Output Current(Single, Three-U)
- br\_5 : Output Current(Three-V)
- br\_6 : Output Current(Three-W)
- br\_7 : Output Power
- br\_8 : Output reading
- br\_9 : Transmission Status + Alarm Output



(Note) Alarm outputs 1 and 2 light up when alarm output is ON.

Fig. 4-3-10. Transmission Status + Alarm Output:  br\_9

6.o02	Operation Limit Selection
-------	---------------------------

When operation-only is enabled, only the following items will work.

Item	Function
Dial	Enable
MODE/RESET key	Function code setting/selecting: Disable
SET key	Enable
RUN key	Disable
STOP key	

The “Operation Limit” method:

- [1] Function code  6.o02 [Operation Limit Selection] is displayed using a dial.
- [2] Press the SET key, turn a dial and display  Limit [Operation Limit: Enable].
- [3] If the SET key is pressed, APD3 will be in an operation limited state.

The release method of “Operation Limit”:

- [1] The MODE/RESET key is pressed among monitor mode, and  0.0.0.0. is displayed.
- [2] A dial is turned and  0.1.2.3. is displayed.  
Next, if the SET key is pressed, each function code can be setting.
- [3] Function code  6.o02 [Operation Limit Selection] is displayed using a dial.
- [4] Press the SET key, turn a dial and display  no [Operation Limit: Disable].
- [5] If the SET key is pressed, APD3 will be in an operation state.  
In the state not to display  0.1.2.3., if the SET key is pressed, it will become an alarm code " E\_10 [Password Input Error]".

(Note) At the time of the “Operation Limit”, during the monitor display after power activation, if the mode reset key is pressed, it will be displayed as  0.0.0.0. It is not failure.

6.o03	Standby State Selection
-------	-------------------------

Select from the following items to enable/disable the display standby state of the APD3.

- SUSP : Standby State Enable
- Acti : Standby State Disable

In the case of  SUSP [Standby Status Enabled], the data display and unit display will turn off 5 minutes after the last operation.

To turn it on again, operate the dial or key.

6.o04	Data Check & Change
-------	---------------------

The function code changed from the factory settings state is displayed.  
Function code data can be changed.

(Note) Refer to the menu "4.2.2. (3) Manu "Data check & change" Fig. 4-2-4.

6.o05	Factory Setting Selection
-------	---------------------------

It chooses in  yES [Factory Setting Selection] or  no [Factory Setting Does Not Choose.].  
When  yES [Factory Setting Selection] is chosen, after a  wAit [A Setting Is In The Middle Of Change.] displayed,  End [Normal End] is displayed.

6.o06	Data Write
-------	------------

It is used to copy the APR-V function code data to other APR-V.

**First, execute function code  6.o07 [Data Read].**

**Next, use this function code  6.o06 [Data Write] to write data to the target APR-V.**

(Note) The function codes that can be copied are 4.3.1. Function code list It is marked with "o" in the data copy column.

Process:

- [1] Connect the target APR-V and APD3 (data has been read).
- [2] Function code  6.o06 [Data Write] is displayed using a dial.
- [3] If the SET key is pressed,  CoPy [Write-In Waiting State] is displayed.
- [4] Press the SET key, and display  no .
- [5] The  yES is displayed with a dial, and then presses the SET key.
- [6] All the data of APD3 is written in into APR-V.
- [7] Writing is an end when the normal end  End displays.

An alarm code  E\_07 [Data Writing/Reading Failure] is displayed at the time of an abnormal end.

6.o07	Data Read
-------	-----------

It is used to copy the APR-V function code data to other APR-V.

Before writing the function code data to other APR-V, read data from the original APR-V into APD3.

(Note) The function codes that can be copied are 4.3.1. Function code list It is marked with "o" in the data copy column.

Process:

- [1] Connect the original APR-V and APD3.
- [2] Function code  6.o07 [Data Read] is displayed using a dial.
- [3] If the SET key is pressed,  LoAd [Read-In Waiting State] is displayed.
- [4] Press the SET key, and display  no .
- [5] The  yES is displayed with a dial, and then presses the SET key.
- [6] All the data of APR-V is read into APD3, and is saved.
- [7] Reading is an end when the normal end  End displays.

An alarm code  E\_07 [Data Writing/Reading Failure] is displayed at the time of an abnormal end.

\* It can be used as a backup function when temporarily changing the function code data.

6.o08	Alarm History Check
-------	---------------------

If the SET key is pressed,  HiSt [Alarm History Display] is displayed.

Er.0 will be displayed, if there is no alarm history when a dial is turned to the right.

If there is an alarm history, the newest alarm code will be displayed.

(Note) Refer to the menu "4.2.2. (4) Manu "Alarm History Check " Fig.4-2-5.

6.o09	Alarm History Clear
-------	---------------------

Although it is the purpose to delete the alarm history of APR-V, since it is an object for makers, it cannot delete. When the SET key is pressed accidentally, press the MODE/RESET key. Or stand by for 20 seconds. It returns to monitor mode.

6.o10	APD3 : Operation After Communication Error Selection
-------	--

After communication error generating between APR-V and APD3, operation of APR-V is chosen as follows.

- SP-0 : An alarm code  E\_02 [Communication Error (Between APR And APD3)] displayed, and immediate cessation of the operation is carried out.
- SP-1 : Communication is retried for 6 seconds, and if not recovered, alarm code  E\_02 is displayed and operation is stopped. Once communication is restored, the alarm code will disappear and operation will resume.
- SP-2 : The communication is retried for 6 seconds, and if it does not recover, alarm code  E\_02 is displayed but the operation continues.

6.o11	APD3 : RUN/STOP Key Operation Selection
-------	---

The RUN key and STOP key of APD3 are chosen in  on.r [RUN/STOP Key Enable] and  oFF.r [RUN/STOP Key Disable].

- on.r : RUN/STOP key Enable
- oFF.r : RUN/STOP key Disable

If  oFF.r [RUN/STOP Key Disable] is used,

When the control circuit terminal [RUN-COM] is short-circuited, operation can be started without pressing RUN key.

When the operation key or the stop key is pressed, an alarm code  E\_11 [Operation Error (APD3)] is displayed.

6.o13	APD3 : Communication Error Detect Selection
-------	---

Select from the following items to enable/disable APD3 communication error detection  E\_02 [Communication Error (Between APR And APD3)].

- on : Communication Error Enable
- oFF : Communication Error Disable

When set to  oFF [Communication Error Disable], the alarm code  E\_02 [Communication Error (Between APR And APD3)] will not be detected even if APD3 is not connected.

7.d01	Advanced function Display Selection
-------	-------------------------------------

Select to display or hide the advanced setting function from the following items.

- OFF.d : Advanced Function Display  
 on.d : Advanced Function Hidden

When set to  on.d [Advanced Function Display], the following function code and function code data are displayed.

Function code 7. d02 [Auto/Manual Operation Signal Selection] ~ 7. d11 [Maintenance Data Display Selection]

Function code 7. t01 [Terminal: Manual Setting] ~ 7. t18 [Setter: IT Setting]

(Note) The relevant function code and function code data may not be displayed depending on other skip conditions.  
Refer to "4.3.1. Function code list skip column".

7.d02	Auto/Manual Operation Signal Selection
-------	--

Set auto/manual setting switching from APD3.

Select either automatic selection, manual setting, auto signal (4-20mA), or auto signal (1-5V) from the following items.

- no : Switch between auto and manual according to the wiring of the control circuit terminal [AUTO-COM].  
 mAnU : The control circuit terminal [AUTO-COM] is disable and the manual setting is fixed.  
 4-20 : The control circuit terminal [AUTO-COM] is disable and the auto (4 – 20mA) setting is fixed.  
 1-5 : The control circuit terminal [AUTO-COM] is disable and the auto (1 – 5V) setting is fixed.

7.d03	Reset Terminal : Waveform Control System Change Selection
-------	---

Set the control circuit terminal [RST-COM] to switch between phase control and cycle control.

Select enable/disable of the function from the following items.

- oFF : Disable  
 on : Enable

Control circuit terminal [RST-COM] Open...Phase control, Close...Cycle control

When set to  on [Enable], the following functions are disabled.

Function selection switch SW2 Waveform control method switching

Function code  2. b08 [Waveform Control Method Selection]

## 7.d04

## Function Select Switch &amp; Setter for Adjustment Selection

Select the Enable/Disable setting of the function selection switch + adjustment setter on the APR main unit from the following items.

OFF : Disable

on : Enable

Operates according to the settings of the function select switch and the adjuster.

(Note) If this setting is changed during output, the output may change suddenly.

When set to  on [Enable], the following function codes are skipped or disabled, and the function selection switch or adjuster takes over the function.

Skip, or disabled function code	Alternate function selection switch	Alternate adjuster
<input type="checkbox"/> 3.F01 [Operation Mode Selection]	SW6 [Control Systems B, C, D, E: Enable/Disable]	-
<input type="checkbox"/> 2.b04 [Auto Setting (Voltage Signal) Selection]	SW4 [Voltage Signal Setting]	-
<input type="checkbox"/> 4.n11 [Master Slave Selection]	SW3 [Master Slave Selection]	-
<input type="checkbox"/> 2.b07 [Waveform Control System Selection]	SW6 [Cycle Control Rush Current Auto Suppression], SW2 [Waveform Control System Changeover]	-
<input type="checkbox"/> 0.i01 [Rated Voltage Setting]	-	PVC
<input type="checkbox"/> 1.b04 [Soft Start Time Setting]	SW1 [Soft Start Time Range Selection]	ST
<input type="checkbox"/> 1.b05 [Soft Up Time Setting]	SW7 [Soft Up/Down Time Selection], SW1 [Soft Start Time Range Selection]	ST
<input type="checkbox"/> 1.b06 [Soft Down Time Setting]	SW7 [Soft Up/Down Time Selection], SW1 [Soft Start Time Range Selection]	ST
<input type="checkbox"/> 3.F03 [AC CLR Selection]	-	CLR
<input type="checkbox"/> 3.F05 [P Control Setting]	-	P
<input type="checkbox"/> 3.F06 [I Control Setting]	-	I
<input type="checkbox"/> 3.F07 [Heater Disconnection : Judgment Level Setting]	-	HT
<input type="checkbox"/> 1.b03 [Base Load Setting]	-	BL

## 7.d05

## Monitor : Load Resistance Display Selection

Select monitor: Load Resistance display or hide from the following items.

OFF : Load Resistance Monitor Hidden

on : Load Resistance Monitor Display

When set to  on [Load Resistance Monitor Display], the following monitor items are hidden. (Because of the same data address)

No.	Monitor item	Explanation of displayed value
10	Output setting signal	Setting signal detection value
11	Gradient setting signal	Gradient signal detection value
12	CLR setting signal	CLR signal detection value

**7.d06 Monitor : CT Value Display Selection**

Select monitor: CT value display or hide from the following items.

- OFF : CT Signal Monitor Hidden
- on : CT Signal Monitor Display

**7.d11 Maintenance Data display Selection**

Select the data display switching of function code  -  from the following items.

- OFF : Input Signal Check  
...Displays information on the APR main unit adjuster and control circuit terminal block.
- on : Maintenance Data  
...Displays APR maintenance data.

"Code designation switch selection for input signal check" switch item

Function code	Input signal check function	Data for the maintenance of APR
7.t01	Terminal : Manual Setting	Alarm number 2, 1
7.t02	Terminal : Gradient Setting	Alarm number 4, 3
7.t03	Terminal : Current Setting Signal	Alarm number 5
7.t04	Terminal : Voltage Setting Signal	Operation accumulation time the last 4 digits
7.t05	Terminal : CT0 (CT – U phase)	Voltage setting signal self-adjustment (110V)
7.t06	Terminal : CT1 (CT – V phase)	Current detection level self- adjustment
7.t07	Terminal : CT0 RMS (CT – W phase)	CT0, CT1 balance self- adjustment
7.t08	Terminal : VT1 RMS (VT – U phase)	Voltage detection level self- adjustment
7.t09	Terminal : VT2 (VT – V phase)	DC in detection level self- adjustment
7.t10	Terminal : Input of DC	DC in detection level self- adjustment (= <input type="text" value="7.t09"/> )
7.t11	Setter : PVC setting	Operation accumulation time the first 4 digits
7.t12	Setter : Soft start time setting	EEPROM writing frequency the last 4 digits
7.t13	Setter : CLR setting	EEPROM writing frequency the first 4 digits
7.t14	Setter : P control	Number of alarm history preservation
7.t15	Setter : I control	Voltage zero crossing self-adjustment
7.t16	Setter : HT Setting	Current setting signal self-adjustment (4mA)
7.t17	Setter : BL Setting	Current setting signal self-adjustment (20mA)
7.t18	Setter : IT Setting	Voltage setting signal self-adjustment (220V)

Example of view of alarm detection order 1, 2, 3, 4 and 5: Alarm name (alarm number, priority level)  
When 5 continuations occur in order of "End of life of cooling fan" (13, 13), "Heater disconnection" (07, 07), "Power supply frequency fall" (08, 10), "Over current" (01, 01), "Main fuse blown" (03, 03):

- [1] Alarm code  [Overcurrent] is displayed.
- [2] Function code  [Alarm Number 2, 1] displays it with "07.03".
- [3] Function code  [Alarm Number 4, 3] displays it with "13.08".
- [4] Function code  [Alarm Number 5] displays it with "00.00".

When an alarm occurs in succession, the APD3 displays it in high-priority order (1: high - 5: low).  
For alarm numbers, see Table 4-2-5. List of alarm code list.

Example of view of Operation accumulation time:

When the first 4 digits is  and the last 4 digits is , it becomes "87,600 hours"

**7.t01 - 18 Input signal check function**

The signal input to each terminal is displayed at 0 to 5 VDC.

The dial operation is disabled, the monitor mode is not returned even after 20 seconds, and the latest data is displayed continuously.

Press the MODE/RESET key to return to the setting mode menu.

0.i01	Rated Voltage Setting
-------	-----------------------

Set the rated voltage.

The set value becomes the reference voltage for power supply voltage compensation (output voltage when the setting signal is 100%).

Power supply voltage compensation is a function that reduces and compensates output voltage fluctuations for fluctuations in the power supply voltage.

Type 200V (Input voltage 100V system) : The maximum output voltage can be set to 100V-127V.

(Input voltage 200V system) : The maximum output voltage can be set to 200V-240V.

Type 400V : The maximum output voltage can be set to 380V-480V.

(Note) Power supply voltage compensation cannot exceed the input power supply voltage.

0.i02	Rated Current Display
-------	-----------------------

You can check the rated current value. This is for confirmation only and cannot be changed.

0.i03	Control System Display
-------	------------------------

You can check the control type. This is for confirmation only and cannot be changed.

0.i04	Number Of Phase Display
-------	-------------------------

You can check the number of APR phases. This is for confirmation only and cannot be changed.

0.i06	ROM Version (APD3) Display
-------	----------------------------

Displays the ROM version of APD3.

0.i07	ROM Version (APR) Display
-------	---------------------------

Displays the ROM version of the APR body.

## 4.4 Heater disconnection function

### 4.4.1 Outline of operation and external connection

#### (1) Single-phase type

##### [1] Type 1 (Standard)

Heater disconnection is performed only with the APR. Detected if the heater current decreases to the level below the heater disconnection setting level specified with the adjustment setter [HT].

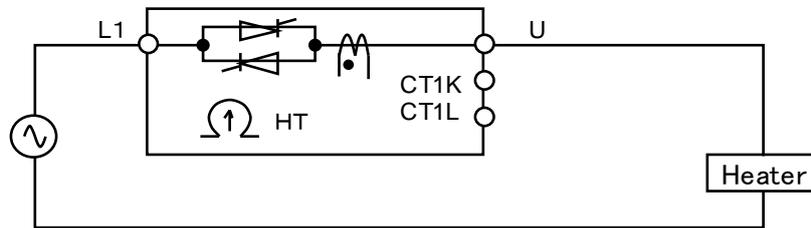


Fig. 4-4-1. External connection 1

##### [2] Type 2 (single function)

The APR and APD3 are used in combination. When it decreases than the heater disconnection setting level that a heater current set in APD3, APR detects it.

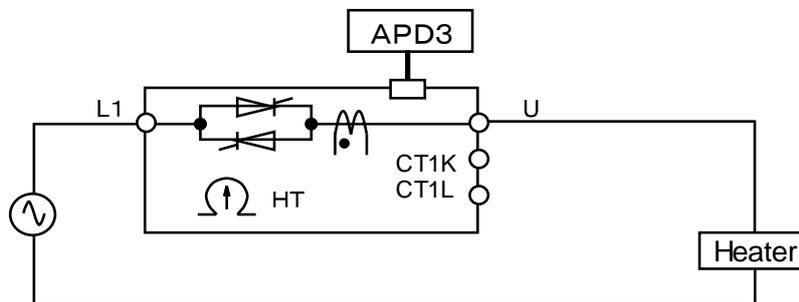


Fig. 4-4-2. External connection 2

##### [3] Type 3 (high function)

The APR, APD3, and external CT-5S are used in combination. The current of the heater divided into two are compared with each other to detect a disconnection. Setting is made with the APD3. The number of heaters connected in parallel is set for each heater divided.

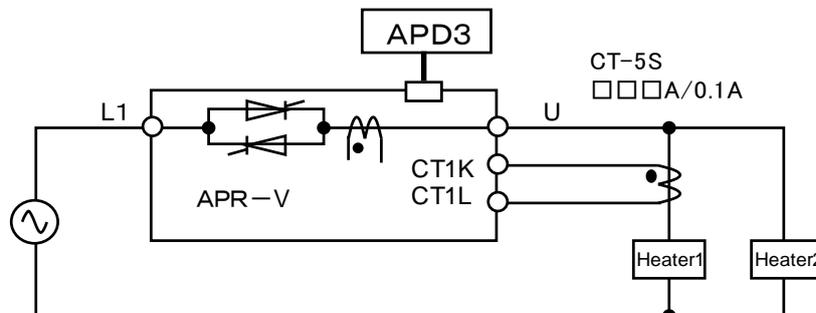


Fig. 4-4-3. External connection 3

(Note.1) Use the CT-5S having the same rated current as that of the APR.  
Match the number of turns.

(Note.2) Make sure that the rated current of the heater 1 flows at 20%-50% when the output voltage is 100%.

#### (2) Three-phase type

Later

## 4.4.2 Type changeover and setting parameters

### (1) Type changeover

- Standard single-phase APR-V (control types A, B, C, D, and E) is Type 1.
- When combined with APD3, it becomes Type2 or Type3.
- Type1 and Type2 (or 3) can be switched by disabling/enabling APD3 (APR main unit "function selection switch: SW8").
- Type2 and Type3 are switched by the function code **3.F11** [Heater Disconnection: Number Of Heaters Setting].  
( **0.0** = Type 2, **1.1** to **5.5** = Type 3)

### (2) Setting parameters

Table 4-4-1. shows the setting parameters of heater burnout.

Table 4-4-1. Setting parameters

Function code	Name	Function code data (settable range)	Increment	Unit	Factory setting	Data processing	Data copy	Skip		Direct drive
								Function code	setting	
3.F07	Heater Disconnection : Judgment Level Setting	0 to 100.0%	0.1	%	0.0%	⊙	○	3.F11	Except 0.0	○
								7.d04	on	
								0.03	t P	
								0.i04	3P	
(Note.1) 3.F08	Heater Disconnection : Judgment Time Setting	0 to 60 sec.	1	Sec.	1sec.	⊙	○	2.b07	CYC1	○
								7.d04	oFF	
								F_SW2	Cycle	
								0.i03	t P	
(Note.2) 3.F09	Heater Disconnection : Operation State Selection	Operation Continue : rUn Operation Stop : StoP	—	—	rUn	⊙	○	0.i03	t P	—
3.F10	Heater Disconnection : Detection Selection	Disable : oFF.H Enable : on.H	—	—	oFF.H	⊙	○	0.i03	t P	—
3.F11	Heater Disconnection : Number Of Heaters Setting	0.0 to 5.5 (1Phase)	*.1	—	0.0	⊙	○	0.i03	t P	—

(Note.1) Heater disconnection: judgment time is the time from when the heater burns out until the alarm is sent.

In the case of cycle control, the disconnection judgment time is 4 cycles or longer.

(Note.2) For heater disconnection: operation state selection, select whether to continue or stop APR output after detecting an alarm.

## 4.4.3 Alarm output

### (1) APR body

Refer to "Instruction manual for SINGLE-PHASE APR-V (Detailed version) 4. Maintenance and inspection".

### (2) APD3

Displays alarm code **E Hb** [Heater Disconnection].  
Refer to "4.2.4 Alarm code display".

#### 4.4.4 Single-phase Type 1 (standard)

Refer to "Instruction manual for SINGLE-PHASE APR-V (Detailed version) 9. Heater disconnection".

#### 4.4.5 Single-phase Type 2 (single function)

##### (1) Adaptive heater and configuration

- Applicable heater : Heaters made of alloy  
Configuration : Number of heaters connected in parallel; 5 or less  
(The heaters should be made of the same material and have the same capacity.)  
Applicable heater capacity : Should allow 40 to 100% of the rated current to be fed when the output voltage is 100%.

##### (2) Disconnection judgment setting

Set the function code data with the APD3, following the procedure shown below.

No.	Settings	Function Code	Detail
1	Type selection	3.F11	Set the number of heaters for heater 1 and heater 2 to "0.0".
2	Judgment Time Setting	3.F08	Set the disconnection judgment time.
3	Operation State Selection	3.F09	After detecting the disconnection, select whether to continue the APR operation or stop it.
4	Judgment Level Setting	3.F07	Set the disconnection judgment setting level. ●For phase control: 3-100% of rated current Setting less than 3%: Disconnection judgment disabled 3% or higher setting: Disconnection detection when output current is about 3-100% of rated current ●For cycle control: approx. 10% of rated current 0% setting: Disconnection judgment disabled 100% setting: Heater disconnection detection when the output current is less than about 10% of the rated current (Load open is detected)
5	Detection Selection	3.F10	Select enable/disable of disconnection detection. If you select enabled, set the heater current in a stable state.

##### (3) Judgment range

Detectable output setting range: 30-100% (including gradient setting)

Detectable output voltage range: 30-100%

##### (4) Judgment accuracy

±5%FS or less

##### (5) Heater disconnection detection characteristics and judgment setting method (for phase control)

Refer to "Instruction manual for SINGLE-PHASE APR-V (Detailed version) 9. Heater disconnection".

#### 4.4.6 Single-phase Type 3 (high function)

(1) Adaptive heater and configuration and detection range

Applicable heater : Alloy type, pure metal type, silicon carbide type heater  
 Configuration : According to the table below

Table 4-4-2. Configuration and detection range (single phase)

Total	Number for heater 1	Number for heater 2	Detectable output voltage range
2	1	1	30-100%V
3	1	2	
4	2	2	
5	2	3	
6	3	3	
7	3	4	40-100%V
8	4	4	
9	4	5	50-100%V
10	5	5	

(Note.1) The difference of the number of the heater of heater 1 and heater 2 is one or less. It is "heater 1 ≤ heater 2"

(Note.2) If the total number is odd, reduce the parallel number on the heater 1 side by 1 as shown in the table above.

(Note.3) When  or more is selected for Heater 1, CT of monitor item "Output current" can be displayed.

(Note.4) The heater has the same material and the same capacity. Ideally, the start of use (replacement) should be the same.

Applicable heater capacity : Heater that flows 50-100% of the rated current when the output voltage is 100%

(2) Disconnection judgment setting

Set the function code data with the APD3, following the procedure shown below.

No.	Settings	Function Code	Detail
1	Type Selection	<input type="text" value="3.F11"/>	Select the number of parallel heaters 1 and 2 from Table 4-4-2.
2	Judgment Time Setting	<input type="text" value="3.F08"/>	Set the disconnection judgment time. (Note: Cycle control is skipped)
3	Operation State Selection	<input type="text" value="3.F09"/>	After detecting the disconnection, select whether to continue the APR operation or stop it.
4	Detection Selection	<input type="text" value="3.F10"/>	Select enable/disable of disconnection detection. If you select Enabled, set the heater current in a stable state.
5	Operation Check For Disconnection Detection	—	Remove one heater and check that the disconnection alarm can be detected.

(3) Judgment range

Detectable output setting range: 30-100% (including gradient setting)

Detectable output voltage range: See Table 4-4-2.

#### 4.4.7 Single-phase Type 3 (high function)

Later

## 5. SPECIFICATIONS

### 5.1 General specifications

Table 5.1. General specifications

Item	Specifications
Protective structure	Panel face: IP40, Rear face (mounting face): IP20
Place of use	Indoor use
Ambient temperature	-5 to +50°C
Ambient humidity	30 to 90%RH (No condensation allowed.)
Atmosphere	A place not subject to dust, corrosive gas (such as sulfide gas and ammonia gas), combustible gas, oil mist, steam, water droplets, direct sunlight, and damage by salt. No condensation due to sudden temperature change is allowed.
Altitude	1,000 m or lower
Atmospheric pressure	86 to 106 kPa
Resistance to vibration	1 G or lower
Ambient temperature for storage	-20 to +60°C
Ambient humidity for storage	30 to 90%RH (No condensation allowed.)
Outside dimensions	See the figures shown below.
Installation	Vertical installation (Wall mounting)
Mass	55g

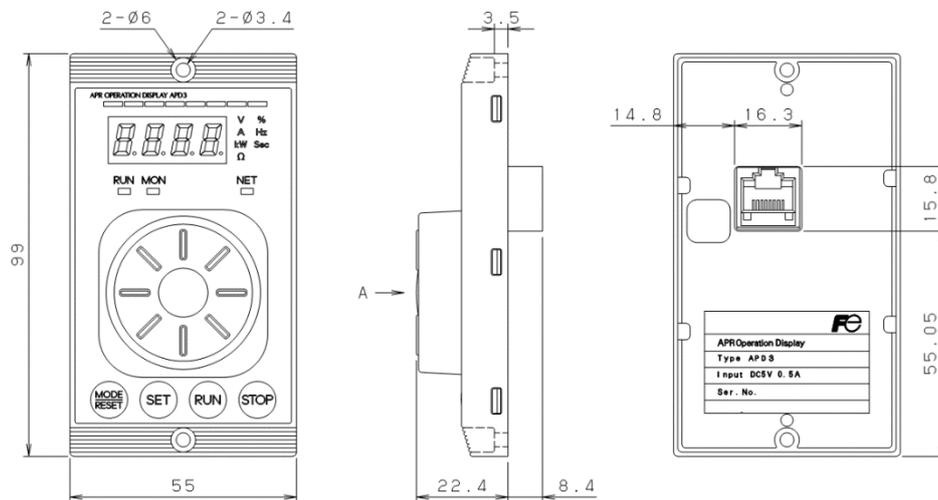


Fig. 5.1. Outside dimensions

### 5.2 Communication specifications

Table 5.2. Hardware specifications

Item	Specifications
Number of units to be connected	One APR unit for one APD3
Connection cable for remote operation	Straight cable that satisfies category 5 (5e) of ANSI/TIA/EIA-568A (Straight cable for 10BASE-T/100BASE-TX)
Maximum communication distance	20 m (not insulated)
External connection terminal	RJ-45 connector (modular jack connector)

Table 5.3. RJ-45 connector pin allocation

Pin No.	Name of signal	Description
1, 8	Vcc	Power supply for APD3
2, 7	GND	Basic potential
3, 6	NC	Terminal not connected
4	DX-	RS-485 communication data (-)
5	DX+	RS-485 communication data (+)

### 5.3 Transmission specifications

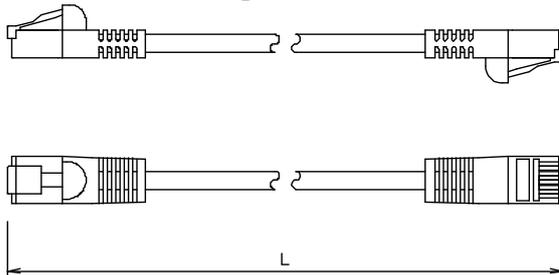
Table 5.4. Transmission specifications

Item	Specifications
Station No.	Specification not required
Communication protocol	Modbus RTU
Synchronous system	Asynchronous
Communication mode	Half-duplex
Communication speed	9600 bps
Parity	Odd parity
Stop bit length	1 bit
Error check system	CRC-16

## 6. Option

### 6.1 Extension cable for remote operation

It is a cable for connecting the APR-V and the APD3. Compliant with European RoHS and UL standards.



Type	Length L (m)
RPN002-1	1
RPN002-3	3
RPN002-5	5

Fig. 6.1. Cable length

### 6.2 APD3 For mounting

Name of optional specifications	Contents	Code symbol
APD3 : For mounting	APD3 for installing the setting indicator to the main unit supplied	RPVE□□□□-□-ZB3



Fig. 6.2. APD3: For mounting (example)

## **7. GUARANTEE PERIOD , DISPOSAL AND CONTACT**

### **7.1 Guarantee period**

The APR undergoes strict test and inspection processes before delivery, but if any defects should be found, contact your dealer or our sales representative.

The guaranteed term of the product becomes a period until either of "One year after the purchase" or "18 months from the manufacturing years described in the plaque" passes early. However, it becomes an investigation for a fee and a repair in the following cases in the guaranteed term it.

- (1) Caused by the mistake in use and an improper repair and remodeling.
- (2) When using it within the range to have exceeded the standard specification value.
- (3) Caused by damage and the damage when it falls and it is transporting after it purchases it.
- (4) Caused by an earthquake, a fire, damage from storm and flood, lightning, an abnormal voltage, other natural disasters, and the second disasters.
- (5) When the customer has the responsibility origin.

### **7.2 Disposal**

Dispose of the instrument as industrial waste by consigning the disposal to an expert waste disposal service.

### **7.3 Contact**

If failure, damage, and other problems should be found, contact your dealer or our sales representative nearest to you, providing the following information:

- (1) Type of APR (begin in "RPV-")
- (2) Serial No. of APR (manufacturing number)
- (3) State of alarm LED of APR (At and after power ON)
- (4) State of drive monitor
- (5) State of function select switch SW1-SW8
- (6) Change in function code data
- (7) ROM version
- (8) Time of purchase
- (9) Details of inquiry (such as position and degree of damage, questionable points, faulty phenomenon, situations, etc.)

.....  
Note: Contact your dealer or our sales representative nearest to you if you find any unclear points or have questions.

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

We are not responsible for the result of operation of the instrument despite the foregoing descriptions.  
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