INST.No. INE-823-3

CHINO

Graphic Program Controller

D P 1 0 0 0 G

[General]

INSTRUCTIONS

CHINO

Table of Contents

1. Introduction

Thank you for your purchasing Graphic Program Controller "DP1000G". DP1000G is a graphic program controller equipped with a highly visible 5.6 type TFT color LCD for advanced operability including enhanced monitoring function and interactive configuration.

It can store full universal inputs and up to 200 types of program patterns (up to 4000 steps), and operate the desirable execution patterns by calling them optionally.

It is a high-performance controller with control interval of 0.1 second, possible five digits display, and indicating accuracy of ±0.1 %, and thus can be used for a wide range of applications that require precise and complex pattern control.

The user is strongly recommended to read this manual carefully and gain comprehensive knowledge to avoid possible problems before using this product.

This document is intended for "General" instruction manual. For specification with communications, see also "Communications" instruction manual.

Request

- For persons doing instrumentation, installation, and sales -

Be sure to handover this instruction manual to the persons using this product.

- For users of this product -

Keep this instruction manual carefully until you scrap this product.

Write down the settings and keep it for your records.

Product warranty range

This product is warranted for one year from the date of delivery. This product is guaranteed against mechanical failure and will be repaired with no charge within the warranty period, provided that it has been used normally with due attention and adherence to the cautions written in the instruction manual, product labels, etc. (only in Japan) In such a case, please contact the dealer or our sales office.

However, repair orders can be accepted at your expense in the following cases even in the warranty period:

1. Mechanical failure or damage caused by improper use, connection, or repair
2. Mechanical failures or damages caused by fire, earthquake, wind or flood, thunderbolt, or other natural disasters, or pollution, salt water, harmful gas, abnormal voltage, or use of unspecified power
3. Replacement of parts or accessories that have reached the end of their life

In addition, a guarantee here means the guarantee of only our products. Our company shall take no obligation to pay reparations regardless of the damages caused by failure of our products.

Notice

1. No part of this document may be photocopied or reproduced without the prior written consent of Chino.
2. The information contained in this document is subject to change without notice.
3. The information in this document is provided "as is". If you have any question or find any error or omission, please contact our nearest sales office.
4. Chino shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing or use of this product.

⚠ **Warning**	Perchlorate Material This instrument uses battery with Perchlorate Material. Special handling may apply, see www.dtsc.ca.gov/hazardouswaste/perchlorate

● Before use

After opening the pack, confirm the following before using this product: Although it is rare but if you find anything wrong, please contact the dealer you purchased this product or our nearest sales office.

1. Check the exterior appearance

Check to see the exterior appearance to confirm that there is no damage.

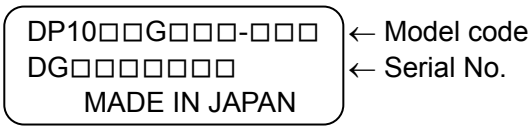
The front panel is covered with a film sheet for protection. Remove it before beginning to use this product.

2. Check the model code

Check to see the model code of this product you purchased to confirm that it is correct.

◆ Model code label and its location

A label as shown below is pasted on the upper surface of this product body:



3. Check the accessories

Since the following accessories are included in the shipment package of the controller, confirm them:

Item Name	Quantity	Remarks
Terminal cover	1	Transparent cover
Mounting bracket	2 (1 set)	For panel mounting
Contact protection device	1	Only the on-off servo specification
Instruction manual [Mounting and wiring]	1	Book form
Instruction manual [General]	1	CD-R
Instruction manual [Communications interface]		
Setup sheets		
Parameter editing software		
Parameter editing software instruction manual		

If you purchase additional accessories, they will be included.

Request

1 Do not drop this product while taking it out from the packing box.

2. When transporting this product, pack it in the packing box and then put it with cushions in another box.
   We recommend you to keep the box for future transport.

3. When this product is not be used for a certain period, while it is removed from the final product (the panel), put it in the packing box and stores it at room temperature in a dust free atmosphere.

2. For safe use of the product

For safe use of this product, observe the following precautions carefully:

2 - 1. Prerequisites for use

To ensure safe use of this product, develop a fail-safe design of the final product and inspect it regularly, and use the product after confirming the safety of the system.

For wiring, adjustment, and operation of this product, contact knowledgeable personnel or companies familiar with instrumentation.

It is also necessary for users who actually use this product to read this instruction manual and have enough knowledge of various precautions and basic operations.

2 - 2. Symbol mark

The following symbol marks are used for the product body and in this instruction manual: Be sure to understand them properly.

Symbol mark	Meaning
⚠ **Warning**	Used to draw the user's attention to the danger that can result in death or serious injury of the involved person. It also explains the way to avoid such an accident.
⚠ **Precautions**	Used to draw the user's attention to the danger that can result in minor injuries of the involved person or damages of the peripheral instruments. It also explains the way to avoid such an accident.
	Equipment protected throughout by double insulation or reinforced insulation.
	Earth (ground) terminal. Please do not use it as a protective conductor terminal.

2 - 3. Important

Precautions	To avoid serious accidents, be sure to observe the instructions mentioned in this manual.

1. Confirm the power supply voltage and wiring

Before starting to supply power to this product, check to see that the wiring is correct, the power supply voltage matches with the rated voltage, and grounding is established.

2. Install switch and over current protection device

In this product, there are neither a power switch nor an over current protection device that can be exchanged. In the power supply supplied to this product, please install the switch and the over current protection device (breaker and circuit protector, etc.) suitable for the rated specification in the place where the hand within 3m reaches easily.

* Reference: For safety, fuse (3.15A/250VAC) is installed in a part of the power supply in this product. It cannot be replaced.

3. Protection of terminal

To avoid an electric shock, provide the terminal of this product with a safety measure that prevents the user from directly touching the final product.

4. Install safety instruments

When using this product for certain facilities, and if a failure in the product or its peripheral instruments may cause serious damages to the facilities, always install safety instruments and develop a fail-safe design for the final product to avoid such damages.

Never use this product for critical facilities that are related to human life, atomic energy, aviation, space, etc.

5. Damage of the protection

If this product is used in a manner not specified by this manual, the protection provided by this product may be impaired.

6. Do not put your hands or foreign substances inside the product

Do not put your hand or a tool inside this product. You may get an injury or an electric shock.

Moreover, please put neither a screw, nor a metal piece and other foreign substances into the inside of this product. In addition to malfunction, there is danger, such as breakage, generation of heat, ignition.

7. Cut power off in the case of suspicion

If there is an offensive smell, strange noise or smoke or if the temperature increases abnormally, it is very dangerous, hence immediately cut power off and contact the dealer or our sales office.

8. Prohibit repairing and remodeling

When repair or modification is needed, contact the dealer or our sales office. Only our authorized service engineers are allowed to repair or remodel this product, including replacement of parts.

9. Strictly observe the instruction manual

In order to use this product correctly and safely, observe this instruction manual. Chino is not liable for any injuries, damages, or loss of profits resulted from improper use of this product.

3. Model code list

DP10 (5) (6) G (8) (9) (10) - (12) (13) (14)

Universal inputs 1CH
100-240 V AC power supply specification

(5) Control mode (Output 1)
- 1: ON-OFF pulse type PID
- 2: ON-OFF servo type PID (Standard load specifications)
- 3: Current output type PID (General accuracy 4-20 mA DC)
- 5: SSR drive pulse type PID
- 6: Voltage output type PID (General accuracy 0-10 V DC)
- 8: ON-OFF servo type PID (Very little load specifications)
- A: Current output type PID (High accuracy 4-20 mA DC)
- B: Current output type PID (High accuracy 1-5 mA DC)
- C: Voltage output type PID (High accuracy 0-10 V DC)

(6) Control mode (Output 2) * (Note 1)
- 0: None
- 1: ON-OFF pulse type PID
- 3: Current output type PID (General accuracy 4-20 mA DC)
- 5: SSR drive pulse type PID
- 6: Voltage output type PID (General accuracy 0-10 V DC)
- A: Current output type PID (High accuracy 4-20 mA DC)
- B: Current output type PID (High accuracy 1-5 mA DC)
- C: Voltage output type PID (High accuracy 0-10 V DC)

(8) Communications interface * (Note 2)
- 0: None
- R: RS-232C (COM1)
- S: RS-485 (COM1)
- A: RS-422A (COM1)
- B: RS-232C(COM1)+RS-232C(COM2)
- C: RS-485(COM1)+RS-232C(COM2)
- D: RS-422A(COM1)+RS-232C(COM2)
- E: RS-232C(COM1)+RS-485(COM2)
- F: RS-485(COM1)+RS-485(COM2)
- G: RS-422A(COM1)+RS-485(COM2)

(9) Transmission signal output I *
- 0: None
- 1: 4~20mADC
- 2: 0~1V DC
- 3: 0~10V DC
- 4: 1~5V DC

(10) Transmission signal output II * (Note 3)
- 0: None
- 1: 4~20mADC
- 2: 0~1V DC
- 3: 0~10V DC

(It is not allowed to specify the transmission signal output II alone.)

(12) Case color
- G: Gray
- B: Black

(13) External input/output signal
- 0: None *
- 1: Digital input/output (non-voltage contact specification for input)
- 2: Digital input/output (external power specification for input) *

(14) Transmitter power supply
- 0: None
- 1: With transmitter power supply *

* Option

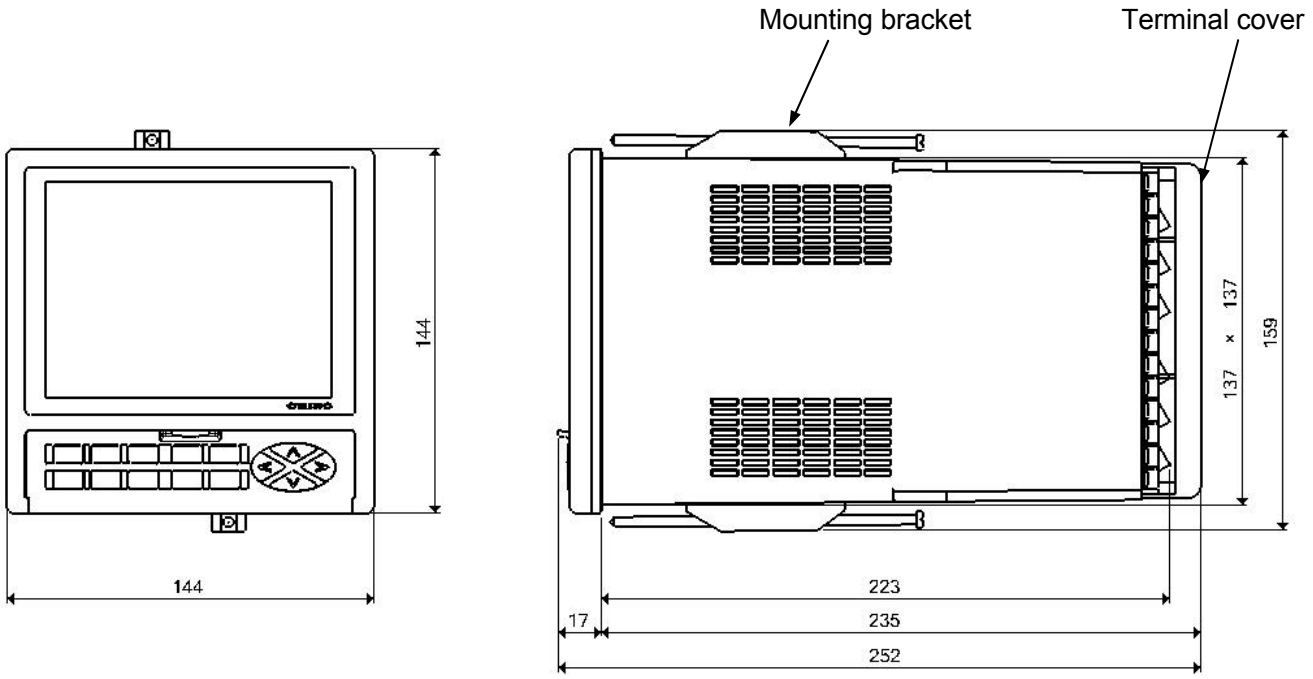
Note 1: When ON-OFF servo type is selected as output 1, output 2 cannot be specified.

Note 2: For COM1, only the rear port is used. For COM2, the front or rear port can be used.

Note 3: When transmission signal output I is NONE, transmission signal output II cannot be specified.

4. Mounting and wiring

4 - 1. External dimensions



[Unit: mm]

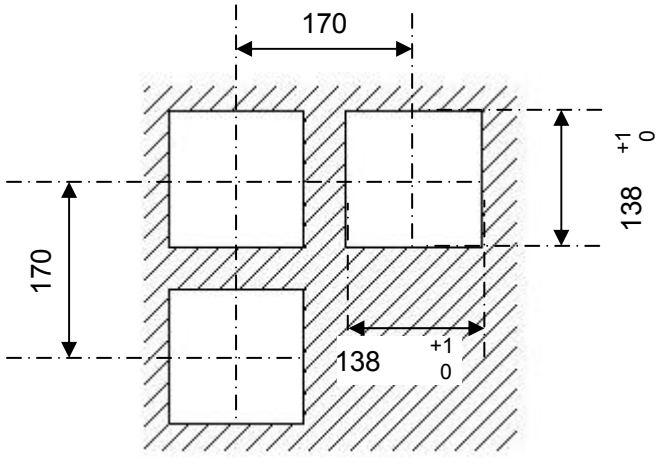
4 - 2. Mounting

4 - 2 - 1. Panel cutout and mounting method

Precaution	(1) Use the unit mounting on an indoor installed instrumentation panel. (2) Use a panel of steel with thickness of 2 to 6mm or equivalent strength.

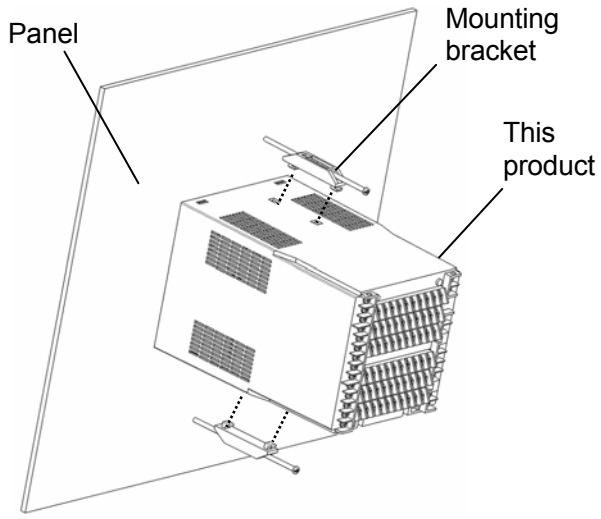
(1) Insert this product into panel cutout.

(2) Place the mounting brackets at the appropriate locations on the top and bottom faces, snap them into the holes, and tightly screw them using a screw driver.
The maximum screwing torque is "0.8 N·m".



Panel cutout

[Unit: mm]



4 - 2 - 2. Installation condition

Precautions	To avoid accidents, be sure to observe the instructions mentioned in this manual.

1. Environment

(1) In a room.
(2) Away from direct sunlight.
(3) Away from high temperatures.
(4) Where there are no vibrations and shocks.
(5) Away from liquids (water, etc.).
(6) Away from condensation.
(7) Under 'Overvoltage category Ⅱ, Pollution level 2' based on EN standards.

2. Atmosphere

(1) Away from strong noise, static electricity, electric field, magnetic field, etc.
(2) Surrounding temperature within -10~50°C, surrounding humidity within 10~90 % RH.
(3) Less variation in temperature.
(4) Away from corrosive gas, explosive gas, ignition gas, and combustible gas.
(5) Away from salt, iron, and conductive material (carbon, iron, etc.).
(6) Away from steam, oil, chemicals, etc.
(7) Away from dust, etc.
(8) Away from the surroundings where high temperature is generated.
(9) Away from places where temperature remains stored.
(10) Wide space above the product.
(11) Away from wind.

3. Mounting position

(1) Installation height is no more than 2,000 m above the sea level.
(2) Mounting position is approximately 1.5 m (approximately eye level position of a person).
(3) Mounting orientation is less than ±10° in longitudinal tilting and less than ±10° in lateral tilting.

4. Miscellaneous

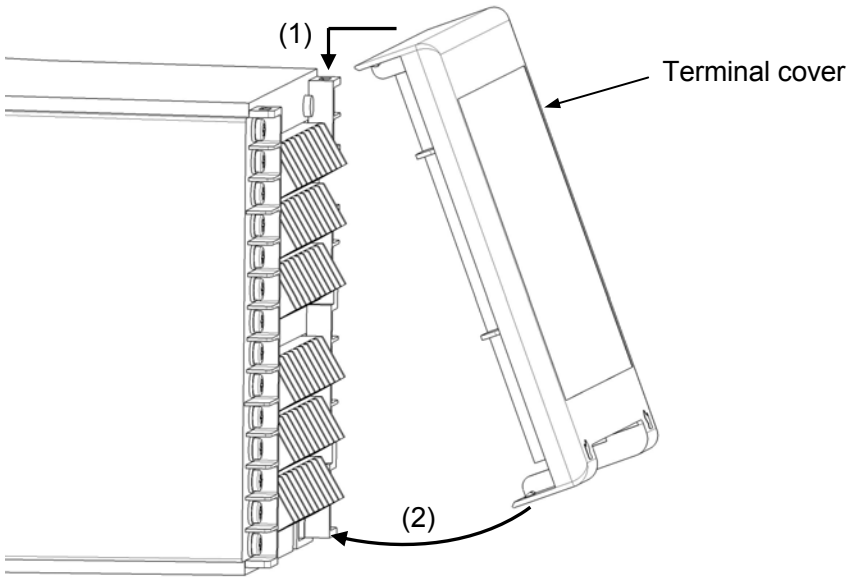
(1) Do not use organic solvent (alcohol, etc.) to wipe this product.
(2) To avoid malfunctioning of this product, do not use a cell phone in its vicinity.
(3) TV or radio placed near this product may be affected.

4 - 3. Mounting/removing terminal cover

A cover is provided to protect the terminals. This cover also prevents a person from touching the terminals. To avoid an electric shock, use this terminal cover or provide a safety measure on the final product that prevents the user from directly touching the terminal.

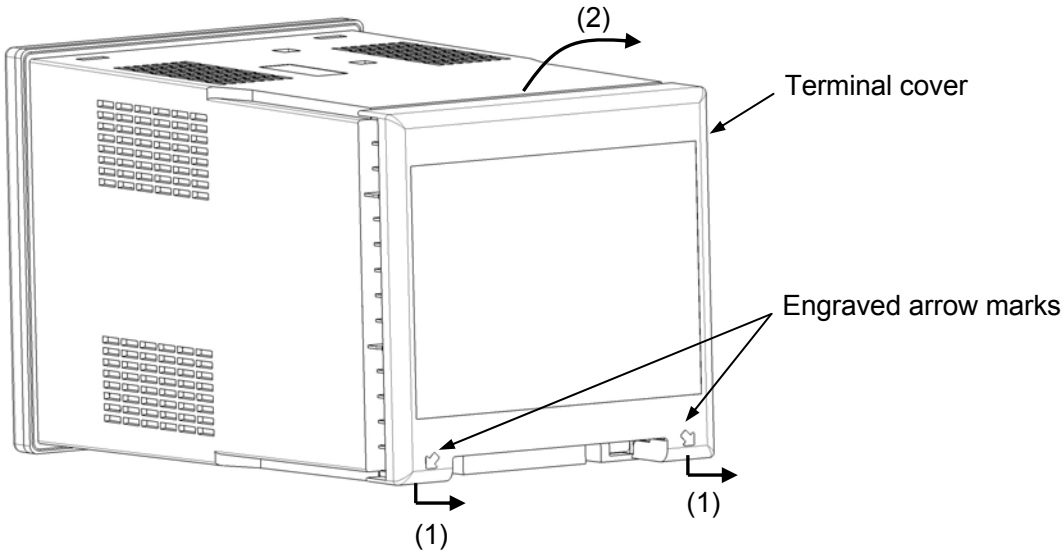
4 - 3 - 1. How to mount the terminal cover

(1) Place the upper hooks of the terminal cover at the top of the body rear face.
(2) Push the bottom part of the terminal cover toward the rear face of the product and insert the lower hooks into the body.



4 - 3 - 2. How to remove the terminal cover

(1) Softly press down the left and right bottom hooks respectively and remove the terminal cover.
(2) Remove the upper hooks of the terminal cover.

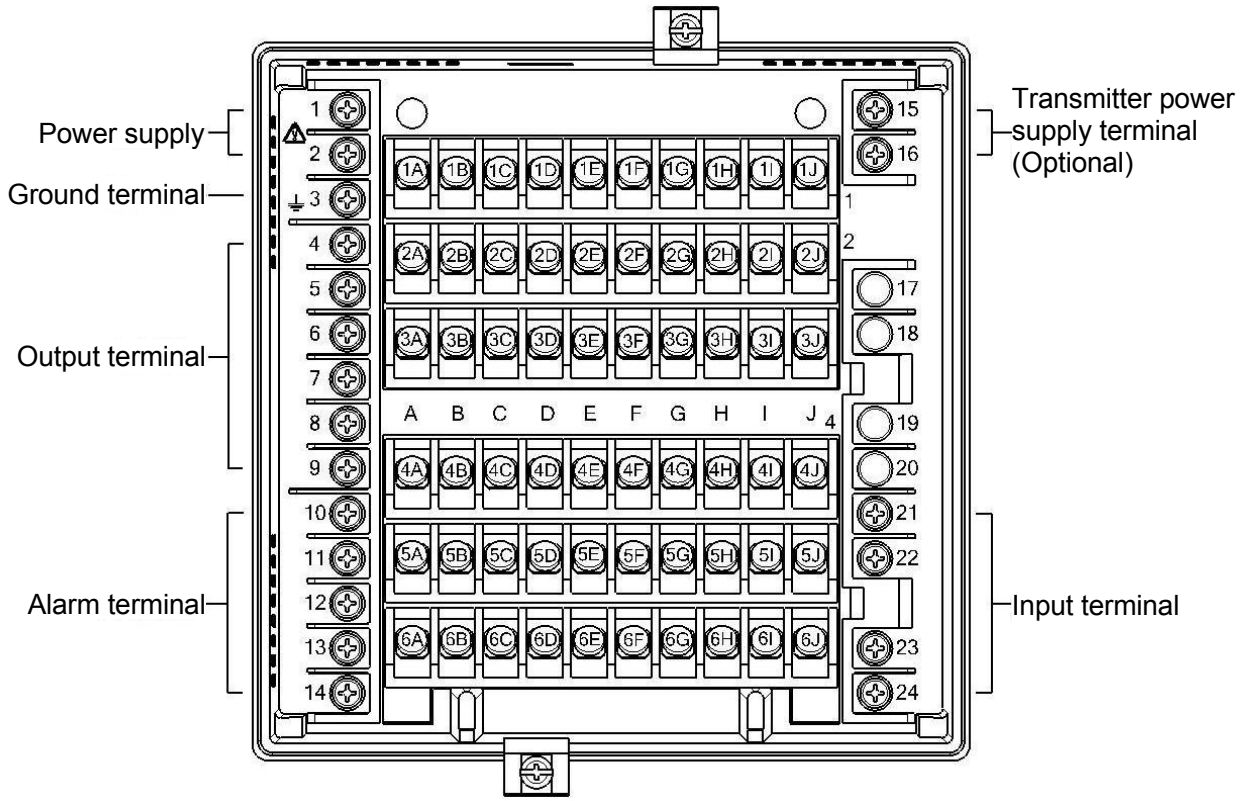


4 - 4. Wiring

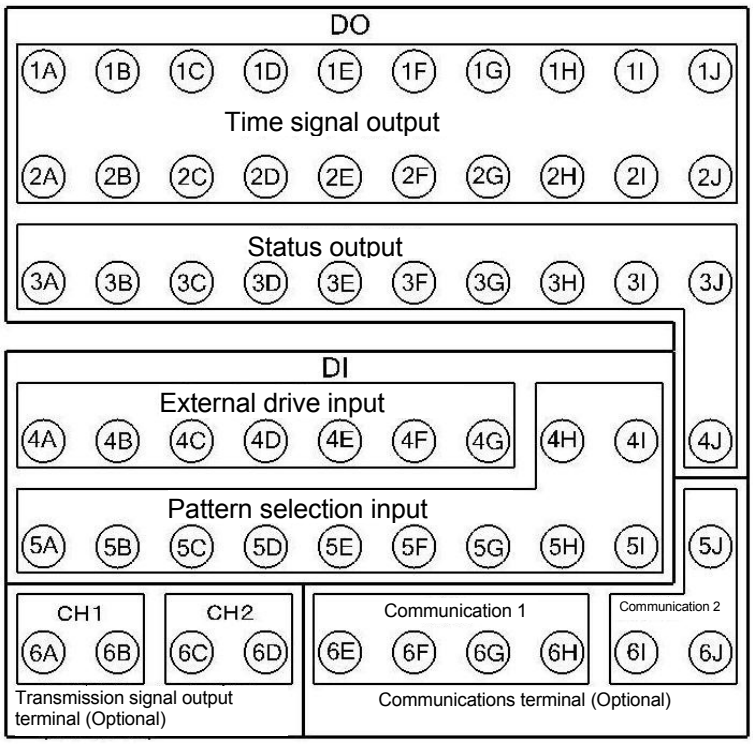
4 - 4 - 1. Terminal array

Depending on the product specification, no terminal screw is provided for some positions.

■ Terminal array diagram



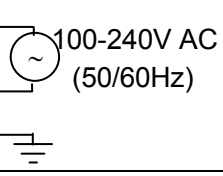
■ Terminal diagram



4 - 4 – 2. Terminal number and functionality

1. Power supply terminal

Terminal number	
1	L
2	N
3	G



2. Input terminal

Terminal number	Thermocouple voltage mV	Voltage (Range No.35) (Range No.37)	Current mA (Range No.36)	Resistance thermometer (3-wire type)	Resistance thermometer (4-wire type)
21					(A)
22	+	+	+	(A)	(A)
23	-	-	-	(B)	(B)
24				(B)	(B)

Note: Be sure to connect only the specified terminals.

3. Output terminal

(1) On-off pulse type

Terminal number		Internal circuit | Outside of instrument
Output 1	4	N.C. (H)
	5	COM. (C)
	6	N.O. (L)
Output 2	7	N.C. (H)
	8	COM. (C)
	9	N.O. (H)

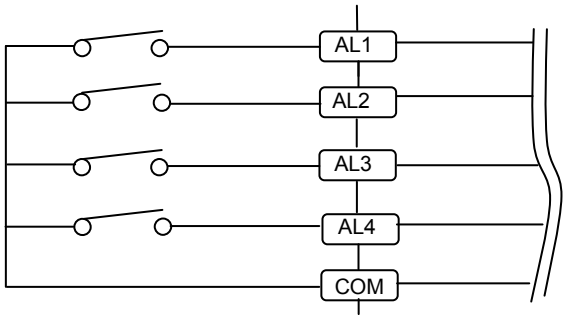
(2) On-off servo type

Terminal number	Internal circuit | Outside of instrument
4	CLOSE — M3
5	OPEN — M2
6	COM. — M1
7	OPEN — R1
8	COM. — RC
9	CLOSE — R2

(3) Current output, SSR drive pulse, and Voltage output types

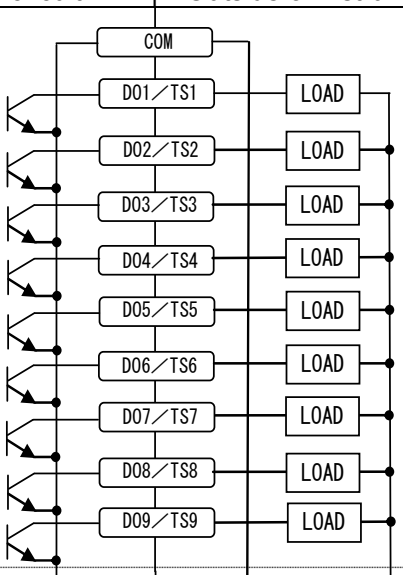
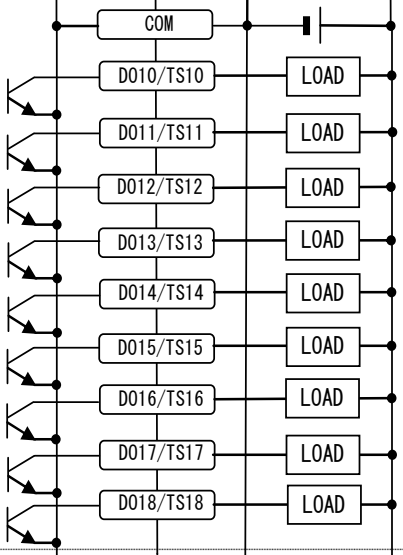
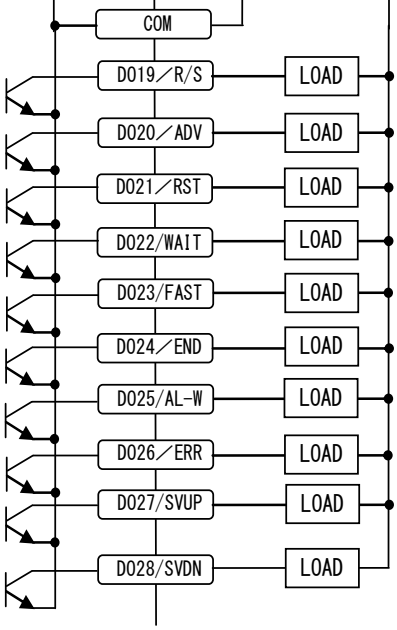
Terminal number		Current output type	SSR drive pulse type	Voltage output type
Output 1	4	+	+	+
	5	-	-	-
	6			
Output 2	7	+	+	+
	8	-	-	-
	9			

4. Alarm terminal

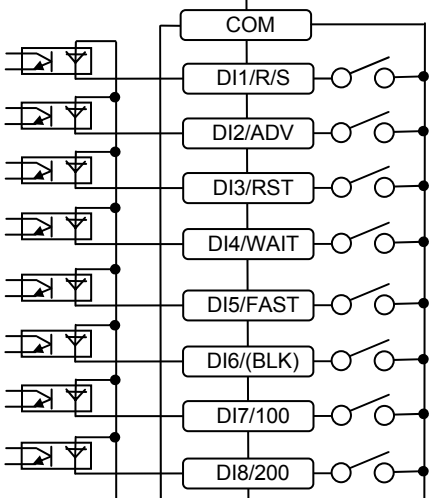
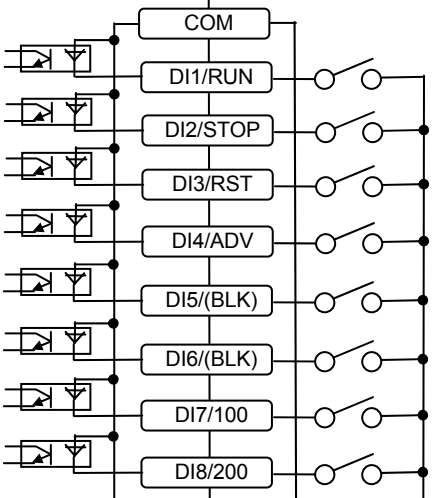
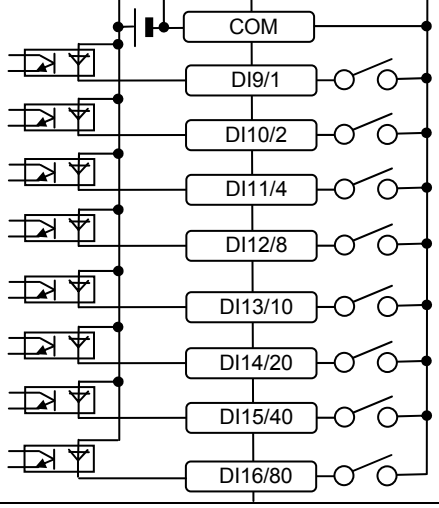
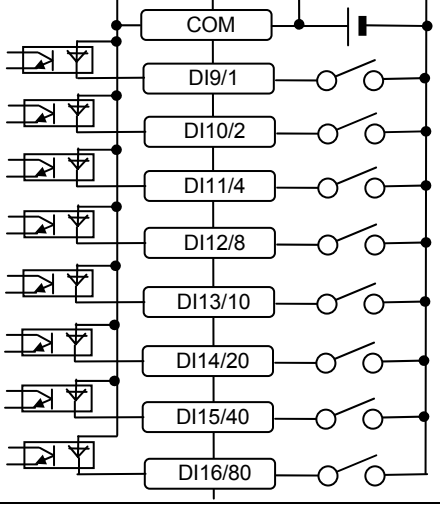
Terminal number	Internal circuit | Outside of instrument
10	
11	
12	
13	
14	

Note: Common (COM) terminal is common through AL1 to AL4.

5. DO terminal (Time signal output/Status output)

Terminal number	Function (Default value)	Transistor open-collector output Internal circuit | Outside of instrument
1A	Time signal	
1B		
1C		
1D		
1E		
1F		
1G		
1H		
1I		
1J		
2A		
2B		
2C		
2D		
2E		
2F		
2G		
2H		
2I		
2J		
3A	Status	
3B		
3C		
3D		
3E		
3F		
3G		
3H		
3I		
3J		
4J		

6. DI terminal (External drive input/Pattern select input)

Terminal number	Function (Default value)	Non-voltage contact specification (When the function setting of external drive signal is [Type I]) Internal circuit | Outside of instrument	External power supply specification (When the function setting of external drive signal is [Type II]) Internal circuit | Outside of instrument
4A	External drive		
4B			
4C			
4D			
4E			
4F			
4G			
4H			
4I			
5A	Pattern select		
5B			
5C			
5D			
5E			
5F			
5G			
5H			
5I			

7. Option terminals

(1) Analog transmission option

Terminal number	Transmission signal output High accuracy type	Transmission signal output 2-outputs specification	
6A	+	High accuracy type	+
6B	-		-
6C		General type	+
6D			-

(2) Communications option

For one communications port (COM1)

Terminal number	RS-232C (COM1)	RS-422A (COM1)	RS-485 (COM1)
6E	RD	RDA (+)	SA (+)
6F	SD	RDB (-)	SB (-)
6G	SG	SDA (+)	SG
6H		SDB (+)	
6I			
6J			
5J		SG	

For two communications ports (COM1 and COM2)

Terminal number	RS-232C (COM1) + RS-232C (COM2)		RS-422A (COM1) + RS-232C (COM2)		RS-485 (COM1) + RS-232C (COM2)		RS-232C (COM1) + RS-485 (COM2)		RS-422A (COM1) + RS-485 (COM2)		RS-485 (COM1) + RS-485 (COM2)	
6E	COM1	RD1	COM1	RDA1 (+)	COM1	SA1 (+)	COM1	RD1	COM1	RDA1 (+)	COM1	SA1 (+)
6F		SD1		RDB1 (-)		SB1 (-)		SD1		RDB1 (-)		SB1 (-)
6G		SG		SDA1 (+)		SG		SG		SDA1 (+)		SG
6H				SDB1 (-)						SDB1 (-)		
6I	COM2	RD2	COM2	RD2	COM2	RD2	COM2	SA2 (+)	COM2	SA2 (+)	COM2	SA2 (+)
6J		SD2		SD2		SD2		SB2 (-)		SB2 (-)		SB2 (-)
5J		SG		SG		SG		SG		SG		SG

Note: No insulation is placed between two communications ports.

(3) Transmitter power supply option

Terminal number	Transmitter power supply
15	+
16	-

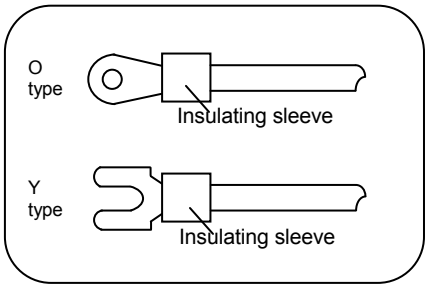
24V DC max 30mA

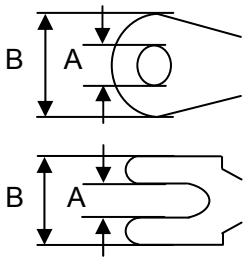
4 - 4 - 3. Basics of wiring

Precautions	To avoid accidents, be sure to observe the instructions mentioned in this manual.

1. Connecting to terminals

   (1) Use crimp style terminals with insulating sleeve for wiring of terminals. To ensure safety, always use O type terminals for power supply terminals and grounding terminals. It is recommended to use O type terminals for other terminal types.





Size

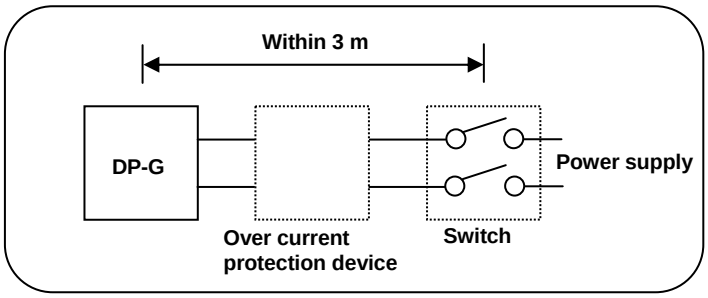
A: 3.7 mm or more

B: 7.0 mm or less

   (2) The maximum terminal screwing torque is "0.8 Nm". If a torque exceeding this value is applied, the terminal screw panel may be damaged.

2. Power supply terminal

   (1) For the power supply, install the over current protection device and switch that conforms to the rating of this product, within 3 m at an easily reachable position.



   (2) For wiring of the power supply, use electric cables that are 600 V vinyl insulation electric cables (rating 1 A AC or more) or equivalent cables.

   (3) To prevent malfunction, use a high quality single phase power supply with small voltage change, wave form distortion, and noise. If large amounts of noise are received, use a noise filter, insulation transformer, etc.

   (4) Be careful since a slight leakage current flows through the ground terminal when using rated supply. The leakage current is approximately 1 mA.

Warning	To avoid serious accidents, be sure to cut power off before wiring.

3. Input terminal

(1) The maximum allowable input for an input terminal is as follows: Be sure not to apply input volumes exceeding these values. If input volumes exceeding these values are applied, the product may be damaged, significantly deteriorated, or malfunction.

- Thermocouple, voltage mV, and voltage V: ±20 V or less.
- Resistance thermometer: 500 Ω or less, or ±5 V or less.
- Current mA: ±30 mA or less, or ±7.5 V or less.

(2) Parallel connection of input is not allowed. Parallel connection may generate measurement errors, inhibits stable control of the system, and result in an entire system failure.

(3) As for a thermocouple, use a thermocouple cable or a compensation lead cable to connect to the input terminal of the product.

(4) As for a resistance thermometer, in order to avoid measurement errors, use the cables with the same resistance value.

(5) When a protection device such as a zenner barrier is connected for input protection, sometimes significant measurement errors may be generated. Check to see that the combination with protection device is appropriate and that the allowable signal source resistance and allowable wire resistance of this product conform to the values in the specification.

4. Output terminal

(1) Use an output terminal within the rated range. If a load out of rated range is applied, this product may be damaged, significantly deteriorated, or malfunction.

(2) If the current output type is mixed with the voltage output type/SSR drive pulse type within the 2 outputs specification, be sure not to turn on the power of the product body when output 1 and output 2 are short-circuited. An excessive current may flow through the output circuit and the controller be damaged.

(3) Be sure to apply the load on the relay output terminal of on-off pulse type or on-off servo type via the buffer relay. In addition, be sure to insert a contact protection device on the coil side of the buffer relay for contact protection of product internal relay and for noise reduction. A small type of contact protection device is also built in the product for internal relay protection. Please note that a slight leak current flows through this contact protection device and load voltage. The leak current is approximately 2 mA when the load voltage is 200 V AC and approximately 1 mA when the load voltage is 100 V AC.

5. Alarm terminal

(1) Use an alarm terminal within the rated range. If a load out of rated range is applied, this product may be damaged, significantly deteriorated, or malfunction.

(2) Be sure to apply the load on the alarm terminal via the buffer relay. In addition, be sure to insert a contact protection device on the coil side of the buffer relay for contact protection of product internal relay and for noise reduction.

6. Option terminals

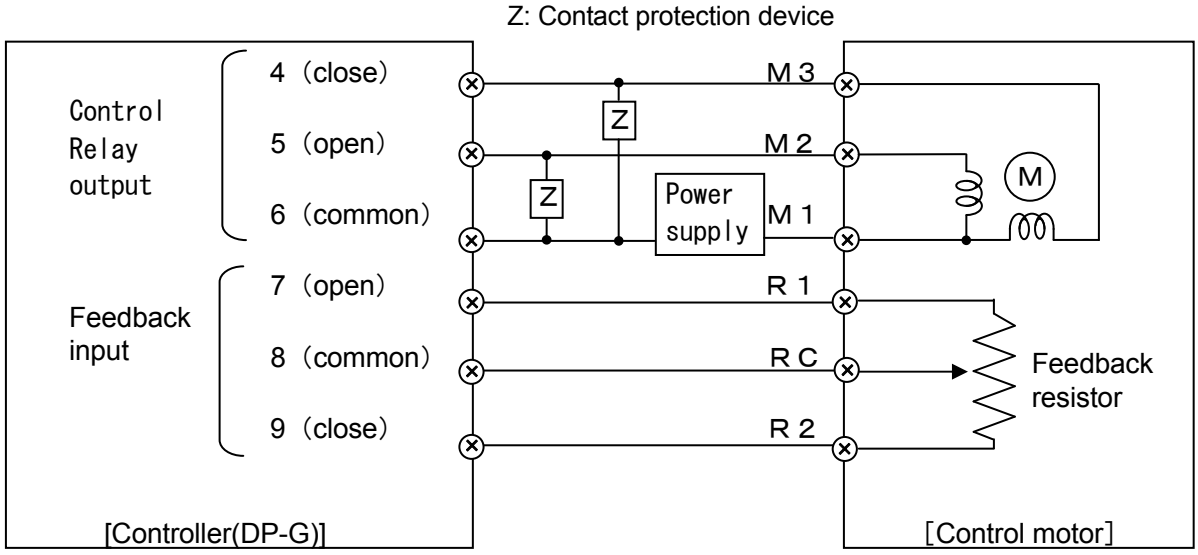
(1) Use an option terminal within the rated range. If a load out of rated range is applied, this product may be damaged, significantly deteriorated, or malfunction.

⚠ **Precautions**	(1) If a power supply out of rated range is applied, this product may be damaged, significantly deteriorated, or malfunction. (2) If an excessive current or voltage is applied to the input terminal of this product, the product may be damaged, significantly deteriorated, or malfunction.

4 - 4 - 4. Example of wiring

1 . Example of wiring for on-off servo type output

On-off servo type is connected with a motor. Refer to the terminal diagram of the motor that uses three terminals of control relay output and three terminals of feedback input and do the wiring.



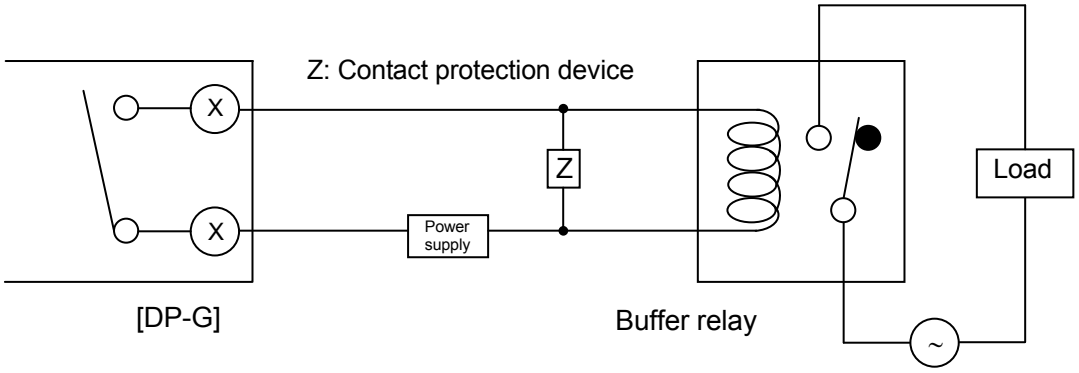
In the above diagram, the controller and control motor manufactured by our company are directly connected however, while actually connecting always insert a buffer relay and then connect. Furthermore, always connect a contact protection device in control relay output terminal.
The contact protection device attached to the controller is for the motor (For load current 700 mA and above).
When connecting with buffer relay, use a contact protection device for light load. If the attached contact protection device is used in buffer relay, operation defect occurs due to leak current.

For your reference symbolic name list of motors of various companies is given below.

Symbolic name list of motors of various companies				
Chino Products	Toho Products	Shin Nippon Keisetsu Products	Japan Servo Products	Yamatake Products
M 3	S	S	T 2	1
M 2	O	O	T 1	2
M 1	C	C	T 3	3
R 1	BM	B	B	Y
R C	RM	R	R	T
R 2	WM	W	W	G

2. Example of wiring for relay output

Be sure to use a buffer relay and a contact protection device to connect to the load for the relay output of on-off pulse type, on-off servo type and alarm output.

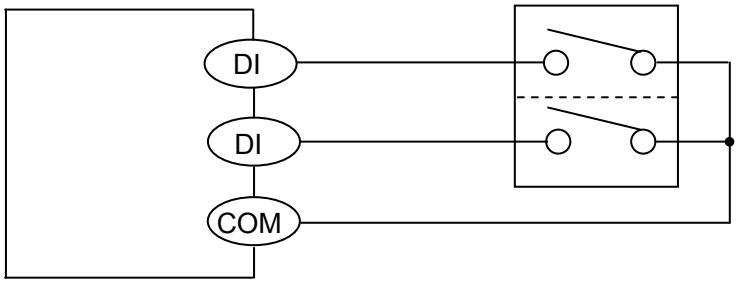


Contact protection device is available from our company (see "16. Accessories").

CR compound instrument and diode are generally used for DC and AC power supplies, respectively.

3. Wiring example of external signal input

(1) In the case of non-voltage contact specification (default)

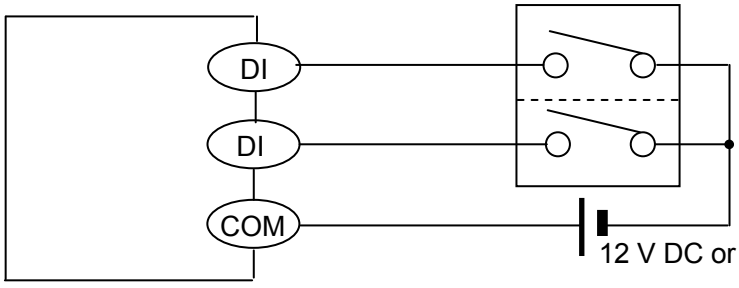


In the left figure,
approximately 5 V and 2 mA are applied to the switch.
Please note the contact capacity.

[DP-G]

Short-circuiting the specified external signal input terminal and a common (COM) terminal enables various types of external signal inputs (DI) to operate. A switch or relay is commonly used for operation, however, the open collector signal of peripheral instrument can also be used for operation.

(2) In the case of external signal output (optional)

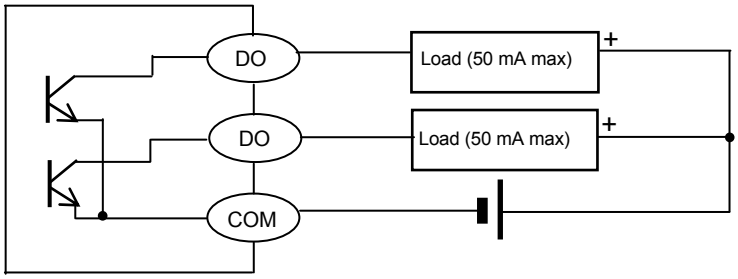


In the left figure,
a maximum current of 12 mA flows through the switch.
Please note the contact capacity.

[DP-G]

Precautions	(1) In the case of external signal output (optional), the voltage applied between each external signal input terminal and the common (COM) terminal triggers operation. When the voltage is applied, the common (COM) terminal is plus (+) and each input terminal is minus (-). Please note the polar character. (2) As for the non-voltage contact specification (default), wiring for the external power supply specification may cause damages in the internal circuit of this product. Check to see the specification to verify the correct wiring.

4. Wiring example of external signal output

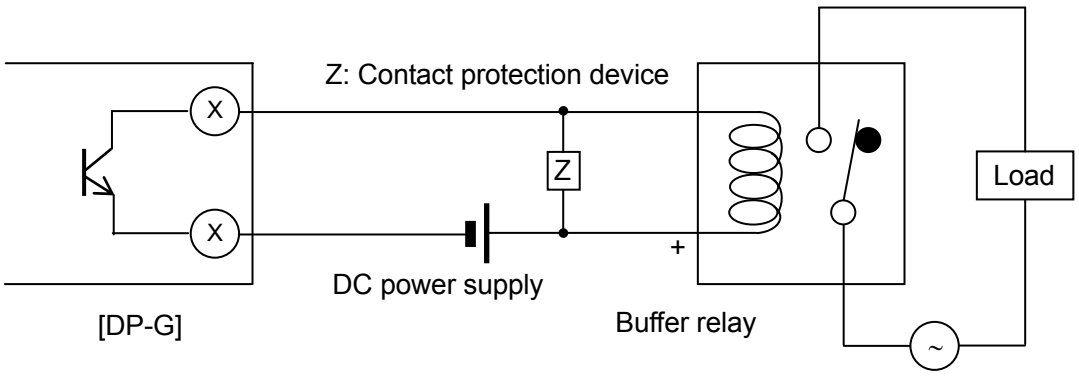


The rated range of open collector signal is DC load, maximum voltage of 24 V DC, and maximum current of 50 mA or less.
Please note the load capacity.

[DP-G]

Precautions	Each external signal output (DO) is generated using open collector signals. If the AC source or a load out of rated range is applied, this product may be damaged, significantly deteriorated, or malfunction.

In the case of open collector signal, when the load capacity is small, connect the load via the buffer relay, as follows: In addition, be sure to insert a contact protection device on the coil side of the buffer relay for noise reduction.



4 - 4 - 5. Precautions for wiring

⚠ Warning	To avoid serious accidents, be sure to observe the instructions mentioned in this manual.

1. Wiring should be done by professionals

Wiring should be done by personnel with basic knowledge of instrumentation and sufficient practical experience.

2. Install the terminal cover

In order to ensure safety, when wiring is completed, take measures to prevent the product terminals from being directly touched.

3. Keep away from strong electric circuit and noise source

In order to avoid adverse effects of noise, do not place the product near noise generating instruments (magnet relay, motor, thyristor regulator, inverter, etc.). In addition, do not use the same duct for the cables of this product and those of noise generating instruments. Always keep the cables away from each other.

Take countermeasures against noise as needed.

4. Be careful of correct connection to the ground terminal

Proper grounding is critical for entire reliability of the final product. In general, it is better to ground each instrument at one point. When grounded separately, each instrument tends to be easily affected by noise. Check to see that the grounding route is reasonable.

5. Keep away from heat sources

In order to avoid adverse affect of high temperature, do not install the product near heat sources. Installing the product near any heat source may result in measurement errors and eventually shorten the life of the product. Take care of the surrounding temperature of the product.

In addition, avoid windy places and sudden temperature changes, since such a condition may also cause measurement errors. Take necessary measures to avoid such a surrounding environment.

6. Unused terminal

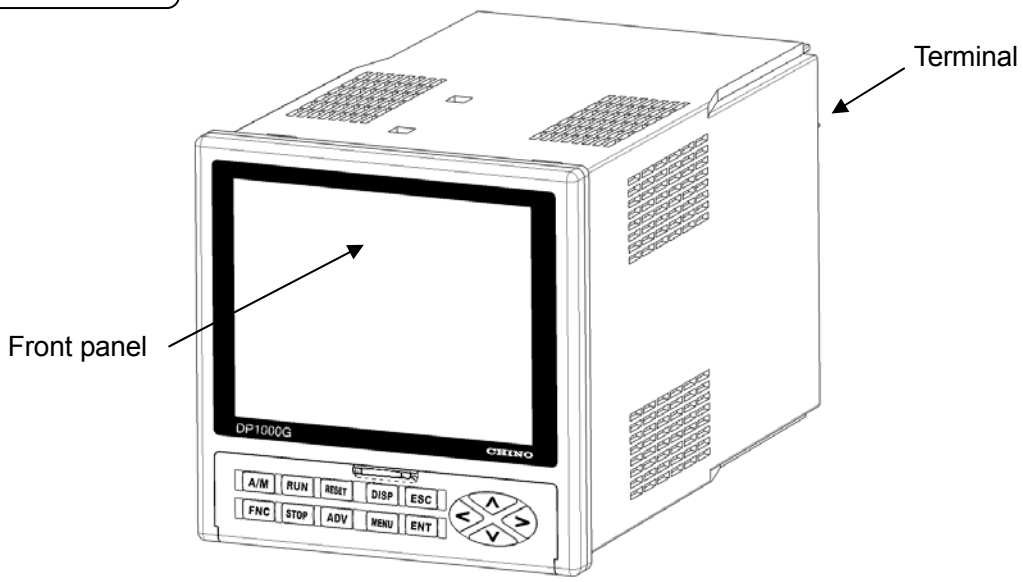
Do not connect anything to unused terminals. Connecting to an unused terminal may damage the product.

7. Countermeasures against erroneous output when power is supplied

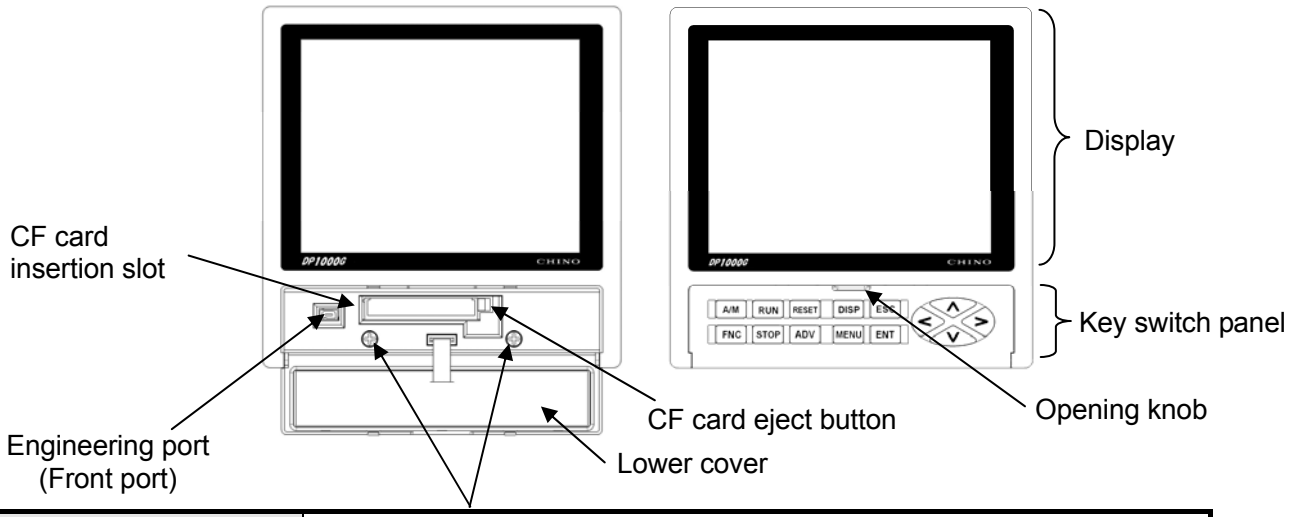
When the power switch is turned on, an output related signal may be momentarily generated until this product is started normally. Take countermeasures in external circuits as needed.

5. Name of various parts

5 - 1. Entire overview



5 - 2. Overview of the front panel



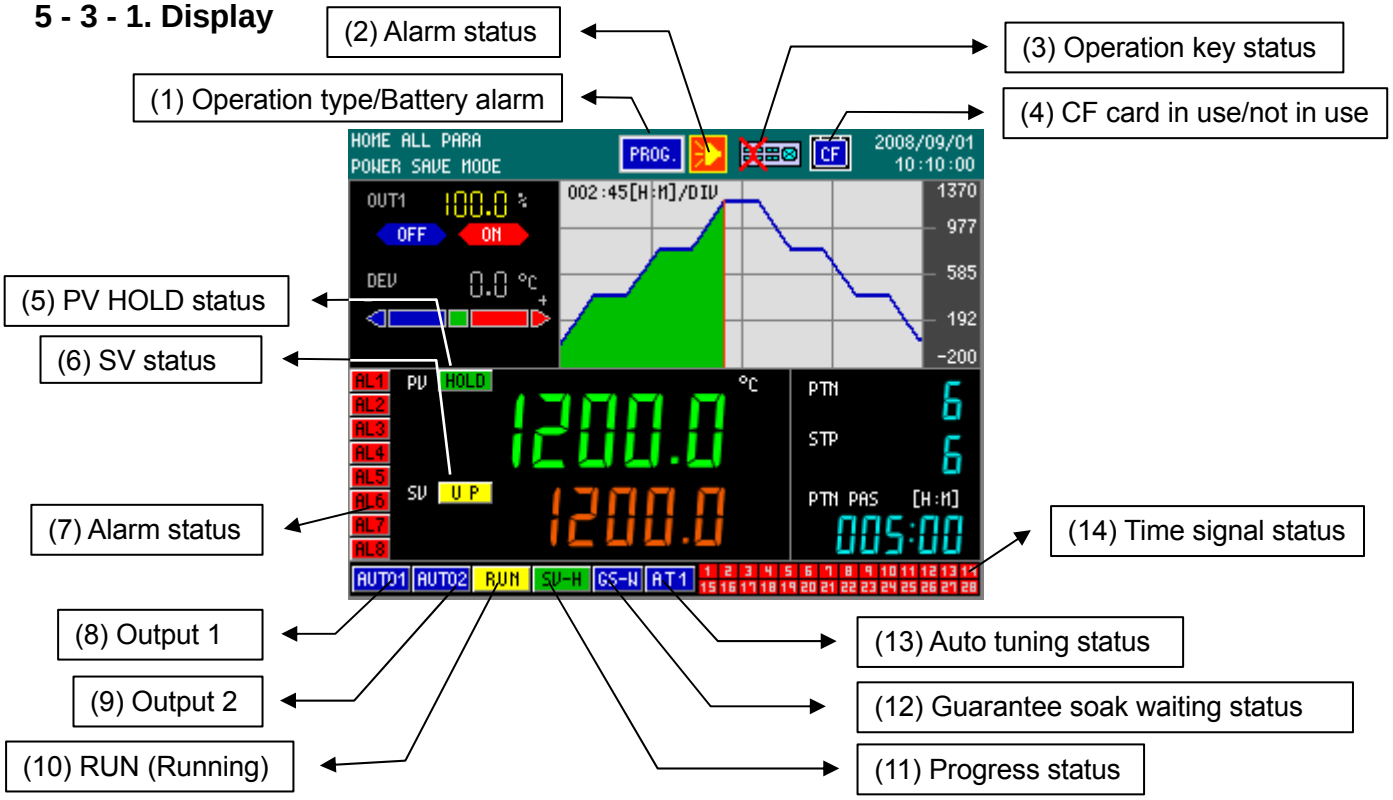
Precautions

These screws are used to fix internal units and should be removed only for maintenance. The user is not allowed to remove these screws.

Name	Function
Display	Displays operation screens, setting screens, PV, SV, and various statuses.
Key switch panel	Used for setting and operation. When FNC is enabled, it lights up in green with backlight.
CF card insertion slot	Used to insert a CF card.
CF card eject button	Push this button to eject the CF card.
Engineering port	Can be used to connect to a PC with a dedicated engineering cable to set up the product from the PC.
Opening knob	Used to open and close the lower cover. Hold it down while pulling it to open the lower cover. To close the lower cover, push it hard with your finger.
Lower cover	Open the lower cover when using the engineering port or the CF card. Otherwise, always close it firmly.

5 - 3. Details of the front panel

5 - 3 - 1. Display



Icons used in the status bar

	(1) Operation type/ Battery alarm	(2) Alarm status	(3) Operation key status	(4) CF card in use/not in use
Status 1	PROG. Program run	No information displayed Alarm is not activated	No information displayed Operation key not locked	No information displayed CF card not in use
Status 2	CONST Stationary operation	<=> (Blinking) Alarm is activated	Operation key locked	CF CF card in use
Status 3	PROG. ⟷ LOW BATTERY CONST ⟷ LOW BATTERY Battery alarm			

PV, SV, Alarm status

	(5) PV HOLD status	(6) SV status	(7) Alarm status
Status 1	No information displayed No PV HOLD	No information displayed SV constant/RESET in progress	AL1 AL2 AL3 AL4 AL5 AL6 AL7 AL8 Alarm is not activated (frame display)
Status 2	HOLD PV HOLD in progress	U P SV ramp-up	AL1 AL2 AL3 AL4 AL5 AL6 AL7 AL8 ⇕ AL1 AL2 AL3 AL4 AL5 AL6 AL7 AL8 Alarm is waiting (Lamp is blinking)
Status 3		DOWN SV ramp-down	AL1 AL2 AL3 AL4 AL5 AL6 AL7 AL8 Alarm is activated (Lamp lights up)
Status 4		W-ALM WAIT ALARM is activated	

Icons used for program run status display

	(8) Output 1	(9) Output 2*1	(10) RUN (Running)	(11) Progress status	(12) Guarantee soak	(13) AT status
Initial status	AUTO1 Automatic	AUTO2 Automatic	No information displayed	No information displayed	No information displayed	"TS"
Status 1	MAN1 Manual operation	MAN2 Manual operation	RUN Program is running	END Operation terminated	GS-W Guarantee soak in progress	AT1 AT1 in progress
Status 2			STOP Operation stopped (STOP)	FAST Fast-forward		AT2 AT2 in progress
Status 3			RUN (Blinking) WAIT (Waiting) * Program Occurred during operation	SV-H SV HOLD		AT3 AT3 in progress
Status 4			STOP (Blinking) WAIT (Waiting) * Occurred when stopped			AT4 AT4 in progress*2 (2-outputs specification)
Status 5						AT5 AT5 in progress*2
Status 6						AT6 AT6 in progress*2
Status 7						FBAT FBAT in progress*3

*1 (9) Output 2: Displayed exclusively for 2-outputs specification

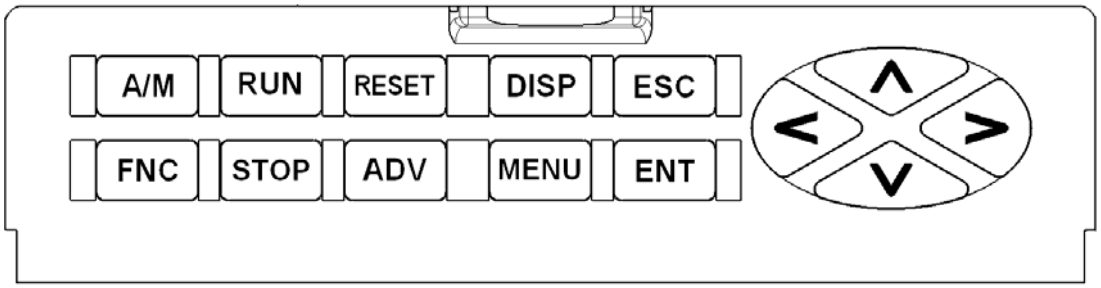
*2 (13) AT status: Exclusively for 2-outputs specification

*3 (13) FBAT status: Exclusively for On-off servo type output specification

Time signal status

	(14) Time signal status
Status 1	 When no time signal is activated.
Status 2	 Time signals are activated. (When all time signals are activated.)

5 - 3 - 2. Key switch panel



Name	Function
MENU	• Displays the [SETUP MENU] screen. (In the operation screen, press the [MENU] key to display the [SETUP MENU] screen.) • Insert or delete steps at a point in a pattern when editing the pattern in Mode 2. • Initialization of setup parameter. (Setup parameters can be initialized by holding down both the [ENT] key and the [MENU] key simultaneously when starting the product. However, since the program patterns are not initialized, use Mode 2 to delete all of the program patterns.)
ENT	• Determine selection items or confirm numeric values input. • Switch between 2-outputs displays. (For 2-outputs specification, holding down the [ENT] key switches the display between output 1 and output 2.)
ESC	• Terminate the menu and setting screens. • Clear selection items or numeric values input status.
DISP	• Displays the operation screen switching menu • Returns to the operation screen (the home screen) during setting. (If you hold down the [DISP] key in the [SETUP MENU] screen or the setting screen except for memory card management, the system is returned to the operation screen without saving the setting data.)
	• Move the cursor left, right, up, or down in the menus or setting screens. • Select setting items or enter numeric values (increase or decrease the values) (∧ ∨) • Operate output values in the manual output status (∧ ∨). • Switch selection among operation patterns in the program RESET status (< >) • Used for the mode lock operation on the menus (press both [FNC] and > simultaneously). • Add steps at the end of a pattern in the pattern edit in Mode 2 (press both [FNC] and > simultaneously)

Name	Function
FNC	• Enable five operation keys. ([RUN], [STOP], [ADV], [RESET], and [A/M]) operations can be performed after pressing the [FNC] key to enable those keys. When the [FNC] key is enabled, it lights up with green backlight. • Used for the mode lock operation. (Used with to lock or unlock a mode on the menu.)
RUN	• Start the program run. (In the operation screen, pressing the [RUN] key after pressing the [FNC] key brings the system to the RUN status.) • Run the program in the fast-forward mode. (During the RUN status in the operation screen, press the [FNC] key, and then hold down the [RUN] key. While holding down the [RUN] key, the program pattern runs at several to several dozen times of the normal speed. When the [RUN] key is released, the fast-forward mode is cleared.) • Clear the STOP status. (During the STOP status in the operation screen, pressing the [RUN] key after pressing the [FNC] key returns the system to the RUN status.)
STOP	• Bring the system to the STOP status. (During the RUN status in the operation screen, pressing the [STOP] key after pressing the [FNC] key brings the system to the STOP status.)
ADV	• Advance the system step by step (ADV). (In the operation screen, pressing the [ADV] key after pressing the [FNC] key advances the system to the next step.) • The step advances continuously when pushing continuing [ADV] key for 0.5 seconds or more with [FNC] key lights.
RESET	• Bring the system to the RESET status. (In the operation screen, pressing the [RESET] key after pressing the [FNC] key brings the system to the RESET status.)
A/M	• Switch between the AUTO and MAN statuses (During the automatic output operation in the operation screen of the output display, pressing the [FNC], [A/M], and [ENT] keys sequentially brings the system to the manual output operation status. On the other hand, during the manual output operation status, pressing the [FNC], [A/M], and [ENT] keys sequentially brings the system to the automatic output operation status.)

6. CF card

For the controller, a CF (Compact Flash) card is available to save or manage the setup parameters and program patterns (CF cards are sold separately). Since data is stored as a file format in the CF card, you can use your PC to manage and edit the data (Use the dedicated software tool separately provided to edit data).

6 - 1. Available CF card

The following CF cards are available:

- CompactFlash™ Specification compliant CF (Compact Flash) card
- Card capacity: 128 MB to 2 GB
- Format: FAT16 or FAT32
- Recommended vendors: Apacer Technology Inc., TDK Corporation

Precautions	Some CF cards may not be used due to mismatching connectors or less compatible data read/write methods. Before selecting a CF card, be sure to check if it is compatible with the controller.

Precautions	If your CF card is not formatted or formatted in an incompatible format, use your PC to format it in FAT16 or FAT32. In this case, quick format is not applicable.

6 - 2. Inserting/ejecting CF card

6 - 2 - 1. CF card insertion

(1) Open the lower cover.

(2) Place your CF card at the entrance of the CF card slot and push it into the slot firmly until it reaches the end of the slot (with the front side of the CF card up).

(3) When the CF card is inserted, the [CF] mark appears in the status bar.

Precautions	If the [CF] mark is not displayed, check to see if the CF card is firmly inserted.

6 - 2 - 2. Ejecting CF card

(1) Open the lower cover.

(2) Push the eject button located to the right of the CF card slot to remove the CF card.

(3) When the CF card is ejected, the [CF] mark disappears from the status bar.

Precautions	Be sure not to eject the CF card or turn off the power of the controller while saving, reading, deleting, verifying and formatting data in the CF card, or formatting the CF card. Otherwise, the data in the card may be corrupted.

6 - 3. Functions of CF card

The controller provides the following functions available for a CF card:

(1) Save (from DP-G to a CF card)
Current setup parameters and patterns/sequences can be stored as a file in a CF card.

* Please note that the following configuration parameters are not preserved on the CF card.

MODE	Parameter not preserved on CF card	
Mode 0 (EXECUTING PARAMETER)	All parameters	
Mode 1 (OPERATION STATUS)	Key lock status	Alarm reset status
	Auto tuning status	
	PV hold status	SV hold status
	Time display type	Graph scale
Mode 8 (COMMUNICATION)	All parameters	
Mode 10 (ENHANCED SETUP)	Tag setup, Display setup	

(2) Read (from a CF card to DP-G)
Setup parameters and pattern/sequence files can be read in the CF card and stored into the controller.

(3) Delete (from the CF card)
Setup parameters and pattern/sequence files that are not used any longer can be deleted from the CF card.

(4) Verify (between DP-G and a CF card)
Setup parameters and pattern/sequence files in the CF card can be verified with those in the controller to see if their status are matched exactly.

(5) Format (formatting of a CF card)
All files are removed from the CF card and the card is reset to its initial status.
However, the formatting in the controller is only quick format. When a CF card is formatted for the first time or it does not work as expected, use your PC to perform a physical format on the CF card.

6 - 4. Storage folder and file names

When the controller is used to store data in a CF card, the following folders and files are created in the card. When you manage files on your PC and create a CF card to be read into the controller, first create appropriate folders in the CF card and then store files.

The file names of patterns/sequences (all) and files for automatic loading are predefined. The extension of each file is also predefined. Be sure not to change those extensions, otherwise the controller can not recognize them properly.

	Function name	Contents	Folder name	Storage file name	Extension
(1)	Setup parameter	Saves setup parameters.	\SET	Any name within 20 characters (bytes)	.ds1
(2)	Pattern/ sequence (individual)	Saves one of the program patterns and sequence settings.	\PAT	Any name within 20 characters (bytes)	.dp1
(3)	Pattern/ sequence (all)	Saves all of the program patterns and sequence settings registered in the controller.		Predefined file name ALL_PAT_001 ~ ALL_PAT_200	
(4)	AUTO LOAD	Saves one program pattern/sequence and setup parameter as a set so as to facilitate smooth program run immediately after reading them into the controller. The target of the program pattern is always No.1.	\ALLSET	Predefined file name Pattern/sequence No.1: ALL_PAT_001	.dp1
				Predefined file name Setup parameter: SETUP	.ds1

Up to 500 files can be stored in each folder (Auto-load is limited to one set).

An approximate size of each file is listed in the following table:

	Function name	Size of one file (as a guideline)	Size for 500 items (as a guideline)
(1)	Setup parameter	6 K bytes	3 M bytes
(2)	Pattern/sequence (individual)	24 K bytes	12 M bytes

* Be sure to use the dedicated software tool when you use your PC to edit data stored in a CF card. If something such as the data format is corrupted, the data can not be read properly by the controller.

7. Operation screen

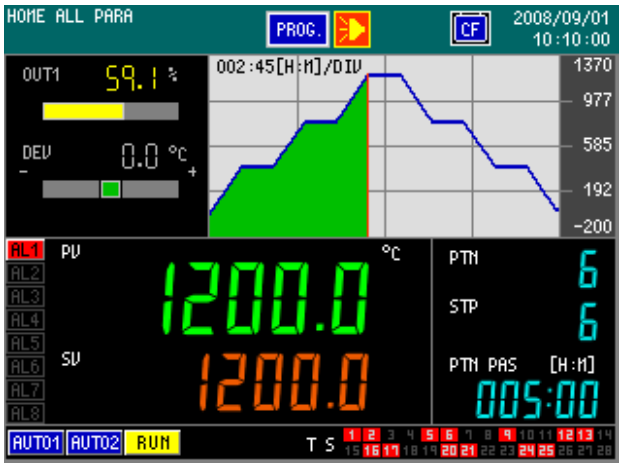
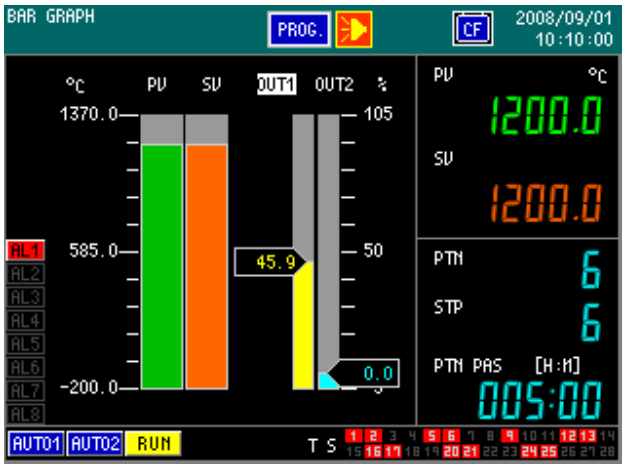
The operation screen and the setting screen are displayed in the display panel. The contents displayed in the operation screen vary depending on the output type of the product. The operation screen consists of the status bar, the program run status/time display, and the view area of current values.

7 - 1. Operation screen

<table>
<tr><th>Display screen</th><th>Description of screen</th></tr>
<tr><td>Status bar (When program pattern running)
 

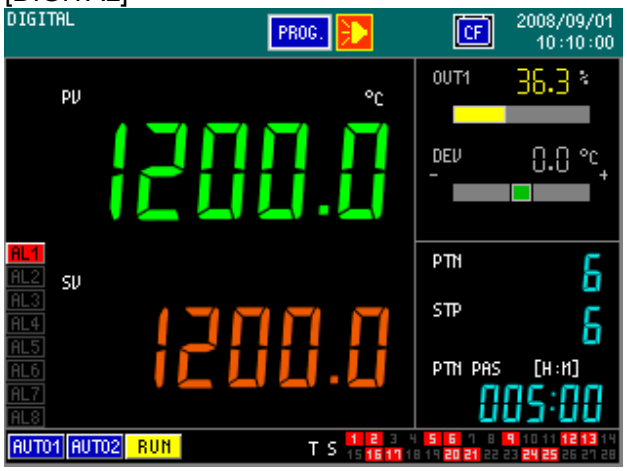
Status bar (When program pattern reset)
 

Status bar (Power save mode)
 

Status bar (Battery alarm ON)
 
</td><td>(1) Status bar
Current display type, power save mode, control mode (program run/constant value operation), alarm indicator, run operation key lock status, CF card in use/not in use, and date/time display.
While resetting, the pattern selection operation method is also displayed.
(2) When the battery alarm is generated, LOW BATTERY and PROG. / CONST is alternately displayed.
* The status bar is always visible regardless of the displayed operation screen type.</td></tr>
<tr><td>[ALL PARA]
 
</td><td>(1) PV/SV
(2) Output value/deviation display
When output type is on-off servo, the feedback value is displayed.
(3) Program progress display
(4) Alarm status display
(5) Pattern No./Step No. display
(6) Program time display
STP PAS: Step elapsed time,
PTN PAS: Pattern elapsed time
STP REM: Step remaining,
PTN REM: Pattern remaining
(7) Program run status display
(8) Time signal status display
* In the initialized status, this screen is registered as the HOME screen.</td></tr>
<tr><td>[BAR GRAPH]
 

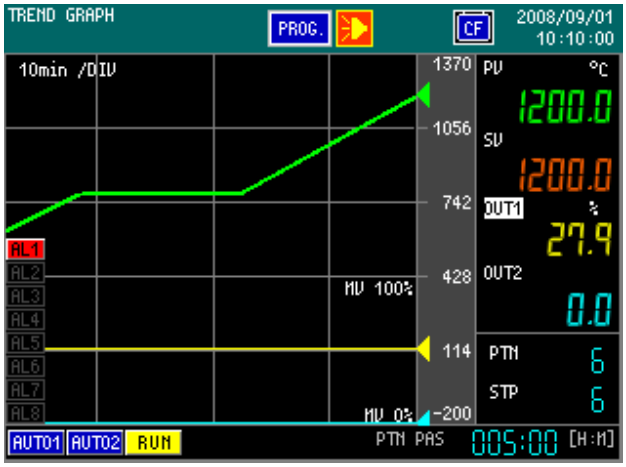
* Example of display in the case of 2-outputs specification</td><td>(1) PV/SV/output bar graph
In the case of 2-outputs specification, adjustable manual output CH labels are highlighted.
When output type is on-off servo, the feedback value is displayed.
(2) PV/SV
(3) Alarm status display
(4) Pattern No./Step No. display
(5) Program time display
STP PAS: Step elapsed time,
PTN PAS: Pattern elapsed time
STP REM: Step remaining,
PTN REM: Pattern remaining
(6) Program run status display
(7) Time signal status display</td></tr>
</table>

[DIGITAL]



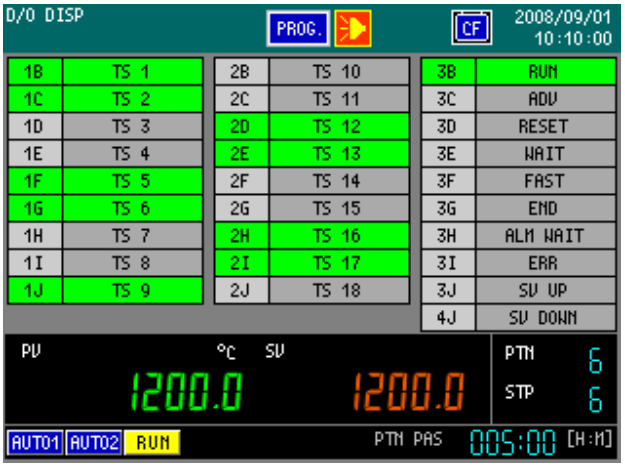
(1) PV/SV
(2) Output value/deviation display
When output type is on-off servo, the feedback value is displayed.
(3) Alarm status display
(4) Pattern No./Step No. display
(5) Program time display
STP PAS: Step elapsed time,
PTN PAS: Pattern elapsed time
STP REM: Step remaining,
PTN REM: Pattern remaining
(6) Program run status display
(7) Time signal status display

[TREND GRAPH]



(1) Trend graph display
Trend types of PV (green), SV (orange), OUT1 (yellow), and OUT2 (light blue) are displayed.
A red vertical line is displayed at the power supply turning on position.
(2) PV/SV
(3) Output value
In the case of 2-outputs specification, adjustable manual output CH labels are highlighted.
(4) Alarm status display
(5) Pattern No./Step No. display
(6) Program run status display
(7) Program time display
STP PAS: Step elapsed time,
PTN PAS: Pattern elapsed time
STP REM: Step remaining,
PTN REM: Pattern remaining

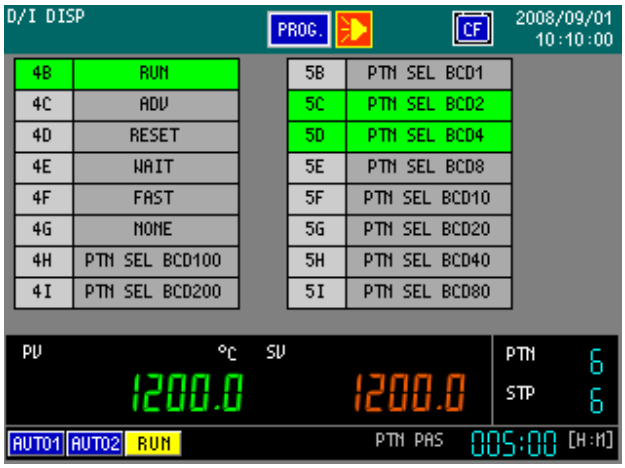
[D/O DISP]



(1) Display D/O output status
- ON: Lights in green
- 1B-4J corresponds to rear terminal numbers Displays the signal types assigned in [M10 ENHANCED SETUP] - [D/O SET UP]. If the tags are assigned to the time signals, those tags are displayed.

(2) PV/SV
(3) Pattern No./Step No. display
(4) Program run status display
(5) Program time display
STP PAS: Step elapsed time,
PTN PAS: Pattern elapsed time
STP REM: Step remaining,
PTN REM: Pattern remaining

[D/I DISP]



(1) Display D/I input status
- ON: Lights in green
- 4B-5I corresponds to rear terminal numbers Displays the signal types assigned in [M10 ENHANCED SETUP] - [D/I SET UP].

(2) PV/SV

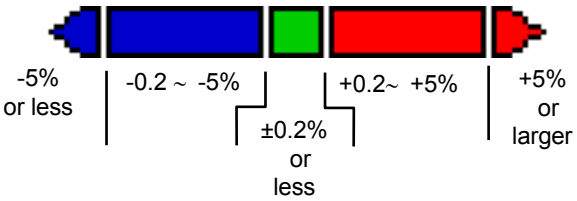
(3) Pattern No./Step No. display

(4) Program run status display

(5) Program time display
STP PAS: Step elapsed time,
PTN PAS: Pattern elapsed time
STP REM: Step remaining,
PTN REM: Pattern remaining

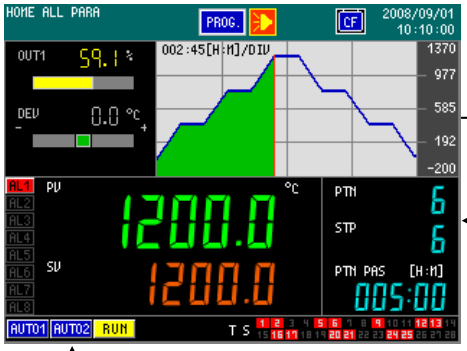
* If the total time of the program pattern is 1,000 days or more, "---:--" is displayed on the time display PTN PAS and PTN REM.

7 - 2. Output/deviation display screen

Output display screen	Description of screen
[On-off pulse type] [SSR drive pulse type]  * The above screen is a pseudo-display and actually OFF and ON do not light simultaneously.	(1) ON: Lights when output is ON. OFF: Lights when output is OFF. (2) Displays MV (output value) in digital form. (3) "OUT1": For automatic output operation (Auto output) "MOUT1": For manual output operation (Manual output) (4) In the case of 2-outputs specification, holding down the ENT key switches the display between "OUT1" and "OUT2".
[Current output type] [Voltage output type]  * The above screen is a pseudo-display and actually do not light simultaneously.	(1) Bar-graph displays MV > 100.0%: ▷ arrow is displayed 0.0 <= MV <=100.0%: The bar appears alone MV < 0.0%: ◁ arrow is displayed (2) Displays MV (output value) in digital form. (3) "OUT1": For automatic output operation (Auto output) "MOUT1": For manual output operation (Manual output) (4) In the case of 2-outputs specification, holding down the ENT key switches the display between "OUT1" and "OUT2".
[On-off servo type]  * The above screen is a pseudo-display and actually do not light simultaneously.	(1)  : When "OPEN" output is turning on. : When "CLOSE" output is turning on. : When both outputs of "OPEN" and "CLOSE" are turned off (2) Displays MV (output value) in digital form. (3) "OUT1": For automatic output operation (Auto output) "MOUT1": For manual output operation (Manual output (4) "FB": For feedback value
[Deviation display]  * The above screen is a pseudo-display and actually do not light simultaneously.	(1) Displays the deviation value (PV-SV) of the input value against the set value. 

7 - 3. Switching between operation screens

HOME
(The screen registered as the HOME screen.
Select one of the operation screens in [M10 ENHANCED SETUP].)



DISP

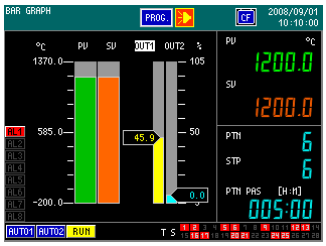
ESC

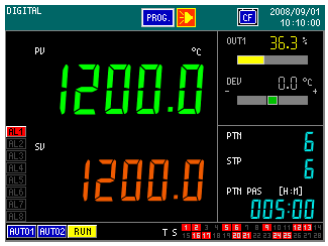
Monitor screen menu

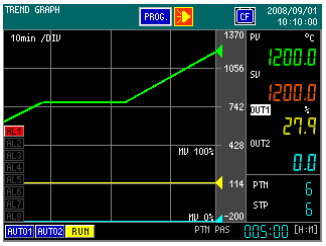
Select by the key

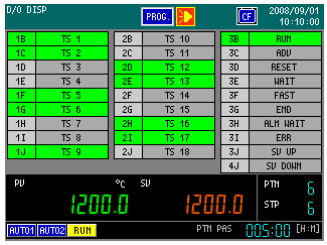
ENT

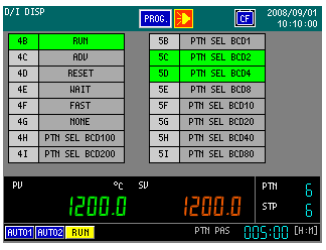
Other than the HOME screen











DISP

DISP key
Moves to the HOME screen

8. Setting screen

8 - 1. Basics of setting

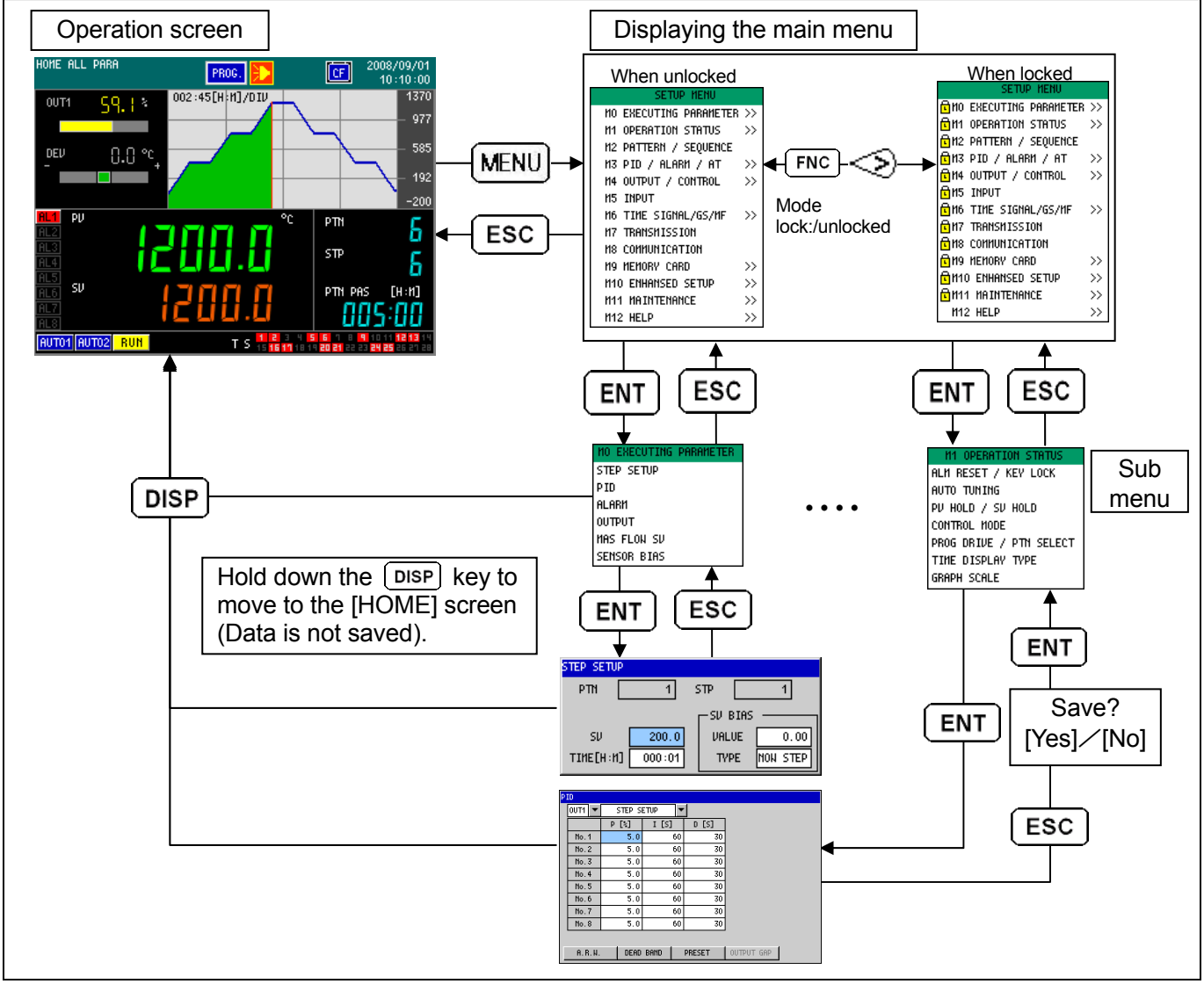
8 - 1 - 1. Call up the setting screen

(1) When a set screen is called from the operation screen, “Setup menu” is displayed with MENU key, and the set mode is selected with ∧/∨ key and ENT key is pushed.

(2) Because the submenu is displayed according to the selected mode, a detailed item is selected in addition with ∧/∨ key and ENT key is pushed.

(3) It returns to the operation screen when ESC key is pushed in “Setup menu” or the submenu (From the submenu twice).

(4) It returns to the HOME screen when DISP key is pushed for one second or more on a submenu or a each setting screen.

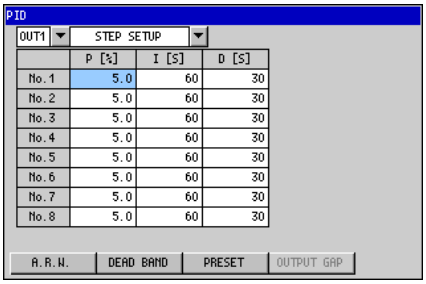
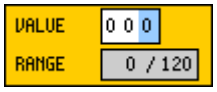


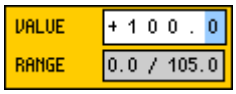
- POWER SAVE MODE
  If any key operation has not been performed for approximately three or more minutes, the system makes LCD BRIGHTNESS minimum (BRIGHTNESS 1) and moves its mode into the Power save mode. When performing a key operation, LCD BRIGHTNESS is returned to the original status.
- MAIN DISP RETURN function
  When [MAIN DISP RETURN] is set to [YES] in the [ENHANCED SETUP] screen on the [M10 ENHANCED SETUP] menu, the menu or any setting screen is returned to the operation screen automatically if any key operation has not been performed in it for approximately three or more

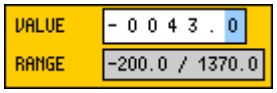
8 - 1 - 2. Basic operations on the setting screen

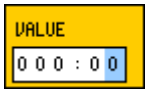
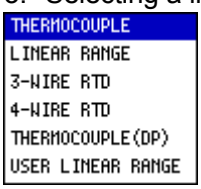
In the setting screen, use the direction and [ENT] keys to change numeric values and select items, and use the [ESC] key and [ENT] key to complete the setting.

<table>
<tr><th colspan="2">Examples of basic operations</th></tr>
<tr><td>1. Setting operations of the setting screen

Example of setting screen (MODE3:PID setting)
 
</td><td>(1) The cursor (light blue painting out frame) is moved with ∧ ∨ < > key and a set item is selected.
(2) When the cursor is put on the item of a numeric setting and [ENT] key is pushed, a numeric setting becomes possible. Please refer to the numeric setting example.
(3) When the cursor is put on the item of the list selection and [ENT] key is pushed, the select list is displayed. Please refer to the list selection example.
(4) Please refer to the explanation of each MODE for details in a set each screen.
(5) When A key is pushed after a set content is changed, the preservation confirmation message is displayed.
The change result is preserved when "Yes" is selected and [ENT] key is pushed and it returns to the display of the previous state (set menu or submenu).
When "No" is selected, the change result is annulled.
"Cancel" continues a set screen as it is.
* It returns to the previous screen at once when [ESC] key is pushed when there is no change in a set content.
* In MODE 0 " EXECUTING PARAMETER " and MODE 1 " OPERATION STATUS " - "Key lock/Alarm reset", "Auto tuning", and "PV hold/SV hold" , when the preservation confirmation is not and changes, the content is reflected.</td></tr>
<tr><td>2. Examples of setting numeric values
Unsigned integer
 

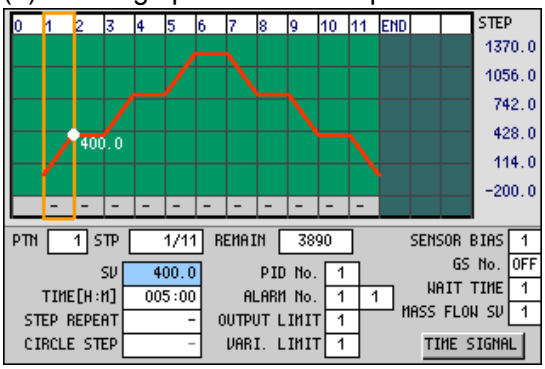
Unsigned decimal fraction
 

Signed decimal fraction
 

Time setting
 
</td><td>(1) The cursor is positioned on the least significant digit when opening the numeric value setting screen.
(2) <: Moves the cursor to a higher digit
>: Moves the cursor to a lower digit
(3) ∧: Increases the value on the cursor position (the value is carried up automatically).
∨: Decreases the value on the cursor position (the value is carried down automatically).
(4) Pressing the [ENT] key closes the numeric value setting screen and changes the numeric value on the called screen.
Except for modes 0 and 1, the value changed is not saved until the setting screen is closed.
(5) Pressing the [ESC] key closes the numeric value setting screen and returns the value changed to the original one.</td></tr>
<tr><td>3. Selecting a list
 
</td><td>(1) The cursor is positioned in the currently set item when opening the list selection.
(2) Use the ∧ or ∨ key to move to the desired item.
(3) Pressing the [ENT] key changes the setting (it is not saved yet).
(4) Use the [ESC] key to return to the previous item.
(5) In the list selection, pressing the ∧ key at the top of the list moves the cursor to the bottom of it. Similarly, pressing the ∨ key at the bottom of the list moves the cursor to the top of it.
(6) If there are too many list items to be displayed in a list, use the < or > key to move the previous or next list items displayed in the list.</td></tr>
</table>

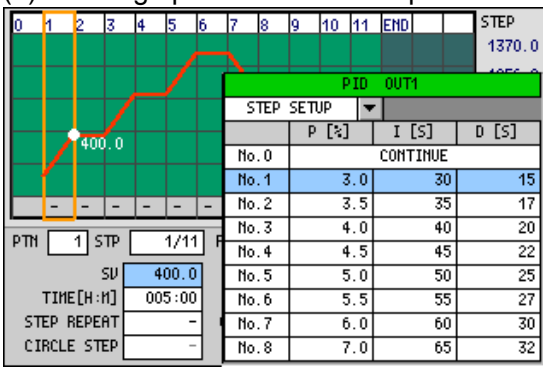
4. Setting operations of the pattern and sequence

(1) Setting operations of the pattern



1) In the pattern setting, use the <> or <> key to select a step to be set.
   (The step selected is displayed with an orange frame on the graph display.)
2) To add a step to the end of the pattern, move the orange frame to the last step and hold down the [FNC] key while pressing the <> key.
3) To insert or delete a step in the middle of the pattern, move the orange frame to the desired step and press the [MENU] key. When [INSERT] or [DELETE] button appears, select it and press the [ENT] key. When [INSERT] is selected, a step is inserted immediately before the step displayed with the orange frame.
   * When the pattern is edited while executing it, the step addition to the pattern end is possible.
     However, the step cannot be inserted (or deleted) on the way of the pattern.
     When the pattern is edited in the reset state, it is not possible to insert (or delete) it in the previous position according to the step advanced for the ADV operation.
     Even if the key is pushed, the “insert”/”delete” button is not displayed.
4) The setting items for each step are placed at the bottom of the screen. Use the ∧ or ∨ key to select an item to be set, and then press the [ENT] key to display the numeric values setting list and the set value list. The setting items selected (except for SV and TIME) are also displayed below the graph and can be seen across the steps.
5) When A key is pushed after the pattern is edited, the message of the preservation confirmation is displayed. The edited pattern is preserved when "Yes" is selected and A key is pushed and it returns to the pattern list display.
   When "No" is selected, the edit result is annulled.
   "Cancel" continues the pattern edit screen as it is.

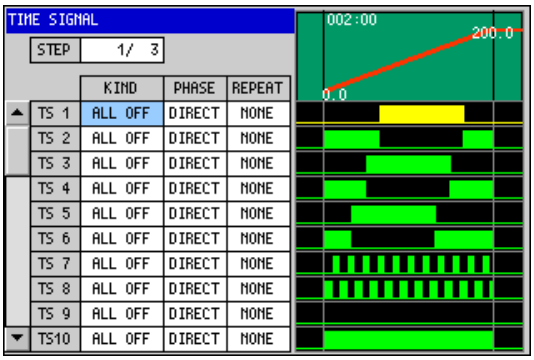
(2) Setting operations of the sequence



1) To set the sequence such as PID, select an item to be set, and then press the [ENT] key to display the set value list according to the item selected. (Figure above: Example when selecting the PID)
2) Use the ∧ or ∨ key to select the number you want to use in the set value list, and then press the [ENT] key to confirm it.

Examples of basic operations

(3) Setting the time signal



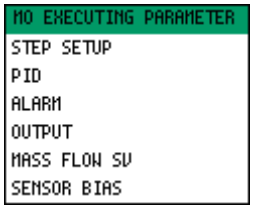
1) In the [PATTERN] or [SEQUENCE] setting screen, select the [TIME SIGNAL] button, and then press the ENT key to display the [TIME SIGNAL] setting screen.
2) Use the ∧ or ∨ key to select the time signal number to be set.
3) Use the < and > keys to select the setting item, and then press the ENT key to display the setting.
4) When the cursor is positioned in the setting item at the far left or right, press the < or > key to move to the previous or next step.

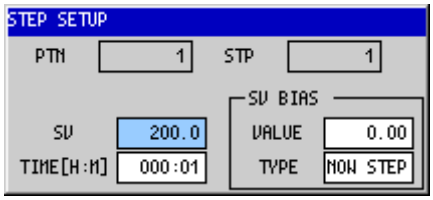
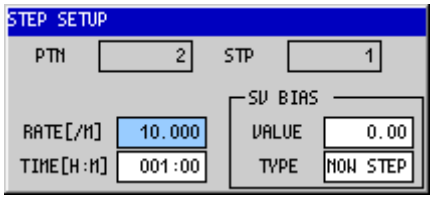
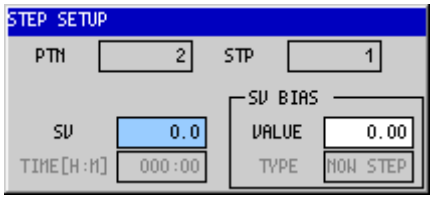
Mode numbers and setting items

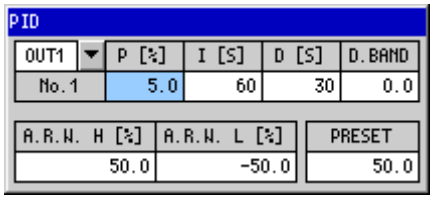
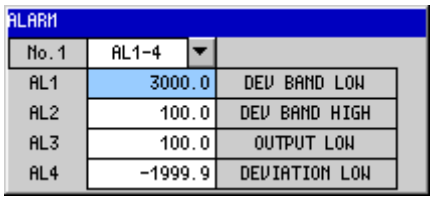
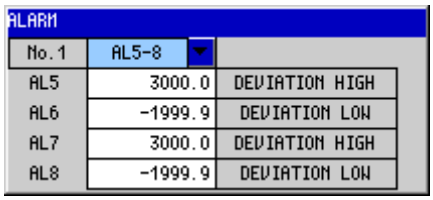
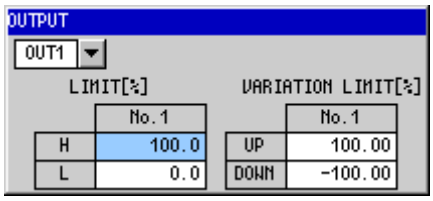
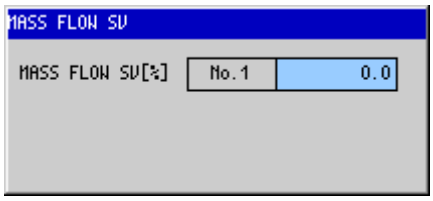
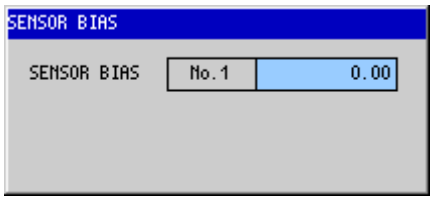
Mode number	Common (to all models)			Specific model only
Mode 0 (EXECUTING PARAMETER)	Step setup during execution, SV bias	PID constant during execution	Alarm value during execution	Output 2 PID constant during execution
	Output setting during execution	MASS FLOW SV during execution	Sensor bias during execution	Output 2 setting during execution
Mode 1 (OPERATION STATUS)	Operation key lock	Alarm reset	Run the auto tuning 1~3	Run the auto tuning 4~6
	PV hold	SV hold	Change the control mode	
	Actions on repower	Program drive type	Pattern selection type	
	Time display type	Graph scale		
Mode 2 (PATTERN / SEQUENCE)	Pattern/sequence settings	Repeat	Circle step	
	PID number selection	Alarm number selection	Output limit number selection	
	Output variation number selection	Sensor bias number selection	Guarantee soak number selection	
	Waiting time alarm number selection	MASS FLOW number selection	Time signal number time signal selection	
	Controls when exiting the program	Pattern link destination setting	SV when resetting	
	Pattern copy	Pattern check display	Pattern deletion	
Mode 3 (PID / ALARM / AT)	PID: 8 types	PID: SV 8 sections for No.9	PID: 8types for No.9	Output 2 PID: 8 types
	A. R. W: 8 types	PID dead band: 8 types	PID output preset: 8 types	Output 2 Gap
	A. R. W: 8 types for No.9	PID dead band: 8 types for No.9	PID output preset: 8 types for No.9	SV 8 sections for AT5/6
	SV 8 types for AT2	Start direction and Set/Unset for AT2	SV 8 sections for AT3	Start direction and Set/Unset for AT5/6
	Start direction and Set/Unset for AT3	Alarm type (AL1~8)	Alarm value (AL1~8)	
	Alarm dead band (AL1~8)	Alarm delay (AL1~8)	Alarm wait enable/disable (AL1~8)	
	Alarm latch enable/disable (AL1~8)	Control loop error time	Alarm actions in reset (AL1~8)	
Mode 4 (OUTPUT / CONTROL)	Direct/Reverse control type	Control algorithm	Control interval	On-off pulse setting
	Output at PV over / under error	CPU error output	Output limit: 8 types	On-off servo output adjustment
	Output variation limit: 8 types	Output limit/Output variation limit: SV 8 sections for No.9	Output limit: 8 types for No.9	Output 2 limit/ Output 2 variation limit
	Output variation limit: 8 types for No.9	Limit on the manual output enabled/disabled	Cascade primary controller	Set the heating & cooling
Mode 5 (INPUT)	Measuring range	Reference junction compensation necessary/unnecessary	Unit	
	PV decimal point	Digital filter	Burn out	
	Linear range	Linear scale	Linear scale decimal point	
	User linearize table	Sensor bias	Input calculation	
Mode 6 (TIME SIGNAL/GF /MF)	Time signals: 30 types	Guarantee soak: 8 types	Waiting time alarm: 8 types	
	MASS FLOW SV: 8 types			
Mode 7 (TRANSMISSION)	Transmission kind	Transmission scale		
	Secondary transmission kind	Secondary transmission scale		
Mode 8 (COMMUNICATION)	Communications protocol	Select the communications function	Device number (RS-485, RS-422A)	
	Baud rate	Communications transmission kind	Switch the communications port (COM2 only)	
Mode 9 (MEMORY CARD)	Save (parameters, program patterns)	Read (parameters, program patterns)	Delete (parameters, program patterns)	
	Verify (parameters, program patterns)	CF Card Format		
Mode 10 (ENHANCED SETUP)	DI setup	DO setup	Tag setup	
	Home screen selection	LCD Brightness	Language	
	Set the date and time	Set the control operation output	Time signal /Alarm status during FAST	
	Main disp return yes/no	Trend graph display settings	Program time unit	
Mode 11 (MAINTENANCE)	Display the instrument information	D/I Check	D/O Check	
	Key check	Display check		
Mode 12 (HELP)	Display the key operation	Display the Status Explanation		

8 - 2. Mode 0 (Change the setting of execution steps)

Mode 0 is used for changing the settings of main parameters being executed.

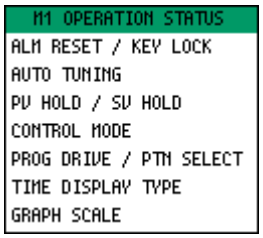
Menu screen	Description of screen
M0 EXECUTING PARAMETER  	• This is the menu screen of mode 0. Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it.

Setting screen	Description of screen
STEP SETUP When [SV/TIME] selected  When [RATE/TIME] selected  When CONST (constant value operation) is performed  	The numbers of the pattern and the step being executed are displayed during the program operation. (1) When [SV/TIME] is selected for [PATTERN SET TYPE] (It is set in [PTN SETTING TYPE] in mode 2) • SV and the time for the step being executed can be changed. • The SV can be set within the input scaling range. (2) When [RATE/TIME] is selected for [PATTERN SET TYPE] (It is set in [PTN SETTING TYPE] in mode 2) • The rate and the time for the step being executed can be changed. • The rate can be set within -99.999 ~ 99.999. (3) The changes of SV, time, and RATE settings are not reflected to the settings in the program pattern on mode 2, and they are only reflected to the step in progress. (4) SV bias value and the bias type can be changed. • The SV bias value can be set within -99999 to 99999. The decimal point is positioned one digit higher than the decimal point position of the measuring range or the linear scale on mode 5. • If "NOW STEP" is selected for SV bias type, only the values for the step in progress are compensated. If [ALL STE] is selected, all the values for the steps after the one in progress are compensated. (5) For the operations after changing the settings, see "10 - 6 - 1. Change in settings during operation". The SV value and the SV bias value are displayed during CONST (constant value operation). • SV value and SV bias value can be changed. • The SV can be set within the input scaling range. • The SV bias value can be set within -99999 to 99999. The decimal point is positioned one digit higher than the decimal point position of the measuring range or the linear scale on mode 5.

PID  	(1) The PID setting, ARW setting, PID dead band, and output preset for the step being executed can be changed. • Switch between CH1 and CH2 at the top of the screen and display these values. (2) The changes made on this screen are not reflected to the PID, ARW, PID dead band, and output preset on mode 3 and they are only applied here.
ALARM (AL1 - 8 enabled)   	(1) The set values of the alarm 1 - 8 for the step being executed can be changed. • The currently selected alarm number is displayed on the upper-left corner. • Switch between the alarms 1 - 4 and 5 - 8 at the top of the screen and display the values. (2) The changes made on this screen are not reflected to alarm 1 - 8 on mode 3 and they are only applied here.
OUTPUT  	(1) Output limit, output scaling (when the set type on mode 10 is OUTPUT SCALE), or output variation limit for the step being executed can be changed. • Switch between CH1 and CH2 at the top of the screen and display these values. (2) The changes made on this screen are not reflected to output settings 1 - 8 on mode 4 and they are only applied here.
MASS FLOW SV  	(1) The MASS FLOW SV value for the step being executed can be changed. (2) The changes made on this screen are not reflected to MASS FLOW SV settings 1 - 8 on mode 6 and they are only applied here.
SENSOR BIAS  	(1) The sensor bias value for the step being executed can be changed. (2) The sensor bias value changed on this screen is not reflected to sensor bias settings 1 - 8 on mode 5 and they are only applied here.

8 - 3. Mode 1 (Selection of operating status)

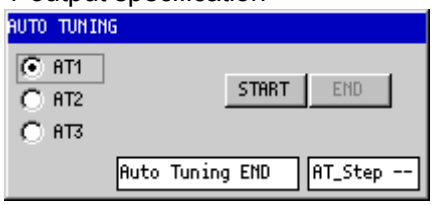
Mode 1 is used for configuring the operation status related settings.

Menu screen	Description of screen
	• This is the menu screen of mode 1. Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it.

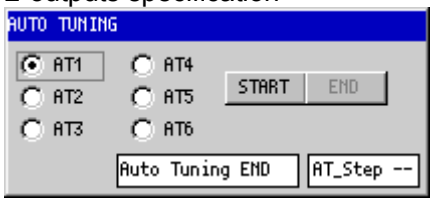
Setting screen	Description of screen
ALARM RESET/KEY LOCK 	(1) Operation keys can be locked. • "UNLOCK": Unlocked status Operations can be performed using keys. • "LOCK": Locked status Operations can not be performed using keys. (2) The generated alarm outputs can be reset temporarily. • If you want to reset the generated alarm, select the clear button and press ENT to reset the alarm outputs. The alarm display lamp goes into a wait status and flashes after this operation. • Once the alarm generation condition is not satisfied while in a reset (wait) status, the alarm display lamp goes out and it returns to a normal condition. • [ALARM RESET] section includes group reset buttons such as [ALL RESET], [AL1-4 RESET], and [AL5-8 RESET], and buttons for resetting each alarm. • If using specification with external signal, the alarm output is reset by setting the external signal to ON when it is reset using the external signal. Set the external signal to OFF immediately after the alarm output is reset. If it remains ON, not returned to OFF, the alarm output continues to be reset.

AUTO TUNING

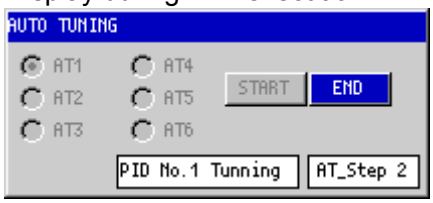
1-output specification



2-outputs specification



Display during AT1 execution



(1) The auto tuning of PID is performed (calculated automatically).
(2) Select an AT type among AT 1 - 6 and perform the auto tuning.
- AT1: AT on SV being executed (for Output 1)
- AT2: AT on 8 types of SV for AT 2 on mode 3 (for the Output 1)
- AT3: AT on 8 types of SV for AT 3 on mode 3 (for the Output 1)
- AT4: AT on SV being executed (for Output 2)
- AT5: AT on 8 types of SV for AT 5 on mode 3 (for the Output 2)
- AT6: AT on 8 types of SV for AT 6 on mode 3 (for the Output 2)

(3) Press the [START] button to start the auto tuning.
(4) To abort the auto tuning, press the [END] button.
(5) The PID calculated in the auto tuning can be found in the setting screen of each PID.

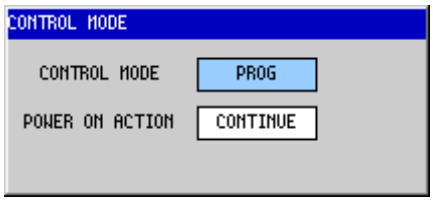
PV HOLD / SV HOLD

(1) PV HOLD
- It holds the PV update.
- HOLD: Holds the PV value at the current value
- CLEAR: Clears PV hold

(2) SV HOLD
- It holds the SV update.
- HOLD: Holds the SV value at the current value
- CLEAR: Clears SV hold

Precautions: The time of the program pattern continues to gain while holding SV. For details on the actions while holding SV and after clearing it, see "11 - 14. SV hold action".

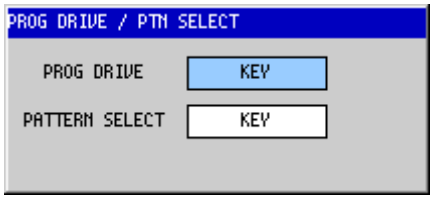
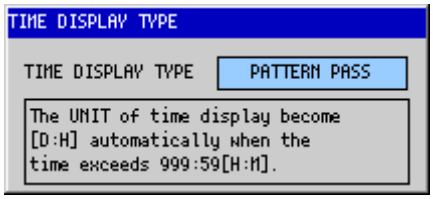
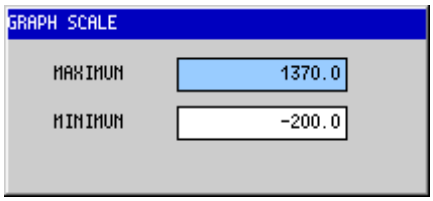
CONTROL MODE



(1) Select the control mode
- PROG: Program run
- CONST: Constant value operation
  When you switch to the constant value operation during running a program, the operation is performed with the SV at that point.
  SV must be changed in mode 0.

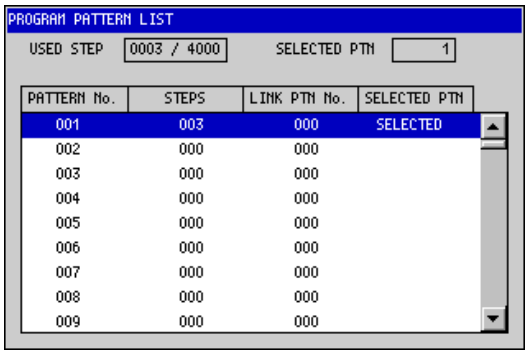
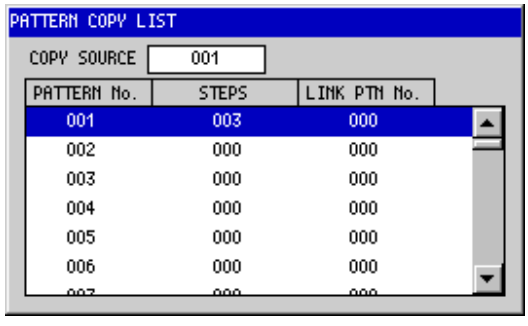
(2) Select the action on repower
- RESET: Transfers to the reset status when turning on power
- CONTINUE: Maintains the status just before turning off power and starts to operate from that status when turning on power again

Precautions: If the power is turned on when [RESET] is selected, it transfers to the RESET status even if the setting screen, external signal, and communications are in RUN status. In this case, it transfers to the RUN status by setting back to the RESET status and changing to the RUN status again. However, note that the operations are started from the beginning of the pattern.

PROG DRIVE / PTN SELECT  	(1) Set the program drive type • KEY: Drive the program using the front key • EXT: Drive the program using the external signal It can be set only when using specifications with external signal. • COM: Drive the program using the communications function It can be set only when using specifications with communications. • SLAVE: Drive the program using the external signal synchronized with others It can be set only when using specifications with external signal. Precautions: When [EXT] ,[COM]or [SLAVE] is selected, auto/manual can be also switched using key operations. (2) Set the pattern selection type • KEY: Select by the front panel key • EXT: Select using the external signal It can be set only when using specifications with external signal. • COM: Select using the communications It can be set only when using specifications with communications.
TIME DISPLAY TYPE  	(1) Select the time display type Select the program time type being displayed in the operation screen. ・STEP PASS: Display the elapsed time of the step being executed. [STP PAS] is displayed in the operation screen. ・PATTERN PASS: Display the elapsed time of the pattern being executed [PTN PAS] is displayed in the operation screen. ・STEP REMAIN: Display the remaining time of the step being executed. [STP REM] is displayed in the operation screen ・PATTERN REMAIN: Display the remaining time of the pattern being executed. [PTN REM] is displayed in the operation screen.
GRAPH SCALE  	(1) MAXIMUM • Upper limit of the graph showing progress of process and trend It is set in the input scaling. (2) MINIMUM • Lower limit of the graph showing progress of process and trend It is set in the input scaling.

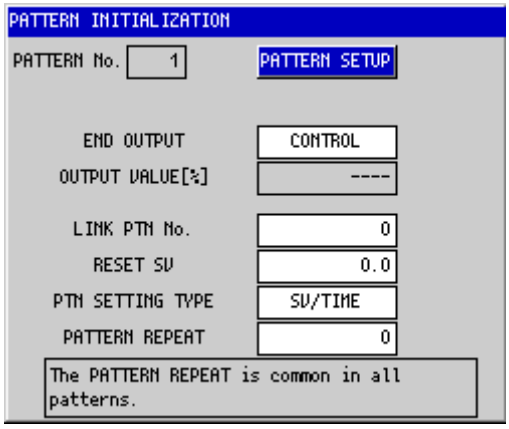
8 - 4. Mode 2 (Pattern/Sequence)

Mode 2 is used for configuring the program pattern related settings.

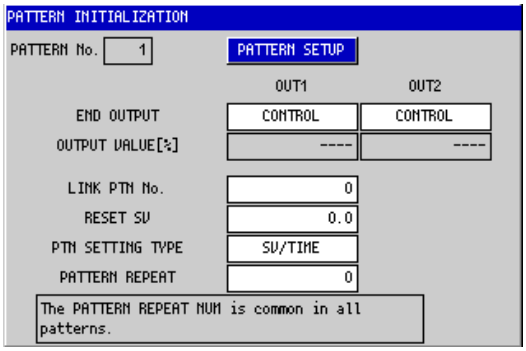
Setting screen	Description of screen
PROGRAM PATTERN LIST 	1. Program pattern list (1) Total number of the used steps, the selected pattern number, and the program pattern list (pattern number, number of the used steps, pattern link number, and selected pattern) are displayed. (2) Use the ∧ and ∨ keys to move the cursor in the pattern list and select the pattern to be edited. Moreover, the cursor movement can be fast-forwarded with < > key. (3) The pattern selected as the execution pattern is indicated with SELECTED. (4) The number of the used steps is 000 for the unregistered program pattern. (5) The maximum number of patterns is 200, the maximum number of steps per step is 199, and the maximum total number of steps is 4000.
PROGRAM PATTERN EDIT 	1. In the [PROGRAM PATTERN LIST] screen, select a pattern and press the ENT key to display the [PROGRAM PATTERN EDIT] as shown in the left figure. 2. Program pattern edit function (1) EDIT: Creates or changes a program pattern (2) CHECK: Checks the configured program pattern The settings of patterns can not be changed. (3) COPY: Copies the program pattern See "Pattern copy " (4) DELETE: Deletes the selected program pattern (5) ALL DELETE: Deletes all program patterns
PATTERN COPY LIST 	1. Pattern copy list (1) When [COPY] is selected in [PROGRAM PATTERN EDIT], [PATTERN COPY LIST] as shown in the left figure is displayed. (2) Select the pattern number to copy to and press the ENT key to copy the program pattern. However, a program pattern is not copied to the pattern which has already another program pattern registered. If the pattern has a program registered, delete it before copying another. When the number of remainder steps is few and cannot be copied, it becomes an error.

PATTERN INITIALIZATION

1 OUTPUT TYPE



2 OUTPUT TYPE



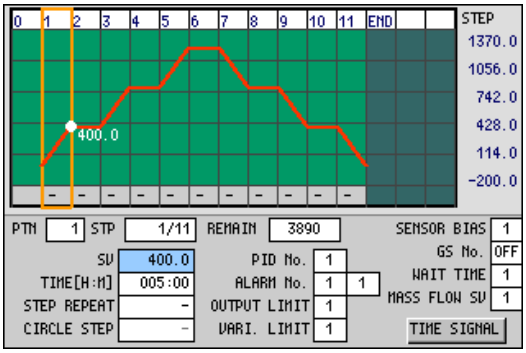
1. When [EDIT] is selected in [PROGRAM PATTERN EDIT]:
   (1) [PATTERN SETUP] button
   This button leads to the setting screen for pattern/sequence.
   (2) END OUTPUT
   - CONTROL: After the program ends, it is controlled with the last SV value.
   - CONST: After the program ends, the output value is fixed.
     In the case of 2-outputs specification, the settings for Output 2 must be configured.

   (3) OUTPUT VALUE[%]
   When you select [CONST], also set the output when the program ends. You can not set the output when you select [CONTROL].
   In the case of 2-outputs specification, the settings for Output 2 must be configured.
   (4) LINK PTN No.: Set the link pattern number.
   * Note that the operation continues permanently when you set your own pattern number.
   (5) RESET SV: Set the SV in a reset status.
   (6) PTN SETTING TYPE:
   - SV/TIME: Set the pattern by setting SV and time
   - RATE/TIME: Set the pattern by setting rate and time
     * It can only be selected only when a new pattern is created.

   (7) PATTERN REPEAT No.: Set the repeat count of the pattern.
   This setting is applied to all pattern numbers. All program patterns including pattern links which are already set are repeated.

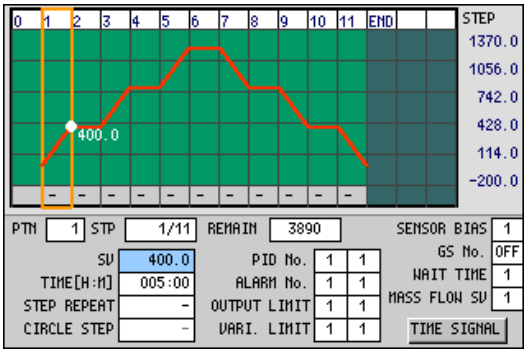
Pattern/sequence settings

1 OUTPUT TYPE



* A left frame is AL1-4 in the warning column, and a right frame is AL5-8.

2 OUTPUTS TYPE



* A left frame in the column of PID, output limit, and change amount limit is for the output 1, and a right frame is for the output 2.

* A left frame is AL1-4 in the warning column, and a right frame is AL5-8.

2. Pattern/sequence settings

(1) Set the SV (or rate), time, step repeat, each sequence parameter number, and time signal for each step.

(2) A left frame is AL1-4 in the warning column, and a right frame is AL5-8.

(3) For 2-outputs specification, PID,, and VARI. LIMIT fields are displayed in two columns. The column on the left is for Output 1 and the one on the right is for Output 2.

(4) The setting items selected (except for SV and TIME) are also displayed below the graph and can be seen across the steps.

(5) When A key is pushed after the pattern is edited, the message of the preservation confirmation is displayed. The edited pattern is preserved when "Yes" is selected and A key is pushed and it returns to the pattern list display.

When "No" is selected, the edit result is annulled.

"Cancel" continues the pattern edit screen as it is.

1) PATTERN SETUP

(1) SV or Rate

- Set [SV] when [SV/TIME] is selected in [PTN SETTING TYPE], and set rate when [RATE/TIME] is selected.
- For step 0, this value is set to SV when starting the operation.

(2) TIME

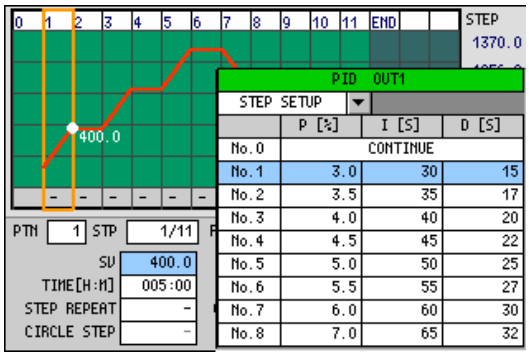
- Set the step time. The unit varies depending on the time unit which is set.
- If the  key is pressed when "000:00" is displayed in TIME, "END?" is displayed. If you confirm it, that step becomes the END step and other steps after it are deleted. However, "END?" is not displayed in the step over which it has already passed.
- If the  key is pressed when [SV/TIME] is selected in [PTN SETTING TYPE] and "END?" is displayed in [TIME], "CIRCLE" is displayed. If you confirm it, that step becomes a circle step.
- If you want to display a normal number instead of "END?" or "CIRCLE" in TIME, press the  key.
- For Step 0, select "SV start" or "PV start".

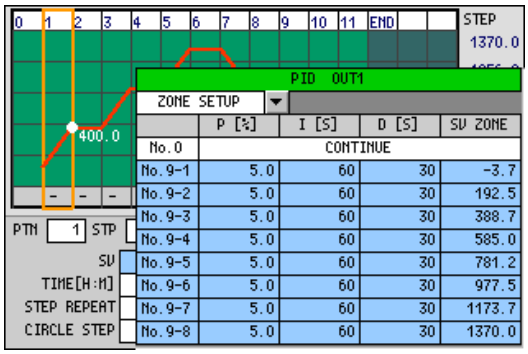
(3) REPEAT No.

- Set the repeat section within steps.
- Set the first step for the repetition to "00". If you press the  key when "--" is displayed, you can enter the number.
- For the last step for the repetition, set the repeat count. This repeats the section between the step which is set to 00 and the last step the number of times specified here.
- Set "--" for the steps other than the first and the last one for the repetition. If the  key is pressed when "00" is displayed, "--" is displayed.

(4) CIRCLE STEP

Set the SV variation per pulse when it is set to a circle step.



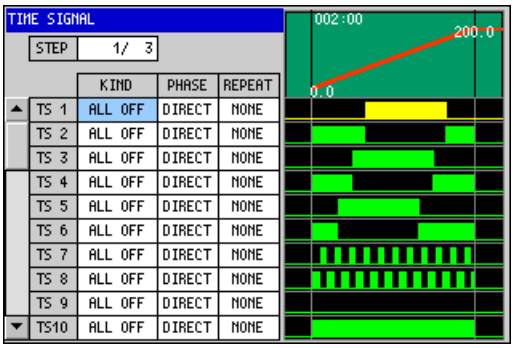


2) Sequence setting

(1) When setting the sequence such as PID, select one from No.1 to 8 in the set value list displayed. When selecting No.0, it means that the same number as the previous step is applied.

(2) In the section such as PID, there is a drop-down menu for switching to the SV zones automatically in addition to the No.1 to 8 fields. When you switch to ZONE SETUP in the set value list, the corresponding list is displayed.
No.9 -1 to 9 - 8 fields are selected at a time in ZONE SETUP. When you select a field using the ENT key, that field is displayed as 9 in the PATTERN or the SEQUENCE setting screen.

Setting the time signal



3) Setting the time signal

(1) For each step, set the time signal type and phase, and set if the repetition is enabled or not.

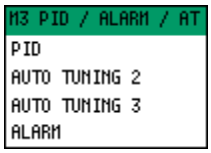
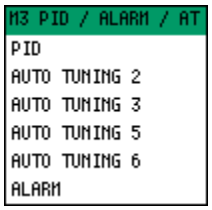
(2) KIND
In the displayed list, select the time signal number from 1 to 30 set in Mode 6, ALL OFF, or ALL ON.

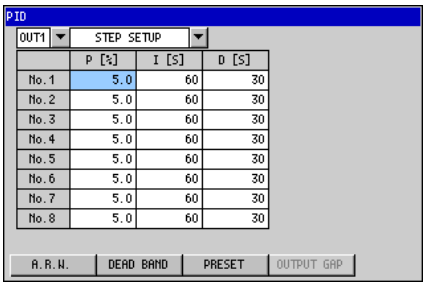
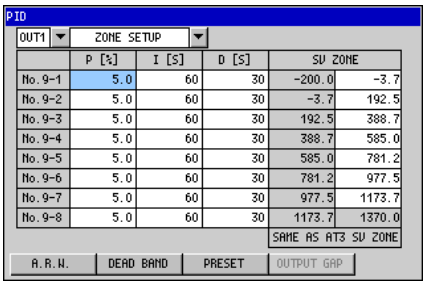
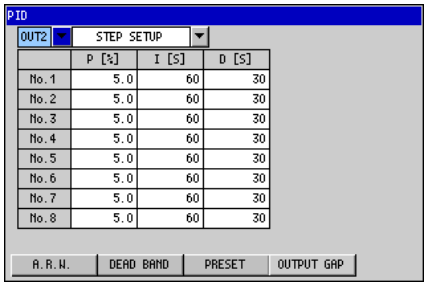
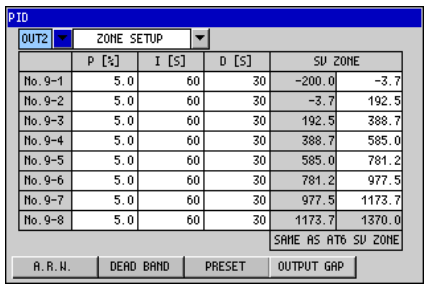
(3) PHASE
DIRECT outputs it according to the selected time signal.
REVERSE outputs it with ON and OFF reversed in a step. If ALL OFF or ALL ON is selected, it is fixed to DIRECT.

(4) REPEAT
Outputs the selected time signal repeatedly in a step. If ALL OFF or ALL ON is selected, it is fixed to NONE.

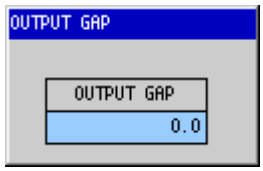
8 - 5. Mode 3 (PID/Alarm/AT)

Mode 3 is used for configuring the PID and alarm related settings.

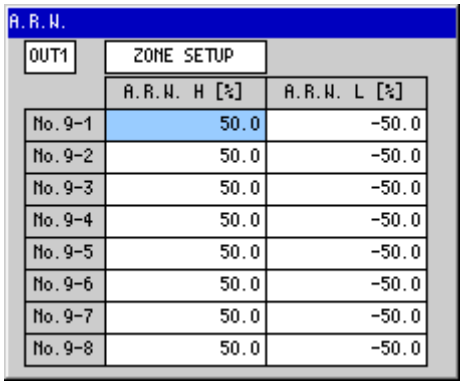
Menu screen	Description of screen
 1-output specification  2-outputs specification	• The menu screen of mode 3 Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it.

Setting screen	Description of screen
PID (Step, CH 1)  PID (Zone, CH1)  PID (Step, CH 2)  PID (Zone, CH2) 	(1) Select PID type to be set (step/zone, CH 1/2). • CH1/CH2: Switch the settings of PID constants to be used in Output 1 or Output 2. * If Output 2 does not exist, you can not select CH. • STEP SETUP: Set 8 types of PID (No.1~8). • ZONE SETUP: Set 8 types of PID for switching to the SV zone automatically (No.9 - 1 to 9 - 8). (2) When P is set to 0.0%, two-position control is performed. (3) If I is set to 0.0 second, it corresponds to ∞ (infinity) and the integral operation is not performed. (4) If D is set to 0.0 second, it corresponds to OFF. (5) Setting SV ZONE These are the set values of sections when PID is set to zone. No.9 - 1 is the setting for the first section from MIN value of the scale range. In the No.9 - 2 setting, the MAX value of No.9 - 1 is considered as its MIN value. Set the values up to No.9 - 7 in turn with consideration for the relation of MIN and MAX values shown here. No.9 - 8 can not be set because it is the MAX value of the scale range. The Max value of a SV zone is the same as MIN value of the next SV zone. However, if SV is that value, PID value of the zone below is used. (6) Setting PID for Output 2 The PID for Output 2 can be set in the same way as Output 1, but OUTPUT GAP tab is enabled. * After setting these values, the PID No. used in each pattern/step must be set in Mode 2.

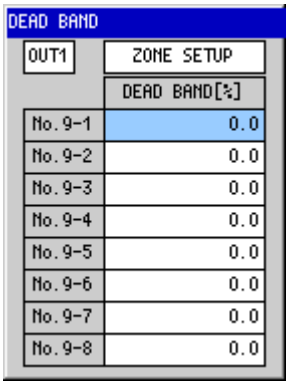
OUTPUT GAP (for 2 Outputs only)



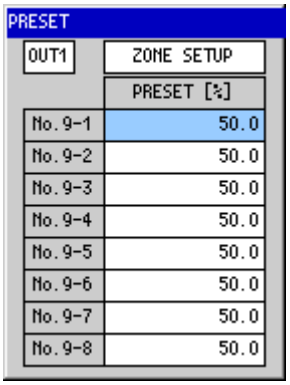
A.R.W.SETUP



DEAD BAND



PRESET



(7) OUTPUT GAP

This item can be set only when Output 2 (CH2) is selected.
Set the relation between the operating locations of the first and the second PID.
Set the gap between the SV and Output 2 0% in relation to the input span.

(8) A. R. W.(anti-reset windup)

- This is the function which limits the range in which the integral (I) operation is performed with the deviation from the SV in PID Control. If the deviation exceeds this range, a PD operation is performed.
- Here, set the upper deviation (A.R.W. H) and the lower deviation (A.R.W. L) from the SV for each PID. Set these values with % in relation to the input scaling (including linear scale).
- These values are applied only when controlling with PID type POSITION.

(9) Dead band

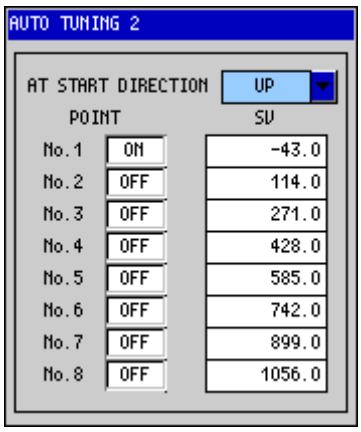
- For 2 position operations (P = 0.0%, I and D = option), it functions as output dead band.
- If P is not set to 0.0%, It functions as "PID dead band". The PID control operation in no feeling belt is stopped, and the amount of the control can be stabilized.

* When PID is controlled with P≠0.0%, a set value of the dead band is assumed to be usual 0.0%. The control might worsen, the offset be caused, and set it, please after understanding the function enough if you set other values.
Please refer to "15. the explanation of the term" for details of the function.

(10) Output preset

Set the output preset value.
The output range falls within the output limiter range.
After setting these values, the output settings No. used in each pattern/step must be set in Mode 2.

AT2



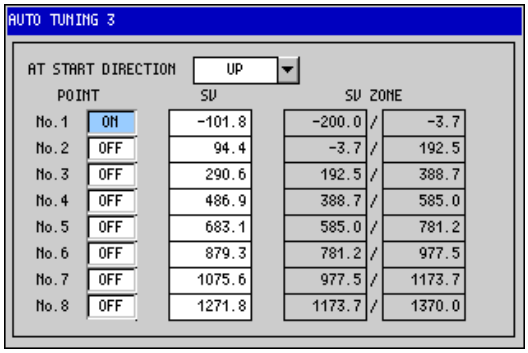
(1) Set the auto tuning AT 2 for Output 1.
(2) Set the direction for running auto tuning AT 2.
- UP: Run the auto tuning from SV1 down to SV8
- DOWN: Run the auto tuning from SV8 up to SV1

(3) Set 8 types of SV for the auto tuning AT 2.
(4) You can enable/disable the auto tuning.
- ON: AT is performed
- OFF: AT is not performed

(5) The setting range falls within the measuring range (including linear scale).
The values must be set in ascending sequence using the expression "SV of No.n < SV of No.n + 1".
(6) The PIDs calculated in SV No.1~8 for AT 2 are registered with PID No.1~8.
(7) If the measuring range, unit, or linear scale is changed, the setting range or the decimal point position may be changed or initialized accordingly.

* SV values must be set in ascending sequence. If they are not set in ascending sequence, the auto tuning is finished at that point.

AT3



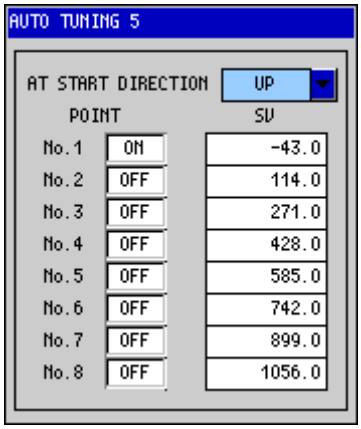
(1) Set the auto tuning AT 3 for Output 1.
(2) Set the direction for running auto tuning AT 3.
- "UP": Run the auto tuning from SV1 down to SV8
- "DOWN": Run the auto tuning from SV8 up to SV1

(3) Set 8 types of SV section for the auto tuning AT 3.
(4) You can enable/disable the auto tuning.
- ON: AT is performed
- OFF: AT is not performed

(5) The setting range falls within the corresponding SV zone range.
In the zone where the MIN value and the MAX value are equivalent in the SV zone, the auto tuning is not performed.
(6) The PIDs calculated in SV No.1~8 for AT 3 are registered with PID No.9 - 1 to 9 - 8.
(7) If the measuring range, unit, or linear scale is changed, the setting range or the decimal point position may be changed or initialized accordingly.

* The values of the SV zone are equivalent to the ones of SV zone for PID.
* SV values must be set after setting SV zones.

AT 5 (2-outputs specification)



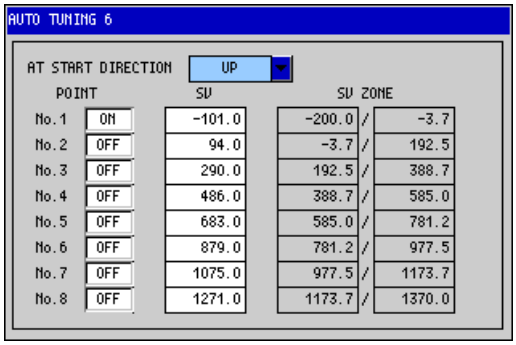
(1) Set the auto tuning AT 5 for Output 2.
(2) Set the direction for running auto tuning AT 5.
- "UP": Run the auto tuning from SV1 down to SV8
- "DOWN": Run the auto tuning from SV8 up to SV1

(3) Set 8 types of SV for the auto tuning AT 5.
(4) You can enable/disable the auto tuning.
- ON: AT is performed
- OFF: AT is not performed

(5) The setting range falls within the measuring range (including linear scale).
The values must be set in ascending sequence using the expression "SV of No.n < SV of No.n + 1".
(6) The PIDs calculated in SV No.1~8 for AT 5 are registered with PID No.1~8.
(7) If the measuring range, unit, or linear scale is changed, the setting range or the decimal point position may be changed or initialized accordingly.

* SV values must be set in ascending sequence. If they are not set in ascending sequence, the auto tuning is finished at that point.

AT 6 (2-outputs specification)



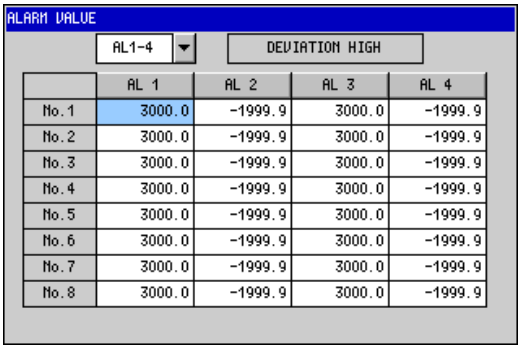
(1) Set the auto tuning AT 6 for Output 2.
(2) Set the direction for running auto tuning AT 6.
- "UP": Run the auto tuning from SV1 down to SV8
- "DOWN": Run the auto tuning from SV8 up to SV1

(3) Set 8 types of SV section for the auto tuning AT 6.
(4) You can enable/disable the auto tuning.
- ON: AT is performed
- OFF: AT is not performed

(5) The setting range falls within the corresponding SV zone range.
In the zone where the MIN value and the MAX value are equivalent in the SV zone, the auto tuning is not performed.
(6) The PIDs calculated in SV No.1~8 for AT 6 are registered with PID No.9 - 1 to 9 - 8.
(7) If the measuring range, unit, or linear scale is changed, the setting range or the decimal point position may be changed or initialized accordingly.

* The values of the SV zone are equivalent to the ones of SV zone for PID.
* SV values must be set after setting SV zones.

ALARM VALUE



Configure the alarm related settings.

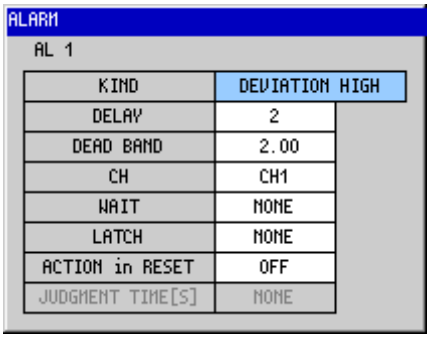
(1) The alarm setting is divided into basic (AL1~AL4) and enhanced (AL5~AL8). To set values, switch between them.

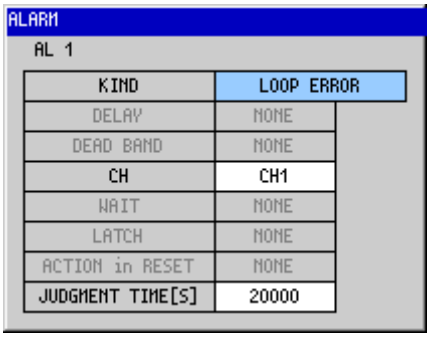
(2) Set alarm values.

Precautions: If the measuring range, unit, linear scale, or Alarm mode is changed, the setting range or the decimal point position may be changed accordingly.

After setting these values, the alarm No. used in each pattern/step must be set in Mode 2.

ALARM KIND





In the ALARM VALUE screen, position the cursor on the AL1~AL8 and press [ENT] key to show the ALARM screen as shown in the left figure.

If WAIT TIME, END SIGNAL or FAIL is set for ALARM KIND, the set values for DEAD BAND, CH, WAIT, LATCH or ACTION in RESET are disabled.

(1) ALARM KIND

・ABS HIGH ・ABS LOW ・DEVIATION HIGH
・DEVIATION LOW ・DEV BAND HIGH
・DEV BAND LOW ・VARIATION HIGH
・VARIATION LOW ・SV LOW ・SV HIGH
・OUTPUT HIGH ・OUTPUT LOW
・LOOP ERROR ・FAIL ・WAIT TIME
・END SIGNAL

(2) DELAY

- Set the number of times an alarm is detected sequentially until it is generated.
- The alarm is detected every 100 ms.
- An alarm is turned ON when the judgment time for the alarm is equal or more than the set value sequentially. If the judgment time for the alarm is less than the set value, an alarm is not turned on.

(3) DEAD BAND

- Set the alarm dead bands for AL1 - 4 (or 1 - 8).
- The unit varies depending on the set value for each alarm.

Precautions: If the measuring range, unit, linear scale, or Alarm mode is changed, the decimal point position may be changed accordingly.

(4) CH

For 2-outputs specification, select the CH for a loop error. It is fixed to CH1 for other settings.

(5) WAIT

Set if the wait function exists or not.

(6) LATCH

Set if the keep function exists or not.

(7) ACTION in RESET (an alarm operation when resetting the program)

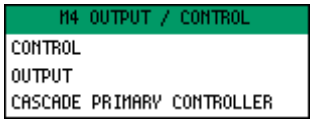
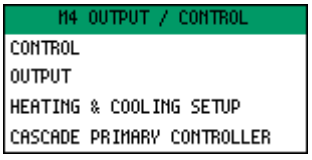
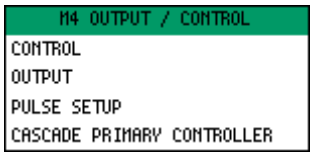
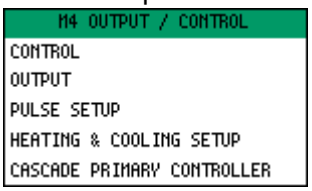
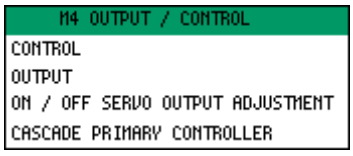
- OFF: The alarm judge is not performed
- ACTION: The alarm judge is performed

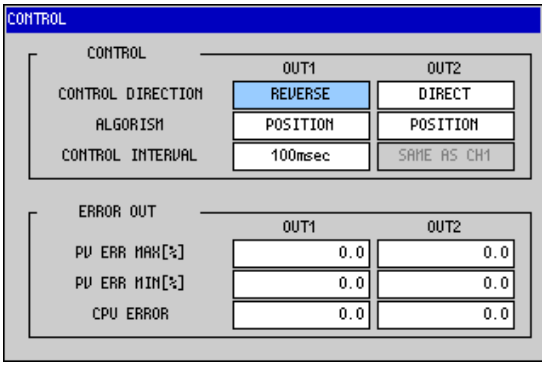
(8) Alarm judgment time

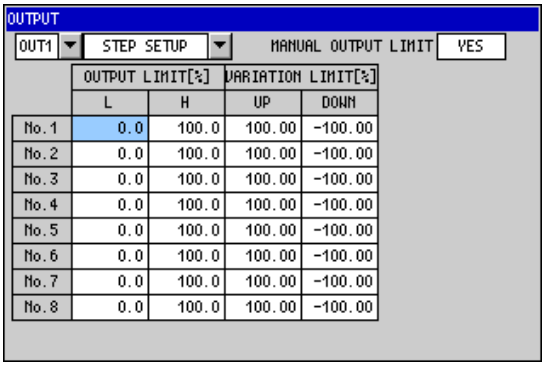
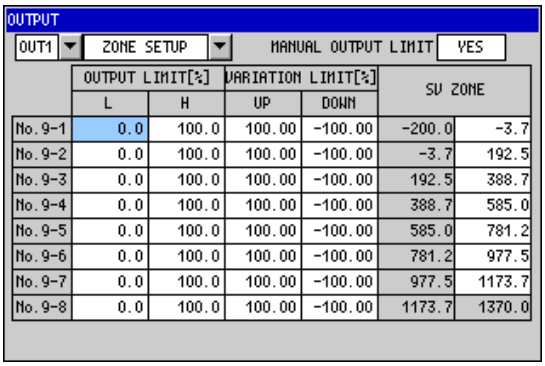
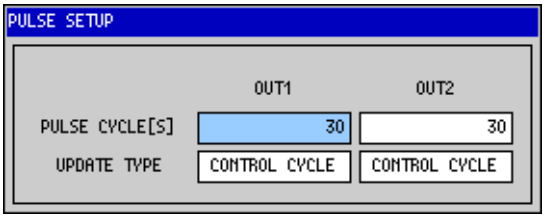
It is enabled when LOOP ERROR is selected.
Set the time in seconds until the loop error is determined.

8 - 6. Mode 4 (Output/Control setting)

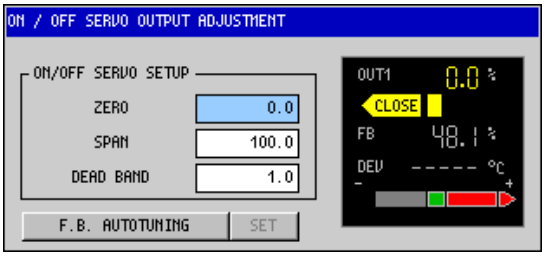
Mode 4 is used for configuring the control output related settings.

Menu screen	Description of screen
Analog Output 1CH  Analog Output 2CH  Pulse Output 1CH  Output 2CH • Pulse Output/ Analog Output • Pulse Output 2CH  On-Off Servo Output 	• This is the menu screen of mode 4. Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it.

Setting screen	Description of screen
CONTROL  * For 1-output specification, only the values for 1CH are displayed	(1) CONTROL DIRECTION • DIRECT: Cooling operation • REVERSE: Heating operation (2) Set the algorithm Select position type PID or velocity type PID. (3) CONTROL INTERVAL Select the update period for the control output. 100msec/200msec/300msec/500msec (4) PV ERR MAX[%]: Set the output when the input value is over the range (5) PV ERR MIN[%]: Set the output when the input value is under the range (6) CPU ERROR: Set the output if CPU error occurs

Setting screen	Description of screen
OUTPUT STEP SETUP  OUTPUT OUT1 STEP SETUP MANUAL OUTPUT LIMIT YES OUTPUT LIMIT[%] VARIATION LIMIT[%] L H UP DOWN No.1 0.0 100.0 100.00 -100.00 No.2 0.0 100.0 100.00 -100.00 No.3 0.0 100.0 100.00 -100.00 No.4 0.0 100.0 100.00 -100.00 No.5 0.0 100.0 100.00 -100.00 No.6 0.0 100.0 100.00 -100.00 No.7 0.0 100.0 100.00 -100.00 No.8 0.0 100.0 100.00 -100.00 ZONE SETUP  OUTPUT OUT1 ZONE SETUP MANUAL OUTPUT LIMIT YES OUTPUT LIMIT[%] VARIATION LIMIT[%] SV ZONE L H UP DOWN No.9-1 0.0 100.0 100.00 -100.00 -200.0 -3.7 No.9-2 0.0 100.0 100.00 -100.00 -3.7 192.5 No.9-3 0.0 100.0 100.00 -100.00 192.5 388.7 No.9-4 0.0 100.0 100.00 -100.00 388.7 585.0 No.9-5 0.0 100.0 100.00 -100.00 585.0 781.2 No.9-6 0.0 100.0 100.00 -100.00 781.2 977.5 No.9-7 0.0 100.0 100.00 -100.00 977.5 1173.7 No.9-8 0.0 100.0 100.00 -100.00 1173.7 1370.0 * CH can not be selected in the 1-output specification	(1) Select limit type to be set (step/zone, CH 1/2). (2) When selecting an Output 1 step, set 8 types of output limit and variation limit value for each step used in Output 1. (3) When selecting an OUT1 ZONE • Set 8 types of output limit/output scale value and variation limit value for each zone used in Output 1. • Set SV zones in which output setting value is used. No.1 is the setting for the first section from MIN value of the scale range. In No.2, the MAX value of No.1 is considered as its MIN value. No.8 can not be set because it is the MAX value of the scale range. The Max value of a SV zone is the same as MIN value of the next SV zone. However, if SV is that value, output limit value/variation limit value of the zone below is used. (4) When selecting an Output 2 step, set output limit/output scale value and variation limit value for each step used in Output 2. (5) When selecting an OUT2 ZONE • Set output limit/output scale value and variation limit value for each zone used in Output 2. • Set sections in which output setting value is used. No.1 is the setting for the first section from MIN value of the scale range. In No.2, the MAX value of No.1 is considered as its MIN value. No.8 can not be set because it is the MAX value of the scale range. The Max value of a SV zone is the same as MIN value of the next SV zone. However, if SV is that value, output limit value/variation limit value of the zone below is used. (6) After setting these values, the output settings No.used in each pattern/step must be set in Mode 2.
PULSE SETUP  PULSE SETUP OUT1 OUT2 PULSE CYCLE[S] 30 30 UPDATE TYPE CONTROL CYCLE CONTROL CYCLE * It is not displayed if the On-off pulse type output or the SSR drive pulse type output is not used.	(1) Set the pulse when the On-off pulse type output or the SSR drive pulse type output is used. (2) PULSE CYCLE Select the pulse cycle. (setting range: 1~180 seconds) (3) UPDATE TYPE Set the output update system. • PULSE CYCLE: Updates the output value in every pulse cycle which is set. The relay operation count is less than the one in CONTROL INTERVAL, so you can reduce the consumption of a contact. • CONTROL INTERVAL: Updates the output value in every control interval. It turns on and off according to changes in the output value between the pulse cycles, so you can control it more accurately. However, the relay operation count is more than the one in PULSE CYCLE. Please select CONTROL INTERVAL when you update it from past DP.

ON-OFF SERVO OUTPUT ADJUSTMENT



* It is not displayed if the On-off servo type output is not used.

(1) Feedback zero and the dead band are adjusted and set with this product and the actuator(motor etc.) combined at the on-off servo type output.

(2) Zero/span are basically adjusted by the automatic operation. "FB-auto tuning" button is selected and executed. After an auto tuning ends, zero/span is automatically registered.

(3) When zero/span are set by the manual operation, the value of zero/span is input directly within the range of 0-100%. Please push and register the "SET" button after inputting the numerical value.

(4) The FB dead band sector (gain) is set.
In general, a large value is set as much as possible within the range where the control is not negatively affected. Please push and register the "SET" button after inputting the numerical value.

* Please understand as a value of the standard because a set value of the dead band is not % accurate value. Moreover, please set the dead band value three times the value of DP as a standard for equal operation when updating it from a past DP series.
Example : FB dead band･･･DP:0.5(%)→DP-G:1.5(%)

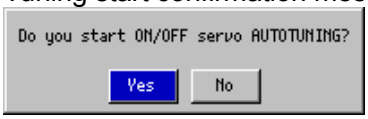
* The output status can be confirmed in the output display part.

* Please refer to "11-8 . On-off servo output adjustment" for details of the FB tuning.

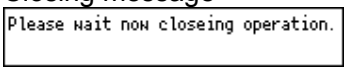
FEEDBACK AUTO TUNING

Feedback auto tuning screen

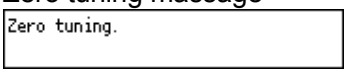
Tuning start confirmation message



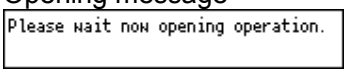
Closing message



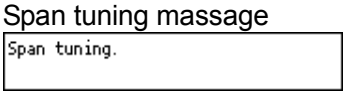
Zero tuning massage



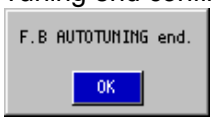
Opening message



Span tuning massage



Tuning end confirmation message



(1) The feedback auto tuning of the on-off servo type output is executed.

(2) It is a function to request a set value of FB zero/span of this product and the actuator (motor etc.) by the automatic operation.

(3) FB auto tuning progresses in order of the close operation, the zero adjustment, the opening operation, and the span adjustments after it begins. Meanwhile, the message is displayed to progress.

(4) When an auto tuning ends, the end confirmation message is displayed. When [ENT] key is pushed, the tuning result is registered as a set value.

(5) Please operate "End" button when you want to discontinue the FB tuning on the way. The tuning result is not registered when discontinuing it, and the value before it begins is maintained.

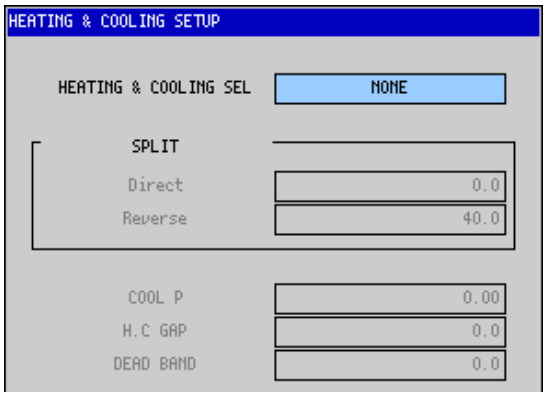
(6) Please push [ESC] key to return to the output adjustment screen.

* When the movement of the operation edge is too late, it is not possible to automatic in "FB tuning" calculation. In that case, the tuning is discontinued when the fixed time passes, and zero/span value is not registered.

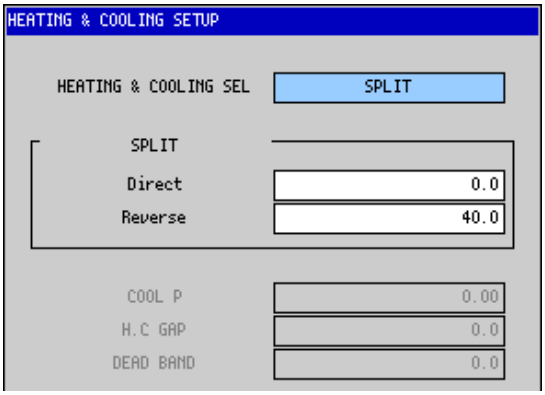
* It is judged the tuning failure when the result of FB auto tuning becomes zero >= span and doesn't register zero/span value.

HEATING & COOLING SETUP
(for 2-outputs specification only)

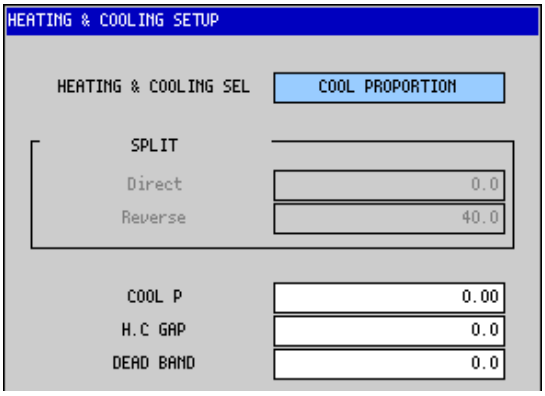
When heating & cooling is not set



When SPLIT is selected



When COOL PROPORTION is selected



(1) In 2-outputs specification, you can set simple heating/cooling control. Select one from the following three types.

- NONE: The heating & cooling operation is not performed.
- SPLIT: The split operation is performed for MV and output the result to Output 1 and Output 2.
- COOL PROPORTION: The cool proportion operation is performed for Output 2.

* When SPLIT or COOL PROPORTION is selected, the result of the selected operation is output to Output 2 preferentially. The operation is not performed with second PID settings.

* When SPLIT is selected, Output 1 is set to "Direct" and Output 2 is set to "Reverse" regardless of the control direction which is set for Output 2.

* When COOL PROPORTION is selected, the control direction set for Output 2 is ignored and it is always set to "Direct".

* If you want the advance control, set COOL PROPORTION to None and set the detail in second PID.

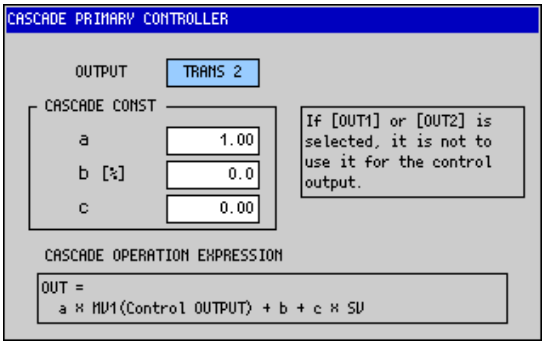
(2) Setting the split
When SPLIT is selected, the following settings are enabled.

- DIRECT: Set the output range for Output 1 in %.
- REVERSE: Set the output range for Output 2 in %.

(3) COOL PROPORTION
When COOL PROPORTION is selected, the following settings are enabled.

- COOL P CONST: Set the proportion band for cooling output (Output 2) with proportion to the proportion band for Output 1
- H.C.GAP: Set the relation between the operating locations of the first and the second PID. Set the gap between the SV and Output 2 (0%) in % in relation to the input span.
  * This value is the common setting to the output gap for the Output 2 PID.
- DEAD BAND: Set the dead band for Output 2.
  * This value is the common setting to the dead band No.1 for the Output 2 PID.

CASCADE PRIMARY CONTROLLER

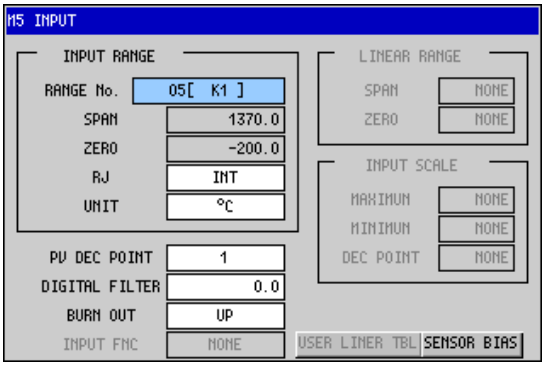
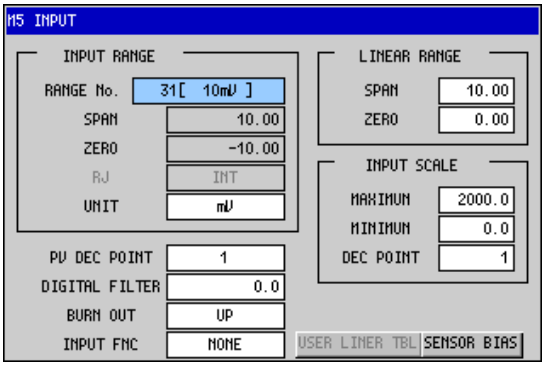
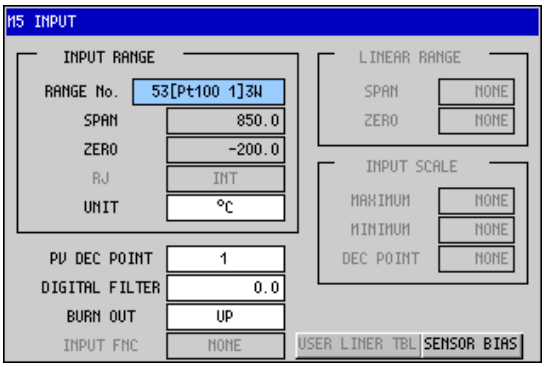
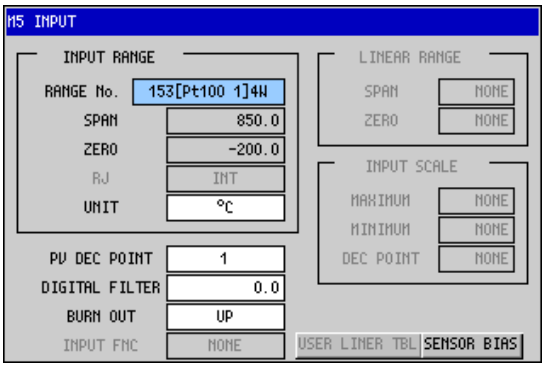


(1) Set the cascade primary controller.
(2) Select the destination from Off, OUTPUT 1, OUTPUT 2, TRANS 1, or TRANS 2. Note that the selection items vary depending on the output specification.
When OFF is selected, the cascade operation is not performed.
(3) Cascade constants can be set only when the destination is selected.
(4) Set the cascade constants a, b, and c.

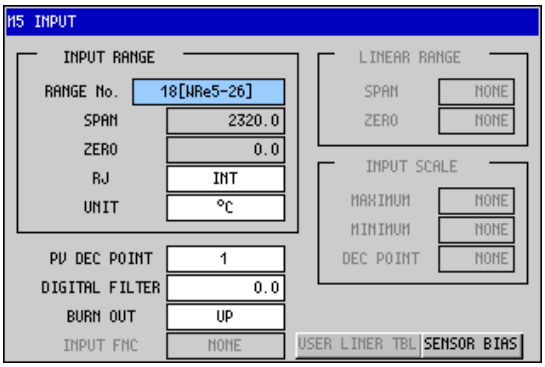
* When OUTPUT 1 or OUTPUT 2 is selected for OUTPUT, the cascade primary controller output takes precedence and the normal control output is not output.

8 - 7. Mode 5 (Input setting)

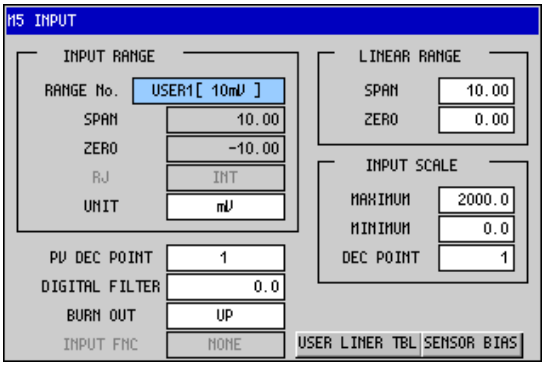
Mode 5 is used for configuring the input related settings.

Setting screen	Description of screen
INPUT When THERMOCOUPLE is selected  When LINEAR RANGE is selected  When PT (3-wire type) is selected  When PT (4-wire type) is selected  	1. INPUT RANGE (1) Select an input range number. The input range is classified as follows. Select a range to be used among them. • Thermocouple: It is a general thermocouple range. • Linear range: It is a range for DC voltage/current (mV, V, mA). • 3-WIRE RTD: It is a range for 3-WIRE RTD. • 4-WIRE RTD: It is a range for 4-WIRE RTD. • Thermocouple (DP MODE range): It is a range for updating DP for a W system or PtRh system thermocouple. • User linear range 1: It is a range in which any linearize table can be created using a range for DC voltage/current (mV, V, mA). If a range number is selected, the measurement input range is displayed in ZERO and SPAN. * For a thermocouple or resistance thermometer, the measuring range indicates as follows: • P in PID operation corresponds to 100 %. • It is the maximum setting range for SV range and so on. * For a linear input, it is defined with LINEAR RANGE and INPUT SCALE. * It becomes over range if it is about 5 percent more than the upper limit value in the scale range, and it becomes under range if it is about 5 percent less than the lower limit value, which may be different depending on the measuring range. * If the measuring range is changed, the setting range or the decimal point position may be changed or initialized accordingly. (2) Reference junction (RJ) This item is enabled only when a thermocouple input range is selected. If the temperature is measured in a thermocouple, select whether the reference junction temperature is compensated by using the built-in function of the unit (INT) or setting the external compensation unit (EXT). reference junction does not need to be set if a thermocouple range is not used. (3) Setting a unit Select a unit. * If the unit is changed, the setting range or the decimal point position may be changed or initialized accordingly.

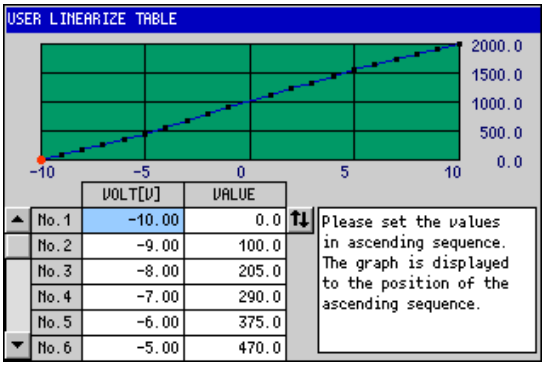
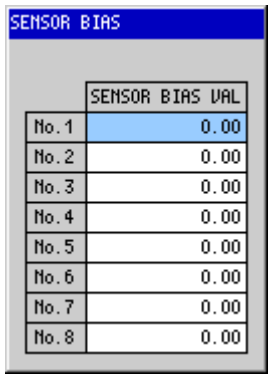
When the thermocouple DP MODE range is selected



When user linear range is selected



2. LINEAR RANGE
   (1) This item is enabled only when a linear input (DC voltage/current) is selected.
   (2) Set the range which is actually used within the measuring range for the selected range No.
   - The set value for a linear range is the basic range which is used as a basic value in a linear scale (scaling).
   - P in PID operation corresponds to 100 %.
3. INPUT SCALE
   (1) This item is enabled only when a linear input (DC voltage/current) is selected.
   (2) Set the scale (scaling) and the decimal point position for the basic range which is set within the measuring range.
   * If the linear scale is changed, the setting range or the decimal point position may be changed or initialized accordingly.
   * Also, note that SV for the program pattern may be changed accordingly if the decimal point of the linear scale is changed.
4. PV DEC POINT
   (1) Set the decimal point position of PV.
   (2) The decimal is displayed in up to 6 digits including the integer part based on the decimal point position which is set. Therefore, if there are a few digits included in the integer part, more digits after the decimal point are displayed within the range of the decimal point location which is set.
   * If the measuring range, unit, measuring range, or linear scale is changed, the decimal point position may be changed accordingly.
5. DIGITAL FILTER
   (1) The first order lag operation is performed for PV. This is an useful function if the PVs being measured are inconsistent.
6. BURN OUT
   (1) Select UP, DOWN, or NONE in case of an input snapping.
   (2) This item can not be selected if the input voltage of the linear range is equal or more than 100 mV.
   - UP: The value is operated as over range if the snapping is detected.
   - DOWN: The value is operated as under range if the snapping is detected.
   - None: The action varies depending on the circumstances of the snapping.
7. INPUT FNC
   (1) The square roots calculation or log operation is performed for PV.

LINEARIZE TABLE  	8. USER LINEARIZE TABLE These values can be set when the user linear range is selected. (1) Any characteristic scale (Linearize table) can be created. (2) Set the measured values (input voltage or current)/values including up to 19 turning points. (3) The measured values (voltage in the figure on the left) must be set in ascending sequence. If there is a value which is not set in ascending sequence, the values before it are considered as a table and the ones after it are ignored.
SENSOR BIAS  	(1) Set 8 types of the sensor bias values. (2) After setting these values, the sensor bias number each pattern/step must be set in Mode 2. (3) If the measuring range, unit, measuring range, or linear scale is changed, the decimal point position may be changed accordingly.

8 - 8. Mode 6 (Time signal/Guarantee soak/MASS FLOW SV)

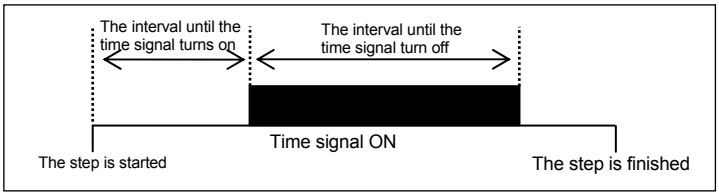
Mode 6 is used for configuring time events.

Menu screen	Description of screen
M6 TIME SIGNAL/GS/MF TIME SIGNAL GS / WAIT TIMER MASS FLOW SV	• This is the menu screen of mode 6. Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it.

Setting screen	Description of screen
TIME SIGNAL	1. Setting the time signal (1) 30 types of time signals can be set. (2) STP→ON TIME: The interval until the time signal turns on after the step is started ON→OFF TIME: The interval until the time signal turns off after it turns on
GS/WAIT TIMER	2. Guarantee soak setting (1) Set 8 types of guarantee soak. (2) After setting these values, the guarantee soak number used in each pattern/step must be set in Mode 2. (3) If the measuring range, unit, measuring range, or linear scale is changed, the decimal point position may be changed accordingly. 3. Setting WAIT TIME ALARM (1) Set 8 types of waiting time alarm. (2) The unit is the one which is set in 時間単位 in Mode 2. (3) After setting these values, the waiting time alarm number used in each pattern/step must be set in Mode 2.
MASS FLOW SV	4. Set the MASS FLOW SV (1) Set 8 types of MASS FLOW SV. (2) After setting these values, the MASS FLOW SV used in each pattern/step must be set in Mode 2.

TIME SIGNAL [H:M]

	STP→ON TIME	ON→OFF TIME		STP→ON TIME	ON→OFF TIME
No.1	000:00	001:00	No.16	000:00	001:00
No.2	000:00	001:00	No.17	000:00	001:00
No.3	000:00	001:00	No.18	000:00	001:00
No.4	000:00	001:00	No.19	000:00	001:00
No.5	000:00	001:00	No.20	000:00	001:00
No.6	000:00	001:00	No.21	000:00	001:00
No.7	000:00	001:00	No.22	000:00	001:00
No.8	000:00	001:00	No.23	000:00	001:00
No.9	000:00	001:00	No.24	000:00	001:00
No.10	000:00	001:00	No.25	000:00	001:00
No.11	000:00	001:00	No.26	000:00	001:00



(3) The unit is set in TIME DISPLAY TYPE in Mode 1.
(4) After setting these values, the time signal number used in each pattern/step must be set in Mode 2.

GS / WAIT TIMER

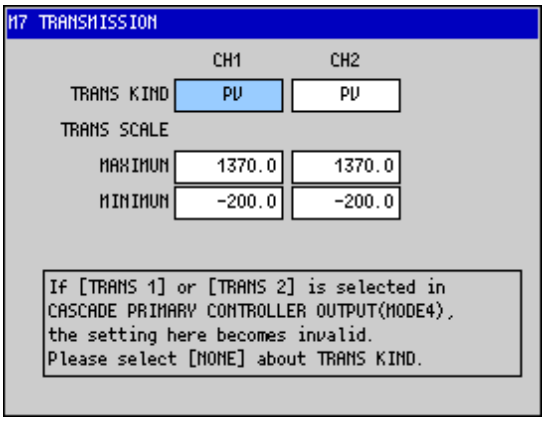
	GUARANTEE SOAK	WAIT TIMER [H:M]
No.1	2000.0	001:00
No.2	2000.0	001:00
No.3	2000.0	001:00
No.4	2000.0	001:00
No.5	2000.0	001:00
No.6	2000.0	001:00
No.7	2000.0	001:00
No.8	2000.0	001:00

MASS FLOW SV

	MASS FLOW SV[%]
No.1	0.0
No.2	10.0
No.3	20.0
No.4	30.0
No.5	40.0
No.6	50.0
No.7	60.0
No.8	70.0

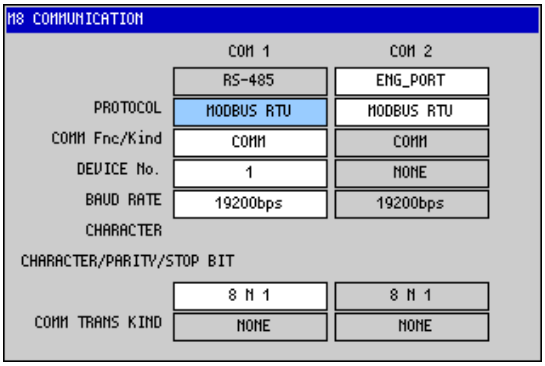
8 - 9. Mode 7 (Transmission setting)

Mode 7 is used for configuring the transmission signal output.

Setting screen	Description of screen
TRANSMISSION  * When there is optional transmission * Figure is transmission 2CH specification. The CH2 side is not displayed in 1CH specification.	(1) Setting the transmission kind • NONE: Unused • PV: Measured value (PV) • SV: Set Value (SV) • DEV: Deviation value (DEV) • MV1: Output value (MV1) • MV2: Output value (MV2) (2-outputs specification only) • MFB: Feedback value (On-off servo output only) • MFSV: MASS FLOW SV Transmits the data of the selected items in analog. (2) Setting the transmission scale • MAXIMUM: Set the upper limit value of the scale (100%) in relation to the maximum value of the transmission signal output (100%). • MINIMUM: Set the lower limit value of the scale (0%) in relation to the minimum value of the transmission signal output (0%).

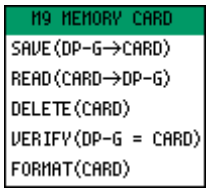
8 - 10. Mode 8 (Communications setting)

Mode 8 is used for the communications related settings.

Setting screen	Description of screen
COMMUNICATION  * Only when the communications option are set	(1) Communications type: COM1 is fixed according to the communications specification COM2 is used switching between ENG port and PORT 2. (2) Selecting the protocol • MODBUS RTU • MODBUS ASCII • PRIVATE Traditional CHINO protocol • PRIVATE（TS17） Traditional CHINO protocol of a special specification that can be handle the time signal up to 17 points. * When ENG port is selected for COM2, PRIVATE can not be set (3) Selecting the communications function/kind • COMM: Upper communications • TRANS: Communications transmission * When ENG port is selected for COM2, TRANS can not be set (4) INSTRUMENT No. • 0~99 (This value is disabled for RS-232C) When the communications function is set to upper communication, this number is set to the value that doesn't overlap with other equipment within the range of 1-99. When the communications function is set to TRANS, this number is set to 0. (5) BAUD RATE • Choose 2400, 4800, 9600, 19200, or 38400 bps (6) CHARACTOR/PARITY/STOP BIT • Choose 7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1, 8O2 (7) COMM TRANS KIND It is enabled if TRANS is selected for COMM Fnc in (3). • NONE: Unused • PV: Measured value (PV) • SV: Set Value (SV) • DEV: Deviation value (DEV) • MV1: Output value (MV1) • MV2: Output value (MV2) (2-outputs specification only) • MFB: Feedback value (On-off servo output only) • MFSV: MASS FLOW SV Transmits the data of the selected items in communications.

8 - 11. Mode 9 (Memory card management)

Mode 9 is used for configuring the memory card management.

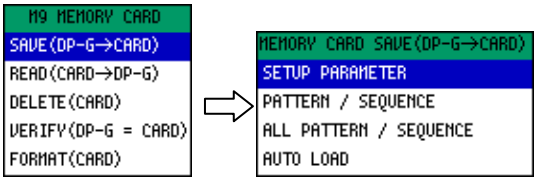
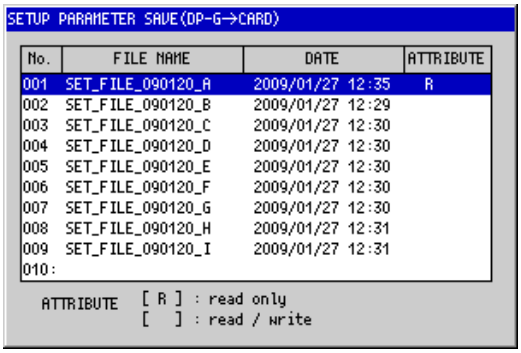
Menu screen	Description of screen
MEMORY CARD  	• This is the menu screen of mode 9. Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it. • SAVE(DP-G → CARD): The data in the controller is saved to a CF card. • READ(CARD→ DP-G): The data in a CF card is read into the controller. • DELETE(CARD): The data in a CF card is deleted. • VERIFY(DP-G = CARD): The data in the controller is verified with the one in a CF card. • FORMAT(CARD): CF card is formatted. (Quick Format)
The message displayed if a CF card is not inserted  	• If a CF card is not inserted, the message shown in the figure on the left is displayed.

* Be sure not to change folder names above in a CF card by operations from PC and so on. Otherwise, the data in the controller can not be operated.

* Be sure not to eject the CF card or turn off the power of the controller while saving, reading, deleting, or verifying data in the CF card, or formatting the CF card. Otherwise, the data in the card may be corrupted.

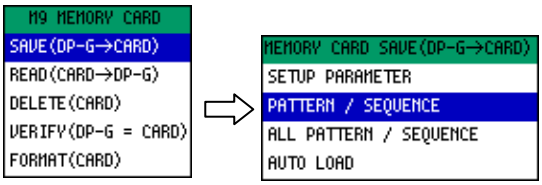
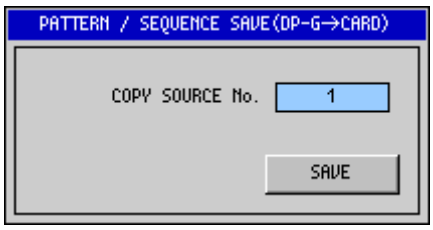
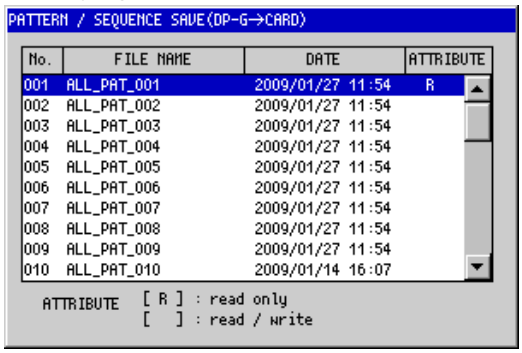
* Be sure to use the dedicated software tool when you use your PC to edit data stored in a CF card. If something such as the data format is corrupted, the data can not be read properly by the controller.

8 - 11 - 1. Saving setup parameters (DP-G → CF card)

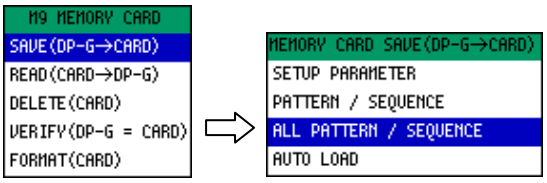
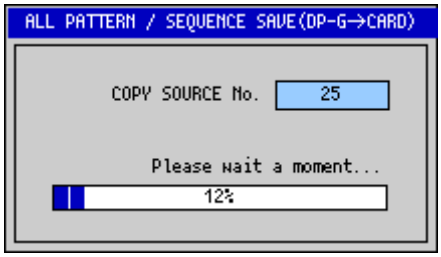
Setting screen	Description of screen
Saving setup parameter 	Select SAVE(DP-G → CARD) → SETUP PARAMETER The setup parameter file list is displayed.
Displaying file list 	(1) The parameters for controlling the controller are saved to a CF card with names. (2) The controlled parameters files currently saved in the CF card are displayed. If a file is selected in the list, it is saved. If a number which has no file is selected, a new file is created and saved. In this case, a keyboard is displayed. The file with "R" in the ATTRIBUTE field is a read-only file. This file can not be overwritten. Precautions: Tag setup details can not be saved to a CF card.
Keyboard displayed 	(1) When a new file is saved, enter the file name. (2) Capital and lower-case alphabetical characters, one-byte katakanas, and numeric characters can be used.

* Please note that the state of the operation and a part of parameter and the tag setting content cannot be preserved on the CF card.
Please refer to "6-3. Function of CF card" for details.

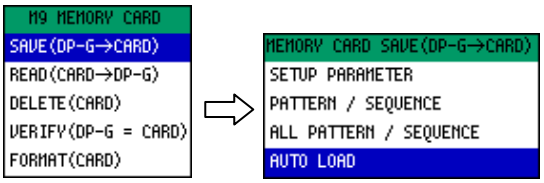
8 - 11 - 2. Saving pattern/sequence (individual) (DP-G → CF card)

Setting screen	Description of screen
Saving pattern/sequence (individual) 	Select SAVE (DP-G → CARD) → PATTERN / SEQUENCE The Saving pattern/sequence (individual) screen is displayed.
Selecting a pattern number to be saved 	(1) Enter the pattern number to be saved. (2) Select the [Save] button. (3) The file list containing current patterns/sequences is displayed.
Displaying file list 	(1) The set data of a pattern/sequence (individual) is saved to the CF card with a name. (2) All patterns/sequences files saved in the CF card are displayed. If a file is selected in the list, it is saved. If a number which has no file is selected, a new file is created and saved. In this case, a keyboard is displayed. The file with "R" in the ATTRIBUTE field is a read-only file. This file can not be overwritten.

8 - 11 - 3. Saving pattern/sequence (all) (DP-G → CF card)

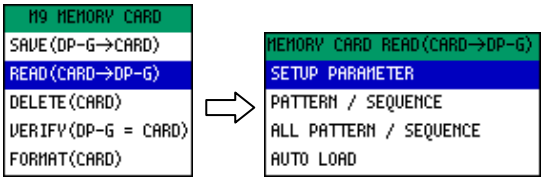
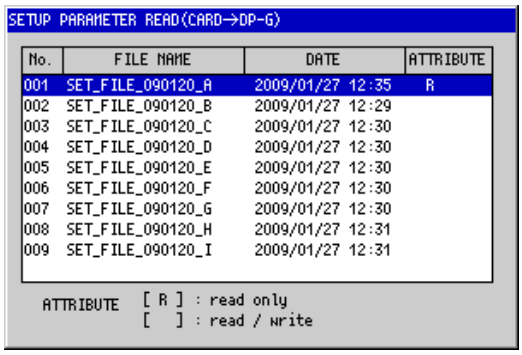
Setting screen	Description of screen
Saving pattern/sequence (all) 	Select SAVE(DP-G → CARD) → ALL PATTERN / SEQUENCE The ALL PATTERN / SEQUENCE SAVE(DP-G → CARD) message screen is displayed.
Confirmation message displayed 	(1) When Yes is selected, the pattern/sequence file starts to be saved. Precautions: The pattern/sequence (all) file is saved as "ALL_PAT_nnn.***" in the PAT folder. "nnn" in the file name indicates the pattern number and "***" indicates the extension. The file name can not be changed here. If another file with the same name already exists, it is overwritten.
The box displayed while saving data 	(1) All pattern/sequence data which is currently set is saved. (2) To abort the operation, use the ESC key. Other key operations can not be performed while saving data.

8 - 11 - 4. Saving AUTO LOAD (DP-G → CF card)

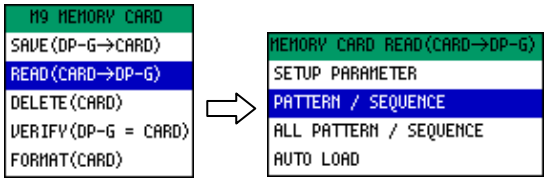
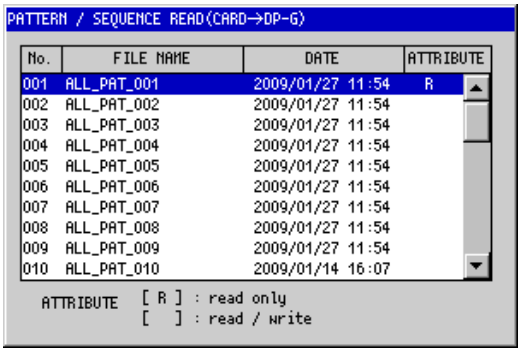
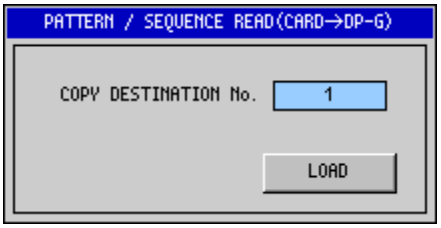
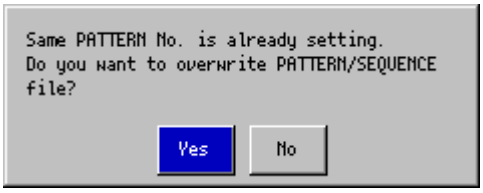
Setting screen	Description of screen
AUTO LOAD 	Select SAVE(DP-G → CARD) → AUTO LOAD The confirmation message screen to ask you if you save AUTO LOAD is displayed.
Confirmation message displayed 	(1) If Yes is selected, the file for AUTO LOAD is saved. Precautions: The file for AUTO LOAD makes pairs with a program pattern/sequence and a setup parameter and saves them to the folder for AUTO LOAD. The program pattern is saved from the data No.1 in the controller. Set the program pattern to be saved for AUTO LOAD to No.1 before operation. Also, the file for AUTO LOAD is saved with a fixed file name such as "ALL_PAT_001.***" or "SETUP.***" in the ALLSET folder ("***" indicates the extension). If another file with the same name already exists, it is overwritten. Be sure not to change the file name on the PC.

* Please note that the state of the operation and a part of parameter and the tag setting content cannot be preserved on the CF card.
Please refer to "6-3. Function of CF card" for details.

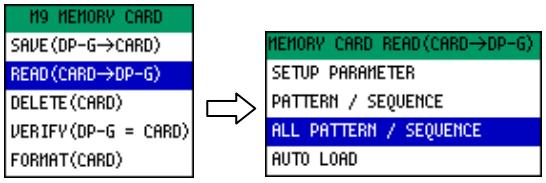
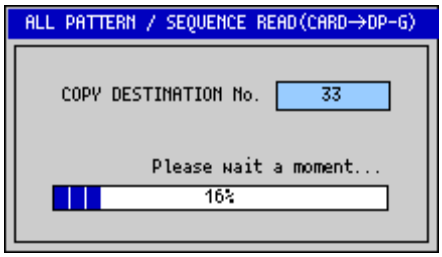
8 - 11 - 5. Reading setup parameters (CF card → DP-G)

Setting screen	Description of screen
Reading setup parameters 	Select READ(CARD → DP-G) → SETUP PARAMETER The list of setup parameter files which are saved in the CF card is displayed.
Displaying file list 	Setup parameters are read from the CF card. (1) All setup files in the CF card are listed. Select a file name and read it to the controller from the CF card. Precautions: When you read the parameters from the CF card, please read after the setting of MODE 10 “Time unit” is matched to the setting when data is preserved. The parameter that relates at time changes when not matching.

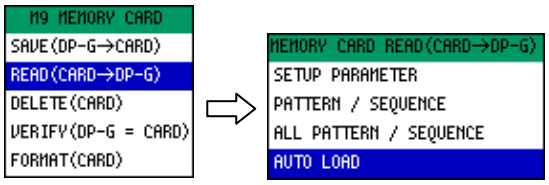
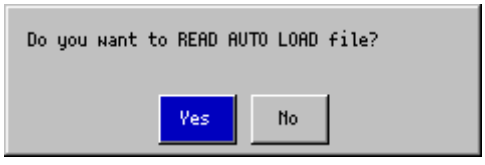
8 - 11 - 6. Reading pattern/sequence (individual) (CF card → DP-G)

Setting screen	Description of screen
Reading pattern/sequence (individual)  	Select READ(CARD → DP-G) → PATTERN / SEQUENCE The confirmation message screen to ask you if you read pattern/sequence (individual) in the CF card is displayed.
Displaying the file list    	The program patterns are read from the CF card. (1) All program patterns files saved in the CF card are displayed. (2) Select a file name. * You can not specify the number of the program pattern which is being executed. (3) Enter the destination pattern No. of the controller and press the [LOAD] button to start reading it. (4) If the other pattern data already exits in the pattern whose number is selected when reading, the confirmation message to ask you if you overwrite the pattern is displayed. If Yes is selected, that pattern data is saved. Precautions: When you read the program pattern from the CF card, please read after the setting of MODE 10 “Time unit” is matched to the setting when data is preserved. The parameter that relates at time changes when not matching.

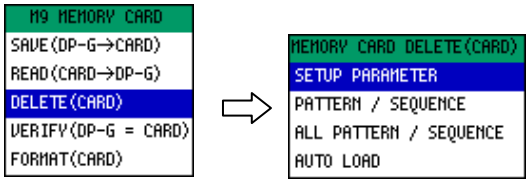
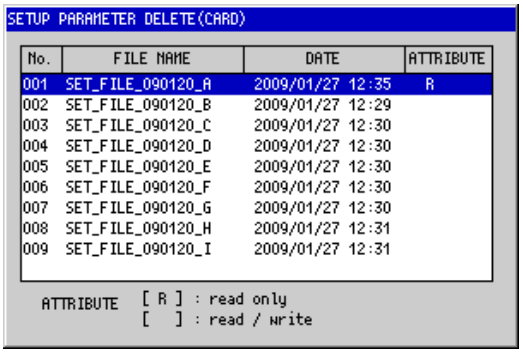
8 - 11 - 7. Reading pattern/sequence (all) (CF card → DP-G)

Setting screen	Description of screen
Pattern/sequence (all)  	Select READ(CARD → DP-G) → ALL PATTERN / SEQUENCE The confirmation message screen to ask you if you read pattern/sequence (all) is displayed. * The operation can be performed in a RESET status only.
Displaying file list   	All program patterns are read from the CF card. (1) When Yes is selected, the pattern/sequence data starts to be read. Note that the pattern data which is already set is overwritten by a new one. (2) The key operations can not be performed while reading data. Precautions: When you read the program patterns from the CF card, please read after the setting of MODE 10 “Time unit” is matched to the setting when data is preserved. The parameter that relates at time changes when not matching.

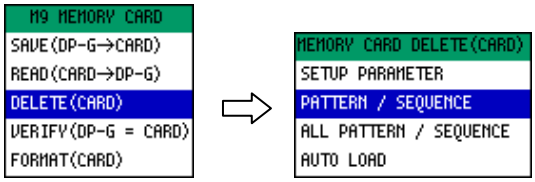
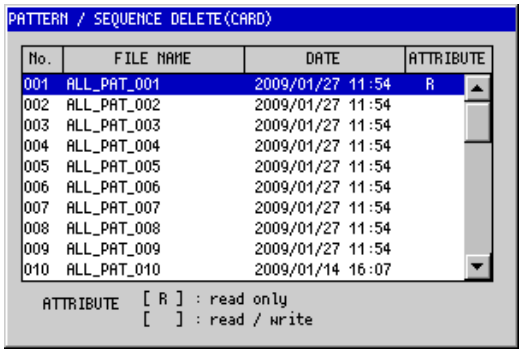
8 - 11 - 8. Reading AUTO LOAD (CF card → DP-G)

Setting screen	Description of screen
AUTO LOAD reading  	Select READ(CARD → DP-G) → SETUP PARAMETER The confirmation message screen to ask you if you read the file for AUTO LOAD is displayed. * The operation can be performed in a RESET status only.
AUTO LOAD  	(1) If Yes is selected, setup parameters and the program pattern/sequence for AUTO LOAD are read automatically. (2) The pattern/sequence is always read to the pattern No.1. Note that the pattern/sequence overwrites even if another pattern is set in the pattern No.1. (3) The program pattern No. selected for the operation is switched to No.1 automatically when reading the file, so RUN operation must be performed immediately after the reading operation. Precautions: When you read the program pattern and the parameters from the CF card, please read after the setting of MODE 10 “Time unit” is matched to the setting when data is preserved. The parameter that relates at time changes when not matching.

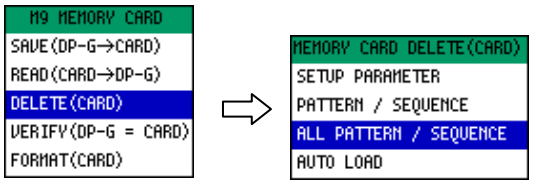
8 - 11 - 9. Deleting setup parameters (CF card)

Setting screen	Description of screen
Deleting setup parameters 	Select DELETE(CARD) → SETUP PARAMETER The list of setup parameter files which are saved in the CF card is displayed.
Deleting setup parameters 	(1) Select a file and delete it. Note that the deleted file can not be restored.

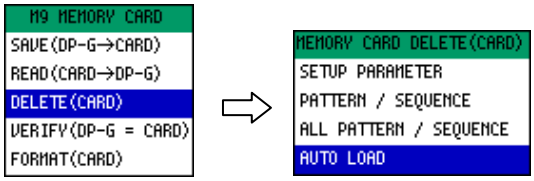
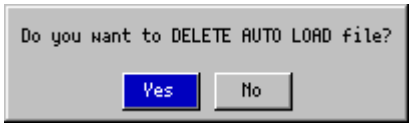
8 - 11 - 10. Deleting pattern/sequence (individual) (CF card)

Setting screen	Description of screen
Deleting pattern/sequence (individual) 	Select DELETE(CARD) → PATTERN / SEQUENCE The list of pattern/sequence files which are saved in the CF card is displayed.
Displaying file list 	(1) Select a file and delete it. Note that the deleted file can not be restored.

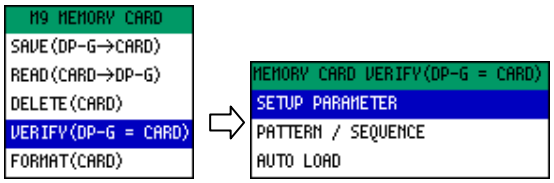
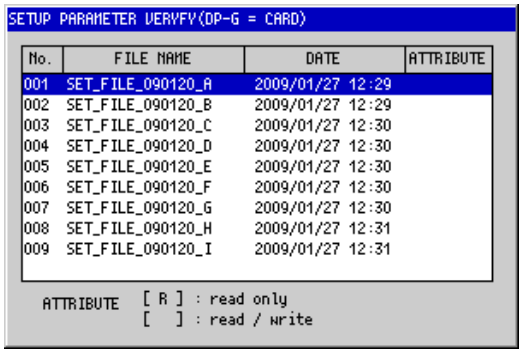
8 - 11 - 11. Deleting pattern/sequence (all) (CF card)

Setting screen	Description of screen
Deleting all patterns/sequences 	Select DELETE(CARD) → ALL PATTERN / SEQUENCE The confirmation message screen to ask you if you delete all pattern/sequence files is displayed.
Confirmation message displayed 	(1) If Yes is selected, all program patterns in the CF card are deleted. Note that the deleted file can not be restored.

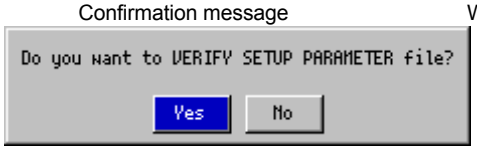
8 - 11 - 12. Deleting AUTO LOAD (CF card)

Setting screen	Description of screen
AUTO LOAD deleting 	Select DELETE(CARD) → AUTO LOAD The confirmation message screen to ask you if you delete the file for AUTO LOAD is displayed.
AUTO LOAD deleting 	(1) If Yes is selected, the files for AUTO LOAD in the CF card are deleted. Note that the deleted file can not be restored.

8 - 11 - 13. Verifying setup parameters (DP-G <=> CF card)

Setting screen	Description of screen
Verifying Setup parameter 	Select VERIFY(DP-G = CARD) → SETUP PARAMETER The list of setup parameter files which are saved in the CF card is displayed.
Displaying file list 	(1) The setup parameters are verified between the controller and the selected file in the CF card. (2) Select a file. (3) If Yes is selected in the confirmation message, the verification operation is performed. (4) The result is presented by the message shown in the figure below. Precautions: Please confirm it is the same as the data preservation of the setting of mode 10 “time unit” when you verify the parameters. The verification result becomes " not consistent " when set the time unit rugged differing.

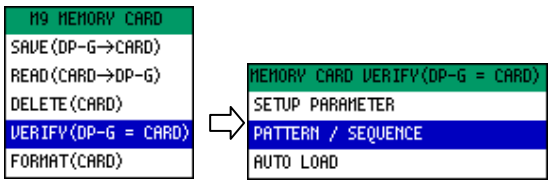
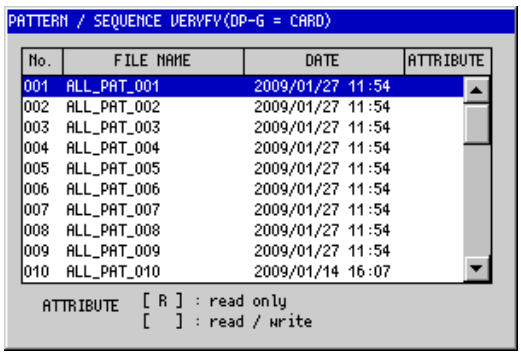
Confirmation message



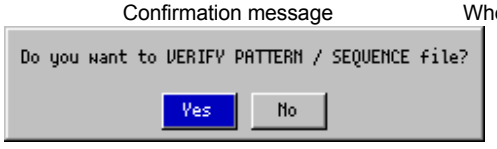
When the verification result is consistent

When the verification result is not consistent

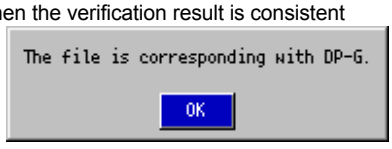
8 - 11 - 14. Verifying pattern/sequence (individual)(DP-G <=> CF card)

Setting screen	Description of screen
Verifying pattern/sequence (individual) 	Select VERIFY(DP-G = CARD) → PATTERN / SEQUENCE The list of pattern/sequence files which are saved in the CF card is displayed.
Displaying file list 	(1) The patterns/sequences are compared between the controller and the selected file in the CF card. (2) Select a file. (3) If Yes is selected in the confirmation message, the verification operation is performed. (4) The result is presented by the message shown in the figure below. Precautions: Please confirm it is the same as the data preservation of the setting of mode 10 “time unit” when you verify the program pattern. The verification result becomes " not consistent " when set the time unit rugged differing.

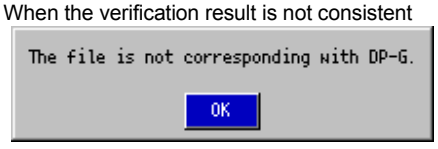
Confirmation message



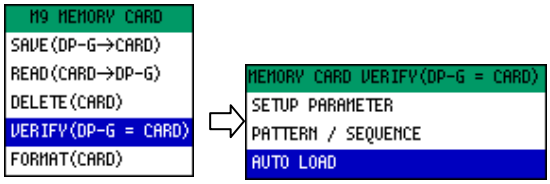
When the verification result is consistent



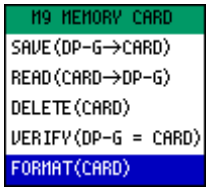
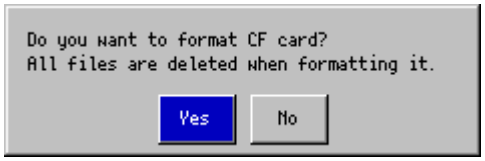
When the verification result is not consistent



8 - 11 - 15. Verifying AUTO LOAD (DP-G <=> CF card)

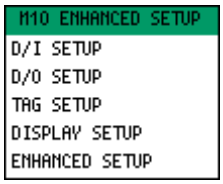
Setting screen	Description of screen
AUTO LOAD verification 	Select VERIFY(DP-G = CARD) → AUTO LOAD The confirmation message screen to ask you if you verify AUTO LOAD is displayed.
Confirmation message  When the result is consistent  When the result is not consistent 	(1) The files for AUTO LOAD are compared between the controller and the file in the CF card. (2) If Yes is selected in the confirmation message, the verification operation is performed. (3) The result is presented by the message shown in the figure on the left. Precautions: Please confirm it is the same as the data preservation of the setting of mode 10 “time unit” when you verify the program pattern and the parameters. The verification result becomes " not consistent " when set the time unit rugged differing.

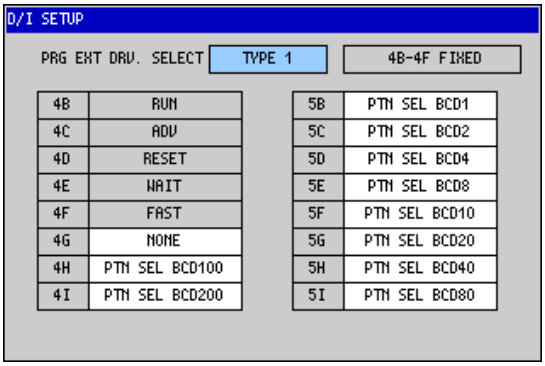
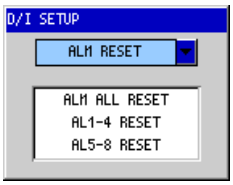
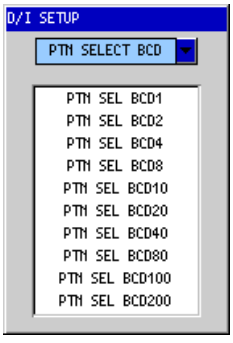
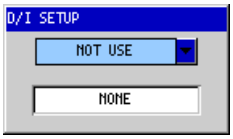
8 - 11 - 16. Format (CF card)

Setting screen	Description of screen
Format 	Select FORMAT(CARD) The confirmation message screen to ask you if you perform the format operation is displayed.
Execution confirmation message displayed 	(1) The CF card is formatted (Quick Format). (2) If Yes is selected in the execution confirmation message screen, the format operation is performed. Precautions: You can not perform a physical format or format the unformatted card using DP-G. Use your PC to format the card in FAT16 or FAT32 before using it.

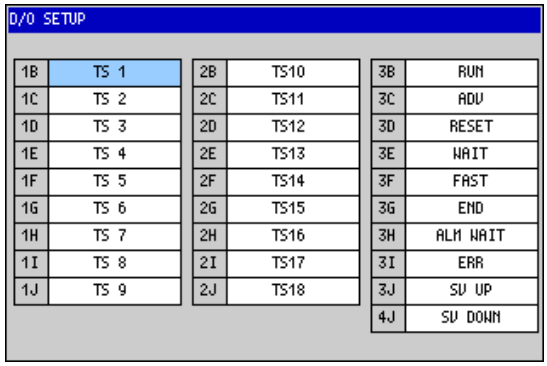
8 - 12. Mode 10 (Enhanced setup)

Mode 10 is used for configuring the enhanced setup.

Menu screen	Description of screen
	• This is the menu screen of mode 10 Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it.

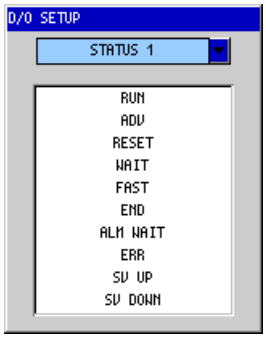
Setting screen	Description of screen
D/I SETUP     	The functions of 16 points of DI terminal are set. (The function can be set for each terminal. See "11 - 17. External signal input" for more details.) Select one from function items and set the functions. 1. PRG EXT DRV. SELECT (1) TYPE 1 (DP series compatible type) • RUN • ADV • RESET • WAIT • FAST (2) TYPE2 (DP-I compatible type) • RUN • STOP • RESET • ADV 2. PV, SV, and MAN operation (1) Crcl Pls (2) PV HOLD (3) SV HOLD (4) MANUAL1 (5) MANUAL2 3. Alarm reset (1) ALM ALL RESET (2) AL1-4 RESET (3) AL5-8 RESET 4. PTN SELECT BCD (1) PTN SEL BCD1 (2) PTN SEL BCD2 (3) PTN SEL BCD4 (4) PTN SEL BCD8 (5) PTN SEL BCD10 (6) PTN SEL BCD20 (7) PTN SEL BCD40 (8) PTN SEL BCD80 (9) PTN SEL BCD100 (10) PTN SEL BCD200 5. NOT USE NONE: NOT USE

D/O SETUP

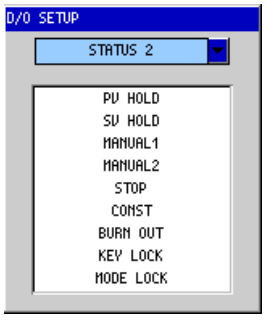


The functions of 28 points of DO terminal are set.
(The function can be set for each terminal.)

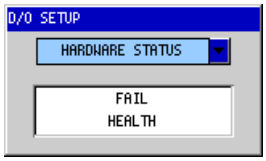
Select one from function items and set the functions.
If TS (time signal) is selected when a tag is set, that tag is displayed following the TS number.



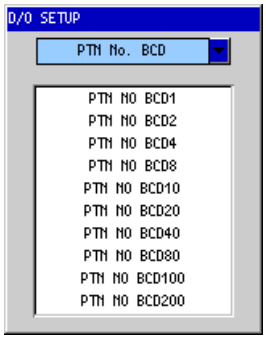
1. STATUS 1
   (1) RUN
   (2) ADV
   (3) RESET
   (4) WAIT
   (5) FAST
   (6) END
   (7) ALM WAIT
   (8) ERR
   (9) SV UP
   (10) SV DOWN



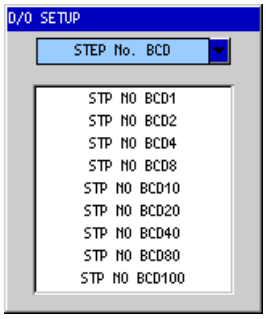
2. STATUS 2
   (1) PV HOLD
   (2) SV HOLD
   (3) MANUAL 1
   (4) MANUAL 2
   (5) STOP
   (6) CONST
   (7) BURN OUT
   (8) KEY LOCK (OPERATION KEY LOCK)
   (9) MODE LOCK(M0-M10 ALL MODE LOCK)

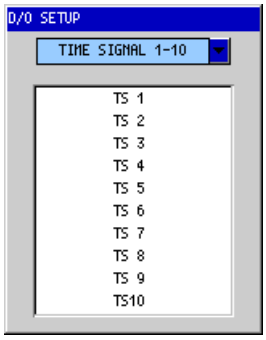


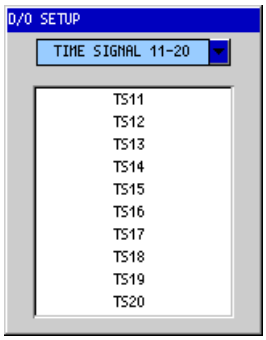
3. HARDWARE STATUS
   (1) FAIL
   (2) HEALTH

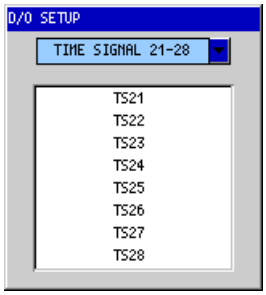


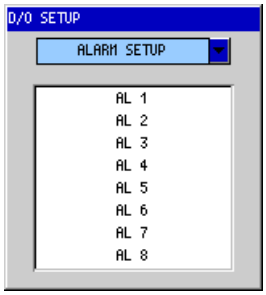
4. PTN No. BCD
   (1) PTN NO BCD1
   (2) PTN NO BCD2
   (3) PTN NO BCD4
   (4) PTN NO BCD8
   (5) PTN NO BCD10
   (6) PTN NO BCD20
   (7) PTN NO BCD40
   (8) PTN NO BCD80
   (9) PTN NO BCD100
   (10) PTN NO BCD200

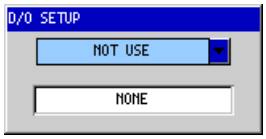












5. STEP No. BCD
   (1) STP NO BCD1
   (2) STP NO BCD2
   (3) STP NO BCD4
   (4) STP NO BCD8
   (5) STP NO BCD10
   (6) STP NO BCD20
   (7) STP NO BCD40
   (8) STP NO BCD80
   (9) STP NO BCD100

6. TIME SIGNAL 1 - 10
   (1) TS 1 (2) TS 2
   (3) TS 3 (4) TS 4
   (5) TS 5 (6) TS 6
   (7) TS 7 (8) TS 8
   (9) TS 9 (10) TS 10

7. TIME SIGNAL 11 - 20
   (1) TS 11 (2) TS 12
   (3) TS 13 (4) TS 14
   (5) TS 15 (6) TS 16
   (7) TS 17 (8) TS 18
   (9) TS 19 (10) TS 20

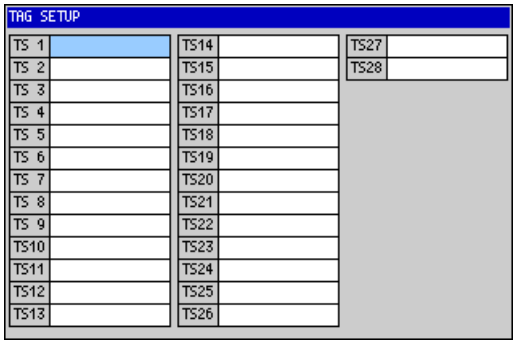
8. TIME SIGNAL 21 - 28
   (1) TS 21 (2) TS 22
   (3) TS 23 (4) TS 24
   (5) TS 25 (6) TS 26
   (7) TS 27 (8) TS 28

* If a tag is set to the time signal, that tag is displayed following the TS number.

9. ALARM SETUP
   (1) AL 1 (2) AL 2
   (3) AL 3 (4) AL 4
   (5) AL 5 (6) AL 6
   (7) AL 7 (8) AL 8

10. NOT USE
    NONE: NOT USE

TAG SETUP

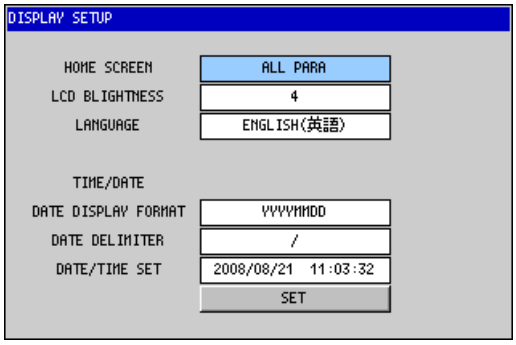


Tags can be set to time signals.
The tags set in this screen are displayed in the operation screen "D/O DISP" and the "DO setup" screen in "ENHANCED SETUP" in mode 10.

- Tags can be set to TS1~28.
- The tags can be set with up to 10 half size alphanumeric characters and one-byte katakanas.

Precautions: Tag setup details can not be saved to a CF card.

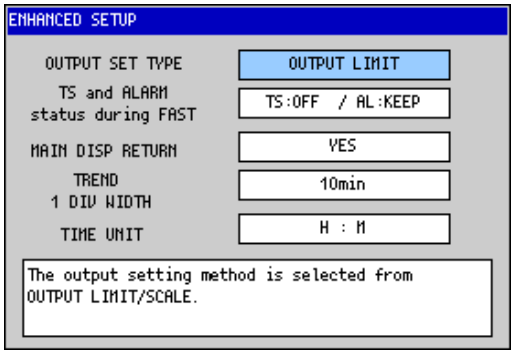
DISPLAY SETUP



(1) DISPLAY SETUP:
- HOME SCREEN: ALL PARA, BAR GRAPH, DIGITAL, TREND, D/O DISP or D/I DISP can be selected for HOME SCREEN.
- LCD BRIGHTNESS: LCD brightness can be set from 1 - 4. Value 1 indicates the minimum brightness and 4 indicates the maximum.
- LANGUAGE: The display language can be switched. JAPANESE / ENGLISH

(2) Setting the date and time: Set the current date and time.
- DATE/TIME FORMAT: the format for year-month-day
- DATE DELIMITER: A date delimiter can be selected from "/", "-", or "."
- DATE TIME SET: The current date and time can be changed. This date and time are not applied until SET is pressed.

ENHANCED SETUP



(1) ENHANCED SETUP
- OUTPUT SET TYPE: OUTPUT LIMIT or OUTPUT SCALE can be selected to restrict the control operation output.
- The action of the time signal/alarm during program FAST can be set. IF OFF is set, it is not output during FAST. If KEEP is set, FAST is performed with keeping the status just before this operation.
- MAIN DISP RETURN: MAIN DISP RETURN function can be enabled or disabled. When setting it to "YES", it automatically returns to the home screen when about three minutes pass though there is no key operation excluding the operation screen.
- TREND 1 DIV WIDTH: A scale displayed in the simple TREND screen can be set to 1, 2, 5, 10, 30, or 60 min.
- TIME UNIT: Time unit of program pattern can be selected from “H:M” or ”M:S”.

  H:M (Hour:Minute) ･･･000h00m - 999h99m

  M:S (Minute:Second)･･･000m00s - 999m99s

Precautions: Only the time units change without the numerical values changing into a set value of the time of the program patterns and the parameters that has already been set.

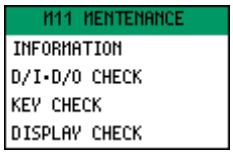
Example : 3h15m⇒3m15s

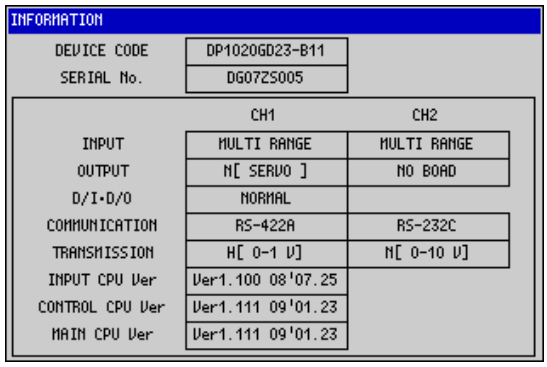
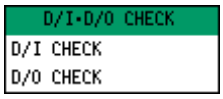
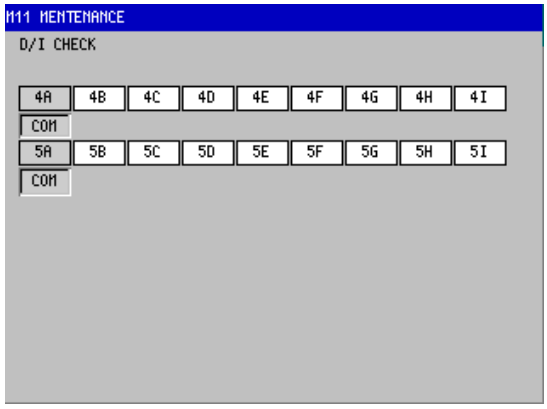
576m45s⇒576h45m

However, please match the time unit of the CF card preservation and this product setting when reading of the CF card and verifying it. The data that relates at time changes when the time unit is not corresponding, and the disagreement of the comparative result is caused.

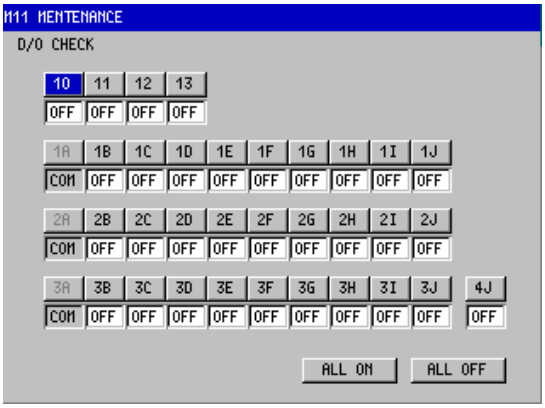
8 - 13. Mode 11 (Maintenance)

Mode 11 is used for the maintenance.

Menu screen	Description of screen
	• This is the menu screen of mode 11. Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it. Precautions: The check screens can be opened only during RESET.

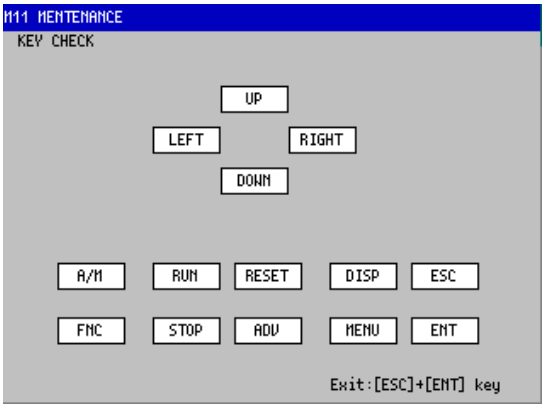
Setting screen	Description of screen
INFORMATION 	1. The specification information of the instrument can be checked. (1) Model code (2) Serial No. (3) INPUT (4) OUTPUT (There are 2 types: General type (N) and High accuracy type (H)) (5) D/I • D/O (6) COMMUNICATION (7) TRANSMISSION (There are 2 types: General type (N) and High accuracy type (H)) (8) INPUT CPU Software Version (9) CONTROL CPU Software Version (10) MAIN CPU Software Version
D/I・D/O CHECK 	Select D/I check or D/O check.
D/I CHECK 	2. The status of the DI signal can be checked. (1) The input status of each DI input signal can be checked. (2) The input terminal No. is indicated in green.

D/O CHECK



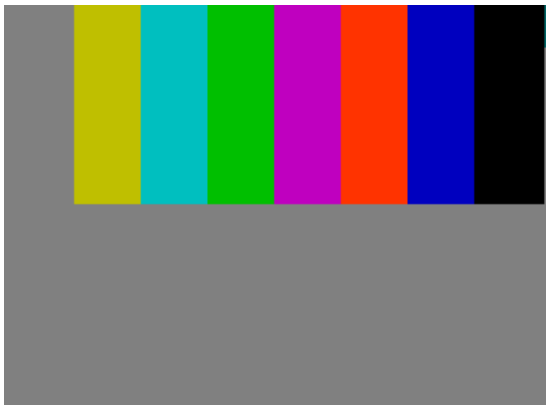
3. DO signal can be checked.
   (1) Select the number of the terminal whose output signal status is changed and press the [ENT] key to switch to ON from OFF, and vice versa.
   (2) When the output signal is ON, its color is changed to red.
   (3) When ALL ON is selected, all DO signal outputs are switched ON.
   (4) When ALL OFF is selected, all DO signal outputs are switched OFF.

KEY CHECK



4. The operations of the front panel keys can be checked.
   (1) The key pressed is indicated in blue on the screen.
   (2) To finish key checks, press both the [ESC] key and the [ENT] key simultaneously.

DISPLAY CHECK

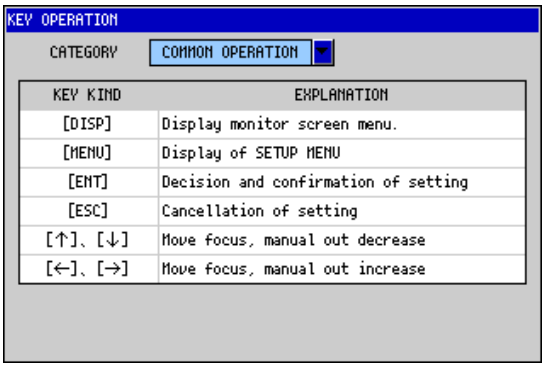
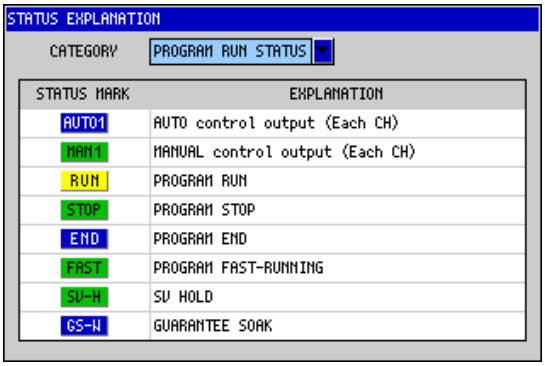


5. The indicator on the screen can be checked.
   (1) The display status for each segment can be checked by dividing the whole LCD display into 2 parts vertically and displaying 8 colors in the upper half.

8 - 14. Mode 12 (Help)

Mode 12 is used for displaying Help.

Menu screen	Description of screen
M12 HELP KEY OPERATION STATUS EXPLANATION	• This is the menu screen of mode 12. Use the ∧ and ∨ keys to move the cursor to the desired item on the left and press the ENT key to select it.

Setting screen	Description of screen
KEY OPERATION  	KEY OPERATION display screen (1) COMMON OPERATION DISP, MENU, ENT, ESC, ∧, ∨, <, >, key operations (2) PROGRAM DRIVE FNC, A/M, RUN, RUN HOLD, STOP, RESET, ADV, key operations (3) PATTERN SET MENU, <, >, FNC+> key operations (4) PARTICULAR KEY DISP for 1s, ENT for 2s, FNC + >, MENU +ENT key operations
STATUS EXPLANATION  	STATUS EXPLANATION display screen (1) PROGRAM RUN STATUS AUTO/MAN, RUN, STOP, END, FAST SV-HOLD, GUARANTEE SOAK status explanation (2) PV, SV, and ALARM status PV-HOLD, SV ramp-up, SV ramp-down, WAIT ALARM ON ALARM ON, ALARM OFF status explanation (3) STATUS BAR PROGRAM control icon, CONST control icon, explanation of the alarm lamp, Operation key is locked., memory card YES/NO icon explanation

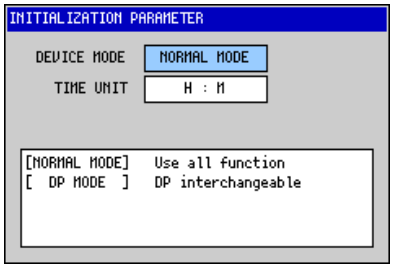
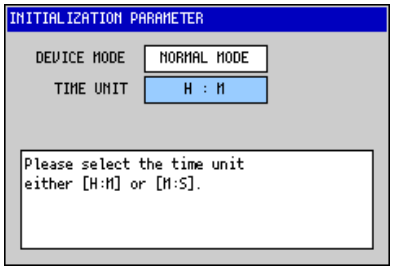
9. Initialization

9 - 1. Initialization of parameter

9 - 1 - 1. Initialization procedure

This product provides the function to initialize all the parameter to their factory settings. Use this operation as a step of starting initialization when turning the power on. When initializing the parameters, the two items, "INSTRUMENT MODE" and "TIME UNIT", can be specified.

* Settings of "INSTRUMENT MODE" and "TIME UNIT" can be changed only on initialization.
* Program patterns are not removed through the initialization start-up operation. To delete program patterns, select "PATTERN / SEQUENCE", "PROGRAM PATTERN EDIT", and then "ALL DELETE" in Mode 2.
* For more information about factory setting, see "18. Parameter list".

Initialization procedure	
1. Starting initialization	While pressing the [MENU] and [ENT] keys simultaneously, turn on the power of this product. After the initialization screen is displayed, the "INSTRUMENT MODE" and "TIME UNIT" screens appear.
2. INSTRUMENT MODE 	"NORMAL MODE" and "DP MODE" are provided. • "NORMAL MODE": All functions of this product are available. • "DP MODE": Some of the parameters have restrictions on viewing and setting in such a way similar to the DP series. This mode is useful when upgrading from the DP series and facilitates setting. * For more information about the functional restrictions of "DP MODE", see "9 - 1 - 2. Variety of functions depending on instrument mode".
3. TIME UNIT 	Select a time unit for a specific program pattern. • "H : M":.Set with "hours and: minute". (000h00m~999h59m) • "M : S": Set with "minutes and: second". (000m00s~999m59s) * When program patterns have already been set, only the time units change without the numerical values changing into a set value of the time of the program patterns and the parameters that has already been set. Example : 3h15m⇒3m15s 576m45s⇒576h45m However, please match the time unit of the CF card preservation and this product setting when reading of the CF card and verifying it. The data that relates at time changes when the time unit is not corresponding, and the disagreement of the comparative result is caused. * As for time unit of the program pattern, the setting change is possible even in mode 10.
4. Completing initialization	To finish initialization, press the [ESC] key and in the screen prompting for saving settings, press [YES].

9 - 1 - 2. Variety of functions depending on instrument mode

The following shows the differences between "NORMAL MODE" and "DP MODE". Related setting menus, setting screens, and operation screens are automatically switched.

Item	NORMAL MODE	DP MODE
PID	When the Output 2 option is specified, the Output 2 PID is also allowed to be set for automatic switching of "8 types" and "SV ZONE".	Only "1 type" is allowed for PID of Output 2. * Related screens: M2, M3
ALARM	8 points of alarms (basic 4 points + enhanced 4 points) are allowed to be set. All types of alarms can be set.	Limited to basic 4 points. The alarm types and enhanced functions are limited to those corresponding to DP. * Related screens: M0, M1, M3 * Alarm lamps are provided at 4 points on the operation screens.
OUTPUT LIMIT OUTPUT VARIATION LIMIT	For both Output 1 and Output 2, settings of "OUTPUT LIMIT" is allowed to be set for automatic switching of "8 types" and "SV ZONE". "OUTPUT VARIATION LIMIT" can be set with its upper limit and lower limit independently.	No setting is provided for automatic switching of "SV ZONE". Only 1 type is used for "OUTPUT LIMIT" and "OUTPUT VARIATION LIMIT" of Output 2. The upper limit and lower limit are commonly used for "OUTPUT VARIATION LIMIT". * Related screens: M0, M2, M4
Pattern/sequence	The enhanced alarm No. (AL5~8) and Output 2 options are used, then PID-No. of Output 2 and Output limit No. are to be specified.	The enhanced alarm No. (AL5~8) and PID-No. of Output 2, Output limit No., or Output variation limit No. are not to be specified. * Related screens: M2
Auto tuning	In the case of the Output 2 option is used, AT4, AT5, and AT6 are available.	In the case of the Output 2 option is used, Limited to AT4. * Related screens: M1
CONTROL	Control intervals can also be set. Output settings can be configured for the upper/lower limits of the PV errors. Output settings can be configured for CPU errors.	No settings are provided for control intervals. The upper limit and lower limit are commonly used for "PV ERR". No settings are provided for CPU error output. * Related screens: M4
Setting the pulse cycle	For on-off pulse output/SSR drive pulse, the pulse update type can be specified ("PULSE CYCLE" or "CONTROL INTERVAL").	Settings for pulse update types are fixed with " CONTROL INTERVAL ". * Related screens: M4
Set the MASS FLOW SV	8 types of MASS FLOW SV can be set.	The MASS FLOW SV functions are not available. * Related screens: M0, M6

9 - 2. Parameter setting

In "8. Setting screen", setting screens are described for each mode, but you need not use all of them. The customer is asked to select and set only the required parameters depending on this product specification, the system configuration of the final product, control conditions, etc. This section describes the steps required at least for initial setup of the controller when it is installed on the final product. Configure other settings as required.

: Always set　　: Set as required

(1) Set "INPUT RANGE" : Mode 5
* Set the input range according to the sensor and the scale range.

↓

(2) Set "LINEAR RANGE" : Mode 5
* In the case of linear input, set the input range actually used. It is not required to set this range for thermocouples and resistance thermometers.

↓

(3) Set "INPUT SCALE" : Mode 5
* In the case of the linear range with the input range, specify the scale.

↓

(4) Set "CONTROL DIRECTION DIRECT/REVERSE" : Mode 4
* Specify the control direction of control actions.

↓

(5) Set "PROGRAM PATTERNS" : Mode 2
* Specify program patterns.

↓

(6) Set "PID / ALARM / AT" : Mode 3
* Set the PID constants.

↓

(7) Set "PID / ALARM / AT" : Mode 3
* Set alarms.

↓

(8) "PIDNo.and alarm number" : Mode 2
* Sets a PID No. for each step of set program pattern.

↓

(9) "Pattern No." selection : Operation screen
* Select a pattern No. to be executed.

↓

(10) "RUN" operation : Operation screen
* Execute the RUN operation and start operation.

10. Operation

10 - 1. Confirmations before operation

Read carefully the following description, before starting the operation.

Item	Check Contents
1. Wiring	• Check to see that the wiring is correctly completed. In particular, the wiring of high voltage parts such as power, output, and alarm should be thoroughly checked. Check the terminal screws for looseness. • In addition to the wiring of this product, check the entire finished product for its wiring. In particular, it is important to check the peripheral parts of operation terminals (thyristor regulator, heater, motor, etc.). Perform a thorough inspection.
2. Power supply	• Confirm that the power supply is in the rated range.
3. Actual settings	• Check to see that the actual settings are correct. Check to see that the controller is in the RESET status when the power is turned on. If the controller is in the RUN status, it immediately starts a control operation. If it is not desirable to generate output, set 0% in manual output operation as required.

⚠ Precautions	
	(1) If a power supply other than the rated one is connected, this product may be damaged, extremely deteriorated, or malfunction. (2) If an excessive current or voltage is applied to the input terminal of this product, the product may be damaged, extremely deteriorated, or malfunction.

10 - 2. Program run and run operation

10 - 2 - 1. Run operation

Four types of run operations are available by selecting "OPERATION STATUS" and then "PROG DRIVE / PTN SELECT" in Mode 1. The following describes how to operate with the keys.

- Operation with the front keys (KEY)
- Operation with external input (external drive) (EXT)
- Operation through communications (COM)
- Operation with external drive as slave instruments (SLAVE)

FNC key:
To operate with the front keys, usually enable the FNC key first (lights in green) and then press another operation key. The FNC key lights up in green when it is pressed and lights out when pressed again.
When the FNC key enabled, pressing the RUN STOP RESET keys extinguish the FNC key after the operation is completed, and disables the key.

Status	Key operation	Description
1. Pattern select	[Key operation] In the operation screen, press the ◁ ▷ key.	• Pattern No. selection • Enabled in the RESET status. • Use the ◁ ▷ key to select the pattern number to be run from the preset pattern numbers. At this point, the selected number appears in the Pattern Status screen.
2. RESET	[Key operation] In the operation screen, press the FNC key and then press the RESET key.	• Resets the program operation. • Enabled in the RUN status or in the STOP status. • The RESET status represents the condition in which no program operation is performed, the output value (MV) is 0%, and no alarm operation is performed. • When the controller is in the RESET status and the step number is going forward step by step with the ADV operation, the step number is reverted to "0" by the RESET operation. • When a constant value operation is being performed in the RESET status, since it is a normal control operation, the alarm operations are also performed.
3. RUN	[Key operation] In the operation screen, press the FNC key and then press the RUN key.	• Perform a RUN of program operation • Enabled in the RESET status or in the STOP status. • Performs a control operation according to a specific program pattern. • When a RUN is executed in the RESET status, the program operation starts. When a RUN is executed in the STOP status, the program operation resumes.
4. STOP	[Key operation] In the operation screen, press the FNC key and then press the STOP key.	• Stops the program operation. • Enabled in the RUN status. • When a STOP is issued in the RUN status, the program pattern (SV and time) is stopped and the program operation is continued with the SV of that time (becomes a constant value operation). * The STOP operation does not work for the steps for which the circle function is specified.
5. ADV	[Key operation] In the operation screen, press the FNC key and then press the ADV key.	• Execution advances step by step. • Enabled in the RUN status, the Stop status, or the RESET status. • When an ADV operation is executed in the RUN status, the program operation is continued from the current stepping point. • When an ADV operation is executed in the STOP status, the program operation is stopped at the current stepping point. • When an ADV operation is executed in the RESET status, the program operation is reset at the current stepping point. • Since one ADV operation executes one step, issue the ADV operations the same number of times as the user want to advance the program steps.

Status	Key operation and operation screen	Description
6. FAST	[Key operation] In the operation screen, press the FNC key and then press the RUN key.	• Fast-forwards the program pattern. • Enabled in the RUN status. • When a RUN operation is issued in the RUN status, the program pattern progresses in a speed several times or dozens times faster than the normal speed while the RUN key is pressed down. When the RUN key is released, the FAST mode is reset. • In the FAST mode, the same output status as the one before the FAST operation is kept for the output value (MV). The time signal output and the alarm output function according to the settings in "TS and ALARM status during FAST" which is displayed by selecting Mode 10 " ENHANCED SETUP ". For each of the time signal output and alarm output, you can select whether the previous status is retained or set to OFF. * Limited to the case in which external signal output is specified in the specification and the time signal is assigned and specified. • While the ADV operation executes the program pattern step by step to the top of specified step number, the FAST operation executes the program pattern to the specified point within the program pattern (or step).

10 - 2 - 2. Procedure of program operation

When the program pattern and parameters are already defined, the start/end procedure of program operation is as follows.

(1) Change the status to RESET. * See the above two sections.

↓

(2) Select the pattern number of the program to be run. * See the above one section.

↓

(3) Change the status to RUN. * See the above three sections.

↓

(4) The operation is started, the control operation is performed according to the program pattern, and then the program operation terminates (END status).

* When repetition of step, repetition of pattern, or pattern link is specified, the status is changed to END when all of them are completed.

↓

(5) Change the status to RESET. * See the above two sections.

10 - 3. Trial operation

When the checks before operation are completed, start a trial operation to verify various points. The following is a sample procedure of the basic trial operations. Add appropriate checkpoints depending on the specification of this product, the system configuration of finished product, the control conditions, etc.

(1) Turn on the power. For safe start of operation, set the control output of this product to 0% by setting the output in RESET status to 0% or the output of manual output operation to 0% when the power is turned on.

↓

(2) Verify that the instruments composing the system, including this product are functioning normally.

↓

(3) Verify that all signal levels (voltage value, current value, ON/OFF signal, etc.) among the instruments composing the system, including the controller, is also normal.

↓

(4) When the output format is the current output type and a thyristor regulator is attached as an operation terminal, check to see the settings of the thyristor regulator. For other output format, check to see the operation terminals and adjust them as required.

↓

(5) Set this product to the output status of 0% with manual output operation. Gradually power up the output, and verify that the action of the operation terminal is corresponding to the output level and is normal.

↓

(6) Specify an appropriate program pattern, start the program operation by the "RUN" operation, switch the operation mode to the automatic output operation, and then enter the system to the automatic control status.

↓

(7) Check to see the status for a while. If the control is stable, there is no problem. If not stable, adjust the parameters (PID, etc.) of this product. PID can also be calculated automatically with the automatic tuning function.

↓

(8) Verify that the operations (alarm, external signal input, etc.) with peripheral instruments connected to this product are normal.

↓

↓

(9) Set various parameters of this product as required.

↓

(10) When several hours have passed after the operation started, verify that the final product, including this product and all of the instruments composing the system, is functioning properly.

10 - 4. Constant value operation

Although this product is intended for exclusive use in a program operation, and a constant value operation can also be performed by the following method. Use it as requirement.

Action	Description
1. From PROGRAM RUN STATUS to the constant value operation	(1) Set "CONST" in "CONTROL MODE" of Mode 1. • It becomes a constant value operation with SV obtained when switching over to "CONST". • For parameters other than SV, a control operation is performed using parameters of Mode 0. (2) Set the desired SV in "STEP SETUP" of Mode 0. • Parameters other than SV are set in Mode 0. (3) When returning the operation mode to a program operation, set it to "PROG" in "CONTROL MODE" of Mode 1. • Program operation resumes when switched to "PROG".
2. Switching from the RESET status to the constant value operation	(1) Set "CONST" in "CONTROL MODE" of Mode 1. • Operation starts when set. • A constant operation is performed with the target value (SV) in "STEP SETUP" of Mode 0. • For parameters other than SV, a control operation is performed using PID parameters of Mode 0. (2) Set the desired SV in "STEP SETUP" of Mode 0. • Perform the same steps when changing SV. • Parameters other than SV are set in Mode 0. (3) When reverting to the program operation, set "PROG" in "CONTROL MODE" of Mode 1. • The RESET status starts when switched to "PROG".

10 - 5. Automatic output operation and manual output operation

Operation mode	Description
Automatic output operation (Auto output)	• Based on the SV of the select execution No. and PV under measurement, perform the control operation to generate the control output value. • In general, the control operation is performed under this type of automatic output operation.
Manual output operation (Manual output)	• The predefined control output values are generating regardless of SV or PV. • It is commonly called as manual output.

In the case of the Output 2 specification, each output CH can be handled independently. While the displayed output CHs can be used in the "ALL PARA" or "DIGITAL" screen, the CHs of which "OUT1"/"OUT2" are displayed in white can be used in the "BAR GRAPH" or "TREND GRAPH" screen. The [ENT] key for a while to change the output CH to be used.

Switching between the automatic output operation (Auto output) and the manual operation (manual output) is as follows:

• Automatic output operation (Auto output) → Manual operation (Manual output)

(1) After enabling the [FNC] key, press the [A/M] key.

(2) When prompted with the message "Set to [MAN] control output CH1?" (or "Set to [MAN] control output CH2?") is displayed, select [YES] and then press the [ENT] key.
The "AUTO1" (or "AUTO2") display at the bottom of the operation screen changes to the "MAN1" (or "MAN2") display and the manual output operation starts. When a manual output operation is being performed, "MOUT1" (or "MOUT2") is displayed in the control output value display part.
Immediately after an automatic output operation is switched to a manual output operation, the previous control output values are retained.

(3) During a manual output operation, the [∧] [∨] keys can be used to change the control output values.
While the range of output values that can be handled in manual is the range of preset output limit when the settings in "MANUAL OUTPUT LIMIT" is enabled, which is displayed selecting "OUTPUT / CONTROL" and then "OUTPUT" of Mode 4, it is set to -5%~105% when set to disabled.

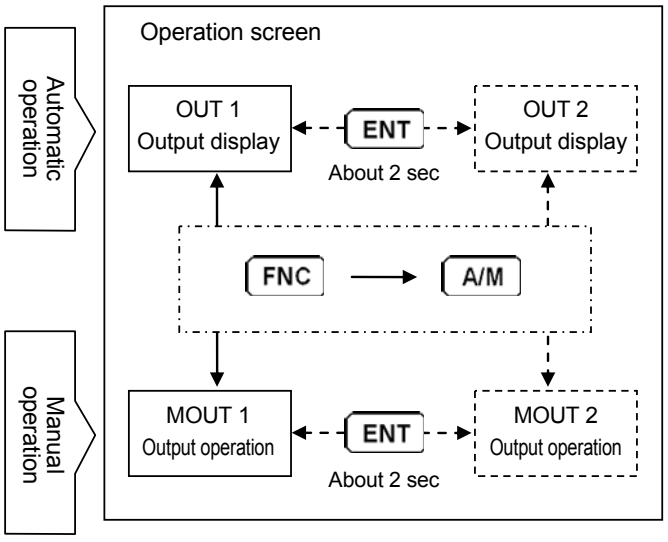
• Manual operation (Manual output) → Automatic output operation (Auto output)

(1) After enabling the [FNC] key, press the [A/M] key.

(2) When prompted with the message "Set to [AUTO] control output CH1?" (or "Set to [AUTO] control output CH2?") is displayed, select [YES] and then press the [ENT] key.

(3) The "MAN1" (or "MAN2") display at the bottom of the operation screen changes to the "AUTO1" (or "AUTO2") display and the automatic output operation starts. When an automatic output operation is being performed, "OUT1" (or "OUT2") is displayed in the control output value display part.
To prevent the control output values from changing drastically, the balanceless bumpless feature is employed when changing from a manual output operation to an automatic output operation.

Switching procedure between automatic output operation and manual output operation



The dashed lines represent the case of Output 2 specification.

The external signal input can also be used to switch between the automatic output operation (auto output) and manual operation (manual output).

When "PROG DRIVE" is set to "EXT" in "OPERATION STATUS" of Mode 1, a switching operation can be performed by an external input signal to which "MANUAL1" (or "MANUAL2") is assigned by selecting "ENHANCED SETUP" and then "D/I SETUP" of Mode 10.

When using an external input signal to perform a switching, keys can also be used to perform a switching operation. In this case, the last switching operation is effective regardless of whether it is performed by an external input signal or with a key operation.

10 - 6. Precautions during operation

10 - 6 - 1. Change in settings during operation

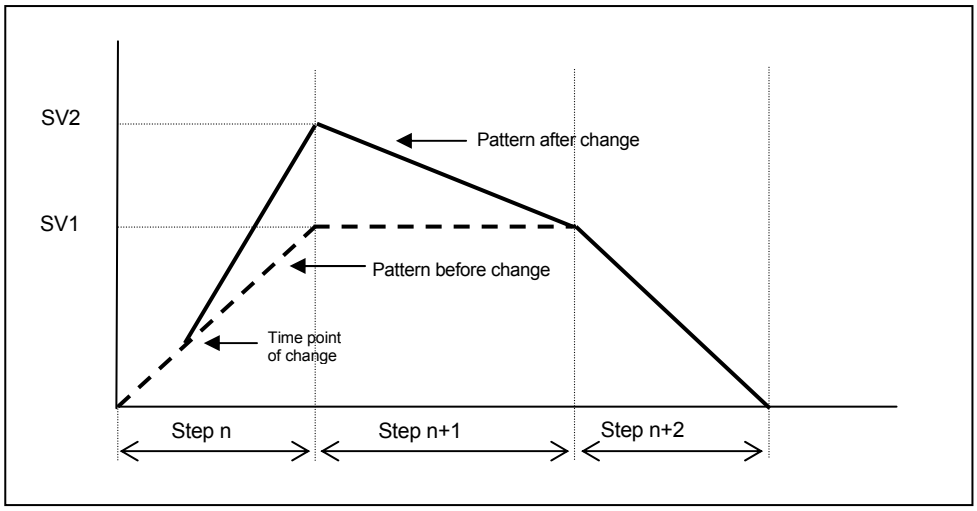
Settings can be changed during operation except for certain setup screens. An error message appears when trying to change settings that can not be changed during operation. It should be noted that, however, for some parameters, changing the settings during a control operation may adversely affect the control.

It is also possible to change settings for running steps through "M0 EXECUTING PARAMETER". See the following example in which settings are changed for running steps.

(1) When SV or rate is changed

In this example, SV1 (setting value) of step n is changed to SV2. In this case, while a constant value operation is performed at the step n+1 before change, no constant value operation is performed at the step n+1 after change.

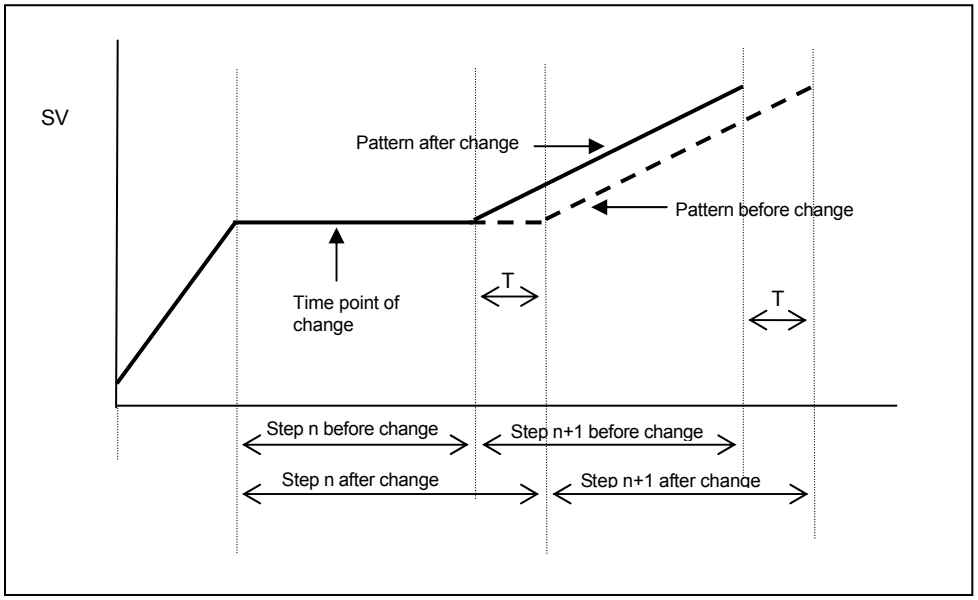
When the RATE setting is changed, the rate changes in such a way that it starts from the end point of post-change and moves to the target value of the next step.



(2) When TIME is changed

In this example, TIME (required time) of step n is shortened by T. The overall program operation is performed with an offset of T from the original value. If TIME is shorter than the elapsed time of step when changed, immediately proceeds to the next step.

In the case of RATE settings, while the end point varies depending on the changes to TIME, the next step also changes in the same way as the SV change.



10 - 6 - 2. Precautions when power supply is started

1. P (proportion) operation when the power supply is started

   Even if the controller is set to PID control, the P (proportional) operation is invoked for the first control operation immediately after the power in turned on. Therefore, please note that a momentary large output value may be generated depending on the condition when the power is turned on.

2. Countermeasures against erroneous output when power is supplied

   When the power switch is turned on, an output related signal may be momentarily generated until this product is started normally. Take countermeasures against erroneous output in external circuits as needed.

3. Precaution against momentary power outage

   The operation status when the power is turned on depends on the settings specified through selecting "CONTROL MODE" and then "POWER ON ACTION" of Mode 1.

   When "CONTINUE" is selected, the controller is reverted to the status when the power is turned off. In other works, if it was in the RUN status it is reverted to the RUN status and if it was in the RESET status it is reverted to the RESET status. When "RESET" is selected, even if the status is set to "RUN" in the setting screen or the external signal input, the status is always reverted to "RESET". In this case, to set the status to RUN, first revert the RUN status in the setting screen or the external signal input to RESET, and then execute a RUN again. In this case, the RUN status starts at the step No.0. Please be aware of the sequence when using the external signal input.

   Even if the user does not operate this product or the power is not turned off/on by the sequence from the final product, when an accidental momentary power outage occurs, the product detects it as the power is turned off and on, and then it functions according to the settings of "POWER ON ACTION" in "CONTROL MODE" of Mode 1. For example, when a high quality power supply is not equipped and "RESET" is selected, if a momentary power outage occurs, be aware that the status may become "RESET". Do not select "RESET" since it adversely affects the entire system of the final product when a stable power supply is not installed.

   This product detects a momentary power outage of approximately 200 ms (power supply voltage:0%) or longer.

Precautions	(1) Please take care when changing the settings while the controller is running. Depending on the parameters to be changed, the controller may be adversely affected in its control. (2) Use a stable power supply with high quality. Noise or a momentary power outage may adversely affect this product and cause an unexpected malfunction.

11. Detailed explanation of main functions

11 - 1. Measuring range

This product is a universal input type and can be used for various measuring ranges.

Select the appropriate measuring range according to the sensor type and the scale range actually used. With regard to the thermocouple and resistance thermometer, check the standards and then select the appropriate measuring range. In particular, be aware that the "Pt100Ω" system of resistance thermometer has three types of standards.

[Universal inputs]

No.	Measuring range		Scale range (°C)	Scale range (K)	No.	Measuring range		Scale range (°C)	Scale range (K)
01	Thermocouple	B	0.0 - 1820.0	273.0 - 2093.0	28	Thermocouple	L	-200.0 - 900.0	73.0 - 1173.0
02		R1	0.0 - 1760.0	273.0 - 2033.0	29		N	0.0 - 1300.0	273.0 - 1573.0
03		R2	0.0 - 1200.0	273.0 - 1473.0	31	DC voltage	10mV	±10mV	
04		S	0.0 - 1760.0	273.0 - 2033.0	32		20mV	±20mV	
05		K1	-200.0 - 1370.0	73.0 - 1643.0	33		50mV	±50mV	
06		K2	0.0 - 600.0	273.0 - 873.0	34		100mV	±100mV	
07		K3	-200.0 - 300.0	73.0 - 573.0	35		5V	±5 V	
08		E1	-270.0 - 1000.0	3.0 - 1273.0	37		10V	±10 V	
09		E2	0.0 - 700.0	273.0 - 973.0	36	DC current	20mA	0 - 20mA	
10		E3	-270.0 - 300.0	3.0 - 573.0	41	Thermometer resistance 3 wire system	JPt100 1	-200.0 - 649.0	73.0 - 922.0
11		E4	-270.0 - 150.0	3.0 - 423.0	42		JPt100 2	-200.0 - 400.0	73.0 - 673.0
12		J1	-200.0 - 1200.0	73.0 - 1473.0	43		JPt100 3	-200.0 - 300.0	73.0 - 573.0
13		J2	-200.0 - 900.0	73.0 - 1173.0	44		JPt100 4	-200.0 - 200.0	73.0 - 473.0
14		J3	-200.0 - 400.0	73.0 - 673.0	45		JPt100 5	-100.0 - 100.0	173.0 - 373.0
15		J4	-100.0 - 200.0	173.0 - 473.0	46		QPt100 1	-200.0 - 649.0	73.0 - 922.0
16		T1	-270.0 - 400.0	3.0 - 673.0	47		QPt100 2	-200.0 - 400.0	73.0 - 673.0
17		T2	-200.0 - 200.0	73.0 - 473.0	48		QPt100 3	-200.0 - 300.0	73.0 - 573.0
61		WRe5-WRe26	0.0 - 2310.0	273.0 - 2583.0	49		QPt100 4	-200.0 - 200.0	73.0 - 473.0
62		W-WRe26	0.0 - 2310.0	273.0 - 2583.0	50		QPt100 5	-100.0 - 100.0	173.0 - 373.0
63		NiMo-Ni	-50.0 - 1410.0	223.0 - 1683.0	51		Pt50	-200.0 - 649.0	73.0 - 922.0
66		CR-AuFe	--	0.0 - 280.0	52		Pt-Co	--	4.0 - 374.0
23		PR5-20	0.0 - 1800.0	273.0 - 2073.0	53		Pt100 1	-200.0 - 850.0	73.0 - 1123.0
67		PtRh40-20	0.0 - 1880.0	273.0 - 2153.0	54		Pt100 2	-200.0 - 400.0	73.0 - 673.0
64		Plati II1	0.0 - 1390.0	273.0 - 1663.0	55		Pt100 3	-200.0 - 300.0	73.0 - 573.0
65		Plati II2	0.0 - 600.0	273.0 - 873.0	56		Pt100 4	-200.0 - 200.0	73.0 - 473.0
27		U	-200.0 - 400.0	73.0 - 673.0	57		Pt100 5	-100.0 - 100.0	173.0 - 373.0

No.	Measuring range		Scale range (°C)	Scale range (K)	No.	Measuring range		Scale range (°C)	Scale range (K)
141	Thermometer resistance 4 wire system	JPt100 1	-200.0 - 649.0	73.0 - 922.0	150	Thermometer resistance 4 wire system	QPt100 5	-100.0 - 100.0	173.0 - 373.0
142		JPt100 2	-200.0 - 400.0	73.0 - 673.0	151		Pt50	-200.0 - 649.0	73.0 - 922.0
143		JPt100 3	-200.0 - 300.0	73.0 - 573.0	152		Pt-Co	--	4.0 - 374.0
144		JPt100 4	-200.0 - 200.0	73.0 - 473.0	153		Pt100 1	-200.0 - 850.0	73.0 - 1123.0
145		JPt100 5	-100.0 - 100.0	173.0 - 373.0	154		Pt100 2	-200.0 - 400.0	73.0 - 673.0
146		QPt100 1	-200.0 - 649.0	73.0 - 922.0	155		Pt100 3	-200.0 - 300.0	73.0 - 573.0
147		QPt100 2	-200.0 - 400.0	73.0 - 673.0	156		Pt100 4	-200.0 - 200.0	73.0 - 473.0
148		QPt100 3	-200.0 - 300.0	73.0 - 573.0	157		Pt100 5	-100.0 - 100.0	173.0 - 373.0
149		QPt100 4	-200.0 - 200.0	73.0 - 473.0	--				

[List of standards]

K, E, J, T, R, S, B, N: IEC584 (1977, 1982), JIS C 1602-1995, JIS C 1605-1995
WRe5-WRe26, W-WRe26, NiMo-Ni, Platinel II, CR-AuFe, PtRh40-PtRh20: ASTM Vo1.14.03
U, L: DIN43710-1985
Pt100: IEC751 (1995), JIS C 1604-1997
QPt100: IEC751 (1983), JIS C 1604-1989, JIS C 1606-1989
* QPt100 is a code name and previously called as "Pt100Ω".
JPt100: JIS C 1604-1981, JIS C 1606-1986
JPt50: JIS C 1604-1981

When updating a DP series controller that uses a thermocouple listed below, select the range to be used from "Thermocouple (DP compatible)".

[DP compatible range]

No.	Measuring range		Scale range (°C)	Scale range (K)	No.	Measuring range		Scale range (°C)	Scale range (K)
18	Thermo couple	WRe5-26	0.0 - 2320.0	273.0 - 2593.0	24	Thermo couple	PR20-40	0.0 - 1880.0	273.0 - 2153.0
19		WWRe0-26	0.0 - 2320.0	273.0 - 2593.0	25		Platinel1	-100.0 - 1390.0	173.0 - 1663.0
20		Ni-NiMo	0.0 - 1310.0	273.0 - 1583.0	26		Platinel2	-100.0 - 600.0	173.0 - 873.0

11 - 2. Linear scale

When linear input (DC voltage and current) is selected, the initial values of linear scale and measurement scopes are as follows.

Measuring range		Scale range	Linear range (initial value)	Linear scale (initial value)
31	10 mV	-10.00 - 10.00 mV	0.00 - 10.00 mV	0.0 - 2000.0
32	20 mV	-20.00 - 20.00 mV	0.00 - 20.00 mV	0.0 - 2000.0
33	50 mV	-50.00 - 50.00 mV	0.00 - 50.00 mV	0.0 - 2000.0
34	100 mV	-100.0 - 100.0 mV	0.0 - 100.0 mV	0.0 - 2000.0
35	5 V	-5.000 - 5.000 V	0.000 - 5.000 V	0.0 - 2000.0
37	10 V	-10.00 - 10.00 V	0.00 - 10.00 V	0.0 - 2000.0
36	20 mA	0.00 - 20.00 mA	4.00 - 20.00 mA	0.0 - 2000.0

The setting procedure is as follows:

(1) For the "linear range" of Mode 5, set the minimum and maximum values of analog signal actually input from the sensor.

(2) For the "linear scale" of mode 5, after confirming how to display that minimum and maximum values, set the decimal point position and the lower limit and upper limits of the scale.

(3) For example, if you want to display 0.00 to 100.00 for 4 to 20 mA, use the following settings:

- LINEAR RANGE: Span..... 20.00
  Zero..... 4.00
- INPUT SCALE: Maximum..... 100.00
  Minimum..... 0.00
  Decimal point 2

If a linear range is selected, the following operations can be performed on input values. These operations are set in "INPUT FNC" of Mode 5.

(1) Square roots calculation: Value = SQRT((Measurement value - Range zero)/(Range span - Range zero))×(Scale max - Scale min) + Scale minimum

(2) LOG Computation: Value = (Log10(Measurement value - Range zero)/Log10(Range span - Range zero))×(Scale max - Scale min) + Scale minimum

11 - 3. User linear range

For linear range input, any linearize table can be generated and applied. In this case, select one of the following "user linear ranges" to create a user linearize table.

Measuring range		Scale range	Linear range (initial value)	Linear scale (initial value)
USER1	10mV	-10.00 - 10.00 mV	0.00 - 10.00 mV	0.0 - 2000.0
	20mV	-20.00 - 20.00 mV	0.00 - 20.00 mV	0.0 - 2000.0
	50mV	-50.00 - 50.00 mV	0.00 - 50.00 mV	0.0 - 2000.0
	100mV	-100.0 - 100.0 mV	0.0 - 100.0 mV	0.0 - 2000.0
	5V	-5.000 - 5.000 V	0.000 - 5.000 V	0.0 - 2000.0
	10V	-10.00 - 10.00 V	0.00 - 10.00 V	0.0 - 2000.0
	20mA	0.00 - 20.00 mA	4.00 - 20.00 mA	0.0 - 2000.0

A user linearize table specifies the relationship between measurement values and indication values for up to 20 sections (19 turning points).

Measurement values and indication values should be set within the linear range and linear scale, and the table is created in the ascending order of measurement values.

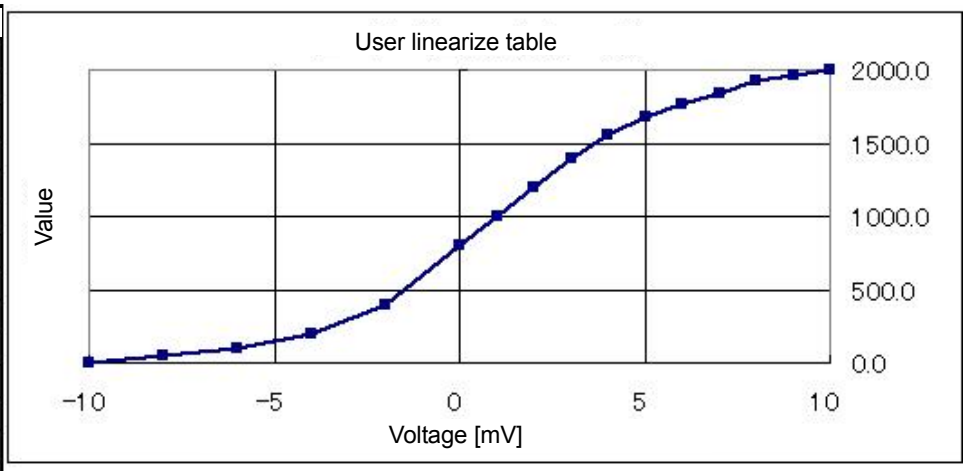
User linearize table creation example

USER ±10 mV range

Range span 10 mV, Range zero -10 mV

Scale max 2000.0, Scale min 0.0

	Voltage [mV]	Value
No.1	−10.00	0.0
No.2	−8.00	50.0
No.3	−6.00	100.0
No.4	−4.00	200.0
No.5	−2.00	400.0
No.6	0.00	800.0
No.7	1.00	1000.0
No.8	2.00	1200.0
No.9	3.00	1400.0
No.10	4.00	1550.0
No.11	5.00	1680.0
No.12	6.00	1760.0
No.13	7.00	1840.0
No.14	8.00	1920.0
No.15	9.00	1960.0
No.16	10.00	2000.0
No.17		
No.18		
No.19		
No.20		



11 - 4. Alarm mode

Available types of alarm formats are as follows:

(1) PV (Measurement value) alarm

- Absolute value alarm: PV alarm due to alarm setting value.
- Deviation alarm: PV Alarm due to setting value + alarm setting value
- Absolute value deviation alarm: PV Alarm due to setting value ± alarm setting value
- Change ratio alarm: Alarms triggered by PV change ratio measured in 10 seconds.

(2) SV (Setting value) alarm

- Setting value alarm: SV alarm due to alarm setting value.

(3) MV (Output value) alarm

- Output value alarm: MV alarm due to alarm setting value.

  * In the case of Output 2 specifications, an alarm is triggered by the output value (MV1) of output 1.

(4) Control loop error: While the control output reached the upper limit, this error is issued when a change greater than the specified volume is not detected for a specified period.

(5) FAIL (Abnormal) alarm: RJ data abnormality, A/D conversion abnormality, internal memory data abnormality, etc.

* No setting values are predefined.

(6) Wait time alarm: Used in combination with the guarantee soak feature. Issued when execution does not proceed to the next step for a specified time period.

* No setting values are predefined.

(7) END SIGNAL: Indicates that the end of program is detected.

* No setting values are predefined.

For the alarm forms from (1) to (3) in the above, specify the following conditions.

- High limit alarm: Alarm is turned ON if the alarm setting value is higher than the upper limit.
- Low limit alarm: Alarm is turned ON if the alarm setting value is lower than the lower limit.
- High limit alarm (with wait): Provides the high limit alarm function with an optional waiting function. After the value falls in the normal range, then alarm is turned ON. When the power is turned on, SV is changed, or the alarm value is changed, it goes into the wait status.
- Low limit alarm (with wait): Provides the low limit alarm function with an optional waiting function. After the value falls in the normal range, then alarm is turned ON. When the power is turned on, SV is changed, or the alarm value is changed, it goes into the wait.
- High limit alarm (with latch):

  The high limit alarm has the latch feature, and once alarm is turned on, the alarm ON status is maintained until it is deactivated. Alarm is reset when an alarm deactivation operation is executed, program operation is RESET, or the power is turned off/on.

- Low limit alarm (with latch):

  The low limit alarm has the latch feature, and once alarm is turned on, the alarm ON status is maintained until it is deactivated. Alarm is reset when an alarm deactivation operation is executed, program operation is RESET, or the power is turned off/on.

- High limit alarm (with waiting/latch):

  The high limit alarm is provided with the waiting feature and the latch feature.

- Low limit alarm (with waiting/latch):

  The low limit alarm is provided with the waiting feature and the latch feature.

Alarms issued during the waiting status are notified by flashing alarm lamps (AL1 - AL8).

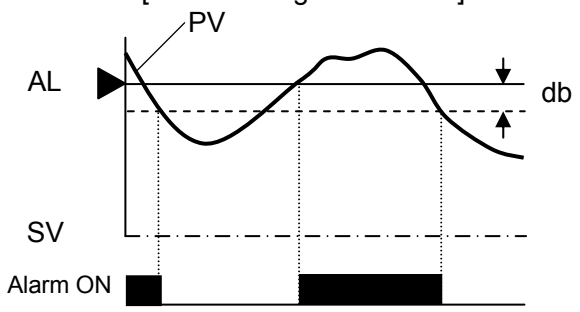
"Action in reset" can be set in the alarm setting.

OFF : Alarm is judged when the program is driven or a fixed value is driven, and the alarm judgment is not done in the reset state.

ACTION : Alarm is judged in all states including the reset state. In that case, the alarm setting value and SV use the value of mode 0.
Moreover, alarm reset is executed by "mode 1. Selection of operating status - alarm reset".

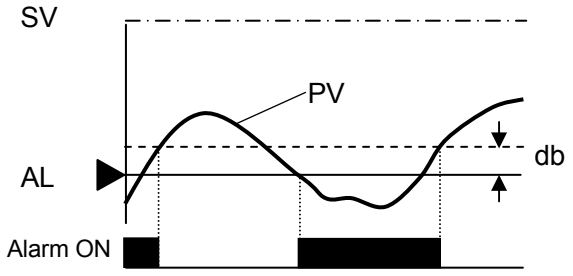
Alarm ON: ■	Alarm setting value (AL): ▶——	Alarm dead band (db): ↕

[Deviation high limit alarm]



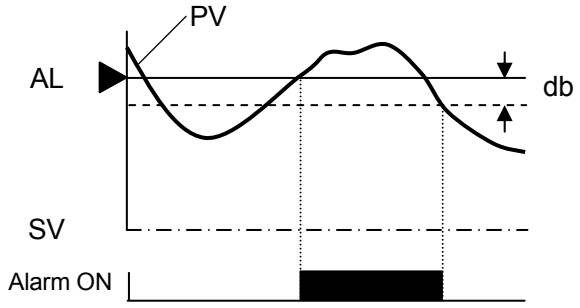
PV>SV+AL:ON,SV+AL-db<PV≤SV+AL:KEEP,PV≤SV+AL-db:OFF

[Deviation low limit alarm]



PV<SV+AL:ON,SV+AL≤PV<SV+AL+db:KEEP,PV>SV+AL+db:OFF

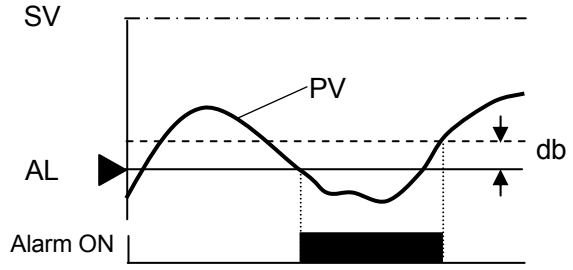
[Deviation high limit alarm (with wait)]



* AL:OFF until once falls in the normal range

PV>SV+AL:ON,SV+AL-db<PV≤SV+AL:KEEP,PV≤SV+AL-db:OFF

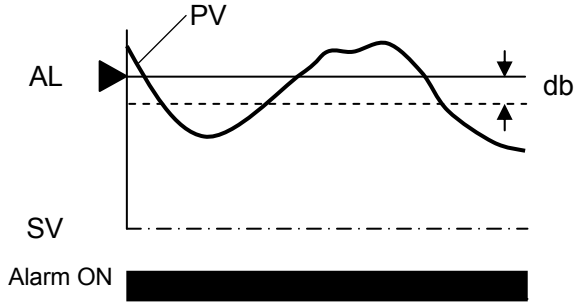
[Deviation low limit alarm (with wait)]



* AL:OFF until once falls in the normal range

PV<SV+AL:ON,SV+AL≤PV<SV+AL+db:KEEP,PV≤SV+AL+db:OFF

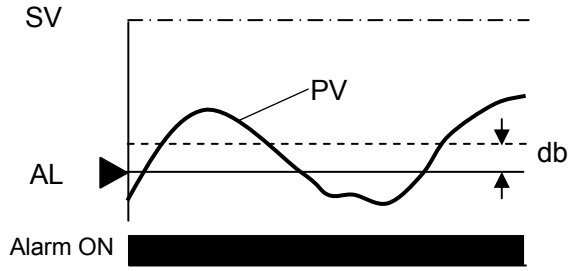
[Deviation high limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

PV>SV+AL:ON,SV+AL-db<PV≤SV+AL:KEEP,PV≤SV+AL-db:OFF

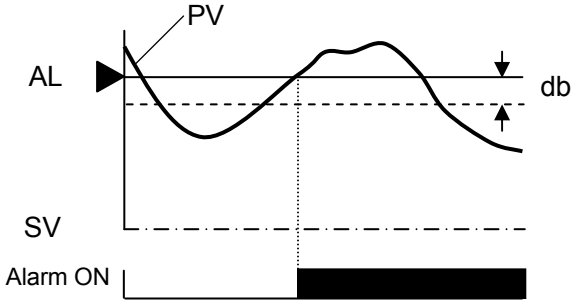
[Deviation low limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

PV<SV+AL:ON,SV+AL≤PV<SV+AL+db:KEEP,PV≤SV+AL+db:OFF

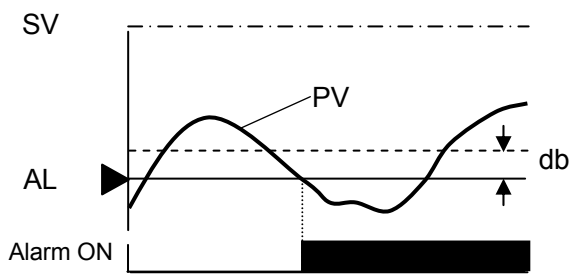
[Deviation high limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

PV>SV+AL:ON,SV+AL-db<PV≤SV+AL:KEEP,PV≤SV+AL-db:OFF

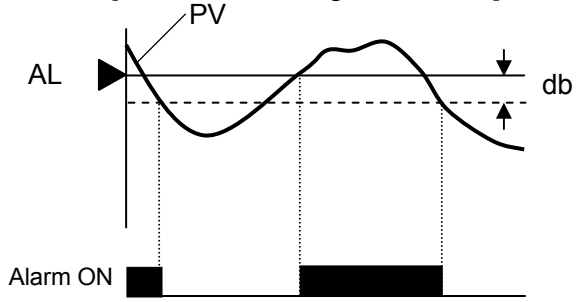
[Deviation low limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

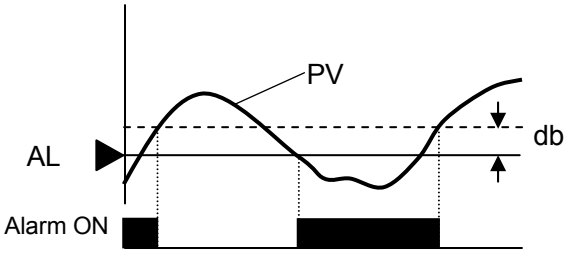
PV<SV+AL:ON,SV+AL≤PV<SV+AL+db:KEEP,PV≤SV+AL+db:OFF

[Absolute value high limit alarm]



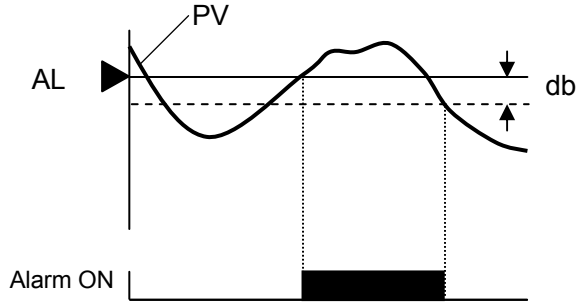
AL<PV:ON,AL-db<PV≤AL:KEEP,PV≤AL-db:OFF

[Absolute value low limit alarm]



AL>PV:ON,AL≤PV<AL+db:KEEP,PV≥AL+db:OFF

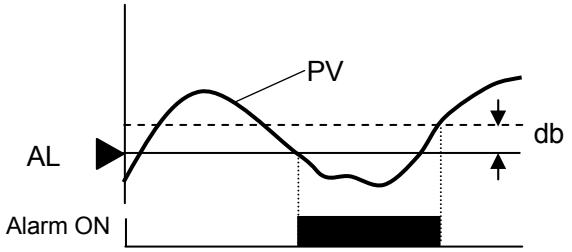
[Absolute value high limit alarm (with wait)]



* AL:OFF until once falls in the normal range

AL<PV:ON,AL-db<PV≤AL:KEEP,PV≤AL-db:OFF

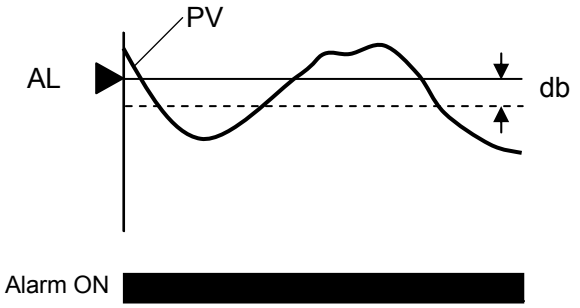
[Absolute value low limit alarm (with wait)]



* AL:OFF until once falls in the normal range

AL>PV:ON,AL≤PV<AL+db:KEEP,PV≥AL+db:OFF

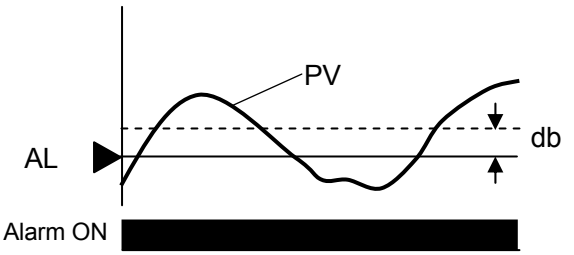
[Absolute value high limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

AL<PV:ON,AL-db<PV≤AL:KEEP,PV≤AL-db:OFF

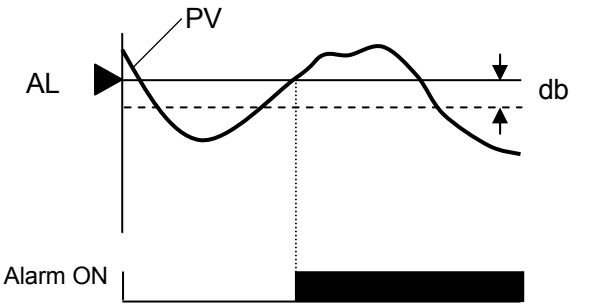
[Absolute value low limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

AL>PV:ON,AL≤PV<AL+db:KEEP,PV≥AL+db:OFF

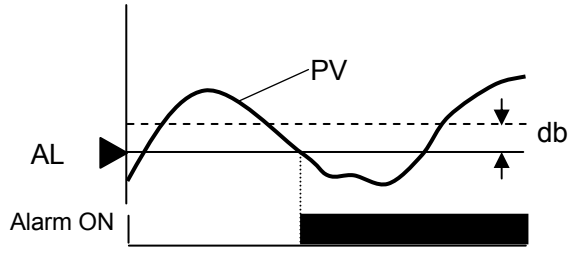
[Absolute value high limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

AL<PV:ON,AL-db<PV≤AL:KEEP,PV≤AL-db:OFF

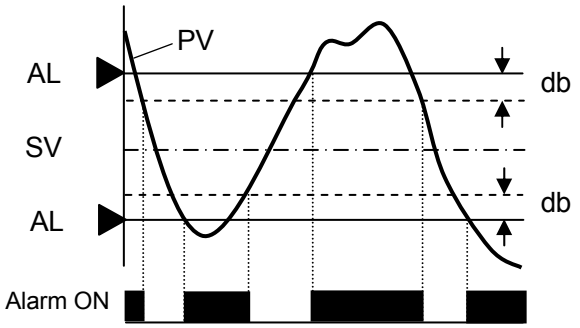
[Absolute value low limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

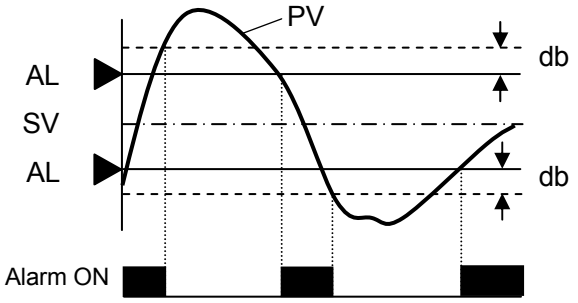
AL>PV:ON,AL≤PV<AL+db:KEEP,PV≥AL+db:OFF

[Absolute value deviation high limit alarm]



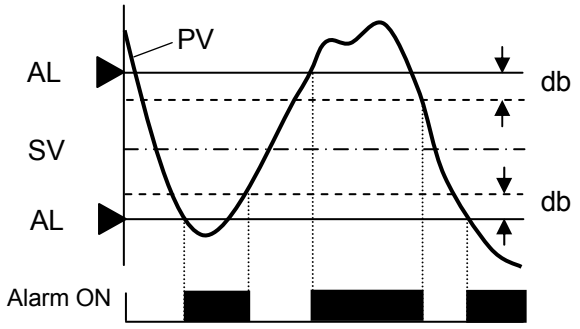
PV>SV+AL:ON,PV<SV-AL:ON,SV+AL-db≤PV≤SV+AL:KEEP
SV-AL≤PV≤SV-AL+db:KEEP,PV<SV+AL-db:OFF,PV>SV-AL+db:OFF

[Absolute value deviation low limit alarm]



SV-AL<PV<SV+AL:ON,SV+AL≤PV≤SV+AL+db:KEEP
SV-AL-db≤PV≤SV-AL:KEEP,PV>SV+AL+db:OFF,PV<SV-AL-db:OFF

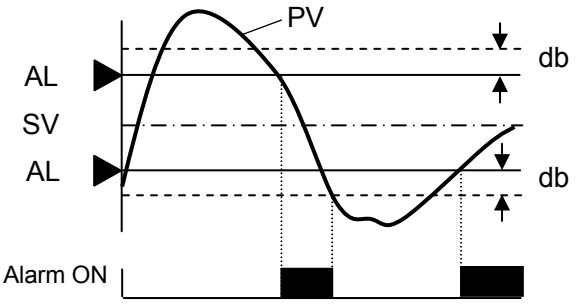
[Absolute value deviation high limit alarm (with wait)]



* AL:OFF until once falls in the normal range

PV>SV+AL:ON,PV<SV-AL:ON,SV+AL-db≤PV≤SV+AL:KEEP
SV-AL≤PV≤SV-AL+db:KEEP,PV<SV+AL-db:OFF,PV>SV-AL+db:OFF

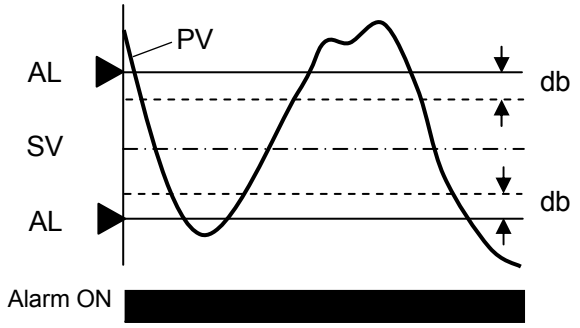
[Absolute value deviation low limit alarm (with wait)]



* AL:OFF until once falls in the normal range

SV-AL<PV<SV+AL:ON,SV+AL≤PV≤SV+AL+db:KEEP
SV-AL-db≤PV≤SV-AL:KEEP,PV>SV+AL+db:OFF,PV<SV-AL-db:OFF

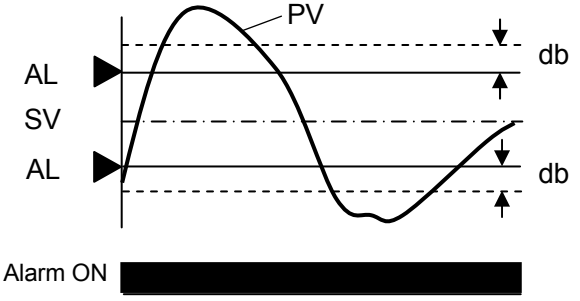
[Absolute value deviation high limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

PV>SV+AL:ON,PV<SV-AL:ON,SV+AL-db≤PV≤SV+AL:KEEP
SV-AL≤PV≤SV-AL+db:KEEP,PV<SV+AL-db:OFF,PV>SV-AL+db:OFF

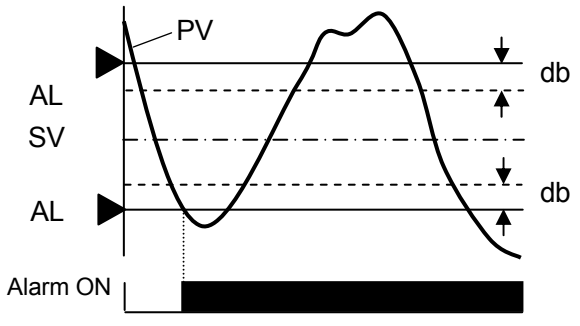
[Absolute value deviation low limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ONdb:OFF

SV-AL<PV<SV+AL:ON,SV+AL≤PV≤SV+AL+db:KEEP
SV-AL-db≤PV≤SV-AL:KEEP,PV>SV+AL+db:OFF,PV<SV-AL-db:OFF

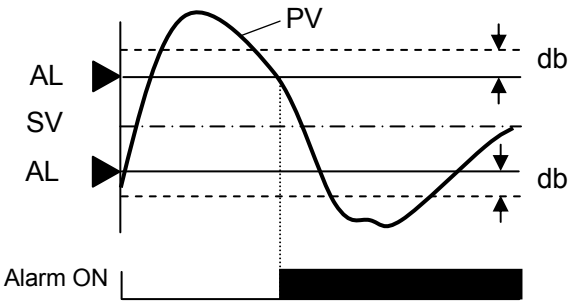
[Absolute value deviation high limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

PV>SV+AL:ON,PV<SV-AL:ON,SV+AL-db≤PV≤SV+AL:KEEP
SV-AL≤PV≤SV-AL+db:KEEP,PV<SV+AL-db:OFF,PV>SV-AL+db:OFF

[Absolute value deviation low limit alarm (with wait/latch)]

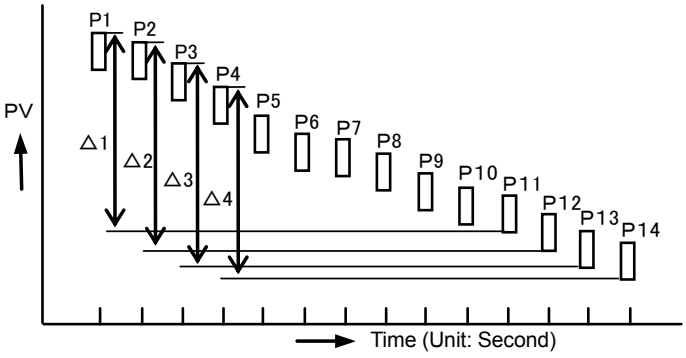


* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

SV-AL<PV<SV+AL:ON,SV+AL≤PV≤SV+AL+db:KEEP
SV-AL-db≤PV≤SV-AL:KEEP,PV>SV+AL+db:OFF,PV<SV-AL-db:OFF

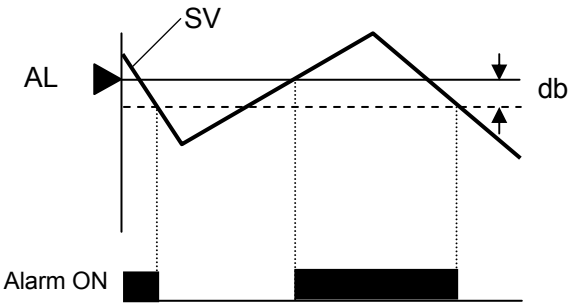
[Variation high alarm, Variation low alarm]

- The magnitude of difference between a measurement value (PV1) and the value measured 10 seconds later (PV10) is evaluated against the alarm values (AL) as :
  Variation high: AL < PV10-PV1:ON
  AL ≥ PV10-PV1: OFF
  Variation low: AL > PV10-PV1: ON
  AL ≤ PV10-PV1: OFF
- PV uses 10 measurement values per one second, and executes evaluation of the difference, every second, between the values measured at the interval of 10 seconds.



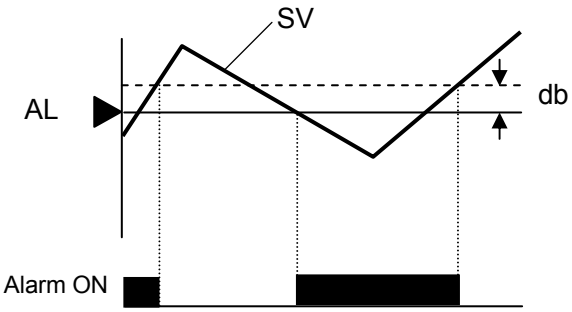
P1 - P14: 10 measurement values per second
△1 - △4: The maximum difference of two values measured with an interval of 10 seconds

[Setting value high limit alarm]



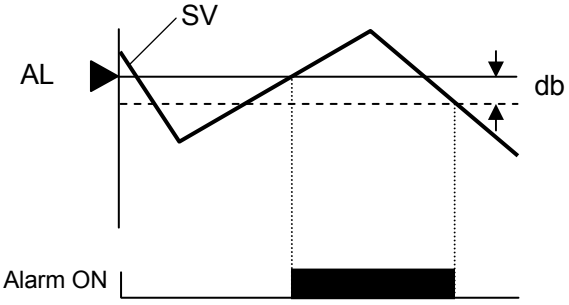
AL<SV:ON,AL-db<SV≤AL:KEEP,SV≤AL-db:OFF

[Setting value low limit alarm]



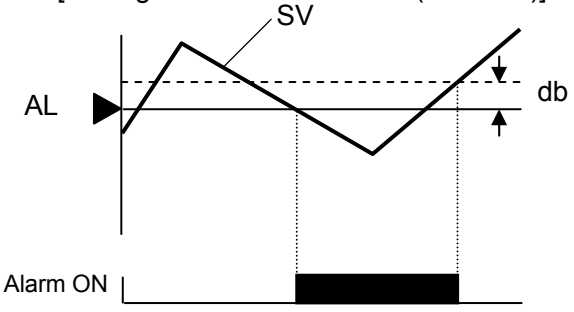
AL>SV:ON,AL≤SV<AL+db:KEEP,SV≥AL+db:OFF

[Setting value high limit alarm (with wait)]



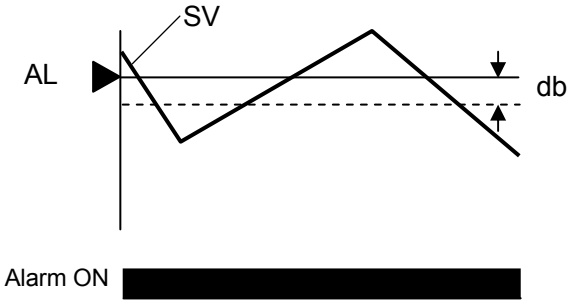
* AL:OFF until once falls in the normal range
AL<SV:ON,AL-db<SV≤AL:KEEP,SV≤AL-db:OFF

[Setting value low limit alarm (with wait)]



* AL:OFF until once falls in the normal range
AL>SV:ON,AL≤SV<AL+db:KEEP,SV≥AL+db:OFF

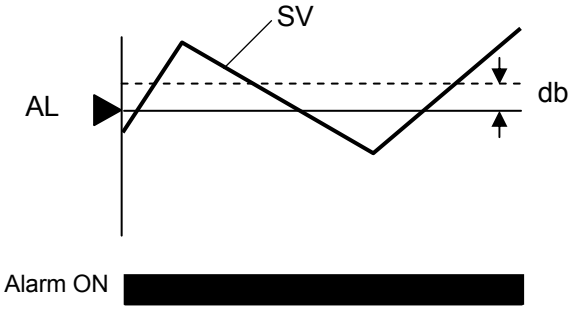
[Setting value high limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

AL<SV:ON,AL-db<SV≤AL:KEEP,SV≤AL-db:OFF

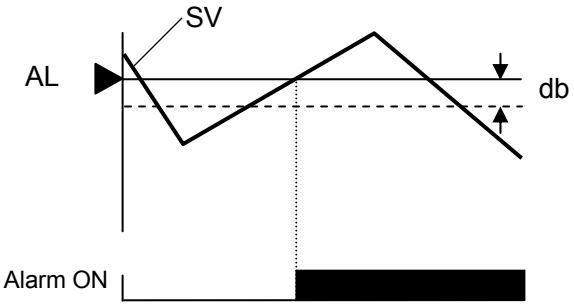
[Setting value low limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

AL>SV:ON,AL≤SV<AL+db:KEEP,SV≥AL+db:OFF

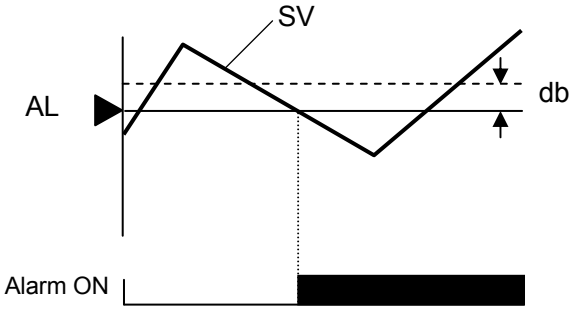
[Output value high limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

AL<SV:ON,AL-db<SV≤AL:KEEP,SV≤AL-db:OFF

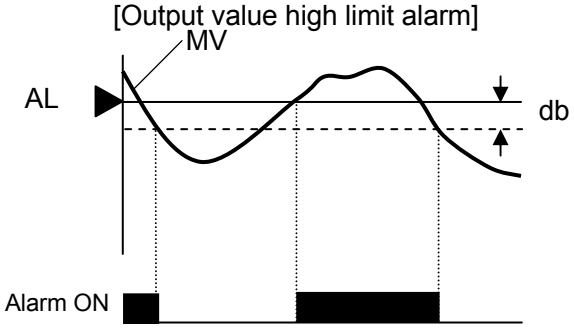
[Output value low limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

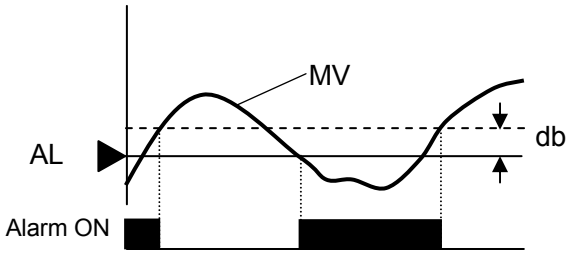
AL>SV:ON,AL≤SV<AL+db:KEEP,SV≥AL+db:OFF

[Output value high limit alarm]



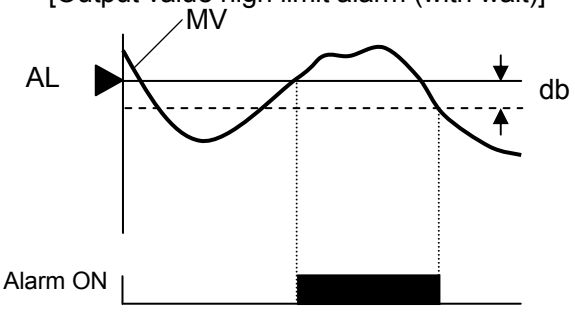
AL<MV:ON,AL-db<MV≤AL:KEEP,MV≤AL-db:OFF

[Output value low limit alarm]



AL>MV:ON,AL≤MV<AL+db:KEEP,MV≥AL+db:OFF

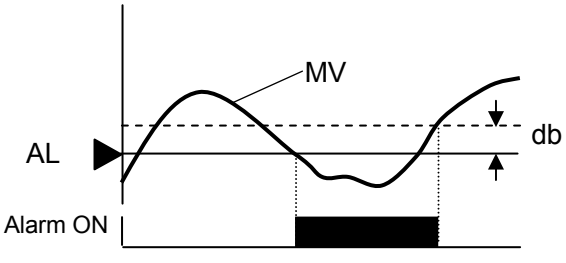
[Output value high limit alarm (with wait)]



* AL:OFF until once falls in the normal range

AL<MV:ON,AL-db<MV≤AL:KEEP,MV≤AL-db:OFF

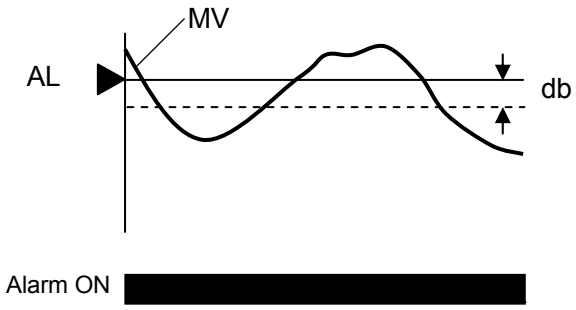
[Output value low limit alarm (with wait)]



* AL:OFF until once falls in the normal range

AL>MV:ON,AL≤MV<AL+db:KEEP,MV≥AL+db:OFF

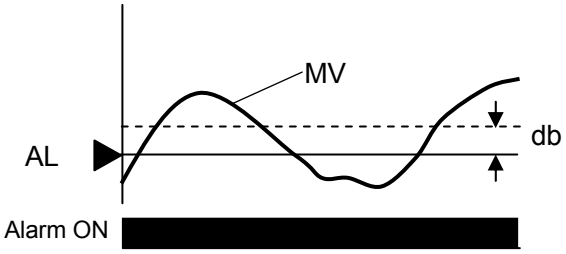
[Output value high limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

AL<MV:ON,AL-db<MV≤AL:KEEP,MV≤AL-db:OFF

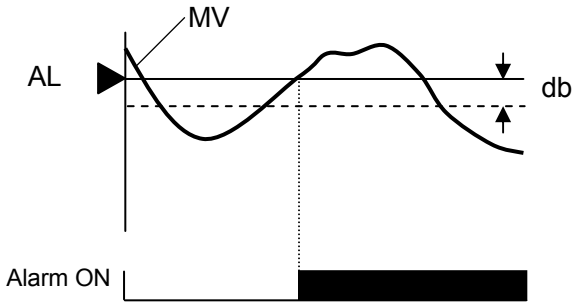
[Output value low limit alarm (with latch)]



* AL:ON until the alarm is deactivated after once AL:ON

AL>MV:ON,AL≤MV<AL+db:KEEP,MV≥AL+db:OFF

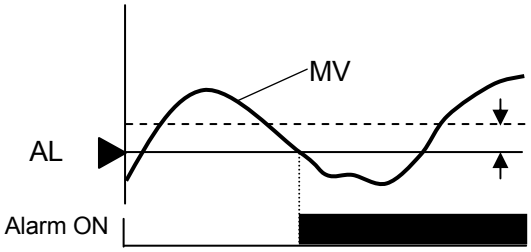
[Output value high limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

AL<MV:ON,AL-db<MV≤AL:KEEP,MV≤AL-db:OFF

[Output value low limit alarm (with wait/latch)]



* AL:OFF until once falls in the normal range
* AL:ON until the alarm is deactivated after once AL:ON

AL>MV:ON,AL≤MV<AL+db:KEEP,MV≥AL+db:OFF

[Control loop error]

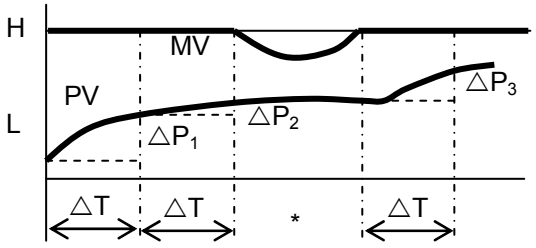
H: Output limiter high limit

L: Output limiter low limit

△T: Error judgment time

During normal times: △Pn > Error judgment width

Abnormality: △Pn < Error judgment width



* When the control output (MV) is within the output limiter, no error judgment is performed.

11 - 5. Auto tuning

Auto tuning (AT) is a function to automatically calculate a PID constant.

There are six types of auto tunings, from AT1-AT6, as shown below:

(1) AT1

- This is an auto tuning for Output 1.
- It is the SV currently executed or for constant value control.
- It can be executed in the RUN status (except for the program end status) or in the constant value control status.
- It executes auto tuning using SV when AT1 is set.
- PID calculated with AT1 is registered in the PID of which PID number is running.

(2) AT2

- This is an auto tuning for SV8 types of Output 1.
- It can be executed under the RESET status (except for the constant value control status).
- Eight types of PIDs can be calculated based on the eight types of SVs predefined for AT2.
- PIDs calculated using AT2 are registered in PID numbers from 1-8 respectively.
  ATs can be set to ON/OFF for eight types independently, and some ATs can be executed with arbitrary numbers.

(3) AT3

- This is an auto tuning for SV section of Output 1.
- It can be executed under the RESET status (except for the constant value control status).
- Eight types of PIDs can be calculated based on the eight types of SVs predefined for AT3.
- PIDs calculated using AT3 are registered in PID numbers from 9 - 1 to 9 - 8 respectively.
  In addition, ATs can be set to ON/OFF for eight types independently, and some ATs can be executed with arbitrary numbers.

(4) AT4

- This is an auto tuning for Output 2.
- It is the SV currently executed or for constant value control.
- It can be executed in the RUN status (except for the program end status) or in the constant value control status.
- It executes auto tuning using SV when AT4 is set.
- PIDs calculated using AT4 are registered in PID of Output 2.

(5) AT5

- This is an auto tuning for SV8 types of Output 2.
- It can be executed under the RESET status (except for the constant value control status).
- Eight types of PIDs can be calculated based on the eight types of SVs predefined for AT5.
- PIDs calculated using AT2 are registered in PID numbers from 1~8 respectively.
  ATs can be set to ON/OFF for eight types independently, and some ATs can be executed with arbitrary numbers.

(6) AT6

- This is an auto tuning for SV section of Output 2.
- It can be executed under the RESET status (except for the constant value control status).
- Eight types of PIDs can be calculated based on the eight types of SVs predefined for AT6.
- PIDs calculated using AT6 are registered in PID numbers from 9 - 1 to 9 - 8 respectively.
  In addition, ATs can be set to ON/OFF for eight types independently, and some ATs can be executed with arbitrary numbers.

In the case of Output 2 specifications, MV (output value) of the output side for which AT is not running is found to be 0%. For example, when AT1 is running, MV (output value) of Output 2 is found to be 0%.

With regard to auto tuning, PID may not be obtained successfully even if an auto tuning operation is started. Possible condition in which no PID can be obtained are as follows. In this case, PID constants are not changed and the original PID constants remain as they are.

- It takes more than 6 hours to get PID due to extremely slow response since the auto tuning operation started.
- The I or D value calculated in auto tuning is less than 1 second due to very quick response.
- The P value calculated in auto tuning is less than 0.1%, or 1000% or larger.

11 - 6. PID control

PID control is the most common control algorithm based on a combination of proportional (P), integral (I), and derivative (D) operations.

(1) P-operation

- It is the basic operation of PID control. It largely affects the responsiveness and the stability. Offset may be generated when using only proportion operations.
- Increasing P decreases the amplitude of PV (measured value) and improves the stability but deteriorates the response.
- When P is set to 0% ("P=0%"), two-position control is performed.

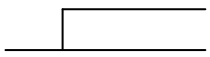
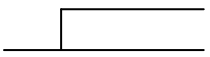
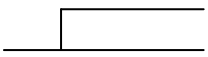
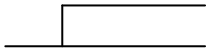
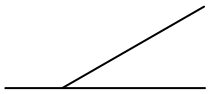
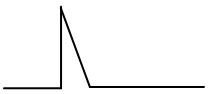
(2) I-operation

- I-operation eliminates offsets caused by P-operation but causes phase lags and thus deteriorates the stability.
- Decreasing I (enhancing the integral operation) improves the response but increases the overshoot.
- A setting value of "0" specifies infinity (∞).

(3) D-operation

- D-operation compensates a delay of phase due to wasted time or delayed elements. However, since increased gains are observed in the high frequency area, this operation has a limited strength.
- Increasing D improves the response to large deviations but deteriorates the stability against deviations for short durations.
- A setting value of "0" specifies OFF.
- The setting of D is commonly about one-sixth to one-fourth of the setting of I.

The PID operation can be summarized as shown in the following table:

	Proportional (P) operation	Integral (I) operation	Derivative (D) operation
Input			
Output			

This product offers two algorithms for PID control, either of which can be selected.

Control algorithm

1) PID type POSITION: Effective for control targets having relatively slow response
2) PID type VELOCITY: Effective for control targets having relatively slow response

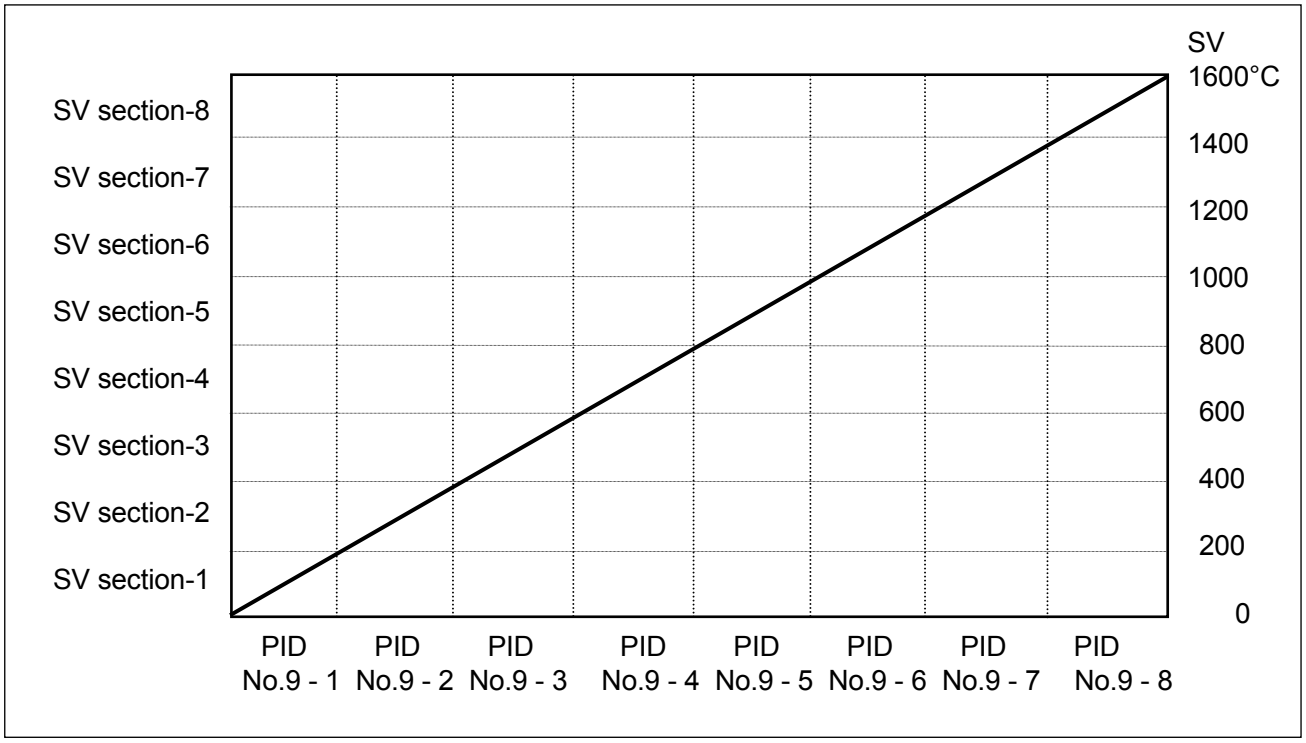
For theory and details of PID control, see appropriate technical documents.

11 - 7. Automatic PID switching type

For execution number system, automatic PID switching system creates up to 8 divisions of a SV section using the measurement scope as the maximum range and registers a PID in each of the SV section in advance. Therefore, this function enables to employ a predefined PID registered for each SV section when any SV is selected for execution.

Hence once the PID numbers from 9 - 1 to 9 - 8 are defined for SV sections and the automatic PID switching system, even if the SV is changed, there is no trouble of changing the PID accordingly.

Automatic PID switching system can be selected for Output 1 PID and Output 2 PID separately.



Based on the above diagram, the following describes the settings.

(1) Setting SV section

- Investigate the setting range and SV range, and then decide the number of divisions to which the SV section is divided.
- Set SV sections through "PID/ALARM/AT", "PID", and then "ZONE SETUP" of Mode 3
  * In the above example, the measurement scope is 0 to 1600°C, and for a span of 1600°C, the SV section is defined with eight 200°C sections.

(2) PID setting

- PID corresponding to "PID/ALARM/AT", "PID", and then "ZONE SETUP" of Mode 3 are set for No.9 - 1 to 9 - 8.
  * PID can also be obtained through auto tuning. Auto tuning that is used to gain the PID numbers from 9 - 1 to 9 - 8 is AT3.

(3) Selecting PID system

- In [PATTERN SETUP] under [PROGRAM PATTERN EDIT] of Mode 2, set the [PATTERN No.] to "No.9".

11 - 8. On-off servo output adjustment

If the output type is On-off servo, the controller and the actuator (motor etc.) should be adjusted. Do the adjustment basically by auto adjustment. Fine adjustment can be done manually also, however if you are using it for the first time, use the automatic adjustment first and then the manual fine adjustment. When auto adjustment is not performed, output value of output display screen and feedback value have a margin of error.

(1) .Auto adjustment

1) Initializing the setting value
   - Before the adjustment, consider the setting value of 'FB dead band' of mode 4 as the initial value.
   - For initial value, the dead band becomes 1.0%.
   - Other than that for output in the range of 0-100%, confirm each parameter.
2) Zero / Span adjustment
   - Please select "FB-auto tuning" button and push [ENT] key in mode 4"On-off servo output adjustment". "FB-auto tuning" screen is displayed.
   - "Start" button is selected and [ENT] key is pushed on "FB-auto tuning" screen. Please select "Yes" after the confirming message of the FB tuning start is displayed and push [ENT] key. The FB tuning is begun.
   - The actuator automatically runs on CLOSE side and OPEN side and calculates the zero span value automatically.
   - The message of the END confirmation is displayed when the FB tuning ends, and push A key, please. After the result of an automatic calculation is displayed, the zero/span value can be confirmed.
3) Dead band adjustment (Gain adjustment)
   - See 5) of “Manual adjustment”.

If the movement of actuator is delayed too much, auto calculation by 'FB tuning' is not possible. In that case after a fixed period return to 'END' and zero/span value is not registered.

(2) .Manual adjustment

1) Initializing the setting value
   - Before the adjustment, return the setting value of 'FB dead band' and 'FB zero/span' of mode 4 "On-off servo output adjustment" to initial value.
   - Initial values are zero is 0.0%, span is 100.0% and dead band is 1.0%.
   - Other than that for output in the range of 0-100%, confirm each parameter.
2) Zero adjustment
   - Perform manual output operation (manual output) and set the output value to 0.0%.
   - Actuator scales out on CLOSE side.
   - Increase the output value by 0.1% every time and request an output value that erases CLOSE display.
3) Span adjustment
   - Similarly the output value is set to 100.0%.
   - Actuator scales out on OPEN side.
   - Decrease the output value by 0.1% every time and request an output value that erases OPEN display.
4) Registering zero span value
   - Set the output value requested in 2) and 3), in 'FB zero/span' of mode 4 "On-off servo output adjustment" respectively.
5) Dead band adjustment (Gain adjustment)
   - Successively, similarly set the output value to 50.0%.
   - Increase the setting value a little every time in 'FB dead band' of mode 4 "On-off servo output adjustment" and request a setting value that erases both the displays of CLOSE and OPEN of the operation screen.
   - Perform a trial operation, increase the setting value little by little until the range where there is no error in controllability and set the greatest value as the settings value of final 'FB dead band'.

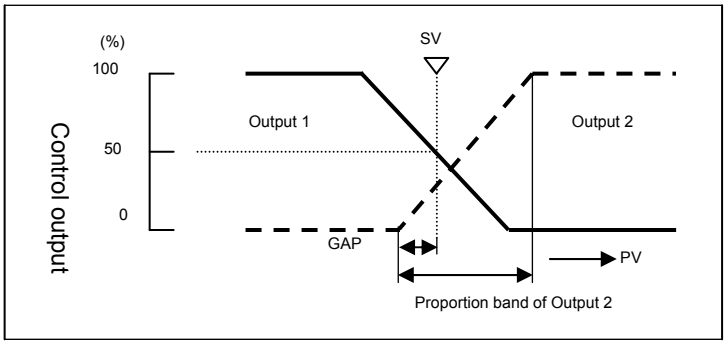
11 - 9. 2 Outputs

The 2 Outputs system of this product is designed for heating and cooling and has three types of systems, PID system, SPLIT system and cooling proportional system. Select the appropriate system after investigating each one for fitness to specific requirements.

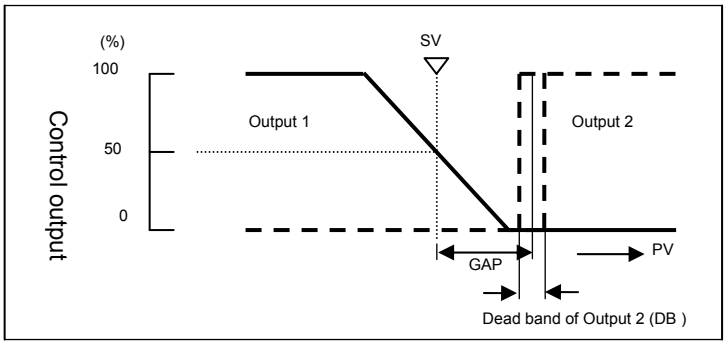
11 - 9 - 1. PID system

- This system specifies the PID of Output 2 and sets a gap between Output 1 and Output 2.
- Usually, Output 1 is set to the heating operation, "Direct/Reverse control operation" of Mode 4 is set to "REVERSE", Output 2 is set to the cooling operation, and the control operation is set to "DIRECT".
- As shown in the diagram below, a gap indicates the distance between SV and 0% of Output 2 (for proportion band), and set by selecting "PID" and then "OUTPUT GAP" of Mode 3.
- When both Output 1 and Output 2 are set to PV=SV, if you want to set output to 50% (I operation and D operation are not included), the gap can be calculated by G (%)= -P/2 (P: Proportion band of Output 2, Output 2 is Direct operation).

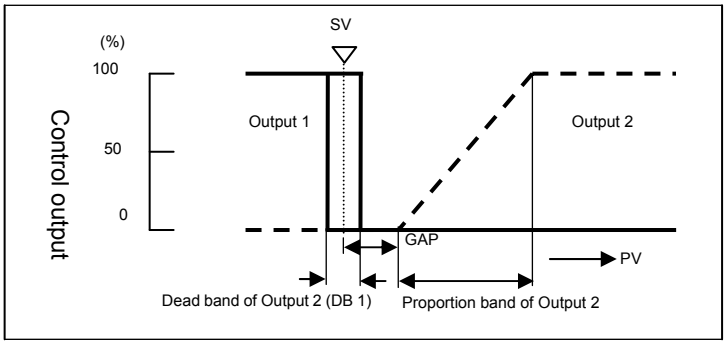
Output 1 P≠0
Output 2 When P≠0



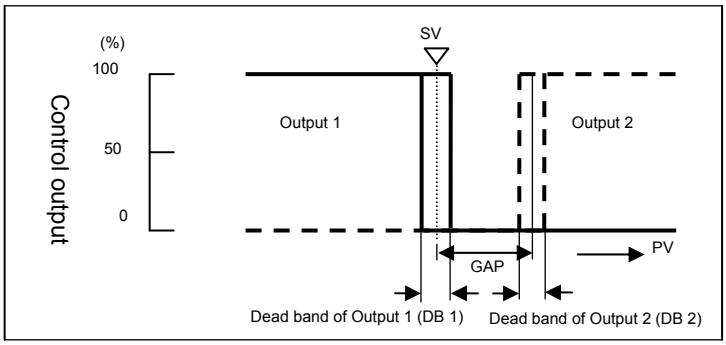
Output 1 P≠0
Output 2 When P=0



Output 1 P=0
Output 2 When P≠0

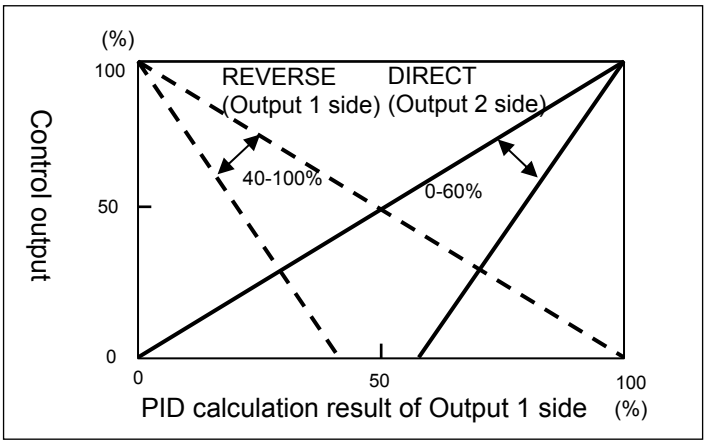


Output 1 P=0
Output 2 When P=0



11 - 9 - 2. Split system (HEATING & COOLING SELECT)

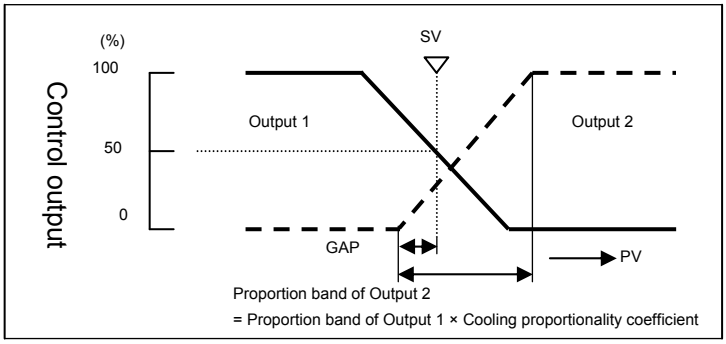
- With the matching box calculation (split calculation) system, operation is performed based on the PID calculation results of Output 1 as shown in the following diagram.
- The setting ranges are 0-60% for DIRECT and 40-100% for REVERSE.
- Regardless of the DIRECT/REVERSE settings specified by selecting "OUTPUT / CONTROL", "CONTROL", and then "CONTROL DIRECTION" of Mode 4, action is set to "REVERSE" for Output 1 and "DIRECT" for Output 2.
- When Split calculation is selected, the output action works independently for Output 1 and Output 2. Even if Output 1 is set to Manual output, if Output 2 is set to Auto output, a split calculation is performed on the PID 1 calculation results to generate Auto output. On the other hand, if Output 2 is set to Manual output, Output 1 is not affected.



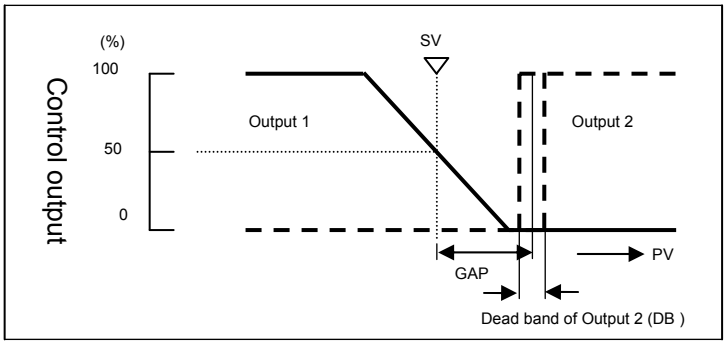
11 - 9 - 3. Cool proportion (HEATING & COOLING SELECT)

- Output 2 uses the proportion band generated by multiplying the proportion band of Output 1 with the cooling proportionality coefficient to perform proportion control.

When the proportionality coefficient, Cool≠0:



When the proportionality coefficient, Cool = 0:



11 - 10. Pulse update type

For the ON-OFF pulse type output and the SSR drive pulse type output, "UPDATE TYPE" of pulse can be specified by selecting "OUTPUT / CONTROL" and then "PULSE SETUP" of Mode 4. Selectable update type and their output actions are as follows:

- PULSE CYCLE: Updates the output value in every pulse cycle which is set. Between intervals, the output value previously updated is used to determine the ON/OFF proportion to take actions. Since only one ON/OFF action is triggered in one cycle, wear of relay contact can be reduced verified with "CONTROL INTERVAL".
- CONTROL INTERVAL:
  Updates the output value in every control interval. More precise control is possible as ON/OFF is switched according to changes in the value between the pulse cycles. However, the number of relay contact switching increases verified to PULSE CYCLE.

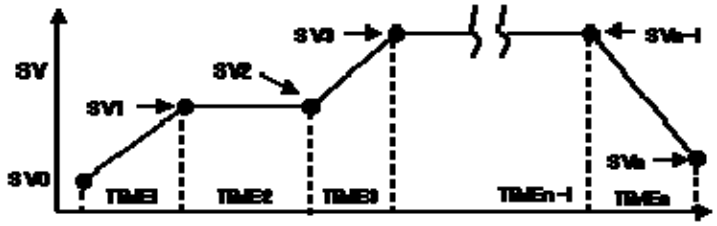
11 - 11. SV and RATE settings

With this instrument, two types of step setting methods are prepared for program patterns. The setting method can be switched in the initial setup screen of a program pattern. However, be aware that it is not allowed to switch the setting method after the program pattern is generated.

For more information about changes in the target value (SV) and time (TIME) during operation, see "10-6. Precautions during operation".

11 - 11 - 1. Setting with SV/TIME

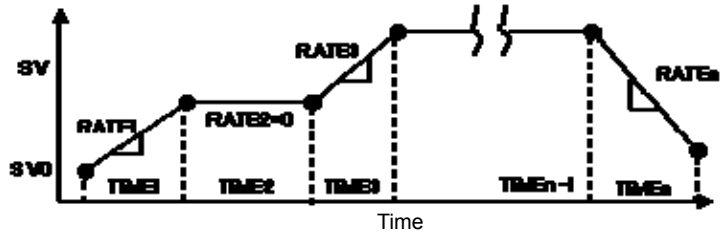
Steps are created with the target value (SV) and the time needed to reach the target (TIME). Each step start SV is the final target value of the previous step (the start SV for Step 1).



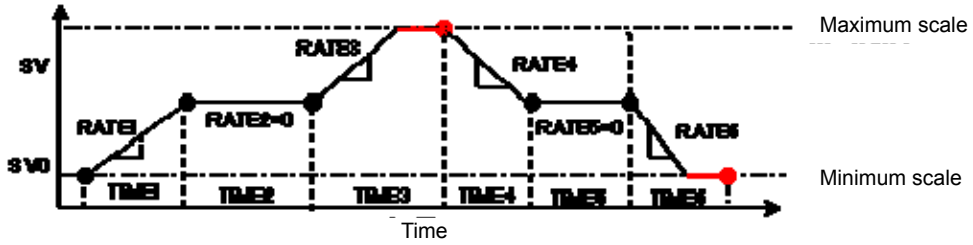
11 - 11 - 2. Setting with RATE/TIME

Steps are created with the rate (RATE) and the time period (TIME) in which the RATE is retained. The step start SV is the final target value of the previous step (the start SV for Step 1). As the result, the target value of each step is calculated by "Rate × Time + Step start SV (final value of the previous step)".

For more information about changes in the target value (SV) and time (TIME) during operation, see "10-6. Precautions during operation".

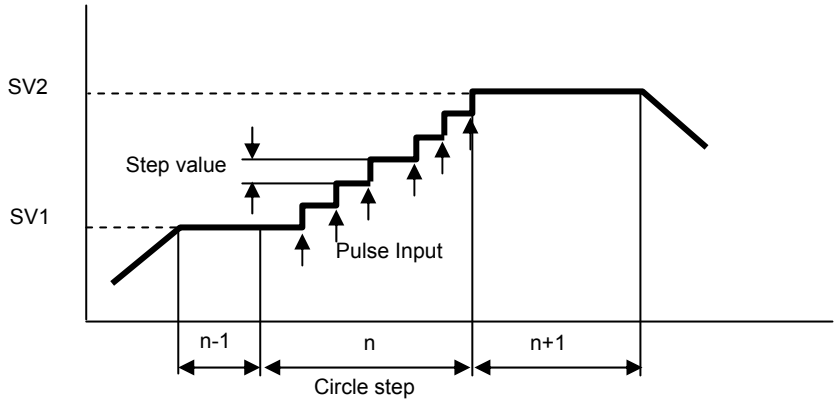


If the target value of a step calculated with the setting values of rate and time exceeds the input scale, the target value is restricted by the maximum or minimum scale and the start SV of the next step is also set to the maximum or minimum scale point.



11 - 12. Circle function

When "CIRCLE" is selected (set Time to 0 and press the V key twice) in the Step time setting within "PATTERN SETUP" displayed from "PATTERN / SEQUENCE" of Mode 2, the step becomes a circle step. With a circle step, the target value changes with a predefined step volume, regardless of time, whenever a pulse is entered. The circle function can be selected for each step and with arbitrary step volume. This function is used in combination with DI.



- Immediately after the circle step is started, the previous target value is retained. It changes with the step volume whenever a pulse is entered.
- The target value increases by the step volume in an ascending step and decreases in a descending step.
- The step target value is reached or exceeded as the result of pulse input, the next step starts by stepping.
  In a Keep step, the next step starts by a single pulse.
- Performing "ADV" and "FAST" triggers the next step with the single stepping mode.
- "STOP" and "WAIT" do not work for a circle step.
- The RUN and STOP keys do not function for a circle step.
- Time is displayed as follows:

Step elapsed time:	Step elapsed time
Pattern elapsed time:	Same time as the final value of the previous step
Step remaining time:	000:00
Pattern remaining time:	Same time as the final value of the previous step

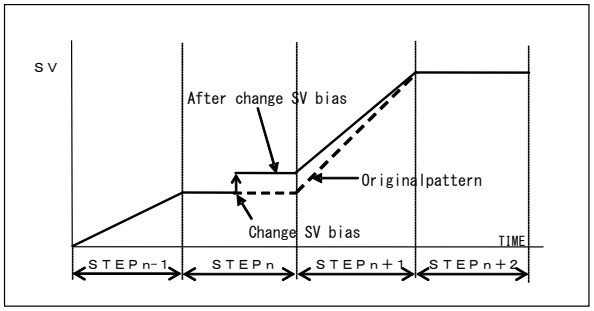
- Pattern progress display is set to Time 0. (However, if all steps are circle steps, it is displayed with a constant interval.)
- Time signal works as specified in the settings according to the step elapsed time.
- When PV start is specified, if the start PV is a circle step, SV starts at the next step of the circle step. If there are contiguous circle steps, SV starts at the step that is not a circle step.

11 - 13. SV bias

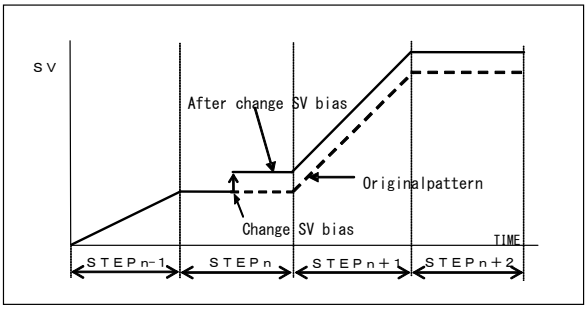
As for SV bias in Mode0 is different according to the selection SV bias type.

If "NOW STEP" is selected for SV bias type, only the values for the step in progress are compensated.

If “ALL STEP” is selected, all the values for the steps after the one in progress are compensated.



[SV bias type = NOW STEP]

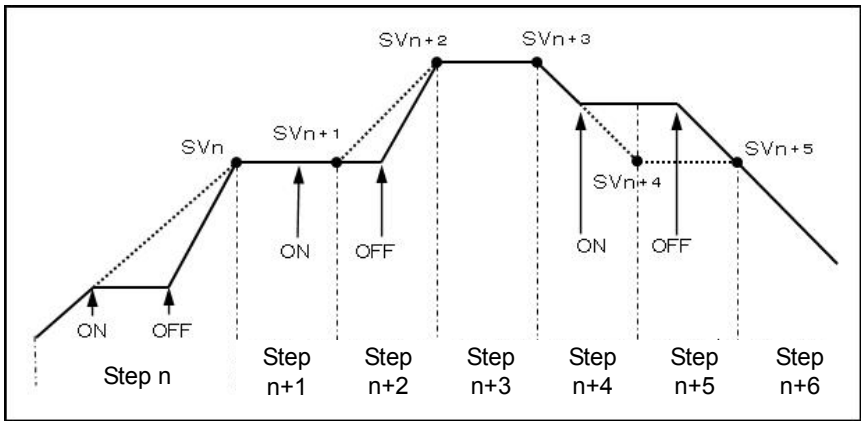


[SV bias type = ALL STEP]

11 - 14. SV hold

The following diagram shows an example of action in which an SV hold operation is executed or reset: During SV hold, SV is fixed to the previous value, but time passes for the program pattern. After being reset, SV starts to change from the fixed SV to the step target value at the time of reset.

The STOP, FAST, and ADV operations are still enabled during an SV hold period. The SV hold is cleared when a reset operation is executed.



11 - 15. Cascade primary controller

This instrument provides the calculation function that can be used as the Cascade primary controller and allows to specify the Output 1/2 (only Output 1 is available for Output 1 specification) and TRANS 1/2 (when the Transmission output option is available) as the output destination. Output values to the specified output are calculated with the following expressions.

- Cascade primary controller:

  Output signal = {a x Control calculation value of first PID (MV1)}
  + b + {c x Target value (SV)}

  a: Coefficient applied to the control calculation value of first PID (MV1) (Setting range: 0.00~1.00)

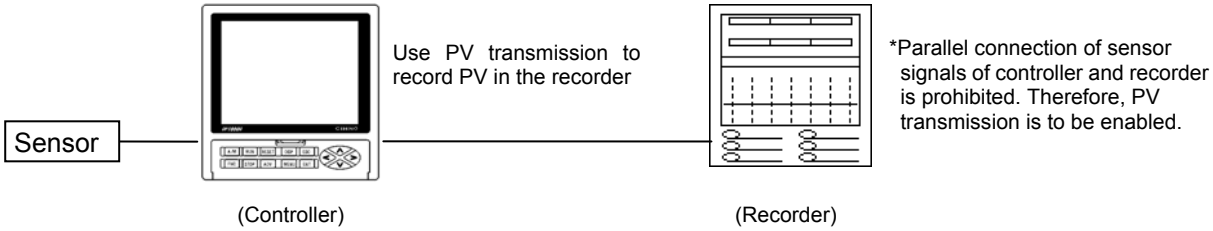
  b: Bias (Setting range: -100.0~100.00)

  c: Coefficient applied to the target value (SV) (Setting range: 0.00~1.00)

11 - 16. Transmission signal output

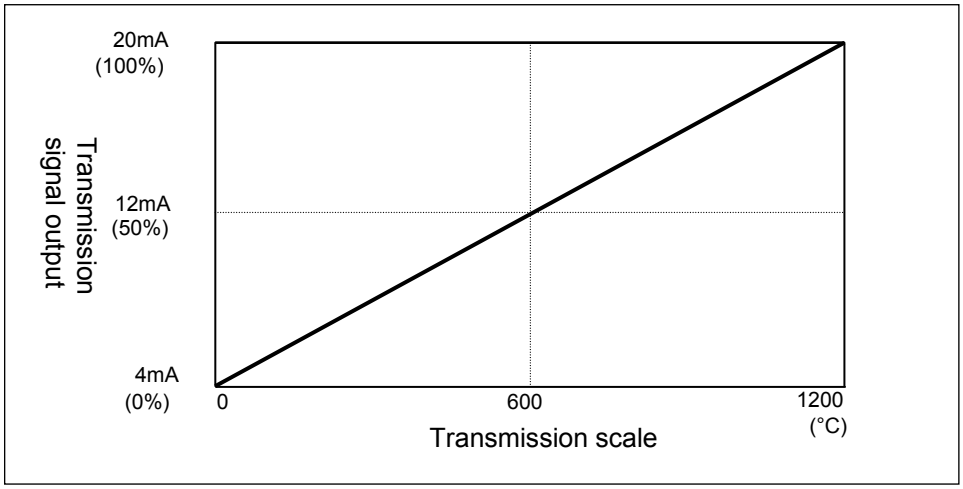
It is a function to select one type from PV (measurement value), SV (setting value), DEV (PV-SV Deviation value), MV1 (Output value 1), MV2 (Output value 2), MFSV (MASS FLOW setting value), or none, and generate analog signal output. Depending on the specification, 2 ch transmission signal outputs are also available.

For example it is available for selecting a PV transmission, connecting the analog signal to the recorder, and recording the PV of this controller in the recorder. Format is used to define the specifications of analog signal.



The following diagram shows the result of PV transmission performed with the specification in which the transmission signal output is set to 4~20 mA, the measurement range is set to K1, and the range is set to 0~1200°C.

- Set "TRANS KIND" to "PV" and "TRANSMISSION SCALE" to "0~1200" in Mode 7.



11 - 17. External signal input

This product can assign an external input signal to select a specific operation or a pattern to be used. "D/I SETUP" of Mode 10 can be used to associate the function of a specific input signal with a terminal number.

Input signals use the conductive signal (ON/OFF) of external non-voltage contact signal (relay, switch, open-collector signal, etc.). However, if the external signal input uses an external power supply specification, the controller works with the voltage signal of 12 V/24 V DC (ON when the power is applied).

11 - 17 - 1. Program external drive selection

Two types of program external drive signals, "TYPE 1" and "TYPE 2", are prepared by classifying basic signals.

"TYPE 1" contains specific signals types and actions different from those of "TYPE 2".

They are enabled only when "EXT" is selected in "PROG DRIVE" of Mode 1. The execution conditions and actions are the same as those in "10 - 2. Program operation and run operation".

● TYPE 1

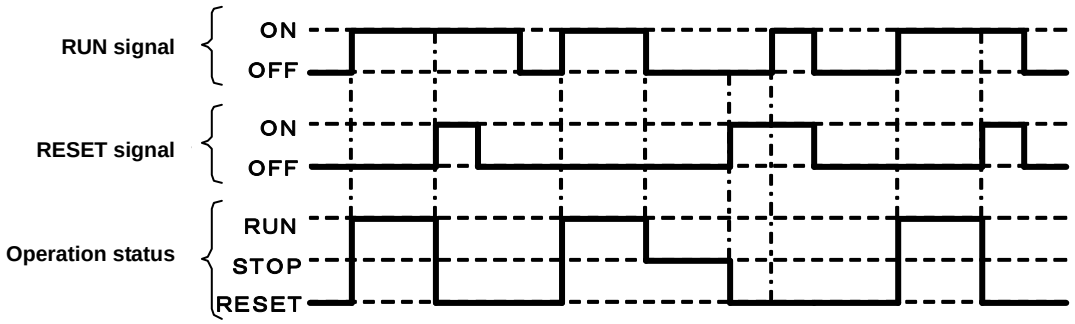
The signals of "TYPE 1" consist of RUN, ADV, RESET, WAIT, FAST (five types).

Functions and actions of each signal are as follows:

When upgrading from the DP series, select "TYPE 1".

Function name	Description
1. RUN	• The RUN/STOP operation is triggered by an external drive signal. • Used to switch between the RUN status of program operation (running) and STOP (stopped). • Specific external signal input is controlled by continuous signals. When conductive (ON), it is in the RUN status. When non-conductive (OFF), it is in the STOP status.
2. ADV	• The ADV operation is triggered by an external drive signal. • It is the function to execute steps of program pattern by ADV (advance: stepping). • Specific external signal input is controlled by momentary signals. It advances only by one step (ADV) when becoming non-conductive (OFF) after it comes in conductive (ON) for about 0.5 seconds or more.
3. RESET	• The RESET operation is triggered by an external drive signal. • It is a function to RESET (reset) program operation. • Specific external signal input is controlled by momentary signals. It enters the state of RESET by the conductive (ON) for about 0.5 seconds or more. In order to revert to the normal status after RESET, select the non-conductive (OFF) mode.
4. WAIT	• It is an operation function dedicated for external signal input. • It is a function to WAIT (wait) program operation. WAIT temporarily halt program operation and maintains control operation at the SV and time just before WAIT. It is a function mainly used for the master-slave synchronous operation. • Specific external signal input is controlled by continuous signals. When conductive (ON), it enters the WAIT status.
5. FAST	• The FAST operation is triggered by an external drive signal. • It is a function to FAST (fast-forward) program operation. • Specific external signal input is controlled by continuous signals. When conductive (ON), it enters the FAST status.

When "TYPE 1" is selected, the relationship between the RUN signal/RESET signal and the operations status is as follows:



● TYPE 2

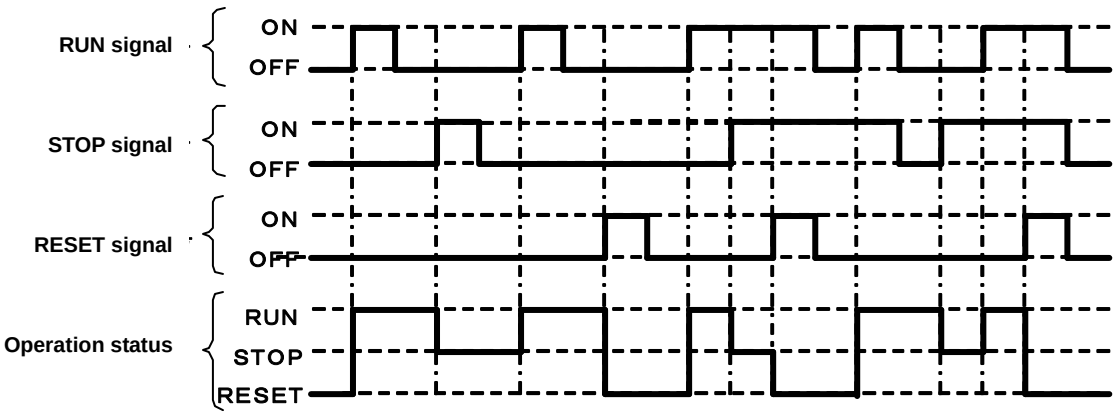
The signals of "TYPE 2" consist of RUN, STOP, RESET, and ADV (four types).

Functions and actions of each signal are as follows:

When upgrading from the DP-I series, select "TYPE 2".

Function name	Description
1. RUN	• The RUN operation is triggered by an external drive signal. • The function to Perform a RUN of program operation (run). • Specific external signal input is controlled by momentary signals. Changes to the RUN status when switched from non-conductive (OFF) to conductive (ON). In order to revert to the normal status after RUN, select the non-conductive (OFF) mode.
2. STOP	• The STOP operation is triggered by an external drive signal. • Used when the RUN status of program operation to issue a STOP (stopped). • Specific external signal input is controlled by momentary signals. Changes to the STOP status when switched from non-conductive (OFF) to conductive (ON). In order to revert to the normal status after STOP, select the non-conductive (OFF) mode.
3. RESET	• The RESET operation is triggered by an external drive signal. • It is a function to RESET (reset) program operation. • Specific external signal input is controlled by momentary signals. It enters the state of RESET by the conductive (ON) for about 0.5 seconds or more. In order to revert to the normal status after RESET, select the non-conductive (OFF) mode.
4. ADV	• The ADV operation is triggered by an external drive signal. • It is the function to execute steps of program pattern by ADV (advance: stepping). • Specific external signal input is controlled by momentary signals. When changing from non-conductive (OFF) into conductive (ON), it advances it only by one step (ADV).

When "TYPE 2" is selected, the relationship between the RUN signal/STOP signal/RESET signal and the operations status is as follows:



11 - 17 - 2. Other external signal input

<table>
<tr><th>Function name</th><th>Description</th></tr>
<tr><td>1. PTN1
PTN2
PTN4
PTN8
PTN10
PTN20
PTN40
PTN80
PTN100
PTN200</td><td>
• Pattern (PTN) No. selection is executed by external signal input.
• Pattern number section by external signal is enabled only when "EXT" is selected in "PATTERN SELECT".
• Pattern No. is selected according to the signal status when changed from the RESET status to the RUN status. Afterward, the pattern number does not change even if the signal status is changed during the RUN status.
• Pattern No. selection is executed according to the control signal of BCD code. Refer to the following list and make the external signal input with conductive (marked with ○) corresponding to the pattern number you want to select.
• If you select a BCD code other than Pattern No.1~200 or undefined pattern number, the pattern numbers before selection are retained as they are.
• Depending on the pattern number to be selected, unnecessary pattern selection signals are not needed to be allotted.
<table>
<tr><th></th><th></th><th colspan="20">Pattern No.</th></tr>
<tr><th></th><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>20</th><th>30</th><th>40</th><th>50</th><th>60</th><th>70</th><th>80</th><th>90</th><th>100</th><th>200</th></tr>
<tr><td rowspan="10">Pattern selection signal</td><td>PTN 1</td><td>○</td><td></td><td>○</td><td></td><td>○</td><td></td><td>○</td><td></td><td>○</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PTN 2</td><td></td><td>○</td><td>○</td><td></td><td></td><td>○</td><td>○</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PTN 4</td><td></td><td></td><td></td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PTN 8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○</td><td>○</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PTN 10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○</td><td></td><td>○</td><td></td><td>○</td><td></td><td>○</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td>PTN 20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○</td><td>○</td><td></td><td></td><td>○</td><td>○</td><td></td><td></td><td></td><td></td></tr>
<tr><td>PTN 40</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○</td><td>○</td><td>○</td><td>○</td><td></td><td></td><td></td><td></td></tr>
<tr><td>PTN 80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○</td><td>○</td><td></td><td></td></tr>
<tr><td>PTN 100</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○</td><td></td></tr>
<tr><td>PTN 200</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○</td></tr>
</table>
</td></tr>
<tr><td>2. Crcl Pls</td><td>
• Allots the pulse input used when the circle pulse function is used.
• Specific external signal input is controlled by momentary signals. If non-conductive (OFF) for approximately 0.5 seconds or more, SV is updated with the specified variation volume when restored to conductive (ON).
</td></tr>
<tr><td>3. PV HOLD</td><td>
• It is the function to temporarily hold PV.
• Specific external signal input is controlled by continuous signals. When conductive (ON), it is held. When non-conductive (OFF), it is deactivated.
• If external signal input is used to perform a hold, deactivate "PV hold" of Mode 1. When deactivated, external signal input can be used for switching.
• In the hold status, PV is fixed at the value of PV just before it was set, and control operations is continued with this PV.
</td></tr>
<tr><td>4. SV HOLD</td><td>
• It is the function to temporarily hold SV. Pattern time still progresses.
• Specific external signal input is controlled by continuous signals. When conductive (ON), it is held. When non-conductive (OFF), it is deactivated.
• If external signal input is used to perform a hold, deactivate "SV hold" of Mode 1. When deactivated, external signal input can be used for switching.
• In the hold status, SV is fixed at the value of SV just before it was set, and control operations is continued with this SV.
</td></tr>
</table>

Function name	Description
5. MANUAL1	• This is the function to switch Output 1 between Automatic output operation (auto output) and Manual output operation (manual output). • Specific external signal input is controlled by conductive signals. When conductive (ON) it is switched to Manual output operation, and when non-conductive (OFF) it is switched to Automatic output operation. • When using external signal input to switch between MAN/AUTO, set "PROGRAM DRIVE" to "EXT" from "OPERATION STATUS" in Mode 1. • Even when using external signal input for switching, the front keys are still available for operation. In such a case, the last switching operation is effective regardless of whether it is performed by an external input signal or by key.
6. MANUAL2	• This is the function to switch Output 2 between Automatic output operation (auto output) and Manual output operation (manual output). • Specific external signal input is controlled by conductive signals. When conductive (ON) it is switched to Manual output operation, and when non-conductive (OFF) it is switched to Automatic output operation. • When using external signal input to switch between MAN/AUTO, set "PROGRAM DRIVE" to "EXT" from "OPERATION STATUS" in Mode 1. • Even when using external signal input for switching, the front keys are still available for operation. In such a case, the last switching operation is effective regardless of whether it is performed by an external input signal or by key.
7. AL ALL RES	• It is the function to reset (clear) all of the alarm output being issued temporarily. • Specific external signal input is controlled by momentary signals. When conductive (ON), changed to the alarm reset status. In order to revert to the normal status after resetting, select the non-conductive (OFF) mode. If not reverted and remained conductive (ON), the reset status is retained.
8. AL1-4 RES	• It is the function to reset (clear) 1~4 of the alarm output being issued. • Specific external signal input is controlled by momentary signals. When conductive (ON), changed to the alarm reset status. In order to revert to the normal status after resetting, select the non-conductive (OFF) mode. If not reverted and remained conductive (ON), the reset status is retained.
9. AL5-8 RES	• It is the function to reset (clear) 5~8 of the alarm output being issued. • Specific external signal input is controlled by momentary signals. When conductive (ON), changed to the alarm reset status. In order to revert to the normal status after resetting, select the non-conductive (OFF) mode. If not reverted and remained conductive (ON), the reset status is retained.

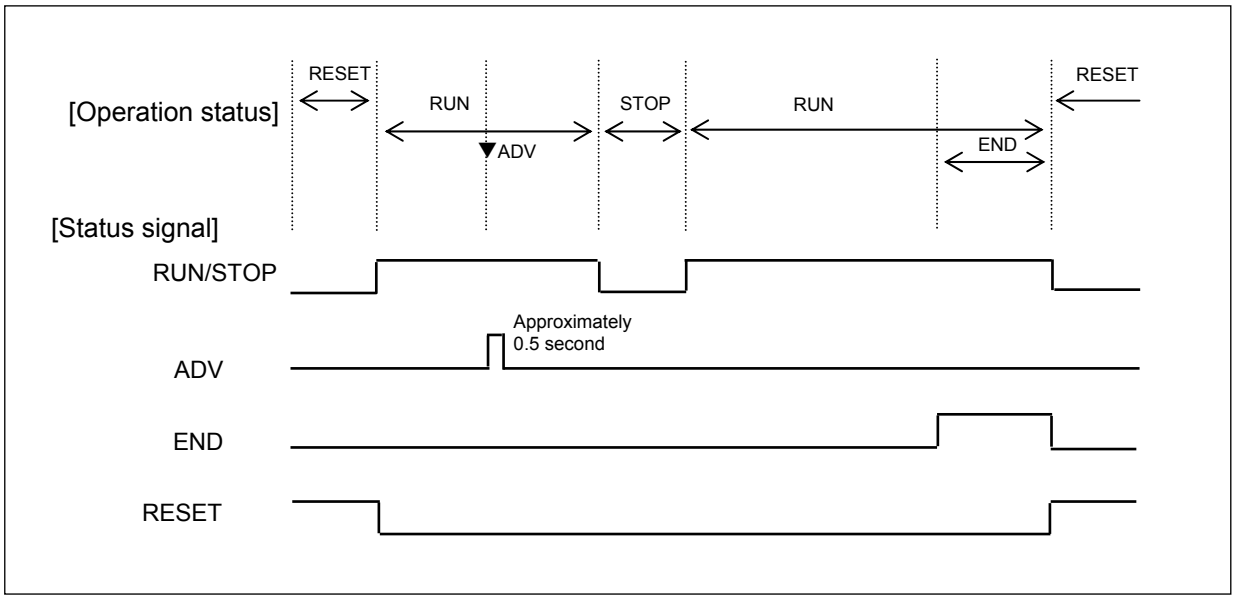
11 - 18. External signal output

The time signal and various status signals can be output as open-collector signal when this product is configured with the specification of external signal output. By selecting "D/O SETUP" from "ENHANCED SETUP" of Mode 10, associate a specific external output signal with a terminal number.

Function name	Description
1. TS1-28	• It is the time signals (continuous signals). • There are 18 types of time signals from TS1 to TS18 (maximum of 28 types up to TS28). ON/OFF time of time signals for Mode 6 can be selected from 30 types. When time signal is set to ON, output signal is ON. • When the program operation status is END, all time signals are turned off.
2. RUN	• It is the status signal of RUN (continuous signal). • When the operation status is RUN, the output signal is ON and when it is STOP, the output signal is OFF.
3. ADV	• It is the status signal of ADV (momentary signal). • When the operation status is ADV, output signal is switched on only for approximately 0.5 second.
4. RESET	• It is the status signal of RESET (continuous signal). • When the operation status is RESET (cleared), the output signal is set to ON.
5. WAIT	• It is the status signal of WAIT (continuous signal). • When the operation status is WAIT, the output signal is set to ON. WAIT represents the wait status during guarantee soak and WAIT is set to ON for external signal input. However, when the program drive system is set to "SLAVE", the WAIT status is not generated as output by an operation of external signal input.
6. FAST	• While a program is being fast-forwarded, the output signal is set to ON.
7. END	• It is the status signal of END (continuous signal). • When the operation status is END, the output signal is set to ON.
8. ALM WAIT	• While a wait time alarm is being issued for guarantee soak, the output signal is set to ON.
9. ERR	• When any CPU operation error, the abnormalities in internal memory data, and FAIL occur, the output signal is set to ON.
10. SV UP	• If the running step is an ascendant step, the output signal is switched to ON.
11. SV DOWN	• If the running step is a descendant step, the output signal is switched to ON.
12. PV HOLD	• When PV is in the held status, the output signal is switched to ON.
13. SV HOLD	• When SV is in the held status, the output signal is switched to ON.
14. MANUAL1	• When Output 1 is set to manual output operation, the output signal is switched to ON.
15. MANUAL2	• When Output 2 is set to manual output operation, the output signal is switched to ON.
16. STOP	• It is the status signal of STOP (continuous signal). • When the operation status is STOP, the output signal is ON and when it is RUN, the output signal is OFF.
17. CONST	• If the control format is set to constant operation, the output signal is switched to ON.

Function name	Description
18. BURN OUT	• If the input is burnt out or exceeds the high/low limit of input range, the output signal is switched to ON.
19. KEY LOCK	• When operation key lock is setting to ON, the output signal is switched to ON.
20. MODE LOCK	• When M0-M10 operations are all locked, the output signal is switched to ON.
21. FAIL	• When any RJ data abnormality, A/D conversion abnormality, or CPU operation error is detected, switched to ON.
22. HEALTH	• When the control action is functioning normally with the control interval, ON/OFF is repeatedly switched per 1 second.
23. PTN NO BCD1 BCD2 BCD4 BCD8 BCD10 BCD20 BCD40 BCD80 BCD100 BCD200	• Currently running pattern (PTN) number. • Generates BCD code for each signal. • Example: If the pattern number is 5, the output signals of BCD1 and BCD4 are switched to ON.
24. STP NO BCD1 BCD2 BCD4 BCD8 BCD10 BCD20 BCD40 BCD80 BCD100 BCD200	• Currently running step (STP) number. • Generates BCD code for each signal. • Example: If the step number is 5, the output signals of BCD1 and BCD4 are switched to ON.
25. AL1-8	• Signals corresponding to the alarm (AL) 1 through 8. • When an alarm is issued, the output signal is switched to ON.

The following diagram shows a summary of the operation status and status signals.



⚠ Precautions	External signal outputs have some delay in change of these signal state. After understanding the following notes, please give safety measures when you use an external signal output as an important manipulate signal of equipment.

* The notes on use of the external signal outputs

When using an external signal output in combination with external receiver machines (PLC etc.), it originates in the characteristic of an output or a receiving circuit, and some delay arises in "ON/OFF" of a received signal. The delay in "change to "OFF" from "ON" state" becomes large especially.

With a receiver machine or signal power supply voltage, although delay time is various, it is generally as follows.

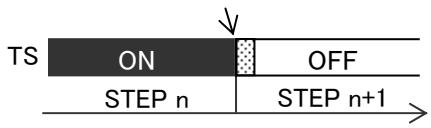
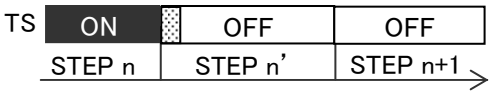
- Change to "OFF" from "ON" : 0.5msec － 2msec
- Change to "ON" from "OFF" : Less than 0.1 msec

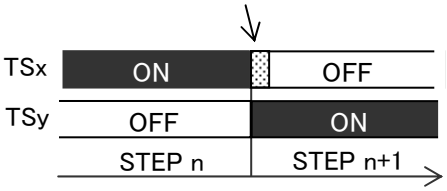
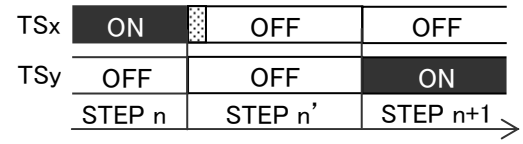
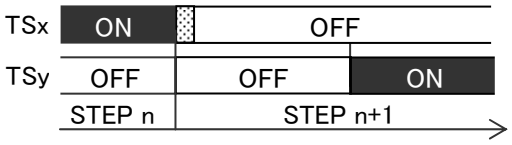
When you use an external signal outputs as important manipulate signals of your equipment, please set up program patterns or give the safety measures by the side of your equipment, after taking signal delay into consideration.

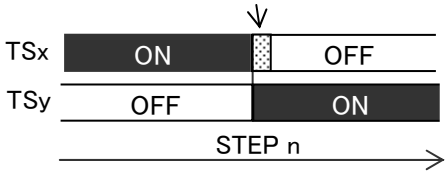
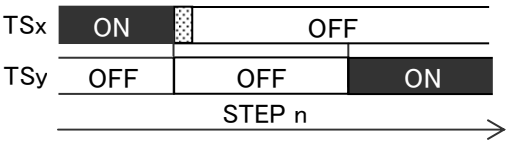
Hereafter, the notes on time signal use are shown as an example of the influence by the delay in external signal outputs.

The notes on time signal use

<table>
<tr><th colspan="2">The problems on use</th><th>Proposed measures by time signal setup</th></tr>
<tr><td>"ON" state remains in case a step changes.

▒ : OFF delay</td><td>"ON" state remains in the following step.
 
</td><td>A dummy step (Time≧000:01) is inserted and the influence of "ON" state remains in the following step is eliminated.
 
</td></tr>
<tr><td rowspan="2">Overlap of "ON" state in case a step changes.

▒ : OFF delay
x ,y : TS_No.(1~28)</td><td rowspan="2">"ON" state overlaps in the following step.
 
</td><td>1) A dummy step (Time≧000:01) is inserted and the influence of "ON" state overlap in the following step is eliminated.
 
</td></tr>
<tr><td>2) ON time setup of the following step is made or more into 000:01, and "ON" state overlap is eliminated. (ALL_ON does not use it.)
 
</td></tr>
<tr><td>Overlap of "ON" state within the same step.

▒ : OFF delay
x ,y : TS_No.(1~28)</td><td>"ON" overlaps within the same step.
 
</td><td>"ON" state overlap is eliminated by setting up time (000:01 or more) for both to be come by "off" between two time signals.
 
</td></tr>
</table>

11 - 19. Master/Slave synchronous operation

Exclusively for the specifications with external signal input and external signal output, by combining the external drive signal and the status signal for a number of DP series units, a synchronous program operation can be performed including a guarantee soak status.

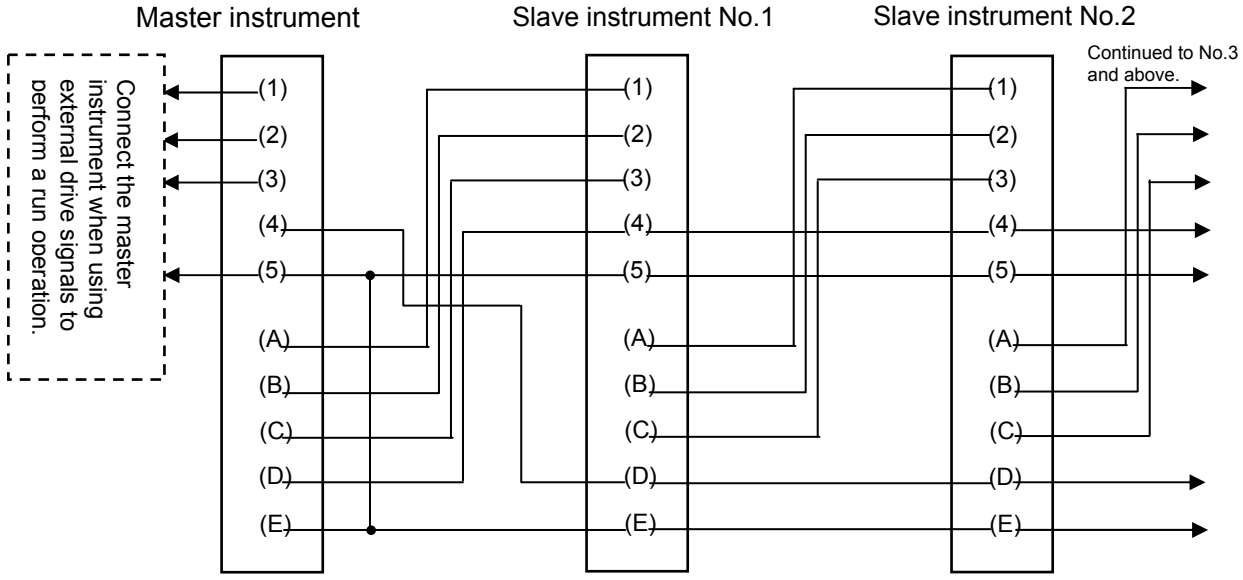
Even if a guarantee soak operation is executed, a system that inherits a synchronous operation is called master slave synchronous operation and considered as one of the excellent functions of DP series. In the case of a guarantee soak operation, when no problem is expected for asynchronous operation, operation using a parallel connection of general external drive signal is acceptable.

11 - 19 - 1. View point

Combine the external drive signal and the status signal. Among a number of units performing synchronous operation, select one unit as the master instrument and the others as slave instruments. Slave instruments receive the status signal, as external drive signals, from the master instrument and perform program operation. If any one of the units falls in the WAIT status during guarantee soak operation, by sending that WAIT status signal to the external drive signal WAIT of the master instrument, all the other slave instruments also fall in the WAIT status. Therefore, in the case of guarantee soak operation, a synchronous operation can be executed to minimize time difference.

11 - 19 - 2. Wiring

An example of basic master slave synchronous operation wiring is shown in the diagram below.



External drive signal		Status signal	
Terminal	Function	Terminal	Function
(1)	RUN/STOP	(A)	RUN/STOP
(2)	ADV	(B)	ADV
(3)	RESET	(C)	RESET
(4)	WAIT	(D)	WAIT
(5)	COM	(E)	COM

* In this table, the terminal number is nothing more than a placeholder, and replaces it by the terminal number actually used.
Develop the actual settings corresponding to the above settings.

11 - 19 - 3. Setup

Set the "Program drive operation" of Mode 1 as follows.

	Settings
Master instrument	Select an appropriate setting from the following: • "KEY": : Set when performing the run operation using the front key. • "EXT" : Set when performing the run operation using external drive input. • "COM" : Set when performing the run operation through communications. Can be selected only when using specifications with communications.
Slave instrument	Set all to "SLAVE".

11 - 19 - 4. Operation

(1) Run operation

- Run operation is executed only for the master instrument.
- All of the slave instruments are run by synchronizing them with the status signal of the master instrument.

(2) Guarantee soak operation

- When guarantee soak is started for any one of the machines, a WAIT status signal is generated from that machine and a WAIT signal is sent to all of the slave instruments from the master instrument. Thus all of the connected products are switched to WAIT and are synchronized.

11 - 20. Communications interface

The product provides various communications functions as follows:

11 - 20 - 1. Engineering port

It is a communications function equipped in all products. When the lower cover is opened, the engineering port is found on the left side of front view. Also it can be used to connect to a PC with a dedicated engineering cable (sold separately).

The communications specification of the engineering port is as follows:

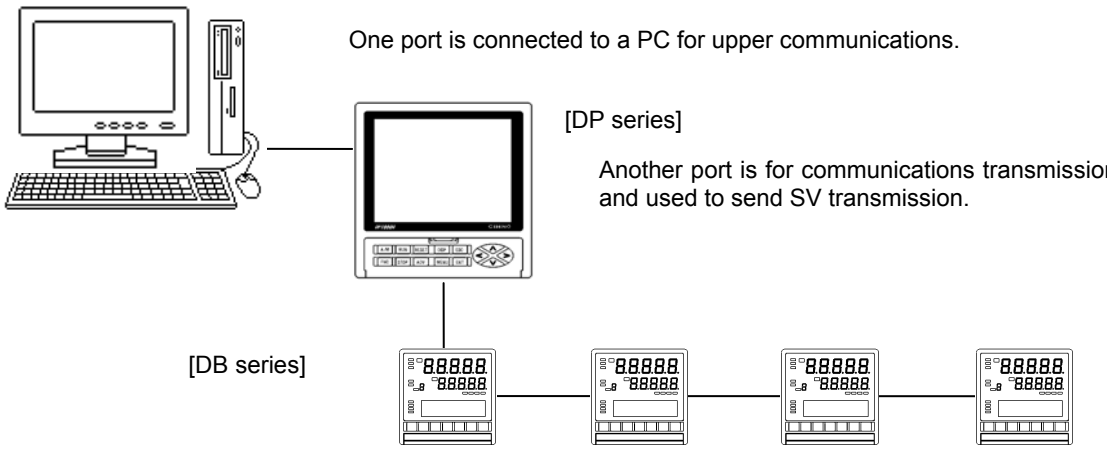
- Communications protocol: MODBUS-RTU/MODBUS-ASCII
- Communication speed: 19200 bps
- Communications character: 8 bit/parity NON/stop bit 1

11 - 20 - 2. Communications specification

If communications is always required, select a specification with communications. Communications type can be selected from RS-232C, RS-422A, and RS-485. In addition, provided that RS-232C or RS-485 is selected, a second port can be added for communications.

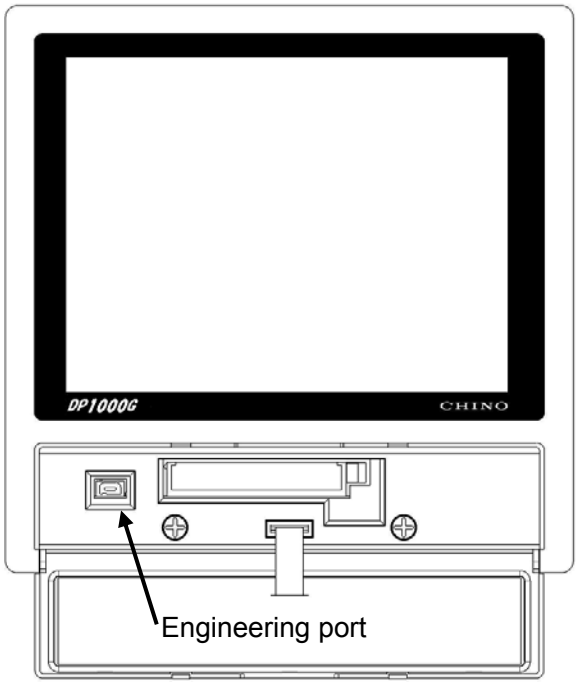
A communications enables setting of parameters (Data Write) and reading data (Data Read) by connecting to a PC and also enables remote operation and data management using a PC. As an additional function of DP series, the communications transmission (digital transmission) function is provided. With this function, combined with the digital indicating controller DB series which is a sister model, SV transmission is sent from a DP series controller through communications and received by a remote SV of DB series, enabling a remote operation without any error. While the remote operation through remote signal input of DB series is called Analog Remote, the remote operation through communications remote is called Digital Remote.

The following diagram shows a model example of remote operation by communications transmission through DP series and communications remote function through DB series, selecting a specification with 2 port communications and performing upper communications with a PC.



12. Engineering port

This function can be used to connect with the PC from the front face of this product. This function is provided for all products by default regardless whether the specification includes the communications interface or not.
An engineering cable for exclusive use can be fitted over an engineering port, and it can connect with a personal computer by MODBUS communication.
However, at our company, the software for personal computers for connecting with DP-G using an engineering port is not supplied (as of the end of 2011).
Please give creation and business mind by the user.



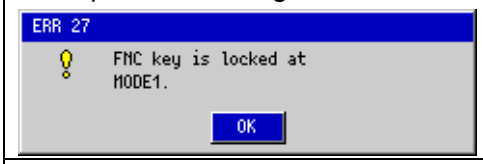
The engineering port is designed for temporary communication connection and is not intended for constant connection. If you want to use communications through constant connection, specify the one with the communications interface and establish a permanent connection from the back side.

Precautions	Be sure to connect/disconnect an engineering cable to/from the engineering port of this product while the power is on.

13. Error massage

13 - 1. Setting & operation errors

When you do not configure the settings or perform operations appropriately, the error message below is displayed. Check the error message contents and configure the settings or perform operations appropriately.

Error message number	Error contents
Example of a message screen 	It indicates that an error occurs during operations.
1. ERR 0	FNC key is invalid
2. ERR27	FNC key is used when it is locked in the setting in Mode 1.
3. ERR29	RUN, STOP, ADV, or RESET key is used during running AT1.
4. ERR30	STOP key is used in RESET.
5. ERR33	RUN, STOP, and ADV were operated in END.
6. ERR34	RUN, STOP, ADV, or RESET key is used in CONST.
7. ERR41	The time 0 is set up by 2 step continuation.
8. ERR49	The number of steps is a maximum (4000 steps). The addition of a step cannot be performed any more.
9. ERR51	The copy destination pattern No. is already set by pattern copy operation in Mode 2. A pattern can not be overwritten.
10. ERR60	It was going to choose and RUN the number of the pattern which is not set up.
11. ERR61	Although a pattern link setup is carried out at the start pattern, since the pattern of a link place has not been set up, it cannot RUN.
12. ERR62	The pattern which is the target for RUN is set for the pattern link. However, RUN can not be performed on that pattern because the linked pattern is not set.
13. ERR65	You try to start AT1 in RESET.
14. ERR66	You try to start AT2 in RUN or CONST.
15. ERR67	You try to start AT3 in RUN or CONST.
16. ERR68	You try to start AT4 in RESET.
17. ERR69	You try to start FB tuning in RUN or CONST.
18. ERR71	You try to start AT2 or AT3 in FB tuning.
19. ERR72	The program drive key is used in the front when MASTER COM is set for PROG.DRIVE TYPE in Mode 1.
20. ERR73	The program drive key is used in the front when EXT is set for PROG.DRIVE TYPE in Mode 1.
21. ERR75	The pattern select key is used in the front when COM is set for PATTERN SELECT TYPE in Mode 1.
22. ERR76	The pattern select key is used in the front when EXT is set for PATTERN SELECT TYPE in Mode 1.
23. ERR111	The opening time exceeded the maximum in FB auto a tuning.
24. ERR112	In FB auto a tuning, the operation time exceeded the maximum without zero detection.
25. ERR113	The closing time exceeded the maximum in FB auto a tuning.
26. ERR114	In FB auto a tuning, the operation time exceeded the maximum without span detection, or zero and span are reversed..

13 - 2. CF card related errors

Error message	Contents	Solution
No CF card.	CF card is not inserted to DP-G.	Insert the CF card to DP-G.
This MODE is locked. Can not change setup parameters.	The key operations for the memory card management are locked.	Reset the key locks related to the memory card management.
There is no file to READ.	There is no file in the target folder in the CF card.	None.
Now in program RUN. Can not read SETUP PARAMETER file.	The setup parameter file can not be read during running program.	Reset the program.
Now in program RUN. Can not read selected PATTERN file.	The selected pattern file can not be read during running program.	Reset the program.
Now in program RUN. Can not read all PATTERN file.	All pattern file can not be read during running program.	Reset the program.
Now in program RUN. Can not read AUTO LOAD file.	AUTO LOAD settings can not be read during running program.	Reset the program.
CF card is full.	There is not enough space in the CF card. SETUP PARAMETER = 6 KB or less PATTERN / SEQUENCE = 24 KB or less	Delete unnecessary files from the CF card.
Can not make directory.	CF card is write-protected. There is not enough space in the CF card. CF card is corrupted.	Delete unnecessary files from the CF card. If the same message appears after deleting unnecessary files, format the disk.
There is no PATTERN data.	There is no step data in the selected pattern No..	Select a pattern which has one or more step data or create a step data.
There is no file to DELETE.	There is no file in the target folder in the CF card.	None.
Can not delete file.	The file is already deleted.	None.
There is no PATTERN No.1 data.	There is no step data in pattern No.1 when saving AUTO LOAD.	Create one or more step data.

13 - 3. Errors displayed in PV display

Error message	Contents	Solution
DATA_H	Data input is above the measuring range	Check the sensor and input it properly.
DATA_L	Data input is below the measuring range	
B_OUT	The sensor is snapped and burnt out	
RJ_ERR	An RJ instrument error or measurement circuit error	If the problem persists after restarting the controller, contact the dealer or our sales office.
AD_ERR	An input circuit error	
COM_ERR	Error when starting CPU	

14. Troubleshooting

Symptom	Check item
1. PV has an error. Or, PV is unstable.	• Make sure there is no problem in the wiring to the sensor. • For a thermocouple, make sure the wiring is made up to the terminal screw using the thermocouple and compensation lead wire. • Make sure the terminal screw is firmly tightened. • Make sure the sensor signal is not in parallel connection with other instruments. • Make sure the impedance is not high even if the sensor signal is provided with a protection device. • Make sure there is no problem in the output signals from the sensor itself and the output specification (impedance, etc.). • Make sure the ground terminal is connected to a good protective grounding. • Make sure no noise is detected. • Make sure there is no problem in the environment and atmosphere (surrounding temperature, wind, etc.). • Make sure the various parameters (measuring range, sensor bias, etc.) are properly set.
2. The PV indicator shows "DATA_H".	• Data input is above the measuring range. Check the sensor signal.
3. The PV indicator shows "DATA_L".	• Data input is below the measuring range. Check the sensor signal.
4. The PV indicator shows "B_OUT".	• The status is burnt-out. Check the sensor signal.
5. The PV indicator shows "RJ_ERR".	• An RJ instrument error or measurement circuit error Turn off the controller, then restart it. If the problem persists after restarting the controller, contact the dealer (instrumentation supplier, installation supplier, distributor) or our sales office.
6. The PV indicator shows "AD_ERR".	• CPU error occurs regarding input and control operation. Turn off the controller, then restart it. If the problem persists after restarting the controller, contact the dealer (instrumentation supplier, installation supplier, distributor) or our sales office.
7. The PV indicator shows "COM_ERR".	• CPU error occurs regarding setting and operation. Turn off the controller, then restart it. If the problem persists after restarting the controller, contact the dealer (instrumentation supplier, installation supplier, distributor) or our sales office.
8. The operation has a problem due to an unknown cause.	• Make sure the actual settings of each parameter are correct. • If the strange operation persists, initialize the settings. Make all the settings again, then make sure there is no problem.
9. The control is unstable.	• Make sure there is no problem in the wiring to the operation terminal. • Make sure the terminal screw is firmly tightened. • Check to see that no noise is detected. • Make sure the various parameters (PID, output limiter, etc.) are properly set. * For controllability, it is necessary to design and adjust controls over the entire final product system rather than over this single product. If the controllability is not improved after adjusting the various settings of this product (PID, etc.), consult with the final product designer.

Symptom	Check item
10. An error message is displayed when setting parameters.	• The settings do not allow for registration of setting. Check the error message and the settings to correct the settings.
11. An error message is displayed when starting the operation.	• The settings do not allow for start of operation. Check the error message and the settings to correct the settings.
12. Key switch defect	• In the [KEY CHECK] screen under [M11 MAINTENANCE], perform operation check of the front keys. When the key is checked out normally, its color changes from white to blue or from blue to white on the screen.
13. The display does not show normally.	• In the [DISPLAY SETUP] screen under [M10 ENHANCED SETUP], set the appropriate value in [LCD BRIGHTNESS]. Value 1 indicates the minimum brightness and 4 indicate the maximum. If the display color is strange, confirm the indication status in the [DISPLAY CHECK] screen under [M11 MAINTENANCE].
14. The battery alarm is displayed.	• The battery is consumed, and there is a possibility that the control operation is not maintained. Please contact store purchased (instrumentation trader, installation trader, and distributor) or our offices.

If the problem persists after performing the above troubleshooting, contact the dealer (instrumentation supplier, installation supplier, distributor) or our sales office.

⚠ Warning	When repair or modification is needed, contact the dealer or our sales office. Only our authorized service engineers are allowed to repair or remodel this product, including replacement of parts. The data that have been set may disappear if an unexpected trouble (power outage, earthquake, other unexpected incidents, etc.) occurs during repair. Record the data that have been set before sending the product for repair. Any lost data is not guaranteed under any circumstances.

15. Checking and maintenance

15 - 1. Checking

15 - 1 - 1. Checking by trial operation

Before starting each operation, perform a trial operation to confirm this product and the final product are normal.

15 - 1 - 2. Accuracy checking

This product has items that require a periodic accuracy check depending on the customer's need. These may be slightly shifted in accuracy from the point of purchase due to aging.

We also perform accuracy checking. For the checking, consult with the dealer or our sales office.

15 - 1 - 3. Overhaul

Overhauling is recommended every two to three years to keep long-term reliability. For overhauling orders, consult with the dealer or our sales office.

15 - 2. Life component

For this product, the components with an obvious life are as follows:

Please understand that most components change or deteriorate with age in general.

Component name	Estimated life (guide for replacement)
1. Relay (for control, alarm)	Approximately 100,000 times
2. Electrolytic capacitor (for power circuit smoothing)	Approximately 5 years (ambient temperature: 30°C, operating duration: 12 hours/day)
3. Battery (for memory backup)	Approximately 10 years (ambient temperature: 30°C, operating duration: 12 hours/day)
4. LCD panel (for display)	Approximately 5 years (ambient temperature: 30°C, operating duration: 12 hours/day)

15 - 3. Disposal

⚠ **Precautions**	(1) A small amount of hazardous substance below the specified level with RoHS directive is included in this product. (2) When disposing this product always request a professional to do it, or dispose this product in according to the garbage collection method of the each community. (3) This product uses lithium battery. When disposing this product, always request a professional to do it after detaching the battery. (4) Dispose and separate the box, plastic bags, and cushioning materials which the controller is packaged in, according to the garbage collection method of the each local government.

・How to detach the battery for disposal

1) Taking out of internal unit (Fig.15-3-1.)

Lower cover of the front unit is opened, and loosen and detach two screws for fixation.
The lower side of the front unit is pulled a little forward, and it is pushed below. Then, the upper hooks of the front unit come off from the case, and the front unit comes to go out forward by about 10mm.
Your finger is multiplied by the edge of the front unit and the internal unit with the front unit is pulled out straight from the case.

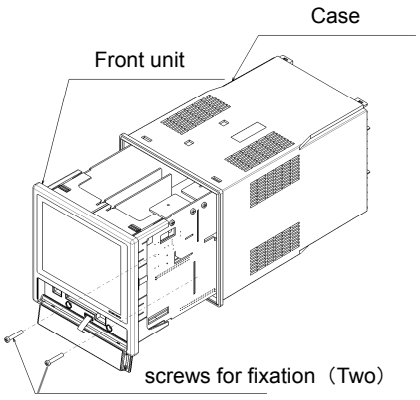


Fig.15-3-1.Taking out of internal unit

2) Separation of substrates (Fig.15-3-2.)

Tabs of the front unit are opened and the substrates are separated from the front unit.
Metallic props, screws, and connector joints that are the fixation between substrates are detached and each substrate is separated.

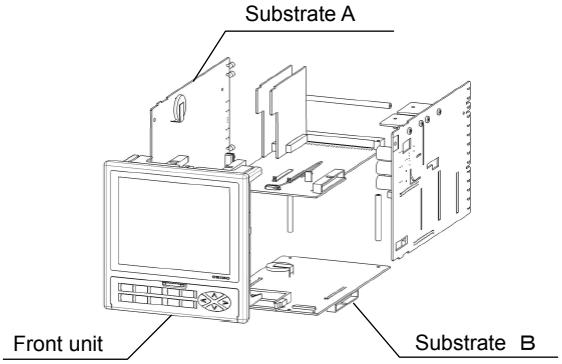


Fig.15-3-2.Separation of substrates

3) Detaching of battery (Fig.15-3-3.)

The battery is installed in each of substrate A and substrate B one by one.
Cut the leads of each battery with a tool such as nipper, and detach the battery from the substrate.

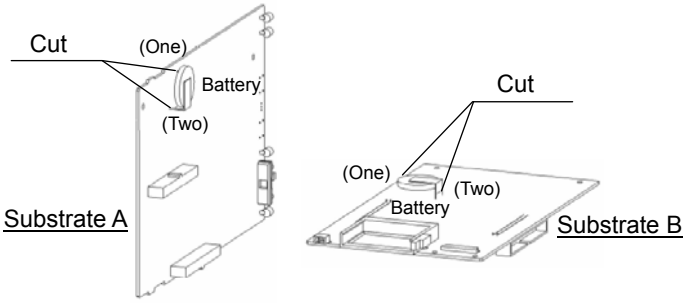
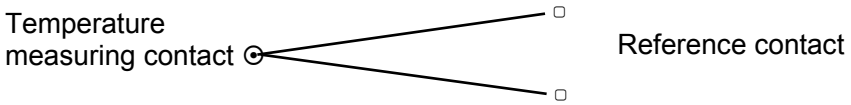
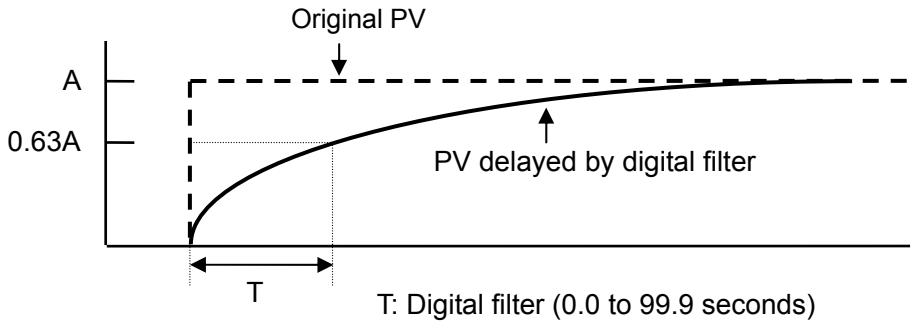


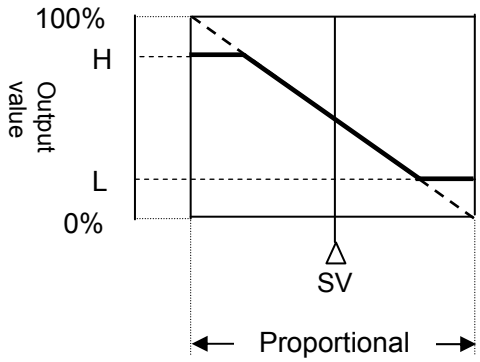
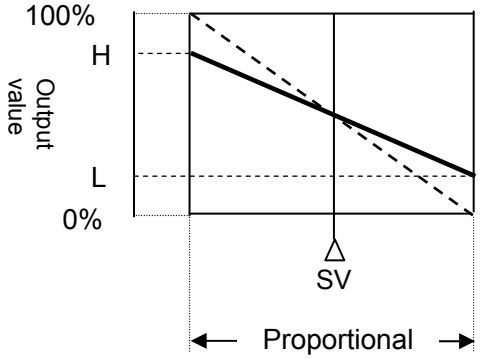
図 Fig.15-3-3.Detaching of battery

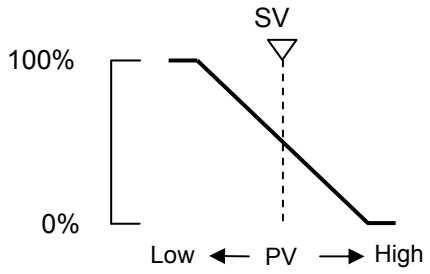
4) Disposal of battery

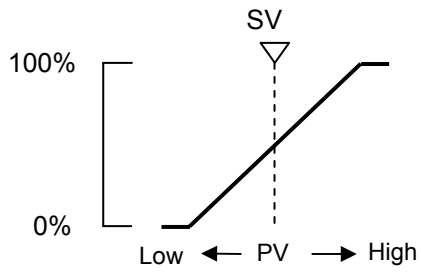
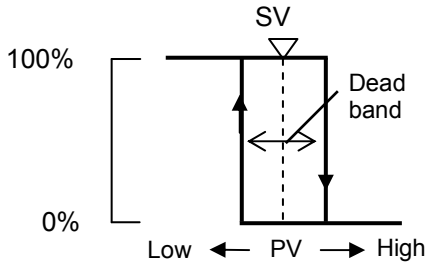
After detaching, request to dispose of the battery by a specialist.
Same with the other parts, request to dispose by a specialist or dispose under the law of your local government.

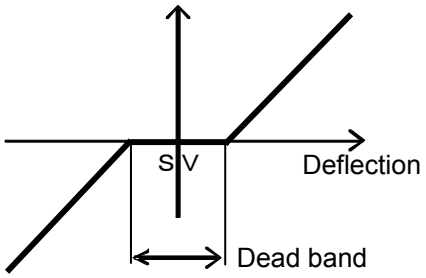
16. Explanation of terms

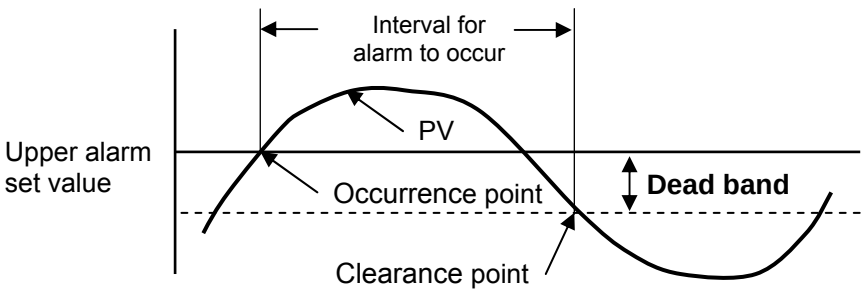
Term	Description
Unit	Select either °C or K only for thermocouples or resistance thermometers. The operation expression is as follows: • °C = K-273.15 • K = °C+273.15
RJ (Reference Junction)	Thermocouple has a temperature measuring contact (on the temperature measuring side) and reference contact (on the electromotive force generation side). For the reference contacts, the electromotive force list (calibration) is specified on the condition of 0°C.  When a thermocouple is wired to the terminal of this product, the terminal is not 0°C because usually the terminal is at around the ambient temperature. This means it is necessary to compensate for the terminal temperature in order to exactly measure the temperature. "RJ" is the function that automatically carries out the compensation within the product. The RJ function is enabled when thermocouple is selected for the measuring range.
Sensor bias	This function compensates (biases) the PV (measured value). It can also be used for zero-point adjustment of sensor signals.
PV decimal point	This function selects the decimal point for the PV (measured value). The decimal point can be defined within 5-digit display.
Digital filter	This is the filtering function on the operation that adds the first order lag operation to the PV (measured value). The set digital filter value serves as a time constant (T) and equals to the time (in second) during which the PV reaches approximately 63% of the original PV change when the PV changes in a stepped shape.  T: Digital filter (0.0 to 99.9 seconds)

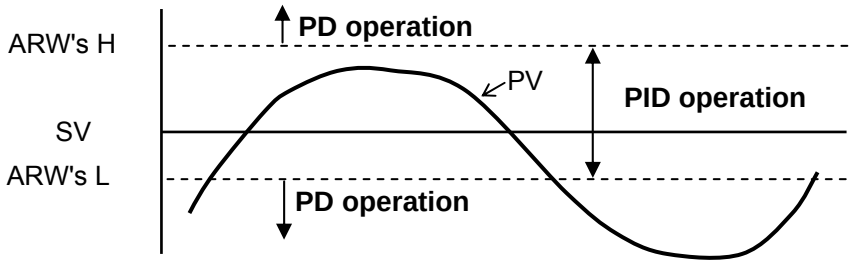
Term	Description
Output limiter	This function sets the upper and lower limits for the MV (output value) within the range from -5.0 to 105.0%. All the MVs (output values) for control shall fall between the upper and lower limits set here. This function can set to be disabled for manual outputting. This function is also disabled for the output at PV error. 
Output scale	For the set upper and lower limits, this function assigns the MV (output value) within the range from 0.0 to 100.0%. All the MVs (output values) for control shall fall between the upper and lower limits set here. However, this function is disabled for manual output operation and the output at PV error. 
Output variation limiter	This function limits the amount of change in MV (output value) per control interval (approximately 0.1 second). Suppose the MV change is 50% and the output variation limiter is set to 5%. Then, the time required is: Approximately 0.1 second x 50/5 = Approximately 1.0 second This means it takes about 1.0 second to reach the 50% change. By taking advantage of this function, the abrupt change in MV (output value) can be prevented, leading to improved controllability. However, this function is disabled for manual output operation and the output at PV error.
Output preset	This function can set the MV (output value) when SV = PV for control over the P (proportional) operation only.
Output at PV error	This function forcibly brings the MV (output value) to the value set here if the PV (measured value) is over the range (including upper burn-out) or under the range (including lower burn-out), or is in the internal data error status. A separate value can be set for over-range (including upper burn-out) and under-range (including lower burn-out). For internal data error, the MV (output value) becomes identical to the one for over-range (including upper burn-out).
Pulse cycle	This function sets an on-off cycle time for on-off pulse type or SSR drive pulse type. The controllability improves as the set value becomes smaller. However, this shortens the life of components such as relay because the ON/OFF count increases. Set as large a value in a range that does not affect the controllability.

<table>
<tr><th>Term</th><th>Description</th></tr>
<tr><td>Control direction</td><td>The "reverse direction" is an adjustment that makes the MV (output) larger as the PV (measured value) gets lower than the SV (set value).
Generally, it is used for heating control.
The "direct direction" is an adjustment that makes the MV (output) larger as the PV (measured value) gets higher than the SV (set value).
Generally, it is used for cooling control.
[Reverse control]
 

[Direct control]
 
</td></tr>
<tr><td>Output dead band
(Two-position control)
and
PID dead band</td><td>Dead band in the PID setting functions by the value of P as output dead band or PID dead band.
(1) It functions as output dead band at P=0.0%.
The longevity of the relay etc. decreases because the frequency of ON/OFF increases though the control improves by a set value small.
Within the range where there is no obstacle in the control, please set a large value as much as possible.
(2) It operates as PID dead band at P≠0.0%.
To calculate PID as deflection=0 in dead band, OUTPUT is not changed. In usual temperature control, dead band is set to 0.0%. Output can be made steady by setting dead band excluding 0% if there is staggering in measurements(PV) and output(MV) is not steady in the vicinity of SV. However, please note that the offset might remain within the range of dead band.
[Output dead band]
(Reverse control)
 

[PID dead band]
Deflection used for PID control
 

Because PID is controlled as deflection =0, MV is not changed in dead band.</td></tr>
<tr><td>Alarm dead band</td><td>This function generates an alarm at the alarm set value and releases the alarm when the alarm dead band set in the alarm set value is deviated.
 
</td></tr>
</table>

Term	Description
Alarm delay	This function delays the alarm output. The alarm turns ON only when the alarm ON judgment continues beyond the set time. The alarm does not turn ON if the alarm ON judgment time is less than the set value. For example, when the alarm delay is set to 5, the alarm turns ON only when the alarm occurs 5 consecutive times. The alarm turns OFF immediately when it is released.
A.R.W (Anti-Reset Windup)	This function defines the range of the PID operation (particularly the I operation) in the position type PID control. The PD operation takes place when this set value is deviated. 
PV start	This function is one of the functions during the PROG operation and starts the SV (set value) of the program pattern from the current PV (measured value). When the PV start is activated, the operation starts with the first SV in the program pattern that is identical to the PV when the operation status is changed from RESET to RUN. When there is no identical SV, the SV start becomes effective that starts the operation from the first step. If the pattern link is set, only the first pattern is enabled. When the first step has the start PV that is set as circle pulse, the system starts with the step next to the circle step. When there are circle steps continued, the system starts with the beginning of a non-circle step.
Guarantee soak	In the PROG operation, if the PV (measured value) is not within the guarantee soak set point for the SV (set value) when proceeding to the next new step, this function stops the time there and runs the CONST operation until the PV falls within the set point, then proceeds to the next step. So, the effective use of this function realizes the control operation in line with a program pattern. Please note that might it pass and "Guarantee soak" not be released to the following taking when a too small value is set.
Waiting time alarm	This is the alarm function for the case in which the guarantee soak-based CONST operation time elapses beyond the set waiting time alarm value.
MASS FLOW SV	This function outputs the set value to MASS FLOW controllers using transmission signal outputs. It can be used as an auxiliary output to external instruments.

17. Accessories

17 - 1. Contact protection device

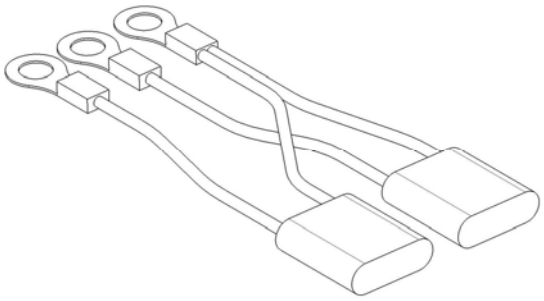
A contact protection device connected to the relay output terminal of this product in order to remove noise. Be sure to use a buffer relay and a contact protection device to connect to the load for the relay output of on-off pulse type, on-off servo type and alarm output.

We also provide the contact protection device as below: Use it as needed.

Model	Specification	Switching current	Use
CX - CR1	0.01μF + 120Ω	0.2 A or less	For light load
CX - CR2	0.5μF + 47Ω	0.2 A or more	For heavy load

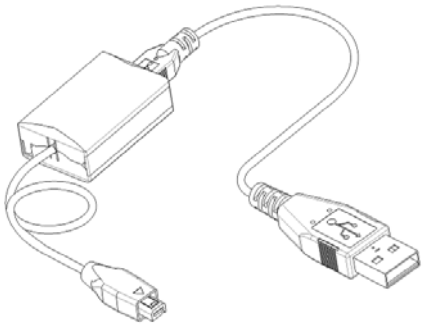
Be careful a leak current flows depending on the load when using.

Model	Supply voltage: 200V		Supply voltage: 100V	
	50Hz	60Hz	50Hz	60Hz
CX - CR1	Approximately 2 mA	Approximately 2 mA	Approximately 1 mA	Approximately 1 mA
CX - CR2	Approximately 45 mA	Approximately 55 mA	Approximately 23 mA	Approximately 28 mA



17 - 2. Engineering cable

A dedicated cable for connecting to the engineering port



[RZ-EC3]

18. Specification

■ Input specification

Input type: Universal inputs
- Thermocouple: B, R, S, K, E, J, T, N, U, L, WRe5-WRe26, W-WRe0-26, NiMo-Ni, CR-AuFe,PR5-20, PtRh40-PtRh20, Platinel II
  Old DP support range available
  (See the measuring range table)
- DC voltage: ±10 mV, ±20 mV, ±50 mV, ±100 mV, ±5 V, ±10 V
- DC current: 0 to 20 mA
- Resistance thermometer: Pt100, JPt100, old Pt100, Pt50, Pt-Co (3-wire, 4-wire)

Accuracy rating:
See the measuring range and accuracy rating table

Reference junction compensation accuracy:
K, E, J, T, N, Platinel II -- ±0.5°C or less
Old DP support range --- ±0.5°C or less
Other than above --------- ±1.0°C or less

Sensor bias: Settable by 0.1-time resolution of the target resolution

Sampling period:
Approximately 0.1 second

Burn-out: Burn-out available for thermocouple, DC voltage (±50 mV or less), and resistance thermometer (output value at occurrence is settable to any value)

Range setting:
The usable range is settable within the measuring range (only for linear range)

Scaling: DC voltage/current input
(Setting range: -99999~99999, decimal point specified)

User linearize table:
Usable for DC voltage and DC current inputs
(19 break points)

Digital filter: 0~99.9 seconds

Allowable signal source resistance:
Thermocouple input and DC voltage input (mV)
-- 100Ω or less
DC voltage input (±5 V, ±10 V)
-- 300Ω or less
Resistance thermometer input
(3-wire) -- 5Ω or less per wire
(4-wire) -- 100Ω or less per wire

Input resistance:
Thermocouple/DC voltage input
-- 1 MΩ or more
DC current input
-- Approximately 100Ω

Current measured:
Resistance thermometer input
-- Approximately 1 mA

Maximum allowable input:
Thermocouple/DC voltage input
-- ±20 V DC
DC current input
-- ±30 mA
Resistance thermometer
-- 500Ω or less, ±5 V or less

Operation function: Square roots calculation, log operation

Maximum common mode voltage:
30 V AC or less

Common mode rejection ratio:
130 dB or more (50/60 Hz)

Normal mode rejection ratio:
50 dB or more (50/60 Hz)

■ Program specification

Pattern set type:
Target - Time or Rate - Time
- Time setting -- hour-minute or minute-second (selected and switched at initialization)
- RATE setting -- temperature/minute or temperature/second

Number of steps:
Up to 199 steps per pattern

Number of patterns:
Up to 200 patterns

Total number of steps:
Up to 4000 steps

Repeat: Pattern - up to 9999 times, Step - up to 99 times

Step setup range:
Target value -- Within the input scale range
Rate ---------- -99.999~99.999
Time ---------- 0 to 999 hours 59 minutes or 0 to 999 minutes 59 seconds

Start temperature:
Select either PV start or arbitrary set value start

Target value (SV) bias:
-99999~99999, linked with decimal point scaling

Fast-forward (FAST):
Program fast-forward function provided (approximately 10 times or 60 times)

End output: Select either constant value control or fixed output (setting: -5 to 105%)

Parameter registration:
Each parameter is selectable per step

(Sequence setting)
- PID constant -- 8 types, or 8 automatic selection types for SV interval (including dead band, ARW upper/lower limits, and output preset)
- Output limit (upper/lower)/output variation limit (upper/lower) -- 8 types for each, or 8 automatic selection types for SV interval
- Guarantee soak deviation -- 8 types
- Wait time for wait time alarm -- 8 types
- Alarm/enhanced alarm -- 8 types for each (a set of 4 points)
- Time signal time -- 30 types, all ON, all OFF, reverse phase, repeat in a step
- Sensor bias/mass flow target value -- 8 types for each

Parameter setting change:
Changeable during operation -- Target value, time, rate, PID, ARW, guarantee soak, output limit, output change rate limit, alarm set value, sensor bias, SV bias, mass flow SV

Additional function:
Pattern link, circle step function, pattern edit (copy, deletion)

■ Control specification

Control switching period:
Approximately 0.1 (initial value)/0.2/0.3/0.5 second

Adjustment method:
On-and-off pulse type PID, current output type PID, SSR drive pulse type PID, voltage output type PID, (high-accuracy type available for current/voltage output type)

PID value: Automatic setting by auto tuning, or manual setting
- P: 0 to 999.9% (0 for 2-position operation)
- I: 0 to 9999 seconds (0 for no I operation)
- D: 0 to 9999 seconds

Auto tuning: 6 modes.
AT1 - Set by the target value during operation
AT2 - Preset the step interval coaxial 8 types
AT3 - Preset 8 automatic selection types for SV interval
AT4~AT6 - Set the secondary output side for the 2-outputs type

On-off pulse type:
Output signal -- on-off pulse conductive signal (relay contact)
Contact capacity
resistance load: 100 V AC/5 A, 240 V AC/5 A, 30 V DC/5 A
Inductive load : 100 V AC/2.5 A, 240 V AC/2.5 A, 30 V DC/2.5 A

On-off servo type:
Output signal -- on-off servo conductive signal (relay contact)
Contact capacity (Standard load specifications)
resistance load: 100 V AC/5 A, 240 V AC/5 A, 30 V DC/5 A
Inductive load : 100 V AC/2.5 A, 240 V AC/2.5 A, 30 V DC/2.5 A
Minimum load: 5 V DC/10mA or more
Contact capacity (Very little load specifications)
resistance load: 100 V AC/5 A, 240 V AC/5 A, 30 V DC/5 A
Inductive load : 100 V AC/2.5 A, 240 V AC/2.5 A, 30 V DC/2.5 A
Minimum load: 5 V DC/1mA or more
Feedback resistance – 100Ω ~ 2kΩ

Current output type:
Output signal ----- 4~20 mA
Load resistance -- 750Ω or less,
High accuracy type: 4~20 mA or 1 to 5 mA, ±0.1%FS
SSR drive pulse type:
Output signal -- On-and-off pulse voltage signal
At ON: 12 V DC±20% (maximum 20 mA)
At OFF: 0.8 V DC or less
Voltage output type:
Output signal -- 0~10 V DC
Output resistance -- Approximately 10Ω
High accuracy type: 0Ω10 V DC, ±0.1%FS
OUTPUT LIMIT:
Upper: 0.0~105.0%, Lower: –5.0~100.0%
Output variation limit:
Up: 0.01~100.00%, Down: -0.01 to -100.00%
Output preset: Output setting in proportional operation when PV = SV: -100.0 to 100.0%
Output dead band:
Dead band setting: 0.0~9.9% (0.1~9.9% for 2-position operation)
Adjustment operation:
Direct/reverse operation switching
Guarantee soak:
Deviation setting: 0~99999, decimal point scaling link
Output at PV error:
Individual setting of outputs at upper and lower limit errors: -5.0~105.0%
A.R.W: Upper: 0.0~100.0%, Lower: -100.0~0.0%
Constant value operation:
Program (PROG)/constant (CONST) mode switching
Manual operation:
Output range: -5.0 to 105.0%
- Balanceless bumpless when switching from MAN to AUTO
- Output at AUTO kept when switching from AUTO to MAN

Control actions on repower:
User can select to continue or reset the program when recovering the power
Adjustment operation:
Position type and speed type are selectable
2-outputs specification:
On-and-off pulse type, current output type, SSR drive type, voltage output type
Current output type (high accuracy), voltage output (high accuracy) Any combination of 6 types, 2-outputs independent PID
Heating and cooling control:
Cooling proportional operation, matching box operation
Cascade primary controller:
Output (%) = a x control operation value + b + c x set value a, c:0.00~1.00, b:-100.0~100.0
Output destination specification - control output 1/2, transmission output 1/2

■ Alarm specification

Number of set points:
4 points + 4 points (for extended assignment setting)
Judgment method:
Upper alarm or lower alarm (with/without wait) using an absolute value
Upper alarm or lower alarm (with/without wait) using a deviation
Upper alarm or lower alarm (with/without wait) using an absolute value deviation
Upper alarm or lower alarm (with/without wait) using a measured value change rate
Upper or lower limit judgment of set value (with/without wait)
Upper or lower limit judgment of output value (with/without wait)
Control loop error, fail, wait time alarm, and end signal
Delay or latch function is selectable
Alarm setting range:
-99999~99999, linked with decimal point scaling
Dead band: 0.1 times of set resolution
Delay setting range:
1~10 times

Output type: Relay contact output: 4 points (common to contact A and common)
Contact capacity:
Resistance load: 100 V AC/3 A, 240 V AC/3 A, 30 V DC/3 A
Inductive load: 100 V AC/0.5 A, 240 V AC/0.5 A 30V DC • 0.5A
Open-collector output : 4 points (for extended assignment setting)
Capacity: 24 V DC, up to 50 mA
Alarm reset: Alarm can be cleared (reset) during occurrence

■ External output signal specification

Number of outputs:
28 points (function assignable per point)
Output type: Open-collector output (24 V DC, up to 50 mA)
Time signal output:
Default assignment: 18 points
Output method: Select ALL-ON, ALL-OFF, or maximum of 30 types per step
Status output: Default assignment: 10 points
Output type: RUN/STOP, ADV, RESET, WAIT, FAST, END, ALM-WAIT, ERR, SV-UP, SV-DOWN
Selective assignment -- Pattern/step No.-BCD Key/Mode lock status
Alarm output: Selectively assignable: 8 points
Output type: AL1~AL8

■ External input signal specification

Number of inputs:
16 points (function assignable per point)
Input type: Non-voltage contact
(contact capacity 12 V DC, 2 mA or more)
External power supply specification: 12/24 V DC
(ON when power is applied, up to 12 mA/point)
External drive input:
Default assignment: 5 points
Input type: RUN/STOP, ADV, RESET, WAIT, FAST, or RUN,STOP,RESET,ADV
Selective assignment • • •
Circle pulse
(programmatically operated)
External A/M switching, alarm reset, PV hold, SV hold
Pattern select input:
Default assignment: 10 points
Input type: 10 types of 1, 2, 4, 8 and 10, 20, 40, 80, 100, 200
Selection method: Select the number from 1~200 using BCD code

■ Display specification

Indicator:5.6-inch TFT color LCD
Display content:
Operation screen;
ALL PARA screen -- Pattern progress, pattern/step No., each data value, status, alarm, enlarged value display, bar graph display, trend graph display, DO display, DI display
Setting screen: Pattern/sequence setting, various parameter setting, memory card management setting, maintenance, setting lock, communications transmission, setting change during operation, etc
LCD backlight:
4 brightness adjustment levels

■ Setting and operation specification

Operation key type:
MENU, DISP, Up/Down/Left/Right keys, ENT, ESC, FUNC, RUN, STOP, ADV, RESET, A/M
Setting and operation method:
Setting -- Menu calling and cursor selection method
Operation -- Direct key operation (combined with FUNC)

Menu setting: Mode 0 (Change in the setting of execution steps),
Mode 1 (operation status selection),
Mode 2 (pattern and sequence)
Mode 3 (PID and alarm), Mode 4 (output/control),
Mode 5 (input), Mode 6 (time event),
Mode 7 (transmission), Mode 8 (communications),
Mode 9 (memory card), Mode 10 (enhanced setup) ,
Mode 11 (maintenance), Mode 12 (help)
Operation: Operation start/stop (RUN/STOP), operation release (RESET), stepping operation (ADV), auto/manual switching (A/M), fast-forwarding (FAST)
Display operation:
Switching between operation screens
HOME screen (registered operation screen) automatic display
Engineering port:
Serial port on the front panel (dedicated cable connection)

■ Memory card specification (card is optional)

Memory media:
Compact flash (CF) card
Memory size: Up to 2 GB
Saved data: Setup parameters, program patterns
batch data (for auto-loading)
Function: Save/read/delete/verify
Card format (simple format)
For program patterns, individual or all-pattern save/delete is selectable

■ General specification

Rated supply voltage:
100-240 V AC 50/60 Hz (universal power voltage)
Maximum power consumption:
50VA
Reference operation condition:
Surrounding temperature and humidity range: 21 to 25°C, 50 to 60%RH
Supply voltage: 100 V AC±1.0%
Supply frequency: 50/60 Hz±0.5%
Attitude: left/right ±3°, forward/backward ±3°
Warm-up time: 30 minutes or more
Normal operation condition:
Surrounding temperature and humidity range: -10 to 50°C, 10 to 90%RH
Supply voltage: 90 to 264 V AC
Supply frequency: 50/60 Hz±2%
Attitude: left/right ±10°, forward/backward ±10°
Transportation condition:
In factory-shipped package
Surrounding temperature and humidity range: -20 to 60°C, 5 to 90%RH
(No dew condensation)
Vibration: 10 to 60 Hz 0.5 G (4.9 m/s^2) or less
Impact: 40 G (352 m/s^2) or less
Storage condition:
Surrounding temperature and humidity range: -20 to 60°C, 5 to 90%RH
(No dew condensation)
Countermeasure against power failure:
The settings are kept using EEPROM and lithium battery backed up RAM
Insulation resistance:
Between secondary terminal and protection conductor terminal; 500 V DC 20 MΩ or more
Between primary terminal and protection conductor terminal; 500 V DC 20 MΩ or more
Between primary terminal and secondary terminal; 500 V DC 20 MΩ or more
Withstand voltage:
Between secondary terminal and protection conductor terminal; 500 V AC for 1 minute
Between primary terminal and protection conductor terminal; 1500 V AC for 1 minute
Between primary terminal and secondary terminal;2300 V AC for 1 minute
* Primary terminal: Power supply (100-240VAC)
The second terminal: All terminals other than primary terminal

Insulated structure:
The part surrounded by the frame insulates mutually.

Power supply	Internal electrical power source	Input terminals
		Control output terminals OUT1／OUT2 ※ON/OFF-pulse type output is individual insulation.
		Alarm output terminals AL1～AL4
		External signal output terminals (time signal/status signal)
		External signal input terminals (external drive / pattern selection signal) Communication terminals COM1/COM2 ※In the case of external power supply specification, communication terminals are individual insulation.
		Transmission output terminals CH1
		Transmission output terminals CH2
		The power supply terminals for transmitters (24VDC)

Outer appearance:
Case, front panel (frame), I/O terminal block
-- Fire-retardant polycarbonate resin
External I/O, transmission output, communications terminal block -- PBT
Color: Front panel frame and case; Gray or black
Mass: Approximately 1.7 kg
Mounting method:
Panel embedded mounting
Terminal screw:
M3.5 (M3 for External I/O, transmission output, communications terminal block)

■ Option specification

[Transmission signal output]
Number of outputs:Up to 2 points
Output type:
Target value, measured value, deviation, output value, and so on
Output method:
4 to 20 mA DC (load resistance 400Ω or less)
0 to 1 V DC (output impedance of approximately 10Ω, load resistance of 50 kΩ or more)
0 to 10 V DC (output impedance of approximately 10Ω, load resistance of 50 kΩ or more)
1 to 5 V DC (output impedance of approximately 10Ω, load resistance of 50 kΩ or more)
The 1 to 5 V DC output is not provided for secondary transmission
Scale setting:
-99999 to 99999, linked with decimal point scaling
Accuracy rating:
Output 1; ±0.1%FS, Output 2; ±0.3%FS
Resolution: Output 1; approximately 1/50000, Output 2; approximately 1/30000
Update period:
Approximately 0.1 second
Insulation: Isolated from internal circuit (20 MΩ or more, 500 V DC), isolated between transmission signals
[communications interface]
Number of communications points:
Up to 2 points (COM1 for rear port, COM2 for rear and front switching)
Communications type:
RS-232C, RS-422A, RS-485 (COM2 does not support RS-422A)
Protocol: MODBUS (RTU) / MODBUS (ASCII) / old DP support protocol
Insulation: Isolated from internal circuit (20MΩ or more, 500 V DC), not isolated between COM1 and COM2
[Transmitter power supply]
Power supply specification:
24 V DC, up to 30 mA

Table 1-1.Measuring range and accuracy rating (thermocouple [standard range])

Input type		Measuring range	Accuracy rating	Exception
Thermocouple	B	0.0 ~ 1820.0 °C	±0.1 %FS ±1 digit	0 ~ 400 °C: Not defined 400 ~ 800 °C: ±0.2 %FS ±1 digit
	R	0.0 ~ 1760.0 °C 0.0 ~ 1200.0 °C		0 ~ 400 °C: ±0.2 %FS ±1 digit
	S	0.0 ~ 1760.0 °C		
	N	0.0 ~ 1300.0 °C		
	K	-200.0 ~ 1370.0 °C 0.0 ~ 600.0 °C -200.0 ~ 300.0 °C		-200 ~ 0 °C: ±0.2 %FS ±1 digit or ±60μV-equivalent value, whichever is greater
	E	-270.0 ~ 1000.0 °C 0.0 ~ 700.0 °C -270.0 ~ 300.0 °C -270.0 ~ 150.0 °C		-270 ~ 0 °C: ±0.2 %FS ±1 digit or ±80μV-equivalent value, whichever is greater
	J	-200.0 ~ 1200.0 °C -200.0 ~ 900.0 °C -200.0 ~ 400.0 °C -100.0 ~ 200.0 °C		-200 ~ 0 °C: ±0.2 %FS ±1 digit or ±80μV-equivalent value, whichever is greater
	T	-270.0 ~ 400.0 °C -200.0 ~ 200.0 °C		-270 ~ 0 °C: ±0.2 %FS ±1 digit or ±40μV-equivalent value, whichever is greater
	U	-200.0 ~ 400.0 °C		-200 ~ 0 °C: ±0.2 %FS ±1 digit or ±40μV-equivalent value, whichever is greater
	L	-200.0 ~ 900.0 °C		-200 ~ 0 °C: ±0.2 %FS ±1 digit
	WRe5-WRe26	0.0 ~ 2310.0 °C		
	W-WRe26	0.0 ~ 2310.0 °C		0 ~ 400 °C: ±0.3 %FS ±1 digit
	NiMo-Ni	-50.0 ~ 1410.0 °C		
	Platinel II	0.0 ~ 1390.0 °C 0.0 ~ 600.0 °C		
	CR-AuFe	0.0 ~ 280.0 K	±0.2 %FS ±1 digit	0 ~ 20 K: ±0.5 %FS ±1 digit 20 ~ 50 K: ±0.3 %FS ±1 digit
	PR5-20	0.0 ~ 1800.0 °C		0 ~ 100 °C: Not defined 100 ~ 200 °C: ±0.5 %FS ±1 digit
	PtRh40-PtRh20	0.0 ~ 1880.0 °C		0 ~ 400 °C: ±1.5 %FS ±1 digit 400 ~ 800 °C: ±0.8 %FS ±1 digit

Accuracy converted to the measuring range under the reference operation condition. Reference junction compensation accuracy not included.
B, R, S, N, K, E, J, T: IEC584, JIS C 1602-1995, JIS C 1605-1995
WRe5-WRe26, W-WRe26, NiMo-Ni, Platinel II, CR-AuFe, PtRh40-PtRh20: ASTM Vol.14.03
U(Cu-CuNi), L(Fe-CuNi): DIN43710

Table 1-2.Measuring range and accuracy rating (thermocouple [DP-compatible range])

Input type		Measuring range	Accuracy rating	Exception
Thermocouple	WWRe5-26	0.0 ~ 2320.0 °C	±0.1 %FS ±1 digit	
	WWRe0-26	0.0 ~ 2320.0 °C		0 ~ 400 °C: ±0.3 %FS ±1 digit
	Ni-NiMo	0.0 ~ 1310.0 °C		
	Platinel	-100.0 ~ 1390.0 °C -100.0 ~ 600.0 °C		
	PR20-40	0.0 - 1880.0 °C	±0.2 %FS ±1 digit	0 ~ 400 °C: ±1.5 %FS ±1 digit 400 ~ 800 °C: ±0.8 %FS ±1 digit

Accuracy converted to the measuring range under the reference operation condition. Reference junction compensation accuracy not included.

Table 1-3.Measuring range and accuracy rating (DC voltage, DC current)

Input type	Measuring range	Accuracy rating	Exception
DC voltage	-10 ~ 10 mV -20 ~ 20 mV -50 ~ 50 mV -100 ~ 100 mV -5 ~ 5 V -10 ~ 10 V	±0.1 %FS ±1 digit	
DC current	0 ~ 20 mA	±0.1 %FS ±1 digit	

Accuracy converted to the measuring range under the reference operation condition.

Table 1-4.Measuring range and accuracy rating (resistance thermometer)

Input type		Measuring range	Accuracy rating	Exception
Resistance thermometer	Pt100	-200.0 ~ 850.0 °C -200.0 ~ 400.0 °C -200.0 ~ 300.0 °C -200.0 ~ 200.0 °C	±0.1 %FS ±1 digit	
		-100.0 ~ 100.0 °C	±0.2 %FS ±1 digit	
	Old Pt100	-200.0 ~ 649.0 °C -200.0 ~ 400.0 °C -200.0 ~ 300.0 °C -200.0 ~ 200.0 °C	±0.1 %FS ±1 digit	
		-100.0 ~ 100.0 °C	±0.2 %FS ±1 digit	
	JPt100	-200.0 ~ 649.0 °C -200.0 ~ 400.0 °C -200.0 ~ 300.0 °C -200.0 ~ 200.0 °C	±0.1 %FS ±1 digit	
		-100.0 ~ 100.0 °C	±0.2 %FS ±1 digit	
	Pt50	-200.0 ~ 649.0 °C	±0.1 %FS ±1 digit	
	Pt-Co	4.0 ~ 374.0 K	±0.2 %FS ±1 digit	4 ~ 20 K: ±0.5 %FS ±1 digit 20 ~ 50 K: ±0.3 %FS ±1 digit

Accuracy converted to the measuring range under the reference operation condition
Pt100: IEC751(1995), JIS C 1604-1997
Old Pt100: IEC751(1983), JIS C 1604-1989, JIS C 1606-1989
JPt100: JIS C 1604-1981, JIS C 1606-1986

Table 2.Reference junction compensation accuracy

Input type	Surrounding temperature: 23°C±10°C	Surrounding temperature: Range other than mentioned in the left column
K, E, J, T, N, Platinel II	±0.5°C	±1.0°C
Other than above	±1.0°C	±2.0°C

Compensation accuracy at measurement input of 0°C. For measurement inputs other than 0°C, the compensation accuracy is the value equivalent to the above (converted to electromotive force).

19. Parameter list

* These parameters are for the Normal mode. Some parameters are hidden or omitted in the DP mode.

Mode 0

Set item		Initial value (factory)	Customer-set value	Setting range
SV and time during execution	SV	0.0		Input scale: Minimum value to maximum value
	Time	000:00		000:00 ~ 999:59
Rate and time during execution	Rate	0.000		-99.999 ~ 99.999
	Time	000:00		000:00 ~ 999:59
SV bias		0.00		-999.99 ~ 999.99
SV bias type		NOW STEP		ALL STEP, NOW STEP
PID during execution	P (%)	5.0		000.0 ~ 999.9
	I (S)	60		0000 ~ 9999 (0 for ∞)
	D (S)	30		0000 ~ 9999 (0 for OFF)
	Dead band (%)	0.0		0.0 ~ 9.9
	A.R.W. H (%)	50.0		0.0 ~ 100.0
	A.R.W. L (%)	-50.0		-100.0 ~ 0.0
	Output preset (%)	50.0		-100.0 ~ 100.0
Output 2 PID during execution	P (%)	5.0		000.0 ~ 999.9
	I (S)	60		0000 ~ 9999 (0 for ∞)
	D (S)	30		0000 ~ 9999 (0 for OFF)
	Dead band (%)	0.0		0.0 ~ 9.9
	A.R.W. H (%)	50.0		0.0 ~ 100.0
	A.R.W. L (%)	-50.0		-100.0 ~ 0.0
	Output preset (%)	50.0		-100.0 ~ 100.0
Alarm during execution	AL1	3000.0		-9999.9 ~ 9999.9 (Absolute value deviation upper and lower limits: 0.0 ~ 9999.9)
	AL2	-1999.9		
	AL3	3000.0		
	AL4	-1999.9		
	AL5	3000.0		
	AL6	-1999.9		
	AL7	3000.0		
	AL8	-1999.9		
Output limiter during execution (Output scale)	H (%)	100.0		0.0 ~ 105.0
	L (%)	0.0		-5.0 ~ 100.0
Output variation limiter during execution	UP (%)	100.0		0.01 ~ 100.00
	DOWN (%)	-100.0		-100.00 ~ -0.01
Secondary output limiter during execution (output scale)	H (%)	100.0		0.0 ~ 105.0
	L (%)	0.0		-5.0 ~ 100.0
Secondary output variation limiter during execution	UP (%)	100.0		0.01 ~ 100.00
	DOWN (%)	-100.0		-100.00 ~ -0.01
MASS FLOW SV during execution		0.0		-5.0 ~ 105.0
Sensor bias during execution		0.00		-999.99 ~ 999.99

Mode 1

Set item	Initial value (factory)	Customer-set value	Setting range
Operation key locked	UNLOCK		UNLOCK, LOCK
Alarm reset	-		ALL RESET, , AL1-AL8(individual) AL1-4 RESET, AL5-8 RESET
Auto tuning	END		AT1, AT2, AT3, AT4, AT5, AT6
PV hold	CLEAR		HOLD, CLEAR
SV hold	CLEAR		HOLD, CLEAR
Change the control mode	PROG		PROG, CONST
Actions on repower	CONTINUE		CONTINUE, RESET
Program drive type	KEY		KEY, EXT, COM, SLAVE
Pattern selection type	KEY		KEY, EXT, COM
Time display type	STEP PASS		STEP PASS, PATTERN PASS, STEP REMAIN, PATTERN REMAIN
Graph display memory, maximum	Maximum input scale value		Input scale: Minimum value to maximum value
Graph display memory, minimum	Minimum input scale value		Input scale: Minimum value to maximum value

Mode 2

Set item		Initial value (factory)	Customer-set value	Setting range
END OUTPUT	OUT1/2	CONTROL		CONTROL, CONST
Output value (%)	OUT1/2	---- (0.0 for CONST)		----, -5.0 ~ 105.0
LINK PTN No.		0		0 ~ 200
SV when resetting		0.0		Input scale: Minimum value to maximum value
PTN SETTING TYPE		SV/Time		SV/Time, Rate/Time
PATTERN REPEAT No.		0		0 ~ 9999
PATTERN SETUP (Step 0)	START SV	0.0		Input scale: Minimum value to maximum value
	Time (H:M/M:S)	SV_START		SV_START, PV_START
PATTERN SETUP (Steps 1~199)	SV or Rate	SV: 0.0 Rate: 0.000		SV: Input scale: Minimum value to maximum value Rate: -99.999 to 99.999
	Time (H:M/M:S)	000:00, 000:01		000:00 to 999:59, END, CIRCLE
	REPEAT No.	--		-, 0, 1~99
	Circle step	--		-, 0.00~999.99
	PID (Output 1/Output 2)	0 (1 for Step 1)		0, 1~8, 9
	Alarm (standard and extended)	0 (1 for Step 1)		0, 1~8
	Output limit (%) (Outputs 1 and 2)	0 (1 for Step 1)		0, 1~8, 9
	Variation limit (%) (Outputs 1 and 2)	0 (1 for Step 1)		0, 1~8, 9
	Sensor bias	0 (1 for Step 1)		0, 1~8
	Guarantee soak	OFF		OFF, 1~8
	Waiting time alarm	0 (1 for Step 1)		0, 1~8
	MASS FLOW SV	0 (1 for Step 1)		0, 1~8
TIME SIGNAL (No.1~28)	KIND	ALL_OFF		ALL_OFF, ALL_ON, No.1~30
	PHASE	DIRECT		Direct, reverse
	REPEAT	NONE		Not available, Available

Mode 3

Set item		Initial value (factory)	Customer-set value	Setting range
PID (No.1~8. No.9 - 1~9 - 8)	P (%)	5.0		000.0 ~ 999.9
	I (S)	60		0000 ~ 9999 (0 for ∞)
	D (S)	30		0000 ~ 9999 (0 for OFF)
	A.R.W H (%)	50.0		0.0 ~ 100.0
	A.R.W L (%)	-50.0		-100.0 ~ 0.0
	Dead band (%)	0.0		0.0 ~ 9.9
	Output preset (%)	50.0		-100.0 ~ 100.0
SV ZONE (for PID)		Equally-divided 8 sections between input scale minimum and maximum		Input scale: Minimum to maximum
Output 2 PID (No.1~8. No.9 - 1~9 - 8)	P (%)	5.0		000.0 ~ 999.9
	I (S)	60		0000 ~ 9999 (0 for ∞)
	D (S)	30		0000 ~ 9999 (0 for OFF)
	A.R.W H (%)	50.0		0.0 ~ 100.0
	A.R.W L (%)	-50.0		-100.0 ~ 0.0
	Dead band (%)	0.0		0.0 ~ 9.9
	Output preset (%)	50.0		-100.0 ~ 100.0
	Output gap (%)	0.0		-100.0 ~ 100.0
SV ZONE (for output 2 PID)		Equally-divided 8 sections between input scale minimum and maximum		Input scale: Minimum value to maximum value
AUTO TUNING2	AT start direction	UP		UP, DOWN
	POINT (No.1~8)	No.1=ON, No.2~8=OFF		ON, OFF
	Execution SV (No. 1~8)	Value in which 1/10 of scales was added to minimum value of input scale - Value in which 8/10 was added (1/10 intervals of input scale)		Input scale: Minimum value to maximum value
AUTO TUNING3	AT start direction	UP		UP, DOWN
	POINT (No.1~8)	No.1=ON, No.2~8=OFF		ON, OFF
	Execution SV (No. 1~8)	Median of each SV zone		SV zone range for each point number
AUTO TUNING5	AT start direction	UP		UP, DOWN
	POINT (No.1~8)	No.1=ON, No.2~8=OFF		ON, OFF
	Execution SV (No. 1~8)	Value in which 1/10 of scales was added to minimum value of input scale - Value in which 8/10 was added (1/10 intervals of input scale)		Input scale: Minimum value to maximum value
AUTO TUNING6	AT start direction	UP		UP, DOWN
	POINT (No.1~8)	No.1=ON, No.2~8=OFF		ON, OFF
	Execution SV (No. 1~8)	Median of each SV zone		SV zone range for each point number

Mode 3 (continued)

Set item		Initial value (factory)	Customer-set value	Setting range
ALARM	KIND	AL1, 3, 5, 7 = DEVIATION HIGH AL2, 4, 6, 8 = DEVIATION LOW		ABS HIGH/LOW, DEVIATION HIGH/LOW, DEV BAND HIGH/LOW, VARIATION HIGH/LOW, SV HIGH/LOW, OUTPUT HIGH/LOW, LOOP ERROR, FAIL, WAIT TIME, END SIGNAL
	DELAY	2		1 ~ 10
	DEAD BAND	2.00		0.00 ~ 999.99
	CH	CH1		CH1
	WAIT	NONE		Not available, Available
	LATCH	NONE		Not available, Available
	Action at RESET	OFF		OFF, operation output
	Judgment time	When control loop error 20000		0 ~ 20000
	Set value	AL1,3,5,7=3000.0 AL2,4,6,8=-1999.9		-9999.9 ~ 9999.9 (Absolute value deviation upper and lower limits: 0.0 ~ 9999.9)

Mode 4

Set item		Initial value (factory)	Customer-set value	Setting range
CONTROL DIRECTION	OUT1	REVERSE		Direct, reverse
	OUT2	DIRECT		Direct, reverse
Algorithm	OUT1	Position type		Position type, Velocity d type
	OUT2	Position type		Position type, Velocity type
Control interval (ms)		100		100, 200, 300, 500
PV over error output (%)	OUT1	0.0		-5.0 ~ 105.0
	OUT2	0.0		-5.0 ~ 105.0
PV under error output (%)	OUT1	0.0		-5.0 ~ 105.0
	OUT2	0.0		-5.0 ~ 105.0
CPU error output (%)	OUT1	0.0		-5.0 ~ 105.0
	OUT2	0.0		-5.0 ~ 105.0
Output limit (%) (No.1~8, No.9 - 1~9 - 8)	H	100.0		0.0 ~ 100.5
	L	0.0		-5.0 ~ 100.0
Variation limit (%) (No.1~8, No.9 - 1~9 - 8)	UP	100.0		0.01 ~ 100.00
	DOWN	-100.0		-100.00 ~ -0.01
SV ZONE (for OUTPUT LIMIT and VARIATION LIMIT)		Equally-divided 8 sections between input scale minimum and maximum		Input scale: Minimum to maximum
MANUAL OUTPUT LIMIT		Valid		Valid, Invalid
Pulse cycle (S)		30		1 ~ 180
Pulse UPDATE TYPE		Control interval		Control interval, Pulse cycle
On-off servo output adjustment	Zero(%)	0.0		0.0 ~ 99.9
	Span(%)	100.0		0.1 ~ 100.0
	Dead band(%)	1.0		0.3 ~ 5.0
HEATING & COOLING SELECT		NONE		NONE, SPLIT, COOL PROPORTION
Split (%)	Direct	0.0		0.0 ~ 60.0
	Reverse	40.0		40.0 ~ 100.0
COOL P CONST		0.00		0.00 ~ 10.00
H.C.Gap (%)		0.0		-100.0 ~ 100.0
Dead band (%)		0.0		0.0 ~ 9.9
Cascade primary controller output destination		OFF		OFF, OUTPUT 1, OUTPUT 2, TRANS 1, TRANS 2
CASCADE CONST	a	1.00		0.00 ~ 1.00
	b (%)	0.0		-100.0 ~ 100.0
	c	0.00		0.00 ~ 1.00

Mode 5

Set item	Initial value (factory)	Customer-set value	Setting range
Range number (measuring range)	05 (K1)		See "Measuring Range List".
RJ	INT		INT, EXT
Unit	°C		°C, K, %, mV, V, mA, BLK
Linear range setting span (at linear range input)	(NONE)		Varies depending on the range
Linear range setting zero (at linear range input)	(NONE)		Varies depending on the range
Input scale, maximum (at linear range input)	(NONE)		-99999 ~ 99999 (The decimal point is decided by the decimal point setting)
Input scale, minimum (at linear range input)	(NONE)		-99999 ~ 99999 (The decimal point is decided by the decimal point setting)
Linear decimal point	(NONE)		0 ~ 4
PV Dec point	1		0 ~ 4
Digital filter (S)	0.1		0.0 ~ 99.9
Burn out	UP		UP, DOWN, NONE
Input calculation	NONE		Square roots calculation, Log10 operation
Sensor bias (No. 1~8)	0.00		-999.99 ~ 999.99

Mode 6

Set item		Initial value (factory)	Customer-set value	Setting range
Time signal (No.1~30) (H:M or M:S)	STP → ON	0:00		0:00 ~ 999:59
	ON → OFF	1:00		0:00 ~ 999:59
Guarantee soak (No. 1~8)	Guarantee soak	2000.0		0.1 ~ 9999.9
	Waiting time alarm	1:00		0:00 ~ 999:59
Mass flow SV (No. 1~8)(%)		No.1= 0.0 No.2= 10.0 No.3= 20.0 No.4= 30.0 No.5= 40.0 No.6= 50.0 No.7= 60.0 No.8= 70.0		-5.0 ~ 105.0

Mode 7

Set item		Initial value (factory)	Customer-set value	Setting range
Transmission kind	CH1	PV		NONE, PV, SV, DEV, MV1, MV2, MFB, MF SV
	CH2	PV		NONE, PV, SV, DEV, MV1, MV2, MFB, MF SV
Transmission scale MAX	CH1	Maximum input scale value		-9999.9 ~ 9999.9
	CH2	Maximum input scale value		-9999.9 ~ 9999.9
Transmission scale MIN	CH1	Minimum input scale value		-9999.9 ~ 9999.9
	CH2	Minimum input scale value		-9999.9 ~ 9999.9

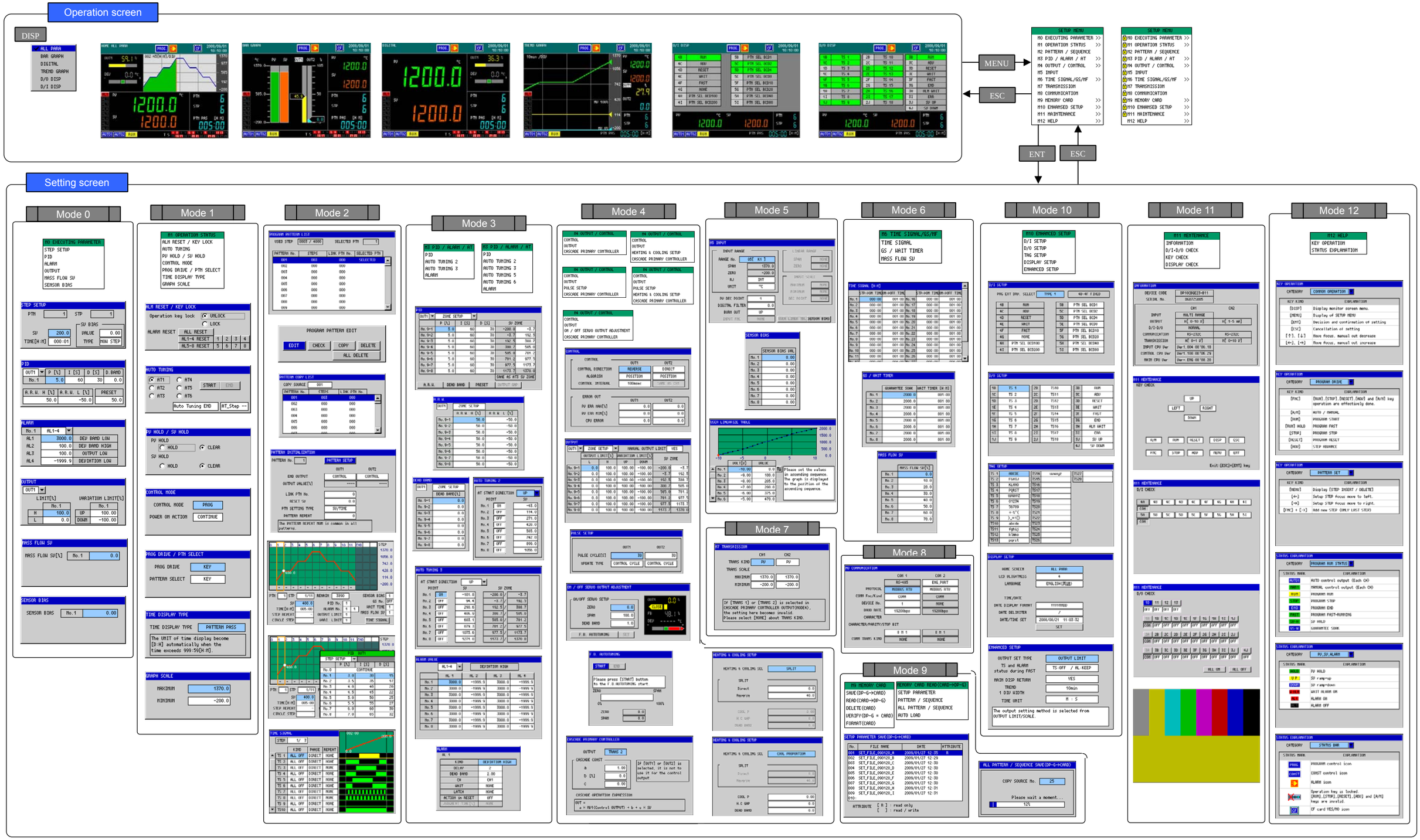
Mode 8

Set item		Initial value (factory)	Customer-set value	Setting range
COM2 communications interface		ENG_PORT		ENG_PORT, PORT2 (Varies depending on the specification)
Communications protocol	COM1	MODBUS RTU		MODBUS RTU, MODBUS ASC, PRIVATE, PRIVATE(TS17)
	COM2	MODBUS RTU		MODBUS RTU, MODBUS ASC, PRIVATE, PRIVATE(TS17) (When ENG_PORT,MODBUS only)
COMM Fnc/Kind	COM1/2	COMM		COMM, TRANS
INSTRUMENT No.	COM1/2	NONE for RS-232C 1 for RS-485/RS-422A		NONE, 0 ~ 99
Baud rate (bps)	COM1/2	19200		2400, 4800, 9600, 19200, 38400
Character/Parity/Stop bit	COM1/2	8N1		7N1, 7N2, 7E1, 7E2, 7O1, 7O2, 8N1, 8N2, 8E1, 8E2, 8O1, 8O2
Communications transmission kind	COM1/2	NONE		NONE, PV, SV, DEV, MV1, MV2, MFB, MF SV

Mode 10

Set item		Initial value (factory)	Customer-set value	Setting range
DI setup	Terminals 4B~4F	TYPE1		TYPE1, TYPE2
	Terminal 4G	NOT USE (NONE)		PV, SV, MAN, ALARM RESET, PTN SELECT BCD, NOT USE (NONE)
	Terminal 4H, 4I, 5B~5I	PTN SELECT BCD 1,2,4,8,10,20, 40,80,100,200		
DO setup	Terminals 1B~1J, 2B~2J	TIME SIGNAL No.1~18		STATUS 1, STATUS 2, HARDWARE STATUS, PTN SELECT BCD, STEP No. BCD, TIME SIGNAL, ALARM SETUP, NOT USE
	Terminals 3B~3J, 4J	Status signal		
TAG SETUP (Time Signals 1 to 28)		None		KANA, alphanumeric characters, up to 10 characters
Home screen		ALL PARA		ALL PARA, BAR GRAPH, DIGITAL, TREND GRAPH, D/O DISP, D/I DISP
LCD Brightness		4		1 ~ 4
DATE / TIME FORMAT		YYYYMMDD		YYMMDD, MMDDYY, DDMMYY, YYYYMMDD, MMDDYYYY, DDMMYYYY
DATE DELIMITER		"/"		"/", "-", "."
OUTPUT SET TYPE		OUTPUT LIMIT		OUTPUT LIMIT, OUTPUT SCALE
Time signal and alarm status during FAST		TIME SIGNAL (TS) OFF ALARM (AL) KEEP		TIME SIGNAL (TS)/ALARM (AL) OFF / OFF KEEP / OFF OFF / KEEP KEEP / KEEP
MAIN DISP RETURN		YES		Not available, Available
Trend 1 DIV display range (min)		10		1, 2, 5, 10, 20, 30, 60

20. Operation/setting screen list



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