OMRON Corporation
Industrial Automation Company

Control Devices Division H.Q.
Analog Controller Division
Shiokoji Horikawa, Shimogyo-ku,
Kyoto, 600-8530 Japan
Tel: (81)75-344-7080/Fax: (81)75-344-7189

Regional Headquarters

OMRON EUROPE B.V.
Wegalaan 67-69, NL-2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ELECTRONICS LLC
1 East Commerce Drive, Schaumburg, IL 60173
U.S.A.
Tel: (1)847-843-7900/Fax: (1)847-843-8568

OMRON ASIA PACIFIC PTE. LTD.
83 Clemenceau Avenue,
#11-01, UE Square,
239920 Singapore
Tel: (65)6835-3011/Fax: (65)6835-2711

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Road (M),
Shanghai, 200120 China
Tel: (86)21-5037-2222/Fax: (86)21-5037-2200

Authorized Distributor:

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E5AR / E5ER Digital Controller
User's Manual Cat. No. Z182-E1-03

OMRON

Digital Controller
E5AR
E5ER

User's Manual

Cat. No. Z182-E1-03

Introduction

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

This manual describes the functions, performance, and application methods needed for optimum use of the E5AR/E5ER Digital Controllers.

Please observe the following items when using the E5AR/E5ER Digital Controllers.

- This product is designed for use by qualified personnel with a knowledge of electrical systems.
- Read this manual carefully and make sure you understand it well to ensure that you are using the E5AR/E5ER Digital Controllers correctly.
- Keep this manual in a safe location so that it is available for reference when required.

Precaution in using the product

Before using the Controller under the following conditions, make sure that the ratings and performance characteristics of the Controller are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms, and also consult your OMRON representative.

- Using the Controller under conditions which are not described in the manual
- Applying the Controller to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment
- Applying the Controller to systems, machines, and equipment that may have a serious influence on lives and property if used improperly, and especially require safety

Notice

(2) The specifications and other information in this manual are subject to change without notice for purposes of improvement.

(3) Considerable care has been taken in the preparation of this manual; however, OMRON assumes no responsibility or liability for any errors or inaccuracies that may appear. In the event that a problem is discovered, please contact one of the Omron offices or agents listed at the end of the manual, and provide the catalogue number shown on the cover of the manual.

Read and Understand this Manual

Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products.

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS
Product specifications and accessories may be changed at any time based on improvements and other reasons.
It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS
Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA
Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS
The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

Precautions

Definition of Safety Notices and Information

The following notation is used in this manual to provide precautions required to ensure safe usage of the product.

The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions.

The following notation is used.

⚠ **Caution**	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

● Symbols

Symbol		Meaning
Caution		**General Caution** Indicates non-specific general cautions, warnings and dangers.
		Electrical Shock Caution Indicates possibility of electric shock under specific conditions.
Prohibition		**General Prohibition** Indicates non-specific general prohibitions.
Mandatory Caution		**General Caution** Indicates non-specific general cautions, warnings, and dangers.

● Precautions

⚠ CAUTION	
Do not touch any of the terminals or terminal blocks while power is being supplied. Doing so may occasionally result in minor injury due to electric shock.	
Do not touch the terminals, or electronic components or patterns on the PCB within 1 minute after turning OFF the power. Doing so may occasionally result in minor injury due to electric shock.	
Do not allow pieces of metal, wire clippings, or fine metallic shavings or filings from installation to enter the product. Doing so may occasionally result in electric shock, fire, or malfunction.	
Do not use the product in locations where flammable or explosive gases are present. Doing so may occasionally result in minor or moderate explosion, causing minor or moderate injury, or property damage.	
Do not attempt to disassemble, repair, or modify the product. Doing so may occasionally result in minor injury due to electric shock.	
Tighten the screws on the terminal block and the connector locking screws securely using a tightening torque within the following ranges. Loose screws may occasionally cause fire, resulting in minor or moderate injury, or damage to the equipment. Terminal block screws: 0.40 to 0.56 N·m	
Perform correct setting of the product according to the application. Failure to do so may occasionally cause unexpected operation, resulting in minor or moderate injury, or damage to the equipment.	
Ensure safety in the event of product failure by taking safety measures, such as installing a separate overheating prevention alarm system. Product failure may occasionally prevent control, or operation of alarm outputs, resulting in damage to the connected facilities and equipment.	
Do not use the equipment for measurements within Measurement Categories II, III, or IV (according to IEC61010-1). Doing so may occasionally cause unexpected operation, resulting in minor or moderate injury, or damage to the equipment. Use the equipment for measurements only within the Measurement Category for which the product is designed.	
The service life of the output relays depends on the switching capacity and switching conditions. Consider the actual application conditions and use the product within the rated load and electrical service life. Using the product beyond its service life may occasionally result in contact welding or burning.	

Precautions for Safe Use

(1) Use and store the product within the specified ambient temperature and humidity ranges. If several products are mounted side-by-side or arranged in a vertical line, the heat dissipation will cause the internal temperature of the products to rise, shortening the service life. If necessary, cool the products using a fan or other cooling method.

(2) Provide sufficient space around the product for heat dissipation. Do not block the vents on the product.

(3) Use the product within the noted supply voltage and rated load.

(4) Be sure to confirm the name and polarity for each terminal before wiring the terminal block and connectors.

(5) Do not connect anything to unused terminals.

(6) Use the specified size of crimp terminals (M3, width: 5.8 mm max.) for wiring the terminal block.

(7) To connect bare wires to the terminal block, use AWG22 to AWG14 (cross-sectional area: 0.326 to 2.081 mm^2) to wire the power supply terminals and AWG28 to AWG16 (cross-sectional area: 0.081 to 1.309 mm^2) for other terminals. (Length of exposed wire: 6 to 8 mm)

(8) Ensure that the rated voltage is achieved no longer than 2 s after turning the power ON.

(9) Turn OFF the power first before drawing out the product. Never touch the terminals or the electronic components, or subject them to physical shock. When inserting the product, do not allow the electronic components to contact the case.

(10) Do not remove the inner circuit board.

(11) Output turns OFF when shifting to the initial setting level in certain modes. Take this into consideration when setting up the control system.

(12) Allow the product to warm up for at least 30 minutes after the power is turned ON.

(13) Install surge absorbers or noise filters in devices near the product that generate noise (in particular, devices with an inductance component, such as motors, transformers, solenoids, and magnetic coils). If a noise filter is used for the power supply, check the voltage and current, and install the noise filter as close as possible to the product. Separate the product as far as possible from devices generating strong high-frequency noise (e.g., high-frequency welders and high-frequency sewing machines) or surges.
Do not tie noise filter input/output wires together.

(14) Keep the wiring for the product's terminal block and connector separate from high-voltage, high-current power lines to prevent inductive noise. Do not run the wiring parallel to or in the same cable as power lines. The influence of noise can also be reduced by using separate wiring ducts or shield lines.

(15) Install an external switch or circuit breaker and label them clearly so that the operator can quickly turn OFF the power.

(16) Do not use the product in the following locations:
· Locations where dust or corrosive gases (in particular, sulfuric or ammonia gas) are present.
· Locations where icing or condensation may occur.
· Locations exposed to direct sunlight.
· Locations subject to excessive shock or vibration.
· Locations where the product may come into contact with water or oil.
· Locations subject to direct radiant heat from heating equipment.
· Locations subject to extreme temperature changes.

(17) Cleaning: Do not use thinners. Use commercially available alcohol.

Precautions for Correct Use

● Service Life

Use the product within the following temperature and humidity ranges:

Temperature: −10 to 55°C (no icing or condensation)
Humidity: 25% to 85%

When the product is installed inside a control panel, make sure that the temperature around the product, not the temperature around the control panel, does not exceed 55°C.

The service life of this product and similar electronic devices is determined not only by the number of switching operations of relays but also by the service life of internal electronic components. Component service life is affected by the ambient temperature: the higher the temperature becomes, the shorter the service life becomes and, the lower the temperature becomes, the longer the service life becomes. Therefore, the service life can be extended by lowering the temperature of the product.

Be sure to install the product according to the specified conditions. Otherwise, the heat generated by the product will cause the internal temperature to rise, shortening the service life. If necessary, cool the product using fans or other means of air ventilation.

When providing forced cooling, however, be careful not to cool down the terminals sections alone to avoid measurement errors.

● Noise Countermeasures

To prevent inductive noise, separate the wiring for the product's terminal block and connector from high-voltage, high-current power lines. Do not run the wiring parallel to or in the same cable as power lines. The influence of noise can also be reduced by using separate wiring ducts or shield lines.

Install surge absorbers or noise filters in devices near the product that generate noise (in particular, devices with an inductance component, such as motors, transformers, solenoids, and magnetic coils).

If a noise filter is used for the power supply, check the voltage and current, and install the noise filter as close as possible to the product.

Separate the product as far as possible from devices generating strong high-frequency noise (e.g., high-frequency welders and high-frequency sewing machines) or surges.

● Measurement Accuracy

When extending the thermocouple lead wire, be sure to use a compensating wire that matches the thermocouple type.

When extending the lead wire of the platinum resistance thermometer, be sure to use wires that have low resistance, and make sure that the resistances of the three lead wires are the same.

If the measurement accuracy is low, check whether the input shift is set correctly.

● Waterproofing

The degree of protection is as shown below.

Front panel	IP66
Rear case	IP20
Terminals	IP00

About this Manual

● How to use the manual

Purpose	Related section	Contents
General explanation of the E5AR/ER	Section 1 Overview	Explains the features, part names, and main functions of the E5AR/ER.
Setup	Section 2 Preparations Section 3 Typical Control Examples	Explains how to set up the E5AR/ER for operation (mounting, wiring, initial settings).
Basic operation of the E5AR/ER	Section 4 Settings Required for Basic Control Section 8 Setting Data	Explains the basic functions of the E5AR/ER.
Advanced functions of the E5AR/ER	Section 5 Functions and Operations Section 8 Setting Data	Explains how to use the customized functions (scaling, SP ramp, etc.) to get the most out of the E5AR/ER.
Communication functions	Section 6 Communication (CompoWay/F) Section 7 Communication (Modbus)	Explains how to use communication-based functions.
User calibration	Section 9 User Calibration	Explains calibration procedures that can be performed by the user.
Troubleshooting	Section 10 Troubleshooting	Explains what to do when you encounter a problem.
Appendix		Product specifications. List of settings. Can be used to make a copy of your settings.

For details on using DeviceNet communications functions, refer to the *E5AR/E5ER Digital Controller DeviceNet Communications User's Manual* (H124).

● Special markings

(1) Important

This appears in cases where incorrect settings or operation will prevent a function from achieving the expected result.

> **Important**
>
> Set the input type before setting the scaling value.
> If the input type is changed after setting the scaling value, the scaling value will be automatically initialized.

(2) Hint

This gives useful hints, advice, and other supplemental information.

> **Hint**
>
> The rise and fall values of the SP ramp of the E5AR/ER can be set separately.

(3) Marks used to indicate "Function," "Setting," "Monitor," and "Reference" in "Setting Data" in Section 8 are explained in Section 8.

● Abbreviations

Abbreviations used in the setting data, illustrations, and text are as follows.

Abbreviation	Meaning
PV	Present value
SP	Set point
SV	Set value
AT	Auto-tuning (A.T)
EU	Unit of industrial quantity*
ch	Channel

* Data after scaling is shown in industrial units such as °C, m, and g, and "EU" is used to indicate the minimum increment of such a quantity. For example, the minimum increment of 50.02 m is 0.01 m, and thus 1 EU would be equal to 0.01 m.

● Notation used for settings

Letters, numbers and abbreviations in settings that appear in the E5AR/ER display are as follows.

A	b	C	d	E	F	G	H	i	J	K	L	M
A	B	C	D	E	F	G	H	I	J	K	L	M

n	o	P	q	r	S	t	U	u	W	X	Y	Z
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

0	1	2	3	4	5	6	7	8	9	-1
0	1	2	3	4	5	6	7	8	9	-1 (Most significant digit)

● Revision History

The revision code of this manual is given at the end of the catalog number at the bottom left of the back cover. The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Cat. No.	Z182-E1-03

Revision code	Date	Pages and changes
01	May 2003	Original production
02	February 2004	The following changes were made. Other changes were also made to improve general quality. **Introduction:** Descriptions mainly on precautionary information updated. **Page 1-5:** "Bar graph" added to the top list. **Page 1-6:** "Function key 1" added to the "Auto/Manual key." **Page 1-7:** Note at the bottom of the page corrected. **Page 1-8:** Event input assignment diagram corrected. **Page 1-10:** Control/transfer output allocation diagram corrected. **Page 1-12:** Item 11 corrected to "Communications method." **Pages 2-4 to 2-7:** Terminal arrangement graphics corrected. **Page 2-8:** Paragraph below the table deleted. **Page 2-9:** Note added below the table. **Page 2-10:** E5ER graphic on the right side deleted and "E5ER" on the left graphic changed to "E5ER-□4□□." **Page 2-11:** "Event inputs 3 to 7" corrected to "event inputs 3 to 6" in two paragraphs under *Event inputs (terminals)*. **Page 3-11 (and throughout the manual):** "Control initial setting level 2" corrected to "Control initial setting 2 level." **Page 3-16:** The RSP indicator in the graphic under *RUN level (Ch 2)* corrected to OFF from ON. **Page 4-7:** "PID adjustment level" corrected to "PID setting level." **Page 4-22:** Auxiliary output assignment diagram corrected. **Page 4-25:** Item 8 "Press the level key twice" corrected to "Press the level key three times." **Page 4-31:** Item (1) "About two seconds" corrected to "About four seconds." **Page 5-9:** Monitor and setting range for SP ramp time unit in the top table corrected. **Page 5-30:** "Auto/Manual (Adjustment level)" corrected to "Auto/Manual (RUN level)" under *Auto/Manual.* **Page 8-12:** DOTC: Disturbance time constant under *Adjustment level* corrected to "0.01-99.99." **Pages 8-15, 8-16, 8-19, 8-27, 8-31, and 8-32:** "PID Set No." corrected to "PID." **Page 8-26:** The seven segment display (7.LSP) at the right top placed in a white box. **Page 8-35:** Description added to RSPH and RSPL in the bottom graphic. **Page 8-46:** Description under *Setting range* in the top table corrected. **Page 8-49:** The second "Cascade standard control" in the bottom table corrected to "Cascade heating/cooling control." **Page 8-51:** The default value under *straight-line approximation* corrected from ON to OFF. **Page A-2:** Note 3 added below the Unit Ratings table. **Page A-2:** "Outflow current: Approx. 7 mA" under *Unit ratings* corrected to "Short-circuit current: Approx. 4 mA." **Page A-3:** "(±5% FS)± digit or less" under *Indication accuracy* corrected to "(±5% FS)± 1 digit max." **Page A-3:** "0.2 to 99.9 seconds" under *Control period* corrected to "0.2 to 99.0 seconds." **Page A-3:** "Acceleration: 10 m/s^2" under *Vibration tolerance* corrected to "Acceleration: 20 m/s^2." **Page A-19:** Description under *Setting (monitor) value* for 0E0C corrected. **Page A-20:** Description under *Setting (monitor) value* for 0E20 corrected. **Page A-22:** The second "Cascade standard control" in the table corrected to "Cascade heating/cooling control." **Page A-30:** DOTC: Disturbance time constant under *Adjustment level* corrected to "0.01-99.99."
02A	November 2004	The following changes were made. **Page A-3:** Information was added to the table and accompanying notes.

Revision code	Date	Pages and changes
03	May 2005	The following changes were made. **Page 4-10:** Information added on direct/reverse operation, alarms, input shift, SP ramp, and PID. **Page 5-6:** “0.0000” corrected to “0.000” and “210.0°C” corrected to “190.0°C” in text and graph. **Pages 5-13 and 8-32:** Setting range changed from “10% to 110% of setting range” to “–19999 to 99999” in table, and related note removed. **Page 5-26:** Condition B changed to “At power on” for standby sequence restart. **Page 8-37:** Note added.

Contents

Section 4 Settings Required for Basic Control

Section 5 Functions and Operations

Section 7 Communication (Modbus)

Section 8 Setting data

Section 9 User calibration

Section 10 Troubleshooting

Appendix

Index

Section 1 Overview

1.1 Main Features of the E5AR/ER

The E5AR/ER is an advanced controller that features high-speed and high-precision control.

The E5AR/ER has the following features:

■ Inputs

● High-speed sampling

● High accuracy/ high resolution

- 50-ms sampling period
- Accuracy Thermocouple:
  (Larger of ±0.1% PV or ±1°C) ±1 digit max
  Platinum resistance temperature input sensor:
  (Larger of ±0.1% PV or ±0.5°C) ±1 digit max
  Analog input: (±0.1% FS)±1 digit max
  (For non-standard specifications, see "Specifications" on page A-2 of the Appendix)
- Input resolution: 1/100°C
  (Pt 100: Resolution range 0.01°C, -150.00 to 150.00°C is available)
- High-speed sampling and high accuracy / high resolution are simultaneously achieved to enable high-accuracy, high-speed control to match the application.

● Multi-inputs

- Wide range of temperature inputs and analog inputs are available.
  Temperature inputs :
  Thermocouples K, J, T, E, L, U, N, R, S, B, W
  Platinum resistance temperature input sensors: Pt 100
  Analog inputs: Current inputs: 4 to 20 mA, 0 to 20mA
  Voltage inputs: 1 to 5 V, 0 to 5V, 0 to 10V

● Multi-point inputs

- A 2-input type and a 4-point input type are available for the E5AR. A 2-point input type is available for the E5ER.
- All multi-point inputs also support multi-input, eliminating the need for an externally connected converter.

■ Controller

● Banks

- Up to 8 banks can be created to store SPs (local SP), alarm values, and PID set numbers.
- Switch between banks by bank selection (event input, key operation, or communication).

● PID sets

- Up to 8 PID sets can be created to store settings (PID value, MV limits, and automatic selection range upper limit) for PID control.

- Selection of a PID is possible not only by direct specification of the PID Set No. in a bank, but also by PID set automatic selection according to the present value and deviation.

● Ample control modes and control functions

- Supports typical control modes (standard control, heating/cooling control, proportional control, cascade control). Note that proportional control and cascade control are only possible on 2-input types.
- Floating control or closed control can be selected for position proportional types. Floating control allows position proportional control without a potentiometer.
- Remote SP
  Two-input types can use an external input for the set point.
- SP ramp function
  This limits the amount of change of the set point based on the rate of change (SP ramp value). This function is useful for control applications such as firing ceramics where sudden changes in temperature are not desirable.
  The E5AR/ER allows an SP ramp rise value and fall value to be set separately.

■ Outputs

● Multi-output

- Multi-output supporting current output and voltage output (pulse) is available.

● High resolution

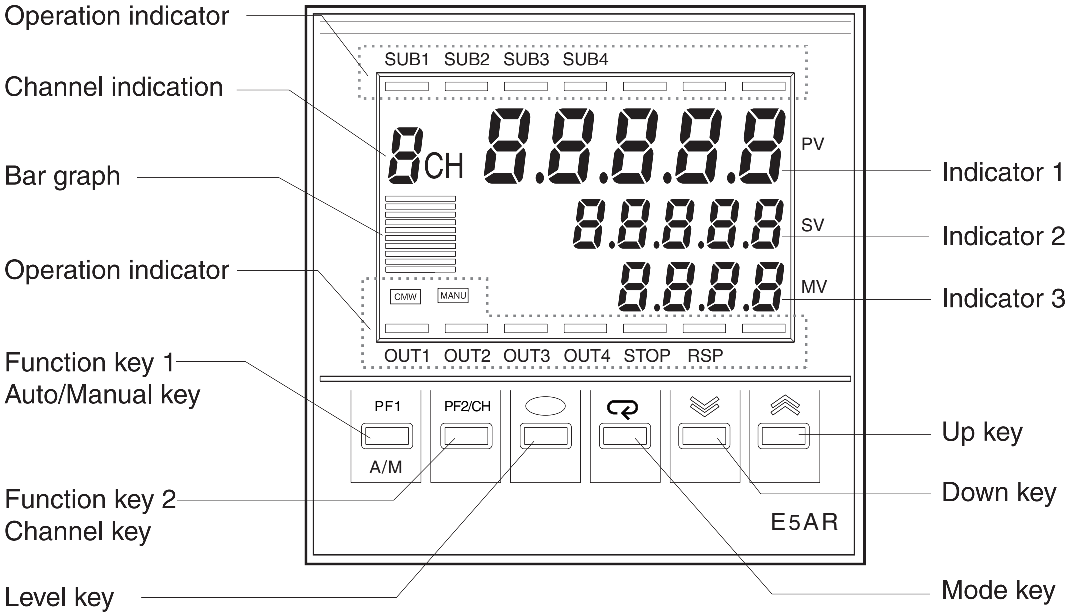
- Resolution of current output
  0 to 20 mA: Approx. 54,000 resolution
  4 to 20 mA: Approx. 43,000 resolution

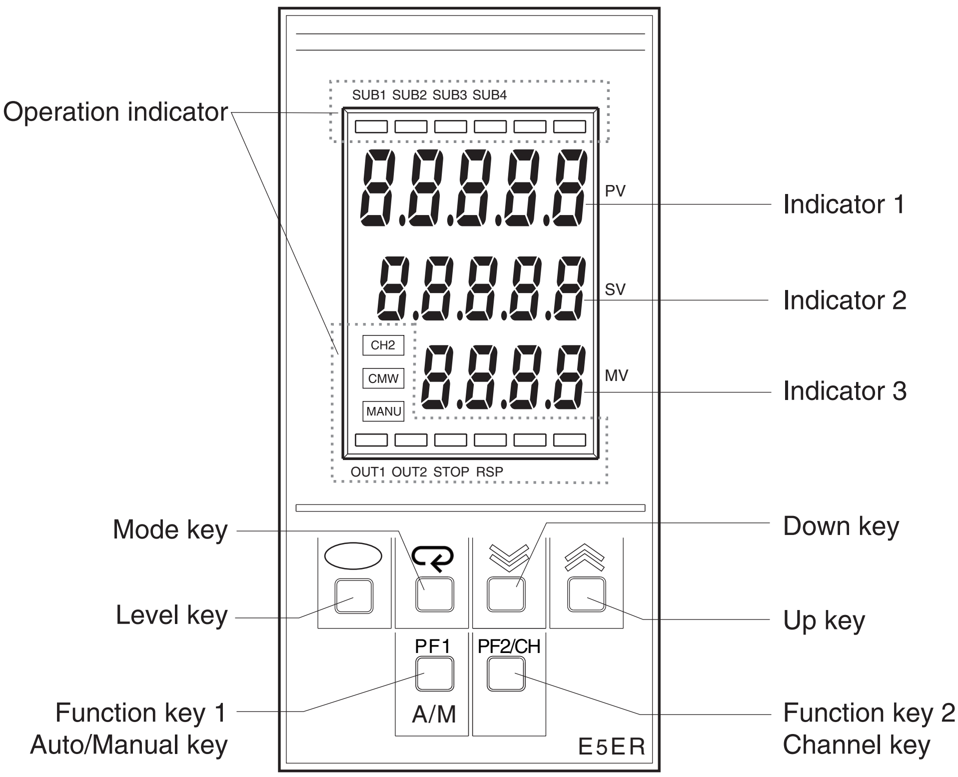
● Control period

- The control period can be set as short as 0.2 seconds, allowing precise time sharing proportional control.

1.2 Part Names and Functions

■ Front





■ How to read the display

● Display 1

Shows the present value and the setting data's name or error name. (Red)

● Display 2

Shows the set point value and the set value of the setting data. (Green)

● Display 3

Shows the Manipulated Variable MV and the bank number or level name. (Orange)

● Channel indication

Shows the set channel number.

Only appears on a multi-point input type. On a single input type, the display is always off. (Orange)

The E5ER shows the corresponding channel when the "CH2" operation indicator is lit.

● Bar graph

Shows a bar graph of the settings.

● Operation indicators

Operation indicators	Model		Common indicator/Single channel indicator	Explanation
	E5AR	E5ER		
OUT1	●	●	Common indicator (orange)	Turns on/off when control output 1 is ON/OFF. *2
OUT2	●	●		Turns on/off when control output 2 is ON/OFF. *2
OUT3	●	–		Turns on/off when control output 3 is ON/OFF.*2
OUT4	●	–		Turns on/off when control output 4 is ON/OFF.*2
SUB1	●	●	Common indicator (red)	Turns on/off when the output function assigned to auxiliary output 1 is ON/OFF.
SUB2	●	●		Turns on/off when the output function assigned to auxiliary output 2 is ON/OFF.
SUB3	●	●		Turns on/off when the output function assigned to auxiliary output 3 is ON/OFF.
SUB4	●	●		Turns on/off when the output function assigned to auxiliary output 4 is ON/OFF.
STOP	●	●	Single channel indicator (orange)	Turns on when operation stops. Otherwise is off. Turns on during control at an event input or when "run/stop" is switched to stop.
RSP	●	●	Single channel indicator (orange)	Turns on when the SP mode is set to remote. Otherwise is off.
MANU	●	●	Single channel indicator (orange)	Turns on when operation is set to manual mode. Otherwise is off.
CMW	●	●	Common indicator (orange)	Turns on/off when write via communication is ON/OFF (enabled/disabled).
CH2	–	●	Single channel indicator (orange)	Turns on when the displayed channel is 2. Otherwise is off.

*1: ●: Indicates that the model has the function. Note that function may be disabled depending on the settings, and in this case the indicator is always off.

–: Indicates that the model does not have the function.

*2: When the control output is current output, the indicator turns off when the MV is 0% or less, and turns on when the manipulated variable is greater than 0%.

■ Explanation of the keys

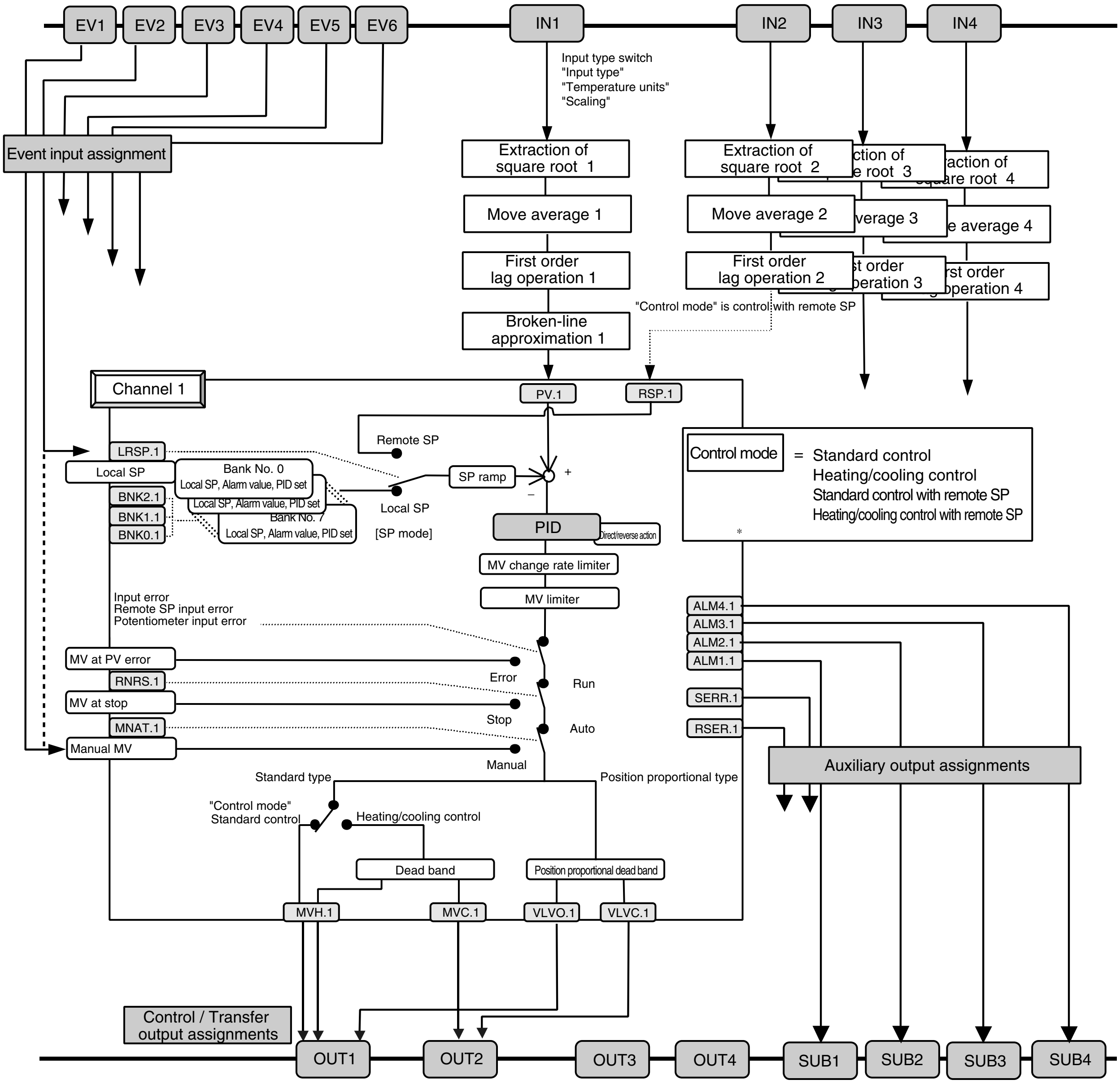
Key	Name	Explanation
□	Level key	Press to change setting levels.
⮐	Mode key	Press to change the setting data within a setting level.
⋀	Up key	Each time ⋀ is pressed, the value of display 2 increases. Hold down the key to increase the value quickly. The key is also used to scroll forward through the setting item.
⋁	Down key	Each time ⋁ is pressed, the value of display 2 decreases. Hold down the key to decrease the value quickly. The key is also used to scroll backward through the setting item.
□+⮐	Protect key	Press to change to a protected level. See "4.1 Configuration of Setting Levels and Key Operation" (page 4-2) for operation when the □ key and ⮐ are pressed simultaneously.
PF1/A/M	Function key 1/ Auto/Manual key	When pressed, this function key activates the function set in "PF1 setting". Example: "PF1 setting" is "A/M" ("A/M" is the default setting) Functions as an Auto / Manual key (hereafter shown as the A/M key) that is used to switch between auto mode and manual mode. The mode changes when the key is pressed for at least one second (the timing of key release does not matter).
PF2/CH	Function key 2 / channel key	Functions as a channel key for multi-channel control.* For 1-point input types, the key acts as a function key that activates the function set in "PF2 setting" when pressed. When used as a channel key: Switches channels on models with a multi-channel configuration. The channel switching sequence is as follows: CH1 → CH2 → ··· → Highest channel set in "Enabled channel setting" ↑____________________↓

*Functions as a start key for the displayed scan.

1.3 Input/output Configuration and Main Functions

■ Input/output configuration

The input/output configuration of the E5AR/ER and internal setting item are shown in the following diagram.



PV.1	Channel 1 PV	LRSP.1	Channel 1 Local/Remote SP mode	ALM1.1	Channel 1 Alarm 1
RSP.1	Channel 1 Remote SP	BNK0.1	Channel 1 bank (bit 0)	ALM2.1	Channel 1 Alarm 2
MVH.1	Channel 1 MV (heating side)	BNK1.1	Channel 1 bank (bit 1)	ALM3.1	Channel 1 Alarm 3
MVL.1	Channel 1 MV (cooling side)	BNK2.1	Channel 1 bank (bit 2)	ALM4.1	Channel 1 Alarm 4
VLVO.1	Channel 1 MV (open side)	RNRS.1	Channel 1 RUN/STOP	SERR.1	Channel 1 Input error
VLVC.1	Channel 1 MV (closed side)	MNAT.1	Channel 1 manual/auto	RSER.1	Channel 1 Remote SP input error

Multi-point input types have the same setting data for channels 2 to 4 depending on the number of input points.

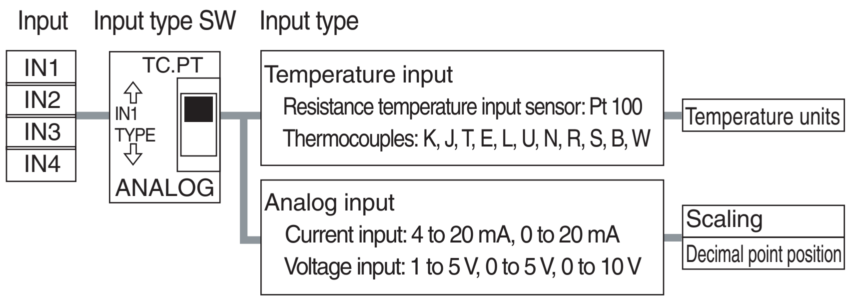
* Cascade standard control, Cascade heating/cooling control, position proportional control and ratio control are also available. See "Section 3, Typical Control Examples" (page 3-1).

■ Main functions

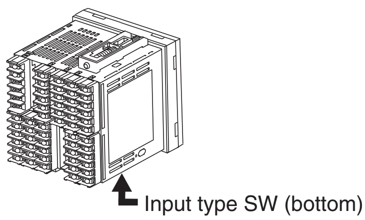
● Input

After selecting the temperature input (TC: thermocouple or PT: resistance temperature input sensor) or analog input (current input or voltage input), with the input type switch select the input type in parameter setting.

If the input type SW is set to temperature input (resistance temperature input sensor or thermocouple), the temperature unit can be set. If the input type SW is set to analog input (current input or voltage input), scaling and the decimal point position can be set.



Location of input type switch

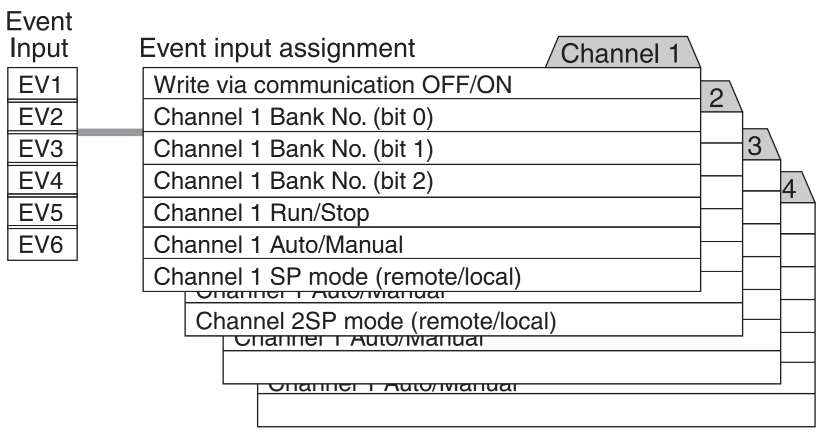


● Event input assignment

An operation command can be assigned to each event input. If event input is to be used, use an E5AR/ER-☐☐B/D.

In the case of a multi-point input type, assignment data can be set for channels 2 and higher as needed for the number of channels.

The operation instruction "Write via communication OFF/ON" is common to all channels



● Control mode

The type of control performed by each controller is selected by setting the control mode. Setting the control mode sets default values for the output assignments required for the control.

After setting the control mode, specify direct / reverse operation for each channel.

Standard type

Control modes that can be selected vary depending on the number of input points.

Control mode	1-input type	2-input type	4-input type	Out-put	Control / Transfer output assignment
Standard control	IN1	IN1	IN1	OUT1	Channel 1 control output (heating side)
		IN2	IN2	OUT2	Channel 2 control output (heating side)
			IN3	OUT3	Channel 3 control output (heating side)
			IN4	OUT4	Channel 4 control output (heating side)
Heating/cooling control	IN1	IN1	IN1	OUT1	Channel 1 control output (heating side)
				OUT2	Channel 1 control output (cooling side)
		IN2	IN2	OUT3	Channel 2 control output (heating side)
				OUT4	Channel 1 control output (cooling side)
Standard control with remote SP	–	IN1 IN2: Remote SP	–	OUT1	Channel 1 control output (heating side)
Heating/cooling control with remote SP	–	IN1 IN2: Remote SP	–	OUT1 OUT2	Channel 1 control output (heating side) Channel 1 control output (cooling side)
Ratio control	–	IN1 IN2: Ratio setting	–	OUT1	Channel 1 control output (heating side)
Cascade standard control	–	IN1: Primary loop IN2: Secondary loop	–	OUT1	Channel 2 control output (heating side)
Cascade heating/ cooling control	–	IN1: Primary loop IN2: Secondary loop	–	OUT1 OUT2	Channel 1 control output (heating side) Channel 1 control output (cooling side)

Direct/Reverse operation	Description
Direct operation (cooling)	Control whereby the MV is increased as the present value increases (When the present value (PV) is higher than the set point (SP), the MV is increased in proportion to the difference between the PV and the SP.)
Reverse operation (heating)	Control whereby the MV is decreased as the present value increases (When the present value (PV) is lower than the set point (SP), the MV is increased in proportion to the difference between the PV and the SP.)

- When pulse output is used, the control period must be set for each channel.

Position proportional type

The position proportional type only uses standard control.

Control mode	1-input type	2-input type	4-input type	Output	Control / Transfer output assignment
Standard control	IN1	–	–	OUT1	Channel 1 control output (open side)
				OUT2	Channel 1 control output (closed side)

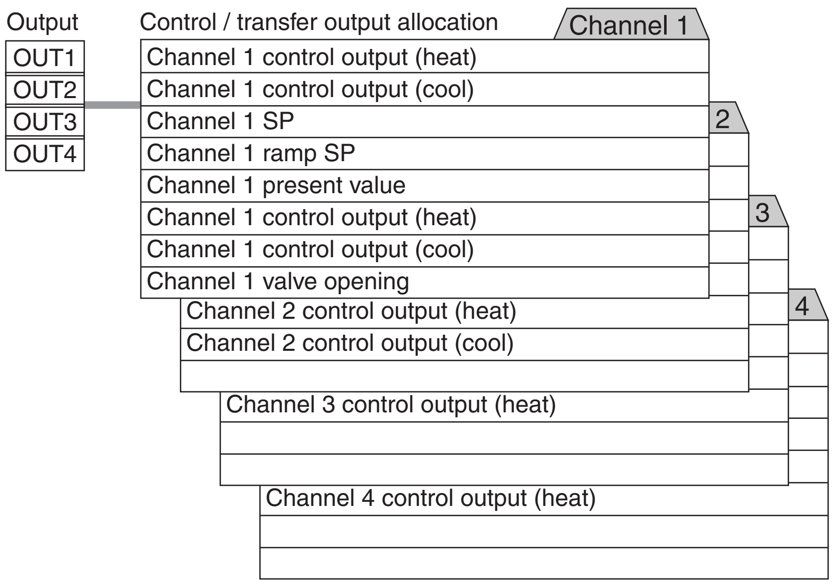
Direct/Reverse action	Description
Direct action (cooling)	Control whereby the MV is increased as the present value increases (When the present value (PV) is higher than the set point (SP), the MV is increased in proportion to the difference between the PV and the SP.)
Reverse action (heating)	Control whereby the MV is decreased as the present value increases (When the present value (PV) is lower than the set point (SP), the MV is increased in proportion to the difference between the PV and the SP.)

- Floating control and closed control can also be selected for the position proportional type. Floating control allows position proportional control without a potentiometer.

● Control / Transfer output allocation

Use this setting to assign what type of data is output from each output.

For the multi-point input type, assignment data can be set for channels 2 and higher as needed for the number of channels.

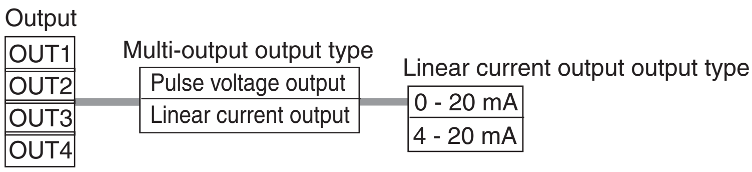


When used for control output, assignments are made automatically based on the control mode setting as explained on the previous page. No changes are necessary.

When used for transfer output type, assign the data to be transferred to an unused output.

For outputs supporting multi-output, specify pulse voltage output or linear current output according to the multi-output output type.

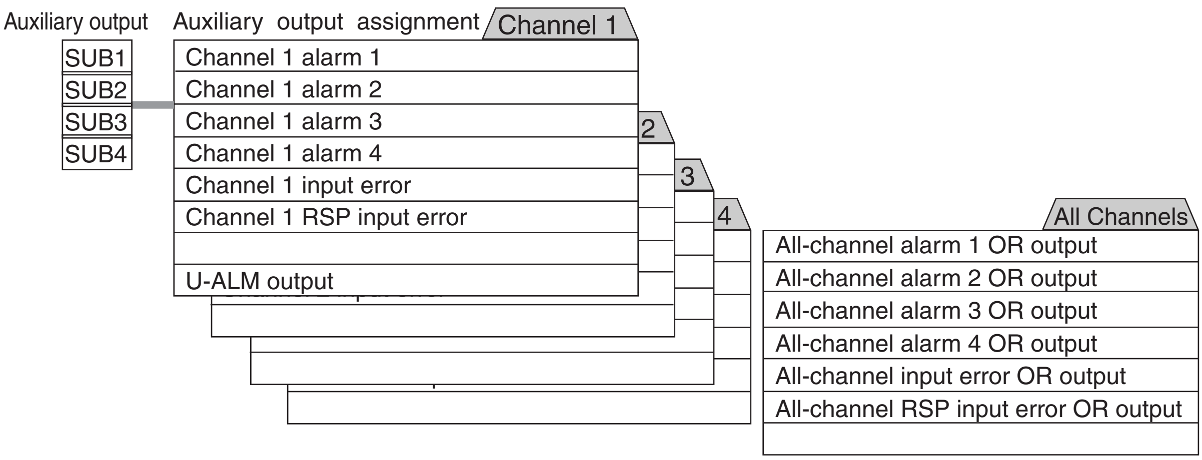
For linear current output, 0 to 20 mA or 4 to 20 mA can be selected. Pulse voltage output is 12 V DC, 40 mA.



● Auxiliary output assignments

Use this setting to assign what type of data is output from each auxiliary output.

For the multi-point input type, assignment data can be set for channels 2 and higher as needed for the number of channels. The U-ALM output is an OR output with alarm functions 1 to 4 for all channels.



■ Explanation of Model Numbers

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪

E5□R–□□□□□□□□□–□□□

① Size

A (96 x 96 mm)	A
E (48 x 96 mm)	E

② Constant/Program

Constant	Blank

③ Control method

Standard / heat cool	Blank
Position proportional	P

④ Output 1

Relay, relay	R
Pulse output + pulse voltage/current	Q
Current + current	C

⑤ Output 2

None	Blank
Relay, relay	R
Pulse output + pulse voltage/current	Q
Current + current	C

⑥ Auxiliary output

None	Blank
Relay 4 output SPST-NO common	4
Transistor output, 2 points	T

⑦ Option function 1

None	Blank
RS-485 communication	3

⑧ Option function 2

None	Blank
Events, 4 points	D

⑨ Input 1

Multi input + event input, 2 points	B
Multi input + FB (Potentiometer input)	F
Multi input + multi input	W

⑩ Input 2

None	Blank
Multi input + multi input	W

⑪ Communications method

None	Blank
CompoWay/F	FLK
DeviceNet	DRT

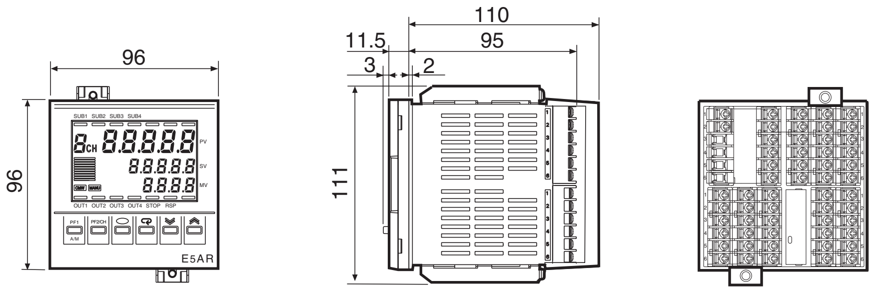
The above is an explanation based on functionality. There may be some differences from the product line depending on the combination of features selected. Please check the catalogue when ordering. For details on using DeviceNet communications functions, refer to the *E5AR/E5ER Digital Controller DeviceNet Communications User's Manual* (H124).

Section 2 Preparations

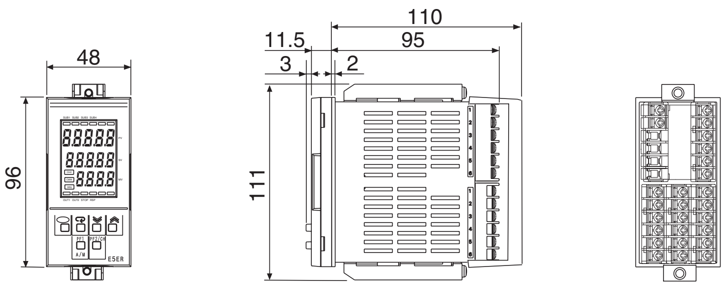
2.1 Installation

■ Dimensions

E5AR



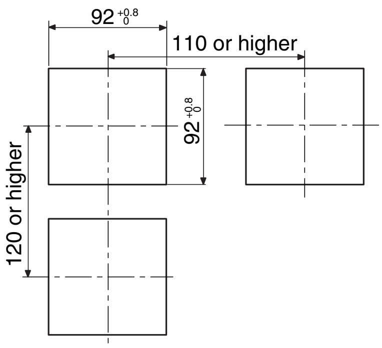
E5ER



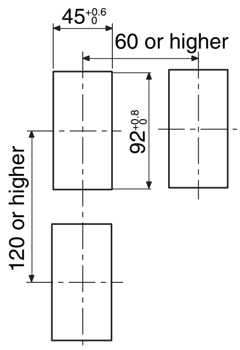
■ Installation

● Panel cutout dimensions

E5AR



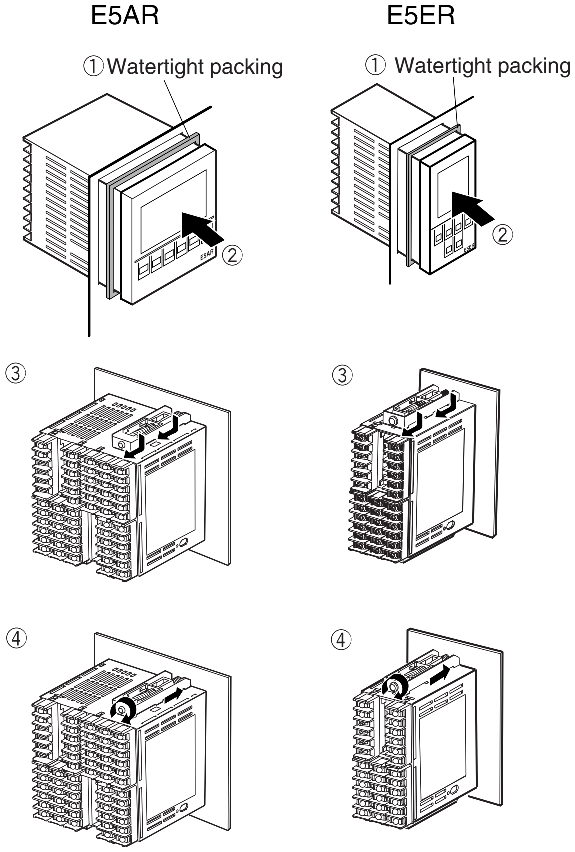
E5ER



● Installation procedure

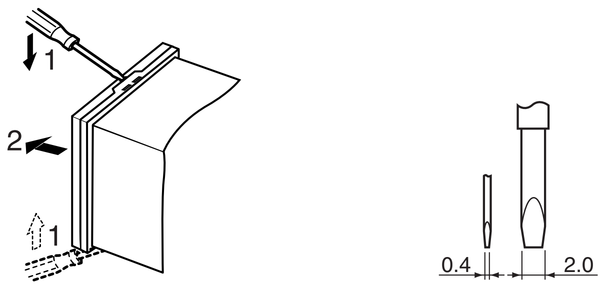
① If the front of the unit needs to be watertight, attach the provided watertight packing. If the front of the unit does not need to be watertight, the watertight packing does not need to be attached.
② Insert the unit into the cutout in the panel.
③ Insert the accompanying fittings into the grooves on the top and bottom of the rear case.

④ Gradually tighten the screws in the top and bottom fittings, alternating between each so that they are balanced. Tighten until the ratchet turns without engaging.



● Pulling the unit out

Normally there is no need to pull out the unit, however, it can be pulled out if needed for maintenance purposes.



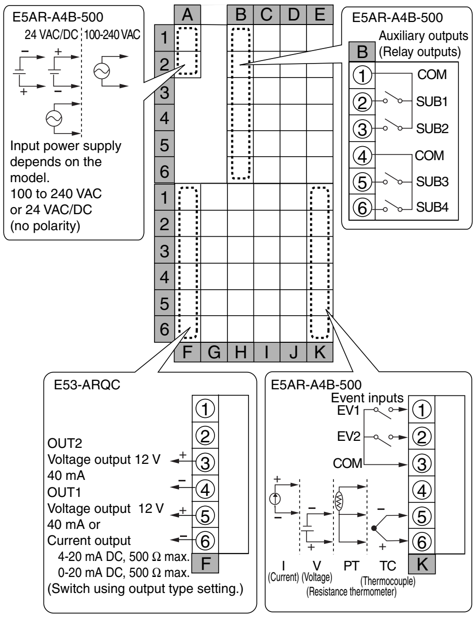
When pulling the unit out, place a cloth over the screwdriver to prevent scratches and other damage.

2.2 How to Use the Terminals

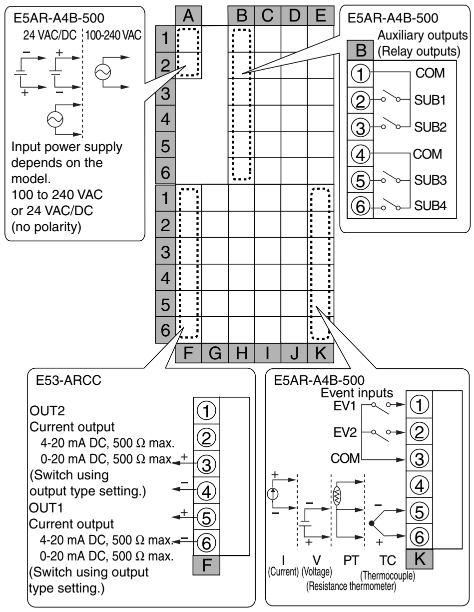
Verify the layout of the terminals (A - , 1 -) using the engravings on the top and sides of the case

■ E5AR

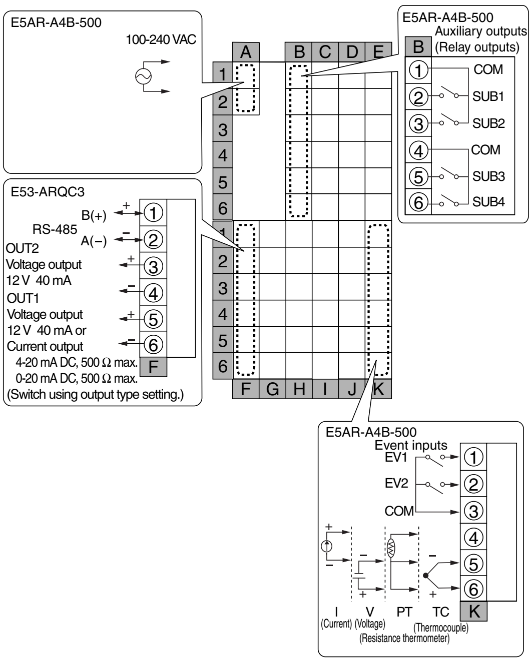
E5AR-Q4B



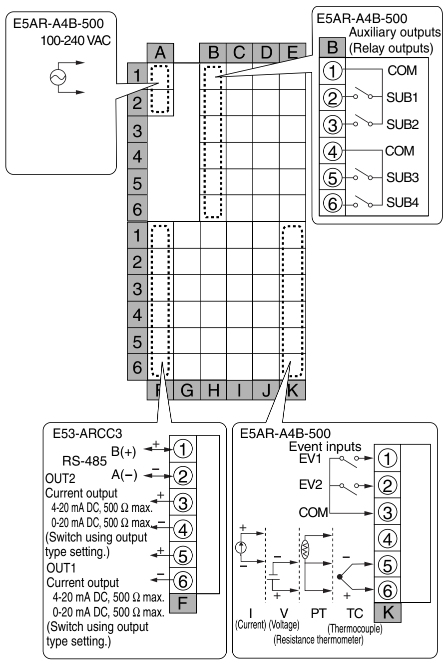
E5AR-C4B



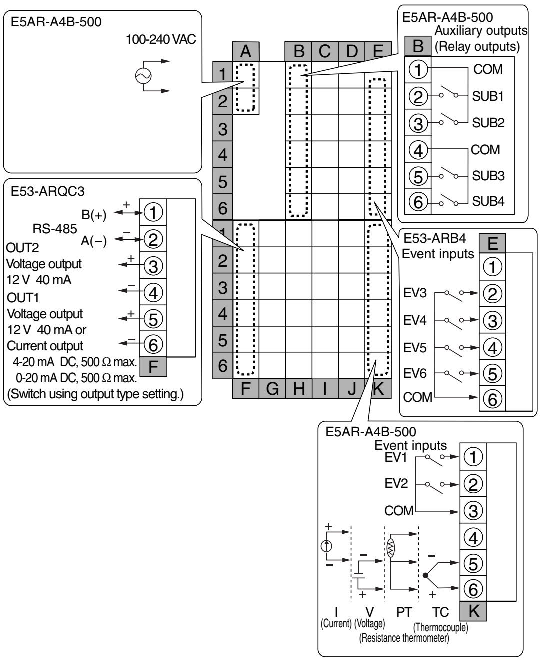
E5AR-Q43B-FLK



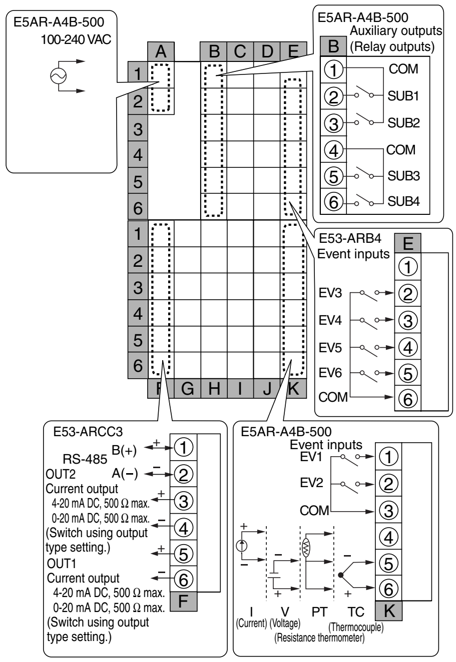
E5AR-C43B-FLK



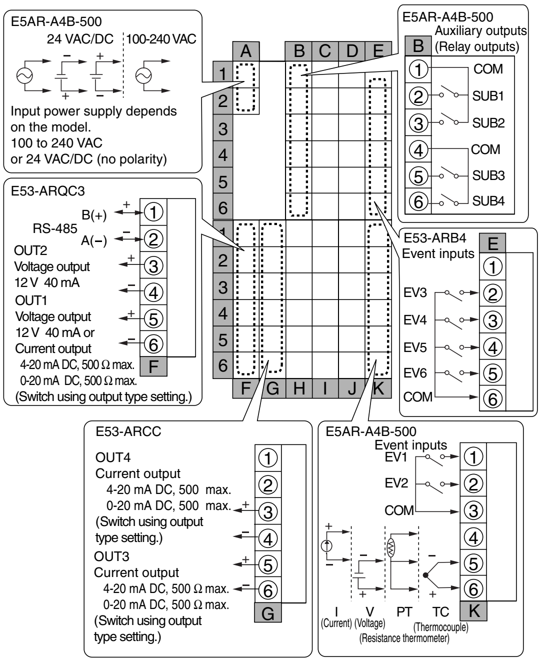
E5AR-Q43DB-FLK



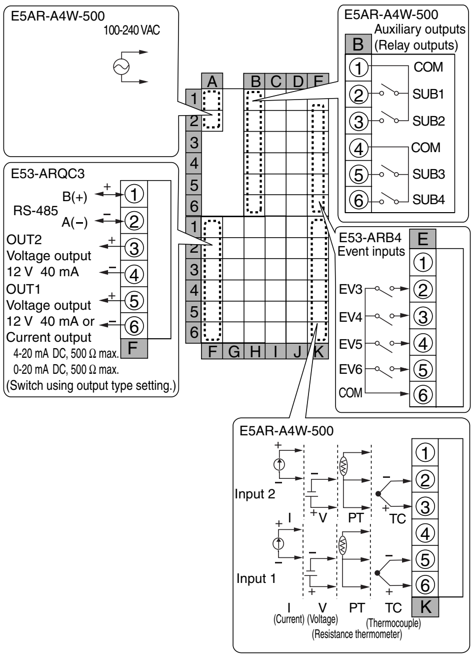
E5AR-C43DB-FLK



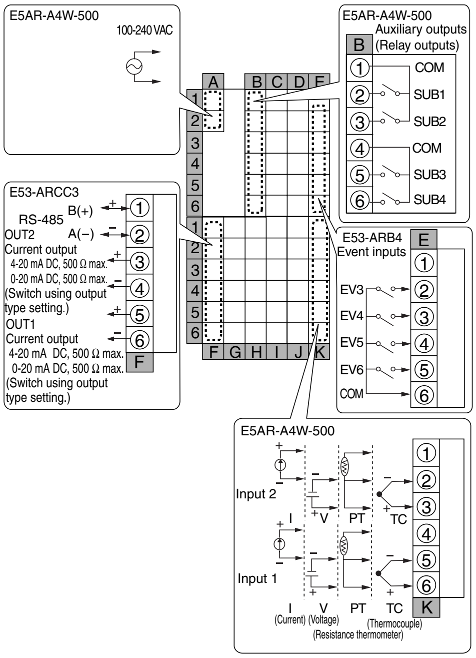
E5AR-QC43DB-FLK



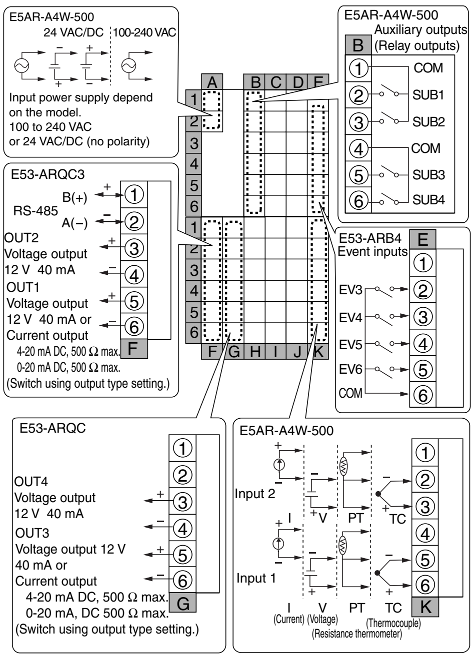
E5AR-Q43DW-FLK (2-loop Control)



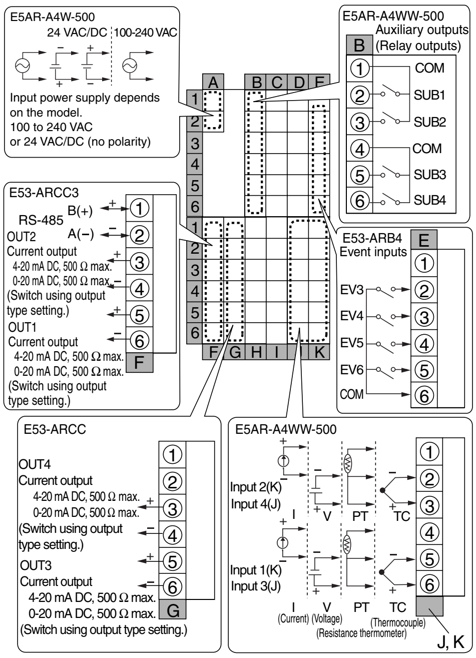
E5AR-C43DW-FLK (2-loop Control)



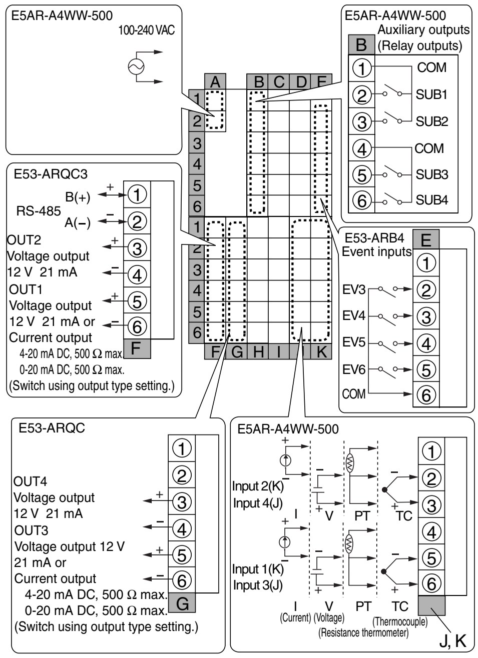
E5AR-QQ43DW-FLK (2-loop Control)



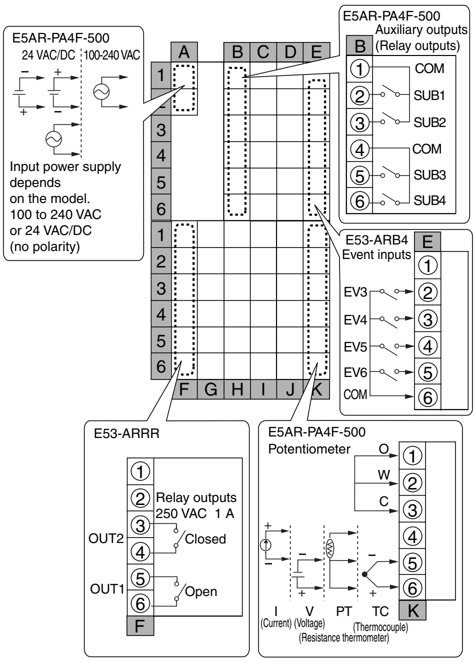
E5AR-CC43DWW-FLK (4-loop Control)



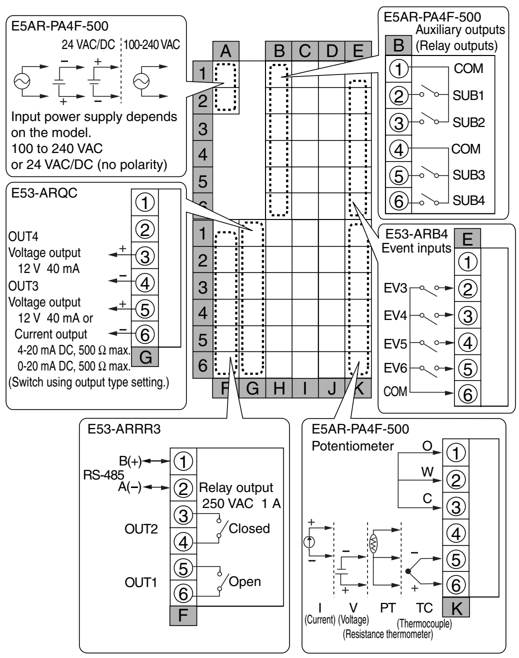
E5AR-QQ43DWW-FLK (4-loop Control)



E5AR-PR4DF

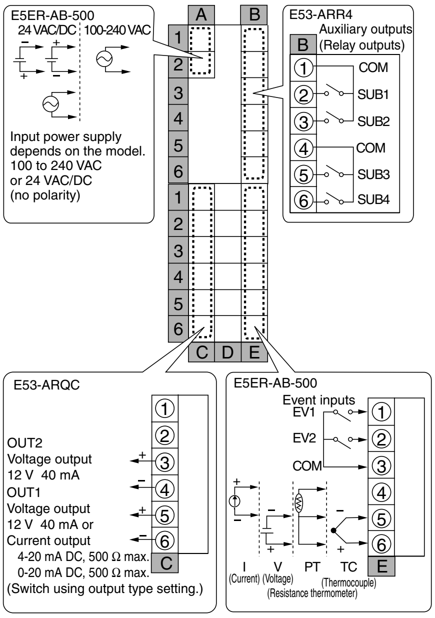


E5AR-PRQ43DF-FLK

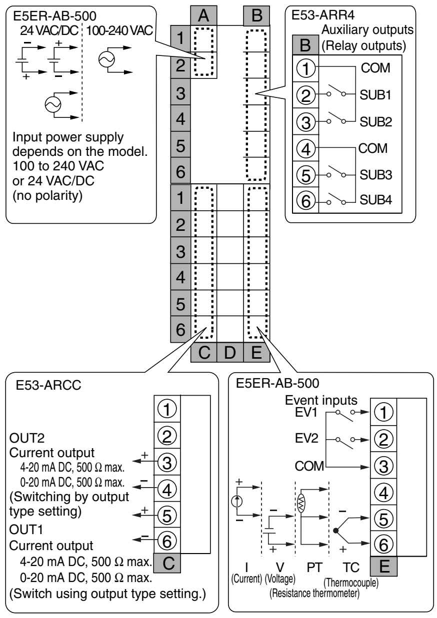


■ E5ER

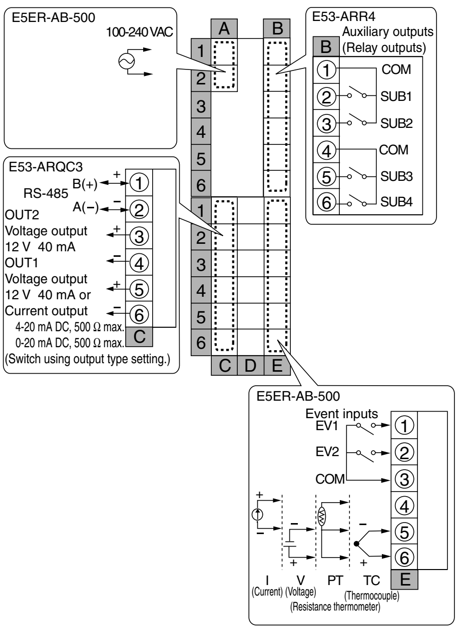
E5ER-Q4B



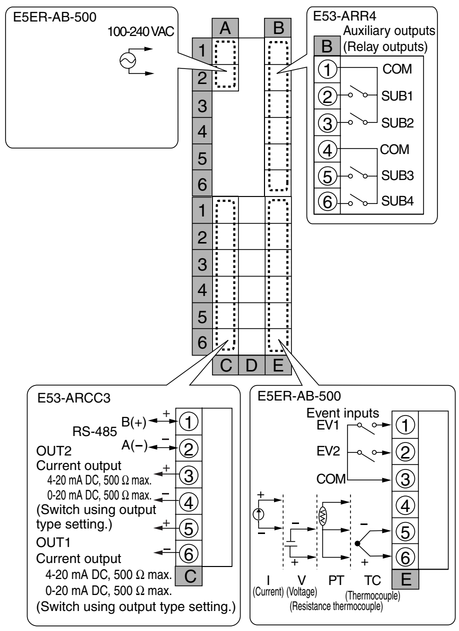
E5ER-C4B



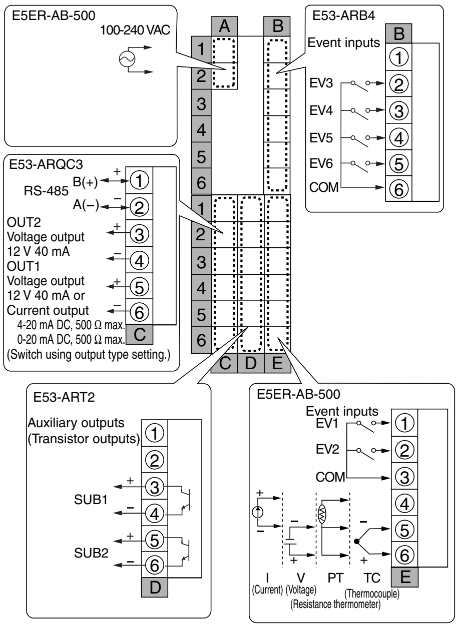
E5ER-Q43B-FLK



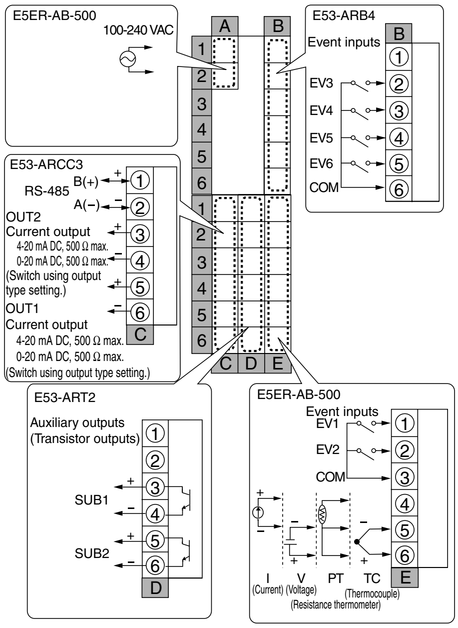
E5ER-C43B-FLK



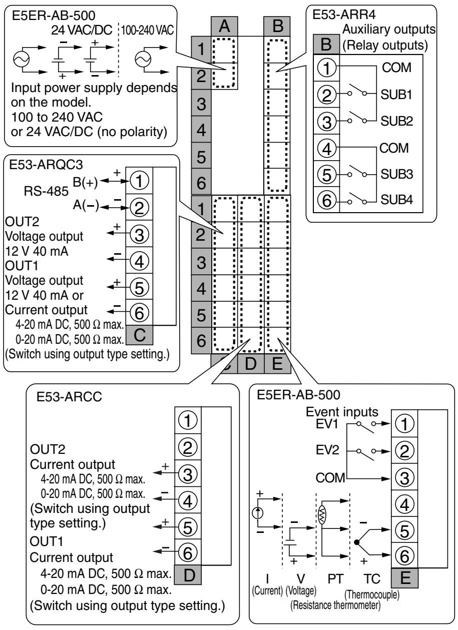
E5ER-QT3DB-FLK



E5ER-CT3DB-FLK



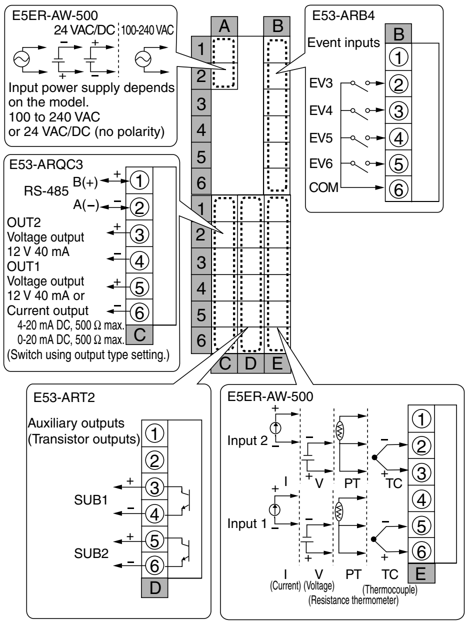
E5ER-QC43B-FLK



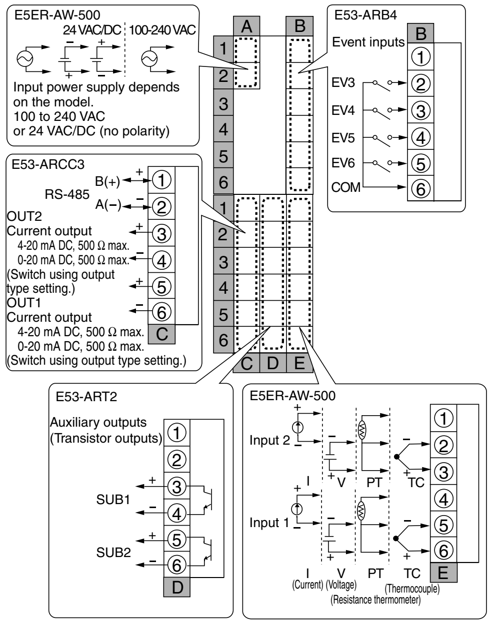
Preparations

Preparations

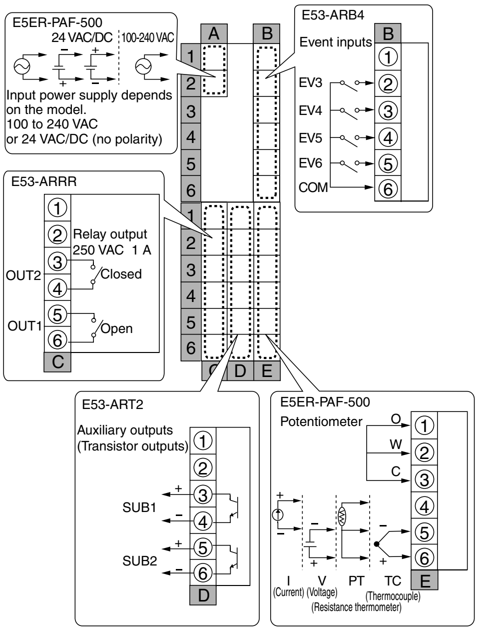
E5ER-QT3DW-FLK (2-loop Control)



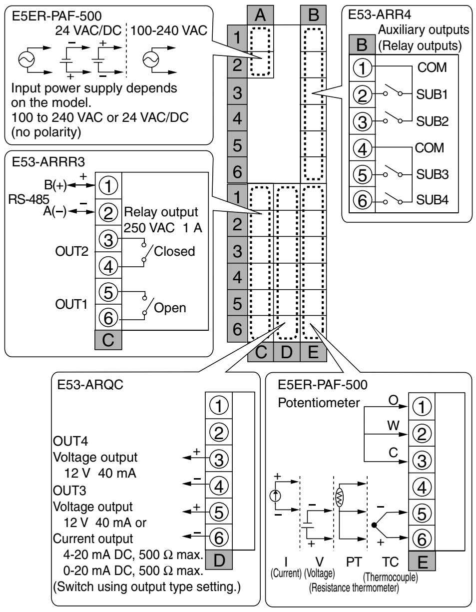
E5ER-CT3DW-FLK (2-loop Control)



E5ER-PRTDF

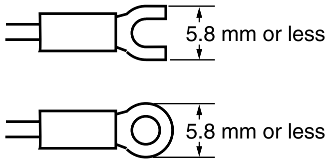


E5ER-PRQ43F-FLK



■ Precautions when wiring

- To avoid the effects of noise, wire the signal wires and the power line separately.
- Use crimp terminals to connect to the terminals.
- Tighten screws to a torque of 0.40 to 0.56 N•m.
- The crimp terminals should be type M3 and either of the following shapes:

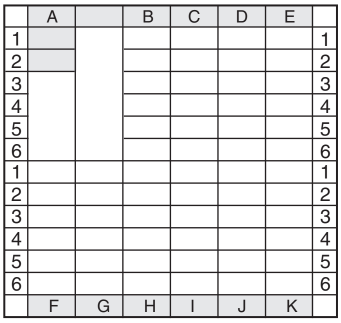


■ Wiring

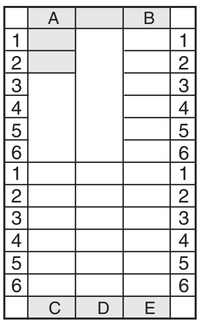
The inside of the frame around terminal numbers in the schematics indicates the interior of the unit, and the outside of the frame indicates the exterior.

● Power supply (terminals)

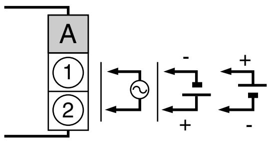
E5AR



E5ER



- Connect terminals A1 to A2 as follows:

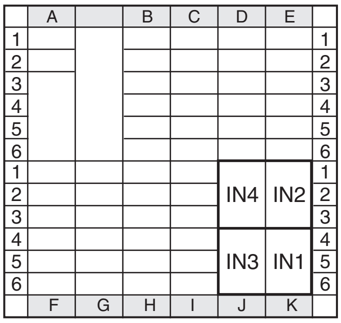


The input power supply varies depending on the model.
100-240 V AC or 24 V AC/DC (no polarity)

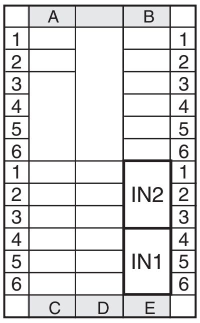
Input voltage	E5AR	E5ER
100-240 V AC 50/60Hz	22 VA	17 VA
24 V AC 50/60Hz	15 VA	11 VA
24 V DC (no polarity)	10 W	7 W

● Inputs (terminals)

E5AR

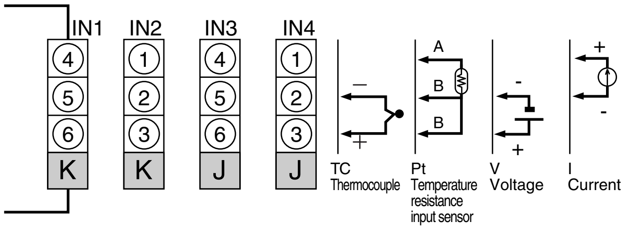


E5ER

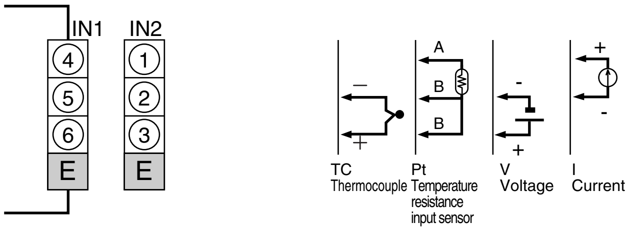


- For Input 1 (IN1), connect terminals K4 to K6 on the E5AR, or E4 to E6 on the E5ER, as follows according to the input type.
- For a multi-point input type, connect inputs 2 to 4 (IN2 to IN4) in the same way according to the number of input points.

E5AR



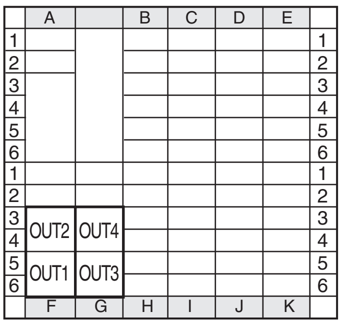
E5ER



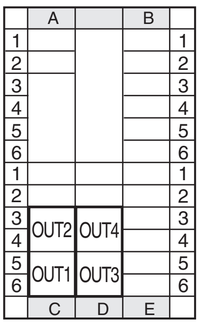
To prevent the appearance of error displays due to unused inputs, set the Number of enabled channels.

● Control outputs / Transfer outputs (terminals)

E5AR



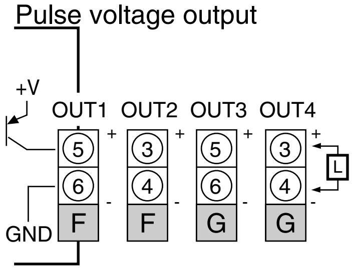
E5ER



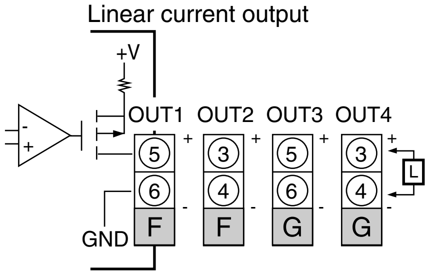
- On the E5AR, control output 1 (OUT1) outputs to terminals F5 to F6, and control output 2 (OUT2) outputs to terminals F3 to F4.
- On the E5ER, control output 1 (OUT1) outputs to terminals C5 to C6, and control output 2 (OUT2) outputs to terminals C3 to C4.
- On a multi-point input type, output takes place from control output 3 (OUT3) and control output 4 (OUT4).

E5AR

Pulse voltage output

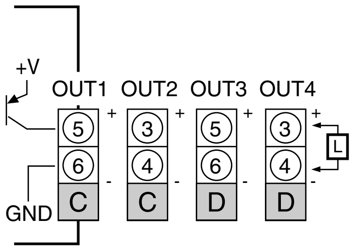


Linear current output

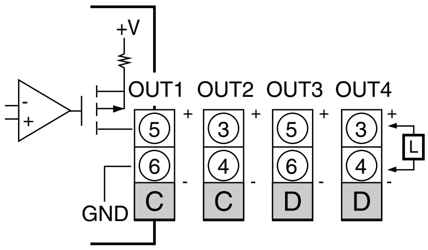


E5ER

Pulse voltage output



Linear current output



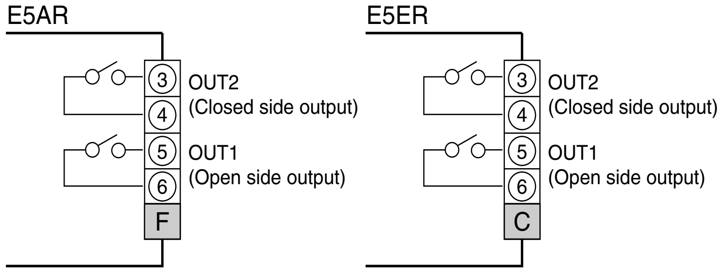
- If terminals ⑤ and ⑥ are used for pulse voltage output, approximately 2 V are output when the power is turned on. (Load resistance: 10 kΩ max. for 10 msec)
- In the case of linear current output, approximately 2 mA are output for 1 second when the power is turned on.

- Control outputs that are not used for control can be used for transfer output with the "control output / transfer output assignment" setting.
- Specifications for each output type are as follows:

Output type	Specifications
Pulse voltage output	Output voltage: 12 V DC+15%, –20%(PNP) Max. load current: 40mA*, with short-circuit protection circuit
Linear current output	0-20 mA DC (resolution: approx. 54,000) 4-20 mA DC (resolution: approx. 43,000) Load: 500 Ω max.

* The value for the E5AR-QQ□□□WW-□□□ is 21 mA max.

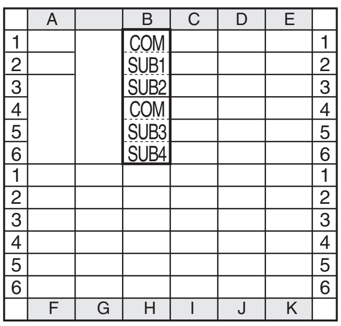
- The position proportional type has relay outputs (250 V AC, 1 A). Control output 1 (OUT1) is open output and control output 2 (OUT2) is closed output.



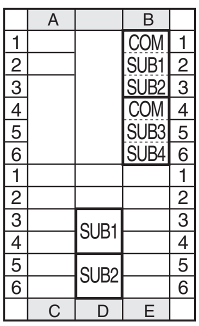
- Relay output specifications are as follows:
  250 V AC, 1 A (including inrush current)

● Auxiliary outputs (terminals)

E5AR

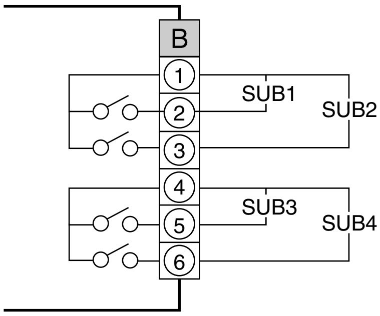


E5ER



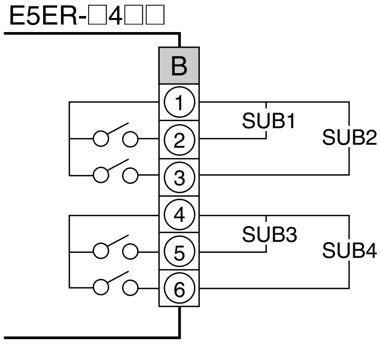
- On the E5AR-□4□□, auxiliary outputs 1 to 4 (SUB1 to 4) output to terminals B1 to B6.

E5AR



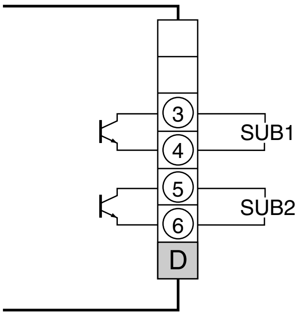
- On the E5ER-□4□□, auxiliary outputs 1 to 4 (SUB1 to 4) output to terminals B1 to B6. On the E5ER-□T□□, auxiliary outputs 1 to 2 (SUB1 to 2) output to terminals D3 to D6.

E5ER-□4□□



- Relay output specifications are as follows:
  250 V AC 1 A
- On the E5ER-□T□□ auxiliary outputs 1 and 2 (SUB1 and 2) output to terminals D3 to D6.

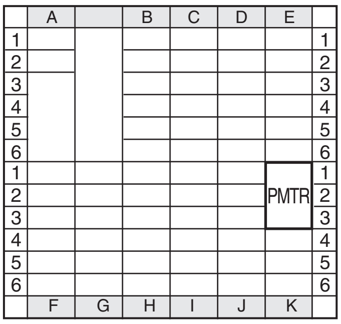
E5ER-□T□□



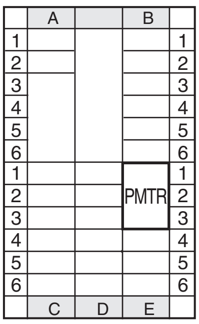
- Transistor output specifications are as follows:
  Max. load voltage 30 V DC
  Max. load current 50 mA
  Residual voltage 1.5 V max.
  Leakage current 0.4 mA max.

● Potentiometer inputs (terminals)

E5AR

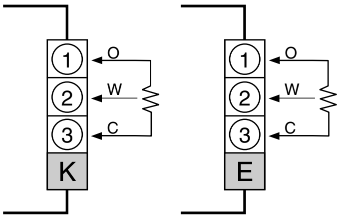


E5ER



- If you wish to use a position proportional control type to monitor the amount of valve opening or perform closed control, connect a potentiometer (PMTR) as shown in the following.

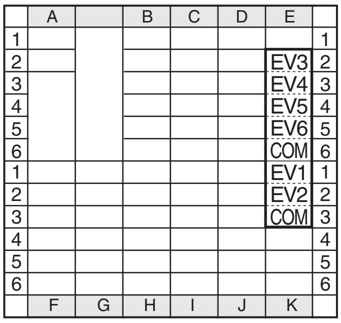
E5AR E5ER



- For information on the potentiometer, see the manual for the valve you are connecting. Terminal number meanings are as follows.
  O:OPEN, W:WIPE, C:CLOSE
  The input range is 100 Ω to 2.5 kΩ (Between C to O).

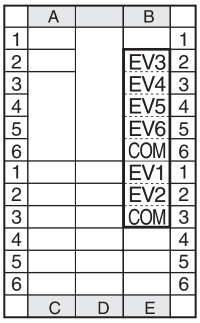
● Event inputs (terminals)

E5AR



- To use event input on the E5AR, connect event inputs 1 and 2 (EV1 and EV2) to terminals K1 to K3, and event inputs 3 to 6 (EV3 to EV6) to terminals numbers E2 to E6. The number of event input points varies depending on the model.

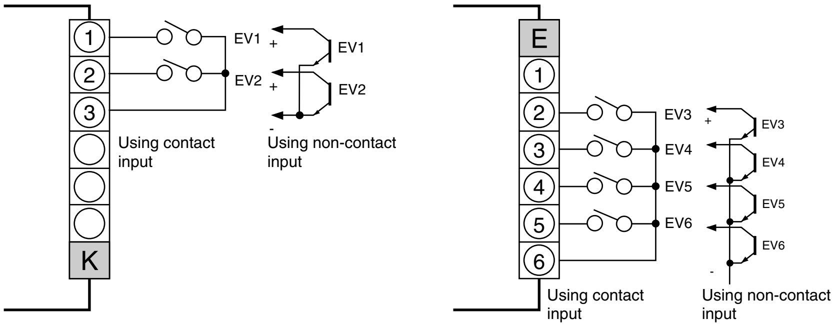
E5ER



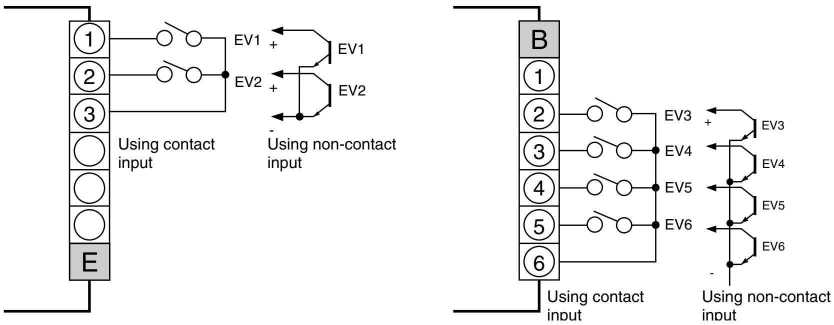
- To use event input on the E5ER, connect event inputs 1 and 2 (EV1 and EV2) to terminals E2 to E3 and event inputs 3 to 6 (EV3 to EV6) to terminals numbers B2 to B6. The number of event input points varies depending on the model.

- The number of input points of each model is as follows:
  E5AR-□□□B, E5ER-□□□B: 2 points, EV1 and EV2
  E5AR-□□D□, E5ER-□□D: 4 points, EV3 to EV6
  E5AR-□□DB: 6 points, EV1 to EV6

E5AR



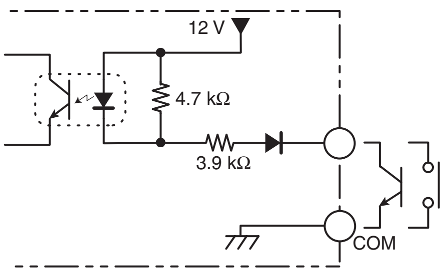
E5ER



- Input ratings of each input are as follows:

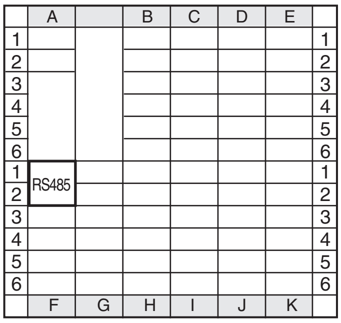
Contact	ON: 1 kΩ max., OFF: 100 kΩ or higher
No contact	ON: residual voltage of 1.5 V max., OFF: leakage current of 0.1 mA max.

<Circuit schematic>

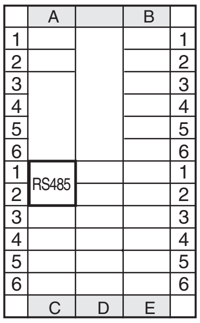


● Communication (terminals)

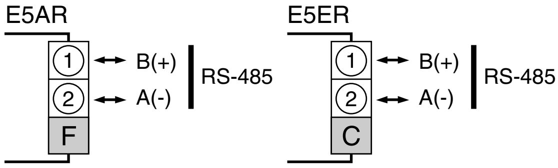
E5AR



E5ER

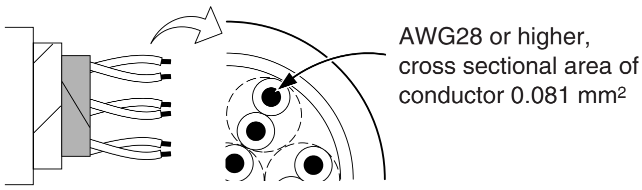


- To communicate with a host system, connect between terminals F1 and F2 on the E5AR, or C1 and C2 on the E5ER.

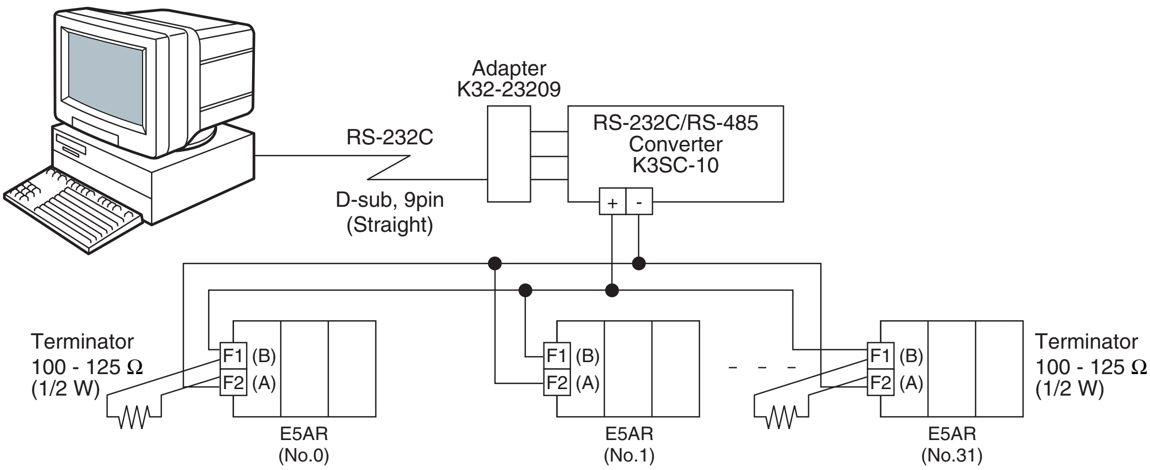


- The connection type is 1:1 or 1:N. In a 1:N installation, up to 32 units, including the host computer, can be connected.
- The maximum total cable length is 500 m.
- Use a shielded twisted pair cable (AWG28 or higher).

<Cable reference diagram>



- Use a resistance of 100 to 125 Ω (1/2 W) in the terminators. Install terminators at both ends of the transmission path, including the host computer.
- To connect to an RS232C port on a computer, use a 232C-485 convertor.
  Example convertor: RS-232C-RS-485 Interface Convertor
  K3SC



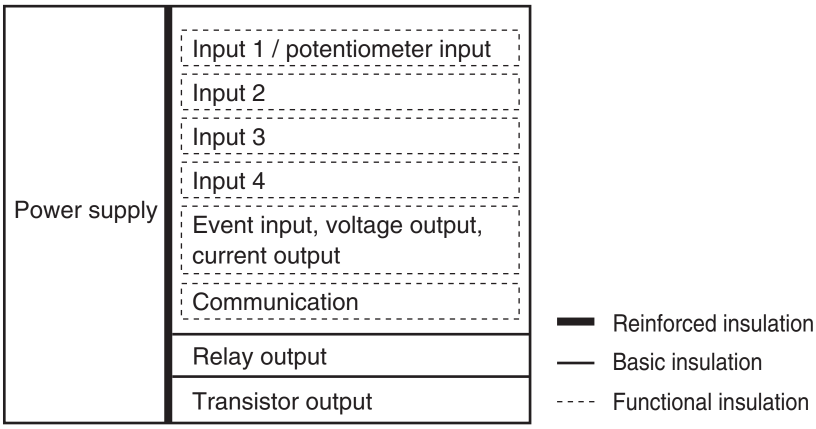
Insulation blocks

As shown in the following diagram, each function block of the E5AR/ER is electrically insulated.

<Input> <event input · voltage output · current output> <communication> are insulated from each other with functional insulation.

<Input · event input · voltage output · current output · communication> <relay output> <transistor output> are insulated from each other with basic insulation.

If reinforced insulation is required, input, event input, voltage output, current output, and communication terminals must be connected to a device that have no exposed chargeable parts and whose basic insulation is suitable for the applicable maximum voltage of connected parts.

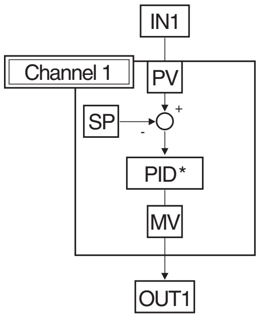


Section 3 Typical Control Examples

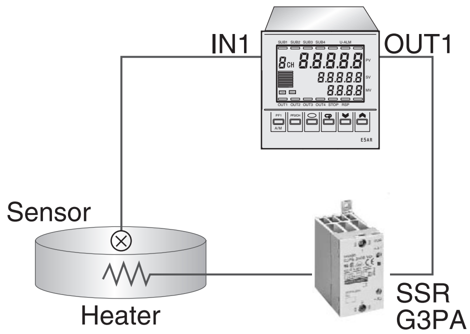
3.1 Standard control

The following is an example of basic, single-loop control whereby temperature control of a heater plate for semiconductors is carried out (example of combined sensor and heater).

■ Application



When controlling a heater plater for semiconductor wafers with the E5AR, the control mode is set to standard control and instrumentation is as shown in the following example.



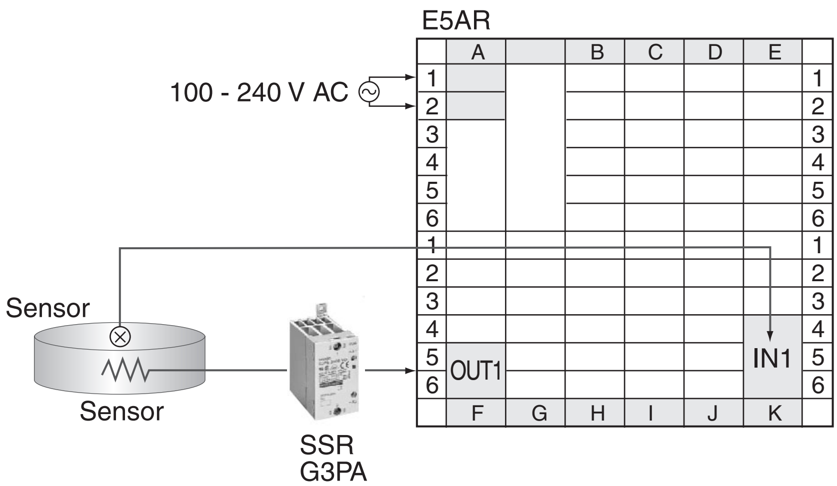
Hint

The control period can be set from 0.2 sec to 99.0 seconds on the E5AR/ER. (The shortest setting on our previous models was 1 sec).
For high precision control applications that previously required the combined use of our cycle control unit (G32A-EA) and an SSR, the G32A-EA is now no longer needed.

■ Wiring

The platinum resistance temperature input sensor Pt100 is connected to the IN1 terminal, and the OUT1 terminal is connected to the SSR.

Wiring for the E5AR-Q4B is shown in the following schematic.



■ Settings

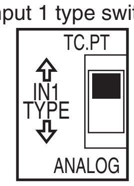
Set the control period to 0.2 sec for high-precision temperature control with the SSR.

Related setting data and settings are as follows.

Input 1 type switch = TC. PT (initial setting)
Input 1 input type = 1: Pt100 -150.00 to 150.00°C
Output 1 output type = 0: Pulse voltage output (initial setting)
Control mode = 0: Control mode (initial setting)
Action = or-r: Reverse action (initial setting)
SP = 115.00(°C)
Control period (heat) = 0.2

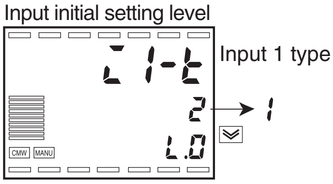
The following explains how to set the input type, the output type of output 1, the SP, and the control period (heat), and how to check the control mode.

Input 1 type switch



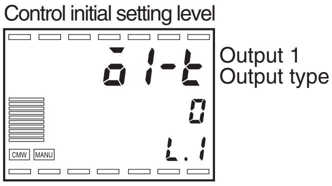
1. Before turning on the power, check that the input 1 type switch is set to TC. PT.

Input initial setting level

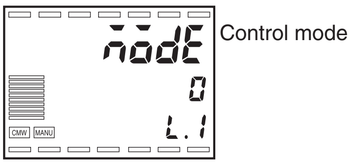


2. Turn on the power and then hold down the □ key at least 3 seconds to move from "RUN level" to "Input initial setting level". "c1-t: Input 1 input type" will appear. Press the ▽ key to select the setting "1: Pt100 -150.00 to 150.00°C".

Control initial setting level

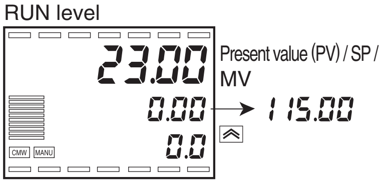


3. Press the □ key less than 1 second to move from "Input initial setting level" to "Control initial setting level". "o1-t: Output 1 Output type" will appear. Check sure that the set value is "0: Pulse voltage output".



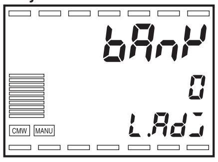
4. Press the ⟲ repeatedly to select "mode: Control mode". Check that the setting is "0: Standard control".

RUN level

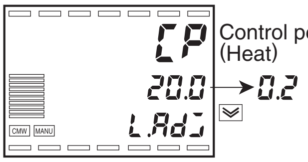


5. Hold down the □ for at least 1 second to return to "RUN level"."PV/SP/MV" will appear. Press the △ key and set the SP to "115.00".

Adjustment level



6. Press the key less than 1 second to move from "RUN level" to "Adjustment level".



Control period (Heat)

7. Press the repeatedly to select "CP: Control period (heat)", and then press the key to select "0.2".

■ Adjustment

To adjust the PID constants, run AT.

For more information, see "4.10 Determining the PID constants (AT, manual settings)" (P.4-20).

> **Hint**
>
> If the overshoot of temperature control (disturbance response) is too large after placing the wafer, the overshoot can be adjusted using the disturbance overshoot adjustment function.
> For information on the disturbance overshoot adjustment function. Refer to "5.2 Control functions" (P.5-8).

3.2 Heating/cooling control of a chemical reaction device

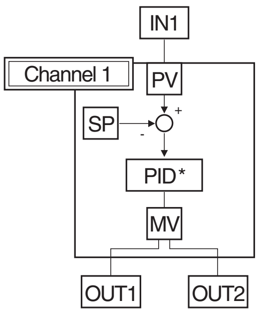
In temperature control of chemical processes where heat is naturally generated by chemical reactions, heating output and natural cooling are not a sufficient means of control, and thus heating/cooling control is used whereby heating output and cooling output are simultaneously manipulated.

Heating/cooling control is also used for high-precision control of constant-temperature tanks where the temperature is held at a constant level, and for extraction molding where the molding material generates heat.

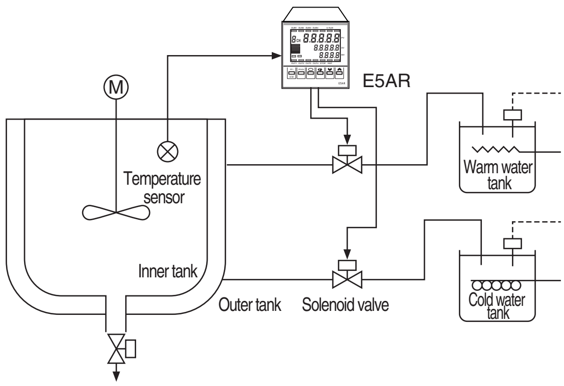
Heating/cooling control can also be applied to pH control using acids and alkali in liquid mixture systems, and to pressure control where pressure reduction is carried out.

Typical Control Examples

■ Application



When the E5AR is used to control a chemical reaction device, the control mode is set to heating/cooling control and instrumentation is as shown in the following example.



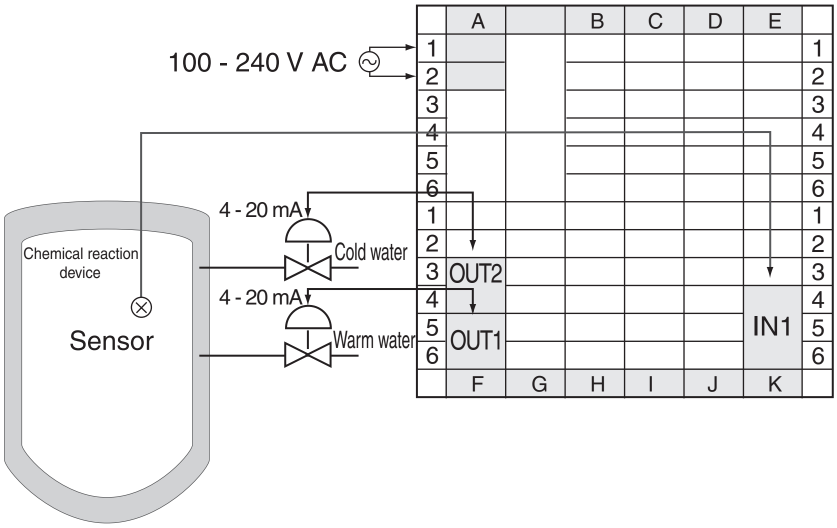
Hint

In addition to control of chemical reactions and other processes that naturally generate heat, heating/cooling control is also being increasingly used to shorten heating and cooling cycles for improved production efficiency in batch process production.
Example: Heating/cooling control of a flip chip bonding machine

■ Wiring

The input is connected to IN1 according to the input type, the heating system is connected to OUT1, and the cooling system is connected to OUT2.

Wiring for the E5AR-C4B is shown at left.



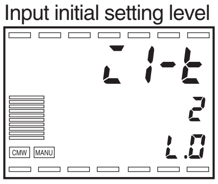
■ Settings

When the object has different heating and cooling characteristics, set the cooling coefficient of heating/cooling control to 0.50

Related setting data and settings are as follows:
- Output type of linear current output 1 = 1: 4 to 20 mA (initial setting)
- Output type of linear current output 2 = 1: 4 to 20 mA (initial setting)
- Control mode = 1: Heating/cooling control
- Action = or-r: Reverse action (initial setting)
- Cooling coefficient = 0.50
- Dead band = 0.00 (°C) (initial setting)

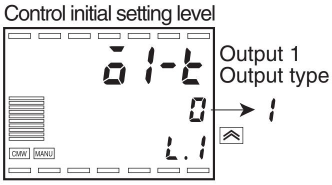
In the following, the control mode, SP, and cooling coefficient are set, and the initial settings are used for the other parameters.

Input initial setting level

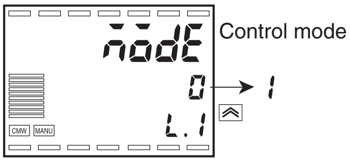


1. Turn on the power and then hold down the ☐ key for at least 3 seconds to move from "RUN level" to "Input initial setting level".

Control initial setting level

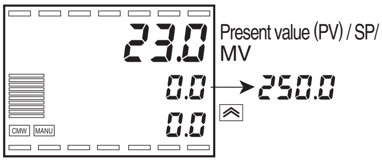


2. Press the key for less than 1 second to move from "Input initial setting level" to "Control initial setting level".



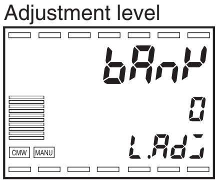
3. Press the repeatedly to select "modE: Control mode". Press the key to select "1: Heating/cooling control".

RUN level

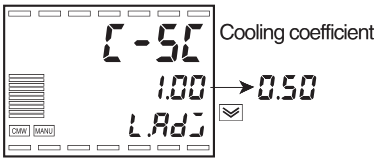


4. Hold down the key for at least 1 second to return to "RUN level". "PV/ SP/MV" will appear. Press the key to set the value to "250.0".

Adjustment level



5. Press the key less than 1 second to move from "RUN level" to "Adjustment level".



6. Press the repeatedly to select "C-SC: Cooling coefficient". Press the key to set the SP to "0.50".

■ Adjustment

To adjust the PID constants, run AT.

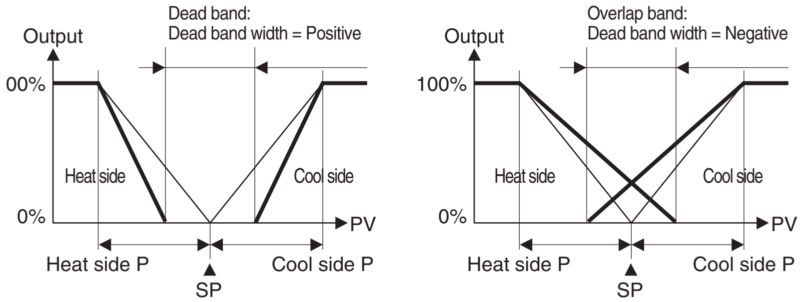
For more information, see"4.10 Determining the PID constants (AT, manual settings)" (P.4-20).

■ Settings for heating/cooling control

When heating/cooling control is selected, the "Dead band" and "Cooling coefficient" settings can be used.

● Dead band

The dead band is set centered on the SP. The dead band width is set in "Dead band" in the "Adjustment level". Setting a negative value changes the dead band to an overlap band.



- The initial setting is "0.00".

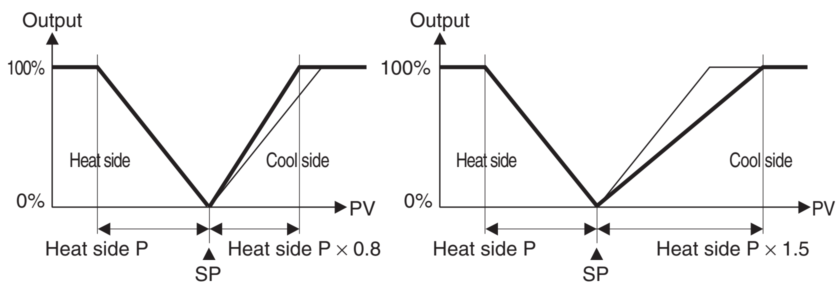
● Cooling coefficient

When the heating characteristics of the object are different from the cooling characteristics and satisfactory control is not possible using the same PID parameters, use the cooling coefficient to adjust the proportional band of cooling control output and thereby balance heating and cooling control. The heating control output P and the cooling control output P are as follows:

Heating P = P

Cooling P = Heating P × Cooling coefficient

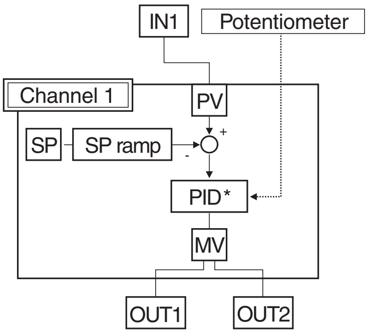
The cooling P is obtained by multiplying the heating P by the cooling coefficient, and cooling output control is performed with different characteristics than heating control output.



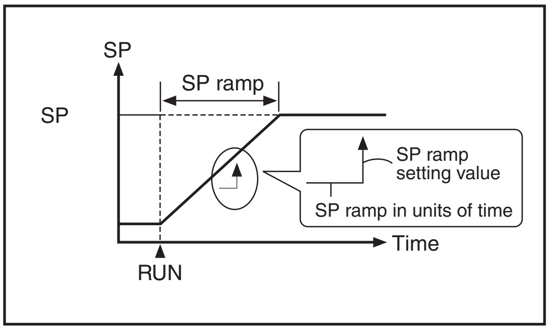
3.3 Position proportional control of a ceramic kiln

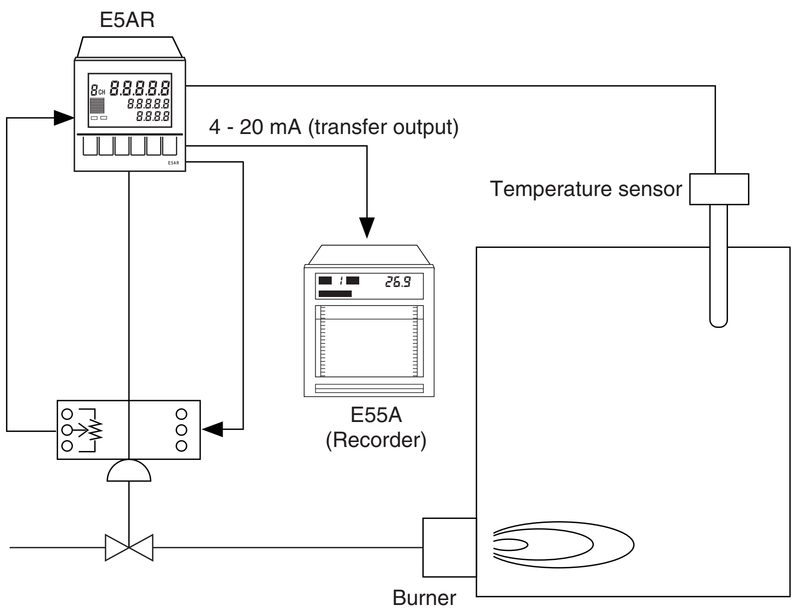
The control method whereby a potentiometer is used to read the amount of opening of a valve and then open or close the valve by means of an attached control motor is called position proportional control or on/off servo control.

■ Application



To control a gas kiln using a position proportional control valve, select the control valve control type and configure the instrumentation as shown in the following example.





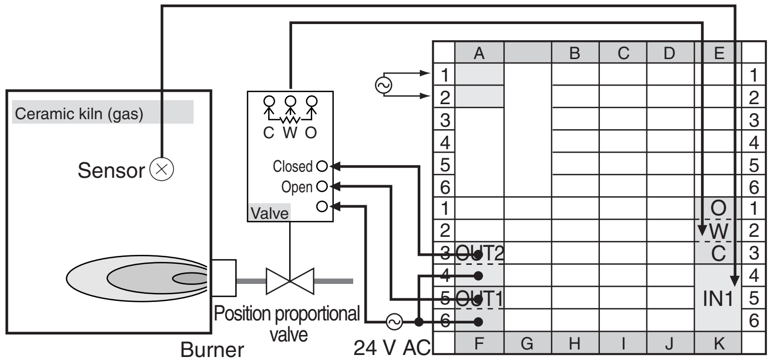
Hint

When there is a concern that sudden temperature changes will damage or change the composition of an object such as a ceramic work, the SP ramp function can be used to limit the rate of change of the SP using the SP ramp value and thereby cause the temperature to change at a constant rate.

■ Wiring

Connect the input to terminal IN1 according to the input type, connect the open side of the position proportional valve to OUT1, and connect the closed side to OUT2.

When using the E5AR-PR4DF, wire as shown below.



When using floating control, there is no need to connect a potentiometer (C, W, O) unless the amount of valve opening is being monitored.

■ Settings

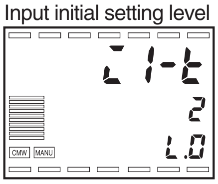
Select the value control type and perform floating control using Position-proportional value with travel time* of 45 seconds. Set SP ramp to change SP within a width of 10.0 °C / minute.

*Time from completely open to completely close.

The related setting data and settings are as follows:
Action = ōr-r : Reverse action (initial setting)
"Closed/Floating" = FLōAt : Floating (initial setting)
Travel time = 45 sec
SP ramp time unit = m̄: min (initial setting)
SP ramp rise value = 10.0 (°C)

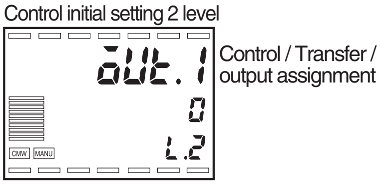
The travel time and SP ramp rise value are set in the following, and the initial settings are used for all other parameters.

Input initial setting level

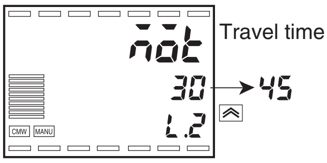


1. Turn on the power and then hold down the ☐ key for at least 3 seconds to move from "RUN level" to "Input initial setting level".

Control initial setting 2 level

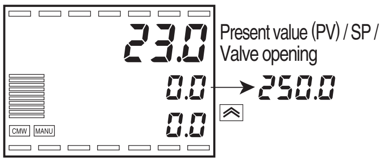


2. Press the □ twice to move from "Input initial setting level" to "Control initial setting 2 level".



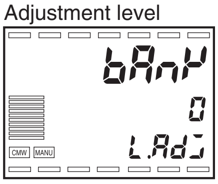
3. Press the ⊡ key repeatedly to select "mot: Travel time". Press the ⌃ key to set the value to "45".

RUN level

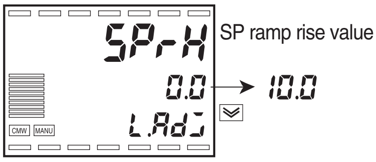


4. Hold down the □ at least 1 second to return to "RUN level". "PV/SP/MV" will appear. Press the ⌃ key to set the SP to "250.0".

Adjustment level



5. Press the □ key less than 1 second to move from "RUN level to "Adjustment level".



6. Press the ⊡ key to select "SPrH: SP ramp rise value", and press the ⌃ key to set the value to "10.0".

■ Adjustment

To adjust the PID constants, run AT.

For more information, see "4.10 Determining the PID constants (AT, manual settings)" (P.4-20).

Hint

On the E5AR/ER, the SP ramp rise value and the SP ramp fall value can be set separately.

■ Settings for position proportional control

When position proportional control is selected, "Closed/Floating", "Motor calibration", "Travel time", "Position proportional dead band", "Open / Close hysterisis", "Operation at potentiometer input error", and "PV dead band" can be used.

● Closed/Floating

- Closed control
  Control whereby a potentiometer is connected to feed back the amount of opening of the valve.
- Floating control
  Control without feedback of the amount of opening of the valve. Control is possible without connecting a potentiometer.

● Motor calibration and travel time

Run "Motor calibration" when a potentiometer is connected for closed control or floating control that monitors the amount of valve opening.

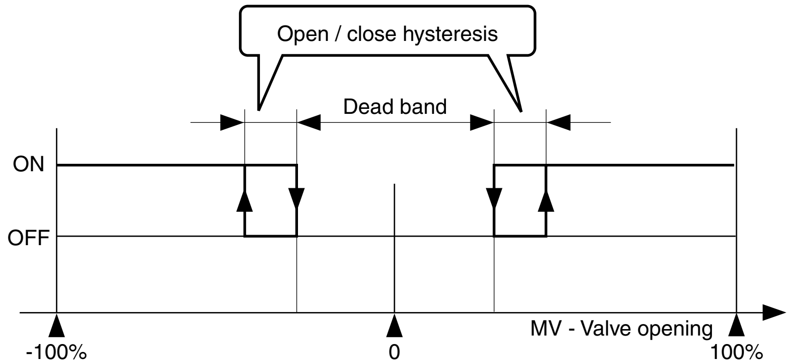
This will also automatically set the "Travel time", which is the amount of time from when the valve is completely open to when the valve is completely closed.

When performing floating control without a potentiometer, it is necessary to manually set the "Travel time". Set the travel time to the amount of time from when the valve is completely open to when the valve is completely closed.

● Position proportional dead band and Open / Close hysterisis

The valve output hold interval (the duration of ON/OFF switching of open output and closed output) is set in "Position proportional dead band", and the hysteresis is set in "Open / Close hysterisis".

The relation to valve opening is shown below.



● PV dead band

When the present value is inside the PV dead band, this function is used to perform control for PV = SP and stop unnecessary output when the PV is close to the SP.

● Operation at potentiometer input error

Use this setting to select whether to stop control or switch to floating control and continue when a potentiometer error occurs during closed control.

> **Important**
> In the event that a break occurs in the O or C wires of the potentiometer, potentiometer errors may not be detectable, thus this function (stop control or switch to floating control) does not operate.

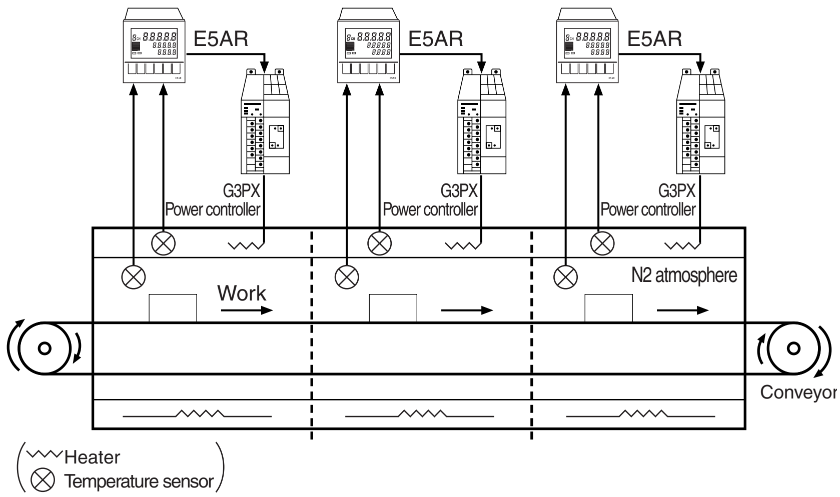
3.4 Cascade control of reflow ovens

Cascade control is used to reduce the effects of disturbances in the manipulated system (disturbances in the secondary loop) by adding a second PID loop to the regular PID loop.

Cascade control is also used in situations where a sensor is added close to the object to improve control performance.

■ Application

Conventional temperature control of reflow ovens is performed using only a sensor installed near the heater. In lead-free reflow ovens, the melting temperature of solder is higher, and in order to minimize heat-induced deterioration of the electronic components, a second sensor is added inside the oven near the board to enable a higher precision of temperature control.



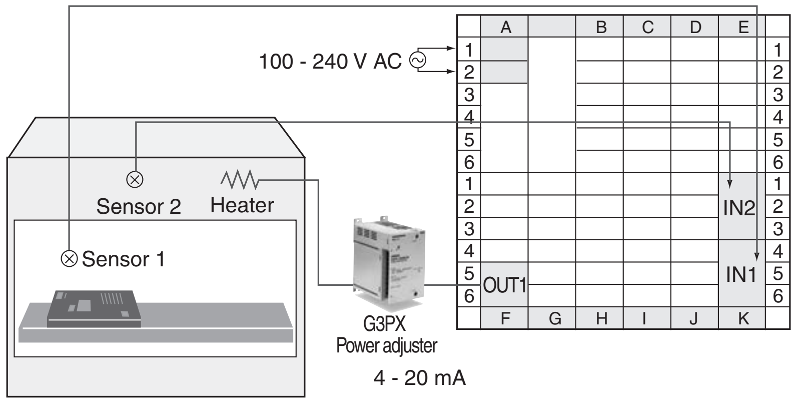
Hint

- A thermocouple or platinum resistance temperature input sensor can also be directly connected to input 2 (previously input 2 only supported 4 to 20 mA or 1 to 5 V, and an external converter was required).
- Auto tuning is now possible in both the cascade closed and cascade open states.

■ Wiring

Thermocouple K close to the heater is connected to IN2, thermocouple K in the oven is connected to IN1, and a power adjuster is connected to OUT1.

When using the E5AR-QQ43DW-FLK, wire as shown below.



■ Settings

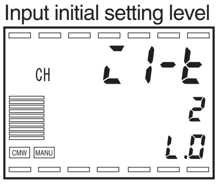
Inputs 1 and 2 are set to thermocouple K and the control mode is set to cascade standard control.

The related setting data and settings are as follows:

Input 1 type switch	= TC.PT (initial setting)
Input 2 type switch	= TC.PT (initial setting)
Input 1 input type	= 2: K-200.0 to 1300.0°C (initial setting)
Input 2 input type	= 2: K-200.0 to 1300.0°C (initial setting)
Output type of output 1	= 1: Linear current output
Output type of linear current output 1	
	= 1: 4 to 20 mA (initial setting)
Control mode	= 5: Cascade standard control
SP	= 180.0

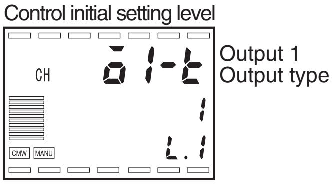
The control mode and SP are set in the following, and the initial settings are used for all other parameters.

Input initial setting level

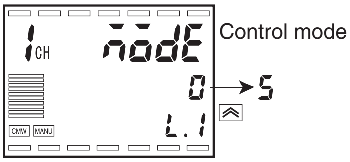


1. Turn on the power and then hold down the ▭ key for at least 3 seconds to move from "RUN level" to "Input initial setting level".

Control initial setting level

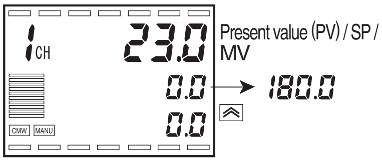


2. Press the ▭ key less than 1 second to move from "Input initial setting level" to "Control initial setting level". "o1-t: Output 1 output type" will appear. Press the ⩔ key to set to "1: Linear current output".



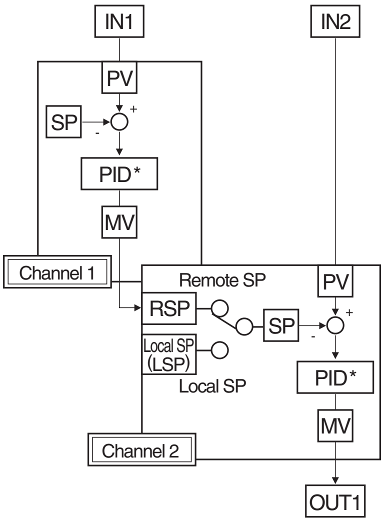
3. Press the key repeatedly to select "modE: Control mode". Press the to select "S: Cascade standard control".

RUN level



4. Hold down the at least 1 second to return to "RUN level". "PV/SP/MV" will appear. Press the key to set the SP to "180.0".

■ Adjustment

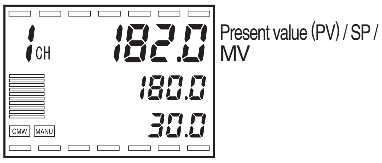


(1) Run AT in the secondary loop to obtain suitable PID values.
When the primary loop achieves stable control close to the SP, set the secondary local SP to the secondary PV.
Set the SP mode of channel 2 to local SP mode (cascade open), and with the secondary loop in the independent control state, run AT.
When AT finishes, obtain the secondary PID values.

(2) Set the control mode to cascade control, and run AT on the primary loop to obtain the primary PID values.
Set the primary SP to local SP.
Set the SP mode of channel 2 to remote SP mode (cascade control), switch to cascade control, and run AT.

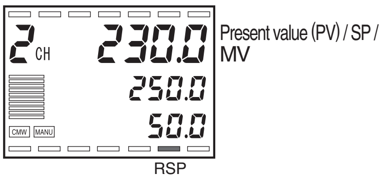
When finished, check the primary and secondary control states (PVs) and manually adjust the PID values. Use the same adjustment method as regular PID control.

RUN level



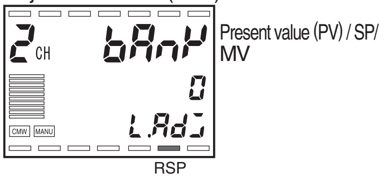
1. After the power is turned on, "PV/SP/MV" of the primary loop appears (ch 1). (Here we assume that cascade control is in progress using near SP of 180.0°C)

Ch 2



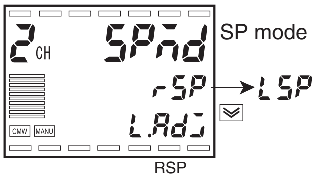
2. Press the CH key to select the secondary (ch 2) "PV/SP/MV". The RSP operation indicator lights on to indicate that the system is in the cascade control (cascade closed) state.
(Here we assume that the secondary PV is 230.0°C. The secondary local SP will be set to 230.0°C in step 5.)

Adjustment level (ch 2)



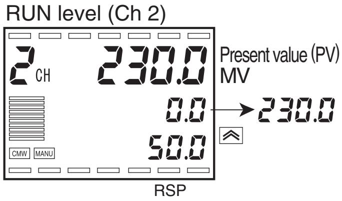
3. Press the ▭ key less than 1 second to move from "RUN level" to "Adjustment level".

Ch 2



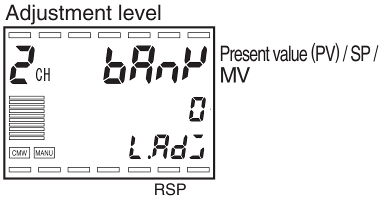
4. Press the key repeatedly to select the secondary (ch 2) "SPMd: SP mode". Press the key to set the SP mode to "LSP: Local SP".
   The RPS operation indicator is off in local SP mode, indicating independent control (cascade open) in the secondary loop.

RUN level (Ch 2)



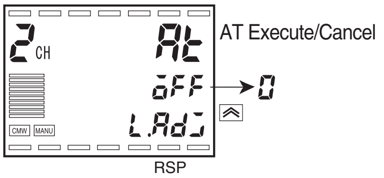
5. Press the ▭ key repeatedly to return to "RUN level". The secondary (ch 2) "PV/SP/MV" will appear. Set the secondary SP to "230.0", which is the PV obtained in step 2.

Adjustment level



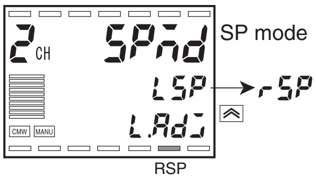
6. Press the ▭ key less than 1 second to move from "RUN level" to "Adjustment level".

Ch 2

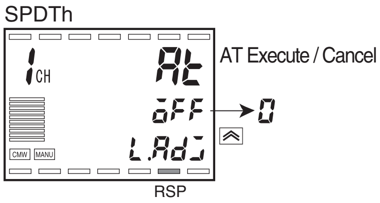


7. Press the key to select the secondary (ch 2) "At: AT Execute / Cancel". Press the key to change the set value to "0" and run AT. During AT the automatically selected PID Set No. is displayed and display 1 (At) blinks. Display 2 shows "oFF" when AT finishes, and display 1 (At) stops blinking.

Ch 2



8. Press the key to select the secondary (ch 2) "SPMd: SP mode". Press the key to select "rSP: Remote SP".
   The RSP operation indicator will light up in remote SP mode to indicate cascade control (cascade closed).



9. Press the CH key and then press the key repeatedly to select "At: AT Execute / Cancel" of the primary loop (ch 1). Press the key to change the set value to "0" and run primary AT. During AT the automatically selected PID Set No. is displayed and display 1 (At) blinks.
   When AT finishes, display 2 changes to "oFF" and display 1 (At) stops blinking.

   This completes PID adjustment for the primary and secondary loops.

Operation when a primary loop input error occurs

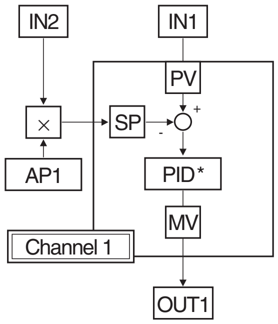
When an input error occurs in the primary loop, MV at error is output for the primary (ch 1) MV, and the secondary loop continues control using a remote SP equivalent to the MV at error of the primary loop.

For this reason, be sure to set MV at error for the primary loop.

3.5 Ratio control of dyeing machines

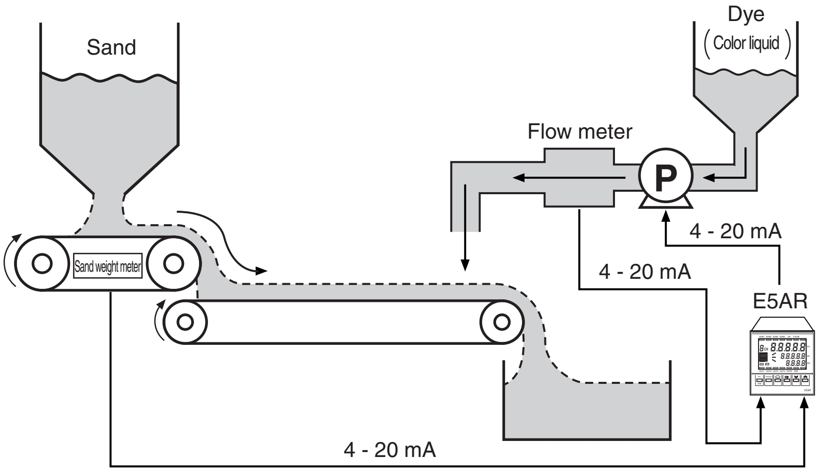
Ratio control is used to maintain a constant proportional relationship between two or more variables.

■ Application



This machine mixes a constant proportion of flowing sand and dye in order to dye the sand a uniform color.

Ratio control that maintains a constant weight ratio between sand and dye



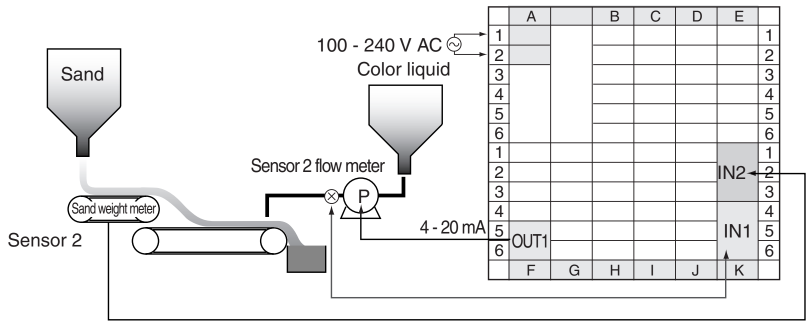
Settings are shown when 4 to 20 mA is used in the input from the dye flow sensor, 4 to 20 mA is used in the input from the sand weight measurement sensor, and a pump is used that is driven by an inverter with a 4 to 20 mA input is used in the manipulation system.

> **Hint**
> Control of the proportion of gas to air is also carried out in firing control in gas kilns.
> With the goal of preventing pollution and saving energy, the proportion of gas to air is strictly controlled to prevent incomplete combustion and improve combustion efficiency.

■ Wiring

IN1 is connected to the adjustment system and IN2 is connected to the sensor in the reference system. (A flow meter is connected to IN1, a sand weight scale is connected to IN2, and a pump (drive inverter) is connected to OUT1.)

When using the E5AR-QQ43W-FLK, wire as shown below.



■ Settings

The scale of sensor 1, which measures the flow of dye, is 0.0 to 25.0 kg/s, and the scale of sensor 2, which measures the weight of sand, is 0.0 to 500.0 kg/s. The ratio value is set to 0.05 so that the proportion of sand to dye will be 110 : 5.

Related setting data and settings are as follows:

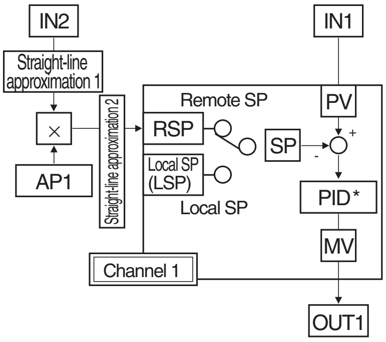
Input 1 type switch	= ANALOG
Input 2 type switch	= ANALOG
Input 1 type	= 15: 4 to 20 mA
Ch 1 scaling input value 1	= 4
Ch 1 scaling display value 1	= 0
Ch 1 scaling input value 2	= 20
Ch 1 scaling display value 2	= 250
Ch 1 decimal point position	= 1
Input 2 input type	= 15: 4 to 20 mA
Output type of output 1	= 1: Current output (initial setting)
Output type of linear current output 1	= 1: 4 to 20 mA (initial setting)
Control mode	= 4: Ratio control
Straight-line approximation 1	= on: Enable
Straight-line approximation 2	= on: Enable

Straight-line approximation 1, Straight-line approximation 2

→ See the setting examples on the next page

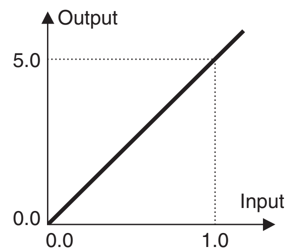
Analog parameter 1	= 0.05
SP mode	= rSP: Remote SP

The following explains how to configure the control mode, straight-line approximation 1 and 2 settings, and the ratio setting. It is assumed that the input 1 and input 2 type settings and the scaling setting have already been configured.



Ratio control is achieved by multiplying input 2 (which serves as a reference) by the proportion and using the result as remote SP.

Set the SP mode to remote SP.



Straight-line approximation 1

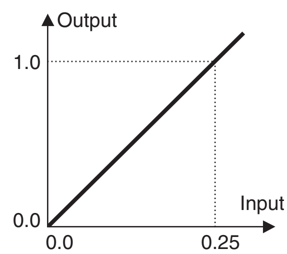
First, to make the units of input 2 match the units of input 1, input 2 is converted from normalized data to an industrial quantity using straight-line approximation 1.

Convert 0.000 - 1.000 to 0 - 5.000.

Straight-line approximation 1 input 1 = 0.000
Straight-line approximation 1 input 2 = 1.000
Straight-line approximation 1 output 1 = 0.000
Straight-line approximation 1 output 2 = 5.000

This result is multiplied by the proportion.

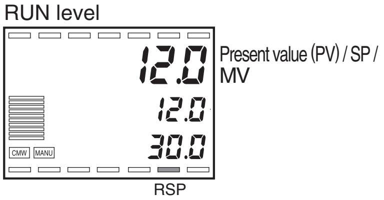
Ratio setting (AP1) = 0.05



Straight-line approximation 2 is then used to convert this result from an industrial quantity to normalized data.

Straight-line approximation 2 input 1 = 0.000
Straight-line approximation 2 input 1 = 0.250
Straight-line approximation 2 input 1 = 0.000
Straight-line approximation 2 input 1 = 1.000

RUN level



When the ratio setting (AP1) is 0.05 and the measured value of input 2 is 240.0 kg/s, control of the dye takes place using an SP of 12.0 kg/s.

■ Adjustment

To adjust the PID constants, run AT.

For more information, see"4.10 Determining the PID constants (AT, manual settings)" (P.4-20).

To change the proportion, change "Proportion setting (AP1)".

Hint

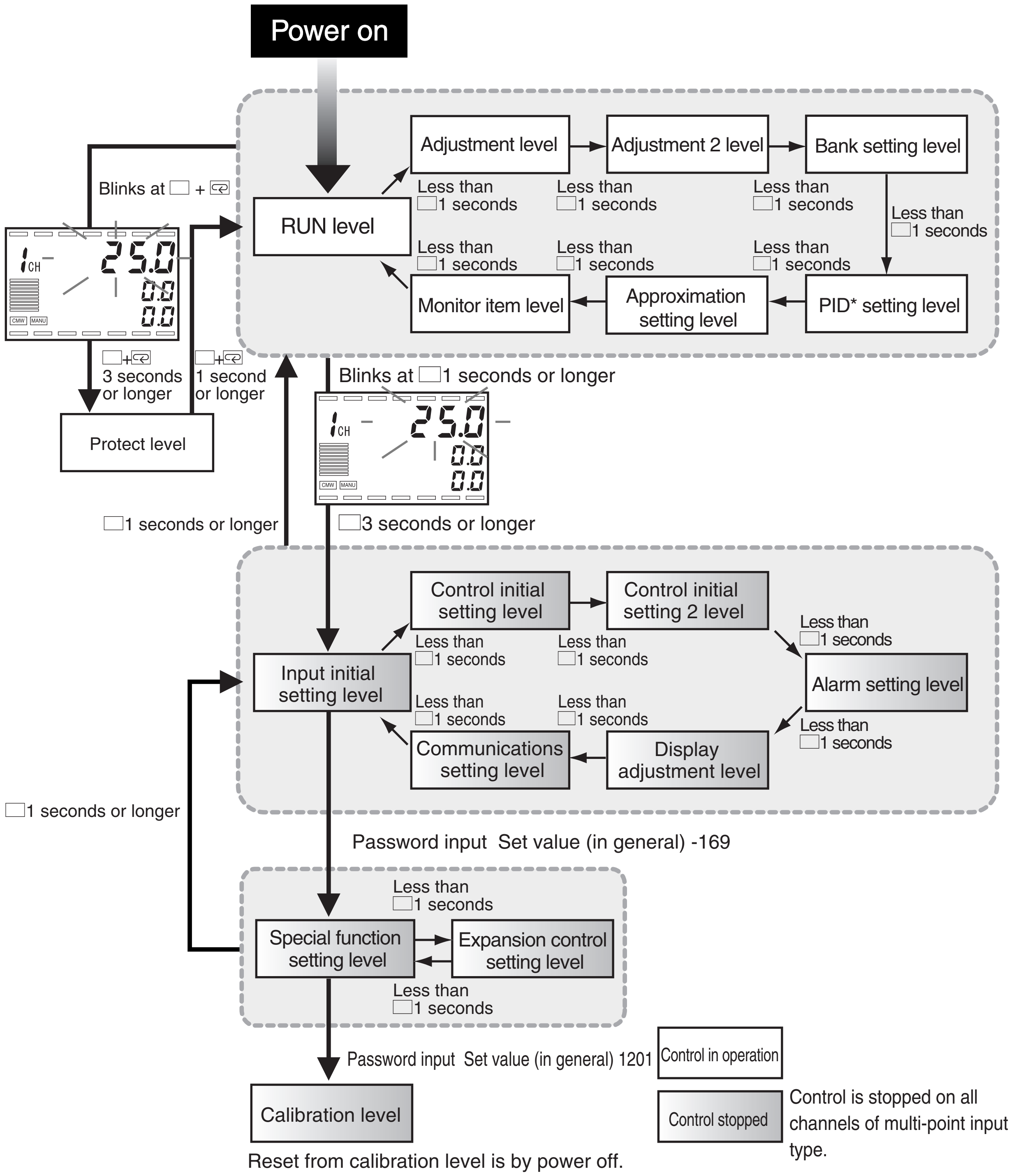
On the E5AR/ER, use normalized numbers for approximation settings such as broken-line and straight-line approximation.
For example, use 0.200 for 20%. Also, if input 1 is K-200.0 to 1300.0°C, use 0% (0.000) for -200.0°C and 100% (1.000) for 1300.0°C.

Section 4 Settings Required for Basic Control

4.1 Setting levels and key operation

The settings are grouped into levels and the set values are called setting data. On the E5AR/ER, the settings are grouped into 17 levels as shown below.

When the power is turned on, all indicators light up for 1 second. The initial level after power-on is "RUN level".



Level	Description	Operation
Protect level	Settings to prevent accidental key input.	During operation
RUN level	Basic display and settings for operation.	
Adjustment level	Option settings and control adjustment.	
Adjustment 2 level	Settings that can be adjusted during operation function control.	
Bank setting level	SP, PID Set No., and alarm settings of each bank.	
PID setting level	P,I,D values of each PID set and limit settings.	
Approximation setting level	Broken-line approximation and straight-line approximation settings.	
Monitor item level	Monitor display of set values.	
Input initial setting level	Initial settings related to input.	When operation is stopped
Control initial setting level	Initial settings for the output type and control mode.	
Control initial setting 2 level	Initial settings for operation functions.	
Alarm setting level	Alarm type and output settings.	
Display adjustment level	Display adjustment settings.	
Communications setting level	Communications speed, communication data length, and other communication settings.	
Special function setting level	Initialization of settings and PF key settings.	
Expansion control setting level	Advanced control settings and position proportional settings.	
Calibration level	Calibration by the user.	

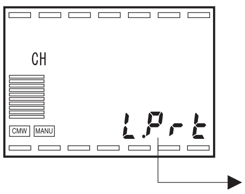
* To move to the special function setting level, set "Initial setting protect" in the "Protect level" to "0".

Settings Required for Basic Control

In following each levels, control is stopped, input initial settings, control initial setting, control initial settings 2, alarm settings, display adjustment, communication settings, advanced function settings, expansion control settings and calibration.

Note that control will stop on all channels if you move to any of these levels.

Display 3 shows the current level. The characters and the corresponding levels are as follows:



Display 3	Level
L.Prt	Protect level
Off *	RUN level
L.AdJ	Adjustment level
L.Ad2	Adjustment 2 level
L.bnK	Bank setting level
L.PId	PID setting level
L.tEC	Approximation setting level (Technical)
L.Mon	Monitor item level
L.0	Input initial setting level
L.1	Control initial setting level
L.2	Control initial setting 2 level
L.3	Alarm setting level
L.4	Display adjustment level
L.5	Communications setting level
L.AdF	Special function setting level
L.EXC	Expansion control setting level
L.CAL	Calibration

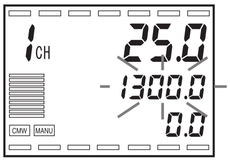
* May appear depending on the selected setting data.

4.2 Set values

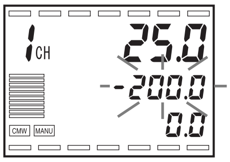
The values selected for each setting are called "set values". There are two types of set values: numbers and characters.

Set values are displayed and changed as follows:

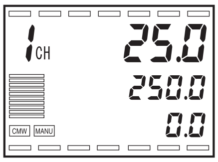
Changing a numeric set value



1. Press the key continuously to increase the set value.
   When the upper limit of the setting is reached, the set value will blink and cannot be further increased.



2. Press the key continuously to decrease the set value.
   When the lower limit of the setting is reached, the set value will blink and cannot be further decreased.



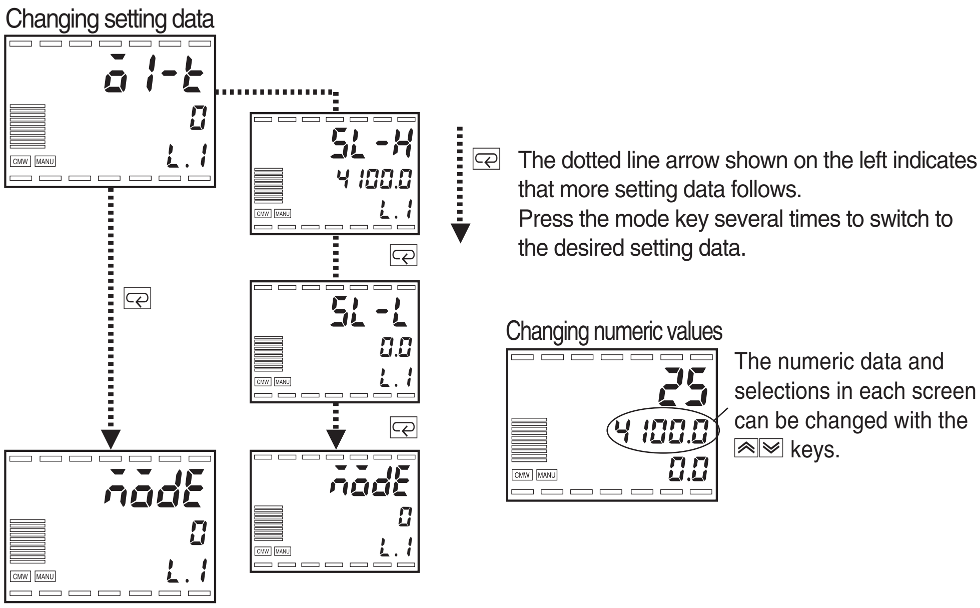
3. Follow steps 1 and 2 to change the set value to the desired value.
   The setting is saved 2 seconds after it is changed, or when a key other than the keys are pressed.

   Note that when setting a manual MV default, the set value is output every 50 ms. The set value is saved as explained above.

4.3 Initial setting examples

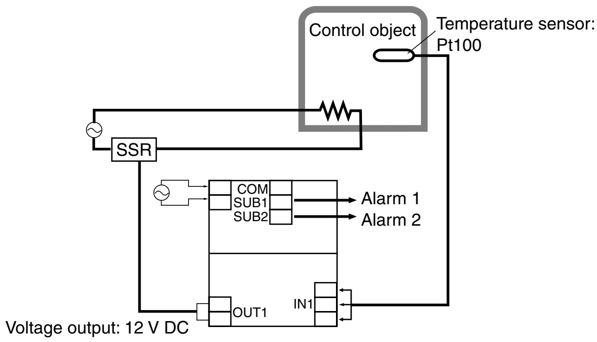
This section explains how to configure the initial settings for the sensor input type, alarm type, control period, and other parameters. Use the □ key and ⏎ key to move through the display screens. The destination screen will vary depending on how long each key is held down.

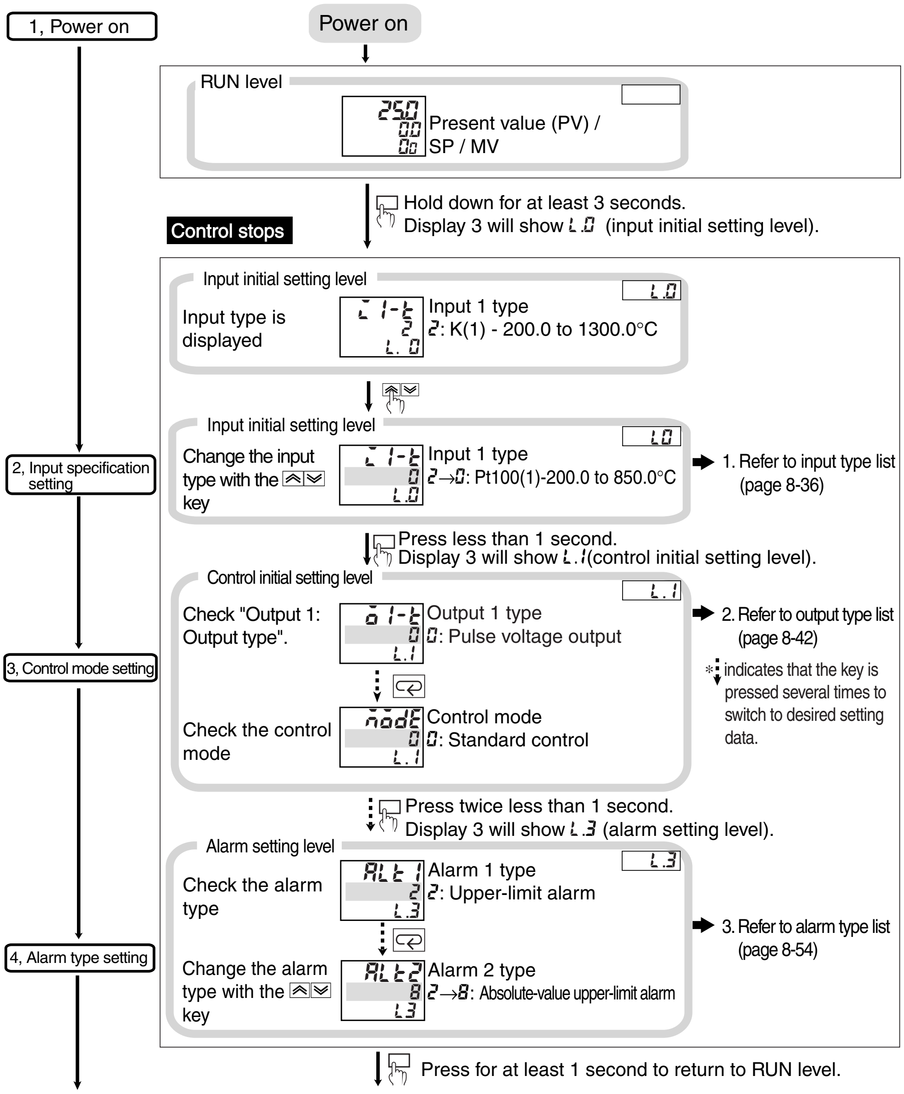
● Typical example

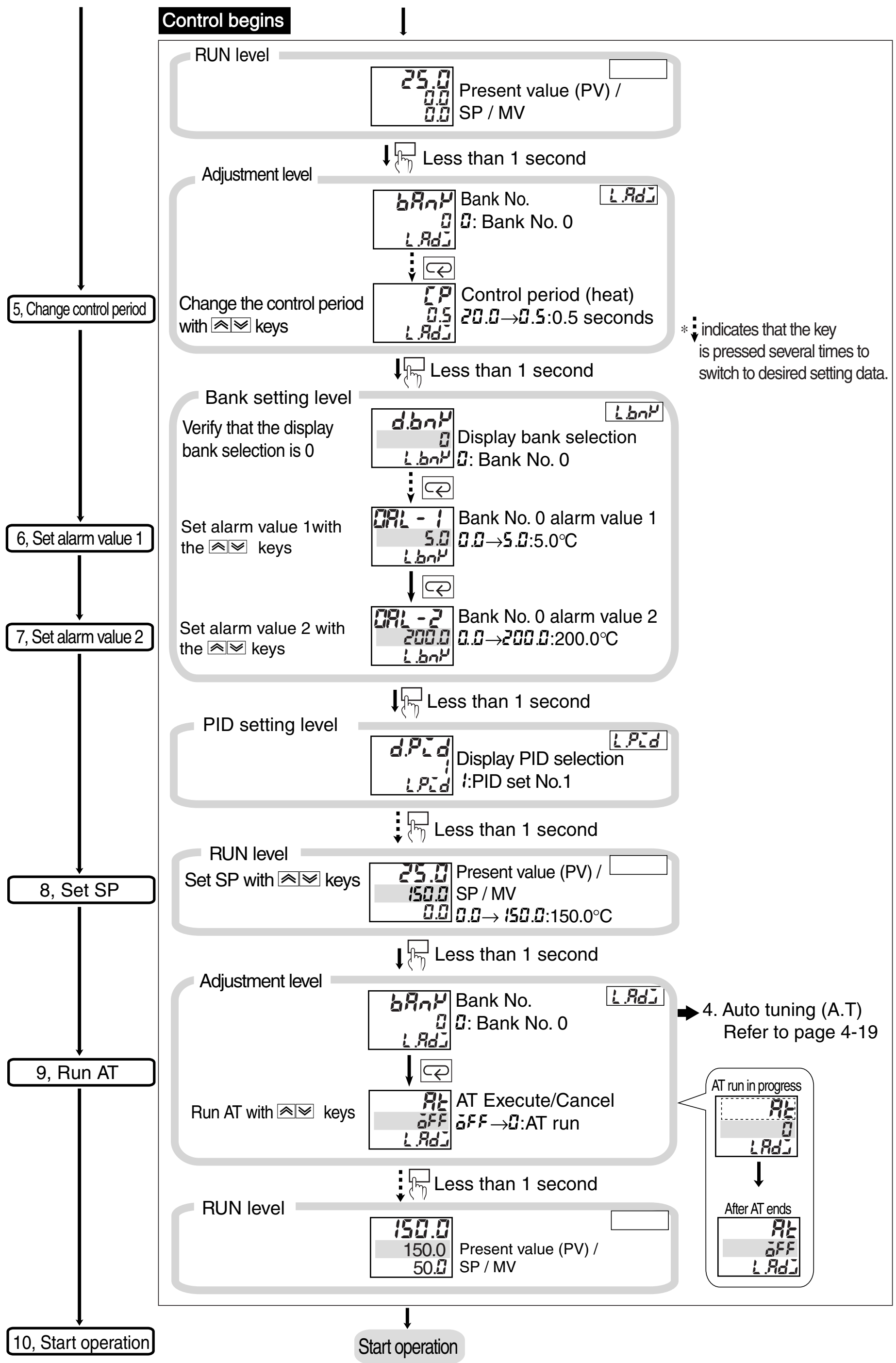


● Typical example

E5AR-Q4B
Input type: 0 Pt100 (-200.0 to 850.0°C)
Control method: PID control
Control output: Pulse voltage output
Alarm 1 type: 2 upper-limit
Alarm value 1: 5.0°C (a deviation is set)
Alarm 2 type: 8 absolute-value upper-limit
Alarm value 2: 200.0°C
PID: Obtained by AT (auto tuning)
SP: 150.0°C




1, Power on
Power on
RUN level
Present value (PV) / SP / MV
Control stops
Hold down for at least 3 seconds.
Display 3 will show L.0 (input initial setting level).
Input initial setting level
Input type is displayed
Input 1 type
2: K(1) - 200.0 to 1300.0°C
2, Input specification setting
Input initial setting level
Change the input type with the key
Input 1 type
2→0: Pt100(1)-200.0 to 850.0°C
1. Refer to input type list (page 8-36)
Press less than 1 second.
Display 3 will show L.1 (control initial setting level).
Control initial setting level
3, Control mode setting
Check "Output 1: Output type".
Output 1 type
0: Pulse voltage output
2. Refer to output type list (page 8-42)
* indicates that the key is pressed several times to switch to desired setting data.
Check the control mode
Control mode
0: Standard control
Press twice less than 1 second.
Display 3 will show L.3 (alarm setting level).
Alarm setting level
4, Alarm type setting
Check the alarm type
Alarm 1 type
2: Upper-limit alarm
3. Refer to alarm type list (page 8-54)
Change the alarm type with the key
Alarm 2 type
2→8: Absolute-value upper-limit alarm
Press for at least 1 second to return to RUN level.



Control begins
RUN level
Present value (PV) / SP / MV
Less than 1 second
Adjustment level
Bank No.
0: Bank No. 0
5, Change control period
Change the control period with keys
Control period (heat)
20.0→0.5:0.5 seconds
* indicates that the key is pressed several times to switch to desired setting data.
Less than 1 second
Bank setting level
Verify that the display bank selection is 0
Display bank selection
0: Bank No. 0
6, Set alarm value 1
Set alarm value 1with the keys
Bank No. 0 alarm value 1
0.0→5.0:5.0°C
7, Set alarm value 2
Set alarm value 2 with the keys
Bank No. 0 alarm value 2
0.0→200.0:200.0°C
Less than 1 second
PID setting level
Display PID selection
1:PID set No.1
Less than 1 second
RUN level
8, Set SP
Set SP with keys
Present value (PV) / SP / MV
0.0→ 150.0:150.0°C
Less than 1 second
Adjustment level
Bank No.
0: Bank No. 0
4. Auto tuning (A.T) Refer to page 4-19
9, Run AT
Run AT with keys
AT Execute/Cancel
oFF→0:AT run
AT run in progress
After AT ends
Less than 1 second
RUN level
150.0
50.0
Present value (PV) / SP / MV
10, Start operation
Start operation

4.4 Setting the input type

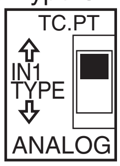
Set the input type switch and configure the input type setting according to the sensor used. Check the table below and set the correct value for the sensor temperature range to be used.

When using a multi-point input type, set input type switches 2 to 4 and configure input type settings 2 to 4 as appropriate for the number of input points.

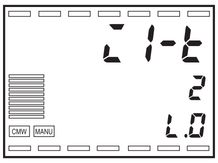
■ Input type

Setting input 1 to "Platinum resistance temperature input sensor, Pt100, -150.0 to 150.0°C"

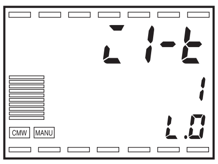
Input type SW



1. Make sure that the input 1 type switch is set to TC.PT and then turn on the power.

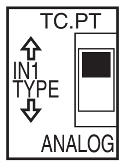


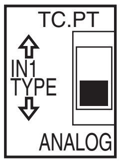
2. Hold down the for at least 3 seconds to move from "RUN level" to "Input initial setting level". The display will show "i1-t:Input 1 type".



3. Press the key to enter the desired sensor value.
   When using a platinum resistance temperature input sensor Pt100 (-150.00 to 150.00°C), set the value to "1".

Input types

Set value	Input type	Setting range (°C)	Setting range (°F)	Input type switch
0	Pt100(1)	-200.0 to 850.0	-300.0 to 1500.0	TC.PT 
1	Pt100(2)	-150.00 to 150.00	-199.99 to 300.00	
2	K(1)	-200.0 to 1300.0	-300.0 to 2300.0	
3	K(2)	-20.0 to 500.0	0.0 to 900.0	
4	J(1)	-100.0 to 850.0	-100.0 to 1500.0	
5	J(2)	-20.0 to 400.0	0.0 to 750.0	
6	T	-200.0 to 400.0	-300.0 to 700.0	
7	E	0.0 to 600.0	0.0 to 1100.0	
8	L	-100.0 to 850.0	-100.0 to 1500.0	
9	U	-200.0 to 400.0	-300.0 to 700.0	
10	N	-200.0 to 1300.0	-300.0 to 2300.0	
11	R	0.0 to 1700.0	0.0 to 3000.0	
12	S	0.0 to 1700.0	0.0 to 3000.0	
13	B	100.0 to 1800.0	300.0 to 3200.0	
14	W	0.0 to 2300.0	0.0 to 4100.0	

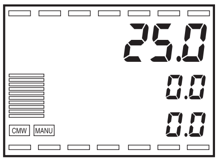
Set value	Input type	Setting range		Input type switch
		(°C)	(°F)	
15	4 to 20 mA	One of the following ranges is displayed depending on the scaling -19999 to 99999 -1999.9 to 9999.9 -199.99 to 999.99 -19.999 to 99.999 -1.9999 to 9.9999		ANALOG 
16	0 to 20 mA			
17	1 to 5 V			
18	0 to 5 V			
19	0 to 10 V			

Set the input type switch according to the "Input type" setting.
The initial settings are "2" and "TC.PT".

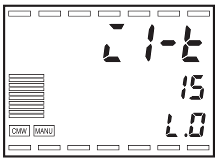
Hint When analog input (voltage input, current input) is used, scaling according to the type of control is possible.

■ Scaling

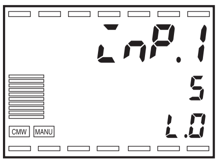
Setting the display to show 0.0 for an input value of 5 mA and 100.0 for 20 mA when the input 1 type is set to "4 to 20 mA".



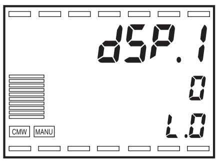
1. Hold the key down for at least 3 seconds to move from "RUN level" to "Input initial setting level".



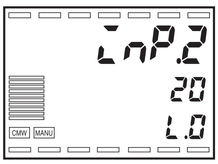
2. Make sure that "i1-t: Input 1 input type" is "15: 4 to 20 mA".



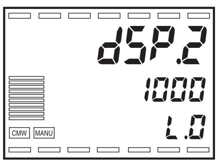
3. Press the key repeatedly to select "inP.1: Scaling input value 1".
   Set to “5” with the keys.



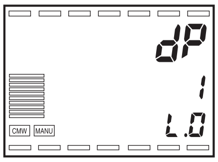
4. Press the key to select "dSP.1: Scaling display value 1".
   Set to “0” with the keys.



5. Press the key to select "inP.2: Scaling input value 2".
   Set to “20” with the keys.



6. Press the key to select "dSP.2: Scaling display value 2".
   Set to “1000” with the keys.



7. Press the key to select "dP: Decimal point position".
   Set to "1" with the keys.

8. Hold down the key for at least 1 second to return to "RUN level".

The scaling setting is configured for each channel. Scaling for inputs 1 to 4 of a multi-point input type corresponds to channels 1 to 4. Select the channel with the CH key and then configure the setting.

Setting data name	Attribute	Display	Setting range	Default value	Units
Scaling input value 1	CH	inP.1	See table below	4	Table below
Scaling display value 1	CH	dSP.1	-19999 to scaling display value 2 - 1	0	EU
Scaling input value 2	CH	inP.2	See table below	20	Table below
Scaling display value 2	CH	dSP.2	Scaling display value 1 + 1 to 99999	100	EU
Decimal point position	CH	dP	0 to 4	0	–

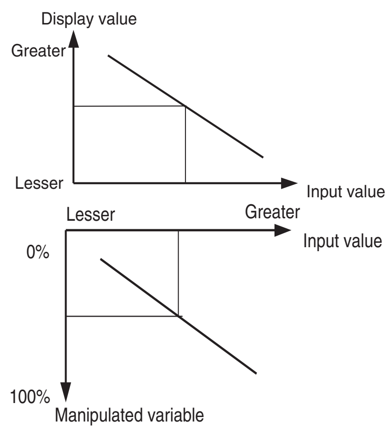
Setting range and units for each input type

Input type	Setting range	Units
4 to 20 mA	4 to 20	mA
0 to 20 mA	0 to 20	mA
1 to 5 V	1 to 5	V
0 to 5 V	0 to 5	V
0 to 10 V	0 to 10	V

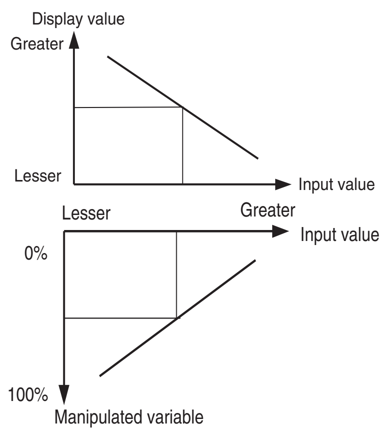
Important

The operation of E5AR/ER control functions and alarms is based on the input values. If a value greater than "inP.2: Scaling input value 2" is set for "inP.1: Scaling input value 1," operation will be as follows for the display value:

- Direct/Reverse Operation
  When direct operation is set, the manipulated variable will increase when the display value decreases. When reverse operation is set, the manipulated variable will increase when the display value increases.



Direct operation

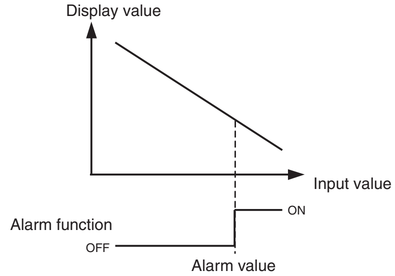


Reverse operation

Important

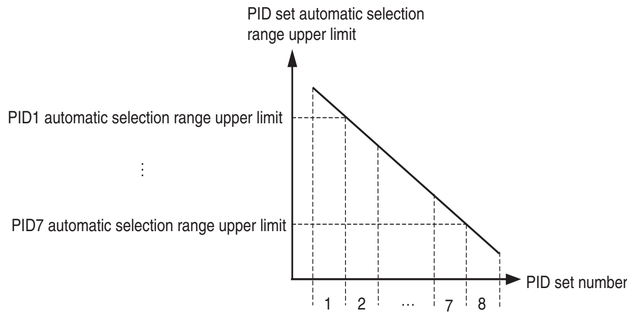
For information on direct and reverse operation, refer to "4.7 Setting output parameters" (P.4-14).

- Alarm
  The upper-limit alarm and lower-limit alarm will be inverted. Therefore, set an alarm type and alarm values that invert the upper limit or lower limit of the display value. For example, if an absolute-value upper limit is set for the alarm type, operation will be as shown in the following figure.



For information on alarms, refer to "4.11 Using auxiliary output" (P.4-23).

- Input Shift
  The sign of the input shift value will be inverted. Therefore, set input shift value 1 and input shift value 2 to values that invert the sign of the display value.
  For information on input shift, refer to "5.1 Input adjustment functions" (P.5-2).
- SP Ramp
  The rise and fall of the ramp will be inverted. Therefore, set the rising direction of the display value for the "SP ramp fall value" and the falling direction of the display value for the "SP ramp rise value."
  For information on the SP ramp, refer to "5.2 Control functions" (P.5-8).
- PID Set Automatic Selection
  If "PID set automatic selection data" is set to PV, set the "PID set automatic selection range upper limit" so that the set values decrease for the PID set numbers in ascending order as shown in the following figure.



If "PID set automatic selection data" is set to DV, the DV used when performing auto-select will be inverted.

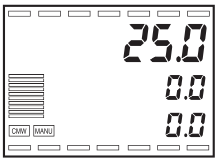
For information on PID set automatic selection, refer to "5.2 Control functions" (P.5-8).

4.5 Selecting the temperature units

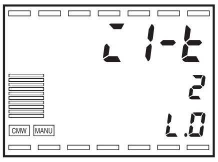
When the input type is set to temperature input (input from a thermocouple or a platinum resistance temperature input sensor), "°C" or "°F" can be selected for the temperature units.

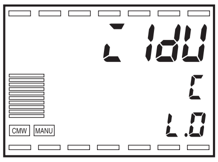
When using a multi-point input type, set the temperature units separately for each input (2 to 4) as appropriate for the number of inputs.

Selecting "°C"



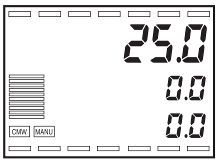
1. Hold the □ key down for at least 3 seconds to move from "RUN level" to "Input initial setting level".





2. Press the ⮐ key to select "i1dU: Input 1 Temperature units".
   Select "°C"/"°F" with the ⏶⏷ key.

   C: °C F: °F



3. Hold the □ key down for at least 1 second to return to "RUN level".

4.6 Selecting the control mode

The control mode allows various types of control to performed.

The control mode is initially set to standard control.

● Standard control

- Performs standard heating or cooling control. The "Direct/reverse operation" setting is used to select heating (reverse action) or cooling (direct action).
- When using PID control, the "Proportional band (P)", "Integral time (I)", and "Derivative time "(D)" settings must be configured.
  These PID constants can be set using AT (Auto-tuning) or manually.
- When the proportional band (P) is set to 0.00%, control becomes ON/OFF control.

● Heating/cooling control

- Performs heating and cooling control
- When using PID control, in addition to the "Proportional band (P)", "Integral time (I)", and "Derivative time "(D)" settings, the "Cooling coefficient" and "Dead band" settings must be configured.
  The PID constants can be set using AT (Auto-tuning) or manually, while the "Cooling coefficient" and "Dead band" must be set manually.
- When the proportional band (P) is set to 0.00%, control becomes ON/OFF control and 3-position control is possible.

The following control modes can only be selected on 2-input types.

● Standard control with remote SP

- An external DC current or voltage signal is input into the remote SP input (input 2), and standard control is performed using the remote SP input as the SP.
- Input 2 can be used within the permitted setting range determined by the input 2 type.

● Heating/cooling control with remote SP

- An external DC current or voltage signal is input into the remote SP input (input 2), and heating/cooling control is performed using the remote SP input as the SP.
- Input 2 can be used within the permitted setting range determined by the input 2 type.

● Ratio control

- Ratio control is used to maintain a set proportional relationship between two variables.

● Cascade standard control

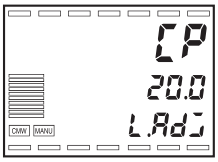
- Cascade control is performed using standard control.
- Input 1 is for the primary loop (ch1) and input 2 is for the secondary loop (ch2).

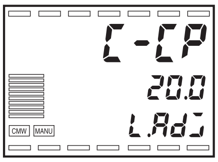
● Cascade heating/cooling control

- Cascade control is performed using heating/cooling control.
- Input 1 is for the primary loop (ch1) and input 2 is for the secondary loop (ch2).

4.7 Setting output parameters

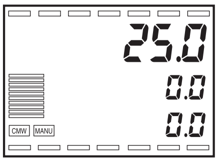
■ Control period

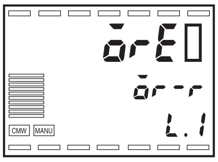




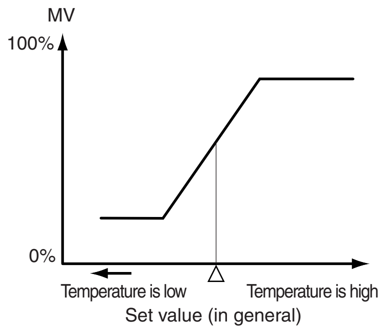
- The output period (control period) must be set. A shorter control period improves controllability, however, when a relay is used to control a heater, a control period of at least 20 seconds is recommended to preserve product life. After setting the control period in the initial settings, readjust it as necessary using trial runs.
- Set the values in "CP: Control period (heat)" and "C-CP: Control period (cool)". The default value is "20.0 sec".
- "Control period (cool)" can only be used in heating/cooling control.
- When each channel is used independently for control, set the control period separately for each channel.

■ Direct operation (cool) / Reverse operation (heat)

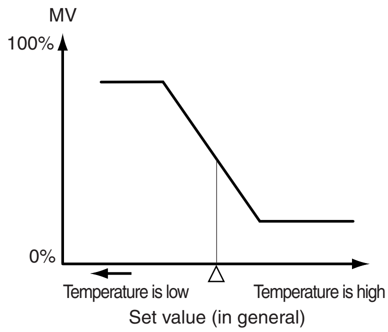




- Control that increases the MV as the PV increases is called direct operation (cool), and control that increases the MV as the PV decreases is called reverse operation (heat).



Direct action

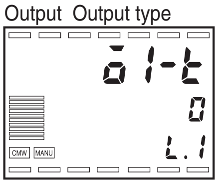


Reverse action

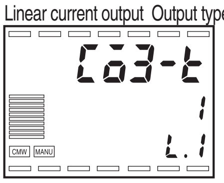
- For example, when the present value (PV) is less than the set point (SP) during heating control, the manipulated valuable (MV) is increased in proportion to the difference between the PV and SP. As such, heating control is "reverse operation". Cooling control, which does the opposite, is "direct operation".
- Set "Direct / reverse operation" to "or-r: Reverse operation" or "or-d: Direct operation". The initial setting is "Reverse operation (heat)".
- When each channel is used independently for control, set the direct / reverse operation separately for each channel.

■ Output type

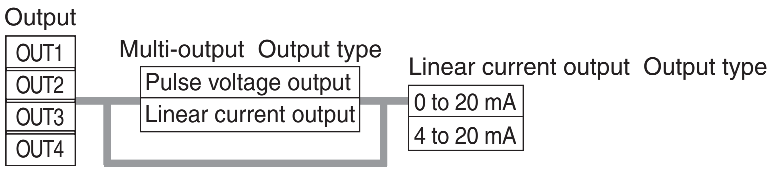
Output Output type



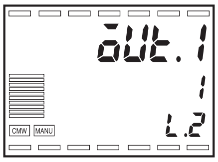
Linear current output Output type



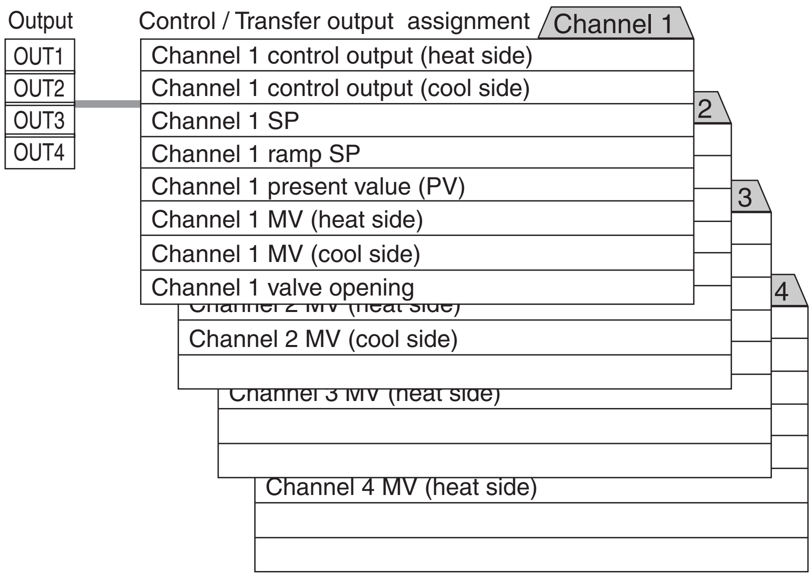
- Multi-output is available on the E5AR/ER, which allows selection of pulse voltage output or linear current output. Select the output type in "Output*: Output type".
  The E5AR-Q□□□□, output 1 of the E5ER-Q□□□, and outputs 1 and 3 of the E5AR-QQ□□ are multi-outputs.
- Linear current output can be set to 4 to 20 mA or 0 to 20 mA in "Linear current output*: Output type".
- Pulse voltage output is 12 V DC, 40 mA.



■ Output assignment



- This is used to assign what type of data is output from each output.
- On multi-point input types, the data assignment can be set for channels 2 and higher as appropriate for the number of channels.



- When used for control output, the assignments are made automatically based on the control mode setting as shown on the following page. There is no need to change the assignments.
- To use an output for transfer output, assign the data you wish to transfer to an unused output.
  Note that if transfer output is assigned to a pulse voltage output, the output will turn OFF.

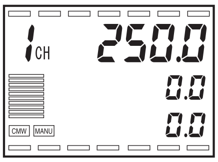
Control mode	1-input type	2-input type	4-input type	Out-put	Control / Transfer output assignment
Standard control	IN1	IN1	IN1	OUT1	Channel 1 control output (heating side)
		IN2	IN2	OUT2	Channel 2 control output (heating side)
			IN3	OUT3	Channel 3 control output (heating side)
			IN4	OUT4	Channel 4 control output (heating side)
Heating/ cooling control	IN1	IN1	IN1	OUT1	Channel 1 control output (heating side)
				OUT2	Channel 1 control output (cooling side)
		IN2	IN2	OUT3	Channel 2 control output (heating side)
				OUT4	Channel 2 control output (cooling side)
Standard control with remote SP		IN1 IN2: Remote SP		OUT1	Channel 1 control output (heating side)
Heating/ cooling control with remote SP		IN1 IN2: Remote SP		OUT1 OUT2	Channel 1 control output (heating side) Channel 1 control output (cooling side)
Ratio control		IN1 IN2: Ratio setting		OUT1	Channel 1 control output (heating side)
Cascade standard control		IN1: Primary loop IN2: Secondary loop		OUT1	Channel 2 control output (heating side)
Cascade heating/ cooling control		IN1: Primary loop IN2: Secondary loop		OUT1 OUT2	Channel 2 control output (heating side) Channel 2 control output (cooling side)
Position proportional control	IN1			OUT1 OUT2	Channel 1 control output (open) *Cannot be changed Channel 1 control output (close) *Cannot be changed

4.8 Setting and changing the SP

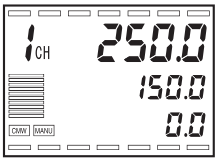
■ Setting and changing the SP

- When "Operation adjustment protect" is set to "4" and "Setting change protect" is set to "ON", the SP cannot be changed. For more information, see "5.5 Protecting settings" (P.5-24).
- To change the SP, press the keys in "PV/SP" (RUN level) to select the desired value. The new setting becomes effective 2 seconds after the change.
- The bank function can be used to switch through as many as eight SPs. For more information, see "5.2 Control functions ■ Banks" (P.5-9).

Changing the SP from a temperature of 0.0°C to 150.0°C



1. The display normally shows "PV/SP". The SP is "0.0" °C.



2. Use the keys to set the SP to "150.0".

4.9 Performing ON/OFF control

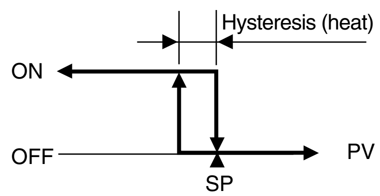
ON/OFF control consists of setting an SP and then having the control output turn off when the temperature reaches the SP during control. When the control output turns off, the temperature begins to fall, and once it falls to a certain point the control output turns on again. This action is repeated around a certain position. ON/OFF control requires setting "Hysteresis (heat)" to the temperature drop from the SP at which it is desired that the control output turn on. The "Direct/reverse operation" setting is used to determine whether the MV is increased or decreased with respect to an increase or decrease of the PV.

■ ON/OFF Control

- On the E5AR/ER, switching between advanced PID control and ON/OFF control is accomplished using the proportional band setting. When the proportional band is set to "0.00", ON/OFF control is performed, and when it is set to any value except "0.00", advanced PID control is performed. The initial setting is "10.00".

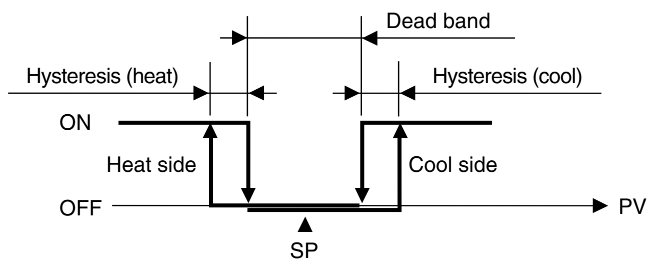
● Hysteresis

- In ON/OFF control hysteresis is added when switching between ON and OFF to stabilize operation. The width of hysteresis is called the "Hysteresis". The hysteresis is set for both heating and cooling control output using the "Hysteresis (heat)" and "Hysteresis (cool)" settings.
- For standard control (heating or cooling control), only the "Hysteresis (heat)" setting is used, regardless of whether heating or cooling is being performed.



● 3-position control

- For heating/cooling control, an area (dead band) can be set where the MV is 0 for both heating and cooling. This means that 3-position control can be performed.



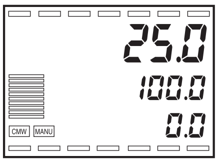
■ Settings

To perform ON/OFF control, the "SP", "Proportional band", and "Hysteresis (heat)" settings must be configured.

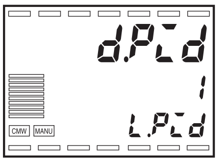
Setting ON/OFF control and an hysteresis (heat) of 2.00%FS

ON/OFF control settings (Proportional band P=0.00)

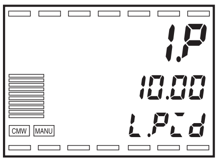
Set "Proportional band to "0.00" in "PID setting level" to select ON/OFF control.



1. Press the □ key repeatedly (less than 1 second each time) to move from "RUN level" to "PID setting level".



2. "Display PID selection" appears in "PID setting level". If a PID Set No. will not be used, use the initial setting "1". If a PID Set No. will be used, select the PID Set No. for the desired control.

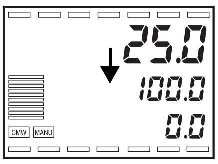


3. Press the ⮐ key to display the "Proportional band" used for control. Use the ⩓⩔ keys in this display to set the value to "0.00".

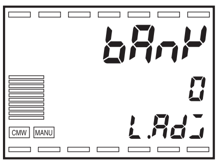
4. Press the □ key repeatedly less than 1 second each time to return to "RUN level".

Setting the hysteresis

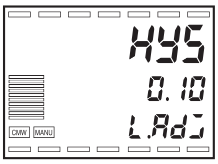
Setting "Hysteresis (heat)" to "2.00" in "Adjustment level"



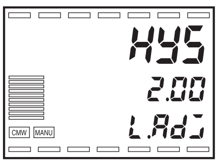
1. Press the □ key less than 1 second to move from "RUN level" to "Adjustment level".



2. "Bank No." appears in "Adjustment level".



3. Press the ⮐ key repeatedly to select "Hysteresis (heat)".



4. Use the ⩓⩔ keys to set the value to 2.00.

5. Press the □ key repeatedly (less than 1 second each time) to return to "RUN level".

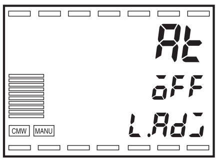
4.10 Determining the PID constants (AT, manual settings)

■ AT (Auto-tuning)

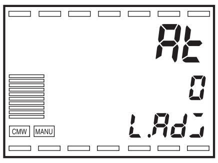
- When AT is run, the most suitable PID constants for the current SP are automatically set. This is accomplished by varying the MV to obtain the characteristics of the object of control (limit cycle method).
- AT cannot be run during STOP or in manual mode.
- When running AT, select "0" to run AT for the PID set currently being used for control, or select "1" to "8" as appropriate to run AT for a specific PID set.
- The results of AT will be reflected in "PID setting level" in the "Proportional band (P)", "Integral time (I)", and "Derivative time (D)" of the PID Set No. specified at the time AT was run.

● Explanation of AT operation

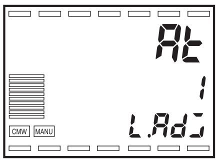
AT excute



AT begins when "AT Execute/Cancel" is changed from "OFF" to "0".

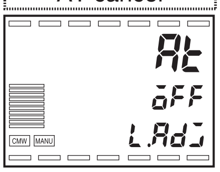


While AT is running, AT Execute/Cancel" blinks in Display 1. Display 2 shows the PID Set No. currently being used for control. When AT ends, "AT Execute/Cancel" goes off and the display stops blinking.

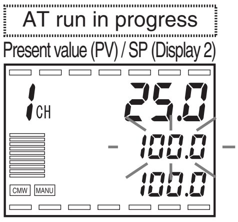


AT runs and the displays show the following;
Display 1: Blinking display indicating AT is running.
Display 2: Shows selected PID Set No..

AT cancel



To stop AT, select "oFF: AT stop".



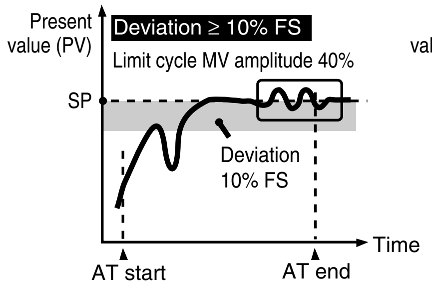
If you attempt to move to "RUN level" and show "PV/SP" while AT is running, Display 2 will blink and indicate that AT is running.

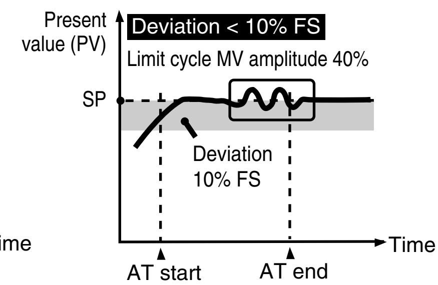
- Only "Write via communication", "Run/Stop", "AT Execute/Cancel", and "Auto/Manual" can be changed while AT is running. No other settings can be changed.
- If "Run/Stop" is set to "Stop" while AT is running, AT will stop and operation will stop. If "Run" is then selected, AT will not resume.
- If an input error occurs while AT is running, AT will stop. AT will run again after recovery from the error.
- If AT is started during SP ramp, AT will run for the ramp SP.

● Limit cycle

The timing for generating a limit cycle varies depending on whether or not the deviation (DV) when AT is begun is less than "the temporary AT execution judgement deviation" (initial setting 10.0% FS).

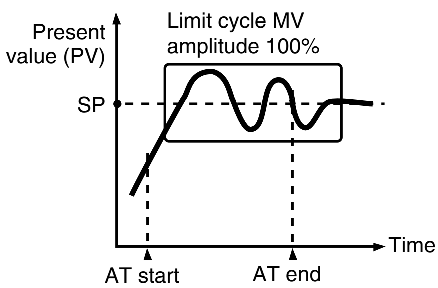
PV during AT is as follows:





The amplitude of change of the limit cycle MV can be changed in "Limit cycle MV amplitude".

For heating/cooling and position proportional floating type control, the limit cycle is as follows regardless of the deviation.



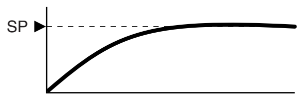
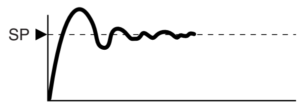
■ Manual settings

To set the PID constants manually, set values for the "Proportional band (P)", "Integral time (I)", and "Derivative time (D)"

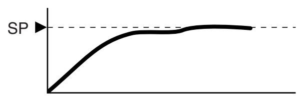
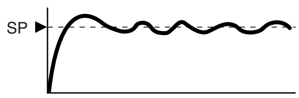
Supplement

- If you already know the control characteristics, directly set the PID constants and adjust control. The PID constants are set in "Proportional band (P)", "Integral time (I)", and "Derivative time (D)".
- I (Integral time) and D (Derivative time) can be set to "0" to select proportional action. In the initial settings, "the manual reset value" is set to 50.0% so that the proportional band is centered on the SP.

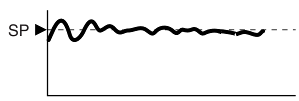
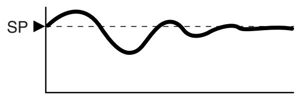
When P (Proportional band) is changed

When P is increased		Slow rise and a longer rectification time, but no overshoot.
When P is decreased		Overshoot and hunting occur, but attains the set value quickly and stabilizes.

When I (Integral time) is changed

When P is increased		Longer time to attain the SP. The rectification time is longer, but there is less hunting, overshoot, and undershoot.
When P is decreased		Overshoot and undershoot occur. Hunting occurs. Quick rise.

When D (Derivative time) is changed

When P is increased		Less overshoot and undershoot rectification time, but fine hunting occurs at own changes.
When P is decreased		Overshoot and undershoot increase and more time is needed to return to the SP.

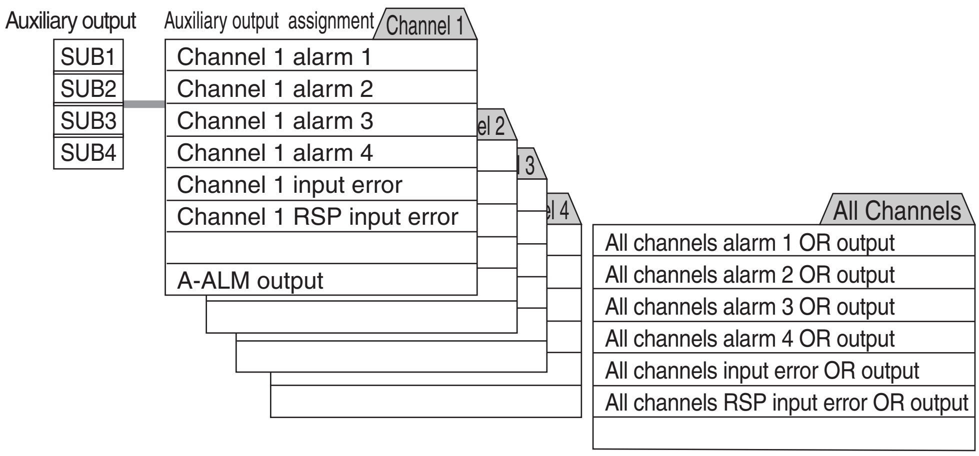
4.11 Using auxiliary output

"Auxiliary output ∗ assignment", "Alarm type", "Alarm value", "Alarm upper limit", and "Alarm lower limit" are explained in this section.

■ Auxiliary output assignment

This setting assigns the type of data that is output from each auxiliary output.

On multi-point output types, data assignments can be set for channels 2 and higher as appropriate for the number of channels.



U-ALM output is an OR output (overall alarm) of alarms 1 to 4 of all channels.

The initial settings are as follows:

Type	SUB1	SUB2	SUB3	SUB4
1-point input type	ch1 alarm 1	ch1 alarm 2	ch1 alarm 3	ch1 alarm 4
2-point input type E5AR-□□□W E5ER-□□□W				
4-point input typeE5AR-□□WW				

The E5ER-□2□□ and E5ER-□T□□ auxiliary output 2-point types are not equipped with SUB3 and SUB4.

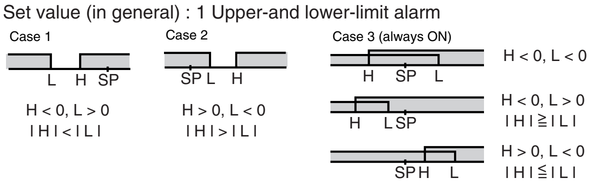
■ Alarm types

SP = Set point

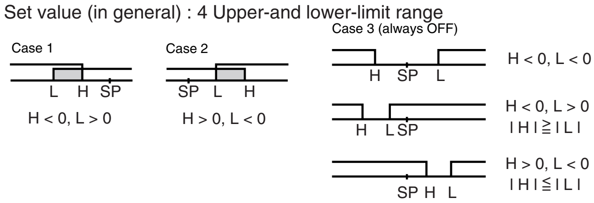
	Set value (in general)	Alarm type	Alarm output function: Alarm value (X) is positive	Alarm output function: Alarm value (X) is negative
	0	Alarm function OFF	Output OFF	
*1	1	Upper-and lower-limit (deviation)	ON OFF L H SP	*2
	2	Upper-limit (deviation)	ON OFF X SP	ON OFF X SP
	3	Lower-limit (deviation)	ON OFF X SP	ON OFF X SP
*1	4	Upper-and lower-limit range (deviation)	ON OFF L H SP	*3
*1,*6	5	Upper-and lower-limit alarm with standby sequence (deviation)	*5 ON OFF L H SP	*4
*6	6	Upper-limit alarm with stanbdy sequence (deviation)	ON OFF X SP	ON OFF X SP
	7	Lower-limit alarm with stanbdy sequence (deviation)	ON OFF X SP	ON OFF X SP
	8	Absolute-value upper-limit	ON OFF X 0	ON OFF X 0
	9	Absolute-value lower-limit	ON OFF X 0	ON OFF X 0
*6	10	Absolute-value upper-limit with standby sequence	ON OFF X 0	ON OFF X 0
*6	11	Absolute-value lower-limit with standby sequence	ON OFF X 0	ON OFF X 0

*1: Set values (in general) 1, 4 and 5 allow upper and lower-limits of alarm value to be separately set, and are indicated by L and H.

*2: Set value (in general) : 1 Upper-and lower-limit alarm



*3: Set value (in general) : 4 Upper-and lower-limit range



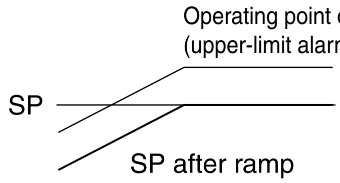
*4: Set value (in general) : 5 Alarm with upper-and lower-limit standby sequence
*With the above upper-and lower-limit alarms
•In cases 1 and 2 •In case 3, always OFF
If hysteresis overlaps at upper-and lower-limit, always OFF

*5: Set value (in general) : 5 Alarm with upper-and lower-limit standby sequence
If hysteresis overlaps at upper-and lower-limit, always OFF

*6: For information on standby sequences, see "5.6 Alarm adjustment functions".

Settings Required for Basic Control

* When using SP ramp, an alarm will activate during RUN with respect to the SP after ramping, and during STOP an alarm will activate with respect to the SP.



■ Alarm values

Alarm values are indicated by "X" in the alarm type table. When separate upper and lower limit alarm values are set, the upper limit value is indicated by "H" and the lower limit is indicated by "L".

When upper- and lower-limit, upper- and lower-limit range, or lower limit alarm with standby sequence is selected, the "Alarm upper limit" and "Alarm lower limit" settings must be configured.

"Alarm value" must be configured when any other alarm type is selected.

Settings Required for Basic Control

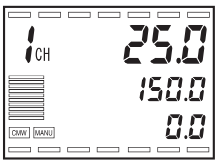
■ Settings

To output an alarm to the auxiliary output, the "Auxiliary output assignment", "Alarm type" and "Alarm value" settings must be configured.

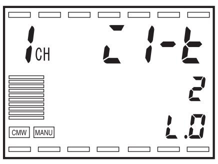
Outputting a lower limit alarm to auxiliary output 2 using CH 1 alarm 1 and an alarm value of 10.0°C

Auxiliary output 2 assignment

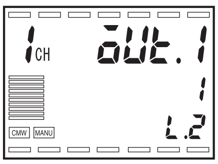
The following explains how to set "Auxiliary output 2 assignment" to "CH 1 alarm 1" in "Control initial setting level 2"



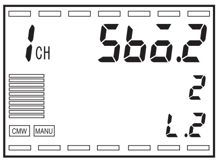
1. Hold down the key at least 3 seconds to move from "RUN level" to "Input initial setting level".

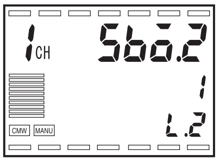


2. In "Input initial setting level", Display 3 shows "L.0".
   Press the key twice (less than 1 second each time) to move to "Control initial setting 2 level".



3. In "Control initial setting 2 level", Display 3 shows "L.2".
   Press the key repeatedly (less than 1 second each time) to select "Auxiliary output 2 assignment".

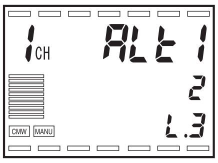




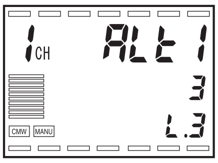
4. Press the to set the auxiliary output 2 assignment to "1: CH 1 alarm 1".

Alarm 1 type

Set "Alarm 1 type" to "Lower-limit alarm" in "Alarm setting level".



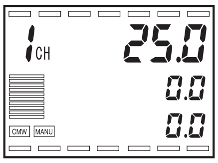
5. Press the key less than 1 second to move to "Alarm setting level".
   The display will show "Alarm 1 type".



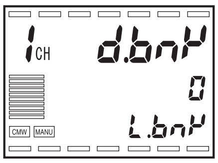
6. Press the key to select "3: Lower limit alarm".

Alarm value setting

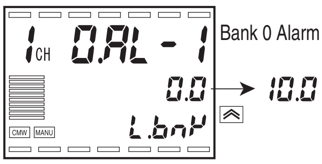
Set "Bank * Alarm 1 value " to "10.0°C" in "Bank setting level"



7. Hold down the key at least 1 second to move to "RUN level".



8. Press the key three times (less than 1 second each time) to move to "Bank setting level".



9. Press the key repeatedly to select "Bank 0 alarm 1 value".
   Press the key to change the value to "10.0".

4.12 Starting and stopping control

■ Control run / Control stop

To start control, set "Run/Stop" to "Run". To stop control, set "Run/Stop" to "Stop".

● MV at stop

- If you wish to output during stop in standard control, set an MV of -5.0 to 105.0% in "MV at stop". The initial setting is "0.0%".
  (In heating/cooling control, set to -105.0 to 105.0%)
- In position proportional control, "Open", "Closed", or "Hold" state can be selected in "MV at stop". In the "Open" state only the open output is ON, in the "Closed" state only the closed output is ON, and in the "Hold" state both open and closed outputs are OFF. The initial setting is "Hold".

● Operation at power ON

- This selects the operation state when the power of the E5AR/ER is turned on.
  The following 3 selections are available.

Setting values	Operation
Continue	Resumes the state of the system before the power was turned off.
Stop	Control is stopped when the power is turned on.
Manual mode	Enters manual mode when the power is turned on.

- Setting values for operation at power ON and additional items are shown below.

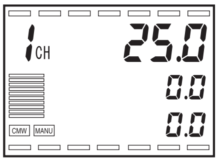
Operation after power ON	Additional items	
Continue	Run/Stop Auto/Manual MV	Hold Hold From initial MV in auto mode Hold in manual mode
Stop	Run/Stop Auto/Manual MV	Stop Hold Hold if in manual mode before power off MV at stop if in auto mode before power off
Manual mode	Run/Stop Auto/Manual MV	Hold Manual Manual MV default at time of power off if in manual mode before power off MV at stop if in auto mode before power off (Note 1)

- The initial setting is "Continue".
- Set "Operation at power off" separately for each channel.
- When the control mode is set to cascade control, set "Operation at power ON" for CH2.

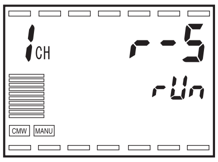
Note 1: If the manual output mode is default value output, the default value of manual MV default is output.

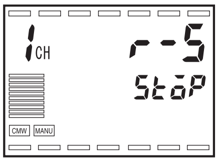
■ Settings

The procedure for stopping control is as follows:



1. Press the key repeatedly to select "r-S: Run/Stop".





2. Press the key to switch to "StoP: Stop". The STOP indicator blinks and control stops.

   To resume control, follow the same steps to switch to "rUn: Run". The STOP indicator goes off and control resumes.

Hint

Switching between run and stop is also possible by event input or communication.
For event input switching, see "5.7 Using event input" (P.5-29). For communication switching, see "5.9 Using communication functions" (P.5-34).

4.13 Performing manual control

■ Manual mode

- In standard control the MV is manipulated, and in position proportional control the amount of valve opening is manipulated.
- To perform manual operation or manually set the MV or valve opening, set the "Manual/Auto" setting to "MAnU: Manual" or hold down the PF key at least 1 second.

● Standard type

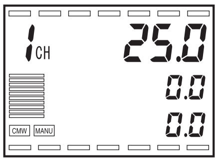
- "MANU" lights up in the operation display while in manual mode. The PV appears in Display 1, the MV appears in Display 2, and "MAnU" appears in Display 3.
- To change the MV, press the ▲▼ keys. The MV is updated every 50 ms.
- When switching between manual mode and auto mode, the action of the MV is balance-less and bumpless.
- Other setting level can be moved to in manual mode. However, "AT Execute/Cancel" cannot be selected and does not appear in the display.
- Switching between auto and manual is possible a maximum of 100,000 times.
- During cascade control, if the primary loop is switched to manual control when the secondary loop is in any of the following conditions, the manual MV is disabled.
  - The SP mode of the secondary loop is local (cascade open).
  - The secondary loop is in manual mode.
  - "Operation at error" is taking place in the secondary loop.

● Position proportional type

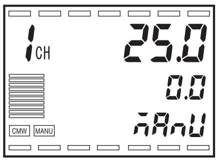
- When a potentiometer is connected, "MANU" lights up in the operation display while in manual mode. The PV appears in Display 1, the valve opening appears in Display 2, and "MAnU" appears in Display 3. When a potentiometer is not connected, Display 2 shows "-----".
- To turn on open output, press the ▲ key. To turn on closed output, press the ▼ key. The MV is updated every 50 ms.
- When switching between manual mode and auto mode, the action of the MV is balance-less, bumpless.
- Other setting screens can be moved to in manual mode. However, "AT Execute/Cancel" cannot be selected and does not appear in the display.
- Switching between auto and manual is possible a maximum of 100,000 times.

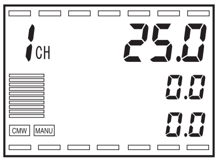
The procedure for switching to manual mode during control and changing the MV is explained in the following.

◆ When Auto / Manual is selected with the PF1 setting or PF2 setting (Initially the PF1 setting is Auto / Manual.)



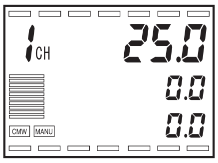
1. Hold down the PF key for Auto / Manual at least 1 second. The MANU indicator lights up and the mode changes to manual.



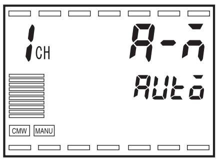


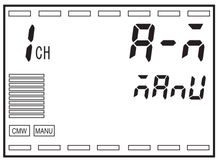
To return to auto mode, hold down the PF key at least 1 second. The MANU indicator goes off and the mode changes to auto.

◆ When Auto / Manual is not selected with either the PF1 setting or PF2 setting

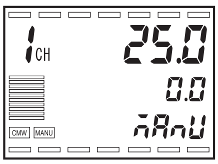


1. Press the key repeatedly to select "A-M: Auto / Manual".





2. Press the key to switch to "MANU: Manual". The MANU indicator lights up and the mode changes to manual.



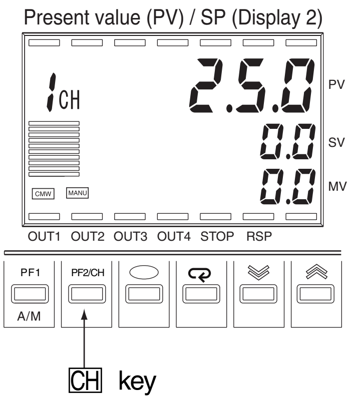
To resume control, follow the same procedure to switch back to "AUTO: Auto". The MANU indicator goes off and the mode changes to auto.

Hint

Switching between auto and manual is also possible by event input or communication.
For event input switching, see "5.7 Using event input" (P.5-29). For communication switching, see "5.9 Using communication functions" (P.5-34).

4.14 Changing channels

■ Changing channels



- On multi-point input type, the channel number increases by 1 each time the CH key is pressed and the displayed channel changes accordingly.
- Only channels that are enabled with the "Number of enabled channels" setting can be displayed.
- If the "Number of enabled channels" setting is set to "2" on a 4-point input type, the display will switch through the channels as follows each time the CH key is pressed:
  Channel 1 → Channel 2 → Channel 1 → Channel 1...

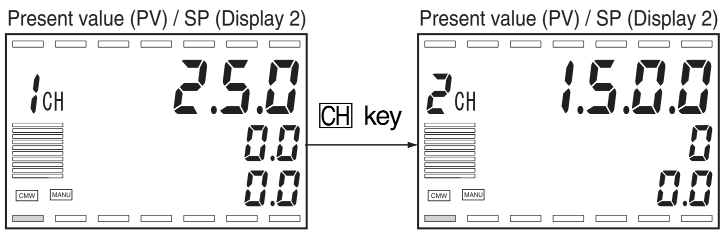
● Level after changing channels

- After changing channels, the level will be that of the currently displayed channel.
- When a manual mode channel is selected, the display will show the manual operation screen of "RUN level".

● Displayed setting data after changing channels

- Displayed data after changing channels is as follows:
  ① If the setting data of a displayed channel continues to be effective after changing to a different channel, the setting data will be displayed.
  ② If the setting data of a displayed channel will not be effective after changing to a different channel due to a different control method or other reason, the next effective setting data is displayed.

The following is an example of changing channels in "RUN level".



* On models with only a single channel, the CH key is disabled.

* Setting data for selected channel appears.

Hint

If you continue to hold down the CH key after changing channels, you will not move to the next channel. To continue changing channels, release and press the CH key again.
For more information, see "5.4 Display and key adjustment functions" (P.5-19).

4.15 Operational considerations

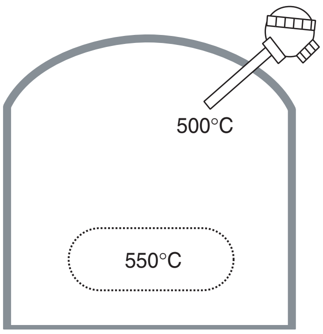
(1) About four seconds is required for the output to turn on after the power is turned on. Take this into consideration when incorporating the controller into a sequence circuit.

(2) Using the controller near radios, televisions, or other wireless devices may cause reception interference.

Section 5 Functions and Operations

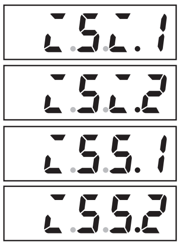
5.1 Input adjustment functions

■ Input shift

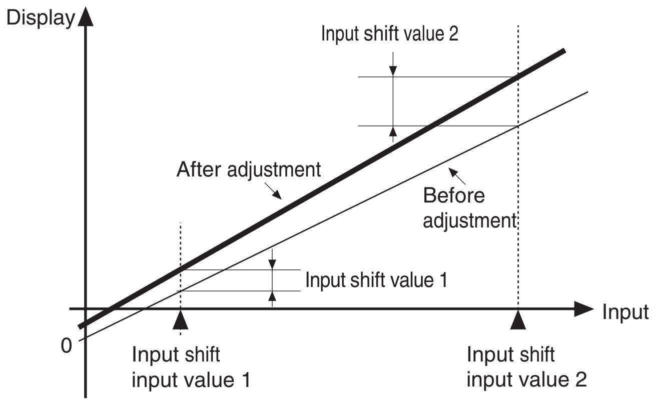


- Input shift is accomplished by 2-point correction.
- In the event that there is a large difference between the temperature at the sensor position and the temperature at a location where a temperature reading is required, with the result being that satisfactory control is not possible, the temperature difference can be set as an input shift value.

● 2-point correction



Input shift input value 1
Input shift input value 2
Input shift value 1
Input shift value 2



Setting data	Setting range	Units	Default value
Input value for input shift 1	-19999 to 99999	EU	-200.0
Input value for input shift 2	-19999 to 99999	EU	1300.0
Input shift 1	-199.99 to 999.99	EU	0.00
Input shift 2	-199.99 to 999.99	EU	0.00

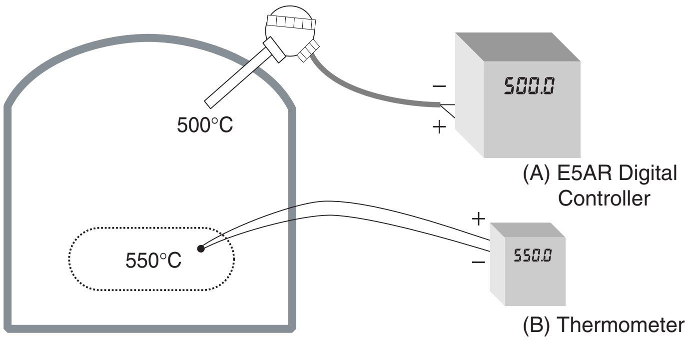
- Straight-line correction is accomplished by setting the value required to correct "Input value for input shift 1" in "Input shift 1", and the value required to correct "Input value for input shift 2" in "Input shift 2". Different correction values may be required for "Input shift 1" and "Input shift 2", and thus the slope of the line between the two points may differ before and after correction.
- Input shift is set for each channel. The input shift settings for inputs 1 to 4 of a multi-point input type correspond to channels 1 to 4. First select a channel with the CH key and then set the corresponding input shift values.

● Obtaining input shift values (2-point correction)

Temperature readings are taken using the E5AR/ER at any two points and the actual temperature at the required location (the object) is measured at the same two points.

[Preparations]

1. Set the input type based on the sensor.
2. Obtain a temperature sensor that can measure the temperature of the object similar to that shown in Figure 1.



(Figure 1. Configuration for input shift)

● Procedure for using 2-point correction

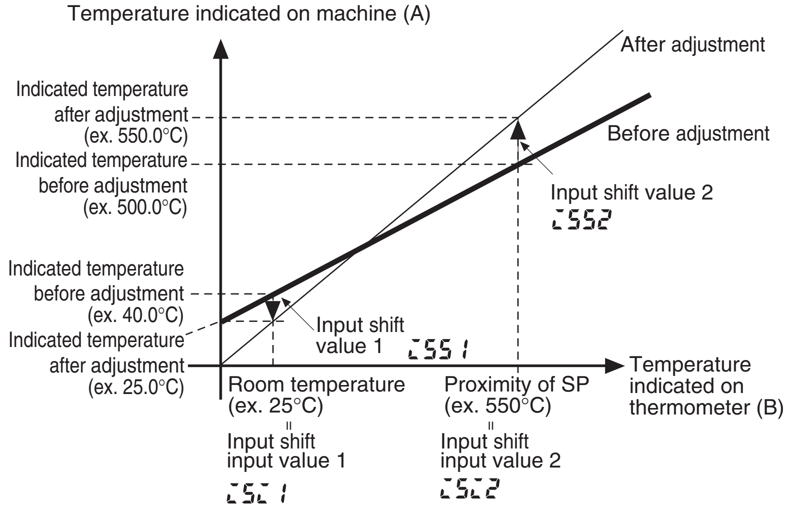
1. Correction will be performed of the temperature readings at two points: one near room temperature and one near the desired SP. Measure the temperature of the object when it is near room temperature and when it is near the SP (B), and check the corresponding readings of the controller (A).
2. Set "Input shift 1" to the difference between the temperature of the object (B) and the controller reading (A) when near room temperature,

Object temperature (B) − Controller reading (A)

   and set "Input value for input shift 1" to the controller reading (A).
3. Set "Input shift 2" to the difference between the temperature of the object (B) and the corresponding controller reading (A) when near the SP,

Object temperature (B) − Controller reading (A)

   and set "Input value for input shift 2" to the controller reading (A).
4. After configuring the settings, check the reading of the controller (A) and the temperature of the object (B).
5. Correction has now been performed at two points, near room temperature and near the SP. If you wish to improve the accuracy near the SP, establish two more correction points above and below the SP. Figure 2 illustrates the correction.



(Image adjustment by point adjustment of Fig. 2.2)

● Example of 2-point correction

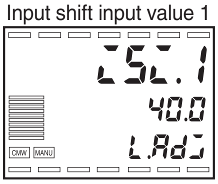
The following is an example when the input type is K (-1) -200 to 1300°C

The temperature of the object will be obtained.

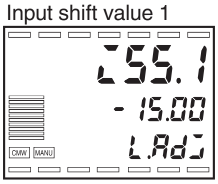
Room temperature:	When (B) = 25°C
the controller reading is	(A) = 40°C
Temperature near the SP: When	(B) = 550°C
the controller reading is	(A) = 500°C

In this case, the input shift values are obtained as follows:

Input shift input value 1



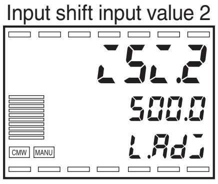
Input shift value 1



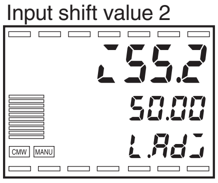
Input value for input shift 1 = Controller reading (A) = 40 (°C)

Input shift 1
= Temperature of object (B) − Controller reading (A)
= 25 − 40 = −15.00 (°C)

Input shift input value 2



Input shift value 2

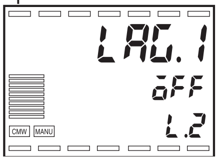


Input value for input shift 2 = Controller reading (A) = 500 (°C)

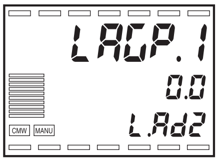
Input shift 2
= Temperature of object (B) − Controller reading (A)
= 550 − 500 = 50.00 (°C)

■ First order lag operation

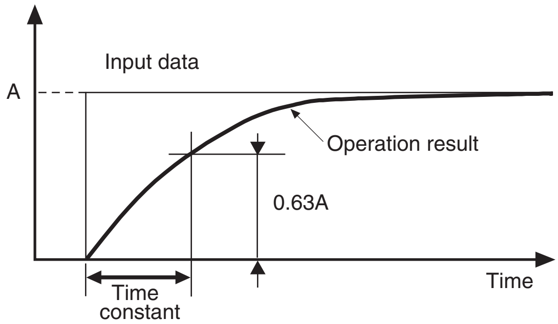
1st order lag operation 1: enabled



1st order lag operation 1 time constant



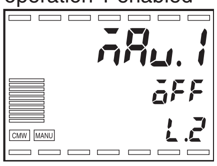
- First order lag operation serves as a filter for each input. For a multi-input type, the operation is set for each of inputs 1 to 4 in "First order lag operation 1 - 4".
- To use first order lag operation, set "First order lag operation enable" to "ON" (the initial setting is OFF). A time constant must also be set, and this is selected so that the result of the operation is 0.63 times the input data.



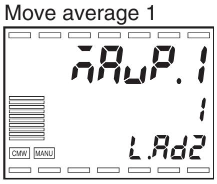
Setting data	Setting range	Units	Default value
First order lag operation 1 to 4: enable	OFF: Disabled, ON: Enabled	–	OFF
First order lag operation 1 to 4 time constants	0.0 to 999.9	Sec	0.0

■ Move average

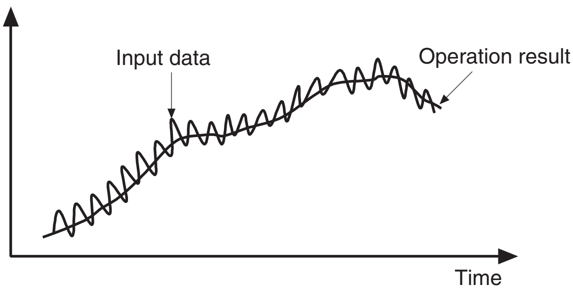
Move average operation 1 enabled



Move average 1



- The move average operation reduces sudden changes in the input due to noise and other factors, and can be enabled for each input.
- To use the move average operation, set "Move average enable" to "ON" (the initial setting is OFF).
- A count must also be selected in the "Move average" setting. Selections are 1, 2, 4, 8, 16, and 32 times.



Setting data	Setting range	Units	Default value
Move average 1 to 4: enable	OFF: Disabled, ON: Enabled	–	OFF
Move average 1 to 4	1, 2, 4, 8, 16, 32	Times (count)	1

■ Broken-line approximation

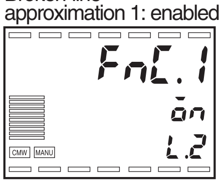
This function is used to correct non-linearity in the input. Twenty broken-line approximation operation points are available for input 1.

To use broken-line approximation, set "Broken line approximation enable" to "ON" (the initial setting is OFF).

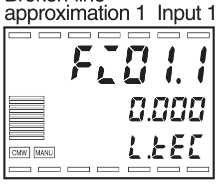
Broken-line approximation includes the settings "Broken-line approximation 1 Inputs 1 to 20" and "Broken-line approximation 1 Outputs 1 to 20". Normalized data is used to set the values such that the lower-limit of the input setting range for input 1 is 0.000 and the upper-limit is 1.000.

● Relation to input types

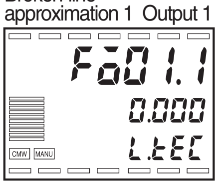
Broken-line approximation 1: enabled



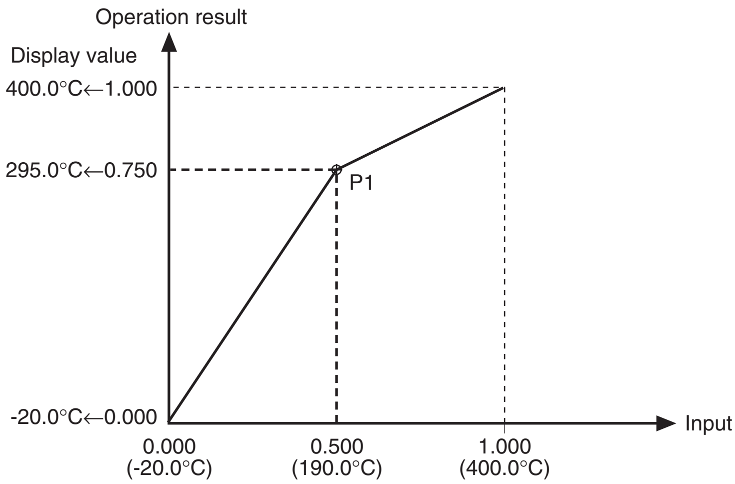
Broken-line approximation 1 Input 1



Broken-line approximation 1 Output 1



- Normalized data is used to set the values for broken-line approximation such that the lower-limit of the input setting range for input 1 is 0.0000 and the upper-limit is 1.000. For example, if the input type of input 1 is J(2) -20.0 to 400.0°C and the broken-line approximation is to be applied to one point, 190.0°C, the values are set as follows:

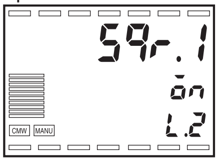


Broken-line approximation 1 Input 1 = "0.000"
Broken-line approximation 1 Output 1 = ""0.000"
Broken-line approximation 1 Input 2 = "0.500"
Broken-line approximation 1 Output 2 = "0.750"
Broken-line approximation 1 Input 3 = "1.000"
Broken-line approximation 1 Output 3 = "1.000"

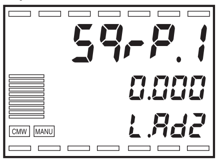
Setting data	Setting range	Units	Default value
Broken-line approximation 1: enable	OFF: Disabled, ON: Enabled	–	OFF
Broken-line approximation 1: Input 1 to Broken-line approximation 1: Input 20	-1.999 to 9.999	–	0.000
Broken-line approximation1: Output 1 to Broken-line approximation 1: Output 20	-1.999 to 9.999	–	0.000

■ Extraction of square root operations

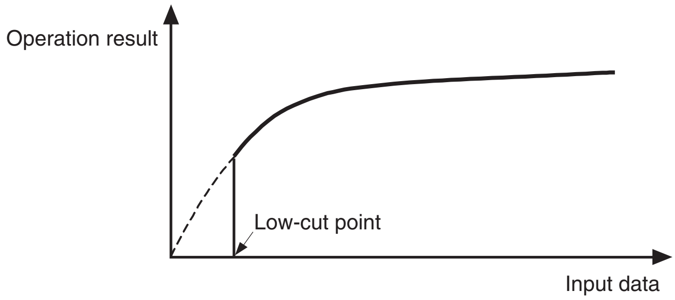
Square root extraction operation 1 enabled



Square root extraction operation



- A extraction of square root operations is available for each input to allow direct input of the signal from a pressure differential flow meter.
- To use square root extraction, set "Square root extraction enable" to "ON" (the initial setting is OFF).
- The square root extraction function includes the "Low-cut point" setting such that when the result of the operation is below the low-cut point, the result is set to "0". The low-cut point is set for each input using normalized data such that the lower-limit of the input setting range is 0.000 and the upper-limit is 1.000.



Setting data	Setting range	Units	Default value
Square root extraction 1 to 4: enable	OFF: Disabled, ON: Enabled	–	OFF
Square root extraction low-cut point 1 to 4	0.000 to 9.999	EU	0.000

■ Other input adjustment functions

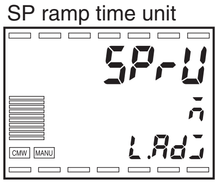
The following input adjustment functions are also available. These functions are explained in "Section 8 Setting data" (P. 8-1).

- Line noise reduction: Input initial setting level
- Display digits after PV decimal point: Input initial setting level

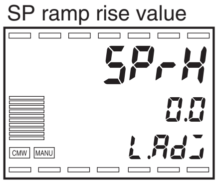
5.2 Control functions

■ SP ramp

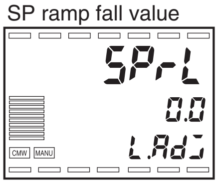
SP ramp time unit



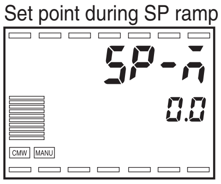
SP ramp rise value



SP ramp fall value



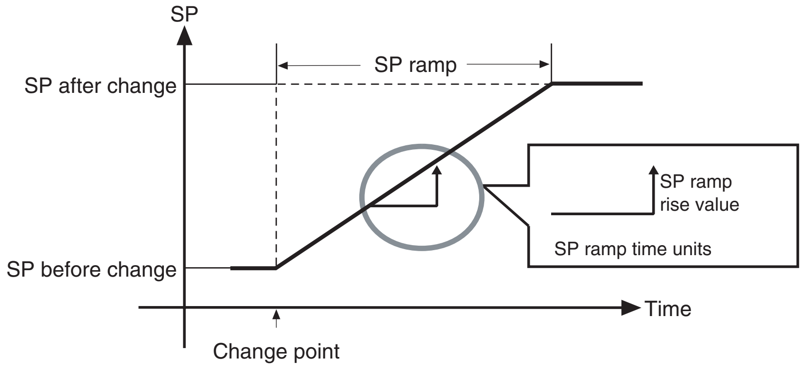
Set point during SP ramp



The SP ramp function limits the amount of change of the SP to a set rate. When this function is enabled and the amount of change exceeds the set rate, a space that limits the SP is created as shown in the diagram below

During SP ramp, control takes place not by changing the SP, but rather by using a value that is limited by the set rate of change (this is called the ramp SP).

On the E5AR/ER, an "SP ramp rise value" and an "SP ramp fall value" can be set separately.



The rate of change during SP ramp is set in "SP ramp rise value", "SP ramp fall value", and "SP ramp time unit".

The initial settings for "SP ramp rise value" and "SP ramp fall value" are "0", which means that SP ramp is disabled.

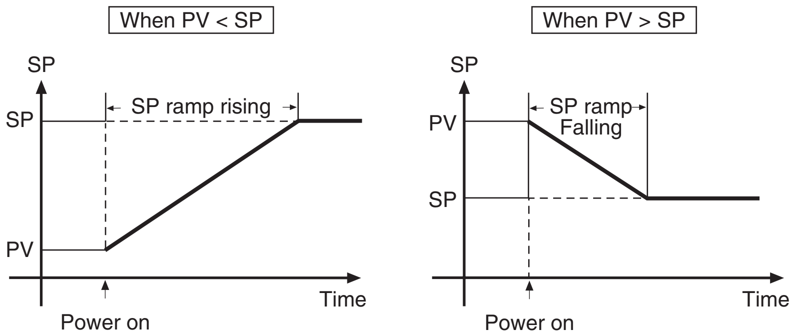
"EU/sec", "EU/min" or "EU/hour" can be selected for "SP ramp time unit". The initial setting is "EU/min".

The ramp SP can be viewed using "Set point during SP ramp".

● Operation at startup (SP ramp)

When the power is turned on (including operation startup), the PV is regarded as the pre-change SP.

SP ramp operation at startup depends on the relation between the PV and SP as follows:



● Limitations during SP ramp

- AT starts at the SP during ramp.
- The ramp SP at AT startup is held during AT.
- SP ramp is disabled when operation is stopped.
- The SP ramp control begins with SP start after recovery from a sensor error. (Control begins about 1 second after recovery from a sensor error.)
- When a sensor error occurs, the goal SP takes effect and the alarm function operates with respect to the goal SP.

Setting data	Monitor and setting range	Units	Default value
SP ramp SP value monitor		EU	-
SP ramp rise value	0 to 99999 *2	*1	0
SP ramp fall value	0 to 99999 *2	*1	0
SP ramp time unit	S: EU/sec, M: EU/min, H: EU/hour	-	1 (EU/min)

*1 EU/sec, EU/min, or EU/hour depending on the "SP ramp time unit" setting
*2 The decimal point position depends on the input type.

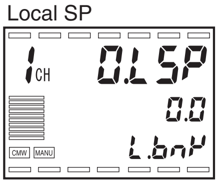
■ Banks

- Up to eight banks can be created. Each bank is used to store an SP (local SP), alarm value, and a PID Set No..

Bank No.	0	1	• • •	7
Local SP	200.0	500.0		
PID Set No.	0	0		
Alarm value 1 to 4	240	300		
Alarm value upper limit 1 to 4	40	30		
Alarm value lower limit 1 to 4	40	30		

● Local SP

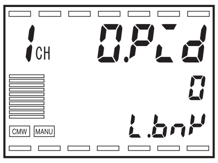
Local SP



- The "Local SP" is the SP that is used during operation. The SP value that appears and can be set in the PV/SP setting screen in "RUN level" is the local SP value of the currently executing bank number.
- The bank number appears as the leading digit of the setting data.

● PID Set No.

PID* Set No.

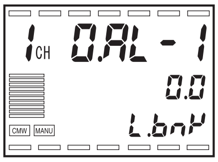


- To select and use a PID Set No., select 1 to 8 and then specify one of PID Set No. 1 to 8 for each bank.
- Normally the initial setting "0: Auto selection" is used. To use this setting data, see "■ PID sets" (P.5-12).
- To check the bank number, view the leading digit of the setting data.

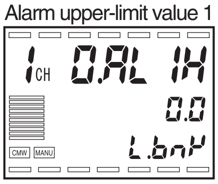
● Alarm values

- Set alarm values for alarms 1 to 4 according to the alarm type. Alarms that have "Alarm type" set to "0: Alarm function OFF" are not displayed.
- See "4.11 Using auxiliary output" (P.4-23) for the setting procedure.
- To check the bank number, view the leading digit of the setting data.

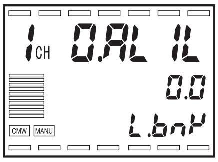
Alarm value 1



Alarm upper-limit value 1



Alarm lower-limit value 1

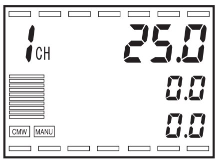


Operation procedure

The procedures for setting the local SP and PID Set No. in Bank No. 2 and for running Bank No. 2 are explained in the following.

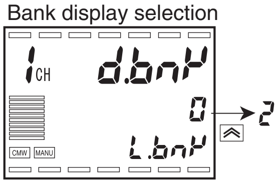
Bank No.	0	1	2	•••	7
Local SP			250.0		
PID Set No.			3		

RUN level



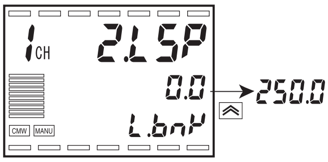
RUN level (PV/SP/MV)

Bank display selection



1. Press the key repeatedly to move to "Bank setting level" (Display 3 shows L.bnK).
2. Use the keys to set "Display bank selection" to "2".

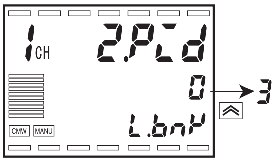
Local SP



3. Press the key to select "Local SP".

4. Use the keys to set the value to "250.0".

PID* set No.



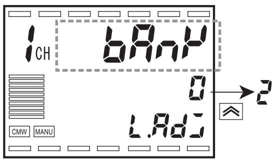
5. Press the key to select "PID Set No.".

6. Use the keys to set the value to "3".

To use a bank, specify it by event input, key operation, or communication.

● Bank specification by key input

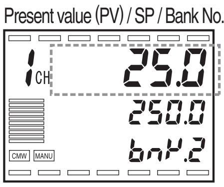
Bank No.



7. Press the key repeatedly to move to "Adjustment level" (Display 3 shows L.AdJ).

8. Use the keys to select "2" to execute Bank No. 2.

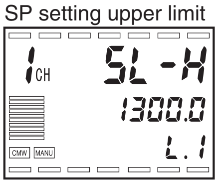
Present value (PV) / SP / Bank No.



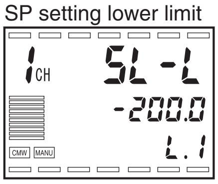
9. Press the key repeatedly to move to RUN level, and then press the key to move to "PV/SP/Bank No.".

■ SP limits

SP setting upper limit



SP setting lower limit



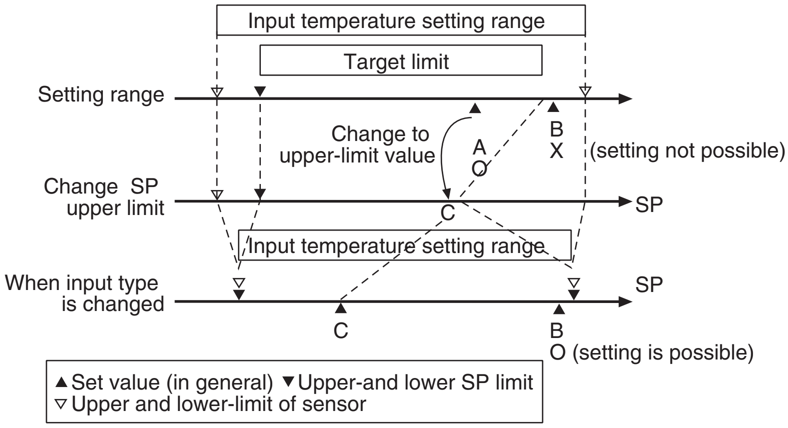
The SP setting upper and lower limits can be set within the input setting range.

If SP limits are set and the SP (local SP) falls outside the limits, the SP will be changed to either the upper or lower SP limit.

Example: Initially the SP is 200°C, the SP setting upper limit is 300°C, and the SP setting lower limit is 100°C. If the SP setting upper limit is changed to 150°C, the SP will fall outside of the SP limit range of 100 to 150°C, and thus will be changed to 150°C.

If "Input type", "Temperature units", or scaling is changed, the upper and lower SP limits will be reset to the upper and lower limits of the input setting range.

The SP limits are set separately for each channel.



■ PID sets

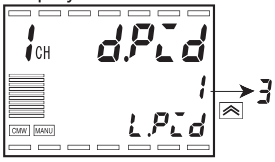
- The E5AR/ER allows setting data to be grouped for use in PID control. A group of setting data is called a PID set. PID sets consist of the following setting data.

PID Set No.	1	2	• • •	8
P (Proportional band)	20.50	35.70		
I (Integral time)	240	300		
D (Derivative time)	40	30		
MV upper limit	105.0	95.0		
MV lower limit	-5.0	5.0		
Automatic selection range upper limit	200.0	400.0		

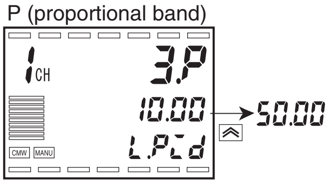
- Select PID Set No. in "Display PID selection" of "PID setting level", and set the data for each PID.

Operation procedure

Display PID* selection



P (proportional band)



Set "P" (proportional band) of PID set 3 to 50.00 %FS.

1. Press the □ key repeatedly to move to "PID setting level" (Display 3 shows L.PId).
2. Use the ⩓⩔ keys to set "Display PID selection" to "3".
3. Press the ⮐ key to select "P (Proportional band)". To check the bank number, view the leading digit of the setting data.
4. Use the ⩓⩔ keys to set the value to "50.00".

- A PID Set No. (1 to 8) is set in "PID Set No." in "Bank setting level". For this reason, PID control parameters different from the selected bank can be used during operation.
- If "PID Set No." is set to "0", the PID set is automatically selected (PID auto selection) according to previously set conditions.

● PID set automatic selection

When "PID Set No." is set to "0" in a bank, the PID set is automatically selected according to previously set conditions.

PID* set	Automatic selection range upper limit	
1	200.0	
2	400.0	PV (present value(PV)) 24.00
3	500.0	
4	600.0	
5	700.0	
6	800.0	
7	1000.0	
8	1300.0	Internal fixed value: 999.9% FS

In the example at left ("PID set selection data" is set to "PV"),
When PV ≤ 200.0°C, PID Set 1 is used
When 200.0 < PV ≤ 400.0°C, PID Set 2 is used

"PID automatic selection range upper limit" is set so that the value increases as the PID Set No. increases.

However, note that the value for PID Set 8 is internally fixed at "Automatic selection range upper limit" = 999.9% FS.

To prevent chattering when changing PID sets, hysteresis can be set in "PID set selection hysteresis".

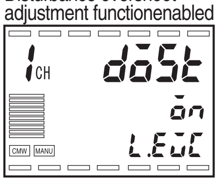
PV or DV (deviation) can be selected for the "PID set selection data".

Setting data	Setting range	Units	Default value
Banks 0 to 7 PID Set No.	0: Auto selection 1 to 8: PID Sets 1 to 8	–	0
PID Sets 1 to 8 Automatic selection range upper limit	-19999 to 99999	EU	1450.0
PID set selection data	0: PV, 1: DV	–	0: PV
PID set selection hysteresis	0.10 to 99.99	%FS	0.50

Functions and Operations

■ Disturbance overshoot adjustment

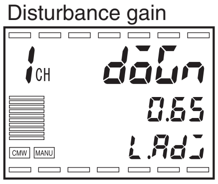
Disturbance overshoot adjustment functionenabled



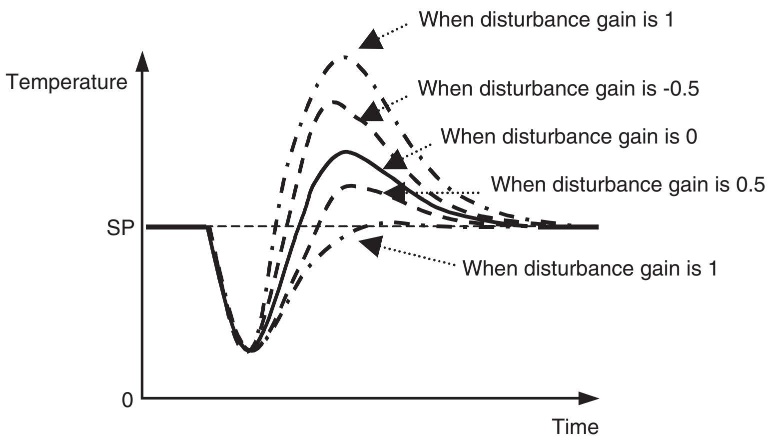
- The disturbance overshoot adjustment function adjusts the control waveform when a disturbance occurs.
- To use this function, set "Disturbance overshoot adjustment function" to "ON" (the initial setting is "OFF").
- The disturbance response waveform can be adjusted using the "Disturbance gain" and "Constant at disturbance" settings.

● Disturbance gain

Disturbance gain



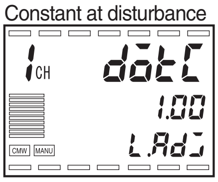
- The "Disturbance gain" setting can be increased to reduce overshoot when a disturbance occurs.
- The "Disturbance gain" setting can be decreased to increase overshoot when a disturbance occurs.
- When "Disturbance gain" is set to "0", the disturbance overshoot adjustment function does not operate.

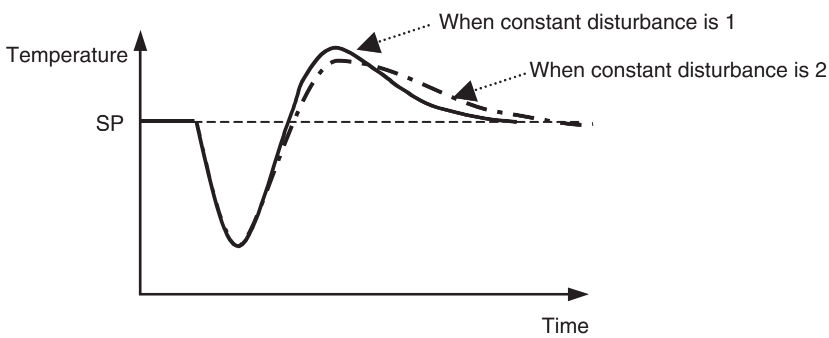


● Constant at disturbance

- The reset time after a disturbance can be lengthened by increasing the disturbance time contstant. (The default value "1" is normally used for the disturbance time constant. In the event that adjustment of the disturbance gain alone is not sufficient, this value can be adjusted for fine-tuning.)

Constant at disturbance

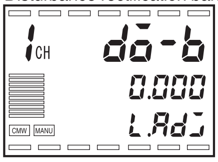




- The waveform may vary from that in the diagram depending on differences in the object of control and differences in PID values.

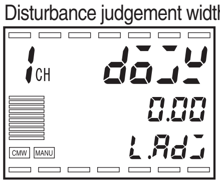
● Conditions for activation of disturbance overshoot adjustment

Disturbance rectification band

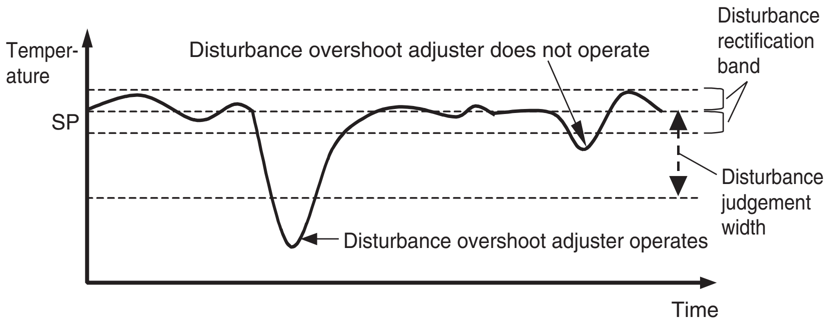


- If the deviation is greater than the "Disturbance judgement width" after the PV is rectified to the "Disturbance rectification band", the disturbance overshoot adjustment function activates.
- When the "Disturbance judgement width" is a positive value, disturbance overshoot adjustment will activate when a disturbance occurs that makes the PV fall. When the "Disturbance judgement width" is a negative value, disturbance overshoot adjustment will activate when a disturbance occurs that makes the PV rise.
- Disturbance overshoot adjustment does not activate in the following situations:
  - When "Disturbance rectification band" or "Disturbance judgement width" is set to "0".
  - When the SP is changed (when the SP change width exceeds the "Disturbance rectification band")
  - During AT
  - During ON/OFF control (P = 0.00)
  - During PD control (I = 0.00)

Disturbance judgement width



- The units for the "Disturbance rectification band" and "Disturbance judgement width" settings are % FS. As such, if the input type is K(1) -200.0 to 1300.0°C and you wish to set the "Disturbance judgement width" to 15.0°C,
  15.0°C/1500.0°C × 100 = 1.00 %FS
  hence "1.00" should be set.



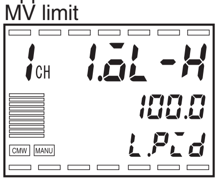
Setting data	Setting range	Units	Default value
Disturbance overshoot adjustment enable	OFF: Disabled, ON: Enabled	–	OFF
Disturbance gain	-1.00 to 1.00	–	0.65
Disturbance time constant	0.01 to 99.99	–	1.00
Disturbance rectification band	0.000 to 9.999	%FS	0.000
Disturbance judgement width	-99.99 to 99.99	%FS	0.00

5.3 Output adjustment functions

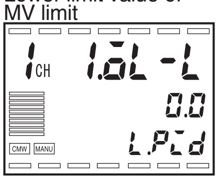
■ MV limit

- Upper and lower limits can be applied to the output of the calculated MV.
- When using ON/OFF control, the MV will be the MV upper limit when output is ON and the MV lower limit when output is OFF.
- The MV limit function does not operate when floating control is selected on a position proportional type.
- The following MVs take precedence over the MV limit function.
  Manual MV default
  MV at stop
  MV at PV error

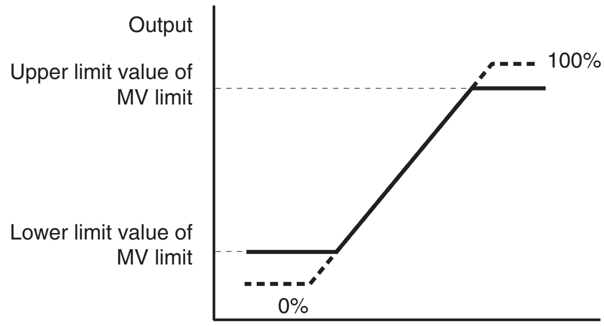
Upper limit value of MV limit



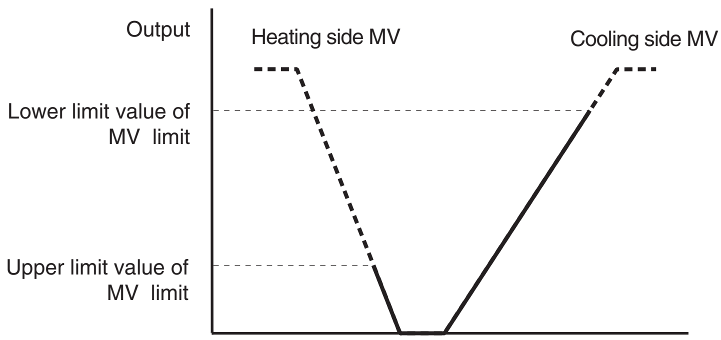
Lower limit value of MV limit



- The "MV upper limit" and "MV lower limit" can also be set in each PID set.



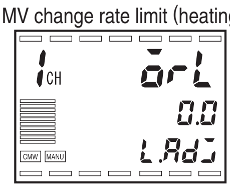
- In the case of heating/cooling control, overall upper and lower limits are set for heating and cooling. (Separate limit settings are not possible.)



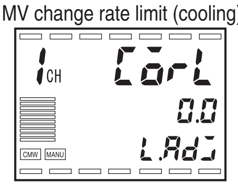
Setting data	Setting range	Units	Default value
MV upper limit	Standard control: MV lower limit + 0.1 to 105.0	%	100.0
	Heating/cooling control: 0.0 to 105.0	%	100.0
MV lower limit	Standard control: -5.0 to MV upper limit - 0.1	%	0.0
	Heating/cooling control: -105.0 to 0.0	%	-100.0

■ MV change rate limit

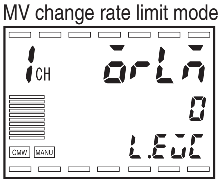
MV change rate limit (heating)



MV change rate limit (cooling)



MV change rate limit mode

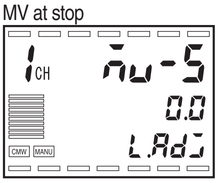


- The MV change rate limit is used to set a maximum allowed change per second in the MV (or in the opening of a valve in the case of a position proportional controll type). If a change occurs in the MV that exceeds this setting, the MV is changed by the set limit each second until the required change is attained. When the limit is set to "0", the function is disabled.
- For standard control, use "MV change rate limit (heat)". "MV change rate limit (cool)" cannot be used.
- For heating/cooling control, separate limits can be set for heating and cooling. "MV change rate limit (heat)" is used for heating and "MV change rate limit (cool)" is used for cooling.
- The MV change rate limit cannot be used in the following conditions:
  - Manual mode
  - During AT
  - During ON/OFF control (P=0.00)
  - When control is stopped (MV output at Stop)
  - During MV output at PV error
- If you only wish to limit the rate of increase in the MV, set the "MV change rate limit mode" to "1".

Setting data	Setting range	Units	Default value
MV change rate limit (heat)	0.0 to 100.0	%/sec	0.0
MV change rate limit (cool)	0.0 to 100.0	%/sec	0.0
MV change rate limit mode	0: Increase/Decrease 1: Increase only	–	0

■ MV at Stop

MV at stop



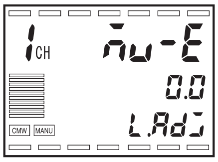
- This specifies the MV when control is stopped.
  In heating/cooling control a negative value is used for the cooling MV, thus when "MV at Stop" is positive, the MV will be sent to the heating output, and when negative the MV will be sent to the cooling output.
  The initial setting is "0.0", which means there is no output at stop for either standard or heating/cooling control.

Setting data	Setting range	Units	Default value
MV at Stop	-5.0 to 105.0 (Standard control) -105.0 to 105.0 (Heating/cooling control)	%	0.0

Note: The order of priority of the MV settings is
Manual MV default >at Stop > MV at PV error

■ MV at PV error

MV at error



This setting is used to output a fixed MV when an input error PV error or remote SP input error occurs.

When position proportional control is selected, "MV at PV error" also functions when a potentiometer input error occurs (when "Operation at potentiometer input error" = "Stop" or "Closed").

When control is stopped, "at Stop" takes precedence. In manual mode, the manual MV default takes precedence.

Setting data	Setting range	Units	Default value
MV at PV error (Standard type)	-5.0 to 105.0 (Standard control) -105.0 to 105.0 (Heating/cooling control)	%	0.0
MV at PV error (Position proportional type)	-1 : Closed output ON (Valve completely open) 0 : No output (valve opening hold) 1 : Open output ON (Valve completely closed)	–	0

Note: The order of priority of the MV settings is
Manual MV default >at Stop > MV at PV error

5.4 Display and key adjustment functions

■ Display scan

Display scan is used to automatically change display channels on a multi-point input type.

This function only applies to channels that are enabled in the "Number of enabled channels" setting.

If the "Number of enabled channels" is "3", channels 1, 2, and 3 are displayed.

● Display scan start/ stop

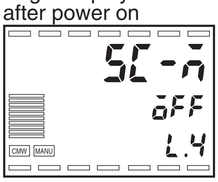
Display scan can be started automatically after power-on or by pressing the CH key.

To stop display scan, hold down the CH key for at least 1 second.

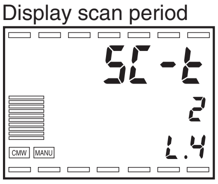
Use the "Begin display scan after power on" and "Display scan period" settings to specify how display scan operates.

Setting values		Start display scan after power on	Display scan using CH key
Begin display scan after power on	Display scan period		
OFF	0 (=OFF)	Disabled	Disabled
	1 to 99		Enabled
ON	0 (=OFF)	Disabled	Disabled
	1 to 99	Enabled	Enabled

Begin display scan after power on

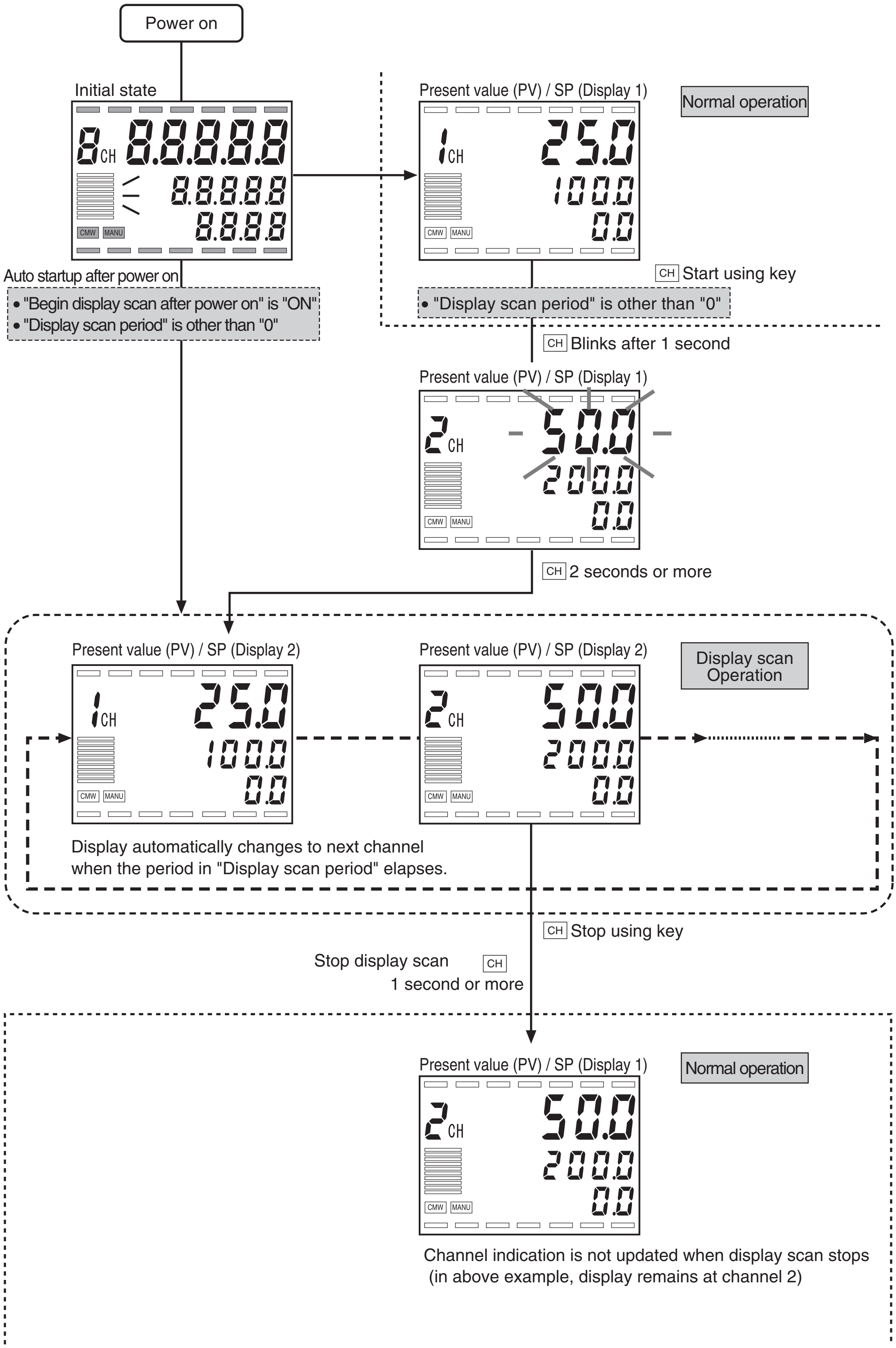


Display scan period



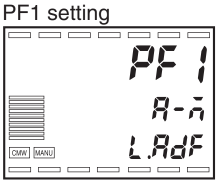
- When display scan is enabled, use the CH key to start or stop display scan.
- To start display scan, hold down the CH key in the Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting, or Monitor item level. Display 1 starts to blink after the key is held down for 1 second, and after the key is held down for another 2 seconds, the display stops blinking and display scan begins.
- If the CH key is held down for more than 1 second during display scan, display scan will stop.
- During display scan, only the CH key is enabled. To use any other keys, display scan must first be stopped with the CH key.
- Channel display in manual mode shows the manual operation screen.

◆ Example of display scan operation

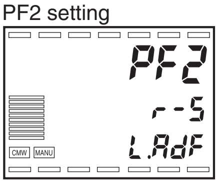


■ PF settings (function keys)

PF1 setting



PF2 setting



- The PF1 and PF2 serve as function keys, and the functions of these keys can be selected.
- Note that on a multi-point input type, the PF2 key functions as a CH key, and thus it cannot be used as a function key (the "PF2 setting" does not appear). However, the key can be used as a function key if the number of enabled channels is set to "1".

Setting values	Description	Function
OFF: oFF	Disabled	Does not function as a function key.
RUN: rUn	Run	Run currently displayed channel.
STOP: StoP	Stop	Stop currently displayed channel.
R-S: r-S	Run/Stop	Switch between run and stop for currently displayed channel.
ALLR: ALLr	Run all	Run all channels.
ALLS: ALLS	Stop all	Stop all channels.
AT: At	AT Execute / Cancel	Switch between AT execute and AT cancel. AT run is executed for the currently selected PID set.
BANK: bAnK	Bank selection	Switch through the bank numbers (adds 1 to the current bank number).
A-M: A-M	A/M key	Switch between auto and manual.
PFDP: PFdP	Monitor/Setting item	Display monitor/setting item. Select "Monitor / Setting item 1" to "Monitor / Setting item 5" (Special function level).

- Hold down the PF1 or PF2 for at least 1 second to execute the function selected in "PF1 setting" or "PF2 setting".

  If "Monitor / Setting item" is selected, the display will scroll through monitor/setting items 1 to 5 each time you press the key.

  * The initial settings for the function keys are as follows:
  PF1 setting: "A-M" (A/M key)
  PF2 setting: "R-S" (run/stop toggle)

  * The function keys are only effective in the Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting, Monitor item level, and Protect levels.
  The keys are only effective when "PF key protect" is "OFF".

  * "Operation adjustment protect" and "Setting change protect" do not apply to the function keys.
  "Run/Stop" and "Bank No." parameter settings can be changed and saved using a function key if the key is set to the corresponding function.

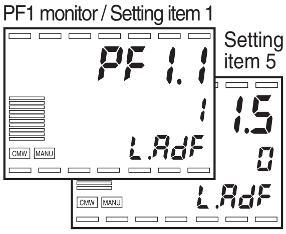
● Monitor/Setting item

"PF1 setting" or "PF2 setting" can be set to "Monitor/Settings (PFdP)" to display monitor/settings using a function key.

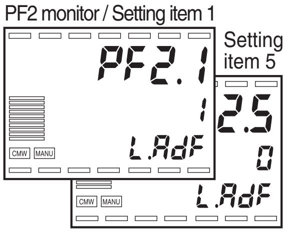
The content to be displayed is set for each channel in "Monitor / Setting item 1" through "Monitor / Setting item 5" of the corresponding function key.

The selections are shown in the following table (for the setting (or monitor) ranges, see the respective explanations of the setting data).

PF1 monitor / Setting item 1



PF2 monitor / Setting item 1



Setting value	Description	Remarks	
		Monitor/Setting	Display
0	Disabled		
1	PV/SP/Bank No.	Can set (SP)	–
2	PV/SP/MV	Can set (SP)	–
3	PV/Deviation	Monitor only	–
4	Proportional band (P)	Can set	P
5	Integral time (I)	Can set	I
6	Derivative time (D)	Can set	d
7	Alarm 1	Can set	AL-1
8	Alarm upper limit 1	Can set	AL1H
9	Alarm lower limit 1	Can set	AL1L
10	Alarm 2	Can set	AL-2
11	Alarm upper limit 2	Can set	AL2H
12	Alarm lower limit 2	Can set	AL2L
13	Alarm 3	Can set	AL-3
14	Alarm upper limit 3	Can set	AL3H
15	Alarm lower limit 3	Can set	AL3L
16	Alarm 4	Can set	AL-4
17	Alarm upper limit 4	Can set	AL4H
18	Alarm lower limit 4	Can set	AL4L
19	Bank No.	Can set	bAnK

◆Displaying "Monitor/Setting item"

To display "Monitor/Setting item", press the function key in Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting or Monitor item level.
Press the key repeatedly to scroll from "Monitor/Setting item 1" to "Monitor/Setting item 5". After "Monitor/Setting item 5", the display changes to the first parameter in RUN level.

* If any of settings "Monitor/Setting item 1" through "Monitor/Setting item 5" are disabled, those settings will not appear and the display will show the next enabled setting.

* If another key is pressed during display of "Monitor/Setting item", the following will take place:
  - If the mode or level key is pressed, the first parameter in RUN level will appear.
  - If a function key set as a channel key is pressed, the channel will change and the first parameter in RUN level of the new channel will appear.
  - If the other function key is pressed and it is also set to "Monitor/Setting item", the "Monitor/Setting item" of that key will appear.
  - If the other function key is pressed and it is set to a function other than the above (such as the A/M key), that function will activate.

* Display 3 operates as follows during Monitor/Setting item
  - If PV/SP/Bank No. is displayed, Display 3 shows the bank number.
  - If PV/SP/MV is displayed, Display 3 becomes a monitor that shows the MV.
  - In cases other than the above, the display goes off.

■ Other display and key adjustment functions

Other display and key adjustment functions are available. These functions are explained in "Section 8 Setting data".

- "PV/SP" display screen selection : Display adjustment level
- Bar graph display item (E5AR only) : Display adjustment level
- Display auto reset : Display adjustment level
- Display refresh period : Display adjustment level
- Monitor item level setting : Display adjustment level
- Display digits after PV decimal point : Initial setting level

5.5 Protecting settings

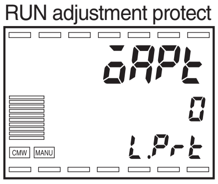
■ Protect

The protect function is used to restrict access to settings in order to prevent accidental changes to the settings.

Protect functions include "Operation adjustment protect", "Initial setting protect", "Setting change protect", and "PF key protect".

● Operation adjustment protect

RUN adjustment protect



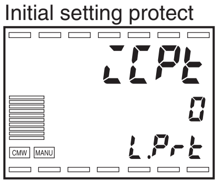
This function restricts key operation in Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting and Monitor item levels.

Setting value	Operation		Adjustment/ Adjustment 2	Bank setting PID setting Approximation setting Monitor item
	"PV/SP"	Other		
0	◎	◎	◎	◎
1	◎	◎	◎	×
2	◎	◎	×	×
3	◎	×	×	×
4	○	×	×	×

- ◎: Can display and change
- ○: Can display
- ×: Cannot display or move to level
- The default value is "0".

● Initial setting protect

Initial setting protect



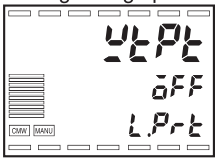
This setting restricts access to Input initial setting, Control initial setting, Control initial setting 2, Alarm setting, Display adjustment, and Communications setting levels.

Setting value	Move to input initial setting level	Move to Control initial setting / Control initial setting 2 / Alarm setting / Display adjustment / Communications setting level
0	Allowed (Displays "Move to special function setting level")	Allowed
1	Allowed (Does not display "Move to special function setting level")	Allowed
2	Prohibited	Prohibited

- When "Initial setting level protect" is set to "2", nothing happens when the level key is held down to move to Input initial setting level from Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting or Monitor item level (the blinking display to indicate movement to another level also does not appear).
- "Initial setting level protect" is initially set to "0".

● Setting change protect

Setting change protect



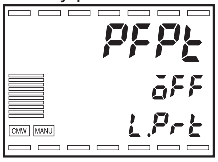
This function prevents use of the ⋀⋁ keys.

Setting value	Description
OFF	Keys can be used to change settings.
ON	Keys cannot be used to change settings. (However, settings can be changed in Protect level.)

- The initial setting is OFF.

● PF key protect

PF key protect



This function prevents use of the PF1/PF2 keys.

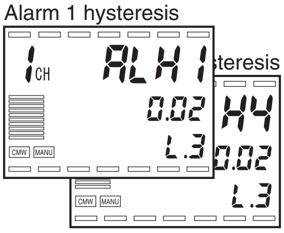
Setting value	Description
OFF	PF1/PF2 keys are enabled.
ON	PF1/PF2 keys are disabled. (Prohibits use as a function key or a channel key.)

- The initial setting for "PF key protect" is "OFF".

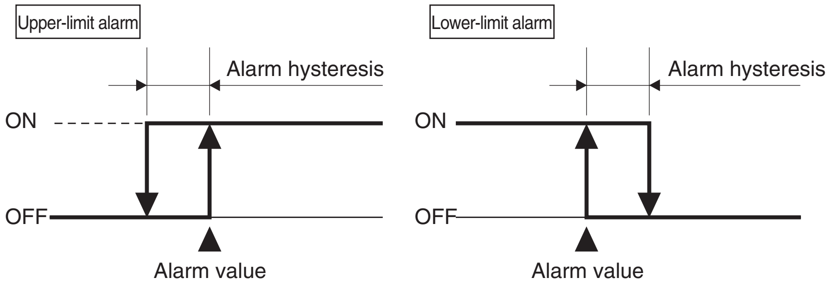
5.6 Alarm adjustment functions

■ Alarm hysteresis

Alarm 1 hysteresis



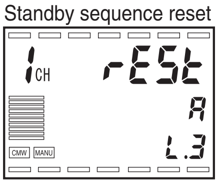
- Hysteresis can be applied when alarm outputs switch on and off, as shown below.



- Alarm hysteresis can be set separately for each alarm in "Alarm 1 to 4 hysteresis".
- All default values are "0.02" (%FS).

■ Standby sequence

Standby sequence reset



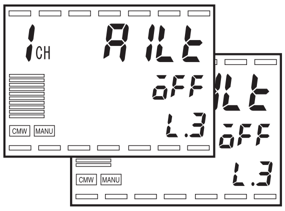
- "Standby sequence" is used to delay alarm output until the PV leaves the alarm range once and then subsequently enters it again.
- For example, in the case of a lower-limit, the PV is normally smaller than the SP when the power is turned on and thus is within the alarm range, which would cause the alarm output to switch on. However, if "With lower limit standby sequence" is selected, the alarm output will not switch on until the PV rises above the alarm set value and out of the alarm range, and then falls below the alarm value a second time.

● Standby sequence restart

- The standby sequence is canceled when alarm output occurs, and then restarts based on conditions specified in the "Standby sequence reset" setting.
- Condition A:
  Operation startup (including power on), or when the alarm value (alarm upper- and lower-limit) or input shift (input value for input shift 1, input shift 1, input value for input shift 2, or input shift 2) is changed, or when the SP is changed.
- Condition B:
  At power on
- The "Standby sequence reset" setting is common to Alarms 1 to 4.
- The initial setting is "0: Condition A".

■ Alarm latch

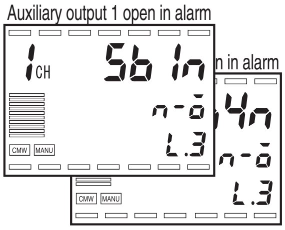
Alarm 1 latch



- The Alarm latch function is used to make an alarm output that has switched on remain on until the power is turned off, regardless of the temperature.
- The alarm latch state can be canceled by turning the power off or by a communication command.
- Alarm latch is set separately for each alarm in "Alarm 1-4 latch".
- The initial setting is "0: OFF".

■ Close in alarm/Open in alarm

Auxiliary output 1 open in alarm



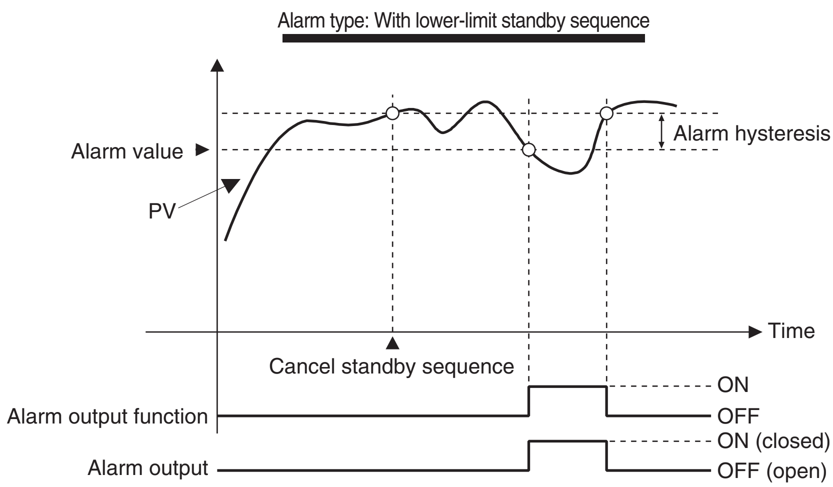
- When close in alarm is selected, an alarm output state is output as-is. When open in alarm is selected, the alarm output state is inverted before output.
- Close in alarm/Open in alarm is set separately for each auxiliary output in "Auxiliary output 1-4 non-exiting".
- The initial setting is "n-ō: Close in alarm".

Setting data	Auxiliary output function	Auxiliary output	Operation indicator
Close in alarm: n-ō	ON	ON	On
	OFF	OFF	Off
Open in alarm: n-C	ON	OFF	On
	OFF	ON	Off

- When the power is turned off and for about 2 seconds after the power is turned on, the auxiliary outputs are OFF (open).

● Alarm operation summary

- The following example summarizes alarm operation ("Lower limit alarm standby sequence" and "Close in alarm" are selected).



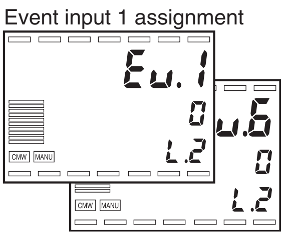
Display characters	Setting data name	Level (Display 3)	Use
ALt ∗	Alarms 1 to 4 Type	Alarm setting (L.3)	Sets the alarm type
A ∗ Lt	Alarms 1 to 4 Latch	Alarm setting (L.3)	Alarm output latch (hold)
ALH ∗	Alarms 1 to 4 Hysteresis	Alarm setting (L.3)	Alarm output hysteresis
rESt	Standby sequence reset	Alarm setting (L.3)	Sets standby sequence restart conditions
Sb ∗ n	Auxiliary outputs 1 to 4 Open in alarm	Alarm setting (L.3)	Close in alarm/Open in alarm

∗:1 to 4

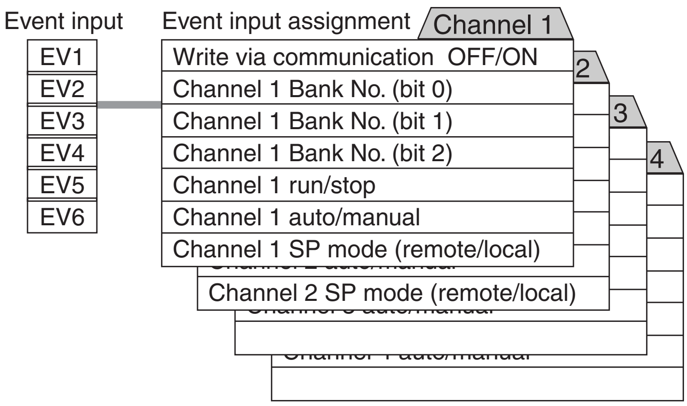
5.7 Using event input

- Event input can be used on the E5AR-☐☐B (2-input), E5ER-☐☐B(2-point), E5AR-☐☐D (4-point), E5ER-☐☐D (4-point), and E5AR-☐☐DB (6-point).
- An order of priority exists for event input, key operation, and communication settings, with the most recent setting taking precedence.
- Operation changeover takes place when event input switches "OFF → ON" and "ON → OFF".

■ Event input allocation



- Function settings for event input using external contact input are configured using "Event input allocation 1 to 6".
- On a multi-point input type, assignment data can be set for channels 2 and higher as appropriate for the number of channels.



● Communication write OFF/ON

- When the event input is ON, setting data can be written with the communication function and the "CMW" indicator lights up. The content of the event input is reflected in "Communication OFF/ON" (Adjustment level).
- This setting data is an operation command that is common to all channels.
- Operation is as follows based on the event input ON/OFF state.

Event input	Description
OFF	Write via communication OFF
ON	Write via communication ON

Functions and Operations

● Bank No. (Bits 0 to 2)

- The bank number is specified by the event input ON/OFF state. The content of the event input is reflected in "Bank No." (Adjustment level).
- This setting data is an operation command that is particular to a single channel.
- Operation is as follows based on the event input ON/OFF state.

Event input			Description
Bank No. (Bit 0)	Bank No. (Bit 1)	Bank No. (Bit 2)	
OFF	OFF	OFF	Run Bank No.0
ON	OFF	OFF	Run Bank No.1
OFF	ON	OFF	Run Bank No.2
ON	ON	OFF	Run Bank No.3
OFF	OFF	ON	Run Bank No.4
ON	OFF	ON	Run Bank No.5
OFF	ON	ON	Run Bank No.6
ON	ON	ON	Run Bank No.7

- To use eight banks (Banks 0 to 7), 3 event input points are required.

● Run/Stop

- When the event input is ON, operation is stopped and the "STOP" indicator lights up. The content of the event input is reflected in "Run/Stop" (Run level).
- This setting data is an operation command that is particular to a single channel.
- Operation is as follows based on the event input ON/OFF state.

Event input	Description
OFF	Run
ON	Stop

● Auto / Manual

- When the event input is ON, the mode switches to manual and the "MANU" operation indicator lights up. The content of the event input is reflected in "Auto / Manual" (Run level).
- This setting data is an operation command that is particular to a single channel.
- Operation is as follows based on the event input ON/OFF state.

Event input	Description
OFF	Auto
ON	Manual

● SP mode

- This function is only effective when the control mode is control with remote SP.
- When the event input is ON, the remote SP (RSP) is used as the SP and the "RSP" operation indicator lights up. When the event input is OFF, the local SP (LSP) is used as the SP. The content of the event input is reflected in "SP mode" (Adjustment level).
- This setting data is an operation command that is particular to a single channel.
- Operation is as follows based on the event input ON/OFF state.

Event input	Description
OFF	Local SP mode
ON	Remote SP mode

Symbol	Setting data name	Level (Display 3)	Use
Ev. *	Event input 1 to 6 assignment	Control initial setting 2 (L.2)	Specify event input

*: 1 to 6

5.8 Using transfer output

■ Transfer output settings

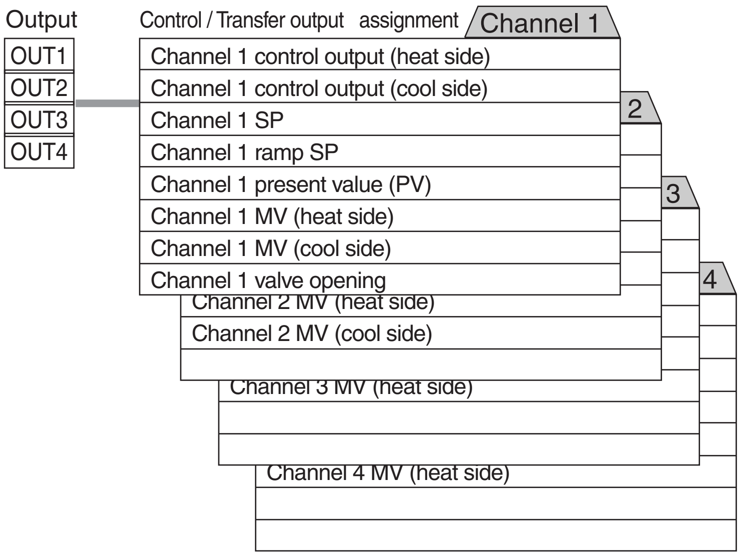
- For transfer output, use an output that is not used for control output.

● Control / Transfer output assignment

- Transfer output can be used to output one of the following 6 types of data as selected in "Control / Transfer output assignment". For more information, see "8.11 Control initial setting 2 level (L.2) Control / Transfer output 1 to 4 assignment (P.8-46).

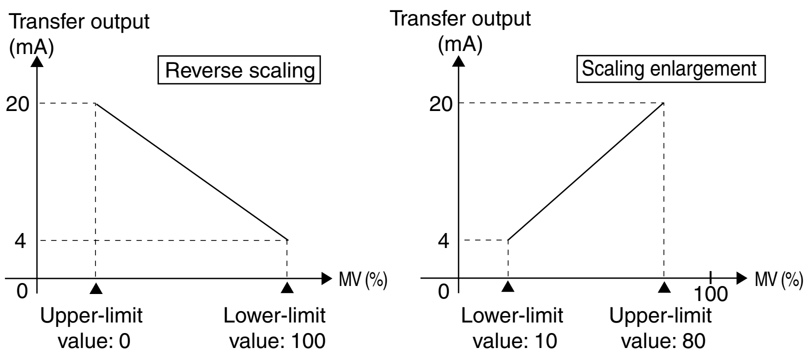
  SP, ramp SP, PV, MV (heat), MV (cool), valve opening

  Note that the heating and cooling MVs can only be output from a standard type, and the valve opening can only be output from a position proportional type with a potentiometer connected.

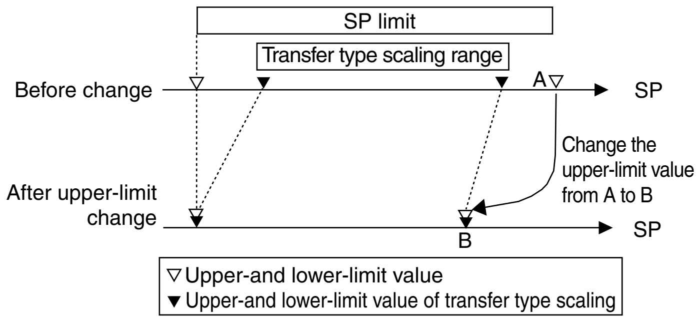


● Transfer output scaling

- Scaling of the output value can be performed using "Transfer output upper limit" and "Transfer output lower limit". The upper-limit can be set to a smaller value than the lower limit to perform reverse scaling. The scale can be enlarged using the width between the upper-and lower-limits specified in the setting data. The following diagram shows an example of scaling the heating MV.



- If the "Input type", "Scaling display value 1, 2", "SP upper and lower limit", or "Temperature units" setting is changed when "SP" or "Ramp SP" is selected, the "Transfer output upper limit" and "Transfer output lower limit" will be respectively returned to the upper and lower limits of the setting range.
- If an input error occurs when the transfer output assignment is set to "PV", the transfer output changes to the upper limit and it changes to the lower limit in the case of reverse scaling.



Display characters	Setting data name	Level (Display 3)	Use
oUt. ∗	Control / Transfer output 1 to 4 assignment	Control initial setting 2 (L.2)	Specify Control / Transfer output
trH. ∗ trL. ∗	Transfer output 1 to 4 upper limit Transfer output 1 to 4 lower limit	Control initial setting 2 (L.2)	Transfer output scaling

∗: 1 to 4

5.9 Using communication functions

■ Setting communication parameters

Communication parameters are set in the Communications setting level.
The parameters and settings are shown in the following table.

Initial settings are highlighted

Display characters	Setting data name	Setting values	Description
PSEL	Protocol selection	CWF / Mod	CompoWay/F, Modbus
U-no	Communication Unit No.	0, 1 to 99	0 to 99
bPS	Communications speed	9.6 / 19.2 / 38.4	9.6/19.2/38.4 (k bit/s)
LEn	Communication data length	7 / 8 (bit)	7/8 (bit)
Sbit	Communication stop bit	1 / 2	1/2
PrtY	Communication parity	nonE / EvEn / odd	None/Even/Odd
SbWt	Transmission wait time	0 - 20 - 99	0 to 99 (ms)

Protocol selections (PSEL)

The communication protocol can be set to CompoWay/F (Omron's unified protocol for general purpose serial communication), or Modbus (based on RTU Mode of Modbus Protocol (Specifications: PI-MBUS-300 Rev.I) of Modicon Inc.).

Communication Unit No. (U-no)

When performing communication with a host computer, a unit number must be set in each controller to allow the host computer to recognize it. Any number from 0 to 99 can be set. The unit number is initially set to 1. When using multiple controllers, make sure that no units have the same unit number or communication will not take place correctly. After setting a unit number, turn off the power and then turn it on again to make the new unit number take effect.

Communications speed (bPS)

Set the communications speed for communication with a host computer. The following speeds are available:
9.6 (9,600 bit/s), 19.2 (19,200 bit/s), 38.4 (38,400 bit/s)
After setting the speed, turn off the power and then turn it on again to make the new speed setting take effect.

Communication data length (LEn)

The communication data length can set to 7 bits or 8 bits.

Communication stop bit (Sbit)

The communication stop bit can be set to 1 or 2.

Communication parity (PrtY)

The communication parity can be set to None (nonE), Even (EvEn), or Odd (odd).

Transmission wait time (SbWt)

After changing the transmission wait time, perform a software reset or turn the power off and then on to make the new setting take effect.

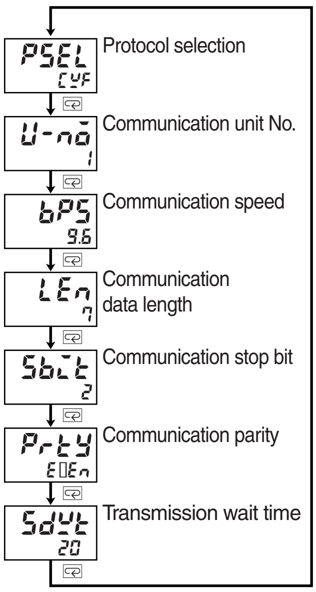
Hint

For information on communication procedures, see "Section 6 Communication (CompoWay/F)" or "Section 7 Communication (Modbus)" (P. 7-1) depending on the communication protocol you are using.

Operation procedure

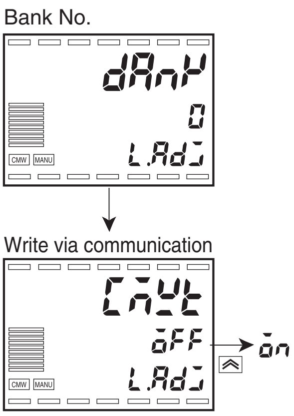
Before performing communication, follow the steps below to set the communication unit number, communications speed, and other communication parameters.

1. Hold down the key for 3 seconds to move from "RUN level" to "Initial setting level".
2. Press the key to move from "Input initial setting level" to "Communications setting level".
3. Press the key to scroll through the setting item as shown at left.
4. Press the keys to change a setting.



Configure communication setting data in accordance with the other computers

■ Write via communication



To allow a host computer to write setting data to a controller, set "Write via communication" (Adjustment level) to "on: Enabled".

1. Press the key less than 1 second to move from "RUN level" to "Adjustment level".
2. Press the key to set "Write via communication to "on".

Important

Setting data can be written 100,000 times.
If you will be writing setting data frequently, select "RAM write mode" (Special function setting level).

Section 6 Communication (CompoWay/F)

6.1 Communication method

■ CompoWay/F communication protocol

Supplement

The communication function is used by creating a program on the host computer. As such, the explanations in this section are from the perspective of the host computer.
For example, "Read/Write" refers to the host computer reading or writing to the E5AR/ER.

CompoWay/F is OMRON's unified protocol for general purpose serial communication. Featuring a unified frame format and commands that are compliant with FINS, which has a record of successful use with OMRON programmable controllers, CompoWay/F makes communication easy between multiple components and a computer.

FINS (Factory Interface Network Service)
This is a protocol for message communication between controllers on an OMRON factory automation network.

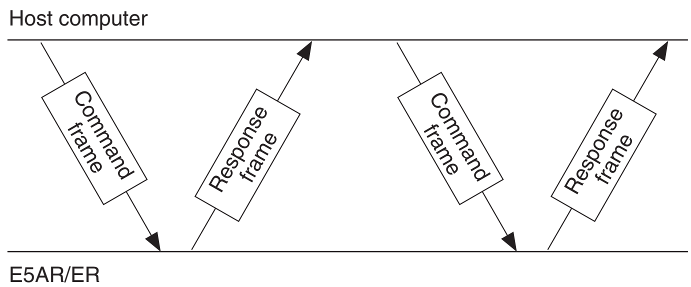
■ Communication specifications

Transfer connection:	Multi-point
Communication method:	RS-485 (2-wire half duplex)
Synchronization method:	Start-stop
Baud rate:	9.6 k/19.2 k/38.4 k bit/s
Send code:	ASCII
Data length:	7/8 bits
Stop bit length:	1/2 bits
Error detection:	Vertical parity (None/Even/Odd) BCC (Block Check Character) Start-stop synchronized data configuration
Flow control:	None
Interface:	RS-485
Retry function:	None

* Initial settings are shaded.

■ Transfer protocol (Communication/ CompoWay/F)

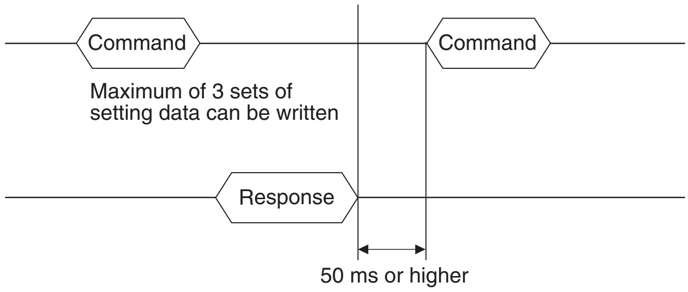
The host computer sends a command frame, and the E5AR/ER sends a response frame based on the content of the command frame. One response frame is sent in response to one command frame.



The exchange between the command frame and response frame is explained below.

After a receiving a response from the controller, have the host computer wait at least 5 ms before sending the next command.

When writing multiple sets of setting data in a row, such as when writing to the variable area or performing a compound write, controllability may be affected. Pay attention to the following points:



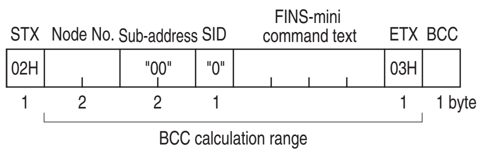
6.2 Frames (Communication/CompoWay/F)

Based on CompoWay/F protocol, commands from the host computer and responses from the E5AR/ER take the form of frames.

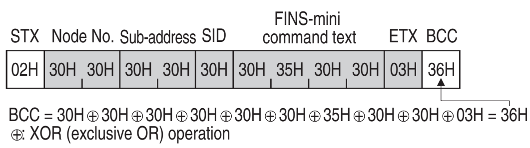
The data comprising command frames and response frames are explained below.

In the following explanation, an "H" following a numeric value (for example 02H) indicates that the value is a hexadecimal number. A number or letters enclosed in quotation marks (for example "00") is an ASCII character.

■ Command frame



STX	Code that indicates the beginning of the communication frame (02H). Be sure to set this code in the leading byte.
Node No.	This number specifies the destination. Specify the Unit No. of the E5AR/ER. When broadcasting to all units, specify "XX". Responses are not sent to a broadcast.
Sub-address	Not used on the E5AR/ER. Be sure to set to "00".
SID (Service ID)	Not used on the E5AR/ER. Be sure to set to "0".
FINS-mini Command text	The text of the command.
ETX	Code that indicates the end of the text (03H).
BCC	Block Check Character. This stores the result of the BCC calculation from Node No. to EXT.



■ Response frame

Supplement

A response is not sent to command frames that do not end with ETX.BCC characters.

STX	Node No.	Sub-address	End Code	FINS-mini response text	ETX	BCC
02H		"00"			03H	
1	2	2	2		1	1 byte

STX	Code that indicates the beginning of the communication frame (02H). Be sure to set this code in the leading byte.
Node No.	The number that was specified in the command frame is repeated here. This is the Unit No. of the responding E5AR/ER.
Sub-address	Not used on the E5AR/ER. Set to "00".
End code	Returns the result of the command executed as instructed by the command frame.
FINS-mini Response text	Text of the response
ETX	Code that indicates the end of the text (03H).
BCC	Block Check Character. This stores the result of the BCC calculation from Node No. to EXT.

End codes (Communication/CompoWay/F)

End code	Name	Description	Error detection order of priority
"0F"	FINS command error	Could not execute the specified FINS command.	8
"10"	Parity error	Sum of bits that are "1" in received data does not agree with the set communication parity value.	2
"11"	Framing error	Stop bit of command frame characters is "0".	1
"12"	Overrun error	Attempted to transfer new data because received data buffer is already full.	3
"13"	BCC error	Calculated BCC different from received BCC.	5
"14"	Format error	Characters other than "0" to "9" or "A" to "F" in FINS-mini command text. In the case of an echo-back test, when data other than the test data is sent. No SID and FINS-mini command text, or no FINS-mini command text. "MRC/SRC" not correct in FINS-mini command text.	7
"16"	Sub-address error	No sub-address, SID, or FINS-mini command text; or sub-address less than 2 characters and no SID and FINS-mini command text.	6
"18"	Frame length error	The received frame exceeds the required number of bytes.	4
"00"	Normal end	Command was executed normally without error.	None

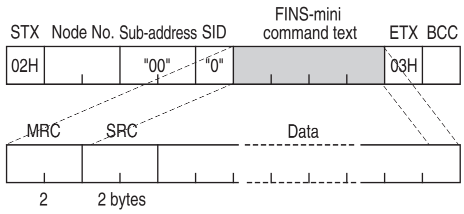
6.3 FINS-mini text

The FINS-mini command text and FINS-mini response text form the body of command/response communication.

FINS-mini command text and FINS-mini response text are configured as follows.

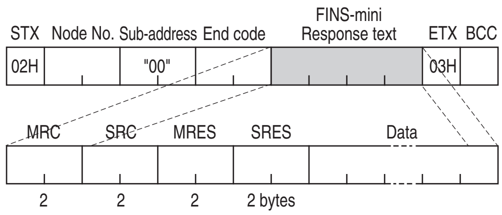
Command text

FINS-mini command text consists of an MRC (main request code) and an SRC (sub request code), followed by the required data.



Response text

FINS-mini response text consists of the MRC and SRC, followed by an MRES (main response code) and SRES (sub response code), and then the required data.



If the specified FINS-mini command was not successfully executed, the response will only contain the MRC, SRC, MRES and SRES.

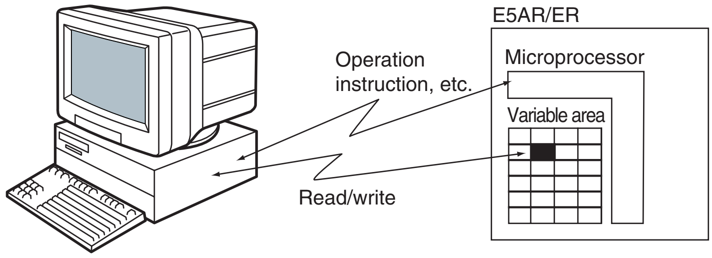
List of FINS-mini service commands (communication/CompoWay/F)

MRC	SRC	Service name	Description
"01"	"01"	Monitor value / setting data read	Reads monitor values / setting data.
"01"	"02"	Monitor value / setting data write	Writes monitor values / setting data.
"01"	"04"	Monitor value / setting data compound read	Performs multiple reads of monitor values / setting data.
"01"	"13"	Monitor value / setting data compound write	Performs multiple writes of monitor values / setting data.
"01"	"10"	Monitor value / setting data compound stored read	Sequentially reads contents of addresses specified in "monitor value / setting data compound read store".
"01"	"11"	Monitor value / setting data compound read store (write)	Specifies addresses to be read using "monitor value / setting data compound stored read".
"01"	"12"	Monitor value / setting data compound read store check (read)	Reads the contents stored using "variable area compound read store".
"05"	"03"	Machine attribute read	Reads the model and other attributes.
"06"	"01"	Controller status read	Reads the operation status.
"08"	"01"	Echo-back test	Performs an echo-back test.
"30"	"05"	Operation command	Commands such as Run/Stop, AT Execute / Cancel, and "Move to setting area 1".

6.4 Variable areas

The area used for data exchange when communicating with the E5AR/ER is called the "variable area". The PV is read and various setting data are read and written using the variable area of the E5AR/ER.

Operation commands and reading of machine attributes do not use the variable area.



A variable area is accessed by specifying the position of a variable within the variable area using the variable type and address.

● Variable types

Variable types in variable areas are as follows:

Variable type	Description	Area
C4	Communication monitor	Setting area 0 (during operation)
C5	Protect level	
C6	RUN level	
C7	Adjustment level	
C8	Adjustment level 2	
C9	Bank setting level	
CA	PID setting level	
CB	Approximation setting level	
CC	Input initial setting level	Setting area 1 (during stop)
CD	Control initial setting level	
CE	Control initial setting 2 level	
CF	Alarm setting level	
D0	Display adjustment level	
D1	Communications setting level	
D2	Special function setting level	
D3	Expansion control setting level	

● Addresses (Communication/ CompoWay/F)

Each variable type has an address. Addresses are 2 bytes long and written in hexadecimal. Addresses are assigned according to units of access size. Each address consists of a "channel identifier" and an "in-area address".

Address (2 bytes)

0	0	0	0	0	0	#	#	0	A_6	A_5	A_4	A_3	A_2	A_1	A_0

Channel identifier (0 - 3)

Address in area 00 to 7F: 128 variables

Channel identifier

For multi-point input types that require settings for channels 2 to 4, specify 1 to 3 to identify the channels.
On single-input types, only "0: Channel 1" can be specified.

Channel identifier	Channel
0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4

In-area address

This is a number that is assigned to each set of data in the variable area. Addresses are assigned in order beginning from the first set.
For more information on addresses, see "Appendix Setting list" (P.A-6). Note that the addresses indicated in the setting list are addresses of channel 1.
For example, to specify an address of channel 2, add 0100 to the address in the setting list. For channel 3 add 0200, and for channel 4 add 0300.

● Number of elements

The number of elements is expressed as a 2-byte hexadecimal number. The specification range for the number of elements varies depending on the command. See "6.9 Commands and responses (Communication/CompoWay/F)" (P.6-14) for more information.

For example, if the number of elements is 0010, the first 16 elements of data (H'10) from the address are specified.

● Set values

Values read and written to the variable area are expressed in hexadecimal and disregard the decimal point position (negative values are expressed as a two's complement).

Example: D'105.0 → H'0000041A

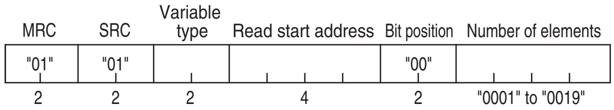
The variable is an 8-digit number in hexadecimal. Negative values are expressed as a two's complement. The decimal is disregarded.
For example, if the PV of the E5AR/ER is 105.0, it will be read as H'0000041A (105.0 → 1050 → H'0000041A).

6.5 Reading the variable area

The data area is read by setting the required data in the following FINS-mini command text format.

Command

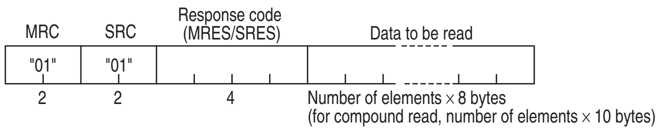
FINS-mini command text



Data name	Explanation
MRC/SRC	Specifies the FINS-mini monitor value/setting data read command.
Variable type	Specify a variable type.
First address of read	Specify the address for the beginning of the read.
Bit position	Not used on the E5AR/ER. Specify "00".
Number of elements	Specifies the number of variables to read (max. of 25 (H'19)). Not needed for a compound read.

Response

FINS-mini response text



Data name	Explanation
MRC/SRC	The FINS-mini command text appears here.
Response code	Result of execution of the command.
Read data	Data that was read.

Response codes

Response code	Error name	Explanation
"1001"	Command length too long	The command is too long.
"1002"	Command length too short	The command is too short.
"1101"	Area type error	Incorrect variable type.
"110B"	Response length too long	Number of elements > 25 (H'0019).
"1100"	Parameter error	Specified bit position is other than "00".
"2203"	Operation error	Unit error, unit change, display unit error, internal non-volatile memory error.
"0000"	Normal end	

6.6 Writing to the variable area

Write to the data area by setting the required data in the following FINS-mini command text format.

Command

FINS-mini command text

MRC	SRC	Variable type	Starting address of write	Bit position	Number of elements	Write data
"01"	"02"			"00"		
2	2	2	4	2	"0001" to "0018" 4	

Data name	Explanation
MRC/SRC	Specifies the FINS-mini monitor value/setting data write command.
Variable type	Specify a variable type.
First address of write	Specify the address for the beginning of the write.
Bit position	Not used on the E5AR/ER. Specify "00".
Number of elements	Specifies the number of variables to be written (max. of 25 (H'19)). Not needed for a compound write.
Write data	Enter data to be written.

Response

FINS-mini response text

MRC	SRC	Response code (MRES/SRES)
"01"	"02"	
2	2	4

Data name	Explanation
MRC/SRC	FINS-mini command text appears here.
Response code	Result of execution of the command.

Response codes

Response code	Error name	Explanation
"1002"	Command length too short	The command is too short.
"1101"	Area type error	Incorrect variable type.
"1003"	Number of elements / Data number do not agree	The specified number of elements does not agree with the actual number of data elements.
"1100"	Parameter error	Bit position specification other than "00". Written data was outside of setting range.
"2203"	Operation error	Write via communication is disabled. Write to setting area 1 was attempted from setting area 0. Write to setting data of protect level was attempted from other than protect level. AT is running. Calibration level in progress. Unit error, unit change, display unit error, internal non-volatile memory error.
"0000"	Normal end	

6.7 Operation commands (Communication/CompoWay/F)

Operation commands are sent using the following FINS-mini command text format.

Command

FINS-mini command text

MRC	SRC	Instruction code	Related information
"30"	"05"		
2	2	2	2

Data name	Explanation
MRC/SRC	Specify the FINS-mini operation command.
Operation code	Specify an operation code.
Related information	Specify information related to the command.

Operation commands for the E5AR/ER are shown in the following.

Operation code	Description	Related information	
		Higher Byte	Lower Byte
00	Write via communication	0 *1	0: OFF (Disabled) 1: ON (Enabled)
01	Run/Stop	0 to 3, F *2	0: Run 1: Stop
02	Bank change	0 to 3, F *2	0 to 7: Bank 0 to 7
03	AT run	0 to 3, F *2	0: Currently selected PID Set No. 1 to 8: PID Set No.
04	Write mode	0 *1	0: Backup mode 1: RAM write mode
05	RAM data save	0 *1	0
06	Software reset	0 *1	0
07	Move to setting area 1	0 *1	0
08	Move to protect level	0 *1	0
09	Auto / Manual	0 to 3, F *2	0: Auto mode 1: Manual mode
0A	AT stop	0 to 3, F *2	0: Stop
0B	Initialize settings	0 *1	0
0C	Cancel latch	0 to 3, F *2	0
0D	SP mode	0 to 3, F *2	0: LSP 1: RSP

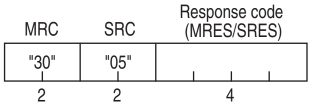
*1: Operates for all channels.
*2: Specify for each channel
0: CH1, 1: CH2, 2: CH3, 3: CH4, F: All channels
*: A software reset will not respond (no service PDU response).
*: When all channels are specified, only enabled channels will respond and processing will begin from Channel 1. If an error is detected on any one channel, an "Operation error" will result. If all channels end normally, "Normal end" results.

Important

When cascade control is selected for the control mode, specify channel 2 commands for the following operation commands:
- Run/Stop
- Auto / Manual
- SP mode
  Cascade open / closed

Response

FINS-mini response text



Data name	Explanation
MRC/SRC	FINS-mini command text appears here.
Response code	Result of execution of the command.

Response codes

Response code	Error name	Explanation
"1001"	Command length too long	The command is too long.
"1002"	Command length too short	The command is too short.
"1100"	Parameter error	Operation code or related information is not correct.
"2203"	Operation error	Unable to execute because write via communication is disabled. Unable to execute operation command. For more information, see corresponding operation command explanation in "6.9 Commands and responses (Communication/CompoWay/F)". Unit error, unit change, display unit error, internal non-volatile memory error
"0000"	Normal end	

6.8 Setting areas

The E5AR/ER has two setting areas for communication: Setting area 0 and setting area 1.

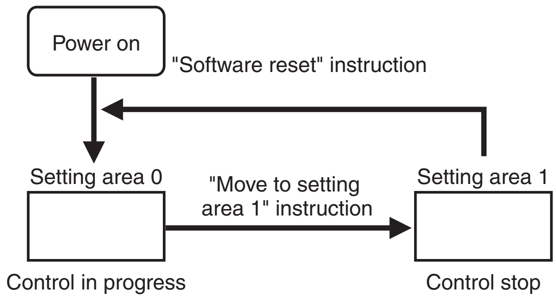
In setting area 0, control continues.

As such, setting area 0 makes it possible to perform operations that require control to be in progress, such as reading the PV, writing an SP, and run/stop, as well as operations that do not interfere with control. On the other hand, operations that may change control such as writing initial setting data cannot be performed. (Note that setting data that cannot be written can still be read.)

In setting area 1, control is stopped.

This makes it possible to perform operations such as writing initial setting data which are not possible in setting area 0.

When the power is turned on, setting area 0 is selected. To access setting area 1, use the "Move to setting area 1" operation command. To return to setting area 0 from setting area 1, turn off the power or use the "Software reset" operation command.



Variable type	Description	Area
C4	Communication monitor	Setting area 0 (During control)
C5	Protect level	
C6	RUN level	
C7	Adjustment level	
C8	Adjustment level 2	
C9	Bank setting level	
CA	PID setting level	
CB	Approximation setting level	
CC	Input initial setting level	Setting area 1 (Control stop)
CD	Control initial setting level	
CE	Control initial setting 2 level	
CF	Alarm setting level	
D0	Display adjustment level	
D1	Communications setting level	
D2	Special function setting level	
D3	Expansion control setting level	

6.9 Commands and responses (Communication/CompoWay/F)

The E5AR/ER provides a set of applied commands that make use of variable area read/write commands, operation commands, and other services provided by the CompoWay/F communication protocol.

E5AR/ER applied commands are explained below.

■ Monitor value read (Communication/CompoWay/F)

Command

MRC	SRC	Variable type	Address	Bit position	Number of elements
"01"	"01"			"00"	"0001"

Variable type	Address	Monitor value		Address	Monitor value	
		Ch	Data name		Ch	Data name
"C0"	"0000"	1	PV	"0200"	3	PV
	"0001"		Status	"0201"		Status
	"0002"		Internal SP	"0202"		Internal SP
	"0003"		None	"0203"		None
	"0004"		MV monitor (heat)	"0204"		MV monitor (heat)
	"0005"		MV monitor (cooling)	"0205"		MV monitor (cooling)
	"0100"	2	PV	"0300"	4	PV
	"0101"		Status	"0301"		Status
	"0102"		Internal SP	"0302"		Internal SP
	"0103"		None	"0303"		None
	"0104"		MV monitor (heat)	"0304"		MV monitor (heat)
	"0105"		MV monitor (cooling)	"0305"		MV monitor (cooling)
"C1"	"0003"	1	SP*1	"0203"	3	SP *1
	"0004"		Bank 0: Alarm value 1	"0204"		Bank 0: Alarm value 1
	"0005"		Bank 0: Alarm value 1 upper limit	"0205"		Bank 0: Alarm value 1 upper limit
	"0006"		Bank 0: Alarm value 1 lower limit	"0206"		Bank 0: Alarm value 1 lower limit
	"0007"		Bank 0: Alarm value 2	"0207"		Bank 0: Alarm value 2
	"0008"		Bank 0: Alarm value 2 upper limit	"0208"		Bank 0: Alarm value 2 upper limit
	"0009"		Bank 0: Alarm value 2 lower limit	"0209"		Bank 0: Alarm value 2 lower limit
	"0103"	2	SP *1	"0303"	4	SP *1
	"0104"		Bank 0: Alarm value 1	"0304"		Bank 0: Alarm value 1
	"0105"		Bank 0: Alarm value 1 upper limit	"0305"		Bank 0: Alarm value 1 upper limit
	"0106"		Bank 0: Alarm value 1 lower limit	"0306"		Bank 0: Alarm value 1 lower limit
	"0107"		Bank 0: Alarm value 2	"0307"		Bank 0: Alarm value 2
	"0108"		Bank 0: Alarm value 2 upper limit	"0308"		Bank 0: Alarm value 2 upper limit
	"0109"		Bank 0: Alarm value 2 lower limit	"0309"		Bank 0: Alarm value 2 lower limit
"C4"	"0000"	1	Version	"0200"	3	Version
	"0001"		Modification type	"0201"		Modification type
	"0002"		PV	"0202"		PV
	"0003"		Internal SP	"0203"		Internal SP
	"0004"		Bank No.monitor	"0204"		Bank No.monitor
	"0005"		PID Set No.monitor	"0205"		PID Set No.monitor
	"0006"		Status	"0206"		Status
	"0100"	2	Version	"0300"	4	Version
	"0101"		Modification type	"0301"		Modification type
	"0102"		PV	"0302"		PV
	"0103"		Internal SP	"0303"		Internal SP
	"0104"		Bank No.monitor	"0304"		Bank No.monitor
	"0105"		PID Set No.monitor	"0305"		PID Set No.monitor
	"0106"		Status	"0306"		Status

*1 Local SP of Bank No. that is selected and running.

This command is used to read the PV, status, and other monitor values. The number of elements can be set from 0002 to 0019 to allow reading of monitor values in contiguous addresses.

When used in setting area 1, the response for the PV and internal SP is "0" and the response for the status is as indicated in the notes in "Appendix Setting list Status" (P.A-8).

Response

MRC	SRC	Response code	Data
"01"	"01"	"0000"	Monitor value

Response codes: The above indicates a normal end. For the response codes, see "6.5 Reading the variable area" (P.6-9).

■ Setting data read (Communication/CompoWay/F)

Command

MRC	SRC	Variable type	Address	Bit position	Number of elements
"01"	"01"			"00"	"0001"

Variable type	Address	Setting data	
		Ch	Explanation
"C4" "C5" "C6" "C7" "C8" "C9" "CA" "CB"	"0000" to "007F"	1	Setting data of setting area 0 Protect level RUN level Adjustment level Adjustment level 2 Bank setting level PID setting level Approximation setting level
	"0100" to "017F"	2	
	"0200" to "027F"	3	
	"0300" to "037F"	4	
"CC" "CD" "CE" "CF" "D0" "D1" "D2" "D3"	"0000" to "0039"	1	Setting data of setting area 1 Input initial setting level Control initial setting level Control initial setting 2 level Alarm setting level Display adjustment level Communications setting level Special function setting level Expansion control setting level
	"0100" to "0139"	2	
	"0200" to "0239"	3	
	"0300" to "0339"	4	

This command is used to read setting data. The number of elements can be set from 0002 to 0019 to allow successive reading of 2 to 25 items of setting data in contiguous addresses.

To specify the variable type or address, see "Appendix Setting list" (P.A-6). The upper limit of an address will vary depending on the variable type.

This command can be used in both setting area 0 and setting area 1.

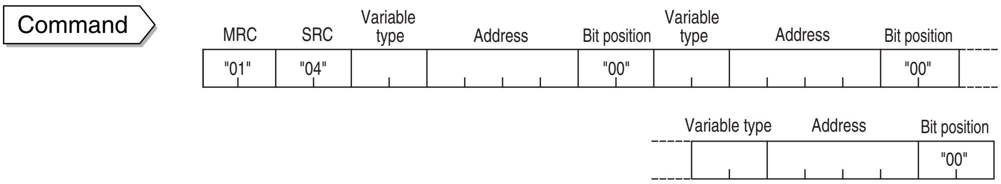
When used in setting area 1, the response for the remote SP monitor, ramp SP monitor, and valve opening monitor is "0" and the response for the status is as indicated in the notes in "Appendix Setting list Status" (P.A-8).

Response

MRC	SRC	Response code	Data
"01"	"01"	"0000"	Setting data

Response codes: The above indicates a normal end. For the response codes, see "6.5 Reading the variable area" (P.6-9).

■ Monitor value / setting data compound read (Communication/CompoWay/F)



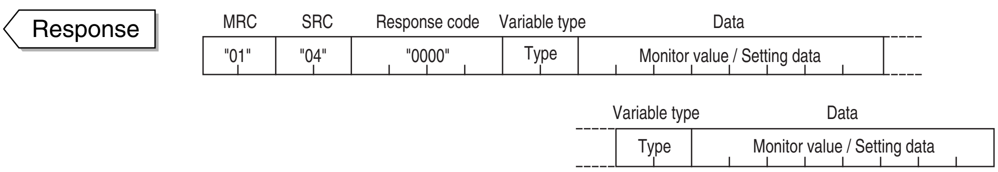
Variable type	Address	Setting data	
		Ch	Explanation
"C4"	"0000"	1	Monitor values
	"0100"	2	
	"0200"	3	
	"0300"	4	
"C5" to "CB"	"0000" to "007F"	1	Setting data of setting area 0
	"0100" to "017F"	2	
	"0200" to "027F"	3	
	"0300" to "037F"	4	
"CC" to "D3"	"0000" to "0039"	1	Setting data of setting area 1
	"0100" to "0139"	2	
	"0200" to "0239"	3	
	"0300" to "0339"	4	

Multiple monitor values or setting data can be read by sending a single command. Up to 20 items can be read even if the addresses are not contiguous.

To specify the variable type or address, see "Appendix Setting list" (P.A-6). The upper limit of an address will vary depending on the variable type.

This command can be used in both setting area 0 and setting area 1.

If an area type error or a setting data error occurs in any of the data being read, no data will be read.



Response codes: The above indicates a normal end. For the response codes, see "6.5 Reading the variable area" (P.6-9).

■ Protect level setting data write

Command

MRC	SRC	Variable type	Address	Bit position	Number of elements	Data
"01"	"02"	"C5"		"00"	"0001"	Protect level setting data

Address	Setting data
"0000"	Operation adjustment protect
"0001"	Initial setting level protect
"0002"	Setting change protect
"0003"	PF key protect

This command writes protect level setting data. See "5.5 Protecting settings" (P.5-24) for information on protect level.

This command is used in setting area 0. An error will result if used in setting area 1.

To use this command, use the "Write via communication" operation command to enable "Write via communication", and then use the "Move to protect level" operation command to move to "Protect level".

Response

MRC	SRC	Response code
"01"	"02"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.6 Writing to the variable area" (P.6-10).

■ Setting data write (Communication/CompoWay/F)

Command

MRC	SRC	Variable type	Address	Bit position	Number of elements	Data
"01"	"02"			"00"	"0001"	Setting data

Variable type	Address	Setting data	
		Ch	Explanation
"C6" "C7" "C8" "C9" "CA" "CB"	"0000" to "007F"	1	Setting data of setting area 0 RUN level Adjustment level Adjustment level 2 Bank setting level PID setting level Approximation setting level
	"0100" to "017F"	2	
	"0200" to "027F"	3	
	"0300" to "037F"	4	
"CC" "CD" "CE" "CF" "D0" "D1" "D2" "D3"	"0000" to "0039"	1	Setting data of setting area 1 Input initial setting level Control initial setting level Control initial setting 2 level Alarm setting level Display adjustment level Communications setting level Special function setting level Expansion control setting level
	"0100" to "0139"	2	
	"0200" to "0239"	3	
	"0300" to "0339"	4	

The above setting data is written. The number of elements can be set from 2 to 24 to write setting data of contiguous addresses.

To specify an address, see "Appendix Setting list" (P.A-6).

Setting data of setting area 1 can be written in setting area 1. An error will result if written in setting area 0.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

To store setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, or Approximation setting levels in non-volatile memory, select "Backup" with the "Write mode" command. If not set to "Backup", the setting data will not remain in memory when the power is turned off. For more information on the above levels, see "4.1 Setting levels and key operation" (P.4-2).

Response

MRC	SRC	Response code
"01"	"02"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.6 Writing to the variable area" (P.6-10).

■ Setting data compound write (Communication/CompoWay/F)

Command

MRC	SRC	Variable type	Address	Bit position	Data	
"01"	"13"			"00"	Setting data	-----

	Variable type	Address	Bit position	Data
-----			"00"	Setting data

Variable type	Address	Setting data	
		Ch	Explanation
"C5" to "CB"	"0000" to "007F"	1	Setting data of setting area 0
	"0100" to "017F"	2	
	"0200" to "027F"	3	
	"0300" to "037F"	4	
"CC" to "D3"	"0000" to "0039"	1	Setting data of setting area 1
	"0100" to "0139"	2	
	"0200" to "0239"	3	
	"0300" to "0339"	4	

Multiple setting data items can be written by sending a single command. Up to 12 items can be written even if the addresses are not contiguous.

To specify the variable type or address, see "Appendix Setting list" (P.A-6).

Setting data of setting area 1 is written in setting area 1. An error will result if written in setting area 0.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

To store setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, or Approximation setting levels in non-volatile memory, select "Backup" with the "Write mode" command. If not set to "Backup", the setting data will not remain in memory when the power is turned off. For more information on the above levels, see "4.1 Setting levels and key operation" (P.4-2).

Response

MRC	SRC	Response code
"01"	"13"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.6 Writing to the variable area" (P.6-10).

■ Monitor value / setting data compound read store (write)

Command

MRC	SRC	Variable type	Read address	Bit position	Variable type	Read address	Bit position		Variable type	Read address	Bit position
"01"	"11"			"00"			"00"	-----			"00"

Variable type	Address	Setting data	
		Ch	Explanation
"C4"	"0000"	1	Monitor values
	"0100"	2	
	"0200"	3	
	"0300"	4	
"C5" to "CB"	"0000" to "007F"	1	Setting data of setting area 0
	"0100" to "017F"	2	
	"0200" to "027F"	3	
	"0300" to "037F"	4	
"C5" to "D3"	"0000" to "0039"	1	Setting data of setting area 1
	"0100" to "0139"	2	
	"0200" to "0239"	3	
	"0300" to "0339"	4	

This command is used to store the addresses of multiple monitor values or setting data that you wish to read.

The stored monitor values or setting data can be read by sending a single "Monitor value / setting data compound store read" command. Up to 20 items can be stored, even if the addresses are not contiguous.

To specify the variable type or address, see "Appendix Setting list" (P.A-6). The upper limit of an address will vary depending on the variable type.

This command can be used in both setting area 0 and setting area 1.

Response

MRC	SRC	Response code
"01"	"11"	"0000"

Response codes: The above indicates a normal end. For the response codes, see"6.5 Reading the variable area" (P.6-9).

■ Monitor value / setting data compound read store check (read)

Command

MRC	SRC
"01"	"12"

This is used to check the contents that were stored using "Monitor value / setting data compound read store".

Response

MRC	SRC	Response code	Variable type	Read address
"01"	"12"	"0000"	Type	

Variable type	Read address	Bit position
Type		"00"

Response codes: The above indicates a normal end. For the response codes, see "6.5 Reading the variable area" (P.6-9).

■ Monitor value / setting data compound store read

Command

MRC	SRC
"01"	"10"

This is used to read by a single command the multiple monitor values or setting data items that were stored using "Monitor value / setting data compound read store (write)".

This command can be used in both setting area 0 and setting area 1.

If an area type error or a setting data error occurs in any of the data being read, no data will be read.

Response

MRC	SRC	Response code	Variable type	Data
"01"	"10"	"0000"	Type	Monitor value / Setting data

Variable type	Data
Type	Monitor value / Setting data

Response codes: The above indicates a normal end. For the response codes, see "6.5 Reading the variable area" (P.6-9).

■ Write via communication

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"00"	

Related information	Description
"00"	Write via communication disable
"01"	Write via communication enable

This command is used to enable or disable "Write via communication". When sent it changes the set value of "Write via communication."

When write via communication is disabled, communication cannot be used to write setting data or send operation commands such as Run/ Stop.

The initial setting is "disabled".

This command can be used in both setting area 0 and setting area 1.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/ F)" (P.6-11).

■ Control Run / Control Stop

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"01"	

Related information	Description	
	Ch	Control state
"00"	1	Run
"01"		Stop
"10"	2	Run
"11"		Stop
"20"	3	Run
"21"		Stop
"30"	4	Run
"31"		Stop
"F0"	All	Run
"F1"		Stop

This is used to run or stop control.

This command can be used in both setting area 0 and setting area 1.

If "All" channels are selected, only those that are enabled will be affected by this command.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Bank change

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"02"	

Related information	Description	
	Ch	Bank No. selected
"00" to "07"	1	0 to 7
"10" to "17"	2	0 to 7
"20" to "27"	3	0 to 7
"30" to "37"	4	0 to 7
"F0" to "F7"	All	0 to 7

This command is used to change banks (there are 8 banks numbered 0 to 7). An SP, alarm values, and a PID Set No. are stored in each bank.

This command can be used in both setting area 0 and setting area 1.

- An operation error will result if AT is running in the selected channel. To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ AT execute

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"03"	

Related information	Description	
	Ch	Command
"00" to "08"	1	00: Currently selected PID Set No. 01 to 08: Specifies PID Set No. 1 to 8
"10" to "18"	2	10: Currently selected PID Set No. 11 to 18: Specifies PID Set No. 1 to 8
"20" to "28"	3	20: Currently selected PID Set No. 21 to 28: Specifies PID Set No. 1 to 8
"30" to "38"	4	30: Currently selected PID Set No. 31 to 38: Specifies PID Set No. 1 to 8
"F0" to "F8"	All	F0: Currently selected PID Set No. F1 to F8: Specifies PID Set No. 1 to 8

This command runs AT. On the E5AR/ER, the PID Set No. must be specified when running AT.

To specify the currently selected PID Set No. (the PID set currently used for operation), set the lower byte of the related information to "0".

This command is used in setting area 0. If used in setting area 1, an operation error will result. An operation error will also result in the following situations:

- "Run/Stop" of the specified channel is set to "Stop".
- "Auto / Manual" of the specified channel is set to "Manual".

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ AT cancel

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"0A"	

Related information	Description	
	Ch	Operation
"00"	1	Stops AT
"10"	2	Stops AT
"20"	3	Stops AT
"30"	4	Stops AT
"F0"	All	Stops AT

This command stops AT.

This command is used in setting area 0. If used in setting area 1, an operation error will result. An operation error will also result in the following situations:

- "Run/Stop" of the specified channel is set to "Stop".
- "Auto / Manual" of the specified channel is set to "Manual".

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Write mode

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"04"	

Related information	Description
"00"	Backup mode
"01"	RAM write mode

This command is used to select backup mode or RAM write mode.

The initial setting is backup mode.

This command can be used in both setting area 0 and setting area 1.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Write mode	Explanation
Backup mode	When communication is used to write setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, or Approximation setting level, the data is also written to internal non-volatile memory.
RAM write mode	When communication is used to write setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, or Approximation setting level, the data is not written to internal non-volatile memory. When SP tracking or PV tracking is ON and the mode is changed to remote SP mode or manual mode, the SP is not written to internal non-volatile memory. Note that when a change is made by key operation, the data is written to non-volatile memory.

When the write mode is changed from RAM write mode to Backup mode, the setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, and Approximation setting levels is written to internal non-volatile memory. Each level is explained in "4.1 Setting levels and key operation" (P.4-2).

Important

The time required for RAM backup varies depending on the number of settings that were changed in RAM backup mode. The more settings that were changed, the longer the time required. For example, if all settings in Operation, Adjustment, Adjustment 2, Bank setting, PID setting, and Approximation levels were changed, the most time would be required, which is about 2 seconds.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ RAM data store

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"05"	"00"

This writes the setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, and Approximation setting levels to internal non-volatile memory. For information on these levels, see "4.1 Setting levels and key operation" (P.4-2).

This command can be used in both setting area 0 and setting area 1.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Software reset

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"06"	"00"

A software reset causes the same operation as turning the power off and on.

This command can be used in both setting area 0 and setting area 1.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

(No response)

A response is not returned to this operation command.

■ Move to setting area 1

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"07"	"00"

Use this command to move to setting area 1.

The command is used in setting area 0. Nothing happens if the command is used in setting area 1.

If the command is used when "Initial setting protect" is set to "2 (Disable move to input initial setting level), an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Move to protect level

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"08"	"00"

Use this command to move to protect level. Protect level is explained in "5.5 Protecting settings" (P.5-24).

This command is used in setting area 0. If used in setting area 1, an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Auto / Manual

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"09"	

Related information	Description	
	Ch	Operation mode
"00"	1	Auto
"01"		Manual
"10"	2	Auto
"11"		Manual
"20"	3	Auto
"21"		Manual
"30"	4	Auto
"31"		Manual
"F0"	All	Auto
"F1"		Manual

Use this command to select auto or manual operation.

This command is used in setting area 0.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Initialize settings

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"0B"	"00"

This returns all settings to the initial settings.

This command is used in setting area 1. If used in setting area 0, an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Cancel latch

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"0C"	

Related information	Description	
	Ch	Command
"00"	1	Cancel alarm latch
"10"	2	Cancel alarm latch
"20"	3	Cancel alarm latch
"30"	4	Cancel alarm latch
"F0"	All	Cancel alarm latch

This command cancels alarm latch. The command is used when the alarm latch function is in use.

This command can be used in both setting area 0 and setting area 1.

If AT is being run in the specified channel, an operation error will result.

- To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ SP mode

Command

MRC	SRC	Instruction code	Related information
"30"	"05"	"0D"	

Related information	Description	
	Ch	Command
"00"	1	Local SP
"01"		Remote SP
"10"	2	Local SP (Cascade open)
"11"		Remote SP (Cascade closed)

Use this command to select the SP mode (Local SP / Remote SP). The command can be used when cascade control or remote SP is in use.

This command can be used in both setting area 0 and setting area 1.

- If AT is being run in the specified channel, an operation error will result.
  To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

MRC	SRC	Response code
"30"	"05"	"0000"

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

■ Read machine attributes

Command

MRC	SRC
"05"	"03"

This command reads the E5AR/ER model and communication buffer size.
The command can be used in any state of the E5AR/ER.

Response

MRC	SRC	Response code	Format	Buffer size
"05"	"03"	"0000"		"00D9"

Response codes: The above indicates a normal end. For the response codes, see"6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

Model

0	1	2	3	4	5	6	7	8	9
E	5	①	R	-	②	③			

*Bytes 7 to 9 are blank

① Size

Symbol	Size
A	A size (96 × 96 mm)
E	E size (96 × 48 mm)

② Constant / program

Symbol	Constant / program
(Blank)	Constant

③ Standard / Position proportional

Symbol	Standard / position proportional
(Blank)	Standard
P	Position proportional

Communication (CompoWay/F)

■ Controller status read (Communication/CompoWay/F)

Command

MRC	SRC
"06"	"01"

This command reads the operation status of the E5AR/ER.

The command can be used in any state of the E5AR/ER.

Response

MRC	SRC	Response code	Operation state	Related information
"06"	"01"	"0000"		

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

◆ Operation state

7	6	5	4	3	2	1	0	Bit position
0	0	0	0					
ch4		ch3		ch2		ch1		

Bit position	Operation state
00	Operating
01	Error (MV at PV error output)
10	Stopped (Including setting area 1)
11	Manual mode

The operation state of each channel is indicated using a 2-bit code.

◆ Related information

7	6	5	4	3	2	1	0	Bit position

Bit position	Status	Bit description	
		0	1
0	Blank	–	–
1	Blank	–	–
2	CT input error	Not occurred	Occurred
3	RSP input error	Not occurred	Occurred
4	Potentiometer error	Not occurred	Occurred
5	Exceeds display range	Not occurred	Occurred
6	Input error	Not occurred	Occurred
7	Blank	–	–

* OR of channels set in "Number of enabled channels".

* When the channel does not exist, is "Not occurred: 0".

* If this command is used in setting area 1, the related information is undefined.

■ Echo back test

Command

MRC	SRC	Test data
"08"	"01"	0 to 200 bytes

This command is used to perform an echo back test.

The command can be used in any state of the E5AR/ER.

Keep the test data within the following ranges depending on the communication data length.

Communication data length	Description
7 bits	ASCII code H'20 to H'7E
8 bits	ASCII code H'20 to H'7E or H'A1 to H'FE

Response

MRC	SRC	Response code	Test data
"08"	"01"	"0000"	0 ~ 200 bytes

Response codes: The above indicates a normal end. For the response codes, see "6.7 Operation commands (Communication/CompoWay/F)" (P.6-11).

6.10 Program example

■ N88Basic

This program displays the response from the E5AR/ER on the screen when command data is entered from the keyboard.

Command data from the unit number to the number of elements must be entered.

The program was created in N88BASIC.

```
1000   ’---------------------------------------------------
1010   ’PROGRAM: E5AR/ER Communication Sample Program(CompoWay/F)
1020   ’VERSION:1.00
1030   (c)Copyright OMRON Corporation 2003
1040   All Rights Reserved
1050   ’---------------------------------------------------
1060   ’
1070   ’======Communication port (PARITY=EVEN, DATA=7, STOP=2) ======"
1080   ’
1090   OPEN "COM:E73" AS #1
1100   ’
1110   *SENDDATA
1120   ’
1130   ========= Communication routine==================
1140   ’
1150   --------Communication data input----------
1160   INPUT "SEND DATA:",SEND$
1170   ’
1180   --------If no input, jump to end routine----------
1190   IF SEND$ = " " THEN *EXITSEND
1200   ’
1210   -------BCC calulation--------
1220   BCC = 0
1230   SEND$ = SEND$+CHR$(3)
1240   FOR I=1 TO LEN(SEND$)
1250      BCC = BCC XOR ASC(MID$(SEND$, I, 1))
1260   NEXT I
1270   BCC$ = CHR$(BCC)
1280   ’
1290   ------Send----------
1300   SDATA$ = CHR$(2)+SEND$+BCC$
1310   PRINT #1, SDATA$;
1320   ’
1330   ========= Receive routine ===========
1340   ’
1350   RDATA$ = " "
1360   TIMEOUT = 0
1370   *RCVLOOP
1380   -------No response detection-------
1390   TIMEOUT = TIMEOUT+1
1400   IF TIMEOUT > 2000 THEN RESP$ = "No Response":GOTO *RCVEND
1410   IF LOC(1) = 0 THEN *RCVLOOP
1420   ’
1430   -----Check for end character (if no end character, continue reading)
1440   RDATA$ = RDATA$+INPUT$(LOC(1),#1)
1450   IF LEN(RDATA$) <2 THEN *RCVLOOP
1460   IF MID$(RDATA$,LEN(RDATA$)-1,1) <> CHR$(3) THEN *RCVLOOP
1470   RESP$ = MID$(RDATA$,2,LEN(RDATA$)-2)
1480   *RCVEND
1490   ’
1500   -------Display received data-----------
1510   PRINT "RESPONSE:";RESP$
1520   GOTO *SENDDATA
1530   ’
1540   *EXITSEND
1550   =========End routine==========
1560   CLOSE #1
1570   END
```

● Operation example

Reading the present value of Unit No.01.

```
RUN↵
SEND DATA:010000101C00000000001↵
RESPONSE:010000010100000000014F
```

SEND DATA: [STX] 01 00 0 0101 C0 0000 00 0001 [ETX] [BCC]

- Number of elements
- Bit position
- Read start address
- Variable type
- MRC/SRC
- SID
- Sub-address
- Node No.

RESPONSE: [STX] 01 00 00 0101 0000 0000014F [ETX] [BCC]

- Data to be read
- Response code
- MRC/SRC
- End code
- Sub-address
- Node No.

Section 7 Communication (Modbus)

7.1 Communication method

■ Modbus communication protocol

Supplement

The communication function is used by creating a program on the host computer. As such, the explanations in this section are from the perspective of the host computer.
For example, "Read/Write" refers to the host computer reading or writing to the E5AR/ER.

This communication method is based on RTU Mode of the Modbus Protocol of Modicon Inc. (Specifications: PI-MBUS-300 Rev.J) Detailed specifications for the Modbus protocol are shown below.

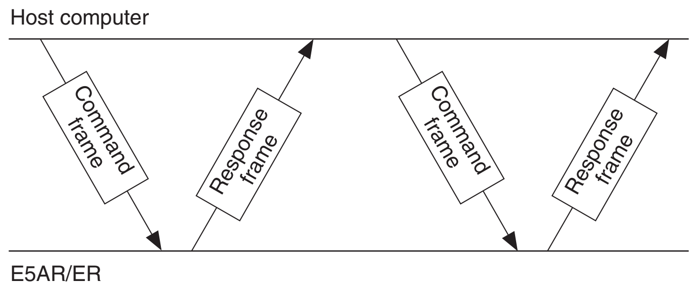
■ Communication specifications

Transfer connection:	Multi-point
Communication method:	RS-485 (2-wire half duplex)
Synchronization method:	Start-stop
Communication speed:	9.6 k/19.2 k/38.4 k bit/s
Send code:	RTU (Remote Terminal Unit)
Data length:	8 bits
Stop bit length:	Automatically set by vertical parity setting
Error detection:	Vertical parity None/Even/Odd CRC-16 (Cyclical Redundancy Check)
Flow control:	None
Interface:	RS-485
Retry function:	None

* Initial settings are shaded.

■ Transfer protocol (Communication/Modbus)

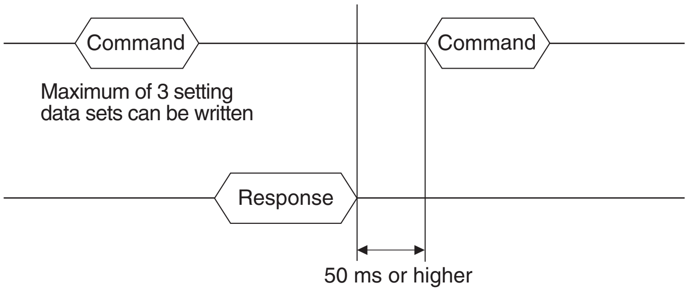
The host computer sends a command frame, and the E5AR/ER sends a response frame based on the content of the command frame. One response frame is sent in response to one command frame.



The exchange between the command frame and response frame is explained below.

After a receiving a response from the controller, have the host computer wait at least 5 ms before sending the next command.

When writing multiple sets of setting data in a row, such as when writing to the variable area or performing a compound write, controllability may be affected. Pay attention to the following points:



7.2 Frames

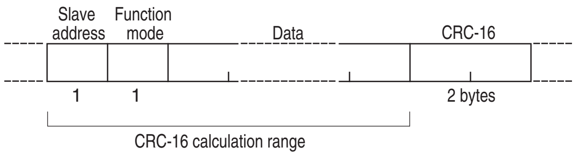
Based on the Modbus (RTU) communication protocol, commands from the host computer and responses from the E5AR/ER take the form of **frames**.

The data comprising command frames and response frames are explained below.

In the following explanation, an "H'" at the beginning of a numeric value (for example H'02) indicates that the value is a hexadecimal number. A number or letters enclosed in quotation marks (for example "00") is an ASCII character.

■ Command frame

In RTU mode each frame begins and ends with a silent time interval that is at least 3.5 characters long.



	Silent interval at least 3.5 characters long.
Client address	Specify the "Unit No." of the E5AR/ER. Set in hexadecimal from H'00 to H'63 (0 to 99). When broadcasting to all units, specify H'00. Responses are not returned to a broadcast.
Function code	The function code indicates the type of command from the host computer. The code is set in hexadecimal and is 1 byte long. For more information, see "7.3 List of functions" (P.7-7).
Data	Text of command based on the function code. Specifies variable addresses and the values of setting data (specify in hexadecimal).
CRC-16	Cyclical Redundancy Check. This is a check code calculated from the client address to the end of the data. Two bytes in hexadecimal.
	Silent interval at least 3.5 characters long.

● Example of CRC-16 calculation

Supplement

CRC-16 calculation method: As indicated at right, the value from the client address to the end of the data is calculated and the result set in CRC-16.

The following explains how a message is processed 1 byte at a time in the processing register (this is a 16-bit register called the "CRC register").

(1) Set an initial value of H'FFFF in the CRC register.

(2) Perform XOR on the CRC register and the 1st byte of the message, and return the result to the CRC register.

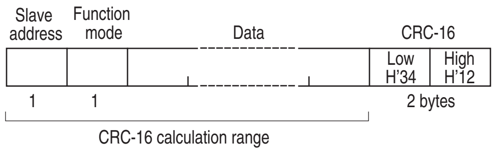
(3) Shift the contents of the CRC register 1 bit to the right, filling the MSB with "0".

(4) If the bit shifted from the LSB is "0", repeat step (3).
If the bit shifted from the LSB is "1", perform XOR on the CRC register and H'A001, and return the result to the CRC register.

(5) Repeat steps (3) and (4) until the contents of the register have been shifted 8 bits to the right.

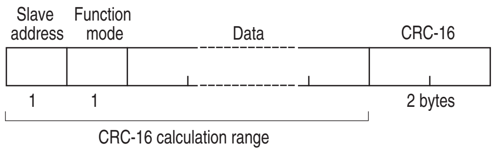
(6) If the end of the message has not been reached, perform XOR on the next byte of the CRC register and the message, return the result to the CRC register, and repeat the procedure from step (3).

(7) Append the result (the value in the CRC register) to the lower byte of the message.
Example of appending the result
If the calculated CRC value is H'1234, this is appended as follows to the command frame.

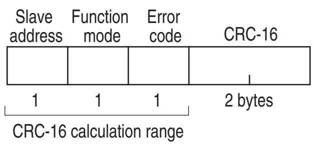


■ Response frame

● Normal response frame



● Error response frame



Client address	The number that was specified in the command frame appears here. This is the unit number of the responding E5AR/ER.
Function code	The function code that was received. In an error response frame, "H'80" is added to the value to indicate that this is an error response. Example: Received function code = H'03 Function code in error response frame = H'83
Error code	End code that indicates the error.
CRC-16	Cyclical Redundancy Check. This is a check code calculated from the client address to the end of the data. Two bytes in hexadecimal.

Error codes (Communication/Modbus)

End code	Name	Description	Error detection priority
H'01	Function code error	Received an unused function code.	1
H'02	Variable address error	The variable area number specified in the variable address is out of range.	2
H'03	Variable data error	The number of elements does not agree with the number of data items. Number of elements × 2 does not agree with the byte count. The response length exceeds the communication buffer size. The operation code or related information in an operation command is not correct. The written data exceeds the setting range.	3
H'04	Operation error	The setting information in the written data is not permitted in the current operation mode. ◆ "Write via communication" is OFF (disabled). ◆ Attempted to write to setting data of setting area 1 from setting area 0. ◆ Attempted to write to protect setting data from other than protect level. ◆ AT is running. ◆ User calibration in progress. ◆ Cannot process the operation command. ◆ Unit error, unit change, display unit error, internal non-volatile memory error.	4

● No response

In the following cases, the received command is not processed and a response is not returned. For this reason, a time-out occurs at the host device.

- The client address in the received command is different from the communication unit number set in the E5AR/ER.
- A parity error, framing error, or overrun error occurred due to a transfer or other error.
- A CRC-16 code error occurred in the received command frame.
- An time interval greater that 3.5 characters occurred between data sets while receiving the command frame.

7.3 List of functions

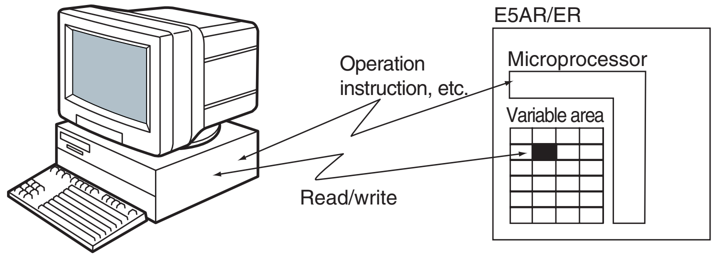
Function codes supported on the E5AR/ER are shown below.

Function codes (Communication/Modbus)

Function codes	Name	Description
03 (H'03)	Read variables (multiple)	Reads the variable area. Multiple variables that are contiguous can be read.
16 (H'10)	Write variables (multiple)	Writes to the variable area. Can write to multiple variables that are contiguous. Broadcasting is possible.
06 (H'06)	Write variable (operation command)	Writes an operation command. Broadcasting is possible.
08 (H'08)	Echo back test	Performs an echo back test.

7.4 Variable area

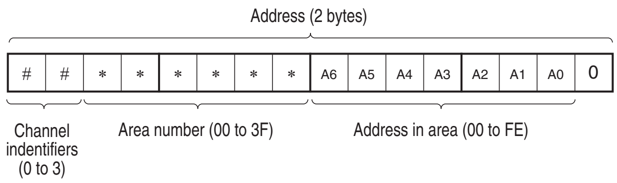
The area used for data exchange when communicating with the E5AR/ER is called the "**variable area**". The PV is read and various setting data are read and written using the variable area of the E5AR/ER. Operation commands do not use the variable area.



The variable area is accessed by specifying the position of a **variable** within the variable area using a channel identifier, area number, and in-area **address**.

● Address (Communication/ Modbus)

Each variable type has an address. Each address is two bytes long and expressed in hexadecimal. Assign addresses according to units of access size. An address consists of a channel identifier, area number, and in-area address.



Area numbers

Area numbers in the variable area are as follows:

Variable type	Description	Area
04	Communication monitor	Setting area 0 (Operation in progress)
05	Protect level	
06	RUN level	
07	Adjustment level	
08	Adjustment level 2	
09	Bank setting level	
0A	PID setting level	
0B	Approximation setting level	
0C	Input initial setting level	Setting area 1 (Operation stopped)
0D	Control initial setting level	
0E	Control initial setting 2 level	
0F	Alarm setting level	
10	Display adjustment level	
11	Communications setting level	
12	Special function setting level	
13	Expansion control setting level	

Channel identifier

For multi-point input types that require settings for channels 2 to 4, specify 1 to 3 to identify the channels.

On single-input types, only "0: Channel 1" can be specified.

Channel identifier	Channel
0	Channel 1
1	Channel 2
2	Channel 3
3	Channel 4

In-area address

This is a number that is assigned to each set of data in the variable area. Addresses are assigned in order beginning from the first set.

For more information on addresses, see the Modbus section in "Appendix Setting list" (P.A-6). Note that the addresses indicated in the variable area map are addresses of channel 1.

For example, to specify an address of channel 2 on a multi-point input type, add H'4000 to the address in the variable area map. For channel 3 add H'8000, and for channel 4 add H'C000.

● Number of elements

The number of elements is expressed as a 2-byte hexadecimal value. The specification range for the number of elements varies depending on the command. See "7.9 Commands and responses (Communication/Modbus)" (P.7-17).

For example, if the number of elements is 0010, the first 8 elements of data (H'10) from the address are specified.

In Modbus protocol one element is two bytes of data, however, setting data on the E5AR/ER is four bytes.

● Set values

Values read and written to the variable area are expressed in hexadecimal and disregard the decimal point position (negative values are expressed as a two's complement).

Example: D'105.0 → H'0000041A

The variable is an 8-digit number in hexadecimal. Negative values are expressed as a two's complement. The decimal is disregarded.

For example, if the PV of the E5AR/ER is 105.0, it will be read as H'0000041A (105.0 → 1050 → H'0000041A).

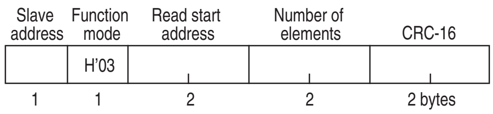
Use of the variable area on the E5AR/ER is explained in the following sections.

7.5 Reading the variable area

The variable area is read by setting the required data in the following command frame.

Command

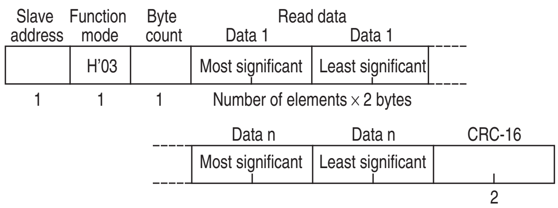
Command frame



Data name	Explanation
Client address	Specify the "Unit No." of the E5AR/ER. Set in hexadecimal from H'01 to H'63 (1 to 99).
Function code	The function code for variable area read is H'03.
First address of read	Specify the address of the setting data that you wish to read. For more information on addresses, see "Appendix Setting list" (P.A-6).
Number of elements	Specify the number of setting data items that you wish to read × 2 for the number of elements. The setting range is H'0002 to H'006A (2 to 106). Example: If the number of setting data sets is 2, specify H' 0004.
CRC-16	Check code calculated based on the value from the client address to the data end. For the calculation method, see "7.2 Frames ■ Command frame ● Example of CRC-16 calculation" (P.7-4).

Response

Response frame



Data name	Explanation
Client address	The value from the command frame appears here.
Function code	This is the received function code. In an error response frame, "H'80" is added to the received function code to indicate that it is an error response. Example: Received function code = H'03 Function code in error response frame = H'83
Byte count	Number of bytes of data that were read.
Read data	The setting data that was read.
CRC-16	This is a check code calculated from the client address to the data end. For the calculation method, see "7.2 Frames ■ Command frame ● Example of CRC-16 calculation" (P.7-4).

Response codes

Function code	Error code	Error name	Cause
H'83	H'02	Variable address error	Error in leading address of read.
	H'03	Variable data error	The number of elements exceeds the specified range.
	H'04	Operation error	Unit error, unit change, display unit error, EEP error (does not occur when number of elements is 0).
H'03	–	Normal end	No error.

◆ Reading non-display data
Setting data can be read even if it is set to non-display or is not displayed due to the model.

Command response example

Reading the PV of channel 1
(Client address: H'01)
PV of channel 1 (set as read-only data))
Address : H'0404
Data read : H'000003E8 (100.0°C)

Command: $\boxed{01}$ $\boxed{03}$ $\boxed{0404}$ $\boxed{00\ 02}$ $\boxed{(CRC\text{-}16)}$
Response: $\boxed{01}$ $\boxed{03}$ $\boxed{04}$ $\boxed{00\ 00\ 03\ E8}$ $\boxed{(CRC\text{-}16)}$

7.6 Writing to the variable area

Write to the variable area by setting the required data in the following command frame.

Command

Command frame

Slave address	Function mode	Write start address	Number of elements	Byte count	Write data Data 1	Data 1	Data n	Data n	CRC-16
	H'10				Most significant	Least significant	Most significant	Least significant	
1	1	2	2	1	Number of elements × 2 bytes				2

Data name	Explanation
Client address	Specify the "Unit No." of the E5AR/ER. Set in hexadecimal from H'01 to H'63 (1 to 99).
Function mode	The function code for variable area write is H' 10.
First address of write	Specify the address of the setting data to which you wish to write. For more information on addresses, see "Appendix Setting list" (P.A-6).
Number of elements	Specify the number of setting data items that you wish to write × 2 for the number of elements. The setting range is H'0002 to H'0068 (2 to 104). Example: When the number of setting data items is 2, specify H' 0004.
Byte count	Specify the number of bytes of data to be written.

Response

FINS-mini response text

Slave address	Function mode	Write start address	Number of elements	CRC-16
	H'10			
1	1	2	2	2

Data name	Explanation
Client address	The value from the command frame appears here.
Function mode	This is the received function code. In an error response frame, "H'80" is added to the received function code to indicate that it is an error response. Example: Received function code = H'10 Function code in error response frame = H'90
Beginning address of write	Beginning address of write that was received.
Number of elements	Received number of elements.
CRC-16	This is a check code calculated from the client address to the data end. For the calculation method, see "7.2 Frames ■ Command frame ● Example of CRC-16 calculation" (P.7-4).

Response codes

Function code	Error code	Error name	Cause
H'90	H'02	Variable address error	Error in leading variable address of write
	H'03	Variable data error	◆ Number of elements and number of data items do not agree. ◆ Number of elements × 2 does not agree with byte count. ◆ Write data exceeds the setting range.
	H'04	Operation error	The operation state does not permit writing. The settings for the write data are not permitted in the current operation mode. ◆ Write via communication is OFF (disabled). ◆ Attempted to write to setting data of setting area 1 from setting area 0. ◆ Attempted to write to protect setting data from other than protect level. ◆ AT is running. ◆ User calibration in progress. Unit error, unit change, display unit error, non-volatile memory error
H'10	–	Normal end	No error

◆ Writing non-display data
It is possible to write to setting data even if it is set to non-display or is not displayed due to the model; however, exercise caution when writing continuously.

Command/response example

Writing to "SP setting upper limit" and "SP setting lower limit" of control initial setting level of channel 1. (Client address: H'01)

SP setting upper limit of channel 1
Address : H'0D1E
Data written : H'00002710 (1000.0°C)

SP setting lower limit of channel 1
Address : H'0D20
Data written : H'FFFFFC18 (-100.0°C)

Command: 01 10 0D 1E 00 04 08 00 00 27 10 FF FF FC 18 (CRC-16)
Response: 01 10 0D 1E 00 04 (CRC-16)

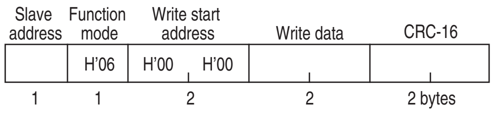
Communication (Modbus)

7.7 Operation commands (Communication/Modbus)

Operation commands are sent using the following command frame.

Command

Command frame



Data name	Explanation
Client address	Specify the "Unit No." of the E5AR/ER. Set in hexa-decimal from H'01 to H'63 (1 to 99).
Function mode	The function code for an operation command is H' 06.
Beginning address of write	Specify H' 0000 for the operation command address.
Data written	Enter the command code of the operation command and related information (see table below).
CRC-16	This is a check code calculated from the client address to the data end. For the calculation method, see "7.2 Frames ■ Command frame ● Example of CRC-16 calculation" (P.7-4).

Operation commands for the E5AR/ER are shown in the following.

Operation code	Description	Related information	
		Upper Byte	Lower Byte
H'00	Write via communication	H'0 *1	H'0: OFF (Disabled) H'1: ON (Enabled)
H'01	Run/Stop	H'0 to 3, F *2	H'0: Run H'1: Stop
H'02	Bank change	H'0 to 3, F *2	H'0 to 7: Bank 0 to 7
H'03	AT run	H'0 to 3, F *2	H'0: Currently selected PID Set No. H'1 to 8: PID Set No.
H'04	Write mode	H'0 *1	H'0: Backup mode H'1: RAM write mode
H'05	RAM data save	H'0 *1	H'0
H'06	Software reset	H'0 *1	H'0
H'07	Move to setting area 1	H'0 *1	H'0
H'08	Move to protect level	H'0 *1	H'0
H'09	Auto/Manual	H'0 to 3, F *2	H'0: Auto mode H'1: Manual mode
H'0A	AT stop	H'0 to 3, F *2	H'0: Stop
H'0B	Initialize settings	H'0 *1	H'0
H'0C	Cancel latch	H'0 to 3, F *2	H'0
H'0D	SP mode	H'0 to 3, F *2	H'0: LSP H'1: RSP

*1: Operates for all channels.
*2: Specify for each channel
0: CH1, 1: CH2, 2: CH3, 3: CH4, F: All channels
*: There is no response to a software reset.
*: When all channels are specified, only enabled channels will respond and processing will begin from Channel 1. If an error is detected on any one channel, an "Operation error" will result. If all channels end normally, "Normal end" results.

Response

Response frame

Slave address	Function mode	Write start address	Write data	CRC-16
	H'06	H'00 H'00		
1	1	2	2	2 bytes

Data name	Explanation
Client address	The value from the command frame appears here.
Function code	This is the received function code. In an error response frame, "H'80" is added to the received function code to indicate that it is an error response. Example: Received function code = H'06 Function code in error response frame = H'86
Beginning address of write	Beginning address of write that was received.
Written data	Received operation command data.
CRC-16	This is a check code calculated from the client address to the data end. For the calculation method, see "7.2 Frames ■ Command frame ● Example of CRC-16 calculation" (P.7-4).

Response codes

Function code	Error code	Error name	Cause
H'86	H'02	Variable address error	The variable address is not H'0000.
	H'03	Variable data error	Error in written data. • Incorrect command code or related information.
	H'04	Operation error	The operation state does not permit writing. • Write via communication is OFF (disabled). Note that the command is received regardless of write via communication ON/OFF. • Cannot process. See explanation of commands in "7.9 Commands and responses (Communication/Modbus)" (P.7-17). Unit error, unit change, display unit error, non-volatile memory error
H'06	–	Normal end	No error

Command/response example

Operation command to channel 2 (client address: H'01)

Channel 2 operation command
Address : H'0000
Written data: H'0111 (Stop command to channel 2)

Command: $\boxed{01}$ $\boxed{06}$ $\boxed{00\ 00}$ $\boxed{01\ 11}$ $\boxed{\text{(CRC-16)}}$
Response: $\boxed{01}$ $\boxed{06}$ $\boxed{00\ 00}$ $\boxed{01\ 11}$ $\boxed{\text{(CRC-16)}}$

7.8 Setting areas

The E5AR/ER has two setting areas for communication functions: **Setting area 0 and setting area 1**.

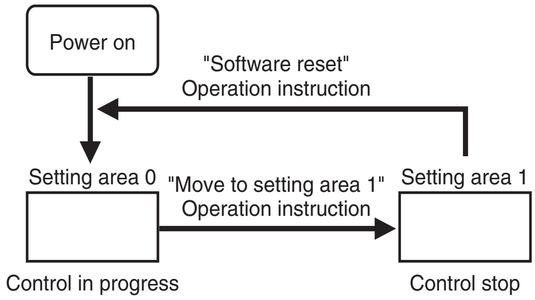
In setting area 0, control continues.

As such, setting area 0 makes it possible to perform operations that require control to be in progress, such as reading the PV, writing an SP, and run/stop, as well as operations that do not interfere with control. On the other hand, operations that may change control such as writing initial setting data cannot be performed. (Note that setting data that cannot be written can still be read.)

In setting area 1, control is stopped.

This makes it possible to perform operations such as writing initial setting data which are not possible in setting area 0.

When the power is turned on, setting area 0 is selected. To access setting area 1, use the "Move to setting area 1" operation command. To return to setting area 0 from setting area 1, turn off the power or use the "Software reset" operation command.



Description	Area
Communication monitor	Setting area 0 (During control)
Protect level	
RUN level	
Adjustment level	
Adjustment level 2	
Bank setting level	
PID setting level	
Approximation setting level	
Input initial setting level	Setting area 1 (Control stop)
Control initial setting level	
Control initial setting 2 level	
Alarm setting level	
Display adjustment level	
Communications setting level	
Special function setting level	
Expansion control setting level	

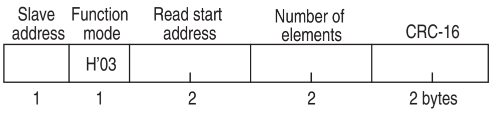
7.9 Commands and responses (Communication/Modbus)

The E5AR/ER provides a set of command frames that make use of variable area read/write commands, operation commands, and other services provided by the Modbus communication protocol.

E5AR/ER command frames are explained below.

■ Monitor value read (Communication/Modbus)

Command

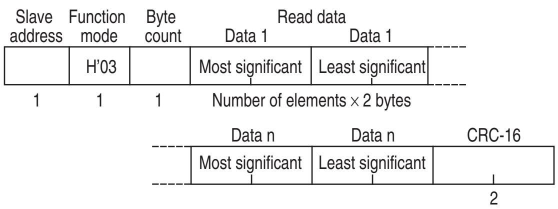


Address	Monitor value		Address	Monitor value	
	Ch	Data name		Ch	Data name
H'0400	1	Version	H'8400	3	Version
H'0402		Modification type	H'8402		Modification type
H'0404		PV	H'8404		PV
H'0406		Internal SP	H'8406		Internal SP
H'0408		Bank No. monitor	H'8408		Bank No. monitor
H'040A		PID Set No. monitor	H'840A		PID Set No. monitor
H'040C		Status	H'840C		Status
H'4400	2	Version	H'C400	4	Version
H'4402		Modification type	H'C402		Modification type
H'4404		PV	H'C404		PV
H'4406		Internal SP	H'C406		Internal SP
H'4408		Bank No. monitor	H'C408		Bank No. monitor
H'440A		PID Set No. monitor	H'C40A		PID Set No. monitor
H'440C		Status	H'C40C		Status

This command is used to read the PV, status, and other monitor values. The number of elements can be set from H'0004 to 006A (4 to 106) to allow reading of monitor values in contiguous addresses.

When used in setting area 1, the response for the PV and internal SP is "0" and the response for the status is as indicated in the notes in "Appendix Setting list Status" (P.A-8).

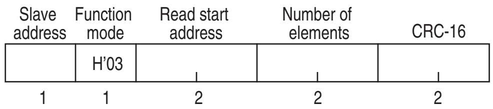
Response



The above indicates a normal end. For information on error responses, see "7.5 Reading the variable area" (P.7-10).

■ Read setting data (Communication/Modbus)

Command



Address	Explanation	
	Ch	
	1	Setting data of setting area 0
H'0600 to 060E		RUN level
H'0700 to 0744		Adjustment level
H'0800 to 0818		Adjustment level 2
H'0900 to 09DE		Bank setting level
H'0A00 to 0A8E		PID setting level
H'0B00 to 0B6E		Approximation setting level
		Setting data of setting area 1
H'0C00 to 0C20		Input initial setting level
H'0D00 to 0D26		Control initial setting level
H'0E00 to 0E60		Control initial setting 2 level
H'0F00 to 0F20		Alarm setting level
H'1000 to 100E		Display adjustment level
H'1100 to 110C		Communications setting level
H'1200 to 1218		Special function setting level
H'1300 to 1332		Expansion control setting level
H'4000 added to above addresses	2	Same setting data as channel 1
H'8000 added to above addresses	3	Same setting data as channel 1
H'C000 added to above addresses	4	Same setting data as channel 1

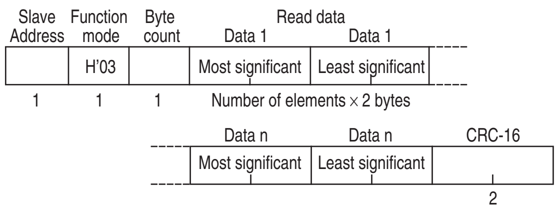
This command is used to read setting data. The number of elements can be set from H'0004 to 006A (4 to 106) to allow successive reading of 2 to 53 items of setting data in contiguous addresses.

To specify the variable type or address, see "Appendix Setting list" (P.A-6). The upper limit of an address will vary depending on the variable type.

This command can be used in both setting area 0 and setting area 1.

When used in setting area 1, the response for the remote SP monitor, ramp SP monitor, and valve opening monitor is "0" and the response for the status is as indicated in the notes in "Appendix Setting list Status" (P.A-8).

Response



The above indicates a normal end. For information on error responses, see "7.5 Reading the variable area" (P.7-10).

■ Write setting data to protect level

Command

Slave Address	Function mode	Write start address	Number of elements	Byte count	Write data	CRC-16
	H'10		H'0002	H'04		
1	1	2	2	1	4 bytes	2

Address	Setting data
H'0500	Operation adjustment protect
H'0502	Initial setting level protect
H'0504	Setting change protect
H'0506	PF key protect

This command writes setting data to Protect level. Protect level is explained in "4.1 Setting levels and key operation" (P.4-2).

This command is used in setting area 0. If used in setting area 1, an error will result.

To use this command, use the "Write via communication" operation command to enable "Write via communication", and then use the "Move to protect level" operation command to move to "Protect level".

Response

Slave address	Function mode	Write start address	Number of elements	CRC-16
	H'10			
1	1	2	2	2

The above indicates a normal end. For information on error responses, see "7.6 Writing to the variable area" (P.7-12).

■ Write setting data (Communication/Modbus)

Command

Slave address	Function mode	Write start address	Number of elements	Byte count	Write data Data 1	Data 1
	H'10				Most significant	Least significant
1	1	2	2	1	Number of elements × 2 bytes	

Data n	Data n	CRC-16
Most significant	Least significant	
		2

Address	Explanation	
	Ch	
	1	Setting data of setting area 0
H'0600 to 060E		RUN level
H'0700 to 0744		Adjustment level
H'0800 to 0818		Adjustment level 2
H'0900 to 09DE		Bank setting level
H'0A00 to 0A8E		PID setting level
H'0B00 to 0B6E		Approximation setting level
		Setting data of setting area 1
H'0C00 to 0C20		Input initial setting level
H'0D00 to 0D26		Control initial setting level
H'0E00 to 0E60		Control initial setting 2 level
H'0F00 to 0F20		Alarm setting level
H'1000 to 100E		Display adjustment level
H'1100 to 110C		Communications setting level
H'1200 to 1218		Special function setting level
H'1300 to 1332		Expansion control setting level
H'4000 added to above addresses	2	Same setting data as channel 1
H'8000 added to above addresses	3	Same setting data as channel 1
H'C000 added to above addresses	4	Same setting data as channel 1

This command is used to write setting data. The number of elements can be set from H'0004 to 0068 (4 to 104) to allow successive writing of 2 to 52 items of setting data in contiguous addresses.

To specify the variable type or address, see "Appendix Setting list" (P.A-6).

Write setting data to setting area 1 from setting area 1. If written from setting area 0, an error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

To store setting data of Operation and Adjustment setting levels in non-volatile memory, select "Backup" with the "Write mode" command. If not set to "Backup", the setting data will not remain in memory when the power is turned off. For more information on Operation and Adjustment levels, see "4.1 Setting levels and key operation" (P.4-2).

Response

Slave address	Function mode	Write start address	Number of elements	CRC-16
	H'10			
1	1	2	2	2

The above indicates a normal end. For information on error responses, see "7.6 Writing to the variable area" (P.7-12).

■ Write via communication

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'00		
1	1	2		2		2 bytes

Related information	Description
H'00	Write via communication disable
H'01	Write via communication enable

This command is used to enable or disable "Write via communication". When sent it changes the set value of "Write via communication."

When Write via communication is disabled, communication cannot be used to write setting data or send operation commands such as Run/Stop.

The initial setting is "disabled".

This command can be used in both setting area 0 and setting area 1.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'00		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Control Run / Control Stop

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'01		
1	1	2		2		2 bytes

Related information	Description	
	Ch	Control state
H'00	1	Run
H'01		Stop
H'10	2	Run
H'11		Stop
H'20	3	Run
H'21		Stop
H'30	4	Run
H'31		Stop
H'F0	All	Run
H'F1		Stop

This is used to run or stop control.

This command can be used in both setting area 0 and setting area 1.

When the control mode is set to cascade control, perform the Run/ Stop operation command of channel 2.

If "All" channels are selected, only those that are enabled will be affected by this command.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'01		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Bank change

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'02		
1	1	2		2		2 bytes

Related information	Description	
	Ch	Selected Bank No.
H'00 to 07	1	0 to 7
H'10 to 17	2	0 to 7
H'20 to 27	3	0 to 7
H'30 to 37	4	0 to 7
H'F0 to F7	All	0 to 7

This command is used to change banks (there are 8 banks numbered 0 to 7). An SP, alarm values, and a PID Set No. are stored in each bank.

This command can be used in both setting area 0 and setting area 1. An operation error will result if AT is running in the selected channel.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'02		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ AT execute

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'03		
1	1	2		2		2 bytes

Related information	Description	
	Ch	Command
H'00 to 08	1	00: Currently selected PID Set No. 01 to 08: Specifies PID Set No. 1 to 8
H'10 to 18	2	10: Currently selected PID Set No. 11 to 18: Specifies PID Set No. 1 to 8
H'20 to 28	3	20: Currently selected PID Set No. 21 to 28: Specifies PID Set No. 1 to 8
H'30 to 38	4	30: Currently selected PID Set No. 31 to 38: Specifies PID Set No. 1 to 8
H'F0 to F8	All	F0: Currently selected PID Set No. F1 to F8: Specifies PID Set No. 1 to 8

This command runs AT. On the E5AR/ER, the PID Set No. must be specified when running AT.

To specify the currently selected PID Set No. (the PID set currently used for operation), set the lower byte of the related information to "0".

This command is used in setting area 0. If used in setting area 1, an operation error will result. An operation error will also result in the following situations:

- "Run/Stop" of the specified channel is set to "Stop".
- "Auto / Manual" of the specified channel is set to "Manual".

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'03		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ AT cancel

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'0A		
1	1	2		2		2 bytes

Related information	Description	
	Ch	Command
H'00	1	AT stop
H'10	2	AT stop
H'20	3	AT stop
H'30	4	AT stop
H'F0	All	AT stop

This command stops AT.

This command is used in setting area 0. If used in setting area 1, an operation error will result. An operation error will also result in the following situations:

- "Run/Stop" of the specified channel is set to "Stop".
- "Auto / Manual" of the specified channel is set to "Manual".

To use the command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'0A		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Write mode

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'04		
1	1	2		2		2 bytes

Related information	Description
H'00	Backup mode
H'01	RAM write mode

This command is used to select backup mode or RAM write mode.

The initial setting is backup mode.

This command can be used in both setting area 0 and setting area 1.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Write mode	Explanation
Backup mode	When communication is used to write setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, or Approximation setting level, the data is also written to internal non-volatile memory.
RAM write mode	When communication is used to write setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, or Approximation setting level, the data is not written to internal non-volatile memory. When SP tracking or PV tracking is ON and the mode is changed to remote SP mode or manual mode, the SP is not written to internal non-volatile memory. Note that when a change is made by key operation, the data is written to non-volatile memory.

When the write mode is changed from RAM write mode to Backup mode, the setting data of Operation, Adjustment, Adjustment 2, Bank setting, PID setting, and Approximation setting levels is written to internal non-volatile memory. Each level is explained in "4.1 Setting levels and key operation" (P.4-2).

Important

The time required for RAM backup varies depending on the number of settings that were changed in RAM backup mode. The more settings that were changed, the longer the time required. For example, if all settings in Operation, Adjustment, Adjustment 2, Bank setting, PID setting, and Approximation levels were changed, the most time would be required, which is about 2 seconds.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'04		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ RAM data store

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'05	H'00	
1	1	2		2		2 bytes

This writes the setting data of Operation and Adjustment levels to internal non-volatile memory. Operation and Adjustment levels are explained in "4.1 Setting levels and key operation" (P.4-2).

This command can be used in both setting area 0 and setting area 1.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'05	H'00	
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Software reset

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'06	H'00	
1	1	2		2		2 bytes

A software reset causes the same operation as turning the power off and on.

This command can be used in both setting area 0 and setting area 1.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

(No response)

A response is not returned to this operation command.

■ Move to setting area 1

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'07	H'00	
1	1	2		2		2 bytes

Use this command to move to setting area 1.

The command is used in setting area 0. Nothing happens if the command is used in setting area 1.

If the command is used when "Initial setting level protect" is set to "2 (Disable move to input initial setting level)", an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'07	H'00	
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Move to protect level

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'08	H'00	
1	1	2		2		2 bytes

Use this command to move to protect level. Protect level is explained in "4.1 Setting levels and key operation" (P.4-2).

This command is used in setting area 0. If used in setting area 1, an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'08	H'00	
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Auto / Manual

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'09		
1	1	2		2		2 bytes

Related information	Description	
	Ch	Operation mode
H'00	1	Auto
H'01		Manual
H'10	2	Auto
H'11		Manual
H'20	3	Auto
H'21		Manual
H'30	4	Auto
H'31		Manual
H'F0	All	Auto
H'F1		Manual

Use this command to select auto or manual operation.

This command is used in setting area 0. If used in setting area 1, an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.
When the control mode is set to cascade control, perform the Auto / Manual operation command of CH2.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'09		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Initialize settings

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'0B	H'00	
1	1	2		2		2 bytes

This returns all settings to the initial settings.

This command is used in setting area 1. If used in setting area 0, an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'0B	H'00	
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Cancel latch

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'0C		
1	1	2		2		2 bytes

Related information	Description	
	Ch	Command
H'00	1	Cancel alarm latch
H'10	2	Cancel alarm latch
H'20	3	Cancel alarm latch
H'30	4	Cancel alarm latch
H'F0	All	Cancel alarm latch

This command cancels alarm latch. The command is used when the alarm latch function is in use.

This command can be used in both setting area 0 and setting area 1.
If AT is being run in the specified channel, an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

Response

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'0C		
1	1	2		2		2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ SP mode

Command

Slave address	Function mode	Write start address		Instruction code	Related information	CRC-16
	H'06	H'00	H'00	H'0D		
1	1	2		2		2 bytes

Related information	Description	
	Ch	Command
H'00	1	Local SP
H'01		Remote SP
H'10	2	Local SP (Cascade open)
H'11		Remote SP (Cascade closed)
H'F0	All	Local SP
H'F1		Remote SP

Use this command to select the SP mode (Local SP / Remote SP). The command can be used when cascade control or remote SP is in use.

This command can be used in both setting area 0 and setting area 1.
If AT is being run in the specified channel, an operation error will result.

To use this command, "Write via communication" must be enabled using the "Write via communication" operation command.

When the control mode is set to cascade control, perform the local SP/ remote SP operation command of CH2.

Response

Slave address	Function mode	Write start address	Instruction code / Related information	CRC-16
	H'06	H'00 H'00	H'0D	
1	1	2	2	2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

■ Echo back test

Command

Slave address	Function mode	Write start address	Test data	CRC-16
	H'08	H'00 H'00		
1	1	2	2	2 bytes

This command is used to perform an echo back test.
The command can be used in any state of the E5AR/ER.
The test data can be any two bytes of hexadecimal data.

Response

Slave address	Function mode	Write start address	Test data	CRC-16
	H'08	H'00 H'00		
1	1	2	2	2 bytes

The above indicates a normal end. For information on error responses, see "7.7 Operation commands (Communication/Modbus)" (P.7-14).

Section 8 Setting data

8.1 How to use this section

● Marks used in this section

Function — Explains the meaning and function of a setting data item.

Setting — Shows the setting range and initial setting of a setting data item.

Monitor — Used for monitor values.

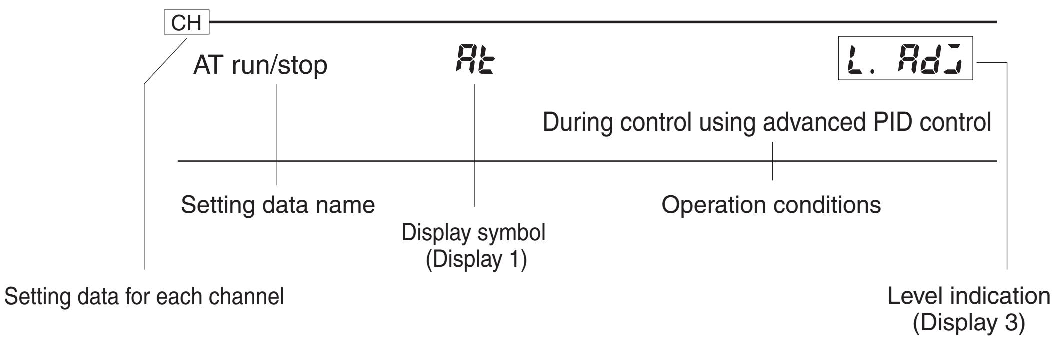
Operation — Explains a procedure for operating the E5AR/ER.

Reference — Indicates where a setting data item is explained and notes related setting data items.

● Display conditions for related setting data

A setting will only appear in the display of the E5AR/ER when the conditions of use for the setting are satisfied (conditions of use are indicated to the right of each setting in this section). Protected settings are not displayed regardless of the conditions of use, although they are in effect.

In the case of settings that can be configured separately for each channel on a multi-point input type, CH appears to upper left of each of these settings in this section.

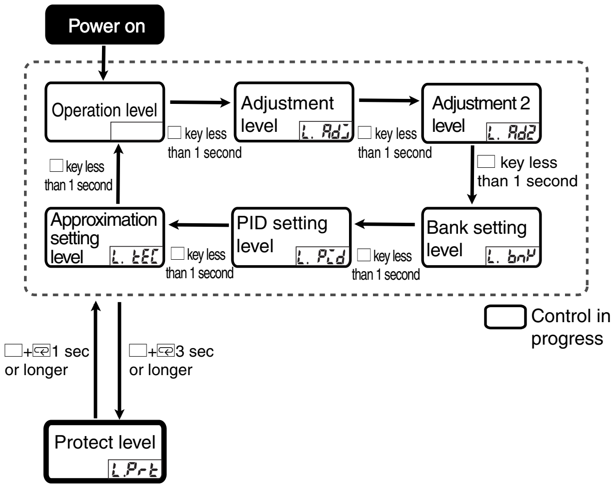


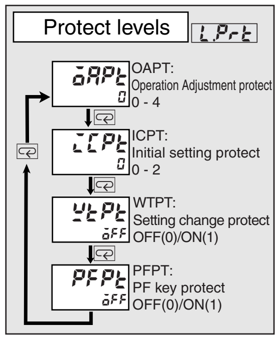
● Order of explanation of settings

Settings are explained by level.

8.2 Protect level (L.Prt)

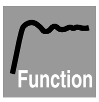
Protect level consists of four types of protection: "Operation adjustment protect", "Initial setting protect", "Setting change protect", and "PF key protect". Each is used to protect the corresponding settings and prevent accidental changes to the settings.





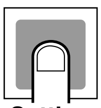
Operation adjustment protect	oAPt	L.Prt
Initial setting protect	iCPt	
Setting change protect	WtPt	
PF key protect	PFPt	

The range of setting data protected is indicated. Initial settings are shaded.



• Operation adjustment protect

Restricts key operation in the Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting, and Monitor item levels.


Setting

Setting values	Operation "PV/SP"	Operation Others	Adjustment Adjustment 2	Bank settings PID settings Approximation settings Monitor items
0	◎	◎	◎	◎
1	◎	◎	◎	×
2	◎	◎	×	×
3	◎	×	×	×
4	○	×	×	×

◎: Display/change: Yes ○: Display: Yes ×: Display/Change levels: No

When the set value is "0", protection is not enabled.

Function

• Initial setting protect

Restricts movement to the Input initial setting, Control initial setting, Control initial setting 2, Alarm setting, Display adjustment, and Communication setting level.

Setting

Setting values	Move to Input initial setting level	Move to Control initial setting, Control initial setting 2, Alarm setting, Display adjustment, and Communication setting level
0	Yes (shows "Advanced function setting level")	Yes
1	Yes (Does not show "Advanced function setting level")	Yes
2	No	No

- When "Initial setting level protect" is set to "2", nothing happens when the level key is held down for 1 second to move to Input initial setting level from Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting, or Monitor item level. (The blinking display to indicate the move does not appear.)

Function

• Setting change protect

Prevents use of the ⩓⩔ keys.

Setting

Setting value	Change settings by key operation	Remarks (exceptions)
OFF	Yes	–
ON	No	• All setting data on Protect level • "Move to special function level" • "Move to calibration level" • "Display bank selection" • "Display PID selection"

- "Setting change protect" is initially set to "OFF".

Function

• PF key protect

Prevents use of the PF1/PF2 keys.

Setting

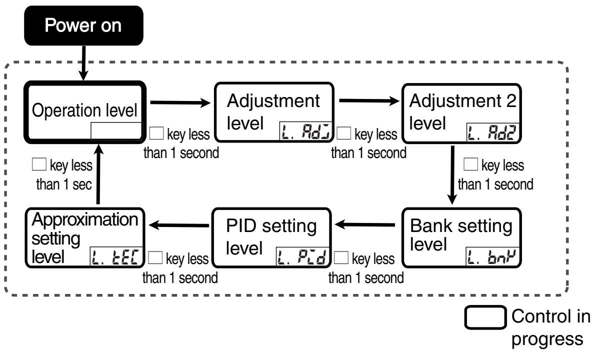
Setting value	Change settings by key operation
OFF	PF1/PF2 keys are enabled
ON	PF1/PF2 keys are disabled (operation as a function key and channel key is disabled)

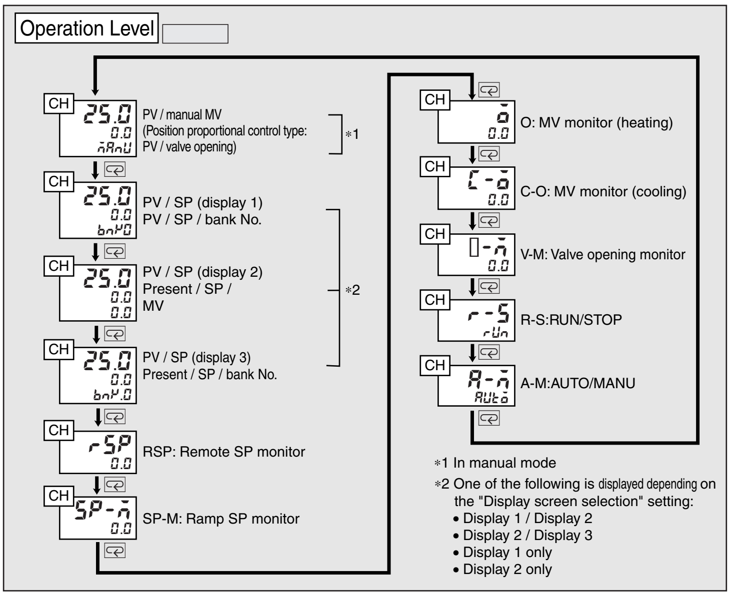
- "PF key protect" is initially set to "OFF".

Setting data

8.3 Operation level ( )

Display this level to operate the control system. The SP can be set and the PV monitored in this level.





CH

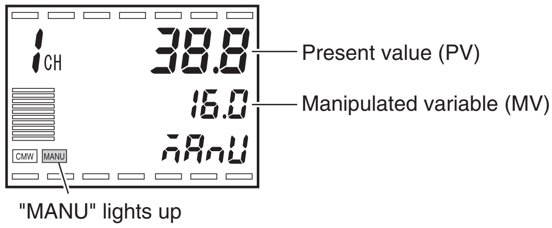
Manual MV

Manual operation

Function

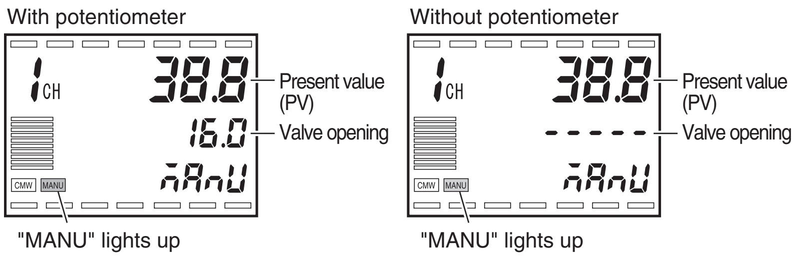
- This sets the MV or valve opening during manual operation. On a standard type the MV is changed by pressing the keys. On a position proportional type, the key turns on "open" and the key turns on "close".
- On a standard type Display 1 shows the PV and Display 2 shows the MV.

Setting data



When changed with the ⩓⩔ keys, the MV is output once every 50 ms and updated in the system.

- When a potentiometer is connected to a position proportional type, Display 1 shows the PV and Display 2 shows the valve opening. When a potentiometer is not connected to a position proportional type, Display 2 shows "- - - - -".



- In manual mode, operation is performed manually and the "MANU" indicator lights up.
- "Manual output method" is used to select the MV that is used when entering manual mode. The MV prior to entering manual mode can be held, or the manual MV default value can be used.
- Switching between manual and auto mode is accomplished with the A/M key, or with "Auto/Manual" in Operation level. If either "PF1 setting" or "PF2 setting" is set to "A-M" (A/M key), "Auto/Manual" will not appear in operation mode and only the A/M key is used for switching.
  - Switching between Auto and Manual with the A/M key
    To switch modes, hold down the A/M key for at least one second in Operation, Adjustment, Adjustment 2, Bank setting, PID setting, Approximation setting, Monitor item, or Protect level.
  - Switching between Auto and Manual with "Auto/Manual"
    To switch modes, change the setting of "Auto/Manual" in Operation level.
- During cascade control, if the primary loop is switched to manual control when the secondary loop is in any of the following conditions, the manual MV is disabled.

  •The SP mode of the secondary loop is local (cascade open).

  •The secondary loop is in manual mode.

  •"Operation at error" is taking place in the secondary loop.

Setting

• Standard type

Control method	Setting range	Units	Default value
Standard	-5.0 to 105.0	%	*1
Heating/cooling	-105.0 to 105.0	%	*1

*1 "Manual output method" (Expansion control setting level) selects the MV that is used when manual mode is entered. The MV prior to entering manual mode can be held, or the manual MV default value can be used.

• Position proportional type

Control method	Monitor range	Units
Position proportional	-10.0 to 110.0	%

Reference

● Related setting data

"Auto/Manual" (Operation level) (P.8-11)
"PF1 setting", "PF2 setting" (Advanced function setting level) (P.8-68)
"Manual output method", "Manual MV default value" (Expansion control setting level) (P.8-77)

CH

PV/SP (Display 1)

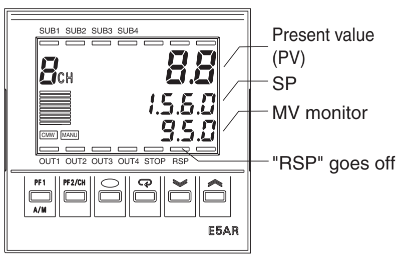
PV/SP (Display 2) MV

PV/SP (Display 3)

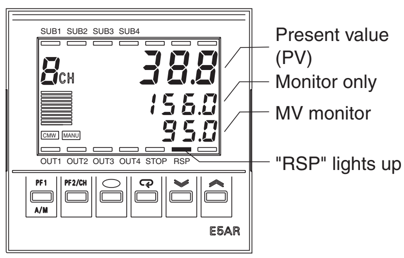
Function

- Display 1 shows the PV and Display 2 shows the SP. The SP can be set.
- Either the local SP or the remote SP is shown depending on the selected SP mode. In the case of remote SP, the value can only be monitored.

Local SP mode



Remote SP mode



- When using a bank in local SP mode, a link is created to the local SP of the selected bank. For example, if Bank 3 is selected, the local SP of Bank 3 appears in Display 2, and when the value is changed, the value of "Bank 3 local SP" (Bank setting level) also changes.

Setting data

- The decimal point position is determined by the selected sensor in the case of temperature input, and by scaling in the case of analog input. If "Display digits after PV decimal point" is set to "OFF" for temperature input, digits following the decimal point are not shown.

Setting

	Monitor range	Units
PV	"Appendix Sensor input setting ranges · Indicator (control) ranges" (P.A-4)	EU

	Setting or monitor range	Units	Default value
PV	Local SP: SP lower limit to SP upper limit	EU	0.0
	Remote SP: Remote SP lower limit to remote SP upper limit Note that the SP limits are in effect.	EU	-

At "Display 1" "Display 2", the bank number appears in Display 3.

At "Display 2", the MV appears in Display 3.

"Display screen selection" (Display adjustment level) can be used to set the display sequence to Display 1/Display 2, Display 2/Display 3, Display 1 only, or Display 2 only.

The initial setting is Display 2/Display 3; PV/SP/MV, PV/SP/Bank No.

Reference

● Related setting data

"Input * type" (Input initial setting level) (P.8-36)
"Input* temperature units" (Input initial setting level) (P.8-37)
"Scaling input value 1", "Scaling display value 1", "Scaling input value 2", "Scaling display value 2", "Decimal point position" (Input initial setting level) (P.8-37)
"Remote SP upper limit", "Remote SP lower limit" (Input initial setting level) (P.8-38)
"PV decimal point display" (Input initial setting level) (P.8-39)
"SP upper limit", "SP lower limit" (Control initial setting level) (P.8-43)
"SP mode" (Adjustment level) (P.8-14)
"PV/SP display screen selection" (Display adjustment level) (P.8-60)

CH

Remote SP monitor rSP

Local SP, control mode set to standard control with remote SP

Function

- This is used to monitor the remote SP while in local SP mode.
- In remote SP mode, the remote SP can be monitored in Display 2 of the PV/SP screen.

Monitor

Monitor range	Units
Remote SP lower limit to remote SP upper limit Note that the SP limits are in effect.	EU

Reference

● Related setting data
"PV/SP" (Operation level)(P.8-7)
"SP mode" (Adjustment level) (P.8-14)
"Remote SP ramp rise value" "Remote SP lower limit" (Input initial setting level) (P.8-38)
"Control mode" (Control initial setting level) (P.8-43)

CH

Ramp SP monitor SP-M

SP ramp rise value ≠ 0 or SP ramp fall value ≠ 0

Function

- Monitors the SP during ramp.
- The ramp function limits the rate of change of the SP.
- The setting is only displayed if a value is entered for "SP ramp rise value" or "SP ramp fall value".
- For other than ramp, the SP value is the same as in "PV/SP".

Monitor

Monitor range	Units
SP lower limit to SP upper limit	EU

Reference

● Related setting data
"PV/SP" (Operation level)(P.8-7)
"SP ramp time unit", "SP ramp rise value", "SP ramp fall value" (Adjustment level) (P.8-18)
"SP upper limit", "SP lower limit" (Control initial setting level) (P.8-43)

CH

MV monitor (heating) O

Standard control, heating/cooling control

Monitors the heating MV during operation.

Function

- Monitors the MV of standard control and the heating MV of heating/cooling control.

Monitor

Control	Monitor range	Units
Standard	-5.0 to 105.0	%
Heating/ cooling	0.0 to 105.0	%

Setting data

CH

MV monitor (cooling) C-o

Control mode is heating/cooling control

Monitors the cooling MV during operation.

Function

- Monitors the cooling MV during heating/cooling control

Monitor

Control	Monitor range	Units
Heating/ cooling	0.0 to 105.0	%

Reference

● Related setting data
"Control mode" (Control initial setting level) (P.8-43)

CH

Valve opening monitor v-M

Position proportional type

Monitors the amount of valve opening during operation.

Function

- Monitors the amount of valve opening during position proportional control.
- A potentiometer can be connected and "Motor calibration" can be executed to monitor the amount of valve opening.

Monitor

Control	Monitor range	Units
Position propor-tional	-10.0 to 110.0	%

Reference

● Related setting data
"Control mode" (Control initial setting level) (P.8-43)
"Motor calibration" (Control initial setting 2 level) (P.8-52)

CH

Run/Stop r-S

- Use this to run or stop control.
- The initial setting is "Run".

Press the keys to select "rUn: Run" or "StoP: Stop". When "Stop" is selected, the "STOP" indicator lights up.

● Related information
"4.12 Starting and stopping control" (P.4-27)

● Related setting data
"PF1 setting", "PF2 setting" (Advanced function setting level) (P.8-68)

CH

Auto/Manual A-M

"PF1 setting" ≠ Auto/Manual
and
"PF2 setting" ≠ Auto/Manual

- Use to select Auto or Manual.
- The initial setting is "AUto".

Press the keys to select "AUto: Auto" for Auto mode, or "MAnU: Manual" for Manual mode. When Manual mode is selected, the "MANU" indicator lights up.

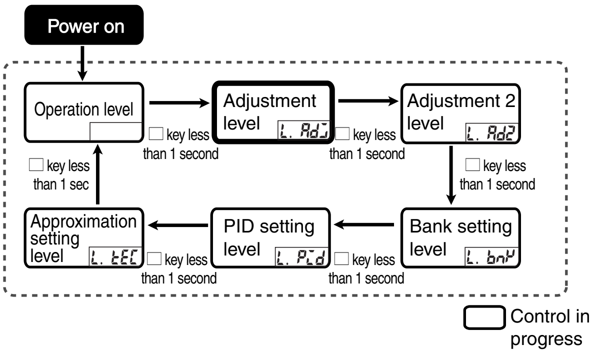
- This setting does not appear if either "PF1 setting" or "PF2 setting" is set to Auto/Manual. "PF1 setting" is initially set to Auto/Manual to enable use of the A/M key, and thus the setting does not appear.

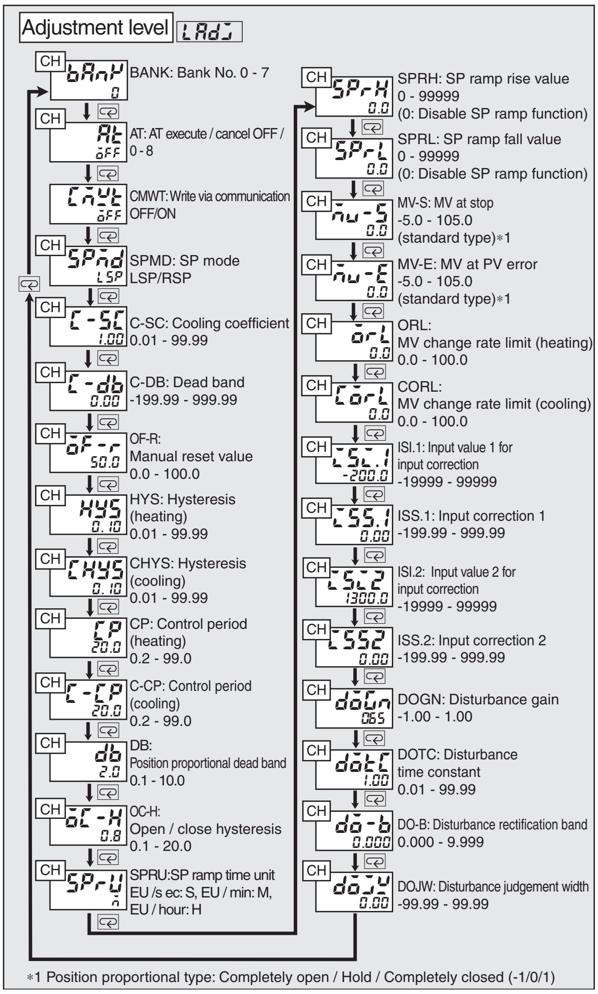
● Related information
"4.13 Performing manual control" (P.4-29)

● Related setting data
"PF1 setting", "PF2 setting" (Advanced setting level) (P.8-68)

8.4 Adjustment level (L.ADJ)

This level contains settings for the purpose of adjusting control, such as change bank No., AT (Auto-tuning), enable/disable write via communication, hysteresis adjustment, input shift settings, and SP ramp settings.





CH

Bank No. bAnK L.Adj

Function

- This setting is used to specify a bank (one of Bank Nos. 0 through 7). Each bank contains an SP (local SP), alarm value, and PID set number, and these settings are stored using the bank function in Bank setting level. A bank can be specified by event input, key operation, or communication.
- This setting is used to specify a bank by key operation.

Operation

Use the ▲▼ keys to specify a bank No..

The initial setting is "Currently used bank No.".

Reference

● Related setting data
"Bank ∗ Local SP" (Bank setting level) (P.8-27)
"Event input ∗ Assignment" (Control initial setting 2 level) (P.8-47)

CH

AT Execute/Cancel At L.Adj

In auto mode, running

This is used to run AT (Auto-tuning)

Function

- The MV is increased and decreased around the SP to obtain the characteristics of the object of control. The PID values are calculated from the results and the "Proportional band", Integral time", and "Derivative time" are automatically set.

Operation

- Normally this is "oFF". AT can be run by pressing the ▲ key to select the PID set number. AT cannot be run while control is stopped.
- Select "0" to specify the PID set currently used for control. Select a number from 1 to 8 to specify a PID set number.
- AT automatically returns to "oFF" when finished.
- The SP blinks if "PV/SP" are monitored during AT.
- The channel cannot be changed during AT.

Reference

● Related setting data
"PID ∗ Proportional band", "PID ∗ Integral time",
"PID ∗ Derivative time" (PID setting level) (P.8-31)

Write via communication CMWT L.ADJ

Models that support communication

Function

- This enables or disables the writing of setting data from a host (computer) to the controller.
- The initial setting is "Disabled: oFF".

Operation

Select "on" to enable or "oFF" to disable write via communication.

Reference

● Related setting data:
"Communication protocol selection"
(Communication setting level) (P.8-64)
"Communication unit No." (Communication setting level) (P.8-64)
"Communication speed" (Communication setting level) (P.8-64)
"Communication data length" (Communication setting level) (P.8-65)
"Communication stop bit" (Communication setting level) (P.8-65)
"Communication parity" (Communication setting level) (P.8-65)
"Transmission wait time" (Communication setting level) (P.8-66)

CH

SP mode SPMD L.ADJ

Control mode is standard control with remote SP, cascade control, or proportional control

Function

- Use this setting to select the SP mode.
- In local SP mode, the local SP set in the bank in the controller is used for control. In remote SP mode, the remote SP specified by an external signal (4 to 20 mA, etc.) is used.

Operation

- Use the ⋀⋁ keys to select "LSP: Local SP" for local SP mode, or "rSP: Remote SP" for remote SP mode. When remote SP mode is selected, the "RSP" indicator lights up.
- When cascade control is used, cascade open (secondary loop independent control) takes place when the SP mode of channel 2 is local SP mode, and cascade closed (cascade control) takes place when the SP mode is remote SP mode.

Reference

● Related setting data
"Control mode" (Control initial setting level) (P.8-43)

Setting data

CH

Cooling coefficient   C-SC   L.AdJ

Heating/cooling control, Advanced PID control
(Proportional band ≠ 0.00)

When there is a large difference in the heating and cooling characteristics of the object and satisfactory control is not possible using the same PID constants, the heating P (proportional band) is multiplied by a coefficient for use in cooling control.

Function

The cooling P in heating/cooling control is obtained and the coefficient is set using the following equation.

Cooling P = Cooling coefficient × P (heating proportional band)

Setting

Setting range	Units	Default value
0.01 to 99.99	None	1.00

Reference

- Related information
  "3.2 Heating/cooling control of a chemical reaction device" (P.3-5)
- Related setting data
  "PID∗ Proportional band" (PID setting level) (P.8-31)

CH

Dead band   C-db   L.AdJ

Heating/cooling control

This sets an output dead band for heating/cooling control. A negative value can also be set to create an overlap band.

Function

Set an area centered on the SP where the control amount is 0 during heating/cooling control.

Setting

Setting range	Units	Default value
-19.99 to 99.99	%FS	0.00

CH

Manual reset value   oF-r   L.AdJ

Advanced PID control (Proportional band ≠ 0.00), Integral time = 0

Function

- This is used to set an MV for rectification during P and PD control to eliminate the offset.
- This setting only appears when Proportional band ≠ 0.00 and Integral time = 0.

Setting

Setting range	Units	Default value
0.0 to 100.0	%	50.0

Reference

- Related setting data
  "PID∗ Proportional band", "PID∗ Integral time ", (PID setting level) (P.8-31)

Setting data

CH

Hysteresis (heating) HYS L.ADJ

Hysteresis (cooling) CHYS ON/OFF Control (P = 0.0)

This sets the Hysteresis to enable stable operation when control is switched ON/OFF.

Function

- For standard control, "Hysteresis (heating)" is used. "Hysteresis (cooling)" cannot be used.
- For heating/cooling control, the Hysteresis can be set separately for heating and cooling. Use "Hysteresis (heating)" for heating and "Hysteresis (cooling)" for cooling.
- This setting appears when Proportional band = 0.00

Setting

Setting range	Units	Default value
0.01 to 99.99	%FS	0.10

Reference

● Related setting data
"PID* Proportional band (PID setting level) (P.8-31)"

CH

Control period (heating) CP L.ADJ

Control period (cooling) C-CP

Function

- This sets the output period. When setting this value, take controllability and product life (if the connected manipulation device is a relay) into consideration.
- "Control period (heating)" is used for standard control.
- For heating/cooling control, control periods can be set separately for heating and cooling.

Setting

Setting data	Setting range	Units	Default value
Control period (heat)	0.2 to 99.0	Sec	20.0
Control period (cooling)	0.2 to 99.0	Sec	20.0

Reference

● Related setting data
"PID* Proportional band (PID setting level) (P.8-31)"

CH

Position proportional dead band db

L.AdJ

Position proportional control type

Function

- This sets the output hold interval (the interval while switching the open output and close output ON and OFF) during position proportional control.

Setting

Data range	Units	Default value
0.1 to 10.0	%	2.0

Reference

● Related setting data

"Open/Close hysterisis" (Adjustment level) (P.8-17)

CH

Open/Close hysterisis oC-H

L.AdJ

Position proportional control type

Function

- This setting is used to add hysteresis when switching the open output and close output ON and OFF during position proportional control.

Setting

Data range	Units	Default value
0.1 to 20.0	%	0.8

Reference

● Related setting data

Position proportional dead band (Adjustment level) (P.8-17)

CH

SP ramp time unit	SPrU	L.AdJ
SP ramp rise value	SPrH	
SP ramp fall value	SPrL	

Function

- This specifies the change rate during SP ramp. The maximum allowed change per unit of time is set as the "SP ramp rise value" and "SP ramp fall value". When these are set to "0", the SP ramp function is disabled.
- The decimal point position of the SP ramp rise and fall values is determined by the selected sensor during temperature input, and by the scaling during analog input.

Setting

Setting data	Setting range	Units	Default value
SP ramp time unit	S: EU/sec, m: EU/min, H: EU/hour	–	EU/min
SP ramp rise value	0 to 99999(0: OFF)	*1	0: OFF
SP ramp fall value	0 to 99999(0: OFF)	*1	0: OFF

*1 Depends on the SP ramp time unit setting. (The initial setting is EU/min.)

Reference

● Related setting data
"Input *type" (Input initial setting level) (P.8-36)
"Scaling input value 1", "Scaling display value 1","Scaling input value 2", "Scaling display value 2", "Decimal point position" (Input initial setting level) (P.8-37)

CH

MV at stop	mu-S	L.AdJ
MV at PV error	mu-E	

Function

- On a standard type, "Manipulated variable at stop" is set to the MV when operation is stopped. On a position proportional controll type, "MV at stop" is set to the position when operation is stopped (Completely open/Hold/Completely closed).
- On a standard type, "MV at PV error" is set to the MV when an error occurs. On a position proportional control type, "MV at stop" is set to the position when an error occurs (Completely open/Hold/ Completely closed).

Setting

- Standard type

Control method	Setting range	Units	Default value
Standard	-5.0 to 105.0	%	0.0
Heating/Cooling	-105.0 to 105.0	%	0.0

A negative value is set for the cooling MV for heating/cooling control.

- Position proportional control type

Control method	Setting range	Units	Default value
Position proportional	-1: Completely closed, 0: Hold, 1: Completely open	–	0: Hold

Reference

● Related information
"4.12 Starting and stopping control" (P.4-27)

CH

MV change rate limit (heating) ōrL

MV change rate limit (cooling) CōrL

L.AdJ

Advanced PID control (Proportional band ≠ 0.00)

Function

- The MV change rate limit sets the maximum allowed change in the MV (or the opening on a position proportional control type) per second. If a change occurs in the MV that exceeds this limit, the MV will be changed at the set rate limit until the required change is attained. When set to "0.0", the function is disabled.
- For standard control, use "MV change rate limit (heating)". "MV change rate limit (cooling)" cannot be used.
- For heating/cooling control, the MV change rate limit can be set separately for heating and cooling. Use "MV change rate limit (heat)" for heating and "MV change rate limit (cooling)" for cooling.
- The MV change rate limit cannot be used in the following situations:
  - Manual mode
  - AT is running
  - During ON/OFF control (P=0.00)
  - During stop (during "Manipulated variable at stop" output)
  - During "MV at PV error" output

Setting

Setting data	Setting range	Units	Default value
MV change rate limit (heat)	0.0 to 100.0	%/sec	0.0
MV change rate limit (cooling)	0.0 to 100.0	%/sec	0.0

Reference

● Related setting data
"PID∗ Proportional band" (PID setting level) (P.8-31)
"MV change rate limit mode" (Expansion control setting level) (P.8-78)

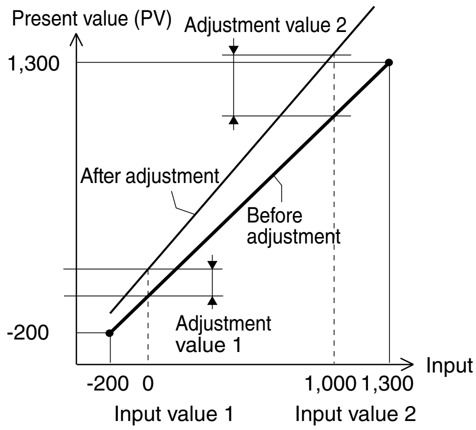
CH

Input value 1 for input correction	isc.1	l.adj
Input shift 1	iss.1	
Input value 2 for input correction	isc.2	
Input shift 2	iss.2	

Input shift can be performed at any two points.

Function

These settings are used to set input shift 1 and input shift 2 for any two points (input value 1 for input correction and input value 2 for input correction) (two-point correction).



Setting

Setting data	Setting range	Units	Default value
Input value 1 for input correction	-19999 to 99999 *1	EU	-200.0
Input shift 1	-199.99 to 999.99	EU	0.00
Input value 2 for input correction	-19999 to 99999 *1	EU	1300.0
Input shift 2	-199.99 to 999.99	EU	0.00

*1 The decimal point position will vary depending on the input type.

*2 If the input type is changed, the default values of the input value for input calibration will change to the upper and lower-limits of the input range of the sensor type being used.

Reference

● Related setting data

"Input ∗ type" (Input initial setting level) (P.8-36)

CH

Disturbance gain	doGn	L.AdJ
Disturbance time constant	dotC	
Disturbance rectification band	do-b	
Disturbance judgment width	doJY	

These settings are used to adjust overshoot to disturbances.

Function

- Disturbance gain is used to adjust the amount of overshoot caused by disturbances.

Setting

Setting data	Setting range	Units	Default value
Disturbance gain	-1.00 to 1.00	–	0.65
Disturbance time constant	0.01 to 99.99	–	1.00
Disturbance rectification band	0.000 to 9.999	%FS	0.000
Disturbance judgment width	-99.99 to 99.99	%FS	0.00

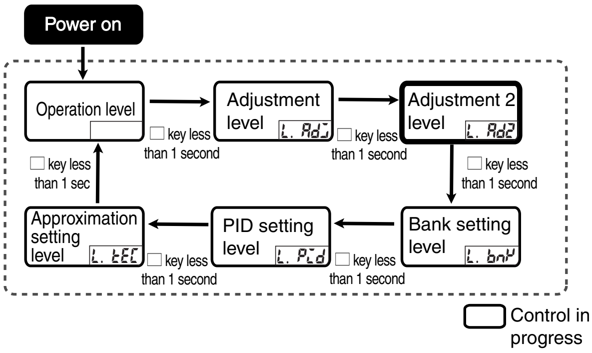
Reference

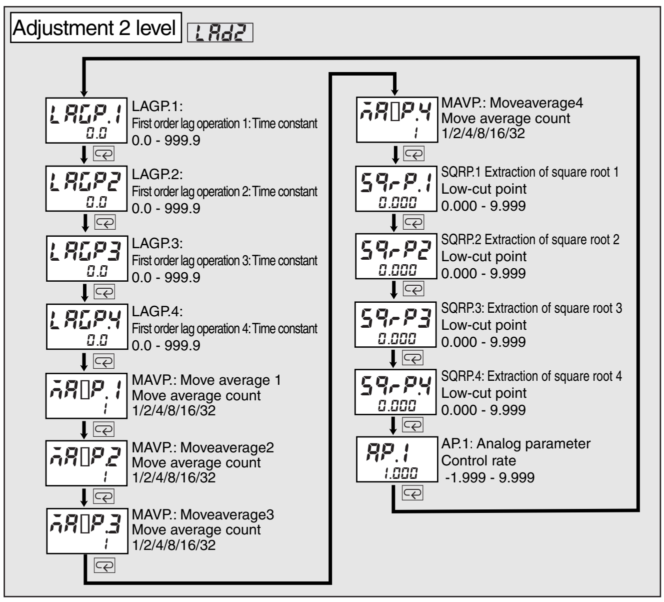
● Related setting data

"Disturbance overshoot adjustment function" (Expansion control setting level) (P.8-80)

8.5 Adjustment 2 level (L.Ad2)

Adjustment level 2 contains supplemental settings for adjustment of control such as the time constant of first order lag operation, move average count, low-cut point of extraction of square root operations, and settings for proportional control. These functions only appear in the display if they are enabled in Control initial setting 2 level.

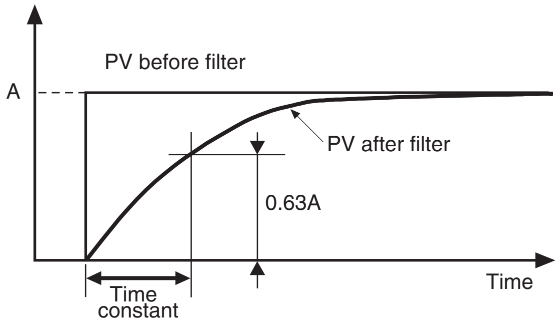




First order lag operation 1: Time constant	LAGP.1	L.Ad2
First order lag operation 2: Time constant	LAGP.2	
First order lag operation 3: Time constant	LAGP.3	
First order lag operation 4: Time constant	LAGP.4	First order lag operation * function is enabled

Function

- These settings are used to set the time constant of the first order filter of each input. Data after the first order lag filter elapses is shown below.
- The filter is used to filter out noise elements in the input.



Setting

Setting range	Units	Default value
0.0 to 999.9	Sec	0.0

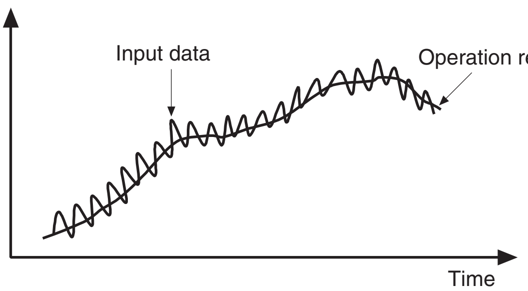
Reference

- Related information
  "5.1 Input adjustment functions ■ First order lag operation" (P.5-5)
- Related setting data
  "First order lag operation ∗ Enable" (Control initial setting 2 level) (P.8-50)

Move average 1 Move average count	mAvP.1		L.Ad2
Move average 2 Move average count	mAvP.2		
Move average 3 Move average count	mAvP.3		
Move average 4 Move average count	mAvP.4	Move average ∗ function is enabled	

Function

- These settings set the move average count for move averaging for each input. Data following the move average is shown below.



- This function is used to reduce changes in the input due to disturbances in the fluid surface when controlling fluid level.

Setting

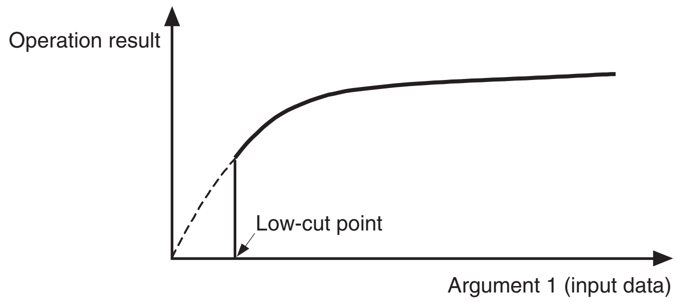
Setting range	Units	Default value
1,2,4,8,16,32	Number of times	1

- Related information
  "5.1 Input adjustment functions ■ Move average" (P.5-5)
- Related setting data
  "Move average ∗ Enable" (Control initial setting 2 level) (P.8-50)

Extraction of square root 1 Low-cut point	SQr-P.1	L.AD2
Extraction of square root 2 Low-cut point	SQr-P.2	
Extraction of square root 3 Low-cut point	SQr-P.3	Extraction of square root *
Extraction of square root 4 Low-cut point	SQr-P.4	function is enabled

Function

- These settings are used to set the low-cut point of each input. Data following extraction of square root operations are shown below.
- This function is used for extraction of square root operations for fluid sensors.



Setting

Setting range	Units	Default value
0.000 to 9.999	–	0.000

- Related information
  "5.1 Input adjustment functions ■ Extraction of square root operations" (P.5-7)
- Related setting data
  "Extraction of square root ∗ Enable" (Control initial setting 2 level) (P.8-51)

Analog parameter 1 AP.1 L.Ad2

Proportional control

Function

This sets the proportion used for proportional control.

Setting

Setting range	Units	Default value
-1.999 to 9.999	–	1.000

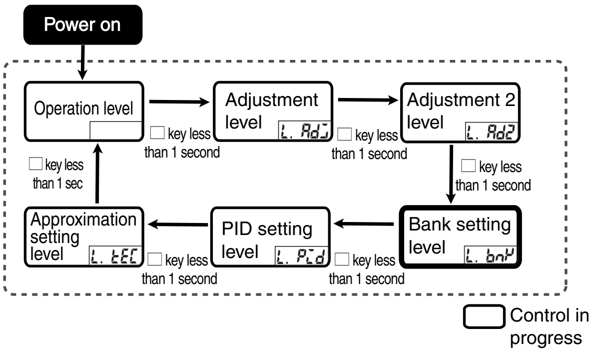
Reference

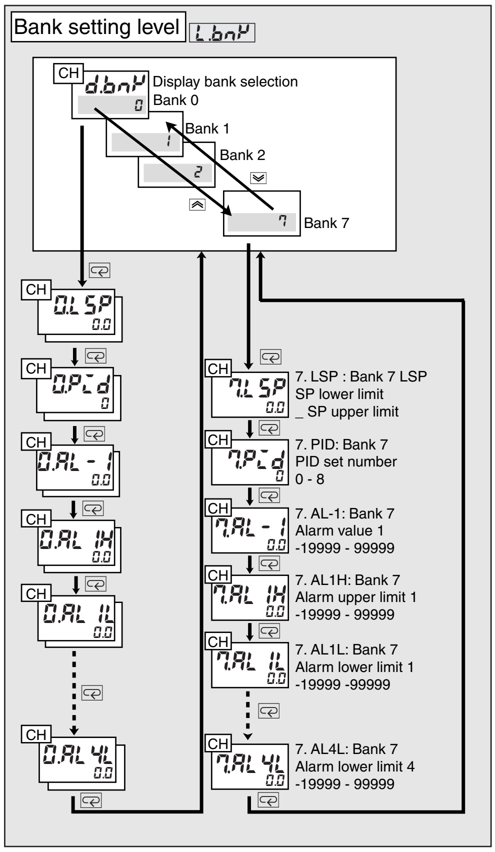
- Related information
  "3.5 Ratio control of dyeing machines" (P.3-18)
- Related setting data
  "Control mode" (Control initial setting level) (P.8-43)

Setting data

8.6 Bank setting level (L.bnK)

This level includes SP, PID set, and alarm settings for each bank. To move to a bank, use "Display bank selection" which appears at the beginning of Bank setting level.





CH

Display bank selection d.bnK L.bnK

Use this setting to select the bank that you wish to display.

Function

- Set the number of the bank that you wish to display.
- Up to 8 banks (Bank Nos. 0 to 7) can be used. An SP (local SP), alarm value, and PID Set No. are stored in each bank.

Setting

Setting data	Setting range	Units	Default value
Display bank selection	0 to 7	–	0

* Bank number selected for execution.

Reference

● Related setting data

"Bank No." (Adjustment level) (P.8-13)

CH

Bank ∗ local SP (LSP) ∗ .LSP L.bnK

(∗: 0 to 7)

Use this setting to set the SP (local SP) in each bank.

Function

- The SP of banks 0 to 7 can be set.
- When an SP is changed in "PV/SP" in Operation level, the local SP of the currently used bank is also changed.

Setting

Setting data	Setting range	Units	Default value
Local SP	SP lower limit to SP upper limit	EU	0

Reference

● Related information
"5.2 Control functions ■ Banks" (P.5-9)

● Related setting data
"PV/SP" (Operation level) (P.8-7)

CH

Bank ∗ PID Set No. ∗ .PId L.bnK

(∗: 0 to 7)

Use this setting to store a PID Set No. in each bank.

Function

- The PID Set No. of banks 0 to 7 can be stored.
- When the PID Set No. is set to "0", the PID set auto select function automatically selects a PID set based on the PV or DV (deviation). If you wish to specify a PID set, set the number of the PID set (1 to 8).

Setting

Setting data	Setting range	Units	Default value
PID Set No.	0 to 8	–	0

Reference

● Related information
"5.2 Control functions ■ Banks" (P.5-9)
"5.2 Control functions ■ PID sets" (P.5-12)

● Related setting data
"PID∗ proportional band", "PID∗ Integral time", "PID∗ derivative time" (PID setting level) (P.8-31)
"PID∗ Automatic selection range upper limit" (PID setting level) (P.8-32)
"PID set automatic selection data" (Expansion control setting level) (P.8-74)

Setting data

CH

Bank * alarm 1	*.AL-1	L.bnK
Bank * alarm 2	*.AL-2	
Bank * alarm 3	*.AL-3	
Bank * alarm 4	*.AL-4	
(*: 0 to 7)		Alarm function is enabled

Use this setting to store alarm values for alarms 1 to 4 in each bank.

Function

- Set the values of alarms 1 to 4 in each of banks 0 to 7.

Setting

Setting range	Units	Default value
-19999 to 99999	EU	0

Reference

This setting can be used when the alarm type is other than "none", "Upper- and lower-limit alarm", "Upper- and lower-limit range alarm", or "Upper- and lower-limit alarm with standby sequence".

● Related setting data
"Alarm * type" (Alarm setting level) (P.8-54)
"Alarm * latch" (Alarm setting level) (P.8-55)
"Alarm * hysteresis" (Alarm setting level) (P.8-56)
"Standby sequence restart" (Alarm setting level) (P.8-57)
"Auxiliary output * non-exciting" (Alarm setting level)(P.8-58)

Setting data

CH

Bank ∗ alarm upper limit 1	∗.AL 1H	Bank ∗ alarm lower limit 1	∗.AL 1L	L.bnK
Bank ∗ alarm upper limit 2	∗.AL 2H	Bank ∗ alarm lower limit 2	∗.AL 2L	Alarm ∗ type is upper- and lower-limit alarm
Bank ∗ alarm upper limit 3	∗.AL 3H	Bank ∗ alarm lower limit 3	∗.AL 3L	
Bank ∗ alarm upper limit 4	∗.AL 4H	Bank ∗ alarm lower limit 4	∗.AL 4L	
(∗: 0 to 7)				

If an alarm mode with upper- and lower-limit settings is selected for "Alarm 1 type" through "Alarm 4 type", the upper limit and lower limit are set separately.

Function

- Set the upper and lower-limits of alarms 1 to 4 in banks 0 to 7.
- For temperature input, the decimal point position will depend on the selected sensor. For analog input, the position is set using the "Decimal point position" setting.

Setting

Setting range	Units	Default value
-19999 to 99999	EU	0

Reference

This setting can be used when the alarm type is "Upper- and lower-limit alarm", "Upper- and lower-limit range alarm", or "Upper- and lower-limit alarm with standby sequence".

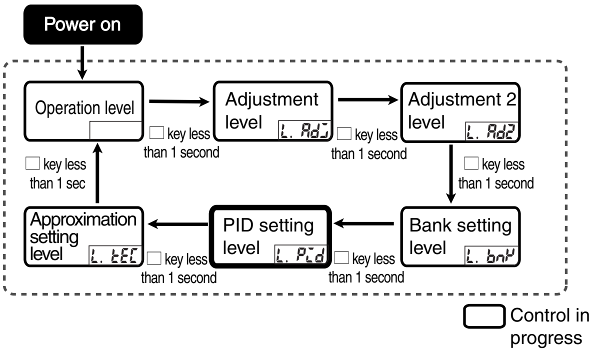
● Related setting data

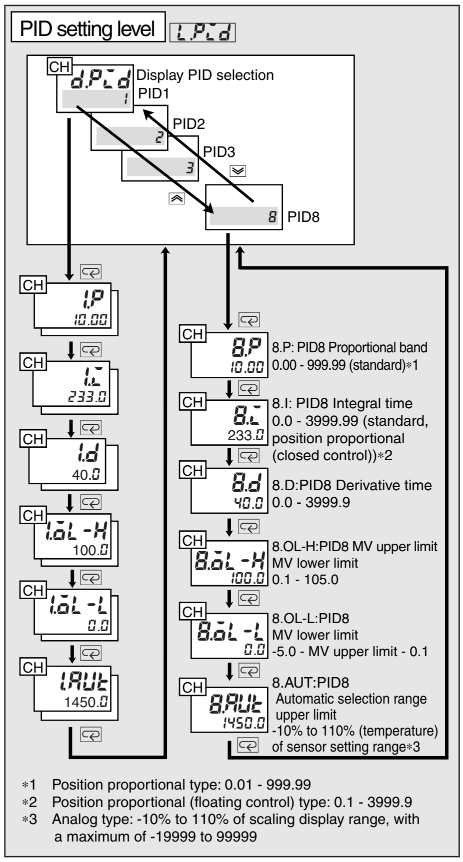
"Alarm ∗ type" (Alarm setting level) (P.8-54)
"Alarm ∗ latch" (Alarm setting level) (P.8-55)
"Alarm ∗ hysteresis" (Alarm setting level) (P.8-56)
"Standby sequence restart" (Alarm setting level) (P.8-57)
"Auxiliary output ∗ non-exciting" (Alarm setting level) (P.8-58)

Setting data

8.7 PID setting level (L.PId)

This level contains the PID value, MV limit, and alarm settings for each PID set. To move to a PID set, use the "Display PID set select" setting at the beginning of PID setting level.





CH

Display PID selection d.PId L.PId

Use this setting to select the PID set that you wish to display.

Function

- Set the number of the PID set that you wish to display.
- Up to 8 PID sets (PID Set Nos. 1 to 8) can be used. PID values, MV upper and lower limits, and automatic selection range upper limit are stored in each PID set.

Setting

Setting data	Setting range	Units	Default value
Display PID selection	1 to 8	–	*

* Selected PID set

Reference

● Related setting data

"Bank No." (Adjustment level) (P.8-13)

CH

PID* Proportional band	* .P	L.PID
PID* Integral time	* .I	
PID* Derivative time	* .D	
(*: 1 to 8)		Advanced PID control

These settings are used to store PID values in each PID set. If AT is run, the values are set automatically.

Function

P action: Control action using an MV proportional to the deviation.

I action: Control action using output that is proportional to the time integral of the deviation. P action causes an offset, and thus it is used in combination with I action. As time elapses the offset disappears and the controlled temperature and SP equalize.

D action: Control action using output that is proportional to the time derivative of the input. P action and I action serve to correct the control result and thus respond slowly to sudden temperature changes. D action corrects control by adding an MV that is proportional to the slope of the temperature change.

Setting

Setting data	Setting range	Units	Default value
Proportional band (P)	0.00 to 999.99	%FS	10.00
Integral time (I)	0.0 to 3999.9	Sec	233.0
Derivative time (D)	0.0 to 3999.9	Sec	40.0

- For ON/OFF control, set the proportional band to "0.0". "0.0" cannot be selected on a position proportional type.
- For P control or PD control, set the integral time to "0.0". "0.0" cannot be selected on a position proportional type when performing floating control or when "Operation at potentiometer error" is set to "Continue".

Reference

● Related setting data
"AT Execute/Cancel" (Adjustment level) (P.8-13)

CH

PID* MV upper limit	* .OL-H	L.PID
PID* MV lower limit	* .OL-L	
(*: 1 to 8)		Advanced PID control

Function

- Use "MV upper limit" and "MV lower limit" to set upper- and lower-limits for the MV. When the unit calculates an MV that is outside of the upper and lower limits, the upper or lower-limit is output.
- MV upper limit
  The setting range differs for standard control and heating/cooling control.
  The cooling MV of heating/cooling control is expressed as a negative value.

- MV lower limit
  The setting range differs for standard control and heating/cooling control.
  The cooling MV of heating/cooling control is expressed as a negative value.
- The MV limit function does not operate on a position proportional type during floating control, and thus the setting is not effective in this case.

Setting

Setting data	Setting range	Units	Default value
MV upper limit	Standard control: MV lower limit + 0.1 to 105.0	%	100.0
	Heating/cooling control: 0.0 to 105.0	%	100.0
MV lower limit	Standard control: -5.0 to MV upper limit - 0.1	%	0.0
	Heating/cooling control: -105.0 to 0.0	%	0.0

The following MVs take precedence over the MV limits:
- Manual MV
- Manipulated variable at stop
- MV at PV error

Reference

● Related information
"5.3 Output adjustment functions ■ MV limit" (P.5-16)

CH

PID∗ Automatic selection range upper limit ∗ .AUt L.PId

(∗: 1 to 8)

When using automatic selection of PID sets, use this setting to set an upper limit for each PID set.

Function

- Set the automatic selection range upper limit for PID Set Nos. 1 to 8.
- Note that the limit for PID Set 8 is fixed at 110% of the sensor setting range, and thus does not need to be set.
- This value is applied to the PV (present value) or DV (deviation) set in "PID set automatic selection data". The initial setting is "PV".

Setting

Setting data	Setting range	Units	Default value
Automatic selection range upper limit	-19999 to 99999	EU	1450.0

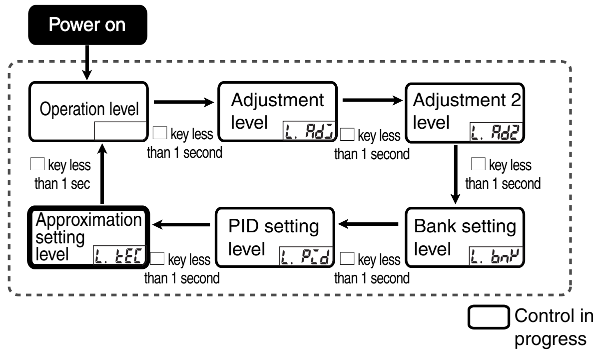
Reference

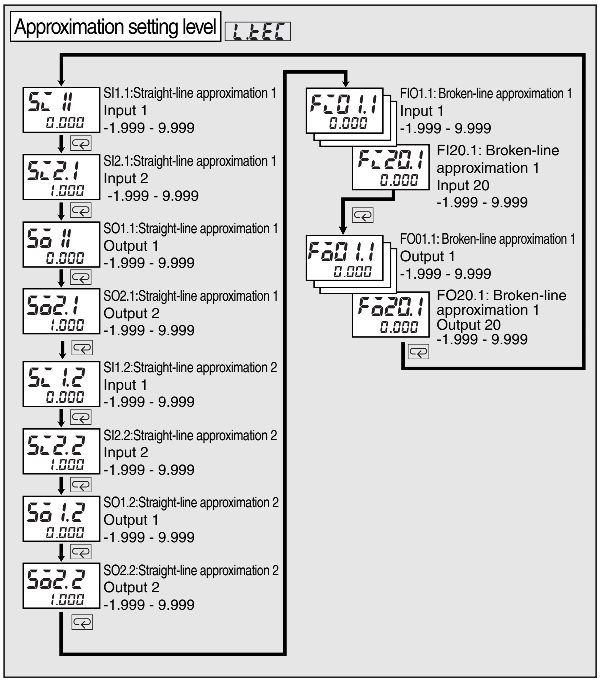
● Related information
"5.2 Control functions ■ Banks" (P.5-9)
"5.2 Control functions ■ PID sets" (P.5-12)

● Related setting data
"PID set automatic selection data" (Expansion control setting level) (P.8-74)

8.8 Approximation setting level (L.tEC)

This level contains straight-line and broken-line approximation settings. These settings only appear if enabled in Control initial setting 2 level.



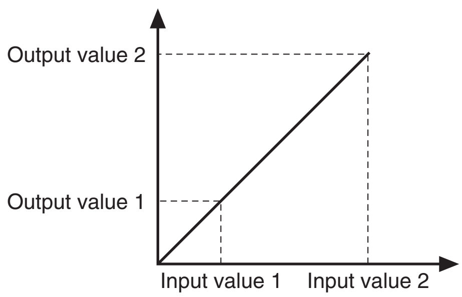


Straight-line approximation ∗ Input 1	SI 1. ∗		L.tEC
Straight-line approximation ∗ Input 2	SI2. ∗		
Straight-line approximation ∗ Output 1	SO 1. ∗		
Straight-line approximation ∗ Output 2	SO2. ∗		
(∗: 1 or 2)		Straight-line approximation ∗ is enabled	

Use these settings to configure straight-line approximation 1 and 2.

Function

- Set values for straight-line approximation. Specify two points: straight-line approximations 1 and 2. Use normalized data for the values.
- If Input 1 = Input 2, the setting will not be effective and will be regarded as straight-line approximation with input data = output data.



Setting data

Setting data	Setting range	Units	Default value
Straight-line approximation ＊ Input 1	-1.999 to 9.999	–	0.000
Straight-line approximation ＊ Input 2	-1.999 to 9.999	–	1.000
Straight-line approximation ＊ Output 1	-1.999 to 9.999	–	0.000
Straight-line approximation ＊ Output 2	-1.999 to 9.999	–	1.000

● Related setting data
"Straight-line approximation 1 enable", "Straight-line approximation 2 enable" (Control initial setting 2 level) (P.8-51)

Broken-line approximation 1 Input 1 to
Broken-line approximation 1 Input 20
FL01.1 to FL20.1

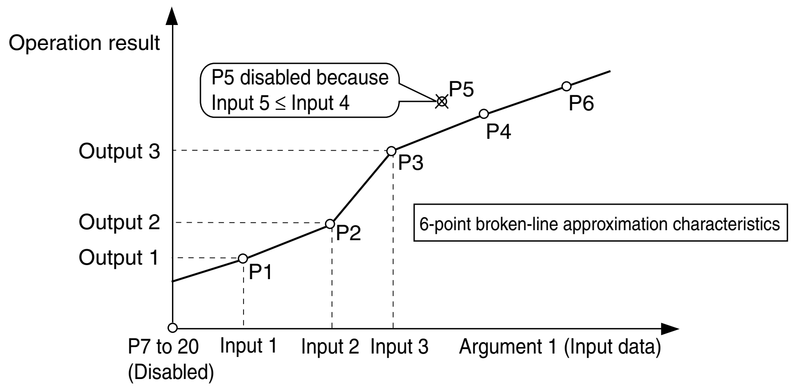
Broken-line approximation 1 Output 1 to
Broken-line approximation 1 Output 20
Fo01.1 to Fo20.1

L.tEC

Broken-line approximation ＊ is enabled

Use these settings to set values for broken-line approximation 1.

- Set values for broken-line approximation. Up to 20 points can be specified for one broken line approximation. Use normalized data for the values.
- If Input n ≥ Input n + 1, the setting of point "n + 1" will not be effective.



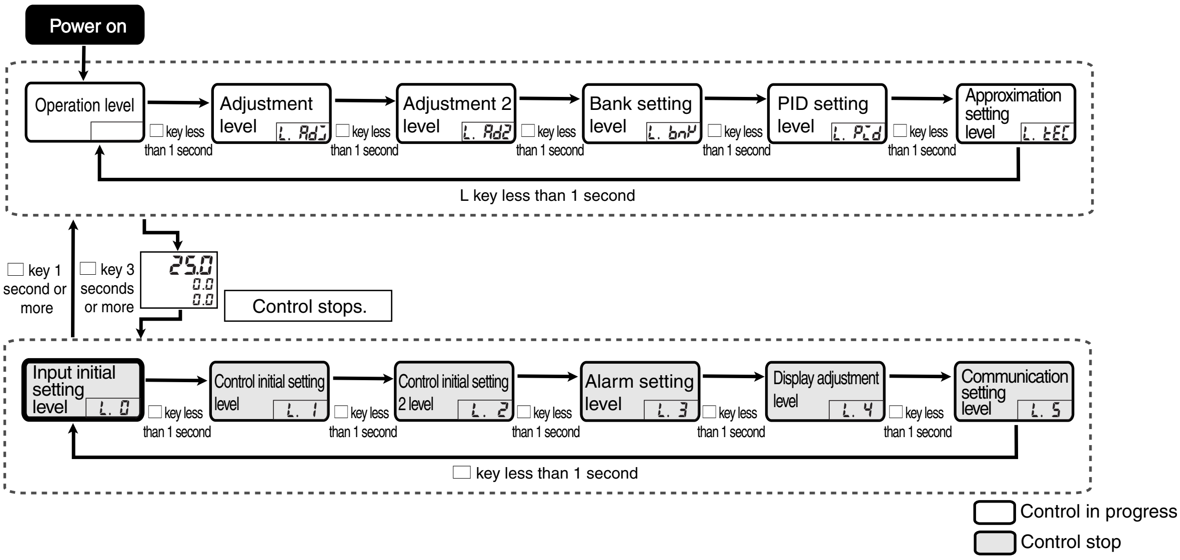
Setting data	Setting range	Units	Default value
Broken-line approximation ＊ Input 1 to Broken-line approximation ＊ Input 20	-1.999 to 9.999	–	0.000
Broken-line approximation ＊ Output 1 to Broken-line approximation ＊ Output 20	-1.999 to 9.999	–	0.000

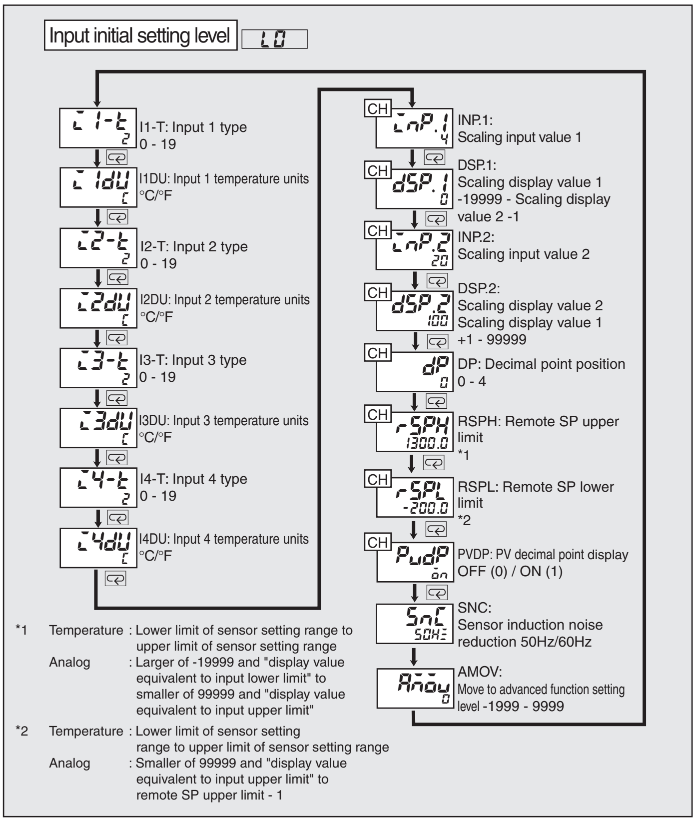
● Related information
"5.1 Input adjustment functions ■ Broken-line approximation" (P.5-6)

● Related setting data
"Broken-line approximation 1 enable" (Control initial setting 2 level) (P.8-51)

8.9 Input initial setting level (L.0)

This level contains initial settings for input, including input type, temperature units, and scaling settings.





*1 Temperature : Lower limit of sensor setting range to upper limit of sensor setting range
Analog : Larger of -19999 and "display value equivalent to input lower limit" to smaller of 99999 and "display value equivalent to input upper limit"

*2 Temperature : Lower limit of sensor setting range to upper limit of sensor setting range
Analog : Smaller of 99999 and "display value equivalent to input upper limit" to remote SP upper limit - 1

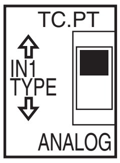
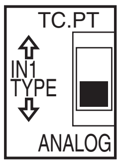
Setting data

Input 1 input type	i1-t	L.0
Input 2 input type	i2-t	
Input 3 input type	i3-t	
Input 4 input type	i4-t	

Function

- These settings are used to set the sensor type.
- If these settings are changed, the SP limit settings are returned to the initial settings. In this case, reset the "SP upper limit" and "SP lower limit" settings as necessary.
- Refer to the following table to configure the settings. Initial settings are shaded.

Setting

Setting value	Input type	Setting range		Input type switch
		(°C)	(°F)	
0	Pt100(1)	-200.0 to 850.0	-300.0 to 1500.0	TC.PT 
1	Pt100(2)	-150.00 to 150.00	-199.99 to 300.00	
2	K(1)	-200.0 to 1300.0	-300.0 to 2300.0	
3	K(2)	-20.0 to 500.0	0.0 to 900.0	
4	J(1)	-100.0 to 850.0	-100.0 to 1500.0	
5	J(2)	-20.0 to 400.0	0.0 to 750.0	
6	T	-200.0 to 400.0	-300.0 to 700.0	
7	E	0.0 to 600.0	0.0 to 1100.0	
8	L	-100.0 to 850.0	-100.0 to 1500.0	
9	U	-200.0 to 400.0	-300.0 to 700.0	
10	N	-200.0 to 1300.0	-300.0 to 2300.0	
11	R	0.0 to 1700.0	0.0 to 3000.0	
12	S	0.0 to 1700.0	0.0 to 3000.0	
13	B	100.0 to 1800.0	300.0 to 3200.0	
14	W	0.0 to 2300.0	0.0 to 4100.0	
15	4 to 20 mA	Depends on scaling One of the following ranges appears depending on the scaling: -19999 to 99999 -1999.9 to 9999.9 -199.99 to 999.99 -19.999 to 99.999 -1.9999 to 9.9999		ANALOG 
16	0 to 20 mA			
17	1 to 5V			
18	0 to 5V			
19	0 to 10V			

Set the input type switch of each input to match the "Input type" setting of the corresponding input.

The initial setting is "2". ("TC.PT")

Reference

● Related setting data
"Input ∗ temperature units" (Input initial setting level) (P.8-37)
"SP upper limit", "SP lower limit" (Control initial setting level) (P.8-43)

Setting data

Input 1 temperature units	i1dU	L.0
Input 2 temperature units	i2dU	
Input 3 temperature units	i3dU	
Input 4 temperature units	i4dU	Input type is temperature input

- Select Celsius (°C) or Fahrenheit (°F) for the temperature units.

Setting range	Units	Default value
C: °C F: °F	–	C: °C

● Related setting data
"Input ∗ Type" (Input initial setting level) (P.8-36)

CH

Scaling input value 1	inP.1	L.0
Scaling display value 1	dSP.1	
Scaling input value 2	inP.2	
Scaling display value 2	dSP.2	
Decimal point position	dP	Input type is analog input

- These settings are used when the input type is analog input.
- Scaling is carried out for analog input. The display value for "Scaling input value 1" is set in "Scaling display value 1", and the display value for "Scaling input value 2" is set in "Scaling display value 2".
- "Decimal point position" is used to specify the decimal point position of setting data (SP, etc.) for which the units are "EU".
- Scaling settings for inputs 2 to 4 of multi-point input types are set in channels 2 to 4. Press the CH key to change to the desired analog input channel and then set the scaling.

Setting data	Setting range	Units	Default value
Scaling input value 1	Input lower limit to input upper limit	∗	4
Scaling display value 1	-19999 to Scaling upper limit – 1	EU	0
Scaling input value 2	Input lower limit to input upper limit	∗	20
Scaling display value 2	Scaling lower limit + 1 to 99999	EU	100
Decimal point position	0 to 4	–	0

* The units depend on the input type settings.

● Related setting data
"Input ∗ type" (Input initial setting level) (P.8-36)

Setting data

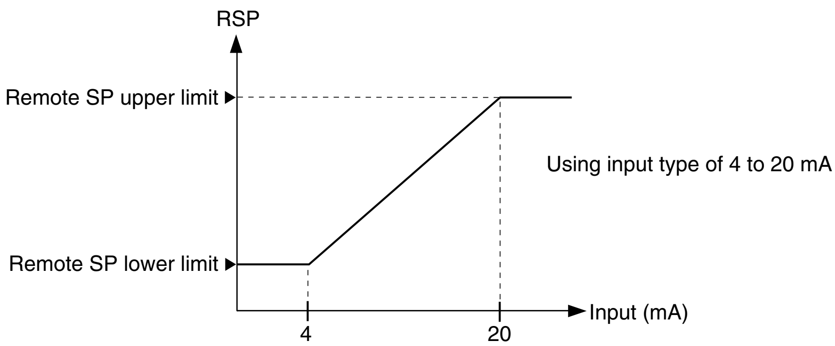
Important

The operation of E5AR/ER control functions and alarms is based on the input values. If a value greater than "inP.2: Scaling input value 2" is set for "inP.1: Scaling input value 1," operation will work in the opposite direction of the display values. The user must confirm compatibility with devices. For details, refer to "4.4 Setting the input type" (P.4-8).

Remote SP upper limit	rSPH	L.0
Remote SP lower limit	rSPL	Control with remote SP*

Function

- This sets the upper- and lower-limit of remote SP. The remote SP upper limit is set with respect to the upper input range limit of input 2, and the remote SP lower limit is set with respect to the lower input range limit of input 2. For example, if the input 2 type is 4 to 20 mA, the remote SP upper limit is set with respect to 20 mA and the remote SP lower limit is set with respect to 4 mA.
- If the input type, temperature units, and scaling of input 1 are changed, the settings are changed to the upper and lower limits of the sensor.
- The decimal point position depends on the selected sensor. For analog input, the decimal point position depends on the "Decimal point position" setting.



Note that the SP limits are in effect, and therefore if the input remote SP is above or below the SP limits, the SP will be clamped to the upper or lower limit.

* During cascade control only Ch2 is displayed.

Setting

Setting data	Setting range	Units	Default value
Remote SP upper limit	Temperature: Lower limit of sensor setting range to upper limit of sensor setting range Analog: Smaller of 99999 and "display value equivalent to upper input limit" to smaller of 99999 and "display value equivalent to upper input limit"	EU	1300.0

Setting data	Setting range	Units	Default value
Remote SP lower limit	Temperature: Lower limit of sensor setting range to upper limit of sensor setting range Analog: Larger of -19999 and "display value equivalent to input lower limit" to smaller of 99999 and "display value equivalent to upper input limit"	EU	-200.0

Reference

● Related setting data
"Input * type" (Input initial setting level) (P.8-36)
"Input * temperature units" (Input initial setting level) (P.8-37)
"Control mode" (Control initial setting level) (P.8-43)
"SP upper limit", "SP lower limit" (Control initial setting level) (P.8-43)

Note: When the input type of remote SP input is set to temperature input, be sure to set the input type of the main input to the same setting as the input type of remote SP input.
If the input type of remote SP input is set to temperature input and the upper and lower limits of remote SP are not the same as the upper and lower limits of the sensor setting range of the input type of remote SP input, it will not be possible to obtain a correct remote SP value.

CH

PV decimal point display — PudP — L.0

Temperature input

This setting can be used to not show the digits of the PV after the decimal point.

Function

- When "PV decimal point display" is turned OFF, the digits of the PV after the decimal point are not shown. When turned ON, the digits after the decimal point are shown according to the input type setting.

Setting

Setting range	Units	Default value
oFF : OFF on : ON	–	on: ON

Reference

● Related data
"Input * type" (Input initial setting level) (P.8-36)

Setting data

Sensor induction noise reduction 5nC | L.0

This function reduces induction noise from the power source in the input.

Function

- This reduces induction noise in the input according to the frequency of the power source.
- Select 50 Hz or 60 Hz as appropriate for the power source used for the controller.

Setting

Setting range	Units	Default value
50HZ: 50 Hz 60HZ: 60 Hz	–	50HZ: 50 Hz

Reference

● Related data
"Input * type" (Input initial setting level) (P.8-36)

Move to advanced function setting level Amov | L.0

"Initial setting protect" is set to "0"

This function is used to move to Advanced function setting level.

Function

- Enter a password to move to Advanced function setting level.
- The password is set to "-169". After entering "-169", press the key or wait two seconds and you will move to Advanced function setting level.

Setting

Setting range	Units	Default value
-1999 to 9999	–	0

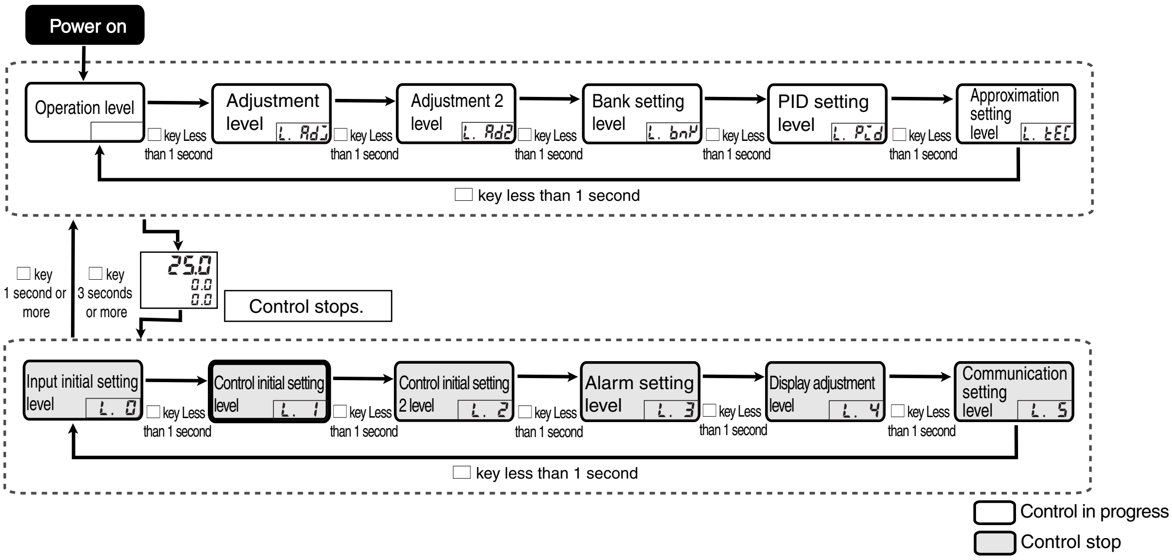
Reference

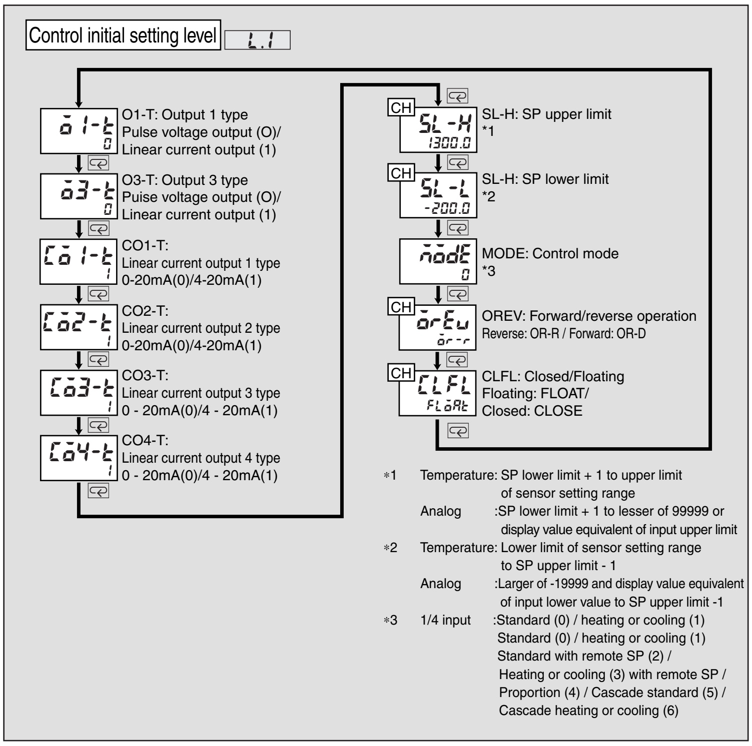
● Related setting data
"Initial setting protect (Protect level) (P.8-3)

Setting data

8.10 Control initial setting level (L. 1)

This level contains initial settings for control such as the control method, as well as the output type, SP limit, control mode, direct/reverse action, and closed/floating settings.





Setting data

Output 1 type	o1-t	L.1
Output 3 type	o3-t	Multi-output model

Use these settings to select the output type for multi-output.

Function

- Select pulse voltage output or linear current output.
- When pulse voltage output is selected, the output is 12 V DC, 40 mA.
- When linear current output is selected, use the "Linear current output type" setting to select an output of 0 to 20 mA or 4 to 20 mA.

Setting

Setting data	Setting range	Units	Default value
Output type	0: Pulse voltage output 1: Linear current output	–	0

Reference

● Related setting data

"Linear current output ∗ type" (Control initial setting level) (P.8-42)

"Control/Transfer output ∗ assignment" (Control initial setting 2 level) (P.8-46)

Linear current output ∗ 1 type	Co1-t	L.1
Linear current output ∗ 2 type	Co2-t	
Linear current output ∗ 3 type	Co3-t	
Linear current output ∗ 4 type	Co4-t	Output is current output

Use this setting to select the linear current output type.

Function

- Select 0 to 20 mA output or 4 to 20 mA output.

Setting

Setting data	Setting range	Units	Default value
Output type	0: 0 to 20 mA 1: 4 to 20 mA	–	1

Reference

● Related setting data

"Control/Transfer output ∗ assignment" (Control initial setting 2 level) (P.8-46)

CH

SP upper limit	SL-H	L.1
SP lower limit	SL-L	

Function

- Use this setting to set upper and limits for the SP setting. The SP can only be set between these limits. Note that if the limits are changed and a previously set SP falls outside of the limits due to the change, the SP will automatically change to the upper or lower limit.
- If the input type and temperature units are changed, the settings will change to the upper and lower limits of the sensor.
- The decimal point position depends on the selected sensor. In the case of analog input, the decimal point position is determined by the "Decimal point position" setting.

Setting

Setting data	Setting range	Units	Default value
SP upper limit	Temperature: SP lower limit + 1 to upper limit of input range Analog: SP lower limit + 1 to smaller of "99999" and "display value equivalent of input upper limit"	EU	1300.0
SP lower limit	Temperature: Lower limit of input range to SP upper limit – 1 Analog: Larger of "-19999" and "display value equivalent of input lower limit" to SP upper limit - 1	EU	-200.0

Reference

● Related setting data
"Input * type" (Input initial setting level) (P.8-36)
"Input * temperature units" (Input initial setting level) (P.8-37)

Setting data

Control mode	MODE	L.1

Use this setting to select the control mode.

Function

- On single-input or 4-input types, select standard control or heating/cooling control.
- On two-input types, select standard control, heating/cooling control, standard control with remote SP, heating/cooling control with remote SP, proportional control, cascade standard control, or cascade heating/cooling control.

Setting

Setting range	Units	Default value
0: Standard 1: Heating/cooling 2: Remote SP standard 3: Remote SP heating/cooling 4: Proportional 5: Cascade standard 6: Cascade heating/cooling	–	0

The setting range is 0 to 1 on a single- or 4-input type, or 0 to 6 on a 2-input type.

Reference

● Related information
"Section 3 Typical Control Examples" (P. 3-1)
"4.6 Selecting the control mode" (P.4-13)

● Related setting data
"Manual reset value" (Adjustment level) (P.8-15)
"Hysteresis (heat)", "Hysteresis (cool)" (Adjustment level) (P.8-16)
"Control/Transfer output * assignment" (Control initial setting 2 level) (P.8-46)

CH

Forward/reverse operation ōrEv L.1

Function

• When direct action is selected, the MV is increased when the PV increases. When reverse action is selected, the MV is increased when the PV decreases.

Setting

Setting range	Units	Default value
ōr-r: Reverse operation ōr-d: Direct operation	–	ōr-r: Reverse action

Reference

● Related information
"4.7 Setting output parameters ■ Direct operation (cool) / Reverse operation (heat)" (P.4-14)

CH

Closed/Floating CLFL L.1

Position proportional type

Function

• Use this setting to select the control method for a position proportional type.

Setting

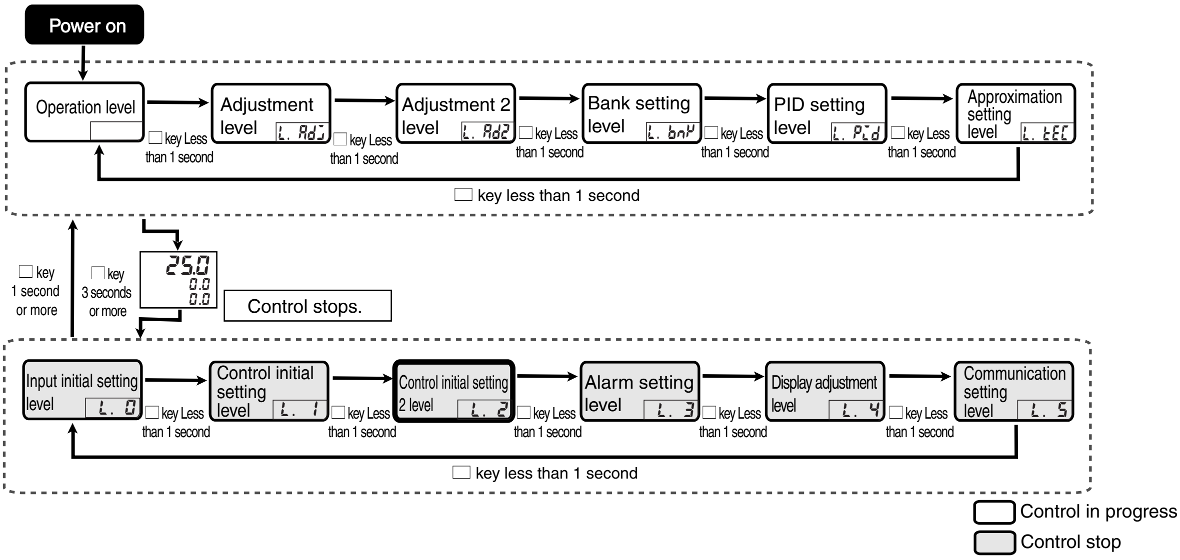
Setting range	Units	Default value
FLōAt: Floating CLōSE: Closed	–	FLōAt: Floating

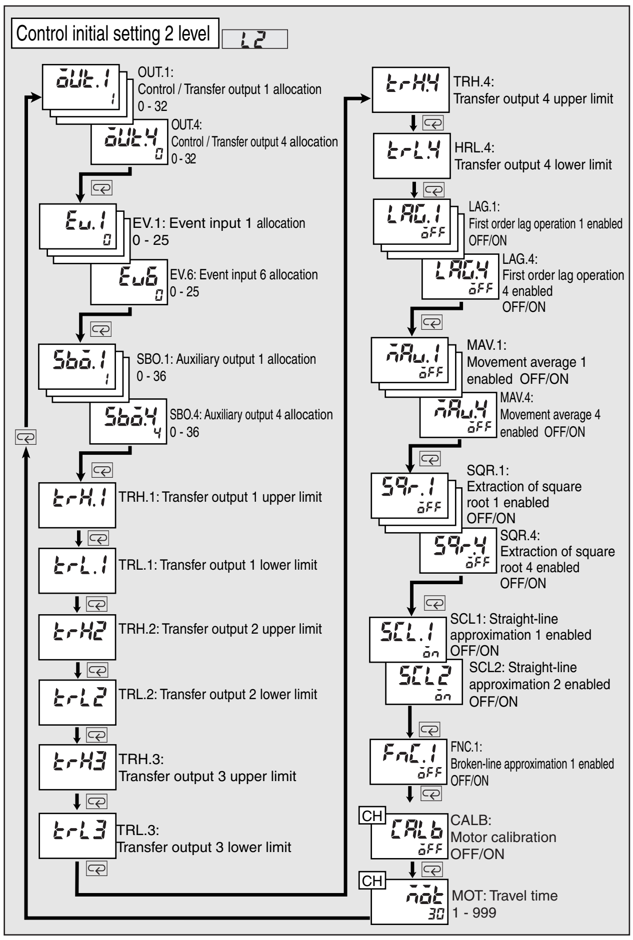
Reference

● Related information
"3.3 Position proportional control of a ceramic kiln" (P.3-9)

8.11 Control initial setting 2 level (L.2)

This level contains initial settings for computational functions, including Control/Transfer output assignment, event input assignment, auxiliary output assignment, and first order lag operation enable/ disable.





Setting data

Control/Transfer output 1 allocation	oUt.1	Control/Transfer output 3 allocation	oUt.3	L.2
Control/Transfer output 2 allocation	oUt.2	Control/Transfer output 4 allocation	oUt.4	

Function

- Use this setting to assign output content to outputs.

Setting

Setting range	Units	Default value
Disable (0) CH1 control output (heating or open) For control output (1) CH1 control output (cooling or close) For control output (2) CH1 SP (3) CH1 ramp SP (4) CH1 PV (5) CH1 control output (heating or open) For transfer output (6) CH1 control output (cooling or close) For transfer output (7) CH1 valve opening (8) CH2 control output (heating) For control output (9) CH2 control output (cooling) For control output (10) CH2 SP (11) CH2 ramp SP (12) CH2 PV (13) CH2 control output (heating) For transfer output (14) CH2 control output (cooling) For transfer output (15) Similarly, CH3 (17 to 23) CH4 (25 to 31)	–	*

* The default value is set according to the control mode setting.

If transfer output is assigned to a bank output (3 to 8 in the case of CH1), the output will be OFF.

Control mode	Input type	Control/Transfer output 1 assignment	Control/Transfer output 2 assignment	Control/Transfer output 3 assignment	Control/Transfer output 4 assignment
Standard control	1 input	1	0	0	0
	2 inputs	1	9	0	0
	4 inputs	1	9	17	25
Heating/cooling control	1 input	1	2	0	0
	2 inputs	1	2	9	10
	4 inputs	1	2	9	10
Remote SP standard control	1 input	–	–	–	–
	2 inputs	1	0	0	0
	4 inputs	–	–	–	–
Remote SP heating/ cooling control	1 input	–	–	–	–
	2 inputs	1	2	0	0
	4 inputs	–	–	–	–
Proportional control	1 input	–	–	–	–
	2 inputs	1	0	0	0
	4 inputs	–	–	–	–
Cascade standard control	1 input	–	–	–	–
	2 inputs	9	0	0	0
	4 inputs	–	–	–	–
Cascade heating/colling control	1 input	–	–	–	–
	2 inputs	9	10	0	0
	4 inputs	–	–	–	–
Position proportional control	1 input	–	–	0	0

● Related setting data
"Linear current output ∗ type" (Control initial setting level) (P.8-42)
"Output 1 output type", "Output 3 output type" (Control initial setting level) (P.8-42)

Event input 1 allocation	Ev.1	Event input 4 allocation	Ev.4	L.2
Event input 2 allocation	Ev.2	Event input 5 allocation	Ev.5	
Event input 3 allocation	Ev.3	Event input 6 allocation	Ev.6	

Function

- Use these settings to assign event input functions.

Setting

Setting range	Units	Default value
Disable (0) Write via communication OFF/ON (1) CH1 Bank No. (Bit 0) (2) CH1 Bank No. (Bit 1) (3) CH1 Bank No. (Bit 2) (4) CH1 Run/Stop (5) CH1 Auto/Manual (6) CH1 SP mode (Remote/Local) (7) CH2 Bank No. (Bit 0) (8) CH2 Bank No. (Bit 1) (9) CH2 Bank No. (Bit 2) (10) CH2 Run/Stop (11) CH2 Auto/Manual (12) CH2 SP mode (Remote/Local) (13) Similarly, CH3 (14 to 19) CH4 (20 to 25)	–	0

- If the same setting is selected for different event input assignments, the event input for which ON/OFF is determined last will be effective. Note that when the power is turned on and the same bank No. assignment is repeated, the event input with the higher number is given priority.
- SP modes (Remote/Local) of CH2 to CH4 are disabled.

Important

When the control mode is set to cascade control, assign the following CH2 operation commands:
- CH2 Run/Stop (11)
- CH2 Auto/Manual (12)
- CH2 SP mode (Remote/Local) (13) Cascade open
  Cascade open / closed

● Related information
"5.7 Using event input" (P.5-29)

Setting data

Auxiliary output 1 allocation	Sbo.1	Auxiliary output 3 allocation	Sbo.3	L.2
Auxiliary output 2 allocation	Sbo.2	Auxiliary output 4 allocation	Sbo.4	

Function

- Use these settings to assign output content to auxiliary outputs.

Setting

Setting range	Units	Default value
Disable (0) CH1 Alarm 1 (1) CH1 Alarm 2 (2) CH1 Alarm 3 (3) CH1 Alarm 4 (4) CH1 Input error (5) CH1RSP Input error (6) Disabled (7) U-ALM (8)* Alarm 1 OR output of all channels (9) Alarm 2 OR output of all channels (10) Alarm 3 OR output of all channels (11) Alarm 4 OR output of all channels (12) Input error OR output of all channels (13) RSP Input error OR output of all channels (14) Disable (15) CH2 Alarm 1 (16) CH2 Alarm 2 (17) CH2 Alarm 3 (18) CH2 Alarm 4 (19) CH2 Input error (20) CH2RSP Input error (21) Disable (22) Similarly, CH3 (23 to 29) CH4 (30 to 36)	–	1 to 4

* On a multi-point input type, assignment data can be set for channels 2 and higher as appropriate for the number of channels. U-ALM output will be OR output of alarm functions 1 to 4 of all channels.

Reference

● Related information

"4.11 Using auxiliary output" (P.4-23)

Transfer output ∗ upper limit	trH. ∗	L.2
Transfer output ∗ lower limit	trL. ∗	
(∗: 1 to 4)		Transfer output using output assignment

Function

- These settings can only be used for outputs selected for transfer output using output assignment.

Setting

Control/ Transfer output assignment data	Setting range	Default value (upper limit/ lower limit of transfer output) *1	Decimal point position	units
SP	SP lower limit to SP upper limit	1300.0/-200.0	Depends on input type	EU
Ramp SP	SP lower limit to SP upper limit	1300.0/-200.0	Depends on input type	EU
PV	Lower limit of sensor setting range to upper limit of sensor setting range (temperature)	Upper- and lower-limit of sensor setting range	Depends on input type	EU
	-19999 to 99999 (analog)	Scaling display value 2/1	Depends on input type	EU
Control output (heating or open)	Standard: -5.0 to 105.0; Heating/ cooling: 0.0 to 105.0	100.0/0.0	1	%
Control output (cooling or close)	0.0 to 105.0	100.0/0.0	1	%
Valve opening	-10.0 to 110.0	100.0/0.0	1	%

*1 Will be initialized if the input type, temperature units, scaling display value, SP upper- and lower-limit, or applicable control/transfer output assignment is changed.

Reference

● Related information

"5.8 Using transfer output" (P.5-32)

● Related setting data

"Input ∗ type" (Input initial setting level) (P.8-36)

"Control/Transfer output ∗ assignment" (Control initial setting 2 level) (P.8-46)

Setting data

First order lag operation 1 enable	LAG.1	First order lag operation 3 enable	LAG.3	L.2
First order lag operation 2 enable	LAG.2	First order lag operation 4 enable	LAG.4	

Function

- Use these settings to enable or disable first order lag operation for each input.

Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF

Reference

- Related information
  "5.1 Input adjustment functions" (P.5-2)
- Related setting data
  "First order lag operation ∗: Time constant" (Adjustment level 2) (P.8-22)

Movement average 1 enable	mAv.1	Movement average 3 enable	mAv.3	L.2
Movement average 2 enable	mAv.2	Movement average 4 enable	mAv.4	

Function

- Use these settings to enable or disable move average for each input.

Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF

Reference

- Related setting data
  "Move average ∗ Move average count" (Adjustment level 2) (P.8-23)

Extraction of square root 1 enable	Sqr.1	Extraction of square root 3 enable	Sqr.3	L.2
Extraction of square root 2 enable	Sqr.2	Extraction of square root 4 enable	Sqr.4	

Function

- Use these settings to enable or disable extraction of square root operations for each input.

Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF

Reference

● Related setting data

"Extraction of square root ∗ Low-cut point" (Adjustment level 2) (P.8-24)

Straight-line approximation 1 enable	SCL.1	L.2
Straight-line approximation 2 enable	SCL.2	Proportional control

Function

- Use these settings to enable or disable straight-line approximation.

Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF

Reference

● Related setting data

"Straight-line approximation ∗ input 1", "Straight-line approximation ∗ input 2", "Straight-line approximation ∗ output 1", "Straight-line approximation ∗ output 2" (Approximation setting level) (P.8-33)

Broken-line approximation 1 enable	FnC.1	L.2

Function

- Use this setting to enable or disable broken-line approximation for input 1.

Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF

Reference

● Related setting data
"Broken-line approximation 1 Input 1" to "Broken-line approximation 1 Input 20", "Broken-line approximation 1 Output 1" to "Broken-line approximation 1 Output 20" (Approximation setting level) (P.8-34)

CH

Motor calibration   CALb   L.2

Position proportional type

Function

- Use this setting to run motor calibration. If you are going to monitor the valve opening, be sure to execute this setting. (During execution the display cannot be changed.)
- Executing this setting also resets "Travel time".

Operation

- When this setting is accessed, the set value is "oFF".
- Select "on" to run motor calibration.
- When motor calibration ends, the setting automatically reverts to "oFF".

Reference

● Related information
"3.3 Position proportional control of a ceramic kiln ■ Settings for position proportional control" (P.3-12)

● Related parameters
"Travel time" (Control initial setting 2 level) (P.8-52)

CH

Travel time   mot   L.2

Position proportional type

Function

- Set the time from valve completely open to valve completely closed.
- This parameter is automatically set when "Motor calibration" is run.

Setting

Setting range	Units	Default value
1 to 999	Sec	30

Reference

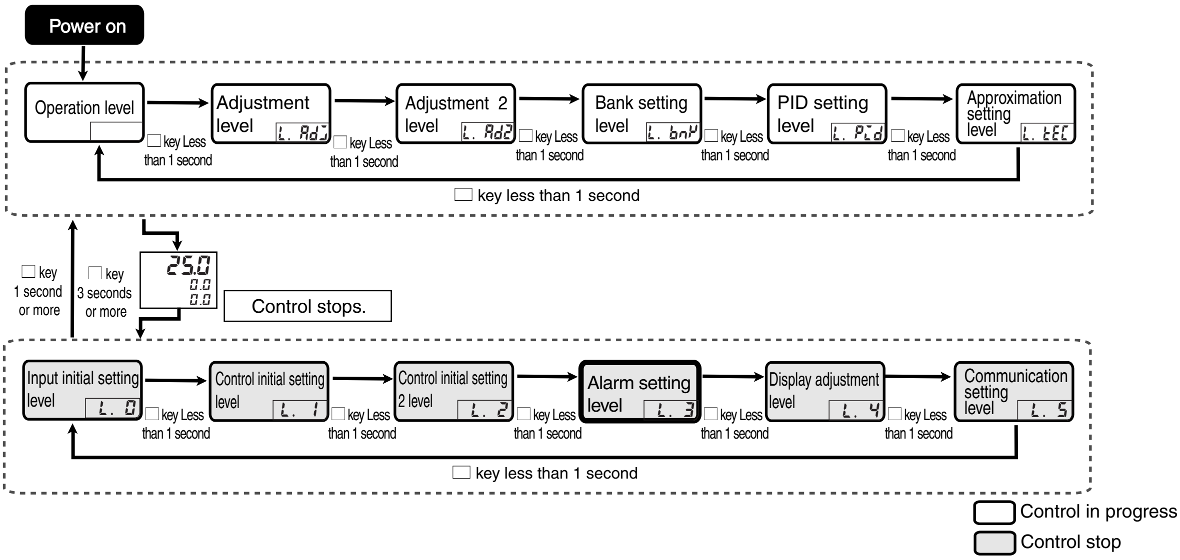
● Related information
"3.3 Position proportional control of a ceramic kiln ■ Settings for position proportional control" (P.3-12)

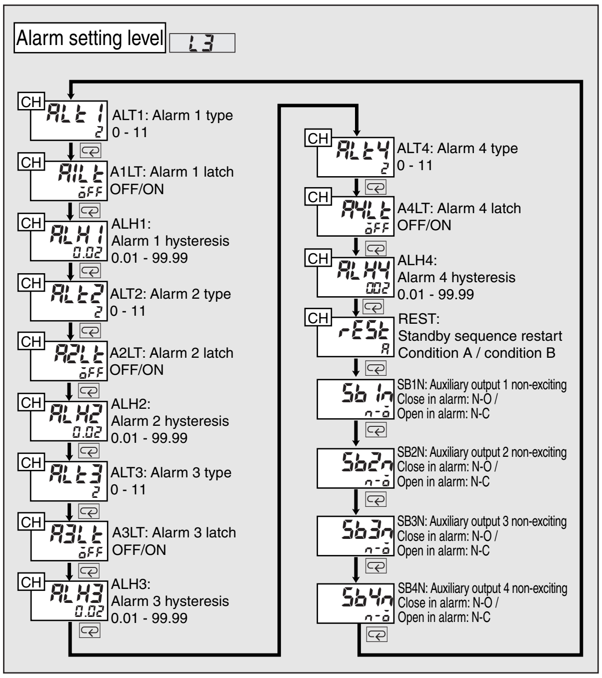
● Related parameters
"Motor calibration" (Control initial setting 2 level) (P.8-52)

Setting data

8.12 Alarm setting level (L.3)

This level contains settings for the type and output operation of alarms, including alarm type, close in alarm/open in alarm, and latch settings.





Setting data

CH

Alarm 1 type	ALt1	L.3
Alarm 2 type	ALt2	
Alarm 3 type	ALt3	
Alarm 4 type	ALt4	Alarm is assigned to auxiliary output.

Function

- These settings are used to select the type of alarms 1 through 4.

Setting

Setting data	Setting range	Units	Default value
Alarm 1 type Alarm 2 type Alarm 3 type Alarm 4 type	0: No alarm function 1: Upper- and lower-limit alarm 2: Upper limit alarm 3: Lower limit alarm 4: Upper- and lower-limit range alarm 5: Upper- and lower-limit alarm with standby sequence 6: Upper limit alarm with standby sequence 7: Lower limit alarm with standby sequence 8: Absolute-value upper-limit alarm 9: Absolute-value lower-limit alarm 10: Absolute-value upper-limit alarm with standby sequence 11: Absolute-value lower-limit alarm with standby sequence	–	2: Upper limit alarm

Reference

● Related setting data

"Bank ∗ alarm value ∗ " (Bank setting level) (P.8-28)
"Bank ∗ alarm upper limit ∗ ", "Bank ∗ alarm lower limit ∗ " (Bank setting level) (P.8-29)
"Auxiliary output ∗ assignment" (Control initial setting 2 level) (P.8-48)
"Alarm ∗ latch" (Alarm setting level) (P.8-55)
"Alarm ∗ hysteresis" (Alarm setting level) (P.8-56)
"Standby sequence restart" (Alarm setting level) (P.8-57)

CH

Alarm 1 latch	A1Lt	L.3
Alarm 2 latch	A2Lt	
Alarm 3 latch	A3Lt	Alarm is assigned to auxiliary output and
Alarm 4 latch	A4Lt	alarm type is set to other than "No alarm".

Function

- When this setting is set to "ON", a latch function is added to the alarm function. Once an alarm goes on, the alarm output is held on until the power is turned off. Note that the latch is canceled if you change to setting area 1.
- When the alarm output is set to close in alarm, closed output is held, and when set to open in alarm, open output is held.
- After changing an alarm 1 to 3 latch setting, a software reset must be executed or the power turned off and on to make the new setting take effect.

Setting

Setting data	Setting range	Units	Default value
Alarm 1 latch Alarm 2 latch Alarm 3 latch Alarm 4 latch	oFF : Disable on : Enable	–	oFF: Disable

Reference

● Related setting data

"Bank ∗ alarm ∗" (Bank setting level) (P.8-28)
"Bank ∗ alarm upper limit ∗ ", "Bank ∗ alarm lower limit ∗ "(Bank setting level) (P.8-29)
"Auxiliary output ∗ assignment" (Control initial setting 2 level) (P.8-48)
"Alarm ∗ type" (Alarm setting level) (P.8-54)
"Alarm ∗ hysteresis" (Alarm setting level) (P.8-56)
"Standby sequence restart" (Alarm setting level) (P.8-57)

CH

Alarm 1 hysteresis	ALH1	L.3
Alarm 2 hysteresis	ALH2	
Alarm 3 hysteresis	ALH3	Alarm is assigned to auxiliary output and
Alarm 4 hysteresis	ALH4	alarm type is set to other than "No alarm".

Function

- These settings are used to enable hysteresis for alarms 1, 2, 3, and 4.

Setting

Setting data	Setting range	Units	Default value
Alarm 1 hysteresis Alarm 2 hysteresis Alarm 3 hysteresis Alarm 4 hysteresis	0.01 to 99.99	%FS	0.02

Reference

● Related setting data

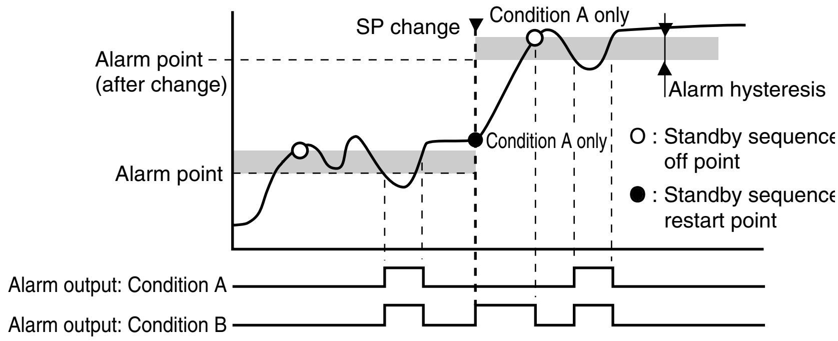
"Bank ∗ alarm ∗" (Bank setting level) (P.8-28)
"Bank ∗ alarm upper limit ∗ ", "Bank ∗ alarm lower limit" (Bank setting level) (P.8-29)
"Auxiliary output ∗ assignment" (Control initial setting 2 level) (P.8-48)
"Alarm ∗ type" (Alarm setting level) (P.8-54)
"Alarm ∗ latch" (Alarm setting level) (P.8-55)
"Standby sequence restart" (Alarm setting level) (P.8-57)

CH

Standby sequence restart **rESt** **L.3**

Alarm types 1 to 4 = With standby sequence

- Use this setting to select the condition for restarting the standby sequence after it has been canceled.
- Condition A: Operation startup (including power on), when an alarm value (alarm upper- and lower-limit) or input shift value (input value for input calibration 1 and 2, input shift 1 and 2) is changed, or when the SP is changed.
- Condition B: Power on
- The following example shows operation using a lower-limit alarm with standby sequence.



- After changing the standby sequence restart setting, a software reset must be executed or the power turned off and on to make the change take effect.

Setting

Setting range	Units	Default value
A: Condition A b: Condition B	–	A: Condition A

Reference

● Related setting data

"Alarm ∗ type" (Alarm setting level) (P.8-54)
"Alarm ∗ latch" (Alarm setting level) (P.8-55)

Auxiliary output 1 non-exciting	Sb1n	L.3
Auxiliary output 2 non-exciting	Sb2n	
Auxiliary output 3 non-exciting	Sb3n	
Auxiliary output 4 non-exciting	Sb4n	

Function

- These settings are used to select the output state of alarms 1, 2, 3, and 4.
- When close in alarm is selected, the state of the alarm output function is output without change. When open in alarm is selected, the state of the output function is inverted before output. The relation between the alarm output function, alarm output, and operation indicator is shown below.

Setting data	Auxiliary output function	Auxiliary output	Operation indicator
Close in alarm	ON	ON	On
	OFF	OFF	Off
Open in alarm	ON	OFF	On
	OFF	ON	Off

Setting

Setting data	Setting range	Units	Default value
Auxiliary output 1 non-exciting Auxiliary output 2 non-exciting Auxiliary output 3 non-exciting Auxiliary output 4 non-exciting	n-o: Close in alarm n-C: Open in alarm	–	n-o: Close in alarm

Reference

● Related setting data

"Bank ∗ alarm ∗" (Bank setting level) (P.8-28)

"Bank ∗ alarm upper limit ∗ ", "Bank ∗ alarm lower limit" (Bank setting level) (P.8-29)

"Auxiliary output ∗ assignment" (Control initial setting level 2) (P.8-48)

"Alarm ∗ type" (Alarm setting level) (P.8-54)

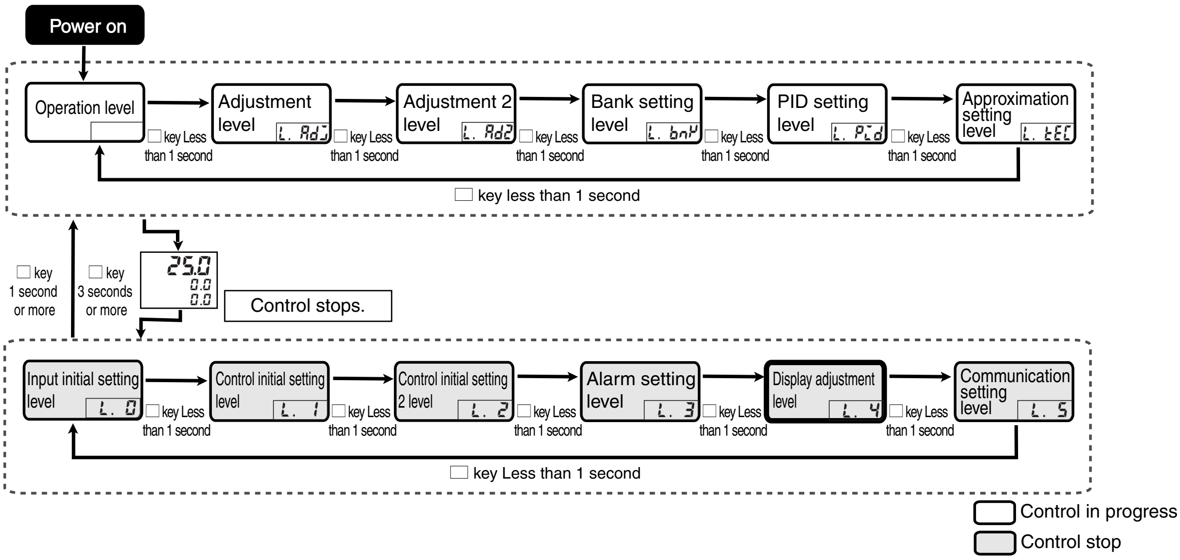
"Alarm ∗ latch" (Alarm setting level) (P.8-55)

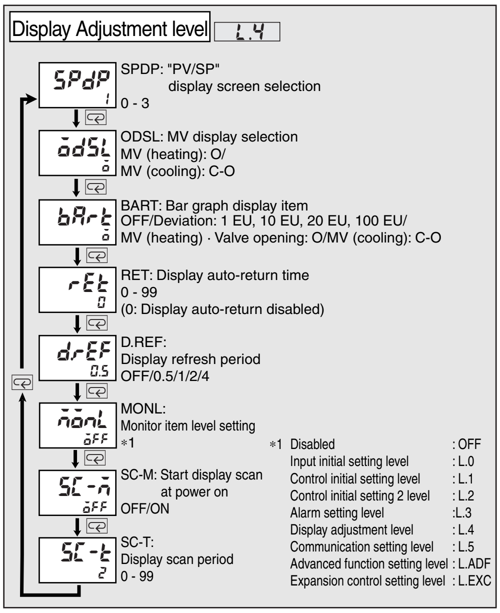
"Alarm ∗ hysteresis" (Alarm setting level) (P.8-56)

"Standby sequence restart" (Alarm setting level) (P.8-57)

8.13 Display adjustment level (L.4)

This level contains settings for adjustment of the display contents, including selection of the "PV/SP" display screen, bar graph display item, display refresh period, monitor item level setting, and display scan.





"PV/SP" display screen selection SPdP L.4

Function

- This setting is used to select the order of display of the "PV/SP" display screen (Operation level).

Setting

Setting range	Units	Default value
0: Display in the order:"PV/SP/Bank" "PV/SP/MV" 1: Display in the order: "PV/SP/MV" "PV/SP/Bank" 2: Display only "PV/SP/Bank" 3: Display only "PV/SP/MV"	–	1

CH

MV display selection odSL L.4

Heating/cooling control

Function

- This setting is used to select which MV is displayed in "PV/SP/MV" (Operation level) during heating/cooling control.
- "Heating MV" or "Cooling MV" can be selected.

Setting

Setting range	Units	Default value
o : Heating MV C-o : Cooling MV	–	o

Bar graph display item	bArt	L.4
		E5AR

Function

- Use this setting to select the contents of the bar graph display of the E5AR.
- The bar graph of the E5AR is 10 segments.

Setting

Setting range	Units	Default value
oFF : No bar graph display 1EU : Deviation 1 EU/segment 10EU : Deviation 10 EU/segment 20EU : Deviation 20 EU/segment 100EU: Deviation 100 EU/segment o : (Standard type) Heating MV (Position proportional type) Valve opening C-o : (Standard type) Cooling MV	–	o

Display auto-return time	rEt	L.4

Function

- This setting is used to select the amount of time without key operation that must elapse for the display to revert to the "PV/SP" screen when in "Operation level", "Adjustment level", "Adjustment level 2", "Bank setting level", "PID setting level", "Approximation setting level", or "Monitor item level".
- When 0 is selected, the function is disabled (no auto reset).

Setting

Setting range	Units	Default value
0 to 99	Sec	0

Display refresh period	d.rEF	L.4

Function

- This setting is used to lengthen the refresh period of the monitor value display. This only slows the display refresh cycle; it does not affect the update period of the PV during control.
- To disable the function, select OFF.

Setting

Setting range	Units	Default value
oFF, 0.5, 1, 2, 4	Sec	0.5

Monitor item level setting	monL	L.4

Function

- One of the following levels can be selected as the monitor item level setting: Input initial setting level, Control initial setting level, Control initial setting 2 level, Alarm setting level, Display adjustment level, Communication setting level, Advanced function setting level, Expansion control setting level.
- The monitor item level is added after the Approximation setting level.
- When OFF is selected, the function is disabled (Monitor item level is disabled).

Setting

Setting range	Units	Default value
oFF : Disabled monitor item level L.0 : Input initial setting level L.1 : Control initial setting level L.2 : Control initial setting 2 level L.3 : Alarm setting level L.4 : Display adjustment level L.5 : Communication setting level L.AdF: Advanced function setting level L.EoC: Expansion control setting level	–	oFF

Start display scan after power ON Display scan period	SC-m SC-t	L.4 Multi-point input type

Function

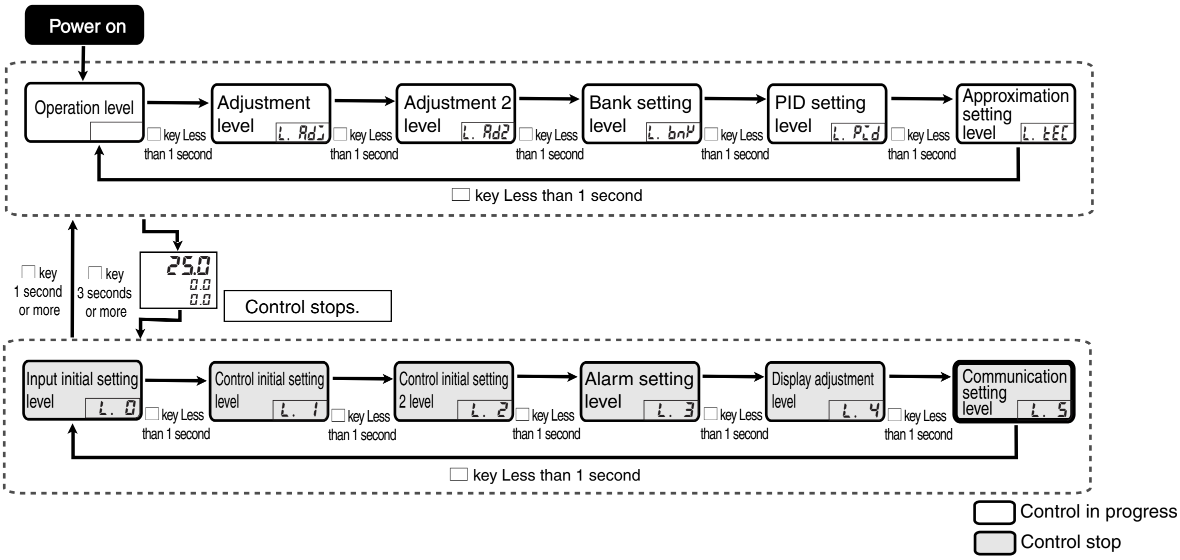
- Display scan automatically switches through channels on the display when multiple channels are used on a multi-point input type.
- Display scan only applies to channels that are enabled using "Number of enabled channels".
- Display scan can be started automatically after the power is turned on or by pressing the CH key.
- To have display scan start automatically after the power is turned on, set "Start display scan after power on" to ON.
- The display scan period is set with "Display scan period". When the period is set to "0", display scan is disabled.

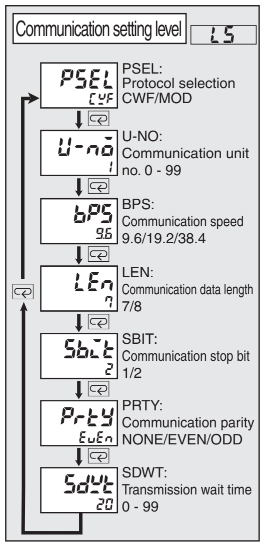
Setting

Setting data	Setting period	Units	Default value
Display scan period	0 to 99 (0: Disable display scan)	Sec	2
Start display scan after power on	oFF: Disable on : Enable	–	oFF

8.14 Communication setting level (L.5)

This level contains initial settings for communication such as protocol selection, communication unit No., and communication speed.





Setting data

Communication protocol selection PSEL

L.5

Function

- This setting is used to select the communication protocol. Selections are CompoWay/F, OMRON's unified protocol for general-purpose serial communication, or Modbus, Modicon Inc.'s protocol based on RTU Mode of Modbus Protocol (Specifications: PI-MBUS-300 Rev.J).

Setting

Setting range	Units	Default value
CWF: CompoWay/F mod: Modbus	–	CWF: CompoWay/F

Communication Unit No. U-no

L.5

Function

- After changing the communication unit No. setting, execute a software reset or turn the power off and on to make the change effective.

Setting

Setting range	Units	Default value
0 to 99	–	1

Communication speed bPS

L.5

Function

- After changing the communication speed setting, execute a software reset or turn the power off and on to make the change effective.

Setting

Setting range	Units	Default value
9.6 19.2 38.4	kbps	9.6

Communication data length LEn L.5

Protocol is CompoWay/F

Function

- After changing the communication data length setting, execute a software reset or turn the power off and on to make the change effective.

Setting

Setting range	Units	Default value
7 to 8	Bits	7

Communication stop bit Sbit L.5

Protocol is CompoWay/F

Function

- After changing the communication stop bit setting, execute a software reset or turn the power off and on to make the change effective.

Setting

Setting range	Units	Default value
1 to 2	Bits	2

Communication parity PrtY L.5

Function

- After changing the communication parity setting, execute a software reset or turn the power off and on to make the change effective.

Setting

Setting range	Units	Default value
nonE: None EvEn: Even odd : Odd	–	EvEn: Even

Transmission wait time	SdWt	L.5

Function

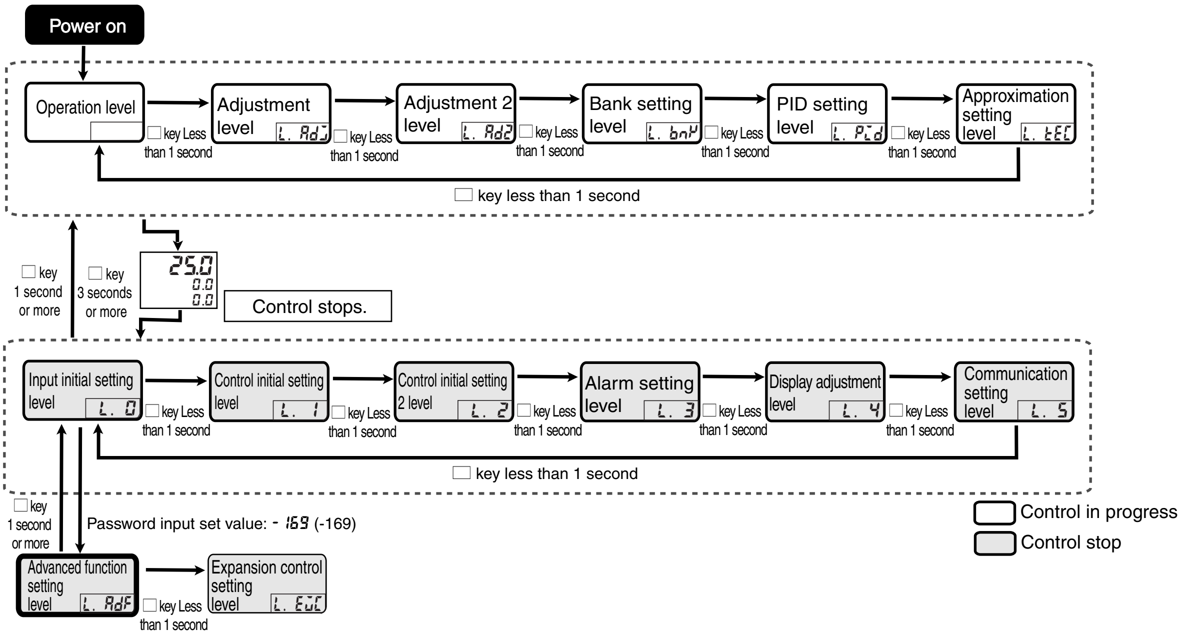
- After changing the transmission wait time setting, execute a software reset or turn the power off and on to make the change effective.

Setting

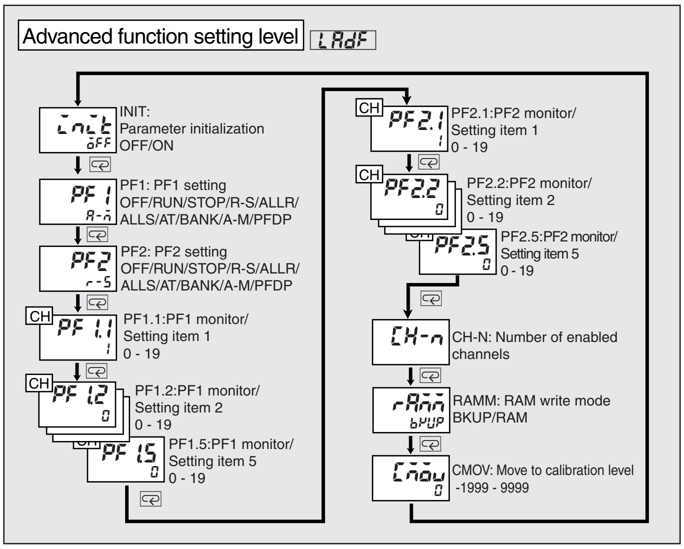
Setting range	Units	Default value
0 to 99	ms	20

8.15 Advanced function setting level (L.AdF)

This level includes setting initialization, PF key, and number of enabled channels settings.



To move to Advanced function setting level, set "Initial setting level protect" in Protect level to "0", and then enter the password (-169) in "Move to Advanced function setting level" (Input initial setting level).



Setting initialization	inIt	L.AdF

Function

- Use this setting to return all settings to their default values.

Operation

ON (on) : Initialize all settings.

OFF (oFF) : "Setting initialization" reverts to "OFF" after the settings are initialized.

PF1 setting PF2 setting	PF1 PF2	L.AdF

Function

- This setting is used to assign functions to the PF1 and PF2 keys to enable them to be used as function keys.
- When performing multi-channel control, the PF2 key functions as a CH key, and thus cannot be used as a function key ("PF2 setting" does not appear).

Setting values	Description	Function
OFF: oFF	Disabled	Does not function as a function key.
RUN: rUn	Run	Run currently displayed channel.
STOP: StoP	Stop	Stop currently displayed channel.
R-S: r-S	Run/Stop	Switch between run and stop for currently displayed channel.
ALLR: ALLr	Run all	Run all channels.
ALLS: ALLS	Stop all	Stop all channels.
AT: At	AT Execute/Cancel	Switch between AT execute and AT cancel. AT run is executed for the currently selected PID set.
BANK: bAnK	Bank selection	Switch through the bank numbers (adds 1 to the current bank number).
A-M: A-M	A/M key	Switch between auto and manual.
PFDP: PFdP	Monitor/Setting item	Display monitor/setting item. Select "Monitor/Setting item 1" to "Monitor/Setting item 5" (Special function level).

- Hold down the PF1 or PF2 for at least 1 second to execute the function selected in "PF1 setting" or "PF2 setting".
  If "Monitor/Setting item" is selected, the display will scroll through monitor/setting items 1 to 5 each time you press the key.

Setting

Setting data	Setting range	Units	Default value
PF1 setting	oFF : Disable rUn : Run StoP: Stop r-S : Run/Stop toggle ALLr: Run all ALLS: Stop all At : AT Execute/Cancel toggle bAnK: Bank scroll A-M : A/M key PFdP: Monitor/setting item	–	A-M: A/M key
PF2 setting		–	r-S: Run/ Stop toggle

CH

PF1 monitor/setting item 1 to	PF1.1 to	L.AdF
PF1 monitor/setting item 5	PF1.5	
PF2 monitor/setting item 1 to	PF2.1 to	
PF2 monitor/setting item 5	PF2.5	PF key set to monitor/setting item

Function

- When one or both PF keys are set to monitor/setting item, "Monitor/ setting item 1" through "Monitor/setting item 5" of each key must be set to the desired values among 0 to 19 below.
- Each time a PF key is pressed, the display scrolls to the next monitor/setting item in order from "Monitor/setting item 1" to "Monitor setting item 5".

Setting

Setting	Setting range	Units	Default value
PF1 Monitor/ setting item 1	0: Disable 1: PV/SP/Bank Configurable (SP) 2: V/SP/MV Configurable (SP) 3: PV/DV Monitor only 4: Proportional band (P) Configurable 5: Integral time (I) Configurable 6: Derivative time (D) Configurable 7: Alarm 1 Configurable 8: Alarm upper limit 1 Configurable 9: Alarm lower limit 1 Configurable 10: Alarm 2 Configurable 11: Alarm upper limit 2 Configurable 12: Alarm lower limit 2 Configurable 13: Alarm 3 Configurable 14: Alarm upper limit 3 Configurable 15: Alarm lower limit 3 Configurable 16: Alarm 4 Configurable 17: Alarm upper limit 4 Configurable 18: Alarm lower limit 4 Configurable 19: Bank No. Configurable	–	1
PF1 Monitor/ setting item 2			0
PF1 Monitor/ setting item 3			0
PF1 Monitor/ setting item 4			0
PF1 Monitor/ setting item 5			0
PF2 Monitor/ setting item 1			1
PF2 Monitor/ setting item 2			0
PF2 Monitor/ setting item 3			0
PF2 Monitor/ setting item 4			0
PF2 Monitor/ setting item 5			0

Reference

● Related setting data

"PF1 setting", "PF2 setting" (Advanced function setting level) (P.8-68)

Setting data

Number of enabled channels **CH-n** **L.AdF**

Multi-point input type

Function

- This setting is used to set the number of enabled channels when using multiple channels on a multi-point input type.

Setting

Setting range	Units	Default value
1 to 4	–	*

* The default value and setting range vary depending on the control mode setting of the multi-point input type.
2-input type: Proportional control, standard control with remote SP, heating/cooling control with remote SP: "1"
Other modes: "2"
4-input type: "4"

Reference

● Related setting data
"Begin display scan after power on", "Display scan period" (Display adjustment level) (P.8-62)

RAM write mode **rAMM** **L.AdF**

Function

- Use this setting to select the write mode.

Write mode	Explanation
Backup mode	When writing setting data to setting area 0 by communication, the data is also written to internal non-volatile memory.
RAM write mode	When writing setting data to setting area 0 by communication, the data is not written to internal non-volatile memory. However, changes to setting data by key operation are written to non-volatile memory.

- When the write mode is changed from RAM write mode to backup mode, the setting data in setting area 0 is written to internal non-volatile memory.

Setting

Setting range	Units	Default value
bKUP: Backup mode rAM : RAM write mode	–	bKUP: Backup mode

Reference

● Related information
"5.9 Using communication functions" (P.5-34)

Move to calibration level	CMOV	L.ADF

This setting is used to move to calibration level.

Function

- Use this setting to enter the password to access calibration level.

Setting

Setting range	Units	Default value
-1999 to 9999	–	0

Reference

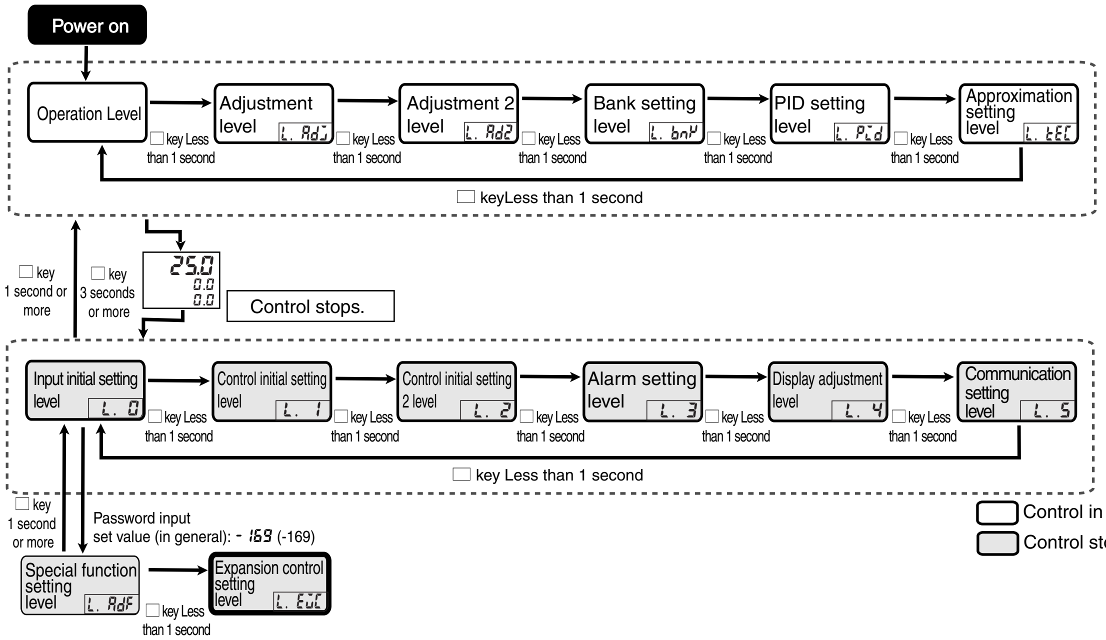
● Related information

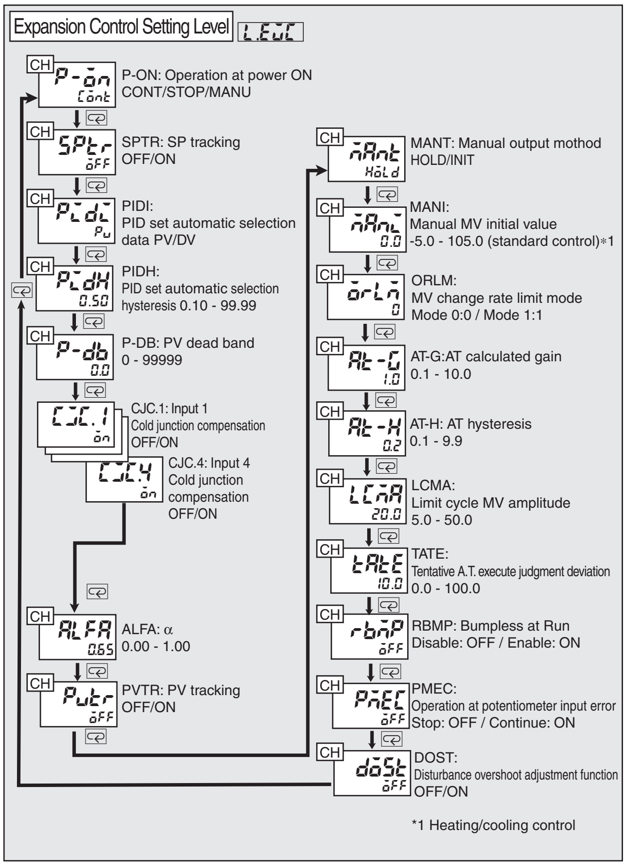
"Section 9 User calibration" (P. 9-1)

Setting data

8.16 Expansion control setting level (L.EUC)

This level includes advanced control settings such as operation after power ON, PID set auto selection, and position proportional settings.





Setting data

CH

Operation at power ON P-on L.EuC

Function

- Select "Continue", "Stop", or "Manual mode" for operation after the power is turned on.
- Operation after a software reset or when moving from Initial setting level to Operation level is also determined by this setting.

Setting

Setting range	Units	Default value
Cont: Continue StoP: Stop MAnU: Manual mode	–	Cont: Continue

Reference

● Related information

"4.12 Starting and stopping control" (P.4-27)

CH

SP tracking SPtr L.EuC

Standard control with remote SP, cascade control, or proportional control

Function

- This setting is used to specify operation when switching from remote SP mode to local SP mode.
- When remote SP tracking is enabled (ON), the value of the remote SP is transferred to the local SP.
- When remote SP tracking is disabled (OFF), the local SP is not affected by the remote SP.

Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF

Reference

● Related setting data

"Control mode" (Control initial setting level) (P.8-43)

"SP mode" (Adjustment level) (P.8-14)

Setting data

CH

PID set automatic selection data PIdC

PID set automatic selection hysteresis PIdH

L.EUC

CH

Function

- This setting is used for automatic selection of the PID set.
- The PID set number to be used is automatically selected based on the value set in "PID set automatic selection data". The switching range is specified in the "PID set automatic select range" (PID setting level).
- "PID set automatic selection hysteresis" is used to prevent chattering when the PID is changed.

Setting

Setting	Setting range	Units	Default value
PID set automatic selection data	Pu: Present value du: Deviation	–	Pu: Present value
PID set automatic selection hysteresis	0.10 to 99.99	%FS	0.50

Reference

● Related information
"5.2 Control functions ■ PID sets" (P.5-12)

● Related setting data
"Bank ✻ PID Set No." (Bank setting level) (P.8-27)
"PID Set No. ✻ Automatic selection range upper limit" (PID setting level) (P.8-32)

CH

PV dead band P-db

L.EUC

Position proportional type

Function

- This setting is used on a position proportional type to have PV = SP when the PV is within the PV dead band.
- This function prevents unnecessary output when the PV is near the SP.

Setting

Setting	Setting range	Units	Default value
PV dead band	0 to 99999	EU	0

Setting data

Reference

● Related information
"3.3 Position proportional control of a ceramic kiln" (P.3-9)

● Related setting data
"Closed/Floating" (Control initial setting level) (P.8-44)
"Motor calibration" (Control initial setting 2 level) (P.8-52)
"Travel time" (Control initial setting 2 level) (P.8-52)
"Position proportional dead band" (Adjustment level) (P.8-17)
"Open/Close hysterisis" (Adjustment level) (P.8-17)
"Operation at potentiometer input error" (Expansion control setting level) (P.8-79)

Input 1 cold junction compensation	CJC.1	L.EuC
Input 2 cold junction compensation	CJC.2	
Input 3 cold junction compensation	CJC.3	
Input 4 cold junction compensation	CJC.4	Input type is thermocouple input

Function

- When the input type is thermocouple input, this setting is used to specify whether cold junction compensation is performed inside the controller or outside the controller.
- Select "External" cold junction compensation when two thermocouples are used to measure the temperature difference or when an external cold junction compensator is used for increased accuracy.

Setting

Setting range	Units	Default value
oFF : External on : Internal	–	on: Internal

Reference

● Related setting data
"Input * type" (Input initial setting level) (P.8-36)

Setting data

CH

α **ALFA** L.EXC

- This setting is normally used at the default value.
- This sets the advanced PID constant α.

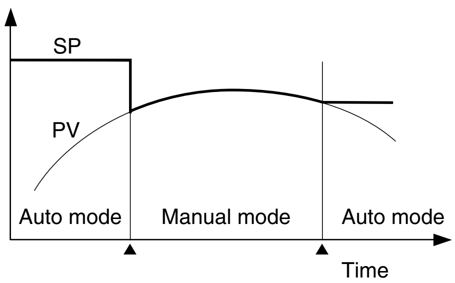
Setting

Setting range	Units	Default value
0.00 to 1.00	–	0.65

CH

PV tracking **Putr** L.EXC

- This setting is used to have the local SP track the PV when in manual mode.
- The setting prevents abrupt changes in the MV when switching from manual mode to auto mode.



Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF : Disable

If an input error occurs during PV tracking, the local SP will change to the upper limit of the sensor setting range.

CH

Manual output method MANT

Manual MV initial value MANI

L.EXC

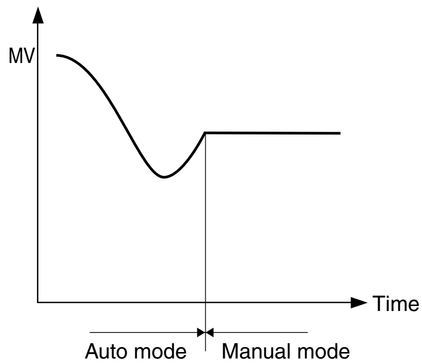
This setting is used to specify how the MV is output when switching from auto mode to manual mode.

Function

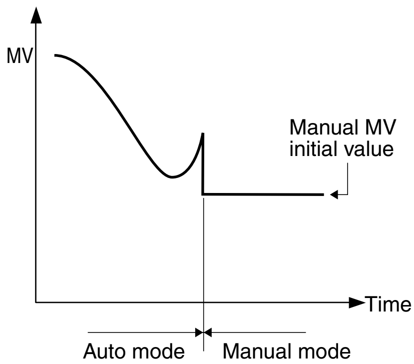
- When "Hold MV" is selected, the MV at the time of switching is held, after which it can be changed using "Manual MV" (Operation level).
- When "Output default value" is selected, the value specified in "Manual MV default value" is used. This can then be changed using "Manual MV" (Operation level).

Examples of how the MV changes using the two methods are shown below.

Setting



At "MV hold"



At "Initial value output"

Setting	Setting range	Units	Default value
Manual output method	Hold MV : HOLD Output initial value: INIT	–	HOLD
Manual MV initial value	-5.0 to 105.0 (Standard) -105.0 to 105.0 (Heating/cooling)	%	0.0

Reference

- Related information
  "4.13 Performing manual control" (P.4-29)
- Related setting data
  "Manual MV" (Operation level) (P.8-5)

Setting data

CH

MV change rate limit mode orLm | L.EXC

Function

- Use this setting to select Mode 0 or Mode 1 for the MV change rate limit.
- When Mode 1 is selected, the MV change rate limit only functions with respect to increases in the MV.

Setting

Setting range	Units	Default value
0: Mode 0 1: Mode 1	–	0

Reference

● Related information
"5.2 Control functions ■ PID sets" (P.5-12)

● Related setting data
"MV change rate limit (heat)", "MV change rate limit (cooling)" (Adjustment level) (P.8-19)

CH

AT calculated gain At-G

AT hysteresis At-H

Limit cycle MV amplitude LCmA*

Temporary A.T. execution judgement deviation tAtE*

L.EXC

* Control mode key: heating/cooling control and position proportional control (floating). During cascade heating/cooling control, only channel 1 is displayed.

Function

- These settings are normally used at the default values.
- "AT calculated gain" specifies the gain used when PID values are calculated during AT. A smaller gain provides greater adaptability, while a larger gain provides greater stability.
- "AT hysteresis" is used to set the value of hysteresis for ON/OFF switching during the limit cycle while AT is being run.
- "Limit cycle MV amplitude" is used to set the MV amplitude during the limit cycle while AT is being run.
- This is effective when P $\neq$ 0.00 in standard control, or when closed is selected in proportional control.
- "Temporary AT execution judgement deviation" is used to judge if temporary AT is excute or not for running temporary AT. When AT is excuted while, the deviation is greater than the set value, temporary AT runs.

Setting

Setting	Setting range	Units	Default value
AT calculated gain	0.1 to 10.0	–	1.0
AT hysteresis	0.1 to 9.9	%FS	0.2
Limit cycle MV amplitude	5.0 to 50.0	%	20.0
Temporary AT execution judgement deviation	0.0 to 100.0	%FS	10.0

Reference

- Related information
  "4.10 Determining the PID constants (AT, manual settings)" (P.4-20)
- Related setting data
  "AT Execute/Cancel" (Adjustment level) (P.8-13)

CH

Bumpless at RUN rbMP L.EUC

Function

- When "Bumpless at RUN" is enabled, an integral MV correction (bumpless) is performed to prevent abrupt changes in the MV when switching from stop to run.
- Even when the setting is disabled, the bumpless correction is performed when PID values change (including changing the PID set) and when AT ends or is stopped.

Setting

Setting range	Units	Default value
oFF : Disable on : Enable	–	oFF: Disable

CH

Operation at potentiometer input error PMEC L.EUC

Position proportional type

Closed control

Function

- This setting is used to select whether control is stopped or changed to floating control when a potentiometer error occurs during closed control in position proportional control.

Setting

Setting range	Units	Default value
oFF : Stop on : Continue	–	oFF: Stop

Reference

- Related setting data
  "Closed/Floating" (Control initial setting level) (P.8-44)

Setting data

CH

Disturbance overshoot adjustment function dōSt L.EūC

Function

- This setting is used to enable or disable disturbance overshoot adjustment.

Setting

Setting range	Units	Default value
ōFF : Disable ōn : Enable	–	ōFF: Disable

Reference

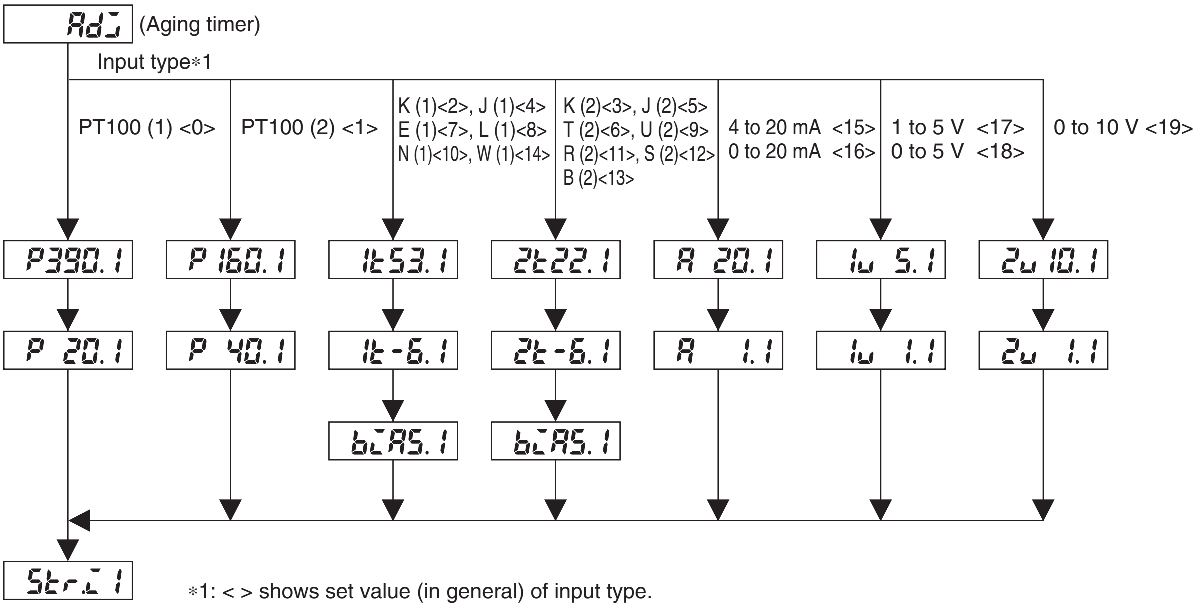
● Related information

"5.2 Control functions ■ Disturbance overshoot adjustment" (P.5-14)

Section 9 User calibration

9.1 Setting data for user calibration

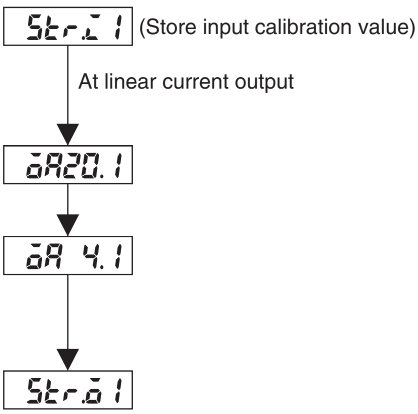
- To perform user calibration, enter "1201" in "Move to user calibration" in Special setting level. The controller will enter calibration mode and "AdJ" will appear in the display.
- If the "Move to user calibration" setting does not appear, set "Initial setting protect" to "0" in Protect level and then move to Special setting level.
- Calibration is ended by turning off the power.
- The setting data for input calibration is shown below.
  (The last digit of Display 1 shows the input number. The example below shows "1" for input 1. In the case of input 2, the display would show "P390.2".)



*1: < > shows set value (in general) of input type.

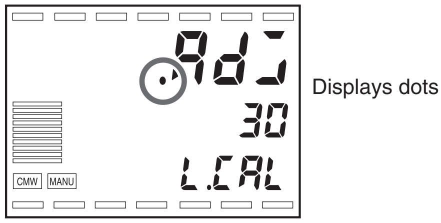
◆ **Output calibration setting data**

The setting data for output calibration is shown below. The display varies depending on the output type of each output.
(In the following example, the last digit of Display 1 shows "1" for output 1. For output 2, this would be "oA20.2".)



User calibration

If user calibration was performed on any of inputs 1 to 4 or outputs 1 to 6 following purchase of the controller, user calibration completion information will appear as shown below when you move to Calibration level.



9.2 User calibration

The E5AR/ER is calibrated before shipment from the factory and thus there is normally no need for the user to calibrate the controller.

In the event that user calibration is necessary, use the calibration functions for temperature input, analog input, and output that are provide in the controller.
However, note that OMRON cannot ensure the results of calibration by the user.
Also, calibration data is overwritten with the latest settings. The default calibration settings cannot be returned to after user calibration.

● Input calibration

The input type selected in the setting data is calibrated. Input types consist of the following 20 types:

- Thermocouple : 13 types
- Analog input : 5 types
- Resistance temperature input sensor : 2 types

● Output calibration

The output type selected in the setting data is calibrated. There is only one output type that can be selected:

- Linear current output

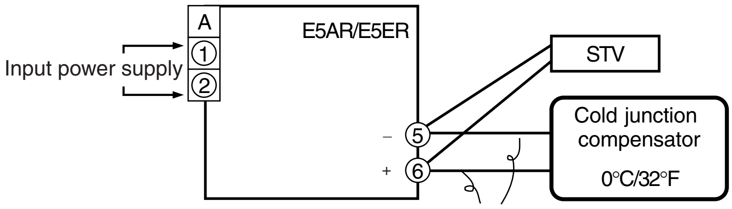
● Registering calibration data

The new calibration data for each item is temporarily registered. It can be offcially registered as calibration data only when all items have been calibrated to new values. So, be sure to temporarily register all items when you calibrate the E5AR/ER.
When calibration data is registered, it is registered regardless of whether or not the E5AR/ER has been calibrated by the user.
Prepare separate measuring devices and equipment for calibration. For details on how to handle measuring devices and equipment, refer to the respective instruction manuals.

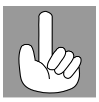
9.3 Thermocouple input calibration

- Thermocouples are calibrated in two groups according to thermocouple type: Group 1 (input types 2, 4, 7, 8, 10, 14) and Group 2 (input types 3, 5, 6, 9, 11, 12, 13).
- Do not cover the bottom of the thermocouple during calibration. Also, do not touch the input terminal or compensation wire.

● Preparations

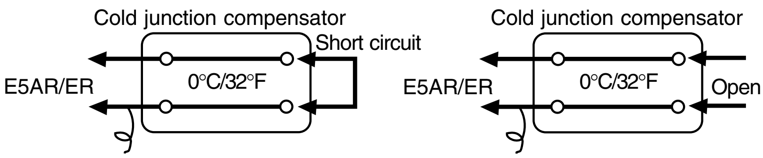


- For the cold junction compensator, use a compensator for calibration of internal thermocouples and set to 0°C. The internal thermocouple should be disabled (tip open).
- STV in the diagram indicates a DC reference current/voltage generator.
- Prepare a compensation wire appropriate for the selected thermocouple. For thermocouples R, S, E, B and W, a cold junction compensator and compensation wire for thermocouple K can be used.



Connecting the cold junction compensator

A correct input value cannot be obtained if the compensation wire connector is touched during thermocouple calibration. Therefore, to connect or disconnect the cold junction compensator, short-circuit (enable) or open-circuit (disable) the tip of the thermocouple inside the cold junction compensator, while keeping the compensation wire connected as shown in the diagram.

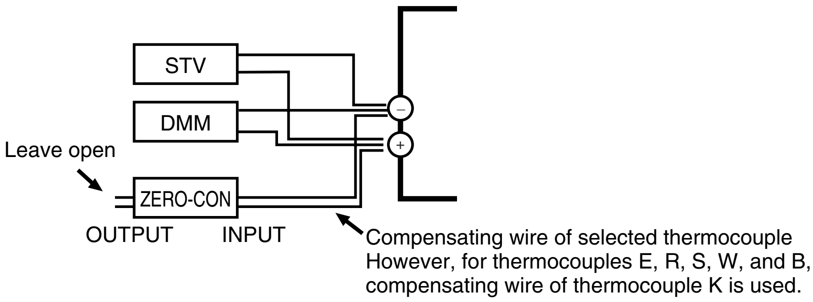


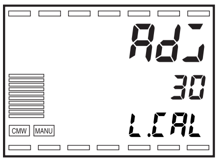
User calibration

Follow these steps to perform calibration when thermocouple input is selected.

1. Connect the power supply.

2. Connect the DC reference current/voltage generator (STV in the following), precision digital meter (DMM in the following), and cold junction compensator (a ZERO-CON is used as an example in the following) to the input terminals of the thermocouple as shown below.



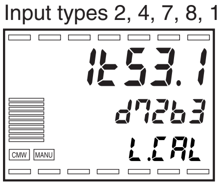


3. Turn on the power.

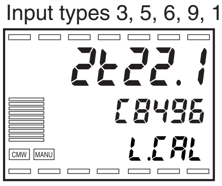
4. Move to calibration level.
   A 30-minute aging time begins. Perform aging using this time as a guideline. When 30 minutes elapses, Display 2 will show "0".

   Note that you can proceed to the next stop before the display shows "0".

Input types 2, 4, 7, 8, 10, 14



Input types 3, 5, 6, 9, 11, 12, 13

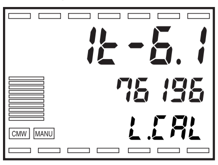


5. Press the key to obtain the display at left.
   The count value that was input will appear in Display 2 in hexadecimal. Set the STV as follows:

   - For input types 2, 4, 7, 8, 10, and 14: 53 mV
   - For input types 3, 5, 6, 11,12, and 13: 22 mV

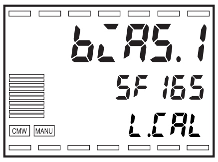
   Wait until the count in Display 2 is sufficiently stable and then press the key. This tentatively saves the calibration data at this point.

Input types 2, 4, 7, 8, 10, 14



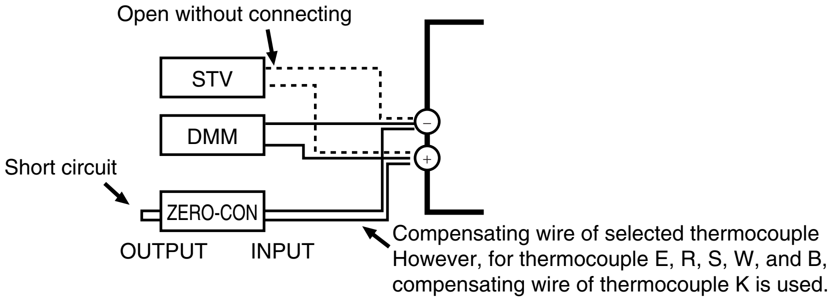
6. Press the key to obtain the display at left.
   Set the STV to -6 mV.

   Wait until the count in Display 2 is sufficiently stable and then press the key. This tentatively saves the calibration data at this point.



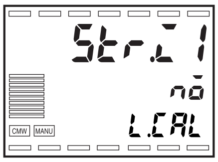
7. Press the key to obtain the display at left.

8. Change the wiring as shown below.



Disconnect the STV and enable the thermocouple in the cold junction compensator. Make sure that the STV is disconnected at this time.

9. Wait until the count in Display 2 is sufficiently stable and then press the key. This tentatively saves the calibration data at this point.



10. Press the key to obtain the display at left. Note that this display will not appear if not all of the required data has been tentatively saved.
Press the key. Display 2 will show "YES". Two seconds after the key is released or when the is pressed, the tentatively saved calibration data is stored in non-volatile memory. If you do not wish to save the data in non-volatile memory, press the key instead of the key.
    - For a multi-point input type, connect as explained in step 2 and repeat steps 5 to 10.
    - If linear current output is selected, continue with the procedure explained in "9.6 Output calibration" (P.9-12).

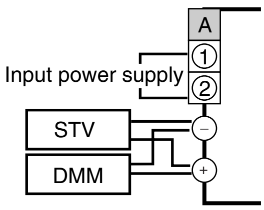
11. Turn off the power to quit calibration mode.

User calibration

9.4 Analog input calibration

Analog input is calibrated in the following groups according to the analog input type: current input group (15, 16), voltage input group 1 (17, 18), and voltage input group 2 (19).

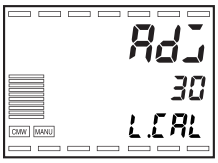
E5AR/E5ER



1. Connect the power supply.

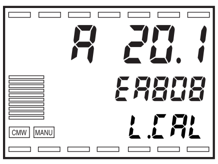
2. Connect the STV and DMM to the input terminals of the analog input as shown above.
   Note that different input terminals are used for current input and voltage input. Make sure the connections are correct.

3. Turn on the power.

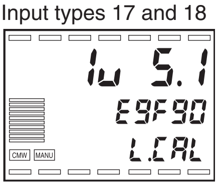


4. Move to calibration level.
   A 30-minute aging time begins. Perform aging using this time as a guideline. When 30 minutes elapses, Display 2 will show "0".
   Note that you can proceed to the next stop before the display shows "0".

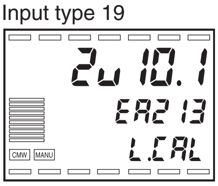
Input types 15 and 16



Input types 17 and 18



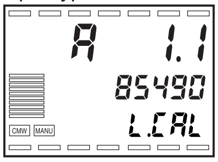
Input type 19



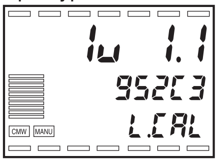
5. Press the key to obtain the display at left.
   The count value that was input will appear in Display 2 in hexadecimal. Set the STV as follows:
   - For input types 15 and 16: 20 mA
   - For input types 17 and 18: 5 V
   - For input type 19: 10 V

6. Wait until the count in Display 2 is sufficiently stable and then press the ▼ key. This tentatively saves the calibration data at this point.

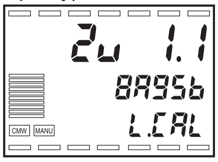
Input types 15 and 16



Input types 17 and 18

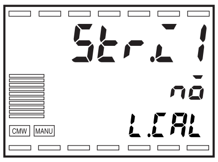


Input type 19



7. Press the key ↵ to obtain the display at left.
   Set the STV as follows:
   - Input types 15 and 16: 1 mA
   - Input types 17 and 18: 1 V
   - Input type 19: 1 V

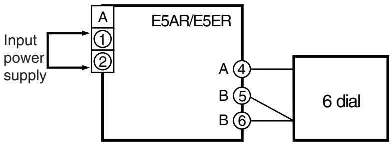
8. Wait until the count in Display 2 is sufficiently stable and then press the ▼ key. This tentatively saves the calibration data at this point.



9. Press the key ↵ to obtain the display at left. Note that this display will not appear if not all of the required data has been tentatively saved.
   Press the ▲ key. Display 2 will show "YES". Two seconds after the key is released or when the ↵ is pressed, the tentatively saved calibration data is stored in non-volatile memory. If you do not wish to save the data in non-volatile memory, press the ↵ key instead of the ▲ key.
   - For a multi-point input type, connect as explained in step 2 and repeat steps 5 to 9.
   - If linear current output is selected, continue with the procedure explained in "9.6 Output calibration" (P.9-12).

10. Turn off the power to quit calibration mode.

9.5 Resistance temperature input sensor calibration



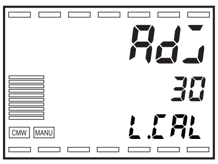
The procedure for calibrating a resistance temperature input sensor is explained in the following.

For the connection wiring, use wiring of the same thickness.

1. Connect the power supply.

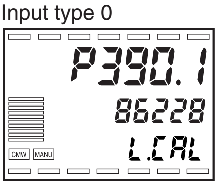
2. Connect a precision resistance box (6-dial in the following) to the input terminal of the resistance temperature input sensor as shown at left.

3. Turn on the power.

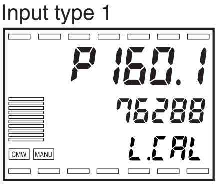


4. Move to calibration level.
   A 30-minute aging time begins. Perform aging using this time as a guideline. When 30 minutes elapses, Display 2 will show "0".
   Note that you can proceed to the next stop before the display shows "0".

Input type 0



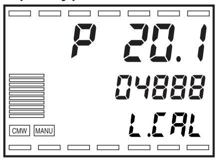
Input type 1



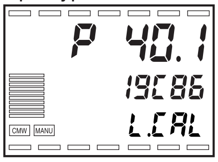
5. Press the key to display the count value for each input type.
   At this time the count value that was input will appear in Display 2 in hexadecimal. Set the 6-dial as follows:
   - Input type 0: 390 Ω
   - Input type 1: 160 Ω

6. Wait until the count in Display 2 is sufficiently stable and then press the key. This tentatively saves the calibration data at this point.

Input type 0

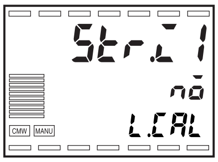


Input type 1



7. Press the to obtain the display at left.
   Set the 6-dial as follows:
   - Input type 0: 20 Ω
   - Input type 1: 40 Ω

8. Wait until the count in Display 2 is sufficiently stable and then press the key. This tentatively saves the calibration data at this point.



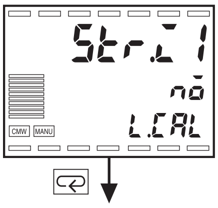
9. Press the key to obtain the display at left. Note that this display will not appear if not all of the required data has been tentatively saved.
   Press the key. Display 2 will show "YES". Two seconds after the key is released or when the is pressed, the tentatively saved calibration data is stored in non-volatile memory. If you do not wish to save the data in non-volatile memory, press the key instead of the key.
   - For a multi-point input type, connect as explained in step 2 and repeat steps 5 to 9.
   - If linear current output is selected, continue with the procedure explained in "9.6 Output calibration" (P.9-12).

10. Turn off the power to quit calibration mode.

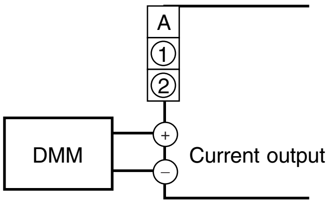
User calibration

9.6 Output calibration

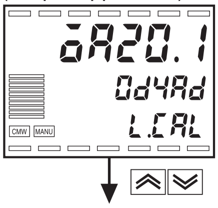
- The procedure for calibration when linear current output is selected is explained in the following.
- Output calibration is displayed after input calibration is finished (after the input calibration values are saved). (Perform aging for at least 30 minutes.)



1. The input calibration value save state appears as shown at left.
2. Connect a precision digital meter (DMM in the following) to the output terminal of the linear current output as shown below.

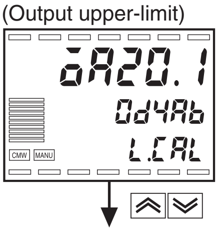


(Output upper-limit)



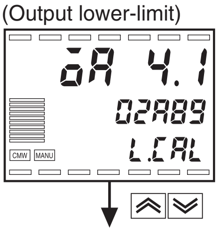
3. Press the key to obtain the display at left and begin 20 mA calibration.

(Output upper-limit)



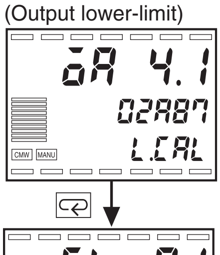
4. While viewing the output on the DMM, use the keys to set the output to 20 mA. In the example at left, "20 mA" appears at a value 2 digits smaller than before calibration.

(Output lower-limit)

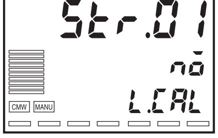


5. Press the key to obtain the display at left and begin 4 mA calibration.

(Output lower-limit)



6. While viewing the output on the DMM, use the keys to set the output to 4mA. In the example at left, "4 mA" appears at a value 2 digits smaller than before calibration.



7. Press the key to obtain the display at left. Note that this display will not appear if not all of the required data has been tentatively saved, or if the data has not been changed.
   Press the key. Display 2 will show "YES". Two seconds after the key is released or when the is pressed, the tentatively saved calibration data is stored in non-volatile memory. If you do not wish to save the data in non-volatile memory, press the key instead of the key.
   - If there is another output, connect the output as explained in step 2, and repeat steps 3 to 7.

8. Turn off the power to quit calibration mode.

User calibration

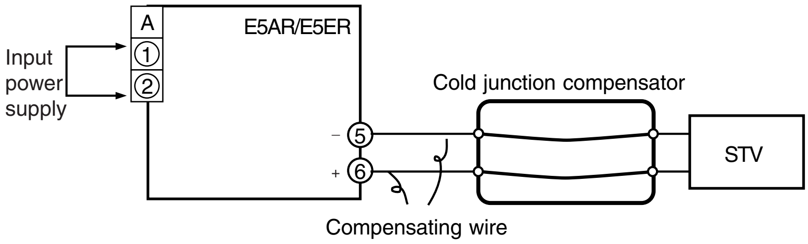
9.7 Inspecting indicator accuracy

- After calibrating input, be sure to inspect the indicator accuracy to verify that the input was calibrated correctly.
- Run the E5AR/ER in the PV/SP state.
- Check the upper limit, lower limit and mid-range limit of the indicator range (3 values).

● Thermocouple

• Preparations

Connect as follows to the required devices. Be sure to connect the E5AR/ER to the cold junction compensator using the compensation wire that you intend to use for the thermocouple.



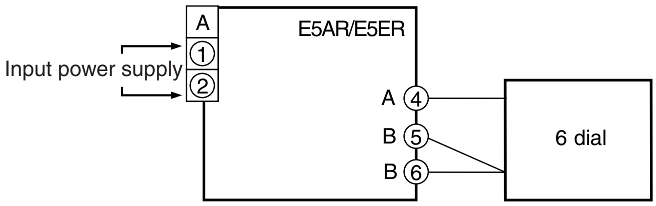
• Operation

Make sure that the cold junction compensator is at 0°C, and set the STV output to the voltage that is equivalent to the inspection value startup power.
If the cold junction compensating system is set to external, a cold junction compensator and compensation wire are not needed.

● Resistance temperature input sensor

• Preparations

Connect as follows to the required devices.



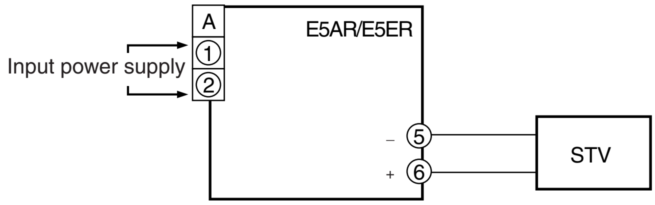
• Operation

Set the 6-dial to the resistance that is equivalent to the inspection value.

● Analog input

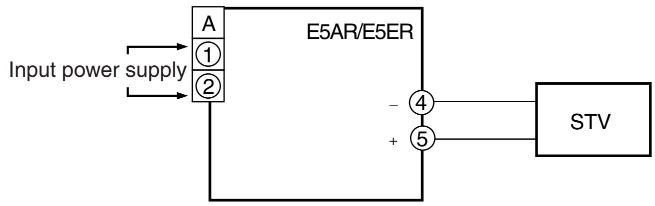
• Preparations

Connect as follows to the required devices.



• **Operation**

Set the STV output to the inspection value voltage or current.



User calibration

Section 10 Troubleshooting

10.1 Troubleshooting checklist

If you encounter difficulty with the controller, use the following checklist to solve the problem.

Check the display

Check the operating state of the E5AR/ER as indicated by the display.

Error messages and indicators are explained in "10.2 Error messages" (P.10-3). If an error message appears, refer to this section to solve the problem.

Check switches and wiring

Check switch settings and wiring

- Power supply
  - Is the power turned on?
  - Are the terminal voltages within the permitted ranges?
- Input type switch
  - Is the switch set to the correct setting for the sensor you are using?
- Wiring
  - Are the terminal connections correct?
  - Are the polarities correct?
  - Are any wires loose?
  - Are any wires or cables broken or not making contact?
- Communication conditions
  - Do the communication conditions match those of the host system?

If you are unable to identify the problem from the above or cannot solve the problem, investigate in more detail.

Check setting data

- Are the setting data correct?
- Check for restrictions on the function you are using.
  See if the cause of the problem lies in your settings.

Infer from conditions

If you were not able to identify the cause of the problem by checking the above, refer to the tables in "10.2 Error messages" (P.10-3) and following.

10.2 Error messages

When an error occurs, Displays 1 and 2 show error messages.

Refer to the following table to check the meaning of the message and how to solve the problem.

Display 1	Display 2	Error	Solution	Output state at error	
				Control output	Alarm output
Unit	Err	Unit error	The unit requires service. Please contact your dealer.	OFF	OFF
Unit	CHG	Unit change	Hold down the □ key for at least 5 seconds to store the current unit configuration. If this does not clear the error display, please contact your dealer.	OFF	OFF
dISP	Err	Display unit error	Service is required. Please consult your dealer.	OFF	OFF
SYS	Err	Unit error			
EEP	Err	Non-volatile memory error	Hold down the □ key for at least 5 seconds in the error display to initialize. *	OFF	OFF
S.Err	Normal display	Input error	Check for an incorrect input connection, broken wire, or short-circuit. Check the input type and input type switch settings.	MV output according to "MV at PV error" setting.	"Upper limit exceeded" operation.
ccccc ɔɔɔɔɔ	Normal display	Exceeds display range (lower line) Exceeds display range (upper line)	Not an error; however, appears when PV exceeds the display range (-19999 to 99999).	Normal operation	Normal operation
Normal display	RSP operation indicator blinks	RSP input error	Is the wire connected to the RSP input broken or short-circuited?	MV at PV error	OFF
Normal display	-----	Potentiometer input error	Check the potentiometer wiring.	When "Closed/Floating" is closed and "operation at potentiometer input error" is OFF, an error MV is output; at all other times, normal operation takes place.	Normal operation
CALb	Err	Motor calibration error	Check the wiring to the potentiometer and valve drive motor, and then try motor calibration again.	OFF	OFF
i1-t i2-t i3-t i4-t	Set value blinks	Input type switch error	Set the input type switch for the input you are using so that it accords with the displayed "Input type" setting.	OFF	OFF

If the system does not operate as expected after configuring settings, check the wiring and set values once again. If there is still a problem, unintended set values may have been accidentally configured in the setting data. In this case, you can initialize the unit and then re-configure your settings.

*

⚠ Caution	Initializing the unit will return all settings to the factory default settings. The factory default settings may cause unexpected output, so disconnect all output wires and eliminate effects to the system before initializing the unit. In addition, write down your settings prior to initialization.

10.3 Inferring causes from conditions (abnormal measured values)

● The measured value is abnormal or measurement is not possible

	Possible cause	Solution
Connections	The polarity or connections to the temperature sensor are not correct.	Connect the wires correctly.
	A temperature sensor that cannot be used with the E5AR/ER is connected.	Change to a temperature sensor that can be used with the E5AR/ER.
	The temperature sensor has a broken wire, a short-circuit, or has deteriorated.	Replace the temperature sensor.
	A temperature sensor is not connected.	Connect a temperature sensor.
	A compensation wire compatible with the thermocouple is not being used.	• Directly connect a thermocouple with a long lead. • Use a compatible compensation wire.
	A metal device other than the thermocouple or compensation wire is connected between the terminals of the E5AR/ER and thermocouple.	Connect with a device that is designed for use with thermocouples.
	The terminal connection screws are loose, resulting in a bad connection.	Tighten the screws securely.
	The lead or compensation wire of the thermocouple is too long and gives rise to resistance effects.	• Use a thick compensation wire. • Change the wiring and locations to allow shorter lengths.
	The 3 wires between the terminals of the E5AR/ER and the platinum resistance temperature input sensor have different resistances.	Use wires of the same resistance for terminals A, B, and B.
Installation	The E5AR/ER is receiving noise from peripheral devices.	• Separate the E5AR/ER from noise-emitting devices. • Install a surge absorber or noise filter in noise-emitting devices.
	The lead and power line of the temperature sensor are too close and induction noise is received from the power line.	• Separate the lead from the power line. • Run the lead and power line through separate conduits or ducts. • Do not wire the lead in parallel with the power line. • Change the wiring to allow a shorter lead. • Use shielded wire for the lead.
	The mounting location of the temperature sensor is too far from the point of control and the thermal response is slow.	Mount the sensor so that the tip of the protective tubing approaches the point of control.
	The ambient operating temperature of the E5AR/ER exceeds the rated temperature.	Keep the ambient operating temperature within the rated range: -10 to 55°C.
	Wireless devices are used near the E5AR/ER.	Shield the E5AR/ER.
	The temperature of the terminal plate is not uniform due to heat dissipation from peripheral devices.	Install the E5AR/ER in a location where it is not exposed to heat dissipation.
	The terminal plate of the E5AR/ER is exposed to strong air flow.	Prevent air flow from blowing on the terminal plate.
Settings	The input type switch setting is not correct.	Set the input type switch to the correct setting for the input.
	The input type setting is not correct.	Set the correct input type.
	The temperature units setting is not correct.	Set the correct temperature units.
	The measured temperature appears to deviate after setting an input shift value.	Set the input shift value to "0.0".
	The units of a data setting are not correct.	Correct the host system program.
	The host system program is not correct.	
Method of use	The input terminal for thermocouple input is short-circuited.	Connect the thermocouple.
	A temperature sensor was replaced or a switch setting was changed while the power was on.	Turn the power off and then on.

Supplement

Simple method for checking input:

Platinum resistance temperature input sensor:
1) Connect a 100 Ω resistor between input terminals A-B and short-circuit B-B.
2) If the measured temperature is approximately 0.0°C or 32.0°F, the E5AR/ER is operating normally.

Thermocouple: 1) Short-circuit the input terminal of the temperature sensor.
2) If the temperature close to the terminal plate can be measured, the E5AR/ER is operating normally.

Analog input: Use a STV to supply the specified current or voltage and verify.

10.4 Inferring causes from conditions (abnormal control)

● The PV does not rise

	Possible cause	Solution
Connections	Abnormal measured value.	Solve as explained in section 10.3.
	A load is not connected to the control output terminal.	Connect a load.
	Incorrect load polarity or incorrect terminal connections.	Wire correctly.
	The terminal connection screws are loose, resulting in a bad connection.	Tighten the screws securely.
	The heater power is not turned on.	Turn on the heater power.
	The heater has a broken wire or has deteriorated.	Replace the heater.
	The heater has a low heat capacity.	• Change to a heater with a high heat capacity. • If using two or more heaters, replace any heaters that have broken wires.
	The overheating prevention device has activated.	Increase the temperature setting of the overheating prevention device to a value higher than the SP of the E5AR/ER.
Settings	Direct action and reverse action settings are incorrect.	Set the correct settings.
	The PID values are not suitable.	• Run AT. • Set suitable PID values.
	Control has not been started.	Start control.
	The output does not increase due to MV limits.	Change the output limits to suitable values.
	The cooling fan is running.	Stop the cooling fan.

● The measured value rises above the SP

	Possible cause	Solution
Connections	Abnormal measured value.	See section 10.3.
	The load is connected to the wrong channel and the heater is being controlled by the control output of another channel.	Wire correctly.
	The contact of the control output drive relay has melted.	Replace the relay.
	Short-circuit failure in SSR.	Replace the SSR.
	Current flows to heater due to SSR leakage current.	Connect a bleeder resistor to prevent action due to leakage current.
Settings	Direct action and reverse action settings are incorrect.	Set the correct settings.
	The PID values are not suitable.	• Run AT. • Set suitable PID values.
	The output does not decrease due to MV limits.	Change the output limits to suitable values.
	Output is taking place in manual mode.	Stop manual mode.
Method of use	The object of control generates heat.	Use heating/cooling control.
	Large overshoot.	See the "Overshoot or undershoot" troubleshooting table.

● Overshoot or undershoot occurs

	Possible cause	Solution
Connections	Abnormal measured value.	See section 10.3.
	A regular slow thermal response temperature sensor is connected to a fast thermal response control system.	Change to a sheath-type temperature sensor.
Settings	The proportional band is too narrow; the P value is too small.	• Increase the P value within the limit that the response speed does not become too slow. • Run AT.
	The integral time is too short; the I value is too small.	• Increase the I value within the limit that the response speed does not become too slow. • Run AT.
	The derivative time is too short; the D value is too small.	• Increase the D value within the limit that stability during rectification does not deteriorate. • Run AT.
	ON/OFF control is being performed.	Use P control or PID control.
	The control period is too long in a fast thermal response control system.	Shorten the control period.
	Overlap band is mistakenly set as a dead band in heating/cooling control.	Set to overlap band.

● Hunting occurs

Check connections and settings as explained above in "Overshoot or undershoot occurs".

	Possible cause	Solution
Method of use	The heat capacity of the heater is too large for the heat capacity of the object of control.	Use a heater with a heat capacity suitable for the object of control.
	Periodic disturbances occur that cause the heat capacity of the object of control to change.	Establish an environment will minimal disturbances.
	AT is running.	Hunting will stop when AT ends.

10.5 Inferring causes from conditions (abnormal output)

● No control output. No alarm output.

	Possible cause	Solution
Connections	Abnormal temperature measurement.	See "10.3 Inferring causes from conditions (abnormal measured values)" (P.10-4).
	Incorrect load polarity or incorrect terminal connections.	Wire correctly.
	The connected load exceeds the output rating.	• Do not exceed the rating. • Repair in the event of a failure.
	A load power supply is not connected to a transistor output.	Use a power supply suitable for the output rating and load.
	The polarity of the load power supply connected to the transistor output is incorrect.	Wire correctly.
Settings	Operation is stopped after the power is turned on.	• Send the control start (run) command after turning on the power. • Set operation to continue at power-on.
	Control has not been started.	Send the control start (run) command.
	The wrong channel is specified.	Set the correct channel number.
	The wrong SP is set.	Set the correct SP.
	The wrong bank No. is specified.	Set the correct bank No.
	When bank No. specification is by event input, input ON or OFF is not held.	Hold the contact ON or OFF during specification.
	When bank No. specification is by event input, specification by communication was attempted.	The latest specification takes priority regardless of the bank No. specification method.
	The alarm mode is set to "0: No alarm".	Set the correct alarm mode.
	Alarm with wait sequence is specified.	Specify an alarm without a wait sequence.
	Deviation alarm is mistakenly set for absolute-value alarm, or vice-versa.	Set the correct alarm mode.

10.6 Inferring causes from conditions (communication problems)

● Cannot communicate. No response.

	Possible causes	Solution
Communication conditions	The communications speed differs from the host system.	Make sure that the communications speeds are the same.
	The communication conditions are different from the host system.	Make sure that the communication conditions are the same.
Connections	The number of parallel connections exceeds the rating.	Do not exceed the rating. • For RS-485, a maximum of 31 units can be connected.
	The length of the communication path exceeds the rating.	Do not exceed the rating. • For RS-485, the total maximum length is 500 m.
	Another unit has the same unit number.	Make sure there are no duplicate unit numbers.
	Noise is corrupting the communication data.	• Separate the communication cable from the noise source. • Use shielded communication cable. • Use an optical interface. • Have the program resend the command when a problem is detected in the response.
	Incorrect use of communication devices: • Optical interface • 232C-485 converter	Verify the method of use in the literature for each device.
	Incorrect installation of RS-485 terminators.	Install terminators only on the devices on the ends of the communication path.
Program	Communication begins as soon as the power of the E5AR/ER is turned on.	Wait at least 2 seconds before beginning communication after the power is turned on.
	Unstable signals that occur when the E5AR/ER is turned on or off are read as host system data.	Initialize the host system reception buffer at the following times: • Before sending the first command. • After the power of the E5AR/ER is turned off.
	The host system sends a command before receiving a response from the E5AR/ER.	Ensure that the program always reads the response after sending a command.
	The interval between receiving a response and sending the next command from the host system is too short.	Allow an interval of at least 5 ms after receiving a response before sending a command.
	Mistake in host system program.	• Correct the program. • Check the command in the line monitor. • Try running a sample program.
Settings	The unit number setting is different from the unit number specified in the command.	Make sure the unit numbers match.

Appendix

Specifications

■ Unit ratings

Power supply voltage[*1]		100 to 240 V AC 50/60 Hz	24 V DC 50/60 Hz/24 V DC
Allowed voltage variance range		85 to 110% of rating voltage	
Power consumption		E5AR: 22 VA max. E5ER: 17 VA max.	E5AR: 15 VA/10 W max. E5ER: 11 VA/7 W max.
Sensor input[*2]		Thermocouples: K, J, T, E, L, U, N, R, S, B, W Platinum resistance temperature input sensors: Pt100 Current input: 4 to 20 mA DC, 0 to 20 mA DC (including remote SP input) Voltage input: 1 to 5 V DC, 0 to 5 V DC, 0 to 10 V DC (including remote SP input) (Input impedance: 150 Ω using current input, approx. 1 MΩ using voltage input)	
Control output	Voltage (pulse) output	12 V DC, 40 mA max.[*3], with short-circuit protection circuit	
	Current output	0 to 20 mA DC/4 to 20 mA DC 500 Ω load max. (including transfer output) (Resolution: Approx. 54000 at 0 to 20 mA DC, approx. 43000 at 4 to 20 mA DC)	
	Relay output	Position proportional control type (open, close) 1a 250 V AC 1 A (including inrush current) (inductive load)	
Auxiliary output	Relay output	1a 250 V AC 1 A (resistive load)	
	Transistor output	Maximum load voltage 30 V DC, maximum load current 50 mA Residual voltage 1.5 V max., leakage current 0.4 mA max.	
Event input	Contact	Input ON: 1 kΩ max., OFF: 100 kΩ max.	
	Non-contact	Input ON: Residual voltage 1.5 V max., OFF: Leakage current 0.1 mA max.	
		Short-circuit current: Approx. 4 mA	
Remote SP input		See "Sensor input"	
Potentiometer input		100 Ω to 2.5 kΩ	
Transfer output		See "Control output"	
Control method		Advanced PID or ON/OFF	
Setting method		Digital setting by front panel keys, setting by communication	
Indicator method		7-segment digital display and LED indicators E5AR: Character height PV 12.8 mm, SV 7.7 mm, MV 7.7 mm E5ER: Character height PV 9.5 mm, SV 7.2 mm, MV 7.2 mm	
Other functions		Varies by model	
Ambient operating temperature		-10 to +55°C(no condensation or ice formation) / 3 year warranty: -10 to +50°C	
Ambient operating humidity		Relative humidity 25 to 85%	
Storage temperature		-25 to +65°C (no condensation or icing)	

*1 100 to 240V AC and 24 V AC/DC are on different models. Please specify when ordering.

*2 Multi-input. Switch between temperature and analog input by input type switch.
Basic insulation between power supply – input terminals, power supply – output terminals.

*3 The voltage output for E5AR-QQ□□□WW-□□□ is 21 mA max.

■ Unit performance specifications

Indication accuracy	Thermocouple input: (±0.1% of indication value or ±1°C, whichever is greater) ±1 digit max. *1 [Not using internal cold contact compensation] (+0.1% of indication value or ±1°C, whichever is smaller) ±1 digit max. *2 Analog input: (0.1% FS) ±1 digit max. Platinum resistance temperature sensor input: (±0.1% of indication value or ±0.5°C, whichever is greater) ±1 digit max. Position proportional potentiometer input: (±5% FS) ± 1 digit max.
Temperature variation influence *3 Voltage variation influence *3	Thermocouple input (R, S, B, W): (±1% of PV or ±10°C, whichever is greater) ±1 digit max. Other thermocouple input: (±1% of PV or ±4°C, whichever is greater) ±1 digit max. *K thermocouple at –100°C max: ±10°C max. Platinum resistance thermometer: (±1% of PV or ±2°C, whichever is greater) ±1 digit max. Analog input: (±1%FS) ±1 digit max.
Control mode	Standard control (heating control or cooling control), heating/cooling control Standard control with remote SP (2-input type only) Heating/cooling control with remote SP (2-input type only) Cascade standard control (2-input type only) Cascade heating/cooling control (2-input type only) Ratio control (2-input type only) Position proportional control (control valve control type only)
Control period	0.2 to 99.0 seconds (units of 0.1 seconds): During time-divided proportional control output
Proportional band (P)	0.00 to 999.99% FS (units of 0.01% FS)
Integral time (I)	0.0 to 3999.9 s (units of 0.1 second)
Derivative time (D)	0.0 to 3999.9 s (units of 0.1 second)
Hysteresis	0.01 to 99.99% FS (units of 0.01% FS)
Manual reset value	0.0 to 100.0% (units of 0.1% FS)
Alarm setting range	–19999 to 99999 *4 (Decimal point position depends on input type and decimal point position setting)
Input sampling period	50 ms
Insulation resistance	20 MΩ or higher (using 500 V DC insulation resistance tester)
Voltage resistance	2000 V AC 50/60 Hz 1 min (different pole, charging terminals)
Vibration tolerance	Vibration frequency: 10 to 55 Hz Acceleration: 20 m/s^2
Shock tolerance	150 m/s^2 (relay contacts: 100 m/s^2) 3 times each in 3 axes and 6 directions
Inrush current	100 to 240 V AC type: 50 A max. 24 V AC/DC type: 30 A max.
Weight	E5AR: Approx. 450 g (unit only), Fittings: Approx. 60 g, Terminal cover: Approx. 30 g
	E5ER: Approx. 330 g (unit only), Fittings: Approx. 60 g, Terminal cover: Approx. 16 g
Protective structure	Front: IP66, rear case: IP20, terminal plate: IP00
Memory protection	Non-volatile memory (Write count:100,000 times)

*1 K, T, N at -100°C max.: ±2°C ±1 digit max..
U and L: ±2°C ±1 digit max..
B at 400°C max. is not specified.
R and S at 200°C max.: ±3°C ±1 max..
W: (Larger of ±0.3%PV and ±3°C) ±1 digit max..

*2 U and L: ±1°C ±1 digit
R and S at 200°C max.: ±1.5°C ±1 digit.

*3 Ambient temperature: –10°C to 23°C to 55°C
Voltage range: –15% to +10% of rated voltage

*4 EU stands for "Engineering Units" and is regarded as the units after scaling. In the case of a temperature sensor, this is °C or °F.

Sensor input setting ranges · Indicator (control) ranges

Input type	Specification	Setting value	Input setting range °C	Input setting range °F	Display (control) range °C	Display (control) range °F
Platinum resistance temperature sensor	Pt100	0	-200.0 to 850.0	-300.0 to 1500.0	-305.0 to 955.0	-480.0.0 to 1680.0
	Pt100	1	-150.00 to 150.00	-199.99 to 300.00	-180.00 to 180.00	-249.99 to 350.00
Thermocouple	K	2	-200.0 to 1300.0	-300.0 to 2300.0	-350.0 to 1450.0	-560.0 to 2560.0
	K	3	-20.0 to 500.0	0.0 to 900.0	-72.0 to 552.0	-90.0 to 990.0
	J	4	-100.0 to 850.0	-100.0 to 1500.0	-195.0 to 945.0	-260.0 to 1660.0
	J	5	-20.0 to 400.0	0.0 to 750.0	-62.0 to 442.0	-75.0 to 825.0
	T	6	-200.0 to 400.0	-300.0 to 700.0	-260.0 to 460.0	-400.0 to 800.0
	E	7	0.0 to 600.0	0.0 to 1100.0	-60.0 to 660.0	-110.0 to 1210.0
	L	8	-100.0 to 850.0	-100.0 to 1500.0	-195.0 to 945.0	-260.0 to 1660.0
	U	9	-200.0 to 400.0	-300.0 to 700.0	-260.0 to 460.0	-400.0 to 800.0
	N	10	-200.0 to 1300.0	-300.0 to 2300.0	-350.0 to 1450.0	-560.0 to 2560.0
	R	11	0.0 to 1700.0	0.0 to 3000.0	-170.0 to 1870.0	-300.0 to 3300.0
	S	12	0.0 to 1700.0	0.0 to 3000.0	-170.0 to 1870.0	-300.0 to 3300.0
	B	13	100.0 to 1800.0	300.0 to 3200.0	-70.0 to 1970.0	-10.0 to 3490.0
	W	14	0.0 to 2300.0	0.0 to 4100.0	-230.0 to 2530.0	-410.0 to 4510.0
Analog input	4 to 20 mA 0 to 20 mA 1 to 5 V 0 to 5 V 0 to 10 V	15 16 17 18 19	One of following ranges depending on scaling: -19999 to 99999 -1999.9 to 9999.9 -199.99 to 999.99 -19.999 to 99.999 -1.9999 to 9.9999		-10 to 110% of setting range Maximum range: -19999 to 99999	

- Applicable input type standards are as follows:
  K, J, T, E, N, R, S, B : JIS C1602-1995
  L : Fe-CuNi, DIN43710-1985
  U : Cu-CuNi, DIN43710-1985
  W : W5Re/W26Re, ASTM E988-1990
  Pt100 : JIS C1604-1997, ICE751

ASCII Codes

Upper / Lower	0	1	2	3	4	5	6	7
0	NUL	DLE	SPACE	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	“	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	‘	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	¥	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

Appendix

Setting list

The setting list shows addresses for CompoWay/F communication and Modbus communication. Refer to the addresses of the protocol that you are using.

The hexadecimal values in the Setting (monitor) value column are the setting ranges in CompoWay/F and Modbus, and the values in parentheses ( ) are the actual setting ranges.

The monitor and setting values can be specified for each channel, and addresses include a channel identifier. The addresses in the variable area map are for channel 1. To specify addresses of other channels on a multi-point input type, refer to the table below.

Channel	Address	
	CompoWay/F	ModBus
1	Address in setting list in Appendix	Address in setting list in Appendix
2	Address in setting list in Appendix + 0100	Address in setting list in Appendix + 4000
3	Address in setting list in Appendix + 0200	Address in setting list in Appendix + 8000
4	Address in setting list in Appendix + 0300	Address in setting list in Appendix + C000

Communication monitor setting (C0 to C1)

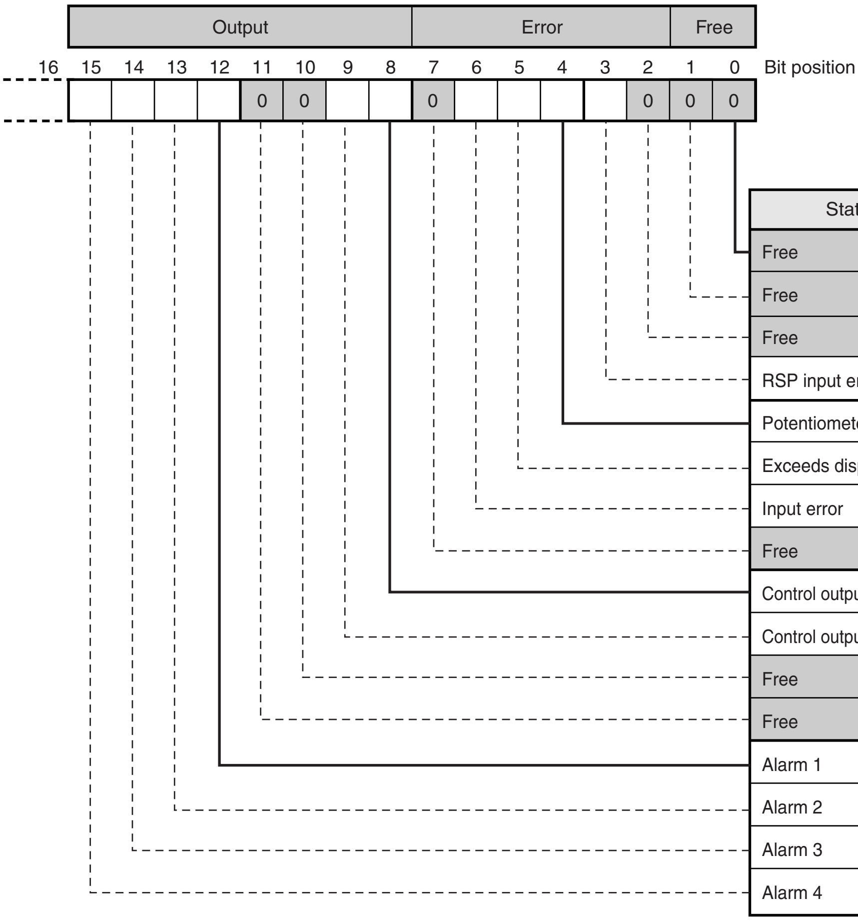
"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units
C0	0000	0000	Present Value(PV)	CH	–	According to specified input range	–	–	According to input type	EU
	0001	0002	Status	CH	–	Refer to following section.		–	–	–
	0002	0004	SP	CH	–	SP setting lower limit to SP setting upper limit	–	–	According to input type	EU
	0004	0008	MV monitor (heat)	CH	o	Standard: H'FFFFFFCE to H'0000041A (-5.0 to 105.0) Heat/cool: H'00000000 to H'0000041A (0.0 to 105.0)	-5.0 to 105.0 0.0 to 105.0	–	1	%
	0005	000A	MV monitor (cool)	CH	C-o	H'00000000 to H'0000041A (0.0 to 105.0)	0.0 to 105.0	–	1	%
C1	0003	0106	SP *1	CH	–	SP setting lower limit to SP setting upper limit	Same as at left	0	According to input type	EU
	0004	0108	Bank 0: Alarm value 1	CH	0.AL-1	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-9999 to 99999	0	According to input type	EU
	0005	010A	Bank 0: Alarm upper limit 1	CH	0.AL1H	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-9999 to 99999	0	According to input type	EU
	0006	010C	Bank 0: Alarm lower limit 1	CH	0.AL1L	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-9999 to 99999	0	According to input type	EU
	0007	010E	Bank 0: Alarm value 2	CH	0.AL-2	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-9999 to 99999	0	According to input type	EU
	0008	0110	Bank 0: Alarm upper limit 2	CH	0.AL2H	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-9999 to 99999	0	According to input type	EU
	0009	0112	Bank 0: Alarm lower limit 2	CH	0.AL2L	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-9999 to 99999	0	According to input type	EU

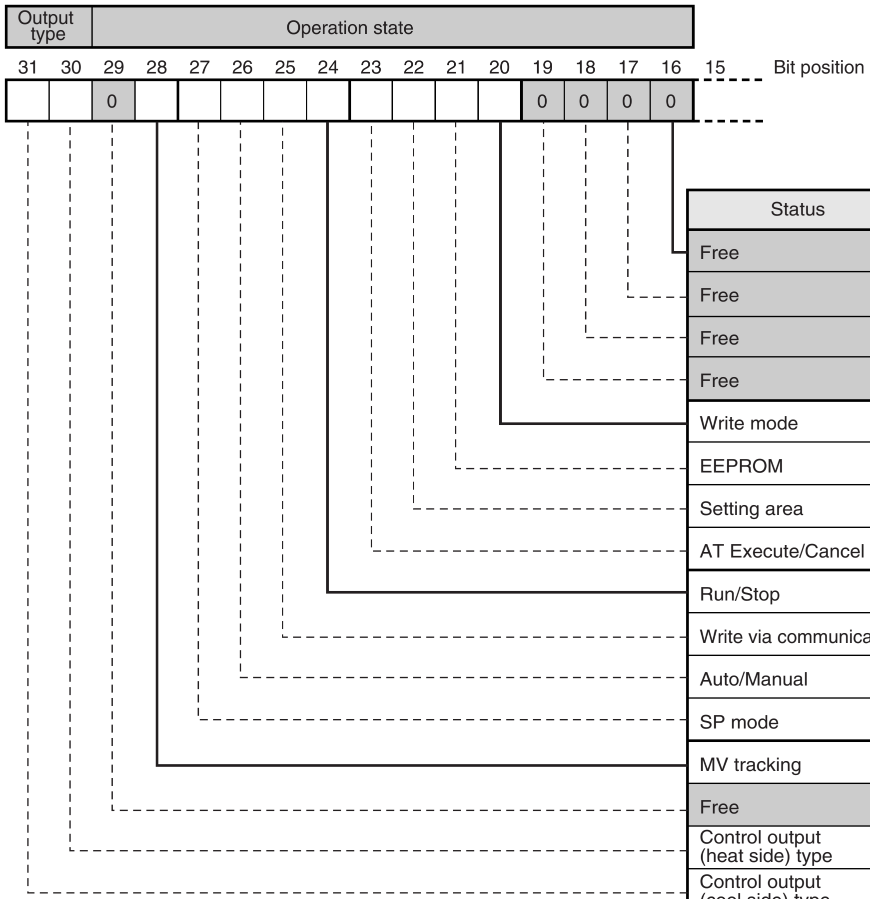
*1 .... Local SP of bank number selected for execution.

Appendix

Status (E5□R) (Communication/CompoWay/F)



Status	0 (OFF)	1(ON)
Free	OFF	–
Free	OFF	–
Free	OFF	–
RSP input error	Not occurred	Occurred
Potentiometer error	Not occurred	Occurred
Exceeds display range	Not occurred	Occurred
Input error	Not occurred	Occurred
Free	OFF	–
Control output (heat side)	OFF	ON
Control output (cool side)	OFF	ON
Free	OFF	–
Free	OFF	–
Alarm 1	OFF	ON
Alarm 2	OFF	ON
Alarm 3	OFF	ON
Alarm 4	OFF	ON



Status	0 (OFF)	1(ON)
Free	OFF	–
Free	OFF	–
Free	OFF	–
Free	OFF	–
Write mode	Backup	RAM write
EEPROM	RAM = "EEPROM"	RAM ≠ "EEPROM"
Setting area	Setting area 0	Setting area 1
AT Execute/Cancel	AT stopped	AT run in progress
Run/Stop	Run	Stop
Write via communication	OFF (plohibited)	ON (permitted)
Auto/Manual	Auto	Manual
SP mode	Local SP (LSP)	RSP
MV tracking	OFF	ON
Free	OFF	–
Control output (heat side) type	Pulse voltage output	inear current output
Control output (cool side) type	Pulse voltage output	inear current output

* As follows when read in setting area 1:

- RSP input error : Clear
- Potentiometer error : Clear
- Display range exceeded : Clear
- Input error : Clear
- Control output (heating), control output (cooling) : Clear
- Alarm 1, Alarm 2, Alarm 3, Alarm 4 : Clear
- AT : Clear
- Run/Stop : ON (stop)
- Auto/Manual : Hold previous value
- SP mode, MV tracking : Update
- Control output (heating), control output (cooling) : Update

* Control output (heating) and control output (cooling) are respectively open output and close output during position proportional control.

* Control output (heating) and control output (cooling) are normally OFF during linear output.

* The control output heating type and/or control output cooling type is off when the corresponding output is pulse voltage output.

Appendix

Communication monitor (C4)

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F		Modbus	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units
Variable type	Address	Address								
C4	0000	0400	Version	Common	–	000 to FFF *1	–	–	–	–
	0001	0402	Modified type	Common	–	000 to FFF	–	–	–	–
	0002	0404	Present Value(PV)	CH	–	According to specified input range	–	–	According to input type	EU
	0003	0406	SP	CH	–	*2	–	–	According to input type	EU
	0004	0408	Bank No. monitor	CH	–	H'00000000 to H'00000007 (0 to 7)	0 to 7	–	–	–
	0005	040A	PID set No. monitor	CH	–	H'00000001 to H'00000008 (1 to 8)	1 to 8	–	–	–
	0006	040C	Status	CH	–	Refer to previous section.	–	–	–	–

*1 .... 00000123 for Ver. 1.23
*2 .... In Local SP mode: SP setting lower limit to SP setting upper limit
In remote SP mode: Remote SP lower limit to remote SP upper limit (Note that SP limits are in effect)
During PV tracking: Determined by input type and decimal point position settings.

Protect level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F		Modbus	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
Variable type	Address	Address									
C5	0000	0500	Operation Adjustment Protect	Common	oAPt	H'00000000 to H'00000004 (0 to 4)	0 to 4	0	-	-	
	0001	0502	Initial setting protect	Common	ICPt	H'00000000 to H'00000002 (0 to 2)	0 to 2	0	-	-	
	0002	0504	Setting change protect	Common	WtPt	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	-	-	
	0003	0506	PF key protect	Common	PFPt	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	-	-	

Operation level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
C6	–	–	PV	CH	–	Specified range of sensor input	–	–	*1	EU	
	0000	0600	Manual MV *2	CH	–	Standard: H'00000000 to H'0000041A (-5.0 to 105.0) Heat/cool: H'FFFFFBE6 to H'0000041A (-105.0 to 105.0) Position proportional: H'FFFFFF9C to H'0000044C (-10.0 to 110.0)	-5.0 to 105.0 -105.0 to 105.0 -10.0 to 110.0	–	1	%	
	0001	0602	SP *3	CH	–	SP setting lower limit to SP setting upper limit	Same as at left	0	According to input type	EU	
	0002	0604	Remote SP monitor	CH	r-SP	Remote SP lower limit to remote SP upper limit	Same as at left	–	According to input type	EU	
	0003	0606	Ramp SP monitor	CH	SP-M	SP setting lower limit to SP setting upper limit *4	Same as at left	–	According to input type	EU	
	0005	060A	MV monitor (heat)	CH	o	H'00000000 to H'0000041A (0.0 to 105.0)	-5.0 to 105.0 0.0 to 105.0	–	1	%	
	0006	060C	MV monitor (cool)	CH	C-o	H'00000000 to H'0000041A (0.0 to 105.0)	0.0 to 105.0	–	1	%	
	0007	060E	Valve opening monitor	CH	v-M	H'FFFFFF9C to H'0000044C (-10.0 to 110.0)	-10.0 to 110.0	–	1	%	
	–	–	Run/Stop	CH	r-S	RUN (0) STOP (1)	rUn, StoP	RUN	–	% –	
	–	–	Auto/Manual	CH	A-M	AUTO (0) MANU (1)	AUto, MAnU	AUTO	–	–	

*1 .... Determined by input type and "Display below PV decimal point" settings.
*2 .... In position proportional control, change is only possible from HMI.
*3 .... Present Value (PV) /SP" has the following 3 displays, and the HMI display is enabled using "Present Value (PV) /SP" display screen selection.
Display 1: Present Value (PV) / SP/Bank No.
Display 2: Present Value (PV) /SP/MV (valve opening during position proportional control)
Display 3: Present Value (PV) /SP/Bank No.
The setting (monitor) values for each are as follows:
PV: Specified range of sensor input
SP
In Local SP mode : SP setting lower limit to SP setting upper limit
In remote SP mode : Remote SP lower limit to remote SP upper limit (Note that SP limits are in effect)
During Present Value (PV) tracking : Determined by input type and decimal point position settings.
MV
Standard / heat/cool : -5.0 to 105.0
Position proportional : -10.0 to 110.0
Bank No.: 0 to 7
*4 .... Note that SP limits are in effect

Adjustment level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
C7	–	–	Bank No.	CH	bAnK	(0 to 7)	0 to 7	0	–	–	
	–	–	AT Execute/Cancel	CH	At	OFF (-1) (0 to 8)	oFF, 0 to 8	OFF	–	–	
	–	–	Write via communication	Common	CmWt	OFF (0) ON (0)	oFF, on	OFF	–	–	
	–	–	SP mode (Remote/Local)*1	CH	SPmd	Local SP (LSP)(0) RSP (1)	LSP, rSP	Local SP (LSP)	–	–	
	0000	0700	Cooling coefficient	CH	C-SC	H'00000001 to H'0000270F (0.01 to 99.99)	0.01 to 99.99	1.00	2	–	
	0004	0708	Dead band	CH	C-db	H'FFFFF831 to H'0000270F (-19.99 to 99.99)	- 19.99 to 99.99	0.00	2	%FS	
	0005	070A	Manual reset value	CH	oF-r	H'00000000 to H'000003E8 (0.0 to 100.0)	0.0 to 100.0	50.0	1	%	
	0006	070C	Hysteresis (heat)	CH	HYS	H'00000001 to H'0000270F (0.01 to 99.99)	0.01 to 99.99	0.10	2	%FS	
	0007	070E	Hysteresis (cool)	CH	CHYS	H'00000001 to H'0000270F (0.01 to 99.99)	0.01 to 99.99	0.10	2	%FS	
	0008	0710	Control period (heat)	CH	CP	H'00000002 to H'000003DE (0.2 to 99.0)	0.2 to 99.0	20.0	1	Seconds	
	0009	0712	Control period (cool)	CH	C-CP	H'00000002 to H'000003DE (0.2 to 99.0)	0.2 to 99.0	20.0	1	Seconds	
	000A	0714	Position proportional dead band	CH	db	H'00000001 to H'00000064 (0.1 to 10.0)	0.1 to 10.0	2.0	1	%	
	000B	0716	Open/Close hysteresis	CH	oC-H	H'00000001 to H'000000C8 (0.1 to 20.0)	0.1 to 20.0	0.8	1	%	
	000C	0718	SP ramp time unit	CH	SPrU	H'00000000: EU/sec: S (0) H'00000001: EU/min: M (1) H'00000002:EU/hour: H (2)	S, m, H	M	–	–	
	000D	071A	SP ramp rise value	CH	SPrH	H'00000000 to H'0001869F (0 to 99999 (0: Disabled SP ramp function))	0 to 99999	0	According to input type	EU	
	000E	071C	SP ramp fall value	CH	SPrL	H'00000000 to H'0001869F (0 to 99999 (0: Disabled SP ramp function))	0 to 99999	0	According to input type	EU	
	000F	071E	MV at stop (standard / heat / cool)	CH	mV-S	Standard: H'FFFFFFCE to H'0000041A (-5.0 to 105.0) Heat / cool: H'FFFFFBE6 to H'0000041A (-105.0 to 105.0)	-5.0 to 105.0 - 105.0 to 105.0	0.0	1	%	
	0010	0720	MV at stop (position proportional)	CH	mV-S	H'FFFFFFFF:-1 (completely open) H'00000000: 0 (hold) H'00000001:1(completely open)	- 1, 0, 1	0	–	–	
	0011	0722	MV at PV error (standard / heat / cool)	CH	mV-E	Standard: H'FFFFFFCE to H'0000041A (-5.0 to 105.0) Heat / cool: H'FFFFFBE6 to H'0000041A (-105.0 to 105.0)	-5.0 to 105.0 - 105.0 to 105.0	0.0	1	%	
	0012	0724	MV at PV error (position proportional)	CH	mV-E	H'FFFFFFFF:-1 (completely open) H'00000000: 0 (hold) H'00000001:1(completely open)	- 1, 0, 1	0	–	–	
	0013	0726	MV change rate limit (heat)	CH	orL	H'00000000 to H'000003E8 (0.0 to 100.0 (0.0: Limiter disabled))	0.0 to 100.0	0.0	1	%/S	
	0014	0728	MV change rate limit (cool)	CH	CorL	H'00000000 to H'000003E8 (0.0 to 100.0 (0.0: Limiter disabled))	0.0 to 100.0	0.0	1	%/S	

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
C7	0015	072A	Input value 1 for input correction	CH	isi.1	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	-200.0 *2	According to input type	EU	
	0016	072C	Input correction 1	CH	iss.1	H'FFFFB1E1 to H'0001869F (-199.99 to 999.99)	-199.99 to 999.99	0.00	2	EU	
	0017	072E	Input value 2 for input correction	CH	isi.2	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	1300.0 *2	According to input type	EU	
	0018	0730	Input correction 2	CH	iss.2	H'FFFFB1E1 to H'0001869F (-199.99 to 999.99)	-199.99 to 999.99	0.00	2	EU	
	001F	073E	Disturbance gain	CH	dogn	H'FFFFFF9C to H'00000064 (-1.00 to 1.00)	-1.00 to 1.00	0.65	2	–	
	0020	0740	Disturbance time constant	CH	dotc	H'00000001 to H'0000270F (0.01 to 99.99)	0.01 to 99.99	1.00	2	–	
	0021	0742	Disturbance rectification band	CH	do-b	H'00000000 to H'0000270F (0.000 to 9.999)	0.000 to 9.999	0.000	3	%FS	
	0022	0744	Disturbance judgement width	CH	dojw	H'FFFFD8F1 to H'0000270F (-99.99 to 99.99)	-99.99 to 99.99	0.00	2	%FS	

*1 .... In Cascade control
Remote SP mode = Cascade closed
Local SP mode = Cascade open
*2 .... When the input type, temperature unit, or scaling display value is changed, settings are initialized as follows:
Temperature input: Set upper and lower limits of sensor input
Analog input: Scaling display value 1 (lower-limit), 2 (upper-limit)

Adjustment level 2

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
C8	0000	0800	First order lag operation 1: Time constant	Common	LAGP.1	H'00000000 to H'0000270F (0.0 to 999.9)	0.0 to 999.9	0.0	1	Seconds	
	0001	0802	First order lag operation 2: Time constant	Common	LAGP.2	H'00000000 to H'0000270F (0.0 to 999.9)	0.0 to 999.9	0.0	1	Seconds	
	0002	0804	First order lag operation 3: Time constant	Common	LAGP.3	H'00000000 to H'0000270F (0.0 to 999.9)	0.0 to 999.9	0.0	1	Seconds	
	0003	0806	First order lag operation 4: Time constant	Common	LAGP.4	H'00000000 to H'0000270F (0.0 to 999.9)	0.0 to 999.9	0.0	1	Seconds	
	0004	0808	Move average 1: Move average count	Common	MAvP.1	H'00000000 to H'00000005 (1/2/4/8/16/32 times (Setting values using communication are 0/1/2/3/4/5))	1, 2, 4, 8, 16, 32	1	–	times	
	0005	080A	Move average 2: Move average count	Common	MAvP.2	H'00000000 to H'00000005 (1/2/4/8/16/32 times (Setting values using communication are 0/1/2/3/4/5))	1, 2, 4, 8, 16, 32	1	–	times	
	0006	080C	Move average 3: Move average count	Common	MAvP.3	H'00000000 to H'00000005 (1/2/4/8/16/32 times (Setting values using communication are 0/1/2/3/4/5))	1, 2, 4, 8, 16, 32	1	–	times	
	0007	080E	Move average 4: Move average count	Common	MAvP.4	H'00000000 to H'00000005 (1/2/4/8/16/32 times (Setting values using communication are 0/1/2/3/4/5))	1, 2, 4, 8, 16, 32	1	–	times	
	0008	0810	Extraction of square root 1 low-cut point	Common	SQrP.1	H'00000000 to H'0000270F (0.0 to 9.999)	0.000 to 9.999	0.000	3	– *	
	0009	0812	Extraction of square root 2 low-cut point	Common	SQrP.2	H'00000000 to H'0000270F (0.0 to 9.999)	0.000 to 9.999	0.000	3	1	
	000A	0814	Extraction of square root 3 low-cut point	Common	SQrP.3	H'00000000 to H'0000270F (0.0 to 9.999)	0.000 to 9.999	0.000	3	– *	
	000B	0816	Extraction of square root 4 low-cut point	Common	SQrP.4	H'00000000 to H'0000270F (0.0 to 9.999)	0.000 to 9.999	0.000	3	1	
	000C	0818	Analog parameter (control proportion)	Common	AP.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	1.000	3	– *	

*1 .... These are set values for each of the operation functions. Set normalized values based on the input data for the operation function.
When a straight-line approximation is included in the input stage of input type K -200.0 to 1300.0°C, -200.0 to 1300.0°C is equivalent to the normalized value 0.000 to 1.000.

Bank setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F		Modbus	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
Variable type	Address	Address									
C9	–	–	Display bank selection	CH	d.bnK	0 to 7	0 to 7	*1	–	–	
	0000	0900	Bank 0 local SP (LSP)	CH	0.LSP	SP setting lower limit to SP setting upper limit	Same as at left	0	According to input type	EU	
	0001	0902	Bank 0 PID set number	CH	0.PId	H'00000000 to H'00000008 (0 to 8 (0: Auto selection))	0 to 8	0	–	–	
	0002	0904	Bank 0 alarm value 1	CH	0.AL-1	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	0003	0906	Bank 0 alarm upper limit 1	CH	0.AL1H	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	0004	0908	Bank 0 alarm lower limit 1	CH	0.AL1L	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	0005	090A	Bank 0 alarm value 2	CH	0.AL-2	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	0006	090C	Bank 0 alarm upper limit 2	CH	0.AL2H	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	0007	090E	Bank 0 alarm lower limit 2	CH	0.AL2L	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	0008	0910	Bank 0 alarm value 3	CH	0.AL-3	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	0009	0912	Bank 0 alarm upper limit 3	CH	0.AL3H	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	000A	0914	Bank 0 alarm lower limit 3	CH	0.AL3L	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	000B	0916	Bank 0 alarm value 4	CH	0.AL-4	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	000C	0918	Bank 0 alarm upper limit 4	CH	0.AL4H	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	000D	091A	Bank 0 alarm lower limit 4	CH	0.AL4L	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	0	According to input type	EU	
	000E	091C	Bank 1 local SP (LSP)	CH	1.LSP	The following is the same as Bank 0					
			~	CH							
	001C	0938	Bank 2 local SP (LSP)	CH	2.LSP						
			~	CH							
	002A	0954	Bank 3 local SP (LSP)	CH	3.LSP						
			~	CH							
	0038	0970	Bank 4 local SP (LSP)	CH	4.LSP						
			~	CH							
	0046	098C	Bank 5 local SP (LSP)	CH	5.LSP						
			~	CH							
	0054	09A8	Bank 6 local SP (LSP)	CH	6.LSP						
			~	CH							
	0062	09C4	Bank 7 local SP (LSP)	CH	7.LSP						
			~	CH							
	006F	09DE	Bank 7 alarm lower limit 4	CH	7.AL4L						

*1 .... Bank number selected for execution.

PID setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CA	–	–	Display PID selection	CH	d.PId	H'00000001 to H'00000008 (1 to 8)	1 to 8	*5	–	–	
	0000	0A00	PID 1 proportional band	CH	1.P	Standard / Heat / cool: H'00000000 to H'0001869F (0.00 to 999.99) Position proportional: H'00000001 to H'0001869F (0.01 to 999.99)	0.00 to 999.99 0.01 to 999.99	10.00	2	%FS	
	0001	0A02	PID 1 integral time	CH	1.I	Standard / Heat / cool / Position proportional (closed, operation stops at potentiometer input error): H'00000000 to H'00009C3F (0.0 to 3999.9) Position proportional (closed, operation continues or floats at potentiometer input error) : H'00000001 to H'00009C3F (0.1 to 3999.9)	0.0 to 3999.9 0.1 to 3999.9	233.0	1	Seconds	
	0002	0A04	PID 1 derivative time	CH	1.d	H'00000000 to H'00009C3F (0.0 to 3999.9)	0.0 to 3999.9	40.0	1	Seconds	
	0003	0A06	PID 1 integral time *1	CH	–	Standard/Heat/cool/Position proportional (closed, operation stops at potentiometer input error) : H'00000000 to H'00061A76 (0.00 to 3999.90) Position proportional (closed, operation continues or floats at potentiometer input error) : H'0000000A to H'00061A76 (0.10 to 3999.90)	–	233.00	2	Seconds	
	0004	0A08	PID 1 derivative time *1	CH	–	H'00000000 to H'00061A76 (0.00 to 3999.90)	–	40.00	2	Seconds	
	0005	0A0A	PID 1 MV upper limit	CH	1.oL-H	Standard: MV lower limit +0.1 to H'0000041A (105.0) Heat/cool: H'00000000 to H'0000041A (0.0 to 105.0)	Same as at left	100.0	1	%	
	0006	0A0C	PID 1 MV lower limit	CH	1.oL-L	Standard: H'FFFFFFCE (-5.0) to MV upper limit -0.1 Heat / cool: H'0000041A to H'00000000 (-105.0 to 0.0)	Same as at left	0.0	1	%	
	0007	0A0E	PID 1 automatic selection range upper limit (PV)	CH	1.AUt	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	1450.0 *2	According to input type	EU	
	0008	0A10	PID 1 automatic selection range upper limit (DV)	CH	1.AUt	H'FFFFB1E1 to H'0001869F (-19999 to 99999)	-19999 to 99999	1650.0 *3	According to input type	EU	
	0009	0A12	PID 2 proportional band	CH	2.P	The following is the same as PID1					
			~	CH							
	0012	0A24	PID 3 proportional band	CH	3.P						
			~	CH							
	001B	0A36	PID 4 proportional band	CH	4.P						
			~	CH							
	0024	0A48	PID 5 proportional band	CH	5.P						
			~	CH							
	002D	0A5A	PID 6 proportional band	CH	6.P						
			~	CH							

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CA	0036	0A6C	PID 7 proportional band	CH	7.P						
			~	CH							
	003F	0A7E	PID 8 proportional band	CH	8.P						
			~	CH							
	0046	0A8C	PID 8 automatic selection range upper limit (PV)	CH	8.AUt	Same as display range of "Present value (PV)" *2		1450.0	According to input type	EU	
	0047	0A8E	PID 8 automatic selection range upper limit (DV)	CH	8.AUt	Temperature input: Specified range of sensor input Analog input: -110% to 110% of scaling range However, maximum is H'FFFFB1E1 to H'0001869F (-19999 to 99999) *4		1650.0	According to input type	EU	

*1 .... Not displayed in HMI.
*2 .... Specified upper limit of input
The maximum is -19999 to 99999.
*3 .... Temperature input: Specified range width of sensor input
Analog input: -110% to 110% of scaling range width
The maximum is -19999 to 99999.
*4 .... The upper limit of the automatic selection range of PID set No. 8 is fixed at 999.99% FS for internal data (this can be changed but it will not affect operation).
*5 .... Selected PID set number.

Approximation setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CB	0000	0B00	Straight-line approximation 1 input 1	Common	Si 1.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	
	0001	0B02	Straight-line approximation 1 input 2	Common	Si2.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	1.000	3	–*1	
	0002	0B04	Straight-line approximation 1 output 1	Common	So 1.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	
	0003	0B06	Straight-line approximation 1 output 2	Common	So2.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	1.000	3	–*1	
	0004	0B08	Straight-line approximation 2 input 1	Common	Si 1.2	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	
	0005	0B0A	Straight-line approximation 2 input 2	Common	Si2.2	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	1.000	3	–*1	
	0006	0B0C	Straight-line approximation 2 output 1	Common	So 1.2	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	
	0007	0B0E	Straight-line approximation 2 output 2	Common	So2.2	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	1.000	3	–*1	
	0010	0B20	Broken-line approximation 1 input 1	Common	Fi01.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	
			~								
	0023	0B46	Broken-line approximation 1 input 20	Common	Fi20.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	
	0024	0B48	Broken-line approximation 1 output 1	Common	Fo01.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	
			~								
	0037	0B6E	Broken-line approximation 1 output 20	Common	Fo20.1	H'FFFFF831 to H'0000270F (-1.999 to 9.999)	-1.999 to 9.999	0.000	3	–*1	

*1 .... These are set values for each of the operation functions. Set normalized values based on the input data for the operation function.
When a straight-line approximation is included in the input stage of input type K -200.0 to 1300.0°C, -200.0 to 1300.0°C is equivalent to the normalized value 0.000 to 1.000.

Input initial setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CC	0000	0C00	Input 1 type	Common	i1-t	H'00000000:Pt100 (0) H'00000001:Pt100 (1) H'00000002:K (2) H'00000003:K (3) H'00000004:J (4) H'00000005:J (5) H'00000006:T (6) H'00000007:E (7) H'00000008:L (8) H'00000009:U (9) H'0000000A:N (10) H'0000000B:R (11) H'0000000C:S (12) H'0000000D:B (13) H'0000000E:W (14) H'0000000F:4 to 20 mA (15) H'00000010:0 to 20 mA (16) H'00000011:1 to 5 V (17) H'00000012:0 to 5 V (18) H'00000013:0 to 10 V (19)	0 to 19	2 *4	–	–	
	0001	0C02	Input 1 temperature units	Common	i1dU	H'00000000: °C (0) H'00000001: F (1)	C, F	°C	–	–	
	0002	0C04	Input 2 type	Common	i2-t	Input 1: Same as input type	0 to 19	2 *4	–	–	
	0003	0C06	Input 2 temperature units	Common	i2dU	H'00000000:°C (0) H'00000001: F (1)	C, F	°C	–	–	
	0004	0C08	Input 3 type	Common	i3-t	Input 1: Same as input type	0 to 19	2 *4	–	–	
	0005	0C0A	Input 3 temperature units	Common	i3dU	H'00000000: °C (0) H'00000001: F (1)	C, F	°C	–	–	
	0006	0C0C	Input 4 type	Common	i4-t	Input 1: Same as input type	0 to 19	2 *4	–	–	
	0007	0C0E	Input 4 temperature units	Common	i4dU	H'00000000: °C (0) H'00000001: F (1)	C, F	°C	–	–	
	0008	0C10	Scaling input value 1	CH	inP.1	Input lower-limit to input upper-limit	Same as at left	4 *3	0	*2	
	0009	0C12	Scaling display value 1	CH	dSP.1	H'FFFFB1E1 (-19999) to scalling display value 2-1	Same as at left	0	–	EU	
	000A	0C14	Scaling input value 2	CH	inP.2	Input lower-limit to input upper-limit	Same as at left	20 *3	0	*2	
	000B	0C16	Scaling display value 2	CH	dSP.2	Scaling display value 1+1 to H'0000270F (99999)	Same as at left	100	–	EU	
	000C	0C18	Decimal point position	CH	dP	H'00000000 to H'00000004 (0 to 4)	0 to 4	0	–	–	
	000D	0C1A	Remote SP upper limit	CH	rSPH	Temperature: Lower limit of sensor setting range to upper limit of sensor setting range Analog: Larger of -19999 and "display value equivalent to input lower limit" to smaller of 99999 and "display value equivalent to upper input limit"	Same as at left	1300	According to input type	EU	
	000E	0C1C	Remote SP lower limit	CH	rSPL	Temperature: Sensor setting range to upper limit of sensor setting range Analog: Larger of -19999 and "display value equivalent to input lower limit" to smaller of 99999 and "display value equivalent to input upper limit"	Same as at left	-200	According to input type	EU	
	000F	0C1E	PV decimal point display	CH	PvdP	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	ON	–	–	
	0010	0C20	Sensor induction noise reduction	Common	SnC	H'00000000:50 Hz (0) H'00000001:60 Hz (1)	50Hz, 60Hz	50 Hz	–	–	
	–	–	Move to advanced function setting level	Common	Amov	H'FFFFF831 to H'0000270F (-1999 to 9999)	-1999 to 9999	0	–	–	

*1 .... Input type settings are 0 to 14 for temperature input and 15 to 19 for analog input as determined by the input type switch (under the unit).
*2 .... Determined by input type setting.
*3 .... Initializes to upper-and lower-limits of input when the input type is changed.
*4 .... The default value for the input type is "2" regardless of the setting of the input type switch.

Appendix

Control initial setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CD	0000	0D00	Output 1 type	Common	o1-t	H'00000000: Pulse voltage output (0) H'00000001: Linear current output (1)	0 to 1	0	–	–	
	0001	0D02	Output 3 type	Common	o3-t	H'00000000: Pulse voltage output (0) H'00000001: Linear current output (1)	0 to 1	0	–	–	
	0003	0D06	Linear current output 1 type	Common	Co1-t	H'00000000: 0 to 20 mA (0) H'00000001: 4 to 20 mA (1)	0 to 1	1	–	–	
	0004	0D08	Linear current output 2 type	Common	Co2-t	H'00000000: 0 to 20 mA (0) H'00000001: 4 to 20 mA (1)	0 to 1	1	–	–	
	0005	0D0A	Linear current output 3 type	Common	Co3-t	H'00000000: 0 to 20 mA (0) H'00000001: 4 to 20 mA (1)	0 to 1	1	–	–	
	0006	0D0C	Linear current output 4 type	Common	Co4-t	H'00000000: 0 to 20 mA (0) H'00000001: 4 to 20 mA (1)	0 to 1	1	–	–	
	000F	0D1E	SP upper limit	CH	SL-H	SP setting lower limit + 1 to input range upper limit (temperature) SP setting lower limit + 1 to H'0001869F (lesser of 99999 or display value equivalent of input upper limit) (analog)	Same as at left	1300.0 *1	According to input type	EU	
	0010	0D20	SP lower limit	CH	SL-L	Lower limit of input range to SP lower limit - 1 (temperature) Larger of H'FFFFB1E1 (-19999) and display value equivalent of input lower value to SP upper limit - 1 (analog)	Same as at left	-200.0 *1	According to input type	EU	
	0011	0D22	Control mode	Common	mode	1-input type, 4-input type H'00000000: Standard (0) H'00000001: Heat/cool (1) 2-input type H'00000000: Standard (0) H'00000001: Heat/cool (1) H'00000002: Remote SP standard (2) H'00000003: Remote SP heating/cooling (3) H'00000004: Proportional (4) H'00000005: Cascade standard (5) H'00000006: Cascade heating or cooling (6)	–	0	–	–	
	0012	0D24	Forward/reverse operation	CH	orEv	H'00000000: Reverse action: OR-R (0) H'00000001: Direct action: OR-D (1)	or-r, or-d	Reverse action	–	–	
	0013	0D26	Closed/floating	CH	CLFL	H'00000000: Floating: FLOAT (0) H'00000001: Close: CLOSE (1)	FLoAt, CLoSE	Floating	–	–	

*1 .... When the input type, temperature units, or scaling display value is changed, settings are initialized as follows:
Temperature input: Set upper and lower limits of sensor input
Analog input: Scaling display value 1 (lower limit), 2 (upper limit)

Control initial setting 2 level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F		Modbus	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
Variable type	Address	Address									
CE	0006	0E0C	Control/Transfer output 1 allocation	Common	oUt.1	H'00000000: Disabled (0) H'00000001: CH1 control output (heating side or open side) For control output (1) H'00000002: CH1 control output (heating side or closed side) For control output (2) H'00000003: CH1 SP (3) H'00000004: CH1 ramp SP (4) H'00000005:CH1 Present Value(PV) (5) H'00000006:CH1 control output (heating side or open side) For transfer output (6) H'00000007:CH1 control output (cooling side or closed side) For transfer output (7) H'00000008: CH1 valve opening (8) Similarly, H'00000009 to H'00000010: CH2 (9 to 15) H'00000011 to H'00000018: CH3 (17 to 23) H'00000019 to H'00000020: CH4 (25 to 31)	0 to 32	*2 (P.A-22)	–	–	
	0007	0E0E	Control/Transfer output 2 allocation	Common	oUt.2	Same as above	Same as above	Same as above	–	–	
	0008	0E10	Control/Transfer output 3 allocation	Common	oUt.3	Same as above	Same as above	Same as above	–	–	
	0009	0E12	Control/Transfer output 4 allocation	Common	oUt.4	Same as above	Same as above	Same as above	–	–	
	000A	0E14	Event input 1 allocation	Common	Ev.1	H'00000000: Disabled (0) H'00000001: Write via communication OFF/ON (1) H'00000002: CH1 Bank (bit 0) (2) H'00000003: CH1 Bank (bit 1) (3) H'00000004: CH1 Bank (bit 2) (4) H'00000005: CH1 Run/stop (5) H'00000006: CH1 Auto/manual (6) H'00000007: CH1 SP mode (remote/local) (7) Similarly, H'00000008 to H'0000000D: CH2 (8 to 13) H'0000000E to H'00000013: CH3 (14 to 19) H'00000014 to H'00000019: CH4 (20 to 25)	0 to 25	0	–	–	
	000B	0E16	Event input 2 allocation	Common	Ev.2	Same as above	Same as above	Same as above	–	–	
	000C	0E18	Event input 3 allocation	Common	Ev.3	Same as above	Same as above	Same as above	–	–	
	000D	0E1A	Event input 4 allocation	Common	Ev.4	Same as above	Same as above	Same as above	–	–	
	000E	0E1C	Event input 5 allocation	Common	Ev.5	Same as above	Same as above	Same as above	–	–	
	000F	0E1E	Event input 6 allocation	Common	Ev.6	Same as above	Same as above	Same as above	–	–	

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CE	0010	0E20	Auxiliary output 1 allocation	Common	Sbo.1	H'00000000: Disabled (0) H'00000001: CH1 Alarm 1 (1) H'00000002: CH1 Alarm 2 (2) H'00000003: CH1 Alarm 3 (3) H'00000004: CH1 Alarm 4 (4) H'00000005: CH1 Input error (5) H'00000006:CH1RSP Input error (6) H'00000007: – H'00000008: U-ALM (8) H'00000009: All channels Alarm 1 OR output (9) H'0000000A: All channels Alarm 2 OR output (10) H'0000000B: All channels Alarm 3 OR output (11) H'0000000C: All channels Alarm 4 OR output (12) H'0000000D: All channels input error OR output (13) H'0000000E:All channels RSP input error OR output (14) H'0000000F: – H'00000010: CH2 Alarm 1 (16) H'00000011: CH2 Alarm 2 (17) H'00000012: CH2 Alarm 3 (18) H'00000013: CH2 Alarm 4 (19) H'00000014: CH2 Input error (20) H'00000015: CH2 RSP input error (21) H'00000016: – Similarly, H'00000017 to H'0000001D: CH3 (23 to 29) H'0000001D to H'00000024: CH4 (30 to 36)	0 to 36	1	–	–	
	0011	0E22	Auxiliary output 2 allocation	Common	Sbo.2	Same as above	Same as above	2	–	–	
	0012	0E24	Auxiliary output 3 allocation	Common	Sbo.3	Same as above	Same as above	3	–	–	
	0013	0E26	Auxiliary output 4 allocation	Common	Sbo.4	Same as above	Same as above	4	–	–	
	0014	0E28	Transfer output 1 upper-limit	Common	trH.1	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	0015	0E2A	Transfer output 1 lower-limit	Common	trL.1	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	0016	0E2C	Transfer output 2 upper-limit	Common	trH.2	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	0017	0E2E	Transfer output 2 lower-limit	Common	trL.2	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	0018	0E30	Transfer output 3 upper-limit	Common	trH.3	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	0019	0E32	Transfer output 3 lower-limit	Common	trL.3	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	001A	0E34	Transfer output 4 upper-limit	Common	trH.4	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	001B	0E36	Transfer output 4 lower-limit	Common	trL.4	*1	Same as at left	Same as at left	Same as at left	Same as at left	
	001C	0E38	First order lag operation 1 enabled	Common	LAG.1	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	001D	0E3A	First order lag operation 2 enabled	Common	LAG.2	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	001E	0E3C	First order lag operation 3 enabled	Common	LAG.3	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	001F	0E3E	First order lag operation 4 enabled	Common	LAG.4	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CE	0020	0E40	Movement average 1 enabled	Common	mAv.1	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0021	0E42	Movement average 2 enabled	Common	mAv.2	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0022	0E44	Movement average 3 enabled	Common	mAv.3	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0023	0E46	Movement average 4 enabled	Common	mAv.4	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0024	0E48	Extraction of square root 1 enabled	Common	sqr.1	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0025	0E4A	Extraction of square root 2 enabled	Common	sqr.2	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0026	0E4C	Extraction of square root 3 enabled	Common	sqr.3	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0027	0E4E	Extraction of square root 4 enabled	Common	sqr.4	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	002A	0E54	Straight-line approximation 1 enabled	Common	SCL.1	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	002B	0E56	Straight-line approximation 2 enabled	Common	SCL.2	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	002E	0E5C	Broken-line approximation 1 enabled	Common	FnC.1	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	002F	0E5E	Reserve								
	–	–	Motor calibration	CH	CALb	OFF (0) ON (0)	oFF, on	OFF	–	–	
	0030	0E60	Travel time	CH	mot	H'00000001 to H'000003E7 (1 to 999)	1 to 999	30	0	Seconds	

	Setting (monitor) value	Default value (transfer output upper-limit / lower-limit)	Decimal point position/units
SP	SP setting lower limit to SP setting upper limit	1300.0/-200.0	Depends on input type / EU
Ramp SP	SP setting lower limit to SP setting upper limit	1300.0/-200.0	Depends on input type / EU
Present Value(PV)	Lower limit of sensor setting range to upper limit of sensor setting range (temperature)	Upper/lower limit of sensor setting range	Depends on input type / EU
	H'FFFFB1E1 to H'0001869F (-19999 to 99999) (analog)	Scaling display value 2/1	Depends on input type / EU
Control output (Heat side or open side)	Standard: H'FFFFFFCE to H'0000041A (-5.0 to 105.0) Heat/cool: H'00000000 to H'0000041A (0.0 to 105.0)	100.0/0.0	1/%
Control output (Cool side or closed side)	H'00000000 to H'0000041A (0.0 to 105.0)	100.0/0.0	1/%
Valve opening	H'FFFFFF9C to H'0000044C (-10.0 to 110.0)	100.0/0.0	1/%

The Input type, temperature units, scaling display value, and SP upper/lower limit are initialized when the corresponding control / transfer output is changed.

*2 Initial settings in each control mode are shown below.

Control mode	Input type	Control transfer output 1 assignment	Control transfer output 2 assignment	Control transfer output 3 assignment	Control transfer output 4 assignment
Standard control	1 input	1	0	0	0
	2 inputs	1	9	0	0
	4 inputs	1	9	17	25
Heating/cooling control	1 input	1	2	0	0
	2 inputs	1	2	9	10
	4 inputs	1	2	9	10
Standard control with remote SP	1 input	-	-	-	-
	2 inputs	1	0	0	0
	4 inputs	-	-	-	-
Heating/cooling control with remote SP	1 input	-	-	-	-
	2 inputs	1	2	0	0
	4 inputs	-	-	-	-
Ratio control	1 input	-	-	-	-
	2 inputs	1	0	0	0
	4 inputs	-	-	-	-
Cascade standard control	1 input	-	-	-	-
	2 inputs	9	0	0	0
	4 inputs	-	-	-	-
Cascade heating/cooling control	1 input	-	-	-	-
	2 inputs	9	10	0	0
	4 inputs	-	-	-	-
Position proportional control	1 input	-	-	0	0

Alarm setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
CF	0000	0F00	Alarm 1 type	CH	ALt1	H'00000000: No alarm (0) H'00000001: Upper-and lower-limit alarm (1) H'00000002: Upper-limit alarm (2) H'00000003: Lower-limit alarm (3) H'00000004: Upper-and lower-limit of range alarm (4) H'00000005: Upper-and lower-limit alarm with standby sequence (5) H'00000006: Upper-limit alarm with standby sequence (6) H'00000007: Lower-limit alarm with standby sequence (7) H'00000008:Absolute-value upper-limit alarm (8) H'00000009: Absolute-value lower-limit alarm (9) H'0000000A: Absolute-value upper-limit with standby sequence (10) H'0000000B: Absolute-value lower-limit with standby sequence (11)	0 to 11	2	–	–	
	0001	0F02	Alarm 1 latch	CH	A1Lt	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0002	0F04	Alarm 1 hysteresis	CH	ALH1	H'00000001 to H'0000270F: 0.01 to 99.99	0.01 to 99.99	0.02	2	%FS	
	0003	0F06	Alarm 2 type	CH	ALt2	Same as alarm type 1	0 to 11	2	–	–	
	0004	0F08	Alarm 2 latch	CH	A2Lt	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0005	0F0A	Alarm 2 hysteresis	CH	ALH2	H'00000001 to H'0000270F: 0.01 to 99.99	0.01 to 99.99	0.02	2	%FS	
	0006	0F0C	Alarm 3 type	CH	ALt3	Same as alarm type 1	0 to 11	2	–	–	
	0007	0F0E	Alarm 3 latch	CH	A3Lt	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0008	0F10	Alarm 3 hysteresis	CH	ALH3	H'00000001 to H'0000270F: 0.01 to 99.99	0.01 to 99.99	0.02	2	%FS	
	0009	0F12	Alarm 4 type	CH	ALt4	Same as alarm type 1	0 to 11	2	–	–	
	000A	0F14	Alarm 4 latch	CH	A4Lt	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	000B	0F16	Alarm 4 hysteresis	CH	ALH4	H'00000001 to H'0000270F: 0.01 to 99.99	0.01 to 99.99	0.02	2	%FS	
	000C	0F18	Standby sequence restart	CH	rESt	H'00000000: Condition A (0) H'00000001: Condition B (1)	A, b	A	–	–	
	000D	0F1A	Auxiliary output 1 non-exciting	Common	Sb1n	H'00000000: Excitation close in alarm: N-O (0) H'00000001: Non-excitation open in alarm: N-C (1)	n-o, n-C	Excitation close in alarm	–	–	
	000E	0F1C	Auxiliary output 2 non-exciting	Common	Sb2n	H'00000000: Excitation close in alarm: N-O (0) H'00000001: Non-excitation open in alarm: N-C (1)	n-o, n-C	Excitation close in alarm	–	–	
	000F	0F1E	Auxiliary output 3 non-exciting	Common	Sb3n	H'00000000: Excitation close in alarm: N-O (0) H'00000001: Non-excitation open in alarm: N-C (1)	n-o, n-C	Excitation close in alarm	–	–	
	0010	0F20	Auxiliary output 4 non-exciting	Common	Sb4n	H'00000000: Excitation close in alarm: N-O (0) H'00000001: Non-excitation open in alarm: N-C (1)	n-o, n-C	Excitation close in alarm	–	–	

Display adjustment level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F		Modbus	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
Variable type	Address	Address									
D0	0000	1000	"PV/SP" display screen selection	Common	SPdP	H'00000000 to H'00000003: 0 to 3	0 to 3	1	–	–	
	0001	1002	MV display selection	CH	odSL	H'00000000: MV (Heating) (0) H'00000001: MV (Cooling) (1)	oo C-o	Heating (0)			
	0002	1004	Bar graph display item	Common	bAr-t	H'00000000: OFF (0) H'00000001: Deviation: 1EU/Segment (1) H'00000002: 10EU/Segment (2) H'00000003: 20EU/Segment (3) H'00000004: 100EU/Segment (4) H'00000005: MV (Heating) / Valve opening: O (5) H'00000006: MV (Cooling) : C-O (6)	oFF, 1EU, 10EU, 20EU, 100EU, o, C-o	MV / Valve opening (5)	–	–	
	0003	1006	Display auto-return time	Common	rEt	H'00000000 to H'00000063 (0 to 99 (0: Display auto reset disabled))	0 to 99	0	–	Seconds	
	0004	1008	Display refresh period	Common	d.rEF	H'00000000: OFF (0) H'00000001: 0.5 sec (1) H'00000002: 1 sec (2) H'00000003: 2 sec (3) H'00000004: 4 sec (4)	oFF, 0.5, 1, 2, 4	0.5	–	Seconds	
	0005	100A	Monitor item level setting	Common	monL	H'00000000: Disabled: OFF (0) H'00000001: Input initial setting level: L.0 (1) H'00000002: Control initial setting level: L.1 (2) H'00000003: Control initial setting 2 level: L.2 (3) H'00000004: Alarm setting level: L.3 (4) H'00000005: Display adjustment level: L.4 (5) H'00000006: Communication setting level: L.5 (6) H'00000007: Advanced function setting level: L.ADF (7) H'00000008: Expansion control setting level: L.EXC (8)	oFF, L.0, L.1, L.2, L.3, L.4, L.5, L.AdF, L.EXC	OFF	–	–	
	0006	100C	Start display scan at power on	Common	SC-m	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	OFF	–	–	
	0007	100E	Display scan period	Common	SC-t	H'00000000 to H'00000063 (0 to 99 (0: Display scan disabled))	9	2	–	Seconds	

Communication setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F		Modbus	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
Variable type	Address	Address									
D1	0000	1100	Protocol selection	Common	PSEL	H'00000000:CompoWay/F: CWF (0) H'00000001:Modbus: MOD (1)	CWF, MOD	CWF	–	–	
	0001	1102		Common	U-NO	H'00000000 to H'00000063 (0 to 99)	0 to 99	1	–	–	
	0002	1104	Communication unit No. Communications speed	Common	BPS	H'00000000:9.6 (0) H'00000001:19.2 (1) H'00000002:38.4 (2)	9.6, 19.2, 38.4	9.6	–	kbps	
	0003	1106	Communication data length	Common	LEN	H'00000000:7 (0) H'00000001:8 (1)	7, 8	7	–	Bit	
	0004	1108	Communication stop bit	Common	SBIT	H'00000000:1 (0) H'00000001:2 (1)	1, 2	2	–	Bit	
	0005	110A	Communication parity	Common	PRTY	H'00000000: Noe: NONE (0) H'00000001: Even: EVEN (1) H'00000002: Odd: ODD (2)	NONE, EVEN, ODD	EVEN	–	–	
	0006	110C	Transmission wait time	Common	SDWT	H'00000000 to H'00000063 (0 to 99)	0 to 99	20	–	ms	

*1 .... Changes in communication parameter settings become effective after reset.

Advanced function setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F		Modbus	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
Variable type	Address	Address									
D2	–	–	Parameter intitialization	Common	inIt	OFF (0) ON (0)	oFF, on	OFF	–	–	
	0000	1200	PF1 setting	Common	PF1	H'00000000: OFF (0) H'00000001:RUN (1) H'00000002:STOP (2) H'00000003:R-S (3) H'00000004:ALLR (4) H'00000005:ALLS (5) H'00000006:AT (6) H'00000007:BANK (7) H'00000008:A-M (8) H'00000009:PFDP (9)	oFF, rUn, StoP, r-S, ALLr, ALLS, At, bAnK, A-M, PFdP	A-M (8)	–	–	
	0001	1202	PF2 setting	Common	PF2	Same as PF1 setting	Same as above	R-S (3)	–	–	
	0002	1204	PF1 monitor / setting item 1	CH	PF1.1	H'00000000: Disabled (0) H'00000001:PV/SP/Bank setting is possible (SP) (1) H'00000002:PV/SP/MV setting is possible (SP) (2) H'00000003:PV/Deviation Monitor only (3) H'00000004:Proportional band (P) setting is possible (4) H'00000005:Integral time (I) setting is possible (5) H'00000006:Differential time (D) setting is possible (6) H'00000007:Alarm 1 setting is possible (7) H'00000008:Alarm upper limit 1 setting is possible (8) H'00000009:Alarm upper limit 1s etting is possible (9) H'0000000A:Alarm 2 setting is possible (10) H'0000000B:Alarm upper limit 2 setting is possible (11) H'0000000C:Alarm upper limit 2 setting is possible (12) H'0000000D:Alarm 3 setting is possible (13) H'0000000E:Alarm upper limit 3 setting is possible (14) H'0000000F:Alarm upper limit 3 setting is possible (15) H'00000010:Alarm 4 setting is possible (16) H'00000011:Alarm upper limit 4 setting is possible (17) H'00000012:Alarm upper limit 4 setting is possible (18) H'00000013:Banks . setting is possible (19)	0 to 19	1	–	–	
	0003	1206	PF1 monitor / setting item 2	CH	PF1.2	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	0004	1208	PF1 monitor / setting item 3	CH	PF1.3	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	0005	120A	PF1 monitor / setting item 4	CH	PF1.4	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	0006	120C	PF1 monitor / setting item 5	CH	PF1.5	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	0007	120E	PF2 monitor / setting item 1	CH	PF2.1	Same as PF1 monitor / setting 1	0 to 19	1	–	–	
	0008	1210	PF2 monitor / setting item 2	CH	PF2.2	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	0009	1212	PF2 monitor / setting item 3	CH	PF2.3	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	000A	1214	PF2 monitor / setting item 4	CH	PF2.4	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	000B	1216	PF2 monitor / setting item 5	CH	PF2.5	Same as PF1 monitor / setting 1	0 to 19	0	–	–	
	000C	1218	Number of enabled channels	Common	CH-n	H'00000001 to H'00000004 (1 to 4)	1 to 4	*1	–	–	
	–	–	RAM write mode	Common	rAM	Backup mode:BKUP (0) RAM write mode:RAM (1)	bKUP to rAM	BKUP (0)	–	–	
	–	–	Move to calibration level	Common	CMoV	-1999 to 9999	-1999 to 9999	0	–	–	

*1 .... The initial setting for the number of enabled channels varies depending on the model, and is the maximum value of the configuration.

Expansion control setting level

"H' -" indicated in set values (monitor values) are values set by communication (monitor).

CompoWay/F Variable type	CompoWay/F Address	Modbus Address	Setting data	Attributes	Character	Setting (monitor) value	Character	Default value	Decimal point position	Units	Set value
D3	0000	1300	Operation at power on	CH	P-on	H'00000000: Continue: CONT (0) H'00000001: Stop: STOP (1) H'00000002: Manual mode: MANU (2)	Cont, StoPo MAnU	CONT	–	–	
	0001	1302	SP tracking	CH	SPtr	H'00000000: Off: OFF (0) H'00000001: On: ON (1)	oFF, on	OFF	–	–	
	0002	1304	PID set automatic selection data	CH	PIdI	H'00000000: PV (0) H'00000001: DV (1)	Pu, du	PV	–	–	
	0003	1306	PID set automatic selection hysteresis	CH	PIdH	H'0000000A to H'0000270F (0.10 to 99.99)	0.10 to 99.99	0.50	2	%FS	
	0004	1308	PV dead band	CH	P-db	H'00000000 to H'0001869F (0 to 99999)	0 to 99999	0	According to input type	EU	
	0005	130A	Input 1 cold junction compensation	Common	CJC.1	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	ON	–	–	
	0006	130C	Input 2 cold junction compensating system	Common	CJC.2	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	ON	–	–	
	0007	130E	Input 3 cold junction compensation	Common	CJC.3	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	ON	–	–	
	0008	1310	Input 4 cold junction compensation	Common	CJC.4	H'00000000: OFF (0) H'00000001: ON (1)	oFF, on	ON	–	–	
	000A	1314	α	CH	ALFA	H'00000000 to H'00000064 (0.00 to 1.00)	0.00 to 1.00	0.65	2	–	
	000B	1316	PV tracking	CH	Putr	H'00000000: Off: OFF (0) H'00000001: On: ON (1)	oFF, on	OFF	–	–	
	000C	1318	Manual output method	CH	MAnt	H'00000000: MV hold: HOLD (0) H'00000001: Default value output: INIT (1)	HoLd, Init	HOLD	–	–	
	000D	131A	Manual MV initial value	CH	MAnI	Standard: H'FFFFFFCE to H'0000041A (-5.0 to 105.0) Heat/cool: H'FFFFFBE6 to H'0000041A (-105.0 to 105.0)	-5.0 to 105.0 -105.0 to 105.0	0.0	1	%	
	000E	131C	MV change rate limit mode	CH	orLM	H'00000000: Mode 0: 0 H'00000001: Mode 1: 1	0, 1	0	–	–	
	000F	131E	AT calculated gain	CH	At-G	H'00000001 to H'00000064 (0.1 to 10.0)	0.1 to 10.0	1.0	1	–	
	0010	1320	AT hysteresis	CH	At-H	H'00000001 to H'00000063 (0.1 to 9.9)	0.1 to 9.9	0.2	1	%FS	
	0011	1322	Limit cycle MV amplitude	CH	LCMA	H'00000032 to H'000001F4 (5.0 to 50.0)	5.0 to 50.0	20.0	1	%	
	0012	1324	Temporary A.T. excitation judgement deviation	CH	tAtE	H'00000000 to H'000003E8 (0.0 to 100.0)	0.0 to 100.0	10.0	1	%FS	
	0013	1326	Bump-less at RUN	CH	rbMP	H'00000000: Disabled: OFF (0) H'00000001: Enabled: ON (1)	oFF, on	OFF	–	–	
	0018	1330	Operation at poteniometer input error	CH	PMEC	H'00000000: Disabled: OFF (0) H'00000001: Enabled: ON (1)	oFF, on	OFF	–	–	
	0019	1332	Disturbance overshoot adjustment function	CH	doSt	H'00000000: Disabled: OFF (0) H'00000001: Enabled: ON (1)	oFF, on	OFF	–	–	

■ Initialization due to setting changes

Settings that are initialized when related settings are changed are shown in "Related settings that are initialized".

Meaning of symbols: O: Initialized,–: Not initialized,Δ: Added channels initialized

	Common	Common	CH	Common	CH	CH	CH	Common	CH	CH	CH
Changed setting data / Object of linked setting data initialization	Input type 1 Input type 2 Input type 3 Input type 4	Temperature unit 1 Temperature unit 2 Temperature unit 3 Temperature unit 4	Scaling display value 1 Scaling display value 2 Scaling input value 1 Scaling input value 2	Control mode (*2)	SP upper-limit SP lower-limit	PID set auto selection data	Closed / Floating	Control / Transfer output 1 assignment Control / Transfer output 2 assignment Control / Transfer output 3 assignment Control / Transfer output 4 assignment	Operation at input error Potentiometer	Alarm 1 type Alarm 2 type Alarm 3 type Alarm 4 type	Decimal point position
Linked parameter not run condition	No assignment	• No assignment • Analog input	Temperature input	• Position proportional control	–	–	–	–	–	–	Temperature input
Scaling display values 1 to 2	(*15)	–	–	(*14)	–	–	–	–	–	–	–
Scaling input values 1to 2	O (*10)	–	–	Δ	–	–	–	–	–	–	–
SP upper-limit	O (Lower-limit of input setting range or scaling display value 1)	O (Upper-limit of input setting range)	O (Scaling display value 2)	Δ	–	–	–	–	–	–	–
SP lower-limit	O (Upper-limit of input setting range or scaling display value 2)	O (Lower-limit of input setting range)	O (Scaling display value 1)	Δ	–	–	–	–	–	–	–
Automatic selection range upper limit (PV/DV) (PID 1 to 8)	O (*3)	O (*3)	O (*3)	Δ (*2)	–	O (*3)	–	–	–	–	–
Remote SP upper limit	O (Lower-limit of input setting range or scaling display value 1)	O (Upper-limit of input setting range)	O (Scaling display value 2)	O (*11)	–	–	–	–	–	–	–
Remote SP lower limit	O (Upper -limit of input setting range or scaling display value 2)	O (Lower-limit of input setting range)	O (Scaling display value 1)	O (*11)	–	–	–	–	–	–	–
Event input assignments 1 to 6	–	–	–	O	–	–	–	–	–	–	–
Control / Transfer output assignments 1 to 4	–	–	–	O	–	–	–	–	–	–	–
Auxiliary output assignments 1 to 4	–	–	–	O	–	–	–	–	–	–	–
Control / Transfer output: Output selection 1 to 6	–	–	–	O	–	–	–	O	–	–	–
Enabled number of channels	–	–	–	O	–	–	–	–	–	–	–
Upper-limit of transfer output 1 to 4	O (*1)	O (*1)	O (*1)	O (*1)	O (*1)	–	–	O (*1)	–	–	–
Lower-limit of transfer output 1 to 4	O (*1)	O (*1)	O (*1)	O (*1)	O (*1)	–	–	O (*1)	–	–	–
SP banks 0 to 7	O (*4)	O (*4)	O (*4)	Δ	O (*5)	–	–	–	–	–	–
Alarm values 1 to 4 (Banks 0 to 7) Alarm upper-limit 1 to 4 (Banks 0 to 7) Alarm lower-limit 1 to 4 (Banks 0 to 7)	O (*6)	O (*6)	O (*6)	Δ	–	–	–	–	–	(*13)	–
SP ramp rise value	O	O	O	Δ	–	–	–	–	–	–	–
SP ramp fall value	O	O	O	Δ	–	–	–	–	–	–	–
Dead band	O	O	O	Δ	–	–	–	–	–	–	–
Input adjustment values 1 to 2	O	O	O	Δ	–	–	–	–	–	–	O
PV dead band	O	O	O	Δ	–	–	–	–	–	–	–
Input adjustment values 1 to 2	O (*8)	O (*8)	O (*8)	Δ	–	–	–	–	–	–	–
Decimal point position	O (*14)	–	–	Δ (*14)	–	–	–	–	–	–	–
SP mode	–	–	–	O (*7)	–	–	–	–	–	–	–
Manipulated variable at stop (standard / heat / cool)	–	–	–	O	–	–	–	–	–	–	–
MV at PV error (standard / heat / cool)	–	–	–	O	–	–	–	–	–	–	–
Manual manipulated variable defaultdefault value (standard / heat / cool)	–	–	–	O	–	–	–	–	–	–	–
Manual manipulated variable default (standard / heat / cool)	–	–	–	O	–	–	–	–	–	–	–
Bar graph display item	–	–	–	O	–	–	–	–	–	–	–
MV display selection	–	–	–	O	–	–	–	–	–	–	–
MV upper limit (PID 1 to 8)	–	–	–	O	–	–	–	–	–	–	–
MV lower limit (PID 1 to 8)	–	–	–	O (*12)	–	–	–	–	–	–	–
Run/Stop	–	–	–	–	–	–	–	–	–	–	–
Auto/Manual	–	–	–	–	–	–	–	–	–	–	–
Integral time	–	–	–	–	–	–	O (*9)	–	O (*9)	–	–

*1: When the set value of "Control / transfer output assignment" is SP or ramp SP, the set values are initialized to the SP upper and lower limits.

*2: When the control mode is changed, initialization takes place of added channels in the same way as the initialization of related parameters of "Input type" (Δ on previous page).

*3: Based on the PID set selection data, this is (setting upper limit + setting range ×0.1) in the case of PV and (setting range ×1.1) in the case of DV.

*4: The default value is normally 0, however, on occasion the default value may also be the value clamped by the SP upper and lower limit.

*5: This becomes the clamp value only when clamped by the SP upper and lower limit.

*6: The default value is 0.

*7: This is remote SP in the case of the secondary loop of cascade control, and local SP in all other cases.

*8: Upper/lower limit of sensor setting range and scaling display values 1 and 2 are initialized.

*9: If Closed/Floating is Float in position proportional control, or if "Operation at potentiometer input error" is "Continue", this is initialized if the integral time is 0.

*10: This is the upper and lower limit of the sensor setting range. For temperature input, this is the range 4 - 20 mA.

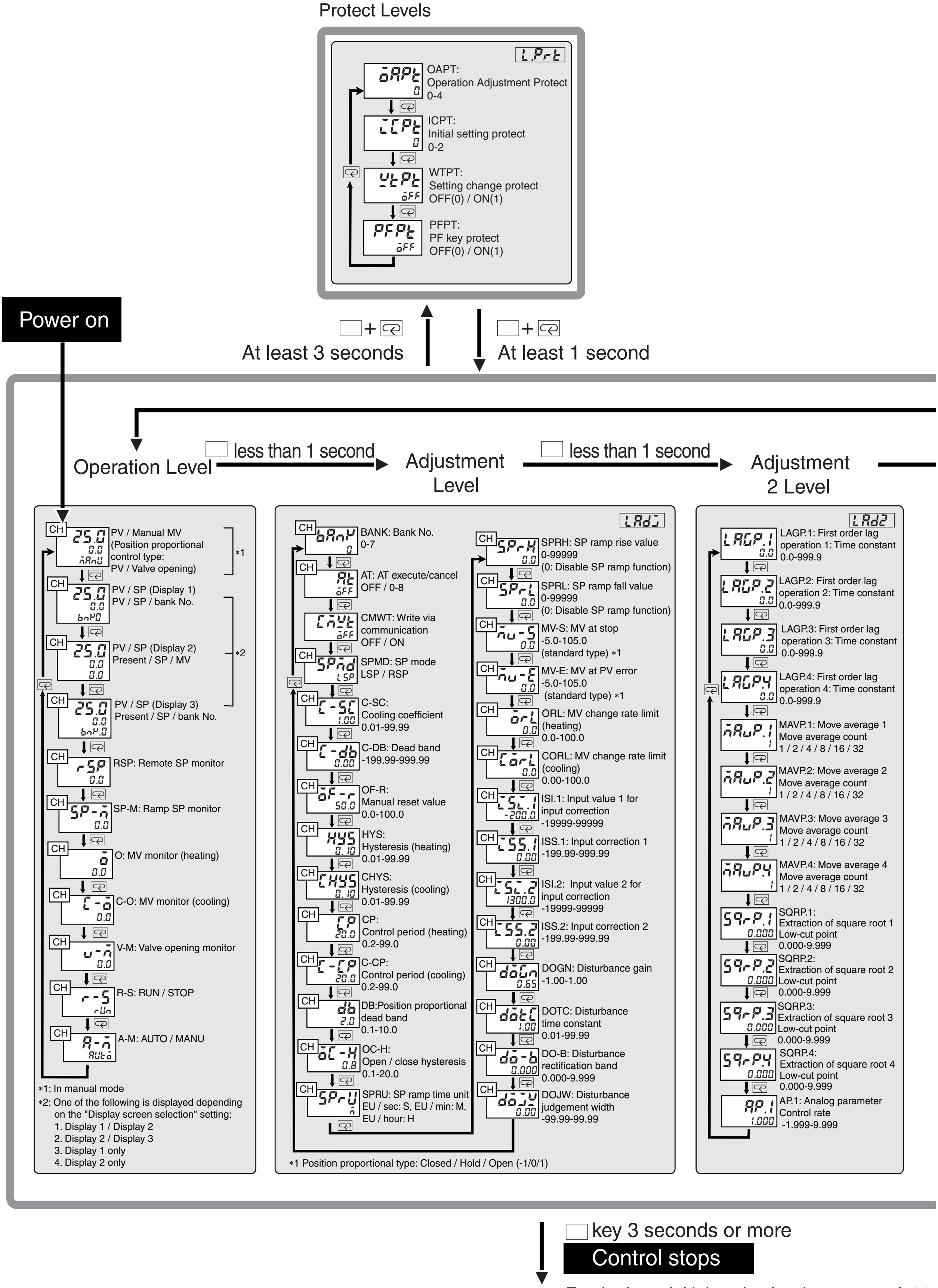
*11: Initialized only if the control mode is changed to ratio control (Temperature: Initializes to upper and lower limits of sensor setting range. Analog: Initializes to scaling display values 1 and 2).

*12: If the applicable channel is used for heating/cooling control, this is -100%, otherwise it is 0%. (Therefore in cascade heating/cooling control, the primary loop is 0% and the secondary loop is -100%.)

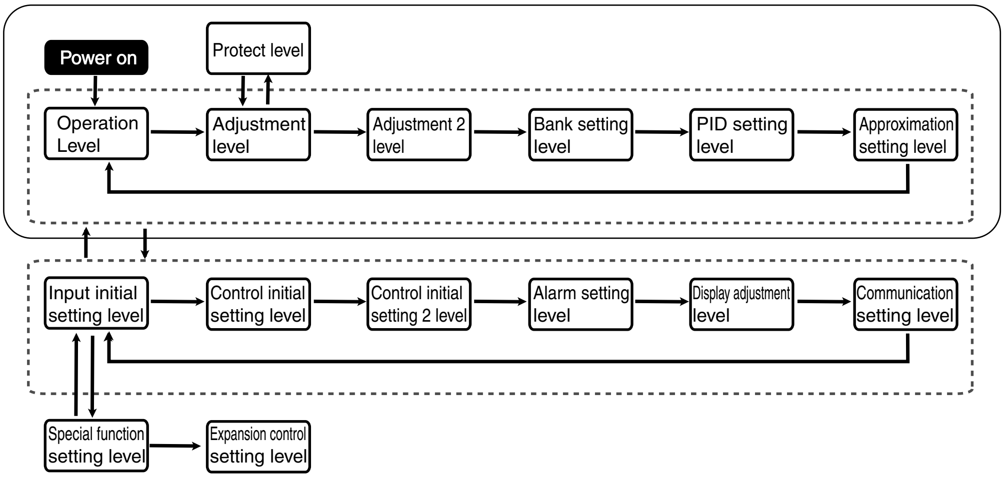
*13: The corresponding alarm type numbers in all banks are initialized to 0.

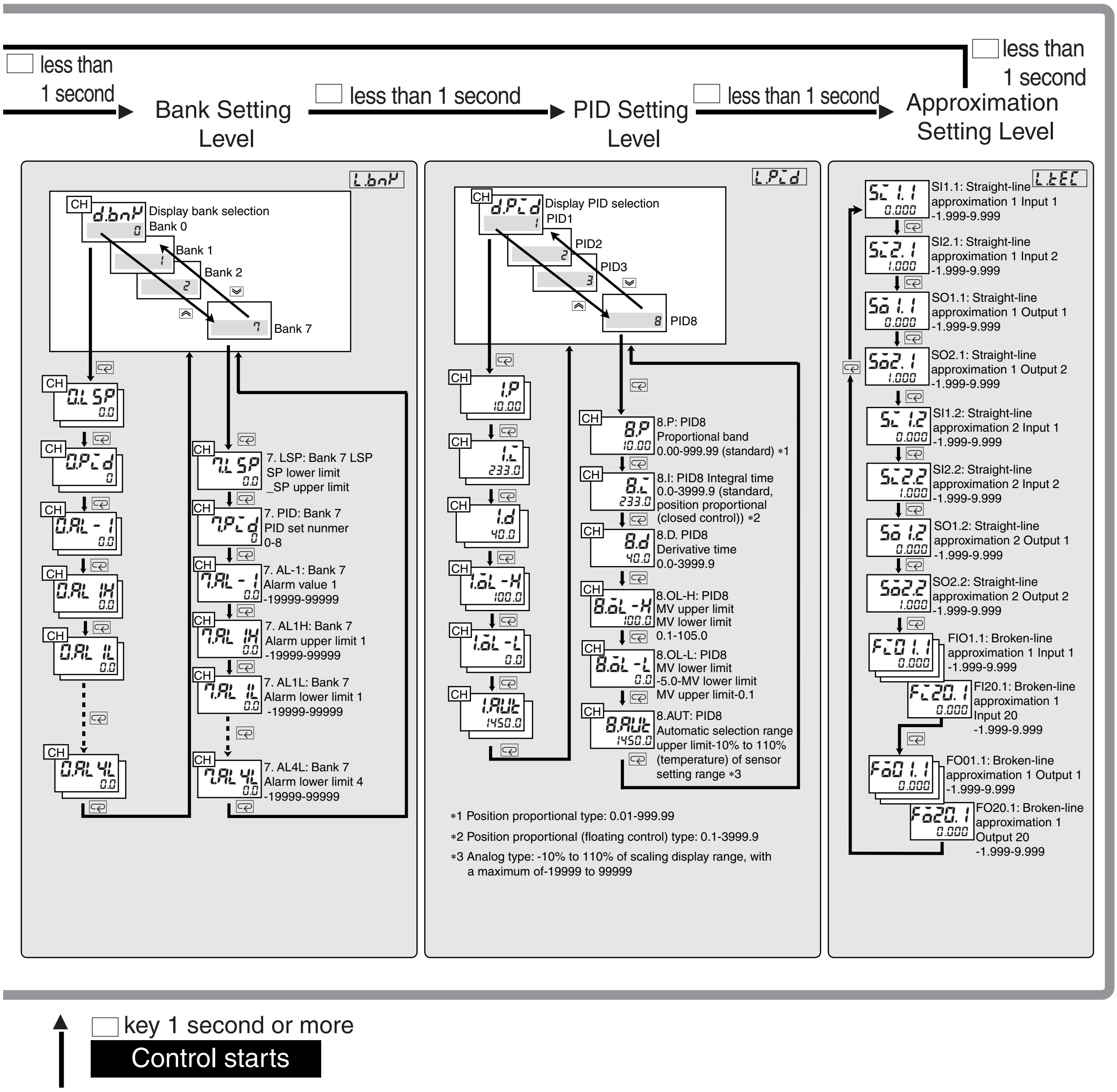
*14: When the input type or control mode is changed and there are added channels, scaling display values 1 and 2 and "Decimal point position" are not initialized.

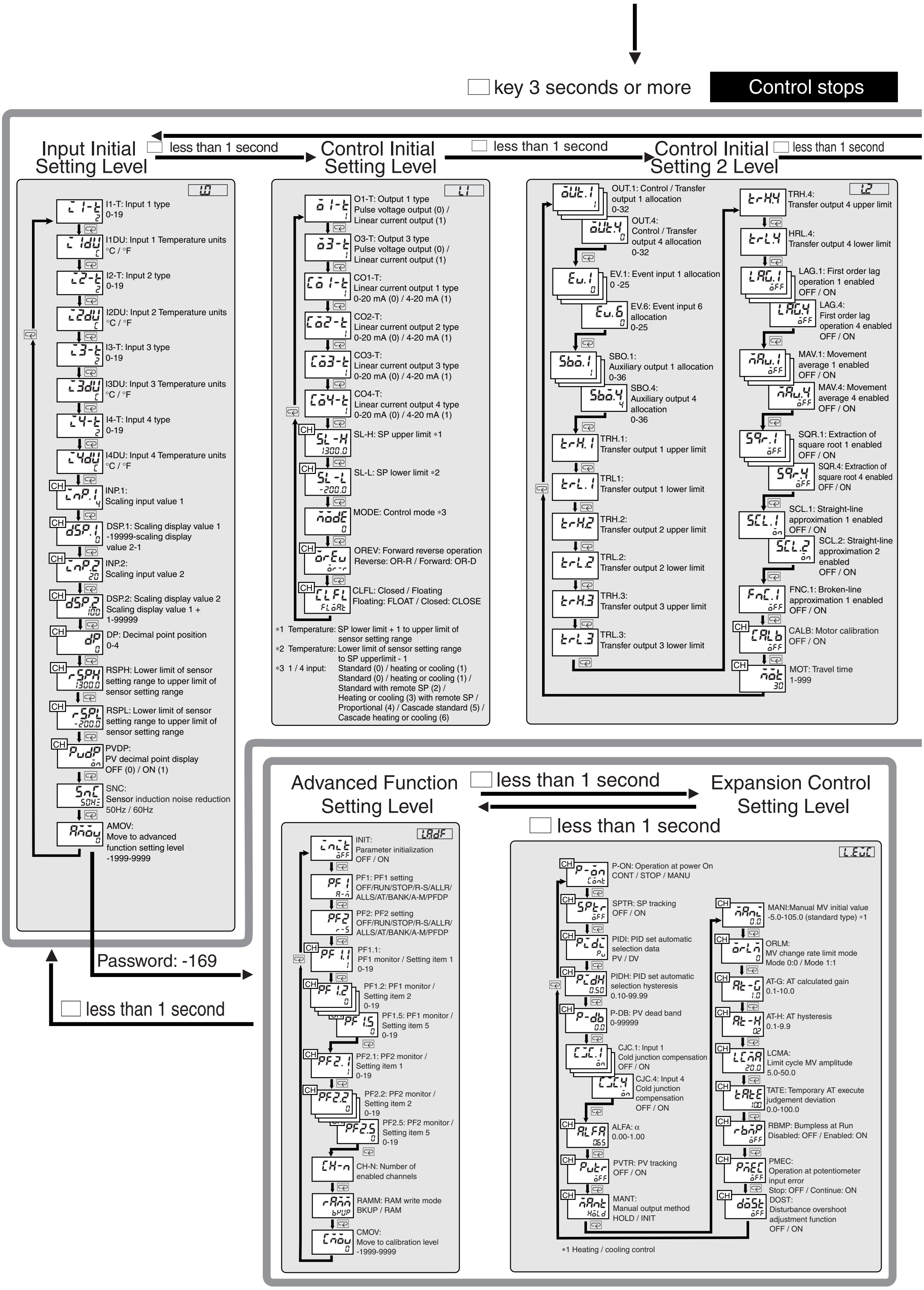
Setting data list



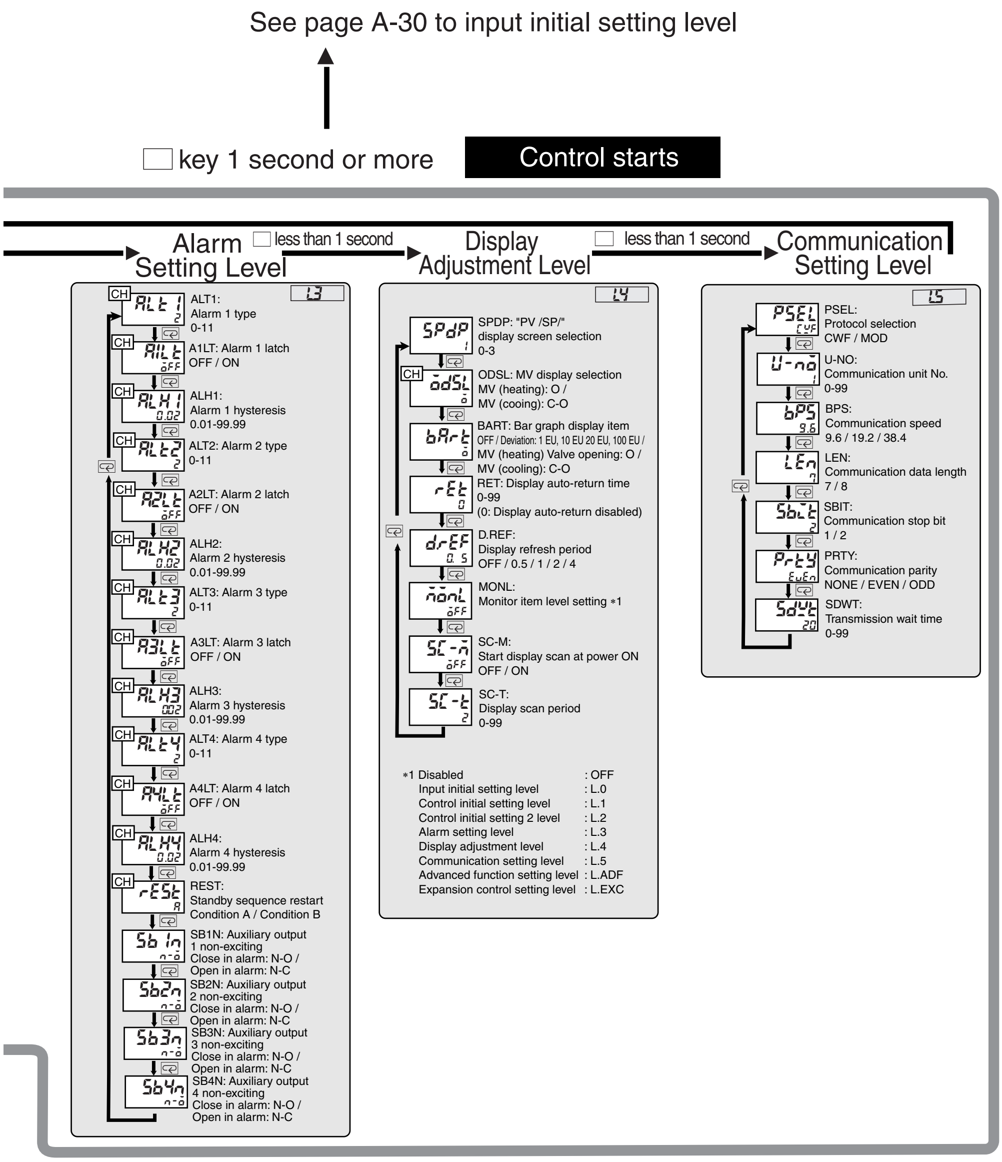
For the input initial setting level, see page A-32

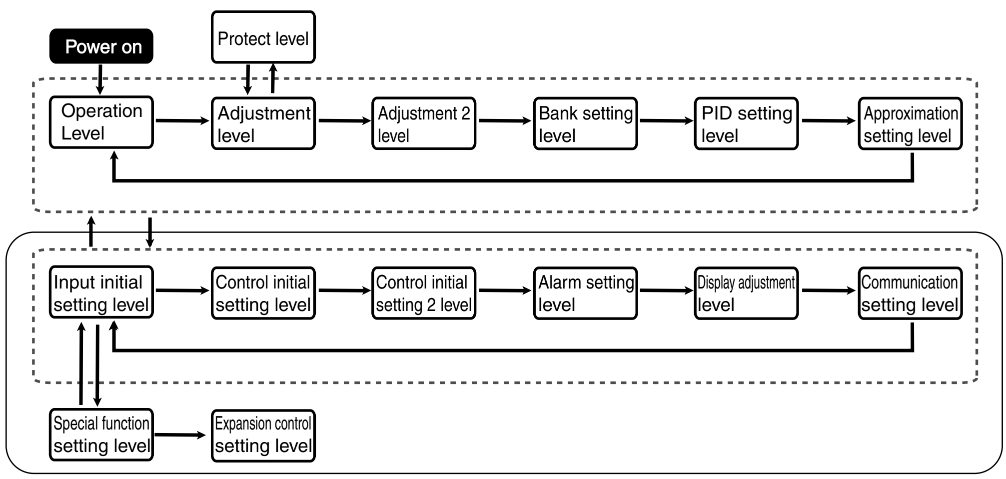

Power on
Protect level
Operation Level
Adjustment level
Adjustment 2 level
Bank setting level
PID setting level
Approximation setting level
Input initial setting level
Control initial setting level
Control initial setting 2 level
Alarm setting level
Display adjustment level
Communication setting level
Special function setting level
Expansion control setting level


less than 1 second
Bank Setting Level
less than 1 second
PID Setting Level
less than 1 second
Approximation Setting Level
less than 1 second
Display bank selection
Bank 0
Bank 1
Bank 2
Bank 7
7. LSP: Bank 7 LSP
SP lower limit
_SP upper limit
7. PID: Bank 7
PID set nunmer
0-8
7. AL-1: Bank 7
Alarm value 1
-19999-99999
7. AL1H: Bank 7
Alarm upper limit 1
-19999-99999
7. AL1L: Bank 7
Alarm lower limit 1
-19999-99999
7. AL4L: Bank 7
Alarm lower limit 4
-19999-99999
Display PID selection
PID1
PID2
PID3
PID8
8.P: PID8
Proportional band
0.00-999.99 (standard) *1
8.I: PID8 Integral time
0.0-3999.9 (standard,
position proportional
(closed control)) *2
8.D. PID8
Derivative time
0.0-3999.9
8.OL-H: PID8
MV upper limit
MV lower limit
0.1-105.0
8.OL-L: PID8
MV lower limit
-5.0-MV lower limit
MV upper limit-0.1
8.AUT: PID8
Automatic selection range
upper limit-10% to 110%
(temperature) of sensor
setting range *3
*1 Position proportional type: 0.01-999.99
*2 Position proportional (floating control) type: 0.1-3999.9
*3 Analog type: -10% to 110% of scaling display range, with
a maximum of-19999 to 99999
SI1.1: Straight-line
approximation 1 Input 1
-1.999-9.999
SI2.1: Straight-line
approximation 1 Input 2
-1.999-9.999
SO1.1: Straight-line
approximation 1 Output 1
-1.999-9.999
SO2.1: Straight-line
approximation 1 Output 2
-1.999-9.999
SI1.2: Straight-line
approximation 2 Input 1
-1.999-9.999
SI2.2: Straight-line
approximation 2 Input 2
-1.999-9.999
SO1.2: Straight-line
approximation 2 Output 1
-1.999-9.999
SO2.2: Straight-line
approximation 2 Output 2
-1.999-9.999
FIO1.1: Broken-line
approximation 1 Input 1
-1.999-9.999
FI20.1: Broken-line
approximation 1
Input 20
-1.999-9.999
FO01.1: Broken-line
approximation 1 Output 1
-1.999-9.999
FO20.1: Broken-line
approximation 1
Output 20
-1.999-9.999
key 1 second or more
Control starts



key 3 seconds or more
Control stops
Input Initial Setting Level
less than 1 second
Control Initial Setting Level
less than 1 second
Control Initial Setting 2 Level
less than 1 second
I1-T: Input 1 type 0-19
I1DU: Input 1 Temperature units °C / °F
I2-T: Input 2 type 0-19
I2DU: Input 2 Temperature units °C / °F
I3-T: Input 3 type 0-19
I3DU: Input 3 Temperature units °C / °F
I4-T: Input 4 type 0-19
I4DU: Input 4 Temperature units °C / °F
INP.1: Scaling input value 1
DSP.1: Scaling display value 1 -19999-scaling display value 2-1
INP.2: Scaling input value 2
DSP.2: Scaling display value 2 Scaling display value 1 + 1-99999
DP: Decimal point position 0-4
RSPH: Lower limit of sensor setting range to upper limit of sensor setting range
RSPL: Lower limit of sensor setting range to upper limit of sensor setting range
PVDP: PV decimal point display OFF (0) / ON (1)
SNC: Sensor induction noise reduction 50Hz / 60Hz
AMOV: Move to advanced function setting level -1999-9999
O1-T: Output 1 type Pulse voltage output (0) / Linear current output (1)
O3-T: Output 3 type Pulse voltage output (0) / Linear current output (1)
CO1-T: Linear current output 1 type 0-20 mA (0) / 4-20 mA (1)
CO2-T: Linear current output 2 type 0-20 mA (0) / 4-20 mA (1)
CO3-T: Linear current output 3 type 0-20 mA (0) / 4-20 mA (1)
CO4-T: Linear current output 4 type 0-20 mA (0) / 4-20 mA (1)
SL-H: SP upper limit *1
SL-L: SP lower limit *2
MODE: Control mode *3
OREV: Forward reverse operation Reverse: OR-R / Forward: OR-D
CLFL: Closed / Floating Floating: FLOAT / Closed: CLOSE
*1 Temperature: SP lower limit + 1 to upper limit of sensor setting range
*2 Temperature: Lower limit of sensor setting range to SP upperlimit - 1
*3 1 / 4 input: Standard (0) / heating or cooling (1) Standard (0) / heating or cooling (1) / Standard with remote SP (2) / Heating or cooling (3) with remote SP / Proportional (4) / Cascade standard (5) / Cascade heating or cooling (6)
OUT.1: Control / Transfer output 1 allocation 0-32
OUT.4: Control / Transfer output 4 allocation 0-32
EV.1: Event input 1 allocation 0 -25
EV.6: Event input 6 allocation 0-25
SBO.1: Auxiliary output 1 allocation 0-36
SBO.4: Auxiliary output 4 allocation 0-36
TRH.1: Transfer output 1 upper limit
TRL1: Transfer output 1 lower limit
TRH.2: Transfer output 2 upper limit
TRL.2: Transfer output 2 lower limit
TRH.3: Transfer output 3 upper limit
TRL.3: Transfer output 3 lower limit
TRH.4: Transfer output 4 upper limit
HRL.4: Transfer output 4 lower limit
LAG.1: First order lag operation 1 enabled OFF / ON
LAG.4: First order lag operation 4 enabled OFF / ON
MAV.1: Movement average 1 enabled OFF / ON
MAV.4: Movement average 4 enabled OFF / ON
SQR.1: Extraction of square root 1 enabled OFF / ON
SQR.4: Extraction of square root 4 enabled OFF / ON
SCL.1: Straight-line approximation 1 enabled OFF / ON
SCL.2: Straight-line approximation 2 enabled OFF / ON
FNC.1: Broken-line approximation 1 enabled OFF / ON
CALB: Motor calibration OFF / ON
MOT: Travel time 1-999
Password: -169
less than 1 second
Advanced Function Setting Level
less than 1 second
Expansion Control Setting Level
less than 1 second
INIT: Parameter initialization OFF / ON
PF1: PF1 setting OFF/RUN/STOP/R-S/ALLR/ ALLS/AT/BANK/A-M/PFDP
PF2: PF2 setting OFF/RUN/STOP/R-S/ALLR/ ALLS/AT/BANK/A-M/PFDP
PF1.1: PF1 monitor / Setting item 1 0-19
PF1.2: PF1 monitor / Setting item 2 0-19
PF1.5: PF1 monitor / Setting item 5 0-19
PF2.1: PF2 monitor / Setting item 1 0-19
PF2.2: PF2 monitor / Setting item 2 0-19
PF2.5: PF2 monitor / Setting item 5 0-19
CH-N: Number of enabled channels
RAMM: RAM write mode BKUP / RAM
CMOV: Move to calibration level -1999-9999
P-ON: Operation at power On CONT / STOP / MANU
SPTR: SP tracking OFF / ON
PIDI: PID set automatic selection data PV / DV
PIDH: PID set automatic selection hysteresis 0.10-99.99
P-DB: PV dead band 0-99999
CJC.1: Input 1 Cold junction compensation OFF / ON
CJC.4: Input 4 Cold junction compensation OFF / ON
ALFA: α 0.00-1.00
PVTR: PV tracking OFF / ON
MANT: Manual output method HOLD / INIT
MANI:Manual MV initial value -5.0-105.0 (standard type) *1
ORLM: MV change rate limit mode Mode 0:0 / Mode 1:1
AT-G: AT calculated gain 0.1-10.0
AT-H: AT hysteresis 0.1-9.9
LCMA: Limit cycle MV amplitude 5.0-50.0
TATE: Temporary AT execute judgement deviation 0.0-100.0
RBMP: Bumpless at Run Disabled: OFF / Enabled: ON
PMEC: Operation at potentiometer input error Stop: OFF / Continue: ON
DOST: Disturbance overshoot adjustment function OFF / ON
*1 Heating / cooling control


See page A-30 to input initial setting level
key 1 second or more
Control starts
Alarm Setting Level
less than 1 second
Display Adjustment Level
less than 1 second
Communication Setting Level
L.3
ALT1: Alarm 1 type 0-11
A1LT: Alarm 1 latch OFF / ON
ALH1: Alarm 1 hysteresis 0.01-99.99
ALT2: Alarm 2 type 0-11
A2LT: Alarm 2 latch OFF / ON
ALH2: Alarm 2 hysteresis 0.01-99.99
ALT3: Alarm 3 type 0-11
A3LT: Alarm 3 latch OFF / ON
ALH3: Alarm 3 hysteresis 0.01-99.99
ALT4: Alarm 4 type 0-11
A4LT: Alarm 4 latch OFF / ON
ALH4: Alarm 4 hysteresis 0.01-99.99
REST: Standby sequence restart Condition A / Condition B
SB1N: Auxiliary output 1 non-exciting Close in alarm: N-O / Open in alarm: N-C
SB2N: Auxiliary output 2 non-exciting Close in alarm: N-O / Open in alarm: N-C
SB3N: Auxiliary output 3 non-exciting Close in alarm: N-O / Open in alarm: N-C
SB4N: Auxiliary output 4 non-exciting Close in alarm: N-O / Open in alarm: N-C
L.4
SPDP: "PV /SP/" display screen selection 0-3
ODSL: MV display selection MV (heating): O / MV (cooing): C-O
BART: Bar graph display item OFF / Deviation: 1 EU, 10 EU 20 EU, 100 EU / MV (heating) Valve opening: O / MV (cooling): C-O
RET: Display auto-return time 0-99 (0: Display auto-return disabled)
D.REF: Display refresh period OFF / 0.5 / 1 / 2 / 4
MONL: Monitor item level setting *1
SC-M: Start display scan at power ON OFF / ON
SC-T: Display scan period 0-99
*1 Disabled : OFF
Input initial setting level : L.0
Control initial setting level : L.1
Control initial setting 2 level : L.2
Alarm setting level : L.3
Display adjustment level : L.4
Communication setting level : L.5
Advanced function setting level : L.ADF
Expansion control setting level : L.EXC
L.5
PSEL: Protocol selection CWF / MOD
U-NO: Communication unit No. 0-99
BPS: Communication speed 9.6 / 19.2 / 38.4
LEN: Communication data length 7 / 8
SBIT: Communication stop bit 1 / 2
PRTY: Communication parity NONE / EVEN / ODD
SDWT: Transmission wait time 0-99


Power on
Protect level
Operation Level
Adjustment level
Adjustment 2 level
Bank setting level
PID setting level
Approximation setting level
Input initial setting level
Control initial setting level
Control initial setting 2 level
Alarm setting level
Display adjustment level
Communication setting level
Special function setting level
Expansion control setting level

Appendix

Index

Below is a list of articles with direct links to our shop Electric Automation Network where you can see:

- Quote per purchase volume in real time.
- Online documentation and datasheets of all products.
- Estimated delivery time enquiry in real time.
- Logistics systems for the shipment of materials almost anywhere in the world.
- Purchasing management, order record and tracking of shipments.

To access the product, click on the green button.

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Temperature and Process Tarj output current / voltage and salt E5_R. tension	129702	E53-ARQC3	Buy on EAN