Single-phase Thyristor Unit
20 A/30 A/45 A/
60 A/80 A/100 A

THV-10

Instruction Manual

RKC® RKC INSTRUMENT INC.

IMR02W05-E2

NOTICE

Thank you for purchasing this RKC product. In order to achieve maximum performance and ensure proper operation of the instrument, carefully read all the instructions in this manual. Please place the manual in a convenient location for easy reference.

This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.

- The figures, diagrams and numeric values used in this manual are only for explanation purpose.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty, expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.
- Various symbols are used on the equipment, and they have the following meaning.

  : Warning (Instrument display)
  This symbol is attached to parts that require care when handling this product in order to protect the operator. Carefully read the cautions in this manual before using the instrument.

  : High temperature caution (Instrument display)
  Do not touch the heat radiation fin while the power is turned on or just after the power is turned off as it may be at high temperatures. If touched, burning may result.

- Windows is a trademark of Microsoft Corporation.
- Modbus is a registered trademark of Schneider Electric.
- Company names and product names used in this manual are the trademarks or registered trademarks of the respective companies.

Safety Precautions

■ Pictorial Symbols (safety symbols)

Various pictorial symbols are used in this manual to ensure safe use of the product, to protect you and other people from harm, and to prevent damage to property. The symbols are described below.
Be sure you thoroughly understand the meaning of the symbols before reading this manual.

⚠ WARNING : This mark indicates precautions that must be taken if there is danger of electric shock, fire, etc., which could result in loss of life or injury.

⚠ CAUTION : This mark indicates that if these precautions and operating procedures are not taken, damage to the instrument may result.


: This mark indicates that all precautions should be taken for safe usage.


: This mark indicates that all precautions should be taken to avoid fire.


: This mark indicates that all precautions should be taken to avoid electric shock.

⚠ WARNING

To prevent injury to persons, damage to the instrument and the equipment, a suitable external protection device shall be required.

All wiring must be completed before power is turned on to prevent electric shock, fire or damage to the instrument and the equipment.

This instrument must be used in accordance with the specifications to prevent fire or damage to the instrument and the equipment.

This instrument is not intended for use in locations subject to flammable or explosive gases.

Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.

When the withstand voltage test or each test is performed, please contact RKC sales office or the agent. If you make a mistake in the test method, the instrument failure may result.

RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel.
Malfunction may occur and warranty is void under these conditions.

⚠ WARNING

Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.

Tighten each terminal screw to the specified torque found in the manual to avoid electric shock, fire or malfunction.

⚠ CAUTION

- This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy plant.)
- This is a Environment A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.
- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless the length.
- This instrument is designed for installation in an enclosed control panel. All high-voltage connections such as power supply terminals must be enclosed in the control panel to avoid electric shock to operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- All wiring must be in accordance with local codes and regulations.
- Always use this product at the rated power supply voltage, load current and power frequency.
- To prevent instrument damage as a result of failure, protect the power line and the input/output lines from high currents with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.
- If this product is used for phase control, higher harmonic noise may be generated. Therefore in this case, take such measures as separating the power line from the high-voltage line for load drive.
- For proper operation of this instrument, provide adequate ventilation for heat dissipation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration may occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to the instrument display, do not rub with an abrasive material or push the front panel with a hard object.

For Proper Disposal

When disposing of each part used for this instrument, always follows the procedure for disposing of industrial wastes stipulated by the respective local community.

Symbols

■ Pictorial Symbols (safety symbols)

NOTE : This mark indicates important information on installation, handling and operating procedures.

: This mark indicates supplemental information on installation, handling and operating procedures.

: This mark indicates where additional information may be located.

■ Character Symbols

7-segment character

0	1	2	3	4	5	6	7	8	9	Minus	Period
											

A	B (b)	C	c	D (d)	E	F	G	H	I	J	K
											

L	M	N (n)	O (o)	P	Q	R	S	T	t	U	u
											

V	W	X	Y	Z	Degree	／	Prime	＊ (Asterisk)
								

		Dim lighting
		Bright lighting

Document Configuration

There are four manuals pertaining to this product. Please be sure to read all manuals specific to your application requirements.

The following manuals can be downloaded from the official RKC website:
https://www.rkcinst.co.jp/english/download-center/

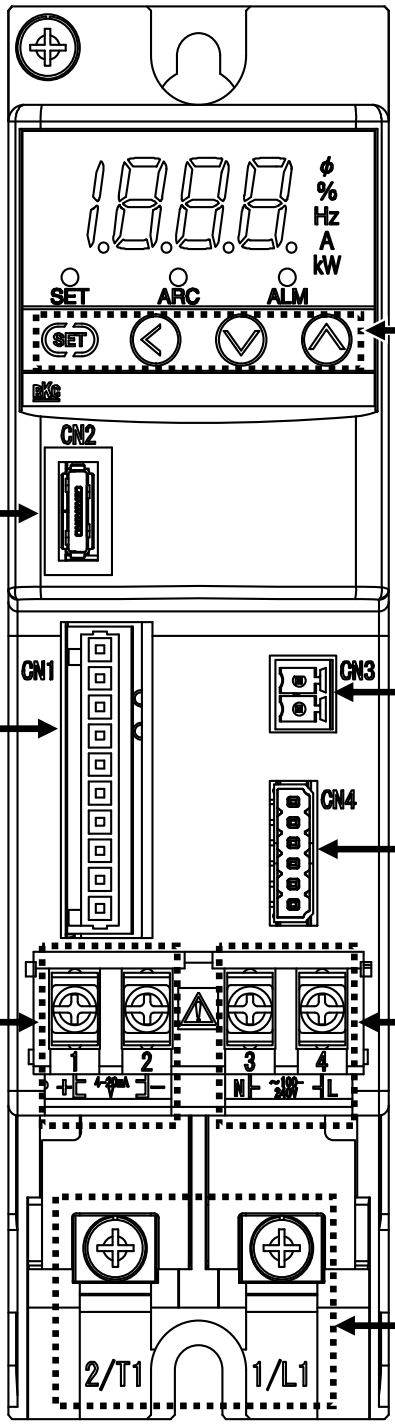
Manual	Manual Number	Remarks
20 A/30 A/45 A/ 60 A/ 80 A/100 A THV-10 Installation Manual	IMR02W01-E☐	This manual is enclosed with instrument. This manual explains the mounting and wiring.
20 A/30 A/45 A/ 60 A/ 80 A/100 A THV-10 Quick Operation Manual	IMR02W04-E☐	This manual is enclosed with instrument. This manual explains the basic key operation, mode menu, and data setting.
20 A/30 A/45 A/ 60 A/ 80 A/100 A THV-10 Instruction Manual	**IMR02W05-E2**	This manual you are reading now. This manual describes installation, wiring, operation of each function, and troubleshooting.
20 A/30 A/45 A/ 60 A/ 80 A/100 A THV-10 Host Communication Instruction Manual	IMR02W06-E☐	This manual explains RKC communication protocol (ANSI X3.28-1976) and Modbus relating to communication parameters setting.

Read this manual carefully before operating the instrument. Please place the manual in a convenient location for easy reference.

Contents

Pictorial table of contents

It shows the corresponding pages for functions that are mainly related to hardware.



Loader communication connector

Connection for Loader communication connector
····· P. 3-19

Input/Output connector

Input/Output Connector
····· P. 3-10
Wiring of External gradient setter
····· P. 3-11
Wiring of External manual setter
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Wiring of Contact input (DI)
····· P. 3-13
Wiring of Input signal transfer
····· P. 3-14
Wiring of Contact input
····· P. 3-15
Wiring of Alarm output
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Input terminals

Wiring of Input signal
····· P. 3-7

Front keys

Operation and settings
····· P. 5-2

Retransmission output connector (optional) *

Wiring of Retransmission connector
····· P. 3-17

Communication connector (optional) *

Wiring of Communication connector
····· P. 3-18

* Choose one of the two. Specify the required options when placing the order.
Connector is not supplied when neither one is specified.

Power supply terminals

Wiring of Main circuit
····· P. 3-4

Main circuit terminals

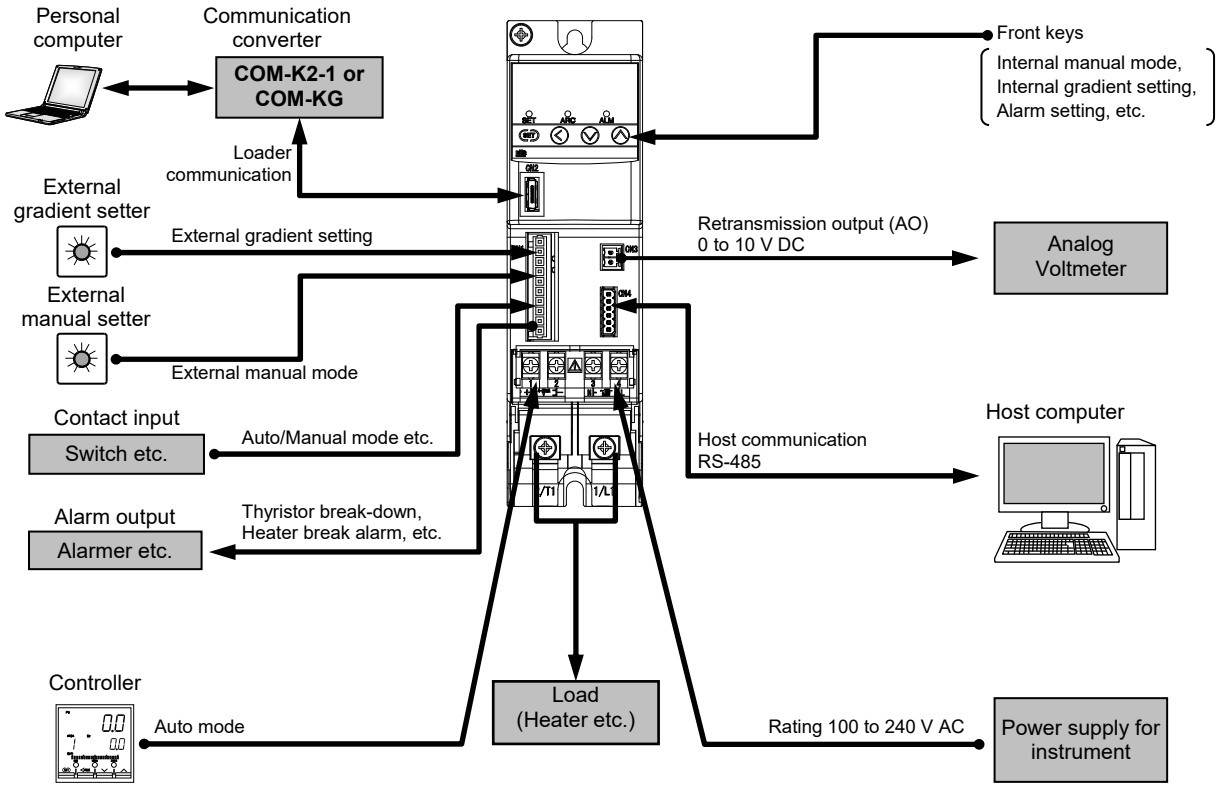
Wiring of Main circuit
····· P. 3-4

1 OUTLINE

This chapter describes features, package contents, model code, etc.

1.1 Features

This instrument is a single-phase thyristor unit for power supply voltage (load) 100 to 240 V AC. It is possible to adjust power supplied to heaters, etc. by the signal from the controller or the setting of the setter (potentiometer) or front keys.



■ Six types of rated current are available

Power supply voltage	100 to 240 V AC					
Rated current	20 A	30 A	45 A	60 A	80 A	100 A

■ The input signal and set value can be checked on the display unit

The display unit can check the input signal from the controller, phase angle ratio, power frequency, current value or set value of each parameter, etc.

■ Front keys or communication can be used for the gradient setting, manual setting, etc.

In addition to the setting by an ordinary potentiometer setting, it is possible to set values for internal gradient setting and internal manual mode by the front keys or communication while checking these numeric values shown on the display unit.

■ Three types of control can be selected

It is possible to select by the front keys or communication and then use any one of Phase control, Zero-cross control (continuous), and Zero-cross control (input synchronous type).

■ Product with current detector (optional)

For instruments with a current detector, the following functions can be selected when ordering.

- Constant current control/Power proportional control
- Current limit function
- Heater break alarm/Thyristor break-down alarm
- Non-linear resistance heater break function
- Protection function for control of primary side of a transformer

■ 1 alarm output (optional)

Several different alarms can be assigned. An alarm signal is output when any one of the assigned alarms is abnormal.

■ Retransmission output (AO) function (optional)

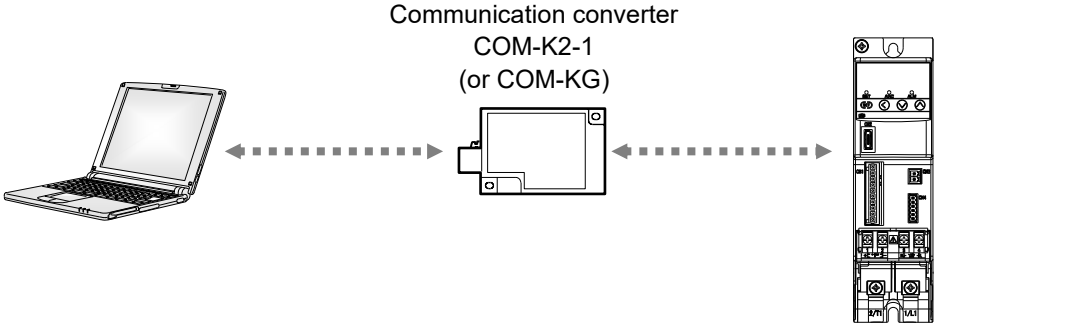
The manipulated output value (phase angle ratio) and monitor value can be output as a voltage continuous output 0 to 10 V DC signal. You can use it by connecting to an analog voltmeter.

■ Host communication (optional)

You can send and receive data by connecting to a host computer using our dedicated protocol RKC communication or Modbus protocol.

■ Loader communication

This instrument is equipped with a loader communication port as standard. This instrument can be linked to a personal computer for setup.



Maximum connections: 1 unit

As for the communication converter, use our communication converter COM-K2-1 (or COM-KG). To perform setup from a personal computer, a dedicated communication tool is necessary.
The communication tool “PROTEM2” can be downloaded from the official RKC website.

1.2 Checking the Product

Before using this product, check each of the following:

- Model code
- Check that there are no scratch or breakage in THV-10 external appearance (case, heat radiation fin, front panel, terminal, etc.)
- Check that all of the items delivered are complete (Refer to below)

The accessories attached to product		Quantity	Remarks	
☐	Plug connector for input/output [Code: THV1P-C01]	1	Bundled with the main unit Supplied when ordered as an option.	
☐	Plug connector for retransmission output [Code: THV1P-C02]	1	Bundled with the main unit Supplied when ordered as an option.	
☐	Plug connector for communication [Code: THV1P-C03]	1	Bundled with the main unit Supplied when ordered as an option.	
☐	20 A/30 A/45 A/60 A/80 A/100 A THV-10 Installation Manual (IMR02W01-E☐)	1	Bundled with the main unit	
☐	20 A/30 A/45 A/60 A/80 A/100 A THV-10 Quick Operation Manual (IMR02W04-E☐)	1	Bundled with the main unit	
☐	**20 A/30 A/45 A/60 A/80 A/100 A THV-10 Instruction Manual (IMR02W05-E2)**	1	This document Sold separately	You can also download it from our website.
☐	20 A/30 A/45 A/60 A/80 A/100 A THV-10 Host Communication Instruction Manual (IMR02W06-E☐)	1	Sold separately	

Refer to **P. 1-6** for the details of optional accessories such as the setter and fuse unit. Make sure that you have the quantity that you ordered.

1.3 Checking the Model Code

Use the following list of codes to check whether the product you have is the one you ordered. Please contact our sales office or distributor if there is any difference from the desired specifications.

■ List of specification codes

THV – 10 PZ □ – □ ∗ □ □ □ – □

(1) (2) (3) (4) (5) (6) (7) (8)

Description		Specification code							
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Power supply for load	100 to 240 V AC	10							
Control method	Phase control/Zero-cross control (Switchable: Factory set value is Phase control)		PZ						
Rated current	20 A AC			020					
	30 A AC			030					
	45 A AC			045					
	60 A AC			060					
	80 A AC			080					
	100 A AC			100					
Input signal	Voltage input 0 to 10 V DC				5				
	Voltage input 1 to 5 V DC				6				
	Current input 4 to 20 mA DC				8				
	Voltage pulse input 0/12 V DC				V				
Heater break alarm Current limit function Constant current control Protection function for control of primary side of a transformer * Power proportional control	No function					N			
	With heater break alarm, Current limit function, Constant current control, Protection function for control of primary side of a transformer, and Power proportional control					H			
	With Non-linear resistance heater break alarm, Current limit function, Constant current control, Protection function for control of primary side of a transformer, and Power proportional control					B			
Alarm output	No alarm output						N		
	1 alarm output						A		
Retransmission output (AO) or communication function	None							N	
	Retransmission output (AO) [Continuous transmission output 0 to 10 V DC] (With plug connector for retransmission output)							A	
	Communication (RS-485) [RKC communication] (With plug connector for communication)							B	
	Communication (RS-485) [Modbus communication] (With plug connector for communication)							C	
Accessory to the plug connector for input/output	None								N
	Supplied								1

* When controlling the primary side of a transformer, it is recommended to select a code H or B.

■ Accessories (Codes for ordering separately)

When you order an accessory, please specify it with the following code.

• Common accessories

Code	Details
THV1P-S01	Setter (potentiometer, knob, and scale plate)
THV1P-C01	Plug connector for input/output
THV1P-C02	Plug connector for retransmission output
THV1P-C03	Plug connector for communication
THVP-V01	Output voltmeter (150 V span) [For phase control]
THVP-V02	Output voltmeter (300 V span) [For phase control]

• 20 A types

Code	UL Standard	Details	Fuse rating*
THVP-F21	Not UL certified	Fuse unit for 20 A (fast-blow fuse and holder [3-circuit types])	20 A
THVP-F20		Fast-blow fuse for 20 A [3-circuit types]	20 A
THVP-H01		Fuse holder for 20 A/30 A [3-circuit types]	—
THVP-F22	Not UL certified	Fuse unit for 20 A (fast-blow fuse and holder [1 circuit type])	20 A
THVP-F2A		Fast-blow fuse for 20 A [for 1 circuit]	20 A
THVP-H02		Fuse holder for 20 A/30 A/45 A [1 circuit type]	—
THVP-F23	UL certified	UL certified fuse unit for 20 A (fast-blow fuse and holder [1 circuit type])	20 A
THVP-F2B		UL certified fast-blow fuse for 20 A [1 circuit type]	20 A
THVP-H04		UL certified fuse holder for 20 A/30 A [1 circuit type]	—

* Rating of the fuse.

• 30 A types

Code	UL Standard	Details	Fuse rating*
THVP-F31	Not UL certified	Fuse unit for 30 A (fast-blow fuse and holder [3-circuit types])	30 A
THVP-F30		Fast-blow fuse for 30 A [3-circuit types]	30 A
THVP-H01		Fuse holder for 20 A/30 A [3-circuit types]	—
THVP-F32	Not UL certified	Fuse unit for 30 A (fast-blow fuse and holder [1 circuit type])	30 A
THVP-F3A		Fast-blow fuse for 30 A [1 circuit type]	30 A
THVP-H02		Fuse holder for 20 A/30 A/45 A [1 circuit type]	—
THVP-F33	UL certified	UL certified fuse unit for 30 A (fast-blow fuse and holder [1 circuit type])	30 A
THVP-F3B		UL certified fast-blow fuse for 30 A [1 circuit type]	30 A
THVP-H04		UL certified fuse holder for 20 A/30 A [1 circuit type]	—

*Rating of the fuse.

• 45 A types

Code	UL Standard	Details	Fuse rating*
THVP-F42	Not UL certified	Fuse unit for 45 A (fast-blow fuse and holder [1 circuit type])	50 A
THVP-F45		Fast-blow fuse for 45 A [1 circuit type]	50 A
THVP-H02		Fuse holder for 20 A/30 A/45 A [1 circuit type]	—
THVP-F43	UL certified	UL certified fuse unit for 45 A (fast-blow fuse and holder [1 circuit type])	50 A
THVP-F4B		UL certified fast-blow fuse for 45 A [1 circuit type]	50 A
THVP-H05		UL certified fuse holder for 45 A/60 A/80 A/100 A [1 circuit type]	—

*Rating of the fuse.

• 60 A types

Code	UL Standard	Details	Fuse rating*
THVP-F62	Not UL certified	Fuse unit for 60 A (fast-blow fuse and holder [1 circuit type])	75 A
THVP-F60		Fast-blow fuse for 60 A [1 circuit type]	75 A
THVP-H03		Fuse holder for 60 A/80 A/100 A [1 circuit type]	—
THVP-F63	UL certified	UL certified fuse unit for 60 A (fast-blow fuse and holder [1 circuit type])	63 A
THVP-F6B		UL certified fast-blow fuse for 60 A [1 circuit type]	63 A
THVP-H05		UL certified fuse holder for 45 A/60 A/80 A/100 A [1 circuit type]	—

*Rating of the fuse.

• 80 A types

Code	UL Standard	Details	Fuse rating*
THVP-FA2	Not UL certified	Fuse unit for 80 A/100 A (fast-blow fuse and holder [1 circuit type])	100 A
THVP-FA0		Fast-blow fuse for 80 A/100 A [1 circuit type]	100 A
THVP-H03		Fuse holder for 60 A/80 A/100 A [1 circuit type]	—
THVP-F83	UL certified	UL certified fuse unit for 80 A (fast-blow fuse and holder [1 circuit type])	80 A
THVP-F8B		UL certified fast-blow fuse for 80 A [1 circuit type]	80 A
THVP-H05		UL certified fuse holder for 45 A/60 A/80 A/100 A [1 circuit type]	—

*Rating of the fuse.

• 100 A types

Code	UL Standard	Details	Fuse rating*
THVP-FA2	Not UL certified	Fuse unit for 80 A/100 A (fast-blow fuse and holder [1 circuit type])	100 A
THVP-FA0		Fast-blow fuse for 80 A/100 A [1 circuit type]	100 A
THVP-H03		Fuse holder for 60 A/80 A/100 A [1 circuit type]	—
THVP-FA3	UL certified	UL certified fuse unit for 100 A (fast-blow fuse and holder [1 circuit type])	100 A
THVP-FAB		UL certified fast-blow fuse for 100 A [1 circuit type]	100 A
THVP-H05		UL certified fuse holder for 45 A/60 A/80 A/100 A [1 circuit type]	—

*Rating of the fuse.

1.4 Preparation Before Operation

Before using this instrument, check each of the following procedures.

Checking the load

Check the rated current and power supply voltage of the load to be connected.

Mounting

When mounting, take precautions so that there is no mistake in the mounting direction.
Refer to **2. MOUNTING (P. 2-1)**

Wiring

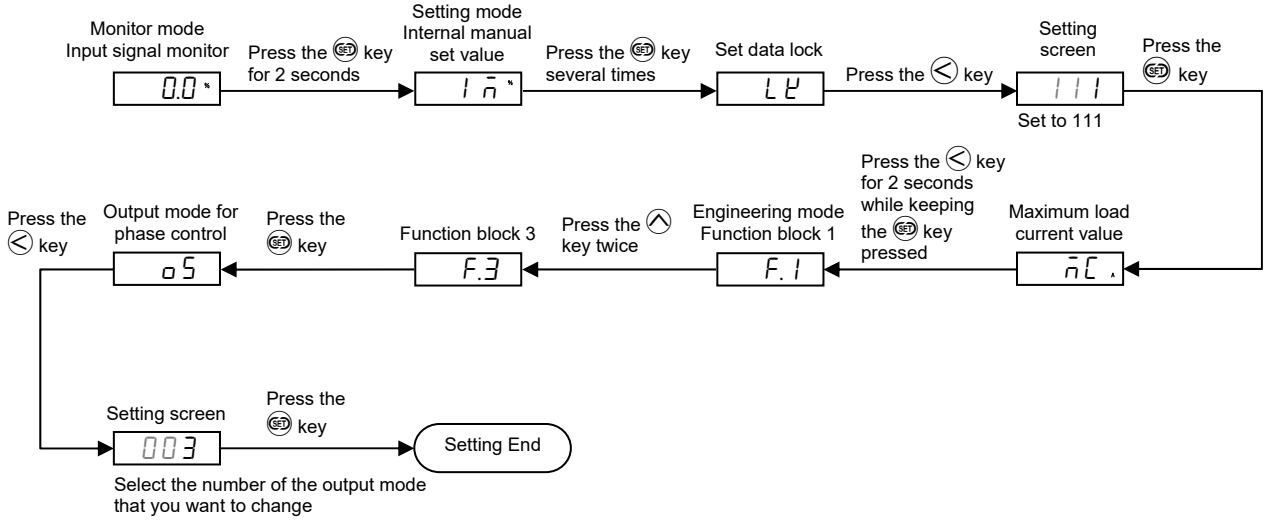
When wiring, take precautions so that there is no mistake in the phases of the instrument power supply and the main circuit terminals of THV-10.
Refer to **3. WIRING (P. 3-1)**

Turning on the instrument power supply of THV-10

Turn on the instrument power supply of THV-10.

I want an output mode that matches the characteristics of the load (during phase control only)

Change the output mode when using a load whose resistance value changes with temperature change or aging.
You can change with the parameters of “Output mode for phase control”.



Output mode

2: Proportional square voltage (electric power) to input:

This mode is suitable for the control of a load whose resistance change by ambient temperature is small.

3: Constant current control:

Suitable for load control where resistance changes significantly due to temperature. (Load such as tantalum, super Kanthal, tungsten, platinum, molybdenum, etc.)

4: Power proportional control:

Suitable for load control where resistance value increases with temperature or aging. (Load such as silicon carbide, silicon unit, etc.)

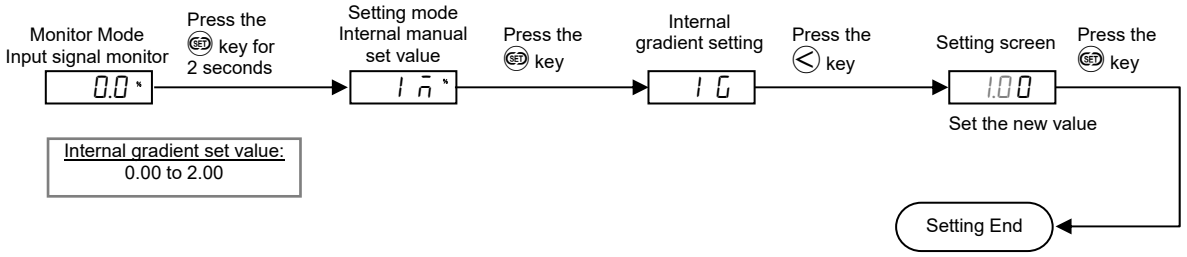
A

A

I would like to change the output voltage (%) of THV-10

The output voltage (%) can be changed using the “Internal gradient setting (IG)” parameter or the external gradient setter.

■ Internal gradient setting



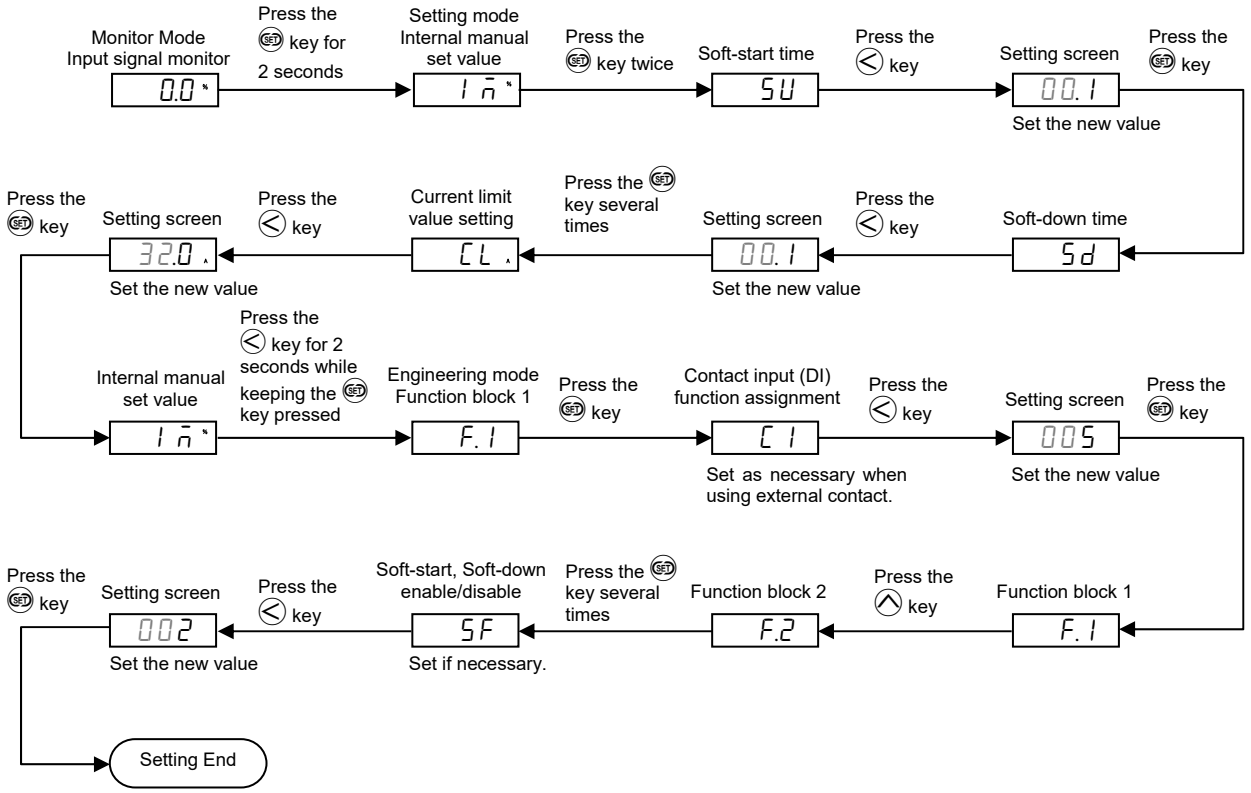
■ External gradient setter

Use the external gradient setter and set the new value.

I would like to suppress the rush current

In order to suppress the rush current, it is recommended to use the Soft-start, Soft-down function and the current limit function together. The rush current cannot be suppressed only with the current limit function.

You can set with the following parameters.

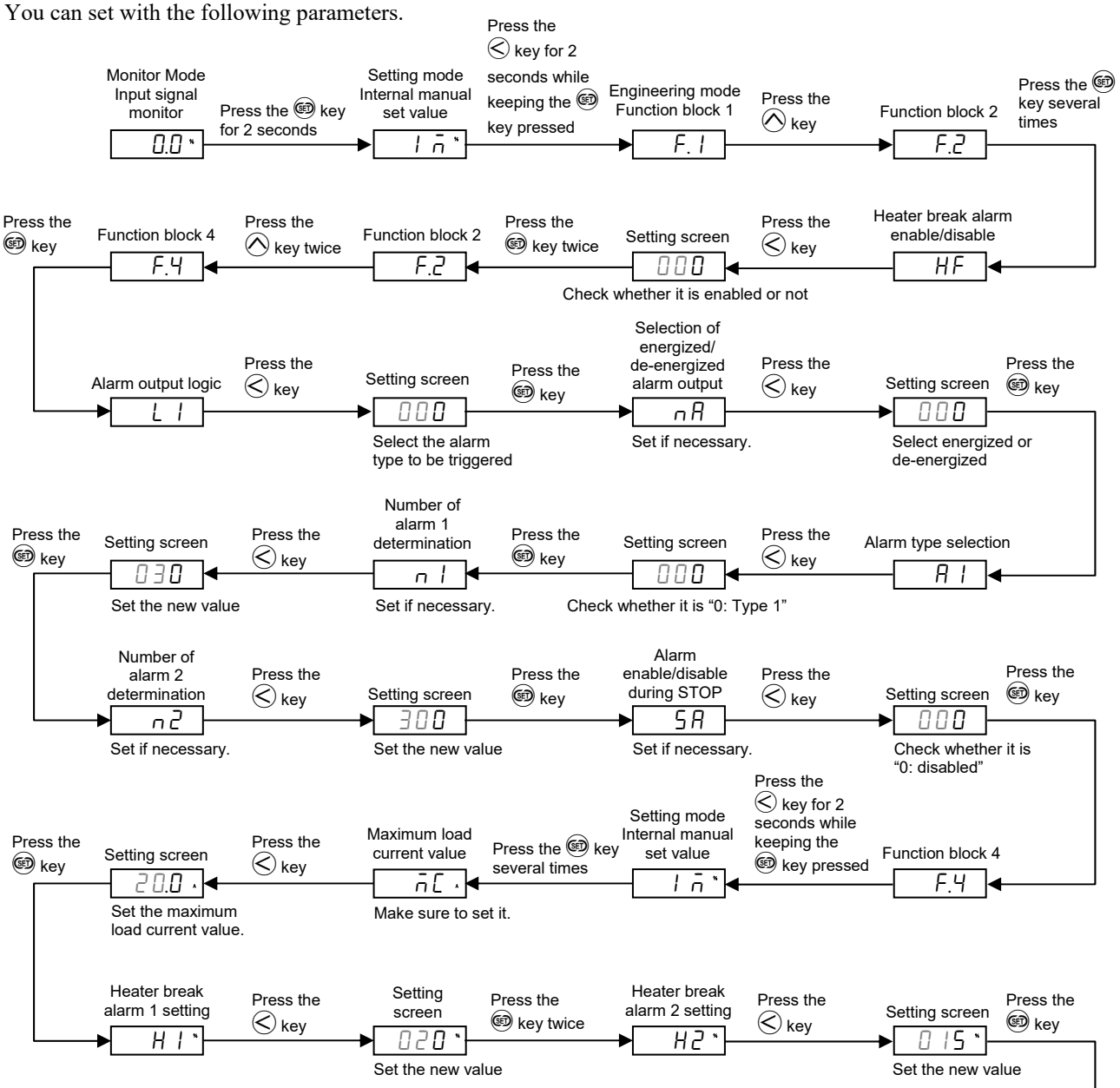


B

B

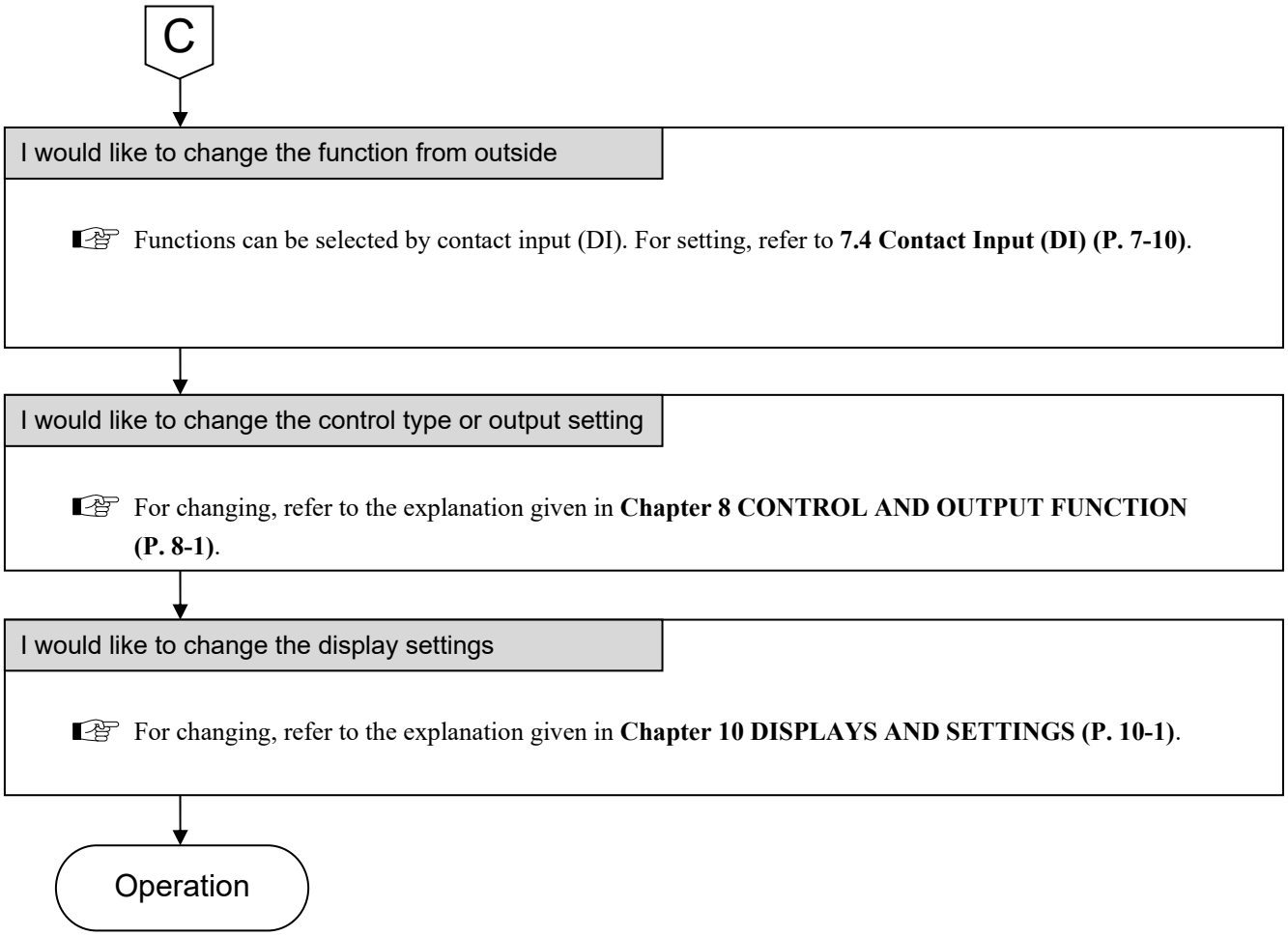
I would like to detect the heater break

This setting is used to detect the heater break alarm (type 1) during phase control.
You can set with the following parameters.



☞ For thyristor break-down alarms and alarms other than Type 1, refer to **Chapter 9 ALARM AND SELF-DIAGNOSIS (P. 9-1)**.

C


C
I would like to change the function from outside
☞ Functions can be selected by contact input (DI). For setting, refer to 7.4 Contact Input (DI) (P. 7-10).
I would like to change the control type or output setting
☞ For changing, refer to the explanation given in Chapter 8 CONTROL AND OUTPUT FUNCTION (P. 8-1).
I would like to change the display settings
☞ For changing, refer to the explanation given in Chapter 10 DISPLAYS AND SETTINGS (P. 10-1).
Operation

MEMO

2 MOUNTING

This chapter describes mounting cautions, dimensions and mounting procedures.

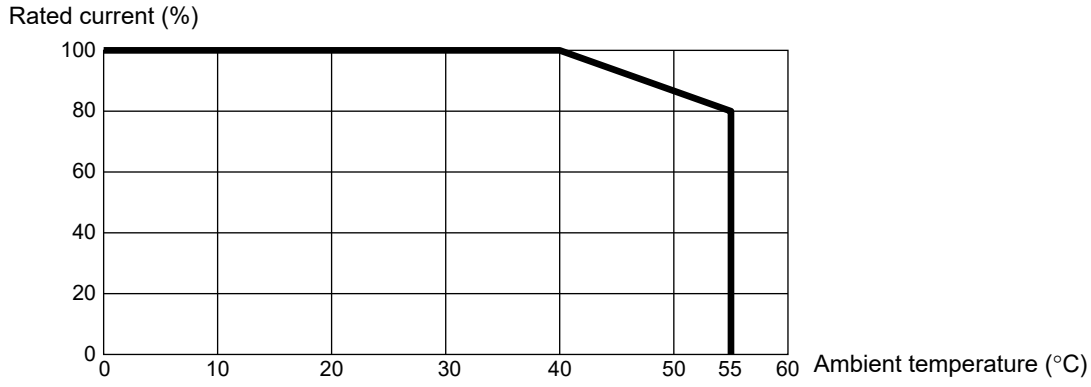
2.1 Mounting Environment

⚠ WARNING

- To prevent electric shock or instrument failure, always turn off the power of the entire system before mounting or removing the instrument.
- Since this instrument generates a lot of heat, installing it in a direction other than the specified direction may cause an accident or failure.
- When carrying the instrument, make sure to cool down the heat radiation fins, and then hold the heat radiation fins to carry the instrument. Carrying with the main unit may cause deformation or damage to the main unit.

(1) This instrument is intended to be used under the following environmental conditions.
- EN60947-4-3, UL508, C22.2 No. 14 POLLUTION DEGREE 2

(2) Use this instrument within the following allowable ranges.
- Allowable ambient temperature: −15 to +55 °C
  The rated current drops when the ambient temperature exceeds 40 °C.



Temperature characteristic (20 to 100 A types)

📖 The temperature characteristic eristic is the same for close mounting.

📖 The temperature characteristic is common to the all types (20 A, 30 A, 45 A, 60 A, 80 A and 100 A).

- Allowable ambient humidity: 5 to 95 %RH
  (Absolute humidity: MAX. W. C 29 g/m^3 dry air at 101.3 kPa)

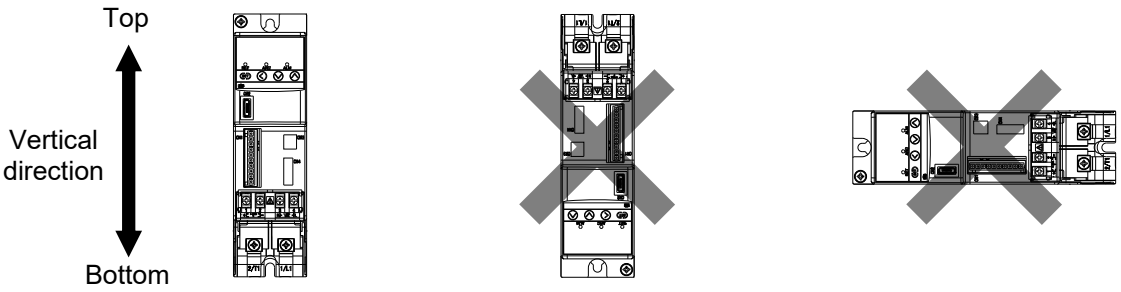
(3) Do not use this instrument in the following environment:
- Sudden change in ambient temperature
- Condensation or icing
- Corrosive or inflammable gases
- Such a place where there are inflammable materials near this instrument
- Strong vibration or impact
- Water, oil, chemicals, vapor, or steam splashes
- Excessive dust, salt, or iron particles
- Excessive induction noise, static electricity, magnetic fields, or noise
- Direct air flow from an air conditioner
- Exposure to direct sunlight
- Direct radiant heat

2.2 Mounting Cautions

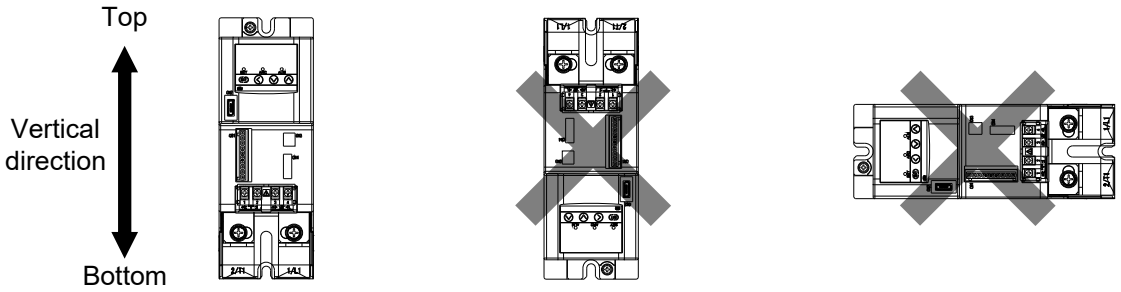
Take the following points into consideration when mounting this instrument.

- The instrument must be mounted in a proper direction. When installing the instrument, observe mounting directions.

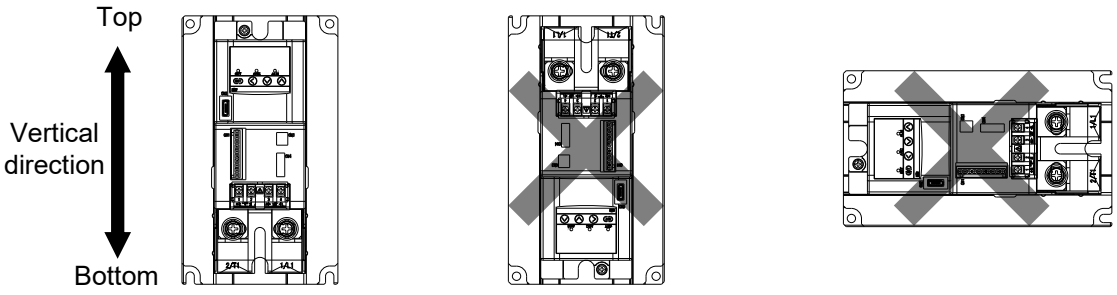
20 A/30 A type



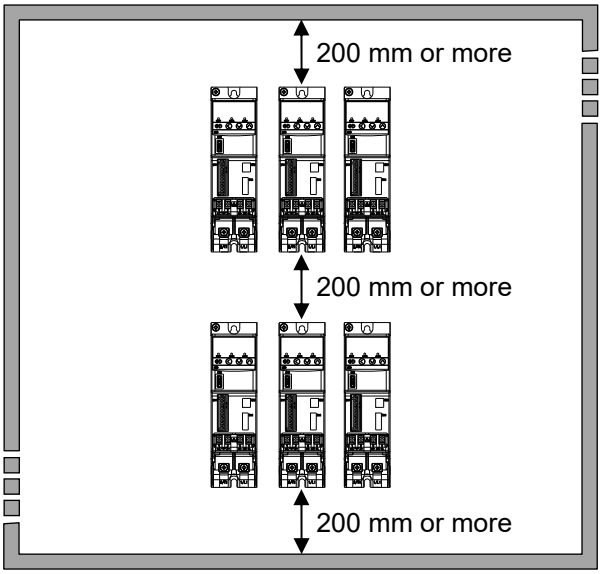
45 A/60 A type



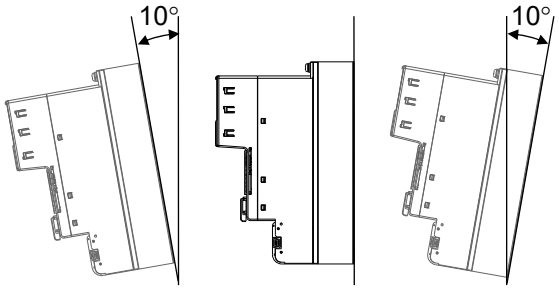
80 A/100 A type



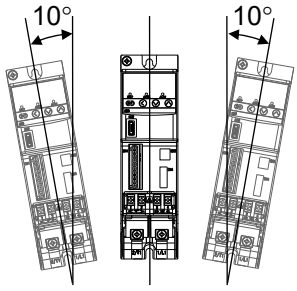
- Radiation space
  The instrument requires radiation space above and below it. Allow minimum 200 mm clearance. Moreover, consider working space as well.
  (The diagram shows 20 A/30 A types. The same space is required for the other types.)



- Mount the instrument tilted within 10° from vertical (back and forth and left and right).
  (The figure shows 20 A/30 A types, but also observe the same angle for other models)



Back and forth



Left and right

- Temperature inside the control panel increases due to heat generation of this instrument itself. Therefore, take into account full ventilation by mounting forced ventilation fans on the panel.

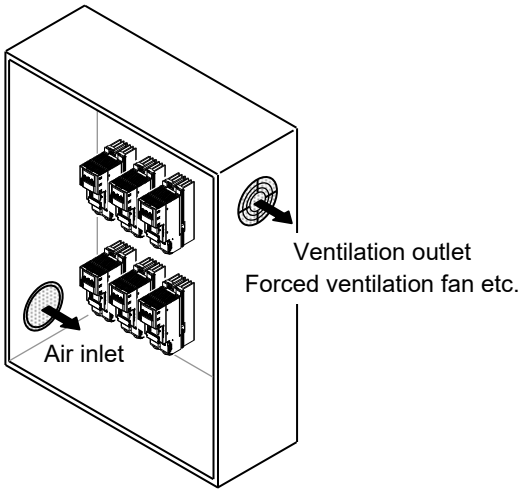


Table of calorific values
(100 to 240 V AC)

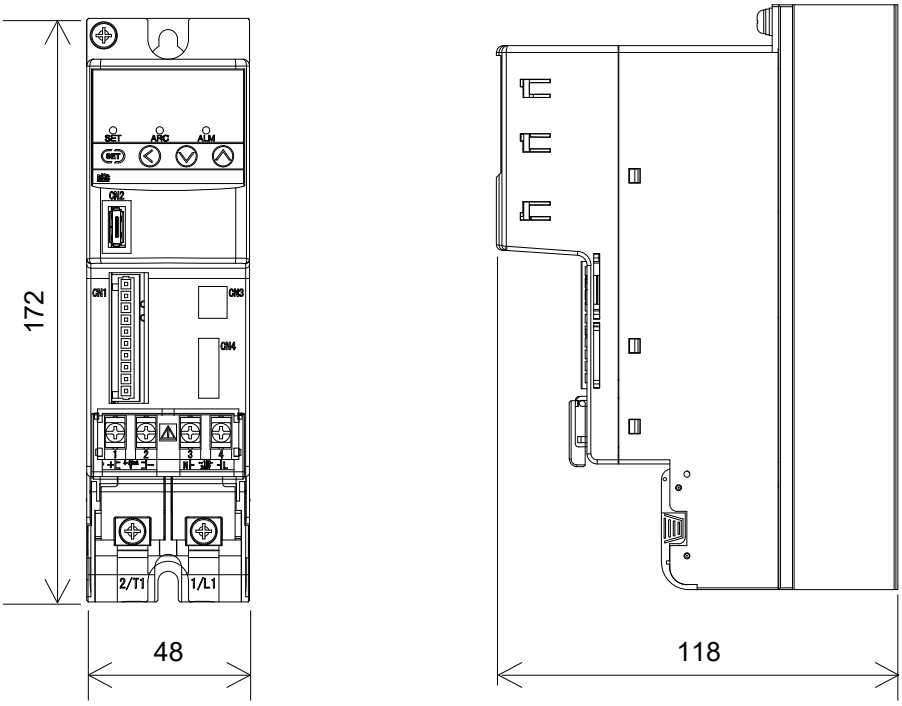
Rating current	Calorific value
20 A	Approx. 30 W
30 A	Approx. 43 W
45 A	Approx. 63 W
60 A	Approx. 84 W
80 A	Approx. 112 W
100 A	Approx. 140 W

2.3 Outer Dimensions and Mounting Dimensions

■ 20 A/30 A type

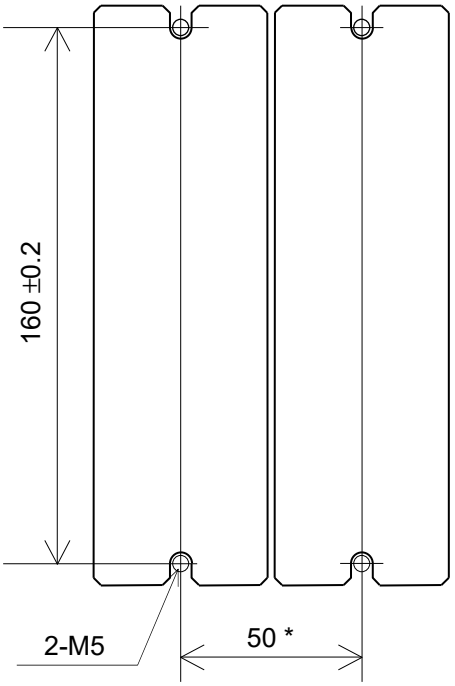
Outer dimensions

Unit: mm



Mounting dimensions

Unit: mm

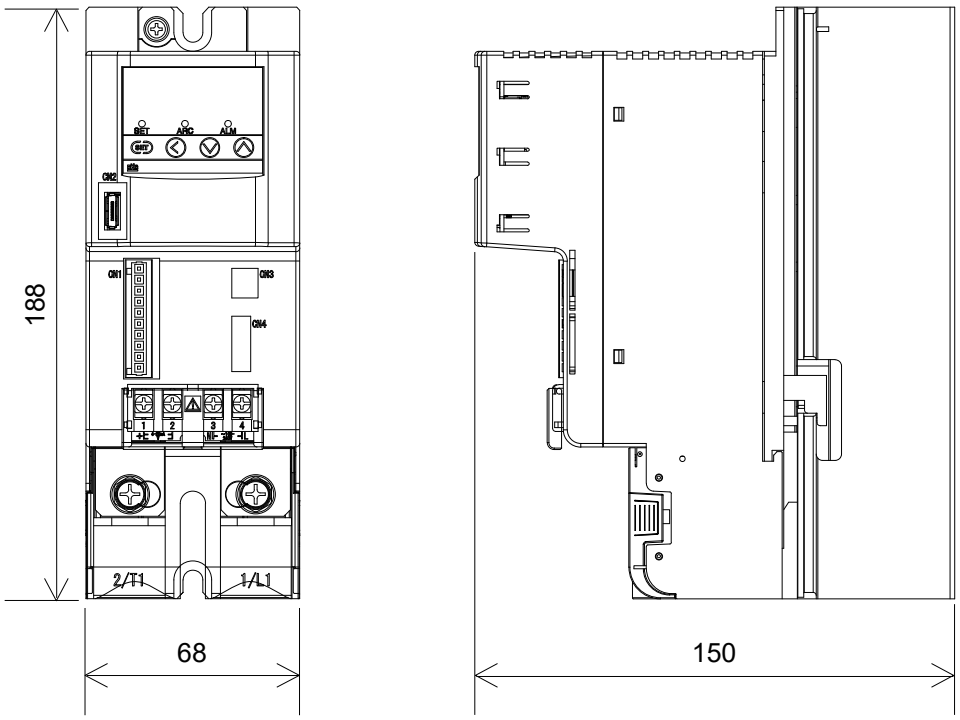


* Minimum space when mounted closely side by side.

■ 45 A/60 A type

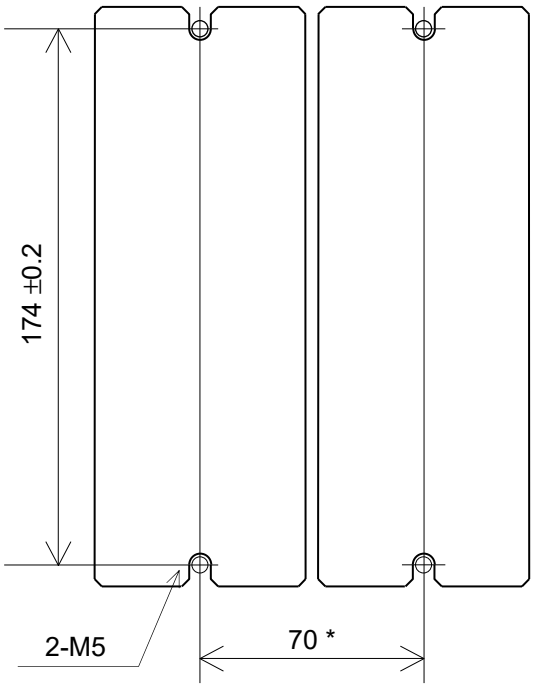
Outer dimensions

Unit: mm



Mounting dimensions

Unit: mm

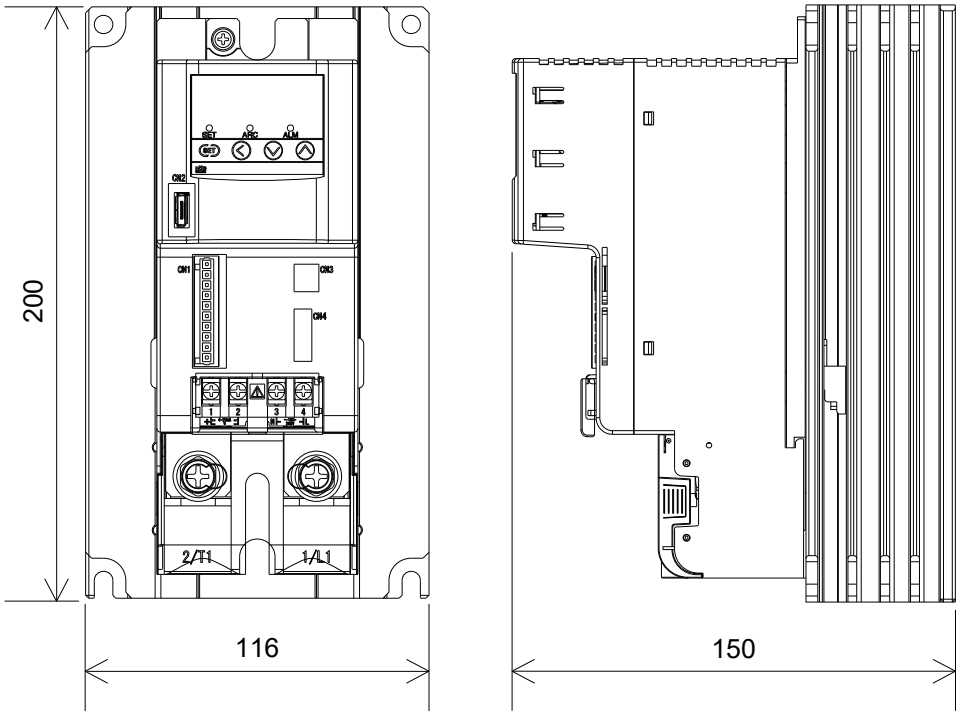


* Minimum space when mounted closely side by side.

■ 80 A/100 A type

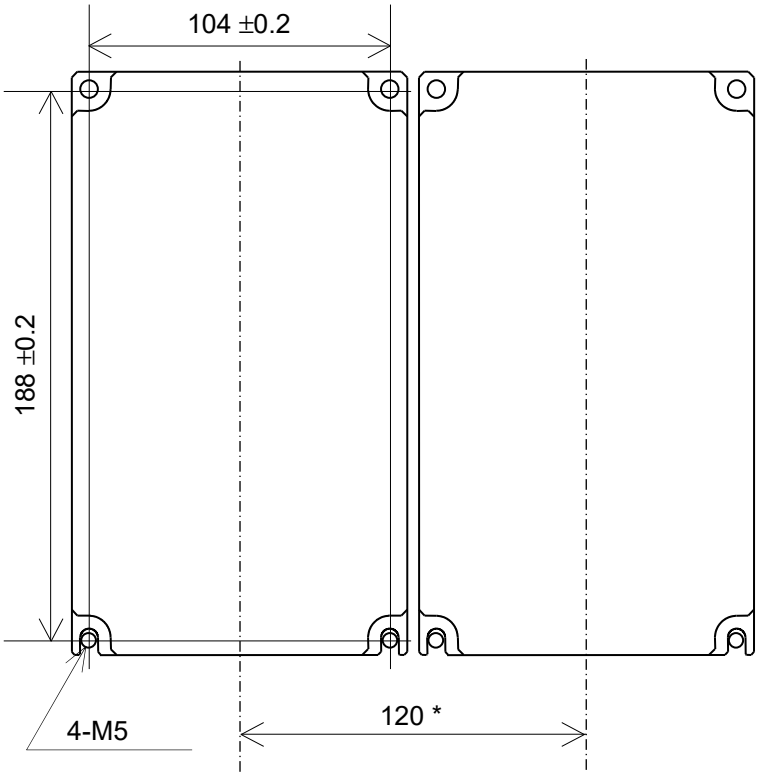
Outer dimensions

Unit: mm



Mounting dimensions

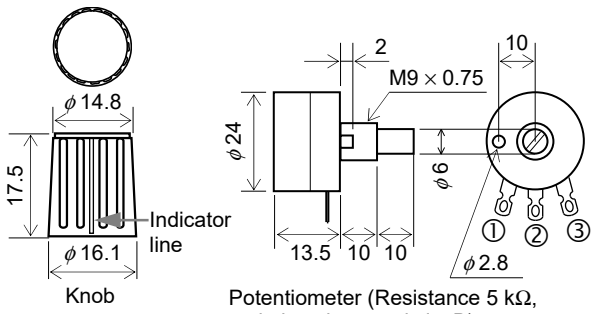
Unit: mm

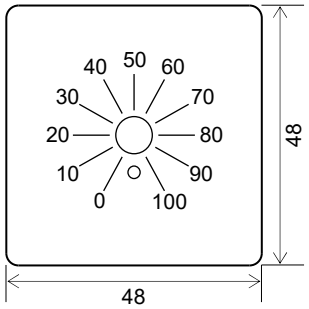


* Minimum space when mounted closely side by side.

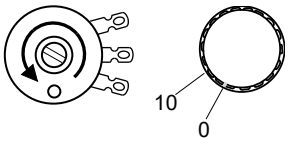
■ Setter [potentiometer, knob, and scale plate] (THV1P-S01)

Unit: mm





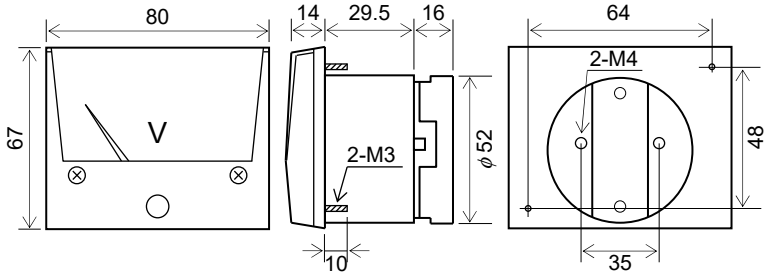
ϕ: Diameter



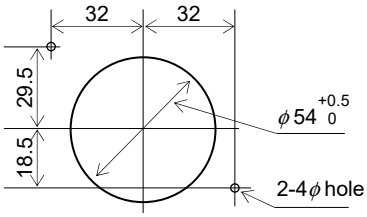
Turn the potentiometer counterclockwise fully before combining it with the scale plate.
When attaching a knob, align the Indicator line on the knob with 0 on the scale plate and then combine it.

■ Output voltmeter 150 V span (THVP-V01), 300 V span (THVP-V02)

Unit: mm

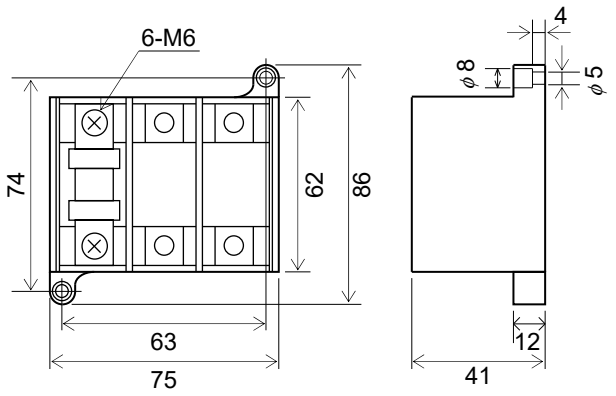


Panel cutout dimensions

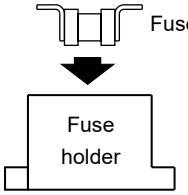


■ Fuse unit for 20 A/30 A [holder: 3-circuit types] (THVP-H01)

Unit: mm

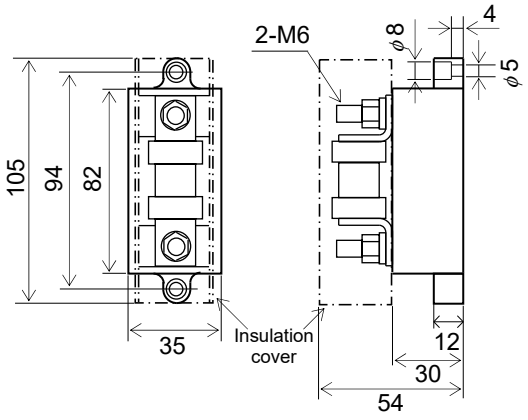


Insert the fuse as shown in the figure below.

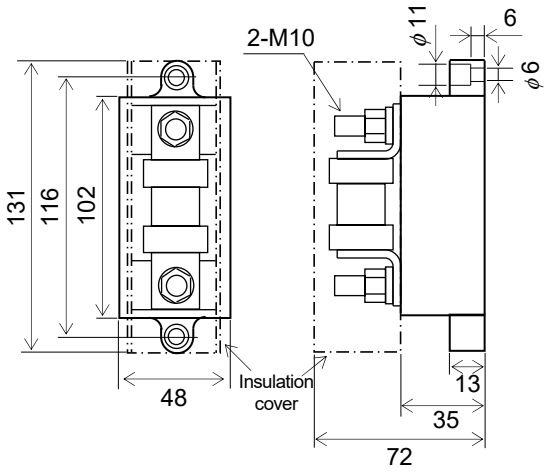


■ Fuse unit [holder: 1 circuit type] (THVP-H02)

● **For 20 A/30 A/45 A**

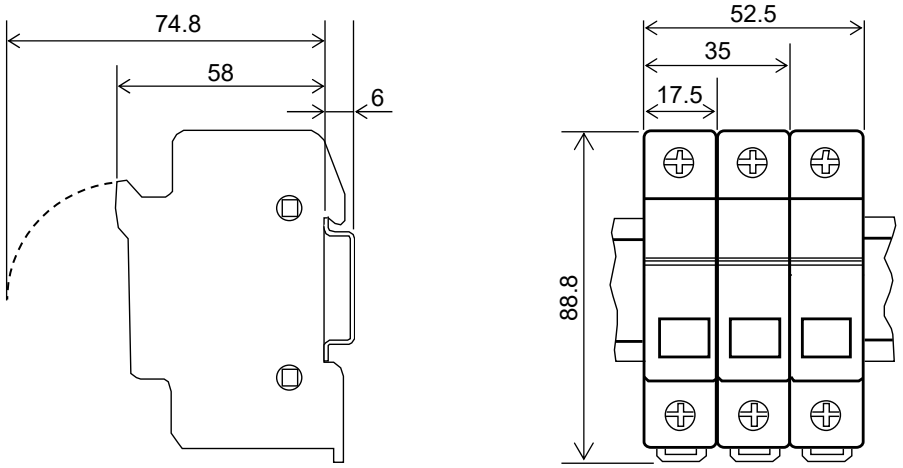


● **For 60 A/80 A/100 A**



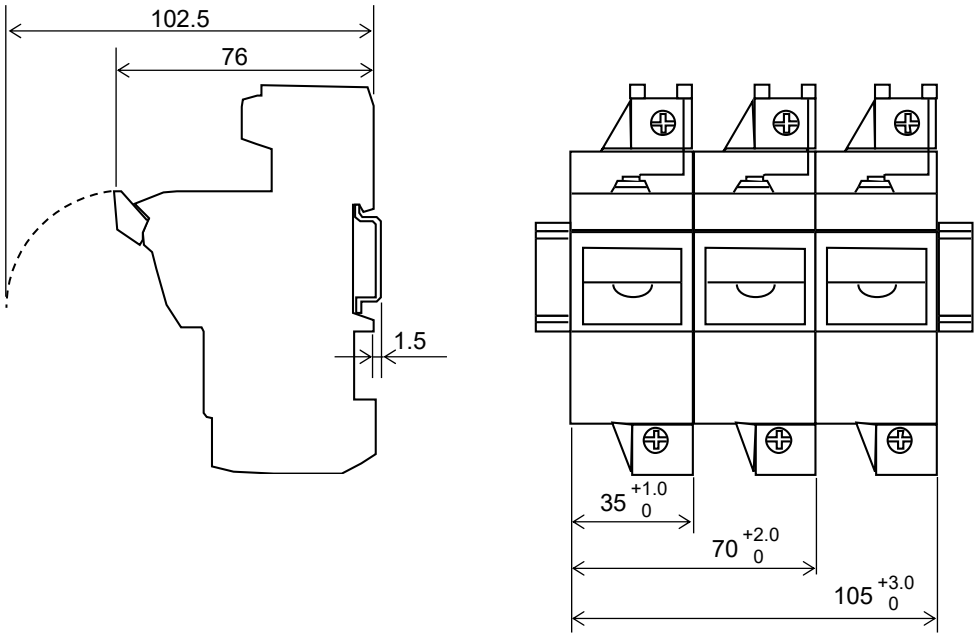
Unit: mm

■ UL certified fuse holder for 20 A/30 A [1 circuit type] (THVP-H04)



Unit: mm

■ UL certified fuse holder for 45 A/60 A/80 A/100 A [1 circuit type] (THVP-H05)



Unit: mm

2.4 Mounting Procedures

1. Prepare the holes as specified in mounting dimensions.

2. Place the instrument so that the mounting positions in the top and bottom of the instrument are aligned with the prepared holes.

3. Insert the mounting screws into the holes, then tighten them with a screwdriver.

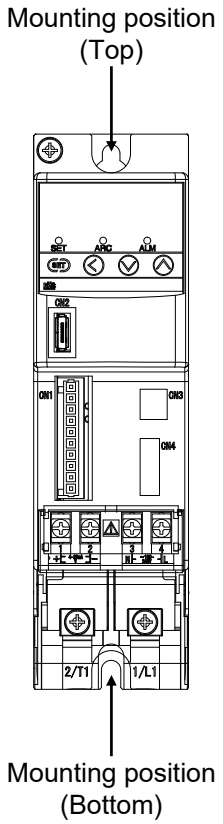
- **Mounting screws**

  Customer must provide the set of mounting screws.

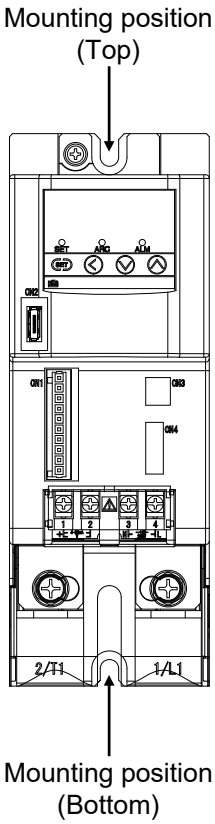
  Screw type: Pan-head screws

  Size: M5, Length: 10 mm or more, Screw head diameter, max. ϕ 10.3

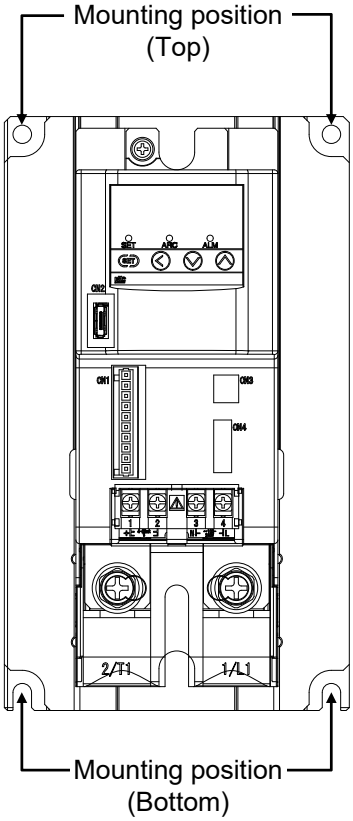
  Recommended tightening torque: 3.6 N·m [36 kgf·cm]



20 A/30 A types



45 A/60 A types



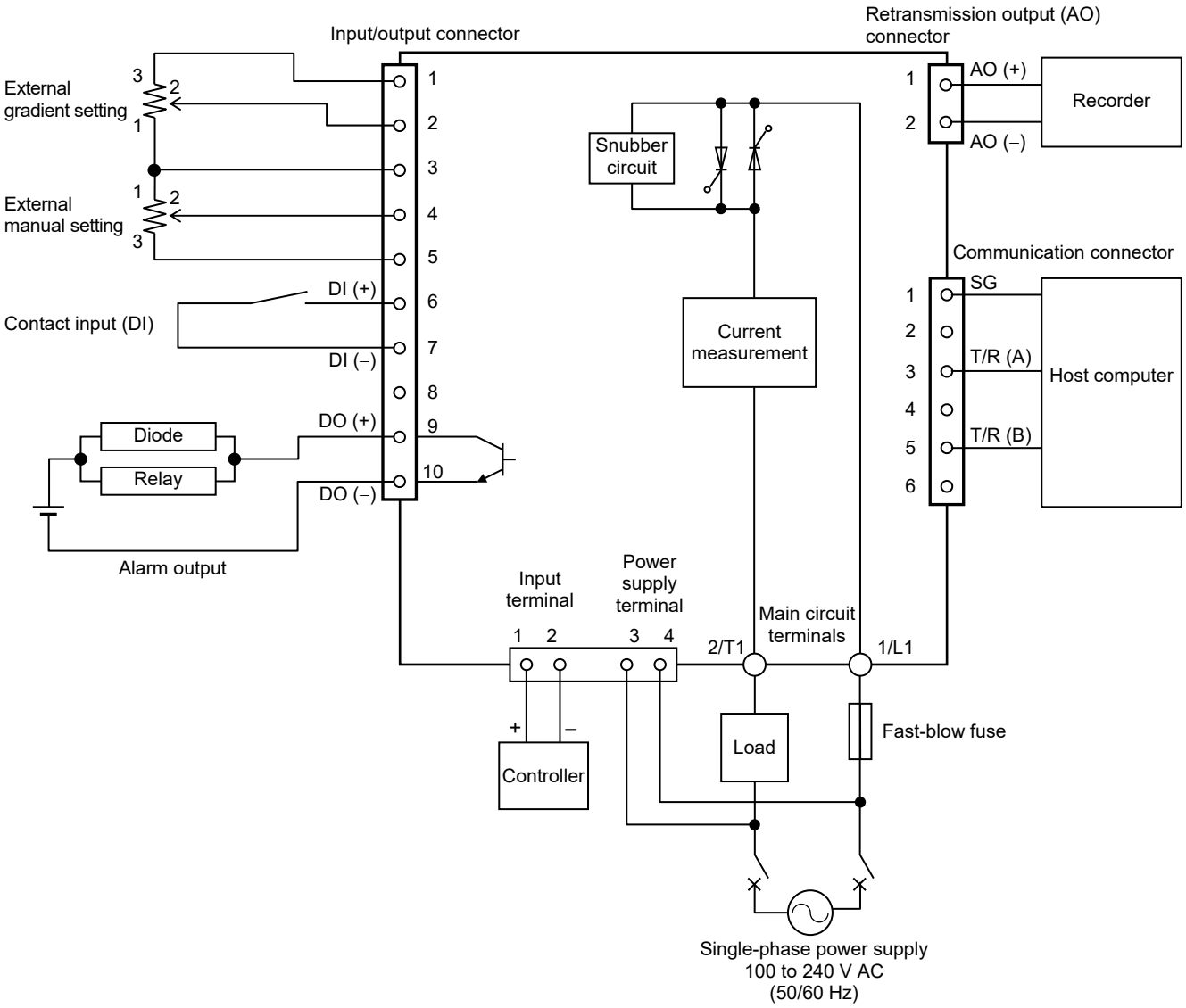
80 A/100 A types

MEMO

3 WIRING

This chapter describes wiring cautions and shows examples of wiring.

3.1 Circuit Block Diagram



- The fast-blow fuse and current measurement circuit are optional.
- If the contact input (DI) is used, you need to assign contact input function.
- Alarm types must be selected for the alarm outputs.

3.2 Wiring Cautions

⚠ WARNING

To prevent electric shock and instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

- When wiring, make sure to match the phases of the main circuit (2/T1) and power supply terminal (No. 3), and the main circuit (1/L1) and power supply terminal (No. 4). If the wiring is incorrect, it will not operate properly.
- For avoiding noise induction, keep input signal wire from the controller away from the power line and load line. If wiring near the power line is unavoidable, use shielded wires.
- There are neither fuses nor power switches in the power supply of this instrument. Therefore install the fuses and switches near the instrument, if necessary.
- The optional fast-blow fuse is used to protect the instrument.
- Choose solderless terminals from the following table.

  Input terminals (1, 2) and power supply terminals (3, 4)

	20 A/30 A/45 A/60 A/80 A/100 A
Maker	J.S.T Mfg. Co., Ltd.
Parts No.	V1.25-MS3

  Main circuit terminals (2/T1, 1/L1)

	20 A/30 A	45 A/60 A	80 A/100 A
Maker	J.S.T Mfg. Co., Ltd.		
Parts No.	V5.5-4 (Circular terminal with isolation)	R14-6 (Circular terminal)	R38-8 (Circular terminal)

- Use wires satisfying the rated current capacity.

  Input terminals (1, 2) and power supply terminals (3, 4)

	20 A/30 A/45 A/60 A/80 A/100 A
Applicable wire (twisted wire)	0.25 to 1.65 mm^2

  Main circuit terminals (2/T1, 1/L1)

	20 A/30 A	45 A/60 A	80 A/100 A
Applicable wire (twisted wire)	2.63 to 5.5 mm^2	10.52 to 14 mm^2	26.66 to 38 mm^2

- Make sure that during field wiring parts of conductors cannot come into contact with adjacent conductive parts.
- Tighten the bolts on the main circuit terminals of the 45 to 100A types with a torque wrench. When tightening the bolts, always place the torque wrench on the hexagonal part of the bolt. Tighten the screws on the main circuit terminals of the 20 and 30 A types with a torque screwdriver.
- Firmly tighten each bolt and terminal screw with the tightening torque specified below. Otherwise, electric shock, fire, or heat generation may result.

  Input terminals (1, 2) and Power supply terminals (3, 4)

	20 A/30 A/45 A/60 A/80 A/100 A
Recommended tightening torque	0.49 N·m (4.9 kgf·cm)

  Main circuit terminals (2/T1, 1/L1)

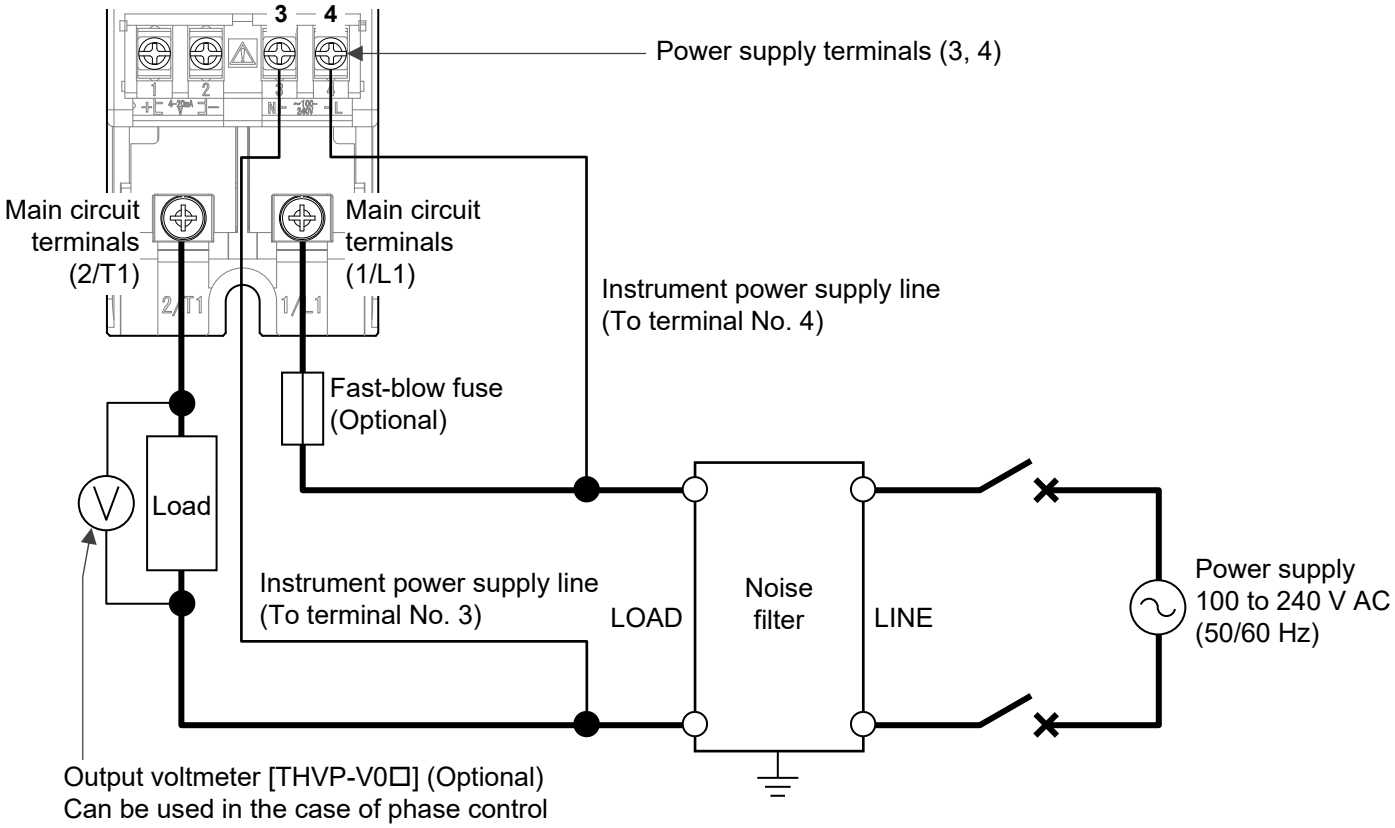
	20 A/30 A	45 A/60 A	80 A/100 A
Recommended tightening torque	1.6 N·m (16 kgf·cm)	3.8 N·m (38 kgf·cm)	9.0 N·m (90 kgf·cm)

3.3 Wiring of Main Circuit

⚠ CAUTION

- In order to comply with the European EMC and low voltage directives, the noise filter should be applied.
  The noise filter specified (SOSHIN ELECTRIC CO., LTD.)
  20 A: LF2030A-NH 45 A: HF2050A-UP 80 A: HF2080A-UP
  30 A: LF2030A-NH 60 A: HF2060A-UP 100 A: HF2100A-UP

  ☞ The instrument does not come with a noise filter. Please prepare a noise filter on your side.



Terminal screws size and recommended tightening torque

		20 A/30 A	45 A/60 A	80 A/100 A
Power supply terminals (3, 4)	Terminal screws size	M3 × 7 (With 5.8 × 5.8 square washer)		
	Recommended tightening torque	0.49 N·m (4.9 kgf·cm)		
Main circuit terminals (2/T1, 1/L1)	Terminal screws size	M4 × 8	M6 × 16	M8 × 20
	Recommended tightening torque	1.6 N·m (16 kgf·cm)	3.8 N·m (38 kgf·cm)	9.0 N·m (90 kgf·cm)

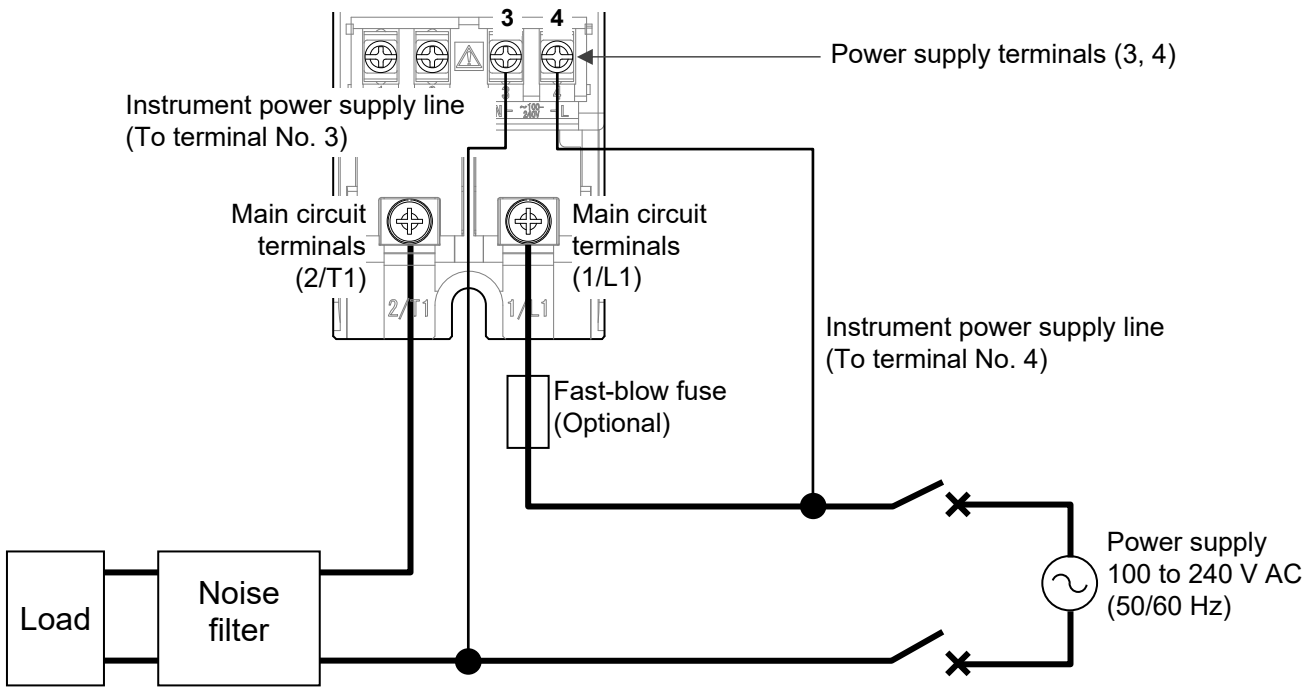
☞ Refer to **P. 3-3** for solderless terminals for wiring.

☞ Refer to **P. 11-9** for how to remove the terminal cover for the main circuit terminal.

■ Caution for connecting a noise filter to the load side of the instrument

⚠ CAUTION

- When the control of this instrument is started without connecting a load in a configuration where a noise filter is connected to the load side of the instrument, a large surge may occur to the noise filter and a damage of the instrument may result. Control must be always conducted with the load connected.



Terminal screws size and recommended tightening torque

		20 A/30 A	45 A/60 A	80 A/100 A
Power supply terminals (3, 4)	Terminal screws size	M3 × 7 (With 5.8 × 5.8 square washer)		
	Recommended tightening torque	0.49 N·m (4.9 kgf·cm)		
Main circuit terminals (2/T1, 1/L1)	Terminal screws size	M4 × 8	M6 × 16	M8 × 20
	Recommended tightening torque	1.6 N·m (16 kgf·cm)	3.8 N·m (38 kgf·cm)	9.0 N·m (90 kgf·cm)

☞ Refer to **P. 3-3** for solderless terminals for wiring.

☞ Refer to **P. 11-9** for how to remove the terminal cover for the main circuit terminal.

■ Caution for connecting a transformer to the load side of the instrument

⚠ CAUTION

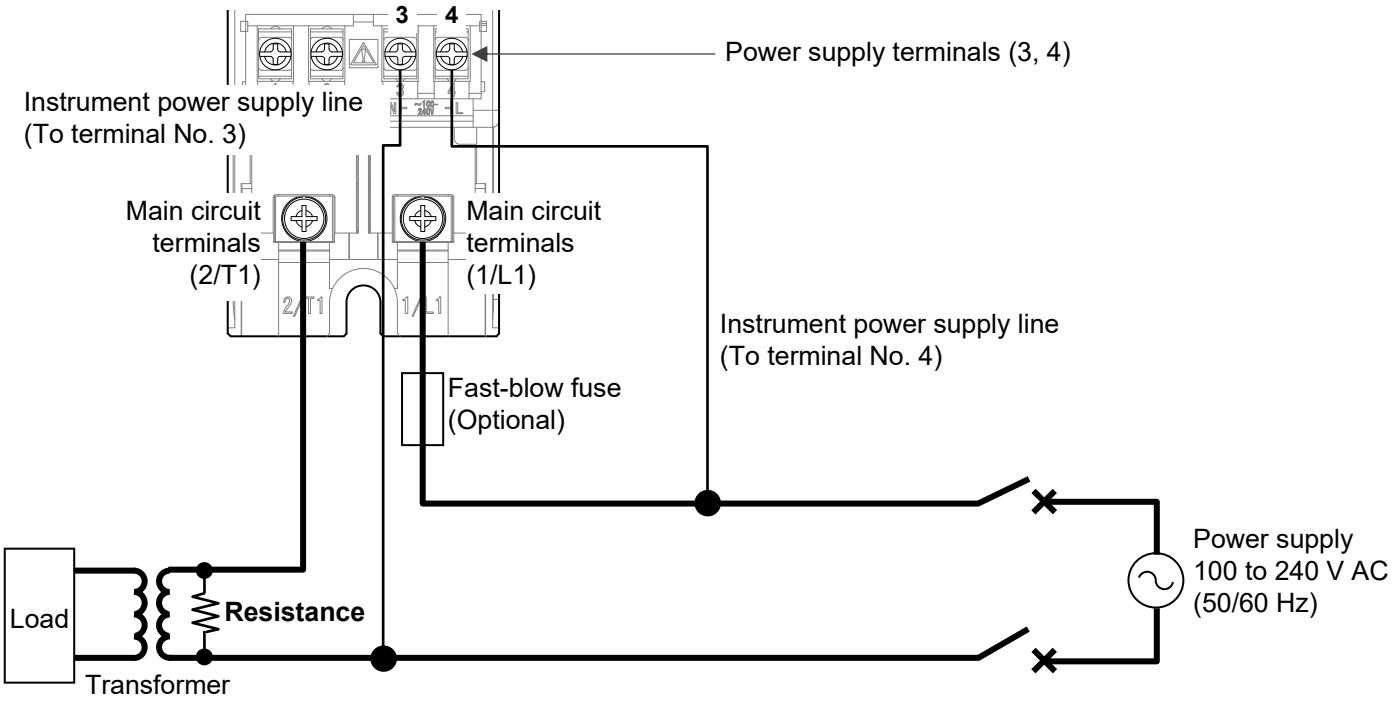
- When a protection function for control of primary side of a transformer is not provided:
  If the action of the device is influenced by excessive current (rush current, current due to flux saturation of transformer), use a transformer 1.25 T (magnetic flux density) or less. Make sure that soft-start time is appropriately set.

  When connecting a transformer to the load side of this product, make sure that the current value of the primary side of the transformer is equal to or more than the minimum load current of this product. When the current value of the primary side of the transformer is less than the minimum load current value of this product, connect a bleeder resistor in parallel with the primary side of the transformer, and allow the current more than the minimum load current to flow.

  Minimum load current: 0.6 A (20 A type) 1 A (30 A type or more)

When control is started on this instrument without connecting a load to the transformer, it may result in heat generation or failure of the transformer.

- When a protection function for control of primary side of a transformer is provided:
  To conduct control of primary side of a transformer, make sure protection function for control of primary side of a control is set. Appropriately adjust the soft-start time in case of break on the secondary side of the transformer depending on the operating condition.



Terminal screws size and recommended tightening torque

		20 A/30 A	45 A/60 A	80 A/100 A
Power supply terminals (3, 4)	Terminal screws size	M3 × 7 (With 5.8 × 5.8 square washer)		
	Recommended tightening torque	0.49 N·m (4.9 kgf·cm)		
Main circuit terminals (2/T1, 1/L1)	Terminal screws size	M4 × 8	M6 × 16	M8 × 20
	Recommended tightening torque	1.6 N·m (16 kgf·cm)	3.8 N·m (38 kgf·cm)	9.0 N·m (90 kgf·cm)

☞ Refer to **P. 3-3** for solderless terminals for wiring.

☞ Refer to **P. 11-9** for how to remove the terminal cover for the main circuit terminal.

3.4 Wiring of Input Signal

Connect output signal lines from a temperature controller, etc to input terminals 1 (+) and 2 (–) of this instrument.

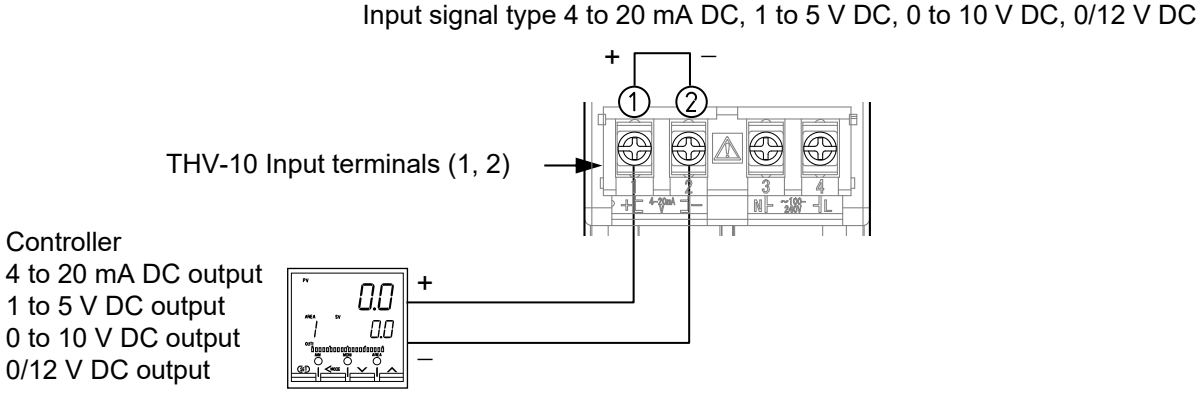
☞ Refer to **P. 3-3** for solderless terminals for wiring and recommended tightening torque.

3.4.1 Wiring method of input signal

Input impedance of THV-10 input terminals

In case of current input: Approx. 50 Ω

In case of voltage input or voltage pulse input: Approx. 30 kΩ



Wiring diagram of input signal

Terminal screws size and recommended tightening torque

		20 A/30 A/45 A/80 A/100 A
Input terminals (1, 2)	Terminal screws size	M3 × 7 (With 5.8 × 5.8 square washer)
	Recommended tightening torque	0.49 N·m (4.9 kgf·cm)

About input signal type

Input signal type is factory preset to your specification. If you need to change it, you can do so by input signal selection (XI) in engineering mode D. When changing, make sure to set the same type as the output signal of the temperature controller.

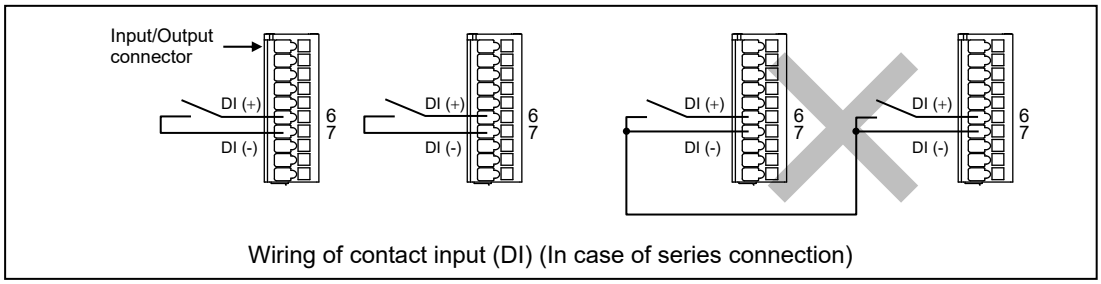
☞ For details on changing the input signal type, refer to **7.1 Control Input (Auto mode) (P. 7-2)**.

3.4.2 Wiring example of the series connection (For current input)

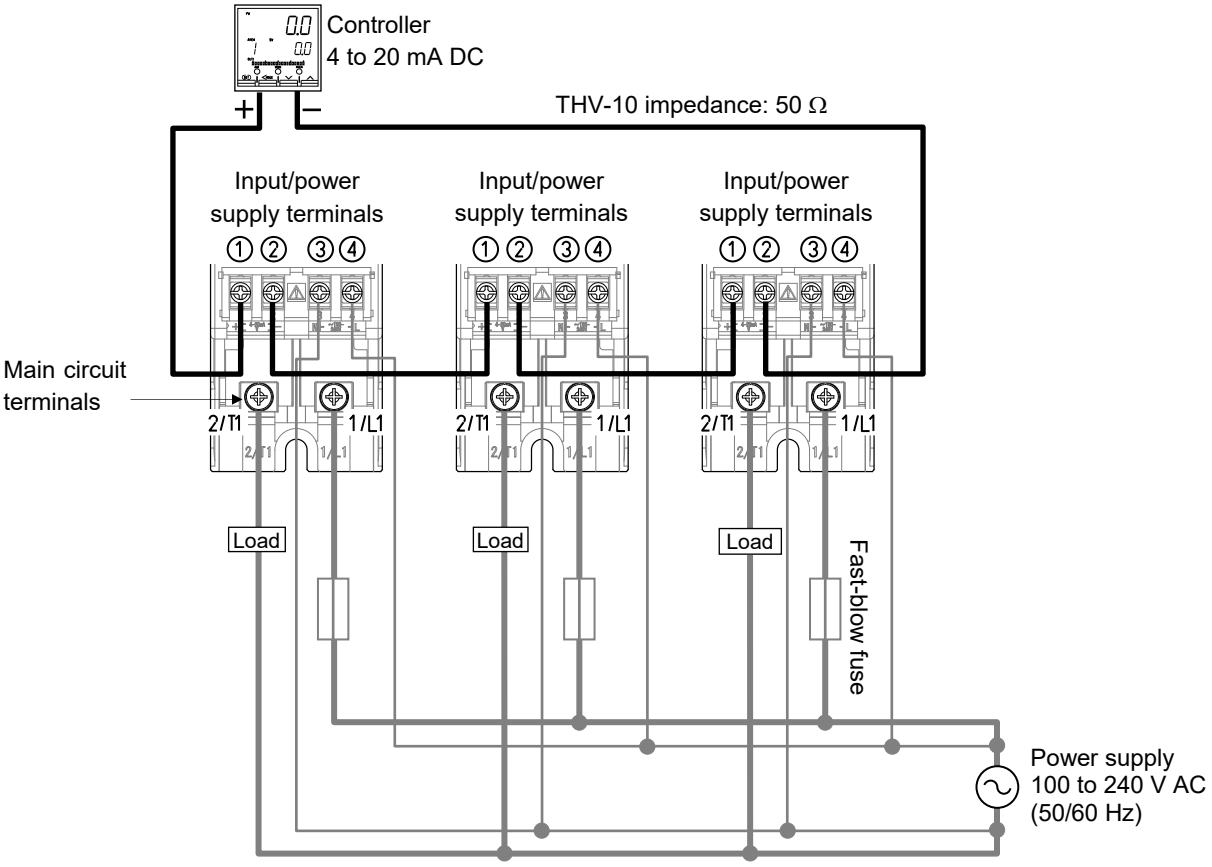
NOTE

Precautions to be taken when connecting control input in series

The control input, external gradient setting, external manual setting, and contact inputs (DI) are not insulated. If any connections other than the control inputs are made between the serially connected devices, the control input may not be input normally. When connecting contact inputs (DI), connect each point to 0 V.

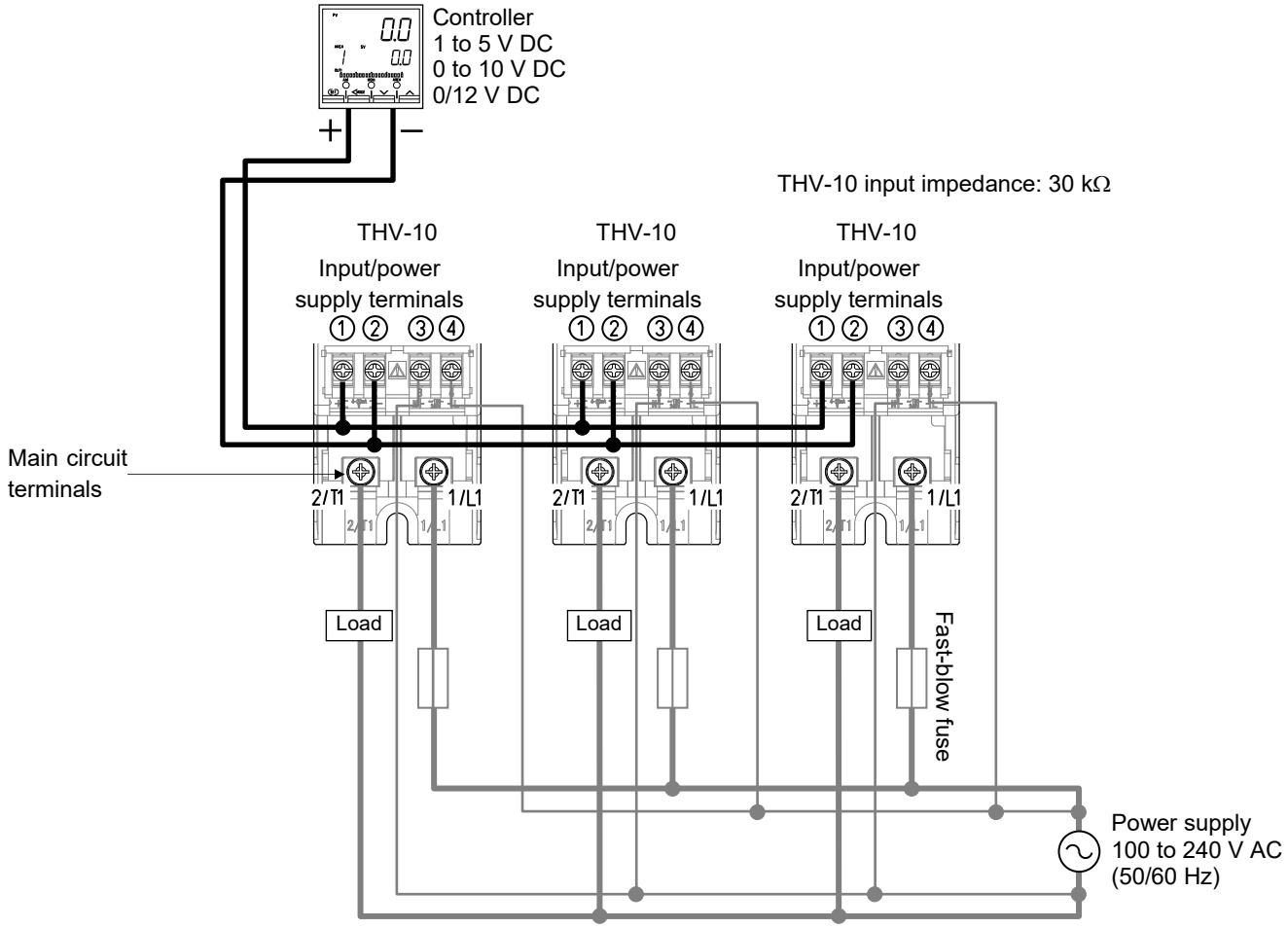


Wiring of contact input (DI) (In case of series connection)



The number of THV-10 that can be connected to one temperature controller depends on the allowable load resistance of the temperature controller. For resistance of the controller, refer to specification of the temperature controller instruction manual.

3.4.3 Wiring example of the parallel connection (For voltage input or voltage pulse input)



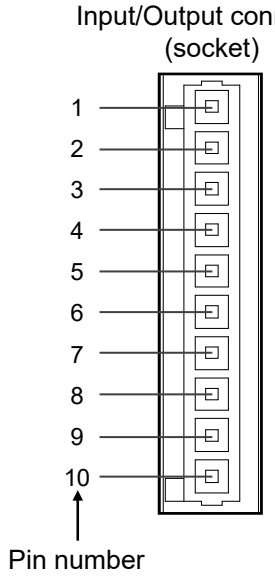
The number of THV-10 that can be connected to one temperature controller depends on the allowable load resistance of the temperature controller. For resistance of the controller, refer to specification of the temperature controller instruction manual.

3.5 Wiring for Input/Output Connector

The input/output connector is used for the following wiring.

- External gradient setting
- External manual setting
- Contact input (DI)
- Alarm output

3.5.1 Input/Output connector pin numbers and details



Pin number	Description
1	+5.0 V (Gradient setting)
2	Gradient setting input (0 to 5.0 V input by gradient setter)
3	0 V (Gradient setting, Manual mode)
4	Manual mode input (0 to 5.0 V input by manual setter)
5	+5.0 V (Manual mode)
6	Contact input: DI (+)
7	0 V (Contact input): DI (–)
8	Unused (Do not connect any device to this terminal)
9	Transistor output (Alarm output): DO (+)
10	Transistor output (Alarm output): DO (–)

DI: Digital input DO: Digital output

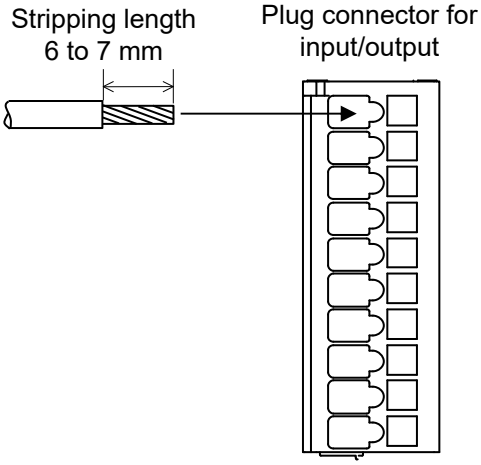
When you prepare the plug connector, it is recommend to use the following connector.
Recommended: WAGO Type: 734-110

3.5.2 Wire size used for input/output connector

Use the stranded leadwires.

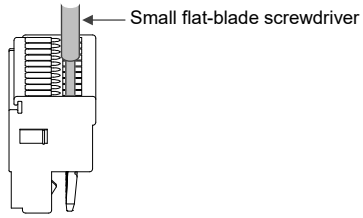
Stranded leadwires: AWG28-14 (cross-section 0.08 to 1.5 mm^2)

Stripping length: 6 to 7 mm

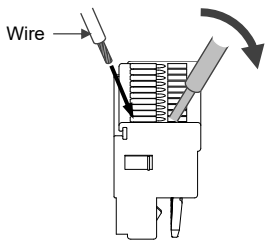


Wiring method

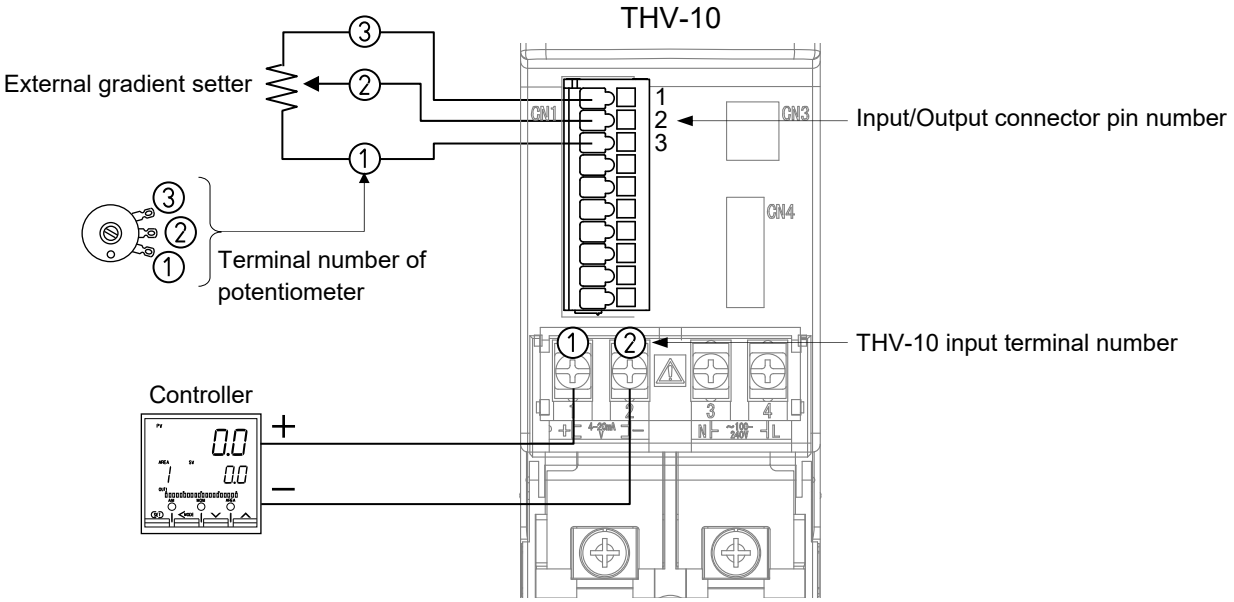
① Insert a small flat-blade screwdriver.



② Tilt the flathead screwdriver to the right and wire the electric wires.

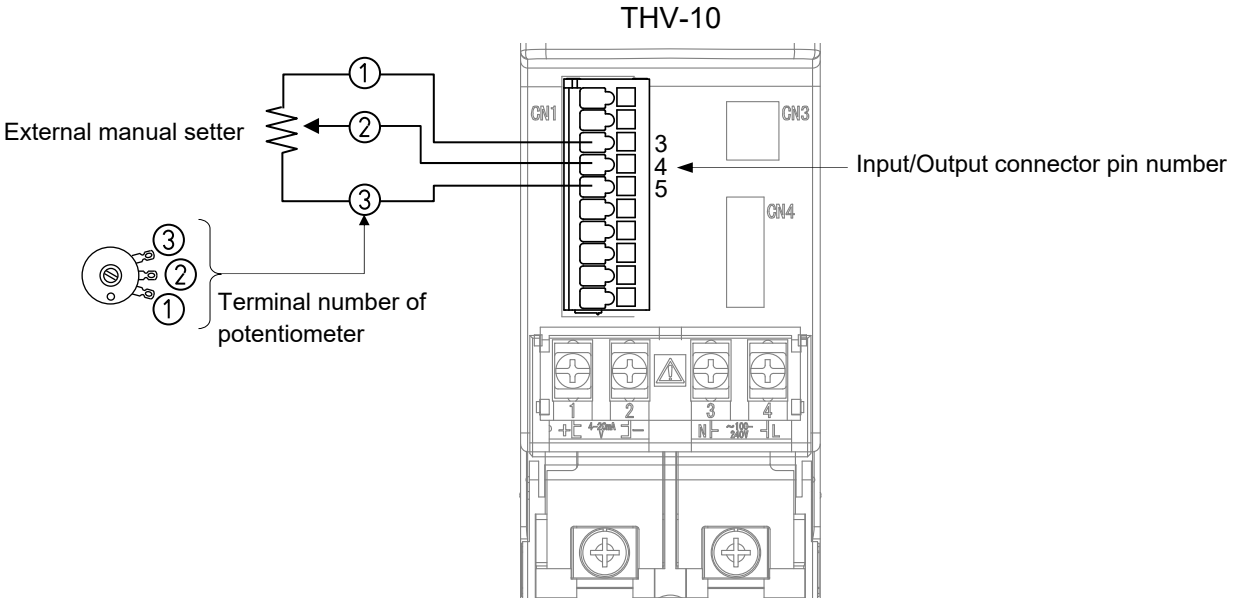


3.5.3 Wiring of external gradient setter

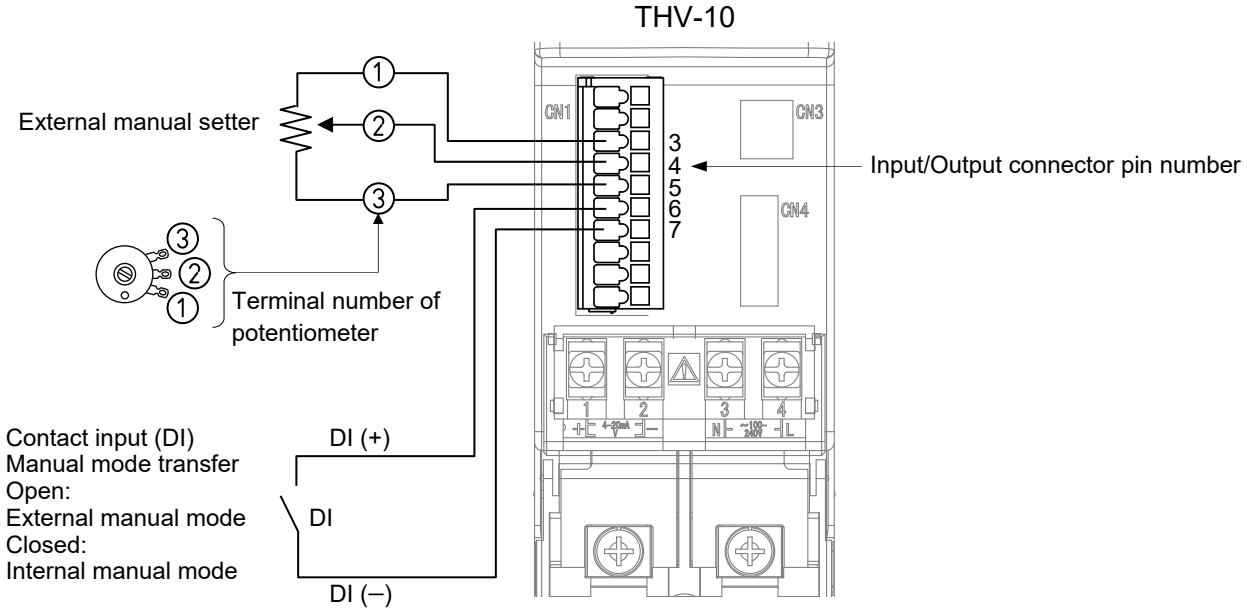


3.5.4 Wiring of external manual setter

■ Only external manual setter

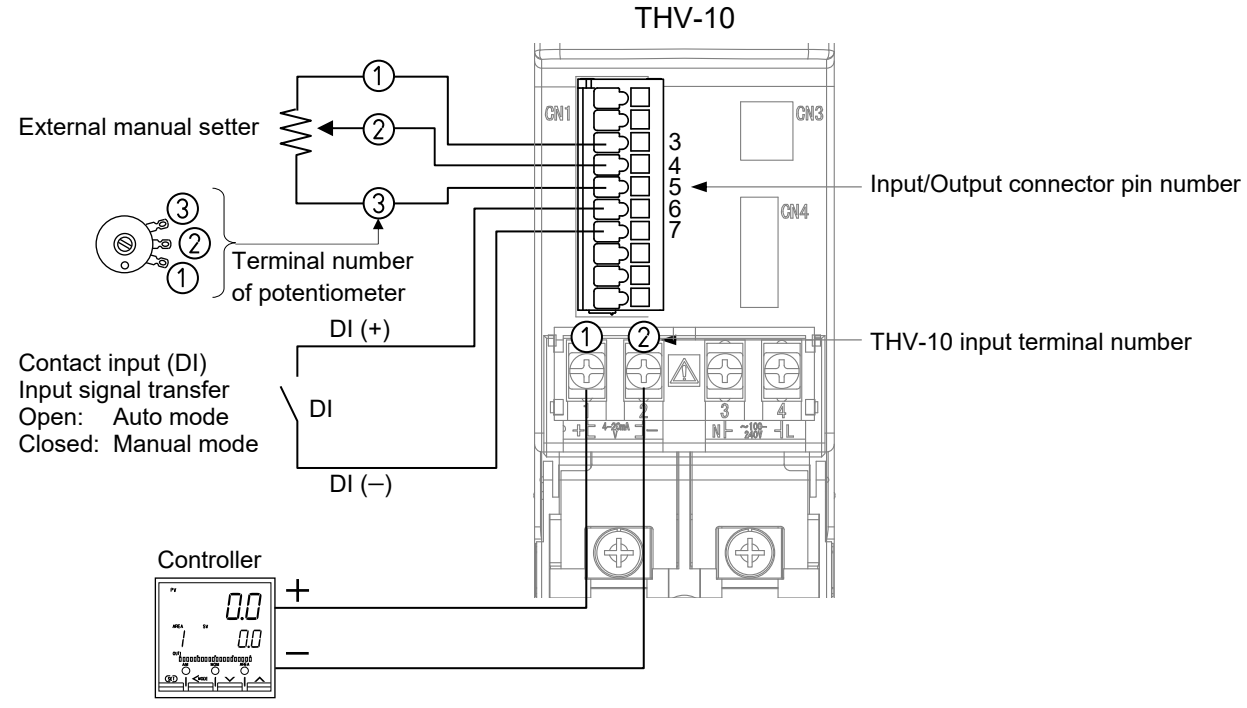


■ External manual setter (with manual mode transfer)



☞ For the allocation of the Contact input (DI) function, refer to "**7.4 Contact Input (DI) (P. 7-10)**."

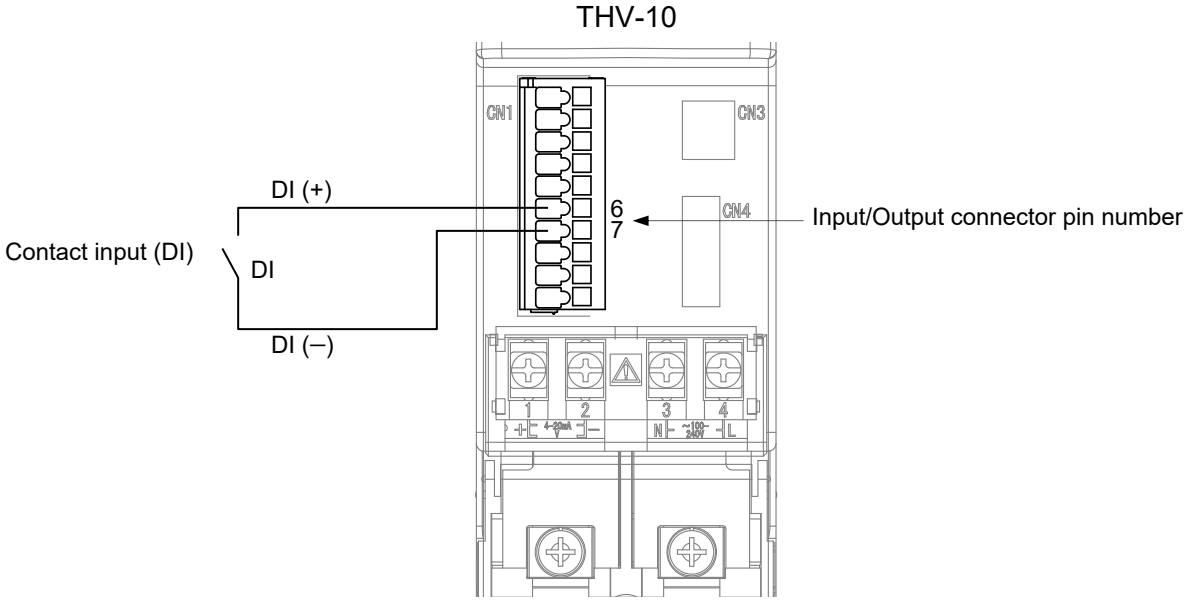
■ External manual setter (with input signal transfer)



☞ For the allocation of the Contact input (DI) function, refer to "**7.4 Contact Input (DI) (P. 7-10)**."

☞ When switching to the manual mode through the external contact input (DI), "External manual mode" needs to be configured in advance at "Manual mode transfer (AM)."
(Factory set value: External manual mode)
Refer to **7.2 Manual Mode (P. 7-4)** for details of setting External manual set value.

3.5.5 Wiring of contact input (DI)

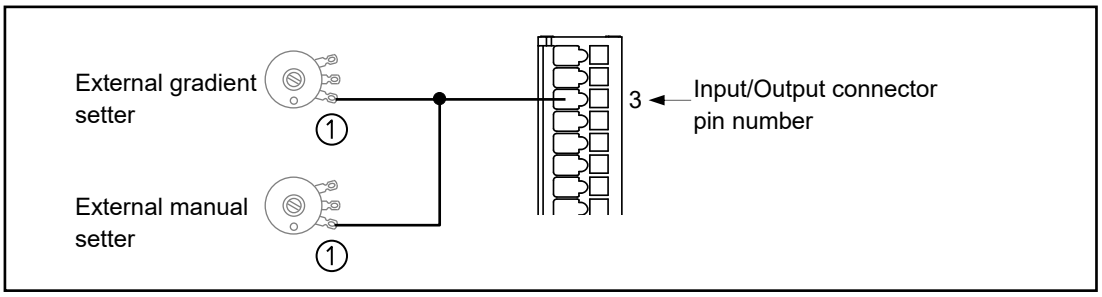


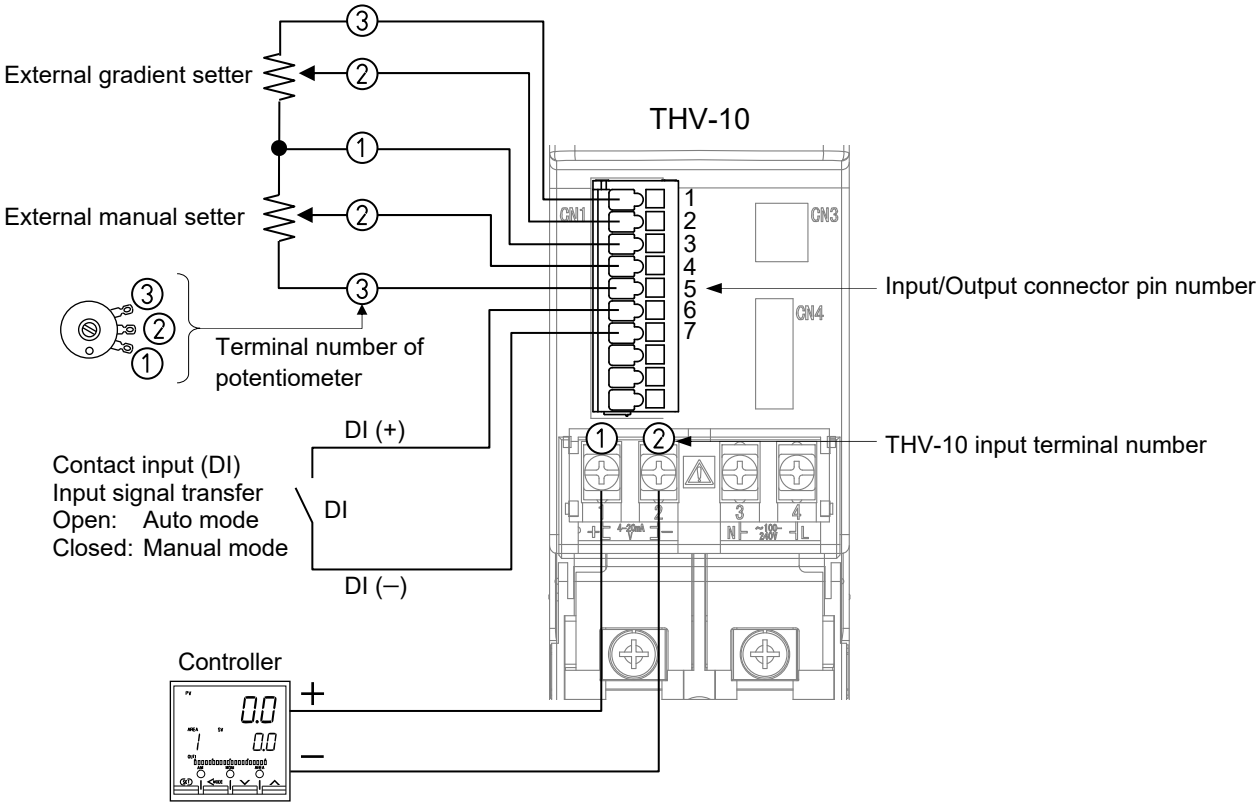
☞ For the allocation of the Contact input (DI) function, refer to "**7.4 Contact Input (DI) (P. 7-10)**."

3.5.6 Wiring of input signal transfer (with external gradient setter)

NOTE

When both of external gradient setter and external manual setter are connected, connect the 0 V wires externally.



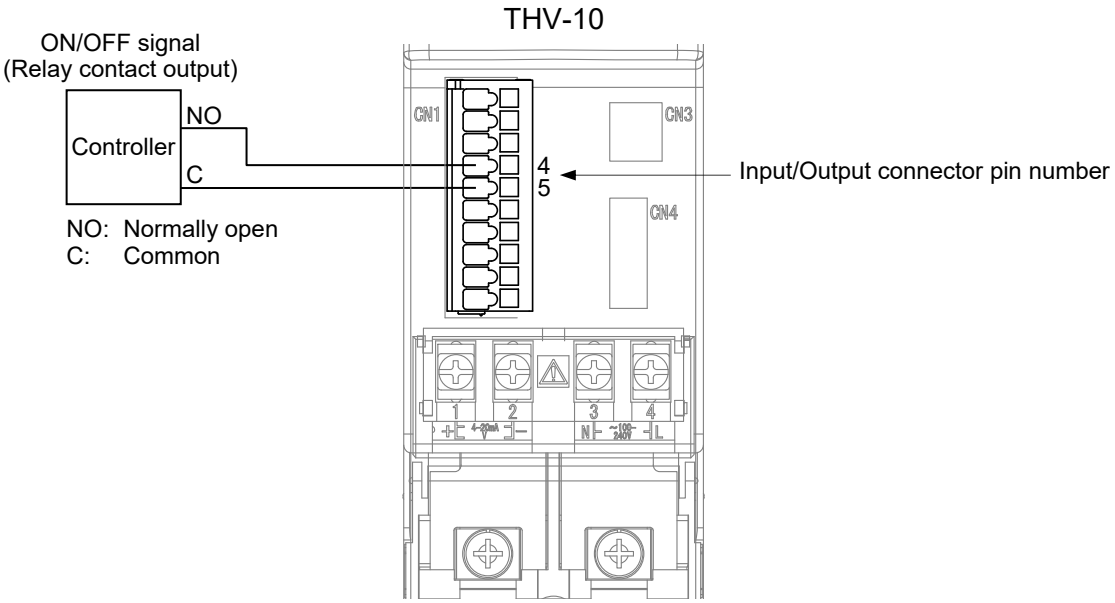


☞ For the allocation of the Contact input (DI) function, refer to "**7.4 Contact Input (DI) (P. 7-10)**."

☞ When switching to the manual mode through the external contact input (DI), "External manual mode" needs to be configured in advance at "Manual mode transfer (AM)."
(Factory set value: External manual mode)
Refer to **7.2 Manual Mode (P. 7-4)** for details of setting External manual set value.

3.5.7 Wiring of contact input

The ON/OFF signal of the controller turns on and off the output of THV-10.



To use the contact input, the following parameters must be configured.

Settings:

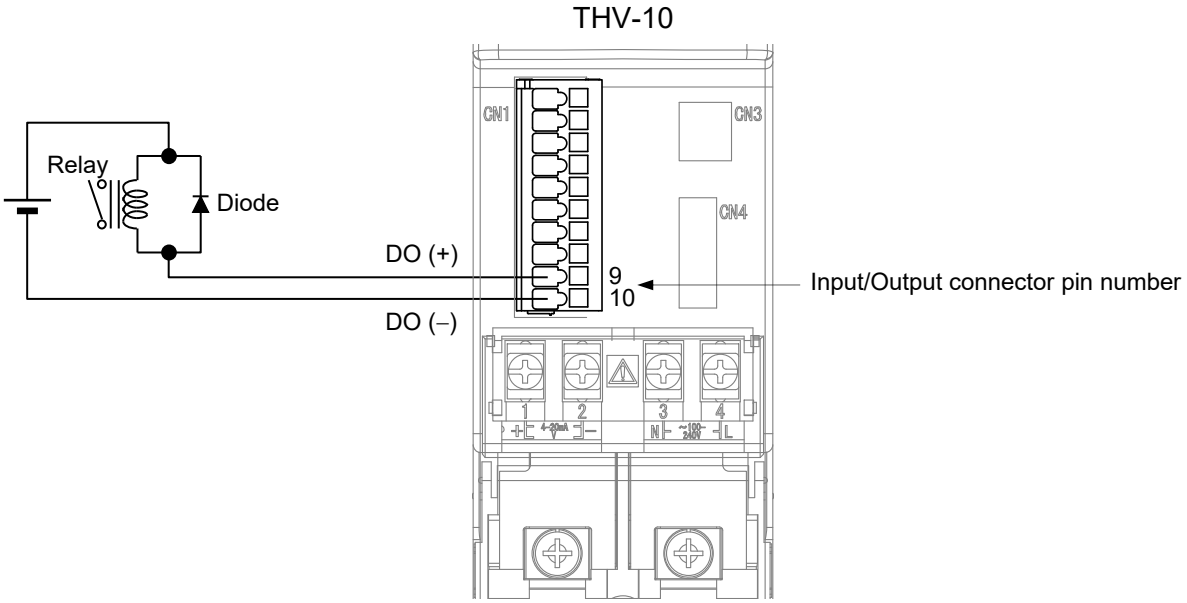
Input signal transfer (dA): 1 (Manual mode)
Manual mode transfer (AM): 0 (External manual mode)

After the contact input is connected, the Output limiter high and Output limiter low can be set to perform ON/OFF control.

Contact closed: Output limiter high
Contact open: Output limiter low

3.5.8 Wiring of alarm output

A diode should be used and connected as show in the diagram, when using a relay.



The alarm output needs to be set for the alarm type.
Set "Alarm output logic (L1)" (**P. 9-54**) in the engineering mode (Function block 4).

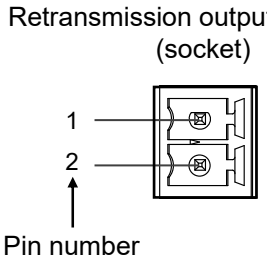
- Heater break alarm 1
- Thyristor break-down alarm 1
- Heater break alarm 2
- Thyristor break-down alarm 2
- Power frequency error
- Over current alarm
- FAIL alarm (fixed at de-energized)

Alarms except FAIL alarm can be configured to energizing or de-energizing action.

3.6 Wiring for Retransmission Output Connector

The retransmission output connector is used when connecting to a recorder or a voltmeter.

3.6.1 Retransmission output connector pin numbers and details

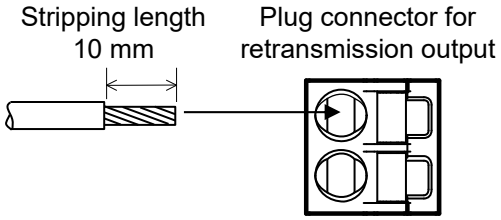


Pin number	Description
1	Retransmission output (+)
2	Retransmission output (–)

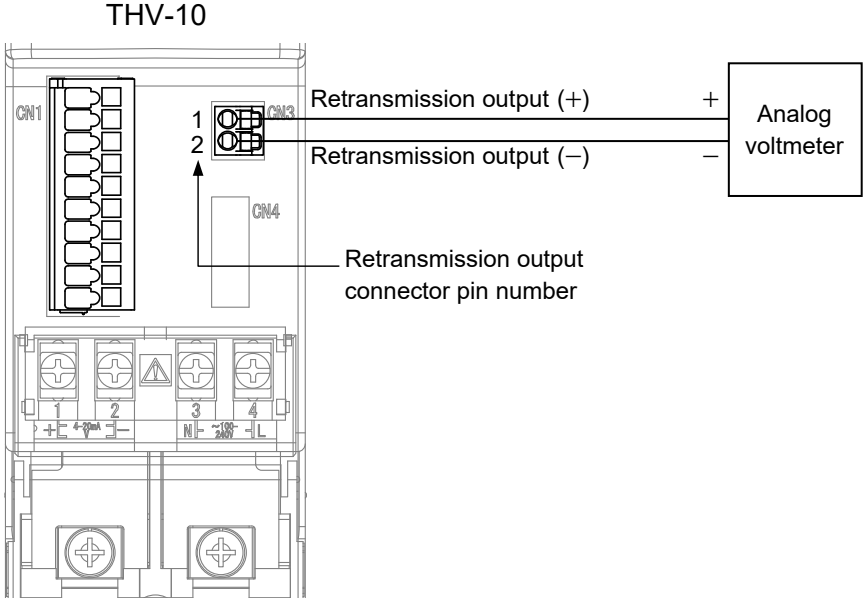
When you prepare the plug connector, it is recommend to use the following connector.
Recommended: PHOENIX CONTACT Type: FMC 1,5/ 2-ST-3,5

3.6.2 Wire size used for retransmission output connector

Use the stranded leadwires.
Stranded leadwires: AWG24-16 (cross-section 0.25 to 1.5 mm^2)
Stripping length: 10 mm



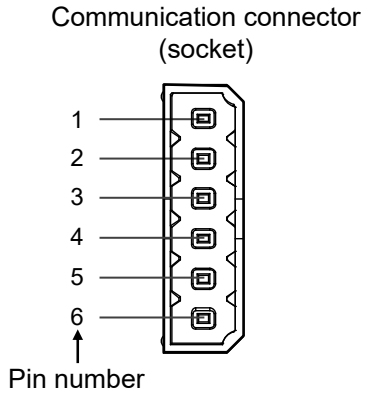
3.6.3 Wiring for retransmission output connector example



3.7 Wiring for Communication Connector

The communication connector is used when connecting to the host computer.

3.7.1 Communication connector pin numbers and details



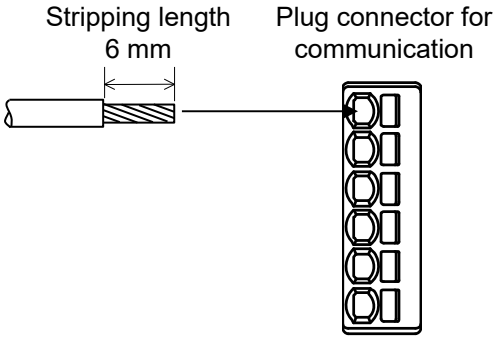
Pin number	Symbol	Signal name
1	SG	Signal ground
2	SG	Signal ground
3	T/R (A)	Send data/receive data
4	T/R (A)	Send data/receive data
5	T/R (B)	Send data/receive data
6	T/R (B)	Send data/receive data

Pin numbers 1 and 2, pin numbers 3 and 4, and pin numbers 5 and 6 are internally connected.

When you prepare the plug connector, it is recommend to use the following connector.
Recommended: PHOENIX CONTACT Type: PTSM 0,5/ 6-P-2,5 WH

3.7.2 Wire size used for communication connector

Use the stranded leadwires.
Stranded leadwires: AWG24-20 (cross-section 0.25 to 0.5 mm^2)
Stripping length: 6 mm

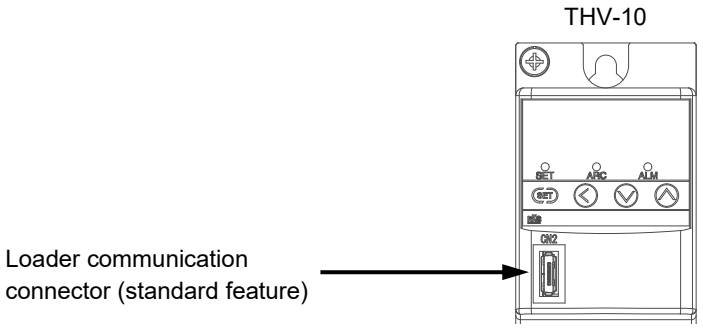


For communication connector connection, refer to **20 A/30 A/45 A/60 A/80 A/100 A THV-10 Host Communication Instruction Manual (IMR02W06-E□)**.

3.8 Connections for Loader Communication

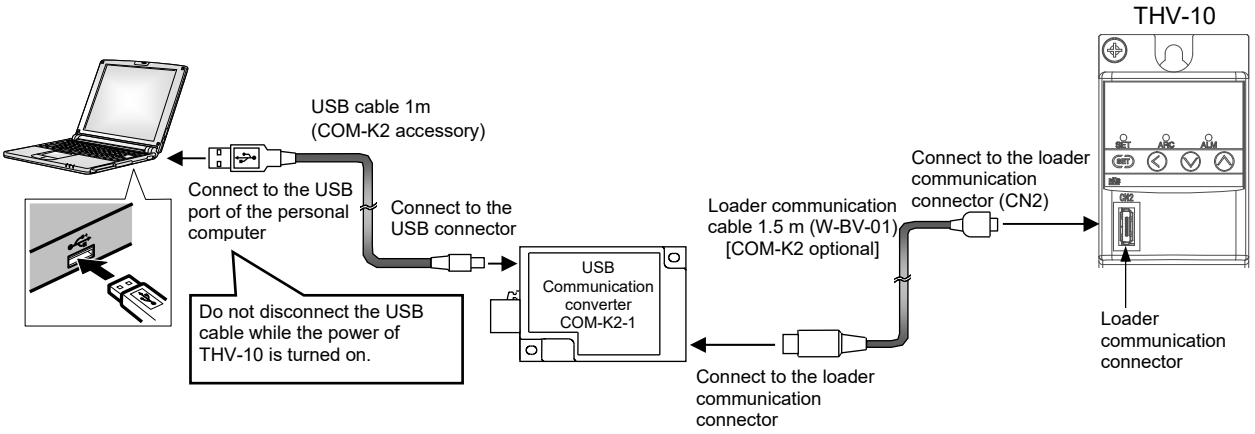
Data of the instrument can be set from a personal computer by using loader communication and our "Communication tool PROTEM2". RKC USB Communication converter COM-K2 or COM-KG (sold separately), loader communication cable, and USB cable are required for connecting this instrument to the personal computer.

■ Position of loader communication connector



■ Connection method

Connect the instrument, COM-K2 (or COM-KG), and personal computer by using a USB cable and a loader communication cable. Make sure the connectors are oriented correctly when connecting.



Connection example of loader communication

NOTE

The loader communication is only for parameter setup. Do not use it for data logging during control.

- Communication tool
  PROTEM2
  Software operation environment:
  Consult the manual that you downloaded.
- Communication setting of the personal computer
  (The following values are all fixed)
  Communication speed: 38400 bps
  Start bit: 1
  Data bit: 8
  Parity bit: None
  Stop bit: 1
- Communication port of the host computer
  USB port: Based on USB Ver. 2.0

- The device address of the loader communication is fixed at "0." The setting of the device address is disregarded.
- The loader communication corresponds to the RKC communication protocol "Based on ANSI X3.28-1976 subcategories 2.5 and A4."
- Loader communication can be used on a THV-10 even when the Communication function (optional) is not installed.

Recommended USB communication converter:
COM-K2-1 or COM-KG (RKC product)
For the COM-K2, refer to the **COM-K2 Instruction Manual**.
For the COM-KG, refer to the **COM-KG Instruction Manual**.

When using the loader communication, USB driver for COM-K2 must be installed on the personal computer. The USB driver can be downloaded the official RKC website. Installation of the USB driver is not necessary when the COM-KG is used on Windows 10.

When the instrument is powered off, power can be supplied to the instrument from COM-K2 (or COM-KG). This function is exclusive for parameter setting, and the instrument functions as follows.

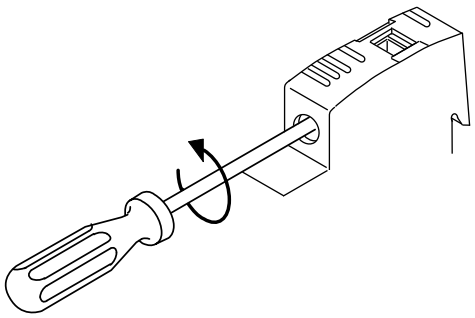
- Control stop (output OFF).
- Host communication is stopped.
- Screen display is "---".

While the instrument is powered by COM-K2 (or COM-KG), if power is applied to the instrument, the instrument will be reset and starts for normal operation.

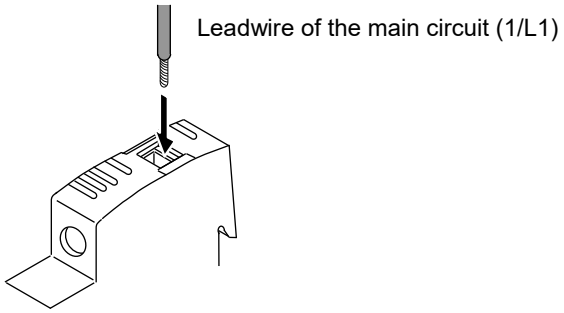
When the instrument is normally powered, the host communication can be used simultaneously.

3.9 Wiring Method of UL Certified Fuse Holder

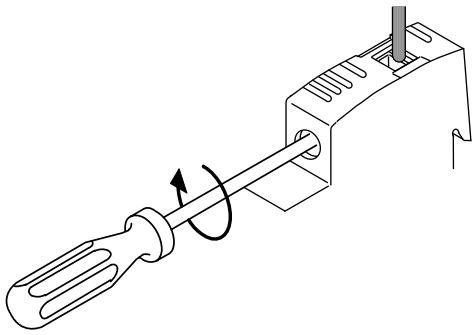
1. Loosen the screws on the front panel.



2. Confirm the location and insert a leadwire.



3. Tighten the screw on the front panel. Perform the wiring to the bottom side in the same way as in ***1***, ***2*** and **3**.



MEMO

4 PARTS DESCRIPTION

This chapter describes names of parts of this instrument.

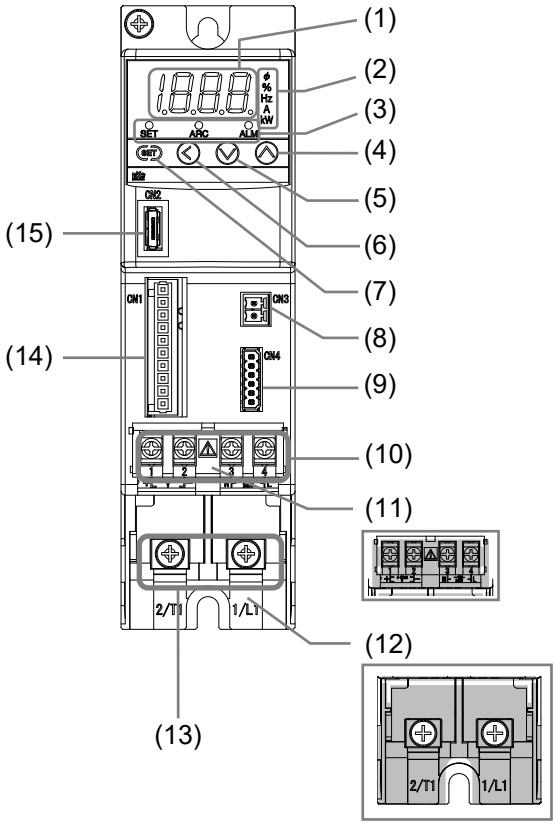
4.1 Parts Description

This section describes the names and functions of display and operating keys located on the front panel of the instrument.

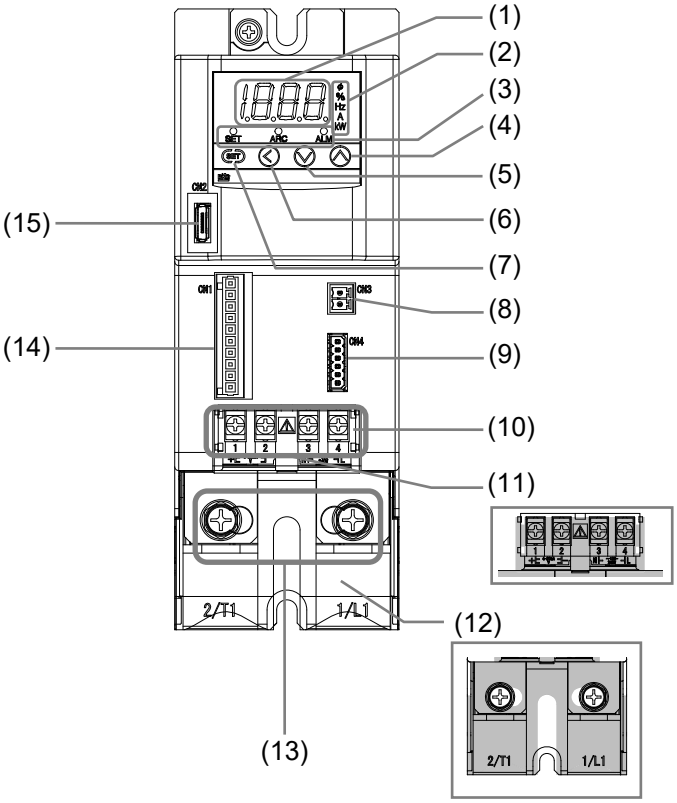
NOTE

To avoid damage to the instrument, never use a sharp object to press keys.

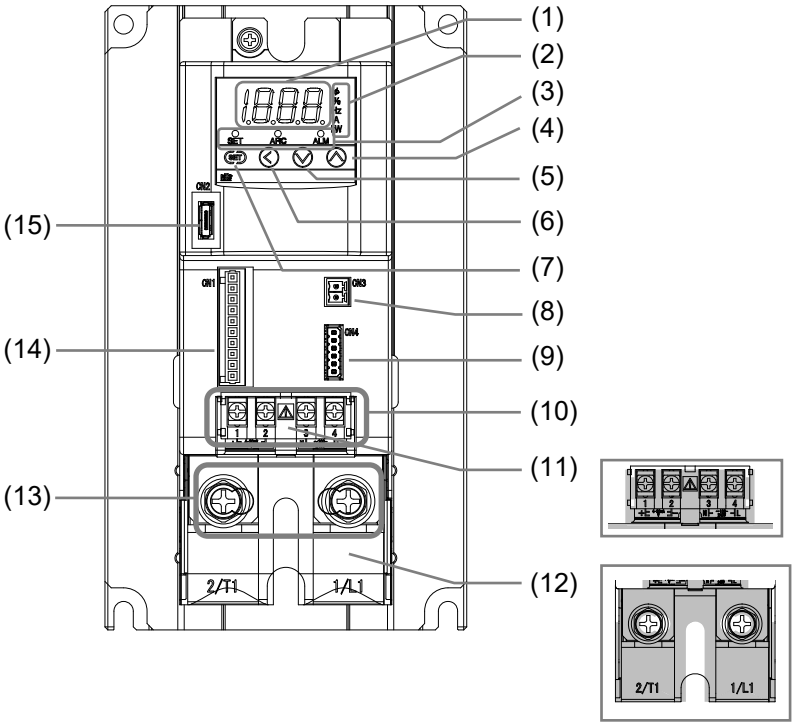
■ 20 A/30 A type



■ 45 A/60 A type



■ 80 A/100 A type



No.	Name	Description
(1)	Display	Parameter symbols, input signal values, or various setting values are displayed.
(2)	Unit display	Units of input signal values and units of various set values are displayed.
(3)	Indication lamps	• SET: Lights up during the Setting mode [C], Parameter select mode [B] or Engineering mode [D]. Flashes while set data lock is active. • ARC: Lights while "knee points" is automatically calculated. (When a Non-linear resistance heater break alarm is used) • ALM: Lights up or blinks when any alarm occurs. The type of the generated alarm can be checked on the Alarm monitor (AL) in the monitor mode.
(4)	UP key (∧)	• Used to increase numerals. • Used to select the function block (F□) in the Engineering mode [D].
(5)	DOWN key (∨)	• Used to decrease numerals. • Used to select the function block (F□) in the Engineering mode [D].
(6)	Shift key (<)	• Shift digits when settings are changed. • Used to select the mode. • Used to show the parameter symbols. • Used to change the display to the setting screen.
(7)	SET key (SET)	• Used for set value registration. • Used to select the mode. • Used to select the parameters.
(8)	Retransmission output connector	A connector that outputs analog signals of 0 to 10 V DC.
(9)	Communication connector	A connector for connecting to the host computer. The communication interface is RS-485.
(10)	Input terminals (1, 2) Power supply terminals (3, 4)	• Input terminals (No. 1, No. 2) Terminals for connecting the input signal wires (controller). • Power supply terminals (No. 3, No. 4) Terminals for connecting the power lines (instrument power supply).
(11)	Terminal cover (for input/power supply terminals)	Terminal cover for input and power supply terminals.
(12)	Terminal cover (for main circuit terminals)	Terminal cover for the main circuit terminal.
(13)	Main circuit terminals (2/T1, 1/L1)	Used to connect main circuit wires.
(14)	Input/Output connector (socket)	Used to connect with a setter (potentiometer), external contact, or controller. Also used as an alarm output terminal.
(15)	Loader communication connector	Connector to connect to our communication converter COM-K2-1 or COM-KG.

MEMO

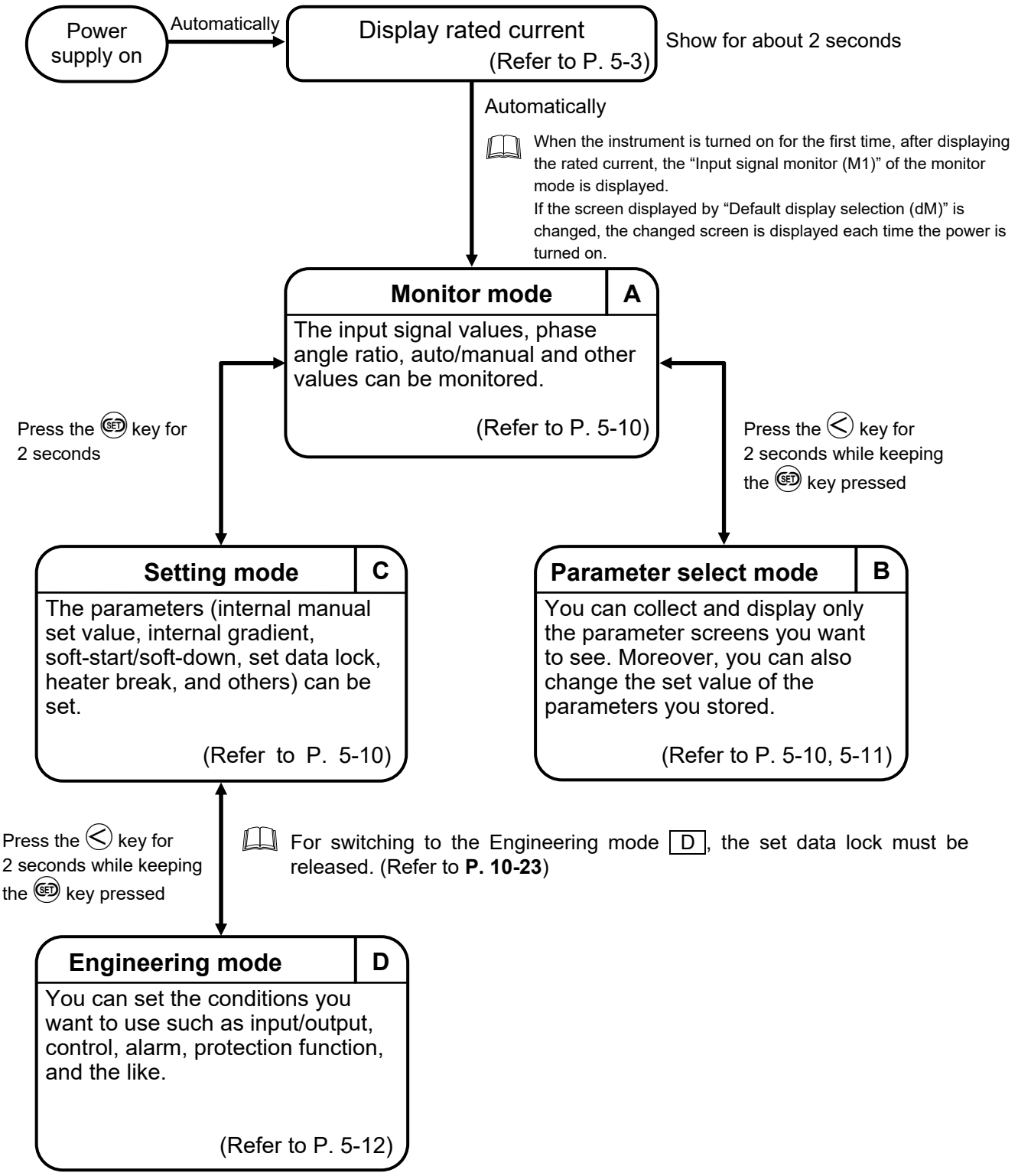
MODE SWITCHING AND PARAMETER SWITCHING

5

This chapter describes various mode types, how to switch between them, and how to change the set values.

5.1 Switching the Mode

Modes of this instruments are divided into the following four types. You can switch the mode by operating the SET key and the ≤ key.

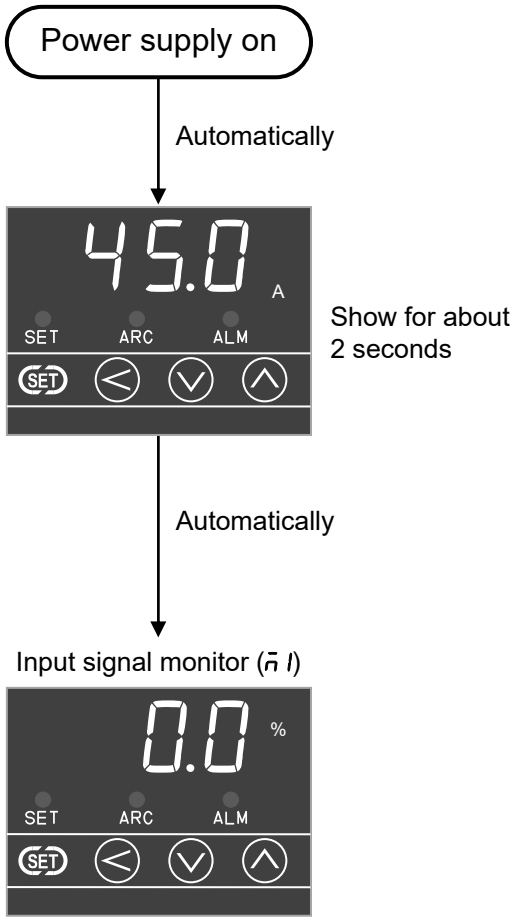


If the instrument is not operated for one minute while a parameter screen or setting screen other than the Monitor mode A is displayed, the screen set in "Default display selection (dM)" is automatically displayed.

■ Display rated current

The instrument displays the rated current immediately after the power is turned on.

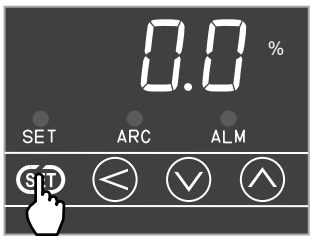
Example: When the rated current of the instrument is “45 A”



Display rated current	Type
20.0 A	20 A type
30.0 A	30 A type
45.0 A	45 A type
60 A	60 A type
80 A	80 A type
100 A	100 A type

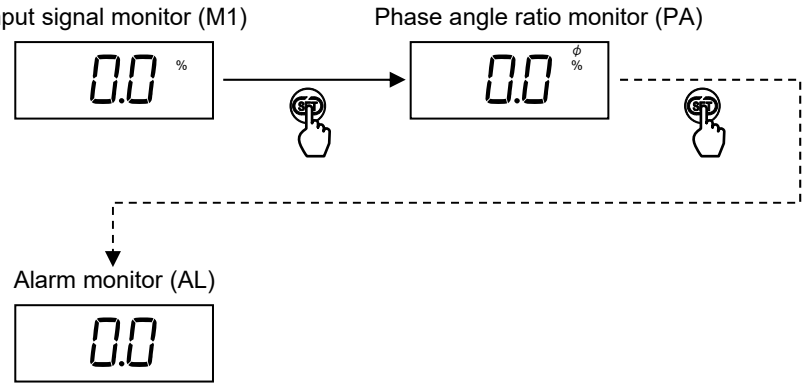
5.2 Switching Parameters Within the Same Mode

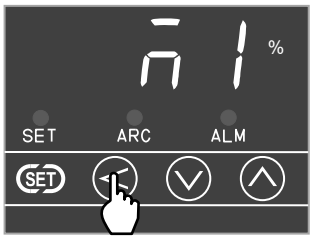
5.2.1 Switching the monitor screen (Monitor mode A)



Select Monitor screen

Every time the SET key (SET) is pressed, the screen goes to the next monitor screens.

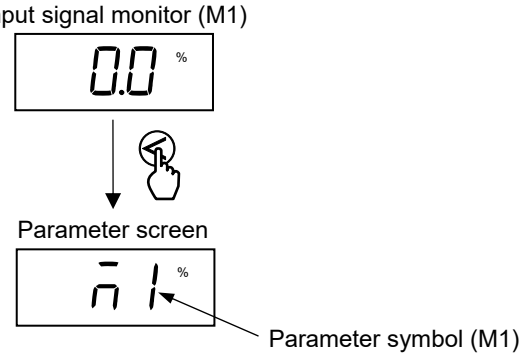




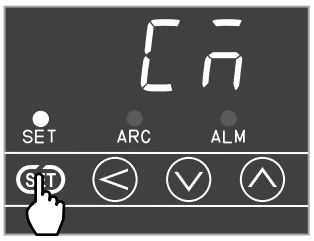
Display parameter symbol

Parameter screen is displayed while the Shift key (<) is pressed.

Example: Display the parameter symbol for Input signal monitor.



5.2.2 Switching the setting screen (Parameter select mode B, Setting mode C)

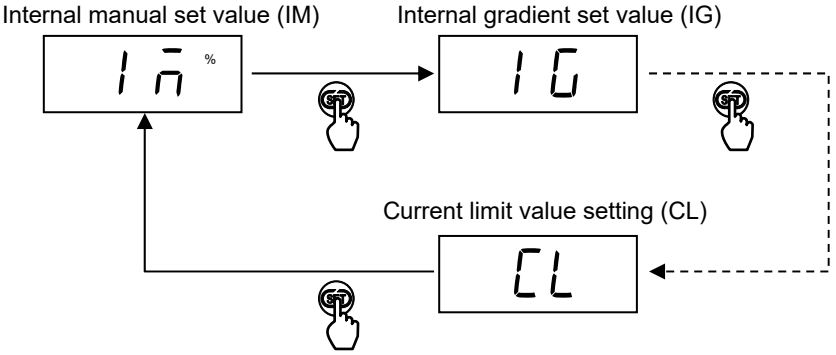


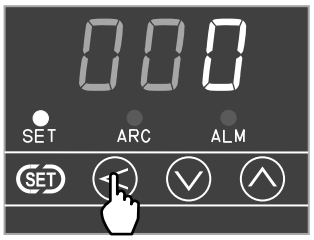
Select setting item

Every time the SET key (SET) is pressed, the screen goes to the next parameter screens.

Keep pressing the SET key until the desired setting parameter is displayed.

Example: Switching within the Setting mode C

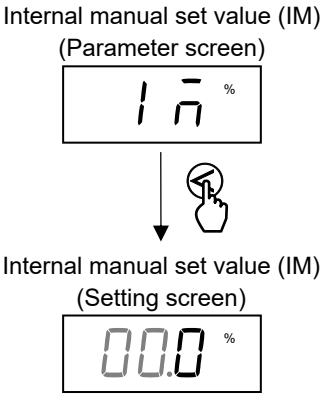




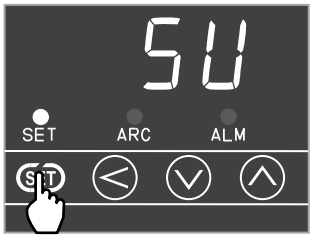
Enter setting screen

Pressing the shift key (<) will change the display from the parameter screen to the setting screen. Then, the parameter becomes adjustable.

Example: Switching to the setting screen of the Internal manual set value (setting mode C)



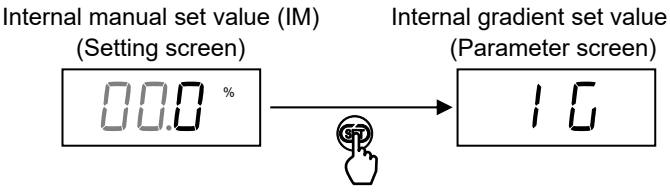
☞ To change the set value, refer to **5.3 Changing and Registering the Set Value (P. 5-8)**.



Return to the parameter screen

Pressing the SET key (SET) will change the display from the setting screen to the parameter screen. After returning from setting, the next parameter is displayed.

Example: Return to the parameter screen from the setting screen of the Internal manual set value (setting mode C)



☞ Refer to **10.4 Parameter Select Function (P. 10-12)** for registering a screen on Parameter select mode B.

5.2.3 Switching the setting screen (Engineering mode D)

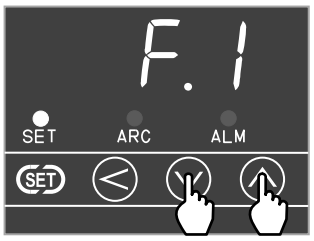
NOTE

Once the parameters in the Engineering mode D are set correctly, no further changes need to be made to parameters for the same application under normal conditions.

Parameter screens of functions that were not specified when you placed the order will not appear.

When changing to the Engineering mode D , it is necessary to unlock the Engineering mode D lock.

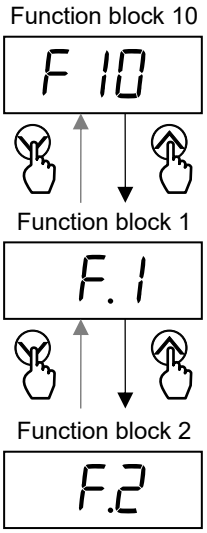
Refer to **10.7 Set Data Lock Function (P. 10-23)** for unlocking the Engineering mode D.

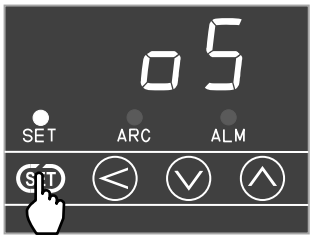


Select function block (F.☐)

Setting items in the Engineering mode D are grouped into Function blocks (F.☐).

Each press of the UP key (⌃) advances one function block (F.☐) forward.
Each press of the DOWN key (⌄) moves one function block (F.☐) backward.

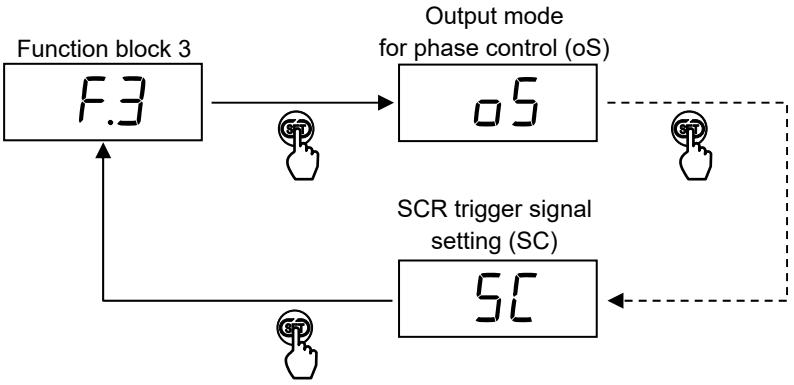


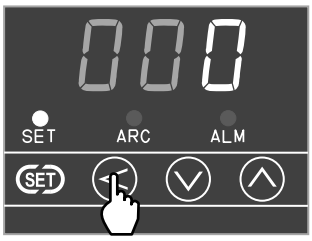


Select setting item

Each press of the SET key (SET) advances the parameter to the next within the same function block. Keep pressing the SET key until the desired setting parameter is displayed.

Example: Parameter screens of function block 3





Enter setting screen

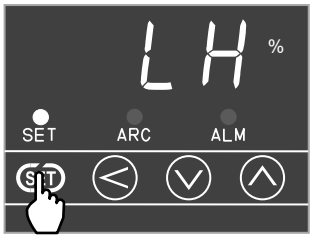
Pressing the shift key (≪) will change the display from the parameter screen to the setting screen. Then, the parameter becomes adjustable.

Example: Switch the screen to the output mode for phase control setting

Output mode
for phase control (oS)
(Parameter screen)

Output mode for
phase control (oS)
(Setting screen)

☞ To change the set value, refer to **5.3 Changing and Registering the Set Value (P. 5-8)**.



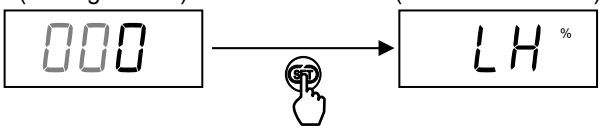
Return to the parameter screen

Pressing the SET key (SET) will change the display from the setting screen to the parameter screen. After returning from setting, the next parameter is displayed.

Example: Switch the screen to the parameter screen from the setting screen of output mode for phase control.

Output mode
for phase control (oS)
(Setting screen)

Output limiter high (LH)
(Parameter screen)

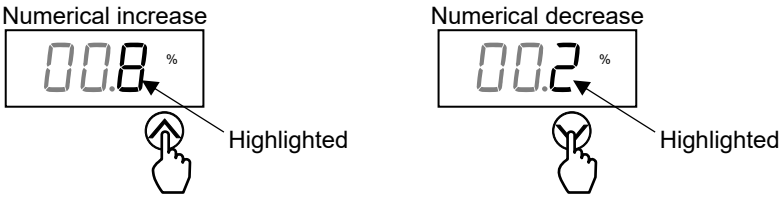


☞ For other setting items in the Engineering mode, refer to the **5.4 List of Parameter Operation (P. 5-10)**.

5.3 Changing and Registering the Set Value

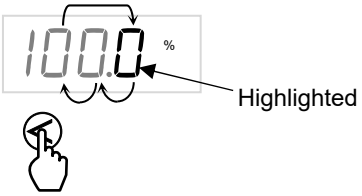
Change numerals

The highlighted digit indicates which digit can be set. The set value can be adjusted by pressing UP (⌃) and DOWN (⌄) keys.



Shift the digit

You can shift the highlighted digit by pressing the shift key (<).

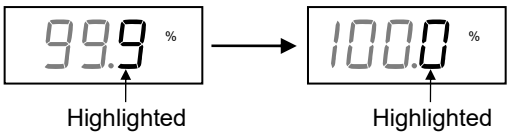


Increasing and decreasing numerals

The following is also available when changing the set value.

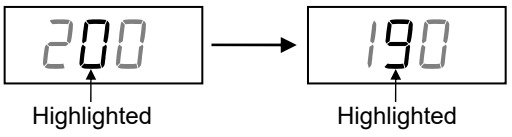
Automatically increase the set value
(Increasing set value from 99.9 to 100.0)

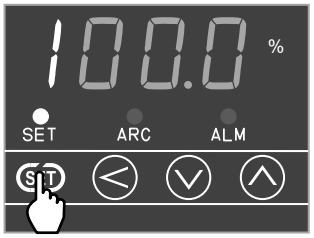
1. Press the Shift key (<) to highlight the least significant digit (first digit from the right).
2. Press the UP (⌃) to change to 0.
   The display changes to 100.0.



Automatically decrease the set value
(Decreasing set value from 200 to 190)

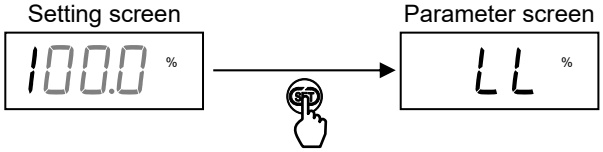
1. Press the Shift key (<) to highlight the tens place.
2. Press the DOWN (⌄) to change to 9.
   The display changes to 190.





Register the set value

For registering the revised value, make sure to press the SET key (SET).
The display changes to the next parameter and the new value will be stored.

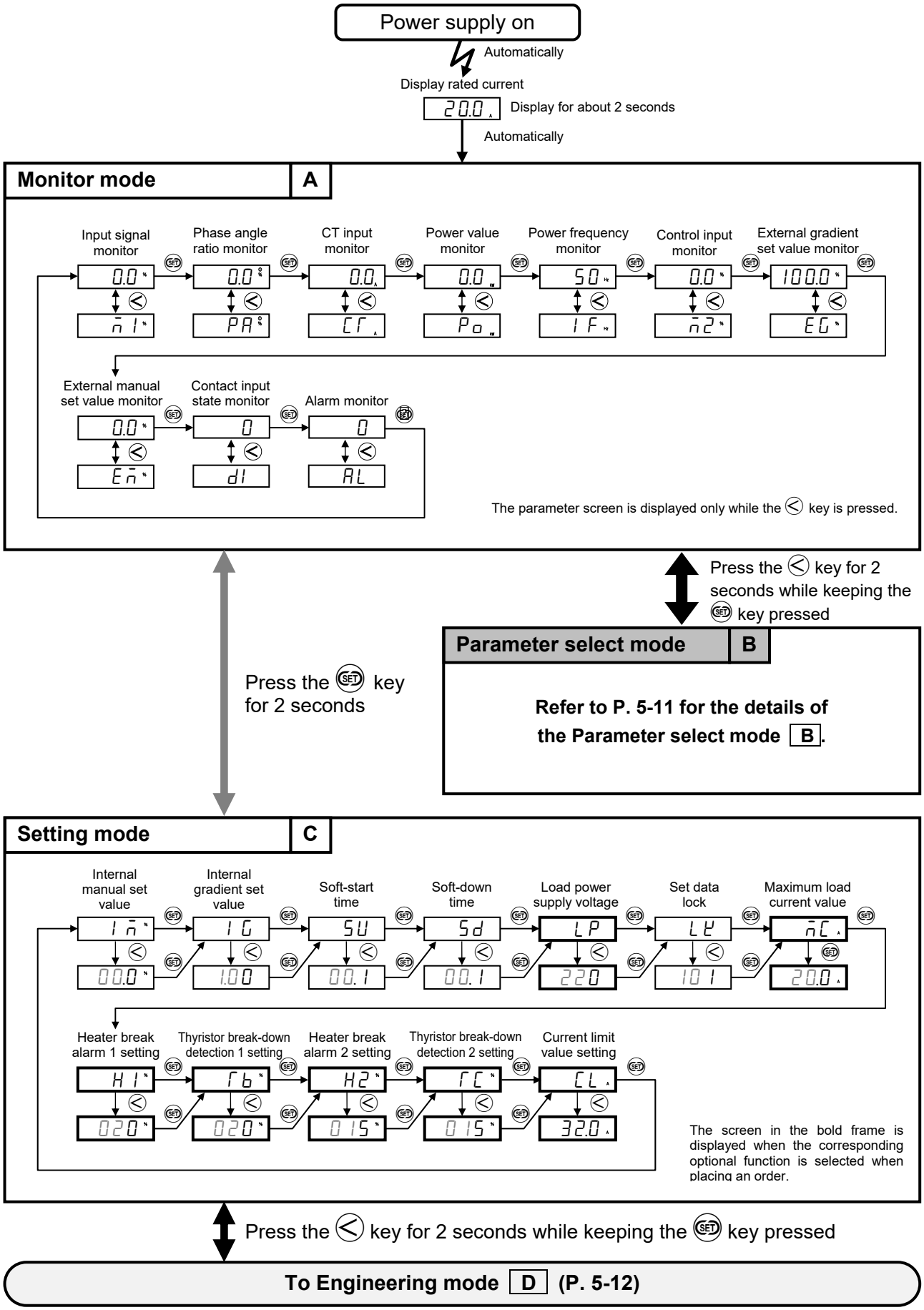


NOTE

Keep the instrument powered on for at least 2 seconds after having stored the changed value. If the instrument is powered off immediately after having stored the changed value, the changed value may not be stored.

- The modified value is not stored only through key operation of UP (⌃) and DOWN (⌄) keys.
- After a new value has been displayed, the display will change to the screen set in Default display selection (dM) after 1 minute has passed without storing. Even in this case, the modified value will not be stored.
- If no key operation is performed for 1 minute or longer in the Parameter select mode B, Setting mode C, or Engineering mode D, the display will automatically return to the screen set in Default display selection (dM).

5.4 List of Parameter Operations

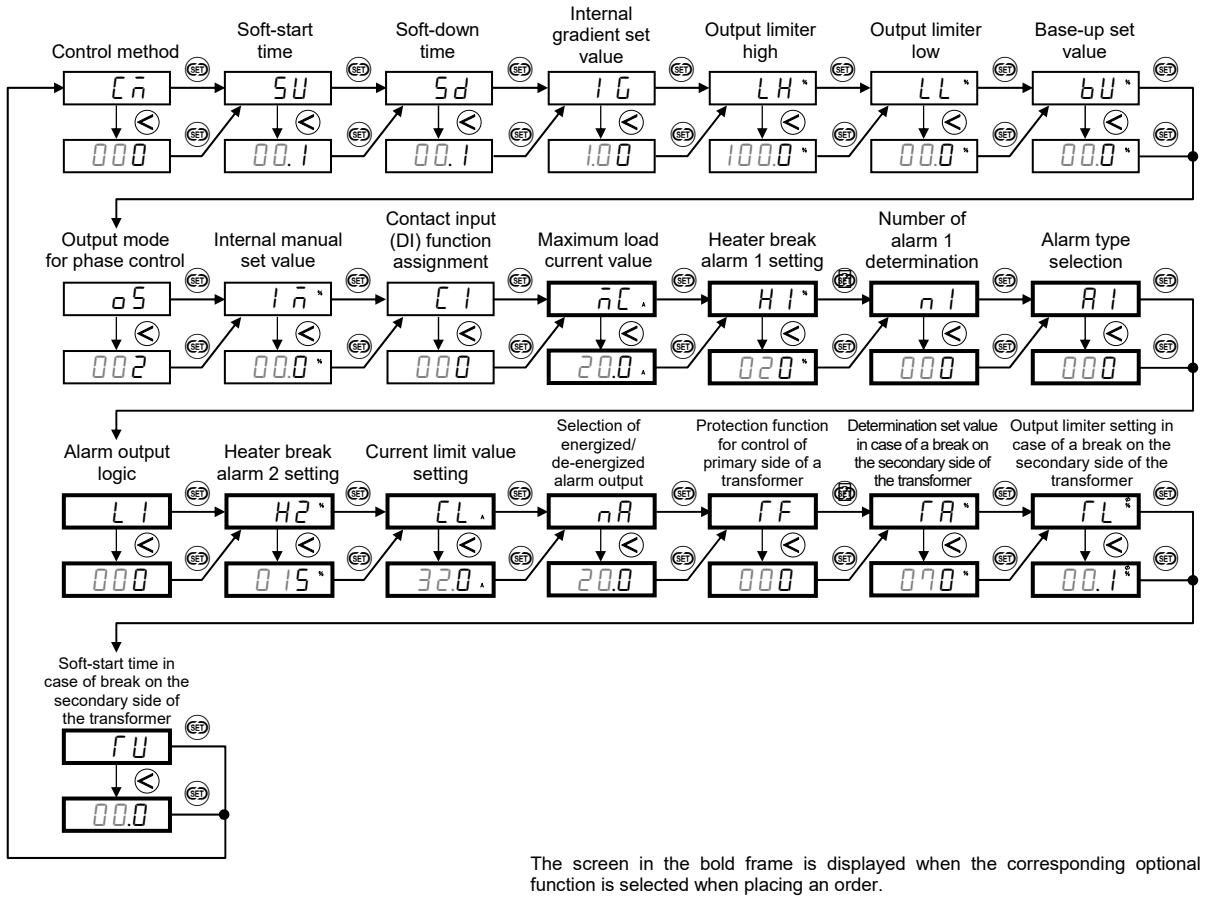


■ Operation of parameters within parameter select mode

From Monitor mode A (P. 5-10)

Press the < key for 2 seconds while keeping the SET key pressed

Parameter select mode B



The screen in the bold frame is displayed when the corresponding optional function is selected when placing an order.

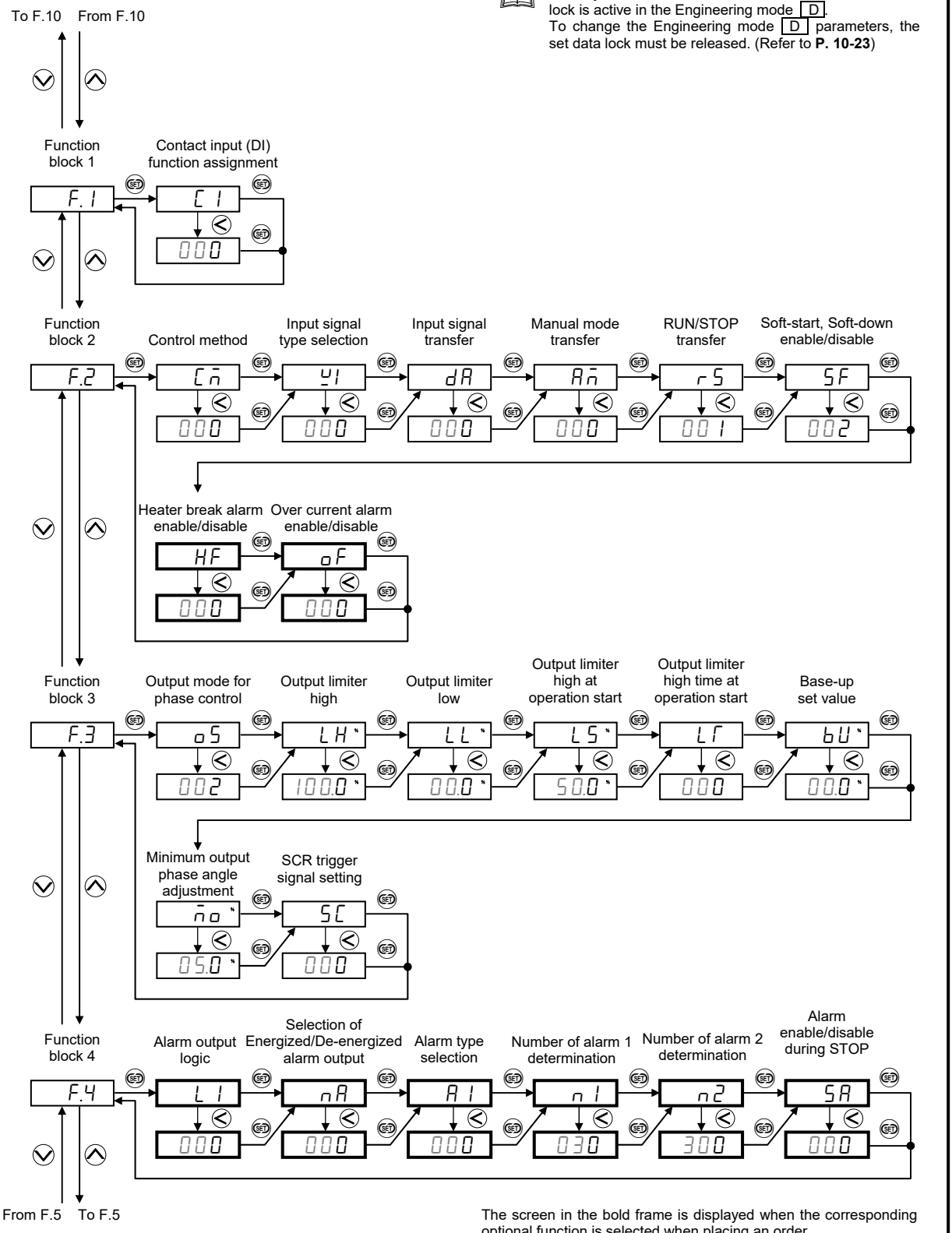
The above parameters are screens registered in Parameter select mode B by default. The screens registered in Parameter select mode B can be changed. For changing, refer to **10.4 Parameter Select Function (P. 10-12)**.

From Setting mode C (P. 5-10)

Press the < key for 2 seconds while keeping the SET key pressed

Engineering mode D

When you turn on the device for the first time, set data lock is active in the Engineering mode D.
To change the Engineering mode D parameters, the set data lock must be released. (Refer to **P. 10-23**)

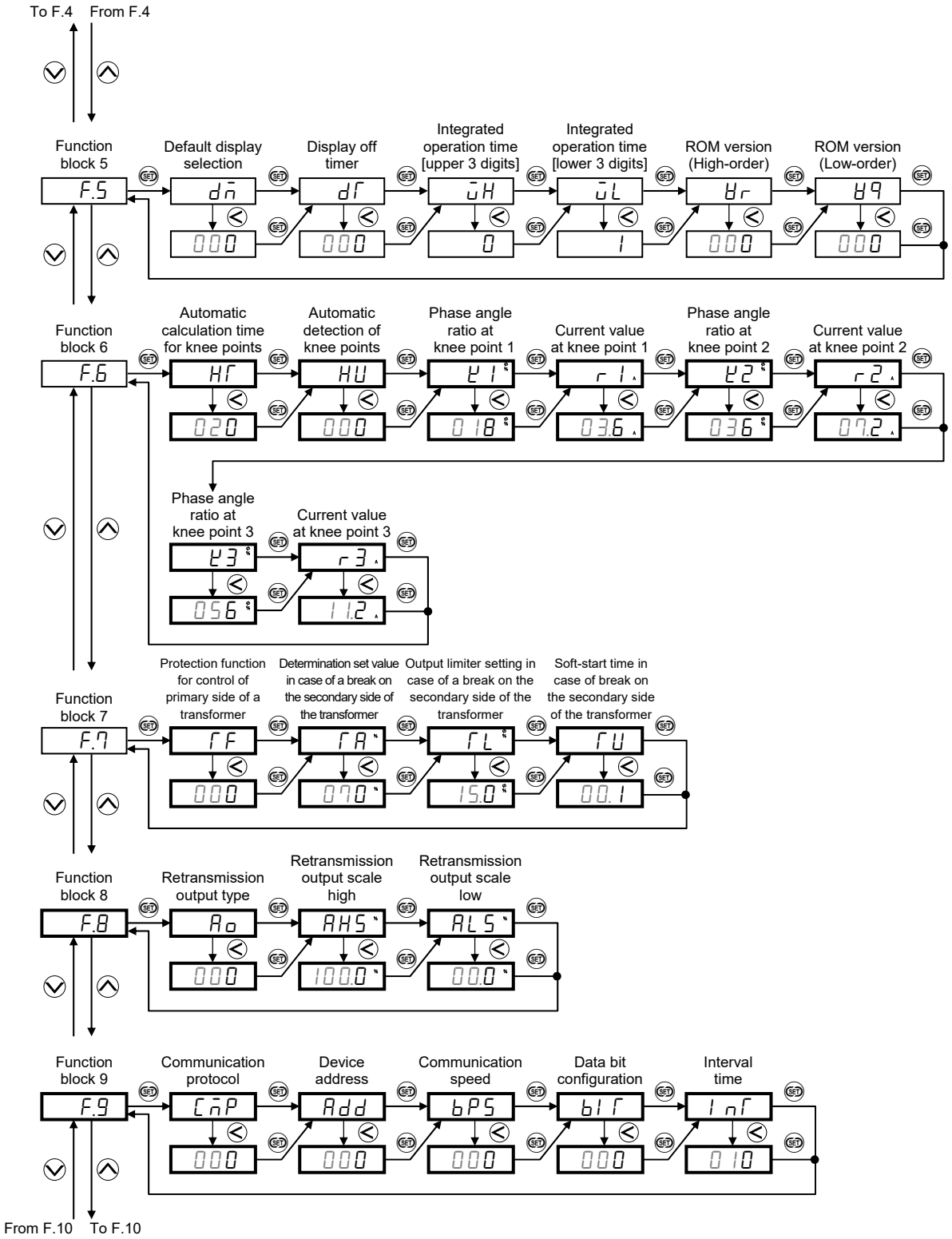


The screen in the bold frame is displayed when the corresponding optional function is selected when placing an order.

To Function block F5 (P. 5-13)

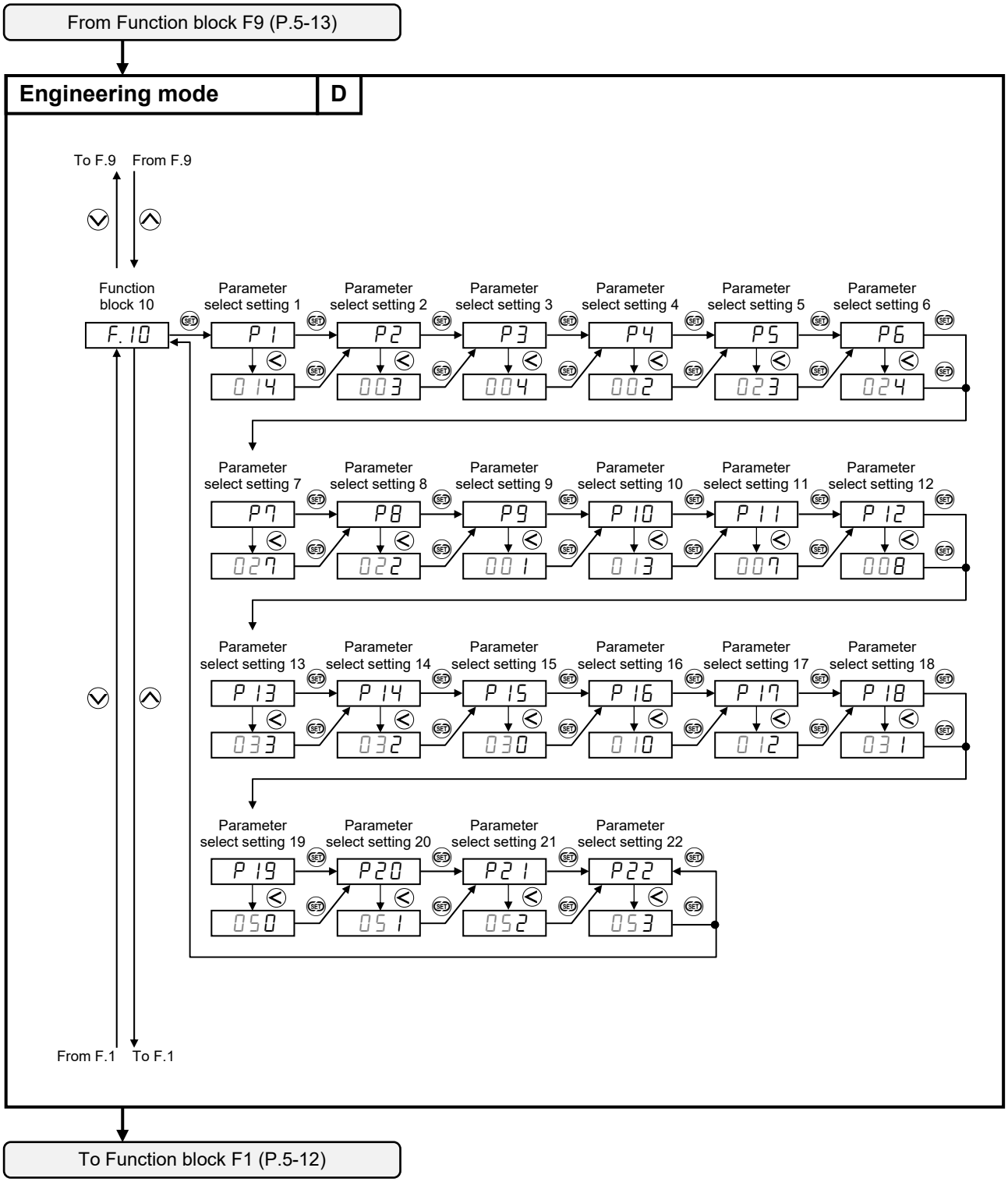
From Function block F4 (P.5-12)

Engineering mode D



The screen in the bold frame is displayed when the corresponding optional function is selected when placing an order.

To Function block F10 (P.5-14)

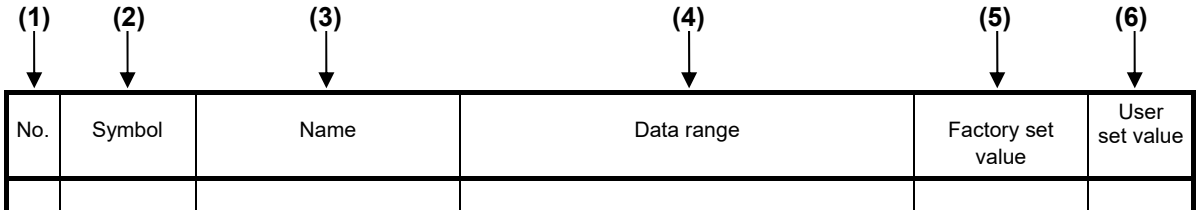

From Function block F9 (P.5-13)
Engineering mode
D
To F.9
From F.9
Function block 10
F.10
Parameter select setting 1
P1
014
Parameter select setting 2
P2
003
Parameter select setting 3
P3
004
Parameter select setting 4
P4
002
Parameter select setting 5
P5
023
Parameter select setting 6
P6
024
Parameter select setting 7
P7
027
Parameter select setting 8
P8
022
Parameter select setting 9
P9
001
Parameter select setting 10
P10
013
Parameter select setting 11
P11
007
Parameter select setting 12
P12
008
Parameter select setting 13
P13
033
Parameter select setting 14
P14
032
Parameter select setting 15
P15
030
Parameter select setting 16
P16
010
Parameter select setting 17
P17
012
Parameter select setting 18
P18
031
Parameter select setting 19
P19
050
Parameter select setting 20
P20
051
Parameter select setting 21
P21
052
Parameter select setting 22
P22
053
From F.1
To F.1
To Function block F1 (P.5-12)

6

PARAMETER LIST

This chapter describes displays, names and data ranges of each parameter.

6.1 Reading the Table



(1) No.: This is the screen number used when registering the screen to be displayed in parameter select mode [B].
Can be registered in "Parameter select setting" of engineering mode [D].
Parameters without numbers cannot be registered in "Parameter select setting".
In the parameter select mode (**P. 6-4 to P. 6-6**), the screen number of the factory default value set in "**Parameter select setting 1 to 22**" of engineering mode [D] is described.

(2) Symbol: Parameter symbol of 7 segments displayed on the parameter screen.

(3) Name: Parameter name.

(4) Data range: Parameter's data range.

(5) Factory set value: Factory set value of the parameter.

(6) User set value: Can be used to record the parameter values set by the customer.
It will be a copy of the data when it is initialized.

6.2 Monitor Mode A

No.	Symbol	Name	Display range	Factory set value	User set value
—	n1 (M1)	Input signal monitor	0.0 to 100.0 %	—	—
—	PA (PA)	Phase angle ratio monitor	0.0 to 100.0 %	—	—
—	CT (CT)	CT input monitor *	0.0 to 40.0 A (20 A type) 0.0 to 40.0 A (30 A type) 0.0 to 90.0 A (45 A type) 0 to 120 A (60 A type) 0 to 160 A (80 A type) 0 to 200 A (100 A type)	—	—
—	Po (Po)	Power value monitor *	0.0 to 7.5 kW (20 A type) 0.0 to 11.3 kW (30 A type) 0.0 to 17.0 kW (45 A type) 0.0 to 22.6 kW (60 A type) 0.0 to 30.2 kW (80 A type) 0.0 to 37.8 kW (100 A type)	—	—
—	IF (IF)	Power frequency monitor	40 to 70 Hz	—	—
—	n2 (M2)	Control input monitor	0.0 to 100.0 %	—	—
—	EG (EG)	External gradient set value monitor	0.0 to 100.0 %	—	—
—	En (EM)	External manual set value monitor	0.0 to 100.0 %	—	—
—	dI (dI)	Contact input state monitor	0: Contact open 1: Contact closed	—	—
—	AL (AL)	Alarm monitor	0 to 191 0: None 1: Heater break alarm 1 2: Thyristor break-down alarm 1 4: Heater break alarm 2 8: Thyristor break-down alarm 2 16: Power frequency error 32: Over current alarm 128: FAIL If two or more alarms have occurred, the sum of the error numbers is displayed.	—	—

* This monitor screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

Monitor mode [A] parameters cannot be registered in parameter select mode [B].

6.3 Parameter Select Mode B

Up to 22 screens registered in "Parameter select setting" of engineering mode D can be displayed. In the initial state, the following parameters are registered in "Parameter select setting" of engineering mode D.

No.	Symbol	Name	Data range	Factory set value	User set value
14	CM (CM)	Control method	0: Phase control 1: Zero-cross control (continuous) 2: Zero-cross control (input synchronous type)	0	
3	SU (SU)	Soft-start time	0.0 to 199.9 seconds (0.0: Soft-start function unused)	0.1	
4	Sd (Sd)	Soft-down time	0.0 to 199.9 seconds (0.0: Soft-down function unused)	0.1	
2	IG (IG)	Internal gradient set value	0.00 to 2.00	1.00	
23	LH (LH)	Output limiter high	0.0 to 100.0 % (Output limiter high ≥ Output limiter low)	100.0	
24	LL (LL)	Output limiter low	0.0 to 100.0 % (Output limiter high ≥ Output limiter low)	0.0	
27	bU (bU)	Base-up set value	–9.9 to +100.0 %	0.0	
22	oS (oS)	Output mode for phase control	0: Proportional phase angle to input 1: Proportional voltage to input 2: Proportional square voltage (electric power) to input 3: Constant current control: (current feedback) * 4: Power proportional control (no voltage feedback) *	2	
1	IM (IM)	Internal manual set value	0.0 to 100.0 % If the power is turned off, internal manual set value is reset to "0.0."	0.0	

* This set value is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

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Parameter select mode B

No.	Symbol	Name	Data range	Factory set value	User set value
13	C 1 (C1)	Contact input (DI) function assignment	0: No function 1: Control method Open: Phase control Closed: Zero-cross control 2: Input signal transfer Open: Auto mode Closed: Manual mode 3: Manual mode transfer Open: External manual mode Closed: Internal manual mode 4: RUN/STOP transfer Open: STOP Closed: RUN 5: Soft-start, Soft-down enable/disable Open: Enable Closed: Disable 6: Heater break alarm enable/disable Open: Enable Closed: Disable 7: Over current alarm enable/disable Open: Enable Closed: Disable 8: Set data lock enable/disable Open: Enable Closed: Disable	0	
7	nC (MC)	Maximum load current value *	0.0 to 32.0 A (20 A type)	20.0	
			0.0 to 32.0 A (30 A type)	30.0	
			0.0 to 55.0 A (45 A type)	45.0	
			0 to 70 A (60 A type)	60	
			0 to 90 A (80 A type)	80	
			0 to 110 A (100 A type)	100	
8	H 1 (H1)	Heater break alarm 1 setting *	Type 1 and non-linear resistance heater break alarm: 0 to 100 % of the reference current Type 2: 0 to 100 % of maximum load current value 0: Heater break alarm 1 unused	20	
33	n 1 (n1)	Number of alarm 1 determination *	1 to 1000 times	30	

* This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

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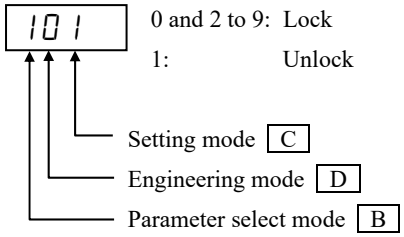
Parameter select mode B

No.	Symbol	Name	Data range	Factory set value	User set value
32	A1 (A1)	Alarm type selection[1]	0: Type 1 (constant resistance type, deviation alarm) 1: Type 2 (linearity resistor type, absolute value alarm) 2: Non-linear resistance heater break alarm (non-linear resistance type, deviation information)	0	
30	L1 (L1)	Alarm output logic [2]	0 to 191 0: No output 1: Heater break alarm 1 2: Thyristor break-down alarm 1 4: Heater break alarm 2 8: Thyristor break-down alarm 2 16: Power frequency error 32: Over current alarm 128: FAIL (fixed at de-energized)	0	
10	H2 (H2)	Heater break alarm 2 setting[1]	Type 1 and non-linear resistance heater break alarm: 0 to 100 % of the reference current Type 2: 0 to 100 % of maximum load current value 0: Heater break alarm 2 unused	15	
12	CL (CL)	Current limit value setting[1]	0.0 to 32.0 A (20 A type)	32.0	
			0.0 to 32.0 A (30 A type)	32.0	
			0.0 to 55.0 A (45 A type)	55.0	
			0 to 70 A (60 A type)	70	
			0 to 90 A (80 A type)	90	
			0 to 110 A (100 A type)	110	
31	nA (nA)	Selection of energized/de-energized alarm output [2]	0: Energized 1: De-energized	0	
50	TF (TF)	Protection function for control of primary side of a transformer [1]	0: Protection function for control of primary side of a transformer disabled 1: Protection function for control of primary side of a transformer enabled	0	
51	TA (TA)	Determination set value in case of a break on the secondary side of the transformer [1]	0 to 100 % of reference current value	70	
52	TL (TL)	Output limiter setting in case of a break on the secondary side of the transformer[1]	15.0 to 50.0 % of phase angle	15.0	
53	TU (TU)	Soft-start time in case of break on the secondary side of the transformer [1]	0.1 to 100.0 seconds	0.1	

[1] This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

[2] This screen is displayed when 1 alarm output is supplied.

6.4 Setting Mode C

No.	Symbol	Name	Display or data range	Factory set value	User set value
1	IM (IM)	Internal manual set value	0.0 to 100.0 % If the power is turned off, internal manual set value is reset to "0.0."	0.0	
2	IG (IG)	Internal gradient set value	0.00 to 2.00	1.00	
3	SU (SU)	Soft-start time	0.0 to 199.9 seconds (0.0: Soft-start function unused)	0.1	
4	Sd (Sd)	Soft-down time	0.0 to 199.9 seconds (0.0: Soft-down function unused)	0.1	
5	LP (LP)	Load power supply voltage *	85 to 264 V	220	
6	LK (LK)	Set data lock		101	
7	MC (MC)	Maximum load current value *	0.0 to 32.0 A (20 A type)	20.0	
			0.0 to 32.0 A (30 A type)	30.0	
			0.0 to 55.0 A (45 A type)	45.0	
			0 to 70 A (60 A type)	60	
			0 to 90 A (80 A type)	80	
			0 to 110 A (100 A type)	100	
8	H1 (H1)	Heater break alarm 1 setting *	Type 1 and non-linear resistance heater break alarm: 0 to 100 % of the reference current Type 2: 0 to 100 % of maximum load current value 0: Heater break alarm 1 unused	20	
9	Tb (Tb)	Thyristor break-down detection 1 setting *	Type 1 and non-linear resistance heater break alarm: 0 to 100 % of the reference current Type 2: 0 to 100 % of maximum load current value 0: Thyristor break-down alarm 1 unused	20	

* This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

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Setting mode C

No.	Symbol	Name	Display or data range	Factory set value	User set value
10	H2 (H2)	Heater break alarm 2 setting *	Type 1 and non-linear resistance heater break alarm: 0 to 100 % of the reference current Type 2: 0 to 100 % of maximum load current value 0: Heater break alarm 2 unused	15	
11	rC (TC)	Thyristor break-down detection 2 setting *	Type 1 and non-linear resistance heater break alarm: 0 to 100 % of the reference current Type 2: 0 to 100 % of maximum load current value 0: Thyristor break-down alarm 2 unused	15	
12	CL (CL)	Current limit value setting *	0.0 to 32.0 A (20 A type)	32.0	
			0.0 to 32.0 A (30 A type)	32.0	
			0.0 to 55.0 A (45 A type)	55.0	
			0 to 70 A (60 A type)	70	
			0 to 90 A (80 A type)	90	
			0 to 110 A (100 A type)	110	

* This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

6.5 Engineering Mode D

In engineering mode, the set data lock is set to “Lock (cannot be set)” at the time of shipment. To change the engineering mode parameters, the set data lock must be released.

■ Function block 1

No.	Symbol	Name	Data range	Factory set value	User set value
—	F. 1 (F.1)	**Function block 1**	—	—	—
13	C 1 (C1)	Contact input (DI) function assignment	0: No function 1: Control method Open: Phase control Closed: Zero-cross control 2: Input signal transfer Open: Auto mode Closed: Manual mode 3: Manual mode transfer Open: External manual mode Closed: Internal manual mode 4: RUN/STOP transfer Open: STOP Closed: RUN 5: Soft-start, Soft-down enable/disable Open: Enable Closed: Disable 6: Heater break alarm enable/disable Open: Enable Closed: Disable 7: Over current alarm enable/disable Open: Enable Closed: Disable 8: Set data lock enable/disable Open: Enable Closed: Disable	0	

■ Function block 2

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.2 (F.2)	**Function block 2**	—	—	—
14	CM (CM)	Control method	0: Phase control 1: Zero-cross control (continuous) 2: Zero-cross control (input synchronous type)	0	
15	XI (XI)	Input signal type selection	0: 4 to 20 mA DC 1: 1 to 5 V DC 2: 0 to 10 V DC, 0/12 V DC	Refer to Note 1	
16	dA (dA)	Input signal transfer	0: Auto mode 1: Manual mode	0	
17	AM (AM)	Manual mode transfer	0: External manual mode 1: Internal manual mode	0	
18	rS (rS)	RUN/STOP transfer	0: STOP (Output OFF) 1: RUN (Output ON)	1	
19	SF (SF)	Soft-start, Soft-down enable/disable	0: Disable 1: Enable (Except switching from STOP to RUN) 2: Enable	2	
20	HF (HF)	Heater break alarm enable/disable *	0: Disable 1: Enable	1	
21	oF (oF)	Over current alarm enable/disable *	0: Disable 1: Enable	1	

* This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

Note 1

Model code (4)	Details	Factory set value
5	0 to 10 V DC	2
6	1 to 5 V DC	1
8	4 to 20 mA DC	0
V	0/12 V DC	2

■ Function block 3

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.3 (F.3)	**Function block 3**	—	—	—
22	oS (oS)	Output mode for phase control	0: Proportional phase angle to input 1: Proportional voltage to input 2: Proportional square voltage (electric power) to input 3: Constant current control: (current feedback) [1] 4: Power proportional control (no voltage feedback) [1]	2	
23	LH (LH)	Output limiter high	0.0 to 100.0 % (Output limiter high ≥ Output limiter low)	100.0	
24	LL (LL)	Output limiter low	0.0 to 100.0 % (Output limiter high ≥ Output limiter low)	0.0	
25	LS (LS)	Output limiter high at operation start	0.0 to 100.0 %	50.0	
26	LT (LT)	Output limiter high time at operation start	0 to 600 seconds	0	
27	bU (bU)	Base-up set value	–9.9 to +100.0 %	0.0	
28	Mo (Mo)	Minimum output phase angle adjustment	Output phase angle 5.0 to 15.0 %	5.0	
29	SC (SC)	SCR trigger signal setting [2]	Phase of the supply voltage for the instrument and the supply voltage for the load 0: Same phase 1: Opposite phase	0	

[1] This set value is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

[2] To change the set value, stop the instrument.

■ Function block 4

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.4 (F.4)	**Function block 4** [1]	—	—	—
30	L 1 (L1)	Alarm output logic [1]	0 to 191 0: No output 1: Heater break alarm 1 2: Thyristor break-down alarm 1 4: Heater break alarm 2 8: Thyristor break-down alarm 2 16: Power frequency error 32: Over current alarm 128: FAIL (fixed at de-energized)	0	
31	nA (nA)	Selection of energized/de-energized alarm output [2]	0: Energized 1: De-energized	0	
32	A 1 (A1)	Alarm type selection [2]	0: Type 1 (constant resistance type, deviation alarm) 1: Type 2 (linearity resistor type, absolute value alarm) 2: Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm) In the case of Zero-cross control (continuous, input synchronous type), alarm is operated as Type 2 regardless of the set value.	0	
33	n 1 (n1)	Number of alarm 1 determination [2]	1 to 1000 times	30	
34	n2 (n2)	Number of alarm 2 determination [2]	1 to 1000 times	300	
35	SA (SA)	Alarm enable/disable during STOP [2]	0: Disable 1: Enable	0	

[1] This screen is displayed when 1 alarm output is supplied.
[2] This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

■ Function block 5

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.5 (F.5)	**Function block 5**	—	—	—
36	dM (dM)	Default display selection	0: Input signal monitor 1: CT input monitor * 2: Power frequency monitor 3: Power value monitor *	0	
37	dT (dT)	Display off timer	0 to 1000 seconds (0: Constantly lit)	0	
38	WH (WH)	Integrated operation time [upper 3 digits]	0 to 999 (Display resolution: 1000 hours)	0	
39	WL (WL)	Integrated operation time [lower 3 digits]	0 to 999 (Display resolution: 1 hour)	0	
40	Vr (Vr)	ROM version (High-order)	Fixed value (Version number) First 4 digits of the version of ROM are displayed	—	
41	Vq (Vq)	ROM version (Low-order)	Fixed value (Running number) Last 2 digits of the version of ROM are displayed	—	

* When the instrument with heater break alarm (non-liner resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer is not specified, even if "1: CT input monitor" or "3: Power value monitor" is set, the display will change to the input signal monitor.

■ Function block 6

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.6 (F.6)	**Function block 6 ***	—	—	—
42	HT (HT)	Automatic calculation time for knee points *	0 to 1000 seconds (0: Automatic detection function of knee points unused)	20	
43	HU (HU)	Automatic detection of knee points *	0: OFF 1: ON 2: Aborted	0	
44	K1 (KI)	Phase angle ratio at knee point 1 *	0 to 100 %	18	
45	r1 (r1)	Current value at knee point 1 *	0.0 to 32.0 A (20 A type)	3.6	
			0.0 to 32.0 A (30 A type)	5.4	
			0.0 to 55.0 A (45 A type)	8.1	
			0 to 70 A (60 A type)	11	
			0 to 90 A (80 A type)	14	
			0 to 110 A (100 A type)	18	
46	K2 (K2)	Phase angle ratio at knee point 2 *	0 to 100 %	36	
47	r2 (r2)	Current value at knee point 2 *	0.0 to 32.0 A (20 A type)	7.2	
			0.0 to 32.0 A (30 A type)	10.8	
			0.0 to 55.0 A (45 A type)	16.2	
			0 to 70 A (60 A type)	22	
			0 to 90 A (80 A type)	29	
			0 to 110 A (100 A type)	36	
48	K3 (K3)	Phase angle ratio at knee point 3 *	0 to 100 %	56	
49	r3 (r3)	Current value at knee point 3 *	0.0 to 32.0 A (20 A type)	11.2	
			0.0 to 32.0 A (30 A type)	16.8	
			0.0 to 55.0 A (45 A type)	25.2	
			0 to 70 A (60 A type)	34	
			0 to 90 A (80 A type)	45	
			0 to 110 A (100 A type)	56	

* This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

■ Function block 7

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.7 (F.7)	**Function block 7** *	—	—	—
50	TF (TF)	Protection function for control of primary side of a transformer *	0: Protection function for control of primary side of a transformer disabled 1: Protection function for control of primary side of a transformer enabled	0	
51	TA (TA)	Determination set value in case of a break on the secondary side of the transformer *	0 to 100 % of reference current value	70	
52	TL (TL)	Output limiter setting in case of a break on the secondary side of the transformer *	15.0 to 50.0 % of phase angle	15.0	
53	TU (TU)	Soft-start time in case of break on the secondary side of the transformer *	0.1 to 100.0 seconds	0.1	

* This screen is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

■ Function block 8

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.8 (F.8)	**Function block 8** [1]	—	—	—
54	Ao (Ao)	Retransmission output type [1]	0: No retransmission output 1: Manipulated output value 2: CT input monitor [2] 3: Power value monitor [2]	No retransmission output (AO) (Model code N): 0 With retransmission output (AO) (Model code A): 1	
55	AHS (AHS)	Retransmission output scale high [1]	0.0 to 100.0 % (Retransmission output scale high ≥ Retransmission output scale low)	100.0	
56	ALS (ALS)	Retransmission output scale low [1]	0.0 to 100.0 % (Retransmission output scale high ≥ Retransmission output scale low)	0.0	

[1] This screen is displayed when the retransmission output (AO) function is supplied.
[2] This setting value is displayed only when the instrument has heater break alarm (or non-linear resistance heater break alarm), current limiter, constant current control function, power proportional control, and protection function for control of primary side of a transformer.

■ Function block 9

No.	Symbol	Name	Data range	Factory set value	User set value
—	F.9 (F.9)	**Function block 9** *	—	—	—
57	CMP (CMP)	Communication protocol *	0: RKC communication 1: Modbus	Refer to Note 1	
58	Add (Add)	Device address *	RKC communication: 0 to 99 Modbus: 1 to 99	RKC communication 0 Modbus: 1	
59	bPS (bPS)	Communication speed *	0: 9600 bps 1: 19200 bps 2: 38400 bps 3: 57600 bps	0	
60	bIT (bIT)	Data bit configuration *	0 to 11 Refer to Data bit configuration table	0	
61	InT (InT)	Interval time *	0 to 250 ms	10	

* This screen is displayed when the communication function is supplied.

Data bit configuration table

Set value	Data bit	Parity bit	Stop bit
0	8	None	1
1	8	None	2
2	8	Even	1
3	8	Even	2
4	8	Odd	1
5	8	Odd	2
6	7	None	1
7	7	None	2
8	7	Even	1
9	7	Even	2
10	7	Odd	1
11	7	Odd	2

: Cannot be set in the case of Modbus.

Note 1

Model code (7)	Details	Factory set value
N	None	0
B	RKC communication	0
C	Modbus	1

■ Function block 10

To change the set value of Function block 10, stop the instrument.

No.	Symbol	Name	Data range	Factory set value	User set value
—	F. 10 (F.10)	**Function block 10**	—	—	—
—	P 1 (P1)	Parameter select setting 1	0 to 61 (Screen No.) 0: No registration	14 [Control method (CM)]	
—	P2 (P2)	Parameter select setting 2		3 [Soft-start time (SU)]	
—	P3 (P3)	Parameter select setting 3		4 [Soft-down time (Sd)]	
—	P4 (P4)	Parameter select setting 4		2 [Internal gradient set value (IG)]	
—	P5 (P5)	Parameter select setting 5		23 [Output limiter high (LH)]	
—	P6 (P6)	Parameter select setting 6		24 [Output limiter low (LL)]	
—	P7 (P7)	Parameter select setting 7		27 [Base-up set value (bU)]	
—	P8 (P8)	Parameter select setting 8		22 [Output mode for phase control (oS)]	
—	P9 (P9)	Parameter select setting 9		1 [Internal manual set value (IM)]	
—	P 10 (P10)	Parameter select setting 10		13 [Contact input (DI) function assignment (C1)]	
—	P 11 (P11)	Parameter select setting 11		7 [Maximum load current value (MC)]	
—	P 12 (P12)	Parameter select setting 12		8 [Heater break alarm 1 setting (H1)]	
—	P 13 (P13)	Parameter select setting 13		33 [Number of alarm 1 determination (n1)]	
—	P 14 (P14)	Parameter select setting 14		32 [Alarm type selection (A1)]	
—	P 15 (P15)	Parameter select setting 15		30 [Alarm output logic (L1)]	
—	P 16 (P16)	Parameter select setting 16		10 [Heater break alarm 2 setting (H2)]	
—	P 17 (P17)	Parameter select setting 17		12 [Current limit value setting (CL)]	
—	P 18 (P18)	Parameter select setting 18		31 [Selection of energized/de-energized alarm output (nA)]	
—	P 19 (P19)	Parameter select setting 19		50 [Protection function for control of primary side of a transformer (TF)]	
—	P20 (P20)	Parameter select setting 20		51 [Determination set value in case of a break on the secondary side of the transformer (TA)]	
—	P2 1 (P21)	Parameter select setting 21		52 [Output limiter setting in case of a break on the secondary side of the transformer (TL)]	
—	P22 (P22)	Parameter select setting 22		53 [Soft-start time in case of break on the secondary side of the transformer (TU)]	

MEMO

7

INPUT FUNCTION

This chapter describes input related functions, setting contents and setting procedure.

7.1 Control Input (Auto Mode)

In this device, you can set the manipulated output value to the load depending on the input signal (automatic set value) from the temperature controller. When using by connecting to a temperature controller, you need to set the input signal type.

7.1.1 Description of function

You can select the input signal to be used for connecting to the temperature controller from the following four types. Select the same input signal type as the control output of the temperature controller to be connected.

○: Normal use △: Conditional use

Control method	Input signal type			
	Current input 4 to 20 mA DC	Voltage input 0 to 10 V DC	Voltage input 1 to 5 V DC	Voltage pulse input 0/12 V DC
Phase control	○	○	○	△
Zero-cross control (continuous)	○	○	○	△
Zero-cross control (input synchronous type)	△	△	△	○

Condition of △:

– When voltage pulse input is selected with phase control or Zero-cross control (continuous):
It becomes the ON/OFF switching signal of the output. When the input signal is 0 %, the output from this instrument is turned off. When tine input signal is 100 %, the output from this instrument is turned on.

– When 4 to 20 mA DC, 0 to 10 V DC, and 1 to 5 V DC is selected with Zero-cross control (input synchronous type):
It becomes the ON/OFF switching signal of the output. When the input signal is less than 50 %, the output from this instrument is turned off. When tine input signal is 50 % or more, the output from this instrument is turned on.

● Checking the input signal

Input signal from the temperature controller can be checked on the Input signal monitor (M1) of Monitor mode [A].

☞ Refer to ■ **Input signal monitor (M1) (P. 10-2)** for the details of the Input signal monitor (M1).

7.1.2 Setting contents

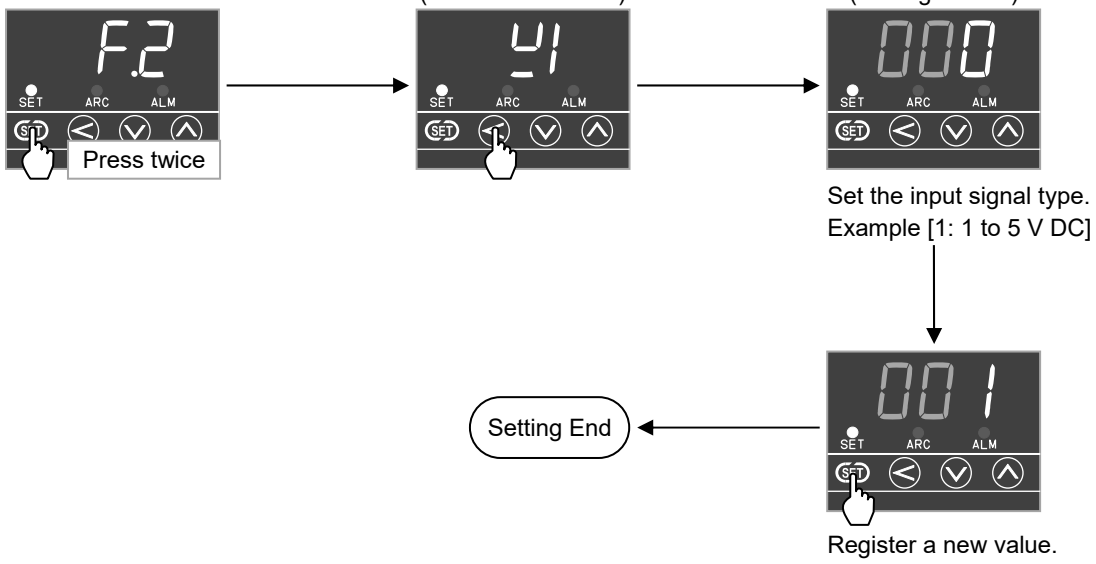
● Input signal type selection (XI) [Engineering mode [D] : Function block 2 (F. 2)]

Parameter symbol	Setting range	Factory set value
XI	0: 4 to 20 mA DC 1: 1 to 5 V DC 2: 0 to 10 V DC, 0/12 V DC	Based on Model code

7.1.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.2 screen appears.



7.2 Manual Mode

When not using the input signal (auto mode) from the temperature controller, you can set the manipulated output value of this instrument manually.

7.2.1 Description of function

There are two types of Manual mode, namely, External manual mode and Internal manual mode. You can use internal manual mode and external manual mode as the main setting of the control by switching over with parameter settings or Contact input (DI).

External manual mode:
Set with external manual setter (variable resistor).

Internal manual mode:
Set with the front key or communication. In the case of front key, you can set the manipulated output value with "Internal manual setting (IM)" of Setting mode C. In the case of communication, you can set the manipulated output value with "Internal manual setting (identifier: IM)" of communication data.

The internal manual set value is reset to 0.0 when the power of the instrument is turned off.

■ Switching between external manual mode and internal manual mode

The method of switching between external manual mode and internal manual mode is different depending on whether you use contact input (DI) or not. When the switching method that uses contact input (DI) is selected, you will not be able to switch with the front key(s) or communication.
Given below are the conditions when switching with and without using contact input (DI).

When contact input (DI) is not used

Contact input (DI) function assignment (C1)	Contact input state	Input signal transfer (dA)	Manual mode transfer (AM)	Main setting used for control
0: No function		0: Auto mode	0: External manual mode	Auto mode
		1: Manual mode		External manual mode
		0: Auto mode	1: Internal manual mode	Auto mode
		1: Manual mode		Internal manual mode

When contact input (DI) is used as "Input signal transfer"

Contact input (DI) function assignment (C1)	Contact input state	Input signal transfer (dA)	Manual mode transfer (AM)	Main setting used for control
2: Input signal transfer	Open	Set data lock condition is enabled, and switching between Auto mode/Manual mode cannot be done.	0: External manual mode	Auto mode
	Closed			External manual mode
	Open		1: Internal manual mode	Auto mode
	Closed			Internal manual mode

When contact input (DI) is used as "Manual mode transfer"

Contact input (DI) function assignment (C1)	Contact input state	Input signal transfer (dA)	Manual mode transfer (AM)	Main setting used for control
3: Manual mode transfer	Open	0: Auto mode	Set data lock condition is enabled, and switching to Manual mode cannot be done.	Auto mode
		1: Manual mode		External manual mode
	Closed	0: Auto mode		Auto mode
		1: Manual mode		Internal manual mode

7.2.2 Setting contents

● Contact input (DI) function assignment (C1) [Engineering mode D : Function block 1 (F. 1)]

Use to assign the Contact input (DI) function. The action of assigned function can be switched by opening and closing the contact input.

Parameter symbol	Setting range	Factory set value
C1	0: No function 1: Control method Open: Phase control Closed: Zero-cross control 2: Input signal transfer Open: Auto mode Closed: Manual mode 3: Manual mode transfer Open: External manual mode Closed: Internal manual mode 4: RUN/STOP transfer Open: STOP Closed: RUN 5: Soft-start, Soft-down enable/disable Open: Enable Closed: Disable 6: Heater break alarm enable/disable Open: Enable Closed: Disable 7: Over current alarm enable/disable Open: Enable Closed: Disable 8: Set data lock enable/disable Open: Enable Closed: Disable	0

● Input signal transfer (dA) [Engineering mode D : Function block 2 (F. 2)]

Use to select control mode if control is done by Auto mode or Manual mode. Also use to modify the display items of the Input signal monitor (M1). The value of the action selected in this item can be viewed in the Input signal monitor (M1).

Parameter symbol	Setting range	Factory set value
dA	0: Auto mode 1: Manual mode	0

📖 The auto set value can be viewed constantly in the Control input monitor (M2).

📖 If Input signal transfer is set in the Contact input (DI) function assignment (C1), the status of Contact input (DI) will take priority and changes with this parameter cannot be made.

● Manual mode transfer (AM) [Engineering mode D : Function block 2 (F. 2)]

Use to choose the Manual mode whether the control is performed with the External manual mode or the Internal manual mode.

Parameter symbol	Setting range	Factory set value
AM	0: External manual mode 1: Internal manual mode	0

📖 If the Contact input (DI) function is set to "Input signal transfer", switching contact to closed (Manual mode) will switch the mode to the manual setting mode set in this parameter.

📖 If Manual mode transfer is set in the Contact input (DI) function assignment (C1), the status of Contact input (DI) will take priority and changes with this parameter cannot be made.

● Internal manual set value (IM) [Setting mode C]

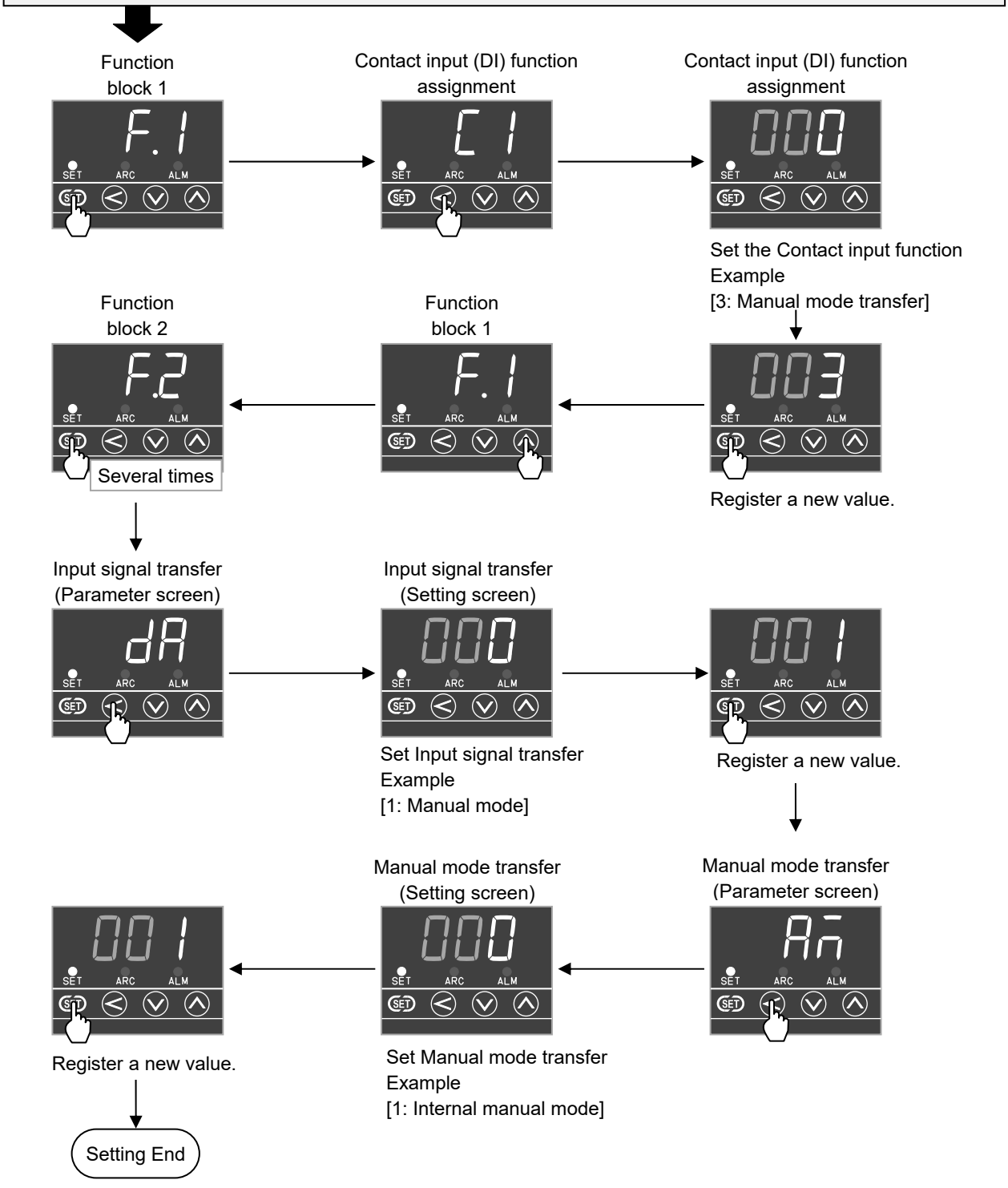
Parameter symbol	Setting range	Factory set value
IM	0.0 to 100.0 %	0.0

📖 If the power supply is turned off, internal manual set value is reset to "0.0."

7.2.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.



7.3 Gradient Setting Function

7.3.1 Description of function

This is a function to set a desired gradient toward the input signal or the set value. Gradient setting includes "External gradient setting" that is set with the external gradient setting device, and "Internal gradient setting" stored in the instrument as the internal data. "Internal gradient setting" can be set with the front key or host communication and loader communication. Gradient output characteristic is a value obtained by multiplying internal gradient setting and external gradient setting with respect to the input signal or the setting.

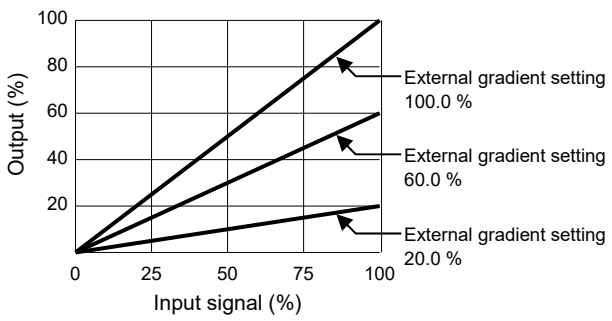
Input signal [Auto mode] (%) × Internal gradient set value × External gradient set value (%)

Setting [External manual set value] (%) × Internal gradient set value × External gradient set value (%)

Setting [Internal manual set value] (%) × Internal gradient set value × External gradient set value (%)

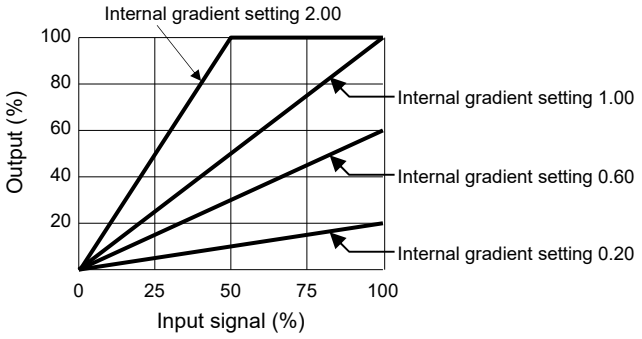
If it is necessary to make only the External gradient setting valid, set the Internal gradient setting to 1.00.

External gradient setting



Gradient output characteristic drawing

Internal gradient setting



Gradient output characteristic drawing

Internal gradient setting can be set up to maximum 2.00.

Example 1: When Input signal [Auto mode] is set to 80 %, Internal gradient setting to 0.50, and External gradient setting to 75 %.

Output (%) = Input signal [Auto mode] (%) × Internal gradient set value × External gradient set value (%)
= 80 % × 0.5 × 75 %
= 30 %

Example 2: When Input signal [Auto mode] is set to 25 %, Internal gradient setting to 2.00, and External gradient setting to 80 %.

Output (%) = Input signal [Auto mode] (%) × Internal gradient set value × External gradient set value (%)
= 25 % × 2.00 × 80 %
= 40 %

7.3.2 Setting contents

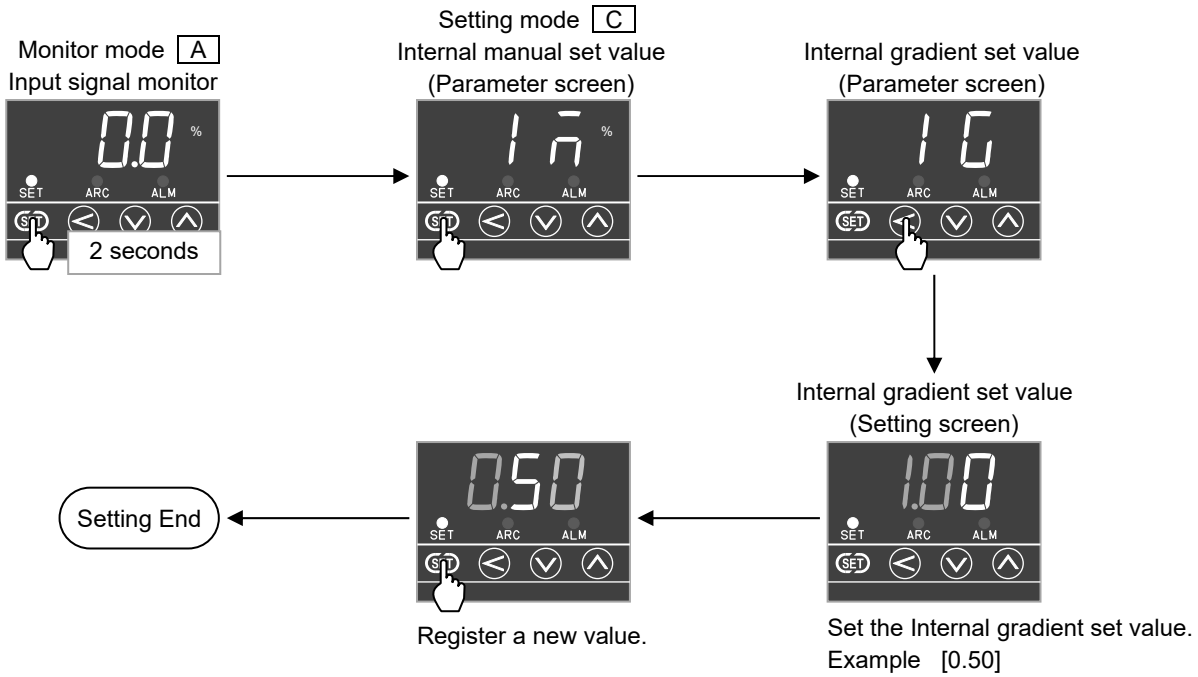
- **Internal gradient set value (IG)**
  [Setting mode C]

Parameter symbol	Setting range	Factory set value
IG	0.00 to 2.00	1.00

When the Control method is Zero-cross control (input synchronous type), Internal gradient set value cannot be used.

7.3.3 Setting procedure

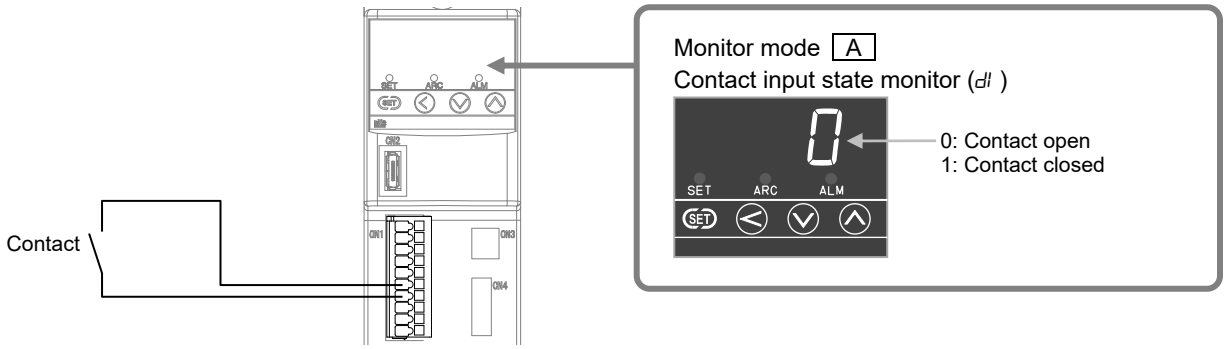
Set value of Setting mode C cannot be adjusted when the set data lock is active. To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.



7.4 Contact Input (DI)

7.4.1 Description of function

Functions can be selected by external contact signals. Eight types of function can be selected, and one of these eight types is used for setting “Contact input (DI) function assignment (C1)”. As for the function that is set, it can be switched by opening and closing the contact input. The open/closed state of contact can be checked on the “Contact input state monitor (dI)”.



NOTE

If you are using THV-1

Please note that the open/close displays of the Contact input state monitor (dI) in the THV-1 are opposite of those in the THV-10.

	THV-1	THV-10
Open	1	0
Closed	0	1

Contact input (DI) function types

(1) Control method

You can switch between Phase control and Zero-cross control (continuous). If this function is assigned, function selected with contact open/closed will take priority. Selection of control method via front key or communication becomes unavailable.

Open: Phase control
Closed: Zero-cross control (continuous)

When this function is assigned, Zero-cross control (input synchronous type) cannot be used. Do not select this function when using Zero-cross control (input synchronous type).

(2) Input signal transfer

You can switch between Auto mode and Manual mode. If this function is assigned, function selected with contact open/closed will take priority. Switching of input signal via front key or communication becomes unavailable. There are two types of manual mode: External manual mode and Internal manual mode. When contact input is closed, the mode set at the "Manual mode transfer (AM)" in the Engineering mode D (function block 2) is used.

Open: Auto mode
Closed: Manual setting (External manual setting or Internal manual setting)

Input signal selected depending on the parameter setting and contact condition is as follows.

Contact input (DI) function assignment (C1)	Contact input state	Input signal transfer (dA)	Manual mode transfer (AM)	Input signal used for control
2: Input signal transfer	Open	Setting value is disabled, and switching between Auto mode/Manual mode cannot be done.	0: External manual mode	Auto mode
	Closed			External manual mode
	Open		1: Internal manual mode	Auto mode
	Closed			Internal manual mode

(3) Manual mode transfer

You can switch between External manual mode or Internal manual mode. If this function is assigned, function selected with contact open/closed will take priority. Switching of manual input via front key or communication becomes unavailable.

Open: External manual mode
Closed: Internal manual mode

Manual input selected depending on the parameter setting and contact condition is as follows.

Contact input (DI) function assignment (C1)	Contact input state	Input signal transfer (dA)	Manual mode transfer (AM)	Manual input used for control
3: Manual mode transfer	Open	0: Auto mode	Setting value is disabled, and switching between External manual setting/Internal manual setting cannot be done.	Auto mode
		1: Manual mode		External manual mode
	Closed	0: Auto mode		Auto mode
		1: Manual mode		Internal manual mode

(4) RUN/STOP transfer

You can switch between RUN and STOP of this instrument. If this function is assigned, function selected with contact open/closed will take priority. RUN/STOP transfer via front key or communication becomes unavailable.

Open: STOP (Output OFF)
Closed: RUN (Output ON)

(5) Soft-start, Soft-down enable/disable

You can “Enable” or “Disable” the Soft-start/Soft-down function. This makes it possible to disable the Soft-start and Soft-down functions without setting the Soft-start time and Soft-down time to "0."
There are two types of Enable actions. When contact input is open, the mode set at the “Soft-start, Soft-down enable/disable (SF)” in Engineering mode [D] (function block 2) is used.

Contact state	Soft-start, Soft-down enable/disable (SF)		
	0	1	2
Open	Disable	Enable (Except switching from STOP to RUN)	Enable (Enable when switching from STOP to RUN)
Closed	Disable		

Even when this function is assigned, you can “Enable” or “Disable” the Soft-start/Soft-down function with the front key or communication. You can switch with “Soft-start, Soft-down enable/disable (SF)” in Engineering mode [D] (function block 2).

(6) Heater break alarm enable/disable

You can “Enable” or “Disable” the Heater break alarm and Thyristor break-down alarm. This makes it possible to disable the Heater break alarm and Thyristor break-down alarm without setting the Heater break alarm set value and Thyristor break-down alarm set value to “0.”

Open: Enable
Closed: Disable

Even when this function is assigned, you can “Enable” or “Disable” the heater break alarm and thyristor break-down alarm with the front key or host communication and loader communication. You can switch with “Heater break alarm enable/disable (HF)” in Engineering mode [D] (function block 2).

These functions are available when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

(7) Over current alarm enable/disable

You can “Enable” or “Disable” the Over current alarm function. If this function is assigned, function selected with contact open/closed will take priority. You will not be able to switch even if you change the setting value of “Over current alarm enable/disable (oF)” with the front key or host communication and loader communication.

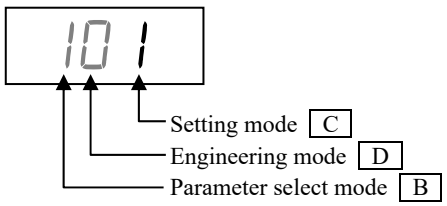
Open: Enable
Closed: Disable

These functions are available when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

(8) Set data lock enable/disable

You can “Enable” or “Disable” the set data lock. When the contact input is open, lock of the mode set with “Set data lock (LK)” in Setting mode [C] is enabled.

Open: Enable (Locked)
Closed: Disable (Unlocked)

Contact state	Enable/Disable state
Open	Enable (Locked) When the contact input is open, lock of the mode set with “Set data lock (LK)” is enabled. In the case of the following settings, changing to open will enable the lock of Engineering mode [D].  0 and 2 to 9: Lock 1: Unlock
Closed	Disable (Unlock in all modes)

Even when this function is assigned, you can “Enable” or “Disable” the setting lock with the front key or host communication and loader communication. You can switch with “Set data lock (LK)” in Setting mode [C].

7.4.2 Setting contents

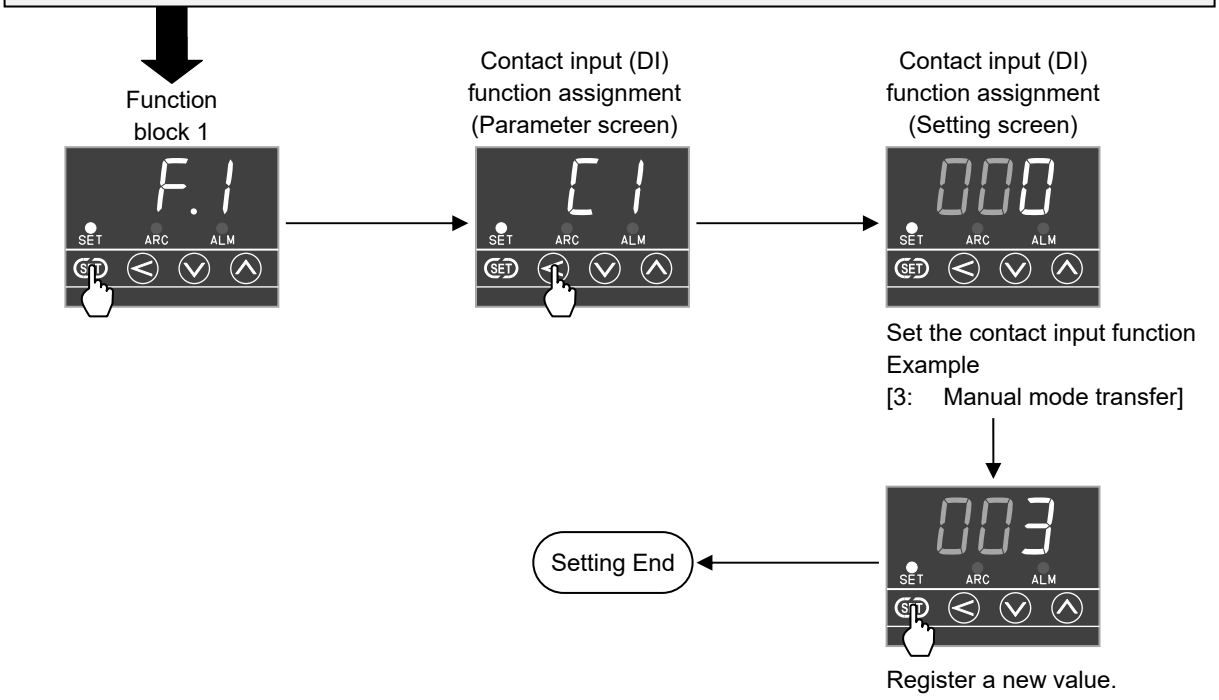
- **Contact input (DI) function assignment (C1)**
  [Engineering mode D : Function block 1 (F. 1)]

Parameter symbol	Setting range	Factory set value
C1	0: No function 1: Control method Open: Phase control Closed: Zero-cross control 2: Input signal transfer Open: Auto mode Closed: Manual mode 3: Manual mode transfer Open: External manual mode Closed: Internal manual mode 4: RUN/STOP transfer Open: STOP Closed: RUN 5: Soft-start, Soft-down enable/disable Open: Enable Closed: Disable 6: Heater break alarm enable/disable Open: Enable Closed: Disable 7: Over current alarm enable/disable Open: Enable Closed: Disable 8: Set data lock enable/disable Open: Enable Closed: Disable	0

7.4.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.



MEMO

CONTROL AND OUTPUT FUNCTION

8

This chapter describes control and output related functions, setting contents and setting procedure.

8.1 Output Limiter High and Low

Use an output limiter to limit the output.

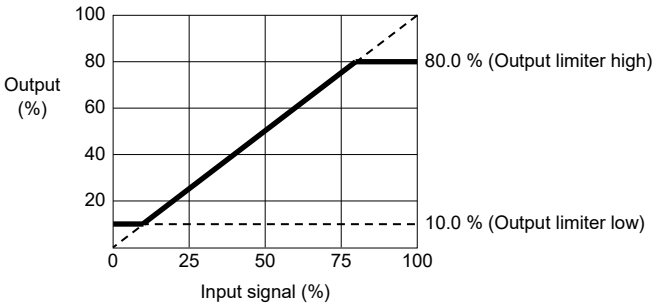
8.1.1 Description of function

Output limiter limits the output range of the instrument. You can limit the upper and lower limits of the output range for input signals or manual setting. Set the output limiter value as follows.

- Output limiter low value ≦ Output limiter high value

The maximum output from the instrument will not exceed the Output limiter high and the minimum output will not go below the Output limiter low.

- Output limiter low ≦ Output ≦ Output limiter high



If input synchronous type Zero-cross control is used, the Output limiter high and Output limiter low are not activated.

When this instrument is set to STOP, the Output limiter low turns off and the low limit output becomes 0%.

8.1.2 Setting contents

- **Output limiter high (LH)**
  [Engineering mode D : Function block 3 (F. 3)]

Parameter symbol	Setting range	Factory set value
LH	0.0 to 100.0 % (Output limiter high ≧ Output limiter low)	100.0

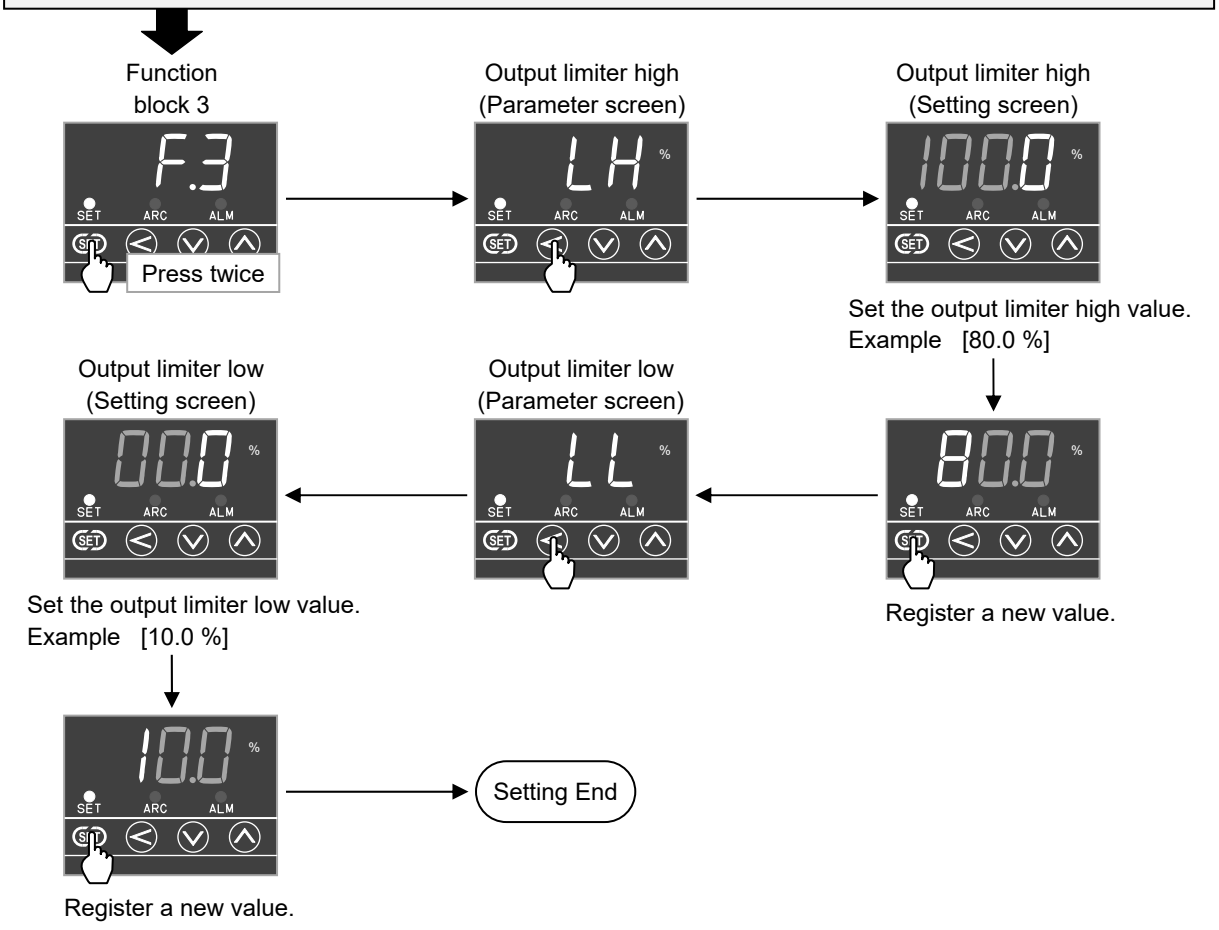
- **Output limiter low (LL)**
  [Engineering mode D : Function block 3 (F. 3)]

Parameter symbol	Setting range	Factory set value
LL	0.0 to 100.0 % (Output limiter high ≧ Output limiter low)	0.0

8.1.3 Setting procedure

☞ The Engineering mode D is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

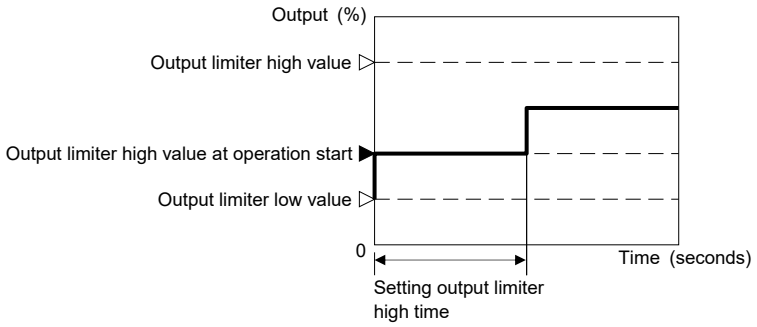
1. Press and hold the SET key (SET) for 2 seconds at Monitor mode A until Setting mode C is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode C until Engineering mode D is displayed.
3. Press the UP key (^) until the F.3 screen appears.



8.2 Output Limiter High at Operation Start

8.2.1 Description of function

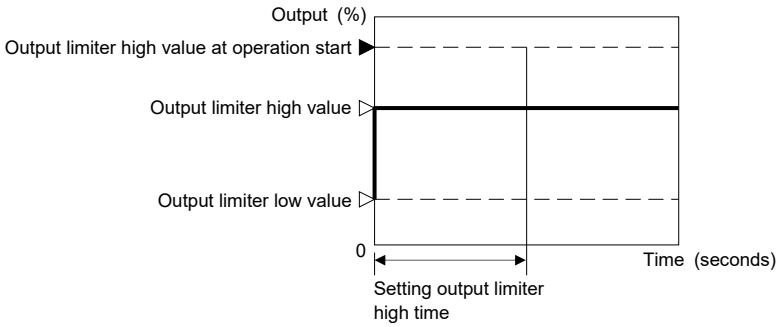
This is a function to limit the output phase angle for the set time period (Output limiter high time at operation start) when the instrument is powered up or when the mode is switched from STOP to RUN. Use of this function enables to suppress sudden output change due to rush current. The use of this function is effective for any heater (halogen lamp, platinum, tungsten, molybdenum, etc.) through which rush current flows.



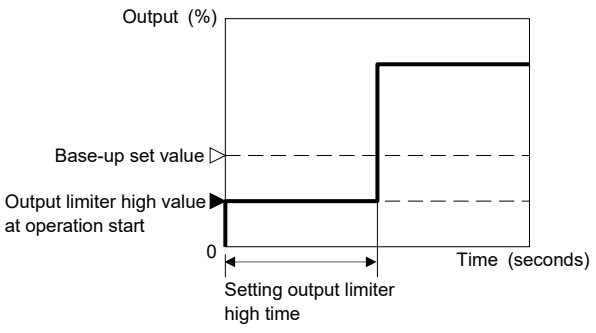
- Output limiter high at operation start function can be used in the case of Phase control.
- When the setting of Soft-start, Soft-down enable/disable is set to “2", the Output limiter high at operation start is activated when this instrument is switched from STOP to RUN.

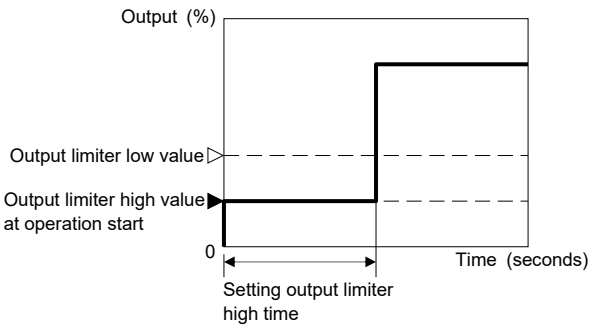
Priority order of Output limiter

In case the Output limiter high at operation start is set at a larger value than the Output limiter high value, priority is given to the Output limiter high.



In case the Output limiter high at operation start is set at a smaller value than the Base-up set value or the Output limiter low value, priority is given to the Output limiter high at operation start.





In case the load current of the output set by the Output limiter high at operation start exceeds the current limiter value, priority is given to the current limiter value.

8.2.2 Setting contents

- **Output limiter high at operation start (LS)**
  [Engineering mode D : Function block 3 (F. 3)]

Parameter symbol	Setting range	Factory set value
LS	0.0 to 100.0 %	50.0

- Output limiter high value at operation start must be lower than Output limiter high.
- Even if the Output limiter high value at operation start is set to 0.0, the function is not disabled.
- To activate the Output limiter high at operation start when the mode is switched from STOP to RUN, Soft-start, Soft-down enable/disable (SF) must be set to "2."

- **Output limiter high time at operation start (LT)**
  [Engineering mode D : Function block 3 (F. 3)]

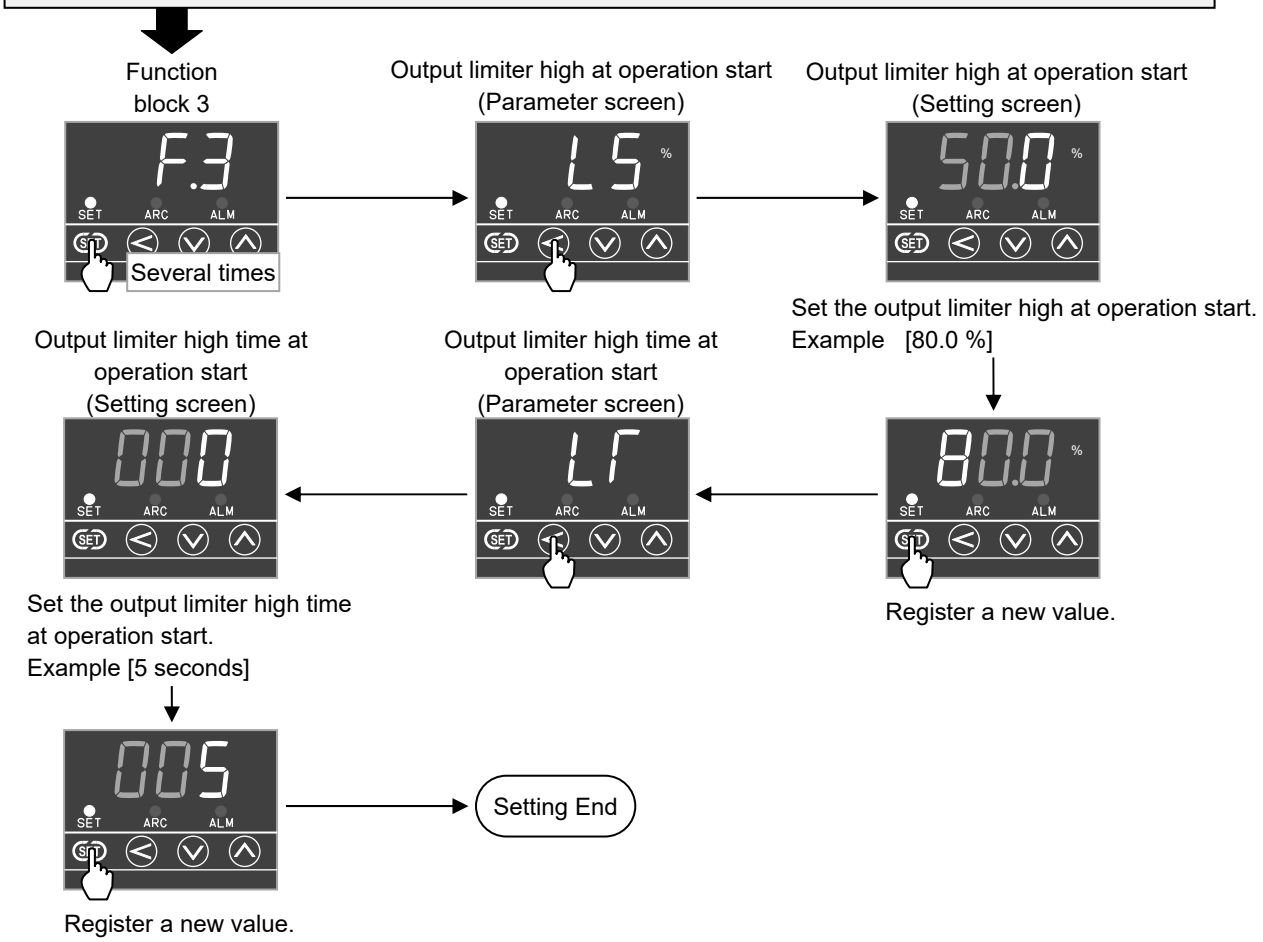
Parameter symbol	Setting range	Factory set value
LT	0 to 600 seconds	0

- In case the Output limiter high time at operation start is set to 0 seconds, the Output limiter high at operation start will be disabled.

8.2.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.3 screen appears.



8.3 Phase Control/Zero-cross Control

The instrument has three types of control methods.

– Phase control
– Zero-cross control (continuous)
– Zero-cross control (input synchronous type)

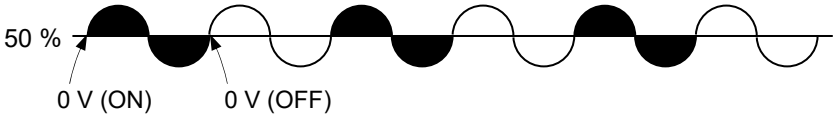
8.3.1 Description of function

Phase control

Phase control is to continuously control electric power supplied to a load by changing phase angle θ of AC voltage applied to the load. Each half-cycle has ON and OFF time.

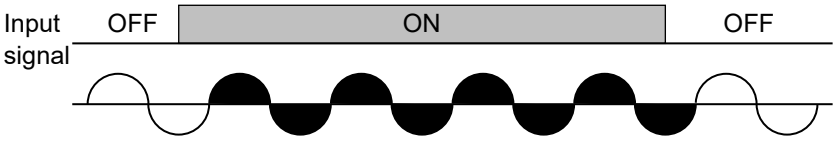
Zero-cross control (continuous)

Continuous zero-cross control is to control electric power supplied to a load by turning the power supply voltage ON and OFF at the point of 0 V AC.
Since thyristor is turned on at 0 V, occurrence of a high frequency noise can be suppressed further than phase control.



Zero-cross control (input synchronous type)

Input synchronous type zero-cross control is to turn the power supply ON and OFF synchronously with the pulse signal from a controller.



8.3.2 Setting contents

- **Control method (CM)**
  [Engineering mode D : Function block 2 (F. 2)]

Parameter symbol	Setting range	Factory set value
CM	0: Phase control 1: Zero-cross control (continuous) 2: Zero-cross control (input synchronous type)	0

If Control method is set in the Contact input (DI) function assignment (C1), the set value cannot be changed.

Functions that cannot be used with certain Control methods

Some functions cannot be used with certain Control methods. (Refer to the table below)

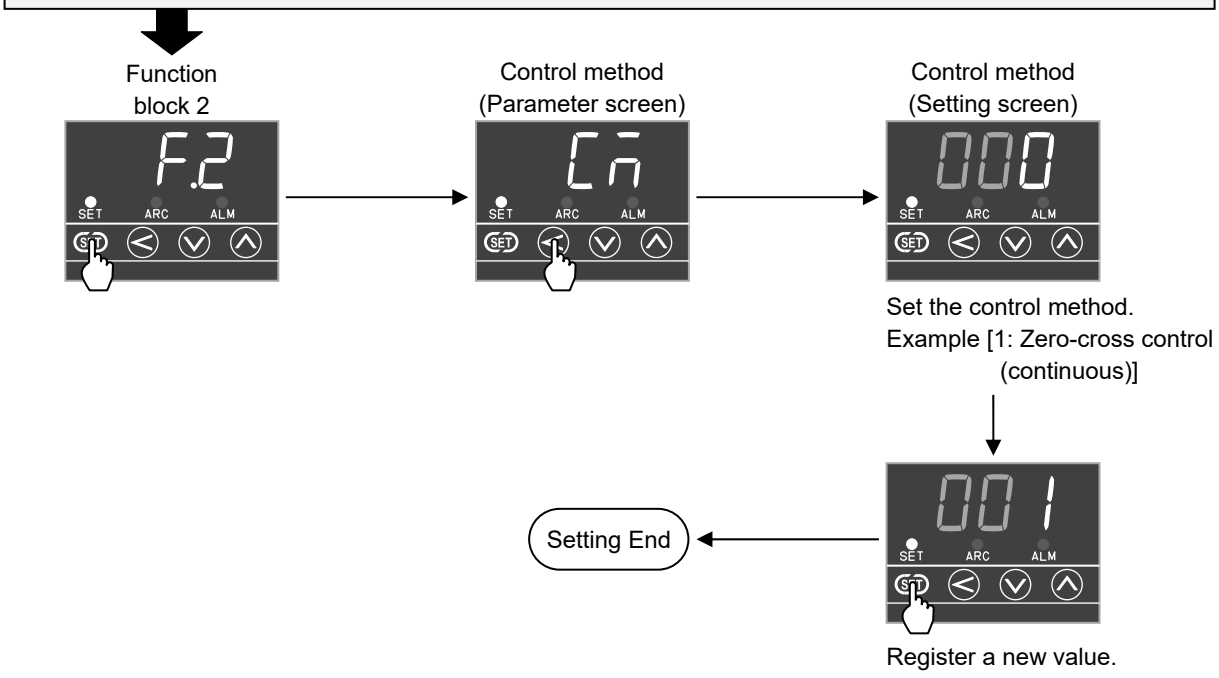
○: Can be used ×: Cannot be used

Function	Phase control	Zero-cross control (continuous)	Zero-cross control (input synchronous type)
Internal gradient setting	○	○	×
Soft-start and Soft-down	○	×	×
Current limit	○	×	×
Output mode	○	×	×
Output limiter high	○	○	×
Output limiter low	○	○	×
Output limiter high at operation start	○	×	×
Base-up set value	○	○	×
Heater break alarm (Type 1)	○	×	×
Non-linear resistance heater break alarm	○	×	×
Protection function for control of primary side of a transformer	○	×	×
Minimum output phase angle adjustment	○	×	×
Retransmission output (AO)	○	×	×

8.3.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.2 screen appears.



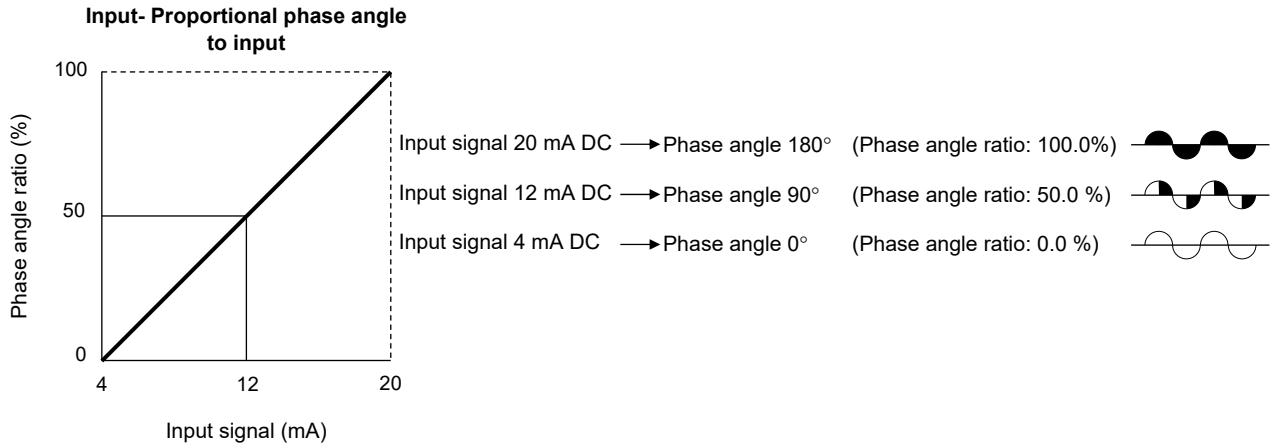
8.4 Output Mode for Phase Control

When using phase control, you can select from the following five types of output modes.
(The Output mode setting is invalid when the control method is Zero-cross control)

8.4.1 Description of function

(1) Proportional phase angle to input

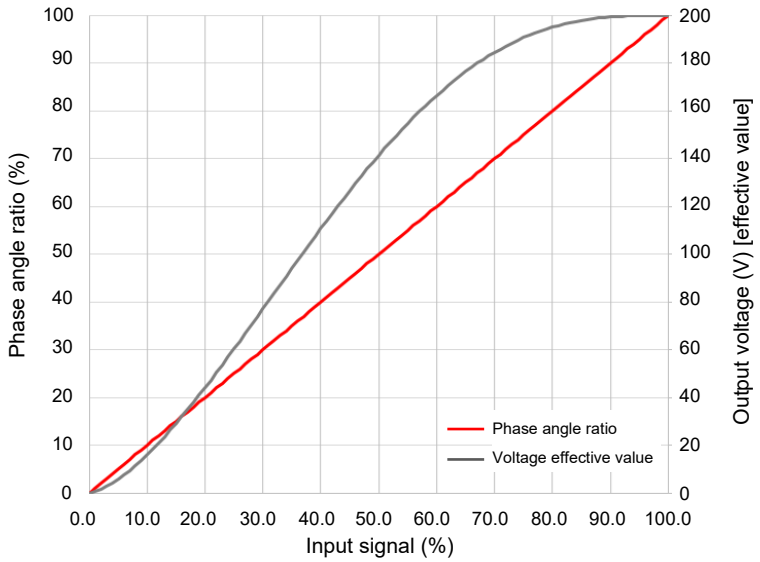
This is the output mode to control the output phase angle ratio of the output voltage applied to the load at a constant value in proportion to the input signal.
For example, the output phase angle ratio will be as follows when the input signal is 4 to 20 mA DC.



Output accuracy, stability: ±10 % of power supply voltage for load

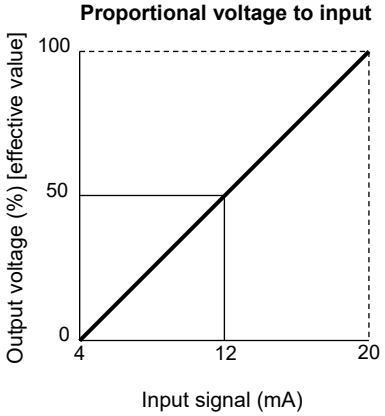
The relation between input signal and phase angle ratio and output voltage [effective value] will be as follows at the time of proportional phase angle to input.

Output mode: Proportional phase angle to input (load voltage = 200 V)



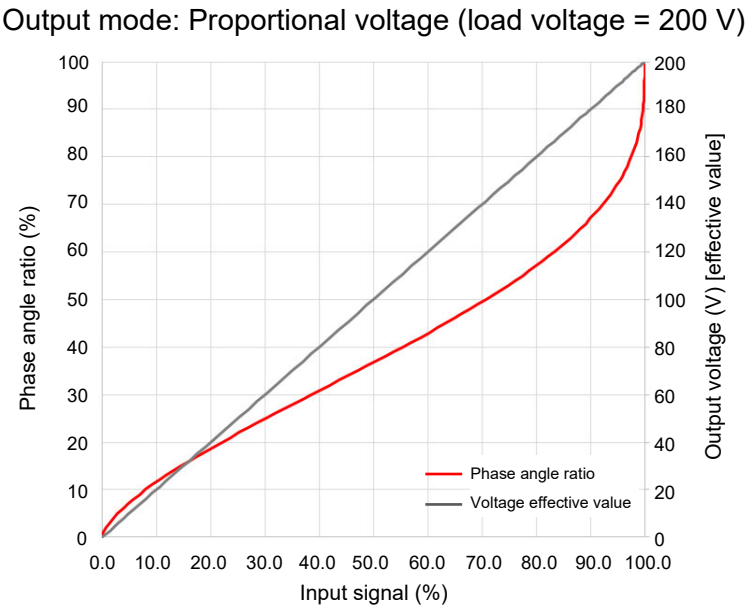
(2) Proportional voltage to input

This is the output mode to control the output voltage [effective value] to be applied to the load at a constant value in proportion to the input signal. For example, the output voltage [effective value] will be as follows when the input signal is 4 to 20 mA DC.



Output accuracy, stability: ±10 % of power supply voltage for load

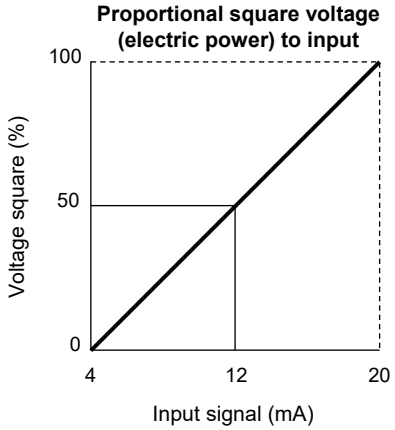
The relation between input signal and phase angle ratio and output voltage [effective value] will be as follows at the time of proportional voltage to input.



The figure above shows an example of a load voltage of 200 V. If the load voltage fluctuates, the output voltage [effective value] also changes.

(3) Proportional square voltage (electric power) to input

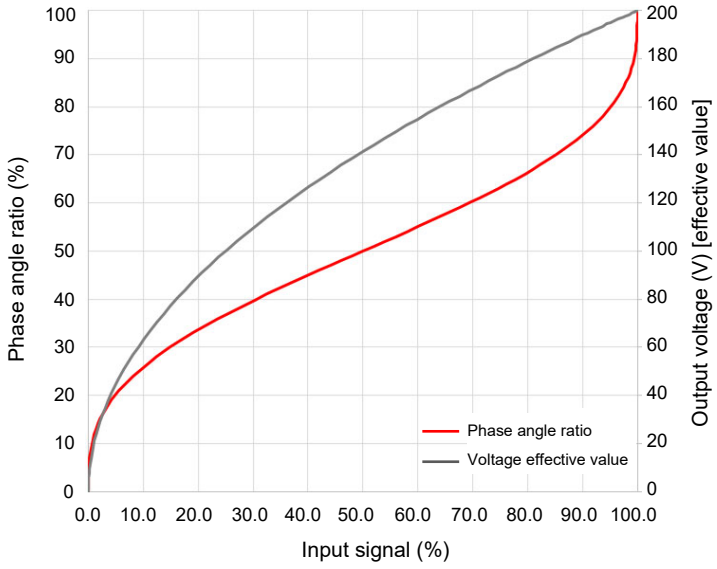
This is the output mode to control the proportional square voltage to be applied to the load at a constant value in proportion to the input signal. Power can be calculated with the calculation formula: Power P (W) = Voltage E (V) ^{2} / Resistance R (Ω). The output voltage will be as follows when the input signal is 4 to 20 mA DC.



Output accuracy, stability: ±10 % of power supply voltage for load

The relation between input signal and phase angle ratio and output voltage [Effective value] will be as follows at the time of voltage square (electric power).

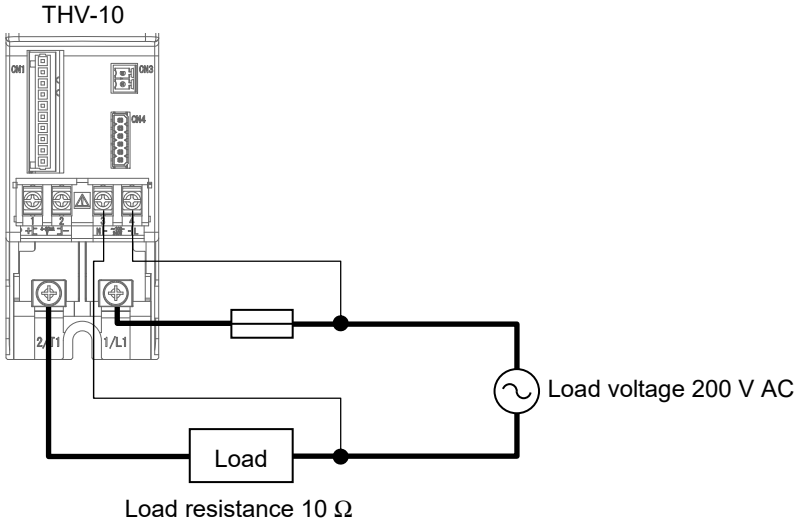
Output mode: Proportional square voltage (load voltage = 200 V)



Proportional square voltage (electric power) to input is the output mode suitable for the control of loads (such as nichrome, iron chromium, etc.) with small change in resistance (change in resistance due to change in temperature).
It cannot be used for loads with large resistance changes due to temperature changes.

■ Example where proportional square voltage (electric power) to input is proportional to input signal

When the load voltage is 200 V and the load resistance (load with small changes in resistance value) is 10 Ω



Power when the input signal is 100%

Power (W) = Load voltage $(V)^2$ / Resistance (Ω)

200 V × 200 V / 10 Ω = 4000 W

Power when the input signal is 50 %

The output voltage [effective value] is “141.1 V” when the input signal is 50 %.
(Refer to P. 8-12 “Output mode: Proportional square voltage” graph)

Power (W) = Load voltage $(V)^2$ / Resistance (Ω)

141.4 V × 141.4 V / 10 Ω = 1999.396 W (About 2000 W)

Power when the input signal is 25 %

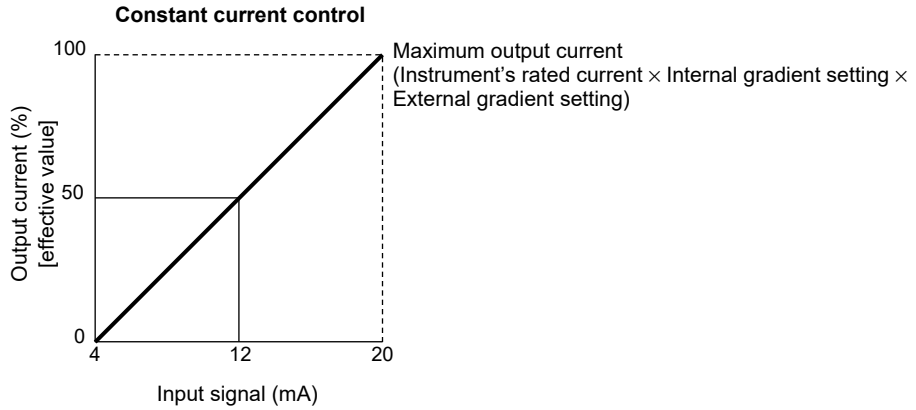
The output voltage [effective value] is “100 V” when the input signal is 25 %.
(Refer to P. 8-12 “Output mode: Proportional square voltage” graph)

Power (W) = Load voltage $(V)^2$ / Resistance (Ω)

100 V × 100 V / 10 Ω = 1000 W

(4) Constant current control

This is the output mode to control the output current at a constant value in proportion to the input signal. This is effective for controlling loads (such as tantalum, super kanthal, tungsten, platinum, molybdenum, etc.) whose resistance varies greatly with temperature changes. The output current will be as follows when the input signal is 4 to 20 mA DC.



Output accuracy, stability:

±10 % of maximum current rating

Power supply voltage variation: Power supply voltage for load: Within ±10 % or
Load variation: Within 2 times

Constant current control is optional. Cannot be used when not selected at the time of order placement.

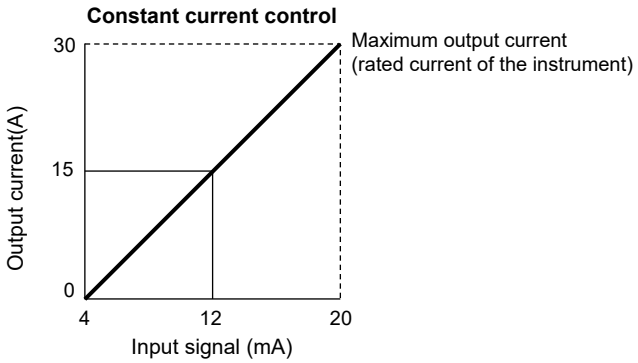
Make sure that the maximum current value of load is less than or equal to the rated current of the instrument.

■ Soft-start operation

When Constant current control is used, the Soft-start function operates for 0.1 seconds after the power is turned on, even if the Soft-start time is set to 0.0 seconds.

■ Caution for using constant current control function

In Constant current control, the maximum output current is the same as the rated current of the instrument when the input signal is 100% (in the figure below, the input signal is 4 to 20 mA DC).



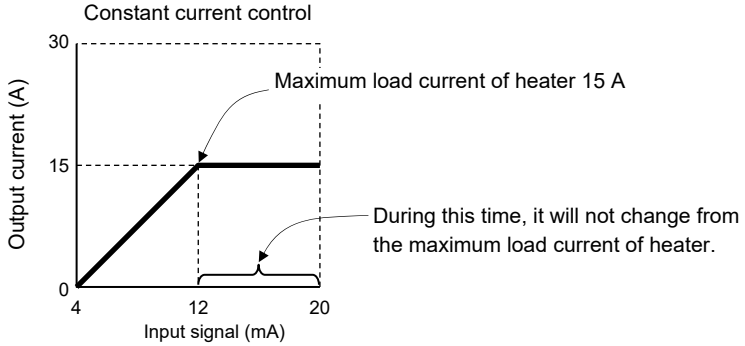
Constant current control when the rated current of the instrument is 30 A and the maximum load current of the heater is 30 A

If the maximum load current of the load is smaller than the maximum output current of the instrument (the rated current of the instrument), compensate for the difference by setting the gradient. If the compensation with the gradient is not appropriate, there will be a range where the output current will not change. A compensation example when there is a difference between the maximum output current (rated current of the instrument) and the maximum load current of the load is shown below.

Example: When used in the following condition

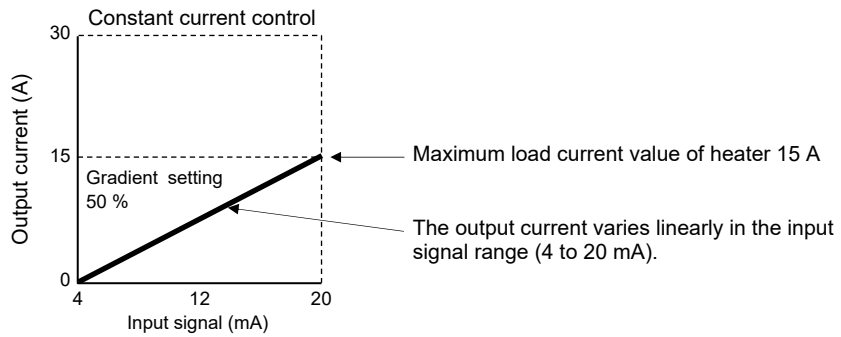
- Rated current of THV-10: 30 A
- Maximum load current of heater: 15 A
- Input signal from controller: 4 to 20 mA DC

When used without changing the gradient, the maximum heater load current becomes 15 A at an input signal of 12 mA. In this case, if the input signal exceeds 12 mA, the maximum load current of the heater will not change from 15 A.



In this case, set the gradient to 50 % so that the maximum heater load current will become 15 A at an input signal of 20 mA. The gradient is valid even if internally set or set by the external gradient setter.

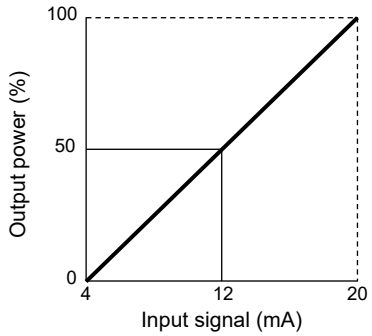
Heater's maximum load current (15 A) = Instrument's rated current (30 A) × Internal gradient setting (0.50) × External gradient setting (100%)



(5) Power proportional control

This is the output mode to control the output power at a constant value in proportion to the input signal. This is effective for controlling loads (such as silicon carbide, silicon units, etc.) whose resistance value increases with temperature or aging. The output voltage will be as follows when the input signal is 4 to 20 mA DC.

Power proportional control function



Output accuracy, stability:

±10 % of rated power (Rated power = 200 V × Maximum rated current / 2)
Load resistance variation: Within 2 times

If the constant current control option is not selected when ordering, power proportional control cannot be used

■ Using power proportional control

When using power proportional control, make sure to set "Load power supply voltage (LP)."
"Load power supply voltage (LP)" is required when calculating power with power proportional control.
For the setting method, refer to page **8-18**.

■ Calculating target power when using power proportional control

For power proportional control, the target power when the input signal is 100% is calculated by using the following formula.

Calculation formula:

Target power (W) = Input signal (%) × 200 V × THV-10 rated current (A) × 0.5 × Internal gradient set value × External gradient set value (%)

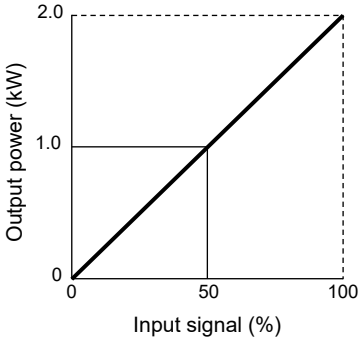
"200 V" and "0.5" in the calculation formula are fixed values.

Example: Target power when the rated current of THV-10 is 20 A type

- Input signal: 100 %
- THV-10 rated current: 20 A
- Internal gradient set value: 1.00
- External gradient set value: 100 %

Target power (W) = 100 % × 200 V × 20 A × 0.5 × 1.00 × 100 %
= 2000 [W] (2.0 kW)

Power proportional control function



If you want to change the power when the input signal is 100%, compensate with the internal gradient set value or external gradient set value.

Example: When the rated current is 20 A type and the input signal is 100% and you want to make it 1.5 kW
For the 20 A type, the standard power when the input signal is 100% is 2.0 kW, but it can be changed to 1.5 kW by changing the gradient set value. The gradient is valid even if internally set or set by the external gradient setter.

• Set to "0.75" when compensating with the internal gradient set value.

Target power (W) = Input signal (%) × 200 V × THV-10 rated current (A) × 0.5 × Internal gradient set value × External gradient set value (%)
= 100 % × 200 V × 20 A × 0.5 × 0.75 × 100 %
= 1500 [W] (1.5 kW)

• Set to "75 %" when compensating with the external gradient setter.

Target power (W) = Input signal (%) × 200 V × THV-10 rated current (A) × 0.5 × Internal gradient set value × External gradient set value (%)
= 100 % × 200 V × 20 A × 0.5 × 1.00 × 75 %
= 1500 [W] (1.5 kW)

8.4.2 Setting contents

● Output mode for phase control (oS) [Engineering mode D : Function block 3 (F. 3)]

NOTE

When Constant current control is selected, no normal operation is performed if the rated current of thyristor differs from that maximum load current flowing through the heater. In such a case, set the gradient so that the Maximum load current value which flows through the heater is obtained at an input signal of 100 %. [For the setting method, refer to ■ Caution for using Constant current control function (P. 8-15)]

Parameter symbol	Setting range	Factory set value
oS	0: Proportional phase angle to input 1: Proportional voltage to input 2: Proportional square voltage (electric power) to input 3: Constant current control (current feedback) * 4: Power proportional control (No electric power feedback) *	2

* This setting becomes active on the display when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control and Protection function for control of primary side of a transformer.

● Load power supply voltage (LP) Setting mode C

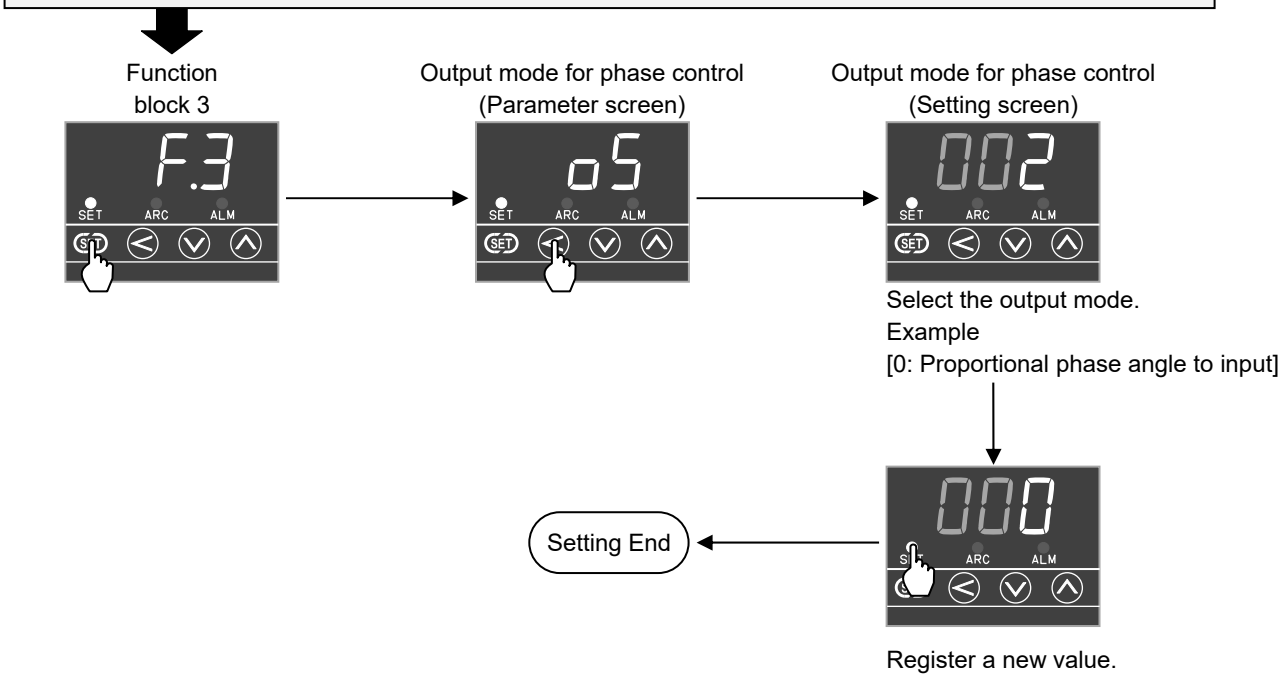
Parameter symbol	Setting range	Factory set value
LP	85 to 264 V	220

Load power supply voltage screen appears when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limiter function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

8.4.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

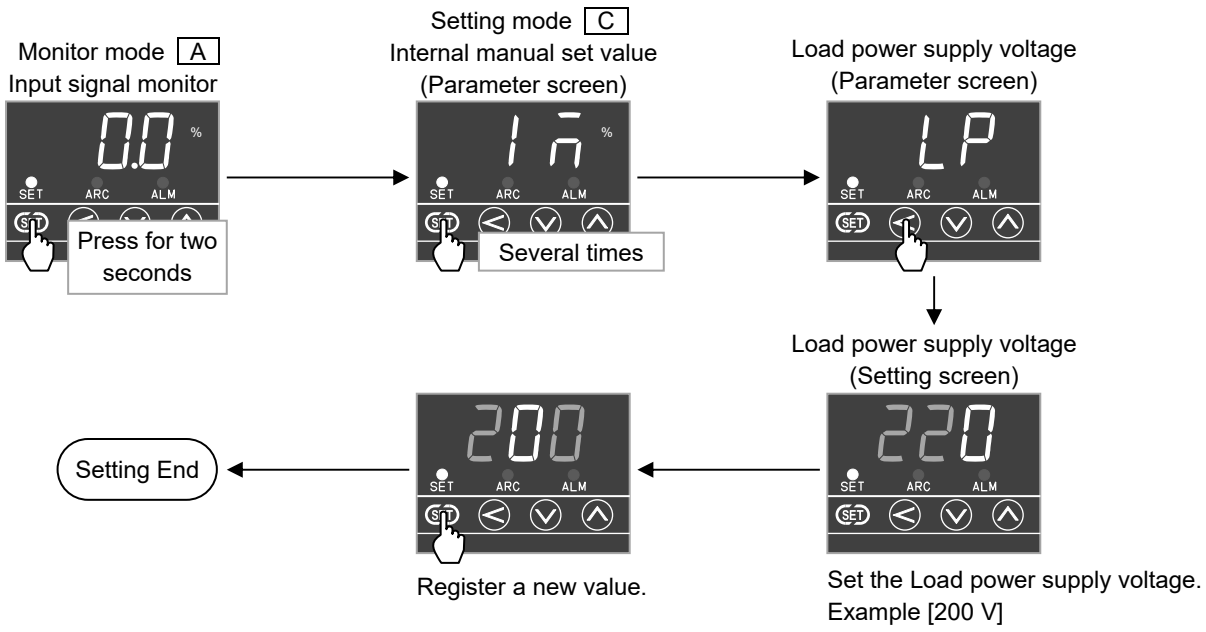
1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.3 screen appears.



When the Output mode for phase control (oS) is the Power proportional control

When using power proportional control, make sure to set "Load power supply voltage (LP)".

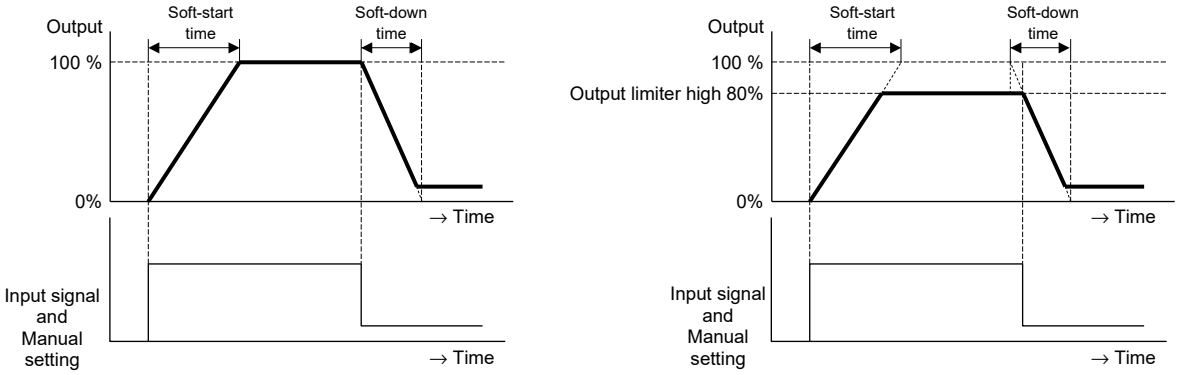
☞ Set value of Setting mode [C] cannot be adjusted when the set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.



8.5 Ramp Function (Soft-Start/Soft-Down Function)

8.5.1 Description of function

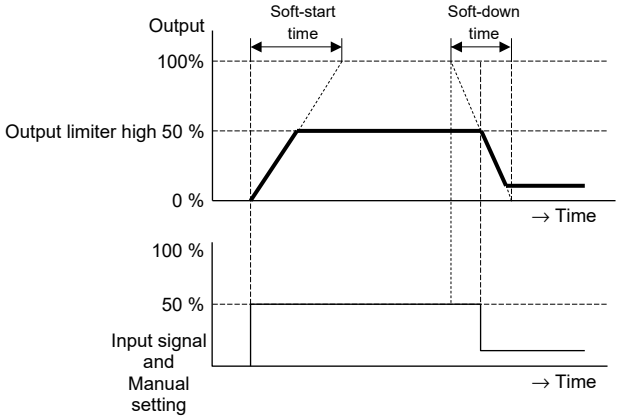
Soft-start/Soft-down function gradually ramps up/down the output (phase angle) to the demand level over the set time to prevent a sudden change in load or voltage. The Soft-start/Soft-down time sets a period of time from 0 % to 100 % or 100 % to 0 %.



Soft-start and Soft-down operation chart

Example: Soft-start and soft-down operation when output is set to 50 %

When the output is set to 50%, it will reach output 50% in half of the time of the Soft-start and Soft-down time that is set.



NOTE

- If a load generating a large rush current is used, thyristor break-down may occur if no appropriate Soft-start time is set.
  (When the Heater break alarm or Non-linear resistance heater break alarm is used)
- In case of Power frequency error and Over current alarm, the output of this instrument may be turned off without the Soft-down function being activated. Also, even if the Power frequency error or Over current alarm is cleared and the instrument is automatically reset, the Soft-start function will not be activated when the output of the instrument is turned on.

8.5.2 Setting contents

● Soft-start time (SU) [Setting mode C]

Set the time for the output (phase angle) to go from 0% to 100% within the range 0.0 to 199.9 seconds.

Parameter symbol	Setting range	Factory set value
SU	0.0 to 199.9 seconds (0.0: Soft-start function unused)	0.1

- When the Control method is Zero-cross control, Soft-start/Soft-down function is not activated.
- When the control method is switched from Phase control to Zero-cross control during Soft-start or Soft-down function, Soft-start/Soft-down process will not be performed. When the control method is switched from Zero-cross control to Phase control, the Soft-start/Soft-down process will be performed.
- Even when Soft-start time is set to “0.0: Soft-start function unused", the Soft-start function operates when one of the following functions is used. When the output is switched to ON from OFF state, the Soft-start function operates for 0.1 second to calculate the maximum phase angle.
  - When using with Constant current control
  - When using the Current limit function
- Soft-start/Soft-down function can be enabled/disabled by the parameter or the Contact input.
- Activation of Soft-start function is selectable (active/inactive at the time of switching the mode from STOP to RUN by the RUN/STOP function of this instrument).
  For details of setting method, refer to **P. 8-21, P. 8-24.**

Caution for using Protection function for control of primary side of a transformer

Action of Soft-start time (SU) depends on the setting (enable/disable) of Protection function for control of primary side of a transformer. When Protection function for control of primary side of a transformer is enabled, the action of the Soft-start time (SU) becomes as follows.

- When soft-start time (SU) is set to 0.0 seconds, Soft-start function is operated for 0.1 seconds.
- Even when Soft-start/Soft-down enable/disable is selected to “0: Disable” or “1: Enable (Except switching from STOP to RUN)," the action becomes the same as that for "enable." However, when Soft-start time (SU) is set to 0.0 seconds, Soft-start function is operated for 0.1 seconds.
- Even if Soft-start and Soft-down functions are selected to "Disable" by the Contact input (DI), the action of the Soft-start time (SU) becomes the same as that for "Enable." However, when Soft-start time (SU) is set to 0.0 seconds, Soft-start function is operated for 0.1 seconds.

● Soft-down time (Sd) [Setting mode C]

Set the time for the output (phase angle) to go from 100 % to 0 % within the range 0.0 to 199.9 seconds.

Parameter symbol	Setting range	Factory set value
Sd	0.0 to 199.9 seconds (0.0: Soft-down function unused)	0.1

When the Control method is Zero-cross control, Soft-start/Soft-down function is not activated.

When the control method is switched from Phase control to Zero-cross control during Soft-start or Soft-down function, Soft-start/Soft-down process will not be performed. When the control method is switched from Zero-cross control to Phase control, the Soft-start/Soft-down process will be performed.

Soft-start/Soft-down function can be enabled/disabled by the parameter or the Contact input.

● Soft-start, Soft-down enable/disable (SF) [Engineering mode D : Function block 2 (F.2)]

This setting is used to enable or disable the Soft-start function and Soft-down function. The Soft-start function and Soft-down function can be disabled without changing the Soft-start time or Soft-down time.
It is selectable to enable/disable the Soft-start and the Output limiter high at operation start at the time of switching the instrument from STOP to RUN.

Parameter symbol	Setting range	Factory set value
SF	0: Disable 1: Enable (Except when switching from STOP→RUN) 2: Enable	2

Even if the Soft-start, Soft-down enable/disable (SF) is set to “0: Disable” when the Protection function for control of primary side of a transformer is set to “Enable,” the Soft-Start and Soft-Down functions will not be disabled.

■ Explanation of Soft-start, Soft-down enable/disable (SF) set value

The actions of Soft-start, Soft-down, and the Output limiter high at operation start occur as follows, depending on the set value.

When Protection function for control of primary side of a transformer is not supplied or when it is disabled.

ON Active OFF: Inactive

Set value	Changes made	Soft-start	Soft-down	Output limiter high at operation start
0: Disable	Auto set value was changed	OFF	OFF	
	Manual set value was changed	OFF	OFF	
	Switched from STOP to RUN	OFF		OFF *
1: Enable (Except when switching from STOP→ RUN)	Auto set value was changed	ON	ON	
	Manual set value was changed	ON	ON	
	Switched from STOP to RUN	OFF		OFF *
2: Enable	Auto set value was changed	ON	ON	
	Manual set value was changed	ON	ON	
	Switched from STOP to RUN	ON		ON

* The action of the Output limiter high at operation start remains on when the instrument is powered.

When Protection function for control of primary side of a transformer is supplied and when it is set enabled.

ON Active OFF: Inactive

Set value	Changes made	Soft-start	Soft-down	Output limiter high at operation start
0: Disable	Auto set value was changed	ON	ON	
	Manual set value was changed	ON	ON	
	Switched from STOP to RUN	ON		OFF
1: Enable (Except when switching from STOP→ RUN)	Auto set value was changed	ON	ON	
	Manual set value was changed	ON	ON	
	Switched from STOP to RUN	ON		OFF
2: Enable	Auto set value was changed	ON	ON	
	Manual set value was changed	ON	ON	
	Switched from STOP to RUN	ON		ON

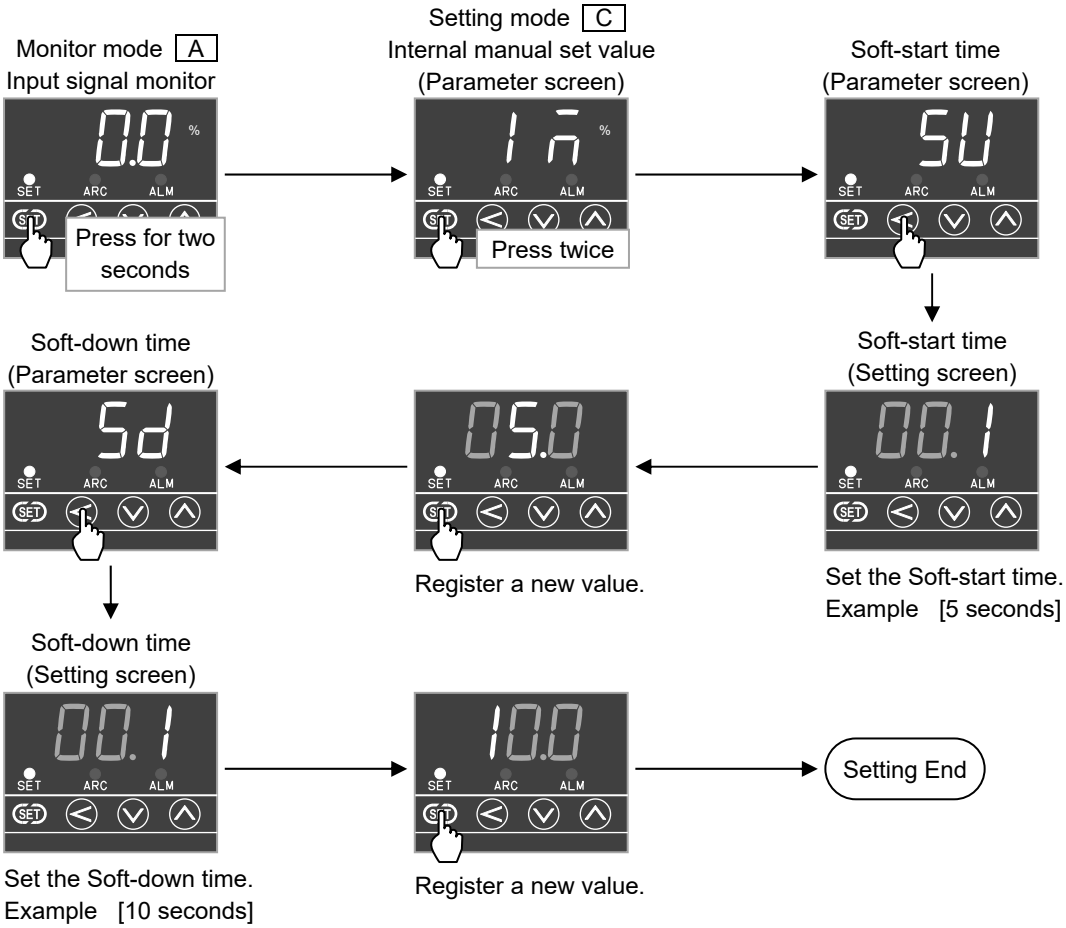
When the Soft-Start time is set to 0.0, the Soft-Start function is disabled in any conditions in the above table.

When the Soft-Down time is set to 0.0, the Soft-Down function is disabled in any conditions in the above table.

8.5.3 Setting procedure

☞ Set value of Setting mode [C] cannot be adjusted when the set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

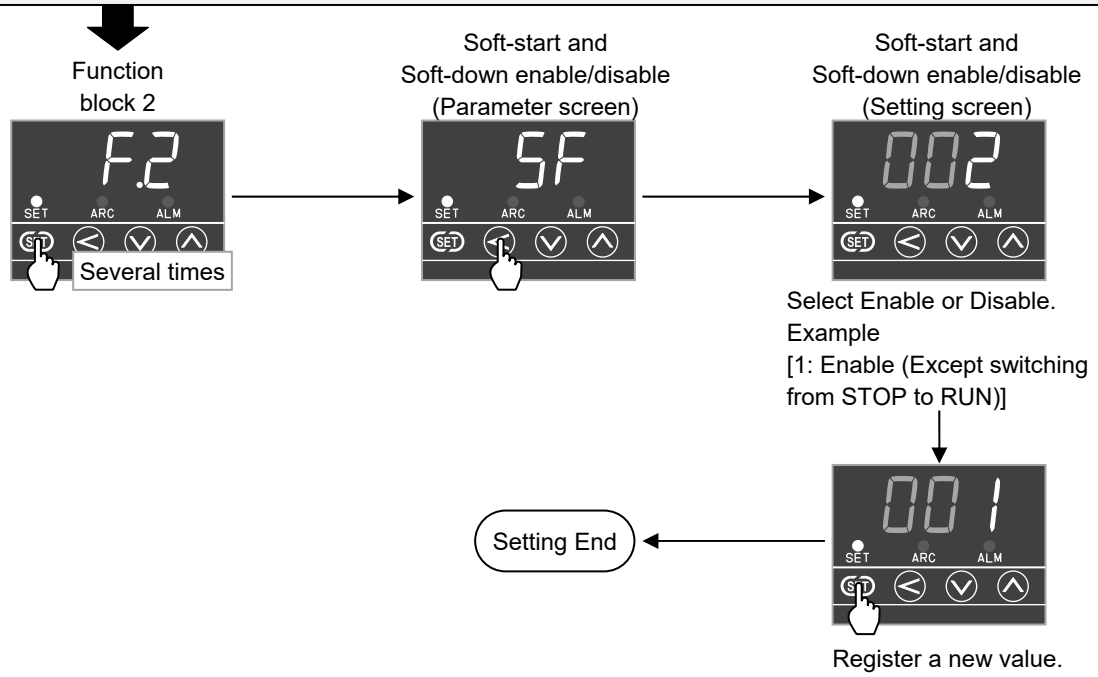
Setting operation of Soft-start and Soft-down time



Setting operation of Soft-start, Soft-down enable/disable (SF)

☞ The Engineering mode [D] is not displayed when Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23).**

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.2 screen appears.



8.6 Minimum Output Phase Angle Adjustment Function

Minimum output phase angle adjustment function is used in the following cases. This function need not be set when the instrument is working normally. Use the instrument at the factory set value.

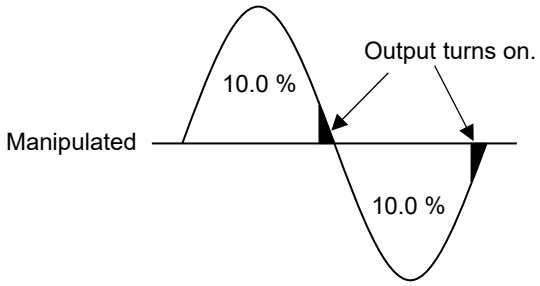
– When the output of this instrument is misfiring due to the distortion of the power supply waveform
– When you want to turn off the output of a small output phase angle

8.6.1 Description of function

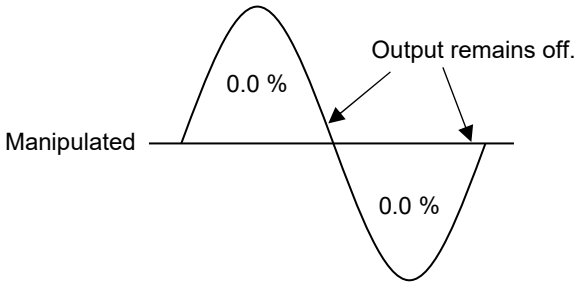
The output just before the zero-cross point can be adjusted in the range of 5.0 to 15.0% of the Output phase angle. When the Output phase angle is less than the setpoint of the Minimum output phase angle adjustment (Mo), the Manipulated output value will be 0%.

Example: When the set value of Minimum output phase angle adjustment (Mo) is set to 10.0%

When the manipulated output value (phase angle ratio) is 10.0%



When the manipulated output value (phase angle ratio) is 9.9%



8.6.2 Setting contents

- **Minimum output phase angle adjustment (Mo)**
  [Engineering mode D : Function block 3 (*F. 3*)]

Parameter symbol	Setting range	Factory set value
⁻ no	Output phase angle 5.0 to 15.0 %	5.0

The minimum output phase angle adjustment function will not be influenced by the output mode. Adjustment is performed by the phase angle regardless of the output mode.

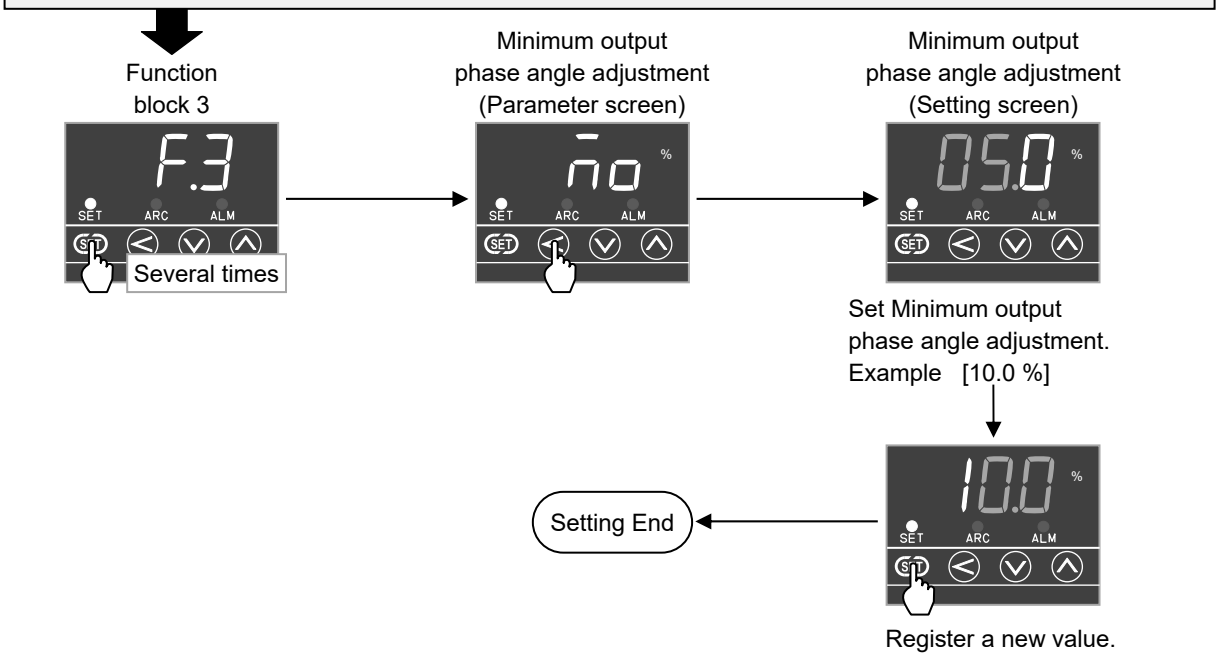
Whichever input type (control input, external manual setting, internal manual set value, external gradient setting or internal gradient set value) is used to set the manipulated output value, the minimum output phase angle adjustment function is valid.

The Minimum output phase angle adjustment function is disabled in the case of Zero-cross control.

8.6.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.3 screen appears.



8.7 Retransmission Output (AO)

You can output the retransmission signal of continuous voltage output of 0 to 10 V DC from the retransmission output (AO) connector.

8.7.1 Description of function

This function outputs any of the Manipulated output value, CT input monitor, and power value monitor with a retransmission signal of 0 to 10 V DC. The retransmission output (AO) scale high and scale low can also be set. It can also be used by connecting to an analog voltmeter.

■ Retransmission output (AO) type

● Manipulated output value

Control output (Phase angle ratio value) can be output from the retransmission signal.

Example: When the Output mode is Proportional phase angle to input, and when using the retransmission output (AO) of Manipulated output value (When the gradient is 100%)

Manipulated output value 0 % (Phase angle 0 degree): Retransmission output (AO) = 0 V
Manipulated output value 50 % (Phase angle 90 degree): Retransmission output (AO) = 5 V
Manipulated output value 100 % (Phase angle 180 degree): Retransmission output (AO) = 10 V

● CT input monitor value

You can output the measured effective current value with retransmission signal. Range of the effective current value is from 0 up to the rated current of the instrument.

Example: When doing retransmission output (AO) of CT input monitor value by using THV-10 of rated current 20 A

Measured CT input monitor value 0 A: Retransmission output (AO) = 0 V
Measured CT input monitor value 10 A: Retransmission output (AO) = 5 V
Measured CT input monitor value 20 A: Retransmission output (AO) = 10 V

● Power monitor value

You can output the effective power value with retransmission signal. Range of the effective power value is from 0 up to "Load power supply voltage value × Rated current of the instrument × 0.5".

Example: When doing retransmission output (AO) of power monitor value by using THV-10 of rated current 20 A with load voltage value = 200 V setting.

Measured power monitor value 0 kW: Retransmission output (AO) = 0 V
Measured power monitor value 1 kW: Retransmission output (AO) = 5 V
Measured power monitor value 2 kW: Retransmission output (AO) = 10 V

■ Action when an alarm occurs

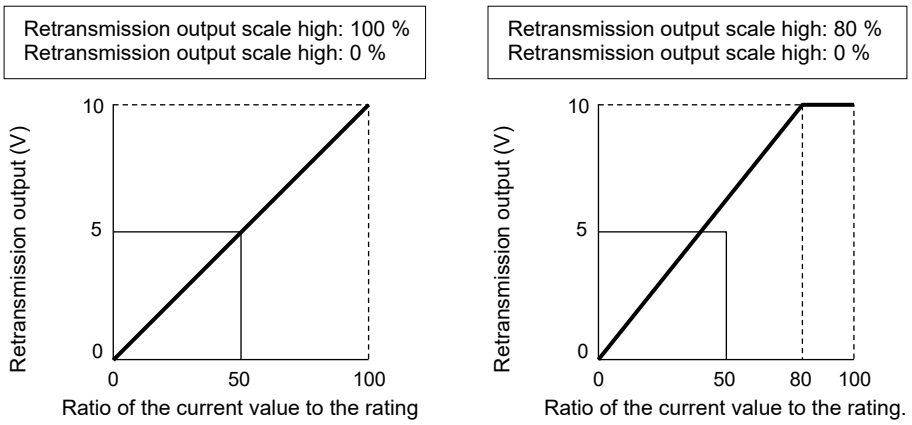
Alarm type	Action
Heater break alarm 1, 2	Continue Retransmission output
Thyristor break-down alarm 1, 2	
Power frequency error	Retransmission output OFF
Over current alarm	
FAIL	

■ Retransmission output scale high/low

Manipulated output value or the monitor value scale can be set in the range of 0 to 100 %. Set it when using in a smaller range than 0 to 100 %.

Example: When the rated current of THV-10 is 20 A and the maximum load current of the heater is 16 A, and when setting the retransmission signal to 10 V while 16 A of current is flowing through the heater

Setting the Retransmission output scale high to 80 %.
Measured CT input monitor value 0 A: Retransmission output = 0 V
Measured CT input monitor value 8 A: Retransmission output = 5 V
Measured CT input monitor value 16 A: Retransmission output = 10 V



8.7.2 Setting contents

● Retransmission output type (Ao)
[Engineering mode D : Function block 8 (F. 8)]

Parameter symbol	Setting range	Factory set value
Ao	0: No retransmission output (AO) 1: Manipulated output value 2: CT input monitor (Optional) 3: Power value monitor (Optional)	Based on model code

● Retransmission output scale high (AHS)
[Engineering mode D : Function block 8 (F. 8)]

Parameter symbol	Setting range	Factory set value
AHS	0.0 to 100.0 % (Retransmission output scale high ≥ Retransmission output scale low)	100.0

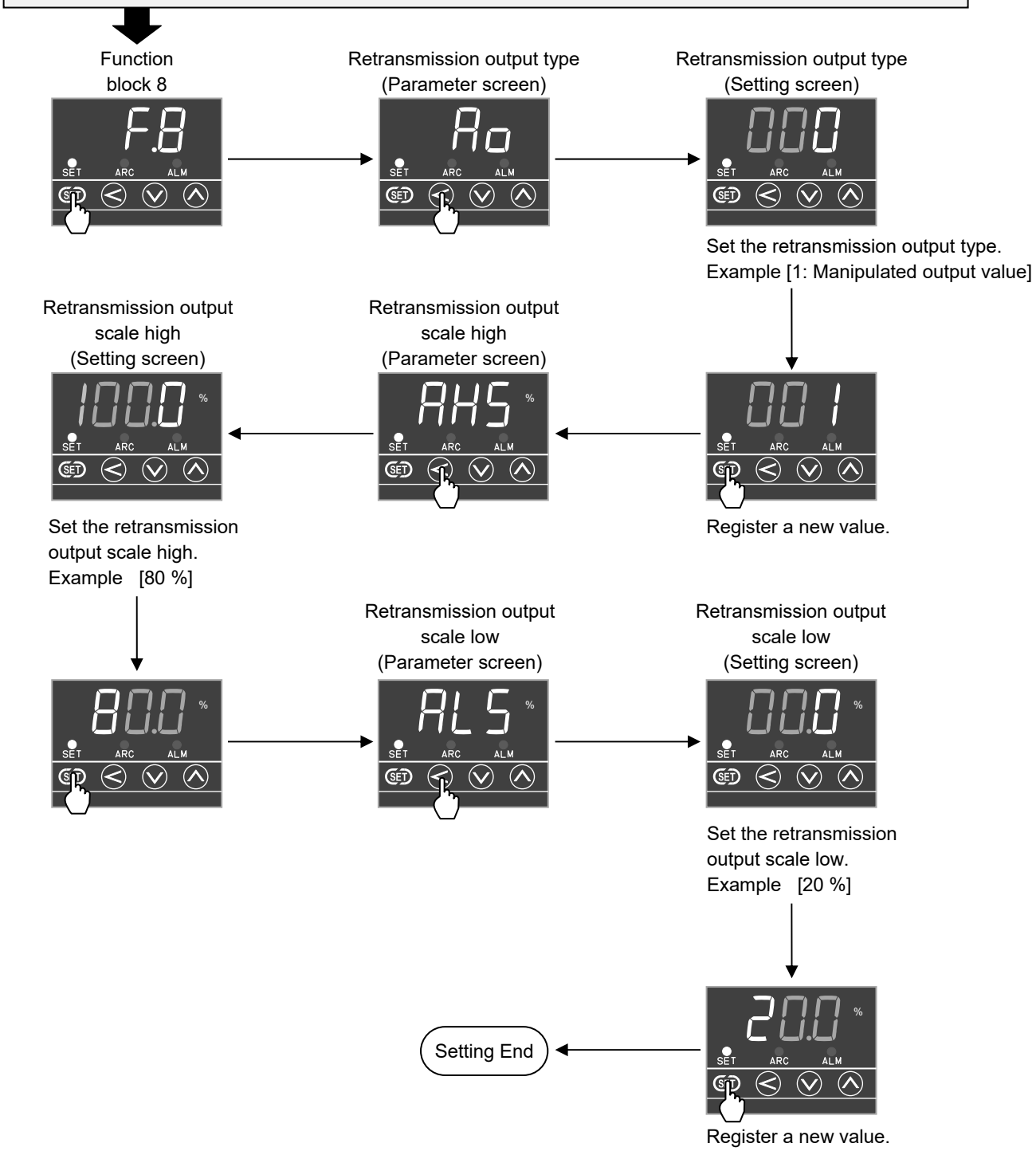
● Retransmission output scale low (ALS)
[Engineering mode D : Function block 8 (F. 8)]

Parameter symbol	Setting range	Factory set value
ALS	0.0 to 100.0 % (Retransmission output scale high ≥ Retransmission output scale low)	0.0

8.7.3 Setting procedure

☞ The Engineering mode [D] is not displayed when Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.8 screen appears.



8.8 Current Limit Function

8.8.1 Description of function

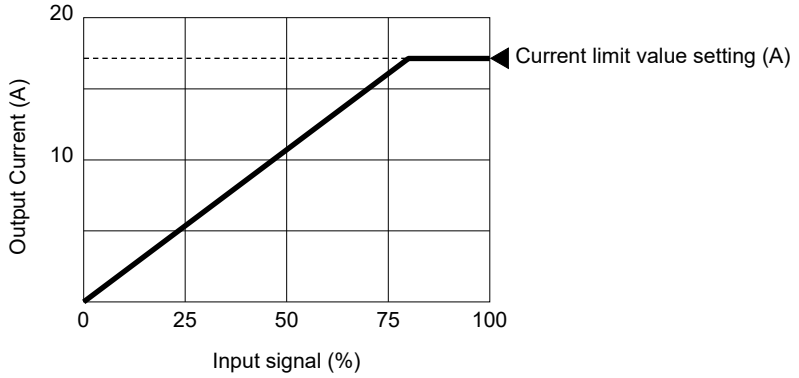
This is the function of limiting an output current to a value not exceeding the preset current limit value. A current value is measured for each constant cycle and then the maximum phase angle not exceeding the current limit value is calculated from the above current value thus measured. If the phase angle at that current output is larger than the maximum phase angle calculated, the current is output at the maximum phase angle to restrict that current. The maximum phase angle is calculated during a time period of 0.1 seconds after the power is turned on. The Current limit function is activated after the maximum phase angle is calculated.

NOTE

If a load through which large rush current flows is used, the Current limit function cannot restrict the above current. In this case, use the Current limit function together with the Soft-start function.

- Even if the Soft-start time is set to 0.0 second or if the Soft-start function is disabled, the Soft-start function may work for 0.1 second after power has been applied in order to calculate the maximum phase angle.
- When the calculated maximum phase angle is smaller than the value set in the Minimum output phase angle adjustment (Mo), the current is limited with the set value set in the Minimum output phase angle adjustment (Mo).
- The Current limit function cannot be used when Zero-cross control is selected.

Example: 20 A type



8.8.2 Setting contents

- **Current limit value setting (CL)**
  [Setting mode C]

NOTE

If a load through which large rush current flows is used, the Current limit function cannot restrict the above current. In this case, use the Current limit function together with the Soft-start function.

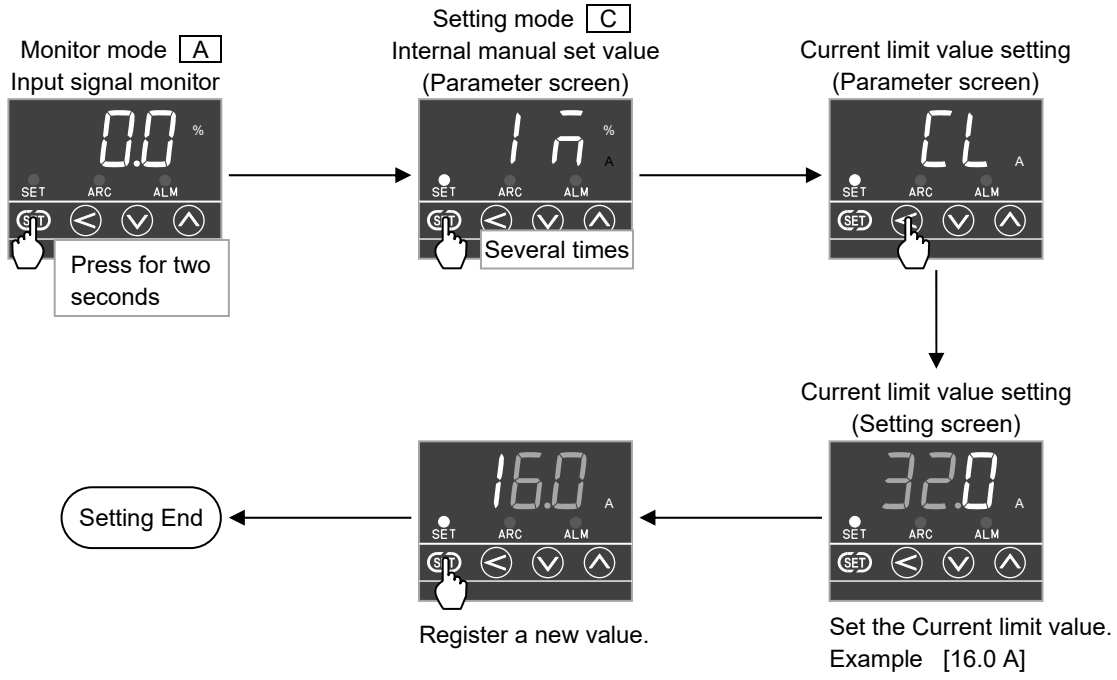
Parameter symbol	Setting range	Factory set value
CL	0.0 to 32.0 A (20 A type)	32.0
	0.0 to 32.0 A (30 A type)	32.0
	0.0 to 55.0 A (45 A type)	55.0
	0 to 70 A (60 A type)	70
	0 to 90 A (80 A type)	90
	0 to 110 A (100 A type)	110

If the Current limit value is set to its maximum value, the Current limit function is disabled. Factory set value is deactivation state.

Current limit value setting screen appears when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

8.8.3 Setting procedure

Set value of Setting mode C cannot be adjusted when the set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.



8.9 Base-Up Setting Function

Even when the temperature controller is stopped, if you want to have the heater preheated, you can use the base-up setting function. When it takes time to increase the temperature of the load, you can shorten it by having the heater preheated.

8.9.1 Description of function

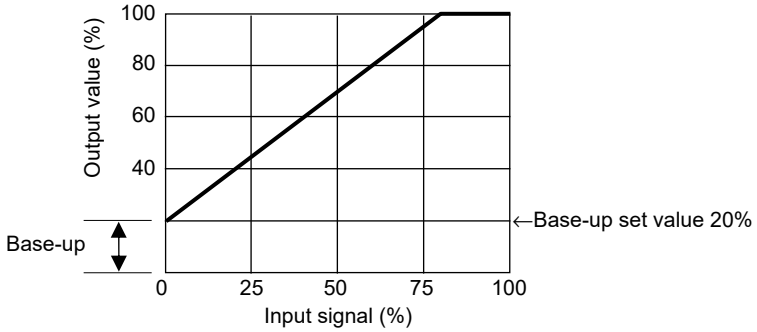
Base-up setting function adds positive bias to the output value calculated with Gradient setting function.

Calculation formula:

Output = Input signal * + Base-up set value

* The input signal is the value selected by Input signal transfer (dA) and Manual mode transfer (AM), which is processed for gradient setting.

Example: Base-up set vale 20 %



8.9.2 Setting contents

- **Base-up set value (bU)**
  [Engineering mode D : Function block 3 (F. 3)]

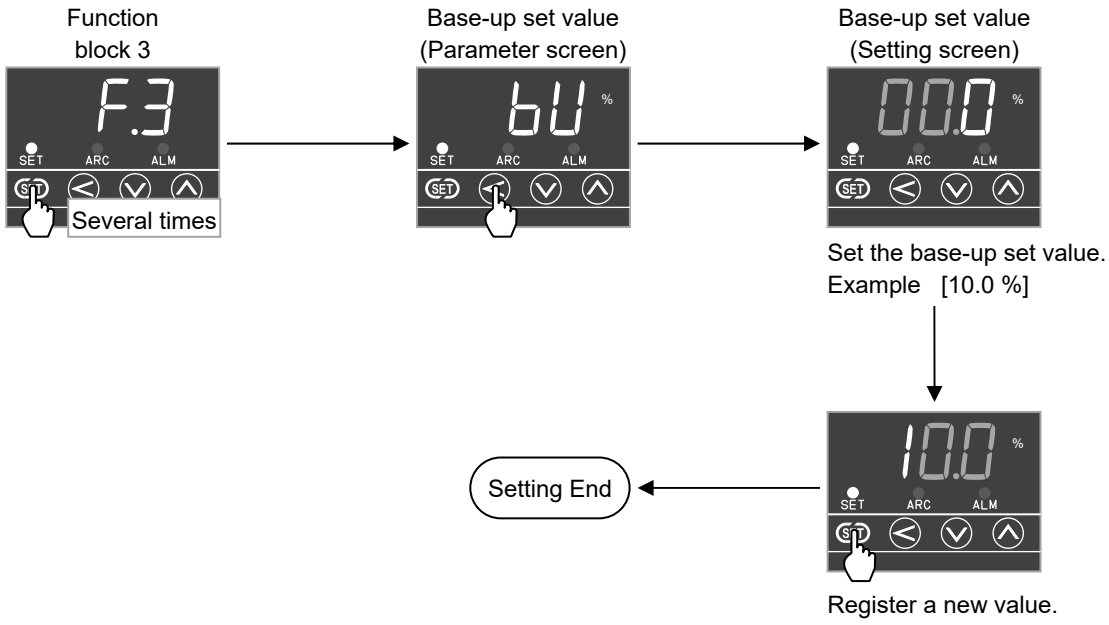
Parameter symbol	Setting range	Factory set value
bU	–9.9 to +100.0 %	0.0

- The Base-up set value will not exceed the Output limiter high.
- The Base-up set value is effective only when the Output limiter low is set to 0.0.
- If Zero-cross control (input synchronous type) is used, the Base-up function is not activated.
- If the instrument is transferred to “STOP,” the Base-up setting function is not activated.

8.9.3 Setting procedure

☞ The Engineering mode [D] is not displayed when Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.3 screen appears.



8.10 Protection Function for Control of Primary Side of a Transformer

8.10.1 Description of function

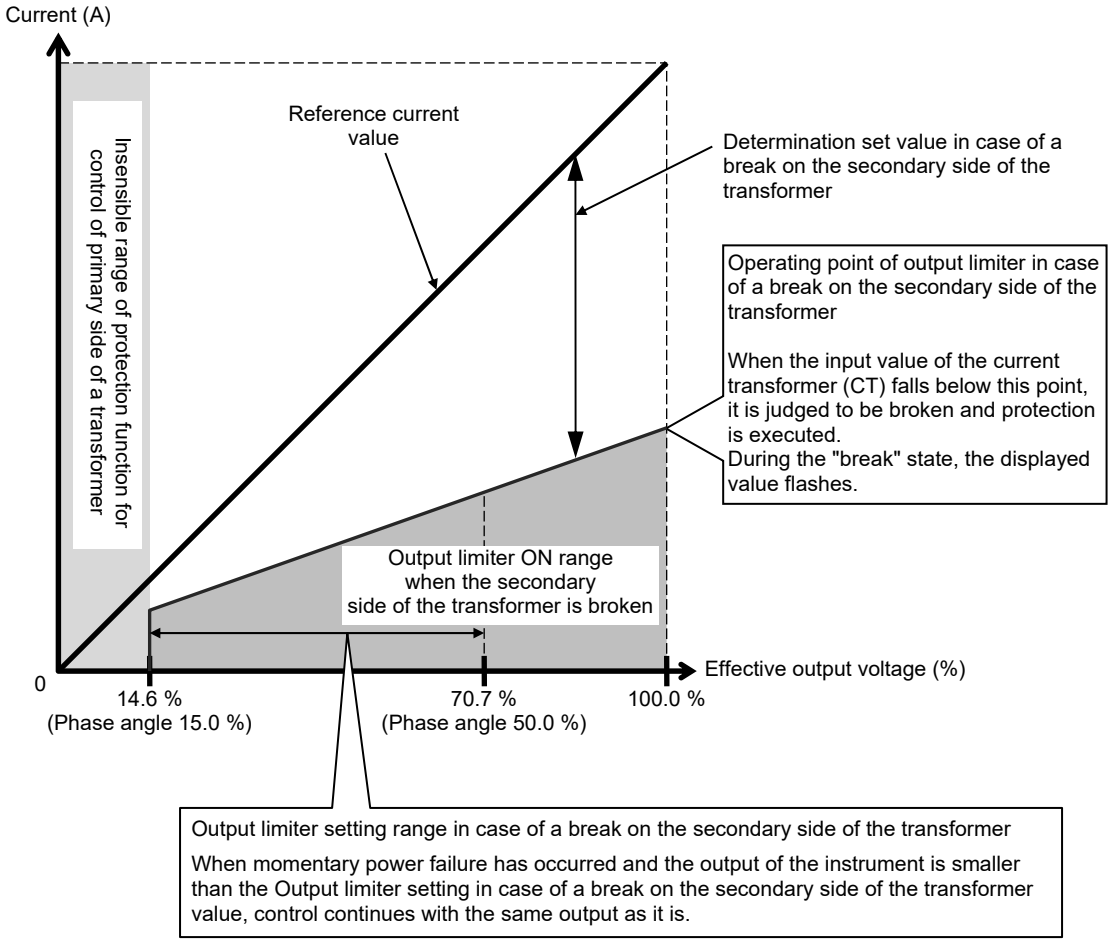
If momentary power failure occurs during execution of the control of primary side of a transformer, inrush current is generated. Protection function for control of primary side of a transformer is to protect the thyristor from the inrush current.

With this protection function enabled, when momentary power failure occurs, the instrument determines that the secondary side of a transformer was disconnected and suppresses the output. When the instrument is automatically reset from the breakdown (momentary power failure), the soft-start function suppresses the inrush current.

To use this protection, the following parameters need to be set.

Protection function for control of primary side of a transformer (ΓF)
Determination set value in case of a break on the secondary side of the transformer (ΓA)
Output limiter setting in case of a break on the secondary side of the transformer (ΓL)
Soft-start time in case of break on the secondary side of the transformer (ΓU)

Operation chart



■ Determination of break and release of secondary side of transformer

• Determination of break

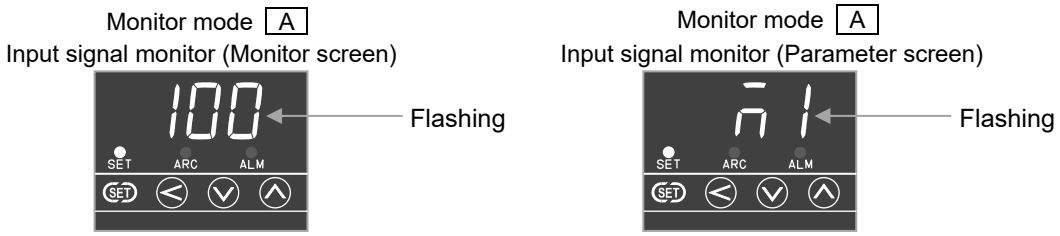
While control of primary side of a transformer is executed, if the current transformer (CT) value goes below the determination set value in case of a break on the secondary side of the transformer, it is judged to be a break (momentary power failure). Below is a formula to convert the Determination set value in case of a break on the secondary side of the transformer (TA) into the current value (A).
Current value [A] = Maximum load current set value [A] × Effective output voltage [%] × (100 % – Determination set value in case of a break on the secondary side of the transformer [%])

• Determination of release

While the phase angle is 15 % or more, if the current goes over the Determination set value in case of a break on the secondary side of the transformer by 0.3 A (instrument of 60 A or more: 1 A), it is judged to be a recovery from a break (momentary power failure).

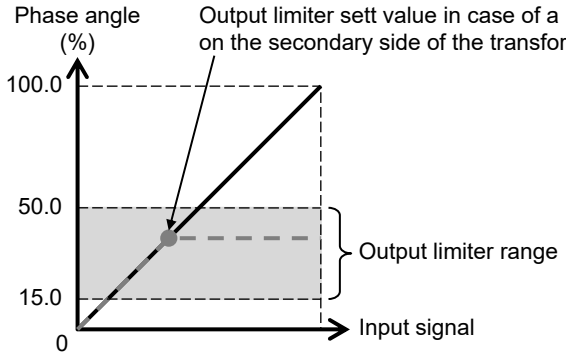
Display in case of break of secondary side of the transformer

When the CT input value goes below the Determination set value of the break on the secondary side of the transformer, the parameter symbol and the value on the display will flash. (Parameter symbols and displayed values in Monitor mode [A] will flash) When the instrument is automatically released from the break (momentary power failure), the display stops flashing and remains lit.



Output limiter setting in case of a break on the secondary side of the transformer

This is a function to limit the phase angle between 15.0 % and 50. 0 % when the signal goes below the Determination set value in case of a break on the secondary side of the transformer. It limits the output of the instrument by restricting the phase angle.



Soft-start function in case of break on the secondary side of the transformer

This is a soft-start function which is activated when the instrument is automatically released from the break (momentary power failure) of the secondary side of the transformer. This function suppresses an abrupt change by the inrush current at the time of automatic recovery from the break (momentary power failure).

While the soft-start function of the Soft-start time (SU) is working, if break (momentary power failure) of secondary side of a transformer occurs, Protection function for control of primary side of a transformer starts working to suppress the output.
When released from the break (momentary power failure), the instrument changes the output according to the Soft-start time in case of break on the secondary side of the transformer (TU). After elapse of the Soft-start time in case of break on the secondary side of the transformer (TU), the Soft-start time (SU) takes over, and output is changed in the remaining time of the Soft-start time (SU).

8.10.2 Setting contents

● Protection function for control of primary side of a transformer (TF) [Engineering mode D : Function block 7 (F. 7)]

Use to enable/disable Protection function for control of primary side of a transformer.
When conducting control of primary side of a transformer, make sure to set to "1: Protection function for control of primary side of a transformer enable".

Parameter symbol	Setting range	Factory set value
rF	0: Protection function for control of primary side of a transformer disable 1: Protection function for control of primary side of a transformer enable	0

📖 Protection function for control of primary side of a transformer is optional. (Specify when ordering)

Protection function for control of primary side of a transformer can be used with Heater break alarm or Non-linear resistance heater break alarm.

● Determination set value in case of a break on the secondary side of the transformer (TA) [Engineering mode D : Function block 7 (F. 7)]

This is a setting to determine if break (momentary power failure) occurred on the secondary side of the transformer. This parameter is used for Protection function for control of primary side of a transformer. When Protection function for control of primary side of a transformer is set to "1: Protection function for control of primary side of a transformer enable," this determination function for break of secondary side of a transformer is enabled.

Parameter symbol	Setting range	Factory set value
rA	0 to 100 % of reference current value	70

📖 This function is available on the instrument with a Protection function for control of primary side of a transformer.

● Output limiter setting in case of a break on the secondary side of the transformer (TL) [Engineering mode D : Function block 7 (F. 7)]

Use to set output limiter to suppress control output in case of a break (momentary power failure) on the secondary side of the transformer. This parameter is used for Protection function for control of primary side of a transformer. Setting the Protection function for control of primary side of a transformer to "1: Protection function for control of primary side of a transformer enable," the Output limiter function for break of secondary side of a transformer is enabled.

Parameter symbol	Setting range	Factory set value
rL	15.0 to 50.0 % of phase angle	15.0

📖 When the instrument is automatically recovered from break on the secondary side of a transformer (momentary power failure), the output limiter for a break of secondary side of a transformer will be released.

📖 This function is available on the instrument with a Protection function for control of primary side of a transformer.

● Soft-start time in case of break on the secondary side of the transformer (TU) [Engineering mode D : Function block 7 (F. 7)]

Use to set the Soft-start time when the instrument is recovered from a break (momentary power failure) on the secondary side of a transformer. This Soft-start function is only activated when the instrument is recovered from a break on the secondary side of a transformer.
This parameter is used for Protection function for control of primary side of a transformer. When Protection function for control of primary side of a transformer is set to "1: Protection function for control of primary side of a transformer enable," this Soft-start function for break of secondary side of a transformer is enabled.

Parameter symbol	Setting range	Factory set value
TU	0.1 to 100.0 seconds	0.1

This function is available on the instrument with a Protection function for control of primary side of a transformer.

8.10.3 Setting procedure

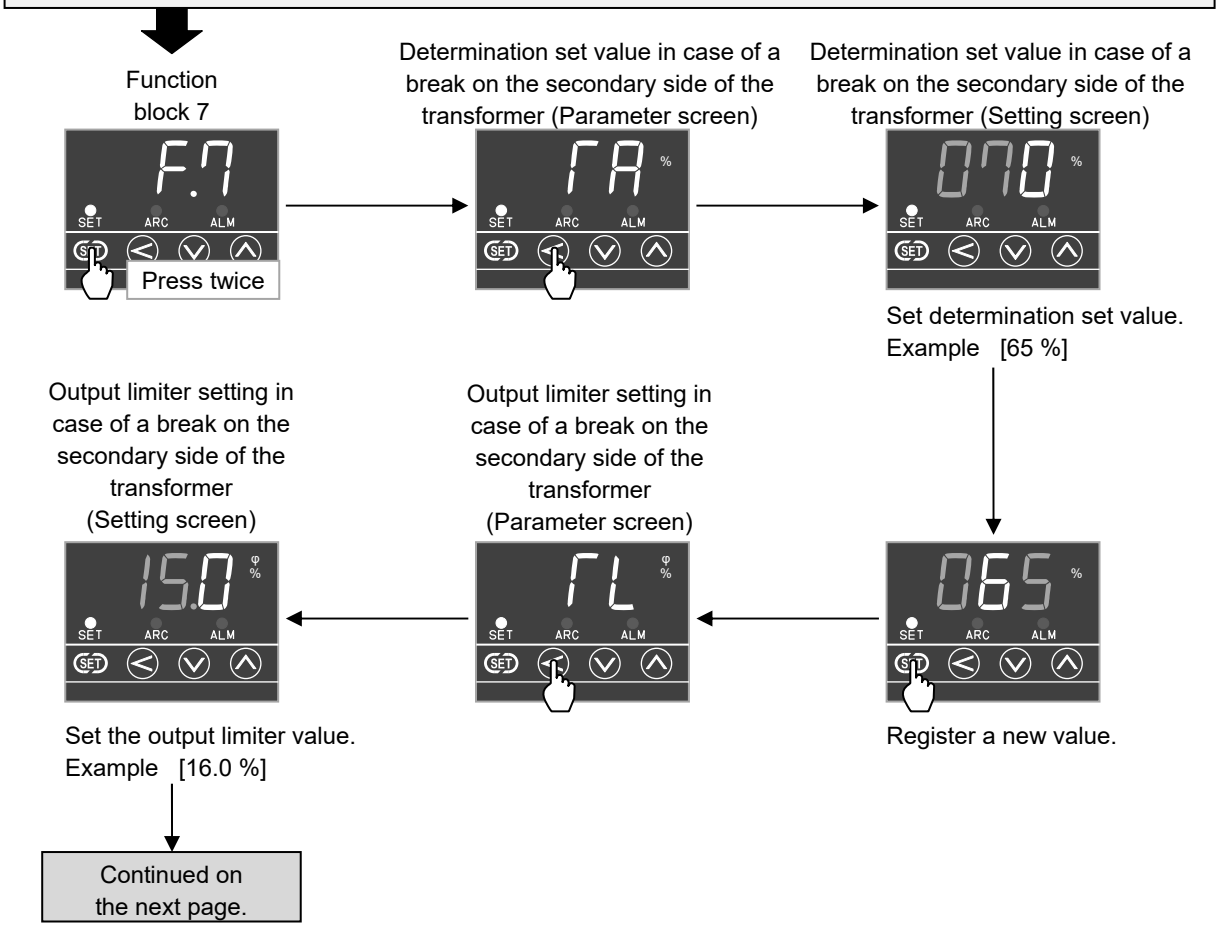
The following parameters need to be adjusted to suit your system.
(If the factory set values satisfy the requirements, they can be used as they are)
After having the following parameters properly adjusted, enable the protection function for control of primary side of a transformer.

Parameters:

- Determination set value in case of a break on the secondary side of the transformer (rA)
  [Factory set value: 70 % of reference current value]
- Output limiter setting in case of a break on the secondary side of the transformer (rL)
  [Factory set value: 15.0 % of Phase angle]
- Soft-start time in case of break on the secondary side of the transformer (rU)
  [Factory set value: 0.1 seconds]

☞ The Engineering mode [D] is not displayed when Set data lock is active.
"To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.7 screen appears.



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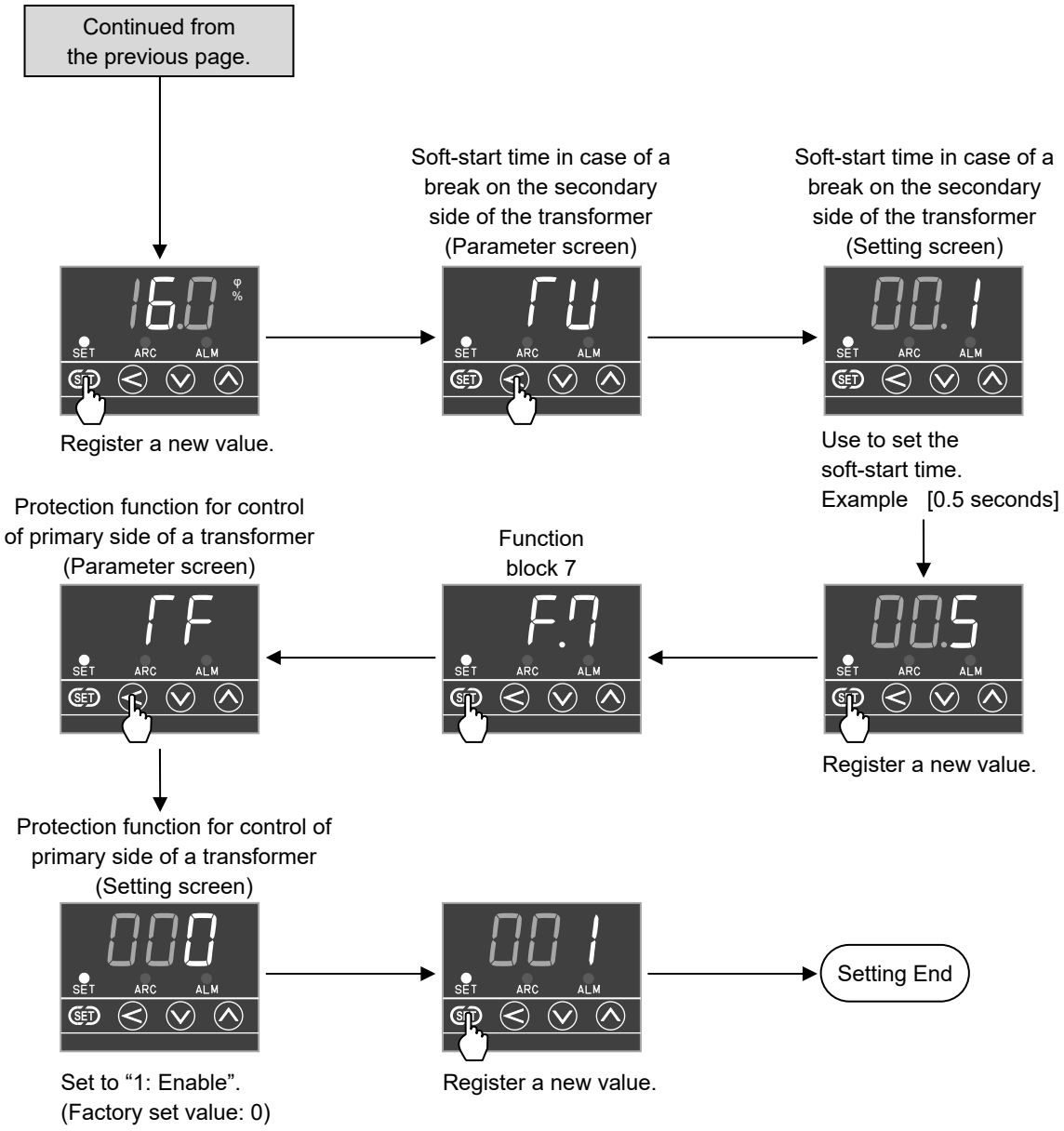

Continued from the previous page.
Soft-start time in case of a break on the secondary side of the transformer (Parameter screen)
Soft-start time in case of a break on the secondary side of the transformer (Setting screen)
Register a new value.
Use to set the soft-start time.
Example [0.5 seconds]
Protection function for control of primary side of a transformer (Parameter screen)
Function block 7
Register a new value.
Protection function for control of primary side of a transformer (Setting screen)
Setting End
Set to “1: Enable”. (Factory set value: 0)
Register a new value.

8.11 RUN/STOP Transfer

8.11.1 Description of function

Use to transfer the mode between RUN and STOP. In the RUN state, the control of the instrument will start. In the STOP state, the output of the instrument turns off.

■ State of each function in RUN/STOP

Contents	State	
	In STOP	In RUN
THV-10 output	Output OFF	Output ON
Heater break alarm[1]	Function is disabled.	Function is enabled.
Non-linear resistance heater break alarm[1]	Function is disabled.	Function is enabled.
Thyristor break-down alarm[1]	Function is enabled.	Function is enabled.
Power frequency monitoring	Function is enabled.	Function is enabled.
Over current alarm[1]	Function is disabled.	Function is enabled.
FAIL	Function is enabled.	Function is enabled.
Output limiter high		Function is enabled.
Output limiter low	Function is disabled.	Function is enabled.
Output limiter high at operation start[1]		Function is enabled.
Base-up setting[1]	Function is disabled.	Function is enabled.
Display off timer[1]	Function is enabled.	Function is enabled.
Ramp function (Soft-start/Soft-down function)[1]	Function is disabled.	Function is enabled.

[1] Provided that the function is enabled, or set such that it is activates.

[2] The function is enabled when Alarm enable/disable during STOP (SA) is set to "1: Enable."

8.11.2 Setting contents

● RUN/STOP transfer (rS)
[Engineering mode D : Function block 2 (F. 2)]

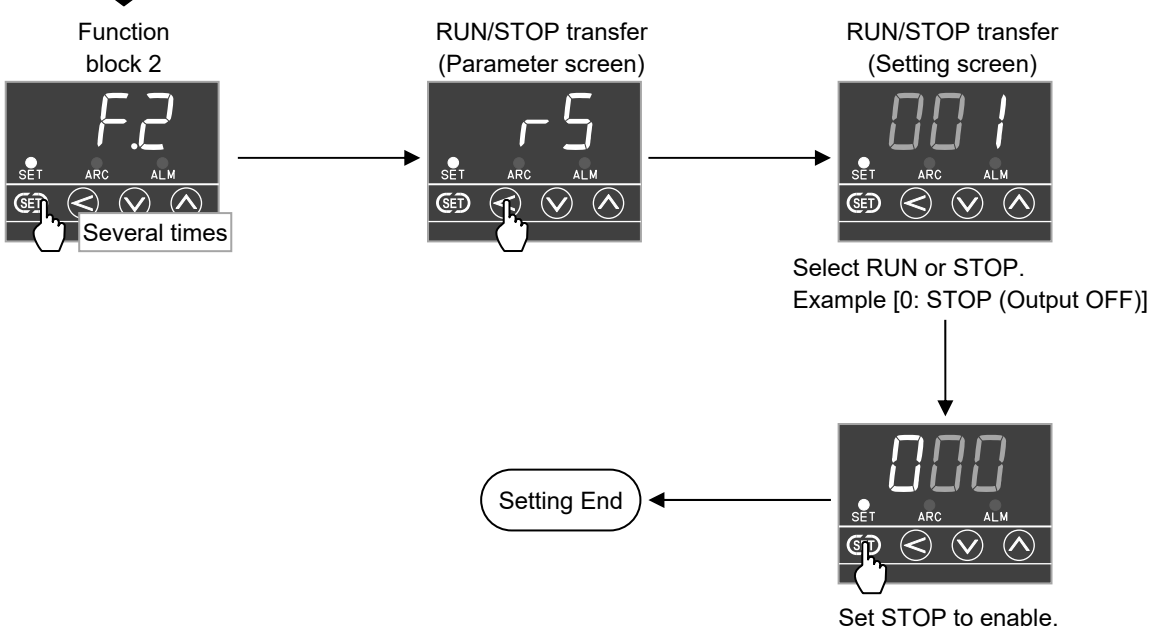
Parameter symbol	Setting range	Factory set value
rS	0: STOP (Output OFF) 1: RUN (Output ON)	1

🕮 If RUN/STOP transfer is set in the Contact input (DI) function assignment (C1), the set value cannot be changed.

8.11.3 Setting procedure

☞ The Engineering mode D is not displayed when Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode A until Setting mode C is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode C until Engineering mode D is displayed.
3. Press the UP key (^) until the F.2 screen appears.

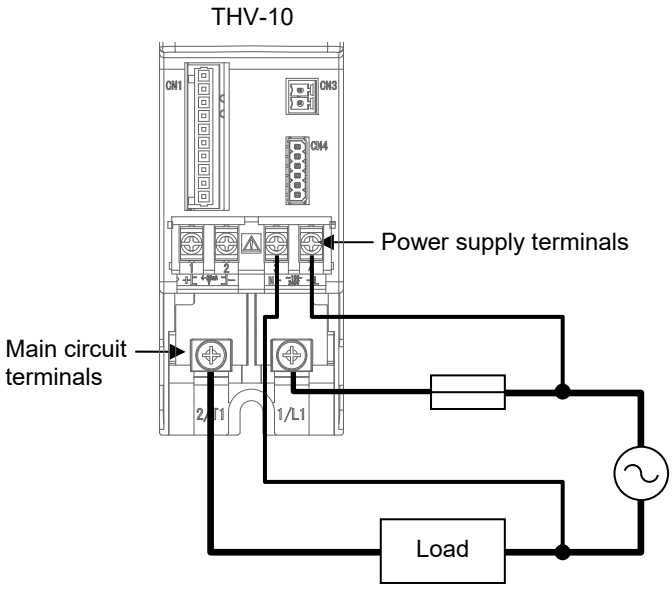


8.12 SCR Trigger Signal Setting

8.12.1 Description of function

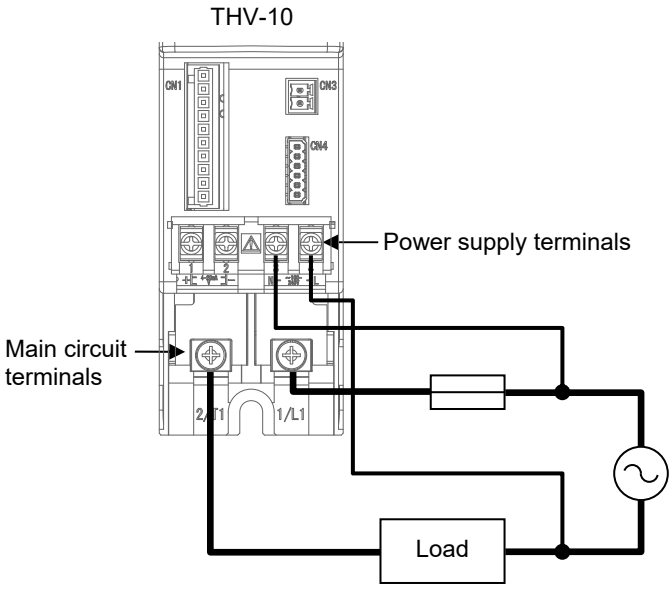
To provide a proper function of the output of this instrument, combination of the main circuit terminal and the power terminal must be properly wired. This is a function to properly output by switching the trigger signal through the setting without re-wiring when combination is incorrectly made.

Trigger signal can be switched using the parameter of SCR trigger signal setting (SC).



Correct wiring combination

- Main circuit terminal (2/T1) and power supply terminal (3)
- Main circuit terminal (1/L1) and power supply terminal (4)



Incorrect wiring combination

- Main circuit terminal (2/T1) and power supply terminal (4)
- Main circuit terminal (1/L1) and power supply terminal (3)

8.12.2 Setting contents

- **SCR trigger signal setting (SC)**
  [Engineering mode D : Function block 3 (F.3)]

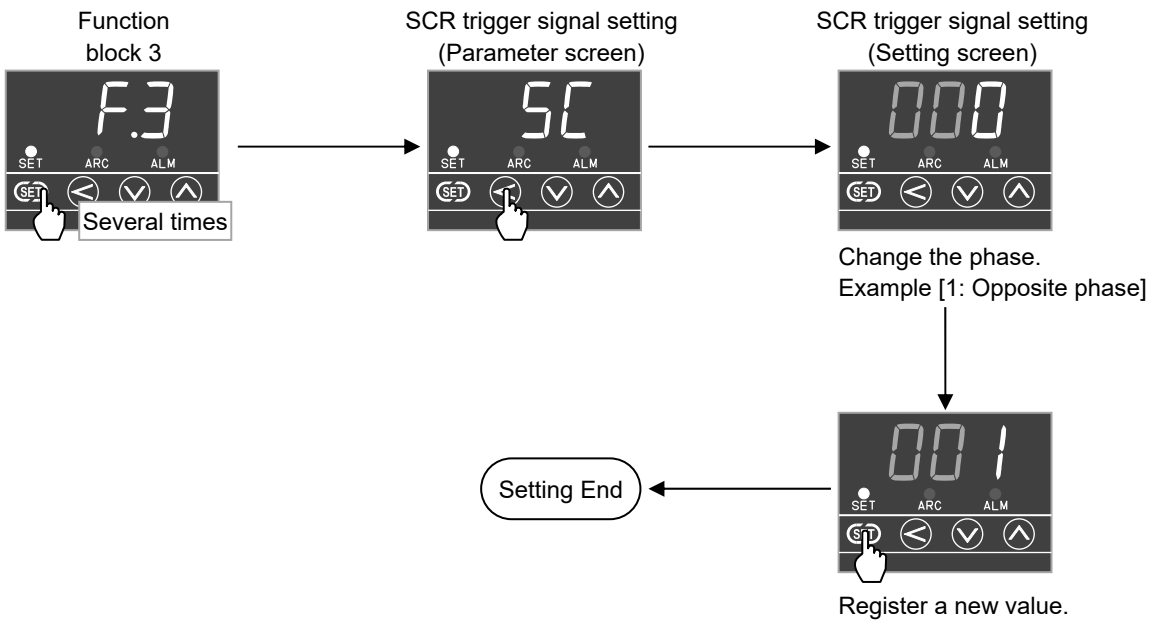
Parameter symbol	Setting range	Factory set value
SC	Phase between the supply voltage for the instrument and the supply voltage for the load 0: Same phase 1: Opposite phase	0

8.12.3 Setting procedure

When changing the SCR trigger signal, change after setting RUN/STOP transfer (rS) of the instrument to STOP.

☞ The Engineering mode D is not displayed when Set data lock is active.
To unlock Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode A until Setting mode C is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode C until Engineering mode D is displayed.
3. Press the UP key (^) until the F.3 screen appears.



MEMO

9 ALARM AND SELF-DIAGNOSIS

This chapter describes alarm and self-diagnosis related functions, setting contents, and setting procedures.

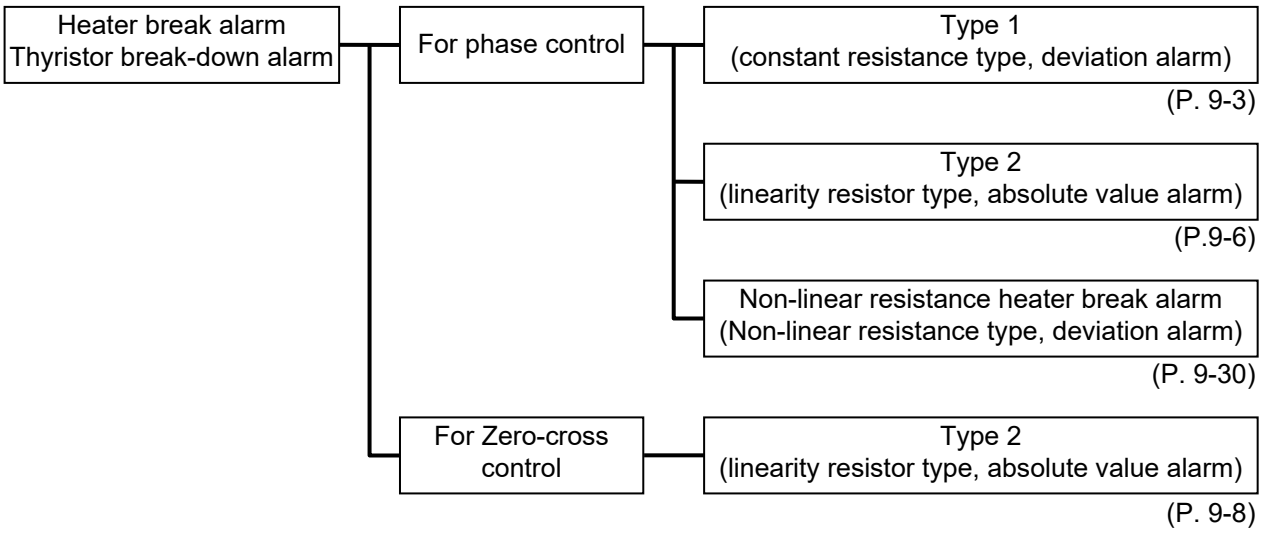
9.1 Heater Break Alarm/Thyristor Break-down Alarm

NOTE

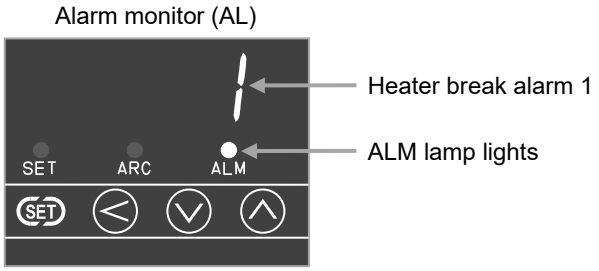
Use the heater break alarm and Thyristor break-down alarm in a system with a current capacity of 10 A or more. Because the error in the current measurement is ±1.5 A (for 20 A and 30 A types) or within ±5 % of the current rating (for 45 A or larger types), the heater break alarm may not function normally if it is used with a small load current value.

9.1.1 Description of function

Heater break alarm/Thyristor break-down alarm measure the current flowing to the load with the current transformer and compare the measured value with the alarm set value. If the measured value is larger or smaller than the alarm set value, the instrument generates alarm. The Heater break alarm/Thyristor break-down alarm are available for the alarm for Phase control and Zero-cross control. In the case of Phase control, there are three types of alarm to choose from according to the application. In the case of Zero-cross control, type 2 alarm is used.
Each of Heater break alarm and Thyristor break-down alarm has two alarm setpoints.



Action during the occurrence of an alarm:
ALM lamp lights
THV-10 continues the control.
Error number corresponding to the alarm status will be displayed on the Alarm monitor (AL).



Error number 1: Heater break alarm 1
Error number 2: Thyristor break-down alarm 1
Error number 4: Heater break alarm 2
Error number 8: Thyristor break-down alarm 2

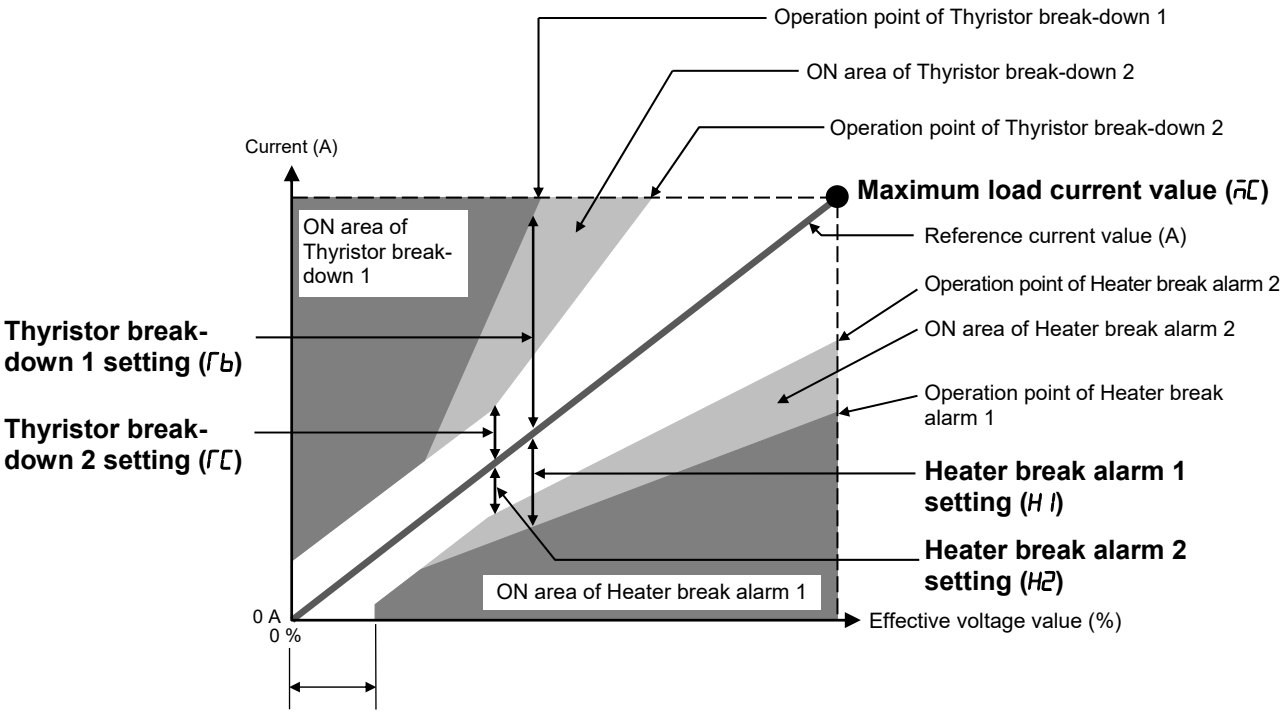
9.1.2 Type 1 for phase control (constant resistance type, deviation alarm)

Type 1 heater break alarm/Thyristor break-down alarm are available for Phase control. The Heater break alarm/Thyristor break-down alarm of Type 1 instrument performs the following calculation to determine the alarm state.

1. Calculates reference current* for each Effective voltage value (%) suitable for the phase angle.
2. Calculates the operation point from the deviation between the reference current value and the alarm set value.
3. Determines the alarm condition when the current value detected by the current transformer has exceeded the operation point and entered the alarm range.

The deviation between the reference current value and the alarm operation point is 0 to 100 % of the reference current or 2 A, whichever is larger. If the condition may attempt to change the set value below 2 A, this instrument makes adjustment to keep the set value 2 A or more.

* The reference current is the load current value that is assumed for the output phase angle of this instrument.



- When alarm is triggered above the reference current value, it is Thyristor break-down.
- When alarm is triggered below the reference current value, it is heater break.

Operation chart of Type 1

■ Heater that can be used with type 1 for phase control

The heater break alarm of Type 1 can be used for general heating elements making small resistance changes (approx. 10 %) with temperature variations.
(General heating elements: Nichrome, ferrochromium, graphite, kanthal A, etc.)

NOTE

- **Cannot be used for noble metal or silicon carbide heating elements.**
- **Type 1 cannot be used for any power supply waveforms other than a sine waveform.**

■ Determination of Heater break alarm and alarm reset

NOTE

To avoid malfunction of the alarm, the Heater break alarm will not function if the phase angle is less than 15 % (less than 15 % of the maximum load current value).

• Determination of heater break

While the phase angle is 15 % or more, if the current input value from the current transformer stays within the Heater break alarm ON area continuously for "Number of alarm determination × Power supply 5 cycles *," alarm is generated.

Current transformer input value ≦ {(Maximum load current value × Effective voltage value [%]) × (100 % – Heater break alarm set value [%])}

• Determination of alarm release

In case of phase angle 15 % or more, if the input value of the current transformer is outside of the Heater break alarm range for power supply 5 cycles * repeatedly, the alarm is released.

Current transformer input value > {(Maximum load current value × Effective voltage value [%]) × (100 % – Heater break alarm set value [%])}
+ Differential gap

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

☞ For the details of differential gap, refer to **9.1.5 Alarm differential gap (P. 9-11)**.

■ Determination of Thyristor break-down alarm and alarm release

• Determination of thyristor break-down

If the current input value from the current transformer stays within the Thyristor break-down alarm ON area continuously for "Number of alarm determination × Power supply 5 cycles *," alarm is generated.

Current transformer input value ≧ {(Maximum load current value × Effective voltage value [%])
× (100 % + Thyristor break-down detection setting [%])}

• Determination of release of Thyristor break-down alarm

When the input value of the current transformer is outside of the Thyristor break-down alarm range for power supply 5 cycles * repeatedly, the alarm is released.

Current transformer input value < {(Maximum load current value × Effective voltage value [%])
× (100 % + Thyristor break-down detection setting [%])} – Differential gap

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

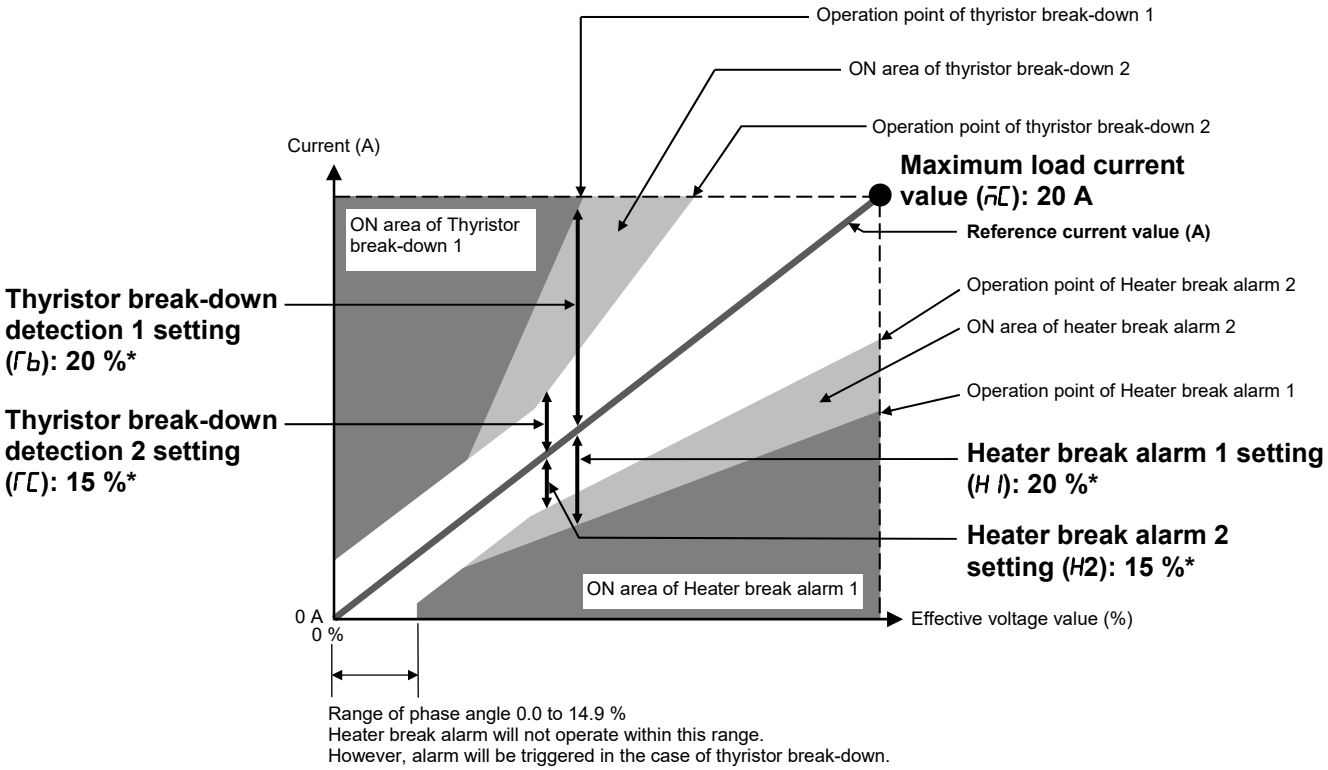
☞ For the details of differential gap, refer to **9.1.5 Alarm differential gap (P. 9-11)**.

■ Operation example of type 1 for phase control

When the parameters are set to the values below, operation takes place as shown in the graph.
(This setting example is for a 20 A type. All parameters except "Alarm output logic (L1)" are default settings.)

Mode	Parameter	Set value
Setting mode C	Maximum load current value (ñC)	20.0 A
	Heater break alarm 1 setting (H1)	20 % [1] [The set value is a percentage (%) against the reference current value]
	Thyristor break-down detection 1 setting (Fb)	20 % [2] [The set value is a percentage (%) against the reference current value]
	Heater break alarm 2 setting (H2)	15 % [3] [The set value is a percentage (%) against the reference current value]
	Thyristor break-down detection 2 setting (FC)	15 % [4] [The set value is a percentage (%) against the reference current value]
Engineering mode D	Control method (Cñ)	0 (Phase control)
	Heater break alarm enable/disable (HF)	1 (Enable)
	Output mode for phase control (o5)	0: Proportional phase angle to input
	Alarm output logic (L1)	15 (Logical OR of Heater break alarm1, Thyristor break-down alarm 1, Heater break alarm 2 and Thyristor break-down alarm 2)
	Selection of energized/de-energized alarm output (nR)	0 (Energized)
	Alarm type selection (A1)	0 (Type 1: Constant resistance type, deviation alarm)
	Number of alarm 1 determination (n1)	30 times
	Number of alarm 2 determination (n2)	300 times
	Alarm enable/disable during STOP (SR)	0 (Disable)

[1] Equation for conversion to current value (A): Current value = Reference current value × Heater break alarm 1 setting (H1) (%)
[2] Equation for conversion to current value (A): Current value = Reference current value × Thyristor break-down detection 1 setting (Fb) (%)
[3] Equation for conversion to current value (A): Current value = Reference current value × Heater break alarm 2 setting (H2) (%)
[4] Equation for conversion to current value (A): Current value = Reference current value × Thyristor break-down detection 2 setting (FC) (%)



* The alarm operation point is calculated from the deviation between the reference current value and the alarm set value. Below is an example of the calculation.

When the reference current value is 15 A: Alarm operation point of Heater break alarm 1 setting (H1) / Thyristor break-down detection 1 setting (Fb) (20 %) is 3 A
(Alarm turns ON when current transformer input value deviates from the reference current value by 3 A)
Alarm operation point of heater break alarm 2 setting (H2)／Thyristor break-down detection 2 setting (FC) (15 %) is 2.25 A
(Alarm turns ON when current transformer input value deviates from the reference current value by 2.25 A)

When the reference current value is 12 A: Alarm operation point of Heater break alarm 1 setting (H1) / Thyristor break-down detection 1 setting (Fb) (20 %) is 2.4 A
(Alarm turns ON when current transformer input value deviates from the reference current value by 2.4 A)
Calculated value of alarm operation point of heater break alarm 2 setting (H2)／Thyristor break-down detection 2 setting (FC) (15 %) is 1.8 A, which is less than 2 A, and hence the alarm operation point will be 2 A.
(Alarm is turned on when the current transformer input value deviates from the reference current value by 2 A)

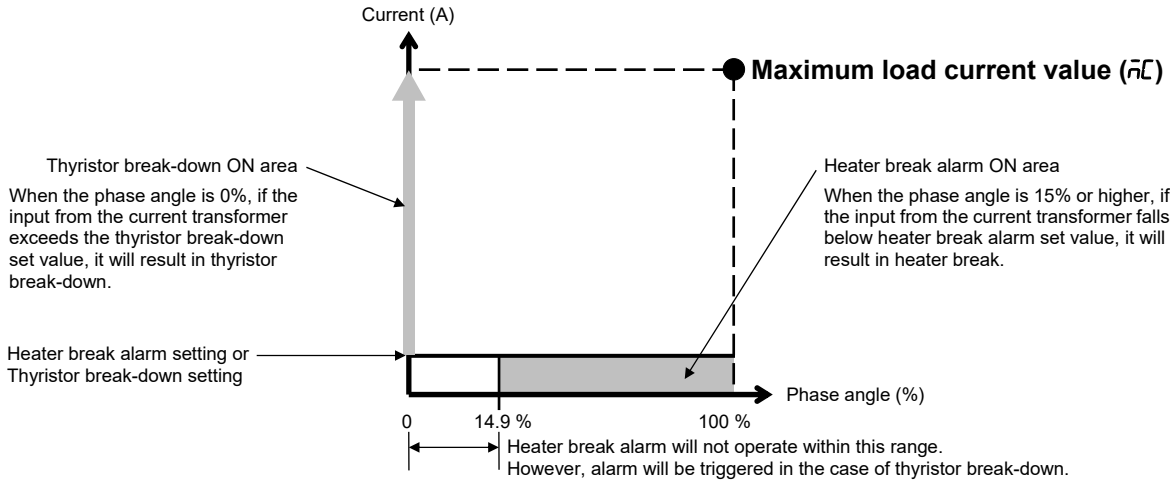
9.1.3 Type 2 for phase control (linearity resistor type, absolute value alarm)

Type 2 heater break alarm/Thyristor break-down alarm are available for Phase control and Zero-cross control. Heater break alarm/Thyristor break-down alarm of Type 2 is used to detect a break of a single heater. For the Type 2, alarm set value is calculated based on the maximum load current value.
The alarm state is judged based on whether the current transformer input value is below the Heater break alarm set value or above the Thyristor break-down set value.

NOTE

Set the Heater break alarm set value or Thyristor break-down set value to approximately 10 % of the maximum load current value. Do not set the heater break alarm set value to more than 15 %.

No Type 2 can be used when two or more heaters are used in parallel connection.



■ Heater that can be used with Type 2 for phase control

The heater break alarm of Type 2 can be used for heating elements such as noble metals making large resistance changes with temperature variations.
(Pure metal heating element: Platinum, molybdenum, tungsten, superkanthal, tantalum, etc.)

■ Determination of Heater break alarm and alarm reset

NOTE

To avoid malfunction of the alarm, the Heater break alarm will not function if the phase angle is less than 15 % (less than 15 % of the maximum load current value).

Determination of heater break

While the phase angle is 15 % or more, if the input value from the current transformer stays within the Heater break alarm ON area continuously for "Number of alarm determination × Power supply 5 cycles *," alarm is generated.

Current transformer input value ≦ Maximum load current value × Heater break alarm setting [%]

Determination of alarm release

In case of phase angle 15 % or more, if the input value from the current transformer is outside of the Heater break alarm range for power supply 5 cycles * repeatedly, the alarm is released.

Current transformer input value > (Maximum load current value × Heater break alarm setting [%]) + Differential gap

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

For the details of differential gap, refer to **9.1.5 Alarm differential gap (P. 9-11)**.

■ Determination of Thyristor break-down alarm and alarm release

NOTE

When the phase angle equals or exceeds the Minimum output phase angle, determination of Thyristor break-down alarm is not done.

• Determination of Thyristor break-down

While the phase angle is less than Minimum output phase angle, if the current transformer input value stays within the Thyristor break-down ON area consecutively for "Number of alarm determination × Power supply 5 cycles *," alarm is generated.

Current transformer input value ≧ Maximum load current value × Thyristor break-down detection setting [%]

• Determination of release of Thyristor break-down alarm

While the phase angle is less than Minimum output phase angle, if the current transformer input value stays outside the Thyristor break-down alarm ON area consecutively for "Number of alarm determination × Power supply 5 cycles *," alarm is released.

Current transformer input value < (Maximum load current value × Thyristor break-down detection setting [%]) – Differential gap

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

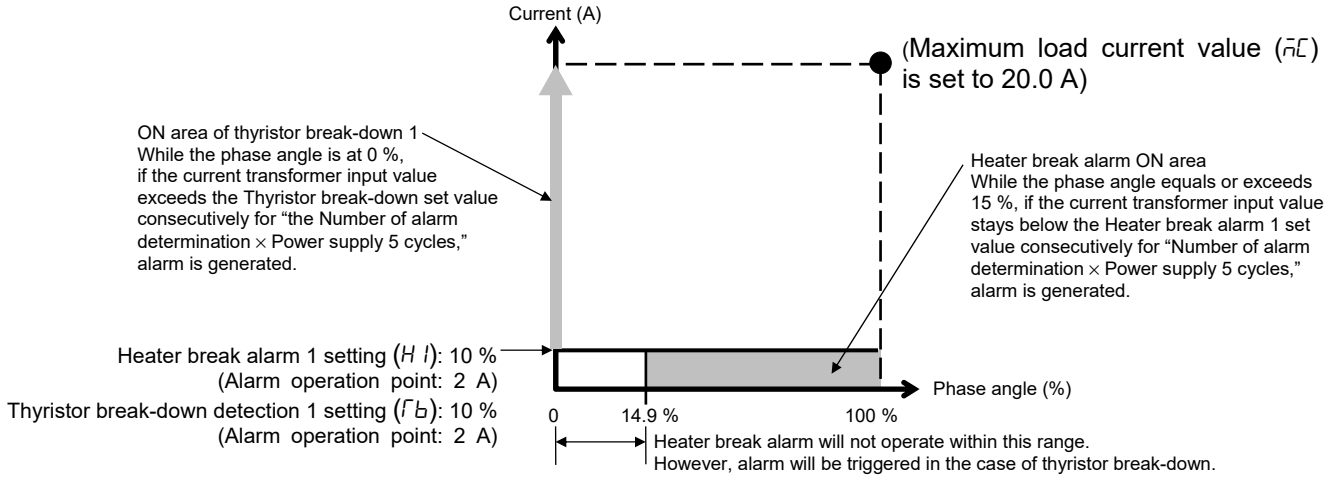
☞ For the details of differential gap, refer to **9.1.5 Alarm differential gap (P. 9-11)**.

■ Operation example of Type 2 for phase control

When the parameters are set to the values below, operation takes place as shown in the graph.

Mode	Parameter	Set value
Setting mode C	Maximum load current value (MC)	20.0 A
	Heater break alarm 1 setting (H1)	10 %[1] [The set value is a percentage (%) against the Maximum load current value]
	Thyristor break-down detection 1 setting (Tb)	10 %[2] [The set value is a percentage (%) against the Maximum load current value]
	Heater break alarm 2 setting (H2)	0 % (Heater break alarm 2 unused) [The set value is a percentage (%) against the Maximum load current value]
	Thyristor break-down detection 2 setting (TC)	0 % (Thyristor break-down 2 unused) [The set value is a percentage (%) against the Maximum load current value]
Engineering mode D	Control method (CM)	0 (Phase control)
	Heater break alarm enable/disable (HF)	1 (Enable)
	Output mode for phase control (oS)	0: Proportional phase angle to input
	Alarm output logic (L1)	3 (Logical OR of Heater break alarm1, Thyristor break-down alarm 1)
	Selection of energized/de-energized alarm output (nA)	0 (Energized)
	Alarm type selection (A1)	1 (Type 2: Linearity resistor type, absolute value alarm)
	Number of alarm 1 determination (n1)	1 time
	Alarm enable/disable during STOP (SA)	0 (Disable)

[1] Equation for conversion to current value (A): Current value = Maximum load current value × Heater break alarm 1 setting (H1) (%)
[2] Equation for conversion to current value (A): Current value = Maximum load current value × Thyristor break-down detection 1 setting (Tb) (%)



9.1.4 Type 2 for Zero-cross control (linearity resistor type, absolute value alarm)

The alarm state is judged based on whether the current transformer input value is below the Heater break alarm set value or above the Thyristor break-down set value.

■ Determination of Heater break alarm and alarm reset

NOTE

While the output of this instrument is off, alarm determination is not done.

• Determination of heater break

While the output of this instrument is on, if the input value from the current transformer stays inside the Heater break alarm ON range for "Number of alarm determination × Power supply 5 cycles *" in a row, then alarm is generated.

Current transformer input value ≦ Maximum load current value × Heater break alarm setting [%]

• Determination of alarm release

While the output of this instrument is on, if the input value from the current transformer stays outside the Heater break alarm ON range for power supply 5 cycles * repeatedly, then alarm is released.

Current transformer input value > (Maximum load current value × Heater break alarm setting [%]) + Differential gap

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

☞ For the details of differential gap, refer to **9.1.5 Differential gap of alarm (P. 9-11)**.

■ Determination of Thyristor break-down alarm and alarm release

NOTE

When the output from this instrument is ON, determination of Thyristor break-down is not done.

• Determination of Thyristor break-down

While the output of this instrument is off, if the input value from the current transformer stays inside the Thyristor break-down alarm ON range for "Number of alarm determination × Power supply 5 cycles *" in a row, then alarm is generated.

Current transformer input value ≧ Maximum load current value × Thyristor break-down detection setting [%]

• Determination of release of Thyristor break-down alarm

While the output of this instrument is off, if the input value from the current transformer stays outside the Thyristor break-down alarm ON range for power supply 5 cycles * repeatedly, then alarm is released.

Current transformer input value < (Maximum load current value × Thyristor break-down detection setting [%]) – Differential gap

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

☞ For the details of differential gap, refer to **9.1.5 Alarm differential gap (P. 9-11).**

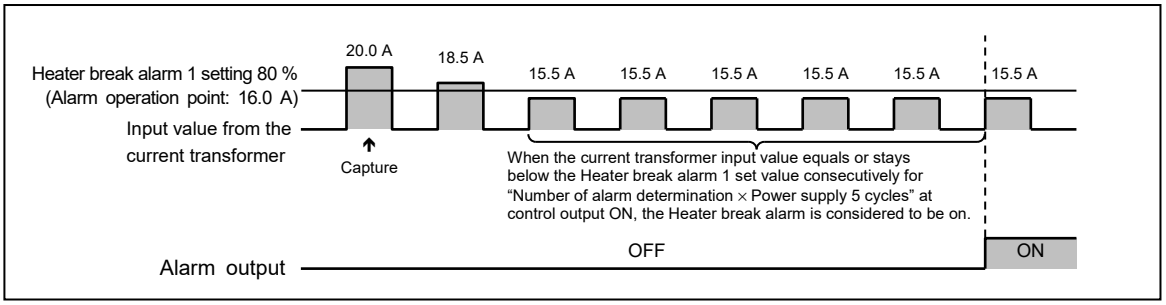
■ Operation example of Type 2 for Zero-cross control

Setting example of heater break alarm

When the parameters are set to the values below, operation takes place as shown in the graph.

Mode	Parameter	Set value
Setting mode C	Maximum load current value (ñC)	20.0 A
	Heater break alarm 1 setting (H1)	80 % * [The set value is a percentage (%) against the Maximum load current value]
Engineering mode D	Control method (Cñ)	1 (Zero-cross control [continuous])
	Heater break alarm enable/disable (HF)	1 (Enable)
	Alarm output logic (L1)	1 (Heater break alarm 1)
	Selection of energized/de-energized alarm output (nA)	0 (Energized)
	Alarm type selection (A1)	1 (Type 2: Linearity resistor type, absolute value alarm)
	Number of alarm 1 determination (n1)	1 time
	Alarm enable/disable during STOP (SA)	0 (Disable)

* Equation for conversion to current value (A): Current value = Maximum load current value × Heater break alarm 1 setting (%)



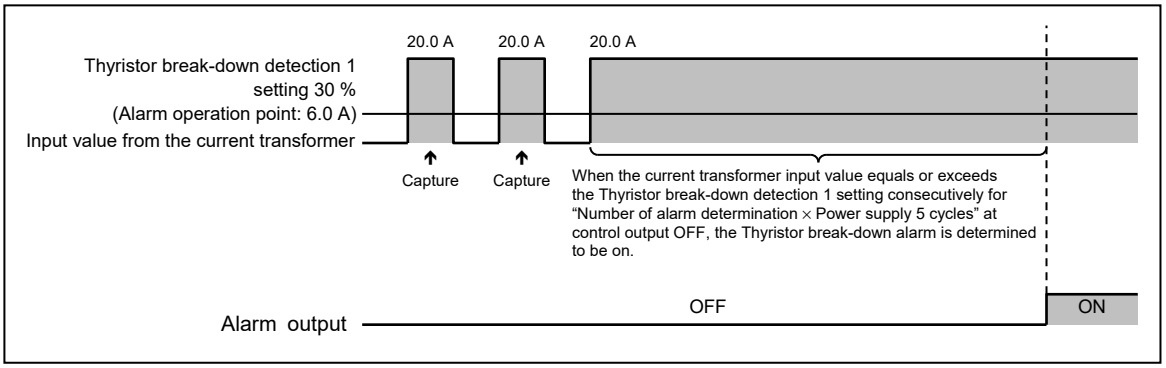
This chart shows the case when Control output is 50 %.

Setting example of Thyristor break-down alarm

When the parameters are set to the values below, operation takes place as shown in the graph.

Mode	Parameter	Set value
Setting mode C	Maximum load current value (ñC)	20.0 A
	Thyristor break-down detection 1 setting (Fb)	30 % * [The set value is a percentage (%) against the Maximum load current value]
Engineering mode D	Control method (ñC)	1 (Zero-cross control [continuous])
	Heater break alarm enable/disable (HF)	1 (Enable)
	Alarm output logic (L1)	8 (Thyristor break-down alarm 2)
	Selection of energized/de-energized alarm output (nA)	0 (Energized)
	Alarm type selection (A1)	1 (Type 2: Linearity resistor type, absolute value alarm)
	Number of alarm 1 determination (n1)	1 time
	Alarm enable/disable during STOP (SA)	0 (Disable)

* Equation for conversion to current value (A): Current value = Maximum load current value × Thyristor break-down detection 1 setting (%)



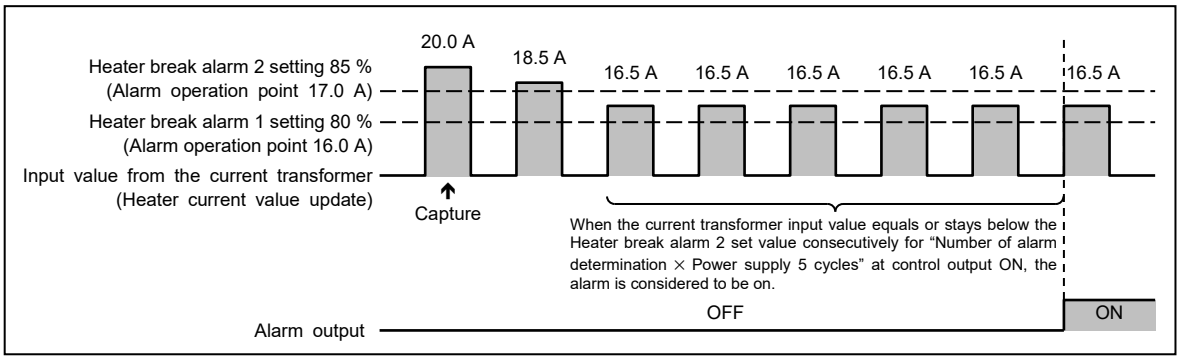
When two Heater break alarms are used

When the parameters are set to the values below, operation takes place as shown in the graph.

Mode	Parameter	Set value
Setting mode C	Maximum load current value for alarm (nL)	20.0 A
	Heater break alarm 1 setting (H1)	80 % [1] [The set value is a percentage (%) against the Maximum load current value]
	Heater break alarm 2 setting (H2)	85 % [2] [The set value is a percentage (%) against the Maximum load current value]
Engineering mode D	Control method (Cn)	1 (Zero-cross control [continuous])
	Heater break alarm enable/disable (HF)	1 (Enable)
	Alarm output logic (L1)	5 (Logical OR of Heater break alarm 1, Heater break alarm 2)
	Selection of energized/de-energized alarm output (nR)	0 (Energized)
	Alarm type selection (A1)	1 (Type 2: Linearity resistor type, absolute value alarm)
	Number of alarm 1 determination (n1)	1 time
	Number of alarm 2 determination (n2)	1 time
	Alarm enable/disable during STOP (SA)	0 (Disable)

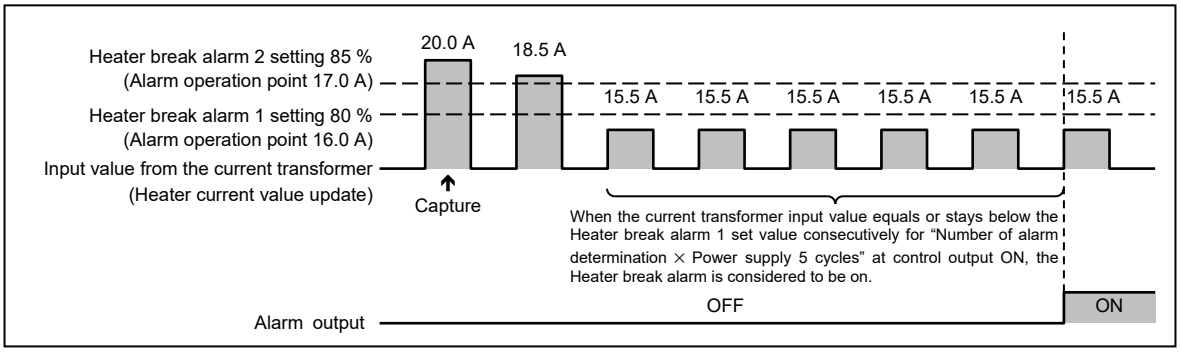
[1] Equation for conversion to current value (A): Current value = Maximum load current value × Heater break alarm 1 setting (%)
[2] Equation for conversion to current value (A): Current value = Maximum load current value × Heater break alarm 2 setting (%)

Operation chart of Heater break alarm 2 setting



This chart shows the case when Control output is 50 %.

Operation chart of Heater break alarm 1 setting



This chart shows the case when Control output is 50 %.

9.1.5 Alarm differential gap

If the measured value from the current transformer is around the alarm set value, due to the fluctuation of the input, Heater break alarm or Thyristor break-down alarm may be generated repeatedly. To avoid such frequent alarm state, an alarm differential gap where alarm state is not checked is supplied on the OFF side against the alarm set value.

Alarm differential gap

The Alarm differential gap is as follows regardless of the alarm type.

- 20 A/30 A/45 A type: 0.3 A
- 60 A/80 A/100 A type: 1 A

9.1.6 Number of alarm determination

The Number of alarm determination is that which delays the occurrence of alarm in order to prevent alarm malfunctioning. When an alarm condition becomes ON status, the output is suppressed until the preset number of sampling times elapses. After the preset number of sampling times elapses, if the alarm output is still ON status, the output will be produced. In addition, if the alarm state is released while the number of alarm determination is being activated, the alarm output is not turned on.

Number of alarm determination for Heater break alarm 1 and Thyristor break-down alarm 1

Number of alarm 1 determination (1 to 1000 times) × Power supply 5 cycles *

Number of alarm determination for Heater break alarm 2 and Thyristor break-down alarm 2

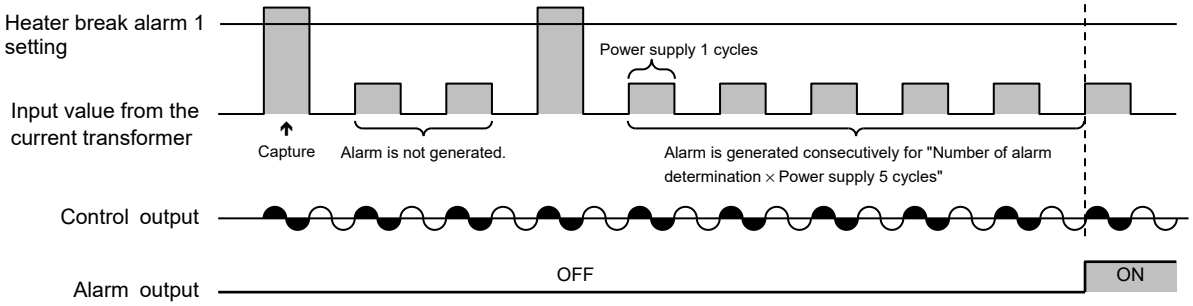
Number of alarm 2 determination (1 to 1000 times) × Power supply 5 cycles *

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms
This “Power supply 5 cycles” is a fixed value.

Example: Zero-cross control (Power frequency 50 Hz)

When Number of alarm 1 determination (n1) is set to 1, alarm output will be activated after alarm state has been checked power supply 5 cycles in succession.

Alarm delay time = Number of alarm 1 determination (1 to 1000 times) × Power supply 5 cycles
= 1 × 100 ms
= 0.1 seconds



This chart shows the case when Control output is 50 %.

9.1.7 Setting contents

● Maximum load current value (MC) [Setting mode C]

Use to set the maximum heater current value (maximum load current value) for Heater break alarm. The maximum load current value means the current value which flows through the heater when the output of the instrument is 100 % (phase angle: 180°).

NOTE

- **If the maximum load current value is not set, heater break judgment cannot be made, and thus it is important to verify that this has been set. In addition, if the correct maximum load current set value is not set, it may cause incorrect operation.**
- **If the maximum current value which flows through the heater changes due to heater secular change or deterioration, change the maximum load current set value.**

Parameter symbol	Setting range	Factory set value
MC	0.0 to 32.0 A (20 A type)	20.0
	0.0 to 32.0 A (30 A type)	30.0
	0.0 to 55.0 A (45 A type)	45.0
	0 to 70 A (60 A type)	60
	0 to 90 A (80 A type)	80
	0 to 110 A (100 A type)	100

In the case of Non-linear resistance heater break alarm, the Maximum load current set value is automatically calculated when automatic detection of knee point is performed.

Maximum load current value screen appears when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

For the details of Maximum load current value calculation method, refer to **(1) How to Find Maximum Load Current Value (P. 9-21)**.

● Heater break alarm 1 setting (H1) [Setting mode C]

Use to set the Heater break alarm 1 set value.

Parameter symbol	Setting range	Factory set value
H 1	In the case of Type 1 (constant resistance type, deviation alarm) and Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm): 0 to 100 % of the reference current * (0: Heater break alarm 1 unused) If the Heater break alarm 1 set value is below 2 A, the instrument adjusts the set value to 2 A or more. In the case of Type 2 (linearity resistor type, absolute value alarm): 0 to 100 % of Maximum load current value (0: Heater break alarm 1 unused) * The reference current is the load current value that is assumed for the output phase angle of this instrument.	20

Heater break alarm 1 setting screen appears when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

Recommended value of Heater break alarm 1 set value

NOTE

Although the following values are recommended, the alarm set value varies depending on the load type and the number of connections. Set the value suited to your system.

When the Control method is Phase control, RKC recommends:

Type 1 (constant resistance type, deviation alarm):

Set the Heater break alarm 1 set value to approximately 20 % of the Maximum load current value.
This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

Type 2 (linearity resistor type, absolute value alarm):

Set the Heater break alarm 1 set value to approximately 10 % of the Maximum load current value. Do not set the Heater break alarm 1 set value to more than 15 %.
This recommended value is a guideline for when there is one connected heater.

Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm):

In the case of a Non-linear resistance heater break alarm, there is no recommended value because the load characteristics vary depending on the non-linear load type.

When the Control method is Zero-cross control, RKC recommends:

Set the Heater break alarm 1 set value to approximately 80 % of the reading of current transformer input. Set the Heater break alarm 1 set value to a slightly smaller value to prevent a false alarm when power supply variation is large. Set the Heater break alarm 1 set value to a slightly larger value to detect a failure of one heater when more than one heaters are connected in parallel. This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

● Thyristor break-down detection 1 setting (Tb) [Setting mode C]

Use to set the Thyristor break-down 1 set value.

Parameter symbol	Setting range	Factory set value
Tb	In the case of Type 1 (constant resistance type, deviation alarm) and Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm): 0 to 100 % of the reference current* (0: Thyristor break-down 1 unused) If the Thyristor break-down 1 set value is below 2 A, the instrument adjusts the set value to 2 A or more. In the case of Type 2 (linearity resistor type, absolute value alarm): 0 to 100 % of Maximum load current value (0: Thyristor break-down 1 unused) * The reference current is the load current value that is assumed for the output phase angle of this instrument.	20

Thyristor break-down detection 1 setting screen appears when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

Recommended value of Thyristor break-down 1 set value

NOTE

Although the following values are recommended, the alarm set value varies depending on the load type and the number of connections. Set the value suited to your system.

When the Control method is Phase control, RKC recommends:

Type 1 (constant resistance type, deviation alarm):

Set the Thyristor break-down 1 set value to approximately 20 % of the Maximum load current value.
This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

Type 2 (linearity resistor type, absolute value alarm):

Set the Thyristor break-down 1 set value to approximately 10 % of the Maximum load current value. Do not set the Thyristor break-down 1 set value to more than 15 %.
This recommended value is a guideline for when there is one connected heater.

Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm):

In the case of a Non-linear resistance heater break alarm, there is no recommended value because the load characteristics vary depending on the non-linear load type.

When the Control method is Zero-cross control, RKC recommends:

Set the Thyristor break-down 1 set value to approximately 80 % of the Maximum load current value.
This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

● Heater break alarm 2 setting (H2) [Setting mode C]

Use to set the Heater break alarm 2 set value.

Parameter symbol	Setting range	Factory set value
H2	In the case of Type 1 (constant resistance type, deviation alarm) and Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm): 0 to 100 % of the reference current* (0: Heater break alarm 2 unused) If the Heater break alarm 2 set value is below 2 A, the instrument adjusts the set value to 2 A or more. In the case of Type 2 (linearity resistor type, absolute value alarm): 0 to 100 % of Maximum load current value (0: Heater break alarm 2 unused) * The reference current is the load current value that is assumed for the output phase angle of this instrument.	15

Heater break alarm 2 setting screen appears when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

Recommended value of Heater break alarm 2 set value

NOTE

Although the following values are recommended, the alarm set value varies depending on the load type and the number of connections. Set the value suited to your system.

When the Control method is Phase control, RKC recommends:

Type 1 (constant resistance type, deviation alarm):

Set the Heater break alarm 2 set value to any value slightly smaller than that of Heater break alarm 1. Setting a smaller value for Heater break alarm 2 than that for Heater break alarm 1 enables alarm detection prior to the Heater break alarm 1. This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

Type 2 (linearity resistor type, absolute value alarm):

Not available for Type 2. Set to "0: Heater break alarm 2 unused."
(This may be used instead of the Heater break alarm 1)

Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm):

There is no recommended value, but set the Heater break alarm 2 set value to any value slightly smaller than that of Heater break alarm 1. Setting a smaller value for Heater break alarm 2 than that for Heater break alarm 1 enables alarm detection prior to the Heater break alarm 1.

When the Control method is Zero-cross control, RKC recommends:

Set the Heater break alarm 2 set value to any value slightly larger than that of Heater break alarm 1.
Setting a larger value for the Heater break alarm 2 than that for the Heater break alarm 1 enables alarm detection prior to the Heater break alarm 1. This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

● Thyristor break-down detection 2 setting (TC) [Setting mode C]

Use to set the Thyristor break-down 2 set value.

Parameter symbol	Setting range	Factory set value
TC	In the case of Type 1 (constant resistance type, deviation alarm) and Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm): 0 to 100 % of the reference current * (0: Thyristor break-down 2 unused) If the Thyristor break-down 2 set value is below 2 A, the instrument adjusts the set value to 2 A or more. In the case of Type 2 (linearity resistor type, absolute value alarm): 0 to 100 % of Maximum load current value (0: Thyristor break-down 2 unused) * The reference current is the load current value that is assumed for the output phase angle of this instrument.	15

Thyristor break-down detection 2 setting screen appears when the instrument is supplied with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

Recommended value of Thyristor break-down 2 set value

NOTE

Although the following values are recommended, the alarm set value varies depending on the load type and the number of connections. Set the value suited to your system.

When the Control method is Phase control, RKC recommends:

Type 1 (constant resistance type, deviation alarm):

Set the Thyristor break-down 2 set value to any value slightly smaller than that of Thyristor break-down 1. Setting a smaller value for Thyristor break-down 2 than that for Thyristor break-down 1 enables alarm detection prior to the Thyristor break-down 1. This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

Type 2 (linearity resistor type, absolute value alarm):

Not available for Type 2. Set the “0: Thyristor break-down 2 unused.”
(This may be used instead of the Thyristor break-down 1 set value.)

Non-linear resistance heater break alarm (non-linear resistance type, deviation alarm):

In the case of a Non-linear resistance heater break alarm, there is no recommended value because the load characteristics vary depending on the non-linear load type.

When the Control method is Zero-cross control, RKC recommends:

Set the Thyristor break-down 2 set value to any value slightly smaller than that of Thyristor break-down 1. Setting a smaller value for Thyristor break-down 2 than that for Thyristor break-down 1 enables alarm detection prior to the Thyristor break-down 1. This recommended value is a guideline for when changes in the resistance of the load due to temperature are small.

● Heater break alarm enable/disable (HF) [Engineering mode D : Function block 2 (F. 2)]

This setting is used to enable or disable the Heater break alarm and Thyristor break-down alarm. Disabling this function will not turn on Heater break alarm or the Thyristor break-down alarm.
The Heater break alarm and Thyristor break-down alarm can be disabled without changing the Heater break alarm set value or the Thyristor break-down set value.

Parameter symbol	Setting range	Factory set value
HF	0: Disable 1: Enable	1

📖 If Heater break alarm enable/disable is set in the Contact input (DI) function assignment (C1), the set value cannot be changed.

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

● Number of alarm 1 determination (n1) [Engineering mode D : Function block 4 (F. 4)]

Use to set the number of determination of Heater break alarm 1 and Thyristor break-down alarm 1.
This setting is common to both Heater break alarm 1 and Thyristor break-down alarm 1.

Parameter symbol	Setting range	Factory set value
n1	1 to 1000 times	30

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

● Number of alarm 2 determination (n2) [Engineering mode D : Function block 4 (F. 4)]

Use to set the number of determination of Heater break alarm 2 and Thyristor break-down alarm 2.
This setting is common to both Heater break alarm 2 and Thyristor break-down alarm 2.

Parameter symbol	Setting range	Factory set value
n2	1 to 1000 times	300

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

● Alarm type selection (A1) [Engineering mode D : Function block 4 (F. 4)]

Use to select the type of Heater break alarm in the Phase control.

Parameter symbol	Setting range	Factory set value
A1	0: Type 1 (constant resistance type, deviation alarm) 1: Type 2 (linearity resistor type, absolute value alarm) 2: Non-linear resistance heater break alarm (Non-linear resistance type, deviation alarm)	0

This setting becomes activated in the following cases.

- When the instrument is supplied with Heater break alarm (Non-liner resistance heater break alarm), Current limiter, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.
- Phase control

9.1.8 Setting example of Heater break alarm/Thyristor break-down alarm

The procedure for setting the Heater break alarm is the same as that for any of Phase control and Zero-cross control. Set while referring to the setting example given on the next page. The setting procedure is as follows.

STEP 1
Determine the Maximum load current value

☞ Refer to **(1) How to Find Maximum Load Current Value (P. 9-21)**

STEP 2
Set alarm conditions

Unlock the Set data lock in the Engineering mode [D]
• Set data lock (LK)

Set the parameters in the Engineering mode [D]
• Alarm output logic (L1)
• Selection of energized/de-energized alarm output (nA)
• Alarm type selection (A1) *
• Number of alarm 1 determination (n1)
• Number of alarm 2 determination (n2)
• Alarm enable/disable during STOP (SA)

* Set the alarm type in the case of phase control.
Setting is ignored in the case of Zero-cross control.

☞ Refer to **P. 9-26, P.9-27**

STEP 3
Set Maximum load current value

Set the Maximum load current value (MC) in the Setting mode [C]

☞ Refer to **P. 9-28**

STEP 4
Set each alarm set value

Set the parameters in the Setting mode [C]
• Heater break alarm 1 setting (H1)
• Thyristor break-down detection 1 setting (Tb)
• Heater break alarm 2 setting (H2) *
• Thyristor break-down detection 2 setting (TC) *

* It is not used in the case of type 2 (linearity resistor type, absolute value alarm) for phase control. Set it to unused.

☞ Refer to **P. 9-28**

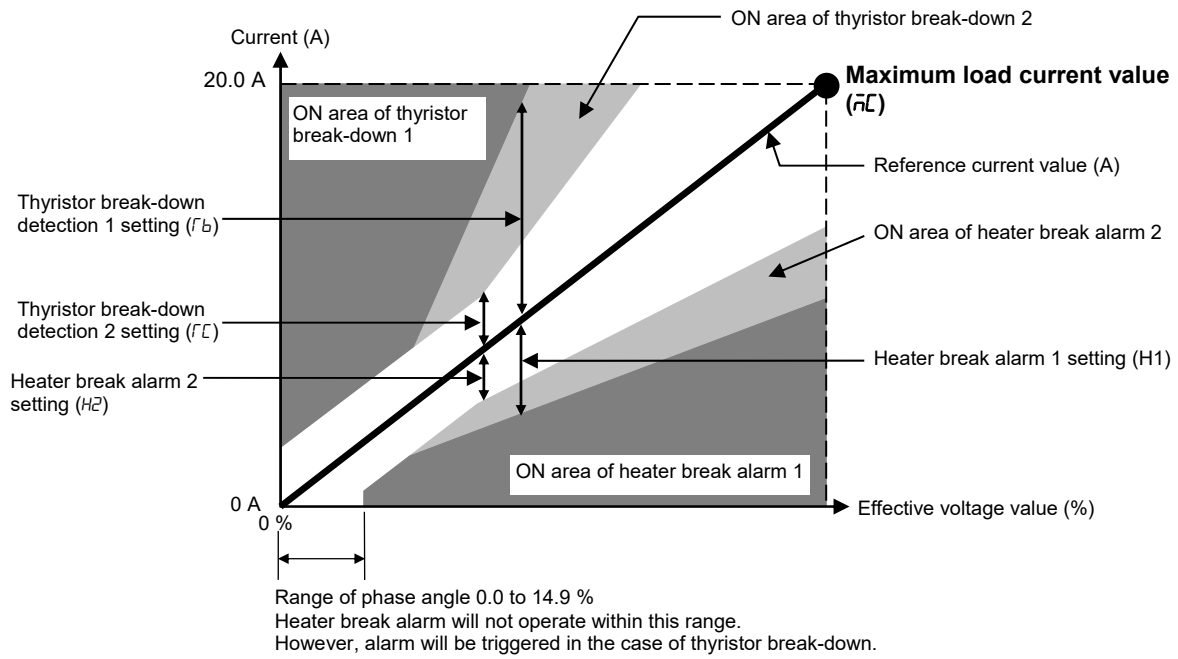
■ Setting example

The procedure for setting the following conditions is explained as an example.

<Operating condition>

THV-10:	20 A type
Control method:	Phase control
Output adjustment:	Auto mode
Power supply voltage:	200 V AC
Heater capacity:	4 kW
Maximum load current value:	20.0 A
Heater break alarm 1 setting:	Use to detect a heater break [Set value: 20 %]
Thyristor break-down detection 1 setting:	Use to detect thyristor short circuit [Set value: 20 %]
Heater break alarm 2 setting:	Use to provide alarm output before Heater break alarm 1 takes place [Set value: 15 %]
Thyristor break-down detection 2 setting:	Use to provide alarm output before Thyristor break-down 1 takes place [Set value: 15 %]
Type of heater break alarm:	Type 1 (constant resistance type, deviation alarm) [Set value: 0]
Alarm output:	Logical OR of the following alarms. [Set value: 15] • Heater break alarm 1 • Thyristor break-down alarm 1 • Heater break alarm 2 • Thyristor break-down alarm 2
Energized/De-energized of Alarm Output:	Energized [Set value 0]

Operation chart



(1) How to Find Maximum Load Current Value

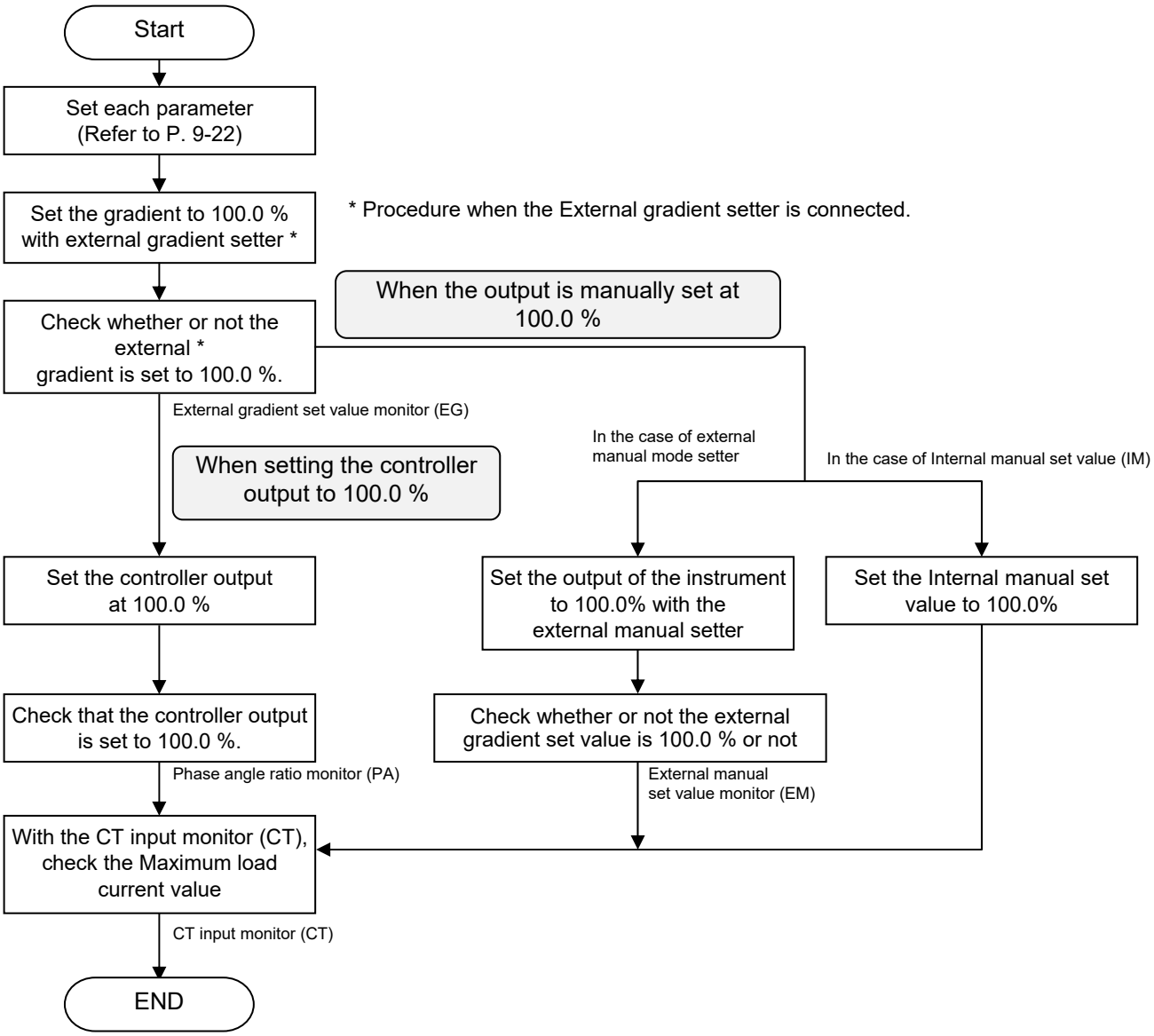
There are three methods to obtain the maximum load current value. In this section, the following ① and ② methods are explained.

① Method of finding the maximum load current value from the output of the instrument
② Calculate the heater's rated current (When it is not possible to flow the maximum current through each heater)
③ Automatically set the maximum load current value with the Automatic detection function of knee points.

☞ With regard to "Automatically set the maximum load current value with the Automatic detection function of knee points" of ③, refer to the ■ **Setting method when automatically detecting the knee points (P. 9-41)**.

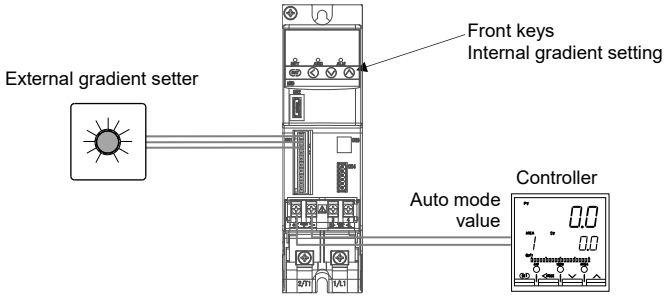
① Method of finding the maximum load current value from the output of the instrument

Check the current value from the CT input monitor (CT) by setting the output of the instrument to 100 %. The value checked at this time corresponds to the maximum load current value. Set the output at 100 % with the controller (Auto mode) or Manual mode (external manual setter or internal manual mode).



Example of finding the maximum load current value by setting the output of the instrument to 100.0%

This is how to check the maximum load current value when used together with the controller. After having set necessary parameters and the gradient, check the maximum load current value with the output from the controller set at 100.0 %.



1. Set parameters to produce 100 % output

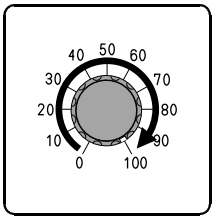
If the following parameters are used to limit the output, the output will never reach 100 % even with the input 100 %. To obtain 100 % output, set each parameter as follows.

Mode	Symbol		Name	Setting contents
Setting mode C	IG	(IG)	Internal gradient set value	Set the Internal gradient set value to 1.00. (Factory set value: 1.00)
	CL	(CL)	Current limit value setting	Set the Current limit value setting to factory set value. Factory set values depend on the current rating of the instrument. Factory set value of each type 20 A type: 32.0 A 30 A type: 32.0 A 45 A type: 55.0 A 60 A type: 70 A 80 A type: 90 A 100 A type: 110 A
Engineering mode D Function block 3	oS	(oS)	Output mode for phase control	Select any one of the following modes. 0: Proportional phase angle to input 1: Proportional voltage to input 2: Proportional square voltage (electric power) to input (factory set value)
	LH	(LH)	Output limiter high	Set the Output limiter high to 100.0 % (factory set value).
	bU	(bU)	Base-up set value	Set the Base-up set value to 0.0 % or more. (Factory set value: 0.0%)

📖 If Soft-start time or Output limiter high at operation start is set, the output becomes 100 % after the set time has passed.

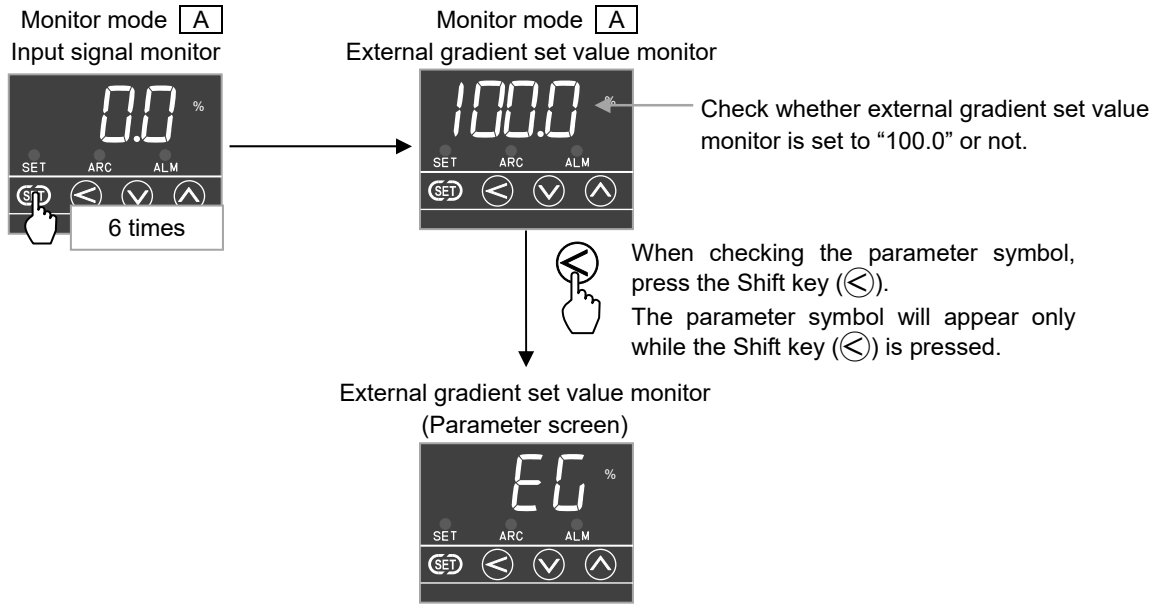
2. Set the external gradient to 100.0 %.
Align the arrow on the knob with "100" on the scale plate.

External gradient setter

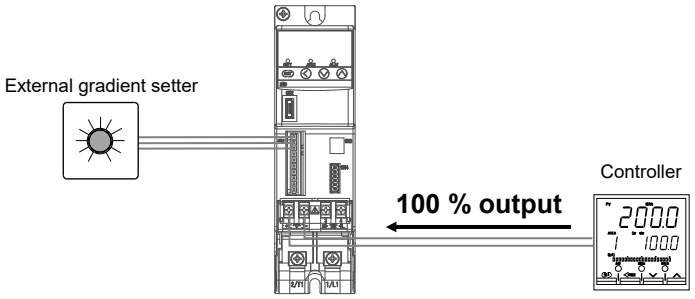


☞ Go to ***4.*** if the external gradient setter is not there

3. Check whether or not the external gradient is set to 100.0%.



4. Set the controller output at 100.0 %
Make adjustment so that the controller output becomes 100.0 %.

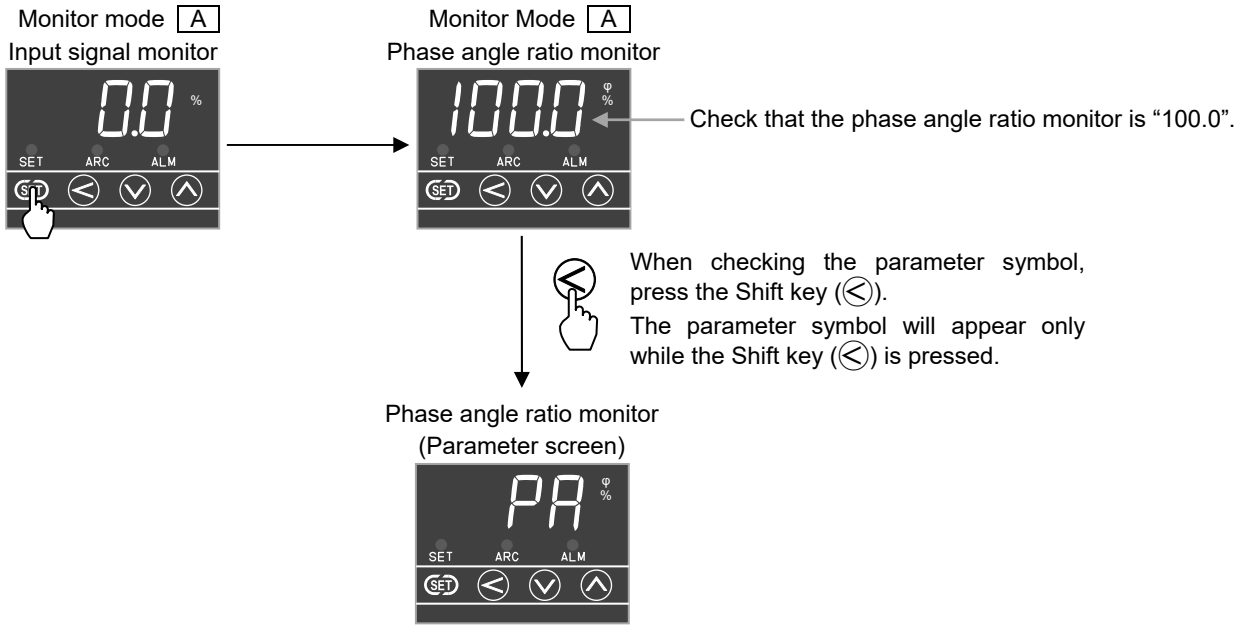


When the output is manually set at 100 %

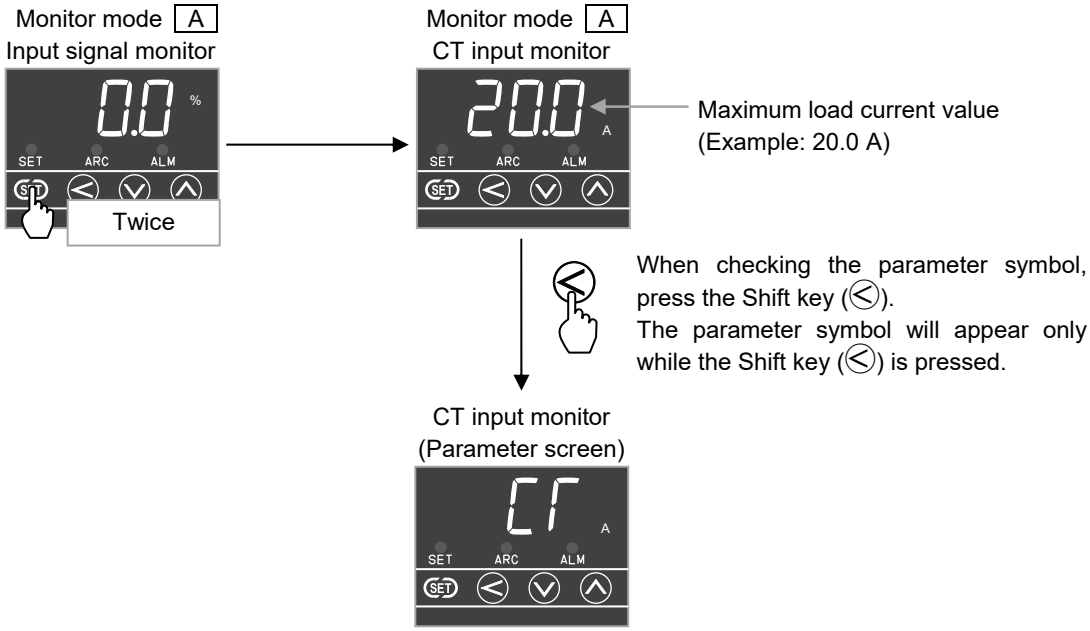
When set by the external manual setter, set the output at 100.0 % with the knob placed in the position of "100."
(It is necessary that External manual mode is enabled)

When set by the front keys, set the Internal manual set value (IM) to "100.0" to set the output to 100.0 %.
(It is necessary that internal manual mode is enabled)

5. Check that the controller output is set at 100.0 %.
Select the Phase angle ratio monitor (PA) and check that the phase angle ratio is 100.0 %. If the phase angle ratio is 100.0 %, the output from this instrument is also 100.0 %.



6. Check for the current value (maximum load current value) at a controller output of 100.0 %.
Check for the current value at a controller output of 100.0 %. Select the CT input monitor (CT) and check the displayed current value. The value at this time is the Maximum load current value.



② Calculate the heater's rated current (When it is not possible to flow the maximum current through each heater)

This is a method of finding the maximum load current value when each heater may be damaged if letting the maximum current flow through the heater. The maximum load current value is found by the equation for calculation.

1. Check for heater power supply voltage and capacity.
Refer to the catalog or instruction manual for the heater used to check for the heater power supply voltage and capacity.

2. Calculate the maximum load current value.
Find the maximum load current value by the equation for calculation.

Equation of calculating: Heater capacity / Power supply voltage = Maximum load current value

Example: For heaters with a capacity of 4 kW and a power supply voltage of 200 V AC (Power factor is assumed to be 1)

4000 (heater capacity) / 200 (power supply voltage) = 20 (maximum load current value)

Maximum load current value 20 A

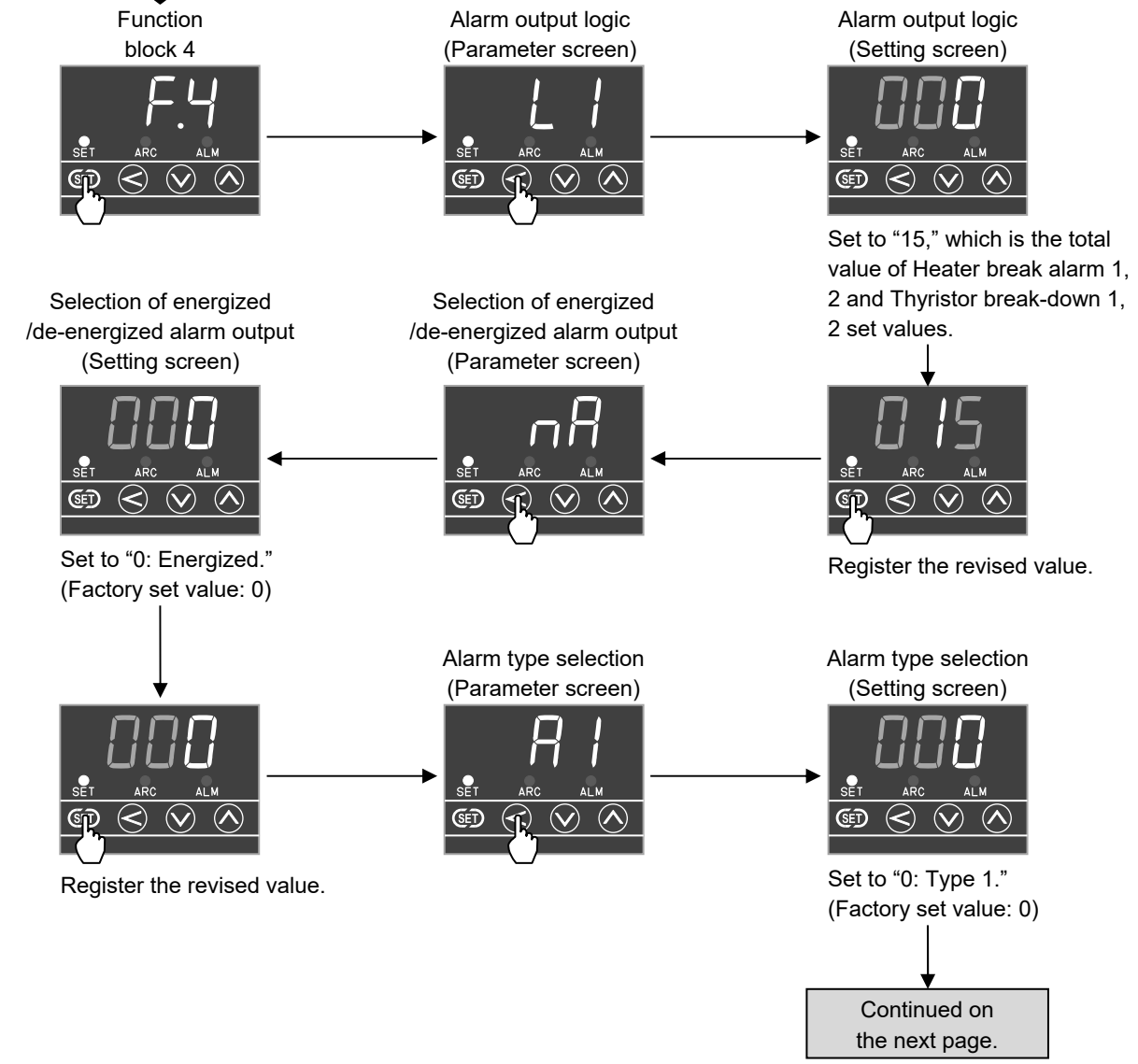
(2) Setting procedure

1. Unlock the setting data
Unlock the Engineering mode D.

☞ Refer to **10.7 Set Data Lock Function (P. 10-23)**.

2. Set the Engineering mode D

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode A until Setting mode C is displayed.
2. Press the Shift key (◁) for 2 seconds while pressing the SET key (SET) at Setting mode C until Engineering mode D is displayed.
3. Press the UP key (△) until the F.4 screen appears.



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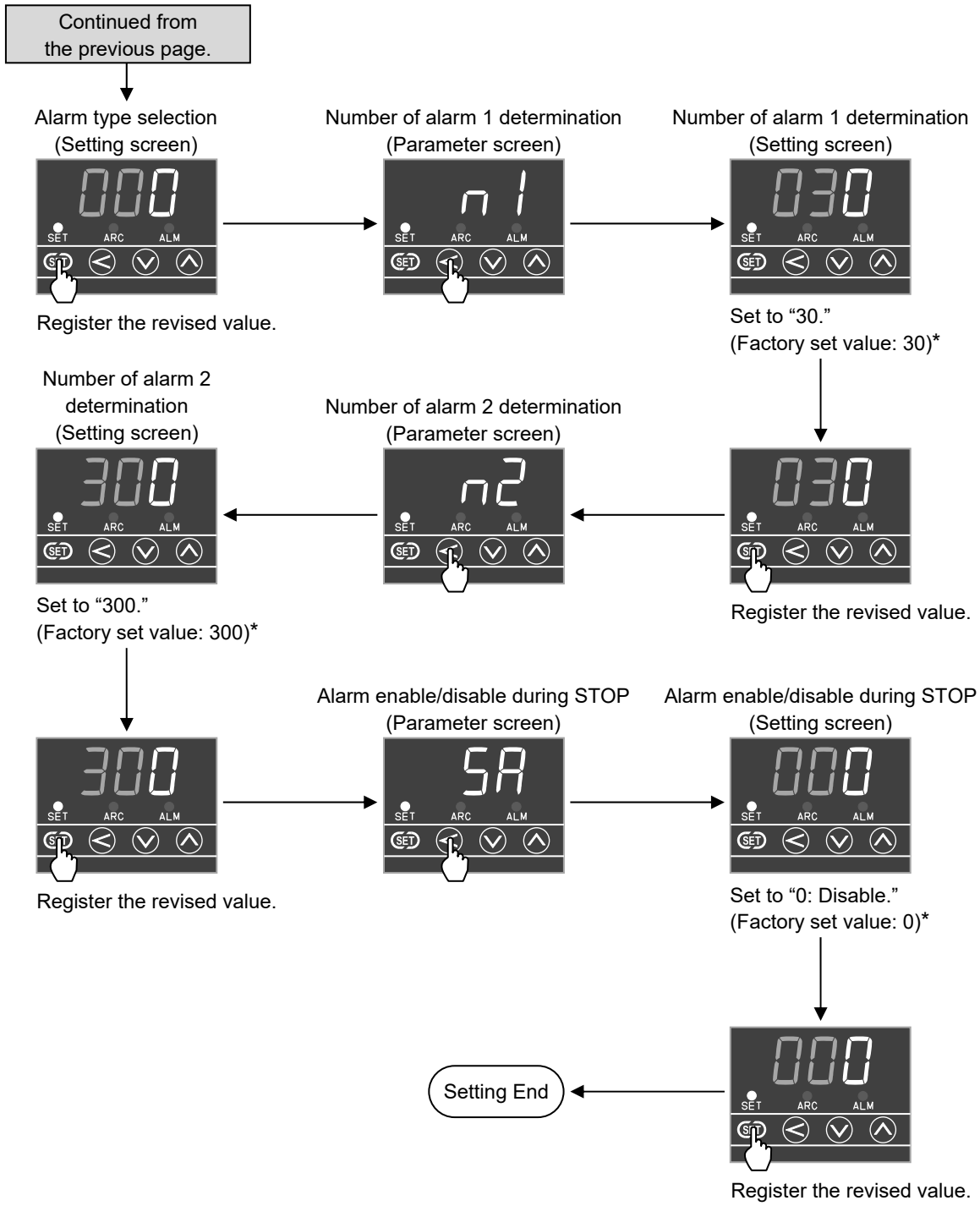


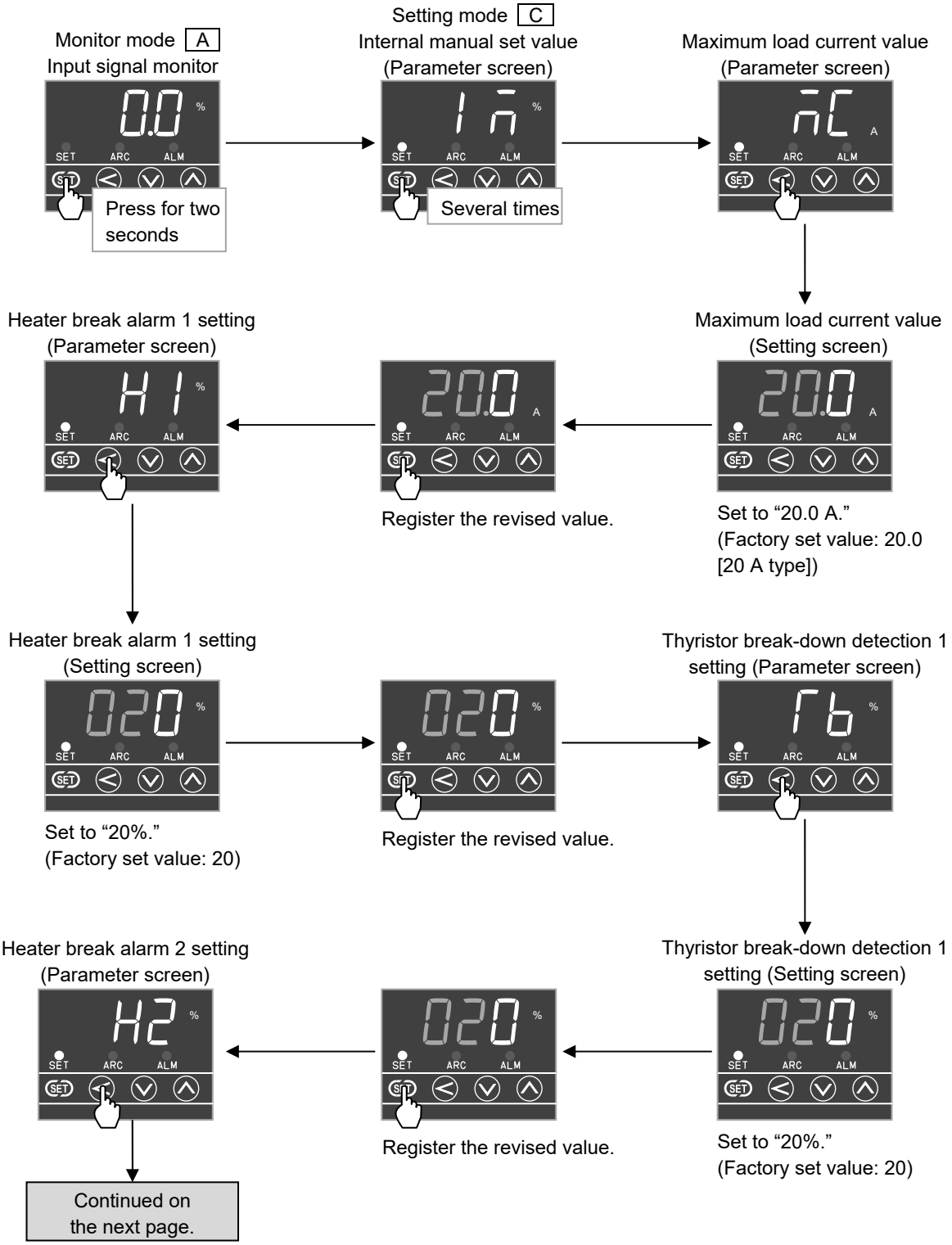
* Here, factory set value is set. However, set any value suitable with your system.

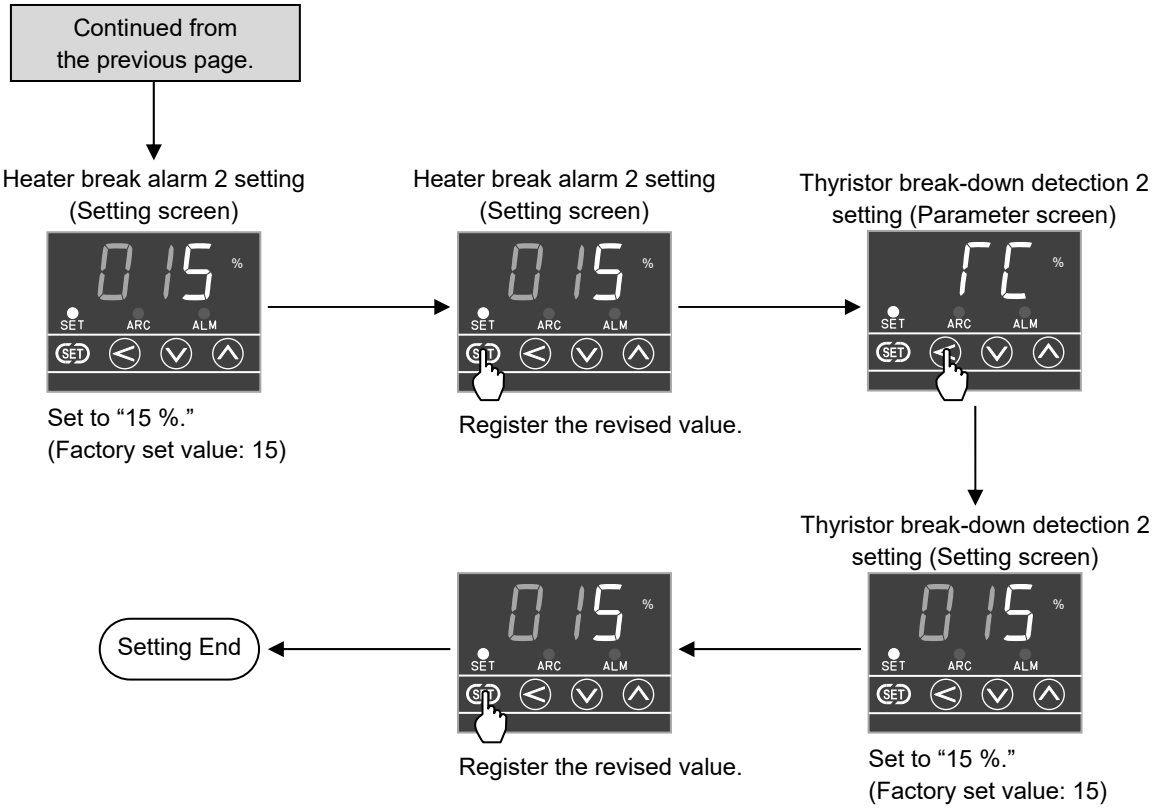
3. Set each alarm set value

NOTE

Before setting the set values of the alarms, check the maximum load current value. If the maximum load current value is not set, heater break judgment cannot be made, and thus it is important to verify that this has been set. In addition, if the correct maximum load current set value is not set, it may cause incorrect operation.

☞ For the maximum load current, refer to **(1) How to Find Maximum Load Current Value (P. 9-21)**.




Continued from the previous page.
Heater break alarm 2 setting (Setting screen)
015
%
SET
ARC
ALM
Set to “15 %.”
(Factory set value: 15)
Heater break alarm 2 setting (Setting screen)
015
%
SET
ARC
ALM
Register the revised value.
Thyristor break-down detection 2 setting (Parameter screen)
rC
%
SET
ARC
ALM
Thyristor break-down detection 2 setting (Setting screen)
015
%
SET
ARC
ALM
Set to “15 %.”
(Factory set value: 15)
015
%
SET
ARC
ALM
Register the revised value.
Setting End

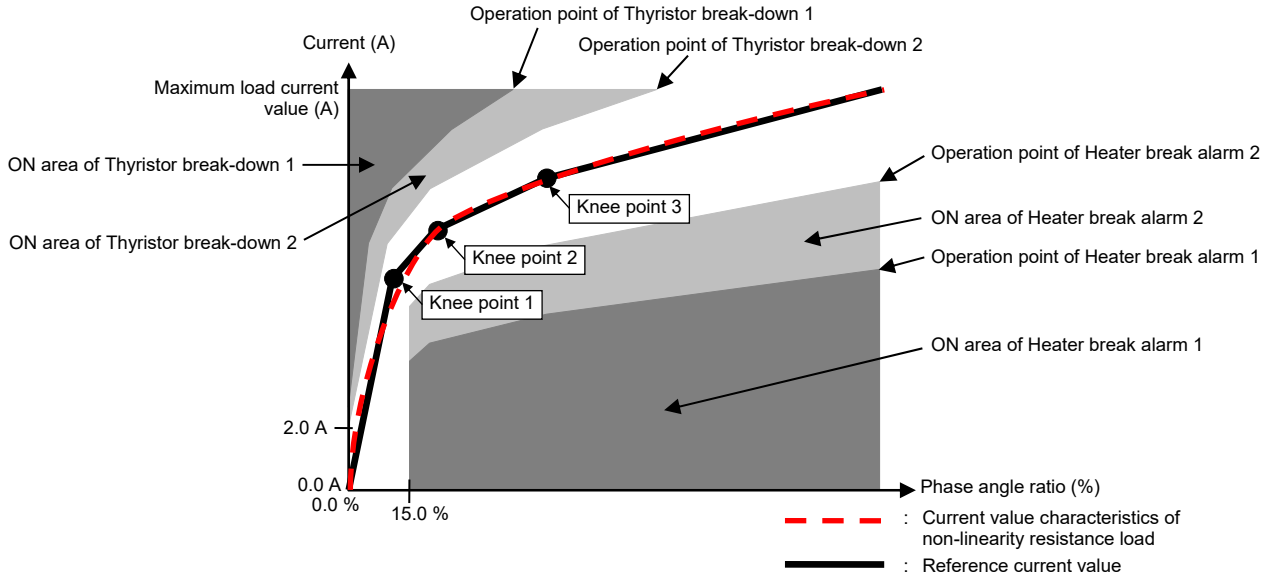
9.2 Non-linear Resistance Heater Break Alarm

NOTE

It may not be possible to use the Non-linear resistance heater break alarm function with some heater types.

9.2.1 Description of function

Non-linear resistance heater break alarm supports phase control. The Non-linear resistance heater break alarm is used to detect breaks in loads with large changes in resistance due to temperature (lamp heaters, etc.). Adjustment is made for the properties of non-linear resistance loads by adding 3 knee points to the computed reference current of the instrument.
You can use the alarm to determine heater break and thyristor break-down. The deviation between the reference current value and the alarm operation point is 0 to 100 % of the reference current or 2 A, whichever is larger. If the condition may attempt to change the set value below 2 A, this instrument makes adjustment to keep the set value 2 A or more.



■ Automatic detection function of knee points

Automatic detection function of knee points is a function to automatically set the following parameters.

Maximum load current value (MC)

Phase angle ratio (K1 to K3) at knee point 1 to 3

Current value (r1 to r3) at knee point 1 to 3

This function adjusts the output of this instrument from 0 % till 100 %, measures the phase angle ratio at knee points 1, 2, and 3 and the current value at the phase angle ratio of 100 %, and automatically rewrites the current values and the maximum load current values of knee points.
When automatic detection is executed with the Current limiter value, Output limiter high, or Soft-start time set, if phase angle ratio different from that before the execution of the automatic detection is measured, phase angle values at knee points 1 through 3 (K1 to K3) are also automatically re-written.

It is recommended to set “Heater break alarm enable/disable (HF)” to “disable” when automatic detection is used.

■ Determination of Heater break alarm and alarm reset

NOTE

To avoiding malfunction of the alarm, the Heater break alarm will not function if the phase angle is less than 15 % (less than15 % of the maximum load current value).

Determination of heater break

While the phase angle is 15 % or more, if the current input value from the current transformer stays within the Heater break alarm ON area continuously for "Number of alarm determination × Power supply 5 cycles *," alarm is generated.

Current transformer input value ≦ {(Reference current value is against the phase angle [A]) × (100 % – Heater break alarm setting [%])}

Determination of alarm release

In case of phase angle 15 % or more, if the input value of the current transformer is outside of the Heater break alarm range for power supply 5 cycles * repeatedly, the alarm is released.

Current transformer input value > {(Reference current value is against the phase angle [A])
× (100 % – Heater break alarm setting [%])} + Differential gap

* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

☞ For the details of differential gap, refer to **9.1.5 Alarm differential gap (P. 9-11).**

■ Determination of Thyristor break-down alarm and alarm release

Determination of Thyristor break-down

If the current input value from the current transformer stays within the Thyristor break-down alarm ON area continuously for "Number of alarm determination × Power supply 5 cycles *," alarm is generated.

Current transformer input value ≧ {(Reference current value is against the phase angle [A])
× (100 % + Thyristor break-down detection setting [%])}

Determination of release of Thyristor break-down alarm

When the input value of the current transformer is outside of the Thyristor break-down alarm range for power supply 5 cycles * repeatedly, the alarm is released.

Current transformer input value < {(Reference current value is against the phase angle [A])
× (100 % + Thyristor break-down detection setting [%])}– Differential gap

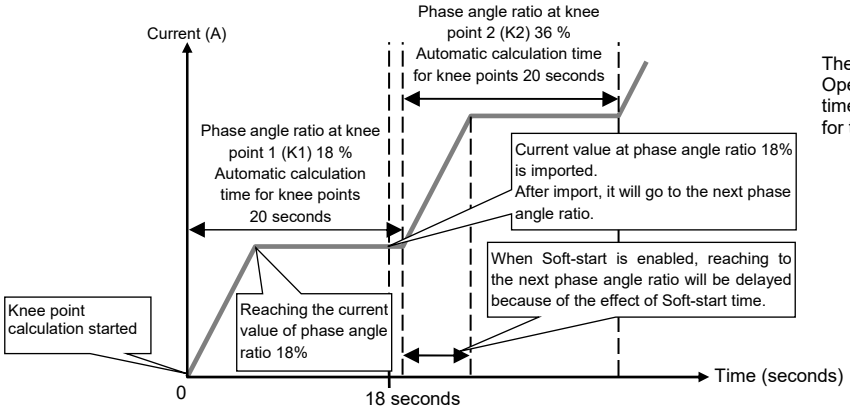
* Power supply 5 cycles: 50 Hz: 20 ms × 5 = 100 ms, 60 Hz: 16.7 ms × 5 = 83.3 ms

☞ For the details of differential gap, refer to **9.1.5 Alarm differential gap (P. 9-11).**

9.2.2 Setting contents

● Automatic calculation time for knee points (HT) [Engineering mode D : Function block 6 (F. 6)]

Set the time until the heater stabilizes as the output time. This instrument takes in current values of each phase angle ratio by changing the phase angle ratio in the order K1, K2, K3 and 100 % before knee point is detected. This requires time until heater gets stable at each phase angle ratio. When the phase angle ratio has reached 90 % of the time required for the knee point calculation, the current is taken, and after the time for the knee point calculation has passed, another phase angle ratio is started.



The Phase angle ratio of knee point in the Operation chart and Automatic calculation time for knee points are factory preset values for the 30A type.

Operation chart

Parameter symbol	Setting range	Factory set value
HT	0 to 1000 seconds (0: Automatic detection function of knee points unused)	20

NOTE

The automatic detection function raises the output of the instrument to 100 %. If you do not want to apply an output of 100 % to the heater, use the Gradient setting, Output limiter, or Current limit to limit the output.

This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, or Constant current control function and Protection function for control of primary side of a transformer.

When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

● Automatic detection of knee points (HU) [Engineering mode D : Function block 6 (F. 6)]

Conduct automatic detection of knee points. Set to "1: ON" will start automatic detection of knee points. When Automatic detection starts, the ARC lamp lights up. After the automatic detection is completed, the set value returns to "0: OFF" automatically. If automatic detection is aborted, the setting becomes "2: Aborted."

NOTE

- **It may not be possible to use the Non-linear resistance heater break alarm function with some heater types.**
- **Use the Non-linear resistance heater break alarm function in a system with a current capacity of 10 A or more. Current measurement error is ±1.5 A (for 20 A and 30 A types) or within ±5 % of rated current (for 45 A or larger types). If this instrument is used with low current level, the knee point may be calculated within the error range of the current measurement.**
- **During the automatic detection of knee points, heater break alarm or thyristor break-down alarm may be generated. To suppress the heater break alarm or thyristor break-down alarm during the automatic detection, set the Heater break alarm enable/disable (HF) to "Disable."**

Parameter symbol	Setting range	Factory set value
HU	0: OFF 1: ON 2: Aborted (Not settable)	0

This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

■ Abort conditions for the automatic detection of knee points

Automatic detection of knee points is aborted because of the following reasons:

Factor	Status during abort	Set value
Mode has been switched from RUN to STOP during the automatic detection.	Aborted	Not updated (The value remains the same as before the automatic detection of knee point was conducted)
Setting of knee points automatic detection has been set to "0: OFF" during the automatic detection	OFF	
Control mode for phase control has been switched from Phase control to Zero-cross control during the automatic detection.	Aborted	
Current limiter value was changed during the automatic detection.		
Limit value of Output limiter high was changed during the automatic detection.		
Phase angle ratio of knee point was changed during the automatic detection.		
Automatic calculation time for knee points was changed during the automatic detection.		
FAIL alarm occurred during the automatic detection.		
Over current alarm occurred.		

* If FAIL occurs due to watchdog timer, automatic detection abort condition is not met.

● Phase angle ratio at knee point 1 (K1) [Engineering mode D : Function block 6 (F. 6)]

The horizontal axis position of knee point 1 is set by the Phase angle ratio (%).
Phase angle ratio at knee point 1 (K1) can be automatically calculated by the Automatic detection function of knee points.

Parameter symbol	Setting range	Factory set value
K1	0 to 100 %	18

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

📖 When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

● Current value at knee point 1 (r1) [Engineering mode D : Function block 6 (F. 6)]

The vertical axis position of knee point 1 is set by the Current value. This is used when the knee point 1 is set manually.

📖 **NOTE**

When setting the current value of the knee point, set a value that is less than the current value of the Maximum load current set value for alarm.
If a value greater than the current value of the Maximum load current set value for alarm is set, the alarm function will not operate normally.

Parameter symbol	Setting range	Factory set value
r1	0.0 to 32.0 A (20 A type)	3.6
	0.0 to 32.0 A (30 A type)	5.4
	0.0 to 55.0 A (45 A type)	8.1
	0 to 70 A (60 A type)	11
	0 to 90 A (80 A type)	14
	0 to 110 A (100 A type)	18

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

📖 When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

● Phase angle ratio at knee point 2 (K2) [Engineering mode D : Function block 6 (F. 6)]

The horizontal axis position of knee point 2 is set by the Phase angle ratio (%).
Phase angle ratio at knee point 2 (K2) can be automatically calculated by the Automatic detection function of knee points.

Parameter symbol	Setting range	Factory set value
K2	0 to 100 %	36

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

📖 When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

● Current value at knee point 2 (r2) [Engineering mode D : Function block 6 (F. 6)]

The vertical axis position of knee point 2 is set by the Current value. This is used when the knee point 2 is set manually.

📖 **NOTE**

When setting the current value of the knee point, set a value that is less than the current value of the Maximum load current set value for alarm.
If a value greater than the current value of the Maximum load current set value for alarm is set, the alarm function will not operate normally.

Parameter symbol	Setting range	Factory set value
r2	0.0 to 32.0 A (20 A type)	7.2
	0.0 to 32.0 A (30 A type)	10.8
	0.0 to 55.0 A (45 A type)	16.2
	0 to 70 A (60 A type)	22
	0 to 90 A (80 A type)	29
	0 to 110 A (100 A type)	36

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

📖 When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

● Phase angle ratio at knee point 3 (K3) [Engineering mode D : Function block 6 (F. 6)]

The horizontal axis position of knee point 3 is set by the Phase angle ratio (%).
Phase angle ratio at knee point 3 (K3) can be automatically calculated by the Automatic detection function of knee points.

Parameter symbol	Setting range	Factory set value
U3	0 to 100 %	56

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

📖 When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

● Current value at knee point 3 (r3) [Engineering mode D : Function block 6 (F. 6)]

The vertical axis position of knee point 3 is set by the Current value. This is used when the knee point 3 is set manually.

📖 **NOTE**

When setting the current value of the knee point, set a value that is less than the current value of the Maximum load current set value for alarm.
If a value greater than the current value of the Maximum load current set value for alarm is set, the alarm function will not operate normally.

Parameter symbol	Setting range	Factory set value
r3	0.0 to 32.0 A (20 A type)	11.2
	0.0 to 32.0 A (30 A type)	16.8
	0.0 to 55.0 A (45 A type)	25.2
	0 to 70 A (60 A type)	34
	0 to 90 A (80 A type)	45
	0 to 110 A (100 A type)	56

📖 This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.

📖 When Zero-cross control is used, the Non-linear resistance heater break alarm function cannot be used.

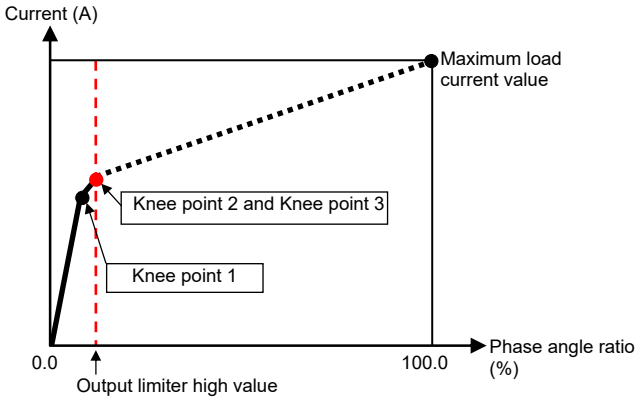
9.2.3 Setting example of Non-linear resistance heater break alarm

■ Precautions for using Non-linear resistance heater break alarm

- It may not be possible to use the Non-linear resistance heater break alarm function with some heater types.
- During the Automatic detection of knee points, the Output mode may be temporarily Proportional phase angle to input even if the output mode is set to other than Proportional phase angle to input.
- If you do not want to apply an output of 100 % to the heater, use the gradient setting, Output limiter, or Current limiter to limit the output. However, when the output is limited by the Output limiter high, the Output mode may be temporarily Proportional phase angle to input. If the instrument is used in Proportional voltage to input or Proportional square voltage (electric power) to input, it is required to calculate the Output limiter high in the Proportional phase angle to input.
  In case of Constant voltage control and Power proportional control, this calculation is not possible. Limit the output using the Current limiter.
- When the Automatic detection of knee point is executed with the output limited by Output limiter high or Current limiter, the calculation result may be as follows if the knee point or the maximum load current value is above the limiter point.

Output limiter high

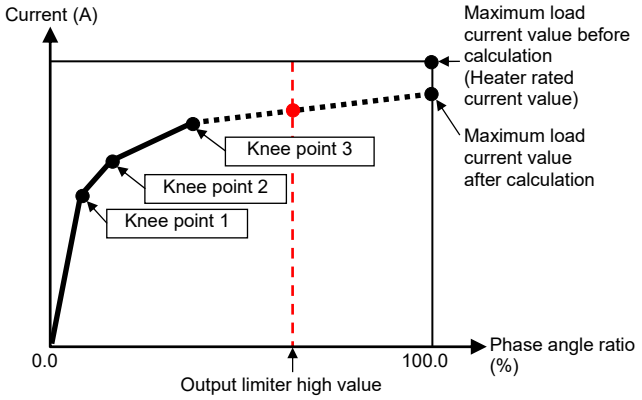
In case Output limiter high is set at any point below the knee point 3.



Explanation of the left figure
When the value of Output limiter high is set at any point below the knee point 3, the line between the value of Output limiter high and the maximum load current value is the reference current value.

For the knee point 1, Phase angle ratio and Current value at knee point 1 are automatically calculated.
For knee points 2 and 3, Phase angle ratio and the current value around the Output limiter high are automatically calculated.
The maximum load current value is not updated.

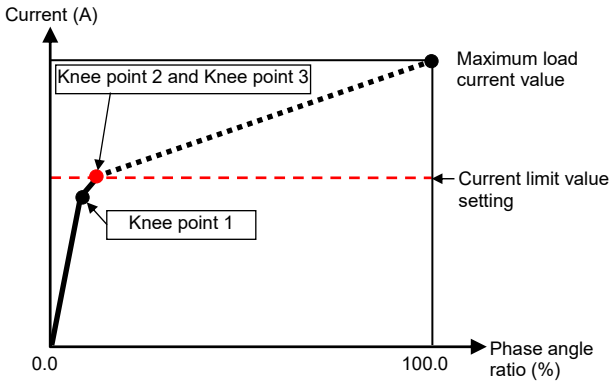
In case the Output limiter high value is set anywhere between the knee point 3 and the maximum load current.



Explanation of the left figure
For the knee points 1 to 3, Phase angle ratio and Current value of knee points are automatically calculated.
For the maximum load current, the current value is automatically calculated from the gradient of the straight line drawn between the Knee point 3 and the Output limiter high value.

Current limit

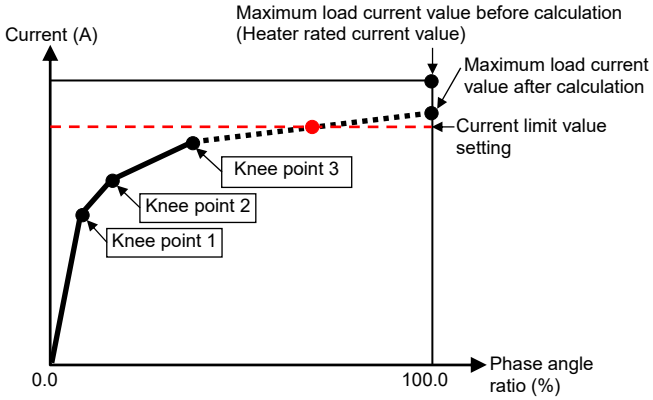
In case Current limiter value is set at any point below the knee point 3.



Explanation of the left figure
When the Current limit value is set at any point below the knee point 3, the line between the Current limit value and the maximum load current value is the reference current value.

For the knee point 1, Phase angle ratio and Current value at knee point 1 are automatically calculated.
For knee points 2 and 3, Phase angle ratio and the current value around the Current limiter value are automatically calculated.
The maximum load current value is not updated.

In case the Current limiter value is set anywhere between the knee point 3 and the maximum load current.



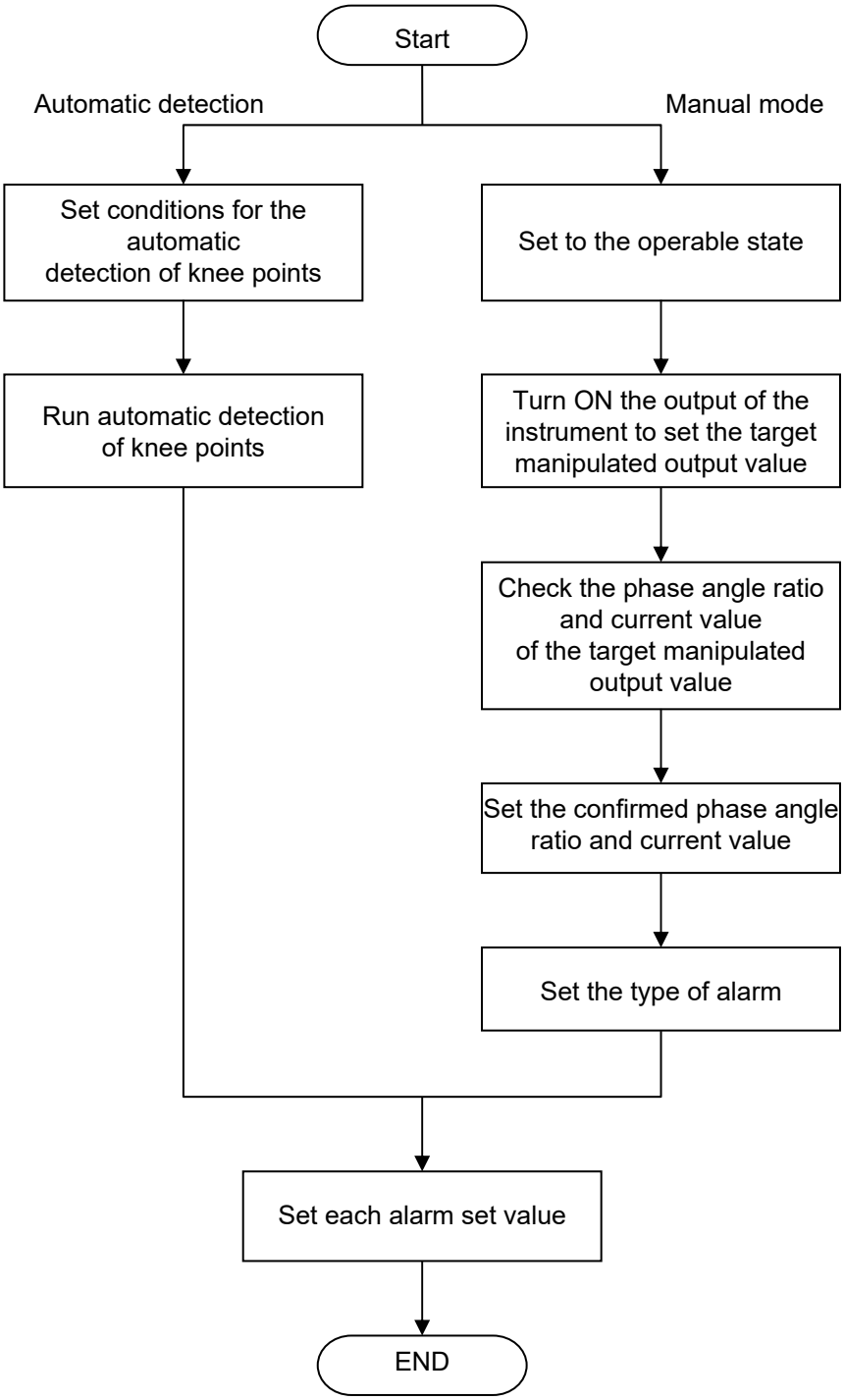
Explanation of the left figure
For the knee points 1 to 3, Phase angle ratio and Current value of knee points are automatically calculated.
For the maximum load current, the current value is automatically calculated from the gradient of the straight line drawn between the Knee point 3 and the current limiter value.

- When manually setting Knee points, set the “Phase angle ratio at knee point” and “Current value at knee point” for each Knee point in order from the Knee point with the smallest phase angle ratio.
  - Set the knee point with the smallest phase angle ratio by setting “Phase angle ratio at knee point 1 (K1)” and “Current value at knee point 1 (r1).”
  - Set the knee point with the intermediate phase angle ratio by setting “Phase angle ratio at knee point 2 (K2)” and “Current value at knee point 2 (r2).”
  - Set the knee point with the largest phase angle ratio by setting “Phase angle ratio at knee point 3 (K3)” and “Current value at knee point 3 (r3).”
- Modifying any of the following items during the Automatic detection of knee points, the automatic detection is aborted. If the automatic detection is aborted, the Phase angle ratio and the Current value of the knee point are not updated.
  - Current limit value setting (CL)
  - Control method (CM)
  - RUN/STOP transfer (RS)
  - Output limiter high (LH)
  - Automatic calculation time for knee points (HT)
  - Automatic detection of knee points (HU)
  - Phase angle ratio at knee point 1 to 3 (K1 to K3)

- The following input signals are disregarded during automatic calculation of the Knee point.
  - Automatic set value (Input signal from controller)
  - External manual set value (Input signal from external manual setter)
  - Internal manual set value (Set by the front keys)
- When the following alarm has occurred during the automatic detection of knee points, the automatic detection is aborted. If the automatic detection is aborted, the Phase angle ratio and the Current value of the knee point are not updated.
  - When the FAIL alarm has occurred
  - When the Over current alarm has occurred

■ Setting procedure

Non-linear resistance heater break alarm can be set in two ways: One is the Automatic detection of the phase angle ratio and the Current value of the knee point. The other is Manual setting.
If Heater break and Thyristor break-down cannot be properly detected with the Phase angle ratio and the Current value of the knee points automatically detected, set the knee points manually.



■ Setting method when automatically detecting the knee points

Preparation prior to the Automatic detection of the knee points

Set the following parameters before calculating the knee point.

Mode	Symbol		Name	Description
Setting mode C	SU	(SU)	Soft-start time	Set the actual values that are used.
	Sd	(Sd)	Soft-down time	Set the actual values that are used.
	nC	(MC)	Maximum load current value	Set rated current of heater.
	CL	(CL)	Current limit value setting	Set the actual values that are used.
Engineering mode D F.2	Cn	(CM)	Control method	Set to "0: Phase control."
	rS	(rS)	RUN/STOP transfer	Set to "1: RUN (Output ON)."
Engineering mode D F.3	LH	(LH)	Output limiter high	When the Output mode for phase control is used for Proportional phase angle to input: Set the Output limiter high value which is to be used. When the Output mode for phase control is used for Proportional voltage to input or Proportional square voltage (electric power) to input: Set the Output limiter high value obtained from the conversion table. (Refer to **9.2.4 Conversion table for output limiter high value at the time of automatic detection of knee points (P. 9-47) for details**.) During the automatic detection of knee points, regardless of the Output mode for phase control (OS), the instrument is operated with the Phase angle ratio to input to detect the knee points. It is necessary to convert the Output limiter high value now used by the user to the Output limiter high value for the Proportional phase angle to input. When the Output mode for phase control is used for Constant current control: Conversion is not available in case of Constant current control and Power proportional control.

Continued on the next page.

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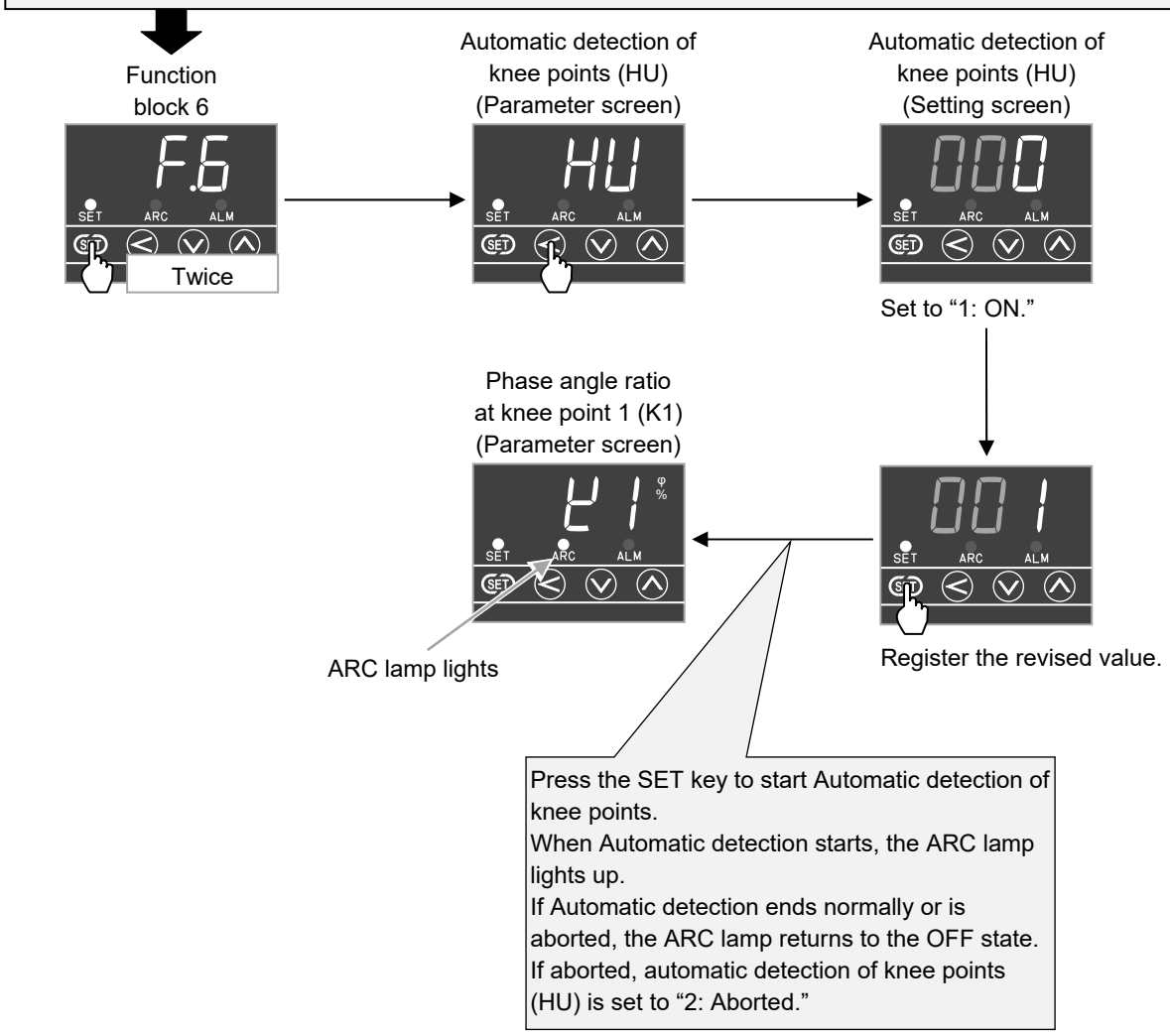
Mode	Symbol		Name	Description
Engineering mode D F.4	A1	(A1)	Alarm type selection	Set to "2: Non-linear resistance heater break alarm (Non-linear resistance type, deviation alarm)." (This item may be set after completion of the Automatic detection of the knee points.)
Engineering mode D F.6	HT	(HT)	Automatic calculation time for knee points	Set the actual values that are used. In case heater temperature characteristics are not stable, extend the output time longer.

Starting Automatic detection of knee points

Execute the "Automatic detection of knee points (HU)" at F.6 in the Engineering mode [D] to automatically detect the knee points.

☞ The Engineering mode [D] is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.6 screen appears.



Setting alarm set value

Set each alarm referring to "***3.* Set each alarm set value" (P. 9-28)**.

■ Set to manually check the knee points

To manually check the Phase angle ratio and Current value of knee points, enter control signal via either Auto mode or Manual mode, to output the desired value. In this example, Internal manual mode is used for explanation.
Determine three Internal manual set values.

Preparation before check

Set the External gradient and the following parameters before checking the Phase angle ratio and Current value of knee points.
Determine the Internal manual set values for setting the desired knee point.

• External gradient setting

If an External gradient setter is used, set the External gradient set value to the actually used value.

• Parameter settings

Mode	Symbol		Name	Description
Setting mode C	IG	(IG)	Internal gradient set value	Set the actual values that are used.
	SU	(SU)	Soft-start time	Set the actual values that are used.
	Sd	(Sd)	Soft-down time	Set the actual values that are used.
	nC	(MC)	Maximum load current value	Check the maximum load current value and set it here. (Refer to **P. 9-21**)
	CL	(CL)	Current limit value setting	Set the actual values that are used.
Engineering mode D F.2	Cn	(CM)	Control method	Set to "0: Phase control."
	rS	(rS)	RUN/STOP transfer	Set to "1: RUN (Output ON)."
	SF	(SF)	Soft-start, Soft-down enable/disable	Set the actual values that are used.
Engineering mode D F.3	oS	(oS)	Output mode for phase control	Set the actual values that are used.
	LH	(LH)	Output limiter high	Set the actual values that are used.
	LL	(LL)	Output limiter low	Set the actual values that are used.
	bU	(bU)	Base-up set value	Set the actual values that are used.

• Internal manual set value

Determine three Internal manual set values where you wish to set knee points.
In this example, we assume that the Internal manual set values are 22.1 %, 55.4 % and 83.3 %.

Set knee points manually

☞ For selecting mode, refer to **5.1 Switching the Mode (P. 5-2)**.

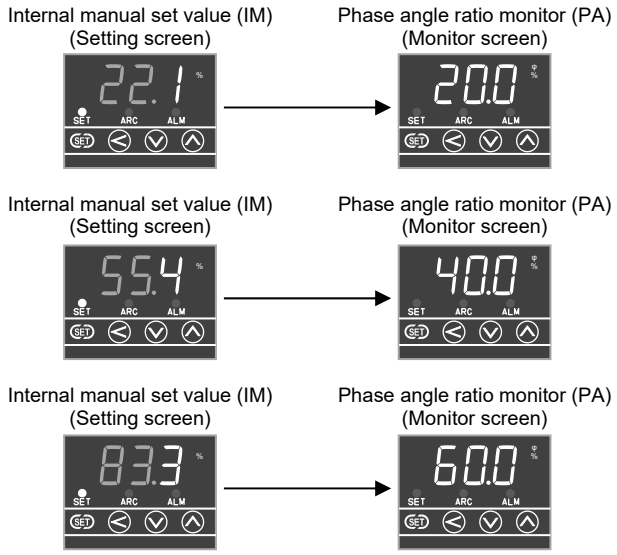
☞ For switching between monitor screen and parameters, refer to **5.4 List of Parameter Operation (P. 5-10)**.

☞ For setting numeric values, refer to **5.3 Changing and Registering the Set Value (P. 5-8)**.

1. Before setting the Knee points, make sure necessary conditions are set, referring to the **Preparation before check (P. 9-44)**.

2. Check and write down the Phase angle ratio and Current values.
Set the Internal manual set values previously determined to the Internal manual set value (IM) in Setting mode [C], and write down the Phase angle ratio and the Current value.
The Phase angle ratio can be checked on the "Phase angle ratio monitor (PA)" and the current value on the "CT input monitor (CT)."
(In this example, we set 22.1 %, 55.4 % and 83.3 % in turns).

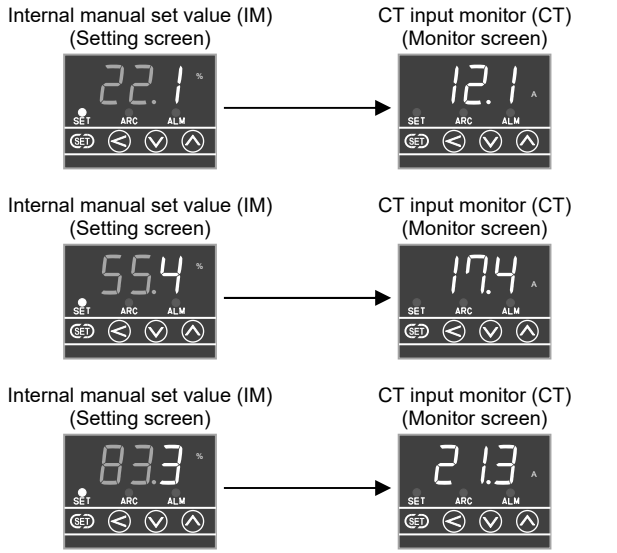
Display example of Phase angle ratio



Record the Phase angle ratio

Internal manual set value	Phase angle ratio*
22.1 %	20.0 %
55.4 %	40.0 %
83.3 %	60.0 %

Display example of Current value



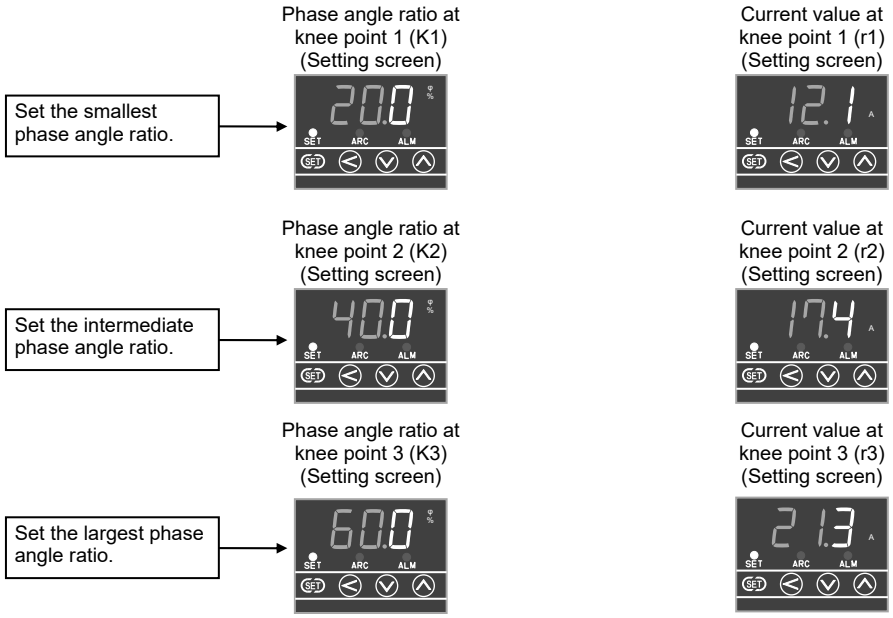
Record the Current value

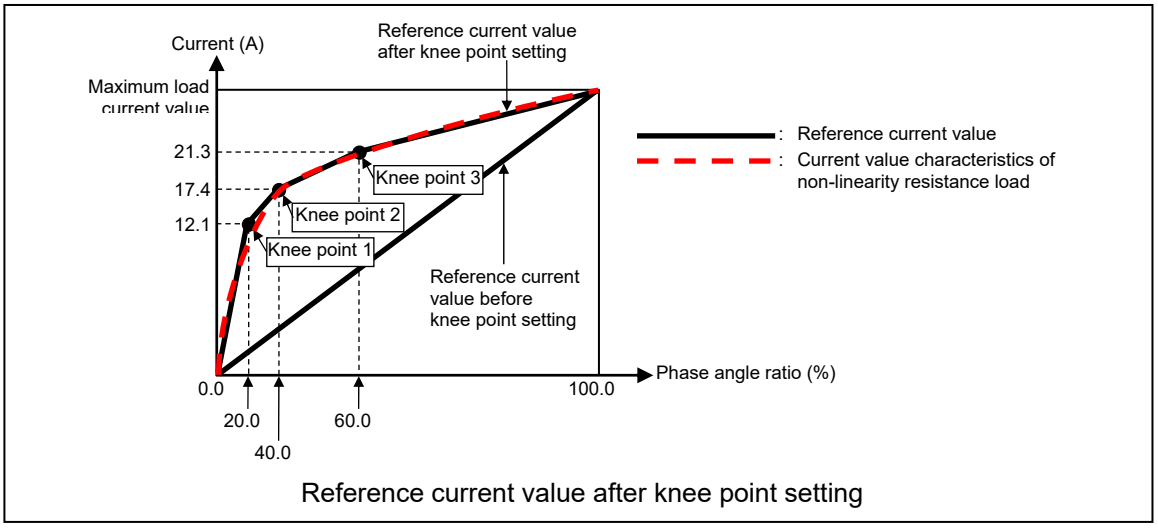
Internal manual set value	Current value*
22.1 %	12.1 A
55.4 %	17.4 A
83.3 %	21.3 A

* Phase angle ratio and Current value in the table are examples.
Actual heater values will be different.

3. Set the written down Phase angle ratio and current value. Set the "Phase angle ratio of knee point" and the "Current value of knee point" from the knee point with the smallest phase angle.

Engineering mode D F.6





4. Set alarm type to Non-linear resistance heater break alarm.
Call Alarm type selection (A1) at F.4 in the Engineering mode D, and set "2: Non-linear resistance heater break alarm (Non-linear resistance type, deviation alarm)."
Setting "2" enables Non-linear resistance heater break alarm.

This completes the manual setting of knee points.

Setting alarm set value

Set each alarm referring to **"*3.* Set each alarm set value" (P. 9-28)**.

9.2.4 Conversion table for output limiter high value at the time of automatic detection of knee points

The function of automatic detection of knee points is used to perform automatic detection according to the Proportional phase angle to input. After the knee points have been successfully calculated, if the customer wants to use them in the Proportional voltage to input or the Proportional square voltage (electric power) to input, convert the Output limiter high value set during automatic detection to the Output limiter high value for the Proportional phase angle mode, and set this value. Refer to the conversion table below to determine the output limiter high value for the Proportional phase angle mode.

NOTE

After the knee points have been successfully calculated, set the Output limiter high value back to the original value used in the Proportional voltage to input or the Proportional square voltage (electric power) to input.

■ Setting example of Output limiter high value

Example: When the instrument is used with the Proportional voltage to input and when the Output limiter high value is set to “40.0%”

1. Look for a value close to 40.0 % in the conversion table from the column of the Proportional voltage to input. In this example, “40.25 %” would be the nearest value (Refer to **P. 9-48**).

2. Look for a value that is converted to the value for the Proportional phase angle.
In the conversion table, refer to the value in the same row as the Proportional voltage to input.
In this case the nearest value for the Proportional phase angle is “31.00 %.”

3. Set “31.0” to the Output limiter high value before executing the automatic detection of knee points.

● Conversion table

Output mode		
Proportional voltage to input	Proportional square voltage (electric power) to input	Proportional phase angle to input
0.00 %	0.00 %	0.00 %
0.26 %	0.00 %	1.00 %
0.73 %	0.01 %	2.00 %
1.33 %	0.02 %	3.00 %
2.05 %	0.04 %	4.00 %
2.86 %	0.08 %	5.00 %
3.76 %	0.14 %	6.00 %
4.73 %	0.22 %	7.00 %
5.77 %	0.33 %	8.00 %
6.87 %	0.47 %	9.00 %
8.03 %	0.65 %	10.00 %
9.25 %	0.86 %	11.00 %
10.51 %	1.11 %	12.00 %
11.82 %	1.40 %	13.00 %
13.18 %	1.74 %	14.00 %
14.57 %	2.12 %	15.00 %
16.01 %	2.56 %	16.00 %
17.47 %	3.05 %	17.00 %
18.97 %	3.60 %	18.00 %
20.50 %	4.20 %	19.00 %

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Conversion table

Output mode		
Proportional voltage to input	Proportional square voltage (electric power) to input	Proportional phase angle to input
22.05 %	4.86 %	20.00 %
23.63 %	5.58 %	21.00 %
25.23 %	6.37 %	22.00 %
26.85 %	7.21 %	23.00 %
28.49 %	8.12 %	24.00 %
30.14 %	9.08 %	25.00 %
31.81 %	10.12 %	26.00 %
33.48 %	11.21 %	27.00 %
35.17 %	12.37 %	28.00 %
36.86 %	13.58 %	29.00 %
38.55 %	14.86 %	30.00 %
40.25 %	16.20 %	31.00 %
41.95 %	17.60 %	32.00 %
43.65 %	19.05 %	33.00 %
45.35 %	20.56 %	34.00 %
47.04 %	22.12 %	35.00 %
48.72 %	23.74 %	36.00 %
50.40 %	25.40 %	37.00 %
52.06 %	27.11 %	38.00 %
53.72 %	28.86 %	39.00 %
55.36 %	30.65 %	40.00 %
56.98 %	32.47 %	41.00 %
58.59 %	34.33 %	42.00 %
60.19 %	36.22 %	43.00 %
61.76 %	38.14 %	44.00 %
63.31 %	40.08 %	45.00 %
64.84 %	42.04 %	46.00 %
66.35 %	44.02 %	47.00 %
67.83 %	46.01 %	48.00 %
69.28 %	48.00 %	49.00 %
70.71 %	50.00 %	50.00 %
72.11 %	52.00 %	51.00 %
73.48 %	53.99 %	52.00 %
74.82 %	55.98 %	53.00 %
76.13 %	57.96 %	54.00 %
77.41 %	59.92 %	55.00 %
78.65 %	61.86 %	56.00 %
79.86 %	63.78 %	57.00 %
81.04 %	65.67 %	58.00 %
82.18 %	67.53 %	59.00 %
83.28 %	69.35 %	60.00 %
84.35 %	71.14 %	61.00 %
85.38 %	72.89 %	62.00 %
86.37 %	74.60 %	63.00 %
87.33 %	76.26 %	64.00 %
88.25 %	77.88 %	65.00 %
89.13 %	79.44 %	66.00 %
89.97 %	80.95 %	67.00 %

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Conversion table

Output mode		
Proportional voltage to input	Proportional square voltage (electric power) to input	Proportional phase angle to input
90.77 %	82.40 %	68.00 %
91.54 %	83.80 %	69.00 %
92.27 %	85.14 %	70.00 %
92.96 %	86.42 %	71.00 %
93.61 %	87.63 %	72.00 %
94.23 %	88.79 %	73.00 %
94.81 %	89.88 %	74.00 %
95.35 %	90.92 %	75.00 %
95.86 %	91.88 %	76.00 %
96.33 %	92.79 %	77.00 %
96.76 %	93.63 %	78.00 %
97.17 %	94.42 %	79.00 %
97.54 %	95.14 %	80.00 %
97.88 %	95.80 %	81.00 %
98.18 %	96.40 %	82.00 %
98.46 %	96.95 %	83.00 %
98.71 %	97.44 %	84.00 %
98.93 %	97.88 %	85.00 %
99.13 %	98.26 %	86.00 %
99.30 %	98.60 %	87.00 %
99.45 %	98.89 %	88.00 %
99.57 %	99.14 %	89.00 %
99.68 %	99.35 %	90.00 %
99.76 %	99.53 %	91.00 %
99.83 %	99.67 %	92.00 %
99.89 %	99.78 %	93.00 %
99.93 %	99.86 %	94.00 %
99.96 %	99.92 %	95.00 %
99.98 %	99.96 %	96.00 %
99.99 %	99.98 %	97.00 %
100.00 %	99.99 %	98.00 %
100.00 %	100.00 %	99.00 %
100.00 %	100.00 %	100.00 %

9.3 Power Frequency Monitoring Function

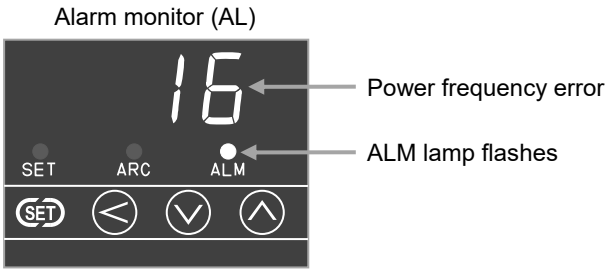
9.3.1 Description of function

When the instrument is powered on, the power supply frequency is checked for 50 Hz or 60 Hz and if the power supply frequency deviates from the detection range, an error is generated. In case the power supply frequency cannot be checked, an error is also generated.

Normal frequency range: 45.0 to 54.9 Hz (50 Hz)
55.0 to 64.9 Hz (60 Hz)

Abnormal frequency range: 40.0 to 44.9 Hz, 55.0 to 70.0 Hz (50 Hz)
40.0 to 54.9 Hz, 65.0 to 70.0 Hz (60 Hz)

Actions on failure of detection: ALM lamp flashes
THV-10 output OFF
"16 (Power frequency error)" is displayed on the Alarm monitor (AL)
(The output can be turned ON when the error is canceled.)



If the power frequency returns to the normal range, the alarm monitor is cleared, and the output of this instrument is also automatically released. However, if an error is determined when the instrument is turned ON, turn OFF the instrument after the power frequency returns to the normal range, and then turn it ON again.

About soft-start and soft-down
In the case of a Power frequency error, the output of this instrument is turned OFF, but the Soft-down function is forcibly deactivated. When recovering from a Power frequency error, the instrument immediately returns to the normal computation output state. At this time, the Soft-start function is not activated.

This function is enabled at all times. The function cannot be disabled.

9.3.2 Display items

- **Alarm monitor (AL)**
  [Monitor mode A]

Parameter symbol	Setting range
AL	0 to 191 0: None 1: Heater break alarm 1 2: Thyristor break-down alarm 1 4: Heater break alarm 2 8: Thyristor break-down alarm 2 16: Power frequency error 32: Over current alarm 128: FAIL

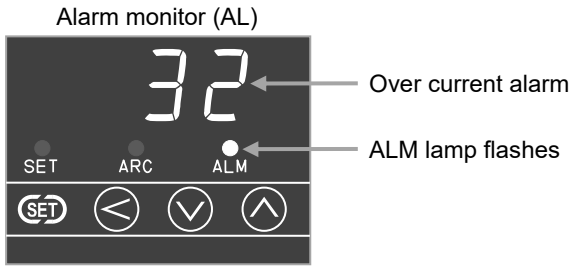
9.4 Over Current Alarm Function

9.4.1 Description of function

This is a function to protect the thyristor element by detecting the over current. In case current 1.2 times larger than the current rating flows into the instrument, the over current alarm is generated.

Current value 1.2 times larger than the current rating: 20 A type: 24 A
30 A type: 36 A
45 A type: 54 A
60 A type: 72 A
80 A type: 96 A
100 A type: 120 A

Actions on failure of detection: ALM lamp flashes
THV-10 output OFF
"32 (Over current alarm)" is displayed on the alarm monitor (AL)



■ Over current alarm judgment conditions

Judgment conditions for the alarm to turn ON

If all of the following conditions are satisfied, Over current alarm is turned on.

- Over current alarm enable/disable (oF) is set to "Enable."
- Current 1.2 times larger than the current rating of this instrument is detected six times in a row.

Judgment conditions for the alarm to turn OFF

If all of the following conditions are satisfied, Over current alarm is turned off.

- The instrument is powered off and powered on again.
- The detected current value is smaller than the Over current alarm detection value by six times in a row in the STOP state when the Alarm enable/disable during STOP (SA) is set to "Disable."

■ Actions related to Over current alarm

Actions when the alarm turns ON

- Alarm monitor (AL) shows 32 (Over current alarm).
- When Over current alarm is specified in the Alarm output logic (L1), the alarm output turns ON.
- The output from this instrument is turned OFF.

Actions when the alarm turns OFF

- The Alarm monitor (AL) shows zero again.
- When Over current alarm is specified in the Alarm output logic (L1), the alarm output turns OFF.
- The output from this instrument is turned ON.

■ About enable/disable of actions related to Over current alarm

Depending on the “Alarm enable/disable during STOP (SA)” and the RUN/STOP state, the actions related to Over current alarm are as described below.

Over current alarm enable/disable (oF)	Alarm enable/disable during STOP (SA)	RUN/STOP transfer	Actions related to Over current alarm	
			Activation (ON)	Deactivation (OFF)
Enable	Enable	RUN	Judged	Not judged
		STOP	Judged	Not judged
	Disable	RUN	Judged	Not judged
		STOP	Not judged	Judged
Disable	Enable	RUN	Not judged	Judged
		STOP	Not judged	Judged
	Disable	RUN	Not judged	Judged
		STOP	Not judged	Judged

9.4.2 Setting contents

● Over current alarm enable/disable (oF) [Engineering mode D : Function block 2 (F. 2)]

This setting is used to enable or disable the Over current alarm. Disabling this function will not activate the Over current alarm.

Parameter symbol	Setting range	Factory set value
oF	0: Disable 1: Enable	1

- If Over current alarm enable/disable is set in the Contact input (DI) function assignment (C1), the set value cannot be changed.
- This setting becomes active when the instrument is supplied with Heater break alarm (or Non-liner resistance heater break alarm), Current limit function, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer.
- Disabling the Over current alarm while the Over current alarm is on will not release the alarm.

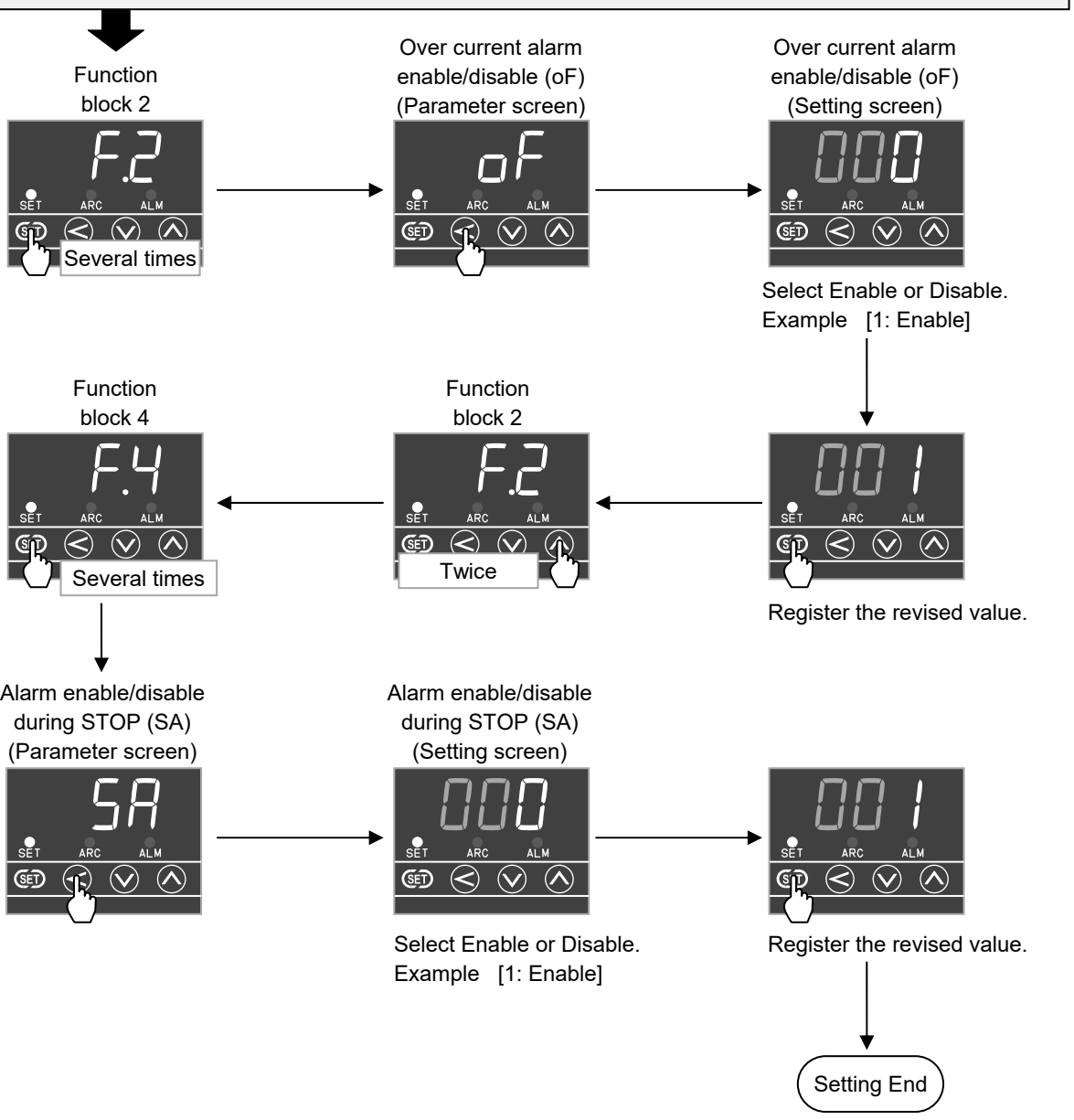
● Alarm enable/disable during STOP (SA) [Engineering mode D : Function block 4 (F.4)]

Parameter symbol	Setting range	Factory set value
SA	0: Disable 1: Enable	0

9.4.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

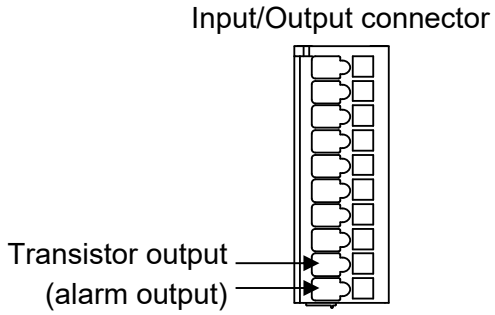
1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.2 screen appears.



9.5 Alarm Output

9.5.1 Description of function

This is a function that outputs an alarm signal from transistor output when the alarm occurrence conditions are satisfied. The type of the alarm to output can be selected from Alarm output logic (L1). Also, if necessary, energized/de-energized of alarm output, and whether to enable or disable alarm output when the instrument is in the STOP state can be selected.



9.5.2 Setting contents

- **Alarm output logic (L1)**
  [Engineering mode D : Function block 4 (F. 4)]

Set the output alarm type from the alarm terminal on the Input/Output connector. To have outputs from two or more alarms, set the sum of the setting values as logical OR. For example, to have a logical OR output of "1: Heater break alarm 1" and "2: Thyristor break-down alarm 1," set "3" as a result of "1 + 2."

Parameter symbol	Setting range	Factory set value
L 1	0 to 191 0: No output 1: Heater break alarm 1 2: Thyristor break-down alarm 1 4: Heater break alarm 2 8: Thyristor break-down alarm 2 16: Power frequency error 32: Over current alarm 128: FAIL (fixed at de-energized)	0

If FAIL output is set, all alarm outputs are de-energized. If energizing type output is required, do not include the FAIL output to the alarm output logic.

To generate the alarm signal, you need to specify the instrument to be supplied with “A: with one alarm output” at the time of ordering.

To generate alarm outputs of Heater break alarm, Thyristor break-down alarm, or Over current alarm, you need to specify the instrument to be supplied with “A: with one alarm output” and “Heater break alarm (or Heater break alarm suitable for non-linear resistance), Current limiter, Constant current control, Power proportioning control, and Protection function for control of primary side of a transformer” at the time of ordering.

Regardless of whether the Alarm monitor (AL) and ALM lamp are set to Alarm output logic (L1) or Selection of alarm output energized/de-energized (nA), the operation described below is performed when an alarm occurs.

Alarm type	Error No.	ALM lamp
Heater break alarm 1	1	Lights
Thyristor break-down alarm 1	2	Lights
Heater break alarm 2	4	Lights
Thyristor break-down alarm 2	8	Lights
Power frequency error	16	Flashes
Over current alarm	32	Flashes
FAIL (fixed at de-energized)	128	Flashes

● Selection of energized/de-energized alarm output (nA) [Engineering mode D : Function block 4 (F. 4)]

Use to set Alarm output action: Energized/De-energized. Selection of alarm output Energized/De-energized (nA) is enabled if FAIL output is not included to the Alarm output logic (L1).

Parameter symbol	Setting range	Factory set value
nA	0: Energized 1: De-energized	0

● Alarm enable/disable during STOP (SA) [Engineering mode D : Function block 4 (F. 4)]

Use to set the alarm enable/disable during the STOP. This function is applicable to the following three alarms.

– Heater break alarm 1
– Heater break alarm 2
– Over current alarm

- In case of Heater break alarm:
  Disabling the Alarm enable/disable during STOP (SA) releases the Heater break alarm state by switching the mode to STOP when Heater break alarm occurs in RUN.
- In case of Over current alarm:
  Disabling the Alarm enable/disable during STOP (SA) activates only the Determination of automatic reset of Over current alarm in STOP.

Parameter symbol	Setting range	Factory set value
SA	0: Disable 1: Enable	0

■ Alarm actions when this function is enabled/disabled

Use to set enable/disable of alarm at STOP as well as alarm state of Heater break alarm and Over current alarm after switching between RUN/STOP.

Heater break alarm *

Alarm enable/disable during STOP (SA) setting	RUN/STOP state	Alarm determination in RUN/STOP
Disable	RUN	Alarm determination active
	STOP	Alarm reset (alarm forced release)
Enable	RUN	Alarm determination active
	STOP	Retain previous alarm state

* The alarm determination of the Thyristor break-down alarm is active regardless of the RUN/STOP state.
Note: In case of Type 2 (Linearity resistor type, absolute value alarm), the Thyristor break-down alarm determination is active only at 0% output.

Over current alarm

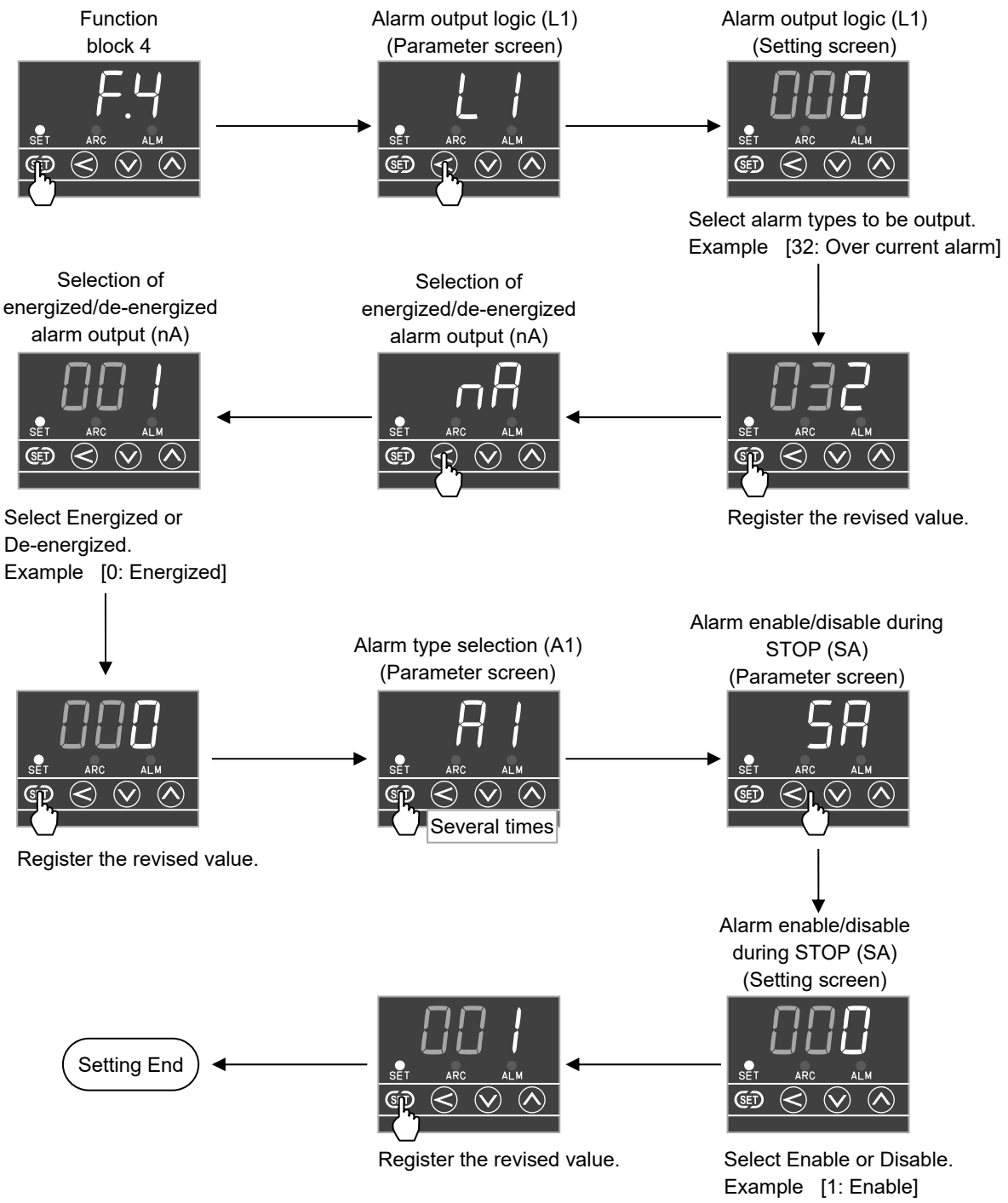
Alarm enable/disable during STOP (SA) setting	RUN/STOP state	Alarm determination in RUN/STOP
Disable	RUN	Alarm determination active (No determination of automatic reset*)
	STOP	Only determination of automatic reset* is active.
Enable	RUN	Alarm determination active (No determination of automatic reset*)
	STOP	Alarm determination active (No determination of automatic reset*)

* Determination of automatic reset: If current transformer input value goes below the Over current alarm detection value six times successively during STOP, alarm state is automatically released.

9.5.3 Setting procedure

☞ The Engineering mode [D] is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.6 screen appears.



MEMO

10 DISPLAYS AND SETTINGS

This chapter describes the display items of each monitor, the setting contents of display related functions, and the setting procedure.

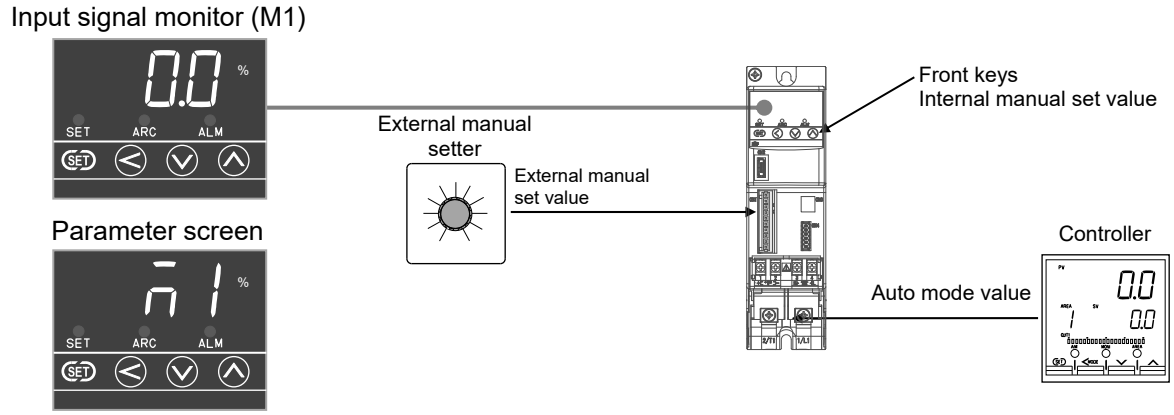
10.1 Monitors

This section describes the screen of Monitor mode [A]. For switching to Monitor mode [A], refer to Chapter 5 "Mode Switching and Parameter Switching."

10.1.1 Description of function

■ Input signal monitor (M1)

A set value of the input signal used for the control is displayed among Auto set value, External manual set value, and Internal manual set value. Default setting is Auto set value.



Display range
0.0 to 100.0 %

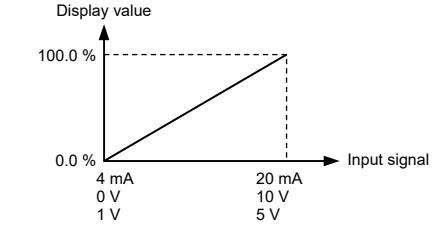
- If the input signal type displayed in Input signal monitor (M1) is changed, control is immediately changed to the set value of the new input signal.
- When the Contact input (DI) is used as "Input signal transfer" or "Manual input transfer," the displayed signal type will be changed every time external contact is switched.
- When the Contact input (DI) is used as "Input signal transfer":
  Selecting the Manual mode by the Contact input (DI) shows either "External manual set value" or "Internal manual set value." For manual set value, the value set at Manual mode transfer (AM) in Engineering mode [D] (function block 2) is displayed.

Description of the display value

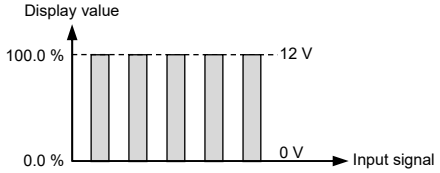
- **Automatic set value (Input signal from controller)**

The Input signal from a controller is displayed as a percentage. The input signal from a controller is proportional to the displayed value.

Current input, Voltage input

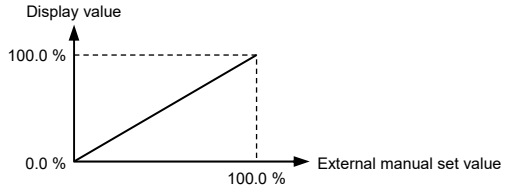


Voltage pulse input



• External manual set value (Set value of external manual setter)

A value set by the External manual setter is displayed. The set value of the external manual setter is proportional to the displayed value.

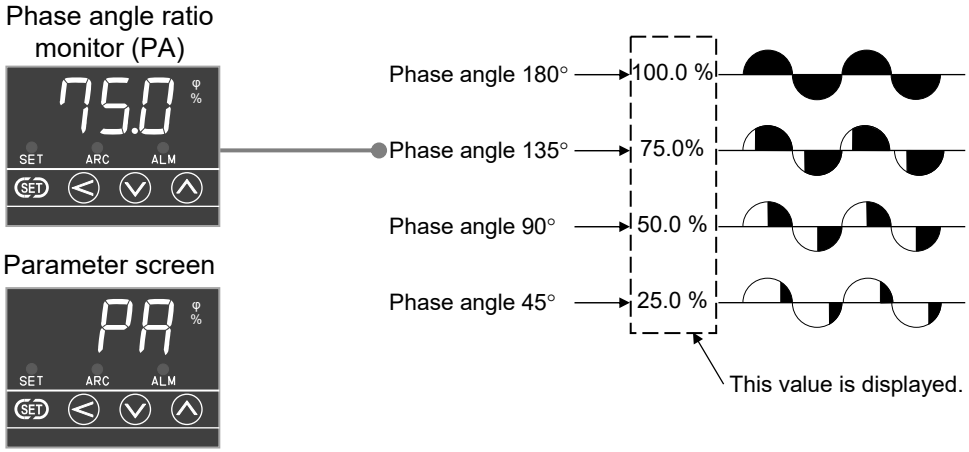


• Internal manual set value (Set value set by THV-10 front keys.)

A value set by the Internal manual set value (IM) is displayed.

■ Phase angle ratio monitor (PA)

Displays the phase angle of the trigger point by percentage. Phase angle is obtained by performing computations such as Soft-start/Soft-down time, Gradient setting, Output limiter setting or Base up setting to the input signal.

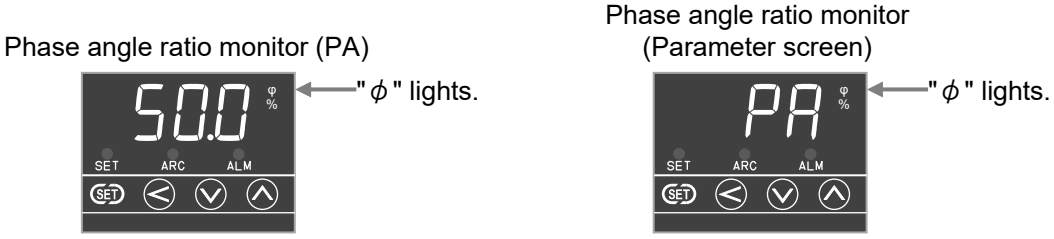


Displays 0.0% when the phase angle is 0°.
Displays 100.0 % when the phase angle is 180°.

Display range
0.0 to 100.0 %

Unit indication

When the Phase angle ratio monitor (PA) is selected, both the LED indicator ϕ and the % unit indicator light to show that the displayed value is the Phase angle ratio.



■ CT input monitor (CT)

Displays the captured value of current transformer. The displayed current value is the RMS value. Display range varies depending on the instrument specification.

CT input monitor (CT)

Parameter screen

Display range
0.0 to 40.0 A (20 A type)
0.0 to 40.0 A (30 A type)
0.0 to 90.0 A (45 A type)
0 to 120 A (60 A type)
0 to 160 A (80 A type)
0 to 200 A (100 A type)

When code N (no option)* is selected at the time of ordering, the indicated value of the Current monitor (CT) is fixed at 0.0.

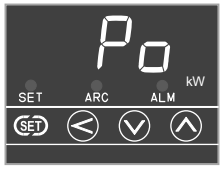
* Optional function: Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control, Protection function for control of primary side of a transformer, and Power proportional control

■ Power value monitor (Po)

Displays the output power value [Load voltage value × Load current value, calculated by the Load power supply voltage (LP) and the output phase angle].
The display unit is "kW."

Power value monitor (Po)

Parameter screen



Display range
0.0 to 7.5 kW (20 A type)
0.0 to 11.3 kW (30 A type)
0.0 to 17.0 kW (45 A type)
0 to 22.6 kW (60 A type)
0 to 30.2 kW (80 A type)
0 to 37.8 kW (100 A type)

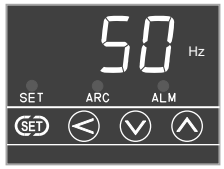
There are conditions that must be met in order to use the Power value monitor (Po). If the following conditions are not met, the indicated value will not change from "0.0."

- Instrument with Heater break alarm (or Non-linear resistance heater break alarm), Current limit function, Constant current control function, Power proportional control and Protection function for control of primary side of a transformer
- Control method (CM) setting is "0: Phase control (factory default)"
- Output mode for phase control (oS) setting is "4: Power proportional control (no voltage feedback)"

■ Power frequency monitor (IF)

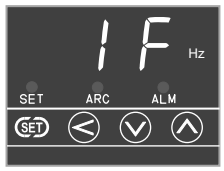
Displays the power frequency.

Power frequency monitor (IF)



Display range
40 to 70 Hz

Parameter screen

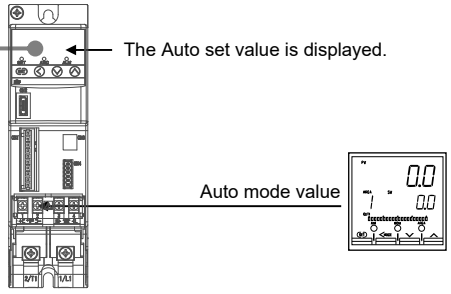


☞ There is a power frequency monitoring function to this instrument.
For details, refer to **9.3 Power Frequency Monitoring Function (P. 9-50)**.

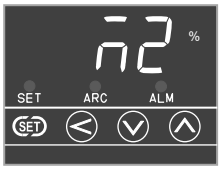
■ Control input monitor (M2)

The auto set value (input signal from a controller) is displayed in percentage.

Control input monitor (M2)



Parameter screen



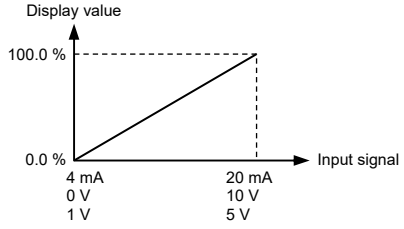
Display range
0.0 to 100.0 %

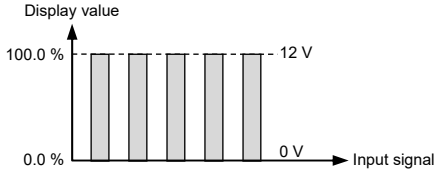
📖 Displays the "0.0" to the Control input monitor (M2), if the controller is not connected.

Description of the display value

The input signal from a controller is proportional to the displayed value.

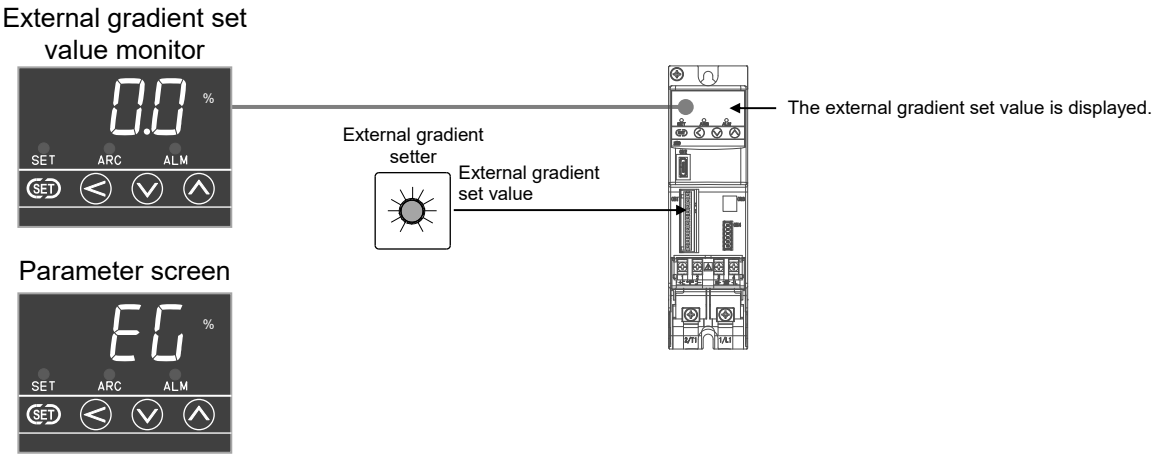
Current input, Voltage input Voltage pulse input





■ External gradient set value monitor (EG)

Displays the external gradient set value (set value of external gradient setter).

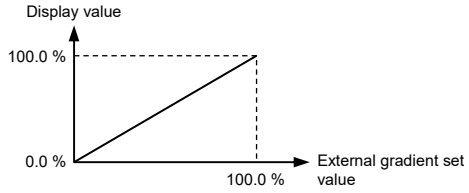


Display range
0.0 to 100.0 %

Displays the "100.0" to the External gradient set value monitor (EG), if the external gradient setter is not connected.

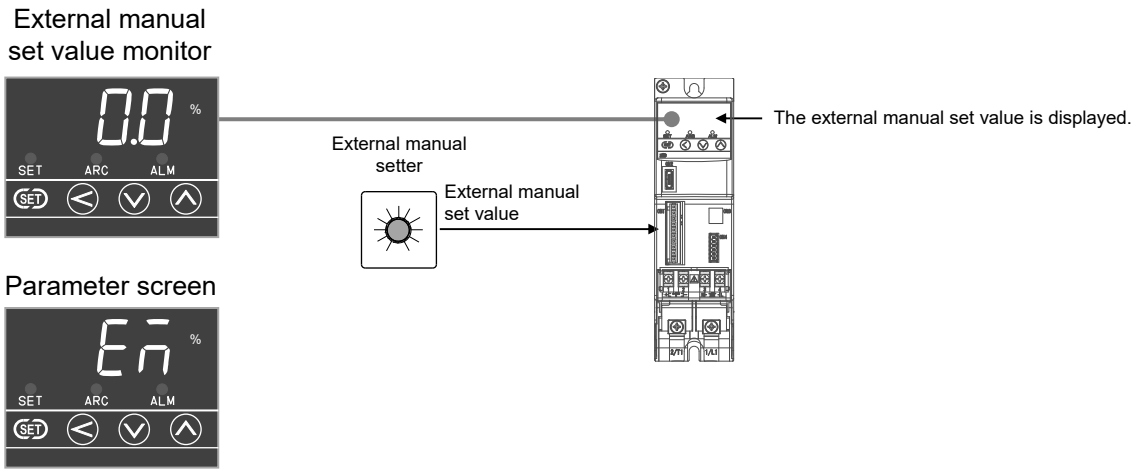
Description of the display value

The set value of external gradient setter is proportional to the displayed value.



■ External manual set value monitor (EM)

Displays the external manual set value (set value of external manual setter).

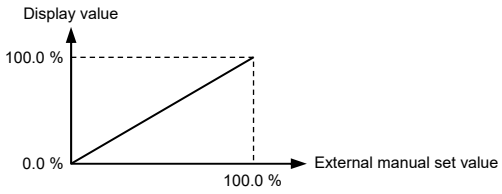


Display range
0.0 to 100.0 %

Displays the "0.0" to the External manual set value monitor (EM), if the external manual setter is not connected.

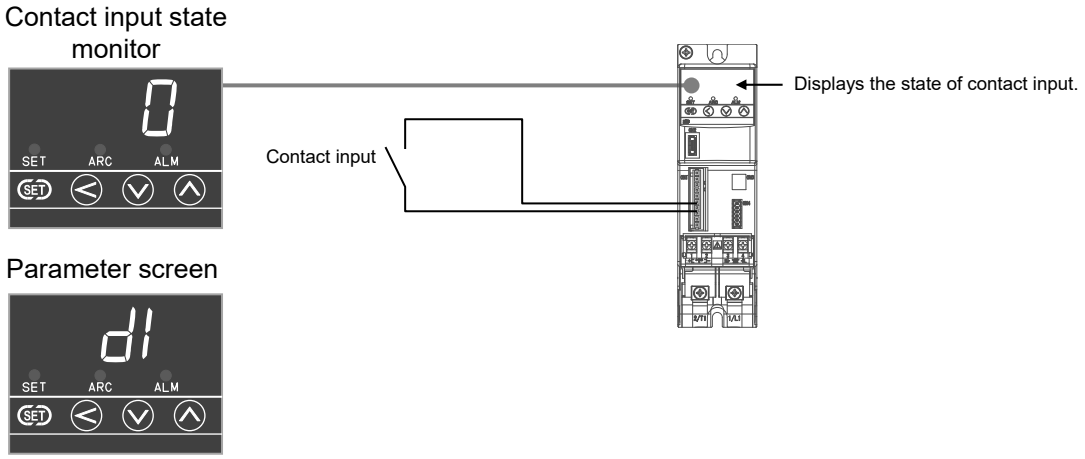
Description of the display value

The set value of the external manual setter is proportional to the displayed value.



■ Contact input state monitor (dI)

Displays the open or closed state of contact input.



Display range
0: Contact open 1: Contact closed

NOTE

For users of the THV-1

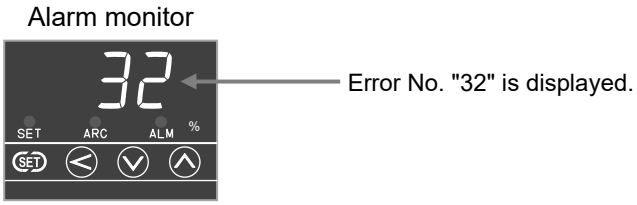
Please note that the open/close displays of the Contact input state monitor in the THV-1 are opposite of those in the THV-10.

	THV-1	THV-10
Contact open	1	0
Contact closed	0	1

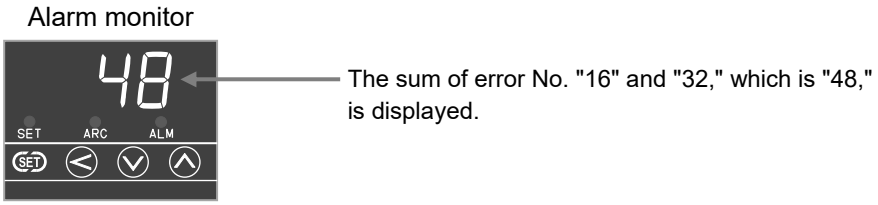
■ Alarm monitor (AL)

In alarm state, error number showing alarm type is displayed. If two or more alarms happen at the same time, the sum of the error numbers are displayed.

Display example 1: In case of Over current



Display example 2: In case of Power frequency error and Over current



Display range
0 to 191 0: None 1: Heater break alarm 1 2: Thyristor break-down alarm 1 4: Heater break alarm 2 8: Thyristor break-down alarm 2 16: Power frequency error 32: Over current alarm 128: FAIL

10.2 Default Display Selection

10.2.1 Description of function

With this function you can set the monitor screen that appears when the instrument is initially powered on or the monitor screen that automatically appears when the instrument is left idle for one minute. For example, if you select "3: Power value monitor," the power value monitor screen will be displayed in either case.

10.2.2 Setting contents

- **Default display selection (dM)**
  [Engineering mode D : Function block 5 (F. 5)]

Parameter symbol	Setting range	Factory set value
dM	0: Input signal monitor 1: CT input monitor 2: Power frequency monitor 3: Power value monitor	0

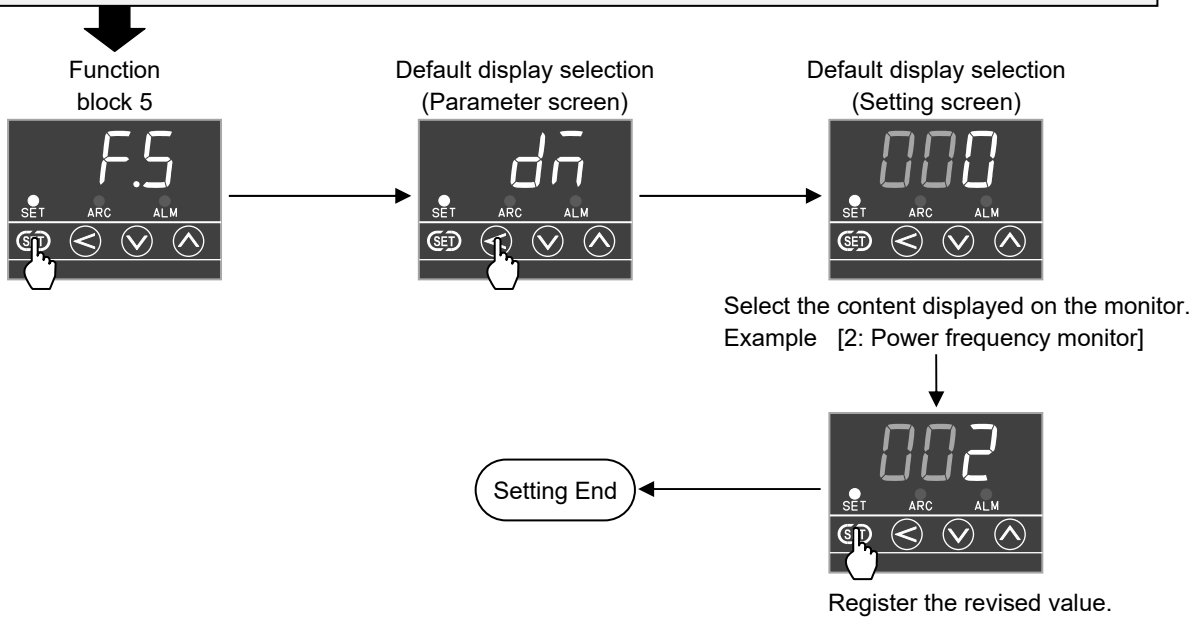
When a product supplied with Heater break alarm (Non-liner resistance heater break alarm), Current limiter, Constant current control function, Power proportional control, and Protection function for control of primary side of a transformer is not specified, even if "1: CT input monitor" or "3: Power value monitor" is set, the display is switched to "0: Input signal monitor."

In Monitor mode A, even if left idle for one minute, the screen will not return to the preset screen automatically.

10.2.3 Setting procedure

The Engineering mode D is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode A until Setting mode C is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode C until Engineering mode D is displayed.
3. Press the UP key (^) until the F.5 screen appears.



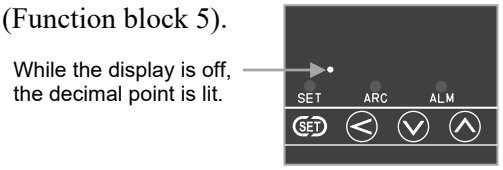
10.3 Display OFF Timer

10.3.1 Description of function

This is a function to turn off the display unit (7 segment LED) if any key is not operated for a certain length of time. To turn on the display again, touch any key on the front panel. The time till the display goes off can be set with the Display off timer (dT) in Engineering mode [D] (Function block 5).

Data range: 0 to 1000 seconds (0: Constantly lit)

While the display is off, only the leftmost decimal point is lit.



Even while the display is set to OFF, the ALM lamp will turn on or blinks when alarm is raised.

Even while the display is set to OFF, ALM lamp starts blinking when self-diagnosis error has been detected. Then, a screen showing a self-diagnostic error number and a monitor mode screen will be displayed alternately.

10.3.2 Setting contents

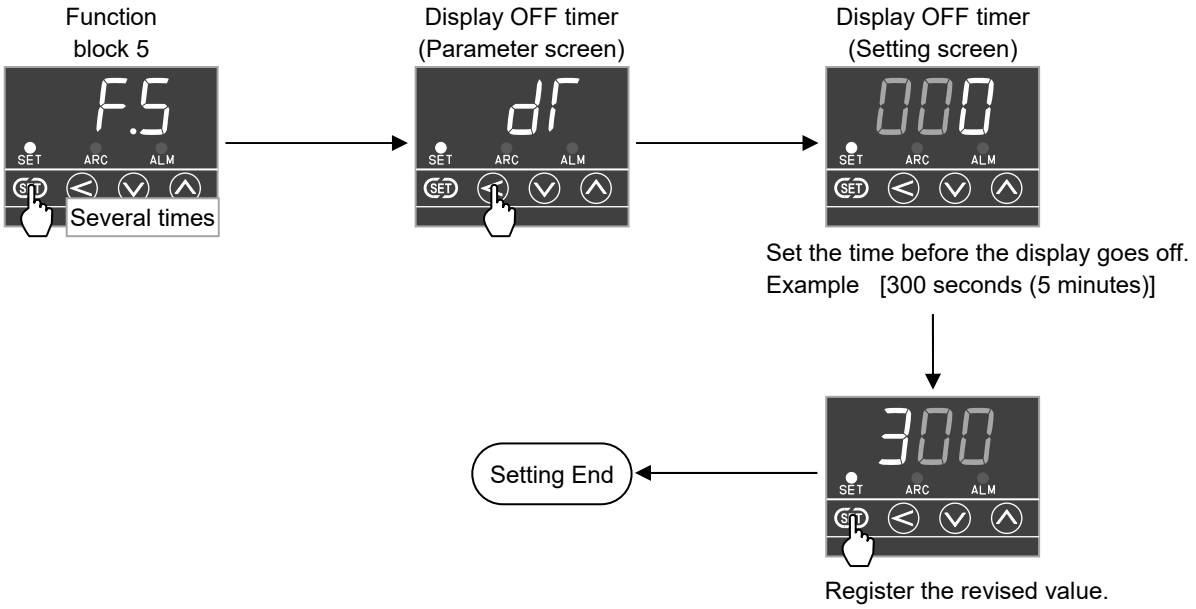
- **Display OFF timer (dT)**
  [Engineering mode [D] : Function block 5 (F. 5)]

Parameter symbol	Setting range	Factory set value
dT	0 to 1000 seconds (0: Constantly lit)	0

10.3.3 Setting procedure

The Engineering mode [D] is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.5 screen appears.



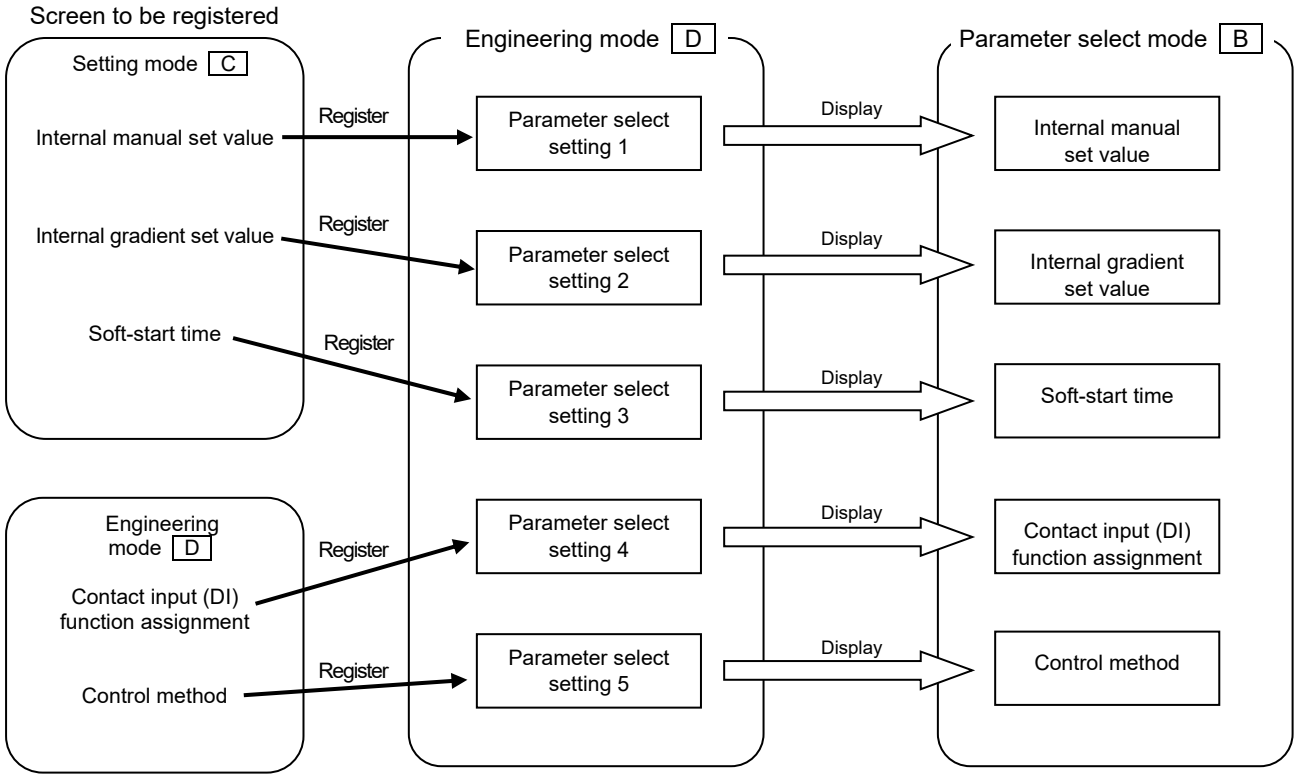
10.4 Parameter Select Function

This instrument has a function that allows a user to specify desired screens to be displayed by grouping them into a single mode. This function is called "Parameter select function." Up to 22 screens can be grouped together.

10.4.1 Description of function

The Parameter select function allows grouping necessary screens into a single mode for display. The Setting mode [C]
and Engineering mode [D] screens can be set in Parameter Select mode [B]. The screens displayed in this mode can be operated in the same manner as they are in the original mode.
Note that a maximum of 22 screens are registered in the default setting state. However, the optional function screen that is not specified at the time of ordering is not displayed. For details on the screen registered with the default settings, refer to **6.3 Parameter Select Mode [B] (P. 6-4)**.

[How does Parameter select function work?]



[Example] When the “Internal manual set value” screen in the Setting mode [C] is registered in Parameter select mode
[B], the “nternal manual set value” screen can be viewed in both the Parameter select mode [B] and the Setting mode [C].

- Set data lock
  The Set data lock function is enabled for each mode. For example, even if the set data lock is enabled only for the Engineering mode [D], the screens registered in the Parameter select mode [B] can be displayed and the setting values can also be changed.

☞ For details on Set data lock, refer to **10.7 Set Data Lock Function (P. 10-23)**.

There are two ways to register screens.

- Screen number entry: Enter the screen No. on Parameter select setting 1 to 22.
  (Settings can be made by the front keys or communication)
- Direct registration: Display the desired screen and register it through key operations.

■ Screen number entry

● Setting by the instrument front keys

Enter the predefined screen number on the Parameter select setting 1 to 22 screen in function block F10 of Engineering mode [D] to display the registered screen in Parameter select mode [B].

[To register screens]

Check the screen No.	Make a note of the screen No. of screens to be registered with reference to **6. Parameter List (P. 6-1).**
↓	
Set the instrument to the STOP state	Set the STOP state from RUN/STOP transfer (rS) of Engineering mode [D].
↓	
Enter the screen No. on Parameter select setting screen	Display the "Parameter select setting" screen in Engineering mode [D] and enter the screen no. of the screen to register. (A maximum of up to 22 screens can be registered)
↓	
Check the registered screen	Check whether or not the registered screen is displayed by switching to Parameter select mode [B].

📖 Parameter screens that have already been registered in Parameter select mode [B] cannot be registered.

[How to delete the registered screen]

Switch to the Parameter select setting screen on which the screen to be deleted is registered. If you set the setting value of the switched screen to "0," the screen will be deleted from Parameter select mode [B].

● Setting by communication

[How to register a screen]

If you enter a screen No. on Parameter select setting 1 to 22 of the communication data, the screen will be displayed in Parameter select mode [B]. For details on the communication data of Parameter select setting 1 to 22, refer to the **THV-10 Host Communication Instruction Manual (IMR02W06-J□)**.

📖 Parameter screens that have already been registered in Parameter select mode [B] cannot be registered.

[How to delete the registered screens]

Call the communication data of the Parameter select setting in which the screen to be deleted is registered. If you enter "0" in the called communication data, the screen will be deleted from Parameter select mode [B].

● Example 1 of relationship between screen registration and display

There are 22 Parameter select setting screens and these are freely settable. Unregistered screens, if any, will be displayed in series on the screen of the Parameter select mode [B].

Engineering mode [D]: Parameter select setting screen (for registration)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	···	22
A	B	C					D	E						···	F

: Registered screens : Unregistered screens (Set value = 0)

Parameter select mode [B]: Displayed screens

A	B	C	D	E	F

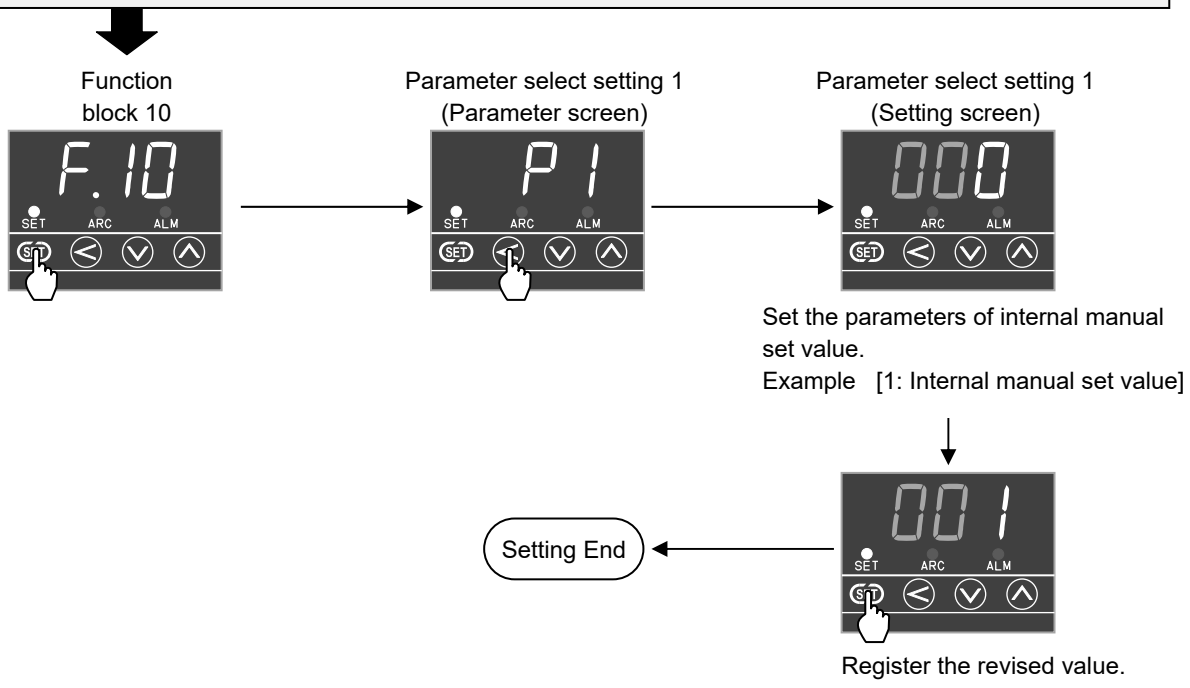
Only registered screens are displayed in series.

● Entering screen No.

☞ The Engineering mode [D] is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

☞ To register a screen, you need to set the instrument to the STOP state. For the procedure of setting the instrument to STOP, refer to **8.11 RUN/STOP Transfer (P. 8-40)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.10 screen appears.



■ Direct registration

Display the screen to register and press the ⊙ and ⊙ keys simultaneously. The screen will be registered on the Parameter select setting screen.

[To register screens]

Set the instrument to the STOP state

Set the STOP state from RUN/STOP transfer (rS) of Engineering mode [D].

Display the desired screen

From the screens of the Setting mode [C] or Engineering mode [D], select the screen to register and then switch to that screen.

Perform screen registration

After displaying the switched screen, press the ⊙ and ⊙ keys simultaneously to register the displayed screen on the Parameter select setting screen.

When you register a screen, the parameter symbol of the parameter screen flashes for approximately 2 seconds.

When screen registration is performed after the registration of 22 screens in Parameter select mode [B], the oldest registered screen is automatically deleted.

Parameter screens that have already been registered in Parameter select mode [B] cannot be registered.

[To delete screens]

Display the screen to delete from the Parameter select mode [B] and press the ⊙ and ⊙ keys simultaneously. The registration of the screen will be deleted.

Set the instrument to the STOP state

Set the STOP state from RUN/STOP transfer (rS) of Engineering mode [D].

Display the screen to delete

Switch to Parameter select mode [B] and display the screen to delete.

Perform screen deletion

After displaying the switched screen, press the ⊙ and ⊙ keys simultaneously to delete the displayed screen from Parameter select mode [B].

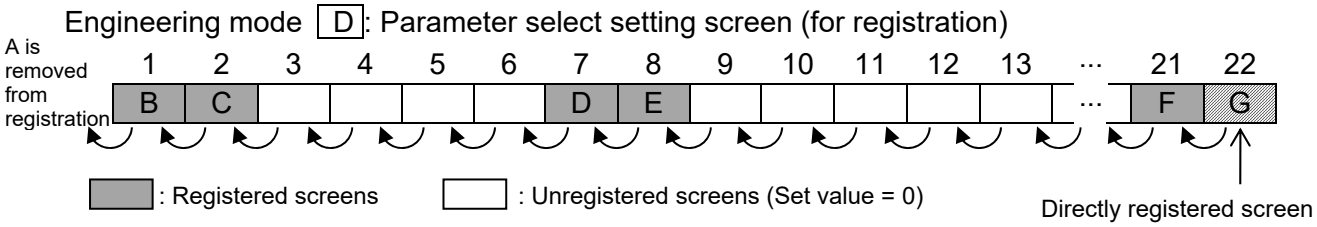
When a registered screen is deleted, the next parameter screen is displayed.

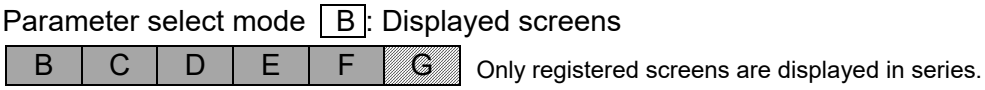
● Example 2 of relationship between screen registration and display

This example shows the case of direct registration under the state of the **"Example 1 of relationship between screen registration and display" (P. 10-14)**.

• When directly registered

When the Parameter select setting 22 screens are registered, the latest direct registration is added to the position of No.22, and the data before that will be moved ahead to toward the direction of the smaller numbers. Consequently, the screen registered at the Parameter select setting 1 will be moved out and removed from the registration.





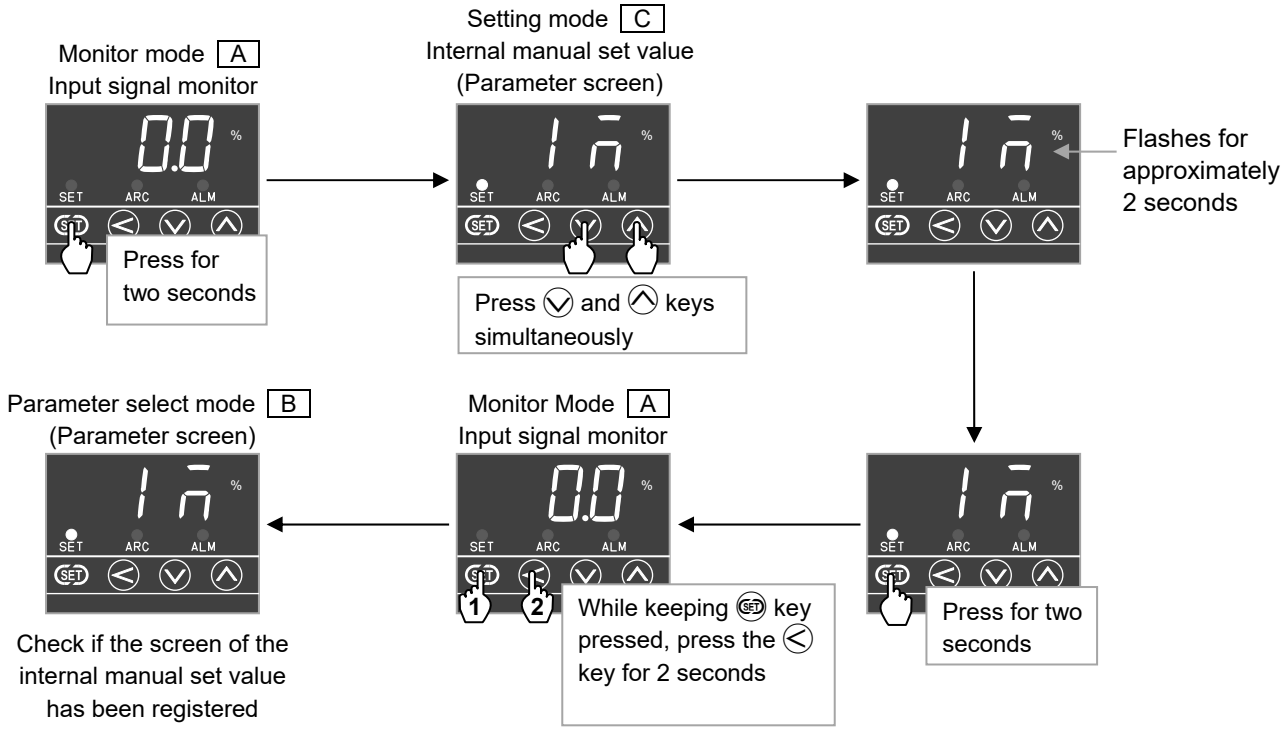
● Example of Direct registration

Example 1: Register the internal manual set value of Setting mode

It is possible to register a screen in Parameter select mode [B] even if Setting mode [C] has been locked by the Set data lock function.

Screen registration is accepted even if Parameter select mode [B] has been locked by the Set data lock function.

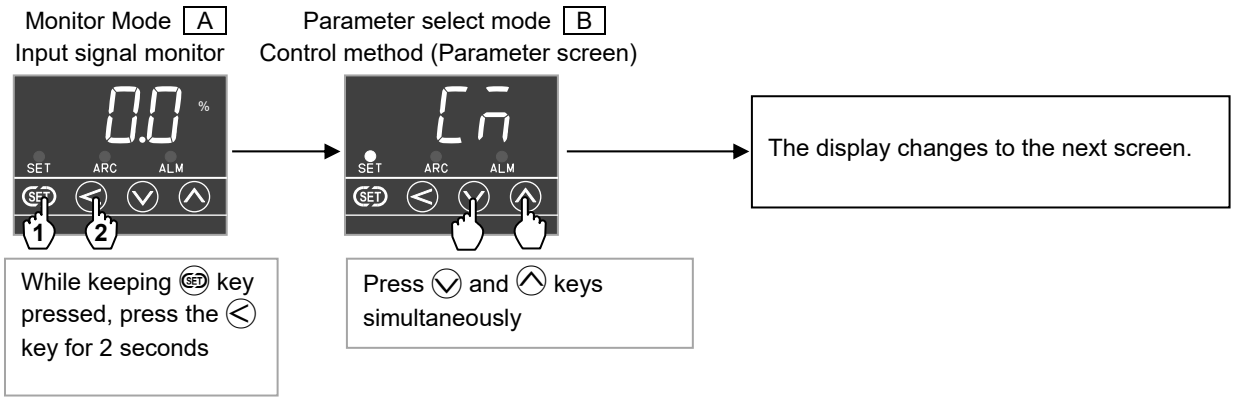
☞ To register a screen, you need to set the instrument to the STOP state. For the procedure of setting the instrument to STOP, refer to **8.11 RUN/STOP Transfer (P. 8-40)**.



Example 2: Delete the Control method (Cn) screen registered in Parameter select mode [B].

☞ Screen deletion cannot be performed when Parameter select mode [B] has been locked by the Set data lock function. To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

☞ To register a screen, you need to set the instrument to the STOP state. For the procedure of setting the instrument to STOP, refer to **8.11 RUN/STOP Transfer (P. 8-40)**.



● About the relationship between the set data lock and the screen registration operation

When the set data lock has been set, the screen registration or deletion operations are restricted. Refer to the table below for the relationship between the set data lock and the screen registration operation.

○: Operation can be performed ×: Operation cannot be performed

	Setting mode [C] locked	Engineering mode [D] locked	Parameter select mode [B] locked
Direct registration	○	×	○
Direct deletion	○	○	×
Screen number entry (front key)	○	×	○
Screen number deletion (front key)	○	×	○
Screen number entry (communication)	○	×	○
Screen number deletion (communication)	○	×	○

10.4.2 Setting contents

● Parameter select setting 1 to 22 (P1 to P22) [Engineering mode [D] : Function block 10 (F. 10)]

Parameter symbol	Setting range	Factory set value
P1 ⋮ P22	0 to 61 0: No registration	P1: 14 [Control method (CM)] P2: 3 [Soft-start time (SU)] P3: 4 [Soft-down time (Sd)] P4: 2 [Internal gradient set value (IG)] P5: 23 [Output limiter high (LH)] P6: 24 [Output limiter low (LL)] P7: 27 [Base-up set value (bU)] P8: 22 [Output mode for phase control (oS)] P9: 1 [Internal manual set value (IM)] P10: 13 [Contact input (DI) function assignment (C1)] P11: 7 [Maximum load current value for alarm (MC)] P12: 8 [Heater break alarm 1 setting (H1)] P13: 33 [Number of alarm 1 determination (n1)] P14: 32 [Alarm type selection (A1)] P15: 30 [Alarm output logic (L1)] P16: 10 [Heater break alarm 2 setting (H2)] P17: 12 [Current limit value setting (CL)] P18: 31 [Selection of energized/de-energized alarm output (nA)] P19: 50 [Protection function for control of primary side of a transformer (TF)] P20: 51 [Determination set value in case of a break on the secondary side of the transformer (TA)] P21: 52 [Output limiter setting in case of a break on the secondary side of the transformer (TL)] P22: 53 [Soft-start time in case of break on the secondary side of the transformer (TU)]

10.5 Integrated Operating Time

10.5.1 Description of function

You can check the operating time of this instrument. By using the two screens of the Integrated operating time [upper 3 digits] and Integrated operating time [lower 3 digits], up to 999,999 hours from 0 can be displayed. If the total Integrated operating time exceeds 999 hours, these digits move from the Integrated operating time display [lower 3 digits] to the Integrated operating time display [upper 3 digits] (WH). Also, one hour (one count) is added to the Integrated operating time every time the instrument is powered on and off.

Example: When 2020 hours are displayed

Integrated operating time
[upper 3 digits]
(Display screen)

Integrated operating time
[lower 3 digits]
(Display screen)

The SET lamp flashes on the screen of the Integrated operating time.

10.5.2 Display items

- **Integrated Operating Time Display [Upper 3 Digits] (WH) [Engineering mode D : Function block 3 (F. 3)]**

Display the Integrated operating time (upper 3 digits).

Parameter symbol	Display range
uH	0 to 999 (Resolution of display: 1000 hours)

- **Integrated Operating Time Display [Lower 3 Digits] (WL) [Engineering mode D : Function block 3 (F. 3)]**

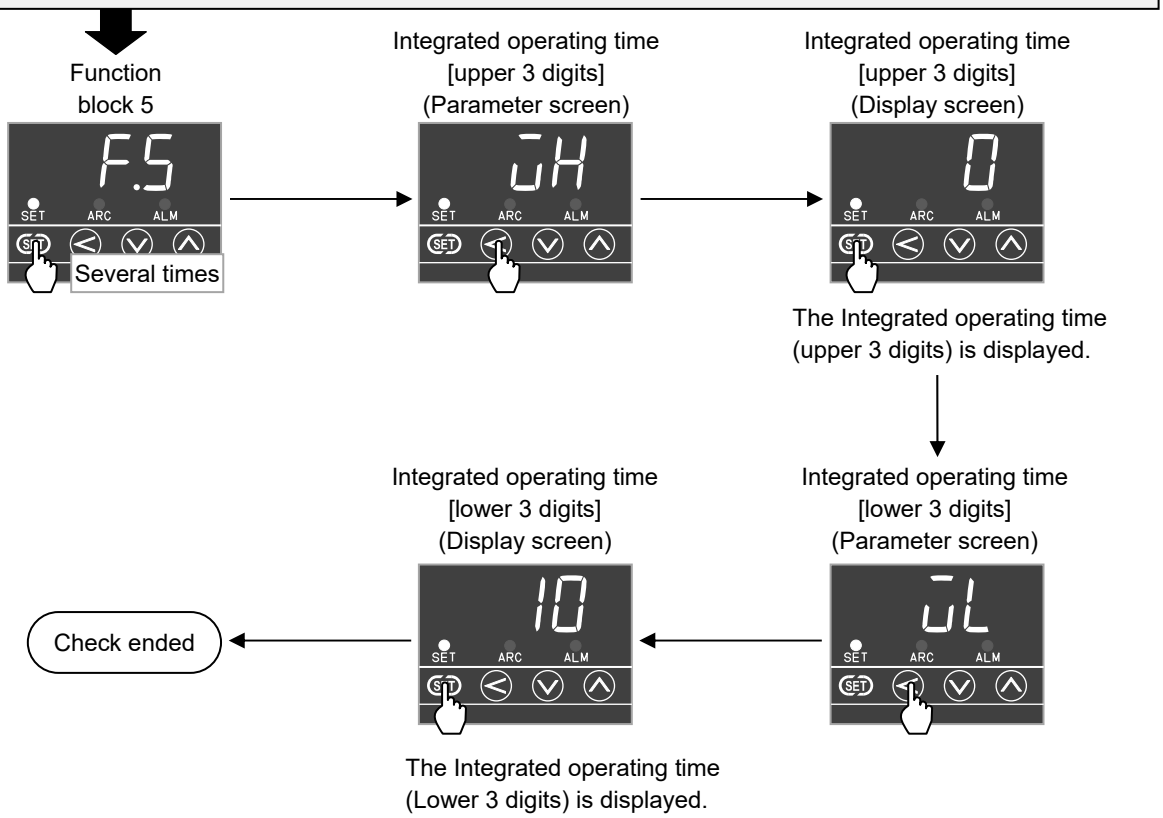
Displays the Integrated operating time (lower 3 digits).

Parameter symbol	Display range
uL	0 to 999 (Resolution of display: 1 hours)

10.5.3 Checking procedure

☞ The Engineering mode [D] is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.5 screen appears.

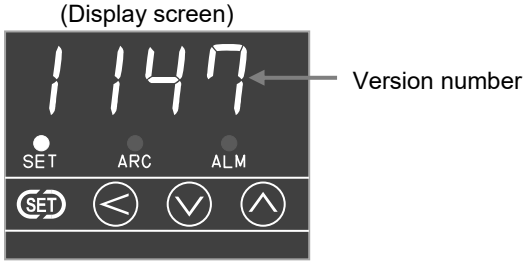


10.6 ROM Version

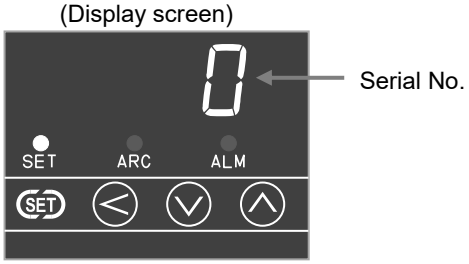
10.6.1 Description of function

In the event of occurrence of a problem, please check the type name and specifications of the product, and also the ROM version on the instrument display when contacting RKC INSTRUMENT INC. or the agent. The ROM version is displayed by using the two screens of ROM Version (High-order) and ROM Version (Low-order).

ROM version (High-order)
(Display screen)



ROM version (Low-order)
(Display screen)



The SET lamp flashes on the screen of the ROM Version.

10.6.2 Display items

- **ROM version [High-order] (Vr)**
  [Engineering mode D : Function block 5 (F. 5)]

Displays the version Number.

Parameter symbol	Display range
Vr	Fixed value (Version Number)

- **ROM version [Low-order] (Vq)**
  [Engineering mode D : Function block 5 (F. 5)]

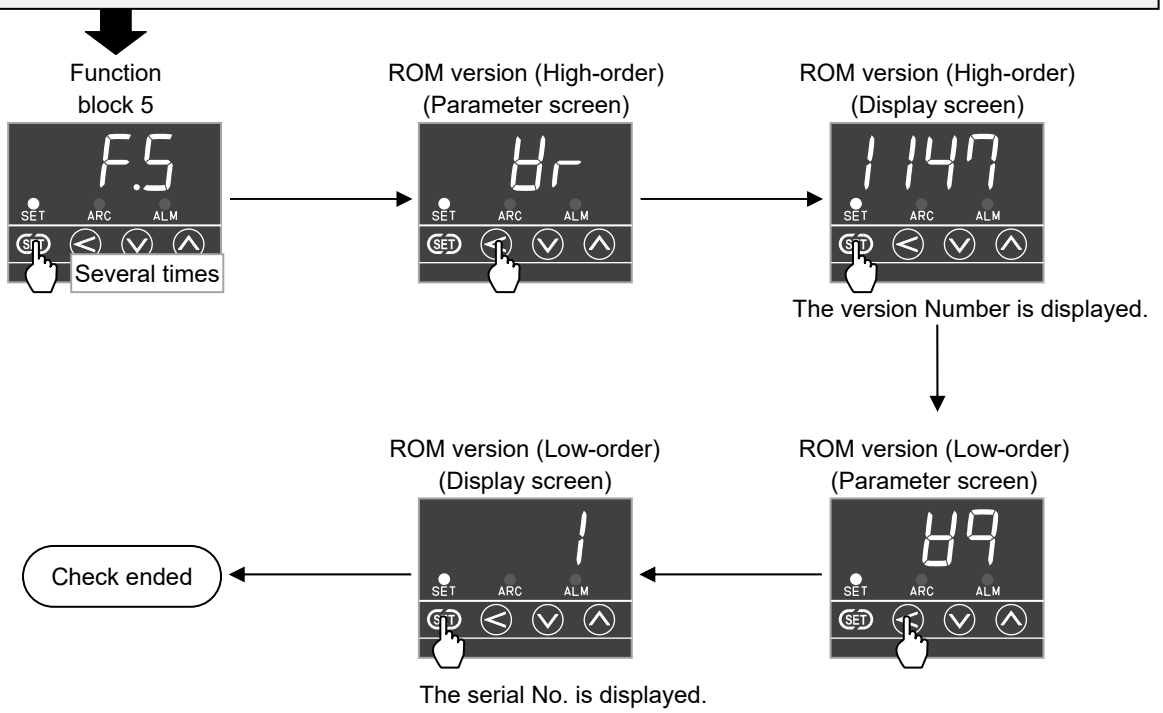
Displays the serial No.

Parameter symbol	Display range
Vq	Fixed value (Serial No.)

10.6.3 Checking procedure

☞ The Engineering mode [D] is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode [A] until Setting mode [C] is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode [C] until Engineering mode [D] is displayed.
3. Press the UP key (^) until the F.5 screen appears.



10.7 Set Data Lock Function

By using the Set data lock function, errors during operation can be prevented.

10.7.1 Description of function

This function is used to restrict mode changes and parameter setting changes by key operation. Settings are configured using the front keys, communication, or Contact inputs (DI).

■ Modes that can be locked

Parameter select mode [B]

When locked, the mode cannot be changed to Parameter select mode [B]. However, if the set value of a parameter that is also registered in Parameter select mode [B] is changed by another mode or communication, the set value of the parameter in Parameter select mode [B] also changes.

Setting mode [C]

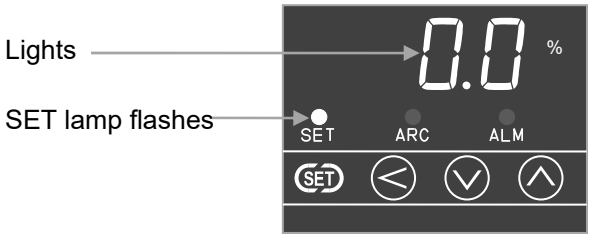
When Setting mode [C] is locked, set values cannot be changed. [Except the Set data lock (LK)]
However, if a parameter of Setting mode [C] is registered in Parameter select mode [B], the set value of the parameter in Setting mode [C] also changes if the set value is changed in Parameter select mode [B].
Since Setting mode [C] can be accessed even if locked, the set values can be checked.

Engineering mode [D]

When locked, the mode cannot be changed to Engineering mode [D]. However, if a parameter of Engineering mode [D] is registered in Parameter select mode [B], the set value of the parameter in Engineering mode [D] also changes if the set value is changed in Parameter select mode [B].

Display during Set data lock

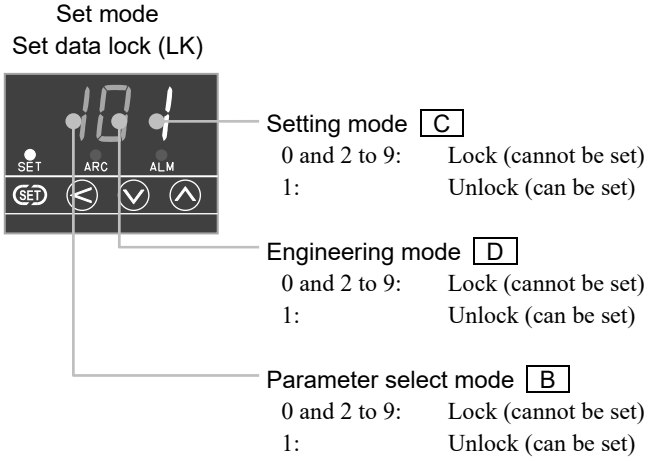
When the locked Setting mode is selected, the SET lamp flashes to indicate the lock mode. All numeric values on the setting screen become brightly lit.



■ When the set data is locked by front keys or communication

When the set data is locked by front keys

The set data lock can be set in Set data lock (LK) of Setting mode.



Set value and lock state

Set value of Set data lock (LK) *	Parameter select mode B	Engineering mode D	Setting mode C
000	Lock	Lock	Lock
001	Lock	Lock	Unlock
010	Lock	Unlock	Lock
011	Lock	Unlock	Unlock
100	Unlock	Lock	Lock
101	Unlock	Lock	Unlock
110	Unlock	Unlock	Lock
111	Unlock	Unlock	Unlock

* To lock the setting, a value between 2 and 9 can be used instead of "0."

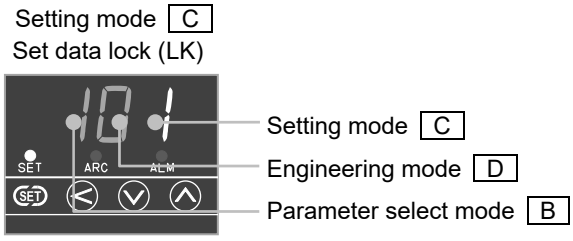
When the set data is locked by communication

The set data can be locked by the communication data "Set data lock (identifier: LK)". For details on the Contents of communication data, refer to the **THV-10 Host Communication Instruction Manual (IMR02W06-E□)**.

■ When the data is locked by Contact input (DI)

Before locking the setting data, set the following parameters, that is, "Set data lock (LK)" and "Contact input (DI) function assignment" Set data lock and unlock becomes available by switching the contacts open and close.

1. Adjust the Set data lock (LK) for Setting mode [C] (0 and 2 to 9: Lock) to lock with the Contact input (DI).



Setting contents
0 and 2 to 9: Lock (cannot be set)
1: Unlock (can be set)

The following table shows the lock state by the front key and the Contact input (DI).

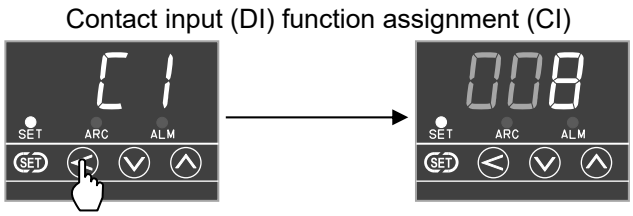
Set value of Set data lock (LK)[1]	Contact input (DI) state[2]	Actual lock state		
		Parameter select mode [B]	Engineering mode [D]	Setting mode [C]
000	Open	Lock	Lock	Lock
	Closed	Unlock	Unlock	Unlock
001	Open	Lock	Lock	Unlock
	Closed	Unlock	Unlock	Unlock
010	Open	Lock	Unlock	Lock
	Closed	Unlock	Unlock	Unlock
011	Open	Lock	Unlock	Unlock
	Closed	Unlock	Unlock	Unlock
100	Open	Unlock	Lock	Lock
	Closed	Unlock	Unlock	Unlock
101	Open	Unlock	Lock	Unlock
	Closed	Unlock	Unlock	Unlock
110	Open	Unlock	Unlock	Lock
	Closed	Unlock	Unlock	Unlock
111	Open	Unlock	Unlock	Unlock
	Closed	Unlock	Unlock	Unlock

[1] To lock the setting, a value between 2 and 9 can be used instead of "0"

[2] Open: Lock (cannot be set) Closed: Unlock (can be set)

If the external contact is switched to open (lock) in Engineering mode [D], it is possible to switch from Engineering mode [D] to another mode.
Once you have switched to another mode, it will not be possible to switch back to Engineering mode [D] unless the external contact is closed (unlock).

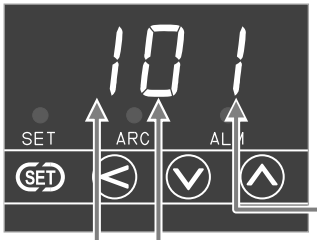
2. Set the Contact input (DI) function assignment in the Engineering mode [D] to "8: Set data lock enable/disable."



10.7.2 Setting contents

- **Set data lock (LK)**
  [Setting mode C]

Set data lock (Setting screen)

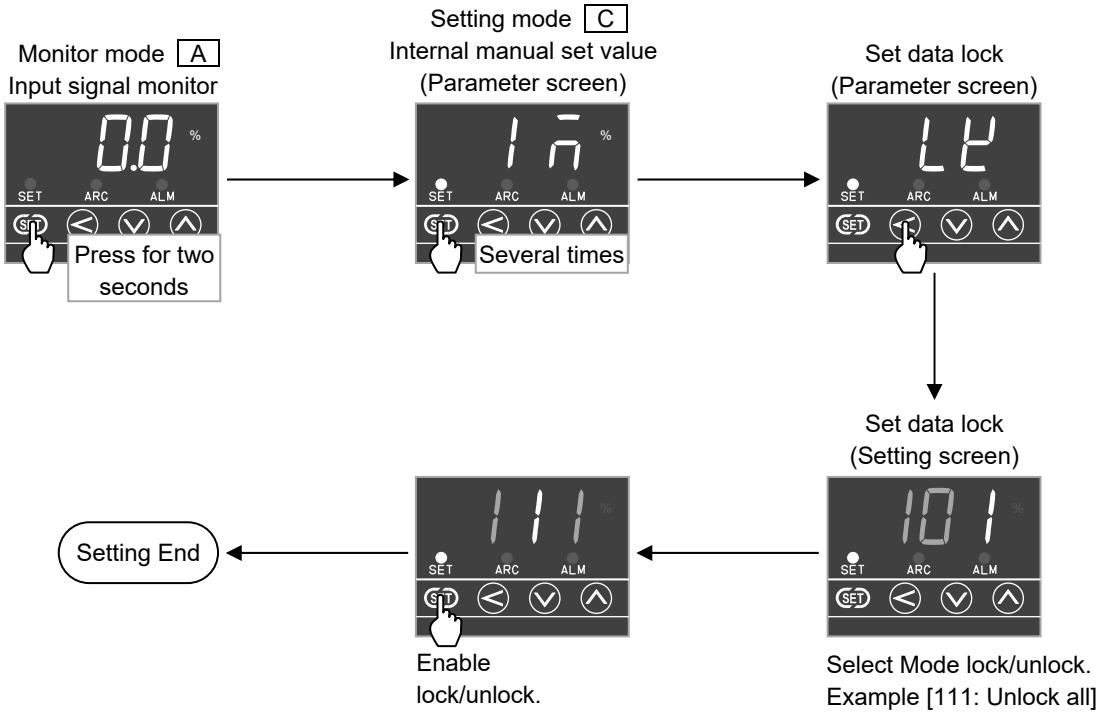


Factory set value: 101

Setting range
Setting mode C Engineering mode D Parameter select mode B Set value 0 and 2 to 9: Lock (cannot be set) 1: Unlock (can be set)

10.7.3 Setting procedure

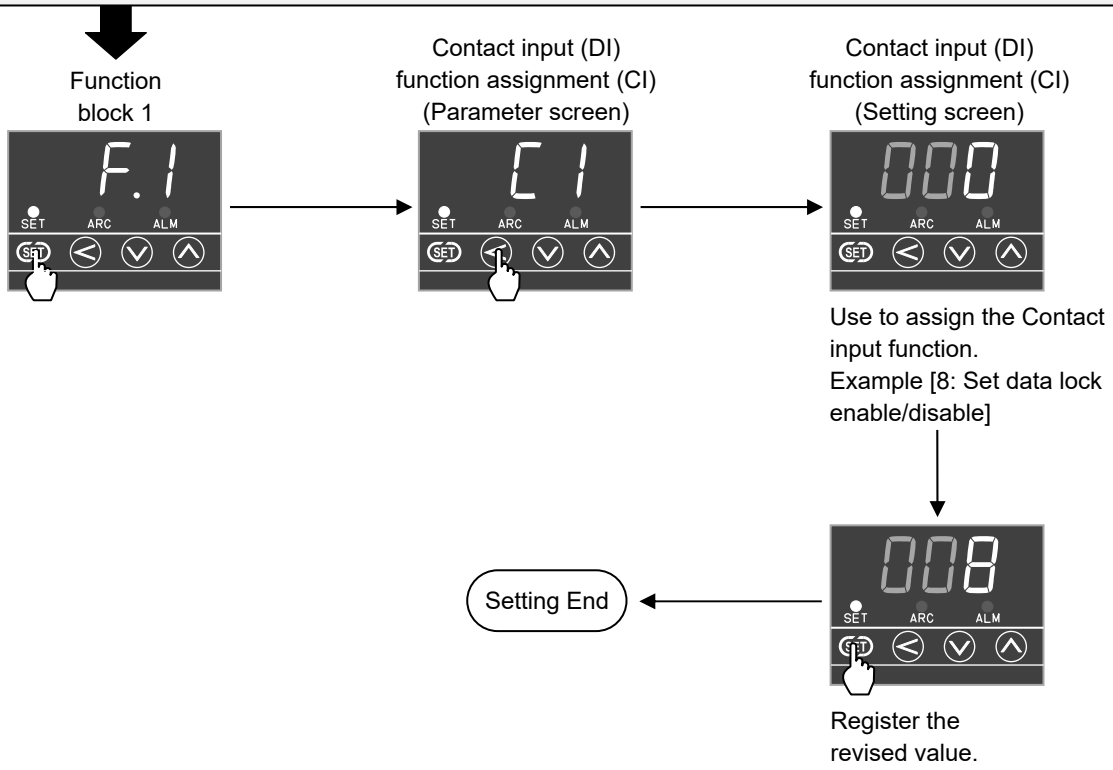
Setting procedure of Set data lock (LK)



Operation of Contact input (DI) function assignment (CI)

☞ The Engineering mode D is not displayed while Data lock is active.
To unlock setting, refer to **10.7 Set Data Lock Function (P. 10-23)**.

1. Press and hold the SET key (SET) for 2 seconds at Monitor mode A until Setting mode C is displayed.
2. Press the Shift key (<) for 2 seconds while pressing the SET key (SET) at Setting mode C until Engineering mode D is displayed.



MEMO

11 TROUBLE SHOOTING

This chapter describes Error displays and countermeasures for errors.

⚠ WARNING

- In order to prevent electric shock or instrument failure, always conduct necessary work after power supplied to the entire system is turned off.
- Conduct work after this instrument is cooled. As the temperature of this instrument is very high just after the power is turned off, never touch the instrument while hot.

11.1 Daily Inspection

Inspect the instrument periodically in order to prevent accidents or instrument failure.

Check item	Details
Inspecting main circuit terminal tightening torque	As the large current flows through each hexagon headed bolt used for the main circuit terminal, the loosened bolt may generate heat to cause ignition. Inspect the tightening torque of the bolt periodically. If loosened, tighten it with adequate torque. Recommended tightening torque: 1.6 N·m (20 A/30 A types) 3.8 N·m (45 A/60 A types) 9.0 N·m (80 A/100 A types)
Cleaning of this instrument	The attachment of dust to the heat radiation fins may reduce the cooling effect. Therefore, remove the dust attached using a vacuum cleaner.

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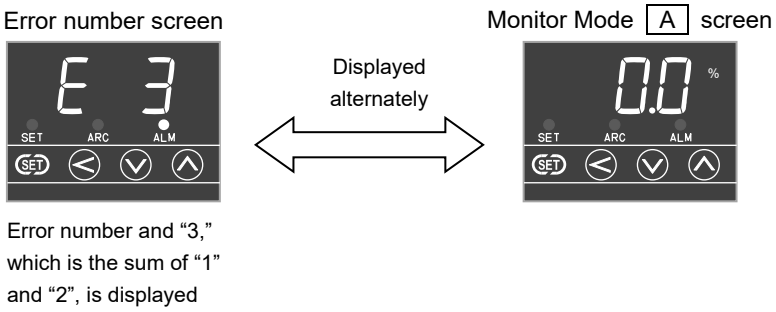
11.2 Error Displays

If an error occurs, the following display processing is made according to the cause of the abnormality.

Adjusted data error, Back-up error, and A/D conversion error

If an error occurs, an error number and a monitor mode [A] screen are alternatively displayed.
If two or more alarms have occurred, the sum of the error numbers is displayed.

Display example: When adjustment data error "1" and back-up error "2" have occurred



Watchdog timer

Only ALM lamp lights, and all others turn off.

Power supply voltage error

All indications are turned off.

Error number	Contents	Display	Action	Solution
1	Adjustment data error	Error number 1 screen and Monitor mode [A] screen are alternately displayed.	THV-10 output OFF Alarm terminal open Retransmission output OFF	Turn off the power at once. If an error occurs after the power is turned on again, please contact RKC sales office or the agent.
2	Back-up error	Error number 2 screen and Monitor mode [A] screen are alternately displayed.		
4	A/D conversion error	Error number 4 screen and Monitor mode [A] screen are alternately displayed.		In the case of A/D conversion error (E4), it is possible that the control output signal type of the temperature controller, and the value of input signal type selection (XI) of THV-10 are not matching. Select the same input signal type of THV-10 as the control output signal type of the temperature controller, and turn on the power supply once again.
—	Watchdog timer	ALM lamp lights		
—	Power supply voltage error	All lamp turns off		

11.3 Troubleshooting

General causes to be assumed and measures to be taken when an error occurs in this instrument are described in the following. For any inquiries, please contact RKC sales office or the agent, to confirm the specifications of the product.

Problem	Possible cause	Solution
No output	The power supply voltage is not being supplied	Supply the power.
	Main circuit terminal and Power supply terminal of this instrument are mistakenly wired	Make sure wiring is properly done. In case re-wiring is difficult, use SCR trigger signal setting (SC) to switch the trigger signal. (Refer to **P. 8-42**)
	Gradient is 0	Set the external gradient or internal gradient to a proper value. (Refer to **P. 7-8**)
	There is no automatic setting input	Check the output signal setting of the instrument and the type of thyristor input signal. (Refer to **P. 7-2**) Check if the temperature controller is properly functioning.
		If the Contact input (DI) is used for switching between Auto and Manual modes, set the contact input to OPEN (Auto mode).
		Set Input signal transfer (dA) to "0: Auto mode". (Refer to **P. 7-10**)
	The fast-blow fuse is broken.	Replace the fast-blow fuse.
	The Output limiter high is set to 0.0%	Set the set value of the Output limiter high (LH) to a proper value. (Refer to **P. 8-2**)
	This instrument is not set to RUN	If switching between RUN and STOP is performed by Contact input (DI), close the contact (RUN).
		Set the "1: RUN" by RUN/STOP transfer (rS) of Engineering mode . (Refer to **P. 8-40**)
Output doesn't turn off	The automatic set value is set to the maximum value.	Check the output signal of temperature controller.
	A thyristor element is shorted.	Please contact RKC sales office or the agent.
	The Output limiter low is set to 100.0 %	Set the set value of the Output limiter low (LL) to a proper value. (Refer to **P. 8-2**)
Error number (E1, E2, E4) appeared FAIL state was occurred	Error of this instrument • Internal data was overwritten (E1) • Backup element got damaged (E2) • Input exceeded control input range (E4)	Refer to **P. 11-3**.

Problem	Possible cause	Solution
Either “1” or “2” appeared on the alarm monitor (heater break alarm was triggered)	Maximum load current value is not set to an appropriate value.	Reset the Maximum load current value. If the Maximum load current value is not set to an appropriate value, heater break judgment cannot be made. (Refer to **P. 9-21**)
	If the alarm triggered even if there is no heater disconnection, it may be because the load rate is low	Avoid this by temporarily setting the Heater break alarm value to a large value. When the load rate is low immediately after the power is turned on, it is possible that Heater break alarm is ON. (Refer to **P. 9-28**)
		Avoid this by temporarily setting Heater break alarm enable/disable (HF) to “0: Disable”. (Refer to **P. 9-28**)
	The Heater disconnection alarm setting value is not set to an appropriate value.	Set the Heater disconnection alarm setting value to an appropriate value. (Refer to **P. 9-28**)
	Heater is broken	Turn off the power, and check or replace the heater, etc.
Either “2” or “8” appeared on the alarm monitor (thyristor break-down alarm was triggered)	A thyristor element is shorted.	Please contact RKC sales office or the agent.
	No soft-start time is appropriately set.	If a load generating large rush current is used, thyristor break-down may occur when no soft-start time is appropriately set. In such a case, make the soft-start time longer. (Refer to **P. 8-19**)
“16” appeared on the alarm monitor (power supply frequency error)	Power frequency is out of the allowable range (detection range) when power is turned on or during operation.	Check the value of power supply frequency, and turn off the power at once. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.
“32” appeared on the alarm monitor (over current alarm was triggered)	A current of more than 1.2 times the rating of this instrument flowed.	Turn off the power, and check or replace the heater, etc.
Setting cannot be changed with key operation	Set data lock is activated	Release set data lock with the set data lock (LK) of the setting mode. (Refer to **P. 10-23**)
No alarm output	Type of alarm is not assigned to the alarm terminals	Check the details of output type assignment with alarm output logic selection (L1) in the Engineering mode. (Refer to **P. 9-52**)
Output doesn’t become 100% with the Constant current control	Rated current of the instrument differs from the maximum load current flowing through the heater	If the rated current of the instrument differs from that maximum load current flowing through the heater, compensate by setting the gradient. (Refer to **P. 8-15**)
No display appears	Power supply terminal contact failure.	Retighten the terminal screws.
	Supply voltage is not correct.	Apply proper power supply voltage by referring to ■ **General specifications (P. 12-12)**.

When an alarm has triggered

Alarm type	Display when an alarm has triggered	Output when an alarm has triggered
Heater break alarm 1	ALM lamp lights, Alarm output ON *	Continue control
Heater break alarm 2		
Thyristor break-down alarm 1		Continue control (In the case of short-circuit, the output of THV-10 will continue to remain ON)
Thyristor break-down alarm 2		
Non-linear resistance heater break alarm		
Power frequency error	ALM lamp flashes, Alarm output ON *	THV-10 output OFF
Over current alarm	ALM lamp flashes, Alarm output ON *	THV-10 output OFF
Break of secondary side of the transformer	Parameter symbols and displayed value of monitor mode [A] flash	Output continues to be restricted at the Output limiter setting value in case of a break on the secondary side of the transformer

* Alarm signal is output only when an alarm type is assigned in Alarm output logic (L1).

■ Communication-related errors

● RKC communication

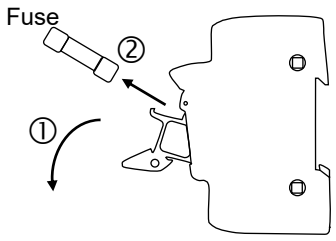
Problem	Possible cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	Error in the data format	Re-examine the communication program
	Transmission line is not set to the receive state after data send (for RS-485)	
	Communication protocol setting is wrong	Refer to **THV-10 Host Communication Instructions Manual (IMR02W06-E□)**, and set the communication protocol to "0: RKC Communication" with function block No. 9 "Communication Protocol: Selection (CMP)" of the engineering mode.
EOT return	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it
	Error in the data format	Re-examine the communication program
NAK return	Error occurs on the line (parity bit error, framing error, etc.)	Confirm the cause of error, and solve the problem appropriately. (Confirm the transmitting data, and resend data)
	BCC error	
	The data exceeds the setting range	Confirm the setting range and transmit correct data
	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it

● MODBUS

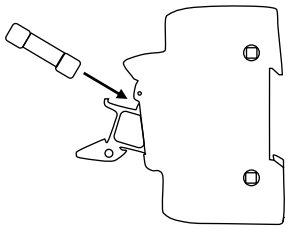
Problem	Possible cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
No response	A transmission error (overrun error, framing error, parity error or CRC-16 error) is detected	Re-transmit after time-out occurs or verify the master program
	The time interval between adjacent data in the query message is too long, exceeding 24-bit time	
	Communication protocol setting is wrong	Refer to **THV-10 Host Communication Instructions Manual (IMR02W06-E□)**, and set the communication protocol to "1: RKC Communication" with function block No. 9 "Communication Protocol: Selection (CMP)" of the engineering mode.
Error code: 1	Function code error (An unsupported function code was specified)	Confirm the function code
Error code: 2	When the mismatched address is specified.	Confirm the address of holding register
Error code: 3	The maximum number (Read from a read holding register or write to Preset multiple registers [Write multiple registers]) has been exceeded.	Confirm the setting data
	The setting of the number of data (the number of requested byte) is not set to a double of the requested number of data at the time of "Preset multiple registers (Write multiple registers)"	
	A value exceeding the setting range is written	

11.4 Replacement of UL Certified Fuse

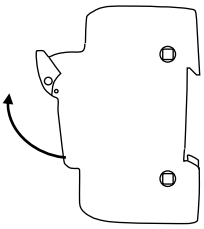
1. Open front lid and take the fuse out of the holder.



2. Insert the new fuse.



3. Close the front lid to finish the work.

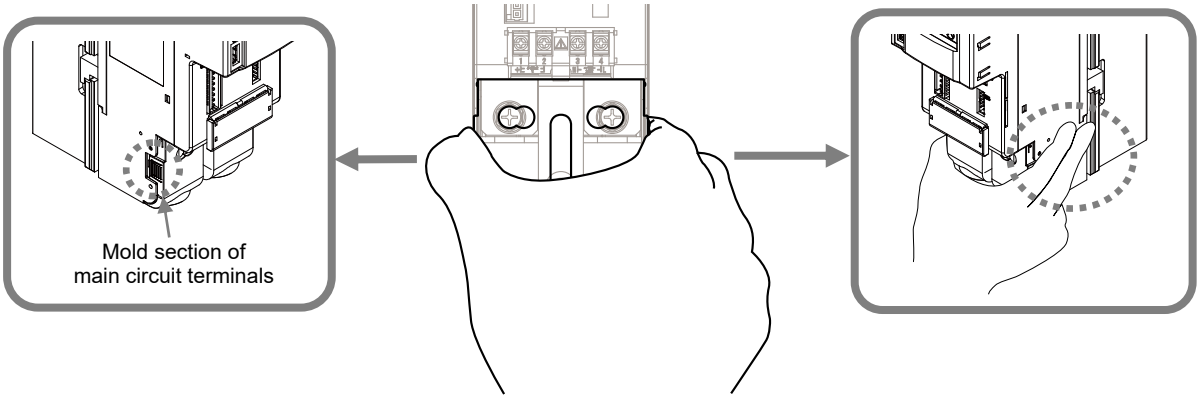


The Figure shows the type of 20 A and 30 A. However, the procedure for replacement is the same as for the type of 45 A to 100 A.

11.5 Removal of Terminal Cover (For Main Circuit Terminals)

The terminal cover (for main circuit terminals) of this instrument can be flipped open and removed.
When attempting wiring, removal of the cover may make the job easier.
Proceed as follows to remove the cover from the instrument.

1. Hold the side of the instrument with the index and the middle fingers and hold the mold section of the terminal cover (for main circuit terminals) with the thumb.

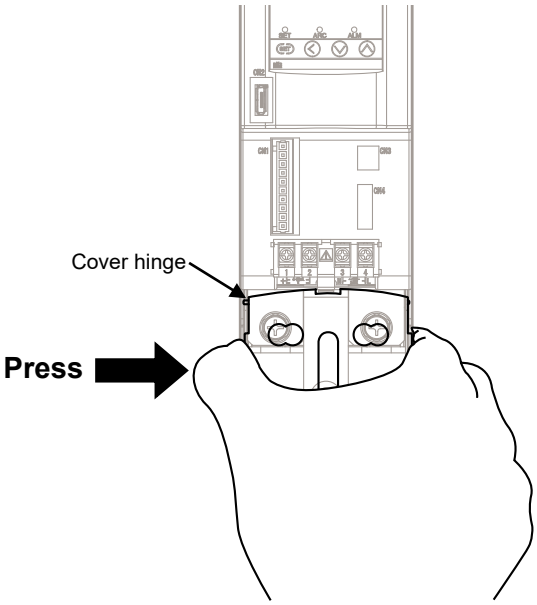


The Figure shows the type of 45 A and 60 A. However, the procedure for removal is same for other types as well.

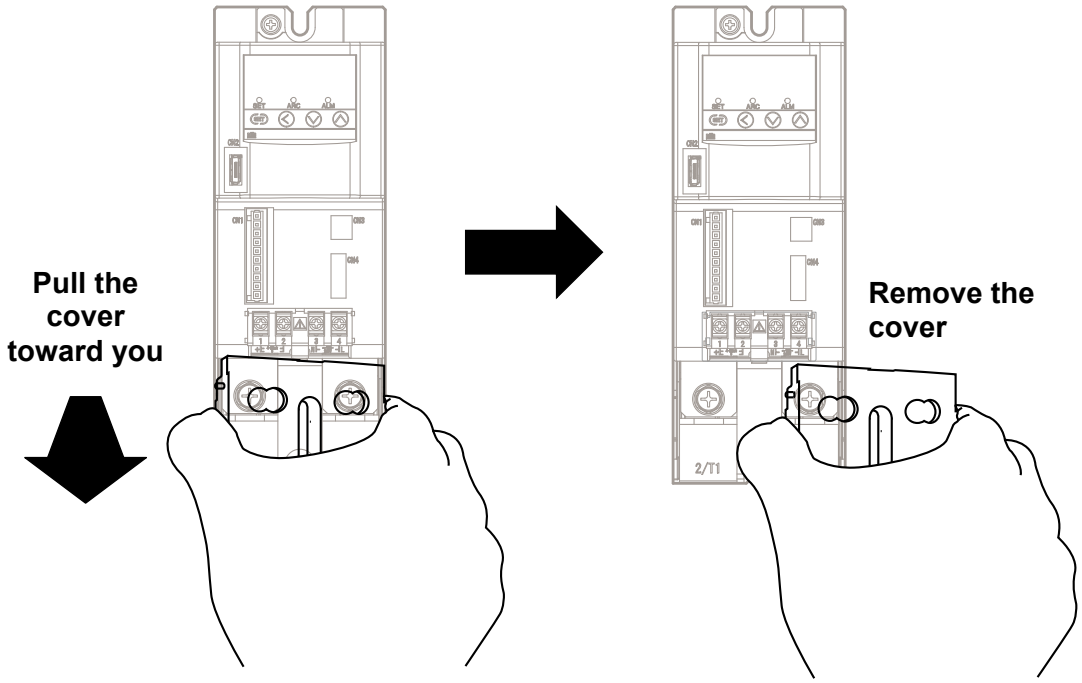
2. Squeeze the side mold section of the terminal cover (for main circuit terminals) with the thumb to remove the cover hinge out of the hole on the instrument.

NOTE

Do not press the mold section of the cover with too much force. The cover may break.



3. Once the cover hinge is out of the hole, pull the cover toward you to remove.



NOTE

After having completed the wiring of the mains circuit, install the terminal cover for the mains circuit for safety.

12

SPECIFICATIONS

■ Control output

Number of phase: Single-phase

Maximum rated current: 20 A AC, 30 A AC, 45 A AC, 60 A AC, 80 A AC and 100 A AC

Minimum load current: 20 A: 0.6 A (When output is 98 %)
30 A, 45 A, 60 A, 80 A and 100 A: 1 A (When output is 98 %)

Supply voltage for load: 85 to 264 V AC [Including power supply voltage variation] (Rating: 100 to 240 V AC)

Power frequency: 50/60 Hz

Allowable power frequency variations:
Performance guarantee
50 Hz: 49 to 51 Hz
60 Hz: 58.8 to 61.2 Hz
Operation guarantee
50 Hz: 48 to 52 Hz
60 Hz: 58 to 62 Hz

Output voltage range: 0 to 98 % of supply voltage for load (excluding voltage drops due to fuse effects)

Control method:
- Phase control
  Output mode: Proportional phase angle to input
  Proportional voltage to input
  Proportional square voltage (electric power) to input
  Constant current control (optional)
  Power proportional control (optional)
- Zero-cross control (continuous)
  Minimum on/off time: 50 Hz: 20 ms
  60 Hz: 16.67 ms
- Zero-cross control (input synchronous type)
  Minimum on/off time: 50 Hz: 20 ms
  60 Hz: 16.67 ms

Applicable load:
- Phase control
  Resistor load (Corresponding utilization category: AC-51 IEC 60947-4-3)
  Control of primary side of a transformer
  (The magnetic flux density: Approx. 1.25 T or less)
  Such loads that cause rush current (lamp heaters, transformers, etc) need Soft-start time setting to suppress the current within 1.35 times of the current rating.
- Zero-cross control (Continuous)
  Resistor load (Corresponding utilization category: AC-51 IEC 60947-4-3)
- Zero-cross control (Input synchronous type)
  Resistor load (Corresponding utilization category: AC-51 IEC 60947-4-3)

Power off leakage current: Approx. 27 mA AC rms or less (load voltage 200 V rms, 60 Hz, Ta = 25 °C)

Rated conditional short-circuit current:
700 A (20 A, 30 A)
1000 A (45 A, 60 A)
1500 A (80 A, 100 A)

Short-circuit protective device (fuse):
Breaking capacity: 100 kA (fast-blow fuse for 20 A to 100 A), Not UL certified
200 kA (fast-blow fuse for 20 A to 200 A), UL certified

Output setting range: Auto set value (control input): 0.0 to 100.0 %
Internal manual set value: 0.0 to 100.0 %
Set by the THV-10 front keys or communication
External manual set value: 0.0 to 100.0 %
Set by the setter (optional)

Output correction: Internal gradient set value: 0.00 to 2.00
Set by the THV-10 front keys or communication
External gradient set value: 0.0 to 100.0 %
Set by the setter (optional)
Output limiter high set value: 0.0 to 100.0 %
Set by the THV-10 front keys or communication
(Output limiter high set value□Output limiter low set value)
Output limiter low set value: 0.0 to 100.0 %
Set by the THV-10 front keys or communication
(Output limiter high set value□Output limiter low set value)
Base-up set value: –9.9 to +100.0 %
Set by the THV-10 front keys or communication
Output limiter high at operation start:
High limit setting:
0.0 to 100.0 %
Set by the THV-10 front keys or communication
Time setting:
0 to 600 seconds
Set by the THV-10 front keys or communication
Soft-start setting: 0.0 to 199.9 seconds
Soft-start function is disabled when set to 0.0 second
Soft-down function: 0.0 to 199.9 seconds
Soft-down function is disabled when set to 0.0 second
Current limiter function (optional):
The Current limit function is activated only during phase control.
Setting range: 0.0 to 32.0 A: (20 A, 30 A)
0.0 to 55.0 A: (45 A)
0 to 70 A: (60 A)
0 to 90 A: (80 A)
0 to 110 A: (100 A)
If a Current limit value is set to its maximum value, the Current limit function is deactivated.
Protection function for control of primary side of a transformer:
Output limiter function for break of secondary side of a transformer operates when determination has been made that the secondary side is disconnected at the time of phase control.
Output limiter setting in case of a break on the secondary side of the transformer range:
15.0 to 50.0 % of phase angle
Minimum output phase angle adjustment function:
Minimum output phase angle adjustment:
Output phase angle 5.0 to 15.0 %

Power proportional control (optional):

Load power supply voltage:	Sets the actual load power supply voltage in power proportional control
Setting range:	85 to 264 V AC

Alarm output (optional):

Number of outputs:	1 point
Output type:	Transistor output
Output method:	Sink type
Allowable load current:	100 mA DC
Load voltage:	30 V DC or less
Voltage drop at ON:	2 V DC or less (at allowable load current)
Leakage current at OFF:	0.1 mA DC or less

Retransmission output (optional):

Number of outputs:	1 point
Output voltage:	0 to 10 V DC
Output range:	0 to 10.5 V DC
Allowable load resistance:	1 kΩ or more

■ Performance

● Reference performance (Performance under the standard performance condition)

Control input:
Accuracy: ±5 % + 1 digit of span
Noise elimination ratio: Series mode: 20 dB or more (50/60 Hz)
Common mode: 120 dB or more (50/60 Hz)
Resolution: 1/4096 (A/D converter performance)
Error during close horizontal mounting:
Included in accuracy

Current measurement [Current detector built-in] (optional):
Accuracy: 20 A/30 A:
±1.5 A (Current measurement 20 A of less: ±1.2 A,
Current measurement 10 A or less: ±1.0 A)
45 A/60 A/80 A/100 A:
±5 % of maximum current rating
Resolution: 1/4096 (A/D converter performance)

External manual setting:
Accuracy: ±5 % of span
±15 % of span (With respect to the scale of external manual setter)
Resolution: 1/4096 (A/D converter performance)

External gradient setting:
Accuracy: ±5 % of span
±15 % of span (With respect to the scale of external gradient setter)
Resolution: 1/4096 (A/D converter performance)

Control output: Output accuracy・stability
Proportional phase angle to input: ±10 % of power supply voltage for load
Proportional voltage to input: ±10 % of power supply voltage for load
Proportional square voltage (electric power) to input:
±10 % of power supply voltage for load
Constant current control (optional): ±10 % of maximum current rating
Power supply voltage variation:
Within 10 % of power supply voltage for load
or Load variation: Within 2 times
Power proportional control (optional): ±10 % of Rated power
(Rated power = 200 [V] × Maximum rated current /2)
Load resistance variation: Within 2 times

Retransmission output: (optional)
Accuracy: ±5 % of span
Output resolution: Approx. 1/1024

Measurement accuracy of frequency:
±1 Hz (However, the measurement range of frequency is 40 to 70 Hz)

● Operating influence (Variation under the operating condition)

Influence ambient temperature:
Control input: ±0.1 %/°C of span
External manual setting: ±0.1 %/°C of span
External gradient setting: ±0.1 %/°C of span
Retransmission output (optional): ±0.015 %/°C of span

Influence of humidity: Same as reference performance

Influence of power supply voltage and power frequency:
Influence of power supply voltage: Same as reference performance
Influence of power frequency: Same as reference performance

Influence of vibration: Same as reference performance

Influence of physical orientation: Same as reference performance

■ Control input

Control input:

Number of input point:	1 point	
Input signal:	Current input 4 to 20 m A DC	
	Voltage input 1 to 5 V DC	
	Voltage input 0 to 10 V DC	
	Voltage pulse input 0/12 V DC	
Sampling cycle:	At 50 Hz: 10 ms	
	At 60 Hz: 8.33 ms	
Input impedance:	Current input: Approx. 50 Ω	
	Voltage input: Approx. 30 kΩ	
	Voltage pulse input: Approx. 30 kΩ	
Action at input break:	Indicates value near 0 %.	
Operation when input is short-circuited:		
	Indicates value near 0 %.	
Allowable input range:	Current: −6 to +35 mA	
	Voltage: −1.5 to +19 V	

External manual mode:

Number of inputs:	1 point	
Allowable resistance range:		
	4 to 6 kΩ	
Input range:	0.0 to 100.0 %	
Sampling cycle:	At 50 Hz:	10 ms
	At 60 Hz:	8.33 ms
Action at input break:	5 V terminal:	Near the 0 %
	0 V terminal:	80 % or more
	Manual input terminal:	Near the 0 %

External gradient setting:

Number of inputs:	1 point	
Allowable resistance range:		
	4 to 6 kΩ	
Input range:	0.0 to 100.0 %	
Sampling cycle:	At 50 Hz:	10 ms
	At 60 Hz:	8.33 ms
Action at input break:	5 V terminal:	20 % or less
	0 V terminal:	Near the 100 %
	Gradient input terminal:	Near the 100 %

Contact input:

Number of inputs:	1 point	
Input type:	Dry contact input	
	OFF state (open):	50 kΩ or more
	ON state (closed):	1 kΩ or less
	Contact current:	5 mA or less
	Voltage when opened:	Approx. 5 V DC
	Capture judgment time:	At 50 Hz: 100 ms
		At 60 Hz: 83.33 ms

Current measurement (optional): Number of inputs: 1 point

Input importing range (CT input monitor display range):

20 A/30 A:	0.0 to 40.0 A
45 A:	0.0 to 90.0 A
60 A:	0 to 120 A
80 A:	0 to 160 A
100 A:	0 to 200 A

Sampling cycle:

At 50 Hz:	10 ms
At 60 Hz:	8.33 ms

■ Indication lamp

Parameter/Data display:

3 digits + 1/2 7-segments LED (orange)

ALM lamp: LED (red)

ARC lamp: LED (orange)

SET lamp: LED (orange)

Unit display:

ϕ:	LED (orange)
%:	LED (orange)
Hz:	LED (orange)
A:	LED (orange)
kW:	LED (orange)

■ Alarm function

Heater break alarm/Thyristor break-down alarm:

Alarm action types: Deviation alarm (constant resistance type)
Absolute value alarm (linearity resistor type)
Deviation alarm (Non-linear resistance type)

Alarm setting rage: Deviation alarm (constant resistance type)
Settable from 0 to 100 % of the reference current or 2 A, whichever is larger.
Absolute value alarm (linearity resistor type)
0 to 100 % of Maximum load current value
Deviation alarm (Non-linear resistance type)
Settable from 0 to 100 % of the reference current or 2 A, whichever is larger.

Number of settings of knee points:
3 points

Setting range of knee point:
Phase angle ratio: 0 to 100 % of 180°
Load current value: 0 to Maximum load current value

Maximum load current value setting:
20 A type: 0.0 to 32.0 A
30 A type: 0.0 to 32.0 A
45 A type: 0.0 to 55.0 A
60 A type: 0 to 70 A
80 A type: 0 to 90 A
100 A type: 0 to 110 A

Alarm determination cycle:
At 50 Hz: 100 ms
At 60 Hz: 83.33 ms

Number of Alarm 1 determination:
1 to 1000

Number of Alarm 2 determination:
1 to 1000

Automatic detection of knee points function:
Detection method: Output is adjusted between 0 to 100 %, and load current value is measured during the fixed setpoint control at 4 points of phase angle ratio, and Knee point of the reference current is set.
Fixed setpoint control point:
18 %, 36 %, 56 % and 100 % of 180°
Automatic calculation time for knee points:
0 to 1000 seconds
Update of data: At the completion of automatic calculation

Power frequency error: Alarm determination area: Outside of 45 to 54.9 Hz and 55 to 64.9 Hz
Output at Alarm state: THV-10 output OFF

Over current alarm: Alarm determination area: When the load current exceeds the permissible limit (1.2 times of the maximum current rating) during the operation.
Output at Alarm state: THV-10 output OFF

FAIL: Alarm condition: When error is detected by self-diagnosis function.

Additional function: Alarm output logic:
Two or more types of alarm outputs can be specified by Logical *OR* function.
Selection of energized/de-energized alarm output:
Selectable
(If FAIL alarm is selected, output type is de-energized only)
Alarm enable/disable during STOP:
Heater break alarm is reset and initialized by disabling the alarm and switching to STOP. Output status other than Heater break alarm is not initialized.
Heater break alarm enable/disable:
Selectable (Alarm is not generated when the alarm is disabled.)
Over current alarm enable/disable:
Selectable (Alarm is not generated when the alarm is disabled.)

Protection function for control of primary side of a transformer:
Applicable control method:
Phase control
Setting range: Protection function for control of primary side of a transformer:
0 (disable)/1 (enable)
Determination set value in case of a break on the secondary side of the transformer:
0 to 100 % of reference current value
(Deviation setting against the reference current value.)
Output limiter setting in case of a break on the secondary side of the transformer:
15.0 to 50.0 % of phase angle
Soft-start time in case of break on the secondary side of the transformer:
0.1 to 100.0 seconds
Abnormity judgment conditions:
Phase angle 15 % or more
Sampling cycle: 0.5 of power cycle
Action at the time of automatic release from the break (momentary power failure) of secondary side of the transformer:
Output by soft-start function at the time of the break (momentary power failure) of secondary side of transformer.

■ Communication

● Host communication

Interface: Based on RS-485, EIA standard

Protocol: RKC communication (ANSI X3.28-1976 subcategories 2.5 and A4)
Modbus-RTU

● Loader communication

Protocol: For RKC communication protocol only (ANSI X3.28-1976 subcategories 2.5 and A4)

Synchronization method: Start/Stop asynchronous type

Communication speed: 38400 bps

Data bit configuration:

Start bit:	1
Data bit:	8
Parity bit:	None
Stop bit:	1
Number of data digits:	7 (fixed)

Maximum connections: 1 point

Connection method: Exclusive cable W-BV-01

Interval time: 10 ms

Other:

① When the instrument is powered off, power can be supplied to the instrument from COM-K2-1 or COM-KG. This function is exclusive for parameter setting, and the instrument functions as follows.

- Control is stopped (Output is off).
- Host communication is stopped.
- The display shows "---."

② While the instrument is powered by COM-K2 or COM-KG, if power is applied to the instrument, the instrument will be reset and starts for normal operation.

③ When the instrument is normally powered, the host communication can be used simultaneously.

■ Self-diagnostic function

Self-diagnostic item	Error display	Communication at error	Output at error	Error recovery
Adjustment data error	Error code 1 screen and Monitor mode [A] screen are alternately displayed.	Error code 1	THV-10 output OFF Alarm output open Retransmission output OFF	Alarm is reset by removing the cause of the alarm and applying power to the instrument.
Back-up error	Error code 2 screen and Monitor mode [A] screen are alternately displayed.	Error code 2		
A/D conversion error	Error code 4 screen and Monitor mode [A] screen are alternately displayed.	Error code 4		
Watchdog timer	ALM lamp lights All the other display is OFF	Communication stop		
Power supply voltage error	All lamp turns off	Communication stop		

■ General specifications

Supply voltage for instrument:

85 to 264 V AC [Including power supply voltage variation]
(Rating 100 to 240 V AC) 50/60 Hz
Frequency variation: At 50 Hz: 48 to 52 Hz
At 60 Hz: 58 to 62 Hz

Match the phase of the instrument power supply with that for the load power supply.

Power consumption: 6 VA MAX. (100 V AC) rush current 5.6 A or less
8 VA MAX. (240 V AC) rush current 13.3 A or less

Insulation resistance:

	Radiator fins	Main circuit terminals	Power terminals for instrument	Input terminals [2]	Alarm output terminal
Radiator fins					
Main circuit terminals	500 V DC 20 MΩ or more				
Power terminals for instrument	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more			
Input terminals *	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more		
Alarm output terminal	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more	
Host communication, Retransmission output terminals	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more	500 V DC 20 MΩ or more

* Input terminals: Control input, External gradient setting, External manual setting, Contact input

Withstand voltage: 50/60 Hz, 1 minute

Time: 1 minute	Radiator fins	Main circuit terminals	Power terminals for instrument	Input terminals [2]	Alarm output terminal
Radiator fins					
Main circuit terminals	2500 V				
Power terminals for instrument	2500 V	2500 V			
Input terminals *	2500 V	2500 V	2300 V		
Alarm output terminal	2500 V	2500 V	2300 V	2000 V	
Host communication, Retransmission output terminals	2500 V	2500 V	2300 V	1000 V	2000 V

* Input terminals: Control input, External gradient setting, External manual setting, Contact input

Power failure: Power failure: The control circuit will not be affected by power failure shorter than about 50 ms in the range of rated voltage.
Memory backup: Backed up by non-volatile memory
Number of writing: Approx. 1,000,000 times
Data storage period: Approx. 10 years
Recovery operation when power fails:
Same action as when power is turned on

Calorific values:

20 A type: Approx. 30 W	60 A type: Approx. 84 W
30 A type: Approx. 43 W	80 A type: Approx. 112 W
45 A type: Approx. 63 W	100 A type: Approx. 140 W

■ Environment conditions

● Operating environmental conditions:

Ambient temperature: −15 to +55 °C (Operation guarantee range)
At the time of standalone mounting and close mounting of rating 20 A, 30 A, 45 A, 80 A, and 100 A, it will be the straight line where the rated current is 0.8 at 55 °C on the derating curve at 40 to 55 °C

Ambient humidity: 5 to 95 %RH (Non condensing)
(Absolute humidity: MAX.W.C 29 g/m^3 dry air at 101.3 kPa)

Vibration: Frequency range: 10 to 150 Hz
Maximum amplitude: 0.075 mm
Maximum acceleration: 9.8 m/s^2
Each direction of XYZ axes

Shock: Drop when a side of the bottom is lifted to the less severe of height 50 mm or 30° with respect to the side opposite to it (X, Y axes)

Operating environment:
- Free from places where sudden changes in ambient temperature occur which may cause condensation or freezing.
- Free from corrosive or inflammable gases
- Free from inflammable materials near this instrument.
- Free from water, oil, chemicals, vapor or steam splashes
- Free from dust, salt or iron particles
- Free from direct air flow from an air conditioner.
- Free from excessive heat accumulation due to radiation heat.

● Reference operating conditions

Reference temperature: 23 °C ±2 °C

Temperature variation: ±5 °C/h

Reference humidity: 50 %RH ±10 %RH

Magnetic field: Geomagnetism

Power supply voltage: Alternating current, Direct current: Reference value ±1 %

● Transportation and Storage environment conditions

Vibration:

Number of vibration	Level		Attenuation slope
HZ	$(m/s^2)^2/Hz$	$[g^2/Hz]$ *	dB/oct
3	0.048	(0.005)	—
3 to 6	—	—	+13.75
6 to 18	1.15	(0.012)	—
18 to 40	—	—	–9.34
40	0.096	(0.001)	—
40 to 200	—	—	–1.29
200	0.048	(0.0005)	—

The effective value of the acceleration is 5.8 m/s^2 [0.59 g*] within the number of vibration.

* g = 9.806658 m/s^2

Shock: Height 60 cm or less

Temperature: −40 to +70 °C

Humidity: Less than 5 to 95 %RH (Non condensing)

Absolute humidity: MAX.W.C 35 g/m^3 dry air at 101.3 kPa

Ambient atmosphere:

- Free from places where sudden changes in ambient temperature occur which may cause condensation or freezing.
- Free from corrosive or inflammable gases
- Free from inflammable materials near this instrument.
- Free from water, oil, chemicals, vapor or steam splashes
- Free from dust, salt or iron particles
- Free from direct air flow from an air conditioner.
- Free from excessive heat accumulation due to radiation heat.

■ Mounting and Structure

Mounting method: Panel mounting

Mounting orientation: Vertical direction
tilt: All four directions within ±10°

Case color: Bluish white

Front panel material: PPE (lame retardancy: UL94 V-1)

Case material: PPE-GF20 (Flame retardancy: UL94 V-1)

Panel sheet material: Polyester

Weight:
20 A/30 A types: Approx. 0.45 kg
45 A/60 A types: Approx. 1.2 kg
80 A/100 A types: Approx. 1.8 kg

Dimensions:
20 A/30 A types: 48 mm × 172 mm × 118 mm (W × H × Depth behind the panel)
45 A/60 A types: 68 mm × 188 mm × 150 mm (W × H × Depth behind the panel)
80 A/100 A types: 116 mm × 200 mm × 150 mm (W × H × Depth behind the panel)

■ Standard

● Safety standards

UL: UL508 (file No. E177758)

cUL: C22.2 No. 14 (file No. E177758)

● Other approved standards

CE marking: LVD: EN60947-4-3 (Form 4), Rated insulation voltage: 240 V
EMC: EN60947-4-3 (Form 4)
RoHS: EN IEC 63000

The noise filter specified: In order to comply with the European EMC- and LV directive the noise filter should be applied.
The noise filter specified (SOSHIN ELECTRIC CO., LTD.):
20 A type: LF2030A-NH
30 A type: LF2030A-NH
45 A type: HF2050A-UP
60 A type: HF2060A-UP
80 A type: HF2080A-UP
100 A type: HF2100A-UP

EMC test standards: Emissions
The EMC emissions test standards required by the standard EN 60947-4-3 'Contactors and motor-starters - AC semiconductor motor controllers and contactors for non-motor loads' are presented in table 1.

Table 1: EMC emissions standards compliance

Emission type	Test standard
Conducted disturbance	CISPR 11 Environment A Group 2
Radiated EM field	CISPR 11 Environment A

Immunity
The EMC immunity test standards required by the standard EN 60947-4-3 ‘Contactors and motor-starters - AC semiconductor motor controllers and contactors for non-motor loads’ are presented in table 2.

Table 2: EMC immunity standards compliance

Test type	Test standard	Test level
Electrostatic discharge	EN 61000-4-2	Contact: 4 kV Air: 8 kV
Radiated, radio frequency electromagnetic field	EN 61000-4-3	Enclosure port: 80–1000 MHz: 10 V/m 1.4 GHz–2 GHz: 3 V/m 2 GHz–2.7 GHz: 1 V/m
Electrical fast transient/burst	EN 61000-4-4	AC Power port: 2 kV Signal port: 1 kV
Surge	EN 61000-4-5	AC Power port: 1 kV (line to line)
Conducted disturbances induced by radio frequency fields	EN 61000-4-6	AC Power port Signal port: 0.15–80 MHz: 10 V
Voltage dips	EN 61000-4-11	AC Power port: 0 % during 0.5 cycle * 0 % during 1 cycle * 40 % during 10/12 cycles * 70 % during 25/30 cycles * 80 % during 250/300 cycles * * Rated operational voltage
Voltage interruptions	EN 61000-4-11	AC Power port: 0 % during 250/300 cycles (Rated operational voltage)

Overload current profile and duty cycle:

$1.1 \times I_e$–60s: 50–60

● Environment Condition

Overvoltage category: OVERVOLTAGE CATEGORY II

Pollution degree: POLLUTION DEGREE 2

Altitude: Altitude up to 2000 m (Indoor use)

INDEX [Alphabetical Order]

P

R

S

T

INDEX [Character Order]

* Mode
A: Monitor mode
B: Parameter select mode
C: Setting mode
D: Engineering mode

Symbol		Name	Mode *	Page
P5	P5	Parameter select setting 5	D F10	5-14, 6-17, 10-18
P6	P6	Parameter select setting 6	D F10	5-14, 6-17, 10-18
P7	P7	Parameter select setting 7	D F10	5-14, 6-17, 10-18
P8	P8	Parameter select setting 8	D F10	5-14, 6-17, 10-18
P9	P9	Parameter select setting 9	D F10	5-14, 6-17, 10-18
P10	P10	Parameter select setting 10	D F10	5-14, 6-17, 10-18
P11	P11	Parameter select setting 11	D F10	5-14, 6-17, 10-18
P12	P12	Parameter select setting 12	D F10	5-14, 6-17, 10-18
P13	P13	Parameter select setting 13	D F10	5-14, 6-17, 10-18
P14	P14	Parameter select setting 14	D F10	5-14, 6-17, 10-18
P15	P15	Parameter select setting 15	D F10	5-14, 6-17, 10-18
P16	P16	Parameter select setting 16	D F10	5-14, 6-17, 10-18
P17	P17	Parameter select setting 17	D F10	5-14, 6-17, 10-18
P18	P18	Parameter select setting 18	D F10	5-14, 6-17, 10-18
P19	P19	Parameter select setting 19	D F10	5-14, 6-17, 10-18
P20	P20	Parameter select setting 20	D F10	5-14, 6-17, 10-18
P21	P21	Parameter select setting 21	D F10	5-14, 6-17, 10-18
P22	P22	Parameter select setting 22	D F10	5-14, 6-17, 10-18
PA	PA	Phase angle ratio monitor	A —	5-10, 6-3, 10-3
Po	Po	Power value monitor	A —	5-10, 6-3, 10-4
R (r) (r)				
r1	r1	Current value at knee point 1	D F6	5-13, 6-14, 9-34
r2	r2	Current value at knee point 2	D F6	5-13, 6-14, 9-35
r3	r3	Current value atknee point 3	D F6	5-13, 6-14, 9-36
rS	rS	RUN/STOP transfer	D F2	5-12, 6-10, 8-40
S (S)				
SA	SA	Alarm enable/disable during STOP	D F4	5-12, 6-12, 9-55
SC	SC	SCR trigger signal setting	D F3	5-12, 6-11, 8-43
Sd	Sd	Soft-down time	B C —	5-10, 5-11, 6-4, 6-7, 8-21
SF	SF	Soft-start, Soft-down enable/disable	D F2	5-12, 6-10, 8-21
SU	SU	Soft-start time	B C —	5-10, 5-11, 6-4, 6-7, 8-20
T (T)				
TA	TA	Determination set value in case of a break on the secondary side of the transformer	B D F7	5-11, 5-13, 6-6, 6-15, 8-36
Tb	Tb	Thyristor break-down detection 1 setting	C —	5-10, 6-7, 9-14
TC	TC	Thyristor break-down detection 2 setting	C —	5-10, 6-8, 9-16
TF	TF	Protection function for control of primary side of a transformer	B D F7	5-11, 5-13, 6-6, 6-15, 8-36
TL	TL	Output limiter setting in case of a break on the secondary side of the transformer	B D F7	5-11, 5-13, 6-6, 6-15, 8-36
TU	TU	Soft-start time in case of break on the secondary side of the transformer	B D F7	5-11, 5-13, 6-6, 6-15, 8-37
V (V)				
Vq	Vq	ROM version (Low-order)	D F5	5-13, 6-13, 10-21
Vr	Vr	ROM version (High-order)	D F5	5-13, 6-13, 10-21

Symbol		Name	Mode *	Page
W (W)				
WH	WH	Integrated operation time [upper 3 digits]	D F5	5-13, 6-13, 10-19
WL	WL	Integrated operation time [lower 3 digits]	D F5	5-13, 6-13, 10-19
X (X)				
XI	XI	Input signal type selection	D F2	5-12, 6-10, 7-2

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