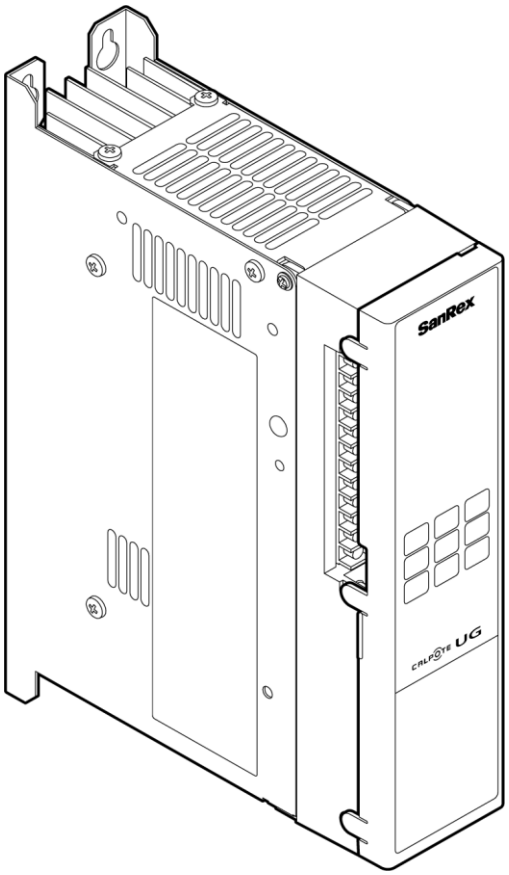
SanRex

CALPOTE UG series

Thyristor Type Power Regulator Unit

UG1 INSTRUCTION MANUAL



Thank you for your purchase of our Thyristor Type Power Regulator Unit CALPOTE UG1 Series.
In order to use this product safely and correctly, read this instruction manual thoroughly before using this product.
This manual is revised from time to time, so please obtain the latest version from our website before use.

K00A0482200AB Mar. 13, 2025

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1 SAFETY PRECAUTIONS

Read this instruction manual to ensure that work is performed correctly and safely.
In order to prevent injury to people, and to prevent damage to property, the following label categories and symbols are used to explain the items that must be observed.

Explanation of label categories

	**WARNING**	This indicates information that involves the risk of death or serious injury.
	**CAUTION**	This indicates information that involves the risk of injury or property damage.

Explanation of symbols

	**Required**	This is an item that must be carried out.
	**Prohibited**	This is an item that is prohibited.

<table>
<tr><td rowspan="2"> 
WARNING</td><td> 
Required</td><td>

Installation, wiring, maintenance, and inspection must all be performed by contractors who specialize in this work.
Before installing, wiring, maintaining, and inspecting this product, turn OFF the input power supply of the distribution panel and check that the power supply is OFF.
Secure a safe space before performing installation, wiring, maintenance, and inspection.
Remove wristwatches and other such metal objects and wear clothing that is appropriate in terms of safety before performing installation, wiring, maintenance, and inspection. There is the risk of electric shock or injury if you perform work while wearing metal objects.
When performing installation, wiring, maintenance, and inspection, use tools for which insulation countermeasures have been carried out. There is the risk of electric shock if you use other tools.
If you detect an odd smell or sound, stop work immediately and stop operating the product. There is the risk of fire if this instruction is not followed.

</td></tr>
<tr><td> 
Prohibited</td><td>

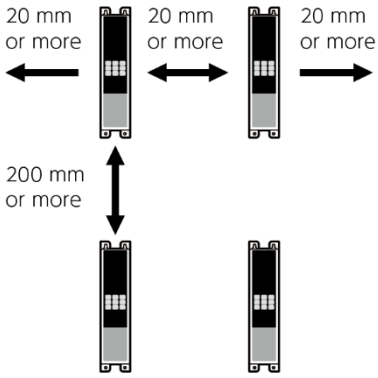
Do not use the product with the unit cover open. There is the risk of electric shock if this instruction is not followed.
Do not insert fingers, metal bars, etc. into the openings. There is the risk of electric shock or injury if this instruction is not followed.
While input power is supplied, do not touch the conducting parts or the wires. There is the risk of electric shock or burns if this instruction is not followed.
During installation, wiring, maintenance, and inspection, individuals other than the workers must not touch the distribution panel. Workers must prevent others from easily touching the distribution panel by erecting a sign stating “Do not turn the power ON.”
Individuals other than the workers must not enter the installation, wiring, maintenance, or inspection work area. Workers must prevent others from easily entering this area by erecting a sign stating “No entry.”

</td></tr>
</table>

1.1 Usage/Storage Location

CAUTION	Prohibited	Do not use or store the product in locations such as the following. There is the risk of fire due to factors such as product failure, damage, and deterioration if this instruction is not followed. ● Hot, cold, or humid locations that are not in compliance with the operating environments specified by the instruction manual. ● Locations exposed to direct sunlight ● Locations subject to vibration or impact ● Locations close to a device that produces sparks ● Locations exposed to direct contact with heat from a dryer or other heat source ● Locations exposed to contact with water ● Locations where there is dust, salt, corrosive gas, or flammable gas ● Outdoors

1.2 Installation

CAUTION	Required	● Depending on the product specifications, the unit weight may exceed 15 kg. Keep safety in mind during installation. For example, perform the work with two or more individuals. ● Install the unit so it is oriented vertically. Orienting the unit horizontally will cause its temperature to increase abnormally, leading to product failure. ● Install the product so its front door can be opened and closed. ● Provide sufficient space on the top, bottom, left, and right of the unit for heat dissipation. 

1.3 Wiring

 WARNING	 Required	● Use wires whose dielectric strength corresponds to the circuit voltage. There is the risk of electric shock if you use wires without dielectric strength. ● Fully cover the input and output terminals and the conducting parts of the wires with tubes, tape, or other such insulating objects. There is the risk of electric shock if you touch exposed parts. If the input and output terminals cannot be fully covered, ensure that direct contact with the exposed parts is not possible.
 CAUTION	 Required	● Use wires with the appropriate diameters to wire the input and output terminals. There is the risk of heating or fire if the wire diameters are too small. ● Use crimp terminals with the appropriate size to wire the input and output terminals. There is the risk of heating or fire if the crimp terminals are not the appropriate size.

1.4 Maintenance/Inspection

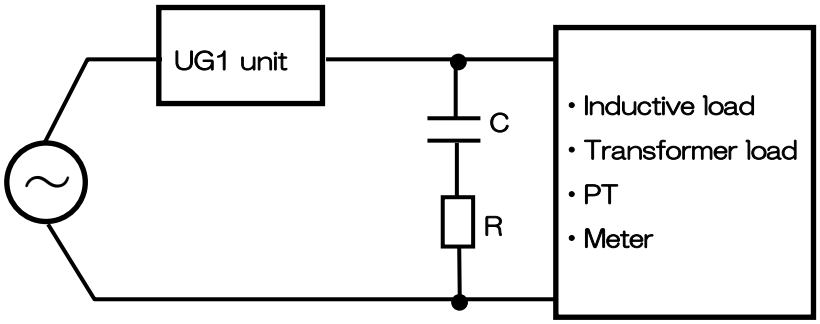
 WARNING	 Required	● Replace parts with ones having the same ratings and model. There is the risk of fire if different parts are used.
	 Prohibited	● Do not touch the transformer, heat dissipation fins, and other such parts that reach high temperatures. There is the risk of burns if this instruction is not followed, even after the input power supply is turned OFF (at which time these parts may still be hot).

2 PRECAUTIONS DURING USAGE

Pay attention to the following when using the unit.

- The main circuit thyristor may be damaged in short circuit mode. To prevent fire and property damage in case of ground faults, ensure that the design is safe by, for example, installing protective functions on the power input side of the unit main circuit using breakers or other devices.
- It is not recommended to operate this product while switching the output between 0% and 100% at intervals of a few minutes repeatedly. The main circuit thyristor will reach the upper limit of the power cycle, breaking down earlier than specified. Reduce the output variation range, select a model with sufficient capacity for the rated current, or take other measures to prevent the early breakdown.
- To wire the main circuit, use cables with sufficient capacity for the rated current of the unit.
- To wire the main circuit, connect the K terminal to the power supply side and the L terminal to the load side.
- Be sure to match the phases of the main circuit power supply and the control circuit power supply.
- Do not bundle the control circuit cables together with the main circuit cables.
- When connecting the control circuit cable, do not forcefully open or close the front door. Also, be careful not to touch the cables or parts inside the unit when connecting.
- When storing the unit in the distribution panel cabinet, provide ventilation in consideration of the internal calorific value of the unit.
  (See “9 UNIT OUTLINE” for the internal calorific value.)
- Note that dust, moisture, overheating, vibration, and other issues may degrade the performance of the unit or cause it to fail.
- Be sure to install the unit upright and vertical and keep space around the unit as instructed in the installation precautions. Installing the unit horizontally or reducing the space may degrade the cooling performance, and may lead to abnormal high temperature.
- Install the unit so that its front door can be opened and closed for maintenance or inspection.
- When operating the unit with cycle control, it is preferable to use a fuse-attached model of the unit.
- The unit cannot be operated with cycle control with inductive loads. Be sure to operate the unit with phase control when inductive loads are applied.
  (Contact us for customized products.)
- If the load capacity is small, a leakage current is applied to the load side even when the signal is off, causing malfunctions. To prevent this, connect a bleeder resistor in parallel with the load. (The minimum load current is 1 A.)
- If the load capacity is small (approximately 10% of the rated capacity or lower), error code Er.14 is displayed with the self-diagnostic function. This, however, does not cause any problems during operation.

- Do not apply 5 V or more or 20 mA or more from the temperature controller.
- A load must be connected during test operation. When test operation is performed with no load, voltage continues to be applied to the output terminal. Additionally, do not perform test operation with no load while the external potential transformer (PT) is connected. Doing so may damage the unit.
- When the unit is operated with an inductive load (including a transformer load) and the feedback PT, resonance may be caused due to the load being low or nonexistent, generating abnormal voltage. Additionally, when the unit is operated with a transformer load, voltage higher than the rating may be generated on the load side of the unit due to surge voltage caused by gate blocking (including the unit being turned ON/OFF with the GT terminal), power supply stoppage, or other causes. When the unit is operated under the above conditions, install a CR absorber on the load side of the unit as shown in the following figure.

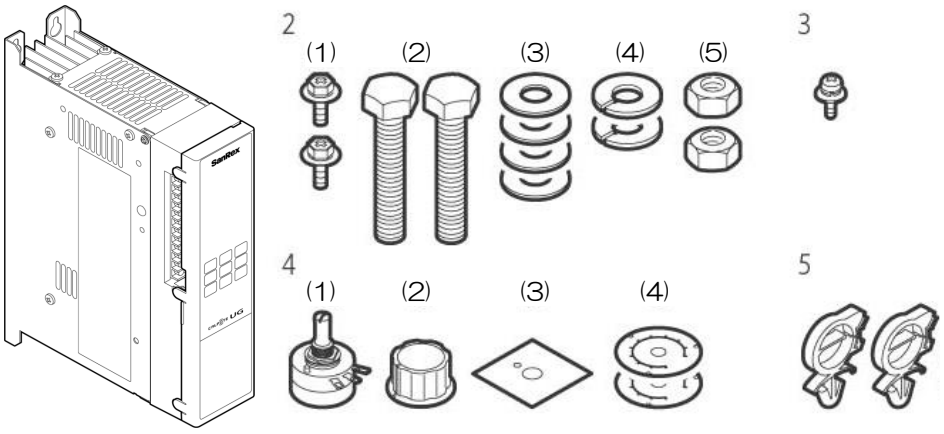


Unit current (A)	200 V system unit		400 V system unit	
	Capacitor (μF)	Resistor (Ω)	Capacitor (μF)	Resistor (Ω)
25 to 100	0.5 (400 VAC)	50 (120 W)	1 (800 VAC)	50 (120 W)
150 to 350	1 (400 VAC)	20 (120 W)	1 (800 VAC)	20 (120 W)
450	2 (400 VAC)	20 (120 W)	2 (800 VAC)	20 (120 W)

3 CHECKING THE PRODUCT

Check the following before installation.

- Check that the product and parts with the correct specifications are included as ordered.

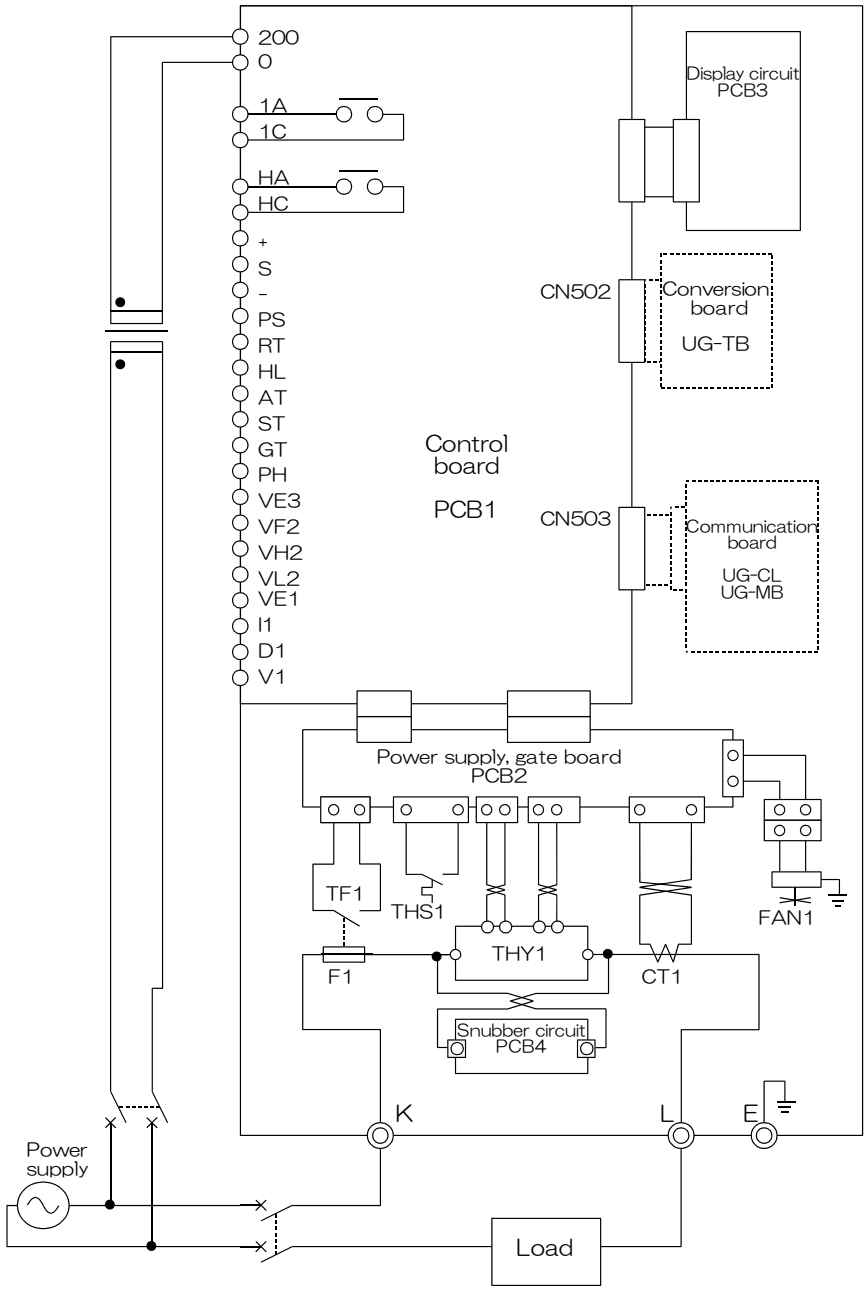


No.	Included item name		Quantity
1	UG1 unit		1
2	Screws, nuts, etc. for output wiring		
	(1) Screw	For models with a rated current of 25 to 250 A	2
	(2) Bolt	Models with a rated current of 350 or 450 A	2
	(3) Washer		4
	(4) Spring washer		2
	(5) Nut		2
3	Ground terminal connection screw		1
4	Adjuster set		
	(1) Adjuster (1 kΩ, B characteristic)		1
	(2) Knob		1
	(3) Insulating sheet		1
	(4) Nameplate (manual output adjustment, gradient setting)		2
5	Easy lock		2
6	Cautionary guide		1

- Check that the optional items with the correct specifications are included as ordered.
  For included items, refer to the installation manual that comes with each optional item.

Optional item	Model	Optional item that needs to be purchased separately
Display panel	UG-DP	Extension cable
Conversion board	UG-TB*** (eight types including 1A and 1V)	Current transformer (CT), PT
Communication board	UG-CL, UG-MB	-

4 UNIT CONNECTION DIAGRAM



THY	Thyristor
FAN	Cooling fan (air-cooled models only)
F	Fuse (only models with a fuse)
TF	Fuse warning contact (only models with a fuse)

CT	Current transformer
PCB	Printed circuit board
CN	Connector
THS	Thermal switch

※ Ensure that the design is safe by installing protective functions on the input side of the main circuit using breakers or other devices.

※ If the power supplied to the main circuit is not 200/220 V, use a transformer to change the control power supply to 200/220 V.

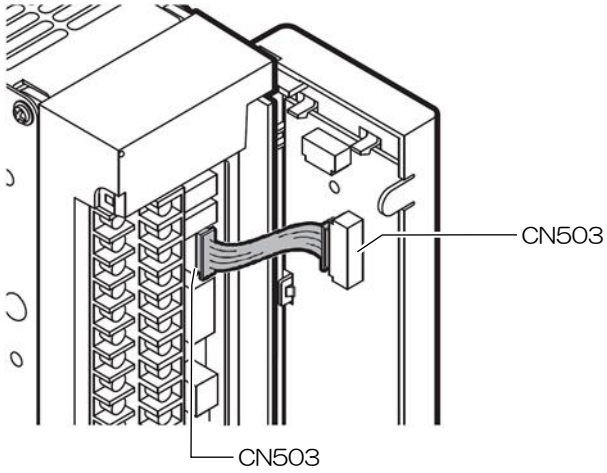
※ Wire the main circuit and control circuit with the correct polarities.

5 EXTERNAL CONNECTIONS OF THE UNIT

5.1 Control Terminal Block

Once you open the front door, you will be able to connect wiring to the control terminal block.

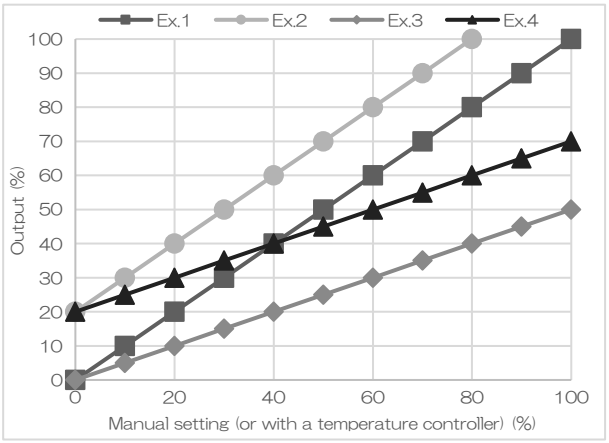
※ When connecting, be careful not to open or close the front door forcefully and be careful not to touch the cables or components inside the unit.



5.2 Functions

Wire the control terminal block of the unit according to the following table. (Terminal screw: M3)

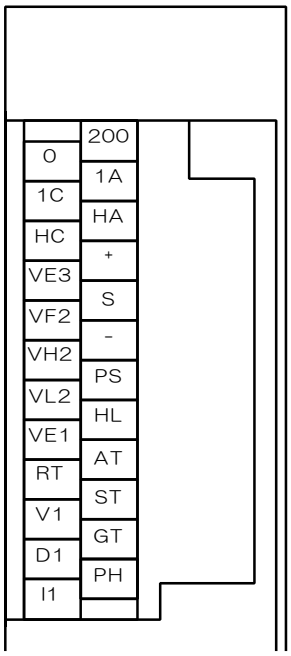
Terminal	Description about functions and purposes	When not in use
200 0	The inputs for the control power supply. These terminals need to be wired according to the main circuit polarity. Models with a rated current of 25 to 75 A: 25 VA, models with a rated current of 100 to 450 A: 50 VA	-
1A 1C	External warning relay (1) output signal The contact is closed when an error occurs. normally open , 250 VAC and 1 A, 30 VDC and 1 A	Open
HA HC	External warning relay (2) output signal The contact is closed when an error occurs. normally open , 250 VAC and 1 A, 30 VDC and 1 A	Open
+ S -	Temperature control signal input Connect (+) of temperature controller to (+) terminal and (-) of temperature controller to (-) terminal. Short-circuit "+" with "S" when the temperature controller is a current source. 4 to 20 mA (DC) Open "S" when the temperature controller is a voltage source. 0 to 5 VDC	Open

<table>
<tr><th>Terminal</th><th>Description about functions and purposes</th><th>When not in use</th></tr>
<tr><td>PS</td><td>Temperature control signal output
This terminal is used when a single temperature controller controls multiple units.
You can also control multiple units by connecting a temperature controller in parallel with them, instead of using PS.
<table>
<tr><th>PS terminal</th><th>Advantage</th><th>Disadvantage</th></tr>
<tr><td>When used</td><td>Control accuracy can be retained even when the number of units connected in parallel increases.</td><td>When the power supply to one unit is interrupted, the subsequent units also stop.</td></tr>
<tr><td>When not used</td><td>Even when the power supply to one unit is interrupted, the other units can continue to be operated.</td><td>When the number of units connected in parallel increases, the temperature controller signal level lowers, decreasing the control accuracy.</td></tr>
</table></td><td>Open</td></tr>
<tr><td>VF2</td><td>VF2: Gradient (proportional) signal input</td><td>Short-circuited with VE3</td></tr>
<tr><td>VH2</td><td>VH2: Manual (upper limit) signal input</td><td>Short-circuited with VE1</td></tr>
<tr><td>VL2</td><td>VL2: Lower point (lower limit) signal input</td><td>Short-circuited with VE1</td></tr>
<tr><td>VE3
VE1</td><td>VE3 – VE1: +5 VDC output for a variable resistor
When a variable resistor (1 kΩ) is connected, the inputs from these terminals are used for setting. The output level is determined by a combination of the three inputs. Setting examples are shown in the following figure.
 

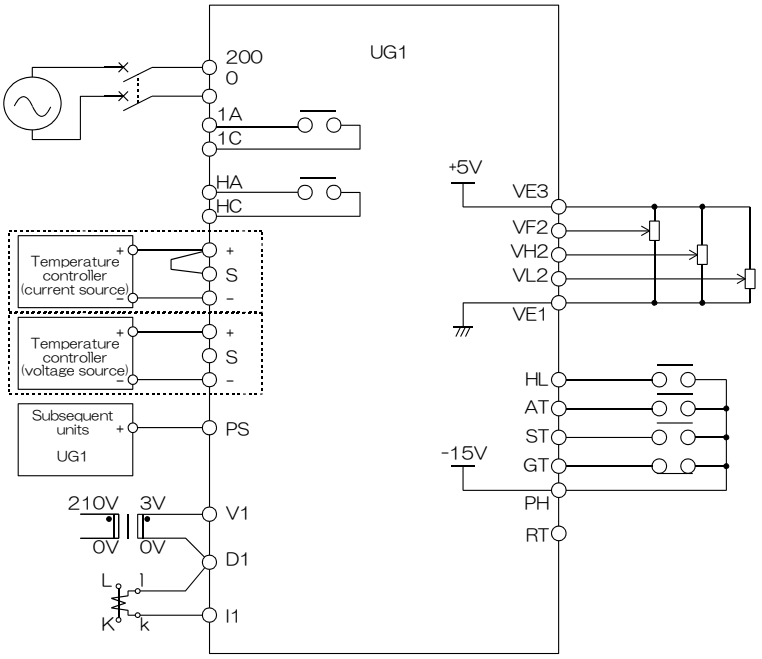
<table>
<tr><th></th><th>Lower point setting</th><th>Gradient setting</th></tr>
<tr><td>Ex.1</td><td>0%</td><td>100%</td></tr>
<tr><td>Ex.2</td><td>20%</td><td>100%</td></tr>
<tr><td>Ex.3</td><td>0%</td><td>50%</td></tr>
<tr><td>Ex.4</td><td>20%</td><td>50%</td></tr>
</table></td><td>↑
* Short-circuiting is not required when the settings are configured via the panel or communication.</td></tr>
</table>

Terminal	Description about functions and purposes	When not in use
HL	Two-position control signal input ・ Short-circuited: Acts according to the manual (upper limit) setting. ・ Open: Acts according to the lower point (lower limit) setting.	Open
AT	Automatic/manual switching signal input ・ Short-circuited: Automatic (control with a temperature controller or two-position control) ・ Open: Manual (control with the manual signal input)	–
ST	Start/stop switching signal input ・ Short-circuited: Starts operation. The output is gradually increased during the soft-start time. ・ Open: Stops operation. In the phase control, the output is gradually decreased during the time specified with the soft-start time. In the cycle control, the output is stopped regardless of the soft-start time. Start/stop can also be switched using the panel or via communication, instead of using the ST terminal. The ST terminal is prioritized over the panel and communication. The concrete behavior is as follows: ・ When the start/stop status is switched via the panel or communication, ST needs to be opened. ・ When ST is short-circuited, the output cannot be stopped via the panel or communication. ・ The output started via the panel or communication stops when ST is opened, short-circuited, and then opened again.	Open
GT	Emergency stop signal. This terminal is used to stop the output in emergencies. ・ Short-circuited: Permits the output. If the output has been switched to the start status via the ST terminal, communication, or the panel, the output resumes with a soft start when this terminal is short-circuited. ・ Open: Emergency stop. The output is unconditionally, immediately, and forcibly stopped.	Short-circuited with PH
PH	The output of -15 VDC for HL, AT, ST, and GT	–
RT	Connection prohibited (for maintenance)	Open
V1	Connect this terminal to the 3 V terminal on the secondary side of the external PT.	Open
D1	Connect this terminal to the l terminal on the secondary side of the external CT and the 0 V terminal on the secondary side of the external PT.	Open

Terminal	Description about functions and purposes	When not in use
I1	Connect this terminal to the k terminal on the secondary side of the external CT.	Open



Layout of the control terminal block



Terminal block connection example

5.3 Connection Diagrams for Setting Methods

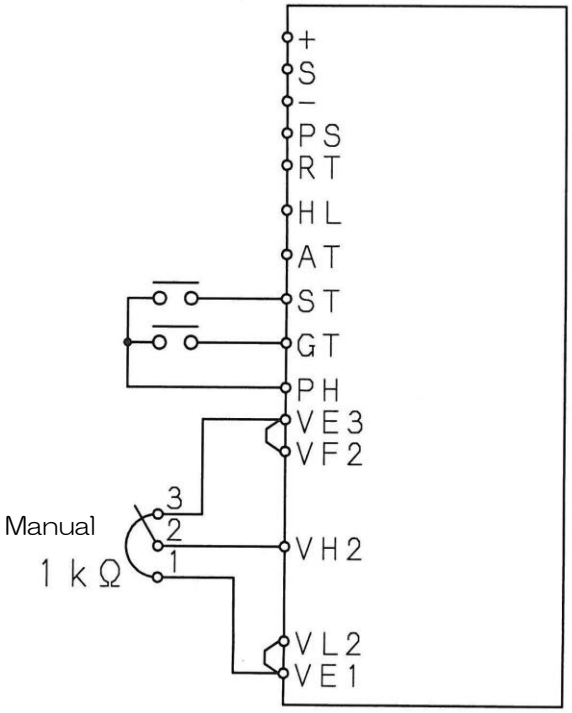
(1) Manual adjustment
(2) Two-position control
(3) Automatic adjustment 1 (4 to 20 mA [DC])
(4) Automatic adjustment 2 (1 to 5 VDC)
(5) Automatic adjustment 3 (0 to 5 VDC)
(6) Manual - Automatic 1 switching (4 to 20 mA [DC])
(7) Manual - Automatic 2 switching (1 to 5 VDC)
(8) Manual - Automatic 3 switching (0 to 5 VDC)
(9) Control of two or more UG1 units using a single temperature controller (4 to 20 mA [DC]) with the gradient set for each unit
(10) Control of two or more UG1 units using a single temperature controller (1 to 5 VDC) with the gradient set for each unit
(11) Control of two or more UG1 units using a single temperature controller (0 to 5 VDC) with the gradient set for each unit

The settings need to be changed on the display panel in addition to establishing the connection according to the diagrams shown on the following pages.
The settings that need to be changed are expressed as shown in the following instruction.
Change the settings according to "7 DISPLAY PANEL."
Example: Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

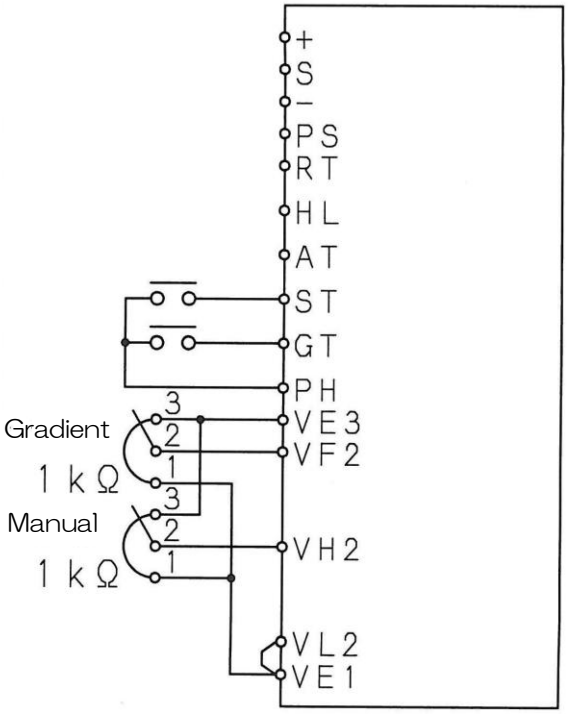
(1) Manual adjustment

Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

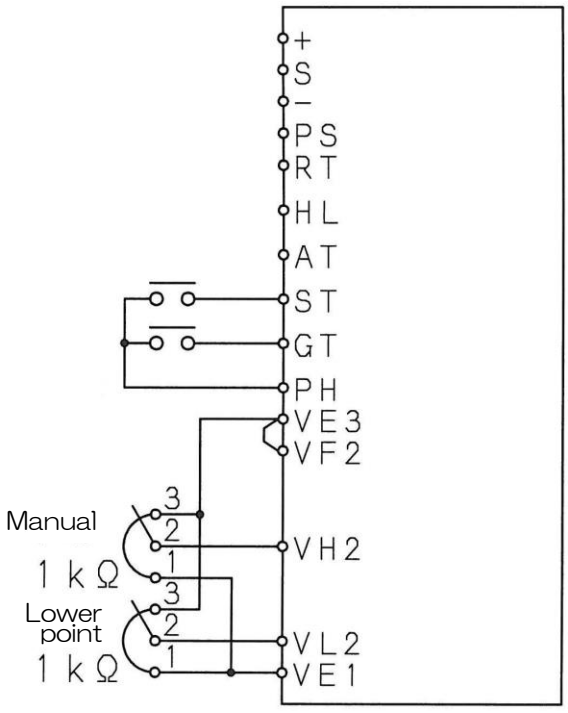
(1) Standard



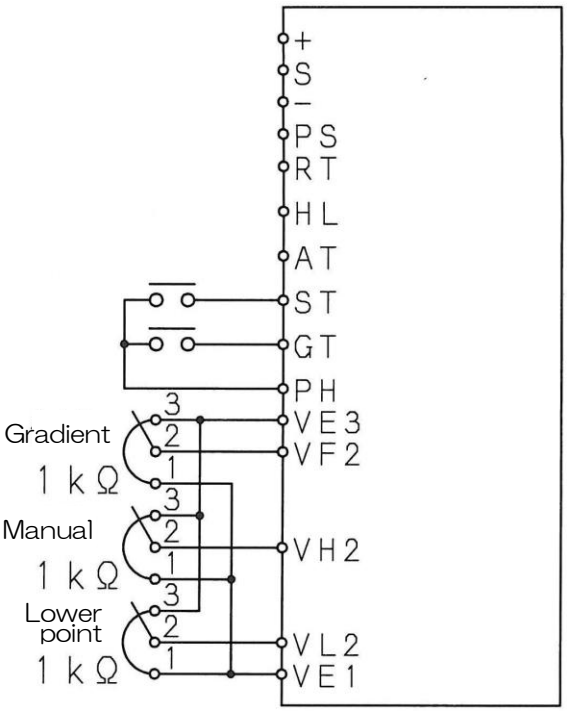
(2) With the gradient setting



(3) With the lower point setting



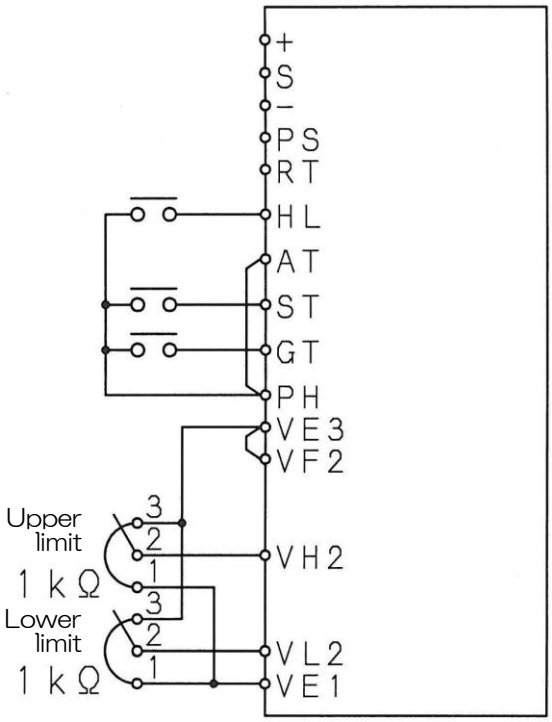
(4) With the gradient setting and the lower point setting



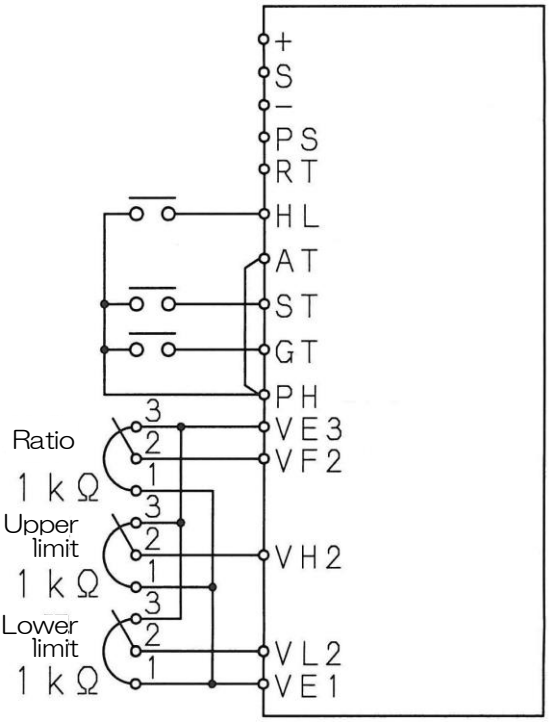
(2) Two-position control

Set [F101: Temperature controller type] to [2: Two-position control].

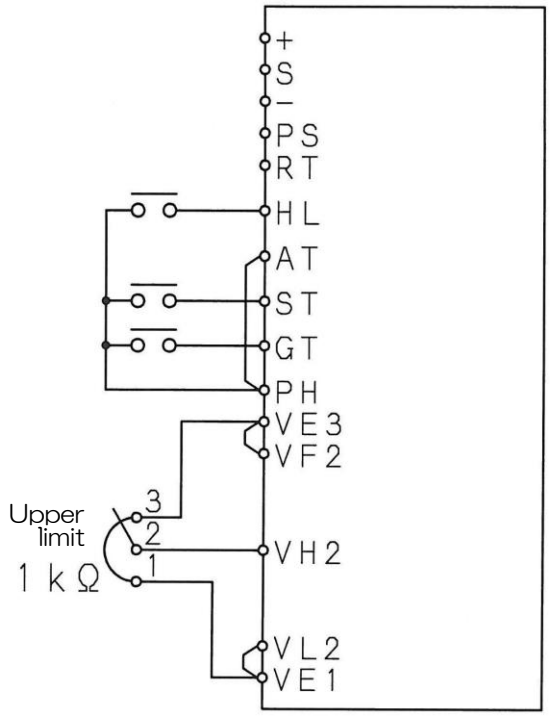
(1) Standard



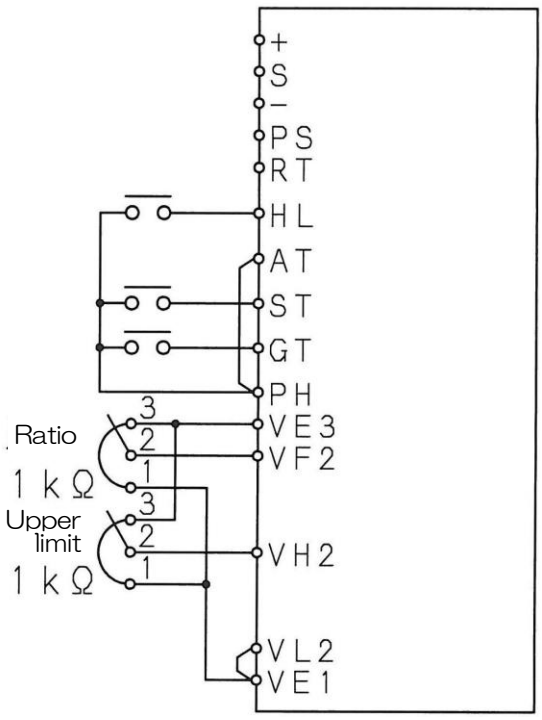
(2) With the proportional setting



(3) Upper limit setting only



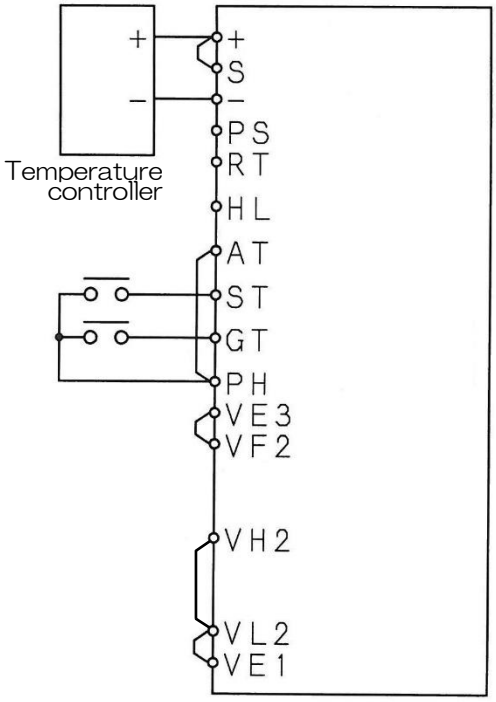
(4) Upper limit setting and proportional setting only



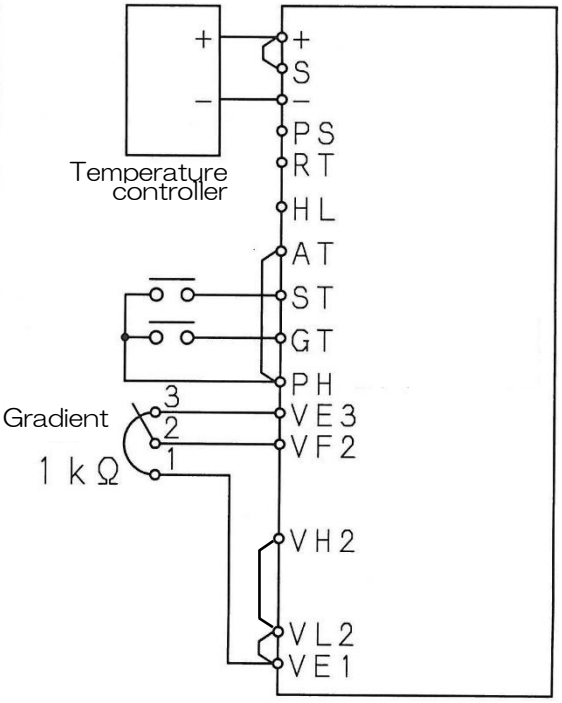
(3) Automatic adjustment 1 (4 to 20 mA [DC])

Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

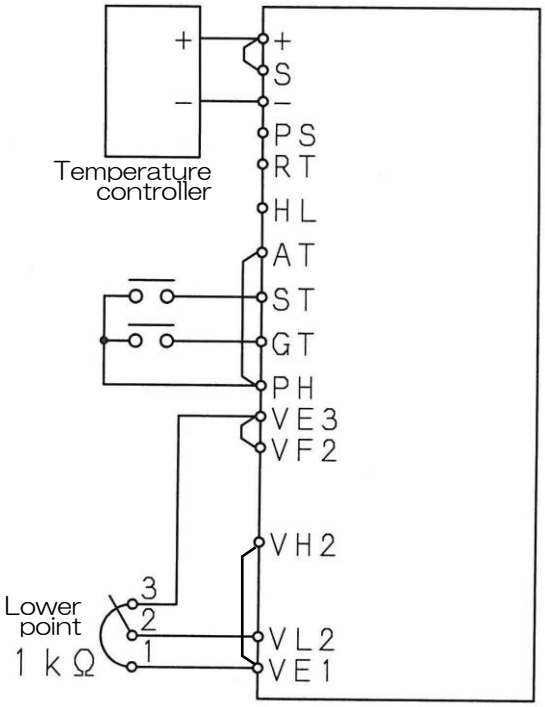
(1) Standard



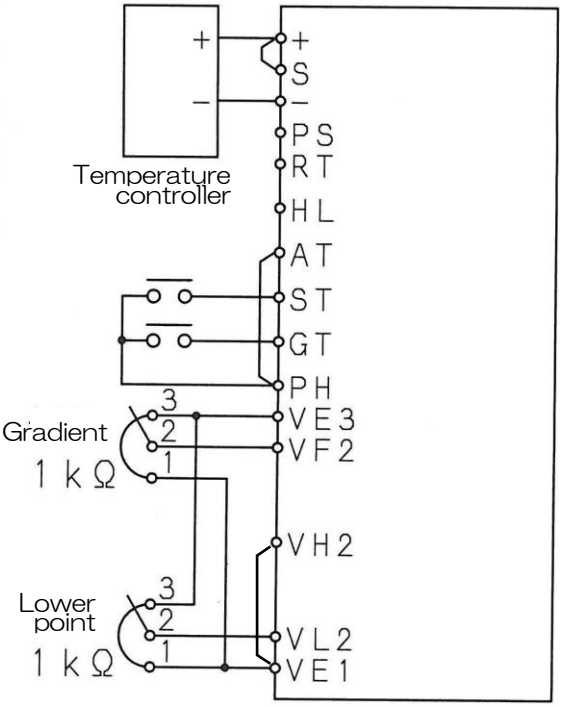
(2) With the gradient setting



(3) With the lower point setting



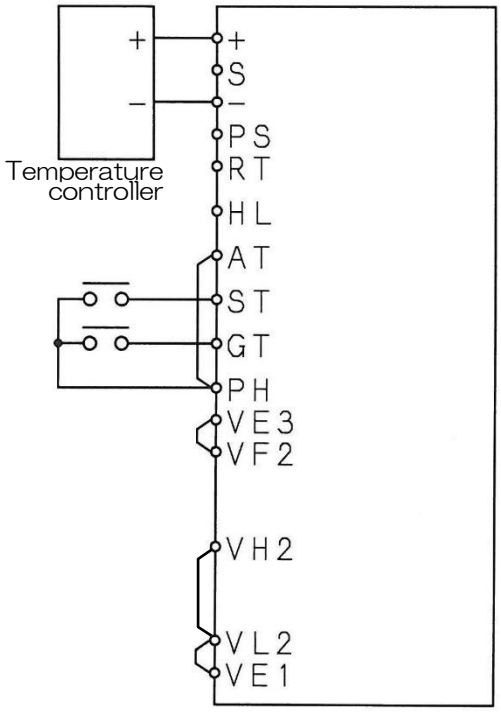
(4) With the gradient setting and the lower point setting



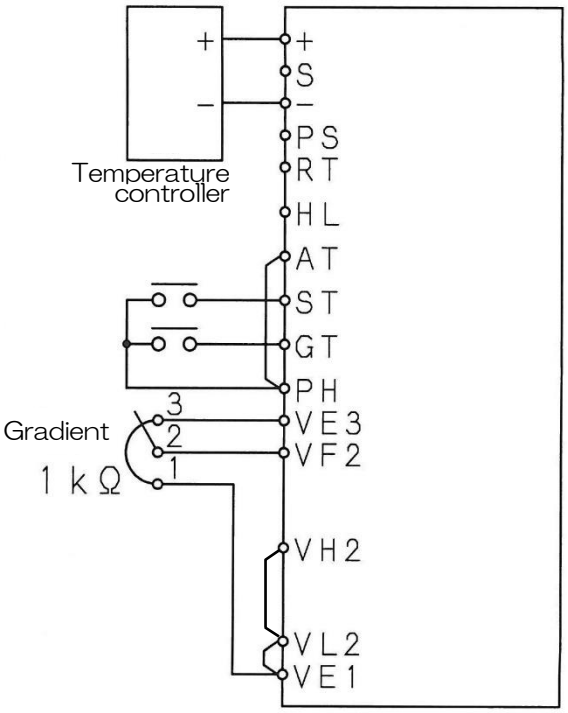
(4) Automatic adjustment 2 (1 to 5 VDC)

Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

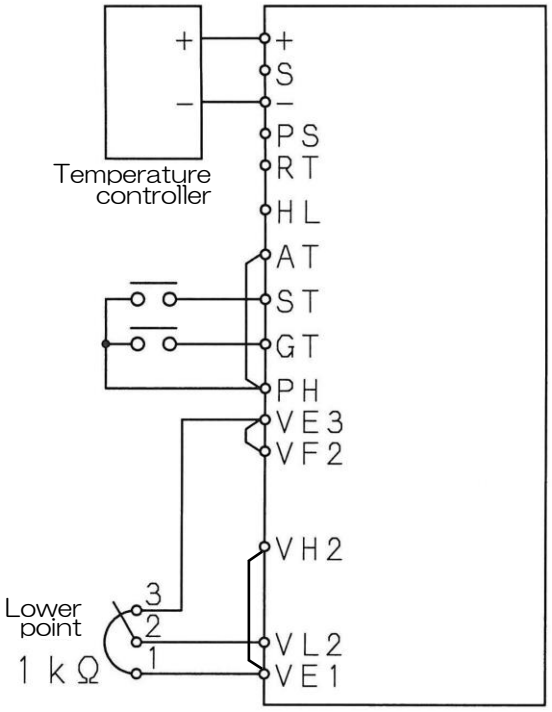
(1) Standard



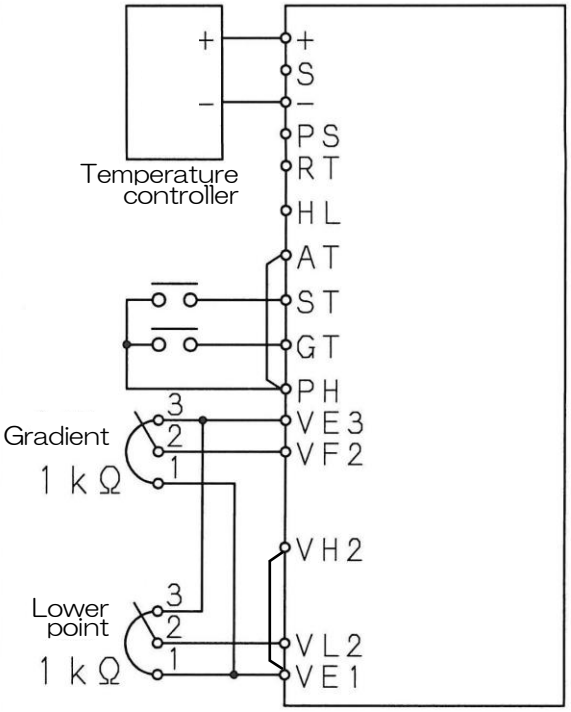
(2) With the gradient setting



(3) With the lower point setting



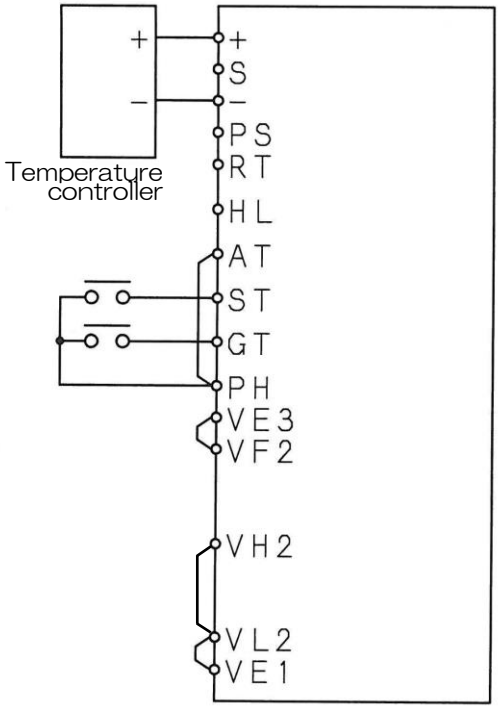
(4) With the gradient setting and the lower point setting



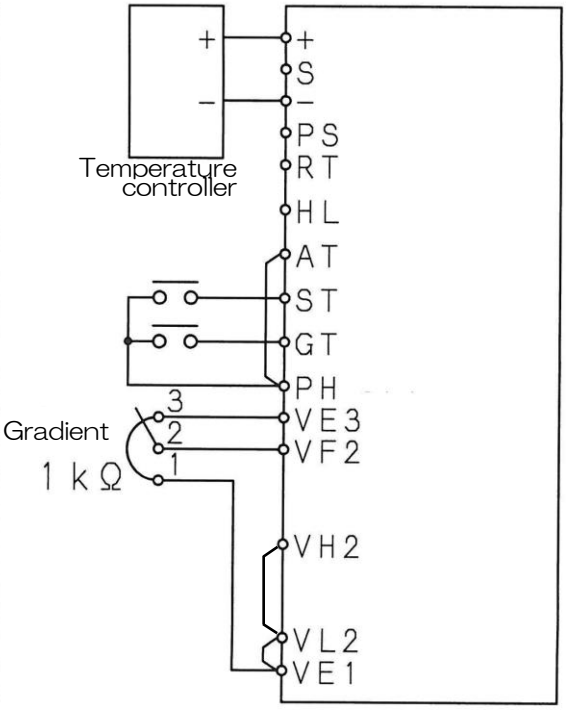
(5) Automatic adjustment 3 (0 to 5 VDC)

Set [F101: Temperature controller type] to [1: 0 to 5 VDC].

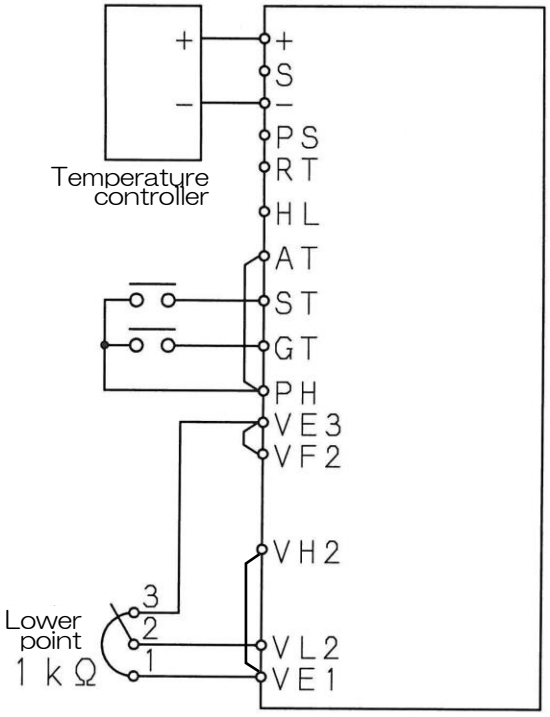
(1) Standard



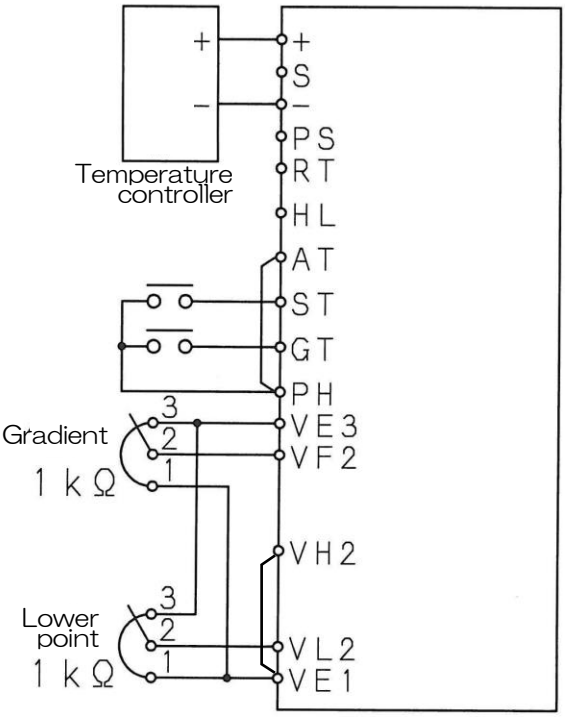
(2) With the gradient setting



(3) With the lower point setting



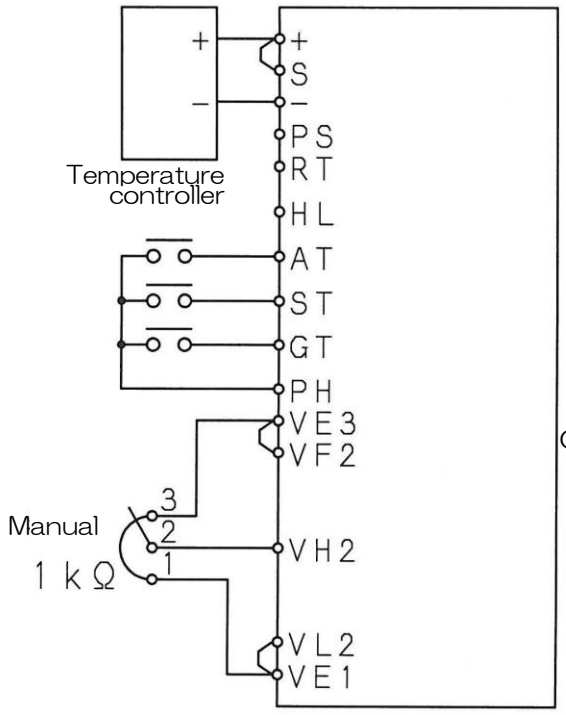
(4) With the gradient setting and the lower point setting



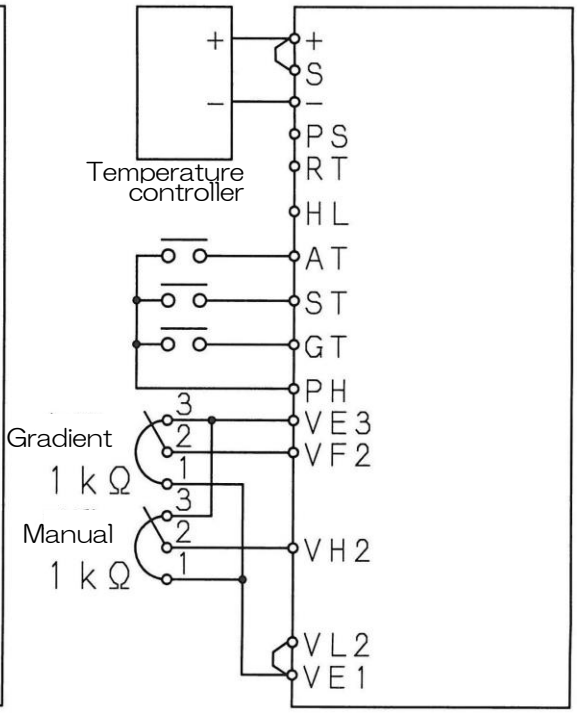
(6) Manual - Automatic 1 switching (4 to 20 mA [DC])

Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

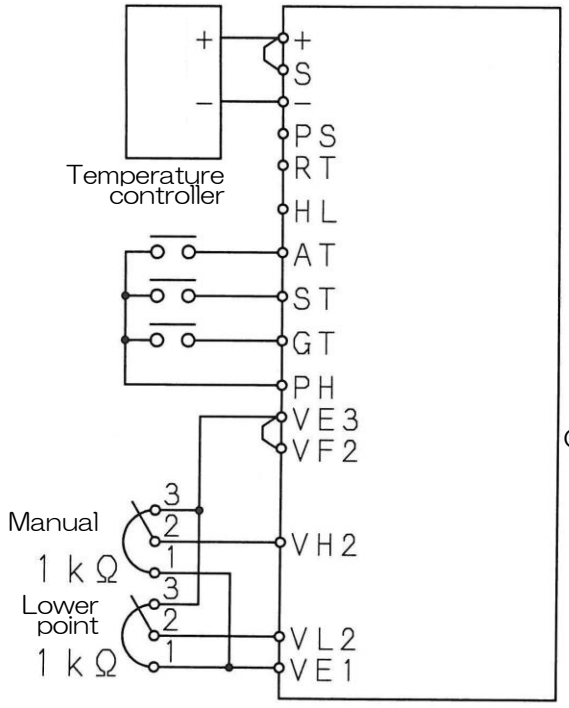
(1) Standard



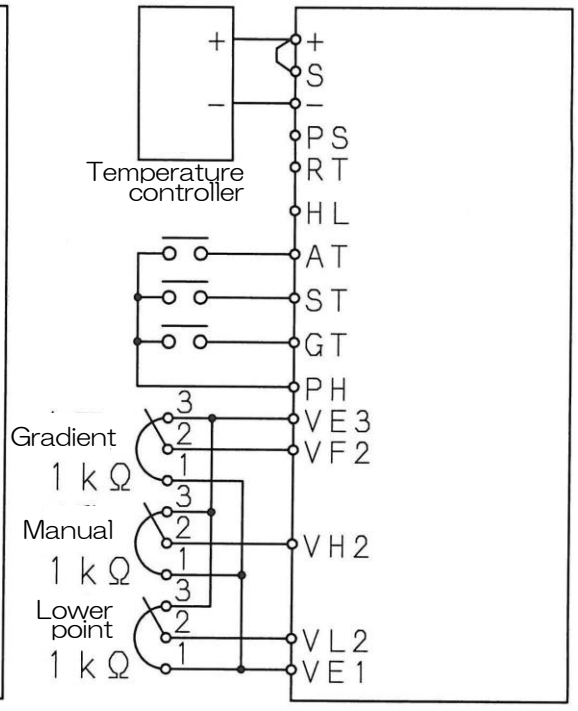
(2) With the gradient setting



(3) With the lower point setting



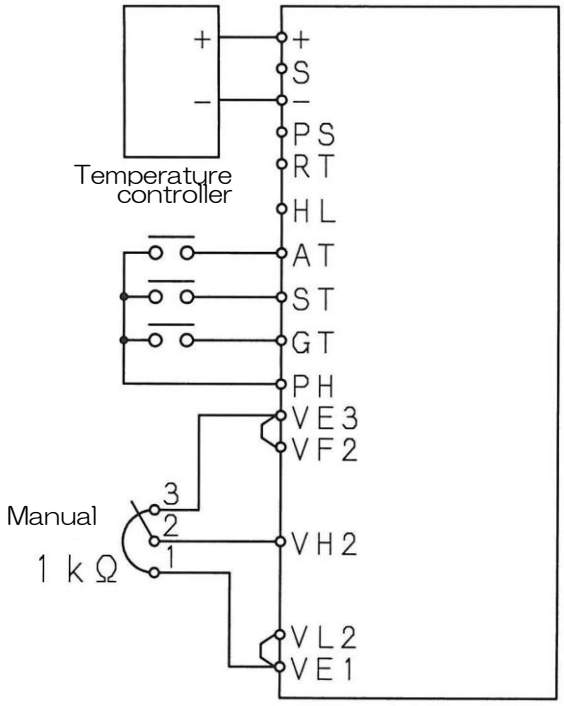
(4) With the gradient setting and the lower point setting



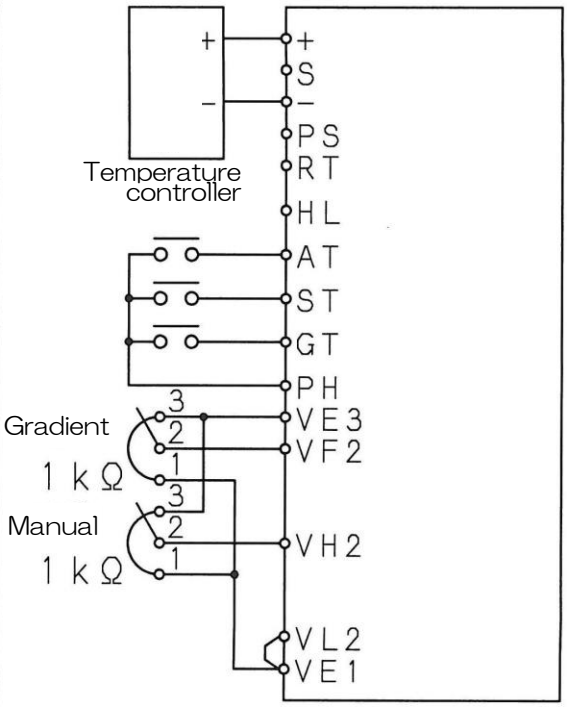
(7) Manual - Automatic 2 switching (1 to 5 VDC)

Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

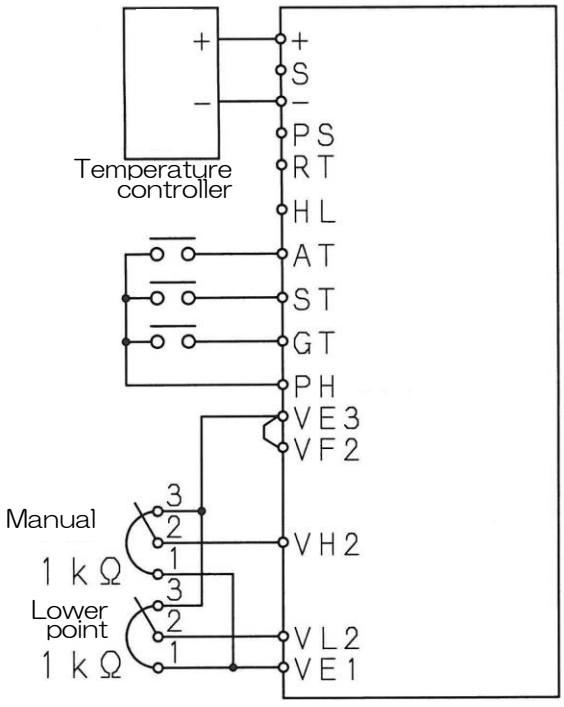
(1) Standard



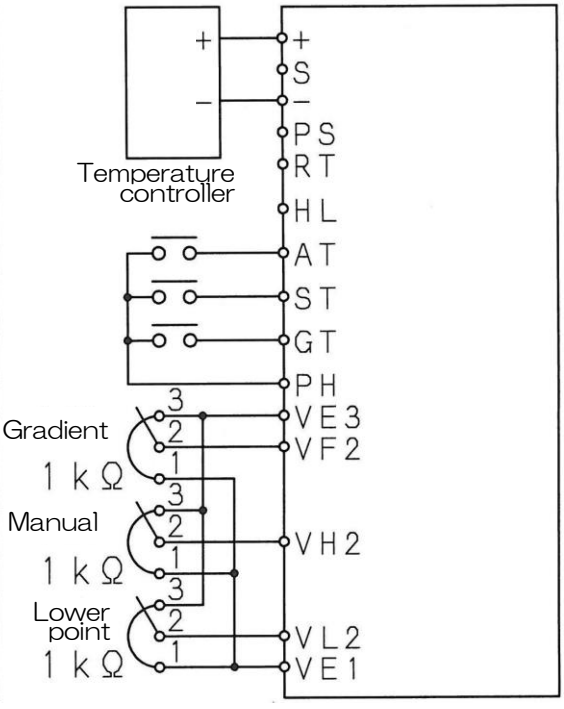
(2) With the gradient setting



(3) With the lower point setting



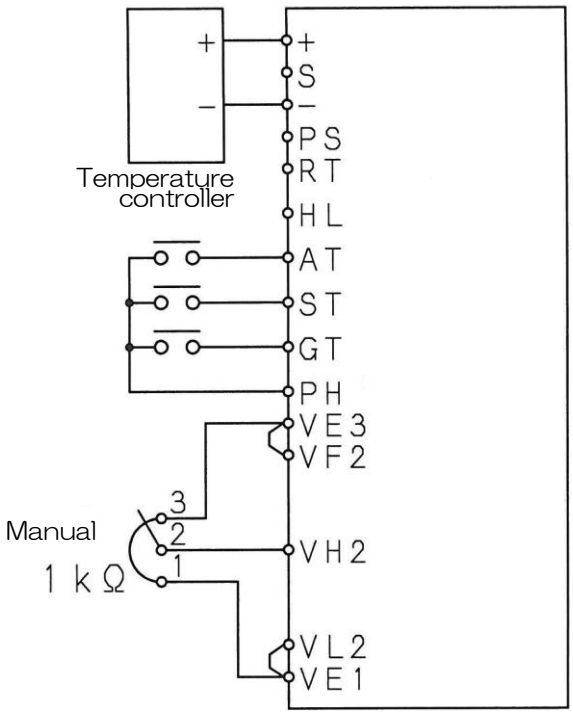
(4) With the gradient setting and the lower point setting



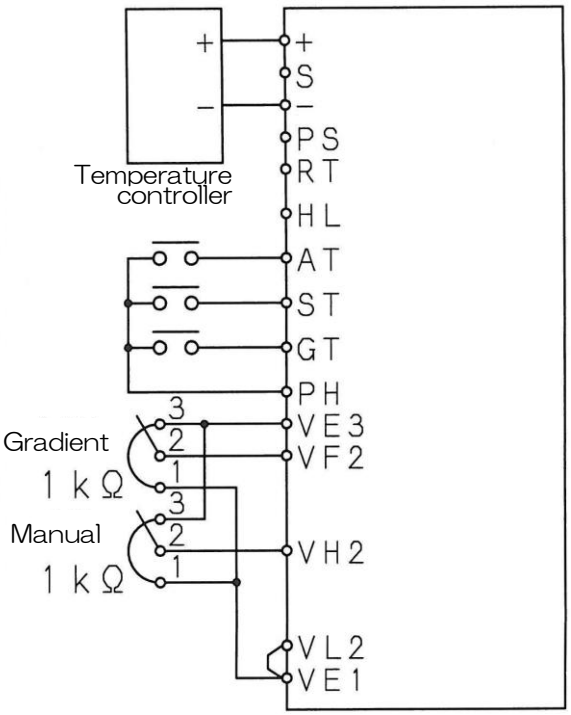
(8) Manual - Automatic 3 switching (0 to 5 VDC)

Set [F101: Temperature controller type] to [1: 0 to 5 VDC].

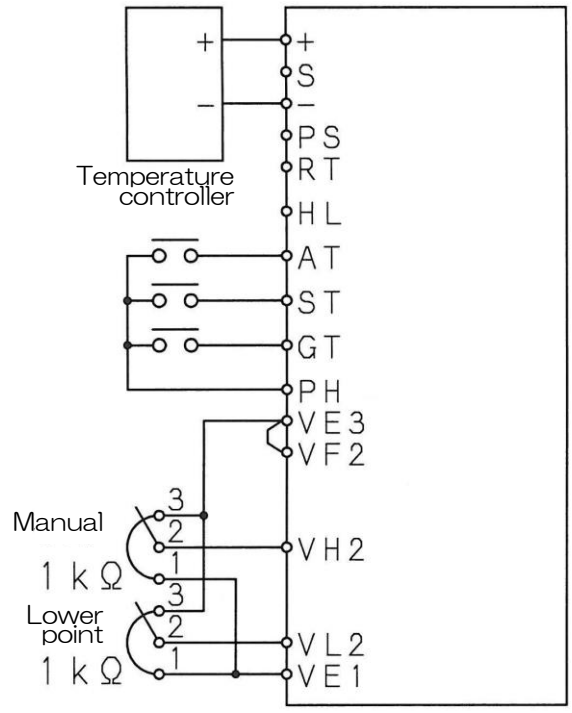
(1) Standard



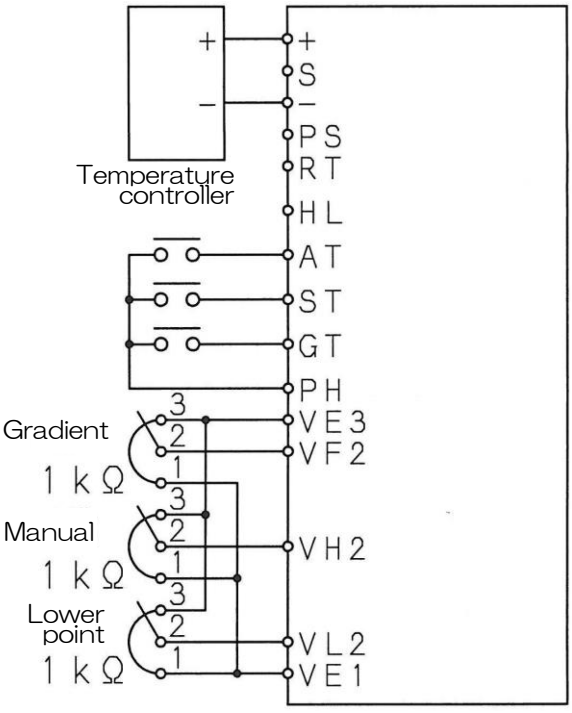
(2) With the gradient setting



(3) With the lower point setting



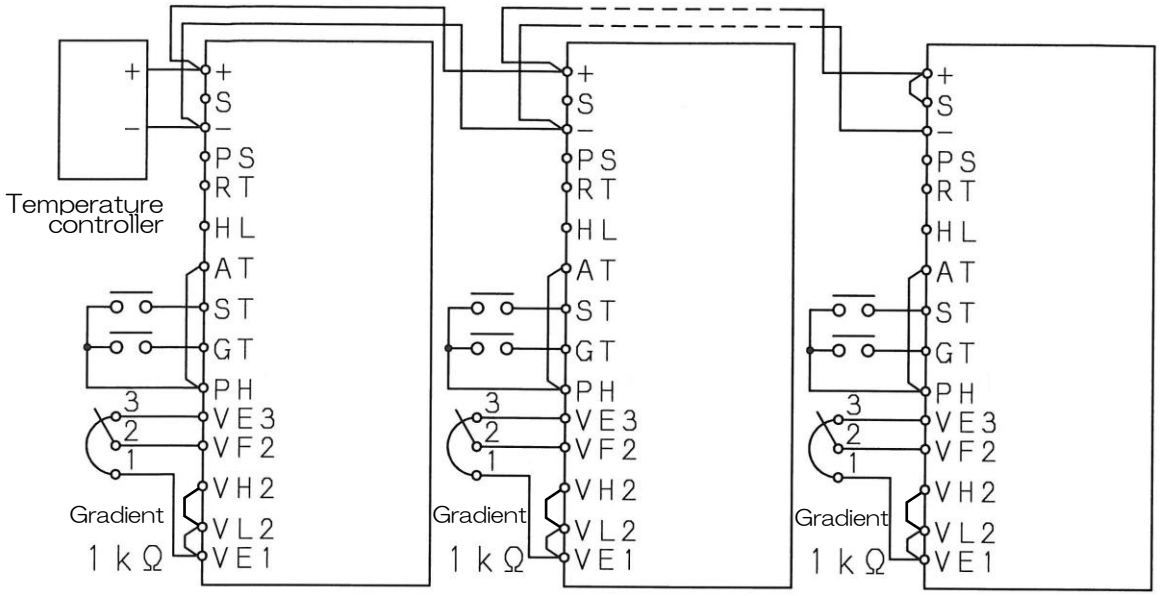
(4) With the gradient setting and the lower point setting



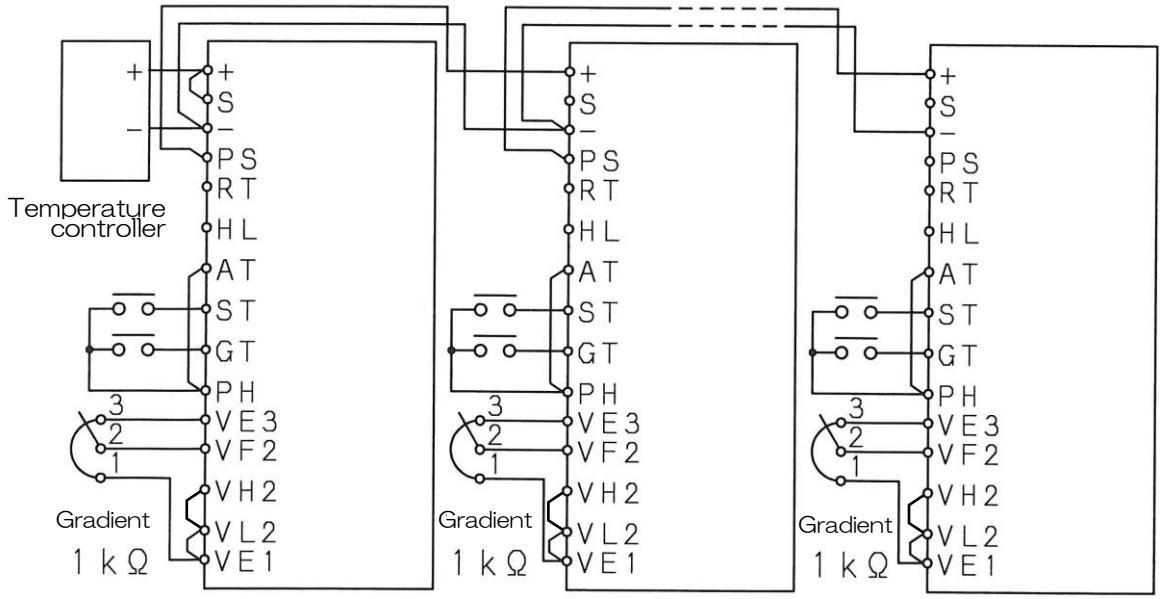
(9) Control of two or more UG1 units using a single temperature controller (4 to 20 mA [DC]) with the gradient set for each unit

Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

(1) When the PS terminal is not used



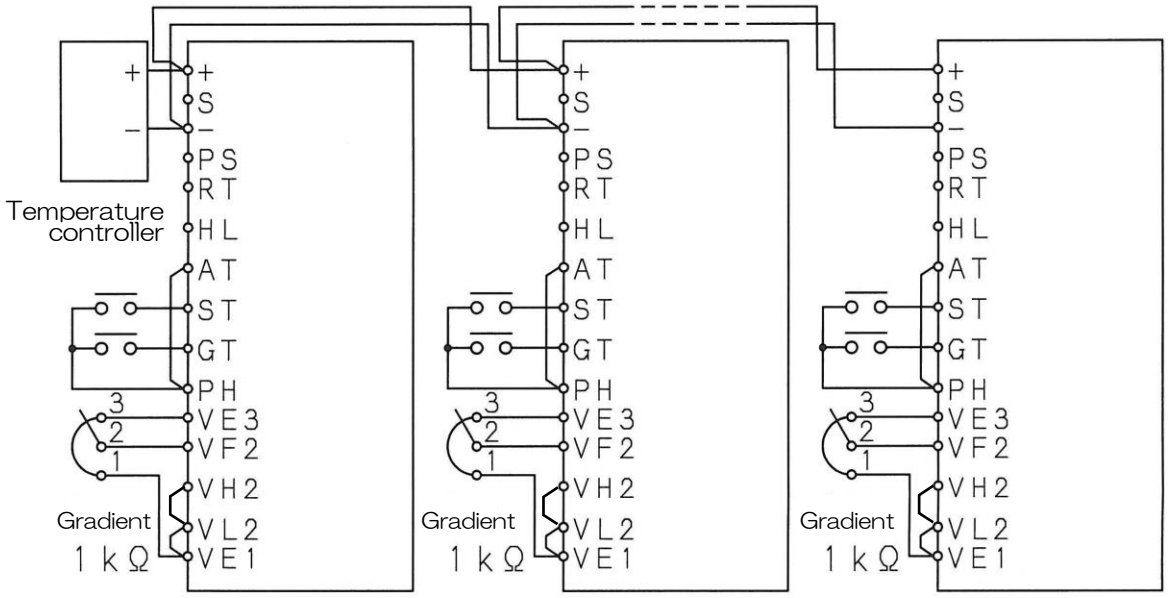
(2) When the PS terminal is used



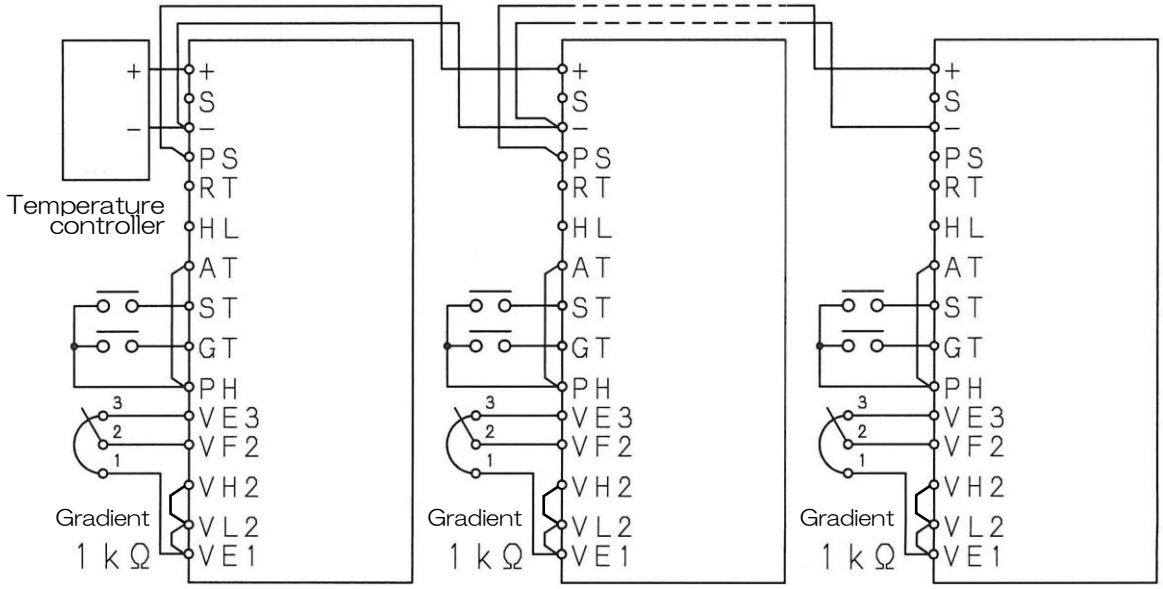
(10) Control of two or more UG1 units using a single temperature controller (1 to 5 VDC) with the gradient set for each unit

Set [F101: Temperature controller type] to [0: 4 to 20 mA (1 to 5 VDC)].

(1) When the PS terminal is not used



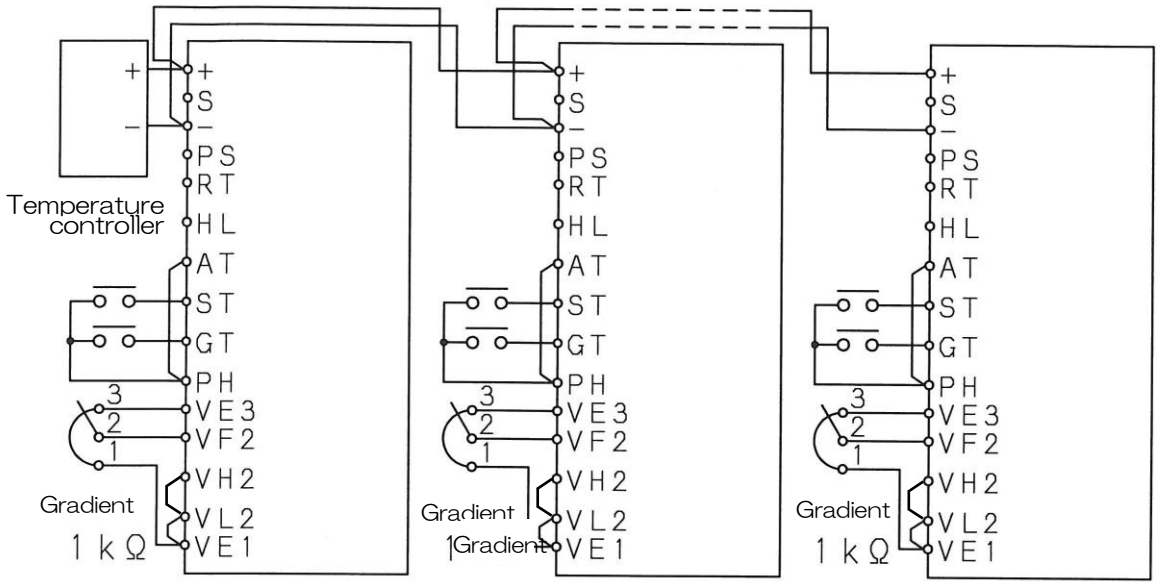
(2) When the PS terminal is used



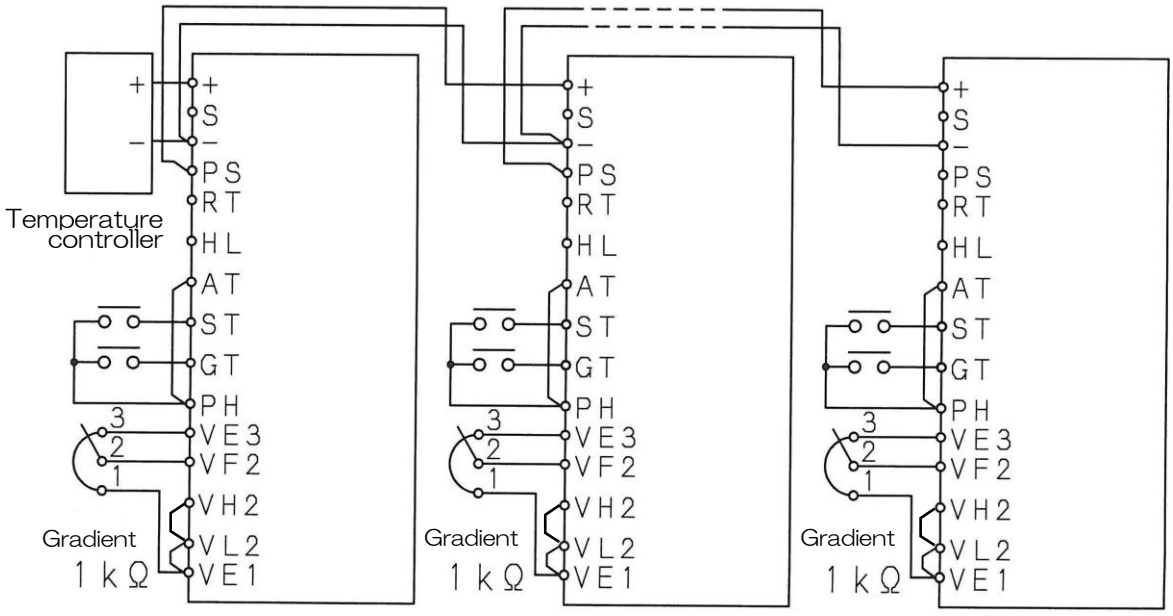
(11) Control of two or more UG1 units using a single temperature controller (0 to 5 VDC) with the gradient set for each unit

Set [F101: Temperature controller type] to [1: 0 to 5 VDC].

(1) When the PS terminal is not used



(2) When the PS terminal is used

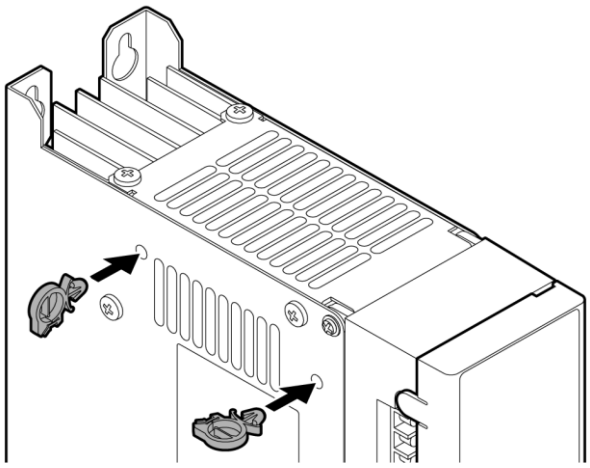


6 UNIT CONTROL WIRING METHOD

6.1 Control Wiring Method

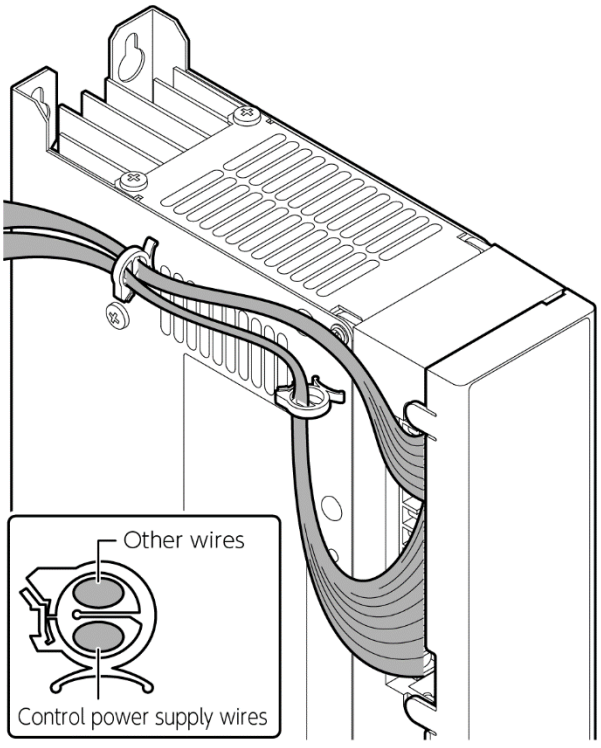
Bundle the unit control wires (the wires connected to the control terminal block) with easy locks.

(1) Attach the easy locks to the unit.



(2) Bundle the control wires with the easy locks.

Bundle the control power supply wires separately from other wires.



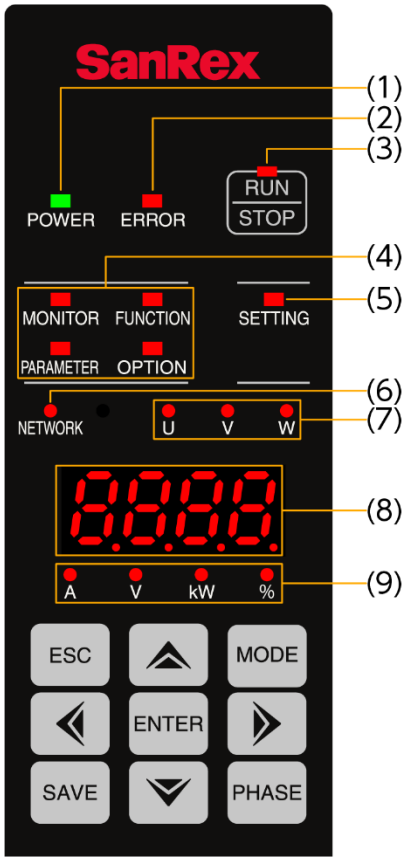
6.2 Grounding

As the unit is designed to be installed in the distribution panel cabinet, the ground terminal at the bottom of the unit is not intended to be used as a main circuit ground terminal.

To ground the unit using its ground terminal, connect a wire with a diameter of 1.25 mm and fasten it with the included ground terminal connection screws (M4 × 8).

7 DISPLAY PANEL

7.1 Names and Overview of the LED Lamps and Keys



(1)	Power receiving LED	This LED turns ON when power is supplied to the control circuit.
(2)	Error LED	This LED turns ON when an error occurs.
(3)	Operation status LED	This LED is ON during operation. It flashes while an error is occurring during operation. It turns OFF when operation stops, including stops due to errors.
(4)	Mode LEDs	The LED of the current screen mode turns ON.
(5)	Setting change LED	This LED is ON during Setting mode.
(6)	Communication LED	This LED is ON during operation of the optional communication function.
(7)	Phase indication LEDs	For the UG1 units, these LEDs are always OFF.
(8)	7seg LED	Displays each mode or function with numeric values. When an error occurs, its code is also displayed here.
(9)	Unit LEDs	The unit corresponding to the values displayed on the 7seg LED turns ON.

RUN STOP	RUN/STOP key	Starts or stops the output. However, the external terminals (ST-PH) take priority over this key. See the explanation about the ST terminal in "5.1 Control Terminal Block."
MODE	MODE key	Switches the display mode. MONITOR → FUNCTION → PARAMETER → OPTION
ENTER	ENTER key	Proceeds to the next item.

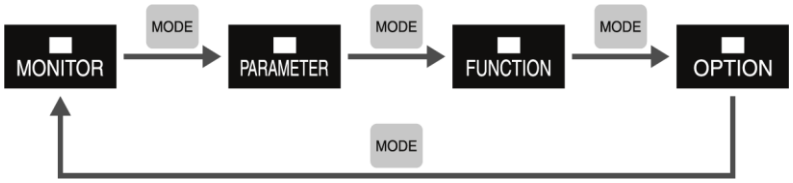
ESC	ESC key	Returns to the previous item.
▲ ▼	UP key DOWN key	'Select parameters' or 'increase/decrease the value'
◀ ▶	LEFT key RIGHT key	Change the selected digit of a value.
SAVE	SAVE key	Applies changed on values.
PHASE	PHASE key	For the UG1, this key is not used.

7.2 Operations

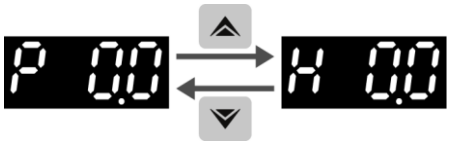
This section describes basic operations common to all modes. Details are explained in the section of each mode on the following pages.

7.2.1 Selecting and displaying modes and items

- The lit mode LED changes every time [MODE] is pressed.



- Press [▲] or [▼] to select an item.



- Press [ENTER] to display the next item selection or value.

- Press [ESC] to return to the item selection.

7.2.2 Changing settings

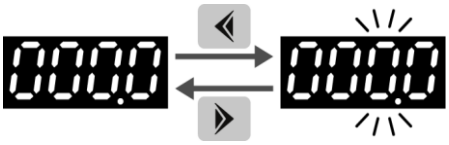
(1) Select the item whose settings will be changed.

(2) Press [ENTER].

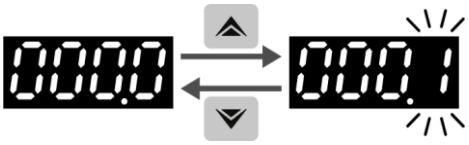
The [SETTING] LED turns ON.

(3) Change the value.

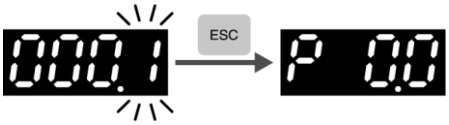
Press [◀] or [▶] to move the digit to set. The selected digit flashes.



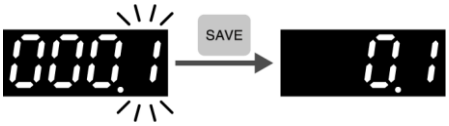
Press [▲] or [▼] to increase or decrease the value. The value increment/decrement differs according to the item.



Press [ESC] to cancel the change and return to the item selection.



(4) Press [SAVE] to set the value.

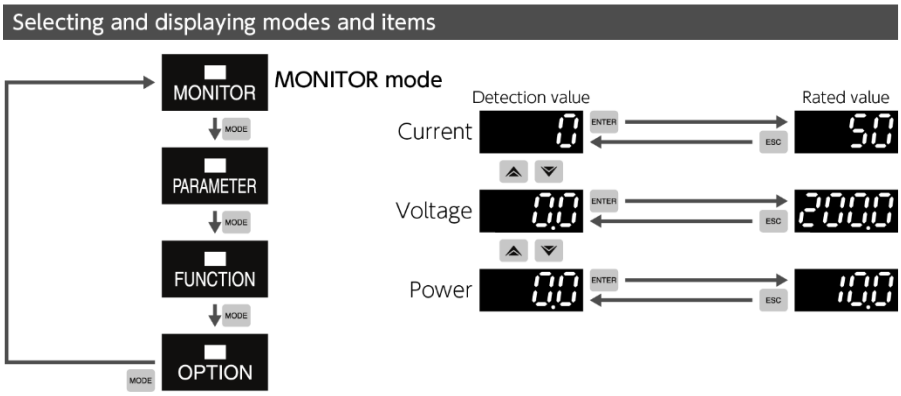


(5) Press [ESC] to return to the item selection.

7.3 Modes

7.3.1 MONITOR mode

The output current, voltage, and power can be checked in MONITOR mode.



Displayed detection value	Display range	Unit	Function
Current	0 to 9999	A	The output current is displayed.
Voltage	0.0 to 999.9	V	The output voltage is displayed.
Power	0.0 to 999.9	kW	The output power is displayed.
	1000 to 9999		

The checkable detection values differ according to the optional conversion board model. The values to be displayed are also different. For details, see "11.2.1 Model list."

Conversion board model	Checkable detection value		
	Current	Voltage	Power
None	✓	✓	—
UG-TB1A	✓	✓	—
UG-TB1V	✓	✓	—
UG-TB3	✓	✓	✓
UG-TB3U	✓	✓	✓

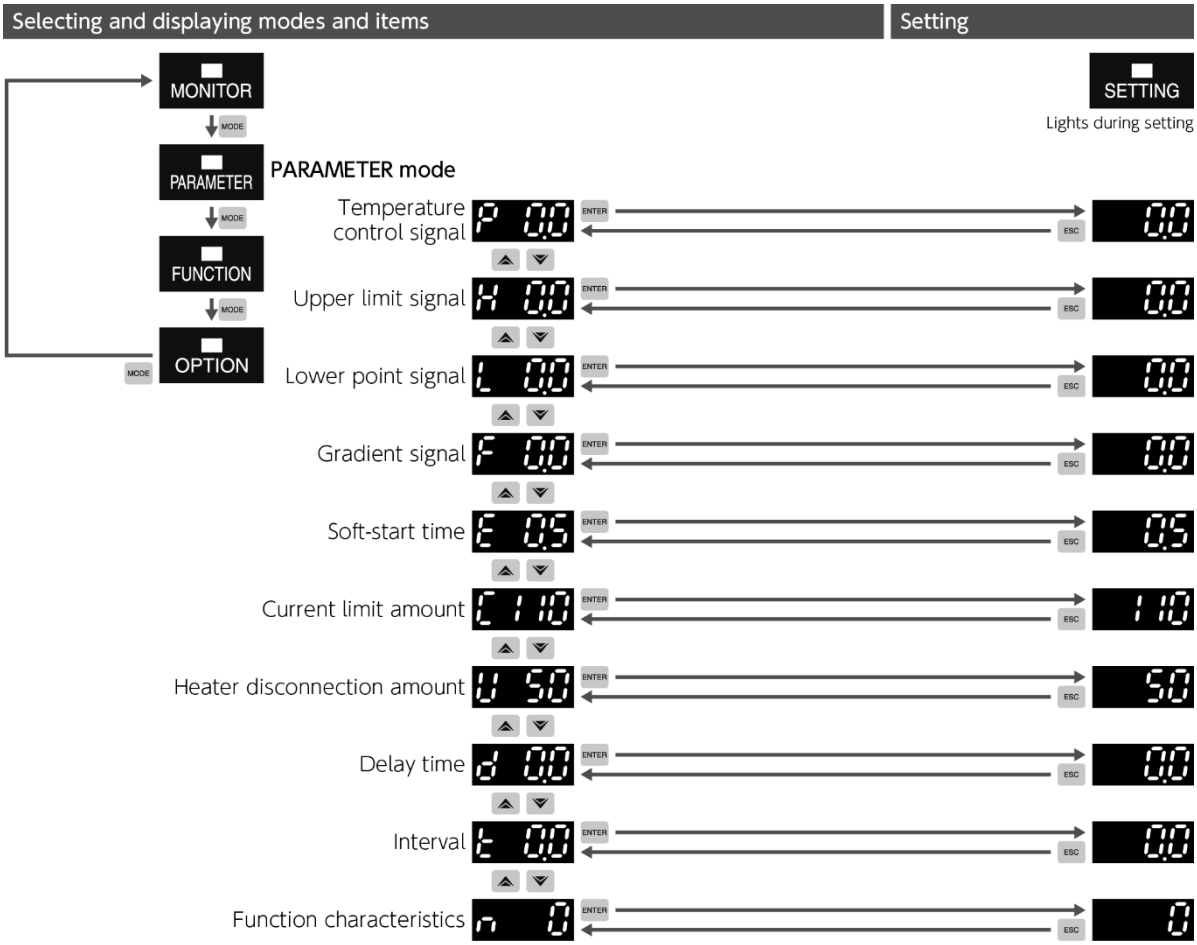
Conversion board model	Checkable detection value		
	Current	Voltage	Power
UG-TB3H	✓	✓	✓
UG-TB3HU	✓	✓	✓
UG-TB4	—	—	✓
UG-TB4H	—	—	✓

7.3.2 PARAMETER mode

The major settings can be checked and changed in PARAMETER mode.

The values that are used for operation are displayed on 7segLED. (See "7.3.3.3 F2: Parameter priority.") During Setting , 7segLED displays values set via the panel or communication.

※ Setting values are ignored when [0: Control terminal block] is selected for [F2: Priority setting].



Parameter list

Display symbol	Name	Setting range	Increment	Unit	Default value	Changeable during operation
P	Temperature control signal	0.0 to 100.0	0.1	%	0.0	✓
H	Manual (upper limit) signal	0.0 to 100.0	0.1	%	0.0	✓
L	Lower point (lower limit) signal	0.0 to 100.0	0.1	%	0.0	✓
F	Gradient	0.0 to 100.0	0.1	%	100.0	✓

Display symbol	Name	Setting range	Increment	Unit	Default value	Changeable during operation
	(proportional) signal					
E	Soft-start time	0.0 to 300.0	0.1	s	0.5	✓
C	Current limit amount	10 to 110	1	%	110	✓
U	Heater disconnection amount	5 to 50	1	%	50	✓
d	Delay time	0.0 to 3.0	0.1	s	0.0	✓
t	Period	1.0 to 3.0	0.1	s	1.0	✓
n	Function characteristics	0 to 7	1	No.	0	✗

↑

(“during operation” ... the operation status LED is ON or flashes, i.e. output is generated.)

Parameter overview

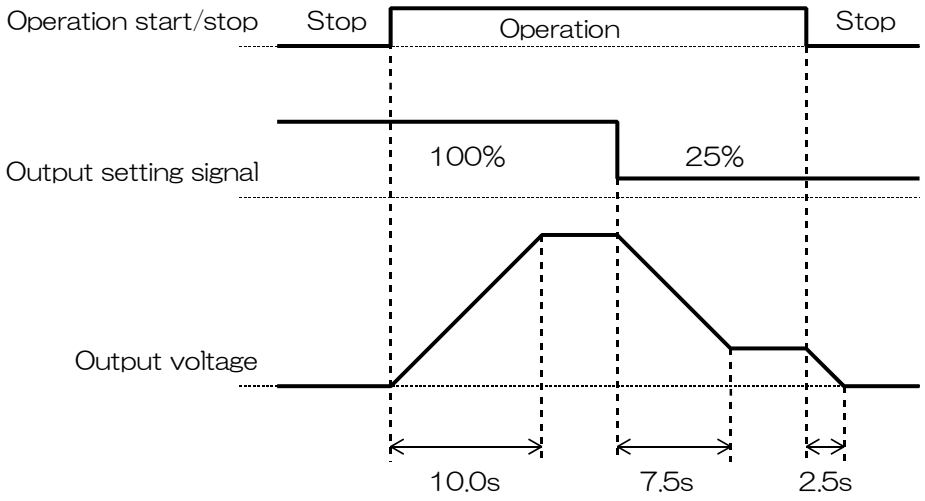
- P: Temperature control signal
  One of the output setting signals, this signal functions in the same way as the “+,” “S,” and “–” terminals on the control terminal block. If [F2 P: Priority setting] is set to [0: Control terminal block], the value set with the temperature controller can be checked when this item is selected If [F2 P: Priority setting] is set to [1: Panel] or [2: Communication], the value can be set via the panel or communication as a substitute for the temperature controller.
- H: Manual (upper limit) signal
  One of the output setting signals, this signal functions in the same way as the “VH2” terminal on the control terminal block. If [F2 H: Priority setting] is set to [0: Control terminal block], the value set with the variable resistor can be checked when this item is selected. If [F2 H: Priority setting] is set to [1: Panel] or [2: Communication], the value can be set via the panel or communication as a substitute for the variable resistor input.
- L: Lower point (lower limit) signal
  One of the output setting signals, this signal functions in the same way as the “VL2” terminal on the control terminal block. If [F2 L: Priority setting] is set to [0: Control terminal block], the value set with the variable resistor can be checked when this item is selected. If [F2 L: Priority setting] is set to [1: Panel] or [2: Communication], the value can be set via the panel or communication as a substitute for the variable resistor input.

- F: Gradient (proportional) signal

  One of the output setting signals, this signal functions in the same way as the "VF2" terminal on the control terminal block. If [F2 F: Priority setting] is set to [0: Control terminal block], the value set with the variable resistor can be checked on when this item is selected. If [F2 F: Priority setting] is set to [1: Panel] or [2: Communication], the value can be set via the panel or communication as a substitute for the variable resistor input.

- E: Soft-start time

  This parameter is set to adjust the time during which the output changes between 0% and 100% when the operation starts or stops (only in the phase control) or the output setting signal changes. If this parameter is set to 0.0 seconds, the operation is executed immediately at the output setting signal value. The following figure shows an example of phase control with a soft-start time of 10.0 seconds.



- C: Current limit amount

  This parameter is used to set the threshold of the current limit function. The current limit function protects the unit or load by limiting the output current when it exceeds the rating of the unit or load due to load fluctuations. The output current is limited so as not to exceed the value of the rated current × current limit. (Specifications: The setting is limited to the range of ±0% to -10%.)

  ※ This function does not prevent inrush currents.

  ※ This protective function is effective for load fluctuations caused by initial heater heating and similar phenomena.

- U: Heater disconnection amount

  This parameter is used to set the threshold for the heater disconnection detection function. For details on the function, see "11.2.4 Heater disconnection detection function."

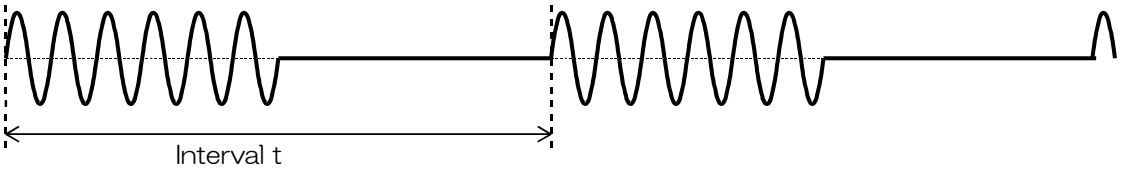
- d: Delay time

  This parameter adjusts the delay function time. The delay function is used for multiple units operated with the continuous cycle control method. The units can start in sequence after the delay time specified for each unit even when the start/stop switching signal turns ON simultaneously. This ON time lag reduces the amount of power supply usage during normal operation.

  ※ This function can be enabled only for operation with the continuous cycle control method.

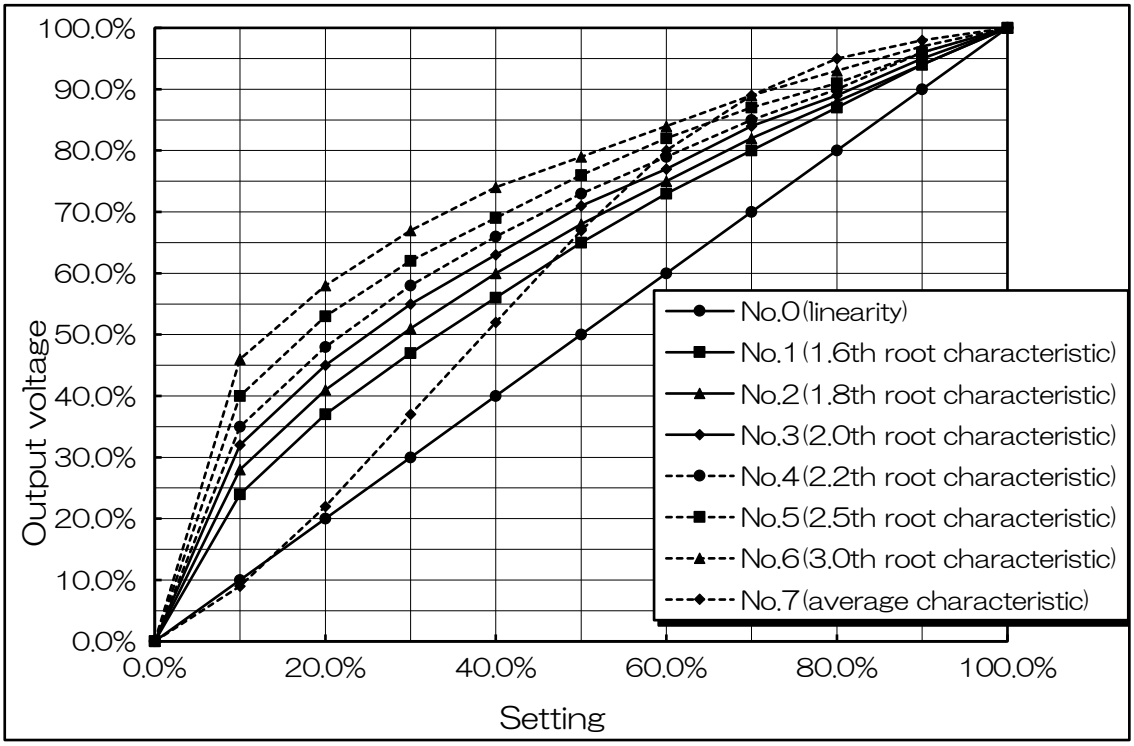
- t: Period

  This parameter adjusts the interval of the continuous cycle control method shown in the following figure.



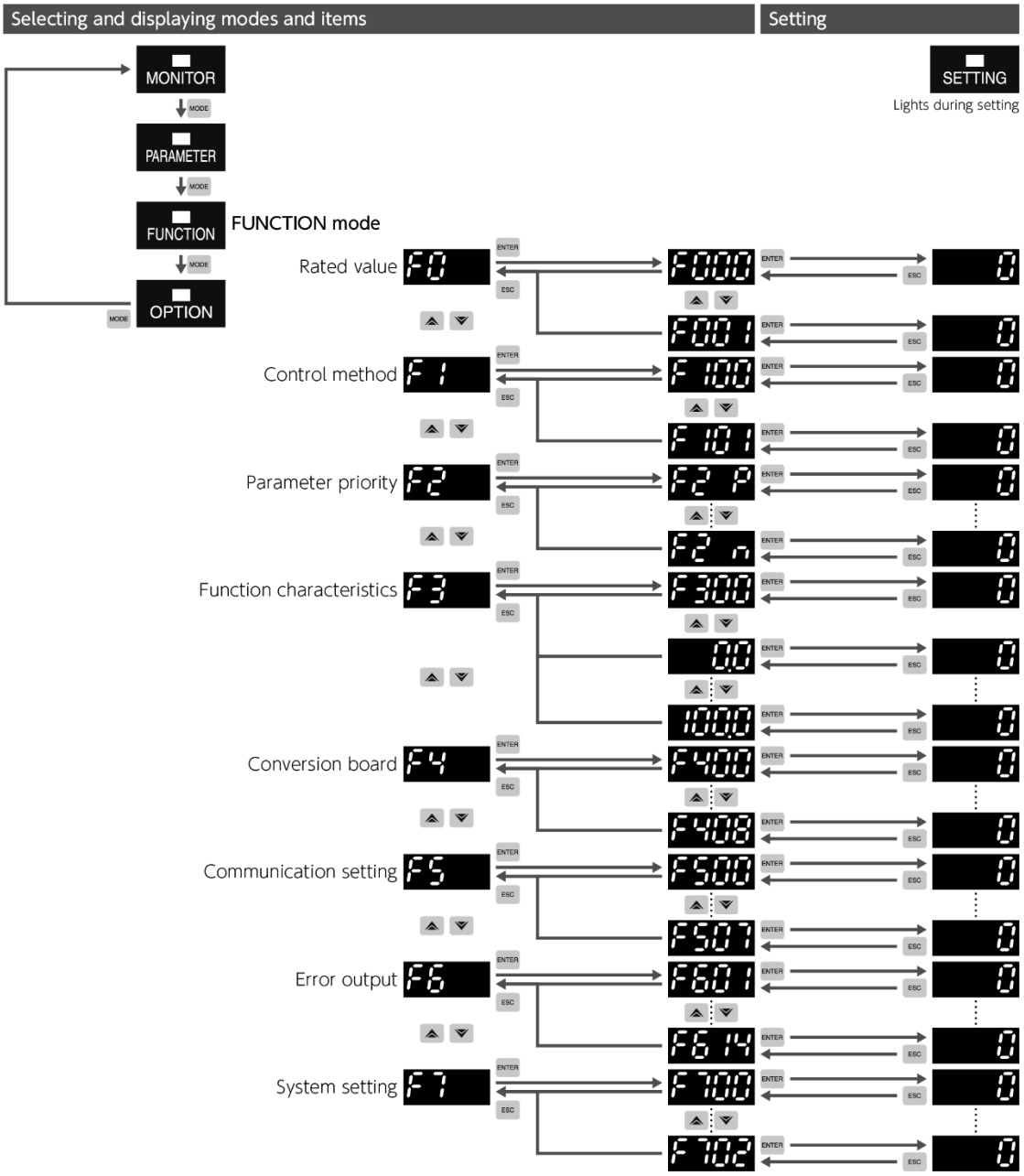
- n: Function characteristics

  This parameter is used to select the characteristic number of the function characteristic function. The default relationship between the control signal and output level has a linear characteristic. The characteristic can be switched using this parameter.



7.3.3 FUNCTION mode

The setting of each function can be changed in FUNCTION mode. A function code is assigned to each function. You can check and change the setting by selecting the corresponding function code.



Function code categories

Function code	Category overview
F0	Rated value
F1	Control method
F2	Parameter priority
F3	Function characteristics

Function code	Category overview
F4	Conversion board
F5	Communication board
F6	Error output destination selection
F7	System setting

7.3.3.1 F0: Rated value

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F000	Rated current setting	1 to 9999	1	A	*1	✓
F001	Rated voltage setting	0.1 to 999.9	0.1	V	*2	✓

(*1: Rated current value of unit model.)

(*2: Rated voltage value of unit model.)

- Rated value setting

  The output current, output voltage, and output power displayed in MONITOR mode are converted on the basis of [F000] and [F001]. To display them correctly, you must set the rated values according to the usage conditions. Appropriate values differ according to the usage status of optional items. See the following table to set the values.

Conversion board to use [F408]	CT to use [F407]	Rated current setting [F000]	Rated voltage setting [F001]
None	Built-in CT	(1)	(3)
UG-TB1A	Built-in CT	(1)	(3)
	External CT (optional item)	(2)	(3)
UG-TB1V	Built-in CT	(1)	(4)
UG-TB3 UG-TB3U	Built-in CT	(1)	(4)
UG-TB3H UG-TB3HU	External CT (optional item)	(2)	(4)
UG-TB4 UG-TB4H	External CT (optional item)	(2)	(4)

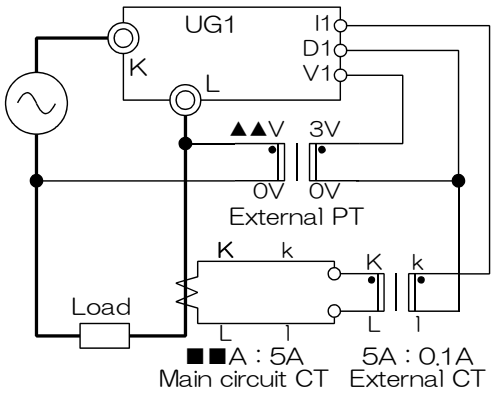
(1) Set the rated current to that specified for the unit model.

(2) Set the rated current to that specified for the primary side of the main circuit CT. (The value indicated with ■■ in the following figure)

(3) Set the rated voltage to that calculated with the following formula.

$$\text{Voltage} = \text{Main circuit input voltage} \times \frac{200}{\text{Control circuit input voltage}}$$

(4) Set the rated voltage to that specified for the primary side of the external PT (optional item). (The value indicated with ▲▲ in the following figure.)



External CT (optional item)

Main circuit CT (prepared by user)

7.3.3.2 F1: Control method

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F100	Waveform control method	0: Phase control 1: Intermittent cycle control 2: Continuous cycle control	-	-	0	✓
F101	Temperature controller type	0: 4 to 20 mA (1 to 5 VDC) 1: 0 to 5 VDC 2: Two-position control	-	-	0	✗

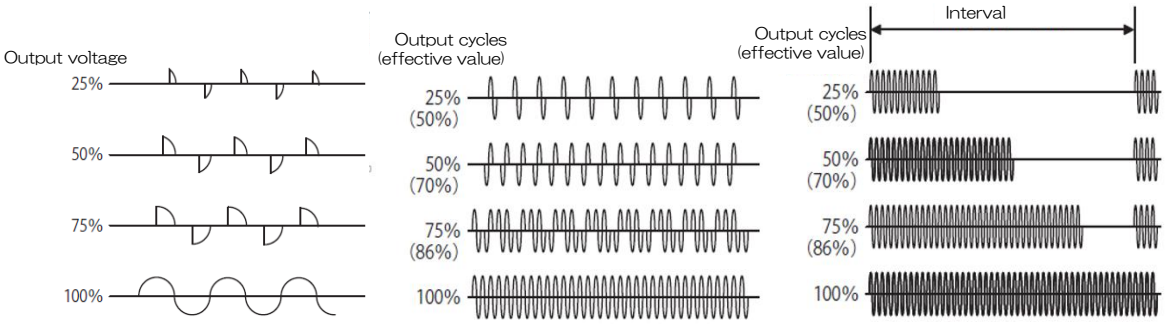
- F100: Waveform control method

  Select the waveform control method.

  The following three methods are available: phase control, intermittent cycle control, and continuous cycle control. Each has the following characteristics.

	Phase control	Intermittent cycle control	Continuous cycle control
Overview	The phase is controlled once every half cycle using the effective value.	The number of ONs in a cycle during a specified period is controlled with the effective value.	
		Period: Automatically adjusted	Period: Fixed at an arbitrary value
Load to apply	Resistance load, inductive load, transformer primary control	Resistance load (Customized product: Transformer primary control)	

	Phase control	Intermittent cycle control	Continuous cycle control
Feedback control	Available	Available	Not available
Responsiveness	High speed	Middle speed	Low speed
Harmonics	May occur	Can be reduced	
Flickering	None	May occur	May occur (May be reduced with the delay function)



Phase control　　Intermittent cycle control　　Continuous cycle control

- F101: Temperature controller type
  Select the temperature controller type.

7.3.3.3　F2: Parameter priority

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F2_P	Priority of the temperature controller signal (P)	0: Control terminal block input	-	-	0	✗
F2_H	Priority of the upper limit signal (H)	1: Panel			0	✗
F2_L	Priority of the lower point signal (L)	2: Communication			0	✗
F2_F	Priority of the gradient signal (F)				0	✗

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F2_E	Priority of the soft-start time (E)	1: Panel 2: Communication	-	-	1	✗
F2_C	Priority of the current limit amount (C)				1	✗
F2_U	Priority of the heater disconnection amount (U)				1	✗
F2_d	Priority of the delay time (d)				1	✗
F2_t	Priority of the interval (t)				1	✗
F2_n	Priority of the function characteristics (n)				1	✗

The parameter values that can be checked and changed in PARAMETER mode can be set using multiple methods. You can select the method to use for each parameter.

- [0: Control terminal block input] selected
  The signal applied to the control terminal block is used as the setting. The value entered on the setting screen in PARAMETER mode is ignored. Requests to rewrite the setting sent via communication are also ignored.
- [1: Panel] selected
  The value entered on the setting screen in PARAMETER mode is used as the setting. The signal applied to the control terminal block is ignored. Requests to rewrite the setting sent via communication are also ignored.
- [2: Communication] selected
  The value entered on the setting screen in PARAMETER mode is used as the setting and can be rewritten via communication. The signal applied to the control terminal block is ignored.

7.3.3.4 F3: Function characteristics

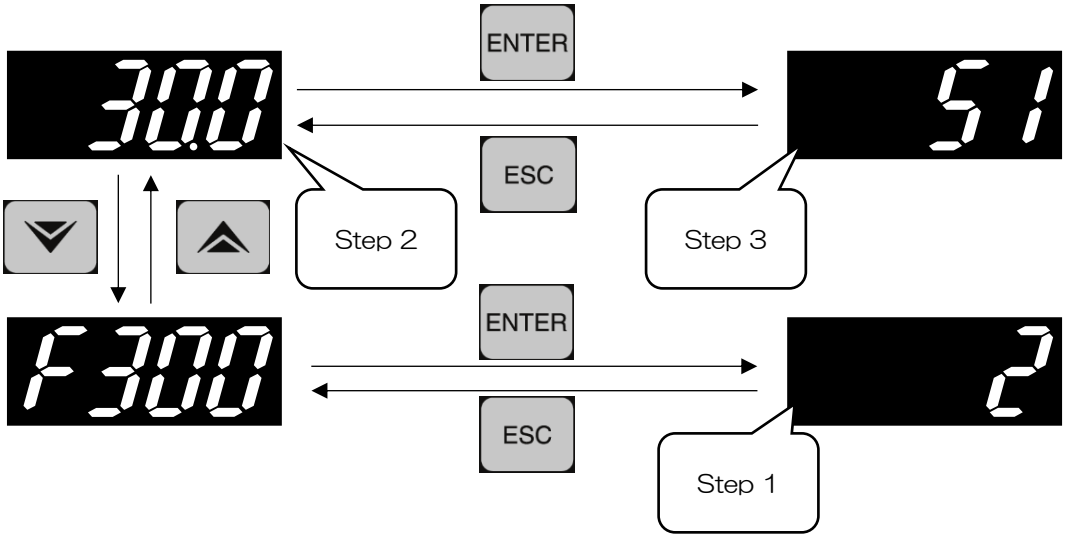
Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F300	Selection of target to change	1 to 7	1	No.	1	✗
—	0.0% of setting	0 to 100	1	%	-	✗
⋮ (The setting can be selected in increments of 10%.)						
—	100.0% of setting	0 to 100	1	%	-	✗

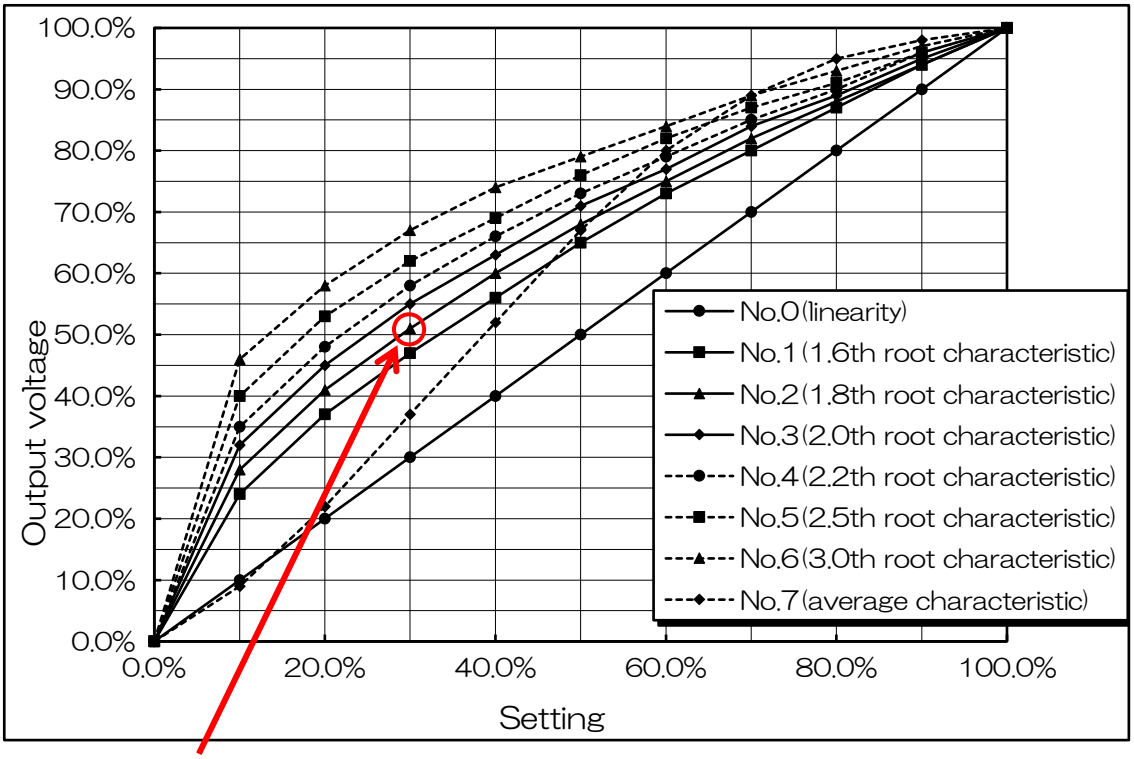
The standard function characteristics can be modified to other characteristics using this function.

Step 1: Select the characteristic number to adjust with [F300: Selection of target to change].

Step 2: Select the horizontal axis setting for the graph in the range of [0.0% of setting] to [100.0% of setting].

Step 3: Adjust the vertical axis of the graph on the setting screen.





In the panel operation example, this point is adjusted.

7.3.3.5 F4: Conversion board

This function is used to set the optional conversion board.

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F400	Feedback control method	0: No feedback 1: Constant current control 2: Constant voltage control 3: Constant power control	-	-	0	✗
F401	Heater disconnection detection function	0: Disable standard version 1: Disable highly functional version 2: Enable standard version 3: Enable highly functional version	-	-	0	✗
F402	Heater A count	1 to 5	1	-	2	✗

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F403	Heater B count	1 to 5	1	-	1	✗
F404	Current gain adjustment	1 to 9999	1	A	-	✓
F405	Voltage gain adjustment	1 to 999.9	0.1	V	-	✓
F406	Power gain adjustment	1 to 999.9	0.1	kW	-	✓
F407	CT selection	0: External CT 1: Built-in CT	-	-	0	✗
F408	Conversion board model check	(No setting)	-	-	-	-

- F400: Feedback control method
  Select the feedback control method. The selectable values depend on the connected conversion board model. For details on the models, see "11.2.1 Model list."
- F401: Heater disconnection detection function
  Select the heater disconnection detection function mode and enable/disable the function. The heater disconnection detection function has two selectable modes: the standard version and the highly functional version. This function can be temporarily disabled with this parameter.
  Select the setting that matches the desired combination of the mode and enabled/disabled state.

Setting	Mode	Enabled/disabled	Condition
0	Standard version	Disabled	When the conversion board model does not support heater disconnection detection. Or, when the circuit is connected for the standard version, but the function needs to be disabled temporarily.
1	Highly functional version	Disabled	When the circuit is connected for the highly functional version, but the function needs to be disabled temporarily. ※
2	Standard version	Enabled	When the circuit is connected for the standard version, and the function needs to be enabled.
3	Highly functional version	Enabled	When the circuit is connected for the highly functional version, and the function needs to be enabled.

The selectable values depend on the connected conversion board model. For details on the models, see “11.2.1 Model list.” For details on the heater disconnection detection function, see “11.2.4 Heater disconnection detection function.”

※ When the highly functional version is used and needs to be temporarily disabled, be sure to set the value to [1: Disable highly functional version]. Failure to do so may cause incorrect feedback control, leading to overcurrent.

- F402: Heater A count, F403: Heater B count

  Specify the number of heaters connected in parallel for the highly functional version of the heater disconnection detection function. For details on this version, see “11.2.6 Heater disconnection detection (highly functional version).”

- F404: Current gain adjustment, F405: Voltage gain adjustment, F406: Power gain adjustment

  When accuracy is required for the feedback control, the detection values can be corrected. For details on the correction procedure, see “11.2.3 Detection value adjustment function.”

- F407: CT selection

  Select the CT used to detect the current and power. The following table shows the characteristics.

	[0: External CT]	[1: Built-in CT]
Main circuit CT	Required	Not required
External CT (optional item)	Required	Not required
Accuracy	Normal (according to the conversion board model.)	Simplified ・ Input fluctuation: ±5% ・ Load fluctuation: ±5% ・ Temperature fluctuation: ±5%

- F408: Conversion board model check

  You can check whether the conversion board is connected correctly. The displayed content differs according to the conversion board in use. Check that this content matches the model of the conversion board in use.

Conversion board model	F408 display
UG-TB1A	
UG-TB1V	
UG-TB3, UG-TB3H	
UG-TB3U, UG-TB3HU	

Conversion board model	F408 display
UG-TB4, UG-TB4H	
(When no conversion board is connected)	

7.3.3.6 F5: Communication board

This function is used to set the optional communication board.

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F501	Node address	0 to 255	1	-	1	✗
F502	Transmission rate	[9.6], [19.2], [38.4]	-	kbps	[9.6]	✗
F503	Transmission mode	[8n1], [8o1], [8E1], [8n2], [8o2], [8E2]	-	-	[8E1]	✗
F507	Transmission latency	0 to 999	1	ms	0	✗

These settings may not be required depending on the communication board model, so check the model before configuring the settings.

Communication board model	Handling of F5 function codes
UG-MBR	The settings can be changed as necessary.
UG-CL	The settings are not required. Use the communication board with the default values. * The communication board may fail to operate if the default values are changed.

- F501: Node address

  Set the slave address of the unit.

  ※ Do not to specify an address used by another unit. Doing so may cause incorrect operation.

  ※ The Modbus protocol permits decimal values from 0 to 247. Be careful when specifying other numbers.

  ※ Address 0 is intended for broadcasting.

- F502: Transmission rate

  Set the transmission rate of the unit. Set it to match that of the master.

- F503: Transmission mode

  Set the transmission mode of the unit. Set it to match that of the master.

F503 setting	Data bit length	Parity	Stop bit length
8n1	8 bits	None	1 bit
8o1	8 bits	Odd	1 bit
8E1	8 bits	Even	1 bit
8n2	8 bits	None	2 bits
8o2	8 bits	Odd	2 bits
8E2	8 bits	Even	2 bits

- F507: Transmission latency

  Set the time from when the unit receives data from the master to when it starts responding. When the unit responds too quickly, a time lag can be set to allow the master to receive data.

7.3.3.7 F6: Error output destination selection

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F601	Er.01: Overcurrent detection	0: No output 1: Output to 1A-1C 2: Output to HA-HC 3: Output to both	-	-	1	✗
F602	Er.02: Temperature rise error		-	-	1	✗
F603	Er.03: Fuse blowout		-	-	1	✗
F604	Er.04: Self-diagnosis Load short circuit error		-	-	1	✗
F605	Er.05: Self-diagnosis Thyristor open		-	-	1	✗
F606	Er.06: Self-diagnosis Thyristor short circuit		-	-	1	✗
F607	Er.07: CPU error		-	-	0	✗
F608	Er.08: Memory error		-	-	0	✗

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F609	Er.09: Emergency stop		-	-	0	✗
F610	Er.10: Power supply voltage drop		-	-	2	✗
F611	Er.11: Instantaneous voltage drop		-	-	2	✗
F612	Er.12: Frequency error		-	-	2	✗
F613	Er.13: Heater disconnection		-	-	2	✗
F614	Er.14: Self-diagnosis Load open error		-	-	2	✗

With this function, the output destination of the external warning relay signal, which is output when an error occurs, can be selected for each error code. For details on the error codes, see "8 ERROR DETECTION."

※ This function does not disable the error detection. It is used to simply switch the relay contact output destination. The settings of this function do not change the output stoppage, error code display, and other operations taken when an error occurs.

- When [0: No output] is selected
  The external warning relay signal is not output. This setting does not disable the error detection.
- When [1: Output to 1A-1C] is selected
  The signal is output to 1A-1C (external warning relay [1]) on the control terminal block.
- When [2: Output to HA-HC] is selected
  The signal is output to HA-HC (external warning relay [2]) on the control terminal block.
- When [3: Output to both] is selected
  The signal is output to both 1A-1C (external warning relay [1]) and HA-HC (external warning relay [2]) on the control terminal block.

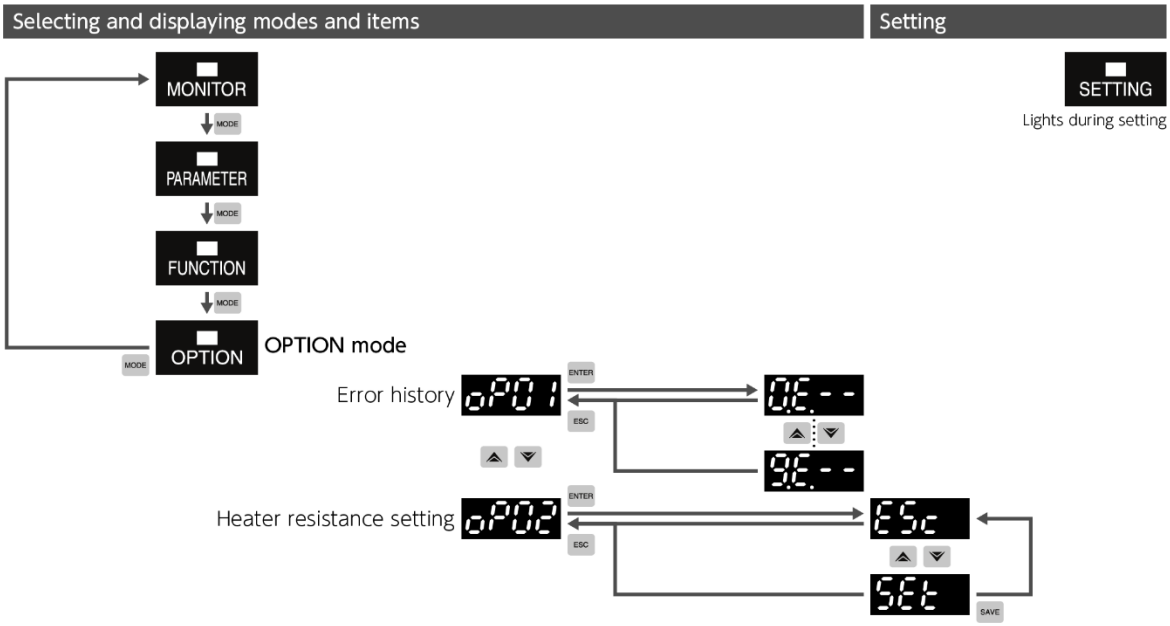
7.3.3.8 F7: System setting

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F700	Self-diagnosis	0: Temporary STOP 1: Enable	-	-	1	✗
F701	RUN/STOP key lock	0: Unlock 1: Lock	-	-	0	✗
F702	SAVE key lock	0: Unlock 1: Lock	-	-	0	✗

- F700: Self-diagnosis stop
  The self-diagnostic function can be suspended for test operation or other purposes.
- F701: RUN/STOP key lock
  Pressing the RUN/STOP key on the display panel can be disabled. This setting disables the starting and stopping of the output from the display panel. (Start/stop switching via the ST terminal on the control terminal block or via communication remains enabled.)
- F702: SAVE key lock
  Pressing the SAVE key on the display panel can be disabled. This setting cannot change the parameters. (Parameter changing via communication remains enabled.)
  Unlocking method: Select [0: Unlock] on the F702 setting screen and press the SAVE key.

7.3.4 OPTION mode

OPTION mode allows you to check the error history and other items.



7.3.4.1 oP01: Error history check

The detected error history can be checked. The last 10 errors can be checked.

Error history display contents

1st digit: Displays the time when the error was detected.

2nd digit: Always displays "E."

3rd and 4th digits: Display an error code. If the number of past errors is less than nine, "--" is displayed to indicate there is no record in the history.

Concrete examples are shown below.

※ Errors that occur in certain situations are not added to the history. For details, see "8 ERROR DETECTION."

This indicates that the last error detected is Er.02: Temperature rise

This indicates that the second last error detected is Er.09:

This indicates that the tenth last error detected does not exist

7.3.4.2 oP02: Heater resistance setting

Set the heater resistance used in standard version mode of the optional heater disconnection detection function. For details on the function and setting method, see "11.2.5 Heater disconnection detection (standard version)."

8 ERROR DETECTION

An error code is displayed on the panel when the error detection circuit is activated. When the panel is operated with an error code displayed, the panel temporarily displays normal screens. If no operations are performed for 5 seconds, the error code appears again.

Error code	Function name	Behavior after detection	Recovery method	Relay output destination	Error history
Er.01	Overcurrent detection	Operation stops	Power OFF	Relay (1)	Saved
Er.02	Temperature rise error	Operation stops	Power OFF	Relay (1)	Saved
Er.03	Fuse blowout	Operation stops	Power OFF	Relay (1)	Saved
Er.04	Self-diagnosis: Load short circuit	Operation stops	Power OFF	Relay (1)	Saved
Er.05	Self-diagnosis: Thyristor open	Operation stops	Power OFF	Relay (1)	Saved
Er.06	Self-diagnosis: Thyristor short circuit	Operation stops	Power OFF	Relay (1)	Saved
Er.07	CPU error	Operation stops	Power OFF	None	Not saved
Er.08	Memory error	Operation stops	Power OFF	None	Not saved
Er.09	Emergency stop	Operation stops	Automatic recovery	None	Saved (only during operation)
Er.10	Power supply voltage drop	Operation stops	Automatic recovery	Relay (2)	Saved (only during operation)
Er.11	Instantaneous voltage drop	Operation stops	Automatic recovery	Relay (2)	Not saved
Er.12	Frequency error	Operation continues	Automatic recovery	Relay (2)	Not saved
Er.13	Heater disconnection	Operation continues	Automatic recovery	Relay (2)	Not saved
Er.14	Self-diagnosis: Load open	Operation continues	Automatic recovery	Relay (2)	Not saved

- Behavior after detection

Operation stops:	The unit stops operation, displays an error code, and outputs the external warning relay signal according to the setting of [F6: Error output destination selection].
Operation continues:	The unit displays an error code and outputs the external warning relay signal according to the setting of [F6: Error output destination selection]. The unit continues operation.

- Recovery method

Power OFF:	Stop the power supply and remove the causes of the detected error. Operation resumes when power is supplied again. Stopping the power supply turns the external warning relay output OFF. ※ Errors may be detected again if the power is turned back ON without first removing the error causes. The unit may be damaged if it repeatedly stops due to errors.
Automatic recovery:	The unit resumes operation when the causes of the detected error are removed. The external warning relay output is also turned OFF.

- Relay output destination

  The above table shows the default values specified with [F6: Error output destination selection].

Relay (1):	The signal is output between 1A and 1C on the control terminal block.
Relay (2):	The signal is output between HA and HC on the control terminal block.
None:	The signal is not output to the external warning relay on the control terminal block.

- Error history

  Errors that occur in certain situations are not added to the history.

8.1 Er.01: Overcurrent Detection

Detection condition:	The built-in CT detects that a current that is at least 1.5 times larger than the unit's rated current flowed continuously for more than a few cycles.
When detected:	The output stops.
Clearing method:	Stop the power supply and remove the causes of the detected error.
Potential causes:	・ An abnormality may have occurred in a load. ・ Some loads generate overcurrent when the unit starts. When the unit is operated with phase control, you may be able to improve this problem by increasing the soft-start time. When the unit is operated with cycle control, check that the unit's rated current is not exceeded during a single cycle.

8.2 Er.02: Temperature Rise Error

Detection condition:	The cooling fin temperature has risen abnormally. (This condition applies only to models with a rated current of 100 A or higher.)
When detected:	The output stops.
Clearing method:	Stop the power supply and remove the causes of the detected error.
Potential causes:	・ The temperature inside the distribution panel cabinet (ambient temperature) may have exceeded the unit's specifications. Use the unit in environments with temperatures of 50° C or lower. ・ The unit's cooling fan may have slowed down or stopped. Check if it is rotating or covered with dust.

8.3 Er.03: Fuse Blowout

Detection condition:	The fuse has blown out. (This condition applies only to units with a fuse.)
When detected:	The output stops.
Clearing method:	Stop the power supply and remove the causes of the detected error.
Potential causes:	・ An abnormality may have occurred in a load. ・ Some loads generate overcurrent when the unit starts. When the unit is operated with phase control, you may be able to improve this problem by increasing the soft-start time. When the unit is operated with cycle control, check that the unit's rated current is not exceeded during a single cycle.

8.4 Er.07: CPU Error

Detection condition:	An abnormality has occurred in the CPU system.
When detected:	The output stops.
Clearing method:	Stop the power supply and contact us.

8.5 Er.08: Memory Error

Detection condition:	An abnormality has occurred in data containing parameter information.
When detected:	The output stops.
Clearing method:	Stop the power supply and contact us.

8.6 Er.09: Emergency Stop

Detection condition:	The circuit between GT and PH on the control terminal block has opened.
When detected:	The output stops.
Clearing method:	Short-circuit GT with PH on the control terminal block.

8.7 Er.10: Power Supply Voltage Drop

Detection condition:	The control power supply voltage has dropped.
When detected:	The output stops.
Clearing method:	Adjust the control power supply voltage so that it falls within the unit's specifications.

8.8 Er.11: Instantaneous Voltage Drop

Detection condition:	The control power supply voltage has instantaneously stopped or dropped. (This error is also temporarily displayed when the power supply is stopped.)
When detected:	The output stops.
Clearing method:	This error is cleared when the control power supply voltage returns to the normal level.

8.9 Er.12: Frequency Error

Detection condition:	An error has occurred in the control power supply frequency.
When detected:	The output continues.
Clearing method:	This error is cleared when the control power supply frequency returns to the range in the unit's specifications.

8.10 Er.13: Heater Disconnection

Detection condition:	The optional heater disconnection detection function detected a heater disconnection. For details, see "11.2.4 Heater disconnection detection function."
When detected:	The output continues. ※ Note that the load voltage may increase, putting a burden on the heaters if the unit is operated with constant current control or constant power control.
Clearing method:	Stop the power supply and replace the disconnected heater. Just stopping operation is not sufficient to clear this error. You can temporarily clear it by setting [F401: Heater disconnection detection function].

8.11 Er.04, Er.05, Er.06, Er.14: Self-diagnostic Function

The self-diagnostic function outputs warnings for the thyristor's open/short circuit and the load's open/short circuit on the basis of internal speculation using values of the current detected with the unit's built-in CT, the signal output from the thyristor, and the current and voltage detected with a conversion board if used. It does not actually check if the thyristor and loads are open or short-circuited. With this mechanism, this function may output false warnings depending on the load type. You can forcibly clear false warnings by setting [F700: Self-diagnosis stop] to [0: Suspend self-diagnosis].

Self-diagnosis targets differ according to the unit status.
Conversion board category A: UG-TB3, UG-TB3U, UG-TB3H, UG-TB3HU
Conversion board category B: When no conversion board or a model other than those listed above is used

		Conversion board category A		Conversion board category B	
		Operation in progress	Operation stopped	Operation in progress	Operation stopped
Er.05	Thyristor open	Diagnosis target	-	*	-
Er.06	Thyristor short circuit	Diagnosis target	Diagnosis target	-	Diagnosis target
Er.04	Load short circuit	Diagnosis target	-	Diagnosis target	-
Er.14	Load open	Diagnosis target	-	Diagnosis target	-

※ A load open is detected even when the thyristor is open.

9 UNIT OUTLINE

9.1 External Dimensions

Model	Rated current	Cooling method	Weight [kg]	Calorific value [W]	Panel surface mounting screw	Main circuit terminal screw	Fuse mounting screw
UG1-□025△	25 A	Self cooling	3.0	43	M4	M5	M5
UG1-□035△	35 A	Self cooling	3.0	57	M4	M5	M5
UG1-□050△	50 A	Self cooling	3.0	77	M4	M5	M5
UG1-□075△	75 A	Self cooling	3.5	113	M4	M6	M6
UG1-□100△	100 A	Air cooling	4.0	164	M4	M6	M6
UG1-□150△	150 A	Air cooling	5.0	224	M4	M8	M8
UG1-□250△	250 A	Air cooling	7.5	349	M6	M10	M10
UG1-□350△	350 A	Air cooling	11.0	390	M6	M12	M10
UG1-□450△	450 A	Air cooling	11.0	522	M6	M12	M10

Rated voltage
□ = 2: 100 to 254 V
□ = 4: 380 to 480 V

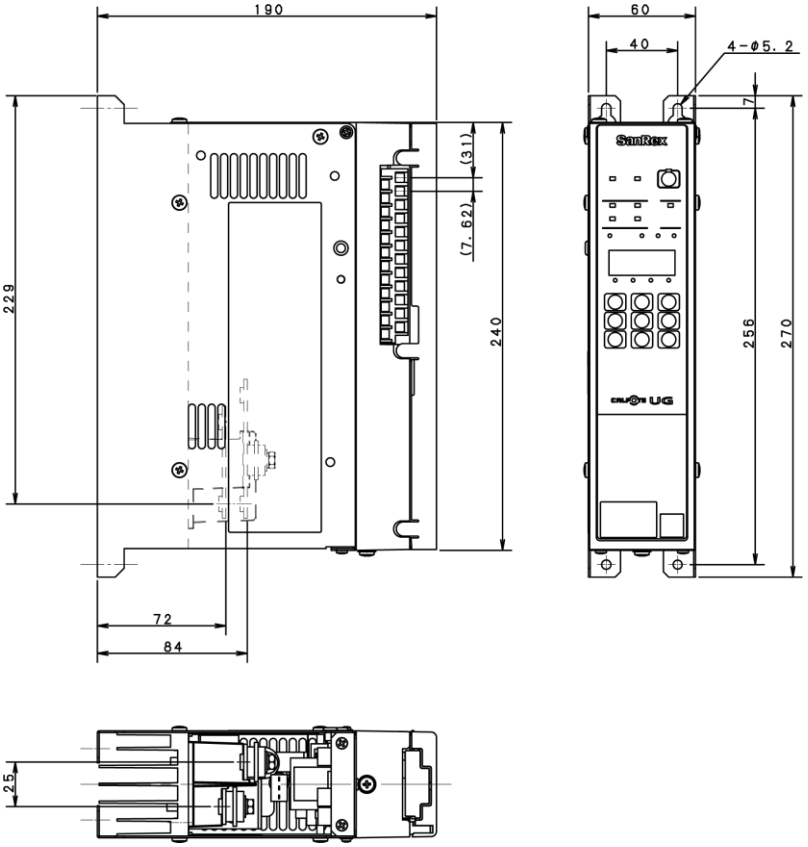
Fuse
△ = Blank: No fuse
△ = F: With a fuse

Screw tightening torque

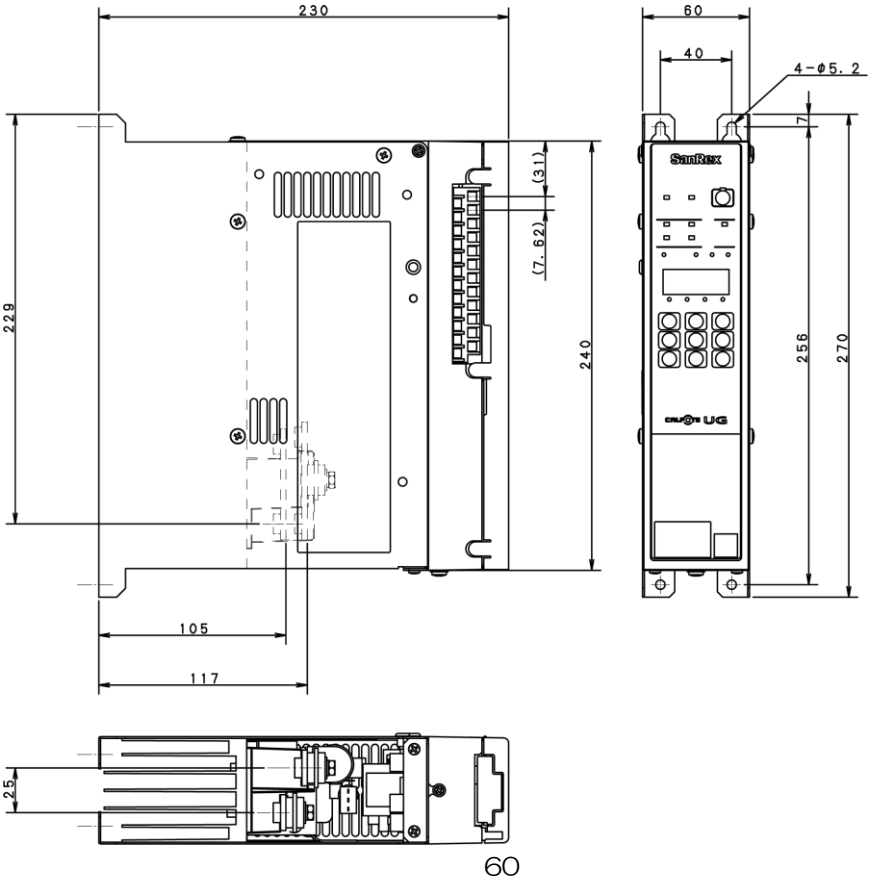
Screw size	Screw tightening torque [N・m]			
M3	0.5	to	0.8	← Screw on the control terminal block
M4	1.5	to	1.8	
M5	2.5	to	3.0	
M6	6.4	to	7.4	
M8	15.7	to	16.7	
M10	23.5	to	26.5	
M12	39.2	to	44.2	

9.2 External View

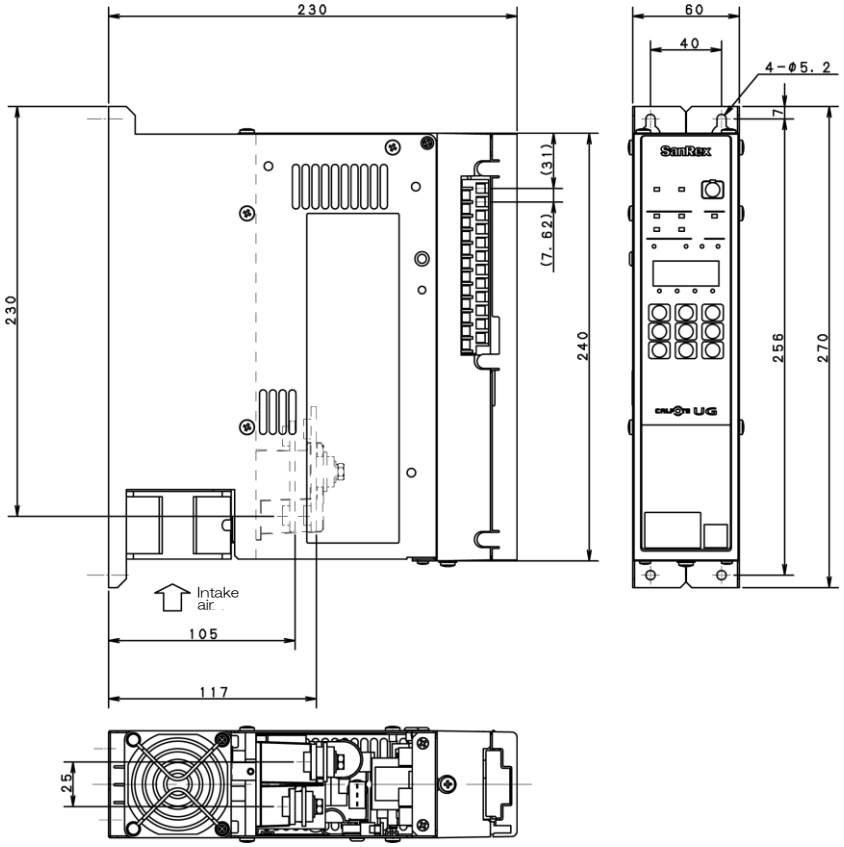
Models with a rated current of 25, 35, or 50 A



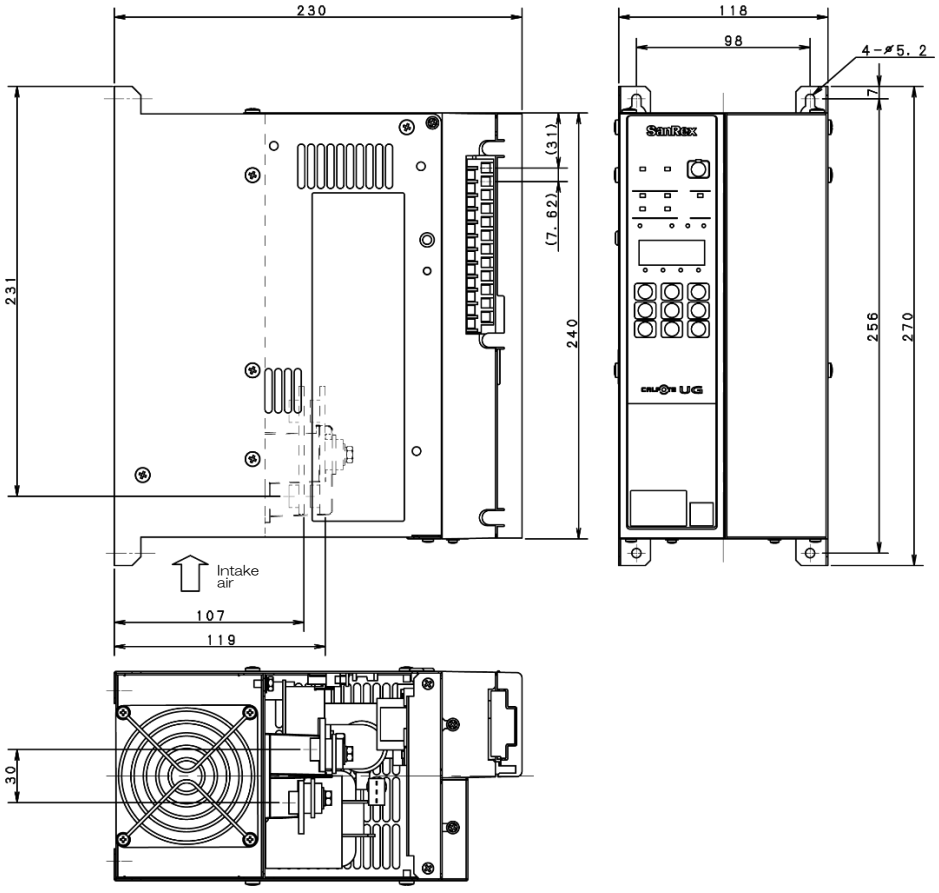
Models with a rated current of 75 A



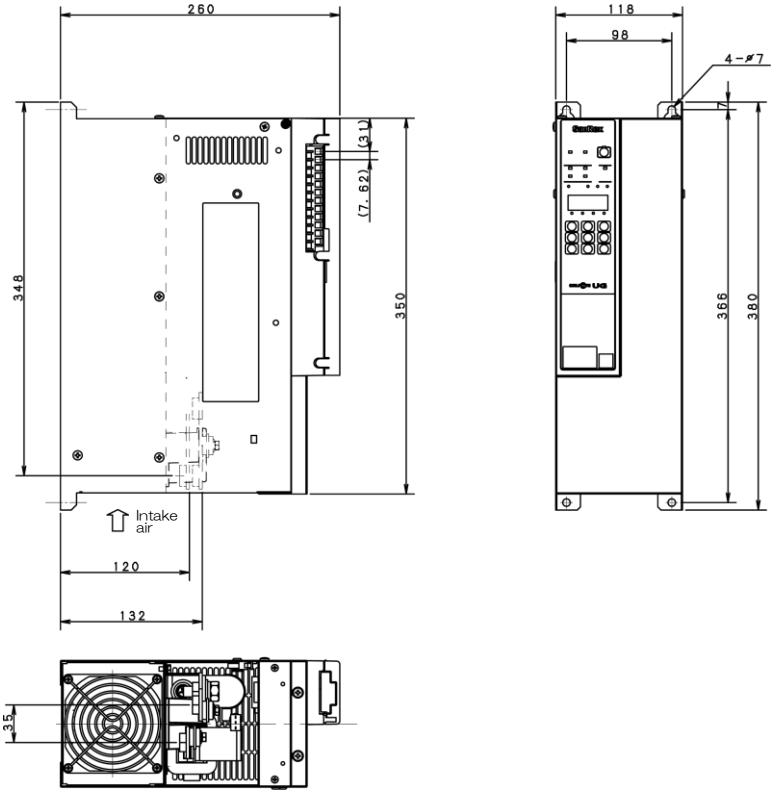
Models with a rated current of 100 A



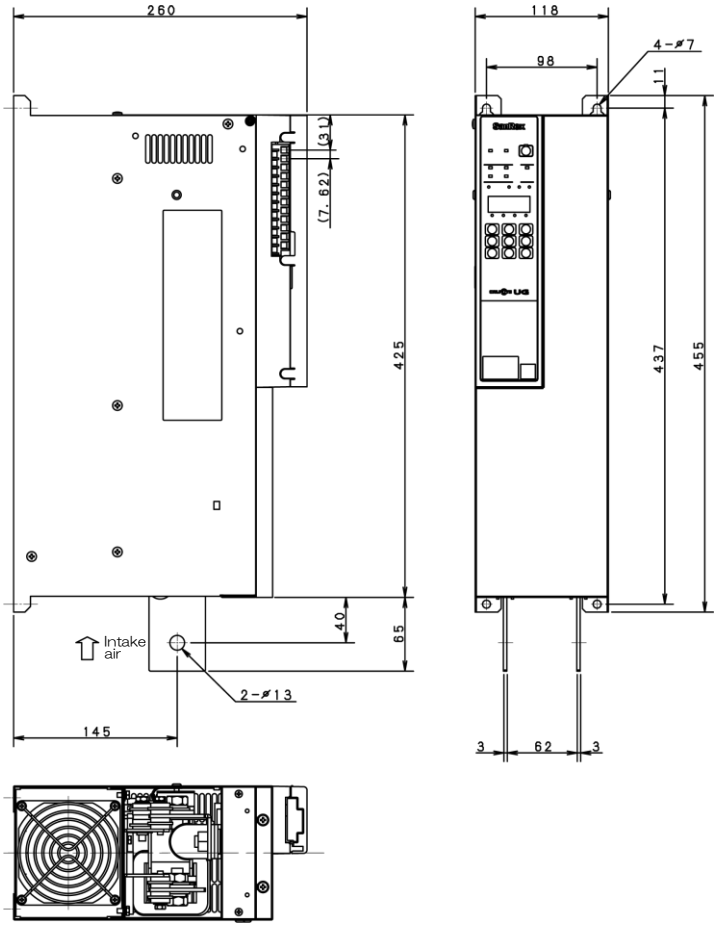
Models with a rated current of 150 A



Models with a rated current of 250 A



Models with a rated current of 350 or 450 A



10 MAINTENANCE PARTS

10.1 Fuse

Rated current of the unit	Fuse model
25 A	660GH-050S
35 A	660GH-063S
50 A	660GH-100S
75 A	660GH-125S
100 A	660GH-160S
150 A	660GH-250S
250 A	660GH-350S
350 A	660GH-500S
450 A	660GH-710S

Replacement procedure

※ Turn OFF the input power supply of the distribution panel and check that the power supply is OFF.

(1) Loosen the screws at the bottom of the unit and open the front cover.

(2) Remove the fuse mounting screws.

(3) Remove the fuse switch from the fuse.

(4) Remove the fuse.

(5) Attach the fuse switch to a replacement fuse.

(6) Attach the replacement fuse to the unit.

(7) Close the front cover and tighten the screws at the bottom of the unit.

10.2 Cooling Fan

Rated current of the unit	Order code
100 A	A00A1917200
150 A	A00A1917300
250 A	A00A1917400
350 A	A00A1917400
450 A	A00A1917400

Replacement procedure

※ Turn OFF the input power supply of the distribution panel and check that the power supply is OFF.

(1) Remove the relay connector of the cooling fan.

(2) Remove the cooling fan harness from the cable clip. (The models with a rated current of 100 A only)

(3) Remove the fixing screws and remove the cooling fan.

(4) Attach a replacement cooling fan oriented so its air blows to the unit.

(5) Hold the cooling fan harness with a cable clip so that the harness does not contact the main wires. (The models with a rated current of 100 A only)

(6) Connect the relay connector of the cooling fan.

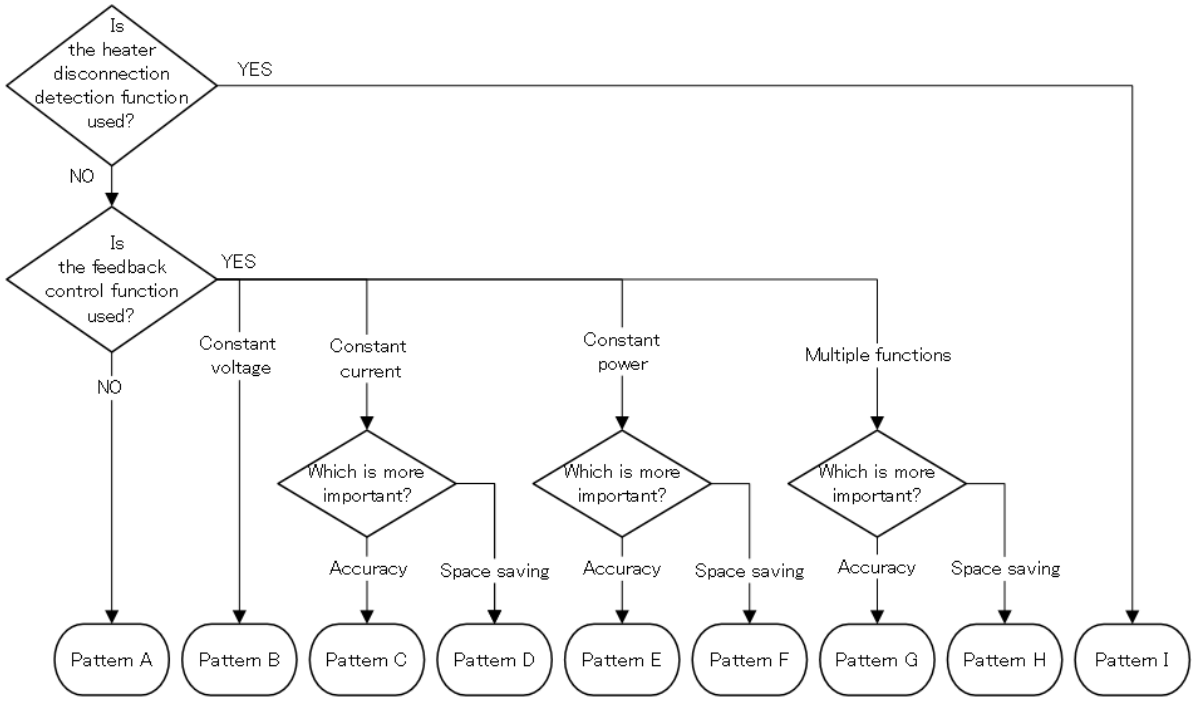
11 CONVERSION BOARD (OPTIONAL)

The conversion board is an optional item that enables constant current control, constant voltage control, constant power control, heater disconnection detection, and other functions. This item does not come with the unit. Parts that are sold separately are required.

11.1 Before Use

11.1.1 Checking the product

Required optional items differ according to the functions to be used. Check that all the necessary parts are present.



Pattern	Required optional item*3			Remark
A	Not required			
B	UG-TB1V		External PT	
C	UG-TB1A	External CT (+ main circuit CT)		
D	UG-TB1A			*1
E	UG-TB4(H)	External CT (+ main circuit CT)	External PT	*2
F	UG-TB4		External PT	*1
G	UG-TB3(H)	External CT (+ main circuit CT)	External PT	*2
H	UG-TB3		External PT	*1
I	UG-TB3(H)U	External CT (+ main circuit CT)	External PT	

*1: Set [F407: CT selection] to [1: Built-in CT] on the display panel.

*2: The conversion board models with "H" (built-to-order products) require the external CT and main circuit CT.

*3: You must prepare the main circuit CT.

The pattern selected here will be used repeatedly in explanations in the subsequent sections. Set the conversion board according to the corresponding pattern.
(The pattern selected here is described as the "conversion board pattern" in the subsequent sections.)

11.1.2 How to install the conversion board

Install the conversion board by following its included installation manual.

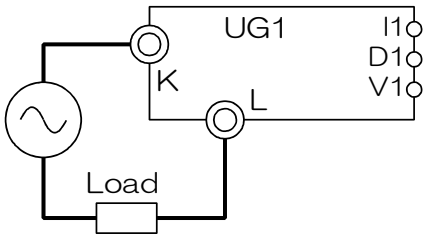
※ The conversion board is not designed to be removed frequently. Note that installing and removing it repeatedly may cause contact failures.

11.1.3 Connection diagrams

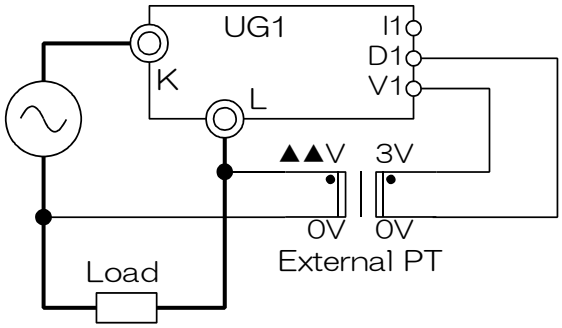
The wiring method differs according to the conversion board pattern. The connection diagrams regarding control terminals I1, D1, and V1 are shown below.

※ The connection of other terminals is common to all models and is therefore omitted. See the connection explained in "5 EXTERNAL CONNECTIONS OF THE UNIT."

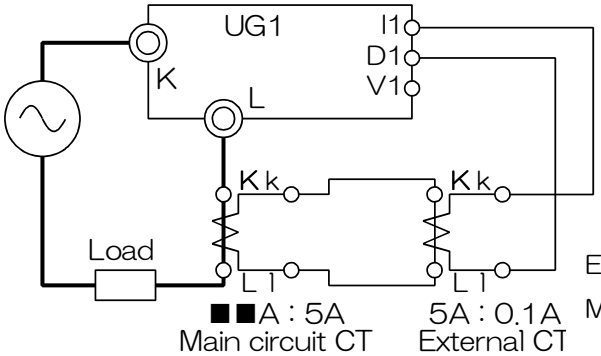
● Connections for patterns A and D
(The external CT and external PT are not used.)



● Connections for patterns B, F, and H
(Only the external PT is used.)

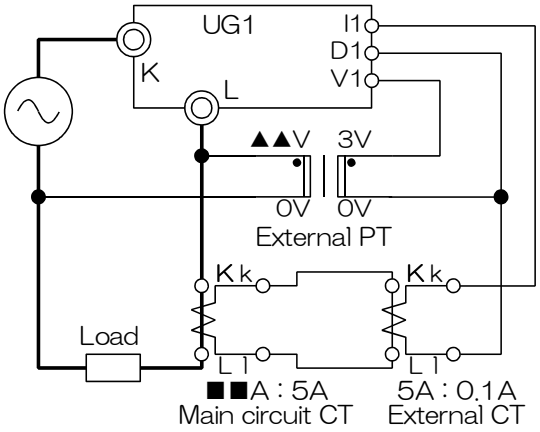


● Connections for pattern C (Only the external CT is used.)



External CT (optional item)
Main circuit CT (prepared by user)

- Connections for patterns E, G, and I (The external CT and external PT are used.)



External CT (optional item)
Main circuit CT (prepared by user)

11.2 Functions

11.2.1 Model list

The available functions differ according to the conversion board model. ✓: Equipped with the function, –: Not equipped with the function

Model	Feedback control method				Detection value display function			Heater
	Constant current control	Constant voltage control	Constant power control	No control	Current	Voltage	Power	Disconnection detection
No conversion board	–	–	–	✓	○	○	–	–
UG-TB1A	✓	–	–	✓	◎	○	–	–
UG-TB1V	–	✓	–	✓	○	●	–	–
UG-TB3	✓	✓	✓	✓	◎	●	◎	–
UG-TB3H	✓	✓	✓	✓	●	●	●	–
UG-TB3U	✓	✓	✓	✓	◎	●	◎	✓
UG-TB3HU	✓	✓	✓	✓	●	●	●	✓
UG-TB4	–	–	✓	✓	–	–	◎	–
UG-TB4H	–	–	✓	✓	–	–	●	–

The detection value display function shows different values according to the conversion board model.

Current	○	Displays the current detected with the built-in CT.
	◎	Displays the currents detected with the CT (built-in CT or external CT) and conversion board.
	●	Displays the currents detected with the external CT and conversion board.
Voltage	○	Displays the control power supply voltage and the voltage output according to the output setting.
	●	Displays the voltages detected with the external PT and conversion board.

Power	◎	Displays the powers detected with the built-in or external CT, external PT, and conversion board.
	●	Displays the powers detected with the external CT, external PT, and conversion board.
	—	Displays nothing.

※ The accuracy of ◎ and ● among the detected values may decrease from the specifications according to the combination of the unit, optional items, and load. When the conversion board is installed or replaced, be sure to adjust detected values. For details, see "11.2.3 Detection value adjustment function"

11.2.2 Feedback control

This function performs feedback control using detected values. Mode can be set by display panel. The related parameters are shown below. This function affects feedback control accuracy and detection value display accuracy.

- F400: Feedback control method

  The selectable modes differ according to the connected conversion board.

Model	Mode selectable with F400
UG-TB1A	0: No feedback, 1: Constant current control
UG-TB1V	0: No feedback, 2: Constant voltage control
UG-TB3 UG-TB3H UG-TB3U UG-TB3HU	0: No feedback, 1: Constant current control 2: Constant voltage control, 3: Constant power control
UG-TB4 UG-TB4H	0: No feedback, 3: Constant power control

※ If only [0: No feedback] can be selected on the setting screen, the conversion board may not be connected correctly. Check if the model is displayed with [F408: Conversion board model check].

※ This parameter needs to be set again after the conversion board is removed and installed again for replacement or other purposes. If you start operation without setting the mode again, this function may fail to operate correctly.

- F407: CT selection

  When conversion board pattern D, F, or H is selected, set this parameter to [1: Built-in CT].

- Parameter F: Gradient (proportional) signal

  The adjustment method differs according to the conversion board pattern and the ratings of the load, external PT, and main circuit CT.

  The following simple terms are used in explanations.

Gradient signal	Indicates parameter F (gradient [proportional] signal).
Input signal	Indicates parameter H (manual [upper limit] signal) or parameter P (temperature control signal), whichever is used.
Measured load value	Indicates the measured value of the load current, load voltage, or load power during operation.
Maximum load capacity	Indicates the maximum load current, maximum load voltage, or maximum load power of the load to be used. The value to be used differs according to the usage condition. See the next table.
Rated value	Indicates the rated value required for the setting. The value to be used differs according to the usage condition. See the next table.

Adjustment method

Feedback control method	Conversion board pattern	Maximum load capacity	versus	Rated value	Adjustment method
Constant voltage control	B, G, H, I	Maximum load voltage	=	Rated voltage of the external PT	(1)
		Maximum load voltage	<	Rated voltage of the external PT	(2)
Constant current control	C, G, I	Maximum load current	=	Rated current of the main circuit CT	(1)
		Maximum load current	<	Rated current of the main circuit CT	(2)
	D, H	Maximum load current	=	Rated current of the unit	(1)
		Maximum load current	<	Rated current of the unit	(2)
Constant power control	E, G, I	Maximum load voltage and Maximum load current	= =	Rated voltage of the external PT Rated current of the main circuit CT	(1)
		Maximum load voltage or Maximum load current	< <	Rated voltage of the external PT Rated current of the main circuit CT	(2)
	F, H	Maximum load voltage and Maximum load current	= =	Rated voltage of the external PT Rated current of the unit	(1)
		Maximum load voltage or Maximum load current	< <	Rated voltage of the external PT Rated current of the unit	(2)

※ For adjustment of constant power control or patterns G and H, if the voltage and current both have a maximum load capacity that is smaller than the rated value, use the maximum load capacity with the larger difference from the rated value.

Adjustment method (1): When the maximum load capacity matches the rated value

Use this function with the maximum gradient signal (100.0%).

Adjustment method (2): When the maximum load capacity is smaller than the rated value

＊ When the maximum load capacity can be output during adjustment

Step 1: Minimize the gradient setting (0.0%) in advance to prevent a measured load value from exceeding the maximum load capacity at power ON.

Step 2: Adjust the gradient setting to output the maximum load capacity with the maximum input signal.

Adjustment method (2"): When the maximum load capacity is smaller than the rated value

＊ When the maximum load capacity is not output during adjustment

Step 1: Minimize the gradient setting (0.0%) in advance to prevent a measured load value from exceeding the maximum load capacity at power ON.

Step 2: Calculate the setting of the input signal (INmax) using the maximum allowable output value (OUTmax).

$$\mathrm{INmax} = \frac{\mathrm{OUTmax}}{\mathrm{Rated\ \ value}} \times 100$$

Step 3: Set the input signal to INmax(%).

Step 4: Adjust the gradient signal so that the measured load value reaches OUTmax.

11.2.3 Detection value adjustment function

The accuracy may decrease from the specifications according to the combination of the unit, optional items, and load. When the conversion board is installed or replaced, be sure to adjust detected values using this function. This function affects feedback control accuracy and detection value display accuracy.

Step 1: Set the feedback control as specified in "11.2.2 Feedback control."

Step 2: Continue operation until the output becomes stable.

※ It is recommended to maximize the input signal value to the extent possible. Set it according to the load specifications.

Step 3: Select [F40*: ** gain adjustment] on the display panel.

The function code to select differs according to the detected values to be adjusted.

- [F404: Current gain adjustment] for adjusting current detection value
- [F405: Voltage gain adjustment] for adjusting voltage detection value
- [F406: Power gain adjustment] for adjusting power detection value

Step 4: Enter the measured load value on the setting screen.

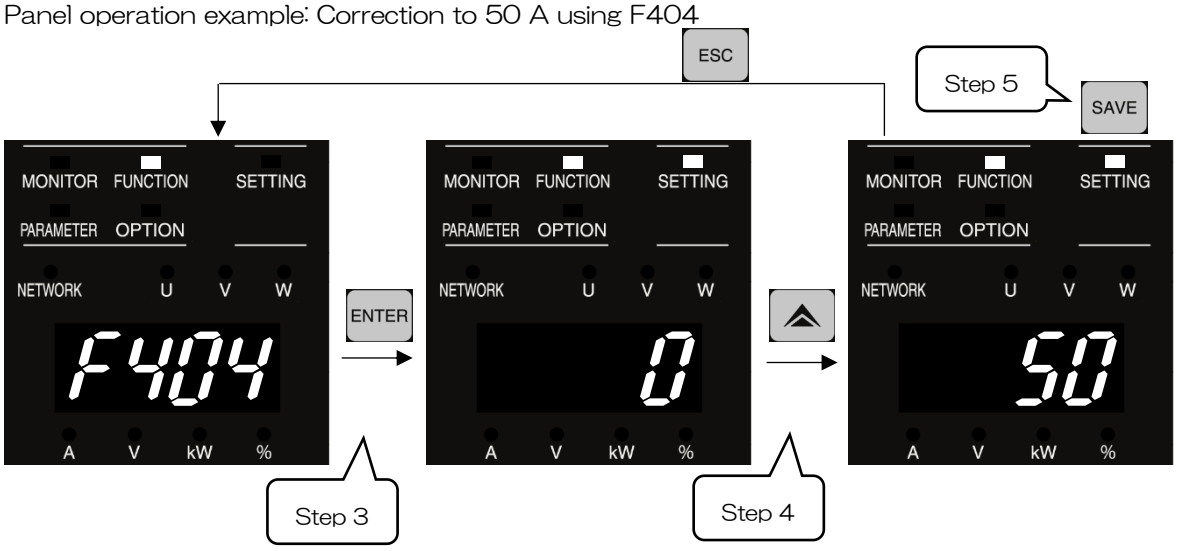
Step 5: Press the SAVE key. If the entered load value is within the correctable range, it is corrected.

※ Correction is not performed correctly if [F0: Rated value] has not been set correctly.

※ Correction is not performed correctly for detected values that differ greatly from measured values. Large differences may be caused by wrong settings. Review this section and the setting of [F0: Rated value].

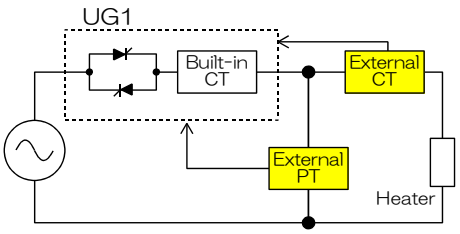
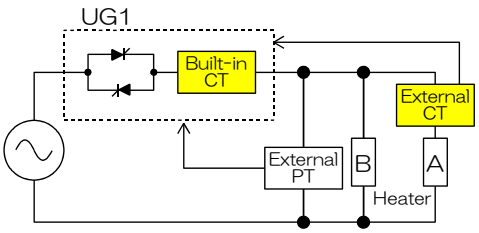
※ The detection values that can be adjusted differ according to the conversion board model. Among the detection value display functions described in ″11.2.1 Model list″, ◎ and ● are adjustable. ○ is not subject to adjustment.

Panel operation example: Correction to 50 A using F404



11.2.4 Heater disconnection detection function

Only the UG-TB3U and UG-TB3HU conversion boards are equipped with the heater disconnection detection function. There are two modes with different specifications.

	Standard version	Highly functional version
Simple connection diagram		 Divide the number of heaters by two so that A is equal to B or B + 1. Connect the external CT to measure the current on the heater A side.
Detection method	Monitor the heater resistance via the external CT and external PT. Disconnection is determined with an amount of change from the initial resistance.	Monitor the ratio of the current detected with the external CT to that detected with the built-in CT. The ratio of the external CT to the built-in CT should be 1:2. Disconnection is determined with a change from this current ratio.

	Standard version	Highly functional version
Heater type	Heaters with a constant resistance	The function can be used for heaters with a resistance that varies when the temperature changes.
Heater capacity	25% of the rated current or higher when the output voltage is 100%	40% of the rated current or higher when the output voltage is 100%
Detection range	10% of the rated voltage and rated current or higher	30% of the rated current or higher
Number of heaters	Up to 20, the same material and capacity	Up to 10, the same material and capacity
Number of disconnected heaters	It is possible to detect disconnection when multiple heaters are disconnected. ※ The amount of change may exceed the detection range depending on the usage condition, resulting in detection failure.	Disconnection of a single heater can be detected normally. ※ The function may fail to detect disconnection or the feedback control may fail to operate normally when multiple heaters are disconnected.

11.2.5 Heater disconnection detection (standard version)

11.2.5.1 Operation overview

(1) The load current and load voltage are obtained via the main circuit CT, external CT, external PT, and conversion board.

(2) The load current (%) and load voltage (%) in the early phase of operation are memorized.

(3) The resistance when the heater load capacity is set is calculated using the memorized load current and voltage.

(4) The resistance is calculated periodically during operation using the load current and load voltage.

(5) When the amount of change in the resistance exceeds the preset heater disconnection detection amount, the error code is displayed and a signal is output on the external warning relay specified with [F6: Error output destination selection]. The unit continues operation, instead of stopping.

(6) For malfunction prevention, the heater disconnection detection is not performed when the load voltage is less than 10% of the rated voltage.

(7) For false detection prevention, the heater disconnection detection is not performed for 5 minutes after the start of operation.

11.2.5.2 Setting method

Connect the conversion board according to conversion board pattern I specified in "11.1.3 Connection diagrams." There is no other connection specific to this function. The related parameters are shown below.

- F401: Heater disconnection detection function
  Select [2: Enable standard version] to enable the standard version function.
  When the function needs to be temporarily disabled for test operation or other purposes, select [0: Disable standard version].
  ※ The highly functional version described in the next section is also available with this function. Note that the function does not work correctly if the highly functional version is selected by mistake.

- Parameter U: Heater disconnection amount
  Set the threshold for the disconnection detection. The threshold needs to be set according to the number of heaters connected in parallel. Set the threshold with the following table as a reference.

Number of heaters connected in parallel	U: Heater disconnection amount
1	(50%)
2	50%
3	33%
4	25%
5	20%
6	16%
7	14%
8	12%
9	11%
10	10%
11	9%
12	8%
13 or 14	7%
15 or 16	6%
17 to 20	5%

U = number of disconnected heaters/number of heaters connected in parallel

(The table on the left shows parameter U when one heater is disconnected.)

- oP02: Heater resistance setting

  [oP02: Heater resistance setting] in OPTION mode of the display panel is used to record the initial heater resistance. Set it with the following procedure.

  Step 1: Complete the settings specified in the previous section.

  Step 2: Continue operation until the heater temperature becomes stable.

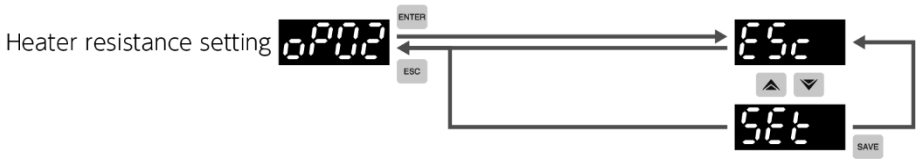
  ※ Disconnection may not be detected correctly if the following steps are executed before the heater temperature becomes stable.

  Step 3: Select [oP02: Heater resistance setting] on the display panel.

  Step 4: Press the DOWN key on the setting screen. [SEt] flashes on the 7-segment LED.

  Step 5: Press the SAVE key. If the heater resistance is within the settable range, [ESc] is displayed.

  ※ The initial value can be set only when it is 25% of the rated voltage and the rated current or higher. If the value is outside the range, the LED continues to flash while displaying [SEt] even when the SAVE key is pressed.



11.2.6 Heater disconnection detection (highly functional version)

11.2.6.1 Operation overview

(1) Divide the number of heaters by two so that A is equal to B or B + 1.

(2) The number of heaters connected to the A side and the B side are memorized by the unit.

(3) The load current of the A side is obtained via the main circuit CT, external CT, and conversion board.

(4) The load current of A + B is obtained via the built-in CT.

(5) The current ratio (balance) of the heaters divided into two is obtained using these load currents.

(6) The current ratio (balance) of the heaters is periodically obtained.

(7) When the current ratio of the heaters deviates from the theoretical current ratio value calculated from the preset number of connected heaters, the error code is displayed and the external warning relay signal specified with [F6: Error output destination selection] is output. The unit continues operation, instead of stopping.

(8) For malfunction prevention, the heater disconnection detection is not performed when the load current of heater A + heater B is less than 10% of the rated current.

(9) For false detection prevention, the heater disconnection detection is not performed for 5 minutes after the start of operation.

Notes on this function

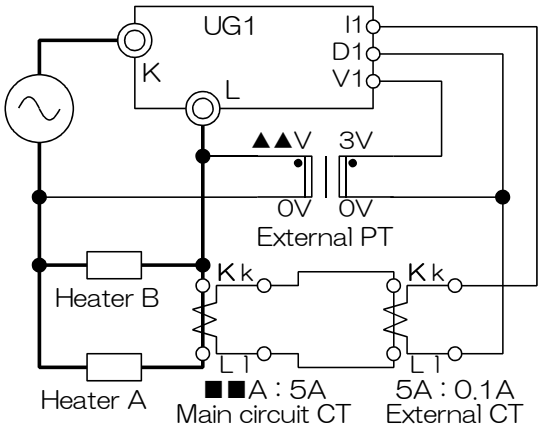
※ If a transformer is included in the main circuit, the current ratio cannot be detected correctly and this function cannot be used.

※ If heaters with different degrees of aging are used together, there will be a deviation from the theoretical current ratio value, which may result in false detection. Feedback control accuracy may also be affected.

※ If one each of heaters A and B is disconnected, the disconnection cannot be detected because the current ratio of the heaters and the theoretical current ratio value match.

11.2.6.2 Connection method

To use this function, the heaters, main circuit CT, external CT, and external PT need to be connected differently from the standard connection. Connect these items according to the following diagram.



※ Select the main circuit CT by referring to the rated current of the unit. It is not necessary to take into consideration heaters divided into two groups when selecting the main circuit CT.

※ It is recommended to connect at least two heaters to the A side. The feedback control, which uses the external CT, cannot be performed correctly if all heaters connected to the A side are disconnected. (The signal continues to be output via the heaters on the B side.)

11.2.6.3 Setting method

The related parameters are shown below.

- F401: Heater disconnection detection function

  Select [3: Enable highly functional version] to enable the highly functional version function. When the function needs to be temporarily disabled for test operation or other purposes, select [1: Disable highly functional version].

  ※ The standard version described in the previous section is also available with this function. Be sure to set the value to [3: Enable highly functional version] or [1: Disable highly functional version] when heaters are divided into two groups for the highly functional version. Failure to do so may cause incorrect feedback control, leading to overcurrent.

- F402: Heater A count
  Specify the number of heaters connected in parallel. The heater A count refers to the number of heaters connected to the side to which the main circuit CT is connected, as shown in the connection diagram.
- F403: Heater B count
  Specify the number of heaters connected in parallel. The heater B count refers to the number of heaters connected to the side without the main circuit CT, as shown in the connection diagram.
- Parameter U: Heater disconnection amount
  Set the threshold for the disconnection detection. The threshold needs to be set according to the number of heaters connected in parallel. Set the threshold with the following table as a reference.

Number of heaters connected in parallel (total of A and B)	U: Heater disconnection amount
3	16%
4	12%
5	10%
6	8%
7	7%
8	6%
9	5%
10	5%

The above settings are approximate values. The value to set may need to be adjusted according to the actual usage conditions.
After configuring settings, perform the test operation in the following procedure to check if detection is performed normally.

Step 1: Perform operation for at least 5 minutes with the number of parallel-connected heaters used to set parameter U.
Step 2: Check that error code Er.13 is not displayed.
If error code Er.13 is displayed, review the connection and the settings of the numbers of heaters.
Step 3: After stopping operation and the power supply, remove one heater A unit. (This simulates heater disconnection.)
Step 4: Perform operation for at least 5 minutes with the absence of one heater.
Step 5: Check that error code Er.13 is displayed.
If error code Er.13 is not displayed, increase the setting of [Parameter U] by 1% and save the new setting. Repeat steps 4 and 5 until the error code is displayed.
Step 6: After completing the test operation, connect the removed heater again.

11.3 Characteristics

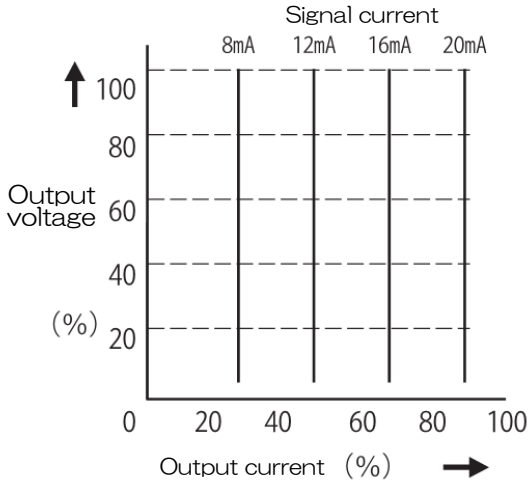
11.3.1 Constant current control

Specifications

Condition		Accuracy
・ Power supply voltage fluctuation	Rated voltage ± 10%	±1%
・ Load	Constant	FS
・ Ambient temperature	Constant	
・ Power supply voltage	Constant	±2%
・ Load fluctuation	10 times the rated load	FS
・ Ambient temperature	Constant	
・ Power supply voltage	Constant	±2%
・ Load	Constant	FS
・ Ambient temperature fluctuation	-10° C to +50° C	

※ For conversion board pattern D, which does not use the external CT, the accuracy is ±5% FS under all the above conditions.

Characteristics

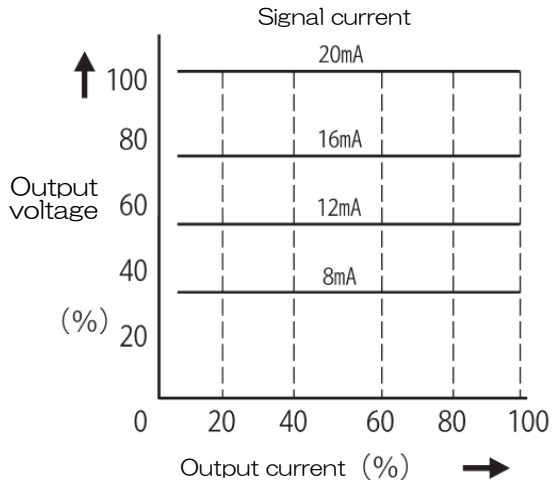


11.3.2 Constant voltage control

Specifications

Condition		Accuracy
・ Power supply voltage fluctuation	Rated voltage ± 10%	±1%
・ Load	Constant	FS
・ Ambient temperature	Constant	
・ Power supply voltage	Constant	±1%
・ Load fluctuation	10 times the rated load	FS
・ Ambient temperature	Constant	
・ Power supply voltage	Constant	±2%
・ Load	Constant	FS
・ Ambient temperature fluctuation	-10° C to +50° C	

Characteristics



11.3.3 Constant power control

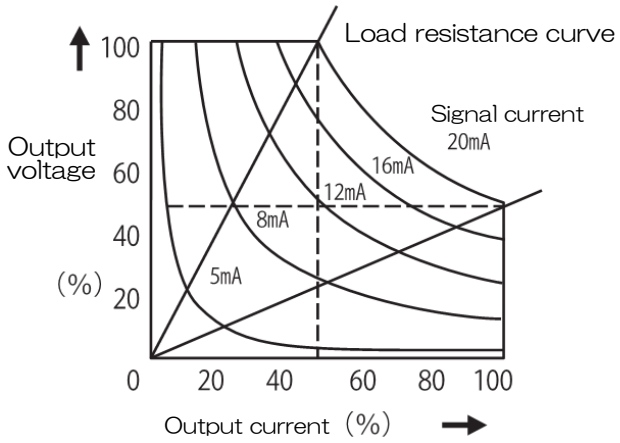
The following characteristics apply to UG-TB3, UG-TB3U, and UG-TB4.

Specifications

Condition		Accuracy
・ Power supply voltage fluctuation ・ Load ・ Ambient temperature	Rated voltage ± 10% Constant Constant	±1% FS
・ Power supply voltage ・ Load fluctuation ・ Ambient temperature	Constant 4 times the rated load Constant	±5% FS
・ Power supply voltage ・ Load ・ Ambient temperature fluctuation	Constant Constant -10° C to +50° C	±3% FS

※ For conversion board patterns F and H, which do not use the external CT, the accuracy is ±5% FS under all the above conditions.

Characteristics



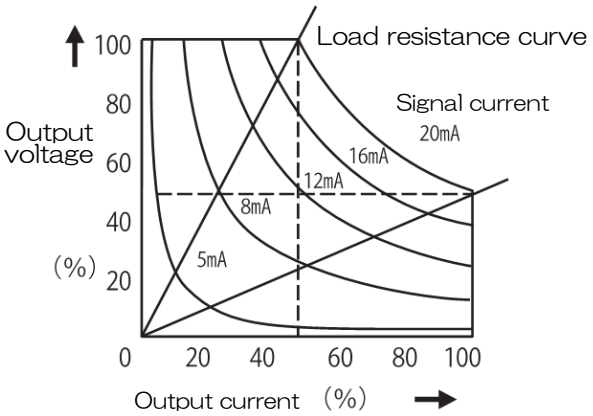
11.3.4 Constant power control (built-to-order products)

The following characteristics apply to UG-TBH3, UG-TBH3U, and UG-TB4H.

Specifications

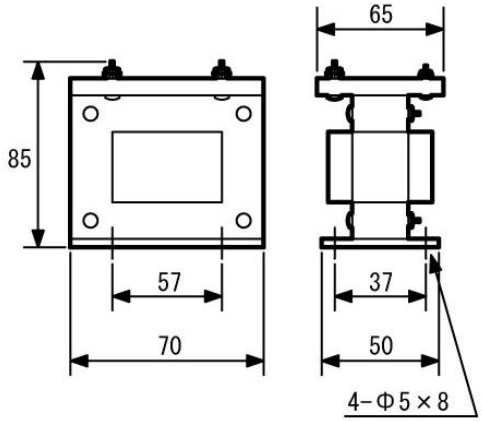
Condition		Accuracy
・ Power supply voltage fluctuation ・ Load ・ Ambient temperature	Rated voltage ± 10% Constant Constant	±1% FS
・ Power supply voltage ・ Load fluctuation ・ Ambient temperature	Constant 10 times the rated load Constant	±1% FS
・ Power supply voltage ・ Load ・ Ambient temperature fluctuation	Constant Constant -10° C to +50° C	±1% FS

Characteristics



11.4 External View

- External CT (optional item)

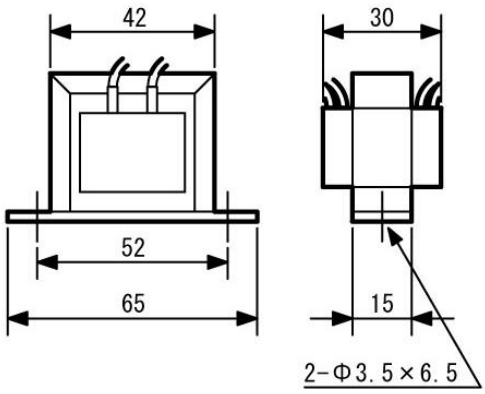


Wiring terminals

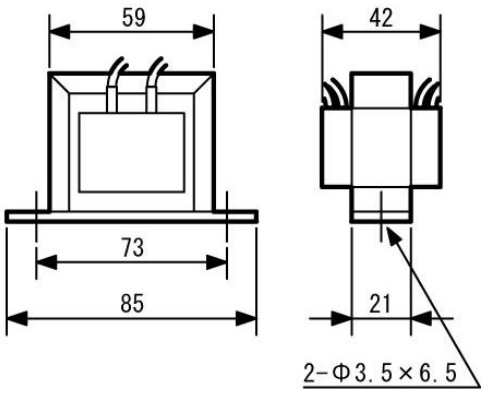
Primary side: M4

Secondary side:

- External PT (optional item)
  - For 210 V and 110 V



  - For 440 V



Wiring terminal processing: None (Process them according to

12 MAINTENANCE AND INSPECTION

- Before maintenance and inspection, be sure to stop the supply of power to the main circuit and control circuit. Note that voltage is applied to the circuits even when operation is stopped via the ST terminal, panel, or communication.
- When the warning circuit is activated, an error code is displayed on the display panel on the front surface of the product. Check the error code. Resume operation after removing causes according to “8 ERROR DETECTION.”
- Note that dust, moisture, overheating, vibration, and other issues may degrade the performance of the unit or cause it to fail.
- Remove dust periodically using compressed air or other tools to prevent dust from accumulating on the unit.

13 TROUBLESHOOTING

Symptom	Item to check	Action
There is no output.	Is an error code displayed?	See "8 ERROR DETECTION" and remove the causes of the error.
	Is the ST terminal short-circuited with the PH terminal?	Short-circuit them.
	Is the VF2 terminal open?	Short-circuit it with the VE3 terminal.
	Are all the input signals zero? • [P: Temperature control signal] • [H: Manual (upper limit) signal] • [L: Lower point (lower limit) signal]	Increase the setting of at least one parameter.
	Is [F: Gradient (proportional) signal] zero?	Increase the setting.
	Is [F101: Temperature controller type] correct?	Check the setting.
	Is the AT terminal setting correct?	Check the setting.
	Does the phase of the main circuit power supply match that of the control power supply?	Match the phases.
Abnormal output	If constant current control does not work, is the load open?	Check the load.
	If constant power control does not work, are the PT and CT polarities correct?	Correct the polarities.
	Are the conversion board settings correct?	Review the [F4: Conversion board] setting.
There is no output when the RUN/STOP key is pressed.	Is the GT terminal short-circuited with the PH terminal?	Short-circuit them.
	Is [F701: RUN/STOP key lock] ON?	Set it to [0: Unlock].
The output does not stop when the RUN/STOP key is pressed.	Is the ST terminal short-circuited with the PH terminal?	Open the circuit between them.

Symptom	Item to check	Action
The detection value display does not match the measured value.	Are the rated value settings correct?	Review the [F0: Rated value] setting.
	Is the secondary-side rated current of the main circuit CT 5 A?	Review the [F0: Rated value] setting in terms of the secondary-side rated current of 5 A.
	Has the correction been performed for the conversion board? The correction needs to be performed when the conversion board is installed or replaced.	Correct the detection value according to "11.2.3 Detection value adjustment function."
The output cannot be fully controlled.	Are the detection lines open?	Check the wiring.
	If constant power control is used, are the external CT, main circuit CT, and external PT polarities correct?	Check the polarities.
A THY error has occurred.	Are the PT and CT detection lines connected?	Check the wiring.
A load error has occurred.	Is the PT detection line connected?	Check the wiring.
The settings cannot be changed.	Is [F702: SAVE key lock] ON?	Set it to [0: Unlock].
	Is the unit operating?	Some function settings cannot be changed during operation. See the list.
The cooling fan does not rotate.	Is the unit stopped?	The fan is designed to rotate only during operation.
	Has dust accumulated on the cooling fan?	Remove dust using compressed air or other tools.
	Has the relay connector been left removed since replacement?	Connect it correctly.
The LED on the display panel does not light up/keys do not operate	Is the cable connector inside the unit loose? (See ″5.1 5.1Control Terminal Block″)	Connect it correctly.

14 UNIT SPECIFICATIONS

Item		Specifications
Model		Without a fuse: UG1-2*** With a fuse: UG1-2***F, UG1-4***F (*** indicates the rated current.)
Main circuit		
	Number of phases	Single
	Rated input voltage	100 V to 254 V, 380 V to 480 V
	Power supply fluctuation range	±10%
	Rated frequency	50/60 Hz (automatic frequency judgment system)
	Frequency fluctuation range	Rated frequency ± 5%
	Rated current	25, 35, 50, 75, 100, 150, 250, 350, 450 A
Control circuit		
	Control power supply	Single phase, 200/220 VAC, 25 VA (50 VA for units with 100 A or higher)
	Rated frequency	50/60 Hz
	Voltage that guarantees performance	180 to 242 VAC
	Power supply to fan	Shared with the control power supply (units with 100 A or higher)
Control method		Phase control, intermittent cycle control, continuous cycle control * Feedback control is not available with the continuous cycle control method.
Output voltage adjustment range		Phase control: 0% to 100% of the main circuit power supply voltage (effective value) Cycle control: 0% to 100% of the main circuit power supply voltage (effective value) * Excluding the amount of voltage drop caused with the thyristor.
Gradient setting range		0% to 100% (for the output)
Lower point setting range		0% to 100% (for the output)
Ambient temperature		-10° C to 50° C (humidity: 90%RH or less)
Storage temperature		-20° C to 70° C
Load to apply		Phase control: Resistance load, inductive load, transformer primary control Cycle control: Resistance load (customized product: transformer primary-side control)

Item	Specifications
Control signal	(1) Current signal: 4 to 20 mA (DC) (internal resistance: 250 Ω) (2) Voltage signal: 1 to 5 VDC, 0 to 5 VDC (internal resistance: 10 kΩ)
Start/stop method	Soft start/stop method, 0.5 seconds (default value) (Adjustable between 0.0 and 300 seconds)
Cooling method	Self cooling (for units with 75 A or less), air cooling (for units with 100 A or more)
Input and output characteristics	Linearity: ±3% FS (at 10% to 90% output) (For the continuous cycle control method, linearity: ±5% FS) (Characteristics of roots of 1.6, 1.8, 2.0, 2.2, 2.5, and 3.0 power and average characteristics are available with the function characteristic function.)
Current limitation characteristics	Settable between 10% and 110% of the rated current (only for phase control)
Warning output function	Two contact output systems. The output destination can be switched. Contact: normally open (250 VAC, 1 A/30 VDC, 1 A)
Withstand voltage	UG1-2***, UG1-2***F: 2000 VAC/1 min between the main circuit and ground UG1-4***F: 2500 VAC/1 min between the main circuit and ground
Insulation resistance	20 MΩ or higher (500 VDC)

15 OPTIONAL ITEM SPECIFICATIONS

Item		Specifications		
Conversion board	Constant current control characteristics (when the built-in CT is used)	Power supply voltage fluctuation	Rated voltage ± 10%	±5% FS
		Load	10 times the rated load	±5% FS
		Ambient temperature	-10° C to +50° C	±5% FS
	Constant current control characteristics (when the external CT is used)	Power supply voltage fluctuation	Rated voltage ± 10%	±1% FS
		Load	10 times the rated load	±2% FS
		Ambient temperature	-10° C to +50° C	±2% FS
	Constant voltage control characteristics	Power supply voltage fluctuation	Rated voltage ± 10%	±1% FS
		Load	10 times the rated load	±1% FS
		Ambient temperature	-10° C to +50° C	±2% FS
	Constant power control characteristics (when the built-in CT is used)	Power supply voltage fluctuation	Rated voltage ± 10%	±5% FS
		Load	10 times the rated load	±5% FS
		Ambient temperature	-10° C to +50° C	±5% FS
	Constant power control characteristics (when the external CT is used)	Power supply voltage fluctuation	Rated voltage ± 10%	±1% FS
		Load	4 times the rated load	±5% FS
		Ambient temperature	-10° C to +50° C	±3% FS
	Constant power control characteristics (built-to-order board)	Power supply voltage fluctuation	Rated voltage ± 10%	±1% FS
		Load	10 times the rated load	±1% FS
		Ambient temperature	-10° C to +50° C	±1% FS

Item		Specifications	
Conversion board	Heater disconnection detection (standard version)	Load to apply	Heaters with a constant resistance
		Disconnection detectable range	Output voltage and current that are 10% of the ratings or higher
		Maximum number of parallel-connected loads	20
	Heater disconnection detection (highly functional version)	Load to apply	Heaters with variable resistance
		Disconnection detectable range	Output current that is 30% of the rating or higher
		Maximum number of parallel-connected loads	10
External PT *	For 110 V	Rated primary input	110 V ± 10%
		Rated secondary output	3 V
		Capacity	0.03 VA
	For 210 V	Rated primary input	210 V ± 10%
		Rated secondary output	3 V
		Capacity	0.03 VA
	For 440 V	Rated primary input	440 V ± 10%
		Rated secondary output	3 V
		Capacity	0.03 VA
External CT		Rated primary input	5 A
		Rated secondary output	0.1 A
		Capacity	5 VA

※ Contact us if the main circuit voltage is not 110 V, 210 V, or 440 V ± 10%.

APPENDIX A. PARAMETER LIST

Display symbol	Name	Setting range	Increment	Unit	Default value	Changeable during operation
P	Temperature control signal	0.0 to100.0	0.1	%	0.0	✓
H	Manual (upper limit) signal	0.0 to100.0	0.1	%	0.0	✓
L	Lower point (lower limit) signal	0.0 to100.0	0.1	%	0.0	✓
F	Gradient (proportional) signal	0.0 to100.0	0.1	%	100.0	✓
E	Soft-start time	0.0 to300.0	0.1	s	0.5	✓
C	Current limit amount	10 to 110	1	%	110	✓
U	Heater disconnection amount	5 to 50	1	%	50	✓
d	Delay time	0.0 to 3.0	0.1	s	0.0	✓
t	Interval	1.0 to 3.0	0.1	s	1.0	✓
n	Function characteristics	0 to 7	1	No.	0	✗

↑

(“during operation” ... the operation status LED is ON or flashes, i.e. output is generated.)

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F000	Rated current setting	1 to 9999	1	A	*1	✓
F001	Rated voltage setting	0.1 to 999.9	0.1	V	*2	✓
F100	Waveform control method	0: Phase control 1: Intermittent cycle control 2: Continuous cycle control	-	-	0	✓
F101	Temperature controller type	0: 4 to 20 mA (1 to 5 VDC) 1: 0 to 5 VDC 2: Two-position control	-	-	0	✗
F2_P	Priority of the temperature controller signal (P)	0: Control terminal block input 1: Panel 2: Communication	-	-	0	✗
F2_H	Priority of the upper limit signal (H)				0	✗
F2_L	Priority of the lower point signal (L)				0	✗
F2_F	Priority of the gradient signal (F)				0	✗
F2_E	Priority of the soft-start time (E)	1: Panel 2: Communication	-	-	1	✗
F2_C	Priority of the current limit amount (C)				1	✗
F2_U	Priority of the heater disconnection amount (U)				1	✗
F2_d	Priority of the delay time (d)				1	✗
F2_t	Priority of the interval (t)				1	✗
F2_n	Priority of the function characteristics (n)				1	✗

↑

(“during operation” ... the operation status LED is ON or flashes, i.e. output is generated.)

(*1: Rated current value of unit model.)

(*2: Rated voltage value of unit model.)

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F300	Selection of target to change	1 to 7	1	No.	1	✗

Default values of function characteristics

	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4	Characteristic 5	Characteristic 6	Characteristic 7
0.0% of setting	0	0	0	0	0	0	0
10.0% of setting	24	28	32	35	40	46	9
20.0% of setting	37	41	45	48	53	58	22
30.0% of setting	47	51	55	58	62	67	37
40.0% of setting	56	60	63	66	69	74	52
50.0% of setting	65	68	71	73	76	79	67
60.0% of setting	73	75	77	79	82	84	80
70.0% of setting	80	82	84	85	87	89	89
80.0% of setting	87	88	89	90	91	93	95
90.0% of setting	94	94	95	95	96	97	98
100.0% of setting	100	100	100	100	100	100	100

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F400	Feedback control method	0: No feedback 1: Constant current 2: Constant voltage 3: Constant power	-	-	0	✗
F401	Heater disconnection detection function	0: Disable standard version 1: Disable highly functional version 2: Enable standard version 3: Enable highly functional version	-	-	0	✗
F402	Heater A count	1 to 5	1	-	2	✗
F403	Heater B count	1 to 5	1	-	1	✗
F404	Current gain adjustment	1 to 9999	1	A	-	✓
F405	Voltage gain adjustment	1 to 999.9	0.1	V	-	✓
F406	Power gain adjustment	1 to 999.9	0.1	kW	-	✓
F407	CT selection	0: External CT, 1: Built-in CT	-	-	0	✗
F408	Conversion board model check	(No setting)	-	-	-	-

↑

(“during operation” ... the operation status LED is ON or flashes, i.e. output is generated.)

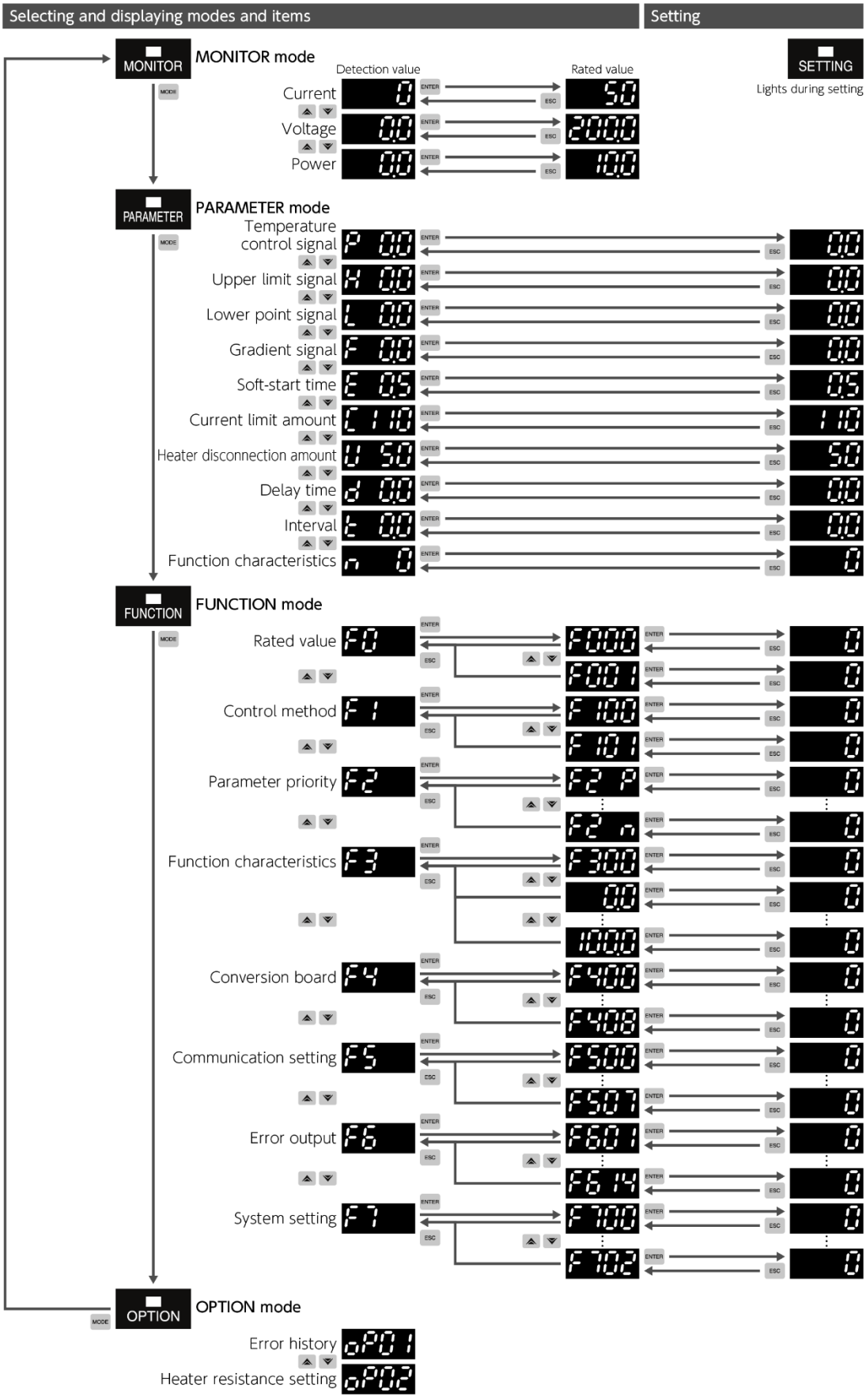
Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F501	Node address	0 to 255	1	-	1	✗
F502	Transmission rate	[9.6], [19.2], [38.4]	-	kbps	[9.6]	✗
F503	Transmission mode	[8n1], [8o1], [8E1], [8n2], [8o2], [8E2]	-	-	[8E1]	✗
F507	Transmission latency	0 to 999	1	ms	0	✗

Code	Function name	Setting range	Increment	Unit	Default value	Changeable during operation
F601	Er.01: Overcurrent detection	0: No output 1: Output to 1A-1C 2: Output to HA-HC 3: Output to both	-	-	1	✗
F602	Er.02: Temperature rise error		-	-	1	✗
F603	Er.03: Fuse blowout		-	-	1	✗
F604	Er.04: Self-diagnosis Load short circuit error		-	-	1	✗
F605	Er.05: Self-diagnosis Thyristor open		-	-	1	✗
F606	Er.06: Self-diagnosis Thyristor short circuit		-	-	1	✗
F607	Er.07: CPU error		-	-	0	✗
F608	Er.08: Memory error		-	-	0	✗
F609	Er.09: Emergency stop		-	-	0	✗
F610	Er.10: Power supply voltage drop		-	-	2	✗
F611	Er.11: Instantaneous voltage drop		-	-	2	✗
F612	Er.12: Frequency error		-	-	2	✗
F613	Er.13: Heater disconnection		-	-	2	✗
F614	Er.14: Self-diagnosis Load open error		-	-	2	✗
F700	Self-diagnosis stop	0: Suspend self-diagnosis 1: Enable self-diagnosis	-	-	1	✗
F701	RUN/STOP key lock	0: Unlock 1: Lock	-	-	0	✗
F702	SAVE key lock	0: Unlock 1: Lock	-	-	0	✗

↑

(“during operation” ... the operation status LED is ON or flashes, i.e. output is generated.)

APPENDIX B. PANEL TRANSITION DIAGRAM



APPENDIX C. ERROR CODE LIST

Code	Function name	Behavior after detection	Recovery method	Relay output destination	Error history
Er.01	Overcurrent detection	Operation stops	Power OFF	Relay (1)	Saved
Er.02	Temperature rise error	Operation stops	Power OFF	Relay (1)	Saved
Er.03	Fuse blowout	Operation stops	Power OFF	Relay (1)	Saved
Er.04	Self-diagnosis: Load short circuit error	Operation stops	Power OFF	Relay (1)	Saved
Er.05	Self-diagnosis: Thyristor open	Operation stops	Power OFF	Relay (1)	Saved
Er.06	Self-diagnosis: Thyristor short circuit	Operation stops	Power OFF	Relay (1)	Saved
Er.07	CPU error	Operation stops	Power OFF	(None)	Not saved
Er.08	Memory error	Operation stops	Power OFF	(None)	Not saved
Er.09	Emergency stop	Operation stops	Automatic recovery	(None)	Saved (only during operation)
Er.10	Power supply voltage drop	Operation stops	Automatic recovery	Relay (2)	Saved (only during operation)
Er.11	Instantaneous voltage drop	Operation stops	Automatic recovery	Relay (2)	Not saved
Er.12	Frequency error	Operation continues	Automatic recovery	Relay (2)	Not saved
Er.13	Heater disconnection	Operation continues	Automatic recovery	Relay (2)	Not saved
Er.14	Self-diagnosis: Load open error	Operation continues	Automatic recovery	Relay (2)	Not saved

Relay (1): Between 1A and 1C on the control terminal block, (2) between HA and HC on the control terminal block

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Contact a representative in charge of power regulators.

This instruction manual is subject to change without notice.