Autonics

Multi-channel Power Controllers

SPRM Series

PRODUCT MANUAL

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.
The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Features

- Single-phase control / three-phase control
- Supports a wide range of rated voltages from 220 to 440 VAC～
- Various rated current models of 25 / 40 / 55 / 70 / 90 / 110 / 160 A
- Improved visibility with 4-line LCD display
- Monitoring load current / voltage / output / resistance / heatsink temperature / power
- Detachable display module can be installed on a separate panel
- Supports various alarms, heater brake, partial heater brake, fuse break, heatsink over heat, overcurrent, FAN error, etc. and saving alarm history
- Improved fuse replacement convenience with open/close structure
- Supports RS485, EtherCAT communication

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss.(e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)
Failure to follow this instruction may result in personal injury, economic loss or fire.
02. Do not use the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.
Failure to follow this instruction may result in explosion or fire.
03. Install on the device panel, and ground to the bolt for grounding separately.
Failure to follow this instruction may result in fire or electric shock.
04. Do not connect, repair, or inspect the unit while connected to a power source.
Failure to follow this instruction may result in fire or electric shock.
05. Check 'Connections' before wiring.
Failure to follow this instruction may result in fire.
06. Do not disassemble or modify the unit.
Failure to follow this instruction may result in fire or electric shock.

⚠ Caution Failure to follow instructions may result in injury or product damage.

01. Use the unit within the rated specifications.
Failure to follow this instruction may result in fire or product damage.
02. Use a dry cloth to clean the unit, and do not use water or organic solvent.
Failure to follow this instruction may result in fire or electric shock.
03. Keep the product away from metal chip, dust, and wire residue which flow into the unit.
Failure to follow this instruction may result in fire or product damage.
04. Since leakage current still flows right after turning off the power or in the output OFF status, do not touch the load terminal.
Failure to follow this instruction may result in electric shock.
05. Be careful not to injure the edges of the heat sink.

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Power supply should be insulated and limited voltage / current or Class 2, SELV power supply device.
- Use the product, after 3 sec of supplying power.
- Before use, set the mode and function according to the specification. Since changing the mode / parameter during operation may result in malfunction, set the mode and function after disconnecting load output.
- Re-supply the power to the unit after 3 sec of turning off the power. Failure to follow this instruction may result in malfunction.
- To ensure the reliability of the product, install the product on the panel or metal surface vertically to the ground.
- Install the unit in the well ventilated place.
- While supplying power to the load or right after turning off the power of the load, do not touch the body and heat sink. Failure to follow this instruction may result in a burn due to the high temperature.
- Install a power switch or circuit breaker in the easily accessible place for supplying or disconnecting the power.
- Do not wire to terminals which are not used.
- Use twisted pair wire for communication line.
- When connecting the display module and the main body with a LAN cable (direct / cross cable), be careful not to generate excessive tension. Poor contact may cause malfunction of the display.
- Since inter element can be damaged when using with coil load, inductive load, etc., the inrush current must be under the rated load current.
- To prevent product malfunction due to noise, wire power, control input, communication, and load cables separately.
- When installing close to the load line, use a line filter for the power line and use a shield wire.

- For stable operation, use shield wire for control, alarm, and communication wires.
  Use a ferrite core on the shield wire to cope with EMC.
- Do not use near the equipment which generates strong magnetic force or high frequency noise.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category III

Ordering Information

This is only for reference, the actual product does not support all combinations.
For selecting the specified model, follow the Autonics website.

SPRM ❶ - ❷ ❸ ❹

❶ Control phases
3: 3-phase

❷ Rated load voltage
F: Free voltage

❸ Rated load current
Number: Rated load current (unit: A)

❹ Communication
R: RS485
EC: EtherCAT

Product Components

- Product
- Instruction manual
- Display blank panel × 1
- RS485 communication connector × 1
- Control input connector × 1
- Power input / Alarm output connector × 1
- Feedback control connector × 1

Manual

For proper use of the product, refer to the manuals and be sure to follow the safety considerations in the manuals.
Download the manuals from the Autonics website.

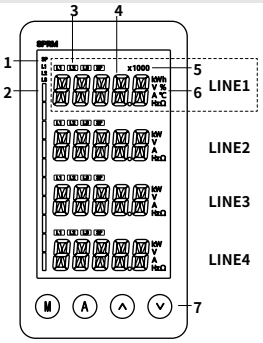
Software

Download the installation file and the manuals from the Autonics website.

■ DAQMaster

It is the comprehensive device management program for Autonics' products, providing parameter setting, monitoring and data management.

Display Module



1. BAR output phase (orange)
: Turns ON L1, L2, L3, or 3P phase of output BAR display.

2. Output BAR (orange)
: 10 bars for output percentage.
Turns ON from the bottom bar. About 10 % of output displays per one bar.

3. Control / Monitor phase (green)
: Turns ON L1, L2, L3, or 3P phase of control or monitor phase.

4. PV / SV display part (white)
: 0000.0 to 9999.9 (fixed decimal point)
LINE 1 to 4 are available to set the desired monitoring value for each line at the setting check mode.

5. × 1000 indicator (green) (only LINE1)
: Turns ON for over 6 digit accumulated power.
Multiply 1000 times for PV / SV display part value.
E.g.) PV/SV display part is 1, Unit indicator is kWh and ×1000 indicator turns ON, it means 1,000 kWh.

6. Unit indicator (green)

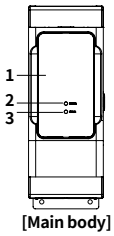
Unit	kWh 01)	kW 02)	V	% 01)	A	°C 01)	Hz	Ω
Load	Accumulated power	Power	Load voltage	Output	Load current	Heatsink temp.	Input power freq.	Load resistance

01) Only LINE1
02) For LINE2 to 4

7. Setting keys (M, A, ▲, ▼)

■ Separate display module

- Press the display module removal button on the top of the unit.
- The separated display module is available to install on a remote panel for convenient load monitoring.
- Connect the RJ45 cable between the display module and main body. This cable should be within 5 m length for prevent noise.



[Main body]

1. Display blank panel
: Attach this for prevent dust from entering the product.

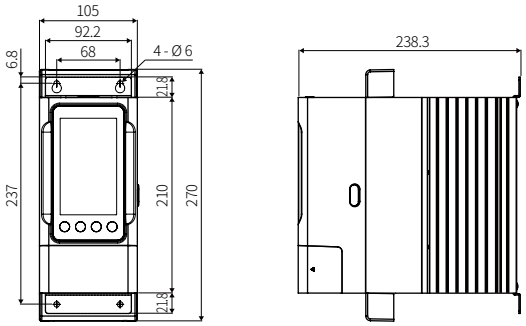
2. Power indicator (POWER, green)
: Turns ON for stable operation after power input

3. Alarm indicator (ERROR, red)
: Flashes for alarm occur

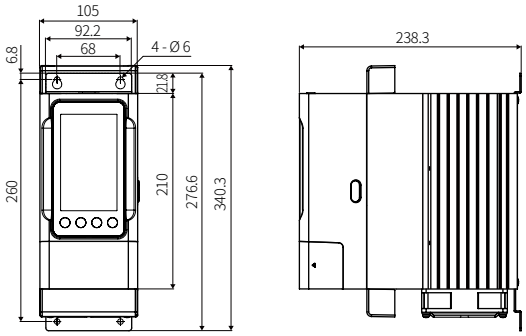
Dimensions

- Unit: mm, For the detailed drawings, follow the Autonics website.

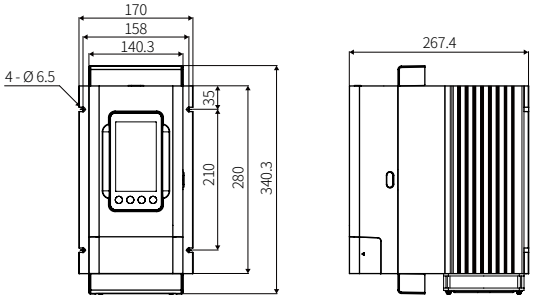
■ Rated load current 25 / 40 / 55 A



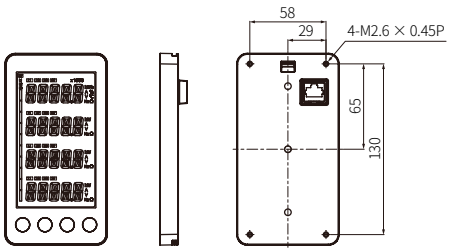
■ Rated load current 70 A



■ Rated load current 90 / 110 / 160 A

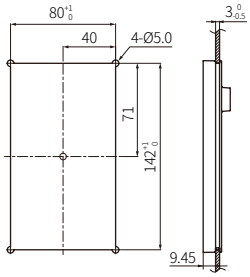


■ Display module

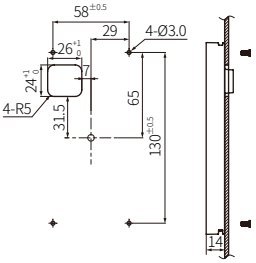


■ Panel cut-out of display module

- Panel flushing mounting



- Bolts fastening



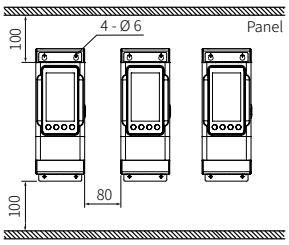
Cautions during Installation

⚠ High Temperature Caution
While supplying power to the load or right after turning off the power of the load, do not touch the body and heatsink.
Failure to follow this instruction may result in a burn due to the high temperature.

■ Mount space

- When installing multiple power controllers, keep space between power controllers for heat radiation.
  Horizontal: ≥ 80 mm, vertical: ≥ 100 mm

- Unit: mm



Specifications

Model	SPRM3-F□R	SPRM3-F□EC
Control phases	Single phase 3 Ch or 3-phase	
Rated load voltage	Free voltage 220 - 440 VAC~ 50 / 60 Hz	
Rated load current [01]	25 / 40 / 55 / 70 / 90 / 110 / 160 A	
Display method	5 digit 11 segment LCD (white) × 4, Output BAR	
Auto control input	Current [02]: DC 4 - 20 mA × 3 Ch, voltage: 0 - 5 / 1 - 5 / 0 - 10 VDC⎓, External adjuster (10 kΩ), communication: RS485, EtherCAT	
Manual control input	Parameter setting	
Digital input (DI)	RUN / STOP selectable, AUTO / MANU selectable, RESET	
Alarm output	250 VAC~ 2 A, 30 VDC⎓ 2 A, 1c resistance load	
Comm. output	RS485	RS485, EtherCAT
Cooling method	Rated load current 25 / 40 / 55 A: natural cooling Rated load current 70 / 90 / 110 / 160 A: forced air cooling (with cooling fan)	
Unit weight (packaged)	Rated load current 25 / 40 / 55 A: ≈ 4.75 kg (≈ 5.75 kg) Rated load current 70 A: ≈ 4.8 kg (≈ 5.8 kg) Rated load current 90 / 110 / 160 A: ≈ 9.42 kg (≈ 10.55 kg)	
Certification	CE EAC cULus KC	
SCCR Rating	100 kA (UL certification)	

01) It is the rated load current of each channel in single-phase operation.
02) Input impedance = 100 Ω

Control method	Phase control	Cycle control
Control mode	Normal / Constant current feedback / Constant voltage feedback / Constant power feedback	Fixed cycle / Variable cycle
Applied load	Resistance load, inductive load	Resistance load
Output range	Resistance load: 0 to 98 % Inductive load: 5 to 98 %	0 to 100 %
Output accuracy	Varies by control mode	
Normal	Within ± 10 % F.S. of rated load voltage	-
Constant current / voltage / power feedback	Within ± 3 % F.S. of rated load current / voltage / power	-

Power supply	24 VDC⎓
Permissible voltage range	90 to 110 % of rated voltage
Min. load current	1 A
Power consumption	≤ 15 W
Insulation resistance	≥ 200 MΩ (500 VDC⎓ megger)
Dielectric strength	Between the charging part and the case: 3,000 VAC~ 50 / 60 Hz for 1 min
Output leakage current	≤ 10 mArms
Noise immunity	± 500 V square wave noise (pulse width: 1 μs) by the noise simulator
Memory retention	≈ 10 years (when using non-volatile semiconductor memory type)
Vibration	0.5 mm double amplitude at frequency of 5 to 55 Hz in each X, Y, Z direction for 2 hours
Vibration (malfunction)	0.5 mm double amplitude at frequency of 5 to 55 Hz in each X, Y, Z direction for 10 min
Ambient temperature	-10 to 40 °C, storage: -20 to 80 °C (no freezing or condensation)
Ambient humidity	35 to 85 %RH, storage: 35 to 85 %RH (no freezing or condensation)

Communication Interface

■ RS485

Comm. protocol	Modbus RTU (16 bit CRC), Modbus ASCII
Application standard	Compliance with EIA RS485
Max. connection	31-unit (address: 1 to 99)
Comm. synchronous method	Asynchronous
Comm. method	2-wire half duplex
Comm. distance	≤ 800 m
Comm. speed	2,400 / 4,800 / 9,600 (default) / 14,400 / 19,200 / 38,400 / 57,600 / 115,200 bps
Comm. response time	0 to 9999 ms (default: 0 ms)
Start bit	-
Data bit	8 bit (fixed)
Parity bit	None (default), Even, Odd
Stop bit	1 bit (default), 2 bit
EEPROM life cycle	≈ 50,000 operations (Erase / Write)

■ EtherCAT

Comm. specifications	EtherCAT
Association approval [01]	EtherCAT Conformance Tested
Connection cable	CAT5e class or over (Shield type: SF/FTP, S/FTP, SF/UTP)
Max. comm. distance	Within 100 m distance between nodes
Max. baud rate	10 / 100 Mbps
Topology	Star, Line, Tree

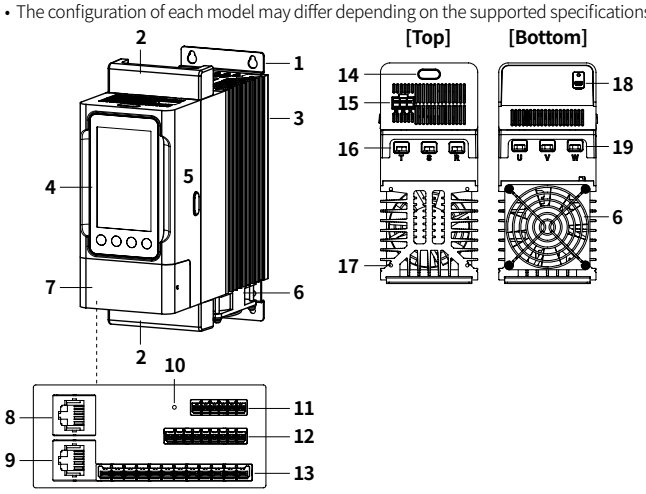
01) EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Load Output Formula

Type	Input		Formula
Auto control (AUTO)	Current	DC 4 - 20 mA	Load output [%] = (Control input [%] × Output slope [%]) + Offset
	Voltage	1 - 5 VDC⎓	
		0 - 5 VDC⎓	
		0 - 10 VDC⎓	
	RS485 / EtherCAT	0 to 100.0 %	
	External adjuster	0 to 10 kΩ	
Manual control (MANU)	Parameter	0 to 100.0 %	Load output [%] = Parameter SV [%]

Unit Descriptions

• The configuration of each model may differ depending on the supported specifications.

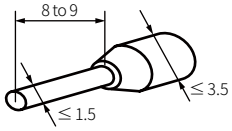


1. Bracket [Rated load current: 25 / 40 / 55 / 70 A model]
2. Load power terminal protection cover
3. Heatsink: Rated load current 90 / 110 / 160 A models have left / right mounting holes.
4. Display module: For more information, refer to Display Module.
5. Case open button
6. Cooling fan [Rated load current: 70 / 90 / 110 / 160 A model]
7. I / O terminal cover
8. EtherCAT communication connector (IN) [Communication: EtherCAT model]
9. EtherCAT communication connector (OUT) [Communication: EtherCAT model]
10. RESET switch: Reset for operation / alarm
11. RS485 communication connector
12. Control input connector
13. Power input / Alarm output connector
14. Display module remove button
15. Feedback control connector
16. R, S, T load input terminal
17. Bolt for grounding (M4)
18. USB connector
: Do not use this connector. It may cause product failure. This connector is used for firmware upgrade, operation mode change, and A/S.
19. U, V, W load output terminal

Cautions during Wiring

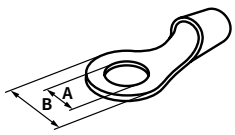
■ RS485 communication connector, Control input connector, Power input / Alarm output connector

Unit: mm, Unit: mm, Use ferrule terminal of size specified below.



■ Load Input / Output Connector

• Unit: mm, Use crimp terminals of size specified below.
Be sure to use crimp terminals with insulating sleeves (tubes).

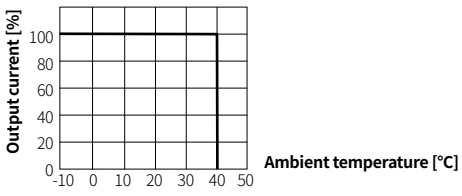


Rated load current	A	B
25 / 40 / 55 / 70 A	≥ 6.0	≤ 16.0
90 / 110 / 160 A	≥ 8.0	≤ 26.0

• Cable / screw / tightening torque spec. is different depending on the load current. Be sure to the below before connection.

Rated load current	Spec.	Power input / Alarm output	Control input / Comm. input	Feedback	Load input / output
25 / 40 / 55 / 70 A	Wiring	AWG 24 to 16	AWG 26 to 16	AWG 30 to 8	AWG 10 to 4
	Screw	-	-	-	M6
	Tightening torque	-	-	-	5.5 to 6.0 N m
90 / 110 / 160 A	Wiring	AWG 24 to 16	AWG 26 to 16	AWG 30 to 8	AWG 3 to 2 / 0
	Screw	-	-	-	M8
	Tightening torque	-	-	-	6.5 to 7.0 N m

Derating Curve



Connections

- The configuration of each model may differ depending on the supported specifications.

■ EtherCAT communication connector

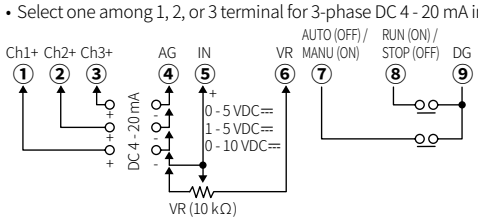
Pin layout	Pin	Function	Pin	Function
LED1 LED2 8…1 IN	1	TD +	5	-
	2	TD -	6	RD -
LED1 LED2 8…1 OUT	3	RD +	7	-
	4	-	8	-

- LED1 (green): Turns ON for data input, LED2 (yellow): Turns ON for data output

■ RS485 communication connector

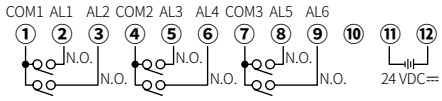
■ Control input Connector

- Select one among 1, 2, or 3 terminal for 3-phase DC 4 - 20 mA input.



■ Power input / Alarm output connector

Alarm output 1 to 6
250 VAC~ 2A 1a, 30 VDC⎓ 3A 1a
Resistive Load



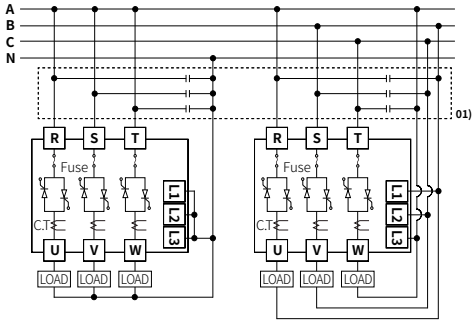
■ Feedback control connector

Pin layout	Pin	Function
L3 L2 L1	L1	R input feedback
	L2	S input feedback
	L3	T input feedback

This is the connection for measuring the load voltage and controlling (constant voltage / constant power) feedback.
If it is not connected, it is impossible to measure the load voltage, and the feedback control and alarm related to the load voltage may be limited.

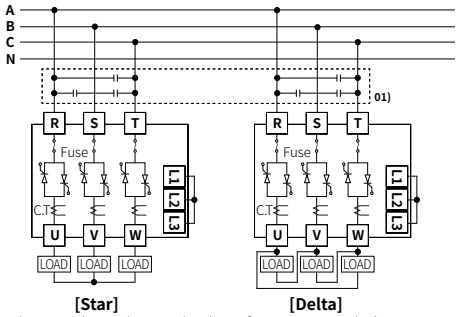
■ Load input / output, feedback terminal connection

- A, B, C = R, S, T = U, V, W = L1, L2, L3 3-phase line
  N = neutral line
  The voltage is applied by combining the 3-phase line, and the neutral line.
- Single-phase connection: Three-channel operation or each phase input power can be applied with one input power.



01) Connect the CAP (capacitor) and it conforms to EMC standards.
- FILM CAPACITOR: ≥ 1μF / 500 VAC~

- 3-phase connection: Set the parameter by Star / Delta connection.



01) Connect the CAP (capacitor) and it conforms to EMC standards.
- FILM CAPACITOR: ≥ 1μF / 500 VAC~

■ Suitable specifications

- The following connectors can be used with equivalent or substitute.

Connector	Connector specifications	Manufacture
EtherCAT communication	RJ45 connector 01)	-
RS485 communication	0225-0806	Dinkle
Control input	0225-0809	
Power input / Alarm output	0226-0812	
Feedback control	EC762HV-03P-BK	

01) EtherCAT dedicated cable must be used and the performance can not be guaranteed when using other cables.

Initial Display When Power is ON

When power is supplied, after all display will flash for 1 sec, model specification is displayed sequentially. After this, enter into RUN mode.

- Model specification: rated current, communication type, firmware version
- Example of SPRM3-F160EC model,

	1. All displays	2. Model spec.	3. Run mode
LINE1	8.8.8.8	ModEL	0.0
LINE2	8.8.8.8	160EC (rated current + comm. type)	0.0
LINE3	8.8.8.8	FW	0.0
LINE4	8.8.8.8	V01 (firmware version)	0.0

Alarm

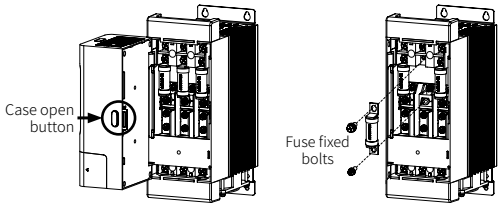
- Parameter setting is available to set alarm usage, alarm delay time, relay output, auto release,etc.

Alarm	Display	Operation		Alarm release 01)
		Alarm	Output (default)	
Overcurrent	oC	Error display flashes at LINE1	Stop (SCR OFF)	• Re-supply power. • Press [RESET]. 02) • Press [▼] for over 2 sec. • Set parameter A-RCY as ON by each alarm
Overvoltage	oV			
Heatsink over heat	otW		Maintain (normal operation)	
Heatsink over heat protection	otP		Stop (SCR OFF)	
Heater break	Ht-bk		Maintain (normal operation)	
Partial heater break	dLF-A			
Load unbalance	UL			
SCR error	SCR-A		Stop (SCR OFF)	
Fuse break	FUSE			
FAN error	FAN		Maintain (normal operation)	
Frequency error	FRQY		Stop (SCR OFF)	

01) If the alarm occurrence condition is not removed, the alarm is re-occur even if the alarm release method is applied.
02) The power is reapplied.

Replacement of Fuse

- Open the case by pressing the case open button on the right side of the product.
- The performance of the product is guaranteed only when using the fuse provided by us. For replacing the fuse, use the recommended fuse.



■ Fuse recommended specifications

- Rated short circuit test is evaluated as a recommended fuse.

Rated load current	Recommended fuse	Manufacturer
25 A	50FE	BUSSMANN
40 A	63ET	
55 A	80ET	
70 A	100FE	
90 / 110 A	660GH-160	HINODE
160 A	660GH-200	

■ Bolt specification

Rated load current	Fuse fixed bolt
25 / 40 / 55 / 70 A	M6
90 / 110 A	Top: M8 Bottom: M6
160 A	M8

Mode Setting

RUN	[M + ▲] 2 sec	→	**Setting check mode**	[M] 2 sec	→	RUN
	[M] 2 sec	→	**Program setting mode**	[M] 2 sec	→	
	[A + ▼] 2 sec	→	**Manual control input** [01]	[M] 2 sec	→	
	[M + A] 2 sec	→	**Alarm setting mode**	[M] 2 sec	→	
	[M] [02]	→	**BAR output phase setting**	Auto	→	
	[A] [02]	→	**LINE1 control / monitor phase setting**	Auto	→	
	[▲]	→	**LINE1 load type setting** [03]	Auto	→	
	[▼]	→	**Input amount check** [04]	Auto	→	
	[M + ▼] 2 sec	→	**EtherCAT status monitoring mode**	[M] 2 sec	→	
	7-9 terminal external contact of control input connector	→	**RUN / STOP**	Auto	→	
	8-9 terminal external contact of control input connector	→	**Auto / Manual control**	Auto	→	
	[▼] 2 sec	→	**Alarm reset**	Auto	→	
	Reset switch of I/O terminal	→	**Operation reset** [05]	Auto	→	

01) This parameter is in program setting mode. It operates when manual control mode.
02) It is available when 3-phase setting as OFF at single-phase / 3-phase parameter setting of Program setting mode.
03) Load type of LINE1 is selectable by the [▲] key in RUN mode or at setting check mode.
Load type of LINE 2 to 4 is selectable at setting check mode.
04) Press the [▼] key when LINE1 displays output and the input amount check is displayed with flashing.
05) In the event of system anomalies and alarms, RESET input restarts the power controller. (parameters are not reset.)

Parameter Setting

- Some parameters are activated / deactivated depending on the model or setting of other parameters.
- For more information, refer to the manuals.

■ Setting check mode

Parameter	LINE1
LINE1 monitor setting	LINE1
LINE2 monitor setting	LINE2
LINE3 monitor setting	LINE3
LINE4 monitor setting	LINE4
Parameter copy	PCoPY
Current time check	tIM-C
Alarm history	ALM-d

■ Program setting mode

Parameter	LINE1
Single-phase / 3-phase	oP-S
Control input	INPUt
Load type	LoAd
Control mode	oPER
Feedback control	Fb-S
Soft start / up / down	SoF-t
Output high / low limit	oUt-L
Output current limit	C-LM
Input slope correction	SLoPE
Input offset	oFSEt
Partial heater break	dLF
Power distribution control	PdC
RS485 communication	RS485
Parameter reset	RSt-P
Reset check	RSt
Lock	LoCK
Manual control input	MANU

■ Alarm setting mode

Parameter	LINE1
Overcurrent alarm	oC
Overvoltage alarm	oV
Heatsink over heat alarm	otW
Heatsink over heat protection alarm	otP
Heater break alarm	Ht-bK
Partial heater break alarm	dLF-A
Load unbalance alarm	UL
SCR error alarm	SCR-A
Fuse break alarm	FUSE
FAN error alarm	FAN
Frequency error alarm	FRQY
Alarm save	ALM-S
Time setting	t-SEt

Alarm

By setting parameters, you can set whether to use each alarm and relay output.

■ Overcurrent alarm

It can protect the load/fuse from overcurrent.
During alarm operation, OC in LINE1 flashes every 0.5 sec and the output stops (SCR OFF).
- Operation condition: If the current higher than the LMT-C set value of the 2-1 overcurrent alarm is applied during the DLY-T set time of the 2-1 overcurrent alarm, an alarm occurs. The set value is based on the RMS value.

■ Overvoltage alarm

It can protect the load from overvoltage.
During alarm operation, OV on LINE1 flashes every 0.5 sec and the output stops (SCR OFF).
- Operation condition: If the voltage higher than the LMT-V set value of the 2-2 overvoltage alarm is applied during the DLY-T set time of the 2-2 overvoltage alarm, an alarm occurs. The set value is based on the RMS value.

■ Heatsink over heat alarm

During alarm operation, OTW on LINE1 flashes every 0.5 sec and the output maintains.
- Operation condition: If the temperature of the heatsink maintains the temperature above the TEMP set value of the 2-3 heatsink over heat alarm during the DLY-T set time of the 2-3 heatsink over heat alarm, an alarm occurs.

■ Heatsink over heat protection alarm

During alarm operation, OTP on LINE1 flashes every 0.5 sec and the output stops (SCR OFF).
- Operation condition: If the temperature of the heatsink maintains the temperature above the TEMP set value of the 2-4 heatsink over heat protection alarm during the DLY-T set time of the 2-4 heatsink over heat protection alarm, an alarm occurs.

■ Heater break alarm

During alarm operation, HT-BK on LINE1 flashes every 0.5 sec and the output stops (SCR OFF).
- Operation condition: If the current below the LMT-C set value of the 2-5 heater break alarm is over the LMT-O set output of the 2-5 heater break alarm during the DLY-T set time of the 2-5 heater break alarm, an alarm occurs.

■ Partial heater break alarm

Partial heater break alarm is available for single phase control.
During alarm operation, DLF-A on LINE1 flashes every 0.5 sec and the output maintains.
- Operation condition: When using up to 6 parallel loads based on single-phase 1 channel, an alarm occurs if some loads (heaters) are disconnected.
An alarm occurs when the average current value of the load generated by scanning the heater (load) is different from the currently measured average current value.

■ Load unbalance alarm

During alarm operation, UL on LINE1 flashes every 0.5 sec and the output maintains.
- Operation condition: If the unbalance rate over the LMT-P set value of the 2-7 load unbalance alarm continues during the DLY-T set time of the 2-7 load imbalance alarm, an alarm occurs.
- Unbalance rate (%) = $\frac{\text{(Max. line current - Min. line current)} \times 100}{\text{Average line current}}$

E.g.) R-phase line current: 100 A, S-phase line current: 90 A, T-phase line current: 80 A,

Unbalance rate (%) = $\frac{(100 - 80) \times 100}{90} = 22.22\ \%$

■ SCR error alarm

During alarm operation, SCR-A on LINE1 flashes every 0.5 sec and the output stops (SCR OFF).
- Operation condition: If the current over the LMT-C set value of the 2-8 SCR error alarm is applied over the LMT-O set output of the 2-8 SCR error alarm during the DLY-T set time of the 2-8 SCR error alarm, an alarm occurs.

■ Fuse break alarm

During alarm operation, FUSE on LINE1 flashes every 0.5 sec and the output stops (SCR OFF).
- Operation condition: If the fuse break, load no-power, or load disconnection continues during the DLY-T set time of the 2-9 fuse break alarm, an alarm occurs.

■ FAN error alarm

During alarm operation, FAN on LINE1 flashes every 0.5 sec and the output maintains.
- Operation condition: If the fan does not operate under the condition that the fan should operate during the DLY-T set time of the 2-10 FAN error alarm, an alarm occurs.
- FAN operation condition: ON at heatsink (inner temperature) 40 °C, OFF at 35 °C

■ Frequency error alarm

During alarm operation, FRQY on LINE1 flashes every 0.5 sec and the output stops (SCR OFF).
- Operation condition: If the power frequency of the load input remains out of 45 to 65 Hz during the DLY-T set time of the 2-11 frequency error alarm, an alarm occurs.

Parameter Setting

- Some parameters are activated / deactivated depending on the model or setting of other parameters. Refer to the description of each parameter.
- Do not change parameters during output.
- If any key is not entered for 60 sec in each parameter, it returns to RUN mode.
- [M], [▲], [▼] key: Changes LINE.
- [A] key: When LINE1 flashes, saves current set value and moves to the next parameter.
  Changes set values.
  Changes setting digits.
- [▲], [▼] key: Changes number when numerical set value is changed
- **Bold** specifications for each parameter setting range are factory default.

■ Setting check mode

0-1. LINE1 monitor setting

Select the parameter to be checked in LINE1 of the RUN mode.

LINE1	**LINE1**
LINE2	**OUT**: Output KWH-1: Accumulated power TMP-H: Heatsink temperature OPER: Control mode IN-CH: Control input FRQY: Input power frequency AMP: Load current VOLT: Load voltage
LINE3	
LINE4	

0-2. LINE2 monitor setting

Select the parameter to be checked in LINE2 of the RUN mode.

LINE1	**LINE2**		
LINE2	U-VOL: U-phase voltage U-V: U-V lines voltage **U-AMP**: U-phase current U-WAT: U-phase power U-HZ: U-phase frequency U-RES: U-phase resistance	V-VOL: V-phase voltage V-W: V-W lines voltage V-AMP: V-phase current V-WAT: V-phase power V-HZ: V-phase frequency V-RES: V-phase resistance	W-VOL: W-phase voltage W-U: W-U lines voltage W-AMP: W-phase current W-WAT: W-phase power W-HZ: W-phase frequency W-RES: W-phase resistance
LINE3			
LINE4			

0-3. LINE3 monitor setting

Select the parameter to be checked in LINE3 of the RUN mode.

LINE1	**LINE3**
LINE2	Same as 0-2. LINE2 monitor setting (default: **V-AMP**)
LINE3	
LINE4	

0-4. LINE4 monitor setting

Select the parameter to be checked in LINE4 of the RUN mode.

LINE1	**LINE4**
LINE2	Same as 0-2. LINE2 monitor setting (default: **W-AMP**)
LINE3	
LINE4	

0-5. Parameter copy

LINE1	**PCOPY**
LINE2	**UP**: Save parameter transfer (Body → Display module) DOWN [01]: Save parameter reception (Body ← Display module)
LINE3	**NONE** START: After flashing WAIT, NONE is ON.
LINE4	

01) When saving the display module settings to the main body (DOWN),
re-apply the SPRM power with the display module mounted on the main body and Set LINE2 to DOWN of 0-5. Parameter copy.

0-6. Current time check

The time of the 0-6. Current time check is displayed based on the time set in the 2-13. Time setting.

LINE1	**TIM-C**				
LINE2	**YEAR**	MONTH	DAY	HOUR	MIN
LINE3	Current year	Current month	Current day	Current hour	Current minute
LINE4					

0-7. Alarm history

Displays the alarm phase on the control / monitor phase of LINE4.

LINE1	**ALM-D**	
LINE2	**EMPTY**: No saved alarms	ALM00 to 09 : Alarm stored in 00 to 09
LINE3		YEAR / MONTH_DAY / HOUR-MIN : Cross check with [A] key
LINE4		OC: 2-1. Overcurrent alarm OV: 2-2. Overvoltage alarm OTW: 2-3. Heatsink over heat alarm OTP: 2-4. Heatsink over heat protection alarm HT-BK: 2-5. Heater break alarm DLF-A: 2-6. Partial heater break alarm UL: 2-7. Load unbalance alarm SCR-A: 2-8. SCR error alarm FUSE: 2-9. Fuse break alarm FAN: 2-10. FAN error alarm FRQY: 2-11. Frequency error alarm

■ Program setting mode

1-1. Single-phase / 3-phase

According to 3PH ON / OFF of single-phase / 3-phase, LINE2 of the following parameters is displayed as 3PH / L1, L2, L3, ALL.
• ALL = L1 + L2 + L3 + 3PH

LINE1	**OP-S**	
LINE2	**3PH**: 3-phase	L1: R-phase (U-phase) L2: S-phase (V-phase) L3: T-phase (W-phase)
LINE3	**ON**: 3-phase operation OFF: Single-phase operation, L1, L2, L3 displayed on LINE2	**ON** OFF
LINE4	**STAR**: Star connection DELTA: Delta connection	

1-2. Control input

LINE1	**INPUT**
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)
LINE3	**CH1_A**: 4 - 20 mA at Channel 1 CH2_A: 4 - 20 mA at Channel 2 CH3_A: 4 - 20 mA at Channel 3 1-5V: 1 - 5 VDC⎓ 0-5V: 0 - 5 VDC⎓ 0-10V: 0 - 10 VDC⎓ EC: EtherCAT communication RS485: RS485 communication EX-R: External volume 10 kΩ NONE: Not used
LINE4	

1-3. Load type

LINE1	**LOAD**
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)
LINE3	**RESIS**: Resistive load TRANS[01]: Transformer load
LINE4	

01) When set as a transformer load, operation stops when cycle control is set due to the risk of fuse breakage.

1-4. Control mode

LINE1	**OPER**
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)
LINE3	**PA**: Phase control F-CY: Fixed cycle control V-CY: Variable cycle control
LINE4	

1-5. Feedback control

Feedback control is available when 1-4. Control mode is set to PA. If set to F-CY, V-CY, set the 1-5. Feedback control to UNUSE.
When 1-1. Single-phase / 3-phase 3PH is set to ON, the average value of U, V, W phases is feedback controlled.

LINE1	**FB-S**			
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)			
LINE3	**UNUSE**: Not used	FB-V: Constant voltage feedback	FB-C: Constant current feedback	FB-W: Constant power feedback
LINE4		3-phase: 110.0 to **380.0** to 480.0 [V] Single-phase: 110.0 to **220.0** to 480.0 [V]	1 to **Rated current** to 110 % of rated current [A]	440 V × 10 % of rated current to **440 V × Rated current** to 440 V × 110 % of rated current[kW]

1-6. Soft start / up / down

Soft start time: Time to get the output which is applied into the load is 100 %
Soft up time: Time to reach rise when changing control value during operation
Soft down time: Time to reach the descent when changing the control value during operation

LINE1	**SOF-T**		
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)		
LINE3	**ST_T**: Soft start time	UP_T: Soft up time	DN_T: Soft down time
LINE4	[Normal, Cycle control model] 0 to **3** to 999 [sec] [Feedback control model] 0 (reach target output value quickly) to **3** to 999 (reach target output value slowly)	[Normal, Cycle control model] 0 to **3** to 999 [sec] [Feedback control model] 0 (reach target output value quickly) to **3** to 999 (reach target output value slowly)	[Normal, Cycle control model] 0 to **3** to 999 [sec] [Feedback control model] 0 (reach target output value quickly) to **3** to 999 (reach target output value slowly)

1-7. Output high / low limit

This function is to high / low limit output range to protect load.
If the low-limit value is set larger than the high-limit value, the output is based on the low-limit value.
E.g.) If the output high-limit is set to 50 %, the output is 50 % above the control input 50 %.
If the output low-limit is set to 20 %, the output is 20 % below the control input 20 %.

LINE1	**OUT-L**	
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)	
LINE3	**HIGH**: Output high-limit value	LOW: Output low-limit value
LINE4	0.0 to **100.0** [%]	**0.0** to 100.0 [%]

1-8. Output current limit

When the output current limit is over, the output turns OFF.

LINE1	**C-LM**
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)
LINE3	1.0 to **110.0 % of rated current** [A]
LINE4	

1-9. Input slope correction

It prevents load damage by limiting 100% of the power supplied to the load.

LINE1	**SLOPE**
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)
LINE3	-99.9 to **0.0** to 99.9 [%]
LINE4	

1-10. Input offset

Sets the offset value as much as the measured value (%) displayed on the display module from the lowest value of the input signal.
E.g.) the measured value = 5 %, offset = -5.0 %

LINE1	**OFSET**
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)
LINE3	-99.9 to **0.0** to 99.9 [%]
LINE4	

1-11. Partial heater break

Displayed when 1-1. Single-phase / 3-phase 3PH is set to OFF.

LINE1	**DLF**				
LINE2	**L1**, L2, L3, ALL				
LINE3	**START**: Start scan	LO_C: Number of multi load	LIM-O: Scan output limit value	UP_T: Output increase scan time	DN_T: Output decrease scan time
LINE4	**OFF**: No scan ST_ON: Starts scan	**2** to 6	25.0, 50.0, 75.0, **100.0** [%]	0 to **1** to 10 [time] (1 time: ≈160 sec)	**0** to 10 [time] (1 time: ≈160 sec)

1-12. Power distribution control

Displayed when 1-1. Single-phase / 3-phase 3PH is set to OFF.
One control input distributes and controls L1, L2, and L3 at variable cycle.
Operation stops when a problem occurs on L1.

LINE1	**PDC**
LINE2	**OFF**, ON
LINE3	**F-CY**: Fixed cycle control V-CY: Variable cycle control
LINE4	

1-13. RS485 comm.

RS485 communication parameters take effect immediately after change.

LINE1	**RS485**						
LINE2	**PROTO**: Protocol	ADDR: Address	BPS: Comm. speed	P-BIT: Parity bit	S-BIT: Stop bit	RS-T: Comm. response time	COPY: Write settings
LINE3	**RTU**: Modbus RTU ASCII: Modbus ASCII	**1** to 99	24: 2,400 [bps] 48: 4,800 [bps] **96**: 9,600 [bps] 144: 14,400 [bps] 192: 19,200 [bps] 384: 38,400 [bps] 576: 57,600 [bps] 1152: 115,200 [bps]	**NONE**: Not used EVEN ODD	**1**, 2 [bit]	**0** to 9999 [ms]	**ON**, OFF
LINE4							

1-14. Parameter reset

LINE1	**RST-P**
LINE2	**NONE**, START
LINE3	
LINE4	

1-15. Reset check

Displayed when 1-14. Parameter reset set to START.
As soon as YES is selected, the parameters are reset.

LINE1	**RST**
LINE2	**NO**, YES
LINE3	
LINE4	

1-16. Lock

LINE1	**LOCK**
LINE2	**OFF**: Not used LOCK1: Locks program setting mode LOCK2: Locks alarm setting mode
LINE3	
LINE4	

1-17. Manual control input

Sets the output for manual control mode.

LINE1	**MANU**
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)
LINE3	**0.0** to 100.0 [%]
LINE4	

■ Alarm setting mode

Sets whether to use an alarm for each situation, delay time, relay output, and whether to use automatic recovery.

2-1. Overcurrent alarm

LINE1	**OC**				
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)				
LINE3	**ENABL**: Enable / Disable	LMT-C: Limit output current value	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE4	**ON**, OFF	1 to **110 % of rated current** [A]	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**

2-2. Overvoltage alarm

LINE1	**OV**				
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)				
LINE3	**ENABL**: Enable / Disable	LMT-V: Limit output voltage	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE4	**ON**, OFF	10.0 to **500.0** V	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**

2-3. Heatsink over heat alarm

If a temperature above the TEMP set value is detected, a heatsink over heat alarm occurrs.
Even if an alarm occurs, the device operates normally.

LINE1	**OTW**			
LINE2	**ENABL**: Enable / Disable	TEMP: Heatsink alarm temperature	DLY-T: Alarm delay time	RLY-O: Relay output
LINE3	**ON**, OFF	40 to **60** to 65 °C	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6
LINE4				

2-4. Heatsink over heat protection alarm

If a temperature above the TEMP set value is detected, a heatsink over heat protection alarm occurrs.
Operation stops immediately after the alarm occurs.

LINE1	**OTP**				
LINE2	**ENABL**: Enable / Disable	TEMP: Heatsink alarm protection temperature	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE3	**ON**, OFF	65 to **80** to 90 °C	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**
LINE4					

2-5. Heater break alarm

LINE1	**HT-BK**					
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)					
LINE3	**ENABL**: Enable / Disable	LMT-C: Limit current output	LMT-O: Limit output	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE4	**ON**, OFF	1 to **110 % of rated current** [A]	0.0 to **100.0** %	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**

2-6. Partial heater break alarm

Displayed when 1-1. Single-phase / 3-phase 3PH is set to OFF.

LINE1	**DLF-A**		
LINE2	**L1**, L2, L3, ALL		
LINE3	**ENABL**: Enable / Disable	DLY-T: Alarm delay time	RLY-O: Relay output
LINE4	**ON**, OFF	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6

2-7. Load unbalance alarm

Displayed when 1-1. Single-phase / 3-phase 3PH is set to ON.

LINE1	**UL**				
LINE2	**3PH**				
LINE3	**ENABL**: Enable / Disable	LMT-P: Unbalance rate	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE4	**ON**, OFF	5 to **30** to 100 %	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**

2-8. SCR error alarm

LINE1	**SCR-A**					
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)					
LINE3	**ENABL**: Enable / Disable	LMT-C: Limit current output	LMT-O: Limit output	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE4	**ON**, OFF	1 to **5** to **110 % of rated current** [A]	**0.0** to 100.0 %	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**

2-9.Fuse break alarm

If a fuse break alarm occurs during single-phase operation, also check whether a 2-5. Heater break alarm occurs. If the load is open, a fuse break alarm occurs.

LINE1	**FUSE**			
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)			
LINE3	**ENABL**: Enable / Disable	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE4	**ON**, OFF	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**

2-10. FAN error alarm

LINE1	**FAN**		
LINE2	**ENABL**: Enable / Disable	DLY-T: Alarm delay time	RLY-O: Relay output
LINE3	**ON**, OFF	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6
LINE4			

2-11. Frequency error alarm

LINE1	**FRQY**			
LINE2	According to 1-1. Single-phase / 3-phase setting (default: **3PH**)			
LINE3	**ENABL**: Enable / Disable	DLY-T: Alarm delay time	RLY-O: Relay output	A-RCY: Auto-recovery
LINE4	**ON**, OFF	0 to **3** to 100 sec	**DISAL**, AL1, AL2, AL3, AL4, AL5, AL6	ON, **OFF**

2-12. Alarm save

If ENABL is set to ON, the contents of the alarm are saved if it continues for more than 30 seconds after the alarm occurs.
The saved alarm history can be checked in the 0-7. Alarm history.

LINE1	**ALM-S**	
LINE2	**ENABL**: Enable / Disable	CLEAN: Alarm save clear
LINE3	**ON**, OFF	**NONE**, START
LINE4		

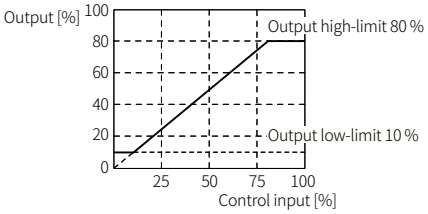
2-13. Time setting

LINE1	**T-SET**					
LINE2	**YEAR**	MONTH	DAY	HOUR	MIN	SAVE
LINE3	2000 to **2020** to 2099	1 to **7** to 12	1 to **13** to 31	0 to **12** to 23	**0** to 59	**NONE** START: Saves the time of the START moment as the set time.
LINE4						

Function

■ Output high / low-limit value

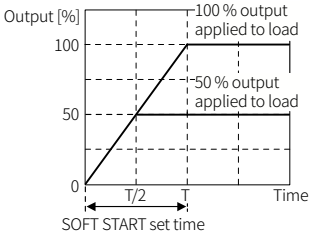
This function is to limit output range to protect load.



■ SOFT START

This function protects the load in cases that the set temperature is high, such as controlling the load (platinum. molybdenum, tungsten, infrared lamp, etc.) in which inrush current flows when power is supplied, or showing large width of temperature rise during initial operation.

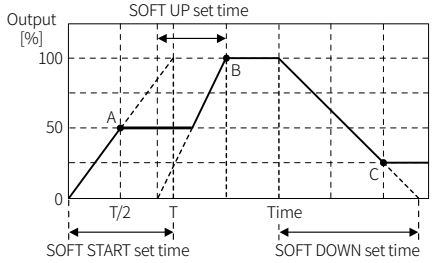
If the input is changed before the end of the SOFT START function, T increases or decreases by the changed difference (%).



- T: SOFT START set time.
  Time to get the output which is applied into the load is 100 %.
- T/2: Time to get the output which is applied into the load is 50 %.

■ SOFT UP / DOWN

Unlike SOFT START which operates only once at supplying power, this function protects load from the inrush current in the RUN mode. When reached to the target output value, operation stops.

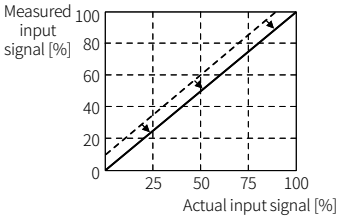


- A: SOFT START function finished
- B: SOFT UP function finished
- C: SOFT DOWN function finished

■ Input OFFSET

It compensates the offset between actual input value and measured input value.

- E.g.) When input monitoring value is 5 % at 4 mA in DC4 - 20 mA control input, setting LINE3 of 1-10 Input offset = -5.0 % calibrates the input monitoring value to 0 %.



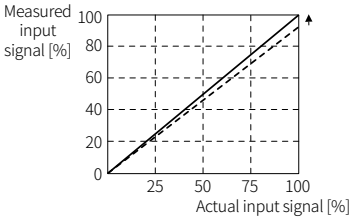
■ Input slope correction

It prevents load damage by limiting 100% of the power supplied to the load. It compensates the gain of the measured 100 % input for actual 100 % input value.

Calibrated monitoring value =

$$\text{Monitoring value} + \frac{\text{Monitoring value}}{\text{100 - input slope correction value}} \times \text{Input slope correction value}$$

- E.g.) When the input monitoring value is 99 % at 20 mA in DC 4 - 20 mA control input, setting LINE3 of 1-9 Input slope correction = 1 % calibrates the input monitoring value to 100 %.

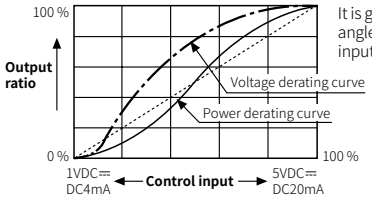


Control Method

■ Phase control

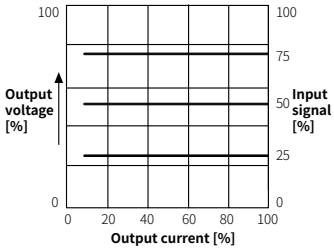
Phase control method is to control output by dividing AC phase by control input signal.

- **Normal = Phase equal division method by control input**



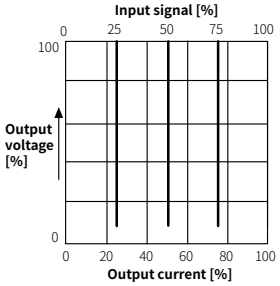
It is general output method to divide control angle proportionally according to control input signal and to output it.

- **Constant voltage feedback control mode**



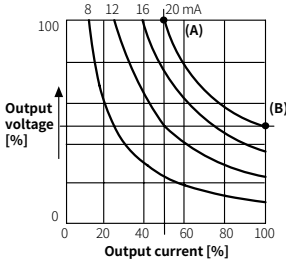
It outputs a constant voltage proportional to the control input so that the output voltage does not fluctuate against fluctuations in power voltage and load resistance fluctuations of loads (iron, chromium, nichrome, etc.) with a small electrical resistance temperature coefficient.

- **Constant current feedback control mode**



It outputs a constant current proportional to the control input so that the output current does not fluctuate against fluctuations in power voltage and load resistance fluctuations of loads (platinum, molybdenum, tungsten, etc.) in which the temperature coefficient of electrical resistance varies significantly from 6 to 12 times the normal temperature.

- **Constant power feedback control mode**



It is proper control method for a heater which resistance value variation by silicon carbide (SiC) heating is big.

It outputs constant power which is proportion to control input even though load variation and power supply variation.

- (A): [output voltage 100 % × output current 50 %]
  (B): [output voltage 50 % × output current 100 %]
- Output characteristics is proper 50 % of the curve which connects the point (A) and the point (B). The current output capacity of this unit should be over two times of load capacity.

■ Cycle control, zero cross turn-on

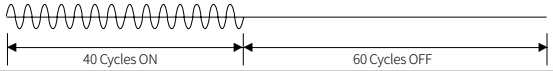
Compared to the phase control method, the load control linearity is better.

Since it is always ON or OFF at the zero point of AC, no noise is generated during ON / OFF, so it is a suitable control method for an environment where noise is not affected or an electric furnace with a large heat capacity.

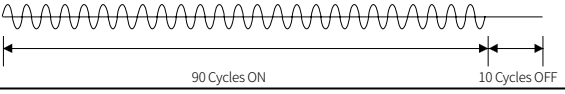
- **Fixed cycle control mode**

During fixed cycle (100 cycles) of load power, it repeats ON / OFF cycle as constant ratio according to control input signal and controls the power supplies on the load.

When controlled by 40 % of the control output signal



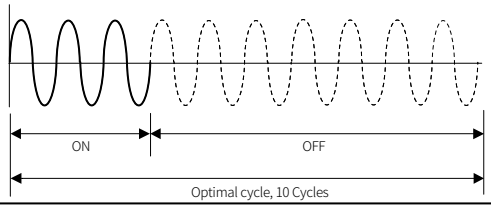
When controlled by 90 % of the control output signal



- **Variable cycle control mode**

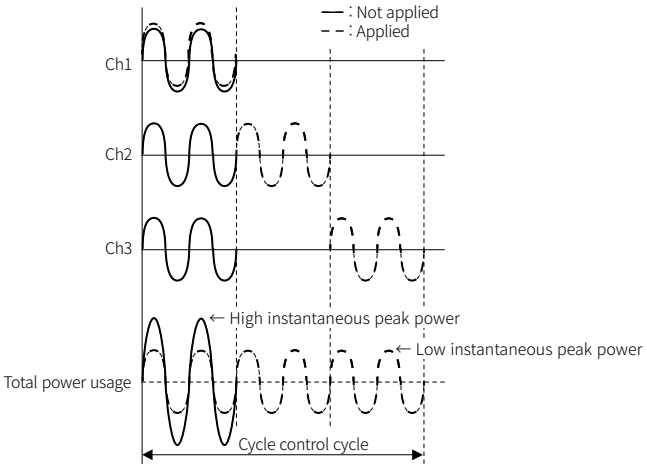
By optimizing the number of cycles of the load power, it controls the power applied to the load by operating ON / OFF at a ratio proportional to the control input signal.

When controlled by 30 % of the control output signal



■ Power distribution control

In case of single-phase 2-channel or 3-channel cycle control, sequential distribution control is performed so that outputs do not overlap at the same time through internal algorithm operation between channels.



Segment Table

The segments displayed on the product indicate the following meanings. It may differ depending on the product.

7 segment				11 segment				12 segment				16 segment			
0	0	ı	I	0	0	ı	I	0	0	ı	I	0	0	I	I
ı	1	J	J	ı	1	J	J	ı	1	J	J	ı	1	J	J
2	2	K	K	2	2	K	K	2	2	K	K	2	2	K	K
3	3	L	L	3	3	L	L	3	3	L	L	3	3	L	L
4	4	M	M	4	4	M	M	4	4	M	M	4	4	M	M
5	5	n	N	5	5	N	N	5	5	N	N	5	5	N	N
6	6	o	O	6	6	o	O	6	6	o	O	6	6	O	O
7	7	P	P	7	7	P	P	7	7	P	P	7	7	P	P
8	8	q	Q	8	8	Q	Q	8	8	Q	Q	8	8	Q	Q
9	9	r	R	9	9	R	R	9	9	R	R	9	9	R	R
A	A	S	S	A	A	S	S	A	A	S	S	A	A	S	S
b	B	t	T	b	B	t	T	b	B	t	T	J	B	T	T
C	C	U	U	C	C	U	U	C	C	U	U	C	C	U	U
d	D	u	V	d	D	v	V	d	D	v	V	J	D	v	V
E	E	y	W	E	E	W	W	E	E	W	W	E	E	W	W
F	F	h	X	F	F	x	X	F	F	x	X	F	F	x	X
G	G	y	Y	G	G	y	Y	G	G	y	Y	G	G	y	Y
H	H	Z	Z	H	H	Z	Z	H	H	Z	Z	H	H	Z	Z