3-Phase Slim Power Controllers

SPR3 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

- Slim and elegant design
- LED display allows real-time monitoring of control input, load voltage, load current, load power, load resistance, and heat-sink temperature
- Stable control with feedback control (constant current, constant voltage, constant power)
- Communication output models available: RS485 (Modbus RTU)
- Parameter configuration via PCs (RS485) : Free device management software (DAQMaster)
- Various alarm functions (alarm output) : overcurrent, overvoltage, heater disconnection, fuse break, heat-sink overheat, diode (SCR) error
- Easy installation with mounting brackets
- Easy fuse replacement and maintenance
- Inter phase insulating barrier included
- High performance SCR (IXYS) diode

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.

Cautions during Use

- Follow instructions in 'Cautions during Use'.
  Otherwise, it may cause unexpected accidents.
- Use the product, after 3 sec of supplying power.
- Before use, set the mode and function according to the specification. Especially, be cautious that the product does not operate when OUT ADJ. is set to 0%. 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 the unit is discharged completely. 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.
- Since inter element can be damaged when using with coil load, inductive load, etc., the inrush current must be under the rated load current.
- 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

CE

Product Components

- Product ×1
- 11-pin connector ×1
- Insulating barrier ×4

Manual

For the detailed information about communication, etc., please refer to the manuals, and be sure to follow cautions written in the technical descriptions.
Visit Autonics website to download manuals.

DAQMaster

- DAQMaster is comprehensive device management program. It is available for parameter setting, monitoring.
- Visit Autonics website to download the manual and the program.

Ordering Information

This is only for reference.
For selecting the specified model, follow the Autonics website.

SPR 3 - ❶ ❷ ❸ ❹ ❺

❶ Rated load voltage
1: 110 VAC～
2: 220 VAC～
3: 380 VAC～
4: 440 VAC～

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

❸ Option output
N: Alarm output
T: Alarm output + RS485 comm. output

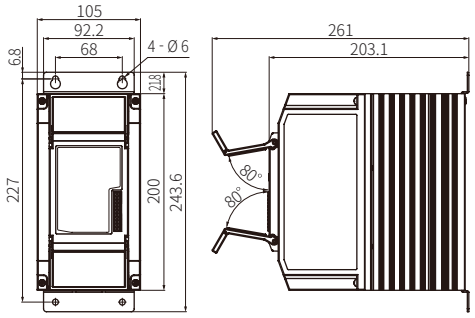
❹ Feedback control
N: Normal control
F: Normal, feedback control (constant current / constant voltage / constant power)

❺ Fuse
N: None
F: Supports fuse

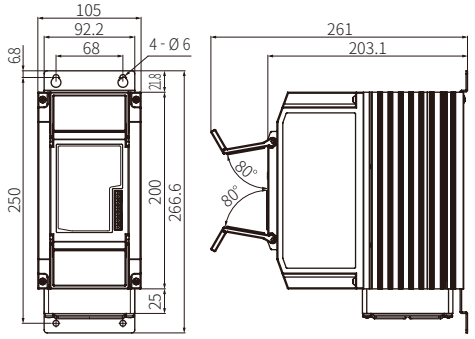
Dimensions

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

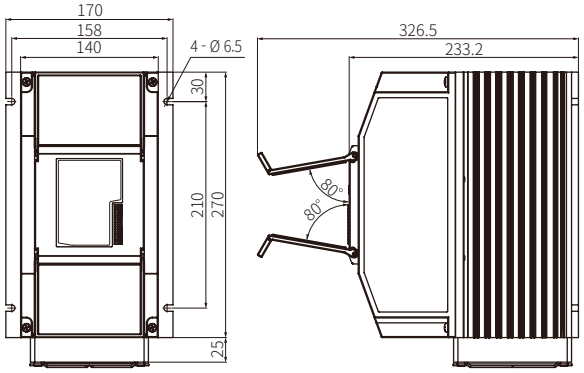
■ Rated load current 25 / 35 / 50 A



■ Rated load current 70 A



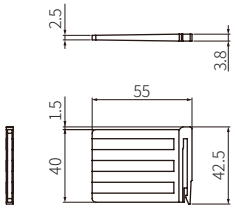
■ Rated load current 100 / 150 A



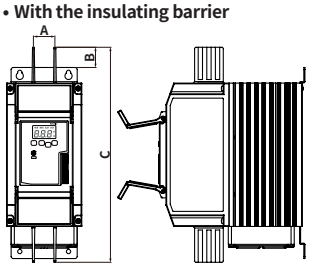
Insulating Barrier

It is recommended to use the included interphase barriers for insulation between phases and reduce influence from conductive material.

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



- **With the insulating barrier**



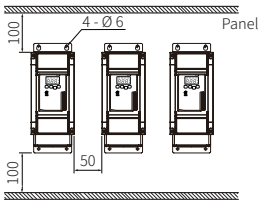
Rated load current	A	B	C
25 / 35 / 50 A	30	28.2	300
70 A	30	28.2	300
100 / 150 A	40.5	50	370

Cautions during Installation

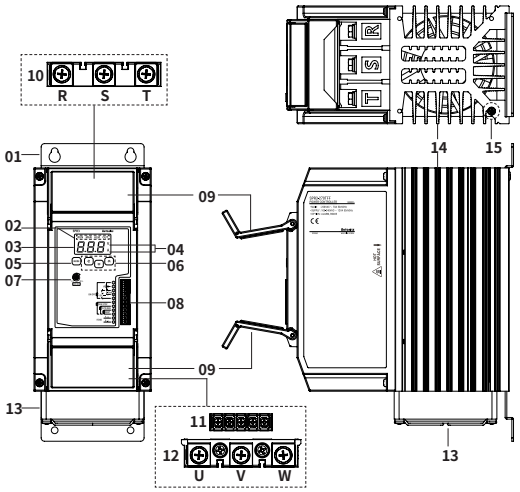
High Temperature Caution
While supplying power to the load or right after turning off the power of the load, do not touch the body and heatsink.
Failure to follow this instruction may result in a burn due to the high temperature.

■ Mount space

- When installing multiple power controllers, keep space between power controllers for heat radiation.
  Horizontal: ≥ 50 mm, vertical: ≥ 100 mm



Unit Descriptions



01. Bracket [except rated load current 100 / 150 A model]
02. Indicator

Indicator		Function
RUN	Operation indicator (green)	Turns on in the RUN mode.
MAN	Manual control indicator (green)	Turns on when adjusting load output in the manual control mode.
ALM	Alarm indicator (red)	Flashes in alarming status.
OUT	Output indicator (red)	Turns on when load control outputs.

03. Display part
RUN mode: Displays depending the front display setting
Setting mode: Displays parameter and setting value

04. Unit indicator (V, A)
Dependent on the display setting.

Display setting	V	A
Resistance and input	OFF	OFF
Voltage	ON	OFF
Current	OFF	ON
Power	ON	ON

05. [MODE] key
Enters parameter group, returns to RUN mode, moves parameters, and saves the setting value.
06. [◀], [▼], [▲] key
Enters SV setting mode and move digits.
07. Output limit adjuster (OUT ADJ)
Limits output from 0 to 100%.
08. Control input / comm. output terminal (11-pin connector terminal)
09. Terminal protection cover
10. R, S, T load input terminal
11. Alarm output / power input terminal
12. U, V, W load output terminal
13. Cooling fan
[Rated load current 70 / 100 / 150 A model]
14. Heatsink
Rated load current 100 / 150 A models have left / right mounting holes.
15. Bolt for grounding (M4)

Specifications

Model	SPR3-1□	SPR3-2□	SPR3-3□	SPR3-4□
Control phase	3-Phase			
Rated load voltage	110 VAC~ 50 / 60 Hz	220 VAC~ 50 / 60 Hz	380 VAC~ 50 / 60 Hz	440 VAC~ 50 / 60 Hz
Rated load current	Rated load current 25 / 35 / 50 / 70 / 100 / 150 A			
Display method	3 digit 7segment LED			
Indicators	Operation / manual control indicator (green) Alarm / output / unit (V, A) indicator (red)			
Auto control input	DC 4 - 20 mA, 1 - 5 VDC⎓, ON / OFF contact (non-voltage input), pulse voltage (5 - 12 VDC⎓)			
Manual control input	External adjuster (10 kΩ), internal adjuster (output limit)			
Digital input (DI)	RUN / STOP selectable, AUTO / MAN selectable, RESET			
Alarm output	250 VAC~ 3 A, 30 VDC⎓ 3 A, 1c resistance load			
RS485 comm. output	Modbus RTU method			
Cooling method	Rated load current 25 / 35 / 50 A: natural cooling Rated load current 70 / 100 / 150 A: forced air cooling (with cooling fan)			
Unit weight (packaged)	Rated load current 25 / 35 / 50 A: ≈ 4.1 kg (≈ 4.9 kg) Rated load current 70 A: ≈ 4.2 kg (≈ 5 kg) Rated load current 100 / 150 A: ≈ 8.7 kg (≈ 9.7 kg)			
Approval	CE			

Control method	Phase control	Cycle control	ON/OFF control
Control mode	Normal / constant current feedback / constant voltage feedback / constant power feedback	Fixed cycle	-
Applied load	Resistance load, inductive load	Resistance load	Resistance load, inductive load
Output range	0 to 98%	0 to 100%	0 / 100%
Phase control output accuracy	• Normal control: within ± 10% F.S. of rated load voltage • Constant current feedback control: within ± 3% F.S. of rated load current • Constant voltage feedback control: within ± 3% F.S. of rated load voltage • Constant power feedback control: within ± 3% F.S. of rated load power		

Power supply	100 - 240 VAC~ ±10% 50 / 60 Hz
Min. load current	1 A
Power consumption	Rated load current 25 / 35 / 50 A: ≤ 14 VA Rated load current 70 A: ≤ 22 VA Rated load current 100 / 150 A: ≤ 32 VA
Insulation resistance	≥ 200 MΩ (500 VDC⎓ megger)
Dielectric strength	2,000 VAC~ 50 / 60 Hz for 1 min (between input and power terminal)
Output leakage currents	≤ 10 mArms
Noise immunity	±2 kV the square wave noise (pulse width: 1 μs) by the noise simulator
Memory retention	≈ 10 years (when using non-volatile semiconductor memory type)
Vibration	0.75mm amplitude at frequency of 5 to 55Hz in each X, Y, Z direction for 2 hours
Vibration (malfunction)	0.5mm amplitude at frequency of 5 to 55Hz in each X, Y, Z direction for 10 min
Ambient temp.	-10 to 55 °C, storage: -20 to 80 °C (rated at no freezing or condensation)
Ambient humi.	35 to 85%RH, storage: 35 to 85%RH (rated at no freezing or condensation)

RS485 Communication Interface

Communication protocol	Modbus RTU
Connection	RS485
Application standard	Compliance with EIA RS485
Max. connections	31 units (address: 01 to 99)
Synchronous method	Asynchronous
Communication method	Two-wire half duplex
Communication distance	Max. 800 m
Communication speed	2400, 4800, 9600, 19200, 38400 bps
Communication response time	5 to 99 ms (default: 20 ms)
Start bit	1-bit (fixed)
Data bit	8-bit (fixed)
Parity bit	None, Even, Odd
Stop bit	1-bit, 2-bit

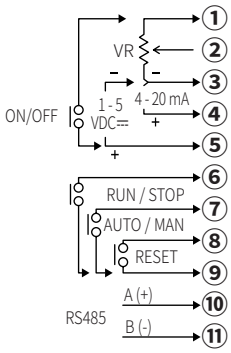
Load Output Formula

Type	Input		Formula
Auto (AUTO)	Current	DC 4 - 20 mA	Load output [%] = Control input [%] × output slope [%]
	Voltage	1 - 5 VDC⎓	
	RS485 communication		Load output [%] = RS485 [%]
Manual (MAN)	Output limit	Internal adjuster	Load output [%] = internal adjuster [%]
		External adjuster	Load output [%] = external adjuster [%]
		Internal / external adjuster	Load output [%] = internal adjuster [%] × External adjuster [%]

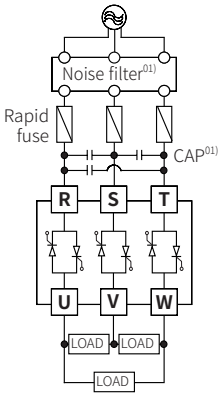
Connections

• Terminal configuration by model may differ depending on the supported spec.

■ Control input / comm. output terminal (11-pin connector)

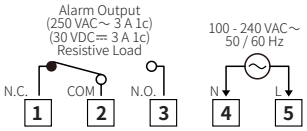


■ Load input / output terminal



01) When connecting noise filter and capacitor, it is appropriate for EMC. [CAP]
Rated load voltage 110 / 220 VAC~ : 1 μF / 250 VAC~
Rated load voltage 380 / 440 VAC~ : 0.47 μF / 500 VAC~

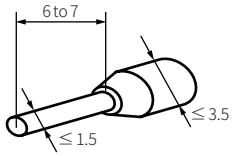
■ Alarm output / power input terminal



Cautions during Wiring

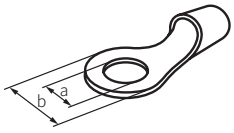
■ Control input / comm. output terminal (11-pin connector)

• Unit: mm, Use penhole terminals of size specified below.



■ Alarm output / power input & R, S, U load output terminal

• Unit: mm, Use crimp terminals of size specified below.



Rated load current	Spec.	Alarm output / power input	Load input / output
25 / 35 / 50 / 70 A	a	≥ 3.0	≥ 6.0
	b	≤ 6.0	≤ 16.0
100 / 150 A	a	≥ 3.0	≥ 8.0
	b	≤ 6.0	≤ 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.	Alarm output / power input	Load input / output
25 / 35 / 50 / 70 A	Cable	AWG 18 to 14	AWG 13 to 4
	Screw	M3	M6
	Tightening torque	0.5 N m	5.5 to 6.0 N m
100 / 150 A	Cable	AWG 18 to 14	AWG 4 to 2 / 0
	Screw	M3	M8
	Tightening torque	0.5 N m	6.5 to 7.0 N m

Alarm

- Supported alarms are different depending on the model.
- When several alarms occur at same time, the highest priority error is displayed based on priority.

Priority	Type	Display	Operation		Alarm release	Model
			Alarm	Output		
1	SCR error	SCr	• Error display flashes. • Alarm indicator (ALM) flashes. • Alarm output turns ON	Output stops. (SCR OFF)	• Re-supply power. • RESET input • Switch to stop (STOP) mode.	Feedback control
2	Over current	o-C				Feedback control
4	Heatsink over heat	tEn				Normal / Feedback control
5	Over voltage	o-u				Feedback control
3	Fuse break	FUS			Automatically cleared when returning within the setting range	Normal / Feedback control
6	Heater break	H-b		Normal operation		Feedback control

- **SCR error alarm**
  Even though output is 0%, if the current of 10% or more of the rated load current flows for over 3 sec continuously, SCR error alarm occurs.
- **Over current alarm**
  This function protects the load from over current. If the current flows over the P2-7 over current alarm value and P2-8 over current alarm delay time, over current alarm occurs.
- **Heatsink over heat alarm**
  When the temperature of a heatsink is over 85 °C, heatsink over heat alarm occurs.
- **Over voltage alarm**
  This function protects the load from over voltage. If the current flows over the P2-9 over voltage alarm value and P2-10 over voltage alarm delay time, over voltage alarm occurs.
- **Fuse break alarm**
  When breaking fuse, not suppling load power, breaking load (single load), fuse brake alarm occurs. In the case of normal control model, real-time fuse break alarm is not available during output, and fuse break alarm operates at 0% output such as RESET.
- **Heater break alarm**
  Comparing the full load resistance value and the current load resistance value, if the current load resistivity is maintained under the P2-12 heater break alarm value for over 3 sec continuously, heater break alarm occurs. This alarm operates when control output is over 10% and load current is over 10% of the rated current. Output does not stop and operates normally.

$$\text{Current load resistance (\%)} = \frac{\text{Full load resistance value} \times 100}{\text{Current load resistance value}}$$

Mode Setting

RUN	[MODE]	→	**Monitoring group**	[MODE] 3 sec	→ RUN
	[MODE] 2 sec	→	**Parameter 1 group**	[MODE] 3 sec	→
	[MODE] 4 sec	→	**Parameter 2 group**	[MODE] 3 sec	→
	[◀ + ▲ + ▼] 5 sec	→	**Parameter reset**	[MODE]	→
	6 - 9 terminal external contact	→	**RUN / STOP**	Auto	→
	7 - 9 terminal external contact	→	**Auto / Manual control**	Auto	→
	[▲ + ▼] 2 sec or 8 - 9 terminal	→	**Reset** 01)	Auto	→

01) 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. Refer to the description of each parameter.
- If any key is not entered for 30 sec in each parameter, it returns to RUN mode.
- [MODE] key: Saves current setting value and moves to the next parameter.
  [◀] key: Changes setting digits.
  [▲], [▼] key: Changes setting values.

■ Monitoring group

Parameter		Display	Display range
M1-1	Monitoring value	In	0 to 100%
M1-2	U-V line load voltage value	U-u	[Feedback control model] 0 to rated voltage range, V
M1-3	V-W line load voltage value	u-v	
M1-4	W-U line load voltage value	v-U	
M1-5	U-phase load current value	U-A	[Feedback control model] 0 to rated current range, A
M1-6	V-phase load current value	u-A	
M1-7	W-phase load current value	v-A	
M1-8	Load power value	L-v	[Feedback control model] 0 to rated Power range, kW
M1-9	Resistance value percentage	L-r	[Feedback control model] 0 to 100% • Displays the present resistance as percentage compared to the set resistance of full load auto recognition.
M1-10	Heatsink temp.	tnP	0 to 100 °C
M1-11	Power supply frequency	Frq	50, 60 Hz

■ Parameter 1 group

Parameter		Display	Default	Setting range
P1-1	SOFT START time	S-t	3	0 to 100 sec
P1-2	SOFT UP time	U-t	3	
P1-3	SOFT DOWN time	d-t	3	
P1-4	Output low-limit value	L-L	0	0 ≤ L-L ≤ H-L ≤ 100 %
P1-5	Output high-limit value	H-L	100	
P1-6	Output slope 01)	SLP	100	0 to 100% • In case of auto control (AUTO), set the output slop limit proportional to control input for limit load power.

■ Parameter 2 group

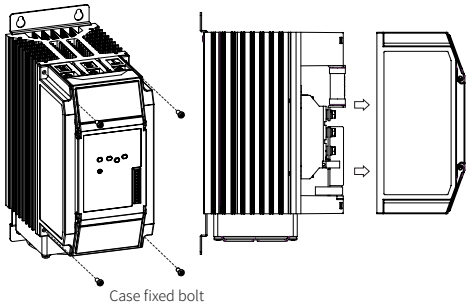
Parameter		Display	Default	Setting range
P2-1	Control input 01)	Int	420	420: DC 4 - 20 mA 1-5: 1 - 5 VDC⎓ 512: 5 - 12 VDC⎓ ONF: ON / OFF contact COM: RS485 communication
P2-2	Control method	C-n	PA	*[Feedback control model] Set / Control method: PA — Phase control — Normal V-F* — Phase control — Constant voltage feedback C-F* — Phase control — Constant current feedback W-F* — Phase control — Constant power feedback F-C — Cycle control — Fixed cycle ONF — ON / OFF control
P2-3	Manual control (MAN) output limit method 01)	nAn	I_r	I_R: Internal adjuster E_R: External adjuster E_I: Internal / external adjuster
P2-4	Input correction 01)	Inb	0.0	-99 to 99%
P2-5	Input slope correction 01)	SPn	0.0	
P2-6	Front display	diS	In	*[Feedback control model] IN: Resistance and input U-V*: U-V line load voltage V-W*: V-W line load voltage W-U*: W-U line load voltage U-A*: U-phase load current V-A*: V-phase load current W-A*: W-phase load current L-W*: Load power
P2-7	Over current alarm value	oCu	120	[Feedback control model] 0 to 120%
P2-8	Over current alarm delay time	oCt	5	[Feedback control model] 0 to 100 sec
P2-9	Over voltage alarm value	ouu	120	[Feedback control model] 0 to 120%
P2-10	Over voltage alarm delay time	out	5	[Feedback control model] 0 to 100 sec
P2-11	Load resistance value auto recognition	F-L	oFF	[Feedback control model] OFF, ON • It executes 100% control output for 3 sec and the load resistance value recognized automatically as the initial set when the function is ON.
P2-12	Heater break alarm value	Hbu	10	[Feedback control model] 10 to 100%, OFF
P2-13	Comm. address	Adr	01	[RS485 communication output model] 01 to 99
P2-14	Comm. speed	bPS	96	[RS485 communication output model] 24, 48, 96, 192, 384 bps (× 100)
P2-15	Comm. parity bit	Prt	non	[RS485 communication output model] NON, EVE, ODD
P2-16	Comm. stop bit	StP	2	[RS485 communication output model] 1, 2 bit
P2-17	Comm. response time	rSt	20	[RS485 communication output model] 5 to 99 ms
P2-18	Comm. write	CnU	EnA	[RS485 communication output model] EN.A: Enable, DS.A: Disable
P2-19	Lock	LoC	oFF	OFF LC1: Locks parameter 1 group LC2: Locks parameter 2 group
P2-20	Parameter reset	Ini	no	NO, YES

01) Set the below parameters available depends on the control input.

Type	Control input		Display		Input correction	Input slope correction	Output slope	Monitoring value
Auto control (AUTO)	Current	DC 4 - 20 mA	INT	420	○	○	○	The last control input value 0 to 100%
	Voltage	1 - 5 VDC⎓		1-5	○	○	○	
	Pulse voltage	5 - 12 VDC⎓		512	×	×	○	
	No-voltage	ON / OFF contact		ONF	×	×	○	
	RS485 communication			COM	×	×	×	
Manual control (MAN)	Output limit	Internal adjuster	MAN	I_R	×	×	×	
		External adjuster		E_R				
		Internal / external adjuster		E_I				

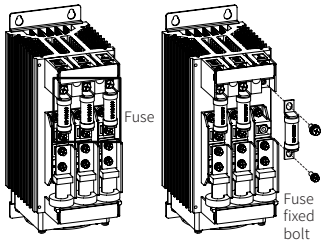
Replacement of Fuse

■ Case removal



■ Replacement of fuse

- Fuse none model is not equipped with a rapid fuse inside. Install the suitable fuse for rated load current of the model separately.
- The performance of the product is guaranteed only when using the fuse provided by us. For replacing the fuse, use the recommended fuse.



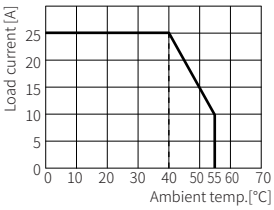
Rated load current	Rec. fuse	Manufacturer
25 A	50FE	BUSSMANN
35 A	63ET	
50 A	80ET	
70 A	100FE	
100 A	660GH-160	HINODE
150 A	660GH-200	

■ Bolt specification

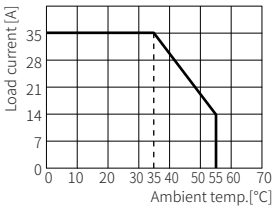
Rated load current	Case fixed bolt	Fuse fixed bolt
25 / 35 / 50 / 70 A	M3	M6
100 A	M4	Top: M8 Bottom: M6
150 A	M4	M8

Derating Curve

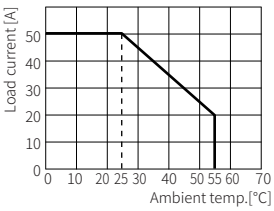
■ Rated load current 25 A



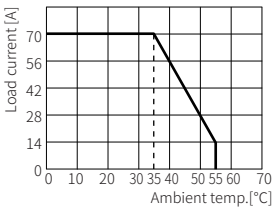
■ Rated load current 35 A



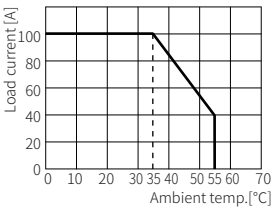
■ Rated load current 50 A



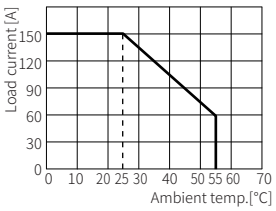
■ Rated load current 70 A



■ Rated load current 100 A



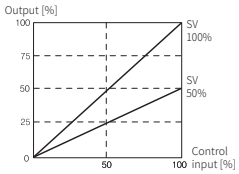
■ Rated load current 150 A



Function

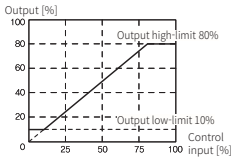
■ Output limit (OUT ADJ)

[Control input (%) × output limit setting (%) = output] It controls the power supplied into the load.
Although control input is 100%, the output is the 50% which is proportioned with OUT ADJ.
It is not available at ON / OFF control method.



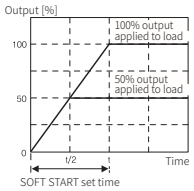
■ Output high / low-limit value

This function is to limit output range to protect load.



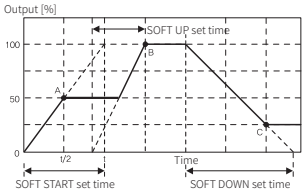
■ SOFT START

When the power is supplied, this function is able to protect the load when it controls load (white gold, molybdan, tungsten, infrared lamp) with inrush current or the width of rising temperature in big (SV is big).
SOFT START set time (T) is the required time that output reaches to 100%, and it is differentiated by OUT ADJ set value.
It is not available at ON / OFF control method.



■ SOFT UP / DOWN

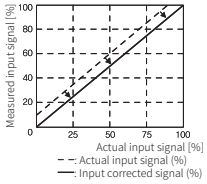
Unlike SOFT START which operates only once at supplying power, this function protects load from the inrush current in the RUN mode. When reached to the target output value, operation stops.
It is not available at ON / OFF control method.



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

■ Input correction

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 INB = -5 calibrates the input monitoring value to 0%.

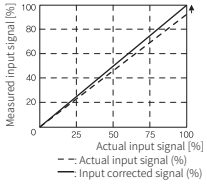


■ Input slope correction

It compensates the gain of the measured 100% input for actual 100% input value.
Calibrated monitoring value =
Monitoring value +

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

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



Segment Table

7 segment				11 segment				12 segment				16 segment			
0	0	I	I	0	0	I	I	0	0	I	I	0	0	I	I
1	1	J	J	1	1	J	J	1	1	J	J	1	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	b	B	T	T
C	C	U	U	C	C	U	U	C	C	U	U	C	C	U	U
d	D	V	V	d	D	V	V	d	D	V	V	d	D	V	V
E	E	W	W	E	E	W	W	E	E	W	W	E	E	W	W
F	F	X	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

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