Thyristor Power Regulator

TPR-3SL-EP

INSTRUCTION MANUAL

Thank you for purchasing Hanyoung Nux products. Please read the instruction manual carefully before using this product, and use the product correctly. Also, please keep this manual where you can view it any time.

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Safety information

Please read the safety information carefully before the use, and use the product correctly. The alerts declared in the manual are classified into Danger, Warning and Caution according to their importance

⚠ DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor injury or property damage

⚠ DANGER

To prevent electric shock while it is running, put to earth with the fixed screw of the unit and do not touch the heat sink since it is very hot. Do not touch or contact the input/output terminals because they cause electric shock.

⚠ WARNING

- If there is a possibility that a malfunction or abnormality of this product may lead to a serious accident, install an appropriate protection circuit on the outside.
- Any use of the product other than those specified by the manufacturer may result in personal injury or property damage.
- Since this product is not designed as a safety device if it is used with systems, machines and equipment that could lead to a risk of life or property damage, please implement safety devices and protections for both lives and the applications and plan for preventing accidents.
- Please supply the rated power voltage, in order to prevent product breakdowns or malfunctions.
- To prevent electric shocks and malfunctions, do not supply the power until the wiring is completed.
- Never disassemble, modify, process, improve or repair this product, as it may cause abnormal operations, electric shocks or fires.
- Please disassemble the product after turning OFF the power. Failure to do so may result in electric shocks, product abnormal operations or malfunctions.

⚠ CAUTION

- Since the product operating environment influences the product performance and expected life span, please avoid using in the following places.
  · a place where humidity is high and air flow is inappropriate.
  · a place where dust or impurity accumulates, ambient temperature is high and vibration level is high.
  · a place where corrosive gases (such as harmful gases, ammonia, etc.) and flammable gases occur.
  · a place where there is direct vibration and a large physical impact to the product.
  · a place where there is water, oil, chemicals, steam, dust, salt, iron or others (Contamination class 1 or 2).
  · a place where excessive amounts of inductive interference and electrostatic and magnetic noise occur.
  · a place where heat accumulation occurs due to direct sunlight or radiant heat.
- Please do not wipe the product with organic solvents such as alcohol, benzene, etc. (use neutral detergents).
- When water enters, short circuit or fire may occur, so please inspect the product carefully.
- Please connect the product and other units after turning off all the power of the product, instruments and units.
- Please make sure that the thyristor power regulator (TPR) is installed vertically.
- Please install the product inside of the control panel and install an exhaust fan onto the top of the control panel.
- Pay attention to the edge of heat sink which is sharp.
- Please close the cover after installation in the place in which there is a cover.
- The external circuit connected with the product should be connected by an insulated circuit more than basic insulation.
- The temperature of the body and the heat sink may be extremely high when electric current is applied, which may cause burns.

Suffix code

Model	Code			Content
TPR-2SL	□	□	- □	Slim type Single phase power regulator
Rated current	040			40 A
	055			55 A
	070			70 A
	090			90 A
	130			130 A
	160			160 A
Power supply voltage		L		100 - 240 VAC (Low)
		H		100 - 440 VAC (High)
Option			EP	Each phase control (3 device individual control)

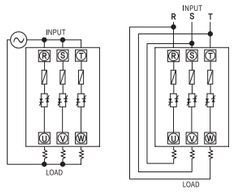
※ The circuit power and fan power must be applied separately 100 - 240 VAC
※ 130 A, 160 A products are FAN power 24 VDC Voltage must be applied.

Specification

Model		TPR-3SL 040L-EP	TPR-3SL 055L-EP	TPR-3SL 070L-EP	TPR-3SL 090L-EP	TPR-3SL 130L-EP	TPR-3SL 160L-EP
	High	TPR-3SL 040H-EP	TPR-3SL 055H-EP	TPR-3SL 070H-EP	TPR-3SL 090H-EP	TPR-3SL 130H-EP	TPR-3SL 160H-EP
Power supply voltage	Low	100 - 240 VAC					
	High	100 - 440 VAC					
Circuit input power		100 - 240 VAC 18 W					
Power frequency		50/60 Hz (Dual usage)					
Rated current		40 A	55 A	70 A	90 A	130 A	160 A
Applying load		Resistive load					
Current input		4 - 20 mA DC (Impedance : 100 Ω)					
Control method		Phase control, Fixed Cycle control, Variable Cycle control					
Movement type		SOFT START, SOFT UP/DOWN					
Output voltage		More than 98 % of the power supply voltage (In case of maximum current input)					
Cooling method		Forced cooling					
Display method		Display by LED					
Insulation resistance		Min 100 MΩ (Base on 500 VDC mega)					
Output control range		0 ~ 100 %					
Dielectric strength		3000 VAC 50/60 Hz for 1 min					
Line noise		Noise by noise simulator (2,500 V)					
Ambient temperature & Humidity		0 ~ 40 ℃(Without Condensation), 30 ~ 85 % RH					
Storage temperature		-25 ~ 70 ℃					
Approval		CE					
Weight(g)		4,324		9,194		9,288	

Connection diagram

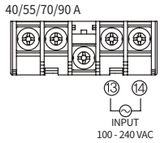
■ Connection diagram of load terminal



· Inside of TPR, the fuse is installed in the R,S,T input power supply portion depending on thespecification of options
· When connecting terminals, please use crimp connectors and securely fasten them due to the high current flow.
(Max space for solder less terminal connection is 40/55/70 A : 16 mm, 90/130 A : 26 mm)
· Only one channel can be used per temperature controller.
(Serial connection disabled)
· Since the internal GND is not separated, use a module or temperature controller that has separate analog inputs for each channel.

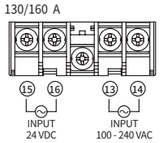
■ Connection diagram of input signal and power terminal

● 40/55/70/90 A



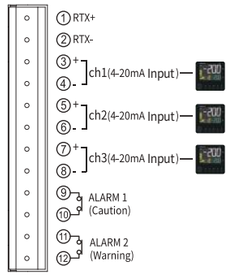
· Extra input power supply (For circuit power and FAX operation power) : 100 - 240 VAC (13, 14)
Have to connect power to operate unit
(Even if do not need to use FAN).

● 130/160 A



· Extra input power supply (For circuit power) : 13, 14
· FAN-driven power source : 15, 16

■ Connection diagram of signal and alarm terminal



- **NO. 1, 2 : RS485 Communication connection port**
- **NO. 3, 4 : Channel 1 4 - 20 mA DC input**
- **NO. 5, 6 : Channel 2 4 - 20 mA DC input**
- **NO. 7, 8 : Channel 3 4 - 20 mA DC input**
- **NO. 9, 10 : Alarm1 caution**

"caution" The alarm is not a serious problem, but it is an alarm that needs to be checked by the user due to abnormal symptoms. At this time, the TPR output will go out to normal and only the alarm will be output.
· Caution error : partial load disconnection, heat sink overheat (60 °C), overcurrent, power failure, fuse disconnection, FAN error

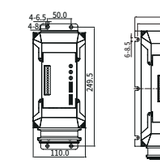
- **NO. 11, 12 : Alarm2 warning**

If a "Warning" alarm can cause damage to the product and the load, a warning will be issued in the following emergency situations. At this time, the TPR will stop the output itself.
· Warning error : Heat sink overheat (80 °C), SCR conduction (Short)

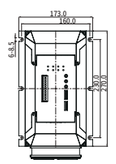
※ **When the input power (100 - 240 VAC) is applied, the alarm relay opens and it is shorted when an alarm occurs. ("B" contact Normal close) In case of using "A" contact**
※ **If an alarm condition occurs, an alarm is output after 3 seconds, and if the alarm condition is released within 3 seconds, an alarm No output.**

Installation panel cutout [Unit : mm]

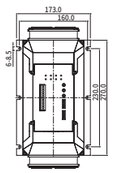
■ 40/55/70 A

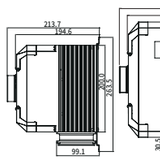


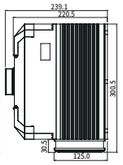
■ 90 A

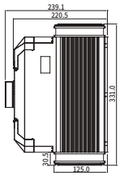


■ 130/160 A

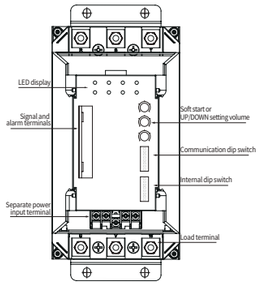








Part name and function



■ LED indicator and explanation

LED indicator name	Description
POWER	POWER indicator is ON when the power is being supplied to the control unit
CH1	Lights up when an alarm related to channel 1 occurs.
CH2	Lights up when an alarm related to channel 2 occurs.
CH3	Lights up when an alarm related to channel 3 occurs.
L.L	• When the heater is configured in parallel with the partial heater disconnection function, at least one of them is disconnected This function is to maintain the process while detecting the heater disconnection. • Detectable when using less than 3 parallel heaters. (In case of 4 or more parallel configurations) • The total load capacity is not detected within the range of less than 6A and 0 to 20%. • Part heater disconnection detection operation method (scan function) - Corresponds to phase control, variable cycle control - After circuit and load power supply is turned on, the LL LED flashes 0 to 100% The heater value is detected while sequentially outputting the output. - If the initial scan function is used only once after connecting the heater, the value stored in the internal CPU Therefore, no further operation is required in the future. - If you do not use the scan function and leave the initial mode 2 ON, Partial heater disconnection function is activated. It is not precise in the way that it is detected by calculation formula automatically.
OT	• The LED flashes when the heat sink temperature rises above 60 ° C during control, Operation is normal, and if the heatsink temperature drops below about 50 °C Will be released. • If the heat sink temperature rises above 80 ° C during control, the LED will light up and TPR output will stop.
O.C	• When an overcurrent occurs, it will light up if a current above a set value is generated to protect the product and load, Operation stop (can be set by communication) • FAN failure: Flashing when FAN fails
EMG	EMG LED lighting situation is as follows. 1. Power failure: The load power is turned on when the circuit powe (100 - 240 VAC) is applied Lights when the heater is disconnected. 2. SCR short: When SCR is shorted, the power is on without control inpu and TPR output Since the heater continues to overheat, the current continues to flow without the control input. The EMG LED flashes when it flows. (10 A or more)

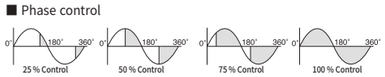
■ Internal dip switch operation

Number	OFF	ON	Initial setup MODE
No. 1	-	RESET (Functioning stops)	OFF ON 1 ■□ 2 ■□ 3 ■□ 4 ■□ 5 ■□ 6 ■□ 7 ■□ 8 ■□
No. 2	load volume scan	Partial load disconnection function	
No. 3	Not Using	Restart mode	
No. 4	-	cycle control fixed cycle method	
No. 5		cycle control variable cycle method	
No. 4, 5		Phase control	
No. 6	Not Using		
No. 7	3 channel function fixed	use all 1, 2, 3 channels	
No. 8	-	4 - 20 mA DC	
No. 7, 8	Check 8 LED lights	-	1. Input mode : 4 - 20 mA DC 2. Control Mode: Phase control

※ The reset operates after turning off the switch 1 and turning it on again through the CPU reset

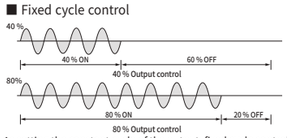
Function descriptions

■ Phase control



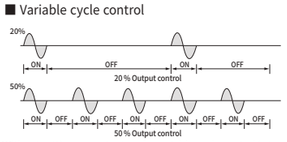
Phase control is to control the AC power supply applied to the load proportionally according to the control input signal as changing phase angle (0 ~ 180 degree) in a each half cycle, 8.33 ms.

■ Fixed cycle control



As setting the constant cycle of the output, fixed cycle control is to control the AC power supply repeatedly with a constant rate of ON/OFF according to the control input.

■ Variable cycle control



Without setting a constant cycle, variable cycle control is to control AC power supply with using the number of cycle.

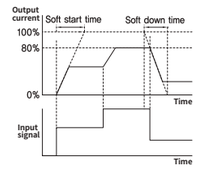
■ Restart function

When a warning or caution alarm occurs, TPR gives alarm 1 or 2 or stop the output.
This function is used to return to normal operation mode when factors caused errors are eliminated.
This function is able to set up when Fuse/Power Supply is in disorder, Heat sink over heat, SCR Short is occurred.
(When Overcurrent is occurred, this function is not working)

■ VR Explanation

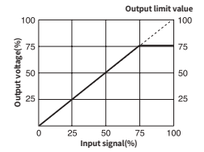
● O.C (overcurrent setting function)

When overcurrent occurs, protection function for TPR and load (Only phase control)
- The overcurrent setting can be different depending on the types of load or VR tolerance.
In order to set an accurate position of the overcurrent setting, adjust the control signal that TPR can have the current that needs to be alarmed. Turn the O.C VR until the O.C indicator is ON. The position of the O.C VR is the overcurrent setting value.
- If OC VR turning to the right of the maximum, overcurrent function does not work.



● SOFT

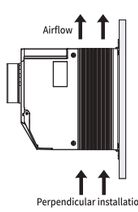
This volume is to set time for Soft start or Soft up/down.
- Soft start : Protection functions against big load of start current (inrush current). It increases output softly. When control input is applied and power is on, Soft start operates when rung signal is applied. In case of maximum VR, it set 60 second. (Example : 20 mA : 60 sec, 12 mA : 30 sec)
- Soft up / down : When run signal and power are applied and if control input is applied, it will operate. It case of maximum VR, it set 15 second.
- If VR turn up to the right, the function does not work. And if VR turn right, time will be reduced.



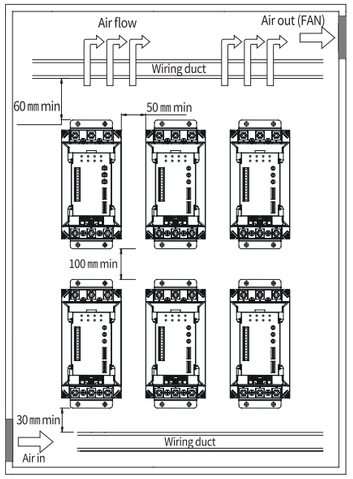
● POWER (output limit function)

This function is to limit the output regardless of the control input amount. Even though the control input is 100 %, the output will decrease as turning POWER volume counterclockwise.

Installation

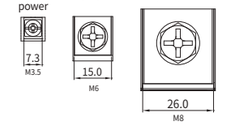


1. Please install it perpendicularly. If the product is installed vertically in unavoidable circumstances, please use 50% of rated current.
2. When multiple products are closely installed, please install them with keeping a distance of more than a width of 5cm and a length of 10cm as shown in the picture.
3. In order to not block the air flow, please install the wiring duct less than the half of the heat sink height.
4. Please consider whether the air flow is good enough when installing the product. If the ambient temperature is as low as possible in the inside then the life span of the product is increasing as the durability and reliability of the product are improving. The operating ambient temperature is 0 ~ 40°C. Please refer to the following graph. However, if the ambient temperature is higher than 40 °C, the maximum load current is decreasing like the below.
5. When connecting R and U, please securely fasten them with using crimp connectors since high current flows into these terminals. If the contact surface of the connectors and terminals are poor, it may lead to a fire since the wires and terminal gets overheated.
6. Before applying power, this model need more than the third class grounding to prevent electric shock. This model does not have separate grounding terminal so we suggest using grounding terminal and bracket together when install this model to a panel.



7. Tighten the screws of the terminal block with the specified torque.
M3.5: 0.6 ~1.2 N.m / M6: 4.41~4.9 N.m / M8: 8.82~9.80 N.m

• Circuit power • 40/55/70A • 90/130/160 A

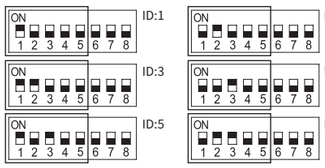


Communication

1. Communication method: RS485 2-wire half-duplex
2. Communication speed: 2400, 4800, 9600, 19200 bps
3. Maximum number of connections: 31
4. Protocol: ModBus RTU, ModBus ASCII

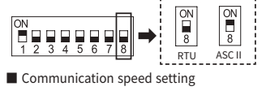
■ Address (ID) setting

- Set the ID with DIP S/W no. 1~5
- Set 1 ~ 31 (except 0).
- When communication setting is changed, the change is applied after reset.



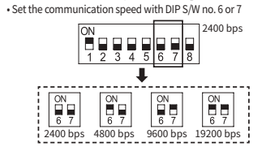
■ Communication protocol selection

- Set the communication protocol with DIP S/W no. 8



■ Communication speed setting

- Set the communication speed with DIP S/W no. 6 or 7



■ Communication setting (ModBus RTU/ASC II)

Communication settings			
Communication speed	2400, 4800, 9600, 19200		bps
Protocol	ModBus RTU	ModBus ASC II	
Parity bit	Even	None	bit
Data bit	8	7	bit
Stop bit	1		bit
ID	1 ~ 31		

Structure (RTU)

Division	Address(ID)	Function	Start Address	No. of Data	CRC
Request	1	1	2	2	2

Division	Address(ID)	Function	No. of Data	Data	CRC
Request	1	1	1	2	2

Example (RTU)

Division	Address (ID)	Function	Start Address		No. of Data		CRC	
Request	0x01	0x03	0x00	0x01	0x00	0x01	0xD5	0xCA

Division	Address (ID)	Function	No. of Data	Data		CRC	
Response	0x01	0x03	0x02	0x00	0x00	0xB8	0x44

Structure (ASC II)

Division	Address (ID)	Function	Start Address	No. of Data	LRC
Request	2	2	4	4	2

Division	Address (ID)	Function	No. of Data	Data	LRC
Response	2	2	2	4	2

Example (ASC II)

Division	Address(ID)		Function		Start Address				No. of Data				LRC		END	
Request	0x01	0x31	0x03	0x33	0x30	0x30	0x30	0x31	0x30	0x30	0x30	0x31	0x46	0x41	0x0D	0x0A

Division	Address(ID)		Function		No. of Data		Data						LRC		END	
Response	0x30	0x31	0x30	0x33	0x30	0x32	0x30	0x30	0x30	0x30	0x46	0x41	0x0D	0x0A		

BOLD : RAM DATA	
READ	monitoring
READ/WRITE	Configurable

Protocol	MODBUS RTU	MODBUS ASCII
Speed	2400, 4800, 9600, 19200 bps	
Parity	Even	None
Data bit	8	7
Stop bit	1	1
ID	1 ~ 31	

Communication MAP

Address	PROCESS	INFO	CAL
0	0	100	200
1	AlarmStatus	System	Scan Start
2	CH1 Status		Scan Out Mode
3	CH2 Status		CH1 Complete
4	CH3 Status		
5		Rev	CH1 LL Rate
6	Soft Time	Out Mode	CH2 Complete
7			CH2 LL Rate
8	CH1 Output		CH3 Complete
9	CH1 Current		
10	CH2 Output	LL Use Mode	CH3 LL Rate
11	CH2 Current	Protocol	
12	CH3 Output	BPS	
13	CH3 Current	Parity	
14	CH1 Input	Stop Bit	
15	CH2 Input	Data Length	
16	CH2 Input	Address	
17		R.Time	
18		CH1 Enable	
19		CH2 Enable	
20		CH3 Enable	
21		CH1 Power Limit	
22		CH2 Power Limit	
23		CH3 Power Limit	
24		CH1 OC Limit	
25		CH2 OC Limit	
26		CH3 OC Limit	

Explanation by address

Process (0 ~ 99)

Address	Parameter	Explanation	Setting range	Unit
1	AlarmStatus	Alarm status information	Refer to Bit Information	
2	CH1 Status	CH1 Status information	Refer to Bit Information	
3	CH2 Status	CH2 Status information	Refer to Bit Information	
4	CH3 Status	CH3 Status information	Refer to Bit Information	
5	-	-	-	-
6	Soft Time	Soft start Setting time	0 ~ 60	sec
7	-	-	-	-
8	CH1 Output	SCR CH1 Yield	0 ~ 100	%
9	CH1 Current	SCR CH1 Load current value	0 ~ CT (max)	(x10) A
10	CH1 Output	SCR CH2 Yield	0 ~ 100	%
11	CH1 Current	SCR CH2 Load current value	0 ~ CT (max)	(x10) A
12	CH1 Output	SCR CH2 Yield	0 ~ 100	%
13	CH1 Current	SCR CH2 Load current value	0 ~ CT (max)	(x10) A
14	CH1 Input	CH1 4 - 20 mA Control signal input	0 ~ 100	%
15	CH2 Input	CH2 4 - 20 mA Control signal input	0 ~ 100	%
16	CH3 Input	CH3 4 - 20 mA Control signal input	0 ~ 100	%

BIT Information

Parameter	AlarmStatus	CH1 Status	CH2 Status	CH3 Status
Address	1	2	3	4
Bit 0	-	Power Fail	Power Fail	Power Fail
Bit 1	FAN Fail	LL Fail	LL Fail	LL Fail
Bit 2	OC Fail	OC Fail	OC Fail	OC Fail
Bit 3	LL Fail	SCR Short	SCR Short	SCR Short
Bit 4	Over Temp 60	-	-	-
Bit 5	Over Temp 80	-	-	-
Bit 6	SCR Short	-	-	-
Bit 7	Power Fail	-	-	-
Bit 8 ~ 15	-	-	-	-

Infomation (100 ~ 199)

Address	Parameter	Explanation	Setting range	Unit
100	System	SCR Product Setup Status	0x0130 : TPR3SLEP	
101	-	-		
102	-	-		
103	-	-		
104				
105	Rev	SCR Revision		
106	Out Mode	Control method setting status	0: phase control 1: fixed cycle cycle control 2: Variable cycle cycle control	
110	LL Use Mode	Whether the partial heater break function is used	0: Disable partial heater disconnection function 1: Using partial heater disconnection function	
111	Protocol	Protocol setting status	2 : ASCII, 3 : RTU	
112	BPS	Communication speed setting status	0 : 2400, 1 : 4800, 2 : 9600, 3 : 19200	
113	Parity	Parity bit setting status	0 : None, 1 : Odd, 2 : Even	
114	STOP BIT	Stop bit setting state	1, 2	
115	DATA LENGTH	Data length	7, 8	
116	ADDRESS	ID (SCR communication number)	1 ~ 31	
117	R.TIME	Response time	0 ~ 10	
118	CH1 Enable	Decide whether to use CH1	0 : Do not use this channel 1 : Use this channel	
119	CH2 Enable	Decide whether to use CH2		
120	CH3 Enable	Decide whether to use CH3		
121	CH1 Power Limit	CH1 output limit setting	0 ~ 100	%
122	CH2 Power Limit	CH2 output limit setting	0 ~ 100	%
123	CH3 Power Limit	CH3 output limit setting	0 ~ 100	%
124	CH1 OC Limit	Set CH1 overcurrent value	0 ~ CT (max)	(x10) A
125	CH2 OC Limit	Set CH2 overcurrent value	0 ~ CT (max)	(x10) A
126	CH3 OC Limit	Set CH3 overcurrent value	0 ~ CT (max)	(x10) A

Calibration (200 ~ 299)

Address	Parameter	Explanation	Setting range	Unit
200	Scan Start	Partial load disconnection scan	0 : Operating, 1:LL Scan	
201	Scan Out Mode	Control mode for partial load disconnection scan	0: phase control 1: fixed cycle cycle control 2: Variable cycle cycle control	
202	CH1 Complete	CH1 heater value saved	control, 2: Variable cycle cycle control	
204	CH1 LL Rate	CH1 Parallel heater breaks	1 ~ 6	EA
205	CH2 Complete	CH2 heater value saved	0 : No scan data, 1 : Complete	
207	CH2 LL Rate	CH2 Parallel heater breaks	1 ~ 6	EA
208	CH3 Complete	CH3 heater value saved	0 : No scan data, 1 : Complete	
210	CH3 LL Rate	CH3 Parallel heater breaks	1 ~ 6	EA

* 200: If it is 1, the status is being scanned. 0 is displayed after scanning is completed (3 channels are scanned at the same time)
* 201: Control method setting status being scanned
* 202: If it is 1, the scan is completed and the heater value is stored in the internal storage device (If it is 0, it is not saved, not scanned)
* 204: Set to 3 for 3 heaters (Low load malfunction concern Output 20% or less Detection prohibited)

Explanation about SCR Alarm

Alarm (LED)	Alarm Description	Checking list
Power Fail (EMG lighting)	When load power is not applied	1. Confirmation of load power voltage for each channel (Example: Check 1CH load voltage when 1CH POWER Fail) 2. Check that the load power breaker is ON (Reset, turn on / off) 3. SCR load power input terminal R, S, T wiring check
	Fuse disconnected	1. Open the upper case of SCR and check the fuse disconnection (Shot is normal when measuring the fuse tester after the load power is turned off)
	When the heater is disconnected	1. Check the resistance value of the load connected to the SCR (disconnection and disconnection) 2. Check the SCR heater connection terminals U, V, W wiring
SCR Short (EMG flashing)	Internal SCR element shorted	1. Symptom: When 4 mA and control input are not applied, load current When more than 5 A flows. 2. Confirm: Check several channel SCR Short 3. Generation channel 4 - 20 mA Input part voltage is less than 0.4 V, Ensure current is measured in clampmeter (SCR failure if confirmed, replacement required)
OC Fail (OC lighting)	In case of overcurrent	1. When the current exceeding the OC Limit setting value flows to the load 2. Clamp meter connected to overcurrent identified channels U, V, W Check the current on the wiring.
Fan Fail (OC flashing)	FAN failure	1. Make sure that the cooling fan on the bottom of the SCR is rotating 2. Make sure that there is foreign substance in the cooling fan
LL Fail (LL lighting)	One or more disconnection in parallel heater configuration	1. Check if the heater value is saved using the Scan function (communication) 2. If you do not know whether or not you have scanned the control signal (4 - 20 mA) When there is no scan, DIP SW 2 turns OFF and scan progress, LL LED When it changes to flashing, it changes to switch ON position again. 3. Check the resistance value of the heater. Comparison of the resistance value of the part (When the resistance value becomes high)
Over Temp 60 (OT flashing)	Heat sink temperature Over 60 degrees	1. Check if cooling fan is rotating well 2. Identify the cooling unit inside the panel 3. If an alarm occurs immediately upon power-on, the SCR internal fault.
Over Temp 80 (OT lighting)	Heat sink temperature Over 80 degrees	