Thyristor Power Regulator

TPR-2SL

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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MB0401KE230202

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		Built-in Fuse	90 A
	110			110 A
	130			130 A
	160			160 A
	200			200 A
Power supply voltage	L			100 - 240 V a.c. (Low)
	H			380 - 440 V a.c. (High)
Options		C		RS485
			F	Built-in Fuse (Only 40/55/70 A)

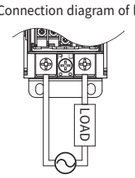
※ Please supply 100 ~ 240 V a.c. to the control unit of the power controller (Thyristor) separately.

Specification

TPR-									
Model	Low	2SL040L	2SL055L	2SL070L	2SL090L	2SL110L	2SL130L	2SL160L	2SL200L
	High	2SL040H	2SL055H	2SL070H	2SL090H	2SL110H	2SL130H	2SL160H	2SL200H
Power supply voltage	Low	100 - 240 V a.c.							
	High	380 - 440 V a.c.							
Circuit input power		100 - 240 V a.c.							
		6 W		16 W	20 W				
Power frequency		50 Hz / 60 Hz (Dual usage)							
Rated current(40 °C Standard)		40 A	55 A	70 A	90 A	110 A	130 A	160 A	200 A
Fuse installation		None			Built-in Fuse				
Applying load		Resistive load							
Control Input	Current input	4 - 20 mA d.c. (Impedance : 100 Ω)							
	Voltage input	1 - 5 V d.c. (Order specification : 0 - 10 V d.c.)							
	Contact input	ON/OFF							
	External VR	External volume (10 kΩ)							
Control method		Phase control, Fixed Cycle control, Variable Cycle control, ON/OFF 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		Natural cooling		Forced cooling	Natural cooling		Forced cooling		
Display method		Display by LED							
Insulation resistance		Min 100 MΩ (Base on 500 VDC mega)							
Output control range		0 ~ 100 %							
Dielectric strength		3,000 V a.c. 50/60 Hz for 1 min							
Line noise		Noise by noise simulator (3,000 V)							
Ambient temperature & humidity		0 ~ 40 °C (Without Condensation), 30 ~ 85 % RH							
Storage temperature		-25 °C ~ 70 °C							
Approval		CE							
Weight(g)		1388		1478	2820				

Connection diagram

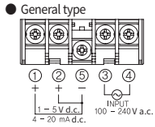
■ Connection diagram of load terminal



- 40/55/70 A items does not have fuse. It is recommended to install a fast fuse between the input power and the "R" terminal. (90/110/130/160/200 A items have fast-acting fuse).
- 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, 90/110/130/160/200 A : 26 mm

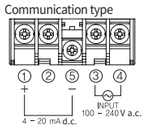
■ Connection diagram of input signal and power terminal

● General type



- Current input : 4 - 20 mA d.c.(connect no. 1 and 5)
- Voltage input : 1 - 5 V d.c.(connect no. 2 and 5)
- Input power voltage(for control unit) : 100 - 240 V a.c.(no. 3 and 4)

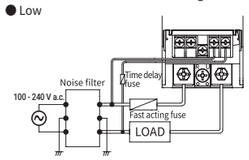
● Communication type



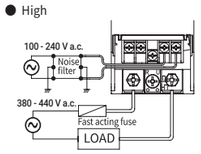
- Current input : 4 - 20 mA d.c.(connect no. 1 and 5)
- Input power voltage(for control unit) : 100 - 240 V a.c.(no. 3 and 4)

■ Recommended connection diagram

● Low



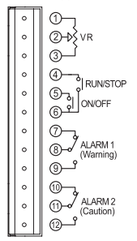
● High



- In case of low voltage model, we suggest connect it as following picture. (90/110/130/160/200 A have fuse).
- If the product is used in a place where there is an excessive amount of noise from power then make sure to use a noise filter satisfied its specification as shown in the picture below. If not, it can be a cause of malfunction.
- When the voltage is used higher than 380 V a.c., please make sure that the input power for the control unit is separately connected to 240 V a.c.
- Protection fuse 0.5A or an equavalent device should be connected in the terminal of power input on circuit.
- Please select a fuse that satisfied with operating current/voltage for the fast acting fuse.
(example) actual operating current 40A : BUSSMANN FWH-40 (please use 40 A r.m.s min)

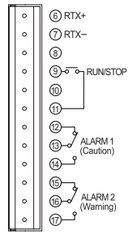
■ Connection diagram of signal and alarm terminal

● General type



- **No. ①, ② and ③ : manual VR**
  - Use variable resistor of 10 kΩ
  - Control 0 ~ 100 % manually
- **No. ④ and ⑥ : RUN/STOP**
  - Be sure to attach RUN contact while it is operating.
- **No. ⑤ and ⑥ : ON/OFF control**
  - When inputting contact, it is operated with 100% output, irrespective of other control input.
- **No. ⑥ is GND terminal of the circuit.**
- **No. ⑦, ⑧ and ⑨ : Alarm 1 - Warning**
  - This is a "warning" alarm which implies that there may be a cause of damage to the product and load. At this moment, TPR stops the output by itself and "warning" alarm is activated.
  - Warning error : Overcurrent, overheated heat sink (85 °C), SCR short-circuit, abnormal frequency and power.
- **⑩, ⑪, ⑫: Alarm 2 (Caution)**
  - This is a "caution" alarm which implies there is not a serious problem, but user needs to check for its system because small and minor problems cause this alarm. At this moment, the output of TPR is normally operating but only "caution" alarm is activated.
  - Caution error : partial load break, overheated heat (65 °C)
- **Initially ⑦ & ⑧ connect. If alarm 1 is activated, ⑧ &⑨ will be connected.**
- **Initially ⑩ & ⑪ connect. If alarm 2 is activated, ⑪ &⑫ will be connected.**

● Communication type

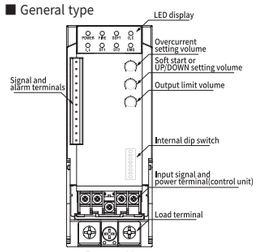


- **6, 7 : 485 communication connected port**
- **9, 11 : RUN / STOP**
  - Always stick the RUN contact in operation
- **10, 11 : ON/OFF Control**
  - When input ting c ontact, there is 100% output regardless of other control input.
- **12, 13, 14: Alarm 1 caution**
  - It is not a serious problem when "Caution" Alarm is on. But, it is a sign of disorder so it is required to be checked out. In this way, TPR's output is fine but, only alarm is on.
  - Error for caution occurrence : disconnection of partial load, overheating of heat sink(65 °C), overcurrent, disorder of frequency, disorder of power supply (disconnection of Fuse)
- **15, 16, 17: Alarm 2 warning**
  - When there is a damage in the product and the load through "Warning" alarm, warning is on by the following emergency situations. In this way, TPR is automatically stopped.
  - Error of warning occurrence : Overheating of heat sink (85 °C), SCR short, Disorder of FAN
- When input power (100-240 V a.c.) is supplied, the contact is changed to 16, 17 from 13, 14. When warning alarm is on, the contact is changed from 15, 16 to 12, 13.

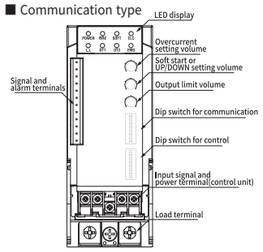
※ When there is an alarm condition, the alarm is on after 3 seconds. If alarm condition is cleared within 3 seconds, the alarm is off.

Part name and function

■ General type



■ Communication type



■ LED indicator and explanation

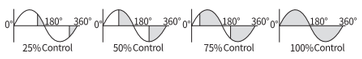
LED indicator name	Description
POWER	POWER indicator turns ON when the power is being supplied separately.
FIRE	FIRE indicator turns ON proportionally to the control output according to the control input. It lights longer if the output amount is large and it is continuously ON if it outputs 100 % continuously.
SOFT	To use Soft start, Soft up/down function, turn Soft VR clockwise and SOFT indicator will turn ON.
O.C	• After overcurrent occurs, lights up when current exceeding O.C VR set value for protection of product and load. • FAN break : The indicator flashes when the fan is broken.(Special order spec) • Over load: When SCR is shorted, the power is turned on and 100% output is exited irrespective of the control input state. If current is over 5A in each control period, it flashes.
L.L	• If the DIP switch 2 is turned OFF after the power is turned on, the heater value will be detected after confirming the capacity of the heater while automatically outputting 0 ~ 100%. When the heater value detection is completed, the LL LED remains on. When the DIP switch 2 is turned ON again, the LED goes off and the partial heater break. The detection function starts. If the heater value is less than 30% of the heater value detected at the initial setting for 6 seconds, "Caution" alarm output and LL LED lights up. • If you want to use the partial heater disconnection detection function automatically, set the DIP switch to the ON state to automatically detect the heater value and start the detection function (but not detect if the heater is already disconnected) Does not. • It will not operate when the output is below 20%.
0.T1	Lights up when the temperature of the heat sink rises above 65° C during control, when the operation is normal and the alarm is cleared when the temperature of the heat sink falls below about 50° C
0.T2	On / off when the heat sink temperature rises above 85° C during control
EMG	The EMG LED indicator is ON in the following situations: 1. Abnormal status with power: when circuit power (24 V d.c.) is being supplied, EMG LED is ON if the load power is not being supplied or the heater is disconnected. 2. SCR short: If the SCR is shorted, the power supply will continue to be conductive even when there are no control input and TPR output, and the heater will continue overheating. Therefore, if the current continues to flow without the control input, the EMG LED will flash (detectable when the load current is 10A or more)

■ Internal dip switch operation

Number	OFF	ON	Initial setting mode
No. 1	RESET CLEAR RESET	RESET	OFF ON 1 ■□ 2 ■□ 3 ■□ 4 ■□ 5 ■□ 6 ■□ 7 ■□ 8 ■□ 1. input mode : 4 ~ 20 mA d.c. 2. control mode : phase control
No. 2	Use function of manual partial load break	Use function of auto partial load break	
No. 3	Partial load disconnection	-	
No. 4	-	Fixed cycle control	
No. 5		Variable cycle control	
No. 4, 5		Phase control	
No. 6	-	Limit mode (Not using internal VR)	
No. 7	Use external and internal V.R simultaneously	1 - 5 V d.c.	
No. 8		External VR	
No. 7, 8		4 - 20 mA d.c.	

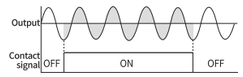
Function descriptions

■ Phase control



Phase control is to control the AC power supplyapplied 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.

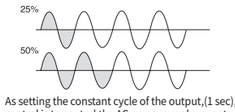
■ ON/OFF control



If ON/OFF contact is ON, then the output is 100 %. ON/OFF always operates near zero point.

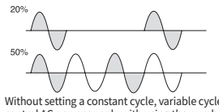
Even though the control input signal is ON, the output is 100 % when ON/OFF control is used.

■ Fixed cycle control



As setting the constant cycle of the output,(1 sec), 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.

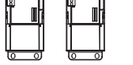
■ Restart function

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)

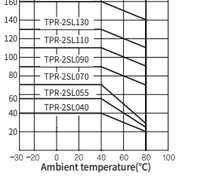
■ VR Explanation

● O.C (overcurrent setting function)

When overcurrent occurs, protection function for TPR and load (Only for phase control)
- VR gradation for overcurrent setting position.

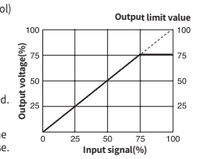
TPR-2SL040/055/070	TPR-2SL090/110/130/160/200
	

- 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

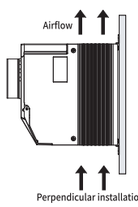
This volume is to set time for Soft start or Soft up/down. (Only phase control, ON/OFF control)
- Soft start : Protection functions against big load of start current (inrush current). It increases output softly. When control input is applied and power is on, Soft start operates when rung signal is applied. 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)

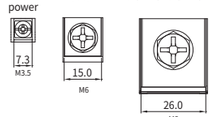
This function is to limit the output regardless of the control input amount. Even though the control input is 100 %, the output will decrease as turning POWER volume counterclockwise.

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 • 90/110/130/160/200A



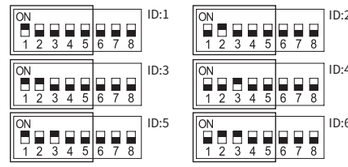
● Current - temperature characteristics

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.

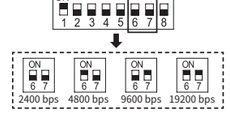


■ Communication protocol selection

- 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	

Process (0 x 0000 ~) : READ					
Modbus Address	Address	Parameter	Content	Setting range	Unit
40002	0x0001	AlarmStatus	Alarm status information	Refer to BIT Information	
40003	0x0002	CT value	Output current value 16bit	0 ~ CT max (X10)	A
40004	0x0003	PWR LMT	Output limit value	0 ~ 100	%
40005	0x0004	DIP SW Status	DIP switch setting status	Refer to BIT Information	
40006	0x0005	-	-	-	-
40007	0x0006	-	-	-	-
40008	0x0007	-	-	-	-
40009	0x0008	-	-	-	-
40010	0x0009	-	-	-	-
40011	0x0010	-	-	-	-
40012	0x0011	-	-	-	-
40013	0x0012	-	-	-	-
40014	0x0013	-	-	-	-

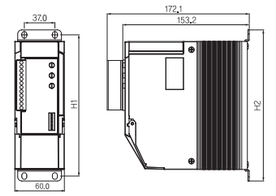
※ PWRLMT Initial value : 100, OCLMT Initial value : 786

BIT Information				
Parameter	AlarmStatus	Content	DIP SW Status	Content
Address	0x0001		0x0004	
Bit 0	-	-	-	-
Bit 1	FAN Fail	DC FAN break	IN MODE	Control input selection status 1 : 4 ~ 20 mA
Bit 2	OC Fail	Overcurrent	-	-
Bit 3	LL Fail	Partial heater burnout occurred	OUT MODE	Current control mode state 01 : fixed cycle control 10 : variable cycle control 11 : phase control
Bit 4	Over Temp 60	Heat sink above 60 °C		
Bit 5	Over Temp 80	Heat sink above 80 °C	-	-
Bit 6	Heat Short	When internal device is shorted (when control signal is not applied)	LL MODE	Status of partial heater disconnection setting 0 : OFF 1 : ON
Bit 7	Power Fail	Failure of supplying power for load	-	-
Bit 8	-	-	-	-
Bit 9	-	-	-	-
Bit 10	-	-	-	-
Bit 11	-	-	-	-
Bit 12	-	-	-	-
Bit 13	-	-	-	-
Bit 14	-	-	-	-
Bit 15	-	-	-	-

Installation panel cutout

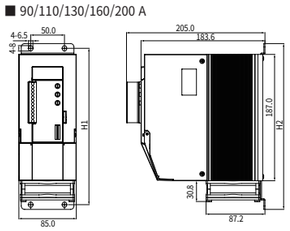
[Unit : mm]

■ 40/55/70 A



	H1	H2
40 / 55 A	171.0 mm	183.0 mm
70 A (With Cooling fan)	191.0 mm	203.0 mm

■ 90/110/130/160/200 A



	H1	H2
90 A (Without Cooling fan)	205.0 mm	219.0 mm
110 / 130 / 160 / 200 A	231.5 mm	245.5 mm