Thyristor Power Regulator

TPR-3SL

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.

MB0601KE190109

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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-3SL	□	□	□	-	□	□	□	Slim type 3-phase thyristor power regulator
Rated current	040							40 A
	055							55 A
	070							70 A
	090							90 A
	130							130 A
	160							160 A
Power voltage		L						100 - 240 VAC (Low)
		H						380 - 440 VAC (High)
Option			C					RS485
				N				No Fuse
						F		Fan mounted (option for 40A, 55 A models)

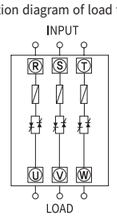
※ Circuit and fan need 100 - 240 VAC voltage power separately.

Specifications

Model		Low	TPR-3SL040L	TPR-3SL055L	TPR-3SL070L	TPR-3SL090L	TPR-3SL130L	TPR-3SL160L
		High	TPR-3SL040H	TPR-3SL055H	TPR-3SL070H	TPR-3SL090H	TPR-3SL130H	TPR-3SL160H
Power voltage			100 - 240 VAC 380 - 440 VAC					
Circuit input power			100 - 240 VAC 18 W			100 - 240 VAC 20 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					
Control Input	Current input		4 - 20 mA DC (Impedance : 100 Ω)					
	Input		1 - 5 VDC					
	Contact input		ON / OFF					
	External VR		External volume (10 kΩ)					
Control method			Phase control, Fixed Cycle control, Variable Cycle control, ON/OFF control (General type only)					
Movement type			SOFT START, SOFT UP/DOWN					
Output voltage			More than 98 % of the power voltage (in case of maximum current input)					
Cooling method			Natural cooling (40 A, 55 A), Forced cooling (70 A, 90 A, 130 A, 160 A)					
Display method			Output display by LED					
Insulation resistance			Min 100 MΩ (based on 500 VDC mega)					
Output control range			0 ~ 100 %					
Dielectric strength			3,000 VAC 50/60 Hz for 1 min					
Line noise			Noise by noise simulator (2,500 V)					
Ambient temperature & humidity			0 ~ 40 °C (without condensation), 30 ~ 85 % RH					
Storage temperature			-25 °C ~ 70 °C					
Approval			CE					
Weight (g)			4,044		4,324		9,100	

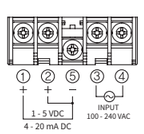
Connection diagrams

■ Connection diagram of load terminal



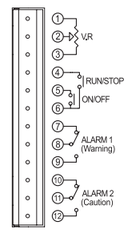
· Inside the thyristor power regulator (TPR), a fuse (FUSE) is mounted on the R, S, T input power part as standard.
· When connecting terminals, please use crimp connectors and securely fasten them due to the high current flow. (Max space for solder less terminal connection is 40/55/70 A: 16 mm, 90/130/160 A: 26 mm)

■ Connection diagram of input signal and power terminals



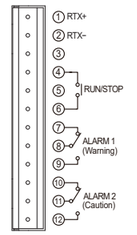
· Current input : 4 - 20 mA DC (connect no. ① and ⑤)
· Voltage input : 1 - 5 VDC (connect no. ② and ⑤)
· Extra input power supply (for circuit power and fan operation power) : 100 - 240 VAC (③, ④) need to connect power to operate unit (even if the fan is not used).

■ Connection diagrams of signal and alarm terminal



● Standard type

- **No. ① , ② , 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. 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. The alarm will be activated when the following emergency situations occur. At this moment, TPR stops the output by itself.
  · Warning errors: overcurrent, SCR short-circuit, fuse disconnection, power failure
- **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 minor problems cause this alarm. At this moment, the output of TPR is normally operating and only "caution" alarm is activated.
  · Caution error: load unbalance, load disconnection, overheated heat sink (85 °C)
- **Initially ⑦ and ⑧ connected. If alarm 1 is activated, ⑧ and ⑨ will be connected.**
- **Initially ⑩ & ⑪ connected. If alarm 2 is activated, ⑪ & ⑫ will be connected.**



● Communication type

- **No. ① and ② : 485 communication connection port**
- **No. ④ and ⑥ : RUN/STOP**
  · Be sure to attach RUN contact while it is operating.
- **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. The alarm will be activated when the following emergency situations occur. At this moment, TPR stops the output by itself.
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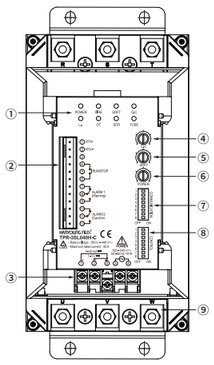
Part names and functions



■ Part names

No	Name	No	Name
①	LED display	⑥	Output limit volume
②	Signal and alarm terminals	⑦	Communication dip switch (Communication type only)
③	Input signal and alarm terminal	⑧	Control dip switch
④	Over current setting volume	⑨	Load terminal
⑤	Soft start or UP/DOWN setting volume		

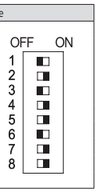
■ LED indicators and descriptions

LED indicator name	Description
POWER	POWER indicator turns ON when the power is being supplied separately. RS485 Flashes during communication. (Communication type only)
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	When there is overcurrent, if the current flows higher than O.C VR set value, then O.C indicator turns ON, to protect the product and the load and alarm 1 is activated.
L.L	When the load is disconnected : in a situation where output is over 10 %, if load current is not detected, the alarm is activated. When the load is unbalanced : in a situation where output is over 10 %, if the load unbalance between phases is over 5 A, the alarm is activated. (Phase control only)
O.T	When heat sink temperature rise over 80 °C', O.T indicator turns ON. Alarm 2 output will be activated but the operation will continue normally. When temperature goes 70 °C, alarm will turn OFF.
FUSE	When inner fuse is disconnected, when load power is not input, or in a situation where circuit power supply (100 - 240 VAC) is applied, if any phase of load power supply is not working or inner part of FUSE is disconnected, alarm output ALARM1 is activated.
SCR	Under certain circumstances, if the internal SCR is shorted, the power supply will continue to be conductive even if there is no control input and TPR output, so that the heater will continue to overheat. So SCR indicator turns ON if current continues to flow for more than 10 A in any phase without control input.

■ Internal dip switch operation

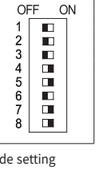
● Standard type

Number	OFF	ON	Initial setup mode
No. 1	-	RESET (function stop)	1. Input mode 4 - 20 mA DC 2. Control Mode: Phase control 3. Extra : Restart is in use, Inner VR is in use
No. 2	External VR in use	Inner Power VR in use	
No. 3	Restart mode in use	Restart mode not used	
No. 4	-	Fixed Cycle Control	
No. 5		Variable Cycle Control	
No. 4,5		Phase control	
No. 6	Not Used		
No. 7	-	1 - 5 V DC	
No. 8		Only external VR in use	
No. 7,8		4 - 20 mA DC	

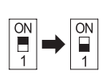


● Communication type

Number	OFF	ON	Initial setup mode
No. 1	-	RESET (function stop)	1. Input mode 4 - 20 mA DC 2. Control Mode: Phase control 3. Extra : Restart is in use
No. 2	Not used		
No. 3	Restart mode in use	Restart mode not used	
No. 4	-	Fixed Cycle Control	
No. 5		Variable Cycle Control	
No. 4,5		Phase control	
No. 6	Not Used		
No. 7	-	1 - 5 VDC	
No. 7,8		4 - 20 mA DC	

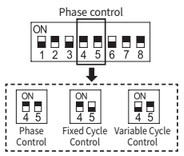


■ Reset description

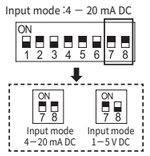


• When using RESET, set DIP S / W No. 1 to ON and then OFF again.

■ Control mode setting

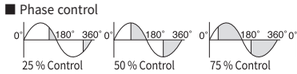


■ Input mode setting



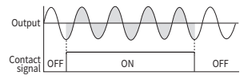
Function descriptions

■ Phase control



The phase control method is to input 1/2 CYCLE to AC power and output power proportionally between 0 and 180 degrees for 8.33 ms according to the control signal.

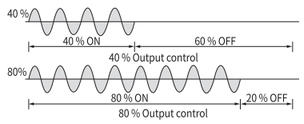
■ ON/OFF control (General type only)



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

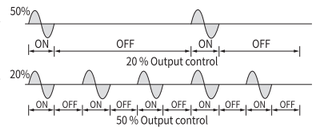
• Even though the control input signal is ON, the output is 100 % when ON/OFF control is used.

■ 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

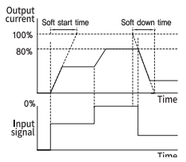
When a warning or caution alarm occurs, TPR gives alarm 1 or 2 or stop the output.
This function is used to return to normal operation mode when factors caused errors are eliminated.
This function is able to set up when Fuse/Power Supply is in disorder, Heat sink over heat, SCR Short is occurred.
(When 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-3SL040/055/070	TPR-3SL090/130/160
17A 37A 58A	37A 81A 123A
O.C	O.C

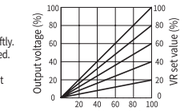


• Depending on load type and VR error, overcurrent setting position can be different.
• The overcurrent setting position may differ depending on the load type and VR error. To adjust the correct overcurrent position, adjust the control input to the current to be set, then turn the OC VR. The OC alarm output position is set to the overcurrent setting.

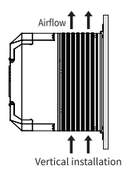
※ Communication type
• Default: 40A, 55A, 70A overcurrent limit: 840 / 90A, 130A, 160A overcurrent limit: 1920 (overcurrent limit value is set to O.C VR set value X 10)
• When address [7] is used for communication, the communication value is applied. The communication setting range is (0 ~ 2000)

● 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 50 second. (Example : 20 mA : 50 sec, 12 mA : 25 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 10 second.
- If VR turn up to the right, the function does not work. And if VR turn right, time will be reduced.

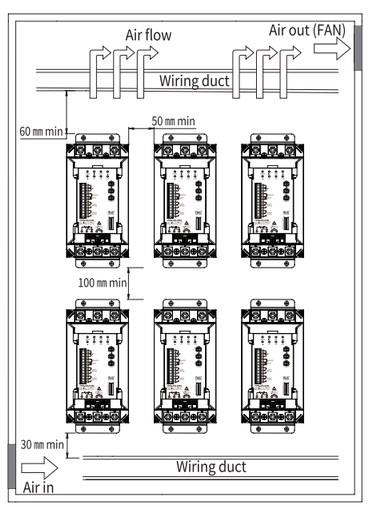
● POWER (output limit function)
This function is to limit the output regardless of he control input amount. Even though the control input is 100%, the output will decrease as turning POWER volume counterclockwise.



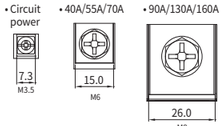
Installation



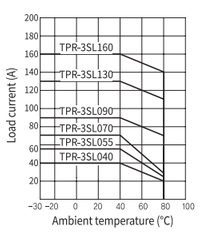
1. Please install it perpendicularly. If the product is installed vertically in unavoidable circumstances, please use 50 % of rated current.
2. When multiple products are closely installed, install them keeping a distance of more than a width of 5 cm and a length of 10 cm as shown in the picture.
3. 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 if the air flow is good enough when installing the product. If the ambient temperature is as low as possible in the inside then the product life span, durability and reliability improve. The operating ambient temperature is 0 °C ~ 40 °C. Please refer to the following graph. However, if the ambient temperature is higher than 40 °C, the max. load current decreases as below.
5. When wiring, use crimp connectors to high current flows terminal. If the contact surface of the connectors and terminals are poor, it may lead to a fire since the wires and terminal get 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



● Current - temperature characteristics

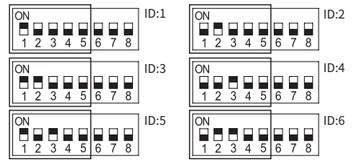


Communication (communication setting dip switch)

1. Communication method: RS485 2-wire half-duplex
2. Communication speed: 9600, 19200, 38400, 57600 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.

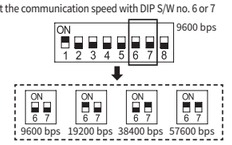


■ Communication protocol selection

• 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	9600, 19200, 38400, 57600	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	9600, 19200, 38400, 57600 bps	
Parity	Even	None
Data bit	8	7
Stop bit	1	1
ID	1 ~ 31	

Communication MAP	
	PROCESS
Address	0
0	SystemID
1	AlarmStatus
2	U Current
3	V Current
4	W Current
5	PWR LMT
6	DIP SW Status
7	OC VR
8	SOFT VR
9	MV OUT
10	LL Control A
11	Rev
12	Protocol
13	BPS
14	Parity
15	Stop Bit
16	Data Length
17	Address

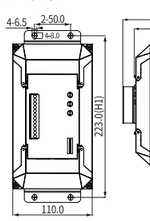
Content by Address				
	Process (0x0000 ~)			
Address	Parameter	Content	Setting range	Unit
0x0000	SystemID	product name	—	
0x0001	AlarmStatus	Alarm status information	Refer to Bit Information	
0x0002	U Current	"U" phase load current value(Phase control only)	0 ~ CT max (X 10)	A
0x0003	V Current	"V" phase load current value(Phase control only)	0 ~ CT max (X 10)	A
0x0004	W Current	"W" phase load current value(Phase control only)	0 ~ CT max (X 10)	A
0x0005	PWR LMT	Output limit set value	0 ~ 100	%
0x0006	DIP SW Status	DIP switch set value	Refer to Bit Information	
0x0007	OC VR	Overcurrent set value	0 ~ 200A (x10)	A
0x0008	SOFT VR	Soft time set value	0 ~ 60	SEC
0x0009	MV OUT	Output amount	0 ~ 100	%
0x0010	LL Control A	Load deviation imbalance phase difference setting	5~20 (X 10)	A
0x0011	Rev	Firmware version	FW version : difference 8 BIT, down 8 BIT	Ver.
0x0012	Protocol	protocol	0 : MODBUS RTU , 1 : MOBUS ASCII	
0x0013	BPS	Communication speed	0 : 9600, 1 : 14400, 2 : 19200, 3 : 38400, 4 : 57600, 5 : 115200	BPS
0x0014	Parity	Parity	0 : NONE , 1 : EVEN , 2 : ODD	
0x0015	Stop Bit	Stop bit	0 : not used , 1 : 1BIT , 2 : 2BIT	BIT
0x0016	Data Length	Data length	7 : 7 , 8 : 8	
0x0017	Address	Equipment address	Address : 1~255	

BIT Information		
Parameter	AlarmStatus	DIP SW Status
Address	1	6
Bit 0	—	—
Bit 1	OC Fail	OUT MODE (00 : not used , 01 : Variable period , 10 : Fixed cycle, 11 : Phase control)
Bit 2	LL Fail	
Bit 3	Over Temp 80	IN MODE (0 : 1~5V, 1 : 4~20mA)
Bit 4	Heat Short	
Bit 5	Power Fail	—
Bit 6	—	—
Bit 7	—	—
Bit 8 ~15	—	—

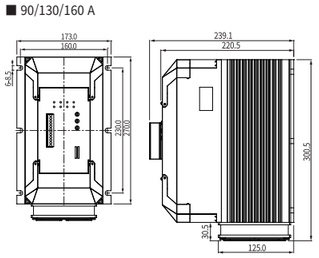
Installation panel cutout

[Unit : mm]

■ 40/55/70 A



■ 90/130/160 A



	H1	H2
70 A (With cooling fan)	249.5 mm	263.5 mm