Vol. 1202E1

Thyristor Power Regulators and Remote Controller

SMART SPR

Digital Thyristor Power Regulator

USER MANUAL

Sanup Temperature Controller

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CONTENTS

Caution for Your Safety

- **Please keep these instructions and review before using this controller.**
- **This instruction manual uses WARNING and CAUTION as signal words for safety.**

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury and at other times will result in death or serious injury. I may also be used to alert against unsafe practice.

WARNING indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.

1. In case of using this unit with machineries (warehouse, medical equipments, vehicle, train, airplane, nuclear power or safety device etc.), it requires installing fail-safe device.
   - **It may result in serious damage, fire or human injury.**
2. Use a rated voltage to prevent damage or trouble.
   - **It may result in fire.**
3. Check the number of terminal when connect each line and signal input.
   - **It may cause fire or trouble.**
4. Do not turn on the power until the wiring completed.
   - **It may cause electric shock.**
5. Do not repair, wiring or checkup when electric power on.
   - **It may cause electric shock.**
6. Installation the controller where there is no dust, corrosive or explosive gas, direct ray of the sun, mechanical vibration or shock present.
   - **It may cause fire or explosive.**
7. This controller must be mounted on panel.
   - **It may cause electric shock.**
8. Do not repair beyond of authorized technician.
   - **It may cause trouble.**

CAUTION indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury and at other times will result in death or serious injury. I may also be used to alert against unsafe practice.

Installation Guidelines

1. Ensure the surrounding ambient operating temperature is between 0~50°C (32~122°F)
   - **It may cause fire or wrong operation.**
2. Altitude over 0~2000m use.
3. Ensure the power supply for the controller does not fluctuate greatly. Main supply voltage fluctuations not exceed ±10% of the normal voltage.
   - **It may cause fire.**
4. Install the controller where there is no dust, corrosive or explosive gas present.
   - **It may cause fire.**
5. Install the controller where there is no risk of mechanical vibration or shock.
   - **It might shorten the life cycle of the product or give an electric shock.**
6. This controller shall not be used outdoors.
   - **It might shorten the life cycle of the product or give an electric shock.**
7. When control signal wire connection, #20AWG (0.5mm2) should be used and screw blot on terminal block with 0.74N.m strength.
   - **It may result in malfunction or error.**
8. Keep the controller away from high current and voltage circuits. The controller and connection wires (esp. compensation conductors and RTD lead wires) should be kept approximately 30cm(12ò) away from high current or voltage circuits to limit the possible affect of noise.
   - **It may cause display fluctuation or error.**
9. Do not use a place where temperature fluctuates or icing occurs.
   - **It may cause fire, explosive or error.**
10. In cleaning the controller, do not use water or an oil-based detergent.
    - **It might cause an electric shock or fire that will result in damage to the product.**
11. Do not inflow dust or dregs into inside of this controller.
    - **It may cause fire or trouble.**
12. Check the number of terminal when connect signal input line.
    - **It may cause fire or trouble.**
13. Installation category II
14. Pollution degree 2

1. General

Smart-SPR is upgraded from TPR-Pro series with advanced digital technology. It may reliability and stability temperature control due to advanced digital technology.

2. Feature

1) Operation by analog (4-20mA) or digital (RS 485) input signals
2) Indicating of analog (4-20mA) signal and output current
3) Automatic output-limit cognition of external volume or internal limit setting
4) Various alarm mode (over current, line failed, Un-load, over-temp. low voltage)
5) Relay alarm output
6) Programmable Soft start
7) Anti-fluctuation by input filtering function
8) Easy alarm confirm by built-in buzzer
9) Output current limit function
10) Built-in watchdog timer
11) RS-485 interface (**MODBUS**® protocol) (Optional)
12) Remote control function by Remote Controller (Optional)
13) Compact Size

3. Installations and Wiring

3.1 Installation Guidelines

1) Ensure the surrounding ambient operating temperature is between 0~50℃.
2) Ensure the power supply for the unit does not fluctuate greatly.
3) Install the unit where there is no dust, corrosive or explosive gas present.
4) Install the unit where there is no risk of mechanical vibration or shock.
5) Keep the unit away from susceptible instruments by high current and voltage circuits. The unit and connection wires (esp. medical instruments, controller and measurement instruments or computers) should be kept approximately 30cm (12ò) away from susceptible instruments by high current and voltage circuits to limit the possible affects of noise.

3.2 Wiring

1) Power

Prior to applying power, ensure the supply voltage is connected to the correct terminals as ordered specification or marked on the electrical connection diagram. Connect the power supply voltage to input line terminals.
Tighten the power connections correctly. Poor tightening can lead to incorrect operation of the unit and can have serious consequences on the installation. All capacity is necessary to connect the power cables using round lugs. See table 1.

Note) Keep the connection line does not shifting R, S and T.

Table 1. Line Input, Output Terminals

Symbol	Description	Operation	Note
R	Input of line R	Input power line	Keep the connection line does not shifting R, U and T.
U	Output of line U		
T	Input of line T		

2) Wiring for control signals

The control signals terminals are located at the inside of the front.
They are used to connect:

-the control signal 4~20mA and the run contact

-the external V.R and the alarm output contact

-the interface terminals and power supply

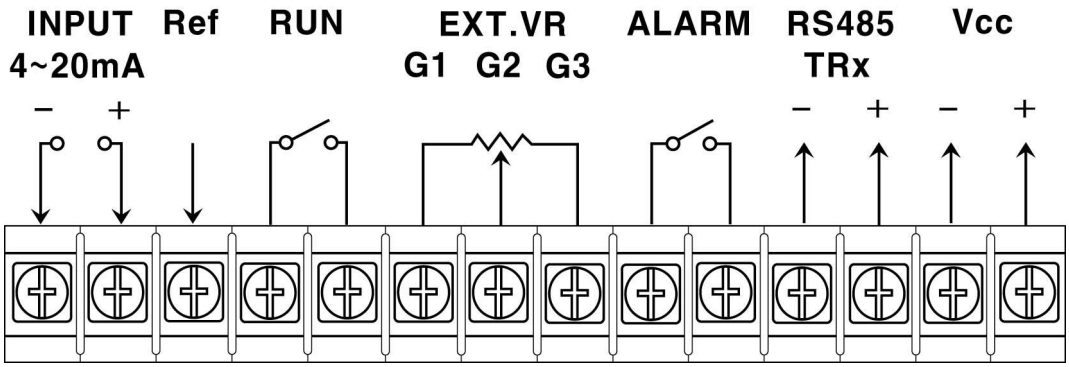

Figure 1. Control signal terminal block

Note 1) Keep isolated between control signal line and power line.
Note 2) Ensure the power supply output voltage (+, −) for the remote controller does not shortage.

Table 2. Control signal terminal

Position	Name	Assignment	Note
1	Control signal input (−)	4-20mA analog input. Input impedance is 250Ω.	
2	Control signal input (+)		
3	REF	1. Supplement +12V power. 2. Suitableness for ON-OFF control. 3. Suitableness for external V.R. input.	Supplement current is 40mA max.

4 5	RUN	Output enables or disable. 1. Suitableness for ON-OFF control. 2. Suitableness emergency stop.	
6 7 8	G1 G2 G3	Connecting external V.R., 1. Suitableness for output limit 2. Suitableness for non-signal control.	V. R.: 1kΩ 1W A-type.
9 10	Alarm output	Relay alarm contactor	250Vac 3A (R load)
11 12	RS485 (-) RS485 (+)	1. RS-485 Interface 2. Connect to remote controller	Optional **MODBUS**® Protocol
13 14	V cc - V cc +	Power supply for remote controller (+12VDC, 200mA)	Optional

4. Operation

4.1 Controller Description

4.2 Indicating

Upon connecting power the unit is in a state of automatic operation and the input signal or load current capacity is indicated on the front display.

If press [ENT] Key more than 2 second change display to input signal and load current capacity R and T line.

Top LED is control signal input sign. (Unit=%)

Middle LED is load current capacity sign of line R. (Unit=A)

Bottom LED is load current capacity sign of line T. (Unit=A)

4.3 Changing Parameters

The set value can be changed by using [▲], [▼] and [ENT] key.

1) If press the [PAR] key, shift input signal to [PAS] for password input.

2) Pass value can be changed by using the increase[▲] and decrease[▼] key on displayed PAS display.

3) After changing the value of a password, the right decimal point blinks, indication the parameter has not been accepted.

4) By pressing [ENT] key this value is accepted and entered into EEPROM

(nonvolatile memory). When the accepted the decimal point disappears.

- Enter password to access parameters setting group. Password is “5”.
- Enter password to access interface parameters setting group. Password is “15”.

5) If pressing [PAR] key, can be select each parameters when entered pass value.

6) Set parameter value after select using parameter.

7) Once finished changing parameter values, pressing [PAR] key for more than 2 seconds returns the controller to normal operation and the process value will be displayed. Waiting approximately 80 seconds without pressing the key will return the meter to normal operation as well.

4.4 Parameters

See table no. 3 for setting parameters.

Table 3. Parameter list

No.	Symbol	Setting Data	Range	Operation	PASS
0	-	Indicating		Changeable display of input signal or load current by [ENT] key.	None
1	PAS	PASS number		Protection of operating parameter	
2	OUt	Output limit high	0~100%	Disable when connected external VR.	5
3	CLn	Load current limit high	5~240A		
4	SSt	Soft Start time	1~250 sec.	If set to ‘0’ stop the function.	

5	CnD	Operation for over current limit alarm.		ALm: Alarm only OFF: Cut off output Cnt: Output control	5
6	PnD	Operation for line failed alarm.		ALm: Alarm only OFF: Cut off output	
7	tnD	Operation for over temperature alarm.		ALm: Alarm only OFF: Cut off output	
8	FLt	Input Filter	0~10 sec.	Against for fluctuation	
9	LbA	Wait time for un-load alarm.	0~254 sec.	If set to '0' stop the function.	
10	bUZ	Operation for internal buzzer.	OFF, ON	OFF: Turn off On: Turn on	
11	SnD	Select input	Analog, Interface	AnA: Analog (4~20mA) COm: Interface	15
12	AdS	Address for interface	0~31	RS 485 address	
13	SPd	Speed for interface	2400, 4800, 9600bps	RS 485 speed	
14	Cdy	Delay time for interface	1~4	Delay time for reply	

4.5 Wiring and Operating According to Control Signal

1) 4~20mA Current Input Signal

This is frequently used operation for control. Control signal is 4~20mA dc current. Maximum output voltage is limited by external V.R or OUt parameter value.

Note 1) In case of connect external V.R, keep the terminals number.

Note 2) If connect external V.R, at G1, G2, and G3 terminal, disable internal parameter OUt automatically.

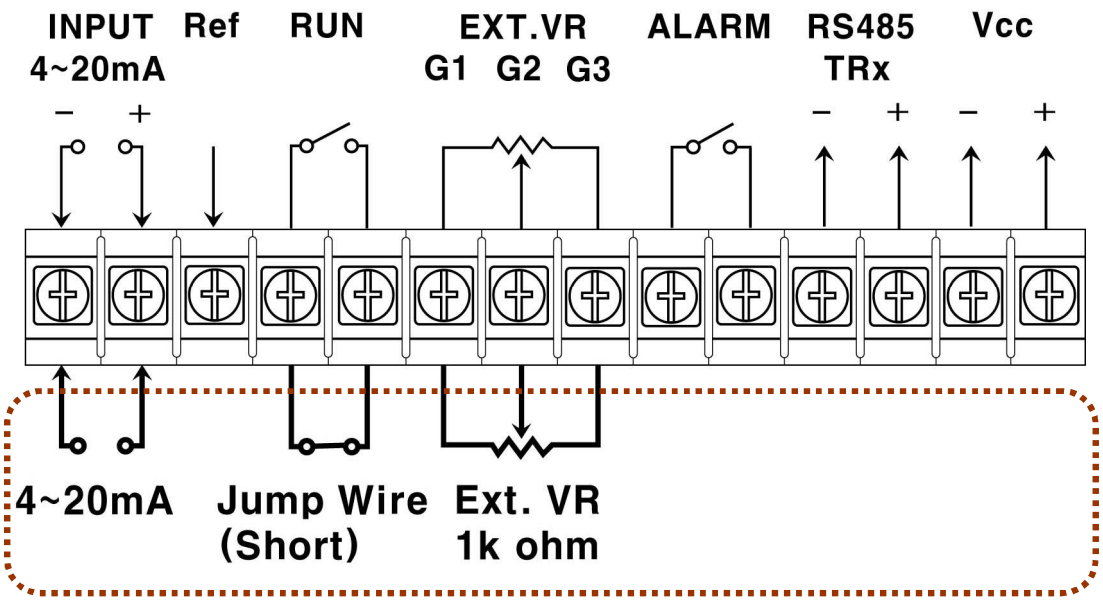

Figure 2. Wiring for current input signal

2) ON-OFF Contact Input Signal

Output will be un-continuous ON-OFF by dry contact signal.

Maximum output voltage limit by output limit parameter [OUt] or external V.R.

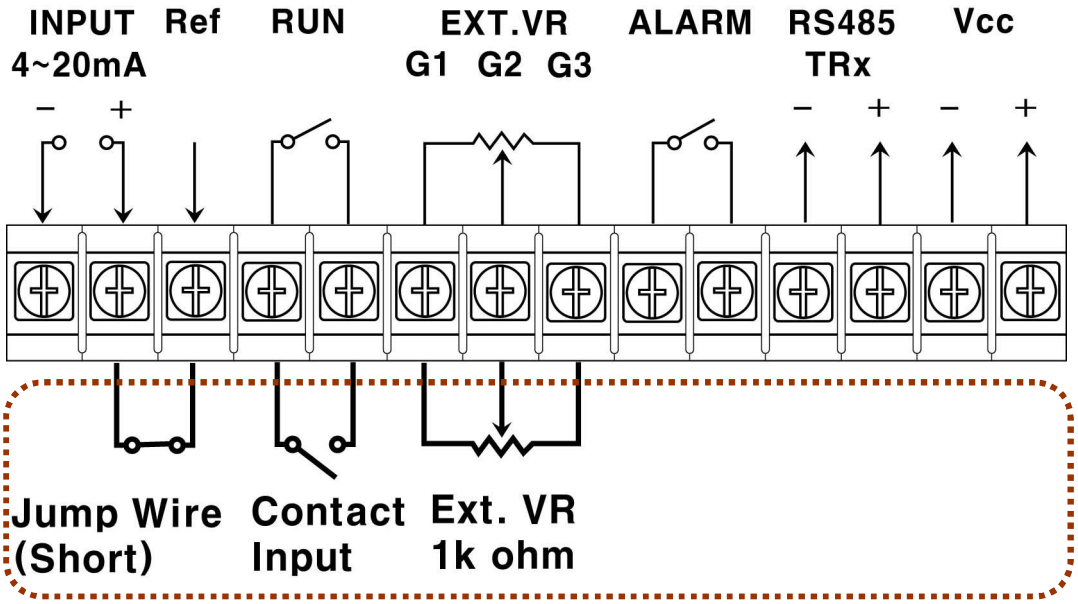

Figure 3. Wiring for contact input signal

3) Manual control by external V.R

Output power will be control by turn angle of output limit V.R or output limit parameter (Symbol: OUt).

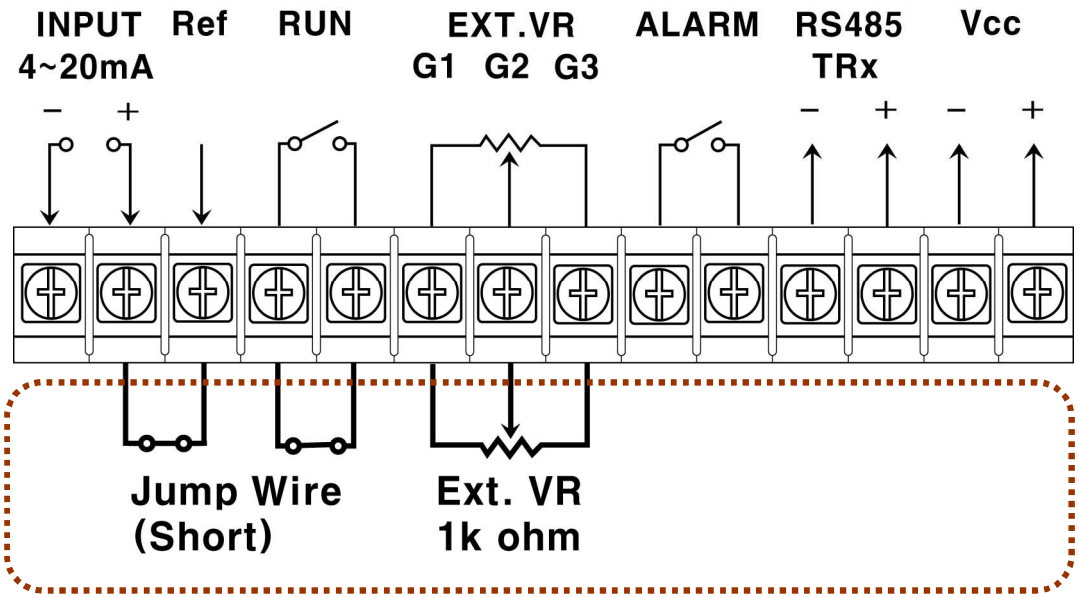

Figure 4. Wiring for non-control input signal

4) RS 485 Interface (Optional)

TPR-3E PLUS will be control by RS-485 interface signals.
Apply power to the TPR-3EPLUS and go to parameter (Symbol: Smd). Set up the control signal input (Symbol: COm). Refer to the TPR-3E PLUS interface manual for instructions on using interface.

Note) If control signal input selected interface, current signal control will be disable.

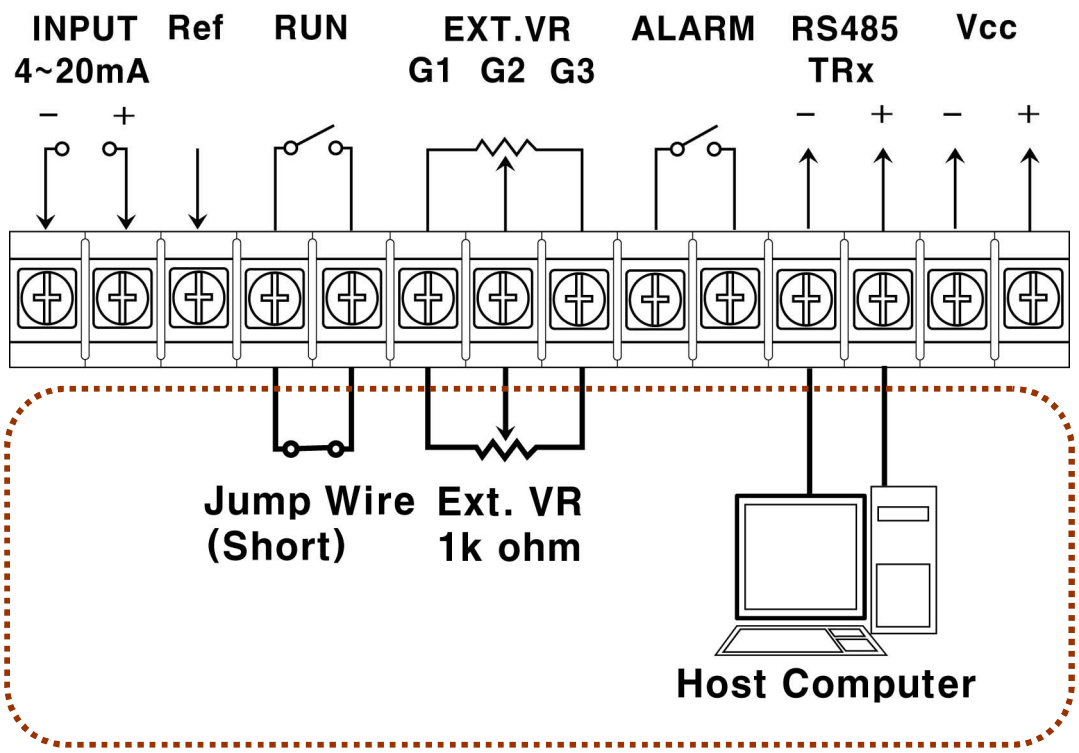

Figure 5. Control by RS 485 Interface

5. Remote Control (Optional)

-Changing parameter by interface function
-Display to operating condition
-Display power current value

5.1 Wiring for Remote Controller (RC-1000)

1) Short distance installation
In case of Install distance is less than 10m: Use main unit power. (Terminal Vcc)

2) Long distance installation
In case of install distance is more than 10m till 1200m: Select remote controller power option. (90-240VAC, 50/60Hz)

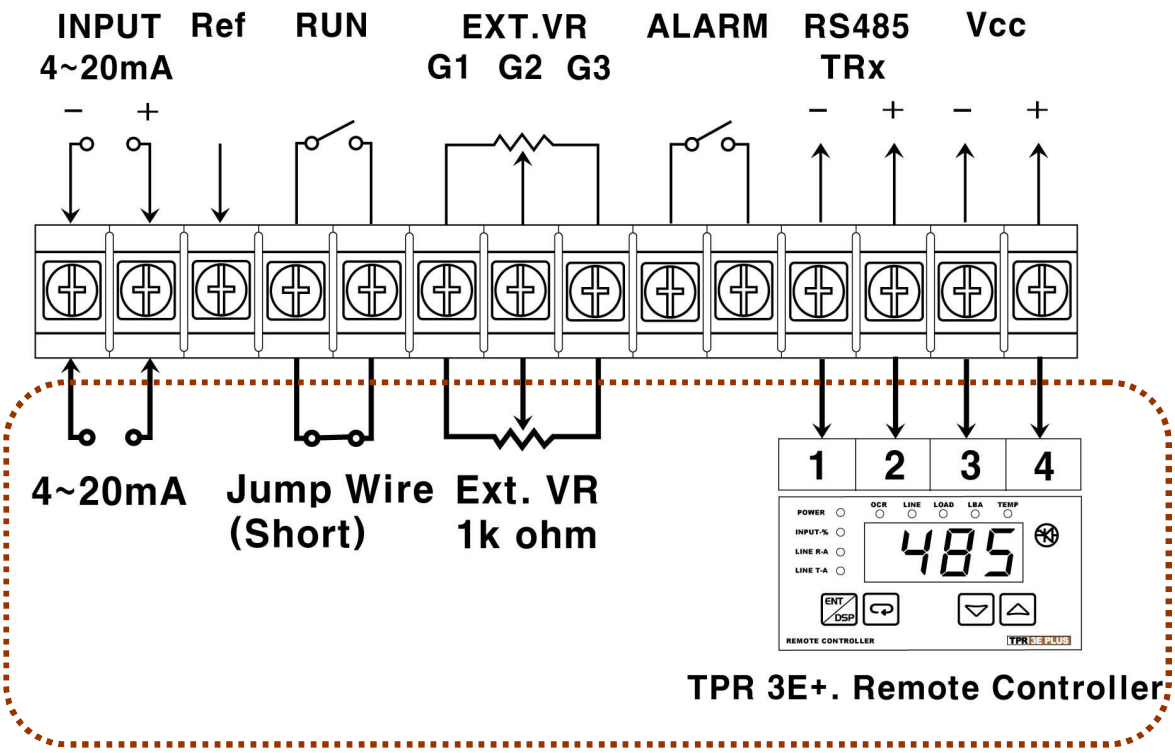

Figure 7. Wiring Remote Controller

5.2 TPR-3E PLUS Parameter Setting Connected Remote Controller

Table 5. Parameter Setting

No.	Symbol	Setting Data	Range	Set Value	Description	PASS
11	SnD	Select input	Analog, COm	Refer to set remote Controller for control type		15
12	AdS	Address	0~31	1	No. 1	
13	SPd	Speed	2400, 4800, 9600bps	96	9600bps	
14	Cdy	Delay time	1~4	1	Default	

5.3 Remote Controller RC-1000

All remote controller functions are almost same with main unit controller function except below.

1) Reset key function from front panel
2) Fixed interface parameters: Address; 1, Speed; 9600 BPS, Delay Time; 1

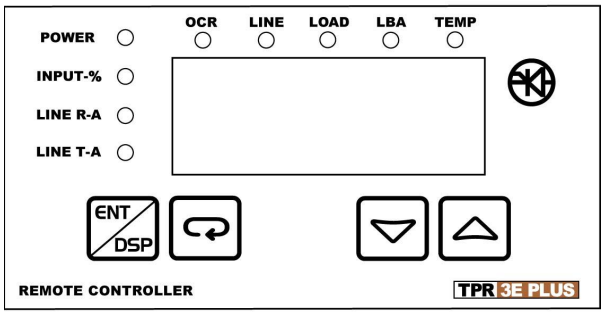

Figure 6. Front of Remote Controller

Table 4. Remote Controller Parameter List

No.	Symbol	Setting Data	Range	Operation	PASS
0	-	Indicating		Changeable display of input signal or load current by [ENT] key.	None
1	PAS	PASS number			
2	OUt	Output limit high	0~100%	Disable when connected external VR.	5
3	CLn	Load current limit high	5~240A		
4	SSt	Soft start time	1~250 sec.	If set to '0' stop the function.	

5	CnD	Operation for over current limit high		ALm: Alarm only OFF: Cut off output Cnt: Output control	5
6	PnD	Operation for line failed		ALm: Alarm only OFF: Cut off output	
7	tnD	Operation for over temp.		ALm: Alarm only OFF: Cut off output	
8	FLt	Input filter	0~10 sec.	Against for fluctuation	
9	LbA	Wait time for un-load	0~254 sec.	If set to '0' stop the function.	
10	bUZ	Operation for internal buzzer	OFF, ON	OFF: Disable On: Enable	
11	CSP	Remote set value	0~100%		15
12	SnD	Select input	Analog, COm	AnA:Analog (4~20mA) COm: Interface	

Note) If set to the 'Com' on parameter no 12, TPR output will control by the remote set value of parameter no. 11.

6. Specification

6.1 Specification

Voltage: One of AC 220V, 380V, 440V (AC 100V, 110V, 120V, 200V, 240V, 460V are made by order) . ±10%

- Cycle: 50/60Hz
- Current capacity: 100A, 120A, 150A, 190A, 240A, 500A.
  (in case of ambient temperature is 50℃ or less)
- Control Mode: Phase angle
- Input Signal: DC4~20mA (Input impedance 250Ω), ON-OFF dry contact, Non-signal (1kΩ VR), Interface (RS485 MODBUS Protocol)
- Output: Maximum 97% of input voltage
- Load: All resistance loads. Primary of transformer
- Interface Protocol: RS 485. MODBUS®
- Operating Temperature: 0~50℃
- Cooling: Under 100A: Natural Cooling
  Above 150A: Fan
- Alarms: Over Current, Partial Line Failure, Low Voltage, Unload, Thyristor Overheating. SCR Short.
- Alarm Output: AC 250V 1A (R Load)
- Insulation Test: Between Power Terminal and Case AC 500V 50MΩ or more
- Puncher Test: Between power terminal and case AC 2000V. 1 min.
- Dimension: 100A, 120A - 150(W) X 276(H) X 172(D) (mm)
  150A~240A - 180(W) X 350(H) X 220(D) (mm)

6.2 Specification of Remote Controller

- Input: Direct communication with Smart-SPR/TPR (Fixed Address 1, Speed 9600bps, Delay Time 1)
- Max. Install Distance: In case of using main unit power; 10m or less
  In case of built-in power board; 1200m max. (Optional)
- Display Parameter: Input signal (%), R and T Φ output current (A)
- Dimension: 96(W) X 48(H) X 100(D) (mm)

6.3 Power capacity and fuse model

SMART SPR
Digital Thyristor Power Regulator

(Power factor cosΘ =1)

Model	Ampere (A)	Power Capacity and used fuse model					
		220V		380V		440V	
		kw	Fuse	kw	Fuse	kw	Fuse
SMART-SPR/TPR	35	13	JR 31-40	23	JR 61-40	26	JR 61-40
	50	19	JR 31-60	32	JR 61-60	38	JR 61-60
	80	30	JR 32-100	52	JR 62-100	60	JR 62-100
	100	38	JR 32-120	65	JR 62-120	76	JR 62-120
	120	45	JR 32-150	78	JR 63-150	91	JR 63-150
	150	57	JR 33-180	98	JR 63-180	114	JR 63-180
	190	72	JR 36-200	125	JR 66-200	144	JR 66-200
	240	91	JR 36-250	157	JR 66-250	182	JR 66-250

SMART-SPR-TPR Optional Price

Item	Spec.	Price (USD)	Remark
RS 485 Interface	MODBUS	20.00	
SMART-SPR/TPR Remote Controller RC-1000	96 X 48 X 100 (mm)	60.00	Optional power for long distance:20.00

Note 1) Use only rapid fuse for semiconductor.

Note 2) Exhortation capacity is 60% or less than of maximum capacity.

Note 3) Equation three phase power: P(kw) = V X I

Note 4) This manual is subject to change without notice.

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