New Digital TPR
User Manual

Application Model: WYU-SDxxxSM/TM

Read the user manual before using the product

REV.7

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WOONYOUNG CO.,LTD.

Contents

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For the Right Use

Fro the right use of the product, be sure to read the following details before use. Our company is not responsible for the accident occurs from not observing the following details.
Be sure to have the designated expert install, wire, operate, repair, and check the product.
Precautions are categorized into the two kinds such as warning and caution. The meaning of warning and caution is as follows.

⚠️**Warning** If there is a possibility of causing serious injury or death from an handling error

⚠️**Caution** If light injury or product damage occurs from an handling error

⚠️ Warning

【Use】

- The product is used for the general industry. Do not use it for the equipment (Ex.: Nuclear power control, medical devices, vehicles, railroad, aerospace, combustion devices, entertainment devices, or safety devices) having a great effect on the human life or the property. Please contact the sales office for the usability for the purpose of use.
  Fire, mortality events, and property loss may occur.
- The sufficient inspection is done during the release of the product, but the double safety measure on the system needs to be taken due to the possibility of the product failure.
- In case of the continued use with the protection fuse disconnected, the product breakage or the secondary disaster may occur.
- The fuse embedded in the product is installed for protecting the thyristor module. Prepare the protective circuit breaker separately.
- Do not do connection, check, and repair activities during energization. Use it with the cover closed during current carrying.
  It becomes the cause of electric shock.
- The system unit and radiator has the high temperature during operation or right after power disconnection. Do not touch them.
- Do not touch the load terminal right after power disconnection.
  Electric shock may occur.
- Do not remodel the product.
  Fire or electric shock may occur.

【Connection】

1. Be sure to use it by mounting it to the panel and earth FG or the ⏚ terminal.
   - Electric shock may occur.

2. In case of connecting power, be sure to check the input power specification and the terminal number for connection.
   - Fire may occur.

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⚠ Caution

【Use】

- Do not use it outside.
  It becomes the cause of shortening the product life cycle, and electric shock may occur.
- Be sure to use it within the rating and performance ranges.
  It becomes the cause of shortening the product life cycle and generating failure.
- Do not do installation and operation in the following places.
  Failure or fire may occur.
  - The damp place
  - The poorly ventilated place
  - The place contacted by the direct light
  - The place where dust or impurity is accumulated
  - The place where the ambient temperature is high or low
  - The place where the system unit directly receives vibration or impact
  - The place exposed to water, oil, chemical, vapor, salt, iron, etc.
  - The place where induction disorder, static electricity, and magnetic noise are generated
  - The place where the corrosive and combustible harmful gas such as acid, ammonia, etc. is generated
- Do not have the harmful conductor such as dust or wire residue come into the inside of the product.
  Failure and fire may occur.
- As the harmonic current (noise) is generated during the phase control operation of the product, review the harmonic current measure.
- The flicker phenomenon may occur depending on the effect of the power capacity during the zero cross control operation of the product. Use it with the product capacity (load capacity) rate for the power capacity being no more than some %.
- For the product, the temperature inside the thyristor element changes greatly (high and low temperatures repeated in the short time of the minute unit). If operation is executed, the lifetime of the thyristor element is shortened remarkably depending on the heat fatigue. In case of utilizing the use method, select the TPR with the rating current being one stage higher for the operation with less than 80% of the rating current.
- If the abnormality of the product is found, shut off the power immediately.
- As the TPR has the door structure, be careful not to have the finger pinched during the door opening and closing and do the work.
- The cooling fan is spinning at the high speed. Be very careful no to have the finger or the object close to it.

【Connection】

- Pay attention to the wire thickness based on the load current in case of power and load wire connection.
  If wire is thin compared with the current, there is a fire risk.
- Fasten the screw of the terminal block with the necessary torque.
  If the screw is released, fire may occur from the bad contact.

【Installation】

● Be careful not to get hurt by the bump or the corner during the work.
● Be very careful of the accident such as the falling of the unit during the work in case of transport or installation.
● Use the required quantities of the suitable mounted bolts and holes of the product for fixing.

【Repair】

● Prohibit the use of water and an organic solvent during cleaning.
  Electric shock, fire, and product deformation may occur.

【In Case of Disposal】

● In case of product disposal, dispose of it as the industrial waste.

1. Preface

Thanks a lot for purchasing the "AC Power Regulator WYU-SD" series before use.

Please read the user manual carefully before use for the right use.

Furthermore, the user manual becomes the manual for the single and three phases. If there is no special statement, read it as the common details.

2. Before Use

2-1 Product Overview

A control type can be selected from the 6 types (phase/zero cross/phase→zero cross/constant current/constant voltage/constant power) in the broad main circuit load voltage (AC90~500V). As it has the embedded setter with the easy operability and responds to the overseas standard CE marking, it can be used in various areas.

2-2 Product Features

- Digital control
- Various operation functions
  - Phase control mode
  - Zero cross control mode
  - Phase→zero cross mixed control mode
  - Constant current control mode (CC)
  - Constant voltage control mode (CV)
  - Constant power control mode (CP)
- Indicating the setting value, the measurement value, and alarm details on the LCD (2×16 LCD)
- 2 alarm output contacts
  - Major Failure Relay:1 unit (Alarm1)
  - Minor Failure Relay:1 unit (Alarm2)
- Automatic frequency identification (50/60Hz)
- Automatic phase tracking function
  - Control is executed with the automatic adjustment in spite of the wiring in the negative phase in case of the three phase so that the negative phase error doesn't occur.
- Heater disconnection detection function
- Response to the Mode bus485 communication
  - The communication control and monitoring of maximum 32 units can be done.

2-3 Model Composition

WYU-SD ☐☐☐ ☐ M

S : SINGLE PHASE(1P)
T : THREE PHASE(3P)

SERIES Name
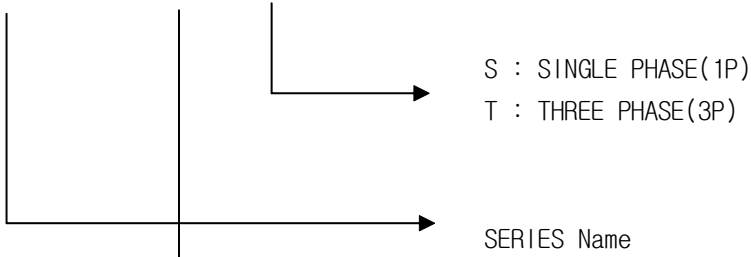
Phase Category	Current Capacity			Case Size Category
Single Phase	0	2	5	CASE-A
	0	4	0	
	0	5	5	
	0	7	5	
	0	9	0	CASE-B
	1	1	0	
	1	3	0	
	1	6	0	
	2	0	0	CASE-C
	2	5	0	
	3	2	0	
	4	0	0	CASE-D
	5	0	0	
Three Phases	0	2	5	CASE-A
	0	4	0	CASE-B
	0	5	5	
	0	7	5	
	0	9	0	CASE-C
	1	1	0	
	1	3	0	
	1	6	0	
	2	0	0	CASE-D
	2	5	0	
	3	2	0	
	4	0	0	CASE-E
	5	0	0	

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2-4 Check of the Ordered Product

- Be sure to check whether the product corresponds to the ordered product before installing the product.
- Check whether there is damage during transport.
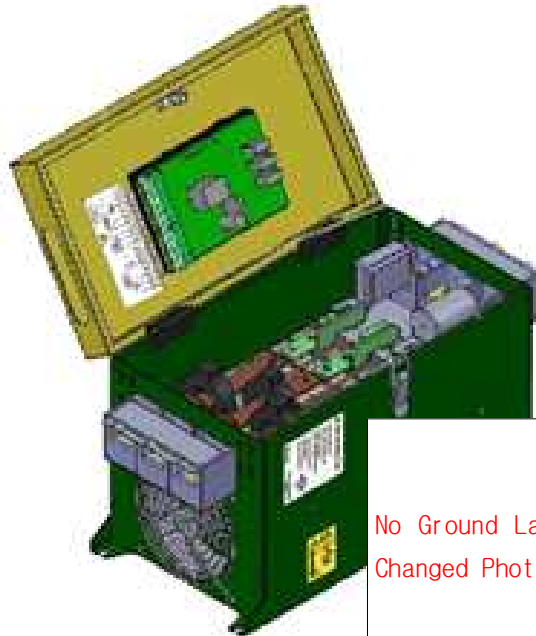
No Ground Label, Ground Terminal Position Changed Photo

2-5 Repair Item (Fuse List)

Model Name	Rated Current Capacity	Fuse Type	
		BUSSMANN	HINODE
WYU-SD25□□	25A	BS88 50FE	660GF-50UL
WYU-SD40□□	40A	BS88 71FE	660GH-63UL
WYU-SD55□□	55A		60GH-80UL
WYU-SD75□□	75A	BS88 100FE	660GH-100UL
WYU-SD110□□	110A	170M1368	660GH-125UL
WYU-SD130□□	130A	170M1369	660GH-160UL
WYU-SD160□□	160A	170M1370	660GH-250UL
WYU-SD200□□	200A	FWH250A	
WYU-SD250□□	250A	FWH300A	
WYU-SD320□□	320A	FWH400A	
WYU-SD400□□	400A	FWH500A	
WYU-SD500□□	500A	FWH600A	

2-6 Specification

Category		WYU-SD□□□SM	WYU-SD□□□TM
Phase		1	3
Module		SCR module-1ea (2Arm)	SCR module 3ea (6Arm)
Rated input voltage		90V ~ 500Vac	
Aux. power		AC 200~240V (External supply)	
Frequency		50Hz/ 60Hz (Automatic selection with the line frequency detection)	
Rated Current	CASE-A	25A　　　　　　　　(Air Cooling)	
	CASE-B	40A/55A/75A　　　　(FAN Cooling)	
	CASE-C	90A/110A/130A/160A　(FAN Cooling)	
	CASE-D	200A/250A/320A　　(FAN Cooling)	
	CASE-E	400A/500A　　　　(FAN Cooling)	
Road control	Phase Control	Output adjustment range: 0~98% (For the input voltage)	
	Constant Current Control	• Output Adjustment Range: 0~98% (For the input current) • Level: ±1% (For the rated current) • Change Range: Load change by 1 to 2 times	
	Constant Voltage Control	• Output Adjustment Range: 0~98% (For the input voltage) • Level: ±1% (For the rated power) • Change Range: Load change by 1 to 2 times • ±10% power change for the rated voltage	
	Constant Power Control	• Output Adjustment Range: 0~98% (For the input voltage) • Level: ±1% (For the rated power) • Change Range: Load change by 1 to 2 times • ±10% power change for the rated voltage	
	Zero Cross Control	Output Adjustment Range: 0~98% (For the input voltage)	
Soft start setting		• Soft start : 0~50 sec (0=0.3sec) • Soft up/down : 0~50sec　(0=0.3sec)	
Load type		Resistive / inducive loads (The 1st side control of the transformer)	
Control input		DC4-20mA / DC 1-5V / V.R / JOG dial / Modbus485	
Display		LCD (2*16)	
Setting		Mode button (1ea), Enter+VR encoder (1ea)	
Communication		Modbus 485 R/W (9600,14400,19200,38400bps)	
Signal terminal		Signal+VR Input(4ea), Run/Stop+automatic/manual (3ea), communication (2ea),alarm (3ea), supplementary power+FG(3ea), and single phase sync(1ea)	
Load terminal	Terminal block	25~75A	25~160A
	BUSBAR	90~500A	200~500A
Dielectric withstand voltage		Load Terminal-Earth : 2,000Vac 1min Signal terminal-Earth : 500Vac 1min Aux power-Signal terminal-Load terminal : 2,000Vac 1min	
Insulation resistance		100MΩ(at 500Vdc mega)	
Operating temperature		0~40℃ (at non-freezing status)	
Operating humidity		35~85%RH	
Storage temperature		-20~80℃ (at non-freezing status)	

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2-7 Temperature Characteristics Data
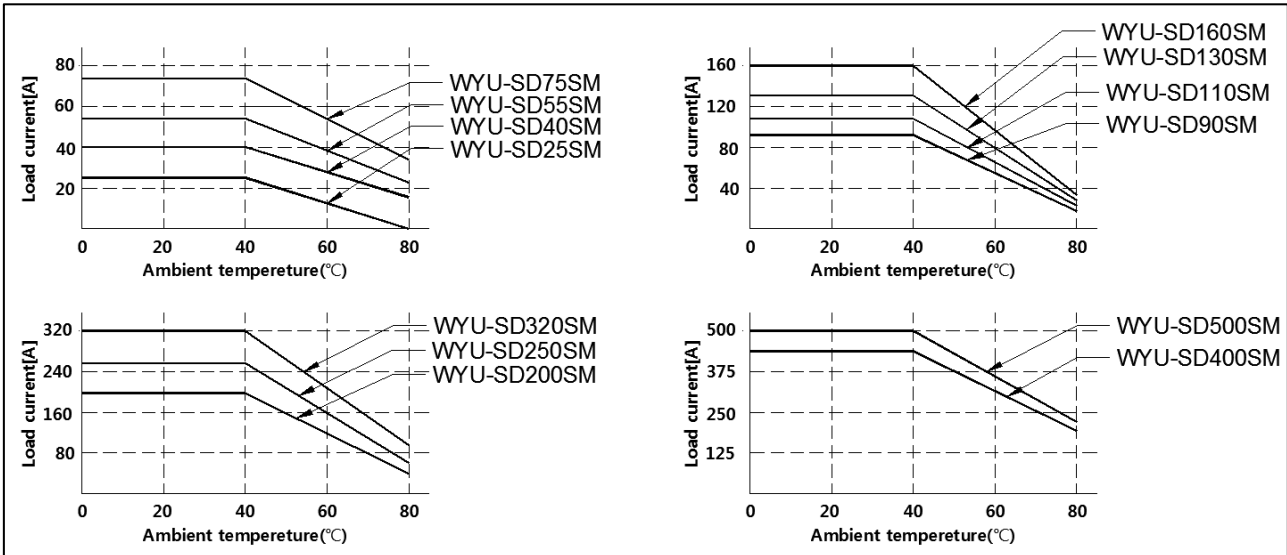
WYU-SD□□□SM Temperature Characteristics
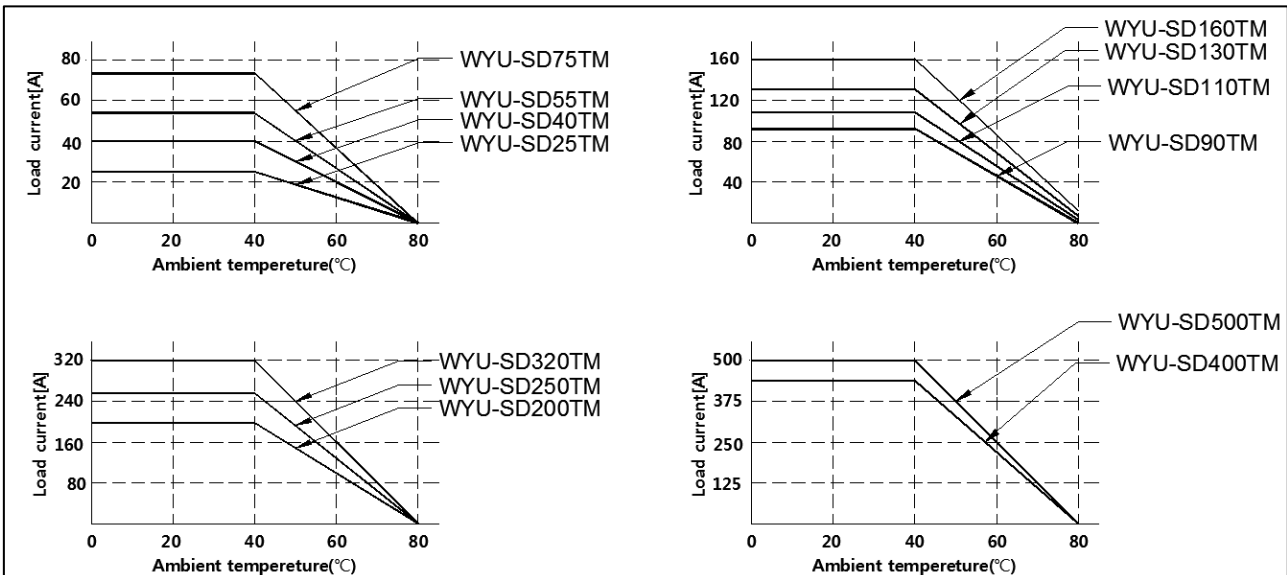
WYU-SD□□□TM Temperature Characteristics

3. How to Use

3-1 Use Conditions

● Do not apply the current being no less than the rated current. It causes heating.

● Lower the ambient temperature for the product and use it within the range of the operating temperature.

● The product opens and closes the load with the semiconductor element. Hence, the temperature inside the box is increased with the heating caused from current carrying. Furthermore, as the radiator becomes very hot, reliability can be improved by lowering the ambient temperature with the ventilation done by adding the fan to the control panel.

3-2 For Installation

● **Because of the possibility of having a major effect on the WPVA lifetime, please do not do installation in the following places.**

  • The damp place
  • The poorly ventilated place
  • The place contacted by the direct light
  • The place where dust or impurity is accumulated
  • The place where the ambient temperature is high or low
  • The place where the system unit directly receives vibration or impact
  • The place exposed to water, oil, chemical, vapor, salt, iron, etc.
  • The place where induction disorder, static electricity, and magnetic noise are generated
  • The place where the corrosive and combustible harmful gas such as acid, ammonia, etc. is generated

● The product has the door structure. Hence, do installation in the place where the front door of the product can be opened and closed to facilitate cleaning and repair.

● Mount the product vertically.

● 4Fix all the 4 mounting holes with bolts.

● Prepare the exhaust fan in the upper side of the control panel mounted to the product and the intake fan in the lower side of it.

【Installation Conditions】   【Ventilation Method of the Control Panel】
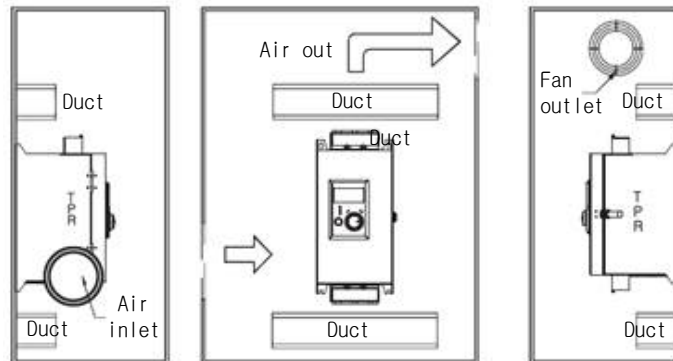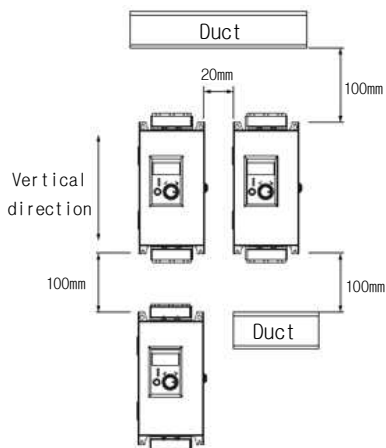
【Relation to duct height】

< faulty >   < good >   < good >
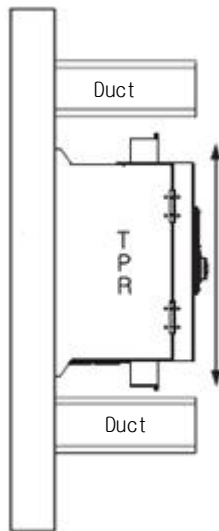
If the upper and lower sides are blocked by the DUCT, heat dissipation is reduced.
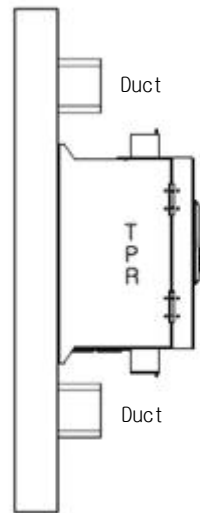
Please use a low DUCT .
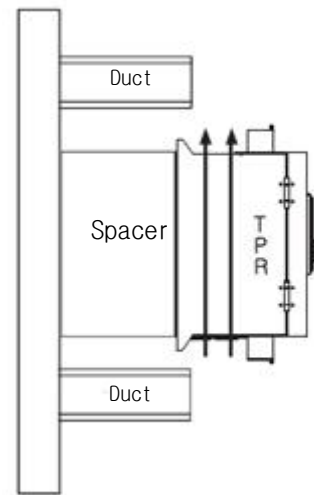
If low DUCT is difficult to use, use a base (metal).

3-3 For Connection

● Connect the I/O wire depending on the terminal number.

● Be sure to connect the earth wire to the earth terminal to prevent electric shock.

● Check the insulation resistance between electric wires and the load resistance of the load before connecting the load.

● Connect the input or outside volume of the temperature indication controller on the basis of 5-2 Control Terminal Composition and 5-3 Connection Diagram.

● Fasten the various bolts of the product with the regulation torque not to cause malfunction.

● Do not use it with the bolt of the output terminal released. The terminal and inside heat generation becomes the cause of ignition.

● Use the 1.5㎟ vinyl electric wire (twisted wire) as the wire for the control terminal. Moreover, do the twister phase wiring. Do the twister 5 times/1m or more.

● Do not do the parallel wiring of the control and power wires for the controller and the external contact for the alarm output signal and do wiring at intervals if possible.

● Regulation Torque Table

BOLT	Regulation Torque
M4	1.1~1.4N.m
M5	2.1~2.9N.m
M6	3.5~4.8N.m
M8	8.4~11.3N.m
M10	16.7~22.6N.m

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● Correspondence Table for the Electric Wire and the Tongue Terminal

Rated Current Capacity	Recommended Size of the Used Electric Wire		Suitable Tongue Terminal	Size of the Tongue Terminal[mm]		
				External Diameter	Internal Diameter	Length
25A	6 ㎟	1 Phase	JOR6-6	12	6.4	26
		3 Phase	JOR6-5	9.5	5.3	20
40A	10 ㎟	1 Phase	JOR10-6	12	6.4	24
		3 Phase	JOR10-5	12	5.3	24
55A	16 ㎟	1 Phase	JOR16-6	12	6.4	30
		3 Phase	JOR16-5	12	5.3	30
75A	25 ㎟	1 Phase	JOR25-6	16.5	6.4	34
		3 Phase	JOR25-6	16.5	6.4	34
90A	35 ㎟		JOR35-6	22	6.4	43
110A	35 ㎟		JOR35-6	22	6.4	43
130A	50 ㎟		JOR50-6	20	6.4	50
160A	50 ㎟		JOR50-6	20	6.4	50
200A	70 ㎟		JOR70-8	24	8.4	51
250A	95 ㎟		JOR95-8	27	8.4	55
320A	120 ㎟		JOR120-8	32.5	8.4	62
400A	150 ㎟		JOR150-10	36	10.5	68
500A	185 ㎟		JOR185-10	38.5	10.5	69

3-4 Operation Method

● Refer to 5-2 Control Terminal Composition and 5-3 Connection Diagram.
● If all the items of 3-3 Connection, turn on the main power.
● Continue operation in case of the normal operation state.

3-5 For the Application Load

The application load of the product responds to the following heating element.
● The heating elements with the small resistance change to the heater temperature including nichrome or iron chrome
  • Phase control, constant current control, constant voltage control, constant power control, and zero cross control can be used as control types.
● The heating elements having the very big resistance change to the heater temperature including the puree metal heating elements such as platinum, molybdenum, tantalum, tungsten, etc. or non-metal heating elements such as molybdenum silicate, etc.
  • The constant current control is optimal.
  ※ Please calculate the margins for various change factors at the customer's discretion.
● The heating elements in which the resistance change to the heater temperature is big and the electric resistance caused from heater consumption changes along time
  • The constant power control is optimal.
  ※ Please calculate the margins for various change factors at the customer's discretion.

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4. Control Terminal Connection

● Manual Setting

```
┌─────────────────────────────────────────────────────────────────┐
│  1  2  3  4  5  6  7  8  9   10 11 12 13 14 15 16                │
│     1  2  3                       ~  ~                           │
│    외부볼륨                                                       │
│    10kΩ                                                          │
│    ON:Manual                       1 Phas : S                    │
│    OFF:Auto                        3 Phase : N.C                 │
│      ON:Run                                                      │
│      OFF:Stop          Aux.Power                                 │
│                        AC 200-240V                               │
└─────────────────────────────────────────────────────────────────┘
```
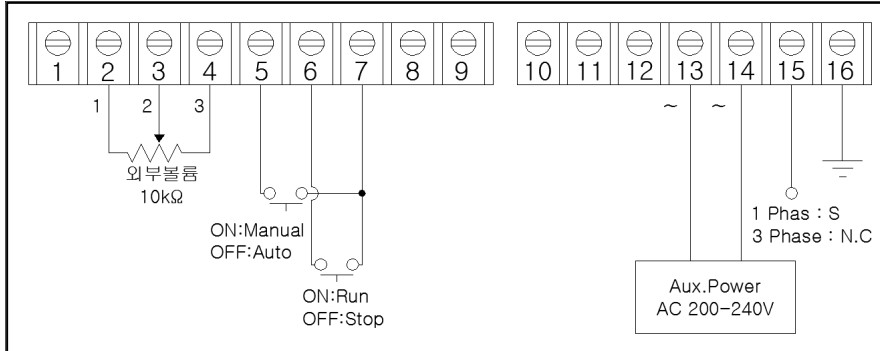
- The control quantity can be controlled with the external volume.
- Use the external volume of 10KΩ.

● RUN/STOP Signal

```
┌─────────────────────────────────────────────────────────────────┐
│  1  2  3  4  5  6  7  8  9   10 11 12 13 14 15 16                │
│                                   ~  ~                           │
│                                                                 │
│                                    1 Phas : S                    │
│                                    3 Phase : N.C                 │
│        ON:Run                                                    │
│        OFF:Stop        Aux.Power                                 │
│                        AC 200-240V                               │
└─────────────────────────────────────────────────────────────────┘
```

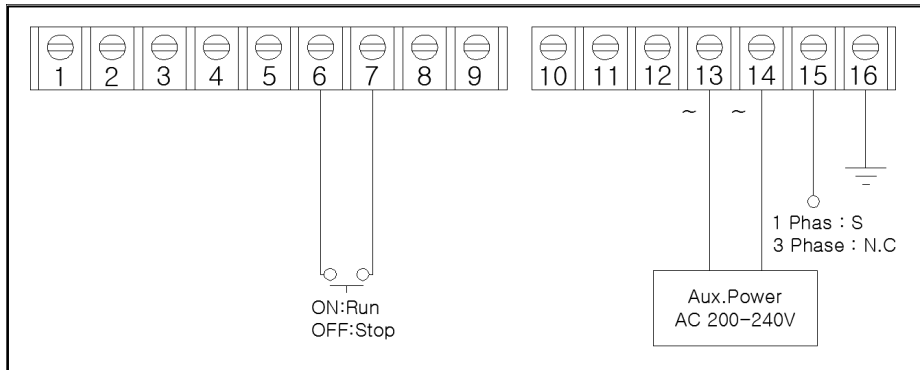- Control is authorized. If the operation Run signal is not connected, do not operate (output) it.
- If the contact point is "ON", operate it. (If the contact point is "OPEN", operation is suspended.)
- Connect the zero voltage contact point or the open collector output (DC24V minimum 20mA).
- Do the short circuit processing in case of not using the operation start signal.

● ALARM Output Signal

```
┌─────────────────────────────────────────────────────────────────┐
│  1  2  3  4  5  6  7  8  9   10 11 12 13 14 15 16                │
│                             N.O N.O COM ~  ~                     │
│                                  AL2                             │
│                                  AL1       1 Phas : S            │
│                                            3 Phase : N.C         │
│                             Aux.Power                            │
│                             AC 200-240V                          │
└─────────────────────────────────────────────────────────────────┘
```
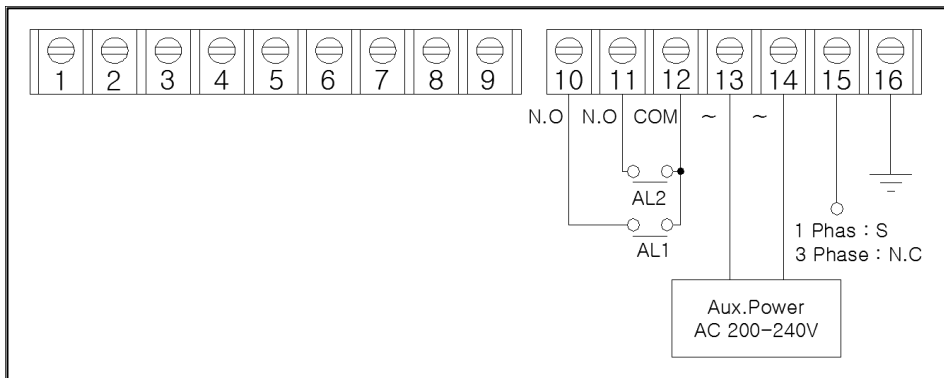
- Output the signal in case of abnormality detection.
- Do the contact point output with the gap between terminals 10 and 12 closed in case of detecting the major failure of Alarm 1.
- Do the contact point output with the gap between terminals 11 and 12 closed in case of detecting the minor failure of Alarm 2.
- The relay contact point capacity is no more than DC30V 5A and no more than AC250V 5A.

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5. Function

5-1. Name and Explanation of the Front Controller

 The front part has the 2×16LCD indicating various information and consists of one operation key and one variable encoder VR. If the Mode button is pressed for 3 or more seconds to prevent the unnecessary operation, setting can be changed.

1) **LCD:** Various information is indicated with 2 X 16 LCD.

2) **RUN**

   Lighting: When the output is done with the control signal
   ● Flickering: Waiting for operation (In case of no Run signal)

3) **AL1(ALARM 1) LAMP**
   ● Lighting: If a major defect occurs, operation is suspended with the corresponding alarm indicated on the LCD.
   ● Flickering: In case of the above near-Alarm 1 condition, it flickers. (maintaining the operation)

4) **AL2(ALARM 2) LAMP**
   ● Lighting: If the AL2 alarm condition set as the minor alarm by the user occurs, operation is maintained, but indication is done with the abnormal status indication and the ongoing operation status crossed.

5) **MODE Button:** The operation mode, various parameters, alarms, etc. are changed or set for use.

6) **Jog-Dial**

   ● Press: It is used to save or select various settings.
   ● Spin: Various parameter values can be increased or decreased.

5-2 Control Terminal Composition
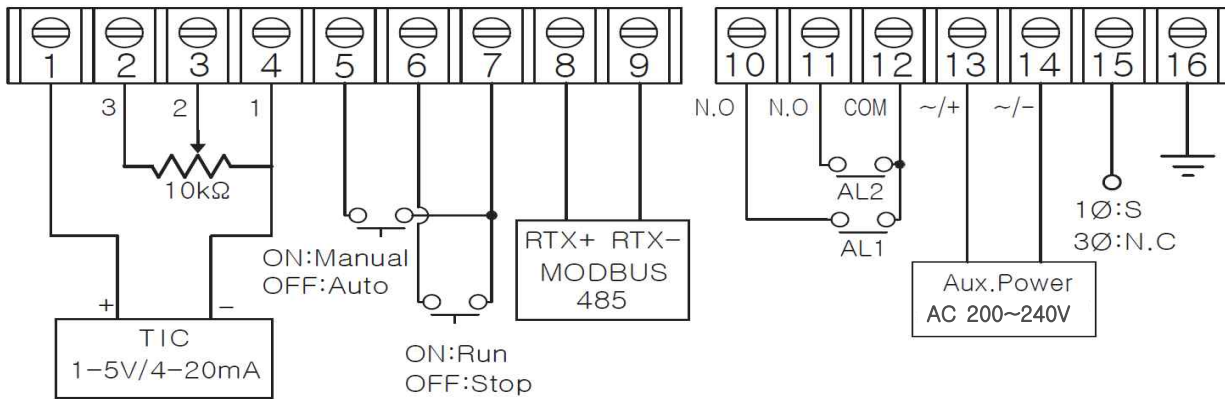
5-3 External Connection Diagram

3-Phase

1-Phase

6. Setting

6-1. Main Menu Composition

MODE KEY
(Press it for 3 seconds.)

Equipment Set-up					
Operating set	Parameter set	Alarm1 set (Major Failure Setting)	Alarm2 set (Minor Failure Setting)	Comm set (Communication Setting)	Check Alarm

Operating set

Mode (Operation Mode)
Phase
Cycle (Zero Cross)
Phase→Cycle
(Phase→Zero Cross)
Const Current
Const Voltage
Const Power

Cycle T-B set
(Zero Cross Cycle Setting)
0.5~10[s]
(Cycle)
Variable[s]
(Variable)

Soft Start
0~50[s]

Soft Up/Dn
(Load Variable Response Speed)
0~50[s]

Ref Source
(Control Input Signal)
4-20[mA]
1-5[V]
485 Comm
Jog Dial

Output Types
Phase
Voltage

Parameter set

Output Slope
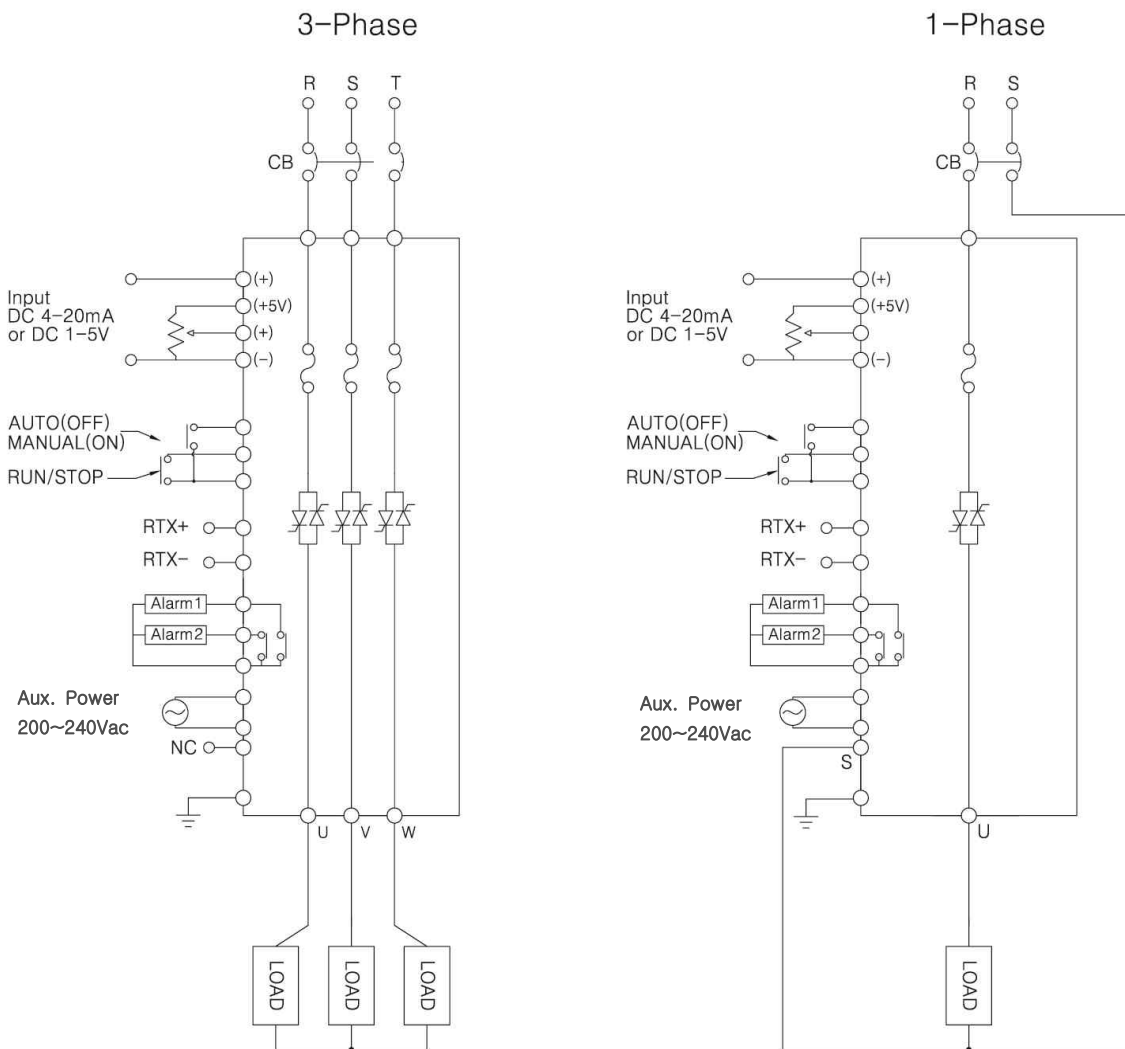(Slope Rate)
10~100[%]

CV Volt set
(Constant Voltage)
100~700[V]

View PV set
(Output Value Indication Method)
ALL / AVG

View IV set
(Input Value Indication Method)
% / SIG

Sync. V set
(Input Voltage)
90/110/220/380/
440/480/500[V]

Alarm1 set (Major Failure Setting)

Load Disconn
OFF/ON

In Sig Disconn
OFF/ON

Power disconn
OFF/ON

Load UB Level
(Load Unbalance Status)
OFF, 30~100[%]

AL1 Restart
(Automatic Release of Alarm 1)
Auto/manual

Alarm2 set (Minor Failure Setting)

PLD Sen set
(Parallel Load Sensing)
Running, Complete, Error

PLD Sen Read
R = xx.xx[Ohm]
S = xx.xx[Ohm]
T = xx.xx[Ohm]

PLD LV set
(Parallel Load Sensitivity)
OFF, 8~50[%]

Over Temp LV
(Abnormal Temperature Sensitivity)
OFF, 30~85[℃]

Over Curr LV
OFF,10~110[%]

AL2 Restart
(Automatic Release of Alarm 2)
Auto/manual

Comm set (Communication Setting)

Port Number
(Communication Number Setting)
OFF,1~32

Baud Rate
(485 Communication Speed)
9600~38400

Retry time
(Retransmission Time)
OFF,1~999[s]

Check Alarm

Alarm
1~10[EA]

※ Indication on LCD in case of the initial power input

WOONYOUNG T.P.R
[55A]   Ver . 5.0

→

IV: 0.0[%] P.H
PV: 0.0[A]   40℃

[55A] : TPR rated current
Ver.5.0 : Software version
IV : 제어 입력 값
PV : 출력 값
P.H : 동작모드 표시
40℃ : 방열판 온도

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6-2. Equipment Set-up

● If the [MODE] key of the front operation part is pressed for 3 seconds, it moves to the Device Setting Menu screen.

● If the jog-dial is spun with the menu selected and with the jog-dial pressed to enter the screen to be selected.

● If there is no operation for 30 seconds, it moves to the Operation screen.

● If [MODE] is pressed during setting, it moves to the upper menu.

Equipment Set-up	
Operating set ←	• Operating set: Operation mode setting
Parameter set	• Parameter set: additional function setting
Alarm 1 set	• Alarm1 set: The major failure alarm function can be set.
Alarm 2 set	• Alarm2 set: The minor failure alarm function can be set.
Comm set	• Comm set: Communication setting can be done.
Check Alarm	• Check Alarm: Alarm occurrence details can be checked.

6-3. Operating set

● It is the menu for setting the operation mode of the device.

● A menu can be selected by spinning the jog-dial, and the menu screen to be set can be entered by pressing the jog dial.

● The setting value of each menu is changed by spinning the jog dial during the RUN lamp flickering, and setting is done by pressing the jog-dial after change. If fixed, it moves to the upper menu.

● The set operation mode is indicated in the upper right corner of the Operation screen.

OP/Mode set	<Operation Mode>
Phase ←	• Phase Control: PH
Cycle	The phase angle of the AC power is outputted in proportion with the control input, and the load power is controlled.
Phase→Cycle	• Cycle (Zero Cross) Control: CY
Const Current	ON/OFF is done in proportion with the control input at the cycle (0.5s, 10s or the average selected) set in case of 0V of the AC power voltage, and the load power is controlled.
Const Voltage	• Phase→Cycle (Phase→Zero Cross) Control: PC
Const Power	It is the complex control type in which the start is outputted with the soft start setting value of the phase mode and operation is performed by converting into the cycle (zero cross) mode if the soft start is completed.

<Operation Mode>
• Phase Control: PH
  The phase angle of the AC power is outputted in proportion with the control input, and the load power is controlled.
• Cycle (Zero Cross) Control: CY
  ON/OFF is done in proportion with the control input at the cycle (0.5s, 10s or the average selected) set in case of 0V of the AC power voltage, and the load power is controlled.
• Phase→Cycle (Phase→Zero Cross) Control: PC
  It is the complex control type in which the start is outputted with the soft start setting value of the phase mode and operation is performed by converting into the cycle (zero cross) mode if the soft start is completed.
• Const Current: CC
  It is the control suitable to the load with the electrical resistance temperature coefficient greatly increasing by 1 to 2 times on the basis of the room temperature. In spite of the change to the power voltage or the load resistance, the fixed current is outputted in proportion with the control input.
  (Control up to 0 to 98% of the control input)
• Const Voltage: CV
  In spite of the change to the power voltage or the load resistance due to the voltage feedback, the fixed voltage is outputted in proportion with the control input. (Control up to 0 to 98% of the control input)
• Const Power: CP
  It is the control method suitable to the heater having the big change of the resistance value caused from the heat generation of silicon carbide (SIC). In spite of the change to the power voltage or the load resistance, the fixed power is outputted in proportion with the control input. (Control up to 0 to 98% of the control input)

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OP/Cycle T-B set 0.5~10[s] <- Variable	Setting the cycle (zero cross) control cycle ・Fixed Cycle: 0.5~10sec ・Variable Cycle: Variable

■ Fixed Cycle Control Waveform

   It is the type in which control is done with the repetition of on/off in the fixed proportion depending on the control input for the set fixed cycle.

40% ON   60% OFF

40% Output Control

80% ON   20% OFF

80% Output Control
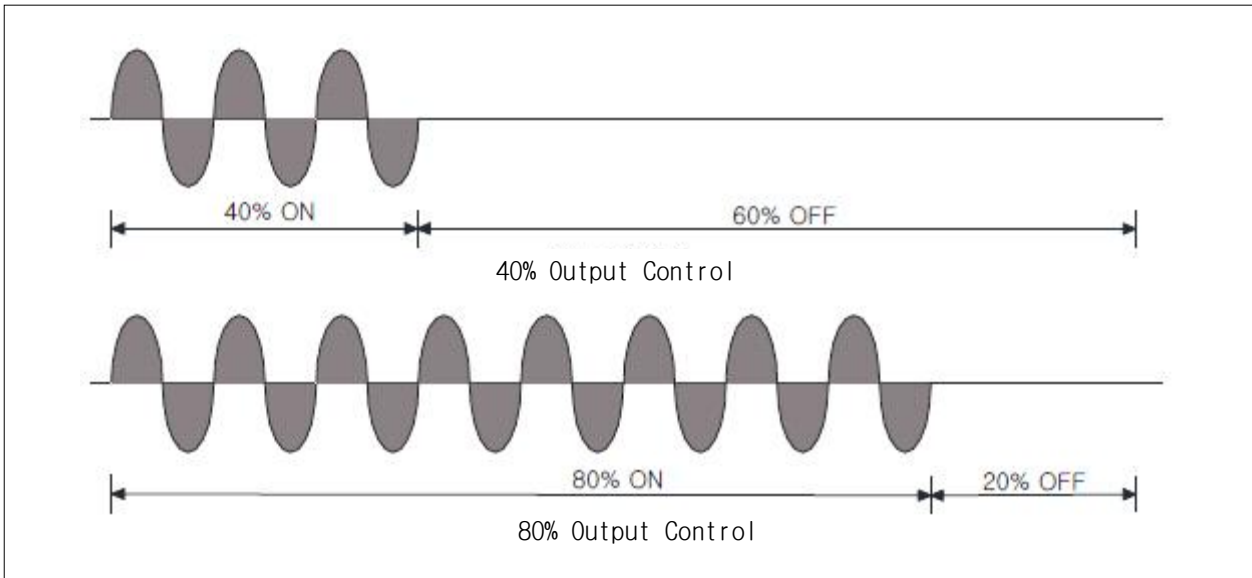
■ Variable Cycle Control Waveform

   It is not the type doing control by fixing the cycle but is the control type doing control by calculating the minimum number of cycles of the AC sine waveform.

ON   OFF   ON   OFF

20% Output Control

ON   OFF   ON   OFF   ON   OFF   ON   OFF   ON   OFF

50% Output Control

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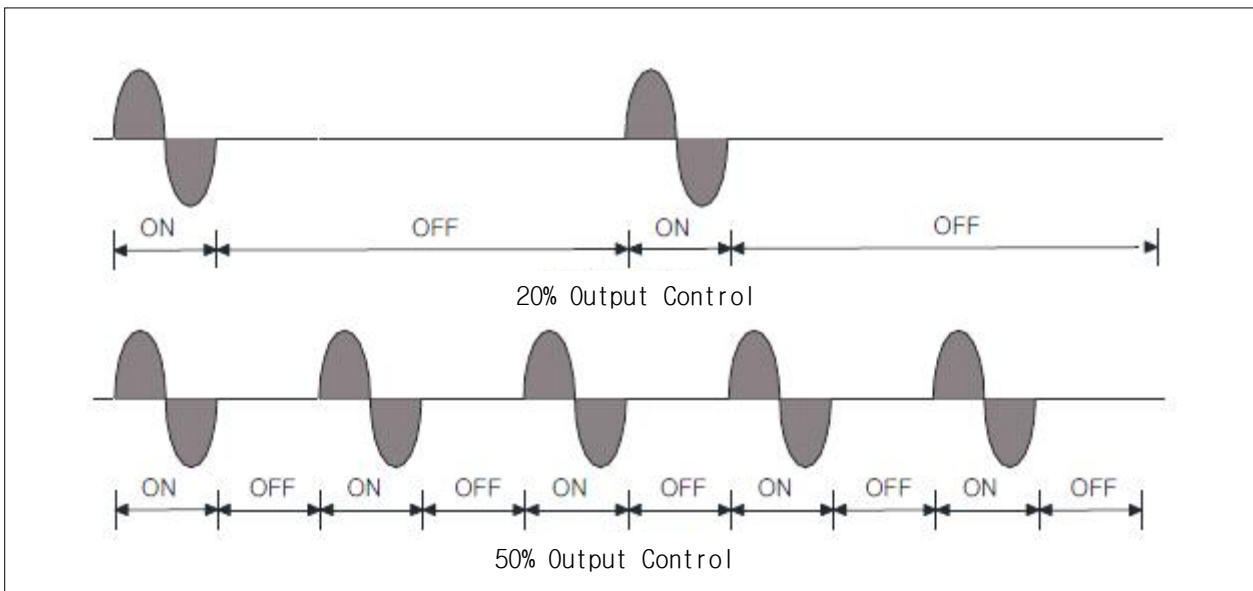
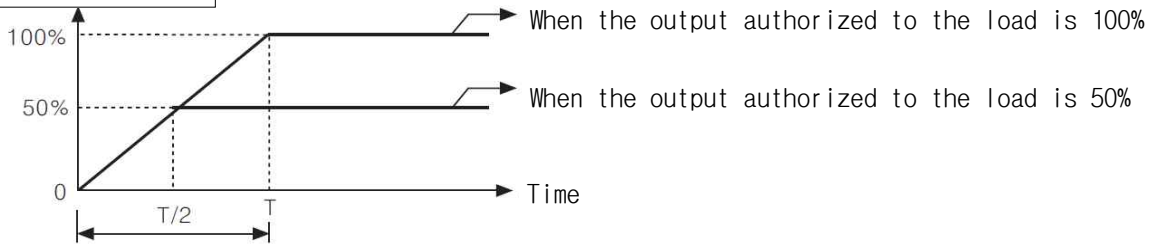| OP/Soft start	Soft Start Setting
0~50[s]	It is the function for preventing the damage to the heater and the device when the load (molybdenum, platinum, tungsten, infrared lamp, etc.) with the inrush current applied in case of the power input is controlled or the initial temperature increase is great. If the Run terminal part is ON, the time for reaching from 0% to 100% can be set within 0 to 50sec.

Control Output

Soft Start Setting Time

- T, the soft start setting time, is the time needed for the output authorized to the load to reach 100%. The time needed to reach the target output value is different depending on the power output slope setting value.

Ex.) If the soft start time (T) is set to be [10sec] with the power output slope set to be 70%, it takes 7sec to reach the target output value.

  [Setting Time (T) x Output Slope(%) = 10sec x 70% = 7sec

- If the soft start is not used, use 0.

OP/Soft Up/Dn	<Setting of the Variable Response Speed of the Load>
0~50[s]	The variable response speed of the load based on the control input change during operation can be set to be 0 to 5sec.

| OP/Ref Source	<Control Input Setting>
4-20mA 1-5[V] 485 Comm Jog Dial	·1-5V, 4-20mA: In case of doing operation with the analog control input signal ·485 Comm: In case of doing control with communication ·Jog Dial: In case of doing control with the jog-dial located in the front of the device

<div style="border:1px solid;">OP/Output Types
Phase
Voltage</div>

<Setting the output voltage characteristics>
In the phase mode, the output voltage characteristics compared with the control input can be changed.
⚠Caution: When measuring the output voltage, the measured value is modulated according to the tester manufacturer
This may differ, and the table below is based on "FLUKE 117".

Output Voltage (V)

○ : V Liner
△ : P Liner
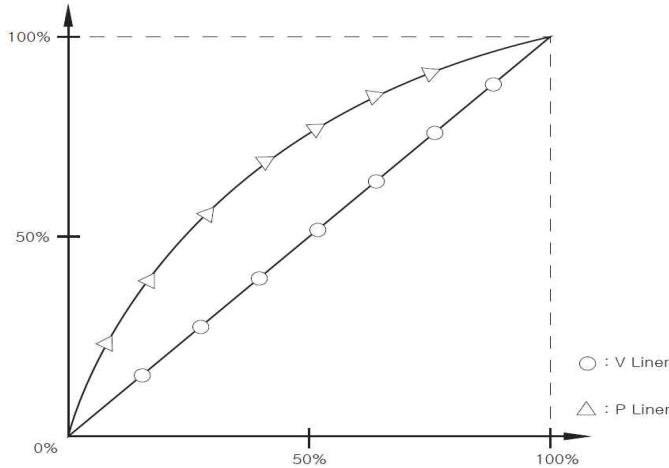
Ex.) 1. Phase
Control Input of 50% × Input Voltage of 100V
≒ Output Voltage of 68V

2. Voltage
Control Input of 50% × Input Voltage of 100V
≒ Output Voltage of 50V

6-4. Parameter set

- It is the menu enabling the setting of the additional function of the device.
- A menu can be selected by spinning the jog-dial, and the menu screen to be set can be entered by pressing the jog dial.
- The setting value of each menu is changed by spinning the jog dial during the RUN lamp flickering, and setting is done by pressing the jog-dial after change. If fixed, it moves to the upper menu.

<div style="border:1px solid;">PA/Output Slope
100[%]　〈—</div>

<Slope Rate Setting>
It is the function doing output with the slope for the input signal.
IV Input (%) X Output Slope (%) = Output (%).

Control Output

If the output limit setting is 100%

If the output limit setting is 50%

<Output Characteristics for the Output Limit Setting and the Control Input>
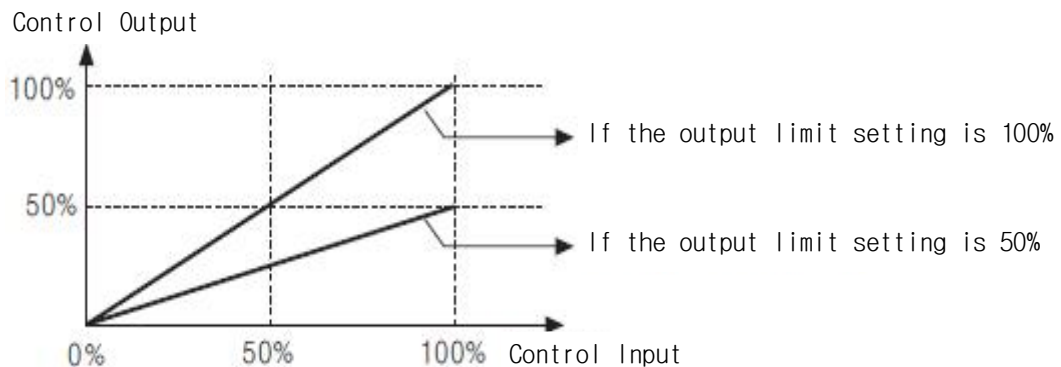
<table>
<tr><td>

PA/CV Volt set
380[V]　〈−

</td><td>

〈Constant Voltage Setting〉

The terminal voltage between R−S for the voltage feedback in case of using the CV or CP mode can be set to 100 to 700V.

⚠Caution: When using constant voltage (CV) or constant power (CP) modes, it is necessary to set the setting. Please.

</td></tr>
</table>

PA/View PV
AVG　〈−
ALL

〈Output Value Indication Setting〉

It is the function enabling the check of the output status. The indication method of the PV value indicated on the front LCD window can be changed.

setting	Model classification	MODE	Display Content
AVG	1/3−Phase	PH/CY/CC	PV[A]
		CV	CV[V]
		CP	CP[kW]
ALL	1−Phase	PH/CY/CC	PV[A]
		CV	PV[A]−CV[V]
		CP	PV[A]−CV[V]−CP[kW]
	3−Phase	PH/CY/CC	IR[A]−IS[A]−IT[A]−PV[A]
		CV	IR[A]−IS[A]−IT[A]−CV[V]
		CP	IR[A]−IS[A]−IT[A]−CV[V]−CP[kW]

⚠Caution: PV value in three phases is $\sum$[A].

PA/View IV
%　〈−
SIG

〈Input Value Indication Setting〉

It is the function enabling the check of the signal input status of the device, and the IV indication value of the display items on the front LCD window can be changed.

・ SIG: Indicated with the V or A unit depending on the control input (Impossible use of the jog dial)

・ %: Indicating the control input in percentage

PA/Sync. volt set

90/110/220/380/440
/480/500

〈Input Voltage Setting〉

Setting can be done depending on the user input voltage.

・If the input voltage is 440V: 440[V]

If the operating voltage is not in the setting value, setting is done with the most approximate value.

Ex.) If the input voltage is 240V: 220[V]

⚠Caution: different set values or not approximated values may cause malfunction.

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6-5. Alarm1 set

- It is the menu for setting the Alarm1 function of the device.
- A menu can be selected by spinning the jog-dial, and the menu screen to be set can be entered by pressing the jog dial.
- The setting value of each menu is changed by spinning the jog dial during the RUN lamp flickering, and setting is done by pressing the jog-dial after change. If fixed, it moves to the upper menu.
- In case of Alarm1 occurrence during operation, the Alarm1 status is indicated on the LCD. Ex.)

> **Alarm 1**
> **Load Disconnect**

- The *Operation Stop + AL1 Lamp Lighting + AL1 Contact Point Output* operation is done. If power is turned OFF or the jog-dial is pressed down for 3 seconds to recover or restart Alarm1, the alarm is released and restarted.
- In case of the steady alarm occurrence after recovery, operation is stopped with the survey done on the failure cause.

AL1/Load Disconn OFF / ON	**\<Load Disconnection Existence Setting\>** Alarm is triggered when the output current is less than 4% of the rated current of the product when the control input (IV) is 51% or higher. *"Load Disconnect"*
AL1/In Sig Discon OFF / ON	**\<Input Signal Line Disconnection Existence Setting\>** Alarm is triggered when the input signal is less than 2mA or 0.5V at RUN ON. "Sig Disconnect" ※If the RUN terminal is turned off, the alarm can be stopped. When the power is re-entered, the alarm automatically returns.
Power Disconnect OFF / ON	**\<Load Unbalance State Setting\>** Alarm is triggered if there is no input power at RUN ON. "Power disconnection" ※If the RUN terminal is turned off, the alarm can be stopped. When the power is re-entered, the alarm automatically returns.
AL1/Load UB LV DISABLE / 30~100[%]	**\<Load Unbalance State Setting\>** ※Impossible use in the single phase unit If the deviation between the maximum and minimum values of each phase current is maintained in the state higher than the setting value for 5 or more seconds, alarm occurs. *"Load Unbalance"* ⚠Caution: single phase not available (DISABLE)

|	
AL1/ Restart Auto/Manual	\<Alarm1 Automatic Release Setting\> If the cause of the alarm disappears after the alarm of Alarm1, then Alarm1 is turned off. It is a feature that can be ordered and automatically repaired. ※ Automatic recovery may occur repeatedly for some functions. When in Manual mode, turn off the power or press and hold the jog dial for 3 seconds to recover.
1. Over Current	Customer Unsettled Overcurrent: AL1 Warning Lamp (☼-☼-☼-☼-) At 90-109% of the rated current, normal operation is performed and "AL1 lamp" flashes once every time. The alarm goes off when the rated current exceeds 110%. "Over Current"
2. Over Temp	Customer cannot be set: AL1 Warning Lamp(☼☼-☼☼-☼☼-☼☼-) When the temperature of the heating plate is 80 to 84°C, it flashes "AL1 Lamp" twice during normal operation, and an alarm occurs when the temperature of the heating plate is 85 [°C] or higher. If the temperature of the heating plate drops to 65 [°C] after the alarm is triggered, the operation is started automatically."Over Temp"
3. Fuse open	Non-Customer Set Fuse Open Circuit: AL1 WarningLamp(☼) If the fuse is open, it stops operation and an alarm occurs. *"Fuse open-[R/S/T/RS/ST/TR]"*
4. SCR Error	Unable to Set Customer SCR Short: AL1 WarningLamp(☼) If a load current is detected on R, S, and T when the IV value is 0%, it is determined by the SCR Short, stops operation, and an alarm is triggered. *"SCR Error-[RS/ST/TR]"*

※ To recover the alarm above AL1, turn off the alarm condition and press the jog dial on the front for 3 seconds to restore the alarm.

6-6. Alarm2 set

■ It is the menu for setting the Alarm2 function of the device.

■ The item value flickering with the jog-dial spinning can be changed or set, pressing the jog-dial after setting for movement to the lower menu or storage.

■ If Alarm2 occurs during operation, the display alternatively indicates the operation state and the Alarm2 state.

| IV: 0.0[%] P.H
PV: 0.0[A] 40℃ | → | Alarm 2
Warning / PLD | → | IV: 0.0[%] P.H
PV: 0.0[A] 40℃ |
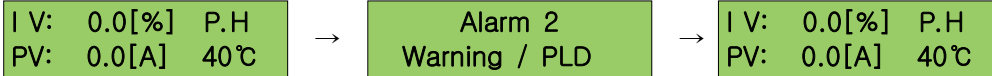
■ **The *AL2 Lamp Lighting + AL2 Contact Point Output*** operation is done. If power is turned OFF or the jog-dial is pressed down for 3 seconds to recover or restart Alarm2, the alarm is released and restarted.

| Alarm 2 Set
PLD Sen set |
| [↓] |
| AL2/PLD Sen set
Running |
| [↓] |
| AL2/PLD Sen set
Complete |
| or |
| AL2/PLD Sen set
Error |
| [↓] |
| Enter ↵ |
| [↓] |
| Alarm 2 Set
PLD Sen set |

<Heater Disconnection Detection Standard Value Storage>
The load current and voltage are detected from the embedded CT and PT to find the standard resistance value of the heater. The PLD level is set for the standard resistance value with the heater resistance value (current value) found frequently. If the change from the standard resistance value to the current resistance value exceeds the PLD level, alarm occurs.
<Standard Value Setting Method>
1. Put the external input terminals (5 and 6) in RUN mode.
2. At the Sen set screen, tap JOG DAIR.
3. The voltage is applied to the heater in PH (Phase Control) mode, IV=100%, Soft start 5[sec] to obtain the reference value. The phase control output is performed according to the set value of Output Slope.
4. The unit of the stored standard value is [Ohm].

⚠Caution

1. It is impossible to use it in the Cycle mode.
2. Pressing the jog-dial during Sen set stops operation.
3. If the heater is stabilized (Stabilization: The state without the change of the resistance value for 3 seconds), Sen set is stopped with *"Complete"* indicated.
※ In case of the state of not storing the Sen set value, *"Error"* is indicated with the display of Impossible Setting. (Reset it after solving the cause.)
　・When there is no load
　・When the load is low (the unit rating of less than 10%)
　・When the user presses the jog-dial during Sen set for stopping
　・When the load is not stabilized after 30sec after starting Sen set

| AL2/PLD Sen read
R= 10.13[Ohm]
S= 10.13[Ohm]
T= 10.13[Ohm] |

<Heater Disconnection Standard Value Check>
1. The stored standard resistance value can be checked by spinning the jog-dial.
2. If the jog-dial is pressed down for 3 seconds, the standard resistance value is deleted.

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AL2/PLD LV set OFF/8~50%	**\<Partial Load Disconnection Sensitivity Setting\>** The partial load disconnection sensitivity alarm can be set in the OFF and 8 to 50% unit. Disconnection Rate $= \dfrac{\text{Number of Detected Heater Disconnections}}{\text{Number of Heater Parallels}} \times 100[\%]$ Ex.) If 1 heater is disconnected when the number of heater parallels is 10 It becomes Disconnection Rate $\dfrac{1}{10} \times 100[\%] = 10[\%]$ Set sensitivity setting to 8~9%, which is lower than open circuit rate=10%. *Warning / PLD*

AL2/Over Temp LV OFF/30~85[℃]	**\<Radiation Panel Overtemperature Sensitivity Setting\>** The overtemperature alarm of the radiation panel can be set in the 30~85℃ 1℃ Step unit. Drive away release an alarm settings in 95 % of settings, be called off the alarm. *Warning / Over temp*

AL2/Over Curr LV OFF/10~110[%]	**\<Overcurrent Sensitivity Setting\>** The overcurrent sensitivity alarm can be set within 100% of the rated current in the 10~110% / 1% unit. *Warning / Over Current*

AL2/ Restart Auto/Manual	**\<Alarm2 Automatic Release Setting\>** It is the function of turning off Alarm2 and doing the automatic recovery if the occurrence cause disappears after the alarm occurrence of Alarm2. When in Manual mode, turn off the power or press and hold the jog dial for 3 seconds to recover.

6-7. Comm set

■ It is the menu for setting the communication of the device.

■ A menu can be selected by spinning the jog-dial, and the menu screen to be set can be entered by pressing the jog dial.

■ The setting value of each menu is changed by spinning the jog dial during the RUN lamp flickering, and setting is done by pressing the jog-dial after change. If fixed, it moves to the upper menu.

Port No   [--]
Baud Rate[38400]
Retry time[500s]

- ・ Port No: Setting of 1 to 32 is possible.
- ・ Baud Rate: setting of 9600/14400/19200/38400 is possible.
- ・ Retry time: In case of controlling the device operation with communication, it is possible to set the waiting time to the next signal to be OFF/1 to 999sec after getting the order of the last operation. If there are no communication data after the setting time, it stops automatically.

6-8. Check Alarm

■ It is the menu for checking the alarm of the device.

■ The previously occurring alarm can be checked by spinning the jog-dial.

Alarm-1
[05]
Over Temp.

- ・ Alarm [XX] Alarm [XX} XX shows the stored number of the alarm.
- ・ The data of 1 to 10 can be checked by spinning the jog-dial.
  If the No.1 data are the alarm data recently occurring and the number of data exceeds 10 units, the oldest data are deleted automatically.
- ・ If the jog-dial is pressed for 3 seconds, the stored alarm history can be deleted.

6-9. The Setting Range and the Values set in the Factory

Equipment set-up		설정범위		Values Set in the Factory
		Single Phase	3 Phases	
Operating set	Mode	Phase/Cycle/Ph→CY/CC/CV/CP		Phase
	Cycle T-B set	0.5~10s, Variable		1
	Soft start	0~50[s] (1step)		5
	Soft Up/Dn	0~50[s] (1step)		5
	Ref Source	4-20[mA]/1-5[V]/485 Comm/Jog Dial		4-20[mA]
	–	Phase Linear / Voltage Linear		Phase Linear
Parameter set	Power Out Slope	10~100[%] (1step)		100
	CV Volt Set	OFF, 100~700[V] (1step)		380
	View PV Set	ALL / AVG		AVG
	View IV Set	% / SIG		%
	Sync volt set	90/110/220/380/440/480/500[V]		380[V]
Alarm1 set	Load disconnect	ON / OFF		OFF
	In Sig disconnect	ON / OFF		OFF
	Power Disconnect	ON / OFF		OFF
	Load UB level	DISABLE	OFF, 30~100%	DISABLE/OFF
	Alarm1 Restart	Auto/Manual		Auto
Alarm2 SET	PLD Sens set	Running / Complete / Error		–
	PLD Sens Read	–		–
	PLD level set	OFF / 8~50[%]		OFF
	Over Temp level	OFF / 30~85[℃]		85
	Over Curr level	OFF / 10~110[%]		110
	Alarm2 Restart	Auto/Manual		Auto
Comm set	Port No	1~32		1
	Baud rate	9600/14400/19200/38400[bps]		19200
	Retry time	OFF / 1~999[s]		OFF

7. 485 Communication

- The ModBus-RTU protocol is used.
- The ModBus-RTU protocol is an open protocol.
- It takes the structure in which the computer or another host becomes the master with the inverter becoming the slave.
- The slave, the power regulator (TPR), responds to the read/write request of the master.

Communication Control	RS-485
Baud rate	9600, 14400, 19200, 38400bps
Data Frame	1 Start bit, 8 Data bit, 1 Stop bit (Total 10 bit)
Parity	Non Parity
Slave No.	1~32 (Device Setting)

7-1. Communication Protocol

Code			Details
Function code	0x03	Read Holding Register	Used for reading the analog setting and memory values of the device
	0x04	Read Input Register	Used for reading the analog state (measurement) or event values of the device
	0x06	Preset Single Register	Used for setting the parameter

7-2. Read Holding Register

- Query code

Slave ID	Function	Starting Addr. Hi	Starting Addr. Lo	No. of Point Hi	No. of Point Lo	CRC Hi	CRC Lo
01	03	00	00	00	01	84	0A

1Point is read from 0x40000 Address to TPR ID 1 with Function 03.

- Response code

Slave ID	Function	Byte Count	Data Hi	Data Lo	CRC Hi	CRC Lo
01	03	02	00	40	B9	B4

TPR ID1 makes the 2byte response from the 0x40000 Address with Function 03.

The responded data are 0x0001.

7-5 Read Holding Register (Read Only)

Function	Addres	Parameter	scale	Unit	Allocation of Each Bit	
0x03	0x00	Parameter setting	–	–	0: Prohibiting the setting with communication	
					1: Permitting the setting with communication	
	0x01	RUN/STOP	–	–	0: STOP	
					1: RUN	
	0x02	Operation command value(IV)	%	0.1		
	0x03	Operation mode	–	–	0: Phase	
					1: Cycle	
					2: Phase→Cycle	
					3: Const Current	
					4: Const Voltage	
					5: Const Power	
	0x04	Cycle T-B set	–	–	0: 0.5~10s	
					1: Variable	
	0x05	Soft start	1	sec		
	0x06	Soft Up/Dn	1	sec		
	0x07	Ref Source	–	–	0:4-20mA	
					1: 1-5V	
					2: 485 COMM.	
					3: JOG DIAL	
	0X08	Output CHAR			0: Phase	1: Voltage
	0X09	Output Slop	1	%		
	0X0A	CV Volt Set	1	V		
	0x0B	View PV Set	–	–	0: ALL VIEW	1: AVG VIEW
	0x0C	View IV Set	–	–	0: %	1: SIG
	0x0D	Sync volt Set	–	V	0: 90	
					1: 110	
					2: 220	
					3: 380	
					4: 440	
					5: 480	
					6: 500	
	0x0E	Load disconnect	–	–	0: OFF	1: ON
	0x0F	In Sig disconnect	–	–	0: OFF	1: ON
	0x10	Power disconnect	–	–	0: OFF	1: ON
	0x11	Load UB level	1	%	0: OFF 8 ~ 32 (8~50)	
	0x12	Alarm1 Restart	–	–	0: AUTO	1: MANUAL
	0x13	1P PLD Sens 값	0.01	Ω		
	0x14	PLD level set	1	%	0: OFF 08 ~ 32 (8~50)	
	0x15	Over Temp level	1	℃	0:OFF 1E ~ 55 (30~85)	
	0x16	Over Curr level	1	%	0B ~ 6E (10~110%)	
	0x17	Alarm2 Restart	–	–	0: AUTO	1: MANUAL
	0x18	Retry time	1	sec	0: OFF 01 ~ 03xE7 (1~999)	
	0x19	PLD Sens R-S 값	0.01	Ω		
	0x1A	PLD Sens S-T 값	0.01	Ω		
	0x1B	PLD Sens T-R 값	0.01	Ω		

7-6 Read Input Register (Read Only)

Function	Addres	Parameter	scale	Unit	Allocation of Each Bit		
0x04	0x00	Product model	–	–	A: Slim Digital TPR 1P		
					B: Slim Digital TPR 3P		
	0x01	SPARE	–	–	2		
	0x02	Rated current	–	–	0:25A	1:40A	2:55A
					3:70A	4:90A	5:110A
					6:130A	7:160A	8:200A
					9: 250A	10: 320A	11:400A
					12:500A	–	–
	0x03	Operation state	–	–	0: 동작대기중		
					1: SOFT START중		
					2: 동작 중		
	0x04	Heatsink Temperature	1	℃			
	0x05	R phase current	0.1	A			
	0x06	S phase current	0.1	A			
	0x07	T phase current	0.1	A			
	0x08	Output voltage	0.1	V			
	0x09	ALARM1 error	–	–	bit 0: Load Disconnect bit 1: In Sig Disconnect bit 2: Power Disconnect bit 3: Load Unbalance bit 4: Over Current bit 5: Over Temp. bit 6: Fuse Open bit 7: SCR Short bit 8: Lost Communication		
	0x0A	ALARM2 error			bit 0: PLD Error bit 1: Warning temp. bit 2: Warning current		
	0x0B~11	SPARE	–	–			
	0x12	Check Alarm1	–	–	bit 0: Load disconnection bit 1 In Sig Disconnect bit 2 Power Disconnect bit 3: Load unbalance bit 4: Over current bit 5: Over Temp bit 6: Fuse open bit 7: SCR short, bit 8: Lost communication bit 9: PLD Error bit 10: Warning temp bit 11: Warning current		
	0x13	Check Alarm2	–	–			
	0x14	Check Alarm3	–	–			
	0x15	Check Alarm4	–	–			
	0x16	Check Alarm5	–	–			
	0x17	Check Alarm6	–	–			
	0x18	Check Alarm7	–	–			
	0x19	Check Alarm8	–	–			
	0x1A	Check Alarm9	–	–			
	0x1B	Check Alarm10	–	–			
	0x1C~31	SPARE	–	–			

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7-7 Write Single Registers command (Read/Write Possible)

Function	Addres	Parameter	scale	Unit	Allocation of Each Bit	
0x06	0x00	Parameter setting	–	–	0: Prohibiting the setting with communication	
					1: Permitting the setting with communication	
	0x01	RUN/STOP	–	–	0: STOP	
					1: RUN	
	0X02	Operation command value(IV)	%	0.1		
	0x03	Operation mode	–	–	0: Phase	
					1: Cycle	
					2: Phase→Cycle	
					3: Const Current	
					4: Const Voltage	
					5: Const Power	
	0x04	Cycle T-B set	–	–	0: 0.5~10s	
					1: Variable	
	0x05	Soft start	1	sec		
	0x06	Soft Up/Dn	1	sec		
	0x07	Ref Source	–	–	0:4-20mA	
					1: 1-5V	
					2: 485 COMM.	
					3: JOG DIAL	
	0X08	Output CHAR			0: Phase	1: Voltage
	0X09	Output Slop	1	%		
	0X0A	CV Volt Set	1	V		
	0x0B	View PV Set	–	–	0: ALL VIEW	1: AVG VIEW
	0x0C	View IV Set	–	–	0: %	1: SIG
	0x0D	Sync. volt Set	–	V	0: 90	
					1: 110	
					2: 220	
					3: 380	
					4: 440	
					5: 480	
					6: 500	
	0x0E	Load Disconnect	–	–	0: OFF	1: ON
	0x0F	In Sig Disconnect	–	–	0: OFF	1: ON
	0x10	Power Disconnect	–	–	0: OFF	1: ON
	0x11	Load UB level	1	%	0: OFF 1E ~ 64 (30~100%)	
	0x12	Alarm1 Restart	–	–	0: AUTO	1: MANUAL
	0x13	SPARE				
	0x14	PLD level set	1	%		
	0x15	Over Temp level	1	℃	1E ~ 55 (30~85)	
	0x16	Over Curr level	1	%	0B ~ 6E (10~110%)	
	0x17	Alarm2 Restart	–	–	0: AUTO	1: MANUAL
	0x18	Retry time	1	s		

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8. Outside View

8.1 1Phase

25~75A Terminal Shape	90~500A Bus Bar Shape
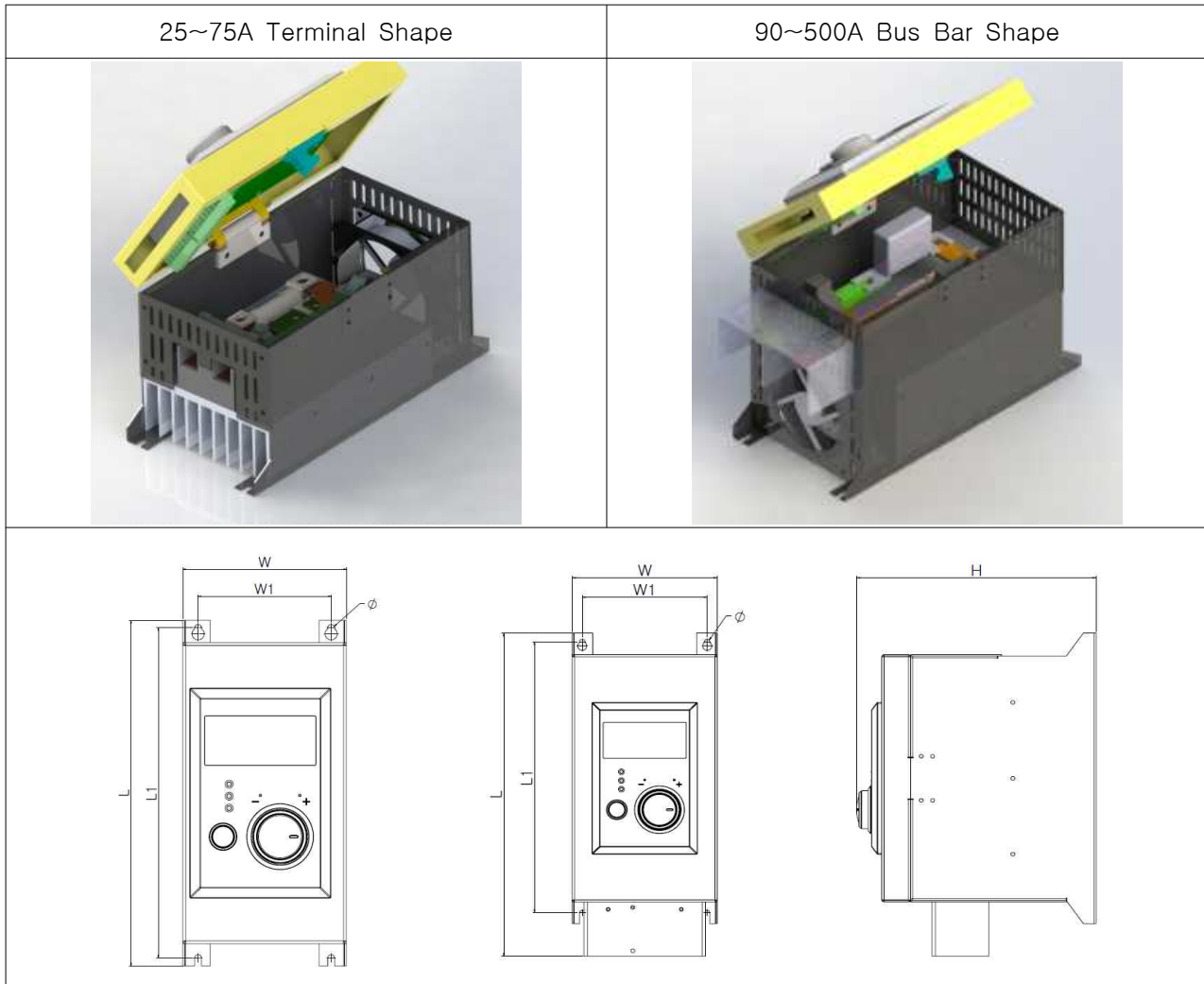
Rated Capacity (A)	TERMINAL	1PHASE						FAN	WEIGHT
		W	L	H	W1	L1	∅		
25	W=14,t=1.8 BOLT=M6	108	230	166	90	220	4.5	X	2.26kg
40,55,75								80*25	2.52kg
90,110,130,160	W=20,t=2.5 BOLT=M6	128	293	216	110	250	5.5	92*25	4.53kg
200,250,320	W=35,t=5 BOLT=M8	128	400	231	105	350	5.5	92*38	6.92kg
400,500	W=50,t=5 BOLT=M10	181	432	272	155	365	6.5	120*38	12.18kg

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8.2 3Phase

25~160A Terminal Shape	200~500A Bus Bar Shape
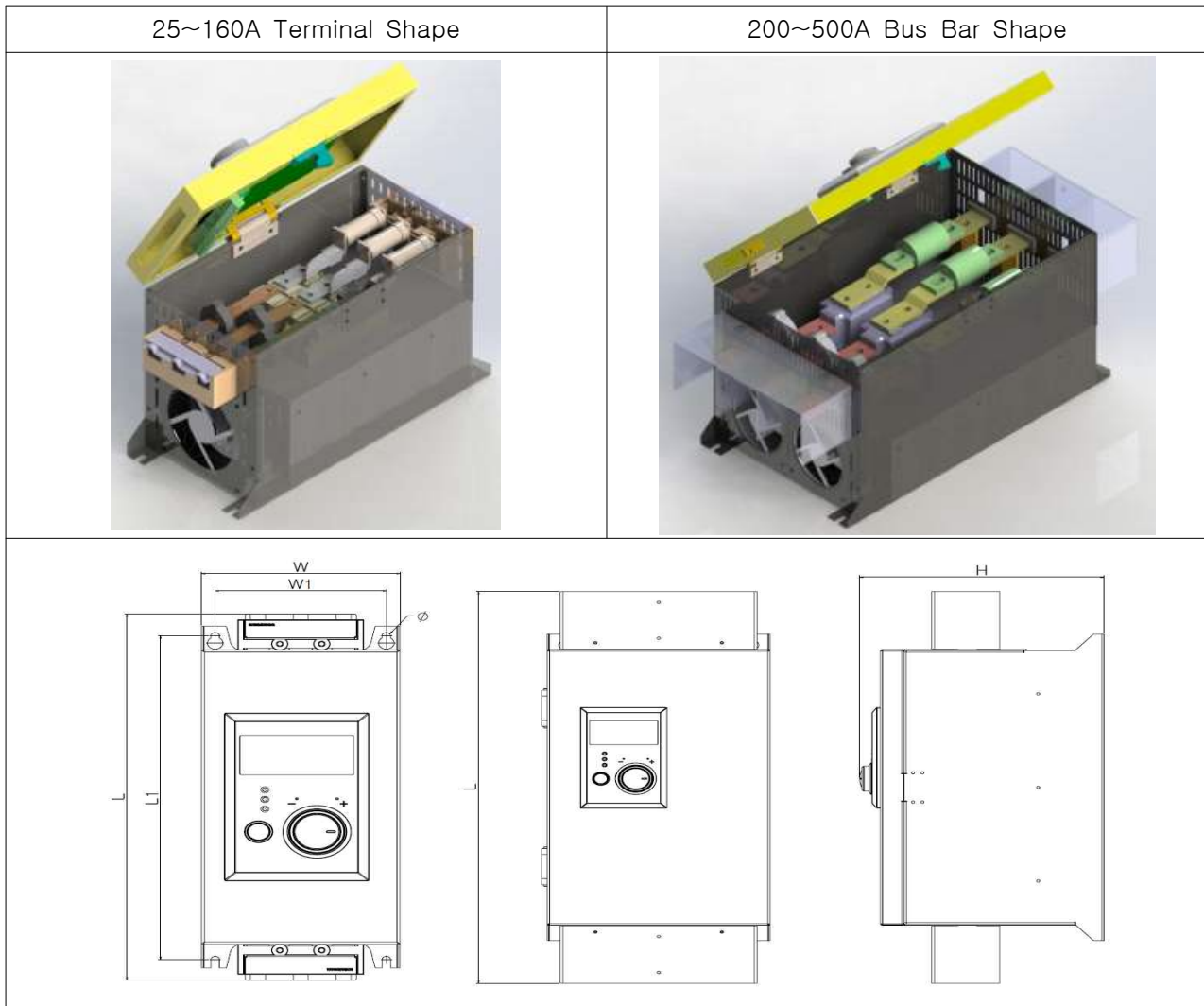
Rated Capacity (A)	TERMINAL	3PHASE						FAN	WEIGHT
		W	L	H	W1	L1	∅		
25	W=14,t=1.8 BOLT=M5	128	282	201	110	245	5.5	X	4.2kg
40								80*25	4.5kg
55,75		128	306	217	110	270	5.5	92*25	5.1kg
90,110,130,160	W=20,t=2.5 BOLT=M6	181	415	247	160	350	5.5	120*38	11kg
200,250,320	W=35,t=5 BOLT=M8	240	496	262	205	410	6.5	92*38*2	18kg
400,500	W=50,t=5 BOLT=M10	305	615	275	265	500	6.5	120*38*2	30kg

9. Troubleshooting

If the TPR operation is abnormal while checking the current carrying, check the following matters.In case of abnormality even after the check, be sure to turn off power and contact the nearby sales office.

Abnormality Details	Abnormal Part	Cause	Action
No Output	Is the power voltage normal?	Is the current carried?	Turn on power.
		Isn't it used with the power except for the TPR rating?	Use the rated power.
	Is the Load current normal?	Is the load connected?	Block the TPR power and do the resistance check among the output terminals U-V-W.
	Is the input from the controller normal?	Isn't the connection to the TPR control terminal incorrect?	Measure the DC voltages of TPR control terminals 1(+) and 4(-). Control Input of 4mA(0%)≒DC 1V Control Input of 20mA(100%)≒DC 5V
	Isn't the setting done with the output not generated?	Isn't the controller setting incorrect?	Change the controller setting.
	Is the external input normal?	Is the automatic manual conversion signal wired correctly?	Automatic: Opening the terminals 5 and 7 Manual: Short-circuiting the terminals 5 and 7
		Is the RUN signal inputted?	Operation: Short-circuiting the terminals 6 and 7
	Is the alarm output generated?	Refer to 6-5.Alarm1 Set and 6-6. Alarm2 Set Setting.	
	Isn't the error message indicated?		
Abnormal Output	Is the controller specification correct?		Correct the controller specification.
	Is the external input normal?	Is the automatic manual conversion signal wired correctly?	Automatic: Opening the terminals 5 and 7 Manual: Short-circuiting the terminals 5 and 7
	Doesn't the load have the insulation defect problem?		Check and change the load.
	Is the external wire twisted?		Twist it.
	Is the load hunting existing?	Is the control input terminal fastened certainly?	Fasten it according to the regulation torque.
		Is the noise from the control input terminal loud?	Use the shield cable.
		Is the power defective?	Check whether the normal sine waveform is generated in case of checking the oscilloscope input terminal and whether the normal frequency (50Hz or 60Hz) is maintained.

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