Preen
AC POWER CORP.

ADG-L Series

Programmable DC Power Supply

User Manual

AC Power Corp. (Preen)

V 1.00EN

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Preen's ADG-L series is warranted against defects in material and workmanship for a period of one (1) year after date of shipment. Preen agrees to repair or replace any assembly or component found to be defective, under normal use during this period. Preen's obligation under this warranty is limited solely to repairing any such product which in sole Preen's opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by the purchaser. Shipment should not be made without prior authorization by Preen.

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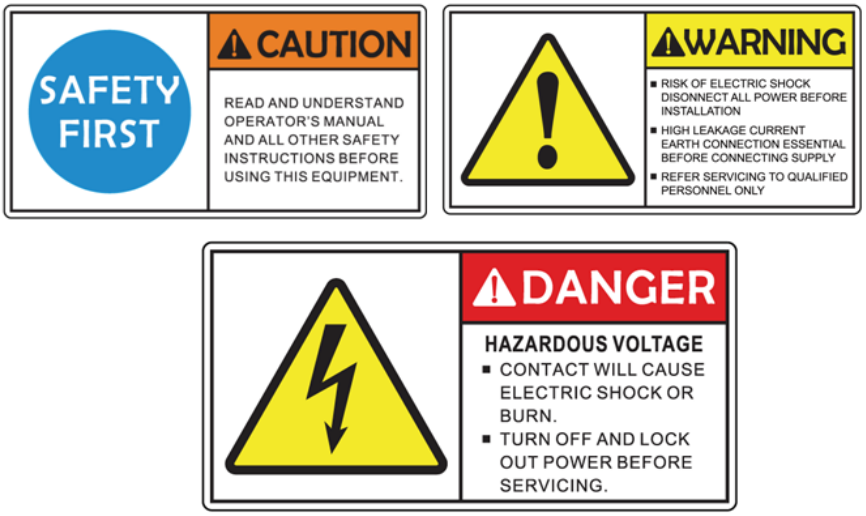
SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or specific WARNINGS given elsewhere in this manual will violate safety standards of design, manufacture, and intended use of the product.

Preen assumes no liability for the customer's failure to comply with these requirements.



1) BEFORE APPLYING POWER

Verify that the product is set to match with the power line input.

2) PROTECTIVE GROUNDING

Make sure to connect the product to the protective ground to prevent an electric shock before turning on the power.

3) NECESSITY OF PROTECTIVE GROUNDING

Never cut off the internal or external protective grounding wire, or disconnect the wiring of protective grounding terminal. Doing so will cause a potential shock hazard that may bring injury to a person.

4) DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the product in the presence of flammable gases or fumes.

5) DO NOT REMOVE THE COVER OF THE PRODUCT

Personnel who operate the product must not remove the cover of the product.

Component replacement and internal adjustment can be done only by qualified service personnel.

Warning
LETHAL VOLTAGES. **The product can supply 1000 peak at its output. DEATH on contact may result if either the output terminals or the output circuits connected to the output are touched when the product output is on.**

Table of Contents

1 General information

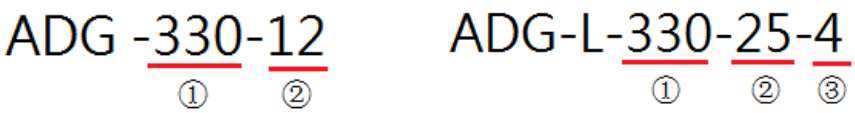
1.1 Introduction

Preen's ADG-L series is a programmable DC power supply with stable output and precision measurements. This compact power supply comes in three power levels, 4kW, 8kW and 12kW; 14 models in total, including 5 auto range models. The 5-inch touch screen and rotary knob of ADG-L series enables intuitive operation and a clear measurement reading display.

Remote control for the product can be accomplished selectively via the standard interfaces RS-232/RS-485 (Modbus) and Analog, or the optional interfaces Ethernet/USB/RS-232/RS-485 (SCPI) or GPIB.

The model naming rule of ADG-L series:

① Output voltage: 330 represents maximum voltage.



② Output current: 12 represents maximum current.

③ Output power: 4 represents maximum power. Only auto-range models have the number to represent output power on the model name.

Example
Examples of model names: ADG-L-160-25: 160V/25A output; ADG-L-1000-12: 1000V/12A output; ADG-L-330-25-4 (auto-range model): 330V/25A output with 4kW maximum power; ADG-L-330-50-8 (auto-range model): 330V/50A output with 8kW maximum power

1.1.1 V/I output limit for the ADG-L series

The following figure shows the V/I limit of the ADG-L series' output, and this can be applied to standard models and auto-range models of the ADG-L series.

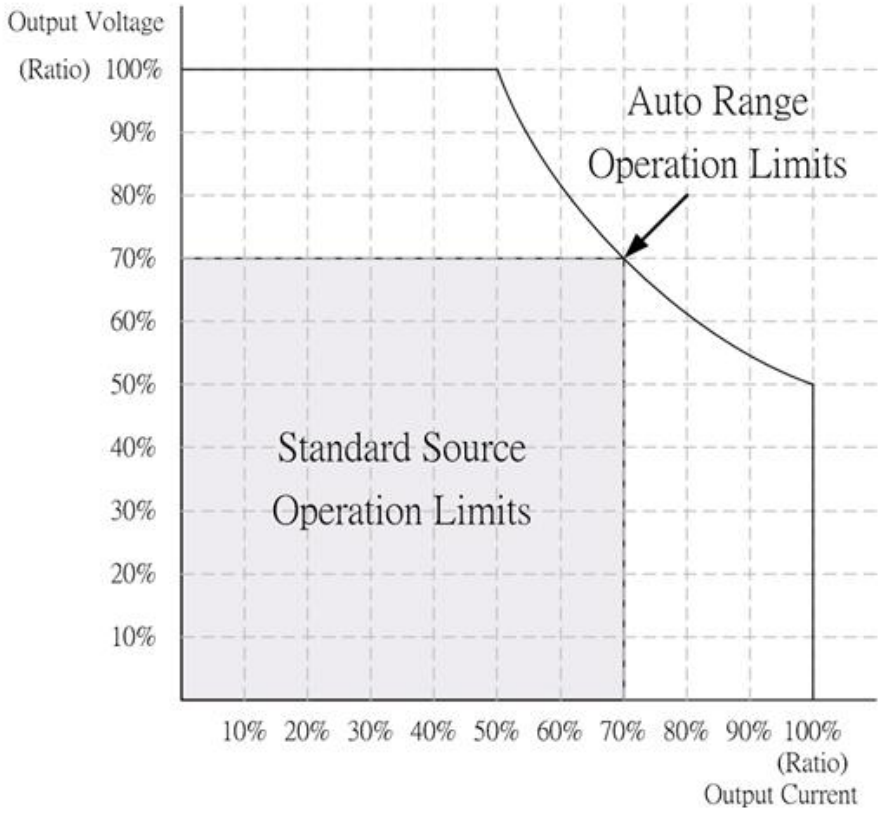


Figure 1.1 V/I output limit for the ADG-L series

1.2 Key features

A. Configuration

1) Local operation via the touch screen and the rotary knob on the front panel.

2) Remote control via RS-232, RS-485, Ethernet, USB or GPIB.

3) Remote control via analog interface.

4) Protection for OVP, OCP, OPP, OTP, Line OVP, Vin LVP, Vin OVP, Phase loss, and Fan Error.

5) Temperature-controlled fan speed.

B. Input/output

1) Universal input voltage range: 187-264Vac (single-phase), 187-264Vac (three-phase △ connection), 340-460Vac (three-phase/four-wire Y connection). Please refer to Table 1.1, Table 1.2 and Table 1.3.

2) Wide output voltage range from 0~160V to 0~1000V.

3) High output current up to 75A in one unit.

4) Measurements of voltage (V), current (I), Power (P).

1.3 Specifications

Technical specifications of ADG-L series are listed below. All specifications have been tested according to Preen's standard test procedures.

Model		ADG-L-160-25	ADG-L-330-12	ADG-L-330-25-4	ADG-L-160-50	ADG-L-330-24
Output Power		4kW	4kW	4kW	8kW	8kW
INPUT						
Input Voltage		1Φ 2W+G 187-264 Vac			1Φ 2W+G 187-264 Vac 3Φ4W+G 340-460 Vac	
Input Current		24A	24A	24A	1Φ : 48A 3Φ : 24A	1Φ : 48A 3Φ : 24A
Input Frequency		47 Hz - 63 Hz				
Power Factor		≧0.99 at max. power				
OUTPUT						
Voltage		0~160V	0~330V	0~330V	0~160V	0~330V
Current		0~25A	0~12A	0~25A	0~50A	0~24A
Voltage Ripple (rms)		≦0.15% F.S.	≦0.08% F.S.	≦0.08% F.S.	≦0.15% F.S.	≦0.08% F.S.
Voltage Ripple (peak to peak)		≦1.6% F.S.	≦0.8% F.S.	≦0.8% F.S.	≦2.5% F.S.	≦1.6% F.S.
Voltage Line Regulation		≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.
Voltage Load Regulation		≦0.08% F.S.	≦0.05% F.S.	≦0.05% F.S.	≦0.08% F.S.+ 80mV	≦0.08% F.S.+ 80mV
Current Ripple (rms)		≦0.15% F.S.	≦0.25% F.S.	≦0.15% F.S.	≦0.15% F.S.	≦0.25% F.S.
Current Line Regulation		≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.
Current Load Regulation		≦0.10% F.S.	≦0.10% F.S.	≦0.10% F.S.	≦0.2% F.S.	≦0.2% F.S.
Load Transient Re-sponse (CP MODE = OFF)		≦3ms	≦3ms	≦3ms	≦3ms	≦3ms
Efficiency(Full load)		≧90% at max. power				
Slew Rate	Rise Time	≦ 25ms	≦ 35ms	≦ 35ms	≦ 25ms	≦ 40ms
	Fall Time (Full Load)	≦30ms	≦40ms	≦40ms	≦35ms	≦45ms
	Fall Time (No Load)	≦10s				
Programming & Measurement						

Voltage Programming Accuracy	≦0.08%F.S.+100mV	
Voltage Measurement Accuracy	≦0.08%F.S.+100mV	≦0.08%F.S.+100mV
Voltage Resolution	100mV	
Current Programming Accuracy	≦0.4%F.S.+60mA	
Current Measurement Accuracy	≦0.3%F.S.+60mA	≦0.3%F.S.+60mA
Current Resolution	10mA	
General Specs.		
Interfaces	Standard: RS-485/RS-232 (Modbus) & Analog Optional: Ethernet/USB/RS-485/RS-232 (SCPI) or GPIB	
Parallel Operation	Up to 2 units in master/slave mode	
Remote sense compen-sation	≦5V	
Operating Temperature	0°C ~ 40°C	
Storage Temperature	-20°C ~ 70°C	
Protections	OVP、OCP、OPP、OTP、Vin OV、Vin UV、 Vin LV、Phase loss、Fan error	
OVP Range	0~110% F.S.	
OCP Range	0~110% F.S.	
Dimension (HxWxD)	132 x 442 x 756 mm / 5.20 x 17.40 x 29.76 inches	
Weight	Approx. 26kg / 57.32lbs	Approx. 33kg / 72.75lbs

* All specifications are subject to change without notice

Table 1.1 Technical Specifications

Model		ADG-L-330-50-8	ADG-L-660-12	ADG-L-660-25-8	ADG-L-160-75	ADG-L-330-36
Output Power		8kW	8kW	8kW	12kW	12kW
INPUT						
Input Voltage		1Φ 2W+G 187-264 Vac 3Φ4W+G 340-460 Vac			1Φ 2W+G 187-264 Vac 3Φ3W+G 187-264 Vac 3Φ4W+G 340-460 Vac	
Input Current		1Φ : 48A 3Φ : 24A	1Φ : 48A 3Φ : 24A	1Φ : 48A 3Φ : 24A	1Φ : 72A 3Φ△: 42A 3ΦY : 23A	1Φ : 72A 3Φ△: 42A 3ΦY : 23A
Input Frequency		47 Hz - 63 Hz				
Power Factor		≧0.99 at max. power				
OUTPUT						
Voltage		0~330V	0~660V	0~660V	0~160V	0~330V
Current		0~50A	0~12A	0~25A	0~75A	0~36A
Voltage Ripple (rms)		≦0.08% F.S.	≦0.08% F.S.	≦0.08% F.S.	≦0.15% F.S.	≦0.08% F.S.
Voltage Ripple (peak to peak)		≦1.6% F.S.	≦0.8% F.S.	≦0.8% F.S.	≦1.6% F.S.	≦1% F.S.
Voltage Line Regulation		≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.
Voltage Load Regulation		≦0.08% F.S.+ 80mV	≦0.05% F.S.	≦0.05% F.S.	≦0.25% F.S.	≦0.25% F.S.
Current Ripple (rms)		≦0.15% F.S.	≦0.5% F.S.	≦0.25% F.S.	≦0.1% F.S.	≦0.15% F.S.
Current Line Regulation		≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.
Current Load Regulation		≦0.2% F.S.	≦0.25% F.S.	≦0.25% F.S.	≦0.1% F.S.	≦0.1% F.S.
Load Transient Response (CP MODE = OFF)		≦3ms	≦3.5ms	≦3.5ms	≦4ms	≦4ms
Efficiency(Full load)		≧90% at max. power				
Slew Rate	Rise Time	≦ 40ms	≦ 60ms	≦ 60ms	≦ 25ms	≦ 35ms
	Fall Time (Full Load)	≦45ms	≦45ms	≦45ms	≦35ms	≦ 45ms
	Fall Time (No Load)	≦10s				
Programming & Measurement						
Voltage Programming Accuracy		≦0.08%F.S.+100mV				
Voltage Measurement Accuracy		≦0.08%F.S.+100mV		≦0.08%F.S.+100mV		
Voltage Resolution		100mV				

Current Programming Accuracy	≦0.4%F.S.+60mA	
Current Measurement Accuracy	≦0.3%F.S.+60mA	≦0.4%F.S.+60mA
Current Resolution	10mA	
General Specs.		
Interfaces	Standard: RS-485/RS-232 (Modbus) & Analog Optional: Ethernet/USB/RS-485/RS-232 (SCPI) or GPIB	
Parallel Operation	Up to 2 units in master/slave mode	
Remote sense compensation	≦5V	
Operating Temperature	0°C ~ 40°C	
Storage Temperature	-20°C ~ 70°C	
Protections	OVP、OCP、OPP、OTP、Vin OV、Vin UV、 Vin LV、 Phase loss、Fan error	
OVP Range	0~110% F.S.	
OCP Range	0~110% F.S.	
Dimension (HxWxD)	132 x 442 x 756 mm / 5.20 x 17.40 x 29.76 inches	
Weight	Approx. 33kg / 72.75lbs	Approx.40kg / 88.18lbs

* All specifications are subject to change without notice

Table 1.2 Technical Specifications

Model		ADG-L-330-75-12	ADG-L-500-24	ADG-L-1000-12	ADG-L-1000-25-12
Output Power		12kW	12kW	12kW	12kW
INPUT					
Input Voltage		1Φ 2W+G 187-264 Vac 3Φ3W+G 187-264 Vac 3Φ4W+G 340-460 Vac			
Input Current		1Φ : 72A 3Φ△: 42A 3ΦY : 23A	1Φ : 72A 3Φ△: 42A 3ΦY : 23A	1Φ : 72A 3Φ△: 42A 3ΦY : 23A	1Φ : 72A 3Φ△: 42A 3ΦY : 23A
Input Frequency		47 Hz - 63 Hz			
Power Factor		≧0.99 at max. power			
OUTPUT					
Voltage		0~330V	0~500V	0~1000V	0~1000V
Current		0~75A	0~24A	0~12A	0~25A
Voltage Ripple (rms)		≦0.08% F.S.	≦0.1% F.S.	≦0.06% F.S.	≦0.06% F.S.
Voltage Ripple (peak to peak)		≦1% F.S.	≦0.8% F.S.	≦0.5% F.S.	≦0.5% F.S.
Voltage Line Regulation		≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.	≦0.03% F.S.
Voltage Load Regulation		≦0.25% F.S.	≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.
Current Ripple (rms)		≦0.1% F.S.	≦0.25% F.S.	≦0.5% F.S.	≦0.25% F.S.
Current Line Regulation		≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.	≦0.05% F.S.
Current Load Regulation		≦0.1% F.S.	≦0.15% F.S.	≦0.15% F.S.	≦0.15% F.S.
Load Transient Response (CP MODE = OFF)		≦4ms	≦3ms	≦3ms	≦3ms
Efficiency(Full load)		≧90% at max. power			
Slew Rate	Rise Time	≦ 35ms	≦ 45ms	≦ 90ms	≦ 90ms
	Fall Time (Full Load)	≦ 45ms	≦ 30ms	≦ 40ms	≦ 40ms
	Fall Time (No Load)	≦10s			
Programming & Measurement					
Voltage Programming Accuracy		≦0.08%F.S.+100mV			
Voltage Measurement Accuracy		≦0.08%F.S.+100mV	≦0.08%F.S.+150mV		
Voltage Resolution		100mV			

Current Programming Accuracy	≦0.4%F.S.+60mA	
Current Measurement Accuracy	≦0.4%F.S.+60mA	≦1%F.S.+150mA
Current Resolution	10mA	
General Specs.		
Interfaces	Standard: RS-485/RS-232 (Modbus) & Analog Optional: Ethernet/USB/RS-485/RS-232 (SCPI) or GPIB	
Parallel Operation	Up to 2 units in master/slave mode	
Remote sense compensation	≦5V	
Operating Temperature	0°C ~ 40°C	
Storage Temperature	-20°C ~ 70°C	
Protections	OVP、OCP、OPP、OTP、Vin OV、Vin UV、 Vin LV、Phase loss、Fan error	
OVP Range	0~110% F.S.	
OCP Range	0~110% F.S.	
Dimension (HxWxD)	132 x 442 x 756 mm / 5.20 x 17.40 x 29.76 inches	
Weight	Approx. 40kg / 88.18lbs	

* All specifications are subject to change without notice

Table 1.3 Technical Specifications

1.4 Outline Drawing

Product outline drawing of the ADG-L series are given as follows.

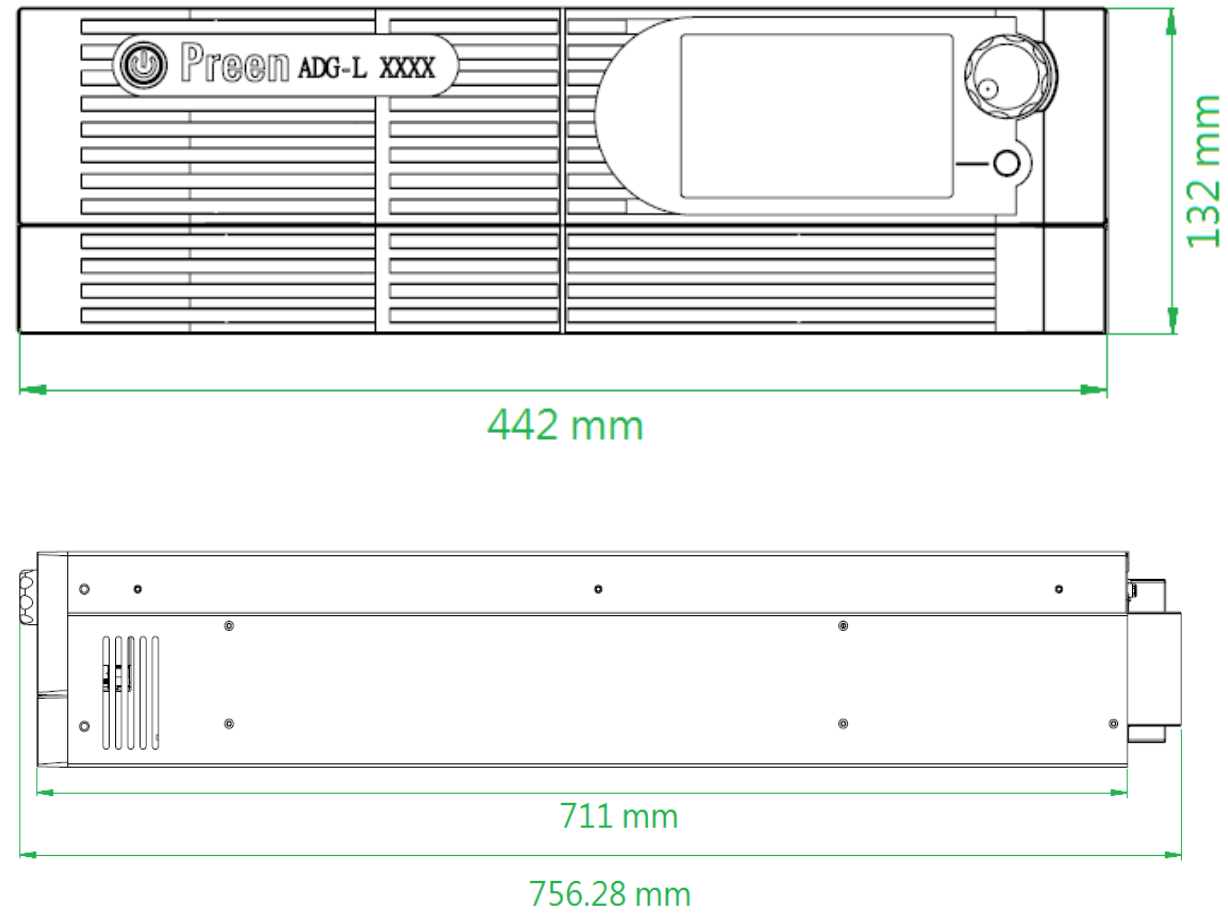


Figure 1.2 Outline drawings of the ADG-L series.

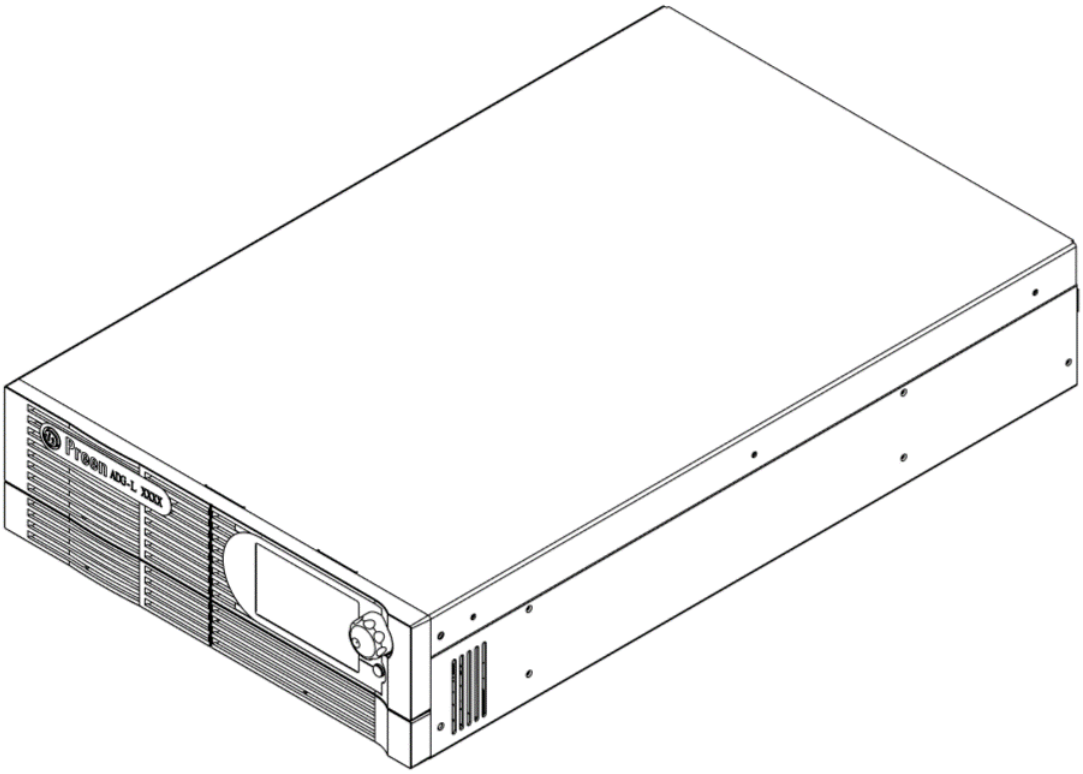


Figure 1.3 Outline drawing of the ADG-L series

1.5 Name of parts

A. **Front panel**

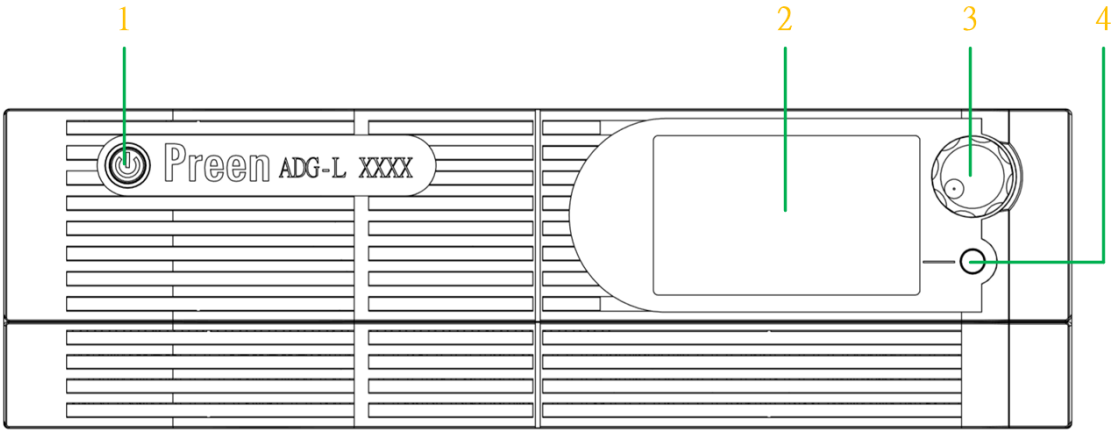


Figure 1.4 Front Panel

Item	Name	Description
1	Power Switch	Press to turn the product ON/OFF.
2	Touch Screen	To set parameters, configure settings and read measurements. The touch screen can be operated with the fingers or with a stylus.
3	Rotary Knob	To set parameters, configure settings and read measurements. Push the knob to confirm the selections or settings.
4	Output & Reset Button	Press the button to enable/disable/reset the product output Blue light indicates that the output is on. Red light indicates that an error occurs

Table 1.4 Description of front panel

B. Rear panel

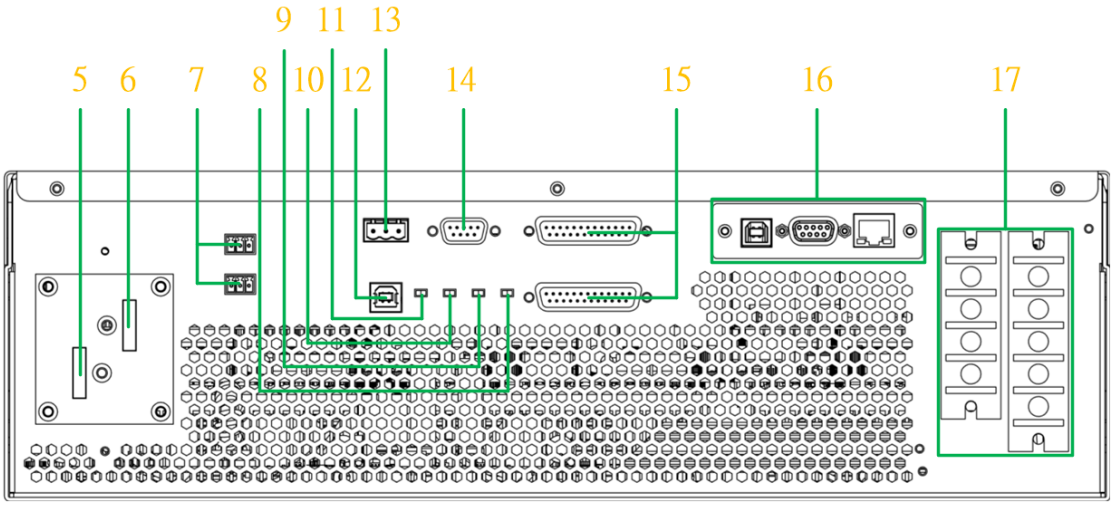


Figure 1.5 Rear panel

Item	Name	Description
5	DC negative output terminal	Used to output DC negative power to the load.
6	DC positive output terminal	Used to output DC positive power to the load.
7	Remote Sense Connector	Used to connect to the load for compensating the voltage drop generated due to cable resistance. Notice: Be sure to connect the remote sense connector “S+” to the positive output terminal and “S–” connector to the negative output terminal.
8	RS232/RS485 Interface switch	Used to select between RS232 and RS485 interface.
9	RS-485 terminal resistor switch	Used to switch the RS-485 terminal resistor ON /OFF.
10	Series and parallel switch	Used to switch series/parallel operation with other units.
11	CANBUS terminal resistor switch	Used to switch the CANBUS terminal resistor ON/OFF.
12	USB interface	Used for updating the firmware by PC via the USB cable.

		NOTICE: It is only serviceable by Preen's service personnel.
13	Accessory power outlet	Used to provide 12V and 5V accessory power. The maximum current is 300mA.
14	RS232/RS485 Interface (standard)	Used for remote control by other device. (support MODBUS protocol)
15	Analog interface	Used to perform the following functions: 1. Perform serial/parallel operation with other units via CANBUS. 2. External analog control 1. Two extra control signal available for use
16	Optional communication interfaces	1. USB interface 2. RS-485/RS-232 interface (support MODBUS and SCPI protocols) 3. Ethernet interface 4. GPIB
17	Input terminals	Used to connect the product to the power line.

Table 1.5 Description of rear panel

2 Installation

2.1 Checking the package

Check if there is any damage or any missing accessories after unpacking it, and keep the complete transport package for return to the manufacturer.
Should any damage be found, contact Preen immediately to request return shipment. Do not return it before obtaining prior acceptance from Preen.

2.2 Preparation

Be sure the power supply is connected to the AC line input that meets the specification. The instrument must be installed in an air-circulated area, so that the fans built-in are able to ventilate the heat generated by components properly. The ambient temperature should be controlled within 40°C.

2.2.1 Notice for installation

1. The equipment must be installed on horizontal grounds, and should be located near the load so that the connection is as short as possible.
2. Leave sufficient space around the equipment for ventilation and maintenance (refer to Figure 2.1). Do not block the cooling fan opening in case of the internal temperature getting too high and having bad impact on product life.
3. The equipment should be located in proper ventilation, the ambient temperature and humidity should not be high.
   Stay away from liquid, flammable gases, corrosive substance, heat sources or direct sunlight. Keep the opening free from dust.
4. The operating environment should be free from dust, volatile organic compounds, high salinity or corrosive substance.
5. Do not operate the equipment outdoor.
6. Use correct cable selection and application for power distribution to ensure the safety of the equipment and the users.

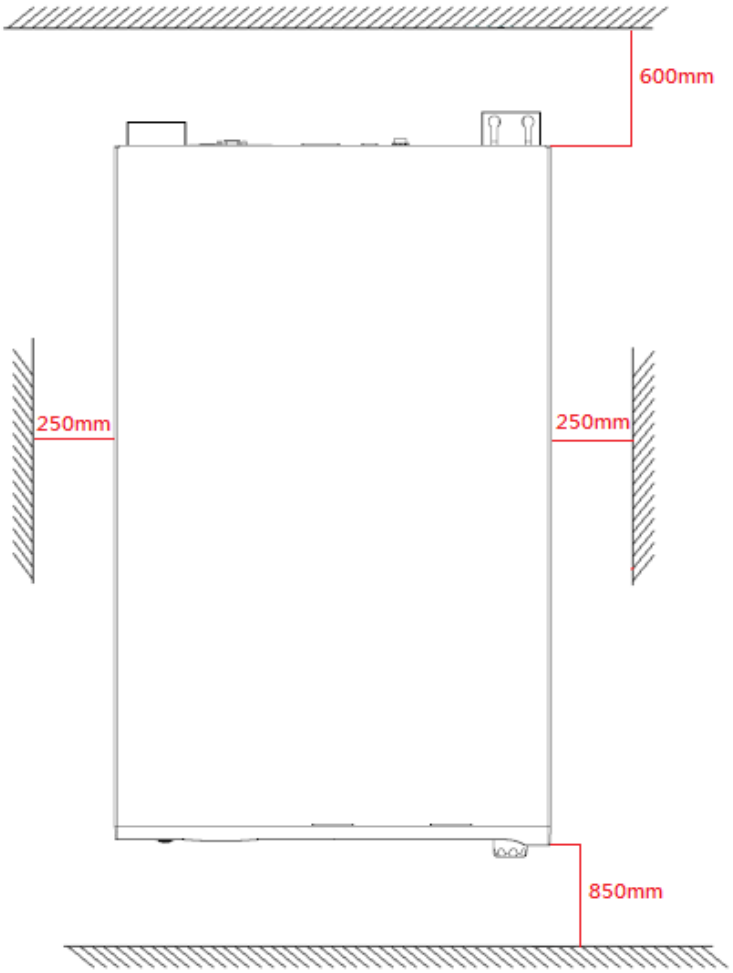


Figure 2.1 The required space for the equipment.

2.3 Input information

2.3.1 Rated value

Input voltage range: 187~264Vac (single-phase), 187~264Vac (three- phase △ connection), 340~460Vac (three-phase / four-wire Y connection). Refer to subsection 1.3 for the standard input voltage of each model type.

Input Frequency: 47~63 Hz.

Maximum current: refer to subsection 2.3.2 for the maximum input current of each model.

Caution
Please ensure the input voltage, which is strongly recommended to be measured by the multimeter, is within the input voltage range according to the label sticker on the unit (refer to Figure2.2). If the input is three-phase, please measure all of the three phases to prevent phase loss issue. If the input voltage exceeds the range, the unit will be damaged.

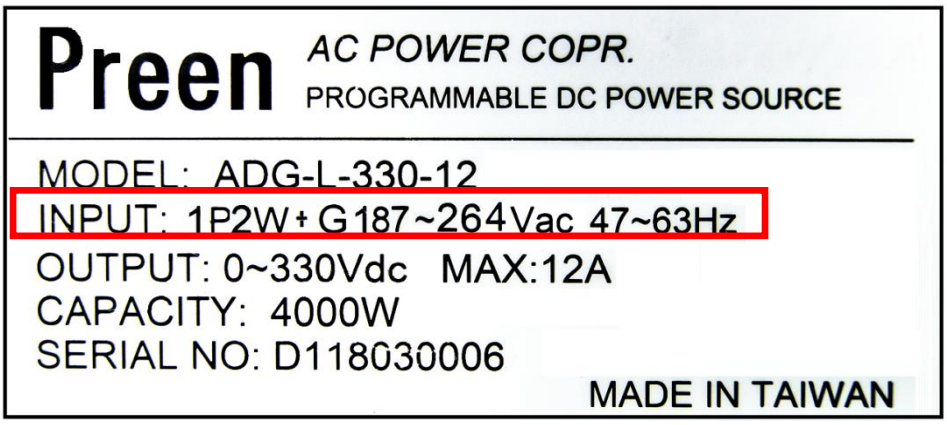


Figure2.2 Label sticker on the unit.
(example of model ADG-L-330-12)

2.3.2 Wire selection

Care must be taken to properly select cables (refer to table Table 2.1, Table 2.2 and Table 2.3) for the input and output of the power supply according to the models. Ensure that the ADG-L series and the DUT are switched off b efore connecting any cables. Refer to Subsection 2.4 and 2.5 for cable conne ction, and install the safety cover in the last step for personal safety.

1) Single-phase input:

Single-phase input voltage (1 phase 2 wire + G) : 200V,208V,220V				
Model	Input current	L	N	G
ADG-L-160-25	25A	4mm^2	4mm^2	4mm^2
ADG-L-160-50	50A	8mm^2	8mm^2	8mm^2
ADG-L-160-75	75A	14mm^2	14mm^2	14mm^2
ADG-L-330-12	25A	4mm^2	4mm^2	4mm^2
ADG-L-330-24	50A	8mm^2	8mm^2	8mm^2
ADG-L-330-36	75A	14mm^2	14mm^2	14mm^2
ADG-L-500-24	75A	14mm^2	14mm^2	14mm^2
ADG-L-660-12	50A	8mm^2	8mm^2	8mm^2
ADG-L-1000-12	75A	14mm^2	14mm^2	14mm^2
ADG-L-330-25-4	25A	4mm^2	4mm^2	4mm^2
ADG-L-330-50-8	50A	8mm^2	8mm^2	8mm^2
ADG-L-330-75-12	75A	14mm^2	14mm^2	14mm^2
ADG-L-660-25-8	50A	8mm^2	8mm^2	8mm^2
ADG-L-1000-25-12	75A	14mm^2	14mm^2	14mm^2

* The wire size is based on the input current of 200V single-phase. When the input voltage is bigger than 200V, the wire size can be smaller or equal to the recom-mended wire size listted on the table above.

2) Three-phases input:

Three-phase input voltage (Δ: 3 phase 3 wire +G; Y :3 phase 4 wire +G): Δ : 200V, 208V, 220V, Y :220V/380V,230V/400V,240/415V				
Model	Input current	L	N	G
ADG-L-160-50	25A	2.5mm^2	2.5mm^2	2.5mm^2

ADG-L-330-24	25A	2.5mm^2	2.5mm^2	2.5mm^2
ADG-L-660-12	25A	2.5mm^2	2.5mm^2	2.5mm^2
ADG-L-330-50-8	25A	2.5mm^2	2.5mm^2	2.5mm^2
ADG-L-660-25-8	25A	2.5mm^2	2.5mm^2	2.5mm^2
ADG-L-160-75	40A	6mm^2	6mm^2	6mm^2
ADG-L-330-36	40A	6mm^2	6mm^2	6mm^2
ADG-L-500-24	40A	6mm^2	6mm^2	6mm^2
ADG-L-1000-12	40A	6mm^2	6mm^2	6mm^2
ADG-L-330-75-12	40A	6mm^2	6mm^2	6mm^2
ADG-L-1000-25-12	40A	6mm^2	6mm^2	6mm^2

* The wire size is based on the input current of 200V three-phase. When the input voltage is bigger than 200V, the wire size can be smaller or equal to the recommended wire size listted on the table above.

Table 2.1 Input cable size

3) Output cable selection

Model	Output voltage	Output current	DC +	DC -
ADG-L-160-25	160V	25A	4mm^2	4mm^2
ADG-L-160-50	160V	50A	8mm^2	8mm^2
ADG-L-160-75	160V	75A	14mm^2	14mm^2
ADG-L-330-12	330V	12A	1.5mm^2	1.5mm^2
ADG-L-330-24	330V	24A	4mm^2	4mm^2
ADG-L-330-36	330V	36A	6mm^2	6mm^2
ADG-L-500-24	500V	24A	4mm^2	4mm^2
ADG-L-660-12	660V	12A	1.5mm^2	1.5mm^2
ADG-L-1000-12	1000V	12A	1.5mm^2	1.5mm^2
ADG-L-330-25-4	330V	25A	4mm^2	4mm^2
ADG-L-330-50-8	330V	50A	8mm^2	8mm^2
ADG-L-330-75-12	330V	75A	14mm^2	14mm^2
ADG-L-660-25-8	660V	25A	4mm^2	4mm^2
ADG-L-1000-25-12	1000V	25A	4mm^2	4mm^2

Table 2.2 Output cable size

4) AWG

AWG	Current rating	AWG	Current rating
18	10A	4	100A
16	15A	2	130A
14	25A	1	145A
12	30A	0 (1/0)	170A
10	40	00 (2/0)	195
8	55	000 (3/0)	225
6	80	0000 (4/0)	260

Ambient temperature below 35℃, Temperature Rating of Conductor Insulation 60 ℃

Table 2.3 Current rating of AWG

Notice
The tables above give *minimum* recommended cable size; these recommendations are for multi core flexible copper cables only and are for reference only. User can select different cables according to the actual conditions of input and output. When the length of cable is more than 20 meters, the cable gauge should be doubled.

2.4 Input connection

The input terminals are located at the right side of the rear panel (refer to Figure 1.5). The input power cables must be rated at least 85℃ and have a current rating greater than or equal to the maximum rated input current of the product. Installation of the input connection must be done by a professional and compliant with local electrical codes.

Please perform the following steps:

1. Remove the safety covers from the rear panel.
2. Connect the power cables firmly to the input terminals. Connection configurations differ from models, single/three-phase input and input voltage. Shorting links are attached for different connection configurations. Please refer to Figure 2.3, and ensure to use the correct shorting link for different connections.
3. Screw the safety covers back to the input terminals.

Warning
Protective Grounding. **To protect users, the wire connected to terminal "PE" (that is protective grounding) must be connected to the earth ground. Under no circumstances shall this product being operated without an adequate protective grounding connection.**

Caution
Please ensure to use the right shorting link and connect the input cables correctly according to the Figure 2.3. The shorting links are marked in gray on Figure 2.3. Wrong connections will cause damage to the ADG-L series.

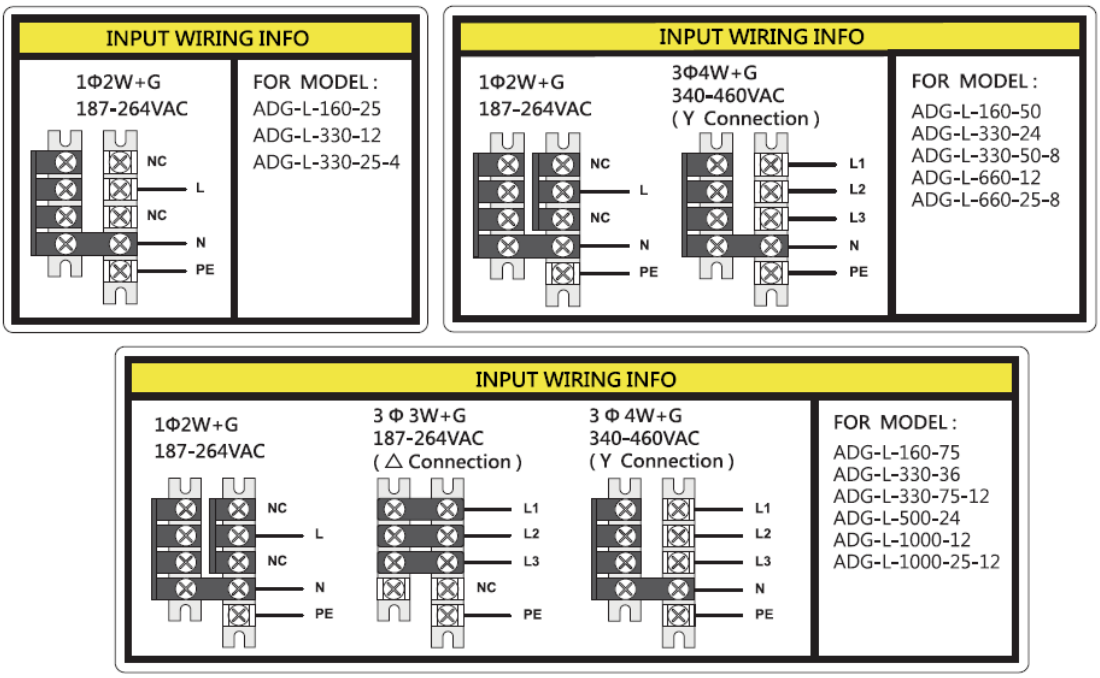


Figure 2.3 Input terminals

2.5 Output connection

The output terminals are located at the right side of the rear panel (refer to Figure 1.5). Connect "+" and "-" of the output terminals to the load. For safety, the safety cover for the output terminals must be fastened after each output connection. The wires to the load must have sufficient gauges, so they will not over-heat due to high output current.

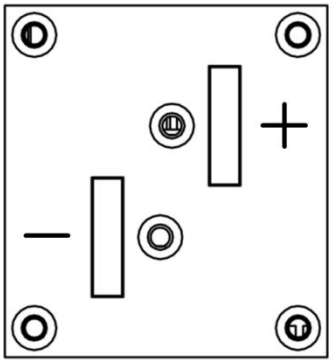


Figure 2.4 Output terminals

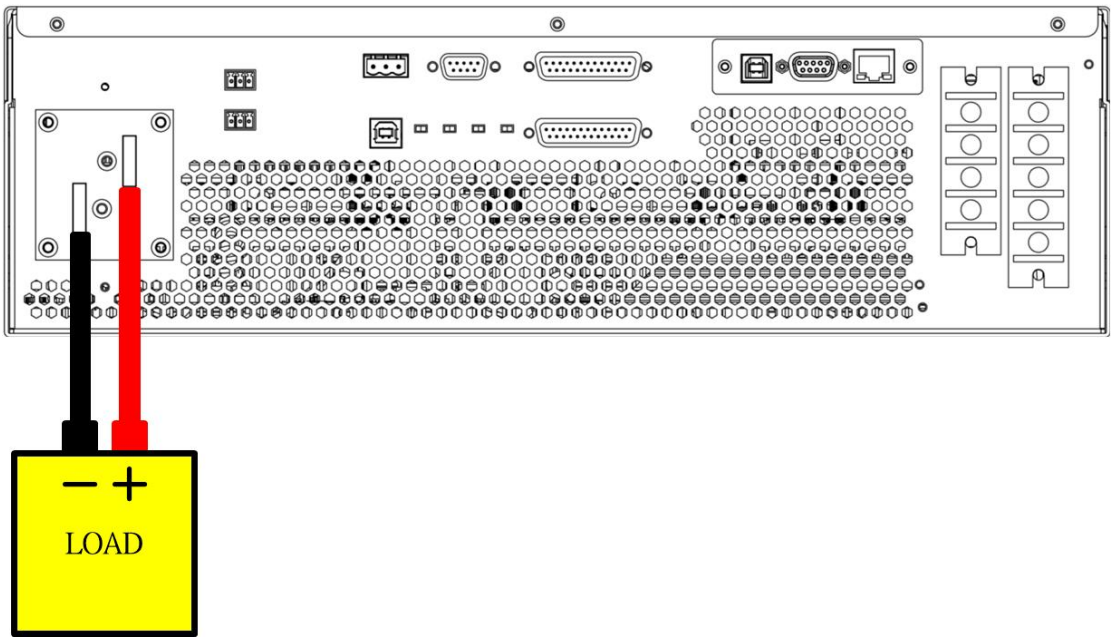


Figure 2.5 Output terminals to the load

2.6 Remote sense connection

The product supports remote sense function, which monitors the voltage at the load instead of the output terminals of the product. It ensures to deliver accurate voltage as programmed at the load by automatically compensating the output voltage drop due to the connecting cable. Refer to Subsection 3.5.4.1 for the setup of line drop compensation via the touch screen.

Connect “S-“and “S+” of the remote sense connector to the corresponding terminals on the DUT. Please connect the remote sense connector as described below in Figure 2.7. Because the sensing leads can carry only millamperes, they are much smaller than the output power cable. The sensing leads are for voltage monitoring feedback of the product, so they must have a low resistance in order to maintain the best performance. The sensing leads must be a shielded twisted pair cable to minimize external noise interference. Insulation of the sensing leads used for high voltage model should be taken into consideration. The sensing leads need to be connected to the DUT as close as possible.

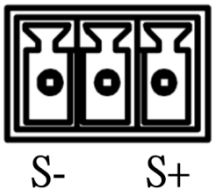
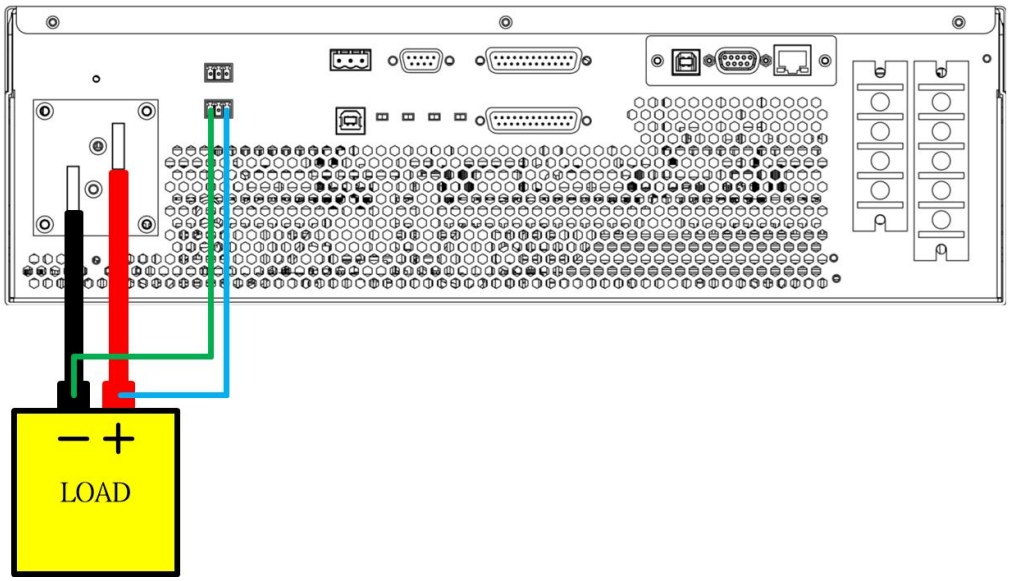
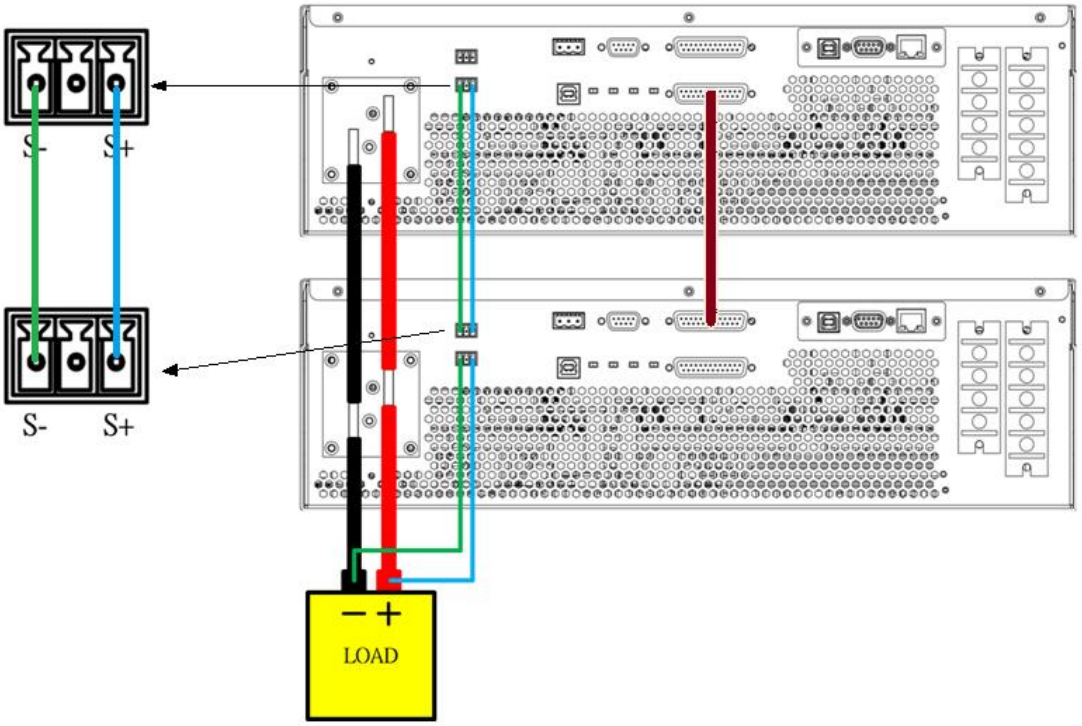


Figure 2.6 Remote sense connector



(a) Remote sensing wiring: single-unit



(b) Remote sensing wiring: parallel operation (example of two units in parallel)

Figure 2.7 Remote sensing connection to the DUT

Caution
When the Line Drop Compensation on the touch screen is set to START (refer to Subsection 3.5.4.1), a. the accuracy of ADG-L series would be affected, if the sensing leads do not connect to the load; b. the sensing leads could burn out, if there is a short on the leads; c. the sensing leads could burn out, if the sensing leads are connected with reverse-polarity.

2.7 Function dip switch

There are four function dip switches on the rear panel of the unit: S1, the RS-232/RS-485 interface switch; S2, the RS-485 terminal resistor switch; S3, the series and parallel switch; S4, the CANBUS terminal resistor switch. Below are the icons and descriptions of the switches:

Figure 2.8 Function dip switch

Switch	Function	Switch in the left position	Switch in the left position
S1	RS-232/RS-485 interface switch	RS-485 interface	RS-232 interface
S2	RS-485 terminal resistor switch	the resistance value to be ∞Ω	the resistance value to be 120Ω
S3	the series and parallel switch	series	parallel
S4	the CANBUS terminal resistor switch	the resistance value to be ∞Ω	the resistance value to be 120Ω

Table 2.4 Function dip switch settings

Notice
All units in series (not available now) or parallel operation should have the S3 switch on the correct position.

2.8 Analog connection

To control the unit remotely via the analog interface, connect a PC with the unit through the DB25 connector on the rear panel and follow the below instructions.

a. S3 switch on the left: series operation (series operation not available now).
b. S3 switch on the right: parallel operation.
c. S4 switch on the left: the CANBUS terminal resistor switches to OFF, used for transmission speed ≦250kb/s or communication distance ≦300m.
d. S4 switch on the right: the CANBUS terminal resistor switches to ON, used for transmission speed>250kb/s or communication distance>300m.

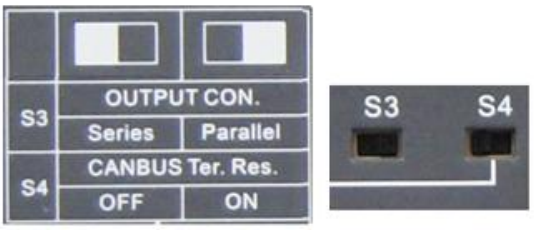


Figure 2.8 S3 and S4 switch position

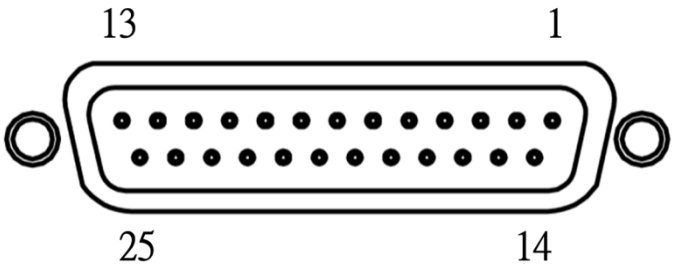


Figure 2.9 DB25 connector

Pin	Name	Type	Description
1	Vset-OVP	Input	Analog control input for programming the over-voltage protection: 0-5 Vdc= 0-110% of full-scale output voltage
2	GND	Ground	Ground
3	GPIO-0	Input or output	Reserved for customized application.
4	GPIO-1	Input or output	Reserved customized application.
5	Ishare	NC	Used for series/parallel operation (not available

			for user).
6	Vset	Input	Analog control input for voltage (Vset) programming: 0-5Vdc= 0-100% of full-scale output voltage.
7	Vo-FB	Output	Analog output for voltage measurement. Please refer to Table 2.6 for output voltage range of each model.
8	GND-I	Ground （NC）	Ground for Iset and Io-FB. Recommended to use when the noise interference is high.
9	Fault	Output	Output signal for indicating a fault state: a logic-high state (5V) indicates a fault occurs; a logic-low state (0V) indicates that the device is in normal operation.
10	Output-syn	NC	Sync signal for series/parallel operation (not available for user).
11	GND	Ground	Ground
12	GND-CAN	NC	Ground for CANBUS signal (not available for user).
13	GND-CAN	NC	Ground for CANBUS signal (not available for user).
14	Iset-OCP	Input	Analog control input for programming of the overcurrent protection: 0-5 Vdc= 0-110% of full-scale output current.
15	PS-ON	Input	Control signal for the device ON/OFF: a logic-high state (5V) is to turn ON the unit; a logic-low state (0V) is to turn OFF the unit.
16	GND	Input	Ground
17	GND	Input	Ground
18	GND-Ishare	NC	Ground for ishare (not available for user).
19	GND-V	Ground （NC）	Ground for Vset and Vo-FB. Recommended to use when the noise interference is high
20	Iset	Input	Analog control input for current (Iset) programming: 0-5Vdc= 0-100% of full-scale output current.
21	Io-FB	Output	Analog output for current measurement:

			0-5Vdc= output current 0-100A.
22	GND	Input	Ground
23	GND	Input	Ground
24	CAN-L	NC	CAN-L signal for series/parallel operation (not available for user).
25	CAN-H	NC	CAN-H signal for series/parallel operation (not available for user).

Table 2.5 DB25 pin

Notice
When user controls the unit remotely via analog interface, the communication mode on the HMI should be switched to analog control (refer to Subsection 3.6.1). Once the analog control is active, the product will automatically turn the CP mode to ON. Please be aware that the CP mode is still ON even when the unit is switched from the analog control back to the local operation, and should be turned off manually if needed (refer to Subsection 3.5.4.2 for CP mode setup). Analog control is not supported for series or parallel operation.

Model (output voltage)	Output voltage(Vo)	output voltage signal(Vo-FB)
ADG-L-500-24 (500V) ADG-L-1000-12 (1000V) ADG-L-1000-25-12 (1000V)	0~1100V	0~4.4V
ADG-L-660-12 (660V) ADG-L-660-25-8 (660V)	0~726V	0~4.14V
ADG-L-160-25 (160V) ADG-L-160-50 (160V) ADG-L-160-75 (160V) ADG-L-330-12 (330V) ADG-L-330-24 (330V) ADG-L-330-36 (330V) ADG-L-330-25-4 (330V) ADG-L-330-50-8 (330V) ADG-L-330-75-12 (330V)	0~363V	0~4.12V

Table 2.6 Analog output for voltage measurement.

2.9 RS-232/RS-485 interface connection

To control the unit remotely via the RS-232/RS-485 interface, connect a PC with the unit through the DB9 connector on the rear panel and follow the below instructions

a. S1 switch on the left: RS-485 interface
b. S1 switch on the right: RS-232 interface
c. S2 switch on the left: the RS-485 terminal resistor switches to OFF, used for transmission speed ≦250kb/s or communication distance ≦300m.
d. S2 switch on the right: the RS-485 terminal resistor switches to ON, used for transmission speed>250kb/s or communication distance>300m.

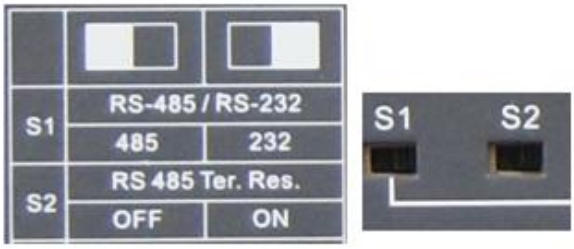


Figure 2.10 S1 and S2 switch position

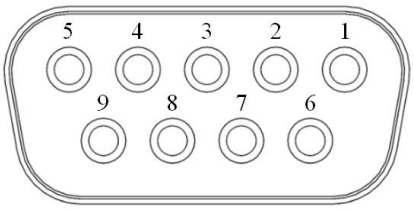


Figure 2.11 DB9 connector

Pin	Name	Type	Description
1	NC	NC	No Connection
2	RS-232-TX	-	Sending data via RS-232
3	RS-232-RX	-	Receiving data via RS-232
4	NC	NC	No Connection
5	GND-COMM	Ground	Ground for RS-232/RS-485
6	RS-485-A	-	RS-485 signal A
7	NC	NC	No Connection
8	NC	NC	No Connection
9	RS-485-B	-	RS-485 signal B

Table 2.7 DB9 pin

Notice
Please use function dip switch S1 to select RS-232 or RS-485 interface.

2.9.1 Remote control Connection

The standard communication via RS-232/RS-485 is supported only by the MODBUS-RTU protocol (refer to Chapter 5). The ADG-L series can be controlled by a PC, a PLC or a DAQ device. RS-232 and RS-485 share one DB9 connector and these two interfaces are selective via the function dip switch S1 on the rear panel.

- The total length of RS-485 communication cable must be no longer than 1200 m (4000 ft) for all connections.
- It is important to used high-quality shielded twisted pair cables. AWG22（0.6mm²）or lower is recommended. Different colors of cables are recommended for identi-fication.
- Avoid “T” connection where a derivation is taken from the main cable.
- Communication cable should stay away from source and electrical nosie as much as possible.
- In order to avoid signal reflections, a terminal resistor with 120~300Ohm / 0.25W must be used at the end of the communication cable.
- If RS-232/RS-485 converters are used, they should have optical isolation and surge protection.

2.9.2 Remote control setup

1	Select RS-232 or RS-485 for communication and set the switch on the rear panel correspondingly
2	Connect a PC to the device with the DB9 connector according to the pin definition.
3	Turn on the unit, and verify the Mudbus ID (default setting is 01).
4	Check the Comm Port number of the unit on the PC and verify to control the unit via the correct Comm Port number.
5	The settings for remote control: ● Start bit: 1 bit ● Stop bit: 1 bit

	● Parity: none ● Data length: 8 bit ● BAUD rate: 115200 bit/second
6	To switch the unit to local operation: The PC sends: 01 10 01 01 38 00 83 F5 The unit (ADG-L) replies: 01 10 00 00 00 1D The touch screen HMI of the unit will show local operation.
7	To switch the unit to remote operation The PC sends: 01 10 01 01 38 01 42 35 The unit (ADG-L) replies: 01 10 00 00 00 1D The touch screen HMI of the unit will show remote operation.
8	Remote control setting is completed.

Warning
The actual connections should correspond with the all the settings and switch positions. For safety, the wire connected to terminal "PE" (GND) must be connected to the earth ground. Under no circumstances shall this product operated without an adequate protective grounding connection.

2.10 Accessory power outlet

This outlet on the rear panel provides 12V and 5V accessory power with maximum current up to 300mA. It can be used as a power supply for analog control device or circuit.

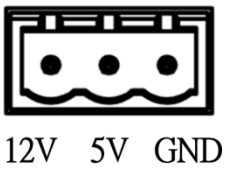


Figure 2.12 Accessory power outlet

2.11 USB interface (for firmware update only)

The standard USB interface on the rear panel is not available for users but for Preen's personnel only to update the firmware of the unit.

Figure 2.13 USB interface

2.12 Power-on procedures

Warning
Before turning on the product, all protective grounding terminals, extension cords, and devices connected to the product must be connected to a protective ground. Any interruption of the protective ground will cause a potential shock hazard that could result in personal injury.

Apply power and press the power switch to turn on the product, then the touch screen on the front panel will light up and display the POWER-ON page shown as below,

Figure 2.14 POWER-ON Page.

After POWER-ON page, the touch screen will show the as follows, and users can input programming data or set up configurations by either pressing the touch screen or turning the rotary knob.

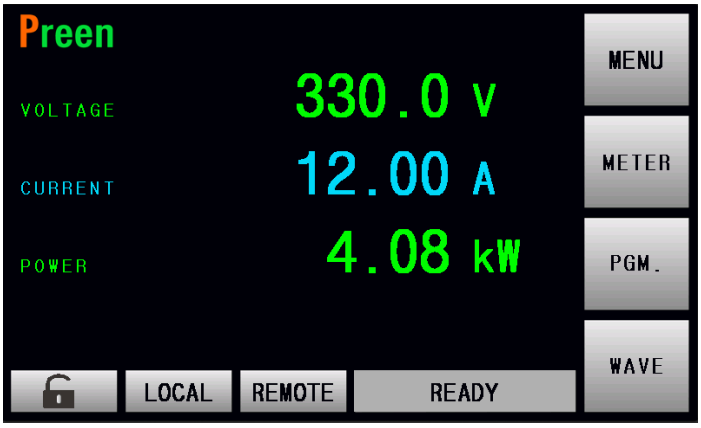


Figure 2.15 MAIN Page.

2.13 Handles installation

To install the handles to the right-side and the left-side of the product, please refer to the Figure 2.16 to fix the handles to the product with eight screws.

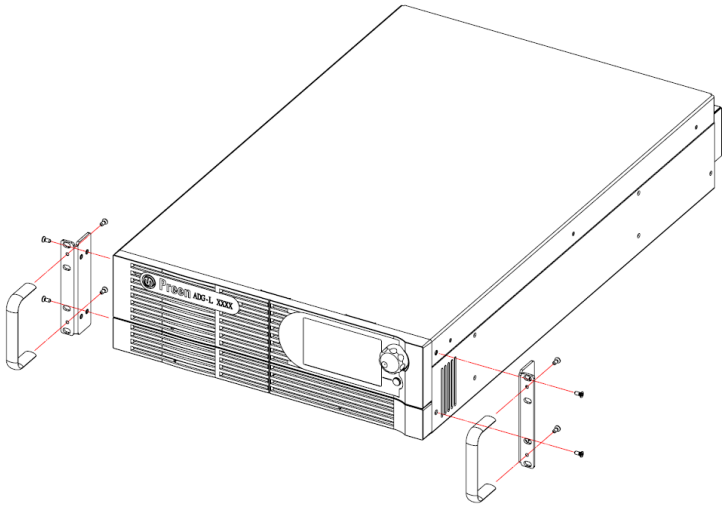


Figure 2.16 Product handles

2.14 Optional communication interface card installation

Unscrew the metal piece on the same location of the optional communication interfaces and install the optional interface card referring to Figure 2.17. Then fix the screws to complete the installation.

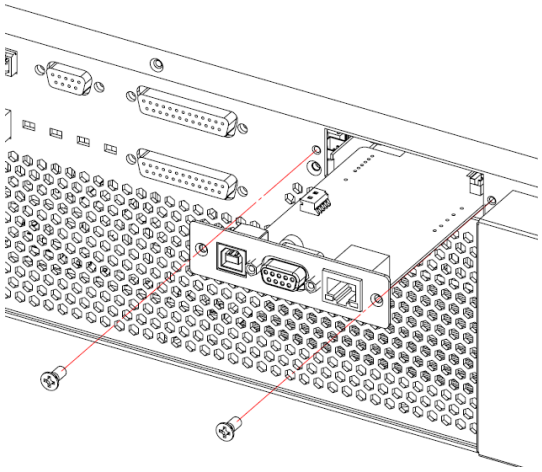


Figure 2.17 Optional interface card installation

Notice
After installation of optional interface card, the S1 function dip switch on the rear panel should be switched to the right position. The optional interface card shares the same pins with RS-232, so please ensure the switch's position for remote communications.

3 Local Operation

3.1 Introduction

The product can support local operation or remote operation. Remote operation via RS-232, RS-485, Analog, Ethernet, USB or GPIB is described in Chapter 4. This section will focus on the local operation via the touch screen and the rotary knob on the front panel.

3.2 Touch screen and rotary knob operation

The product provides user-friendly local operation using the touch screen and rotary knob on the front panel. Each display of the touch screen on the product represents an operational page.

Before the description of each operational page, the following shows how to use touch screen and rotary knob to input programming data or options. When the power-on procedures are finished (refer to Subsection 2.12), the touch screen will display the MAIN page subsequently.

A. Touch screen

Press the item shown on the touch screen directly to enter into next page or to select desired item (see Figure 3.1). Use the numeric keyboard (refer to Figure 3.2) to set value, and then press the icon 

on the touch screen to confirm. After setting value, users can revise value by pressing the icon 

, or press the icon  to return to the previous page.

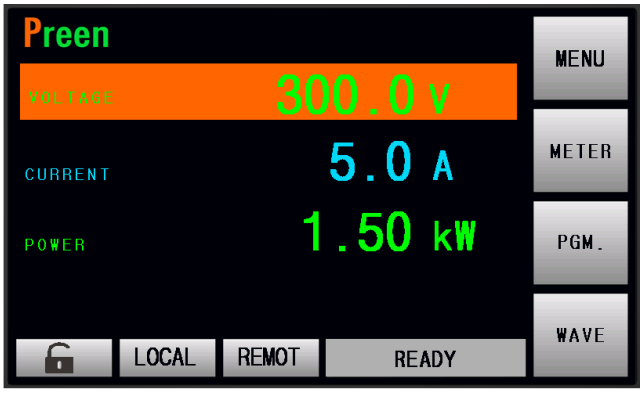


Figure 3.1 Press the desired item on the touch screen

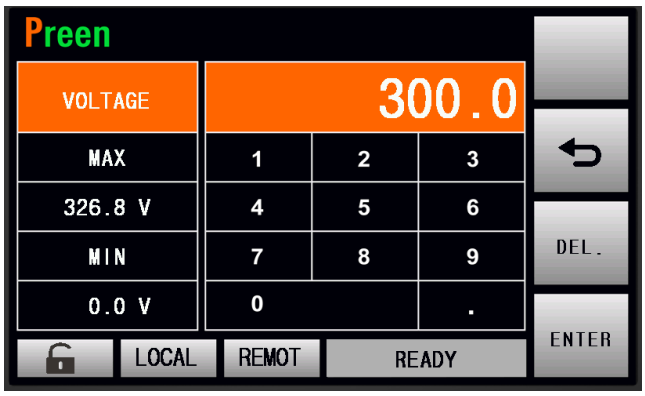


Figure 3.2 Numeric keyboard

B. Rotary knob

Turn the rotary knob on the front panel to move the cursor shown on the touch screen, and press the rotary knob to select item. After item selection, for numeric value, please continue to turn the rotary knob to set value, and then press the rotary knob to confirm.

Figure 3.3 Move the cursor on the touch screen by turning the rotary knob

Notice

Since the default setting of CP mode is OFF, the output power setting is not adjustable (refer to Subsection 3.5.4.2), and the MAIN page will shows P-set lock when press the POWER item.

3.3 MAIN page

When users turn on the product, the touch screen shows the MAIN PAGE after the power-on procedures. The MAIN page shows the output settings and the measurement readings of the product output. Users can set output value by using the touch screen or the rotary knob (refer to Subsection 3.2), and then press the output & reset button on the front panel to enable the output of the product. Please see the following figures,

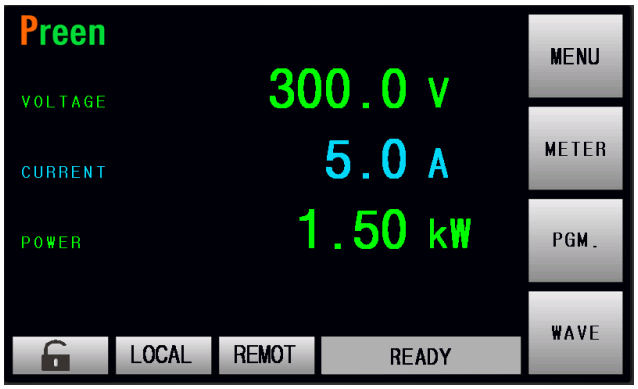


Figure 3.4 MAIN page when the product output switches off.

Figure 3.5 MAIN page when CV/CC/CP mode is active.

The descriptions for the items and the icons on the MAIN page are given as follows,

1) 

: Press to set output voltage on CV mode

2) 

: Press to set output current on CC mode

3) 

: Press to set output power on CP mode

4) 

: Show the elapsed time since start of the output.

5) 

: Press to enter into the MENU page.

6) 

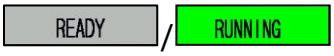
: Press to enter into the METER page

7) 

: Press to enter into the PGM. page

8) 

: Press to enter into the WAVE page (refer to Subsection 3.7)

9) 

: Show the status of the unit or the error code.

10) 
: Press to lock/unlock the touch screen. If an attempt is made to alter something whilst the touch screen is locked, 

will appear on the status of the unit.

11) 

: Press LOCAL to select local operation

12) 

: Press REMOTE to activate remote control.

13) 
: Shows remote control is active.

14) 

: Shows the output is on CV mode.

15) 

: Shows the output is on CC mode.

16) 

: Shows the output is on CP mode.

3.3.1 Constant voltage (CV) mode setting

Press the item VOLTAGE on the MAIN page to enter into the voltage setting for the constant voltage (CV) mode (refer to Figure 3.6). The voltage range varies according to the models (refer to Subsection 1.3). Below is an example of model ADG-L-330-12, of which the output voltage ranges from 0.0V~ 336.3V. The factory default maximum setting voltage is approximately 102% (336.6 = 330V * 1.02) of the maximum rated output voltage of the supply.

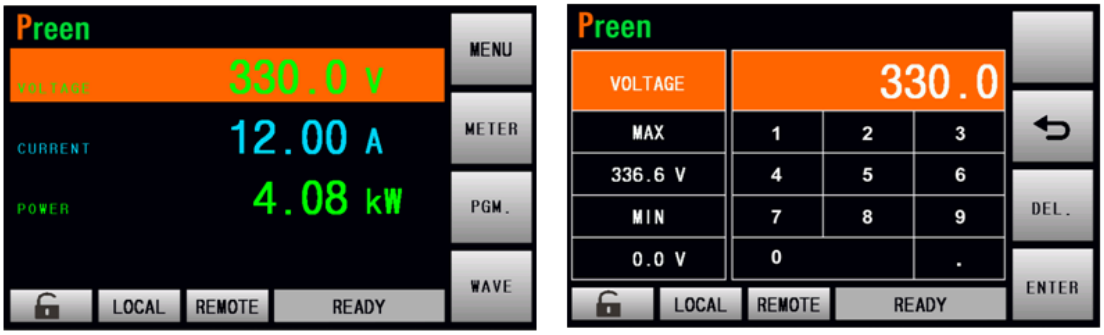


Figure 3.6 CV mode setting on the MAIN page

Notice
If the user would like to operate the unit under CV mode, please ensure: 1. Current setting in CC mode should be set over 0A or over the actual output current. (refer to Subsection 3.3.2 for CC mode setting) 2. Power setting in CP mode should be set over 0W or over the actual output power if CP mode is ON. (refer to Subsection 3.3.2 for CP mode setting) So the output voltage could meet the set value.

3.3.2 Constant current (CC) mode setting

Press the item CURRENT on the main page to enter into the current setting for CC mode (refer to Figure 3.7). The current range varies according to the models (refer to Subsection 1.3). Below is an example of model ADG-L-330-12, of which the output current ranges from 0.00A~ 12.24A. The factory default maximum setting current is approximately 102% (12.24A = 12A * 1.02) of the maximum rated output current of the supply. The CC mode is only active when the output current is larger or equal to the set value of CC; the unit will then adjust the output voltage to maintain the output current as the set value of CC.

Figure 3.7 CC mode setting in MAIN page

3.3.3 Constant power (CP) mode setting

When the CP mode is ON (refer to Subsection 3.5.4.2), press the item POWER on the MAIN page (refer to Figure 3.8) to enter into the power setting for the CP mode. The power range varies according to the models (refer to Subsection 1.3). Below is an example of model ADG-L-330-12, of which the output power ranges from 0.00kW~ 4.08kW. The factory default maximum setting power is approximately 102% (4.08kW = 4kW * 1.02) of the maximum rated output power of the supply. The CP mode is only active when the output current is larger or equal to the set value of CP.

Figure 3.8 CP mode setting in MAIN page.

Notice
When the CP mode is set OFF, the max value of V-set and I-set will be limited according to the rated power. “P-set lock” will be shown on the screen when pressing the item POWER, and power limit cannot be adjusted (refer to subsection 3.5.4.2).

3.4 MENU page

On the MAIN page, users can press the icon 

to enter into the MENU page. Please see the following figures,

Figure 3.9 MENU page

The description for the items and the icons at the MENU page are given as follows,

1)  : Press to enter into the SETTINGS page.

2)  : Press to enter into the PGM. page (refer to the Subsection 3.10)

3)  : Press to enter into the COMMUNICATION page (refer to the Subsection 3.6)

4)  : Press to enter into the EVENT page (refer to the Subsection 3.8)

5)  : Press to enter into the WAVE page (refer to the Subsection 3.7)

6)  : Press to enter into the MULTI MACH page (refer to Subsection 3.11)

7)  : Press to enter into the INFORMATION page (refer to Subsection 3.9).

8)  : Press to enter into the MAIN page.

9)  : Press to return to the previous page.

10)  : Press to move to the previous page of the MENU page

11)  : Press to move to the next page of the MENU page

3.5 SETTINGS page

On the MENU page, users can press the icon  to enter into the SETTINGS page. Please see the following figures.

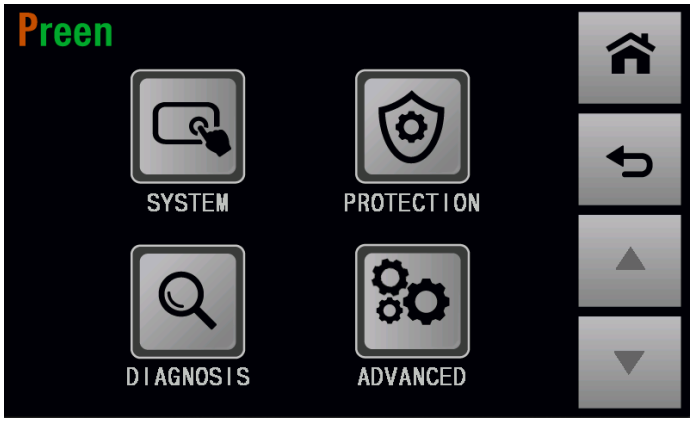


Figure 3.10 SETTINGS page

The description for the items and the icons at the SETTINGS page are given as follows,

1)  : Press to enter into SYSTEM page.

2)  : Press to enter into PROTECTION page.

3)  : Press to enter into the DIAGNOSIS page.

4)  : Press to enter into the ADVANCED page.

5)  : Press to enter into the MAIN page.

6)  : Press to return to the previous page.

3.5.1 SYSTEM Page

Press the icon  to enter into the SYSTEM page. Please see the following figures.

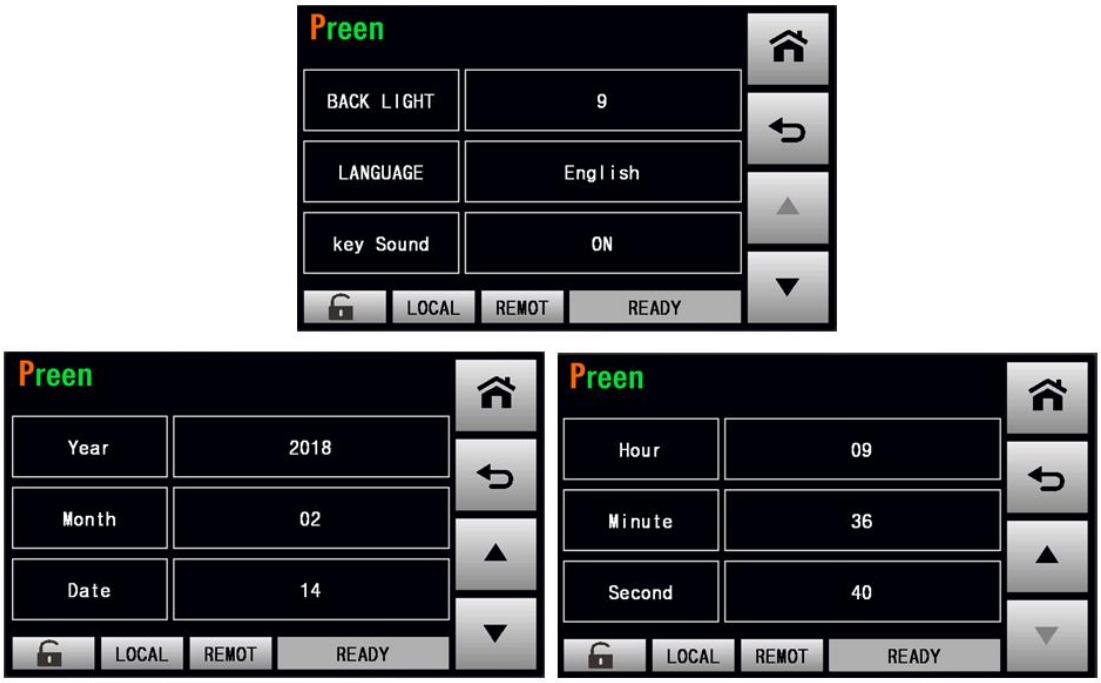


Figure 3.11 SYSTEM page

The description for the items and the icons at the SYSTEM page are given as follows,

1) BACK LIGHT | 8 : Press to set the backlight level of the touch screen, with options from 1 to 8.。

2) LANGUAGE | English : Press to set the language, ENGLISH, 繁體中文 (traditional Chinese), 简体中文 (simplified Chinese).

3) key Sound | ON : Press to enable/disable the key sound.

4) Year | 2018 : Press to set the “year” [0-2099].

5) Month | 02 : Press to set the “month” [0-12].

6) Date | 14 : Press to set the “date” [1-31].

7) 

: Press to set the “hour” [0-24].

8) 

: Press to set the “minute” [0-60].

9) 

: Press to set the “second” [0-60].

10)  : Press to move to the previous page of the SYSTEM

11)  : Press to move to the previous page of the SYSTEM

12)  : Press to enter into the MAIN page.

13)  : Press to return to the previous page.

3.5.1.1 Backlight level

BACK LIGHT Users can set the backlight level of the touch screen from scale 1 to 8 via the touch screen or the rotary knob (refer to Subsection 3.2), and the default backlight level is 8. The higher the level is, the brighter the touch screen will be.

Figure 3.12 Set the backlight level from 8 to 5.

The procedures of setting the backlight level, for example, from 8 to 5 by using the touch screen are given as below:

1) Press the item BACK LIGHT | 8 repeatedly to set the backlight level from 8 to 5.
2) Press the icon ENTER to confirm.

3.5.1.2 Operational language

LANGUAGE Users can set the operational language with three options of ENGLISH, 繁體中文 (traditional Chinese), and 简体中文(simplified Chinese). The default operational language is ENGLISH.

Figure 3.13 Three options of the operational language

The procedures of setting the operational language are given as below:

1) Press the item LANGUAGE English repeatedly to switch the icon status to the desired language.
2) Press the icon ENTER to confirm.

3.5.1.3 Key sound

key Sound Users can set the key sound via the touch screen or the rotary knob (refer to Subsection 3.2). Key sound has two options: ON/OFF. When key sound is set to ON, pressing any key will beep once to remind user. When the key sound is set to OFF, it will not beep when user presses any key.

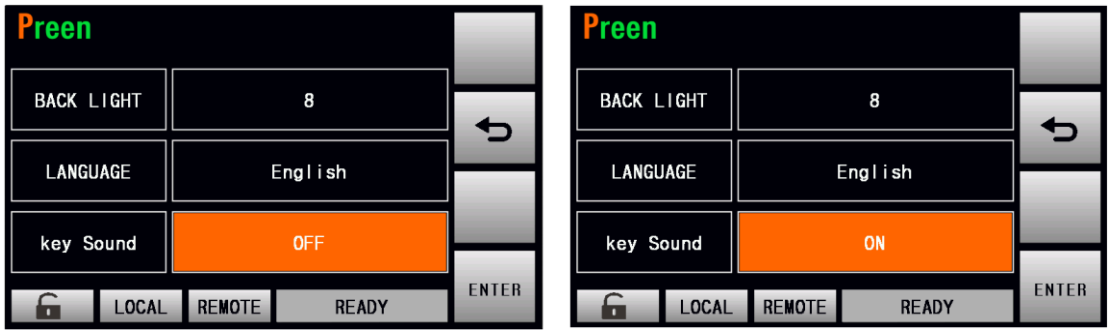


Figure 3.14 Key sound setting

The procedures of setting the key sound are given as below:

1) Press the item 

to switch the key sound.

2) Press the icon 

to confirm.

3.5.1.4 Date and time setting

User is allowed to set date and time in the format of Year/ Month/ Date/ Hour/ Minute/ Second via the touch screen or rotary knob (refer to Subsection 3.2).

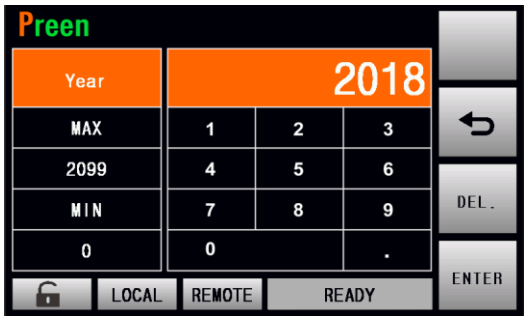


Figure 3.15 Year setting

The procedures of setting date and time are given as below:

1) Press the item  to set year.

2) Press the virtual numeric keyboard to enter the current year, for example "2018".
3) Press the icon  to confirm.

4) Follow the above procedures to complete the date and time setting.

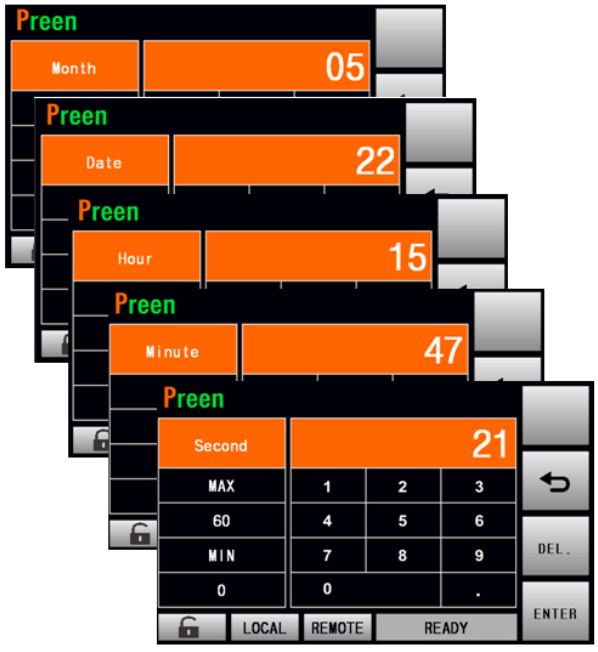


Figure 3.16 Month/Hour/Minute/Second setting

3.5.2 PROTECTION page

Press the icon  to enter into PROTECTION page. Please see the following figure.

Figure 3.17 Protection setting

The descriptions for the items and the icons at the Protection page are given as follows,

1) 

: Press to set the overvoltage protection point.

2) 

: Press to set the overcurrent protection point

3) 

: Press to set the overpower protection point.

3.5.2.1 Overvoltage protection

Users are allowed to set the over voltage protection (OVP) via the touch screen or rotary knob (refer to Subsection 3.2). When the DC supply generates an output voltage higher than the set point of OVP, the OVP will be triggered. The unit's output will be switched off immediately and shows OVP; the Output & Reset Button will turn red.

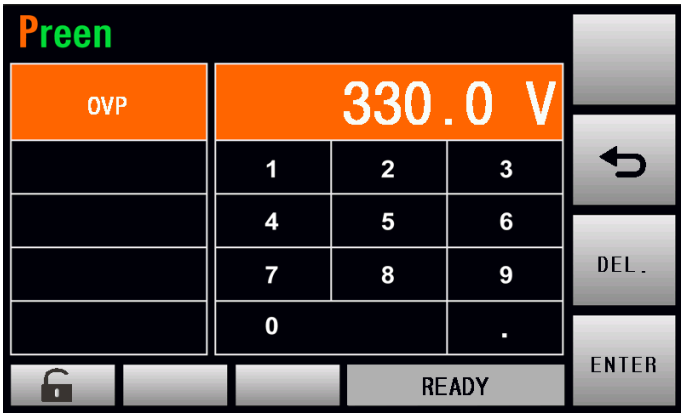


Figure 3.18 OVP setting.

The procedures of setting OVP are given as below:

1) Press the item 

to enter into the OVP setting page.
2) Press the keyboard to set the trigger point of OVP.
3) Press the icon 

to confirm.

3.5.2.2 Overcurrent protection

Users are allowed to set the over current protection (OCP) via the touch screen or rotary knob (refer to Subsection 3.2). When the DC supply generates an output current higher than the set point of OCP, the OCP will be triggered. The unit's output will be switched off and shows OCP; the Output & Reset Button will turn red.

Figure 3.19 OCP setting

The procedures of setting OCP are given as below:

1) Press the item 

to enter into the OCP setting page.

2) Press the keyboard to set the trigger point of OCP.

3) Press the icon 

to confirm.

3.5.2.3 Overpower protection

Users are allowed to set the overpower protection (OPP) via the touch screen or rotary knob (refer to Subsection 3.2). When the DC supply generates an output power higher than the set point of OPP, the OPP will be triggered. The unit's output will be switched off and shows OPP; the Output & Reset Button will turn red.

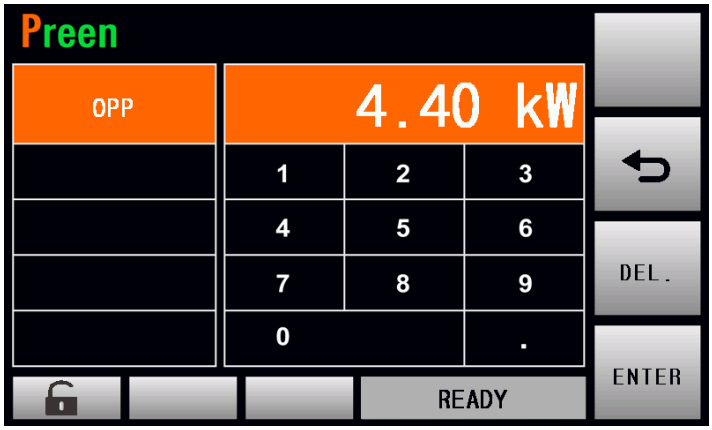


Figure 3.20 OPP setting

The procedures of setting OPP are given as below:

1) Press the item 

to enter into the OPP setting page.
2) Press the keyboard to set the trigger point of OPP.
3) Press the icon 

to confirm.

3.5.2.4 Protection conditions

When the product runs under abnormal condition, the protection will be triggered for safety reason and show an error code corresponding to the protection condition on the touch screen. The descriptions of protection condition are listed as below:

Error Code	Name	Description
OVP	Overvoltage protection	Output voltage > the set value of OVP.
OCP	Overcurrent protection	Output current > the set value of OCP for at least 0.2 second.
OTP	Overtemperature protection	The power module's temperature is detected for over 100℃.
OPP	Overpower protection	Output power > the set value of OPP for at least 1 second.
Vin UV	Input undervoltage	The input voltage < 70V for at least 1 second.
Vin OV	Input overvoltage	The input voltage > 270V for at least 1 second.
Vin Unbalance	Input voltage unbalance	The difference of a power module's input voltage between two phases > 40V.
Vin LV	Input low voltage	The input voltage is between 70V and 180V for at least 1 second.
FAN Error	Fan error	The fan is not running or the fan speed is abnormal.
HW-OVP	Hardware overvoltage protection	The output voltage > 110% rated output voltage.
HW-OCP	Hardware overcurrent protection	The output current > (rated current + 5A).
PhaseLoss	Phase loss	Power module's any input phase voltage phase < 30V
DC Bus Error	DC Bus Error	DC bus detects voltage error.

EEPROM Error	EEPROM Error	EEPROM detects error
LDC OV	Line drop compensation over-voltage	When Line drop compensation is set to “START”, (The output voltage – the set value of output voltage) > 10V for at least 1 second.
MS COMM Error	MS mode communication error	Communication error occurs in MS mode.
Single Rated Err	Unit rated value error in MS mode	In MS mode, model of the connected units are different, and they have different rated input voltage, rated output voltage or rated output current.
Single Num Err	Unit number error in MS mode	In MS mode, the number of the connected units is larger than the set number of the connected units.
MS OVP	MS mode over-voltage protection	In MS mode, the total output voltage > MS_OVP level. Series operation: MS_OVP level = the rated output voltage x 1.1 x the number of the unit Parallel operation: MS_OVP level = the rated output voltage x 1.1
MS OCP	MS mode over-current protection	In MS mode, the total output current > MS_OCP level. Series operation: MS_OCP level = the rated output current x 1.1 Parallel operation: MS_OCP level = the rated output current x 1.1 x the number of the unit
MS OPP	MS mode over-power protection	In MS mode, the total output power > MS_OPP level. Series operation: MS_OPP level = the rated output power x 1.1 x the number of the unit Parallel operation: MS_OCP level = the rated output current x 1.1 x the number of the unit
Single Output Err	Single unit output error in MS mode	In MS mode, an output error occurs in any of the units.

Table 3.1 Protection conditions

Notice
Please notice that if any protection is triggered, users shall eliminate the causes of the protection before resuming using the product.

3.5.3 DIAGNOSIS page

Press the icon  to enter into DIAGNOSIS page (please refer to the following figure). The DIAGNOSIS page records the error information. Please report the information on diagnose page to Preen's service personnel when requested.

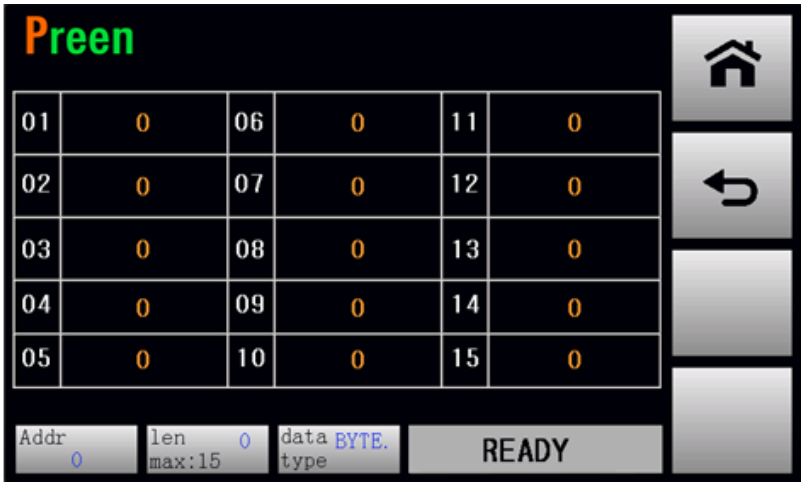


Figure 3.21 DIAGNOSIS page

3.5.4 ADVANCED page

Press the icon  to enter into the ADVANCED setting, please refer to the figure below:

Figure 3.22 ADVANCED setting

The descriptions for the items at the ADVANCED page are given as follows:

1) 

: Press to set the Line Drop Compensation to START/STOP.

2) 

: Press to set the CP MODE to START/STOP.

3.5.4.1 Line Drop Compensation

Users can set up the line drop compensation via the touch screen or the rotary knob (refer to Subsection 3.2). When the line drop compensation is started, the product will monitor the voltage at the load side via remote sensing wires (refer to Subsection 2.6). This will ensure to eliminate the voltage drop by automatically compensating the output voltage. When the line drop compensation is stopped, the product will monitor the voltage at the output terminals at the rear panel.

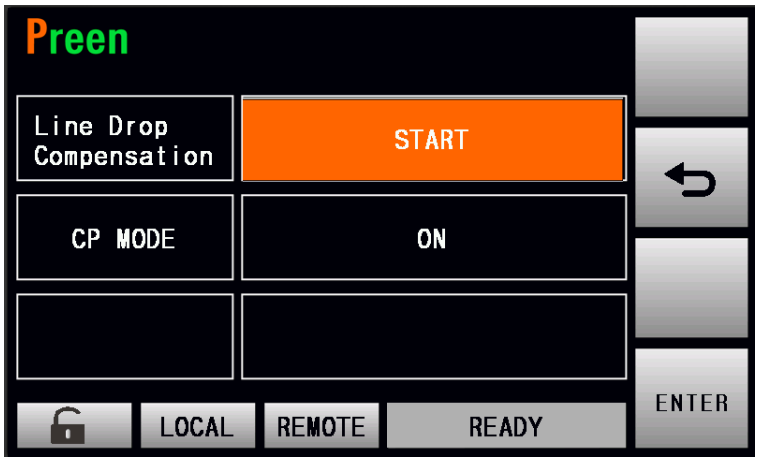


Figure 3.23 Line Drop Compensation setting

The procedures of setting line drop compensation are given as below:

1) Press the item 

to set the line drop compensation to START/STOP

2) Press the icon 

to confirm.

Notice
1. To have the line drop compensation functions correctly, please ensure remote sense connection (refer to Subsection 2.6) is correctly installed before starting the line drop compensation. 2. Please ensure to set the line drop compensation to STOP and uninstall the re-

mote sense connection when switching ADG-L's output power connection to different DUT.

3.5.4.2 Constant power (CP) MODE

Users can switch the CP mode ON or OFF via the touch screen or rotary knob (refer to subsection 3.2). When the CP mode is switched off, the output power limit is not adjustable but the same as the rated output power of the unit. For models with auto range output, maximum set value of the output voltage and current are limited to the rated output power. The unit has better performance when CP mode is off.

When the CP mode is switched ON, the output power limit is adjustable, and the set value of the output voltage and current can be set to the maximum value of the unit. For example, an auto range model of ADG-L-330-25-24 has maximum set value of 330V and 25A for voltage and current when CP mode is off. If the output power exceeds the set value of the output power, then the CP mode will be triggered.

Notice
When the CP mode is set ON, the output performance, such as rise time and response time will be affected, but it will not affect the non-dynamic performance and accuracy. It is recommended to switch the CP mode OFF under normal operation for better output performance. For models of ADG-L-1000-25-12 and ADG-L-660-25-8, when CP mode is set ON, the maximum set value of output current is 12A.

Figure 3.24 CP MODE setting

The procedures of setting line drop compensation are given as below:

1) Press the item 

to switch the CP mode to ON/OFF.

2) Press the icon 

to confirm.

When the CP mode is set OFF, the POWER item for setting power limit on the MAIN page will be locked. The MAIN page will show “P-set lock” if press the POWER item, and the V-set and I-set will show “0” (refer to Figure 3.25).

Figure 3.25 Showing “P-set lock” on the MAIN page.

When the CP mode is set ON, the output power limit in the POWER item can now be adjusted, and the MAIN page will shows “CP ENABLE”. Then the set value of the voltage and current are no longer limited to the rated value (refer to Figure 3.26).

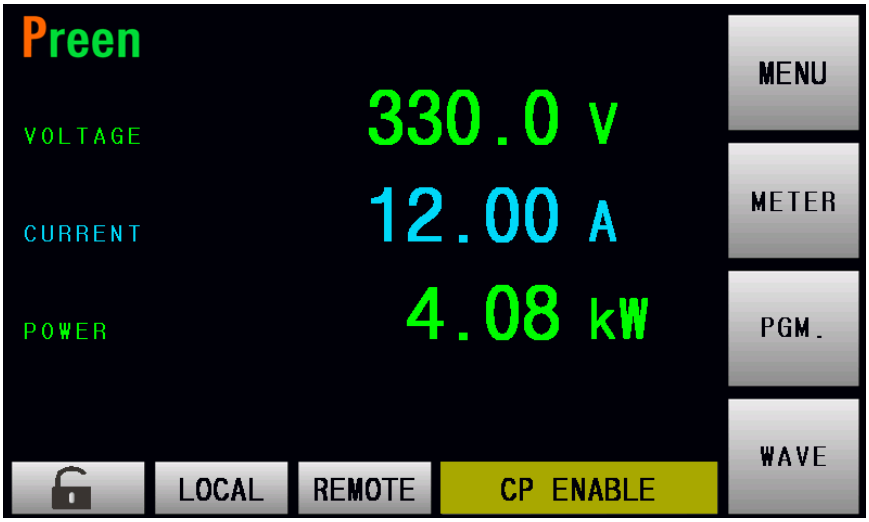


Figure 3.26 Showing “CP ENABLE” on the MAIN page.

3.6 COMMUNICATION page

Press the icon  at MENU page to enter into COMMUNICATION page.

3.6.1 CONTROL MODE page

In COMMUNICATION page, the CONTROL MODE can be switched between LOCAL, REMOTE and ANALOG. Please refer to the figure below:

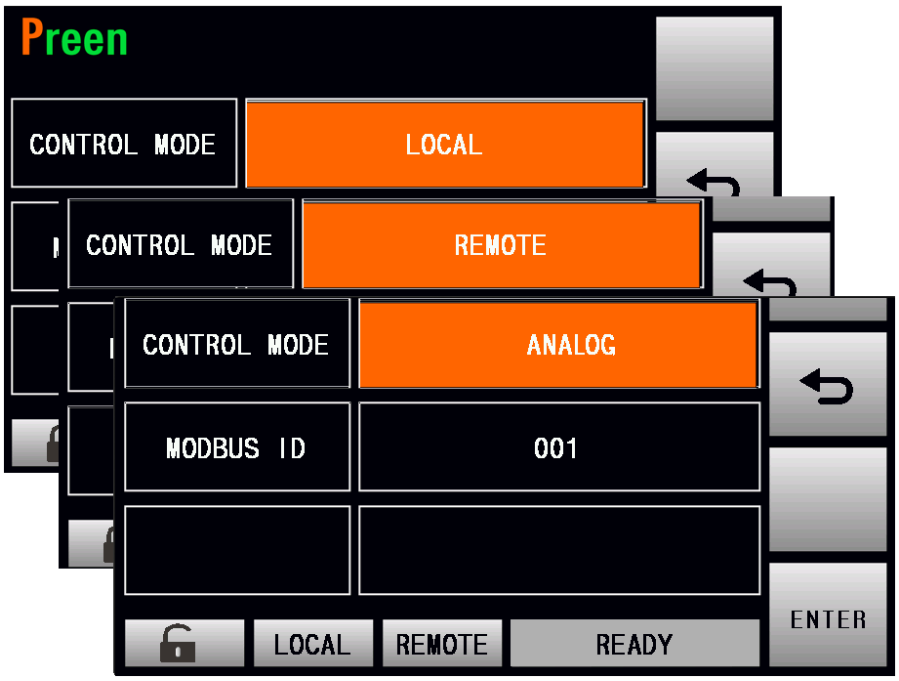


Figure 3.27 CONTROL MODE setting

The descriptions for the items and the icons at the CONTROL MODE page are given as follows:

1) 

: Press to set to LOCAL for local operation.

2) 

: Press to set to REMOTE for remote control. BAUD rate should be set 115200bps (refer to Figure 2.11).

3) 

: Press to set to ANALOG for analog control (refer to Subsection 2.8).

4) 

Press to set MODBUS ID from 001 to 255.

3.6.2 GPIB interface board (OPTIONAL)

When the GPIB interface board is installed (refer to Subsection 2.14), the product will automatically sense the access and the "Ext COMM: GPIB Card" will show at the COMMUNICATION page; press it to enter the setup page. Please refer to the figures below.

Figure 3.28 GPIB card setting

3.6.3 Ethernet/ RS-485/ RS-232/ USB interface board (OPTIONAL)

When optional Ethernet/RS-485/RS-232/USB interface board is installed (Refer to subsection 2.14), the product will automatically sense the access and the "Ext COMM: Net/RS485/RS232/USB" will show at the COMMUNICATION page; press it to enter the setup page. Please refer to the figures below.

Figure 3.29 Net/RS-485/RS-232/USB setting

Figure 3.30 Ethernet setting

Figure 3.31 RS-232/ RS-485/ USB setting

3.7 WAVE page

The unit not only provides measurements on METER page but also can display output waveform as reference for users (refer to Figure 3.32).

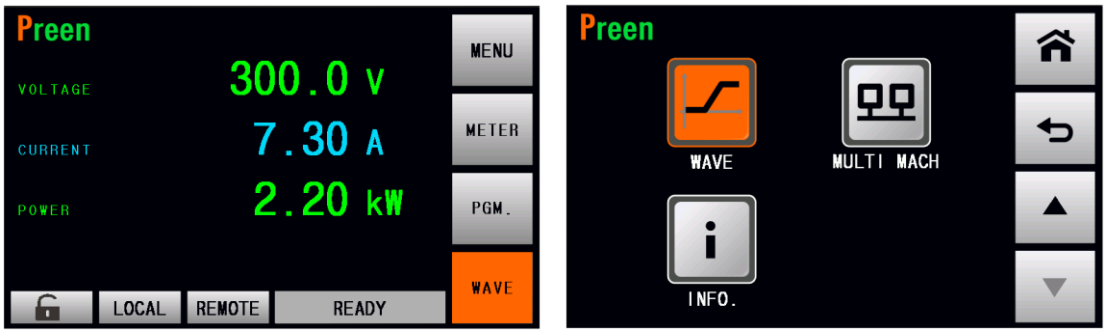


Figure 3.32 The icons to enter into WAVE page at MAIN and MENU page

The procedures of entering WAVE page are given as below:

1) Press the icon  to enter into the WAVE page at MAIN page.

2) Press the icon  to enter into the WAVE page at MENU page.

The descriptions for the items and the icons at the WAVE page are given as follows:

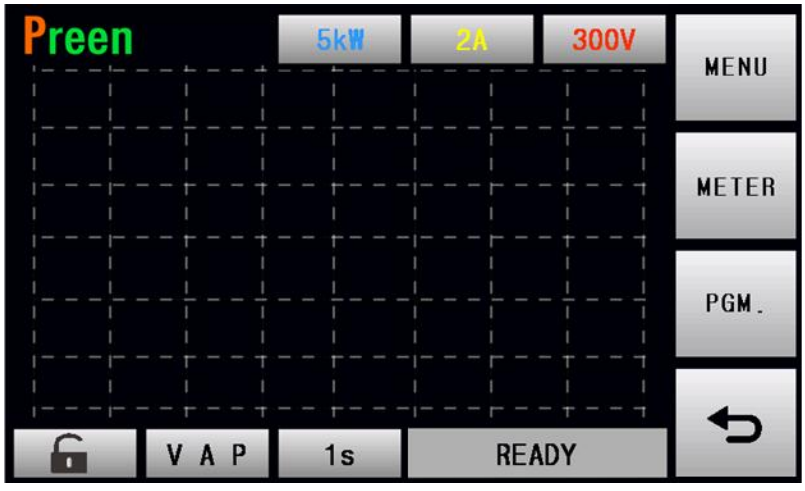


Figure 3.33 The WAVE page when the output is OFF

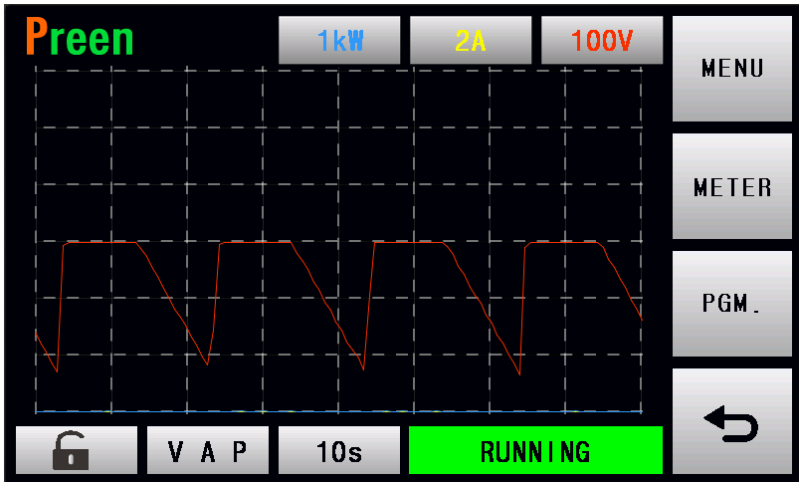


Figure 3.34 The WAVE page when the output is ON

1) V A P : Press to switch between voltage, current, and power waveform or to display three types of waveform at the same time.

2) 1s : Press to switch time per division between 500ms/ 1s/ 2s/ 5s/ 10s.

3) 100V : Press to switch voltage per division between 2V/ 10V/ 40V/ 100V/ 300V.

4) 2A : Press to switch current per division between 2A/ 20A/ 60A.

5) 5kW : Press to switch Power unit per division between 500W/ 1kW/ 5kW/ 10kW.

Notice
The waveform shown in the WAVE page is generated by the unit's HMI, which samples every 100mS. This is a considerable difference from the sample rate of an oscilloscope, which samples every 2nS. Thus the waveform cannot be used for testing verifications but only as a reference for voltage, current and power changes. However it does not affected to the unit's output performance.

3.8 EVENT page

Press the icon  at the MENU page to enter into the EVENT page. The EVENT page records the error information, including date, time and error codes. Please refer to the figure below:

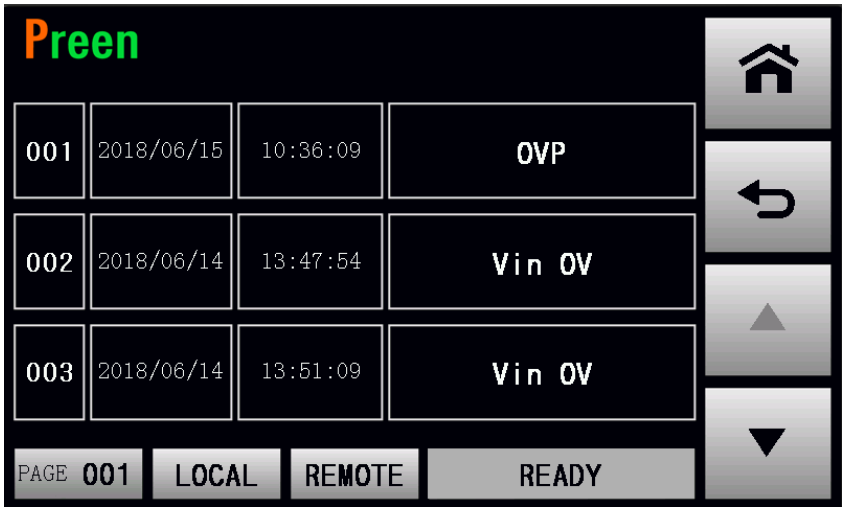


Figure 3.35 EVENT page

3.9 INFORMATION page

Press the icon  at the MENU page to enter into the INFORMATION page.

Figure 3.36 INFORMATION page

The descriptions for the items and the icons at the INFORMATION page are given as follows:

1)  : The manufacturer of the product.

2)  : The model of the product.

3)  : The quantity of the power module.

4)  : The version of DSP Firmware

5)  : The version of DSP PCB.

6)  : The version of the human machine interface (HMI) firmware

7)  : The rated input voltage of the product.

8) 

: The rated output voltage of the product.

9) 

: The rated output current of the product.

10) 

: The version of the hardware of the product.

11)  : Press to move to the previous page of the INFORMATION page

12)  : Press to move to the next page of the INFORMATION page.

3.10 Programmable (PGM.) function

The product can not only provide a steady output but also simulate all kinds of test sequences through Programmable (PGM.) function. Users can set PGM. function by using touch screen or rotary knob (refer to subsection 3.2) to program the output according to the set values in each STEP.

NOTICE
When the unit is operating the PGM. function, the CP mode will be automatically turned ON, so that the output voltage and current could have wider setting range. Please note that for the models of ADG-L-1000-25-12 and ADG-L-660-25-8, the maximum set value of output current is 12A when the CP mode is ON.

3.10.1 PGM. page

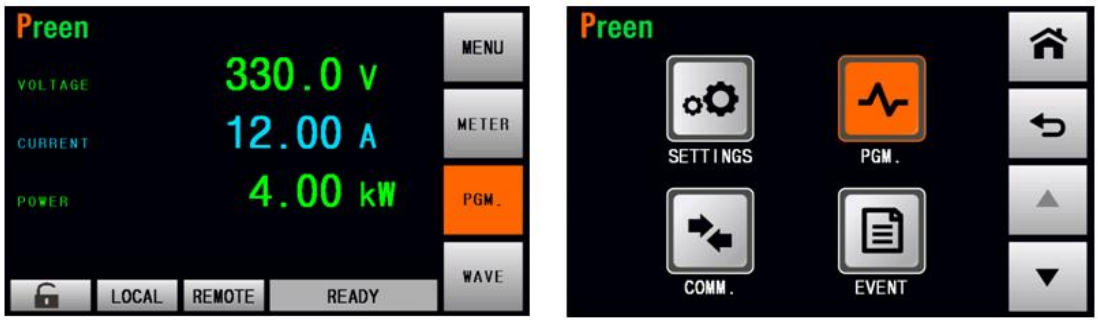


Figure 3.37 The icons to enter into PGM. page at MAIN and MENU page

The procedures of entering PGM. page are given as below (refer to Figure 3.37):

1) Press the icon  to enter into the PGM. page at the MAIN page.

2) Press the icon  to enter into the PGM. page at the MENU page.

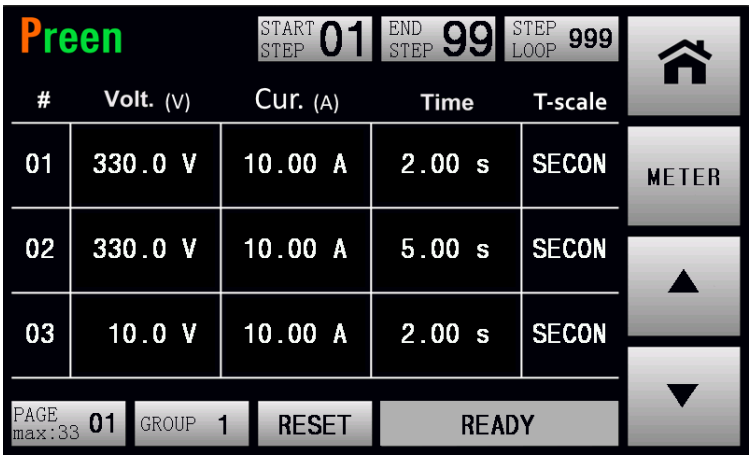


Figure 3.38 PGM. setting

The descriptions for the items and the icons at the PGM. page are given as follows (refer to Figure 3.38):

1) PAGE max:33 01 : Press to select STEP page from page 1 to page 33. Each page shows 3 STEPs and there are totally 99 STEPs in one GROUP (33 pages *3 STEPs).

2) GROUP 1 : Press to select a GROUP from 1 to 5. Each GROUP has 99 STEPs.

3) START STEP 01 : Press to set the starting STEP of a loop from STEP 1 to STEP 99.

4) END STEP 99 : Press to set the ending STEP of a loop from STEP 1 to STEP 99.

5) STEP LOOP 999 : Press to set the STEP loop time from 0 to 999, and set 0 to run an infinite loop.

6) Volt. (V) 330.0 V : Press to set the output voltage of the STEP.

7) Cur. (A) 10.00 A : Press to set the output current of the STEP for CC mode.

8) 

: Press to set the connecting time between this STEP and previous STEP.

9) 

: Press to set the time scale of the STEP.

10)  : Press to move to the previous page of PGM. page.

11)  : Press to move to the next page of PGM. page.

3.10.2 STEP loop

In the PGM. page, users can set the STEP loop for up to 99 STEPs in a GROUP to simulate different test sequences. For example, when the starting STEP of a loop is number 1, the ending STEP of a loop is 6, and the STEP loop times is 5, the unit will sequentially perform from STEP 1 to STEP 6 and repeated 5 times.

The procedures of setting the STEP loop according to the example mentioned above are given as below,

1) Press the icon 

to set the value to 1, and press the icon 

to confirm.

2) Press the icon 

to set the value to 6, and press the icon 

to confirm.

3) Press the icon 

to set the value to 5, and press the icon 

to confirm.

4) Press the output & reset button to start the output and perform the STEP loop.

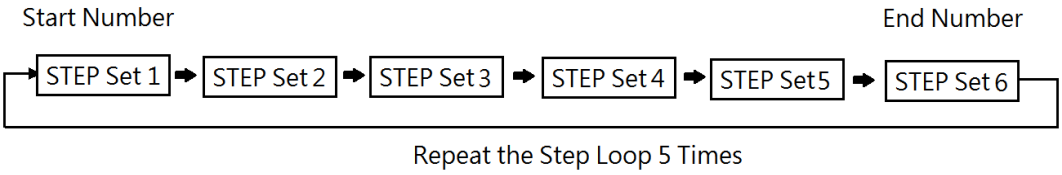


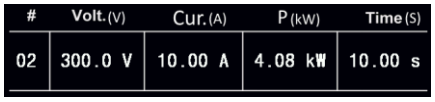
Figure 3.39 The PGM. page when the unit is running the PGM. function

The descriptions for the items and the icons at the PGM. page when the PGM. function is running are given as follows.

1) The icon  shows the number of the starting STEP.

2) The icon  shows the number of the ending STEP.

3) The icon  shows the STEP loop time. The numerator indicates the currently performing STEP loop time; the denominator indicates the total STEP loop time. “000” indicates an infinite loop.

4) The item  shows the currently performing STEP.

5) The item  shows the currently performing GROUP.

6) The item  shows the output voltage of the current STEP.

7) The item  shows the output power of the current STEP.

8) The item  shows the output current of the current STEP.

9) The item  shows the countdown of the current STEP’s

time (for example, if the time is set to 10 seconds, this item will be shown as 10s → 9s → 8s… 2s→ 1s → 0s).

3.10.3 Example of STEPs for simulation

To illustrate the simulation feature through STEPs, the figures shown below are a simulation example of setting the STEP 1 to 6 and the corresponding output wave-form via the remote control software of the ADG-L series.

	V set (V)	I set (A)	P set (W)	Time (S)
1	100.00	0.00	0.00	0.10
2	100.00	0.00	0.00	0.20
3	200.00	0.00	0.00	0.01
4	200.00	0.00	0.00	0.25
5	50.00	0.00	0.00	0.10
6	0.00	0.00	0.00	1.00
7	0.00	0.00	1.00	1.00
8	0.00	0.00	2.00	2.00
9	0.00	0.00	3.00	3.00

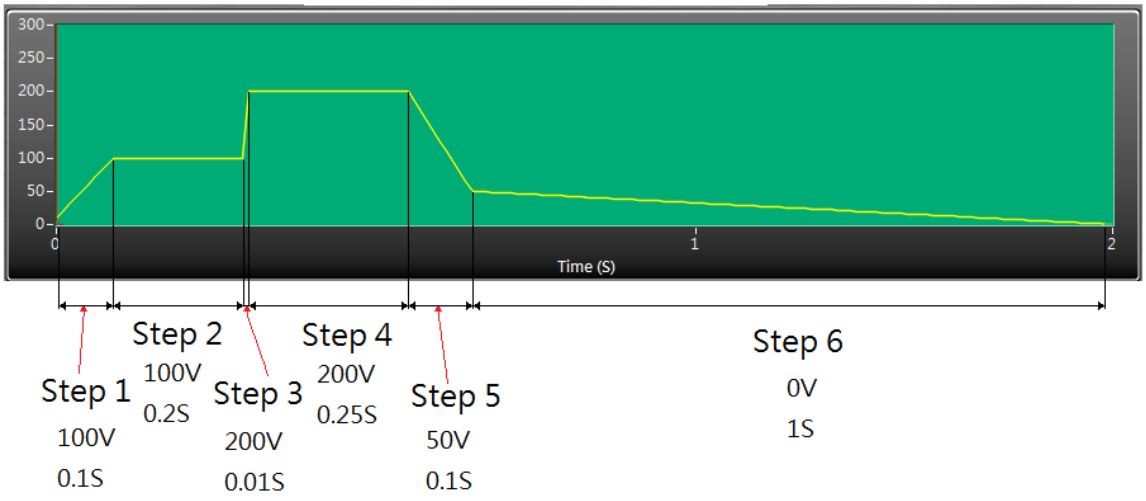
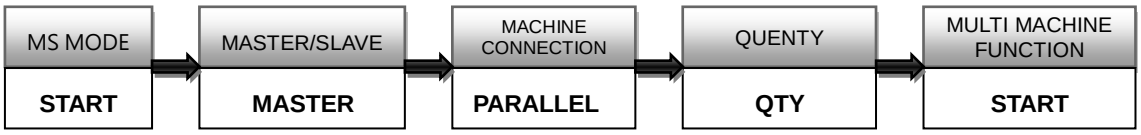


Figure 3.40 Example of Simulation through STEPs.

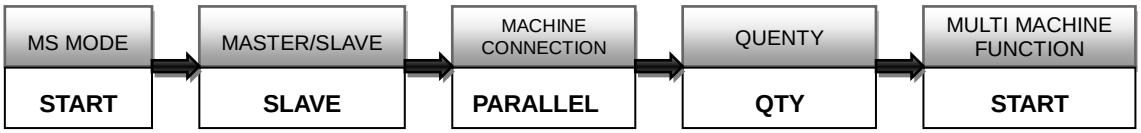
3.11 Multiple Machine (MULTI MACH) function

The product not only can be operated in a single unit, but can also parallel connect with multiple units of same model Users are allowed to operate multiple units in Master-Slave (MS) mode by setting up the Multiple Machine (MULTI MACH) function.

A. Setting the MASTER：



B. Setting the SLAVE：



Notice
The master unit and the slave unit should have the same connection setting. Only parallel operation is available for ADG-L series now.

3.11.1 MULTI MACH settings

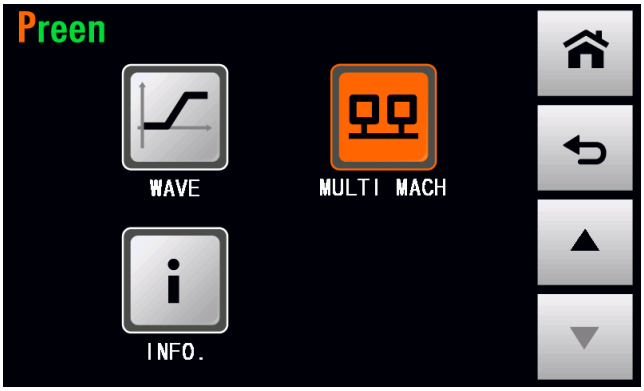


Figure 3.41 the MULTI MACH icon at the MENU page

The procedures of setting MULTI MACH function are given as below (refer to Figure 3.41):

1) Press the icon MENU to enter into the MENU page at the MAIN page.

2) Press the icon ▼ to move to the second page, press the icon to enter into the MULTI MACH settings (referring to the below figure).

Figure 3.42 the MULTI MACH settings

The description for the items at the MULTI MACH page is given as follows (refer to Figure 3.42):

1) Press MS MODE | START to activate multiple machine (MULTI MACH) function settings.

2) Press MASTER/ SLAVE | SLAVE to set the unit as MASTER or SLAVE.

3) Press MACHINE CONNECTION | PARALLEL to set the multi-machine connection to parallel (serial not available now).

4) Press QUENTY | 2 to set the quantity of connected units (Max. =2).

5) Press CAN ID | 2 to set the CAN ID number (0-254) of the unit.

6) Press MULTI MACHINE FUNCTION | STOP to START/STOP the multi-machine function.

Notice
If any setting of the MASTER or SLAVE unit is edited, the unit will automatically stop the multi-machine function and MS mode. Users have to set the Multi-Machine function to START to activate the MS mode when settings are edited. Messages indicating successful connection will be shown on the status (refer to Figure 3.43).

圖 3.43 messages indicating successful multi-machine connection

Notice
When switching from multi-machine connection to single-unit operation, be sure to remove the communication line for connection so that the unit is able to function properly.

3.11.2 MULTI MACH information

When the MULTI MACH function is active and enter into MS mode, the MASTER-SLAVE icon 

will appear in the MAIN page. Press the icon 

to enter into the page to view the information of the connecting units. For example, the MASTER unit is 
with CAN ID: 127 and the SLAVE unit is 
with CAN ID: 1 (refer to the figure below).

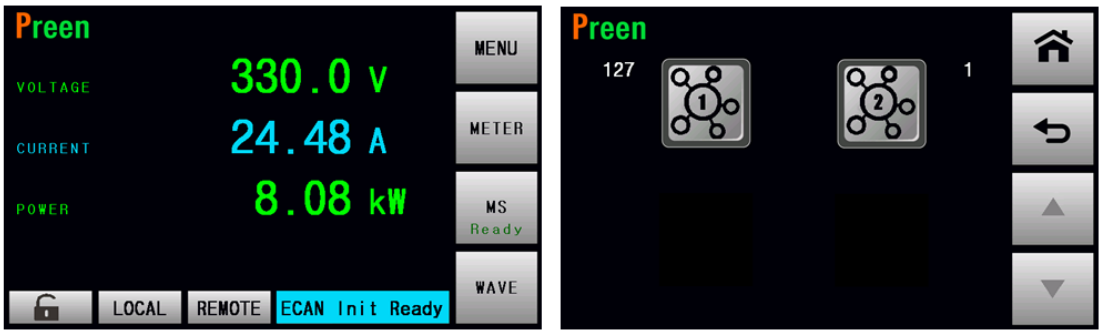


Figure 3.44 information of the connecting units

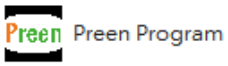
NOTICE
The CAN ID ranges from 0 to 254, and each unit's CAN ID setting cannot be the same. When the MULTI MACH function is active, the PGM. function will be disabled.

4 Remote Operation

To remotely control the product via Preen's control software, user should follow the instructions in READ ME file on the attached CD for installation of the control software and device driver. For SCPI command list, please refer to the READ ME file to find the SCPI programming manual.

4.1 Introduction

With multiple communication interfaces, the product can be controlled remotely via RS-232/ RS-485 (MODBUS), and optional interfaces RS-232/ RS-485 (MODBUS & SCPI), Ethernet, USB or GPIB. Additionally, the product provides the control software Preen Program that allows users to easily setup the remote control for the product without further need of programming. Please follow the instruction below to setup Preen Program.

1) After installation, click the icon 

on the desktop or click [**Start**] → [**Program**] → [**Preen Program**] to start the software.

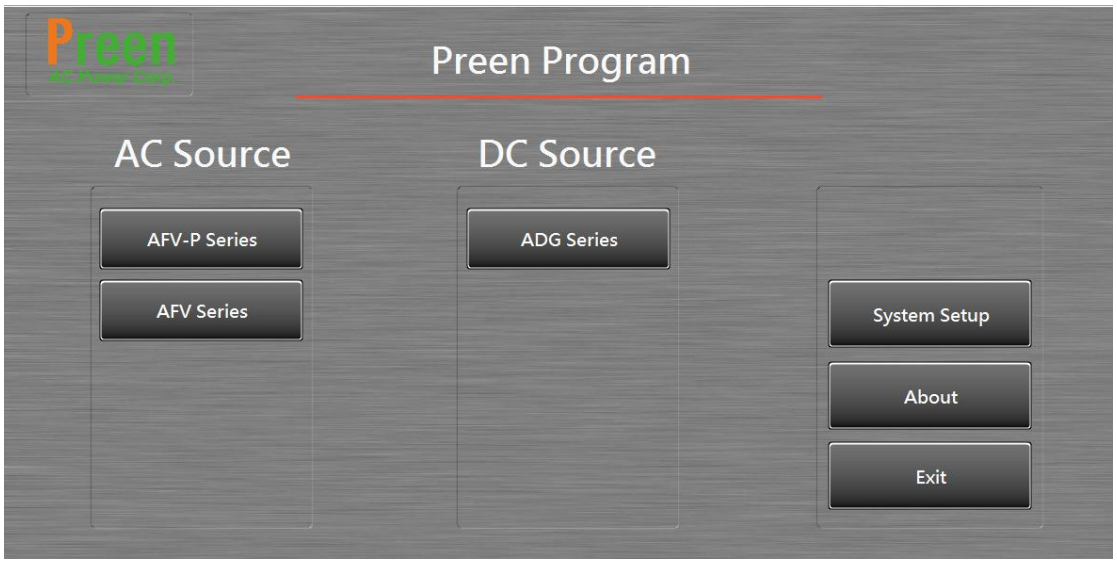


Figure 4.1 the start-up page of Preen program

2) 

: Press to enter into the System Setup page as the figure below.

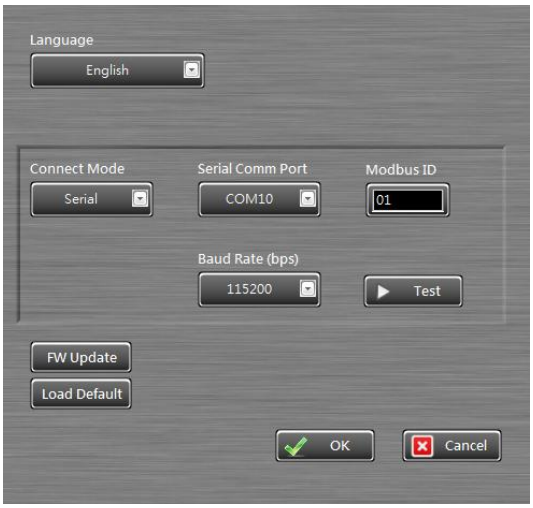
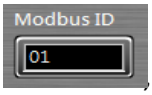


Figure 4.2 system setup page

3) Confirm the following parameters: the Connect Mode 

, the Serial Comm Port 

, the Baud Rate 

, the MODBUS ID 

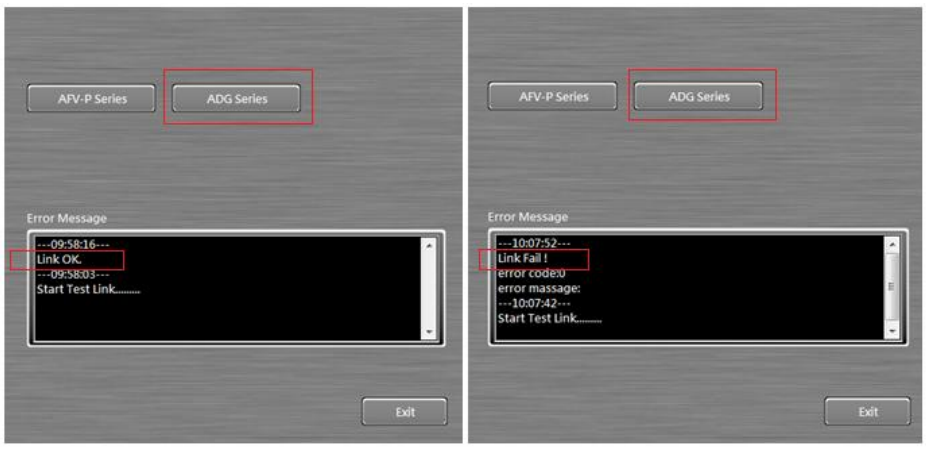
, and the operational language 

. Make sure these settings are identical with the product's setting before communication.

4) Press 

and choose 

to test whether the communication between power supply and PC is well connected. The figures below show the control software's display for successful link and failed link.



Link OK. Link Fail!

Figure 4.3 Communication test

5) After the successful link between the unit and a PC, click EXIT to exit the communication test page. Press 

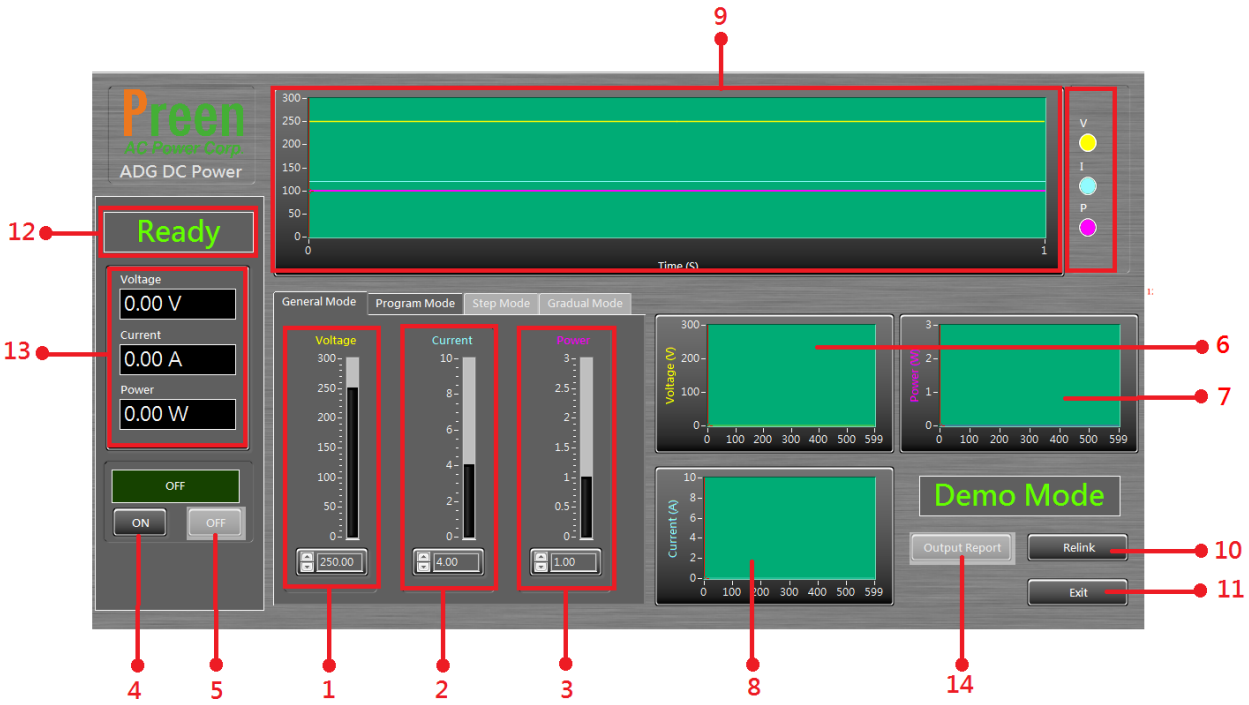
to start remote control referring to the figure below.

Figure 4.4 the user interface of the ADG-L control software

4.2 Control software: GENERAL mode

The GENERAL mode of the ADG-L series' control software is as below

Figure 4.5 control software: general mode



The descriptions for the items and the icons at the GENERAL mode of the control software are given as follows,

1) Use to set the value of voltage for CV mode
2) Use to set the value of current for CC mode
3) Use to set the value of power for CP mode
4) Click to turn on the output (refer to Figure 4.6)
5) Click to turn off the output.
6) Show the output voltage waveform.
7) Show the output power waveform.
8) Show the output current waveform.
9) Show the preview waveform of output voltage/ current/ power.
10) Click to reconnect the communication.
11) Click to quit the control software.
12) Show the current status.
13) Show the output measurement.
14) Click to generate the output measurement report in txt or csv format (refer to

Figure 4.7).

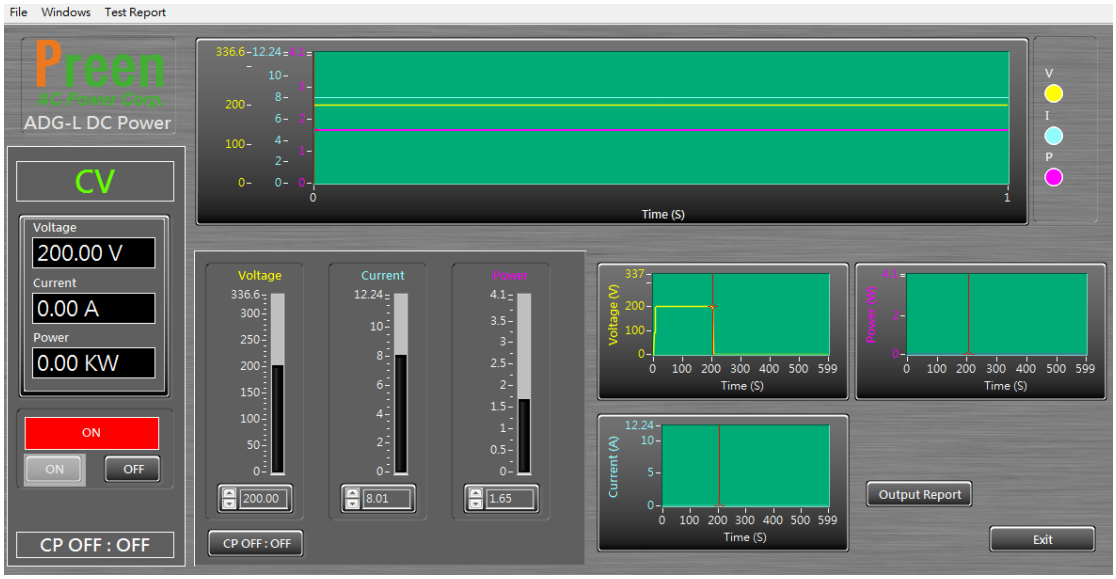


Figure 4.6 GENERAL mode of the control software

Figure 4.7 select to generate the report in txt or csv format

4.3 Control software: PROGRAM mode

To operate the PGM. function of the control software click the “Program Mode” marked in red box below.

The description for the items and the icons at the PROGRAM mode of the control software are given as follows

1) Click Program Mode to setup the STEPs.
2) Click to set the output voltage for CV mode, current for CC mode, power for CP mode and time of the STEP.
3) Use to set the STEP loop time.
4) Use to set the number of starting STEP.
5) Use to set the number of the ending STEP.

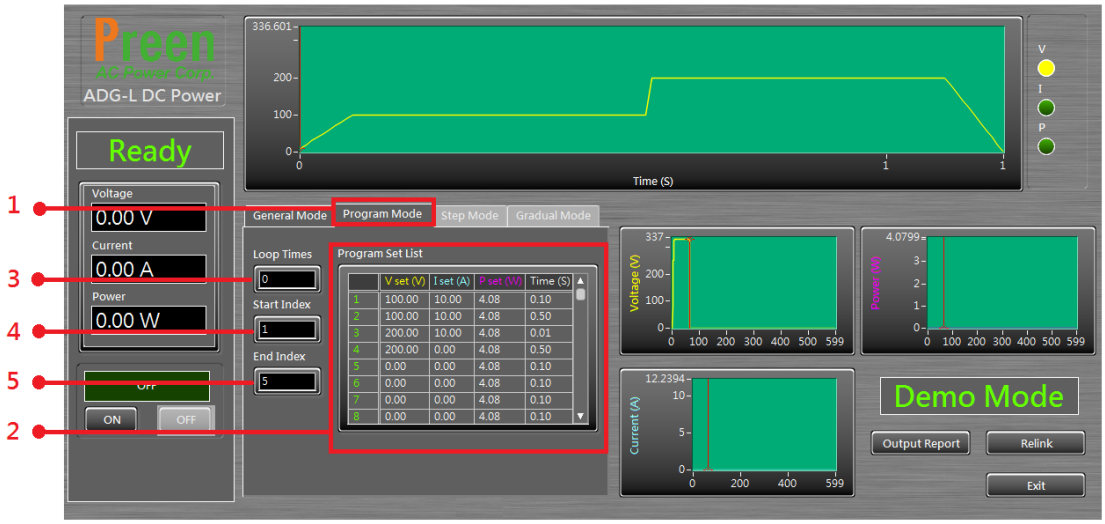


Figure 4.8 Remote control software: PROGRAM mode

5 MODBUS-RTU protocol

Modbus RTU protocol is used for ADG-L's communication. Data format and error check methods are defined in Modbus protocol. The half duplex query and respond mode is adopted in Modbus protocol

Modbus allows master device (PC, PLC etc.) to communicate with slave devices, it will not allow data exchange between slave devices. Therefore, terminal devices will not engage the communication link at initialization but only respond to the master' s request.

5.1 Transmission mode

The mode of transmission defines the data structure within a frame and the rules used to transmit data.

- Start bit: 1 bite
- Stop bit: 1 bite
- Parity: none
- DATA length: 8 bite
- Transmission speed: 115200 bite/second
- The waiting period between the master sends a query and the slave responds > 50ms
- The waiting period between the slave responds and the master sends a query > 50ms

5.2 MODBUS protocol

5.2.1 Frame

When data frame reaches the terminal unit, the unit removes the data frame's header, reads the data; if there is no error, it then implements the data's task. Afterwards, the unit puts its own data with the acquired header, and sends back the frame to the sender. The response data frame contains: ID, Function code, Data and CRC Check. Any error will cause a failure to respond.

ID	Function code	Data	CRC Check, low-byte	CRC Check, high-byte
1-byte	1-byte	N-byte	1-byte	1-byte

Table 5.1 Data frame format

5.2.2 ID field

The ID field is at the start of the frame. It is composed of 1 byte (8 bits); its decimal value range is 0-255. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

5.2.3 Function code field

When a message is sent from a master to a slave device, the function code field tells the slave what kind of action to perform.

Function code (hexadecimal)	Action
03	read the length from the register
10	write the length to the register

Table 5.2

5.2.4 Data field

Data field contains the data that terminals need to complete the request and the data that terminals respond to the request. This data may be a numerical value, address or setting (refer to subsection 5.3) For example, Function Code tells the terminal to read one register; Data Field needs to specify reading from which register and how many registers to read.

5.2.5 CRC check field

The field allows the error check by master and slave devices. Due to electrical noise and other interferences, a group of data may be changed while transmitting from one location to the other. Error Check ensures master or slave devices do not respond to the distorted data during the transmission, which enhances the system security and efficiency. Error Check uses 16-bit Cyclic Redundancy Check (CRC 16).

Every message includes an error checking field which is based on the Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message.

The CRC field is two bytes long. The CRC value is calculated by the transmitting device, and is appended to the message. The receiving device recalculates the CRC value during reception of the message, and compares the calculated value to the actual value it received in the CRC field.

CRC16 calculation:

CRC calculation is first started by preloading the whole 16-bit register to 1's. The process begins by applying successive 8-bit bytes of the message to the current con-

tents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC.

When generating the CRC, each 8-bit character is exclusive ORed with the register contents.

The result is shifted towards the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined, if the LSB equals to 1, the register is exclusive ORed with a preset, fixed value; if the LSB equals to 0, and no action will be taken.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value.

5.3 Communication format

Below is the description of the data field format.

Package status	Data length	Start address, high-byte	Start address, low-byte	Register data
1-byte	1-byte	1-byte	1-byte	N-byte

Table 5.3

5.3.1 Package status field

Included only in the response frame from the slave, the package status field indicates whether the query frame sent by the master is accordance with the device's rule.

Package status (hexadecimal)	Description
00	Frame format correct.
01	CRC check failed.
02	The data length to read or write less than 1-byte or more than 143-byte.
03	Function code not 03 (hexadecimal) or 10 (hexadecimal).
04	The address to read or write incorrect.
05	The value of register data to write is beyond the range.
06	The device is at LOCAL operation; the master is not allowed to write.
07	The frame length received by the terminal is over 150

	bytes.

Table 5.4

5.3.2 Data length field

Included in the query frame from the master or the response frame from the slave, the data length field indicates the data length requested to write or read in the query frame and the data length supplied in the response frame. The unit of measurement for data length is a byte.

5.3.3 Starting address field

Included only in the query frame from the master, the starting address field indicates the starting register address where the master request to write or read. The slave then supplies the requested data according to the address and the data length. The address list of the device will be illustrated in subsection 5.5.

5.3.4 Register data field

Included in the query frame from the master or the response frame from the slave, the register data field indicates the register data that the master request to write or read in the query frame and the register data in the response frame sent by the slave.

Below are the register data types:

- General fraction (4-byte)

Integer		Float	
Data0	Data1	Data2	Data3
1-byte	1-byte	1-byte	1-byte
Range 0 ~ 255	Range 0 ~ 99	Range 0 ~ 99	Range 0 ~ 99
Representing value 0 ~ 25599.9999 in 4-byte. Formula：value = (Data0 x 100) + (Data1) + (Data2 / 100) + (Data3 / 10000) Example: transform the register data 9C 63 0F 23 into value 15699.1535.			

Table 5.5

- Low fraction (4-byte)

Integer			Float
Data0	Data1	Data2	Data3
1-byte	1-byte	1-byte	1-byte
Range 0 ~ 255	Range 0 ~ 99	Range 0 ~ 99	Range 0 ~ 99
Representing value 0 ~ 2559999.99 in 4-byte. Formula：value = (Data0 x 10000) + (Data1 x 100) + Data2 + (Data3 / 100) Example: transform the register data 9C 63 0F 23 into value 1569915.35			

Table 5.6

5.4 Transmission example

5.4.1 Read the register (correct)

The master requests to read the device (ID 01) output voltage (start address 00 00).

Below is the query frame.

ID	01	The device ID
Function code	03	Read the register data from the device.
Data length	04	The data length of the output voltage, requested to read, is 4-byte, according to its start address.
Start address, high-byte	00	The start address of the output voltage, high-byte.
Start address, low-byte	00	The start address of the output voltage, low-byte.
CRC check, low-byte	58	The CRC value, low-bite, after calculating 01 03 04 00 00.
CRC check, high-byte	45	The CRC value, high-bite, after calculating 01 03 04 00 00.

Below is the response frame sent by the slave.

ID	01	The device ID
Function code	03	Read the register data from the device.
Package status	00	Frame format correct.
Data length	04	The data length of the requested data is 4-byte.
Data	01	The data type of output voltage is general fraction.
Data	00	Transform the register data of output voltage 01 00 00 00 into 100.0000V.
Data	00	
Data	00	
CRC check, low-byte	42	The CRC value, low-bite, after checking 01 03 00 04 01 00 00 00.
CRC check, high-byte	FB	The CRC value, high-bite, after checking 01 03 00 04 01 00 00 00.

5.4.2 Read the register (error)

The master requests to read the device (ID 01) output voltage (start address 00 00), but CRC check failed. Below is the query frame.

ID	01	The device ID
Function code	03	Read the register data from the device
Data length	04	The data length of the output voltage, requested to read, is 4-byte, according to its start address.
Start address, high-byte	00	The start address of the output voltage, high-byte.
Start address, low-byte	00	The start address of the output voltage, low-byte.
CRC check, low-byte	58	The CRC value, low-bite, after checking 01 03 04 00 00.
CRC check, high-byte	00	The CRC value, high-bite, after checking 01 03 04 00 00.

Below is the response frame sent by the slave

ID	01	The device ID.
Function code	03	Read the register data from the device.
Package status	01	CRC check failed.
Data length	00	The data length of the requested data is 0 byte
CRC check, low-byte	F0	The CRC value, low-bite, after checking 01 03 01 00.
CRC check, high-byte	48	The CRC value, high-bite, after checking 01 03 01 00.

5.4.3 Write into the register (correct)

The master requests to write the set value of device (ID 01) Iset (start address 01 04) 15.54A. Below is the query frame.

ID	01	The device ID
Function code	10	Write into the device register.
Data length	04	The data length of the Iset, requested to write, is 4-byte, according to its start address
Start address, high-byte	01	The start address of Iset, high-byte.
Start address, low-byte	04	The start address of Iset, low-byte.
Data	00	The register data type of Iset is general fraction. Transform the Iset 15.54A into the register data 00 0F 36 00.
Data	0F	
Data	36	
Data	00	
CRC check, low-byte	94	The CRC value, low-bite, after checking 01 10 04 01 04 00 0F 36 00.
CRC check, high-byte	1E	The CRC value, high-bite, after checking 01 10 04 01 04 00 0F 36 00.

Below is the response frame sent by the slave:

ID	01	The device ID.
Function code	10	Write into the register data.
Package status	00	Frame format correct.
Data length	00	The data length of the requested data is 0 byte.
CRC check, low-byte	00	The CRC value, low-bite, after checking 01 10 00 00.
CRC check, high-byte	1D	The CRC value, high-bite, after checking 01 10 00 00.

5.4.4 Write into the register (error)

The master requests to write the set value of device (ID 01) Iset (start address 01 04) 15.54A, but the CRC check failed. Below is the query frame.

ID	01	The device ID.
Function code	10	Write into the device register.
Data length	04	The data length of the Iset, requested to read, is 4-byte, according to its start address.
Start address, high-byte	01	The start address of Iset, high-byte.
Start address, low-byte	04	The start address of Iset, low-byte.
Data	00	The register data type of Iset is general fraction. Transform the Iset 15.54A into the register data 00 0F 36 00.
Data	0F	
Data	36	
Data	00	
CRC check, low-byte	94	The CRC value, low-bite, after checking 01 10 04 01 04 00 0F 36 00.
CRC check, high-byte	00	The CRC value, high-bite, after checking 01 10 04 01 04 00 0F 36 00.

Below is the response frame sent by the slave:

ID	01	The device ID.
Function code	10	Write into the device register.
Package status	01	The CRC check failed
Data length	00	The data length of the requested data is 0 byte.
CRC check, low-byte	01	The CRC value, low-bite, after checking 01 10 01 00.
CRC check, high-byte	8D	The CRC value, high-bite, after checking 01 10 01 00.

5.5 MODBUS address list

5.5.1 Read only section

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Vout	00 00	4	General fraction	V	0.1
Iout	00 04	4	General fraction	A	0.01
Pout	00 08	4	General fraction	kW	0.01

- Function code available: 03
- Example:

  Device ID: 01; Vout: 88.4V

  Send: 01 03 04 00 00 58 45

  Receive: 01 03 00 04 00 58 04 00 C0 14

  Device ID: 01; Iout: 9.32A

  Send: 01 03 04 00 04 59 86

  Receive: 01 03 00 04 00 09 20 00 58 5E

  Device ID: 01; Pout: 4.71kW

  Send: 01 03 04 00 08 59 83

  Receive: 01 03 00 04 00 04 47 00 31 36

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	Unit	Precision
Output status	00 18	1	Status flag	-	-
Bit-7	reserved				
Bit-6	reserved				
Bit-5	reserved				
Bit-4	reserved				
Bit-3	1：start output 0：stop output				
Bit-2	1：Output in CP mode				
Bit-1	1：Output in CC mode				
Bit-0	1：Output in CV mode				

- Function code available: 03
- Example:

  Device ID: 01; outputting at CV mode

  Send: 01 03 01 00 18 48 4E

  Receive: 01 03 00 01 09 D8 12

  Device ID: 01; outputting at CC mode

  Send: 01 03 01 00 18 48 4E

  Receive: 01 03 00 01 0A 98 13

  Device ID: 01; outputting at CP mode

  Send: 01 03 01 00 18 48 4E

  Receive: 01 03 00 01 0C 18 11

  Device ID: 01; output stopped

  Send: 01 03 01 00 18 48 4E

  Receive: 01 03 00 01 00 18 14

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Abnormal status 01	00 19	1	Status flag	-	-
Bit-7	Vin LV				
Bit-6	Vin Unbalance				
Bit-5	Vin OV				
Bit-4	Vin UV				
Bit-3	OPP				
Bit-2	OTP				
Bit-1	OCP				
Bit-0	OVP				

- Function code available: 03
- Example:

  Device ID: 01; OTP and OCP occur.

  Send: 01 03 01 00 19 89 8E

  Receive: 01 03 00 01 06 98 16

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Abnormal status 02	00 1A	1	Status flag	-	-
Bit-7	HW-OTP				
Bit-6	HW-OCP				
Bit-5	HW-OVP				
Bit-4	Reserved				
Bit-3	Reserved				
Bit-2	FAN Error				
Bit-1	Reserved				
Bit-0	Reserved				

- Function code available: 03
- Example:

  Device ID: 01; fan error and HW-OVP occur.

  Send: 01 03 01 00 1A C9 8F

  Receive: 01 03 00 01 24 18 0F

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Abnormal status 03	00 1B	1	Status flag	-	-
Bit-7	Reserved				
Bit-6	LDC OV				
Bit-5	Reserved				
Bit-4	Reserved				
Bit-3	Reserved				
Bit-2	EEPROM Error				
Bit-1	DC Bus Error				
Bit-0	Phase Loss				

- Function code available: 03
- Example:

  Device ID: 01; phase loss occurs

  Send: 01 03 01 00 1B 08 4F

  Receive: 01 03 00 01 01 D9 D4

5.5.2 Read & write section

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Vset	01 00	4	General fraction	V	0.1
Iset	01 04	4	General fraction	A	0.01
Pset	01 08	4	General fraction	kW	0.01

- Function code available: 03, 10
- The control authority (start address 01 38) should be set 01 (remote control mode) for writing permission.
- For models of 1000V Auto Range and 660V Auto Range the Iset must not over 12A when CP mode is ON.
- For all models of Auto Range the Iset and Vset are limited to the rated power when the CP mode is OFF.
- Example:

  Device ID: 01; write the Vset 66.4V.

  Send: 01 10 04 01 00 00 42 04 00 E0 A9

  Receive: 01 10 00 00 00 1D

  Device ID: 01; write the Iset 5.47A.

  Send: 01 10 04 01 04 00 05 2F 00 BF 8C

  Receive: 01 10 00 00 00 1D

  Device ID: 01; write the Pset 3.22kW.

  Send: 01 10 04 01 08 00 03 16 00 5D DC

  Receive: 01 10 00 00 00 1D

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Output setting	01 18	1	Control flag	-	-
Bit-7	Reserved				
Bit-6	Reserved				
Bit-5	Reserved				
Bit-4	Reserved				
Bit-3	Reserved				
Bit-2	Reserved				
Bit-1	Reserved				
Bit-0	1：Start output 0：Stop output				

- Function code available: 03, 10
- The control authority (start address 01 38) should be set 01 (remote control mode) for writing permission.
- Example:

  Device ID: 01; set the output ON

  Send: 01 10 01 01 18 01 5B F5

  Receive: 01 10 00 00 00 1D

  Device ID: 01; set the output OFF

  Send: 01 10 01 01 18 00 9A 35

  Receive: 01 10 00 00 00 1D

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
OVP point	01 21	4	General fraction	V	0.1
OCP point	01 25	4	General fraction	A	0.01
OPP point	01 29	4	General fraction	kW	0.01

- Function code available: 03, 10
- The control authority (start address 01 38) should be set 01 (remote control mode) for writing permission.
- Example:

  Device ID: 01; write the OVP point 340V

  Send: 01 10 04 01 21 03 28 00 00 7E 36

  Receive: 01 10 00 00 00 1D

  Device ID: 01; write the OCP point 20A

  Send: 01 10 04 01 25 00 14 00 00 4F BE

  Receive: 01 10 00 00 00 1D

  Device ID: 01; write the OPP point 4kW

  Send: 01 10 04 01 25 00 14 00 00 4F BE

  Receive: 01 10 00 00 00 1D

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Reset	01 2D	1	Control flag	-	-
Bit-7	Reserved				
Bit-6	Reserved				
Bit-5	Reserved				
Bit-4	Reserved				
Bit-3	Reserved				
Bit-2	Reserved				
Bit-1	Reserved				
Bit-0	1：Reset				

- Function code available: 10
- The control authority (start address 01 38) should be set 01 (remote control mode) for writing permission.
- Example:

  Device ID: 01; reset the output.

  Send: 01 10 01 01 2D 01 4C A5

  Receive: 01 10 00 00 00 1D

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Control authority	01 38	1	Control code	-	-
00	Local control				
01	Remote control				

- Function code available: 03, 10
- Example:

  Device ID: 01; set the local control.

  Send: 01 10 01 01 38 00 83 F5

  Receive: 01 10 00 00 00 1D

  Device ID: 01; set the remote control.

  Send: 01 10 01 01 38 01 42 35

  Receive: 01 10 00 00 00 1D

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
CP mode switch	01 2F	1	Control flag	-	-
Bit-7	Reserved				
Bit-6	Reserved				
Bit-5	Reserved				
Bit-4	Reserved				
Bit-3	Reserved				
Bit-2	Reserved				
Bit-1	Reserved				
Bit-0	1：CP mode ON 0：CP mode OFF				

- Function code available: 03, 10
- The control authority (start address 01 38) should be set 01 (remote control mode) for writing permission.
- Example:

  Device ID: 01; set the CP mode ON

  Send: 01 10 01 01 2F 01 4D C5

  Receive: 01 10 00 00 00 1D

  Device ID: 01; set the CP mode OFF

  Send: 01 10 01 01 2F 00 8C 05

  Receive: 01 10 00 00 00 1D

5.5.3 **Advanced section**

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
Vset MAX	08 38	4	General fraction	V	0.1
Vset MIN	08 3C	4	General fraction	V	0.1
Iset MAX	08 40	4	General fraction	A	0.01
Iset MIN	08 44	4	General fraction	A	0.01
Pset MAX	08 48	4	General fraction	kW	0.01
Pset MIN	08 4C	4	General fraction	kW	0.01

- Function code available: 03
- Example:

  Device ID: 01; Vset MAX: 330.1V

  Send: 01 03 04 08 38 5E 57

  Receive: 01 03 00 04 03 1E 01 00 22 D5

  Device ID: 01; Iset MAX: 12.5A

  Send: 01 03 04 08 40 5E 57

  Receive: 01 03 00 04 00 0C 05 00 80 54

  Device ID: 01; Pset MAX: 3.3kW.

  Send: 01 03 04 08 48 5F B3

  Receive: 01 03 00 04 00 03 03 00 B3 F7

Parameter name	Start address (Hexadecimal)	Data length (byte)	Data type	unit	Precision
OCP level MAX	08 79	4	General fraction	V	0.1
OCP level MAX	08 81	4	General fraction	A	0.01
OPP level MAX	08 89	4	General fraction	kW	0.01

- Function code available: 03
- Example:

  Device ID: 01; OVP level MAX: 400V

  Send: 01 03 04 08 79 9E 67

  Receive: 01 03 00 04 04 00 00 00 42 37

  Device ID: 01; OCP level MAX: 20A

  Send: 01 03 04 08 81 9F E5

  Receive: 01 03 00 04 00 14 00 00 03 03

  Device ID: 01; OPP level MAX: 5kW.

  Send: 01 03 04 08 89 9E 23

  Receive: 01 03 00 04 00 05 00 00 53 06

6 Maintenance

In order to maintain the best performance of the unit, it is recommended to conduct product maintenance regularly.

6.1.1 Notice for maintenance

1) Pay attention to the safety summary and read the manual carefully.
2) Ensure the power line input is cut off and the product has been shut down for 20 minutes before maintenance.
3) Clean the product regularly, especially the air inlet, to ensure good ventilation.
4) Do not block the cooling fan openings.