MW

MEAN WELL

RPB-1600
# Instruction Manual

RPB-1600 Instruction Manual

Index

0.Product Description

RPB-1600 is MEAN WELL's new generation intelligent battery charger with high power density. Different battery brands and types (lead acid batteries, such as flooded, Gel, AGM, and so on, or lithium-ion batteries, such as lithium iron, lithium manganese, and so on) may require different charging curves and protection mechanisms for batteries. RPB-1600 is able to be accommodated through the communication interface; parameters, such as charge voltage, charge current and taper current, can be adjusted and the protection mechanisms for batteries can also be cancelled.

1.Notes on Operation:

◎ The charger must be installed in a dry and well ventilated area. It should not be exposed to rain or snow.

◎ The cables between charger and battery should be kept as short as possible to prevent excessive voltage drop. Too much voltage drop will lead to longer charging period.

◎ Please make sure charging voltage and current meet battery specification.

◎ While charging batteries in series, do not mix old and new batteries in the same connection.

◎ When connecting or disconnecting wires, please ensure the charger is OFF.

◎ Under normal operating conditions, a 5 years warranty is offered for RPB-1600. If failure results from improper operation, the warranty will not apply to the defective units.

2.Mechanical Design and Installation Procedure

⚠
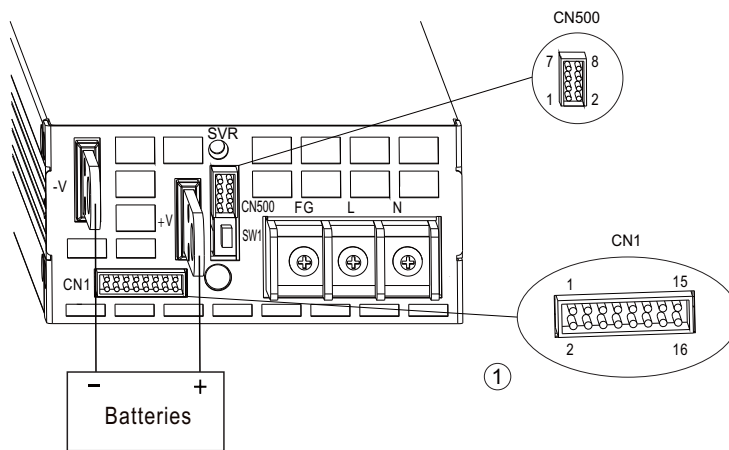
Warning: Before connecting a battery, please make sure the polarity is correct to avoid damaging the charger
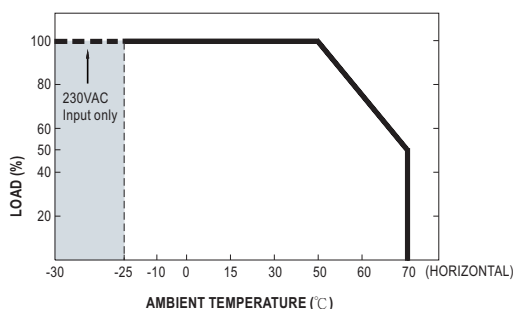
Figure2.1 Front panel
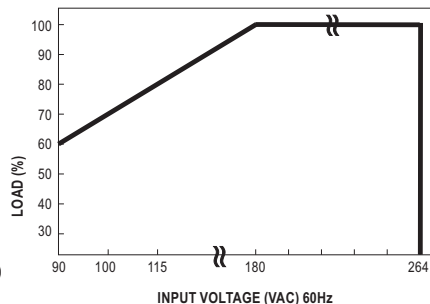
Installation Procedure:

Please make sure the charger is OFF before connecting the battery to the output terminal. Choose a cable with suitable wire gauge according to the charging current to connect between the charger and the battery. Battery polarity must be connected correctly:Terminal(+) to Battery(+); Terminal(-) to Battery(-), and take notice that the positive and negative ends are not shorted.
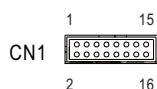
3.Derating Curve

3.1 Charging current vs Temperature

AMBIENT TEMPERATURE (℃)

3.2 Charging current vs Input Voltage

INPUT VOLTAGE (VAC) 60Hz

4.Pin Assignment

CN1

Pin No.	Function	Description
1	+12V-AUX	Auxiliary voltage output, 10.6~13.2V, referenced to GND-AUX (pin2). The maximum load current is 0.8A. This output has the built-in "Oring diodes" and is not controlled by "Remote ON-OFF".
2	GND-AUX	Auxiliary voltage output GND. The signal return is isolated from the output terminals (+V & -V).
3	+5V-AUX	Auxiliary voltage output, 4.5~5.5V, referenced to GND-AUX (pin2). The maximum load current is 0.3A. This output has the built-in "Oring diodes" and is not controlled by "Remote ON-OFF"
4	Remote ON-OFF	The unit can turn the output ON/OFF by electrical signal or dry contact between *Remote ON/OFF* and *+5V-AUX*. (Note.2) Short (4.5 ~ 5.5V) : Power ON ; Open (0 ~ 0.5V) : Power OFF ; The maximum input voltage is 5.5V.
5	DC-OK	High (4.5 ~ 5.5V) : When the Vout ≦8V/16V/32V ±1V. Low (0 ~ 0.5V) : When Vout ≧8V/16V/32V ±1V. The maximum sourcing current is 10mA and only for output. (Note.2) *DC OK* is associated with battery low protection.
6	T-ALARM	High (4.5 ~ 5.5V) : When the internal temperature exceeds the limit of temperature alarm, or when Fan fails. Low (0 ~ 0.5V) : When the internal temperature is normal, and when Fan normally works. The maximum sourcing current is 10mA and only for output(Note.2)
7,8,9	A0,A1,A2	PMBus interface address lines. (Note.1)
10	D0	DIP-switch interface lines for charging curve selection. (Note.1)
11	PC	Connection for output current programming. (Note.1)
12	PV	Connection for output voltage programming. (Note.1)
13	+V (Signal)	Positive output voltage signal. It cannot be connected directly to the load.
14	-V (Signal)	Negative output voltage signal. It is for certain function reference; it cannot be connected directly to the load.
15	RTH+	Temperature sensor(NTC, 5KOhm) comes along with the charger can be connected to the unit to allow temperature compensation of the charging voltage.
16	RTH-	

Note1: Non-isolated signal, referenced to the [-V(signal)].

Note2: Isolated signal, referenced to GND-AUX.

CN500 7 ⬚ 8
       1 ⬚ 2

Pin No.	Function	Description
1,2	DA	Differential digital signal for parallel control.
3,4	DB	Differential digital signal for parallel control.
5,6	-V (Signal)	Negative output voltage signal. cannot be connected directly to the load.
7	SDA	Serial clock used in the PMBus interface.
8	SCL	Serial clock used in the PMBus interface.

SW1

Pin No.	Function	Description
1,2	Terminal resistance	SW1 is the selector of terminal resistor that is designed for DA/DB signals and parallel control function.

5. LED Indicators

LED	Description
🟢 Green	Float (stage 3)
🟠 Orange	Charging (stage 1 or stage 2)
🔴 Red	Abnormal status (OTP, OLP, Fan Fail, Charging timeout)

6. Explanation of Operation Logic : (3 stage charge)

At the beginning stage of operation, the charger provides the largest current to charge the batteries, the LED indicator will lighten in orange. After a period of time (probably a couple of hours, based on the capacity of the batteries), the charging current will decrease gradually. When the output current reduces to 10% of its maximum value, the charger will go into "float" mode, the LED indicator will turn to green. The relationship between charging current and charging voltage for each operation stage is shown in the curves below:
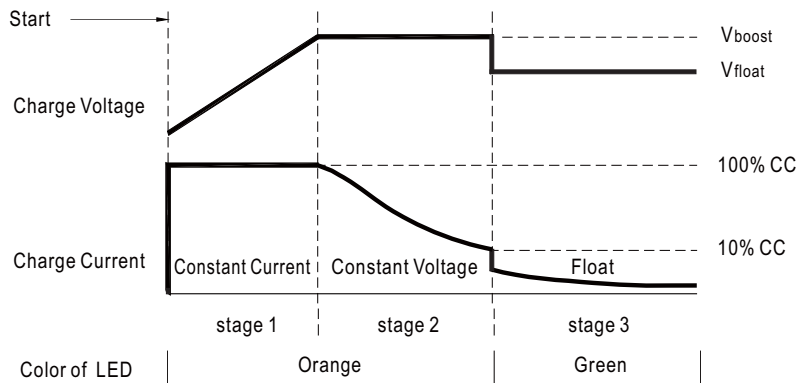
STATUS	RPB-1600-12	RPB-1600-24	RPB-1600-48
CONSTANT CURRENT	100A	55A	27.5A
BOOST CHARGE VOLTAGE	14.4V	28.8V	57.6V
FLOAT CHARGE VOLTAGE	13.8V	27.6V	55.2V

Figure 6.1 Charge Curve

Explanation for 3 stage charge curve

(0) Initial stage (battery analysis)：Check battery voltage level to see whether there is a battery connected.

(1) Stage 1 (constant current)：A constant current is provided so that the battery can be quickly charged to 2.4V per cell.

(2) Stage 2 (constant voltage)：A constant voltage of 2.4V per cell is provided until the charging current gradually reduces to 10%.

(3) Stage 3 (float)：The output voltage switches to the float voltage, making it 2.3V per cell to keep the battery fully charged.

7.Charge Cureve

The factory setting is "default", which can be programmed via PMBus.

◎ Default 3 stage charging curve
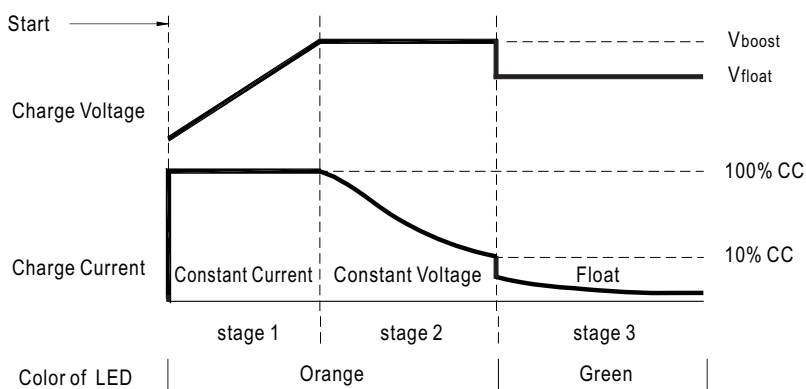
Note: By factory default, PIN10 and PIN14 on CN1 are connected.

◎ Embedded 3 stage charging curve

MODEL	Description	Vboost	Vfloat	CC (default)
12V	Default, programmable	14.4	13.8	100A
	Pre-defined, gel battery	14	13.6	
	Pre-defined, flooded battery	14.2	13.4	
	Pre-defined, AGM battery	14.5	13.5	
24V	Default, programmable	28.8	27.6	55A
	Pre-defined, gel battery	28	27.2	
	Pre-defined, flooded battery	28.4	26.8	
	Pre-defined, AGM battery	29	27	
48V	Default, programmable	57.6	55.2	27.5A
	Pre-defined, gel battery	56	54.4	
	Pre-defined, flooded battery	56.8	53.6	
	Pre-defined, AGM battery	58	54	

8.PMBus Communication Interface

RPB-1600 is compliant with PMBus Rev.1.1, the maximum communication speed is 100KHz and it has the capability of identifying up to 8 addressed units.

◎ PMBus communication interface is able to provide the current operating status and information as follows:

1. Output voltage, current and internal temperature

2. Alarm and status

3. Manufacturer's and model data

4 Read/write of charge curve settings

PMBus Device Addressing and Charge Mode Selection

◎ Each RPB-1600 unit should have their unique and own device address to communicate over the PMbus. This 7-bit address is defined as follows:

MSB   LSB

1	0	0	0	A2	A1	A0

A0-A2 allow users to designate the address for each RPB-1600 unit; these three bits are defined through PIN7 (A0), PIN8 (A1) and PIN9 (A2) on CN1. There are up to 8 different addresses are available to be assigned. When connecting one of these pins, for example, PIN8, with PIN14 (-V(Signal)), the corresponding bit, A1, is set to logic "0"; when it is kept open, for example, PIN7, the corresponding bit, A0, is set to logic "1". Please refer to Figure 8-1(left) for the detailed setup advice.

◎ The charging operation can be determined by the setup over D0, PIN10 on CN1. When D0 is logic "0", connecting PIN10 with PIN14(-V(Signal)), RPB-1600 follows a built charging curve to charge the batteries; when D0 is logic "1", PIN10 kept open, the charging operation is completely defined by the control over PMBus, PV/PC or SVR. Please refer to Figure 8-2(right).

Module No.	Device address		
	A0	A1	A2
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

D0	Description
0	Charging curve
1	PMBus or PV/PC or SVR control

Figure 8-1

Charging Curve

When it is opted for charging curve, D0 set to 0, charging curve function is enabled with additional PMBus commands. There are 4 built-in charging curves, "default" curve, one pre-defined curve for "gel battery", one pre-defined curve for "flooded battery" and one pre-defined curve for "AGM battery". Each curve can be selected by Command B4h CURVE_CONFIG.

In addition, users are able to customize their own charge curves, which will be stored to "default" after modification. Vboost can be set by Command B1h CURVE_VBST ; VFloat can be set by Command B2h CURVE_VFLOAT ; Charge current level of stage1 can be set by Command B0h CURVE_ICHG; Taper current level from stage2 to stage3 can be set by Command B3h CURVE_ITAPER. Please refer to the following PMBus Command List in table 8 - 2 for detailed information on commands and parameters.

NOTE: 1. The updated charging parameters is saved into EEPROM. The updated charging curve
takes effect after RPB-1600 is restarted.

2. When charging curve is enabled, the following commands will be invalid while other PMBus commands are effective: Command 01h OPERATION (regarding Remote ON-OFF function), Command 22h VOUT_TRIM (regarding Output voltage programming function) and Command 46h IOUT_OC_FAULT_LIMIT (regarding Output current programming function).

PMBus, PV/PC or SVR Functions

Users are able to fully control and design the entire charging behavior, without the charging curve, by one of the following means- PMBus command, PV/PC function or SVR adjustment. The operating priority is, PMBus > PV/PC > SVR.

NOTE: When operating in this mode, PMBus commands B0h/B1h…B8h can be set but there will
be no response whereas other PMBus commands and functions work normally.

◎ PMBus commands:

The command list of the RBP-1600 is shown in Table 8-2. It is compliant with the standard protocol of PMBus Rev. 1.1. For more detailed information, please refer to PMBus official website (http://pmbus.org/specs.html)

Command Code	Command Name	Transaction Type	# of data Bytes	Description
01h	OPERATION	R/W Byte	1	Remote ON/OFF control
02h	ON_OFF_CONFIG	Read Byte	1	ON/OFF function configuration
19h	CAPABILITY	Read Byte	1	Capabilities of a PMBus device
20h	VOUT_MODE	R Byte	1	Define data format for output voltage (format: Linear, N= -9)
21h	VOUT_COMMAND	R Word	2	Output voltage setting value (format: Linear, N= -9)
22h	VOUT_TRIM	R/W Word	2	Output voltage trimming value (format: Linear, N= -9)
46h	IOUT_OC_FAULT_LIMIT	R/W Word	2	Output overcurrent setting value
47h	IOUT_OC_FAULT_RESPONSE	R Byte	1	Define protection and response when an output overcurrent fault occurred
79h	STATUS_WORD	R Word	2	Summary status reporting
7Ah	STATUS_VOUT	R Byte	1	Output voltage status reporting
7Bh	STATUS_IOUT	R Byte	1	Output current status reporting
7Ch	STATUS_INPUT	R Byte	1	AC inpit voltage statusreporting
7Dh	STATUS_TEMPERATURE	R Byte	1	Temperature status reporting
7Eh	STATUS_CML	R Byte	1	Communication, logic, Memory status reporting
80h	STATUS_MFR_SPECIFIC	R Byte	1	Manufacture specific status reporting
81h	STATUS_FANS_1_2	R Byte	1	Fan1 and 2 status reporting
88h	READ_VIN	R Word	2	AC input voltage reading value (format: Linear, N=-1)
8Bh	READ_VOUT	R Word	2	Output voltage reading value (format: Linear, N= -9)
8Ch	READ_IOUT	R Word	2	Output current reading value (format: Linear, N= -3)
90h	READ_FAN_SPEED_1	R Word	2	Fan speed 1 reading value (format: Linear, N= 4)
91h	READ_FAN_SPEED_2	R Word	2	Fan speed 2 reading value (format: Linear, N= 4)
98h	PMBUS_REVISION	R Byte	1	The compliant revision of the PMBus (default: 11h for Rev. 1.1)
99h	MFR_ID	Block Read	12	Manufacturer's name
9Ah	MFR_MODEL	Block Read	12	Manufacturer's model name
9Bh	MFR_REVISION	Block Read	6	Firmware revision
9Ch	MFR_LOCATION	Block R/W	3	Manufacturer's factory location
9Dh	MFR_DATE	Block R/W	6	Manufacture date. (format: YYMMDD)
9Eh	MFR_SERIAL	Block R/W	12	Product serial number

Table 8-2

	Command Code	Command Name	Transaction Type	# of data Bytes	Description
Valid when charging according to charge curve (D0=0)	B0h	CURVE_ICHG	R/W Word	2	Constant current setting value of charging curve (format: Linear, N= -3)
	B1h	CURVE_VBST	R/W Word	2	Constant voltage setting value of charging curve (format: Linear, N= -9)
	B2h	CURVE_VFLOAT	R/W Word	2	Constant voltage setting value of charging curve (format: Linear, N= -9)
	B3h	CURVE_ITAPER	R/W Word	2	Taper current setting value of charging curve (format: Linear, N= -3)
	B4h	CURVE_CONFIG	R/W Word	2	Configuration setting of charging curve
	B5h	CURVE_CC_TIMEOUT	R/W Word	2	CC stage timeout setting value of charging curve (format: Linear, N= 0)
	B6h	CURVE_CV_TIMEOUT	R/W Word	2	CV stage timeout setting value of charging curve (format: Linear, N= 0)
	B7h	CURVE_FLOAT_TIMEOUT	R/W Word	2	Floating timeout setting value of charging curve (format: Linear, N= 0)
	B8h	CHG_STATUS	READ Word	2	Charger's status reporting

Note：

◎Definition of Command B4h CURVE_CONFIG：

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
High byte	-	-	-	-	-	FVTOE	CVTOE	CCTOE
Low byte	-	STGS	-	-	TCS		CUVS	

Low byte

Bit 1-0 CUVS ：Charge Curve selecting

00＝Customized Charge Curve (default)

01＝Gel Battery

10＝Flooded Battery

11＝AGM Battery

Bit 3-2 TCS：Temperature Compensation setting

00＝ disable

01＝ -3 mV/℃/cell (default)

10＝ -4 mV/℃/cell

11＝ -5 mV/℃/cell

Bit 6 STGS：2/3 stage charge setting

0＝ 3 stage charge (default, Curve_VBST and CURVE_V FLOAT)

1＝ 2 stage charge (only CURVE_VBST)

High byte

Bit 0 CCTOE：Constant Current Stage timeout indication enable

0＝ disabled (default)

1＝ enabled

Bit 1 CVTOE：Constant Voltage Stage timeout indication enable

0＝ disabled (default)

1＝ enabled

Bit 2 FTTOE：Float Stage timeout indication enable

0＝ disabled (default)

1＝ enabled

◎ Definition of Command B8h CHG_STATUS：

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
High byte	FVTOF	CVTOF	CCTOF	-	BTNC	NTCER	-	EEPER
Low byte	-	-	-	-	FVM	CVM	CCM	FULLM

Low byte

Bit 0 FULLM：Fully Charged
0＝NOT fully charged
1＝fully charged

Bit 1 CCM：Constant Current Mode Status
0＝the charger NOT in constant current mode
1＝the charger in constant current mode

Bit 2 CVM：Constant Voltage Mode Status
0＝the charger NOT in constant voltage mode
1＝the charger in constant voltage mode

Bit 3 FVM：Float Mode Status
0＝the charger NOT in float mode
1＝the charger in float mode

High byte

Bit 0 EEPER: EEPROM Charge Parameter Error
0＝data of charge parameter correct
1＝data of charge parameter error

Bit 2 NTCER: Temperature Compensation Status
0＝NO short-circuit in the circuitry of temperature compensation
1＝the circuitry of temperature compensation has short-circuited

Bit 3 BTNC: Battery Detection
0＝battery detected
1＝NO battery detected

Bit 5 CCTOF：Time-out Flag of Constant Current Mode
0＝NO time-out in constant current mode
1＝constant current mode timed out

Bit 6 CVTOF：Time-out Flag of Constant Voltage Mode
0＝NO time-out in constant voltage mode
1＝constant voltage mode timed out

Bit 7 FTTOF：Time-out Flag of Float Mode
0＝NO time-out in float mode
1＝float mode timed out

Note:

EEPER：When EEPROM Charge Parameter Error occurs, the charger stops charging the battery and the LED indicator turns red. The charger needs to re-power on to re-start charging the battery.

NTCER：When Temperature Compensation Short occurs, the charger output will shut down and the LED indicator will turn red. The charger will automatically restart after the Temperature Compensation Short condition is removed.

BTNC：When there is no battery detected, the charger stops charging the battery and the LED indicator turns red. The charger needs to re-power on to re-start charging the battery.

CCTOF：When timeout arises in the Constant Current stage, the charger stops charging the battery and the LED indicator turns red. The charger needs to re-power on to re-start charging the battery.

CVTOF：When timeout arises in the Constant Voltage stage, the charger stops charging the battery and the LED indicator turns red. The charger needs to re-power on to re-start charging the battery.

FVTOF：When timeout arises in the Float stage, the charger stops charging the battery and the LED indicator turns green. This charging flow is finished; the charger needs to re-power on to start charging a different battery.

PMBus Data Range and Tolerance

◎ Display parameters

PMBus command	Model	Range	Tolerance
READ_VIN	ALL	80 ~ 264V	±10V
READ_VOUT	12V	0 ~ 15V	±0.18V
	24V	0 ~ 30V	±0.36V
	48V	0 ~ 60V	±0.48V
READ_IOUT (Note. 1)	12V	0 ~ 150A	±2.5A
	24V	0 ~ 80A	±1.34A
	48V	0 ~ 40A	±0.67A
READ_FAN_SPEED_1	ALL	0 ~ 26500RPM	±2000RPM
READ_FAN_SPEED_2	ALL	0 ~ 26500RPM	±2000RPM

Figure 8-3

◎ Control parameter

PMBus command	Model	Adjustable range	Tolerance	Default
OPERATION	ALL	00h(OFF) / 80h(ON)	N/A	80h(ON)
VOUT_COMMAND (Note. 2)	12V	12V	N/A	12V
	24V	24V	N/A	24V
	48V	48V	N/A	48V
VOUT_TRIM (Note. 2)	12V	-3 ~ 3V	±0.18V	0V
	24V	-6 ~ 6V	±0.36V	0V
	48V	-12 ~ 12V	±0.48V	0V
CURVE_VCHG (Note. 3)	12V	9 ~ 15V	±0.18V	14.4V
	24V	18 ~ 30V	±0.36V	28.8V
	48V	36 ~ 60V	±0.48V	57.6V
CURVE_VFLOAT (Note. 3)	12V	9 ~ VBST	±0.18V	13.8V
	24V	18 ~ VBST	±0.36V	27.6V
	48V	36 ~ VBST	±0.48V	55.2V
IOUT_OC_FAULT_LIMIT CURVE_ICHG	12V	20 ~ 100A	±2.5A	100A
	24V	11 ~ 55A	±1.34A	55A
	48V	5.5 ~ 27.5A	±0.67A	27.5A
CURVE_ITAPER	12V	5 ~ 30A	±2.5A	10A
	24V	2.7 ~ 16.5A	±1.34A	5.5A
	48V	1.3 ~ 8.3A	±0.67A	2.8A
CURVE_CC_TIMEOUT CURVE_CV_TIMEOUT CURVE_FLOAT_TIMEOUT	ALL	60 ~ 64800 Minute	±5 Minute	600 Minute

Figure 8-4

Note:

1.READ_IOUT will display ZERO amp when output current is less than values in the table below:

Model	Minimum readable current
12V	5A±1A
24V	2.7A±1A
48V	1.3A±1A

2.When using PMBus to adjust output voltage, VOUT_COMMAND only can be used to display the rated voltage of the unit and cannot be written. It is VOUT_TRIM that sets up the amount of trimmed voltage. Taking RPB-1600-12 as an example, to get a 9V output, please set value of VOUT_TRIM to -3V. Adjustable voltage range for each model is shown as below:

Model	Adjustable voltage range
12V	9 ~ 15V
24V	18 ~ 30V
48V	36 ~ 60V

3.The value of CURVE_VFLOAT should be set less or equal to CURVE_V_{BST},If CURVE_VFLOAT is greater than CURVE_V_{BST}, it will be saved as CURVE_VFLOAT = CURVE_V_{BST} in EEPROM.

◎ Please refer to our specifications about PV/PC or SVR Function.

9.Function description

9.1 Input voltage
◎The input voltage range is AC90~264Vor DC127~370V.

◎The provided input voltage must fall within the specified range; otherwise, the unit may be non-functional. Also the active PFC circuit may fail or get damaged.

◎The efficiency will be lower and the output current should be reduced according to the Derating Curve when the unit is applied with an input voltage below AC180V.

9.2 Power factor correction (PFC)
◎Built-in active PFC circuit: PF>0.95 when input voltage is between 90-230Vac with full load at the output. On the other hand, if the input voltage is > 230V or output is not at full load, the PF will drop below 0.95

9.3 Temperature Compensation

Temperature sensor which comes with the charger can be connected to the unit to allow temperature compensation of the charging voltage. If the temperature sensor is not used, the charger can still work normally.
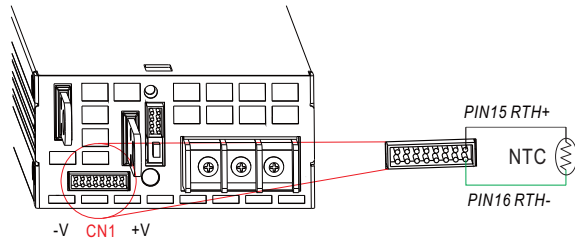
10. Wiring for battery

Select suitable wire guage based on rated charging current. Refer to the following table for minimum wire gauge. It is highly recommend using RED wire for (+) connection and BLACK wire for (-) connection

AWG	Cross section(mm^2)	Maximum current(A) UL1015(600V 105℃)
14	2.1	12
12	3.3	22
10	5.3	35
7	10	46
6	16	60
4	25	80
2	43	110

11. Suggested Battery Capacity

Model	Battery capacity
RPB-1600-12	330-1000AH
RPB-1600-24	180-550AH
RPB-1600-48	90-270AH

Note: 1. Using battery capacity larger than the suggested value will not lead to damage of the battery. The main drawback is it may take longer to fully charge the battery.

2. If you're unsure about max allowable charging current of your battery, please refer to the battery's technical specification or consult its manufacturer.

12.Series and Parallel Connection of Batteries

1.Batteries in series

Voltage can be doubled when 2 batteries are connected in series. However, the capacity (Ah) will remain the same. For example, 2/12V 100Ah batteries connected in series = 24V 100A.

```
+   −     +   −
Batteries  Batteries
```
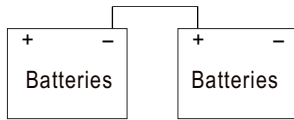
2.Batteries in parallel

When 2 batteries are connected in parallel, voltage remains the same and the capacity (Ah) doubles. For example, 2 x 12V 100Ah batteries connected in parallel = 12V 200Ah.

```
+   −
Batteries

+   −
Batteries
```
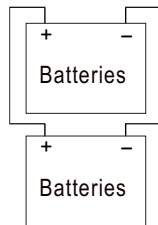
13.Troubleshooting

Failure State	Possible Cause	Suggested Solutions
Unable to charge the battery	Input voltage too low	Make sure input source is between 90~264VAC
LED indicator does not turn Green after a long charging period	Battery is over lifetime or damaged	Replace with a new battery
	Output cables are too thin	Replace with suitable wire gauge

If you are unable to clarify the problem you are facing, please contact MEAN WELL or any of our distributors for repair service.