MEAN WELL

RPB-1600
Instruction Manual

RPB-1600 Instruction Manual

Index

Nov. 2023 Version 5

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.

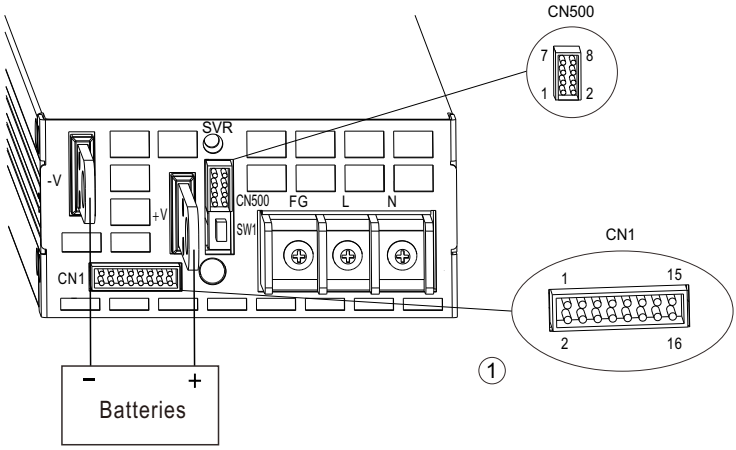
◎ Please make sure charging voltage and current meet battery specification.

◎ 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

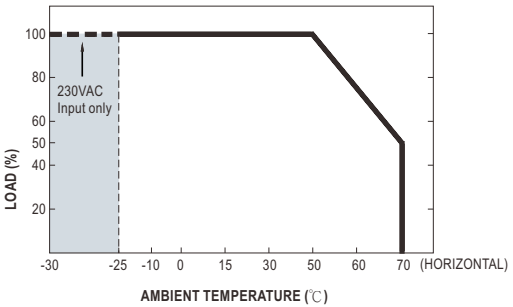
Figure2.1 Front panel

Installation Procedure:

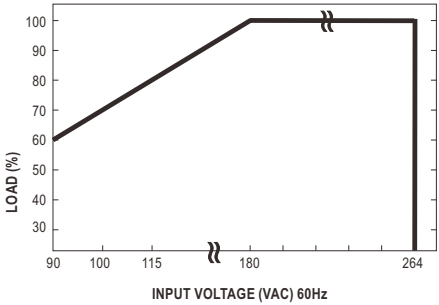
Please make sure the charger is OFF before connecting the battery to the output terminal. Choose a cable with suitable wire gauge according to the charging current to connect between the charger and the battery. Battery polarity must be connected correctly:Terminal(+) to Battery(+); Terminal(-) to Battery(-),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

3.Derating Curve

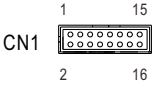
3.1 Charging current vs Temperature



3.2 Charging current vs Input Voltage



4.Pin Assignment



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 (-0.5 ~ 0.5V) : Power OFF ; The maximum input voltage is 5.5V.
5	$\overline{\text{DC-OK}}$	High (3.5 ~ 5.5V) : When the Vout ≦8V/16V/32V ±1V. Low (-0.5 ~ 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 (3.5 ~ 5.5V) : When the internal temperature exceeds the limit of temperature alarm, or when Fan fails. Low (-0.5 ~ 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

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

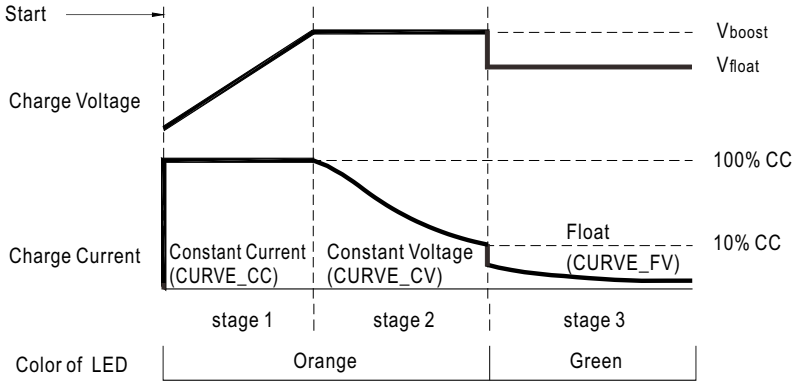
Pin No.	Function	Description
1,2	Terminal resistance	SW1 is the selector of terminal resistor that is designed for DA/DB signals and parallel control function.

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)
Red(Flashing)	The LED will flash with the red light when the internal temperature reaches 60℃; under this condition, the unit still operates normally without entering OTP. (In the meantime, an alarm signal will be sent out through the PMBus interface.)

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.

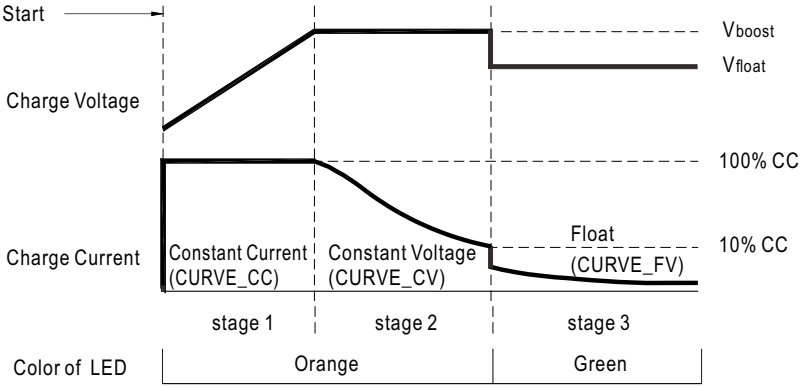
(2) Stage 2 (constant voltage)：A constant voltage of 2.4V per cell is provided until the charging current gradually reduces to 10%.

(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.Communication Protocol

Users can use three different methods to control outputs of RPB-1600. The control priority between the methods is as follows: Communication (PMBus or CAN bus) > PV/PC > SVR. These three control methods can be used interchangeably. When using communication control, it is essential to communicate with the device within 4 seconds. Otherwise, the program will reset the control priority and set the communication parameters back to the factory default values(NOTE 1). However, the following condition will bypass this control logic: setting RPB-1600 to charger mode. In charger mode, PV/PC and SVR controls will become inactive and charging-related settings can only be changed via communication.

NOTE: 1.When D0 is set at "1" and communication function is used, some of the parameters will return to the factory default values if any of the conditions happens, AC recycling and communication timeout. Take RPB-1600-12 as an example, command OPERATION becomes ON, Vo and Io change to 12V and 100A.

2.In charger mode, Remote ON/OFF or OPERATION ON/OFF can be used to activate new curve procedures and import parameters and settings for a new curve profile. Additionally, it can also release protections caused by CURVE_CC_TIMEOUT, CURVE_CV_TIMEOUT, or CURVE_TP_TIMEOUT due to timeouts.

8.1 PMbus Addressing and CAN ID setting

◎Each RPB-1600 unit should have their unique and own device address to communicate over the bus.

*PMbus 7-bit addressing definition :

MSB						LSB
1	0	0	0	A2	A1	A0

*CAN message ID definition :

Message ID	Description
0xC00XX	RPB-1600 to Controller Message ID
0xC01XX	Controller to RPB-1600 Message ID
0xC01FF	Controller broadcasts to RPB-1600

XX means the CAN ID of RPB-1600

A0-A2 allows users to designate an address or ID for the 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 opened, for example, PIN7, the corresponding bit, A0, is set to logic "1". Please refer to Table 8-1(left) for detailed setup.

◎Charge mode can be activated by settings over D0 (PIN10) on CN1. When D0 is logic "0", connecting PIN10 to PIN14(-V(Signal)), RPB-1600 follows a built-in charging curve to charge the batteries; when D0 is logic "1", PIN10 kept opened, operation of the unit is completely defined by the control over PMBus, PV/PC or SVR. Please refer to Table 8-1(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	Function describe
0	Charging curve
1	PMBus or PV/PC or SVR control

Table 8-1

Charging Curve

When it is opted for charging curve, D0 set to 0, charging curve function is enabled with additional PMBus or CAN bus 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 CURVE_CONFIG (PM: B4h; CAN: 0x00B4). In addition, users are able to customize their own charge curves, which will be stored to “default” after modification._ CV can be set by Command CURVE_CV (PM:B1h; CAN: 0x00B1);_ FV can be set by Command CURVE_FV (PM:B2h; CAN: 0x00B2) ;Charge current level of stage1 can be set by Command CURVE_CC(PM:B0h; CAN: 0x00B0);Taper current level from stage2 to stage3 can be set by Command CURVE_TC(PM:B3h; CAN: 0x00B3)). Please refer to the command list for PMBus or CAN bus 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, remoted on/off or operation on/off.
2. When charging curve is enabled, the following commands will be invalid while other commands are effective:, Command VOUT_TRIM(22h)/ VOUT_SET(0x0020) (regarding Output voltage programming function) and Command IOUT_OC_FAULT_LIMIT(46h)/ IOUT_SET(0x0030) (regarding Output current programming function).

8.2 PMBus Communication Interface

◎RPB-1600 is compliant with PMBus Rev.1.1, the maximum communication speed is 100KHz and the maximum number of assignable addresses is up to 8 units on a bus.

◎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 commands: The command list of the RPB 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)

Table 8-2

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 16, N= -9)
21h	VOUT_COMMAND	R Word	2	Output voltage setting value (format: Linear 16, N= -9)
22h	VOUT_TRIM	R/W Word	2	Output voltage trimmed value (format: Linear 16, N= -9)
46h	IOUT_OC_FAULT_LIMIT	R/W Word	2	Output overcurrent setting value (format: Linear 11, N= -2)
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 11, N=-1)
8Bh	READ_VOUT	R Word	2	Output voltage reading value (format: Linear 16, N= -9)
8Ch	READ_IOUT	R Word	2	Output current reading value (format: Linear 11, N= -2)
90h	READ_FAN_SPEED_1	R Word	2	Fan speed 1 reading value (format: Linear 11, N= 5)
91h	READ_FAN_SPEED_2	R Word	2	Fan speed 2 reading value (format: Linear 11, N= 5)
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

	Command Code	Command Name	Transaction Type	# of data Bytes	Description
Valid when charging according to charge curve (D0=0)	B0h	CURVE_CC	R/W Word	2	Constant current setting value of charging curve (format: Linear, N= -2)
	B1h	CURVE_CV	R/W Word	2	Constant voltage setting value of charging curve (format: Linear, N= -9)
	B2h	CURVE_FV	R/W Word	2	Constant voltage setting value of charging curve (format: Linear, N= -9)
	B3h	CURVE_TC	R/W Word	2	Taper current setting value of charging curve (format: Linear, N= -2)
	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

Table 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_CV (Note. 3)	12V	9 ~ 15V	±0.18V	14.4V
	24V	18 ~ 30V	±0.36V	28.8V
	48V	36 ~ 60V	±0.48V	57.6V
CURVE_FV (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_CC	12V	20 ~ 100A	±2.5A	100A
	24V	11 ~ 55A	±1.34A	55A
	48V	5.5 ~ 27.5A	±0.67A	27.5A
CURVE_TC	12V	5 ~ 30A	±2.5A	10A
	24V	2.75 ~ 16.5A	±1.34A	5.5A
	48V	1.5 ~ 8.3A	±0.67A	2.8A
CURVE_CC_TIMEOUT CURVE_CV_TIMEOUT CURVE_FLOAT_TIMEOUT	ALL	60 ~ 64800 Minute	±5 Minute	600 Minute

Table 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

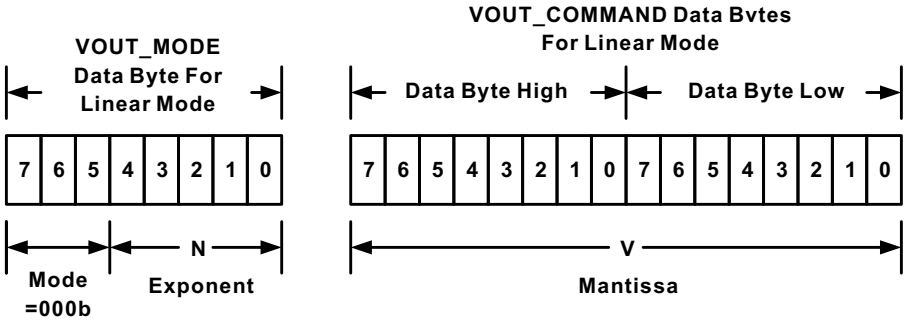
3. The value of CURVE_FV should be set less or equal to CURVE_CV,If CURVE_FV is greater than CURVE_CV, it will be saved as CURVE_FV = CURVE_CV in EEPROM.

Notes on PMBus

1. Insert a at least 50msec delay between commands

2. Examples for Format Conversion :

(1) LINEAR16 format：VOUT_COMMAND、VOUT_TRIM、READ_VOUT、CURVE_CV、CURVE_FV.
Actual voltage = communication reading $V \times 2^N$. There are two definitions in the VOUT_MODE command that refer to N requirements.



Linear Format Data Bytes

The Mode bits are set to 000b.

The Voltage, in volts, is calculated from the equation:

Voltage = $V \cdot 2^N$

Where:

Voltage is the parameter of interest in volts;

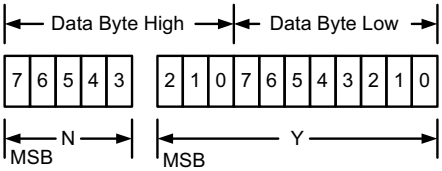
V is a 16 bit unsigned binary integer; and

N is a 5 bit two's complement binary integer.

EX: Vo_real (actual output voltage) = V x 2^N , V is from READ_VOUT. N If VOUT_MODE = 0x17, meaning N is -9. READ_VOUT is 0x3000 12288, then Vo_real =12288 × 2^{-9}=24.0V.

(2)LINEAR11 format：IOUT_OC_FAULT_LIMIT、READ_VIN、READ_IIN、READ_IOUT、READ_TEMPERATURE_1、READ_FAN_SPEED_1、READ_FAN_SPEED_2、CURVE_CC、CURVE_TC、CURVE_CC_TIMEOUT 、CURVE_CV_TIMEOUT 、CURVE_FV_TIMEOUT。

Actual value X = communication read value Y x 2^N. Among them, the definition of the description column for each aircraft type is referred to



Linear Data Format Data Bytes Y, N and the "real world" value is:

The relation between

X = $Y \cdot 2^N$

Where, as described above:

X is the "real world" value;

Y is an 11 bit, two's complement integer; and

N is a 5 bit, two's complement integer.

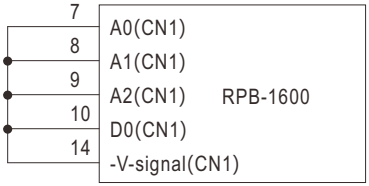
Devices that use the Linear format must accept and be able to process any value of N.

EX: Io_real (actual output current) = Y× 2^N , Y is from READ_IOUT. N If READ_IOUT is 0xF188h, meaning N is -2 and Y is 0x0188. Y is 0x0188 → 392, then Io_real = 392 × 2^{-2} = 98.0A.

Communication Example - Practical Operation of Charger Mode

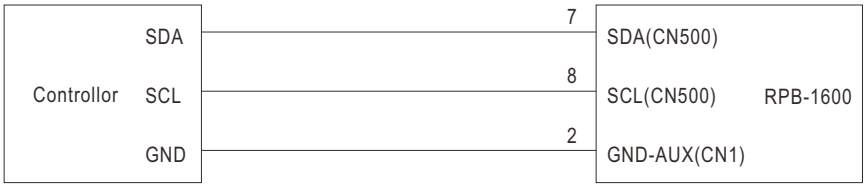
The following steps will describe how to set the RPB-1600-48 to charger mode and adjust its curve for a 2-stage charging process, with a constant current (CC) of 20A and a constant voltage (CV) of 56V.

1.Set the address of the charger to “0” and set it to charge mode.



2.Connect the SDA, SCL and GND pins of the master to the corresponding SDA (PIN7) and SCL (PIN8) of CN500 and GND-AUX (PIN2) of CN1 on the charger.

◎Set speed: 100KHz



3.Communication function can be accessed immediately after RPB-1600 is connected to AC. Frist set the charger to 2-stage charging mode.

Address(7 bit)	Operation	Command Code	Data
0x40	Write	0xB4	0x44, 0x00

Command code: 0xB4(CURVE_CONFIG)

Data: 44(Lo) + 00(Hi). Please refer to definition of CURVE_CONFIG for detailed information.

4.Set the constant current (CC) point to 20A.

Address(7 bit)	Operation	Command Code	Data
0x40	Write	0xB0	0x50, 0xF0

Command code: 0xB0(CHURVE_ICHG)

Data: 20A → 0x50(Lo) + 0xF0(Hi)

NOTE: CURVE_ICHG is LINEAR11 format

5. Set the constant voltage (CV) point to 56V.

Address(7 bit)	Operation	Command Code	Data
0x40	Write	0xB1	0x00, 0x70

Command code: 0xB1(CHURVE_VBST)

Data: 56V → 0x00(Lo) + 0x70(Hi)

NOTE: CHURVE_VBST is LINEAR16 forma

6.Before connecting to the batteries, it is recommended to review all of the settings and parameters using the appropriate commands. In the event that they do not meet your requirements, you may rewrite them as needed. EX: Read CHURVE_VBST to check whether CV level or Vboost was set to a proper level.

Read CURVE_VBST

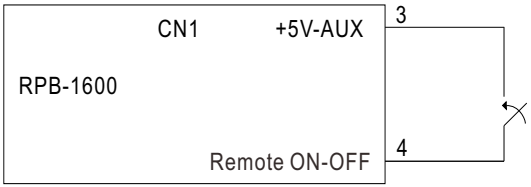
Address(7 bit)	Operation	Command Code
0x40	Read	0xB1

The unit returns data below

Address(7 bit)	Data
0x40	0x00, 0x70

Data: 0x00(Lo) + 0x70(Hi) → 0x7000 → $28672 \times 2^{-9} = 56V$。

7.Finally, short circuit Remote ON-OFF (PIN4) and +5-AUX (PIN3) pins of the CN1 connector on the charger to remote on it to charge the batteries.



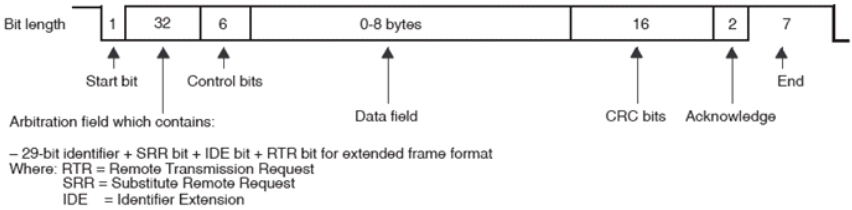
8.3 CANBus Communication Interface

◎Physical layer specification

This protocol follows CAN ISO-11898 with Baud rate of 250Kbps.

◎Data Frame

This protocol uses Extended CAN 29-bit identifier frame format or CAN 2.0B.

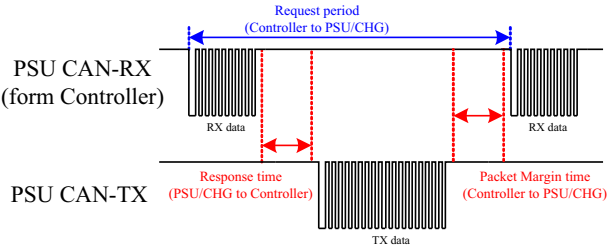


◎Communication Timing

Min. request period (Controller to RPB-1600): 50mSec。

Max. response time (RPB-1600 to Controller): 12.5mSec。

Min. packet margin time (Controller to RPB-1600): 12.5mSec。



◎Data Field Format

Controller to RPB-1600

Write:

Data filed bytes

0	1	2	3
COMD. low byte	COMD. high byte	Data low byte	Data high byte

Read:

Data filed bytes

0	1
COMD. low byte	COMD. high byte

RPB-1600 to Controller

Response:

Data filed bytes

0	1	2	.....	7
COMD. low byte	COMD. high byte	Data low 1	.....	Data high 6

NOTE: RPB-1600 will not send data back when writing parameters, such as VOUT_SET

8.3.1 CANBus Command list

Command Code	Command Name	Transaction Type	# of data Bytes	Description
0x0000	OPERATION	R/W	1	ON/OFF control ON: 01h OFF: 00h
0x0020	VOUT_SET	R/W	2	Output voltage set (format: value, F=0.1)
0x0030	IOUT_SET	R/W	2	Output current set (format: value, F=0.1)
0x0040	FAULT_STATUS	R	2	Abnormal status
0x0050	READ_VIN	R	2	Input voltage read value (format: value, F=1)
0x0060	READ_VOUT	R	2	Output voltage read value (format: value, F=0.1)
0x0061	READ_IOUT	R	2	Output current read value (format: value, F=0.1)
0x0062	READ_ TEMPERATURE_1	R	2	Internal ambient temperature (format: value, F=0.1)
0x0070	READ_FAN_SPEED_1	R	2	Fan speed 1 reading value (Format: value, F=1, unit: RPM)
0x0071	READ_FAN_SPEED_2	R	2	Fan speed 2 reading value (Format: value, F=1, unit: RPM)
0x0080	MFR_ID_B0B5	R	6	Manufacture's name
0x0081	MFR_ID_B6B11	R	6	Manufacture's name
0x0082	MFR_MODEL_B0B5	R	6	Manufacture model name
0x0083	MFR_MODEL_B6B11	R	6	Manufacture model name
0x0084	MFR_REVISION_B0B5	R	6	Firmware version
0x0085	MFR_LOCATION_B0B2	R	3	Manufacture place
0x0086	MFR_DATE_B0B5	R	6	Manufacture date

Command Code	Command Name	Transaction Type	# of data Bytes	Description
0x0087	MFR_SERIAL_B0B5	R	6	Manufacture serial number
0x0088	MFR_SERIAL_B6B11	R	6	Manufacture serial number
0x00B0	CURVE_CC	R/RW	2	Constant current setting of charge curve (format: value, F=0.1)
0x00B1	CURVE_CV	R/RW	2	Constant voltage setting of charge curve (format: value, F=0.1)
0x00B2	CURVE_FV	R/RW	2	Floating voltage setting of charge curve (format: value, F=0.1)
0x00B3	CURVE_TC	R/RW	2	Taper current setting of charge curve (format: value, F=0.1)
0x00B4	CURVE_CONFIG	R/RW	2	Configuration setting of charge curve
0x00B5	CURVE_CC_TIMEOUT	R/RW	2	CC charge timeout setting of charging curve (format: value, F=1)
0x00B6	CURVE_CV_TIMEOUT	R/RW	2	CV charge timeout setting of charging curve (format: value, F=1)
0x00B7	CURVE_FV_TIMEOUT	R/RW	2	FV charge timeout setting of charging curve (format: value, F=1)
0x00B8	CHG_STATUS	R	2	Charging status reporting

Valid when charging according to charge curve(D0=ON)

Table 8-8

8.3.2 Definition and contents of CANBus Command list

◎Definition of Command FAULT_STATUS(0x0040)：

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Low byte	HI_TEMP	OP_OFF	AC_FAIL	SHORT	OLP	OVP	OTP	FAN_FAIL

Bit 0 FAN_FAIL：Fan locked flag
0 = Working normally
1 = Fan locked

Bit 1 OTP：Over temperature protection
0 = Internal temperature normal
1 = Internal temperature abnormal

Bit 2 OVP：DC over voltage protection
0 = DC voltage normal
1 = DC over voltage protected

Bit 3 OLP：DC over current protection
0 = DC current normal
1 = DC over current protected

Bit 4 SHORT：Short circuit protection
0 = Shorted circuit do not exist
1 = Shorted circuit protected

Bit 5 AC_FAIL：AC abnormal flag
0 = AC input range normal
1 = AC input range abnormal

Bit 6 OP_OFF：DC status
0 = DC output turned on
1 = DC output turned off

Bit 7 HI_TEMP：Internal high temperature protection
0 = Internal temperature normal
1 = Internal temperature abnormal

Note: Unsupported settings displays with "0"

◎MFR_ID_B0B5 (0x0080) is the first 6 codes of the manufacturer's name (ASCII); MFR_ID_B6B11 (0x0081) is the last 6 codes of the manufacturer's name (ASCII)

EX: Manufacturer's name is MEANWELL MFR_ID_B0B5 is MEANWE ; MFR_ID_B6B11 is LL

MFR_ID_B0B5					
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0x4D	0x45	0x41	0x4E	0x57	0x45

MFR_ID_B6B11					
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0x4C	0x4C	0x20	0x20	0x20	0x20

◎MFR_MODEL_B0B5 (0x0082) is the first 6 codes of the manufacturer's model name (ASCII); MFR_MODEL_B6B11 (0x0083) is the last 6 codes of the manufacturer's model name (ASCII)

EX: Model names is RPB-1600-48 → MFR_MODEL_B0B5 is RPB-16 ; MFR_MODEL_B6B11 is 00-48

MFR_MODEL_B0B5					
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0x52	0x50	0x42	0x2D	0x31	0x36

MFR_ID_B6B11					
Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
0x30	0x30	0x2D	0x34	0x38	0x20

◎MFR_REVISION_B0B5 (0x0084) is the firmware revision (hexadecimal).
A range of 0x00 (R00.0)~0xFE (R25.4) represents the firmware version of an MCU; 0xFF represents no MCU existed.

EX: The supply has two MCUs, the firmware version of the MCU number 1 is version R25.4 (0xFE), the MCU number 2 is version R10.5 (0x69)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0xFE	0x69	0xFF	0xFF	0xFF	0xFF

◎MFR_DATE_B0B5 (0x0086) is manufacture date (ASCII)

EX: MFR_DATE_B0B5 is 180101, meaning 2018/01/01

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0x31	0x38	0x30	0x31	0x30	0x31

◎MFR_SERIAL_B0B5 (0x0087) and MFR_SERIAL_B6B11 (0x0088) are defined as manufacture date and manufacture serial number (ASCII)

EX: The first unit manufactured on 2018/01/01→MFR_SERIAL_B0B5: 180101 ; MFR_SERIAL_B6B11: 000001

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0x31	0x38	0x30	0x31	0x30	0x31

Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
0x30	0x30	0x30	0x30	0x30	0x31

◎CURVE_CONFIG(0x00B4, only for charger mode) :

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

Low byte

Bit 0:1 CUVS：Charge Curve Selection
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)
1 = 2 stage charge

High byte:

Bit 0 CCTOE：Constant Current Stage Timeout Indication Enable
0 = disable (default)
1 = enabled

Bit 1 CVTOE：Constant Voltage Stage Timeout Indication Enable
0 = disable (default)
1 = enabled

Bit 2 FTTOE：Float Voltage Stage Timeout Indication Enable
0 = disable (default)
1 = enabled

Note: Unsupported settings displays with "0"

◎CHG_STATUS(0x00B8, only for charger mode) :

	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 Mode Status
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 charging parameter error
0 = charging parameter is correct
1 = charging parameter has error

Bit 2 NTCER: temperature compensation error
0 = There is no short circuit in the temperature compensation circuitry
1 = There is a short circuit in the temperature compensation circuitry

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 Mod
0 = NO time out in float mode
1 = float mode timed out

8.3.3 CANBus Value Range and Tolerance

(1)Display parameters

CANBus command	Model	Display value 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	12V	0~150A	±2.5A
	24V	0~80A	±1.34A
	48V	0~40A	±0.67A
READ_ TEMPERATURE_1	ALL	-40~100℃	±5℃
READ_FAN_SPEED_1	ALL	0~26500 RPM	±2000RPM
READ_FAN_SPEED_2	ALL	0~26500 RPM	±2000RPM

(2)Control parameters

CANBus command	Model	Display value range	Tolerance	Default
OPERATION	ALL	00h(OFF)/01h(ON)	N/A	ON
VOUT_SET	12V	9~15V	±0.18V	12V
	24V	18~30V	±0.36V	24V
	48V	36~60V	±0.48V	48V
IOUT_SET	12V	20~100A	±2.5A	100A
	24V	11~55A	±1.34A	55A
	48V	5.5~27.5A	±0.67A	27.5A
CURVE_CV	12V	9~15V	±0.18V	28.8A
	24V	18~30V	±0.36V	57.6A
	48V	36~60V	±0.48V	13.8A
CURVE_FV	12V	9~VBST	±0.18V	13.8A
	24V	18~VBST	±0.36V	27.6A
	48V	36~VBST	±0.48V	55.2A
CURVE_TC	12V	5~30V	±2.5A	10A
	24V	2.75~16.5V	±1.34A	5.5A
	48V	1.5~8.25V	±0.67A	2.8A
CURVE_CC_TIMEOUT CURVE_CV_TIMEOUT CURVE_FV_TIMEOUT	ALL	60~64800 Minute	±5 Minute	600 Minute

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. The setting of CURVE_FV must be less than or equal to CURVE_CV. If CURVE_FV is greater than CURVE_CV, it will be CURVE_VF=CURVE_CV stored in EEPROM.

8.3.4 Communication example

8.3.4.1 Sending comman

The master adjusts output voltage of the unit with address "01" to 30V

CAN ID	DLC (data length)	Command code	Parameters
0xC0101	0x4	0x2000	0x2C01

Command code: 0x0020 (VOUT_SET) → 0x20(Lo) + 0x00(Hi)

Parameters: 30V → 300 → 0x012C → 0x2C(Lo) + 0x01(Hi)

NOTE: Conversion factor for VOUT_SET is 0.1, so $\frac{30V}{F=0.1}$ =300

8.3.4.2 Reading data or status

The master reads operation setting from the unit with address "00".

CAN ID	DLC (data length)	Command code
0xC0100	0x2	0x0000

The unit with address "00" returns data below

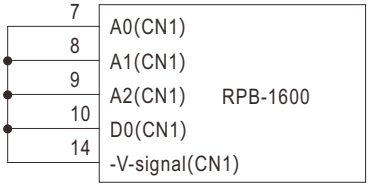
CAN ID	DLC (data length)	Command code	Parameters
0xC0000	0x3	0x0000	0x01

The unit with address "00" returns data below

Practical Operation of Charger Mode

The following steps will describe how to set the RPB-1600-48 to charger mode and adjust its curve for a 2-stage charging process, with a constant current (CC) of 20A and a constant voltage (CV) of 56V

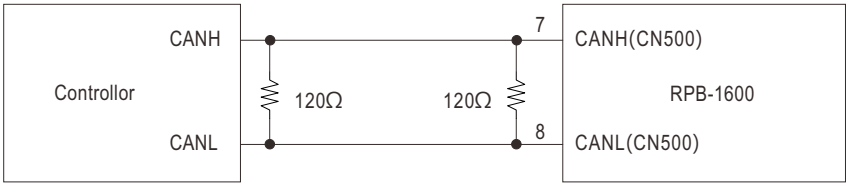
1.Set the address of the charger to “0” and set it to charge mode.



2. Connect the CANH/CANL pins of the master to the corresponding CANH(PIN7) and CANL(PIN8)pins of the CN500 connector on the charger. It is recommended to establish a common ground for the communication system to increases its communication reliability by using GND-AUX (PIN2) of CN1.

◎Set baud rate: 250kbps, type: extended

◎Adding a 120Ω terminal resistor to both the controller and rack shelf ends can increase communication stability



3.Communication function can be accessed immediately after RPB-1600 is connected to AC. Frist set the charger to 2-stage charging mode.

CANID	DLC(data length)	Command Code	Parameters
0xC0100	0x04	0xB400	0x4400

Command code: 0x00B4(CURVE_CONFIG)

Data: 44(Lo) + 00(Hi). Please refer to definition of CURVE_CONFIG for detailed information.

4.Set the constant current (CC) point to 20A

CANID	DLC(data length)	Command Code	Parameters
0xC0100	0x04	0xB000	0xC800

Command code: 0x00B0(CHURVE_CC)

Data: 20A → 200 → 0x00C8 → 0xC8(Lo) + 0x00(Hi)

NOTE: Conversion factor for CURVE_CC is 0.1，so $\frac{20A}{F=0.1}$ =200

5.Set the constant voltage (CV) point to 56V.

CANID	DLC(data length)	Command Code	Parameters
0xC0100	0x04	0xB100	0x3002

Command code: 0x00B1(CHURVE_CV)

Data: 56V → 560 → 0x0230 → 0x30(Lo) + 0x02(Hi)

NOTE: Conversion factor for CURVE_CV is 0.1, so $\frac{56V}{F=0.1}$ =560

6.Before connecting to the batteries, it is recommended to review all of the settings and parameters using the appropriate commands. In the event that they do not meet your requirements, you may rewrite them as needed.

EX: Read CURVE_CV to check whether CV level or Vboost was set to a proper level.

Read CURVE_CV

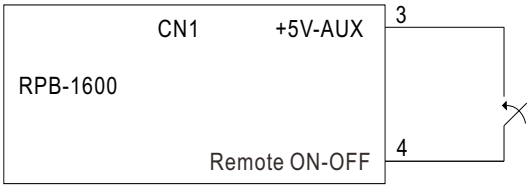
CANID	DLC(data length)	Command Code
0xC0100	0x04	0xB100

The unit returns data below

CANID	DLC(data length)	Command Code	Parameters
0xC0100	0x04	0xB100	0x3002

Data: 0x02(Lo) + 0x30(Hi) → 0x0230 → 560 = 56V。

7.Finally, short circuit remote ON-OFF (PIN4) and +5-AUX (PIN3) pins of the CN1 connector on the charger to remote on it to charge the batteries.



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.

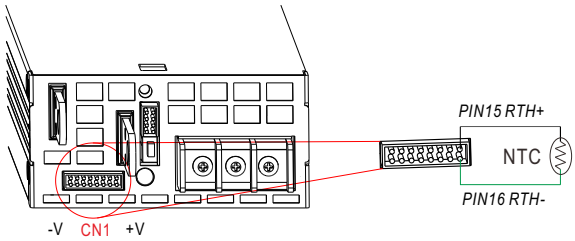
◎The efficiency will be lower and the output current should be reduced according to the Derating Curve when the unit is applied with an input voltage below AC180V.

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

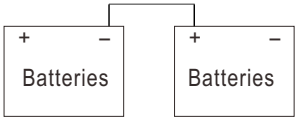
Note:1.Using battery capacity larger than the suggested value will not lead to damage of the battery. The main drawback is it may take longer to fully charge the battery.

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

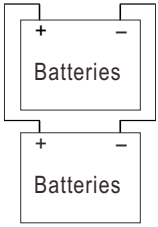
1.Batteries in series

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.



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.



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.

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