

DBU-3200

User's Manual



DBU-3200 Instruction Manual

Index

| | |
|---|----|
| 0.Product Description | 1 |
| 1.Notes on Operation..... | 1 |
| 2.Mechanical Design and Installation Procedure..... | 1 |
| 3.Derating Curve | 2 |
| 3.1 Charging Current vs Temperature..... | 2 |
| 3.2 Charging Current vs Input Voltage..... | 2 |
| 4.Pin Assignment..... | 2 |
| 5.LED Indication..... | 3 |
| 6.Explanation of Operation Logic | 3 |
| 7.Charge Curve..... | 4 |
| 8.Communication Protocol | 5 |
| 8.1 PMBus Addressing and CAN ID setting | 5 |
| 8.2 PMBus Communication Interface | 6 |
| 8.3 CANBus Communication Interface..... | 16 |
| 9.Function Description..... | 28 |
| 9.1 Input Voltage | 28 |
| 9.2 Power Factor Correction(PFC)..... | 28 |
| 9.3 Temperature Compensation | 28 |
| 10.Wiring for Battery | 28 |
| 11.Suggested Battery Capacity..... | 29 |
| 12.Series and Parallel Connection..... | 29 |
| 13.Troubleshooting..... | 29 |

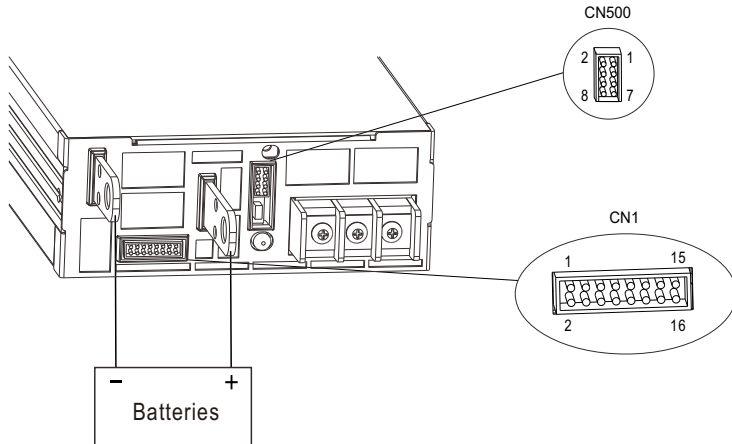
0. Product Description

DBU-3200 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, DBU-3200 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 DBU-3200. 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

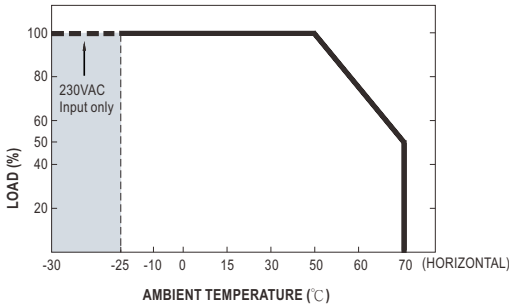
Figure2.1 Front panel

Installation Procedure:

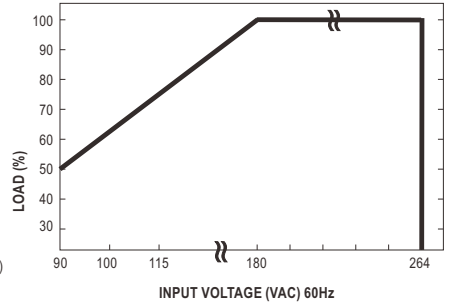
Please make sure the charger is OFF before connecting the battery to the output terminal. Choose a cable with suitable wire gauge according to the charging current to connect between the charger and the battery. Battery polarity must be connected correctly: Terminal(+) to Battery(+); Terminal(-) to Battery(-),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

3. Derating Curve

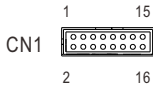
3.1 Charging current vs Temperature



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 <i>Remote ON/OFF</i> 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 | DC-OK | High (3.5 ~ 5.5V) : When the $V_{out} \leq 16V/32V \pm 1V$. Low (-0.5 ~ 0.5V) : When $V_{out} \geq 16V/32V \pm 1V$. 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 works normally. 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.




| 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. It is for local sense; and certain function reference; it cannot be connected directly to the load. |
| 7 | NC | For standard model: None. |
| | SDA | For PMBus model: Serial Data used in the PMBus interface. (Note) |
| | CANH | For CANBus model: Data line used in CANBus interface. (Note) |
| 8 | NC | For standard model: None. |
| | SCL | For PMBus model: Serial Clock used in the PMBus interface. (Note) |
| | CANL | For CANBus model: Data line used in CANBus interface. (Note) |

Note: Isolated signal, referenced to GND-AUX.

SW1

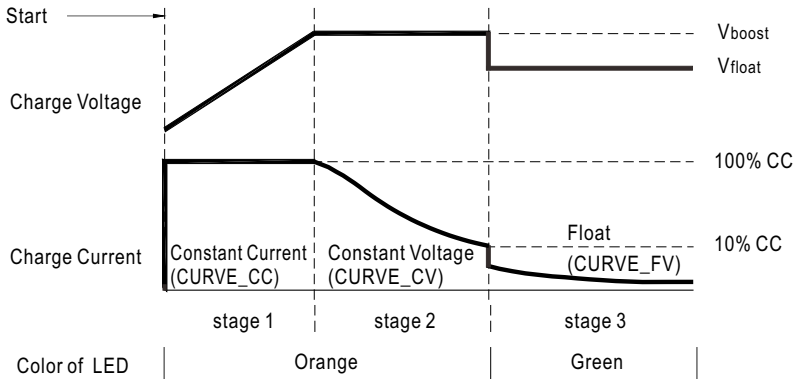
| Pin No. | Function | Description |
|---------|---------------------|--|
| 1,2 | Terminal resistance | SW1 is the selector of terminal resistor that is designed for DA/DB signals and parallel control function. |

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), 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 | DBU-3200-24 | DBU-3200-48 |
|----------------------|-------------|-------------|
| CONSTANT CURRENT | 110A | 55A |
| BOOST CHARGE VOLTAGE | 28.8V | 57.6V |
| FLOAT CHARGE VOLTAGE | 27.6V | 55.2V |

Figure 6.1 Charge Curve

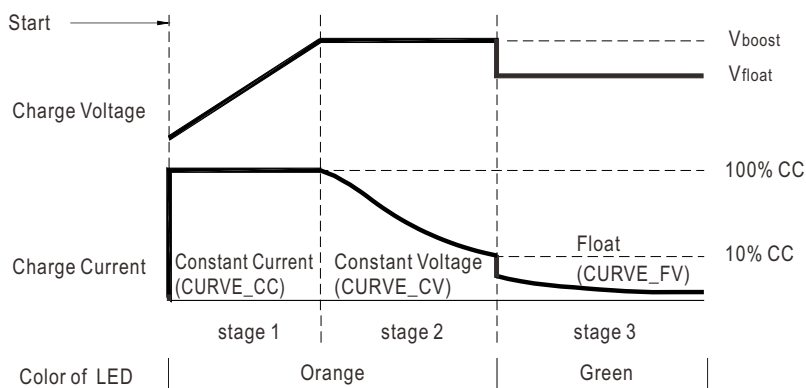
Explanation for 3 stage charge curve

- (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 Curveve

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) |
|-------|---------------------------------|--------|--------|-------------|
| 24V | Default, programmable | 28.8 | 27.6 | 110A |
| | #1 Pre-defined, gel batter | 28 | 27.2 | |
| | #2 Pre-defined, flooded battery | 28.4 | 26.8 | |
| | #3 Pre-defined, AGM battery | 29 | 27 | |
| 48V | Default, programmable | 57.6 | 55.2 | 55A |
| | #1 Pre-defined, gel batter | 56 | 54.4 | |
| | #2 Pre-defined, flooded battery | 56.8 | 53.6 | |
| | #3 Pre-defined, AGM battery | 58 | 54 | |

8.Communication Protocol

Users can use three different methods to control outputs of DBU-3200. 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 DBU-3200 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 DBU-3200-24 as an example, command OPERATION becomes ON, Vo and Io change to 24V and 110A.

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 DBU-3200 unit should have their unique and own device address or ID 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 | DBU-3200 to Controller Message ID |
| 0xC01XX | Controller to DBU-3200 Message ID |
| 0xC01FF | Controller broadcasts to DBU-3200 |

XX means the CAN ID of DBU-3200

A0-A2 allows users to designate an address or ID for the DBU-3200 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)), DBU-3200 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/ID | | |
|------------|-------------------|----|----|
| | 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. Constant voltage level can be set by Command CURVE_CV (PM:B1h; CAN: 0x00B1); Float voltage level 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 of 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 DBU-3200 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 still 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

- ⊙ DBU-3200 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 DBU-3200 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 input voltage status reporting |
| 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 | Fan 1 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 |
|--------------|---------------------|------------------|-----------------|---|
| 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 |

Valid when charging according to charge curve (D0=0)

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/°C/cell (default)

10 = -4 mV/°C/cell

11 = -5 mV/°C/cell

Bit 6 STGS : 2/3 stage charge setting

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

1 = 2 stage charge (only CURVE_CV)

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 FVTOE : 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 FVTOF : 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 remote off/on again or 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 | 24V | 0 ~ 30V | ±0.36V |
| | 48V | 0 ~ 60V | ±0.48V |
| READ_IOUT (Note. 1) | 24V | 0 ~ 160A | ±2.5A |
| | 48V | 0 ~ 80A | ±1.34A |
| 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) | 24V | 24V | N/A | 24V |
| | 48V | 48V | N/A | 48V |
| VOUT_TRIM (Note. 2) | 24V | -6 ~ 6V | ±0.36V | 0V |
| | 48V | -12 ~ 12V | ±0.48V | 0V |
| CURVE_CV (Note. 3) | 24V | 18 ~ 30V | ±0.36V | 28.8V |
| | 48V | 36 ~ 60V | ±0.48V | 57.6V |
| CURVE_FV (Note. 3) | 24V | 18 ~ VBST | ±0.36V | 27.6V |
| | 48V | 36 ~ VBST | ±0.48V | 55.2V |
| IOUT_OC_FAULT_LIMIT CURVE_CC | 24V | 22 ~ 110A | ±2.5A | 110A |
| | 48V | 11 ~ 55A | ±1.34A | 55A |
| CURVE_TC | 24V | 5.5 ~ 33A | ±2.5A | 10A |
| | 48V | 3 ~ 16.5A | ±1.34A | 5.5A |
| 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 |
|-------|--------------------------|
| 24V | 5.3A±1A |
| 48V | 2.7A±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 DBU-3200-24 as an example, to get a 18V output, please set value of VOUT_TRIM to -6V. Adjustable voltage range for each model is shown as below:

| Model | Adjustable voltage range |
|-------|--------------------------|
| 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.

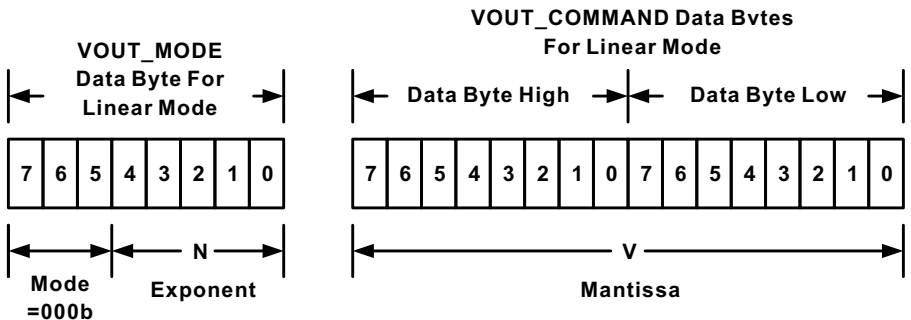
Notes on PMBus

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:

$$\text{Voltage} = V \cdot 2^N$$

Where:

Voltage is the parameter of interest in volts;

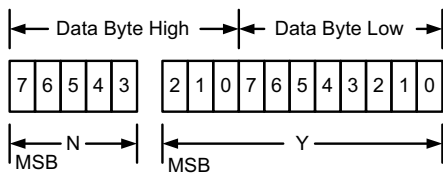
V is a 16 bit unsigned binary integer; and

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

EX: V_{o_real} (actual output voltage) = $V \times 2^N$, V is from READ_VOUT. N If VOUT_MODE = 0x17, meaning N is -9. READ_VOUT is 0x3000 12288, then $V_{o_real} = 12288 \times 2^{-9} = 24.0V$.

(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.

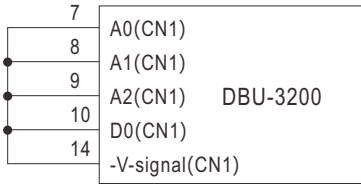
Devices that use the Linear format must accept and be able to process any value of N.

EX: I_{o_real} (actual output current) = $Y \times 2^N$, Y is from READ_IOUT. N If READ_IOUT is 0xF188h, meaning N is -2 and Y is 0x0188. Y is 0x0188 \rightarrow 392, then $I_{o_real} = 392 \times 2^{-2} = 98.0A$.

Communication Example - Practical Operation of Charger Mode

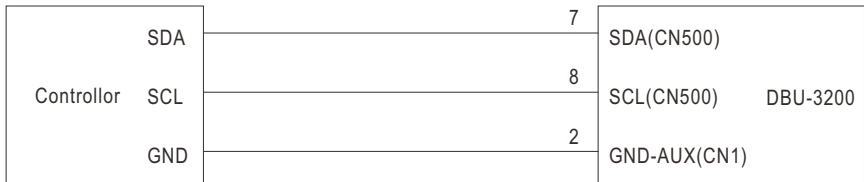
The following steps will describe how to set the DBU-3200-48 to charger mode and adjust its curve for a 2-stage charging process, with a constant current (CC) of 30A and a constant voltage (CV) of 56V.

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 DBU-3200 is connected to AC. First 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 30A.

| Address(7 bit) | Operation | Command Code | Data |
|----------------|-----------|--------------|------------|
| 0x40 | Write | 0xB0 | 0x78, 0xF0 |

Command code: 0xB0(CURVE_CC)

Data: 30A → 0x78(Lo) + 0xF0(Hi)

NOTE: CURVE_CC 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 (CURVE_CV)

Data: 56V → 0x00(Lo) + 0x70(Hi)

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

Read CURVE_CV

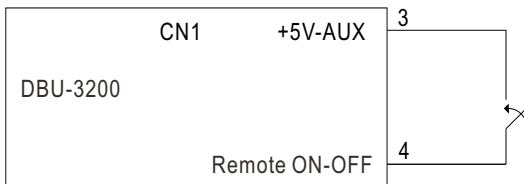
| Address(7 bit) | Operation | Command Code |
|----------------|-----------|--------------|
| 0x40 | Read | 0xB1 |

The unit returns data below

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

Data: 0x00(Lo) + 0x70(Hi) → 0x7000 → $28672 \times 2^{-3} = 56V$ °

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



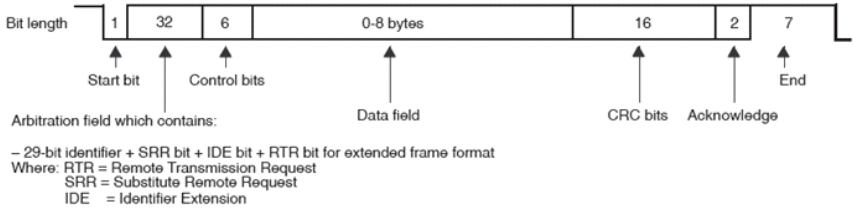
8.3 CANBus Communication Interface

⊙ 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.

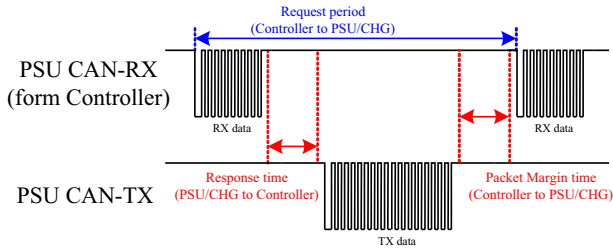


⊙ Communication Timing

Min. request period (Controller to DBU-3200): 50mSec °

Max. response time (DBU-3200 to Controller): 12.5mSec °

Min. packet margin time (Controller to DBU-3200): 12.5mSec °



⊙ Data Field Format

Controller to DBU-3200

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 |

DBU-3200 to Controller

Response:

Data filed bytes



NOTE: DBU-3200 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 |

Valid when charging according to charge curve(D0=0)

| 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/W | 2 | Constant current setting of charge curve (format: value, F=0.1) |
| 0x00B1 | CURVE_CV | R/W | 2 | Constant voltage setting of charge curve (format: value, F=0.1) |
| 0x00B2 | CURVE_FV | R/W | 2 | Floating voltage setting of charge curve (format: value, F=0.1) |
| 0x00B3 | CURVE_TC | R/W | 2 | Taper current setting of charge curve (format: value, F=0.1) |
| 0x00B4 | CURVE_CONFIG | R/W | 2 | Configuration setting of charge curve |
| 0x00B5 | CURVE_CC_TIMEOUT | R/W | 2 | CC charge timeout setting of charging curve (format: value, F=1) |
| 0x00B6 | CURVE_CV_TIMEOUT | R/W | 2 | CV charge timeout setting of charging curve (format: value, F=1) |
| 0x00B7 | CURVE_FV_TIMEOUT | R/W | 2 | FV charge timeout setting of charging curve (format: value, F=1) |
| 0x00B8 | CHG_STATUS | R | 2 | Charging status reporting |

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 DBU-3200-48 → MFR_MODEL_B0B5 is DBU-32 ; 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/°C/cell (default)

10 = -4 mV/°C/cell

11 = -5 mV/°C/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 FVTOE : 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 FVTOF : 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 | 24V | 0~30V | ±0.36V |
| | 48V | 0~60V | ±0.48V |
| READ_IOUT | 24V | 0~160A | ±5.32A |
| | 48V | 0~80A | ±2.68A |
| READ_TEMPERATURE_1 | ALL | -40~100°C | ±5°C |
| 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 | 24V | 18~30V | $\pm 0.36V$ | 24V |
| | 48V | 36~60V | $\pm 0.48V$ | 48V |
| IOUT_SET | 24V | 22~110A | $\pm 5.32A$ | 110A |
| | 48V | 11~55A | $\pm 2.68A$ | 55A |
| CURVE_CC | 24V | 22~110A | $\pm 5.32A$ | 110A |
| | 48V | 11~55A | $\pm 2.68A$ | 55A |
| CURVE_CV | 24V | 18~30V | $\pm 0.36V$ | 28.8V |
| | 48V | 36~60V | $\pm 0.48V$ | 57.6V |
| CURVE_FV | 24V | 18~VBST | $\pm 0.36V$ | 27.6V |
| | 48V | 36~VBST | $\pm 0.48V$ | 55.2V |
| CURVE_TC | 24V | 5.5~33A | $\pm 1.34A$ | 11A |
| | 48V | 3~16.5A | $\pm 0.67A$ | 5.5A |
| 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 |
|-------|--------------------------|
| 24V | 5.3A±1A |
| 48V | 2.7A±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 command

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

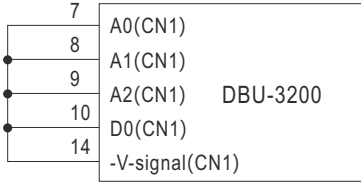
| CAN ID | DLC (data length) | Command code | Parameters |
|---------|-------------------|--------------|------------|
| 0xC0000 | 0x3 | 0x0000 | 0x01 |

The unit with address "00" returns data below

Practical Operation of Charger Mode

The following steps will describe how to set the DBU-3200-48 to charger mode and adjust its curve for a 2-stage charging process, with a constant current (CC) of 30A and a constant voltage (CV) of 56V

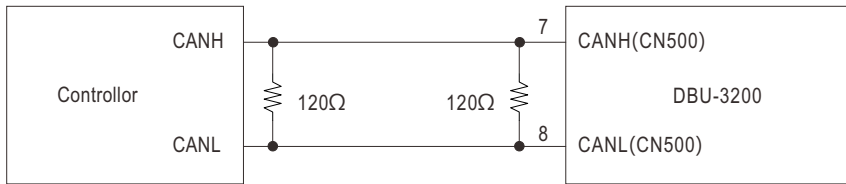
1. Set the address of the charger to "0" and set it to charge mode.



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 increase 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 DBU-3200 is connected to AC. First 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 30A

| CANID | DLC(data length) | Command Code | Parameters |
|---------|------------------|--------------|------------|
| 0xC0100 | 0x04 | 0xB000 | 0x2C01 |

Command code: 0x00B0(CHURVE_CC)

Data: 30A → 300 → 0x012C → 0x2C(Lo) + 0x01(Hi)

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

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

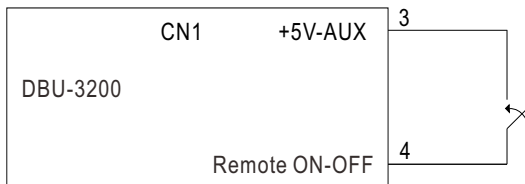
| CANID | DLC(data length) | Command Code |
|---------|------------------|--------------|
| 0xC0100 | 0x04 | 0xB100 |

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

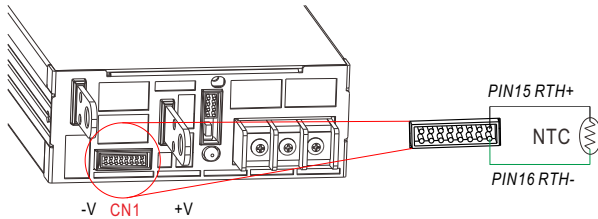
- ⊙ The input voltage range is AC90~264V or DC127~370V.
- ⊙ The provided input voltage must fall within the specified range; otherwise, the unit may be non-functional. Also the active PFC circuit may fail or get damaged.
- ⊙ The efficiency will be lower and the output current should be reduced according 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 gauge based on rated charging current. Refer to the following table for minimum wire gauge. It is highly recommended using RED wire for (+) connection and BLACK wire for (-) connection

| AWG | Cross section(mm ²) | Maximum current(A) UL1015(600V 105°C) |
|-----|---------------------------------|--|
| 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 |
|-------------|------------------|
| DPU-3200-24 | 330-1000AH |
| DPU-3200-48 | 180-550AH |

Note: 1. Using battery capacity larger than the suggested value will not lead to damage of the battery.

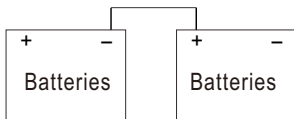
The main drawback is it may take longer to fully charge the battery.

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

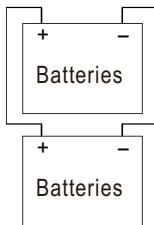
1. Batteries in series

Voltage can be doubled when 2 batteries are connected in series. However, the capacity (Ah) will remain the same. For example, 2 x 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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