

Byte 1 of the frame (0xE6 – header) is not involved to the CRC calculation.

At the function start inData is byte 2 of the frame – address, seed = 0. The function result is seed1=CRC1 from one byte. The second iteration – at the function start seed=seed1 and inData=byte 3 (command). The function result is seed2=CRC2 – from two bytes.

If CRC is calculating for the “Status scan” (0x50) function, the final CRC=CRC2, calculation completed.

For other commands CRC should be calculated with one more iteration: at the function start seed=seed2 and inData=byte 4 (data). The function result is seed3=CRC3 – from three bytes – calculation completed, CRC=CRC3.

## 7. Communication address

Every controller to use communication interface should have own unique address. The maximum number of controllers in the network is 255. At the moment the power is on, the program in the controller checks if there is valid address (0x00 to 0xFE) in the memory. If there is such valid address in the memory, controller turns on the green LED, if there is not valid address, the green LED is turned off.

The default address of controller is 0xFF. It should be changed to any other valid address in range 0x0 to 0xFE to provide control via communication interface.

### 7.1 Set new communication address

The new communication address is set by command 0xA0 (see section 6 and table 5). Just controllers with default address 0xFF in standby mode accept this command.

To change the default address to a valid one, the command “0xA0” with address 0xFF should be sent to the controllers. All controllers in the network with default communication address 0xFF start LED flashing (0.2sec period).

The operator should press the “START/STOP” button at the controller that should receive the new address. The green LED of the controller with new address stops flashing and turns on. At the moment the controller with new address sends the reply as a confirmation of accepting and saving new address. Please, see section 6 and table 5 for details. To cancel setting new address the command 0xA1 should be sent with address 0xFF. The flashing LED at all controllers with default address 0xFF will turn off.

### 7.2 Reset communication address to default 0xFF

To reset a valid communication address to default, please, execute following:

As power is off press and hold the “START/STOP” button, then turn the power on, after that release the “START/STOP” button. After that at one time both green and red LEDs turns on for a short time, and then turn off. The address reset completed and set to default value 0xFF.

## 8. Delivery in complete sets

The brush motor controller BMSD  
Manual BMSD.002

1 pcs.  
1 pcs.

## 9. Warranty

Any repair or modifications are performed by the manufacturer or an authorized company.

The manufacturer guarantees the failure-free operation of the controller for 12 months since date of sale when the operation conditions are satisfied – section 2.

The manufacturer sales department address: Smart Motor Devices OÜ,  
Tallinn Science Park Tehnopol, Mäealuse st. 4, Tallinn 12618, Estonia,  
Phone: + 372 6559914,  
e-mail: mail@stepmotor.biz  
url: http://www.stepmotor.biz

Date of sale:



**SMART MOTOR DEVICES**

<http://www.stepmotor.biz>

## **DC BRUSH MOTOR CONTROLLER BMSD**

*Manual*  
BMSD.002

**2016**

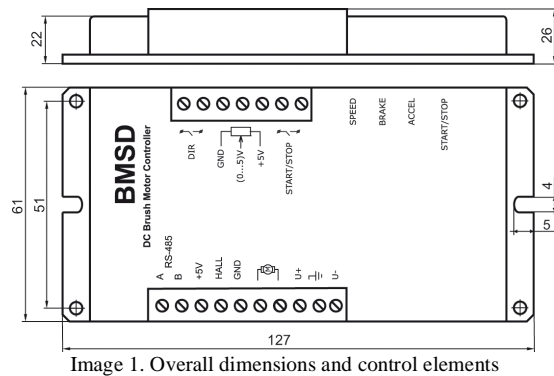
## 1. Product designation

Brush motor controller BMSD is an electronic device to operate and control DC brush motors with or without an encoder. Motor operation parameters are set either by commands via communication interface RS-485 or via controller's inputs. Controller is designed to control speed, direction, smooth start and stop of DC brush motors (up to 12A).

## 2. Technical characteristic

Table 1

Power supply voltage, VDC	12 – 24
Max. operation motor curren, A	12
Current protection, A	16
Max. motor voltage	$0,98 * V_{sup}$
Min. nonzero voltage	$0,05 * V_{sup}$
Min. acceleration and deceleration setting, V/sec	$V_{sup}/8$
Max. acceleration and deceleration setting, V/sec	$3V_{sup}$
External speed adjusting – voltage signal, V	0 - 5
External speed adjusting – external potentiometer resistance, kOhm	1-10
Encoder power supply output, VDC	$5 \pm 0,2$
Max. current of encoder sensor, mA	50
Output of encoder sensor	open collector
Min. value of high-level signal from encoder, V	3,5
Max. value of low-level signal from encoder, V	0,8
Min. value of pulse duration of encoder sensor, ms	10
Max. motor stabilized speed, RPM	15000
Input signals "DIRECTION" and "START/STOP" parameters	
- max. resistance, kOm	2
- max. current:, A	0,5
- signal – clean contact	
Overall dimensions, mm	127 x 61 x 26



### Environmental Conditions:

Ambient Temperature: 0...+50°C  
 Humidity: 90% RH or less upon condition +25°C  
 Condensation and freezing: none  
 Pressure: 650...800 mm of mercury

As the reply sent, the controller sets the revolution counter to zero and start counting again.

For other command the controller sends 5 bytes reply except of command "Cancel setting address" (0xA1). The reply frame has 5 bytes (1 byte communication address, 1 byte command code, 2 bytes data and 1 byte CRC). Commands and reply list are introduced in the table 5.

Table 5 – command list

Command			Reply		
Function	Code	Data	Code	Data 1	Data 2
Set new communication address (accepted just by controllers with address 0xFF)	0xA0	New address 0 – 0xFE	0xA0 (after accepting new address, please, see section 7)	New address 0 – 0xFE	0x00
Cancel setting address (accepted just by controllers with address 0xFF)	0xA1	Any	No answer		
Encoder pulses per revolution	0xA2	Usual 3, 0 – 0xFF	0xA2	0x00	Specified pulses/rev
Set speed, rev/sec	0xA3	0 – 250	0xA3	0x00	Specified speed
Set acceleration	0xA5	1 - 24	0xA5	0x00	Specified acceleration
Set deceleration	0xA6	1 - 24	0xA6	0x00	Specified deceleration
Set direction	0xA7	0 or 1	0xA7	0x00	Specified direction
Status scan	0x50	Don't send this byte for 0x50 command	Status + Counter most significant 4 bits (image 7)	Counter least significant 8 bits	Actual speed
Start motion	0x51	Any	0x51	0x00	Any
Stop motion, go to standby mode	0x52	Any	0x52	0x00	Any

### 6.3. CRC – check sum control calculation.

The final byte of every command and reply frame is CRC. The CRC calculation algorithm is follow:

```

unsigned char OWI_ComputeCRC8(unsigned char inData, unsigned char seed)
{
    unsigned char bitsLeft;
    unsigned char temp;
    for (bitsLeft = 8; bitsLeft > 0; bitsLeft--)
    {
        temp = ((seed ^ inData) & 0x01);
        if (temp == 0)
        {
            seed >>= 1;
        }
        else
        {
            seed ^= 0x18;
            seed >>= 1;
            seed |= 0x80;
        }
        inData >>= 1;
    }
    return seed;
}
    
```

### 3. The motor speed depends on speed adjusting signal.

- **Internal potentiometer** - The minimum speed corresponds to the left position of the potentiometer "SPEED". The maximum speed corresponds to the right position of the potentiometer "SPEED".

- **External potentiometer** - The minimum resistance of the potentiometer corresponds to the maximum motor speed. Increasing resistance leads to reducing motor speed. We recommend using 10KOhm potentiometer.

- **Analog signal 0-5VDC** - the signal source should be connected according to the section 4. The motor speed is proportional to voltage signal.

The motor voltage is  $0,05 * V_{sup}$  (5% of supply voltage) at the minimum speed. The motor can completely stop at the minimum speed if the motor model doesn't accept the voltage. The motor voltage is  $0,98 * V_{sup}$  (98% of supply voltage) at the maximum speed.

**4. The motor acceleration** depends on the "ACCEL" potentiometer position. The maximum acceleration (minimum acceleration time) corresponds to the end left position -  $(3V_{sup})$  V/sec. The minimum acceleration (maximum acceleration time) corresponds to the end right position -  $(3V_{sup}/8)$  V/sec.

**5. The motor deceleration** depends on the "BRAKE" potentiometer position. The maximum deceleration (minimum deceleration time) corresponds to the end left position -  $(3V_{sup})$  V/sec. The minimum acceleration (maximum acceleration time) corresponds to the end right position -  $(3V_{sup}/8)$  V/sec.

## 6. RS-485 data communications protocol

The control via interface is performed as command setting and executing. To control from a computer a converter is required (doesn't the part of the set), communication via virtual RS-232.

### 6.1. Port settings

Table 3

Baud rate (Bitrate)	9600 Bps
Bits in byte (Data)	8
Parity	No
Stop Bits	1

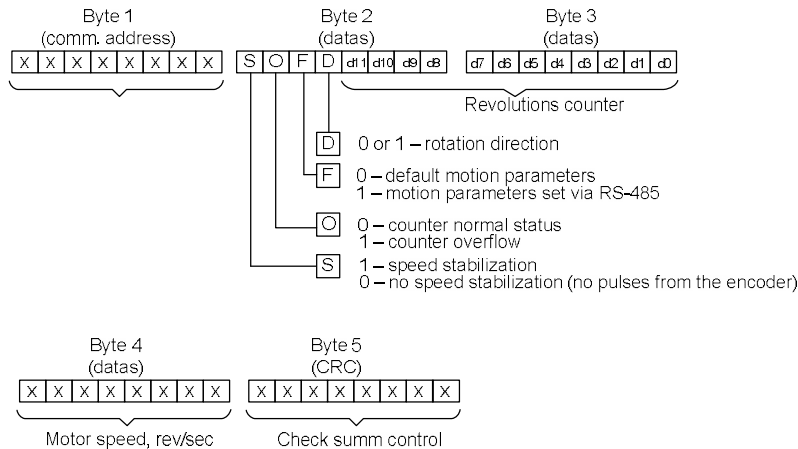
### 6.2. Commands frame format

Every command consists of 4 or 5 bytes and has the following frame format: Table 4

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Header	Controller communication address	Command code	Data*	CRC
0xE6	0 - 0xFF	See table 5	0 - 0xFF	See the section 6.3

For the command "status scan" (byte 3 = 0x50) - Byte 4 is omitted.

As a reply to the command "status scan" (byte 3 = 0x50) the controller in time less 50ms send current data about speed, direction, speed stabilization, encoder pulses and revolutions counter. The reply frame has 5 bytes (1 byte header, 3 bytes data and 1 byte CRC), form is on the image 7.



Img. 7 - status scan command reply

## 3. Construction and control elements

BMSD is designed as a circuit plate with electronics elements, installed on a plate and covered with a metal case. Besides electronic components, there are indicating and control elements, connection terminals and connectors on the board:

- terminal screws for power supply, brush motor windings and encoder lines, and control circuit connection;
- "START/STOP" button;
- Internal preset potentiometers to adjust speed "SPEED", acceleration "ACCEL" and deceleration "BRAKE";
- RS-485 terminals "PE", "A" and "B";
- LED for indication of the controller status.

**Control inputs:** To adjust motor speed internal potentiometer "SPEED" and analog input "(0..5V)" are provided. To adjust acceleration and deceleration internal potentiometers "ACCEL" and "BRAKE" are provided. To change the direction input "REVERSE" is intended. To start or stop motion button and input "START/STOP" are intended.

## 4. Assembly and connection.

Please, learn this manual carefully before connection and assembly.

Please, wire just when power is off. Do not attempt to change wiring while the power is ON.

Please, provide a reliable contact in connection terminals. During wiring, please, observe the polarity and wire management.

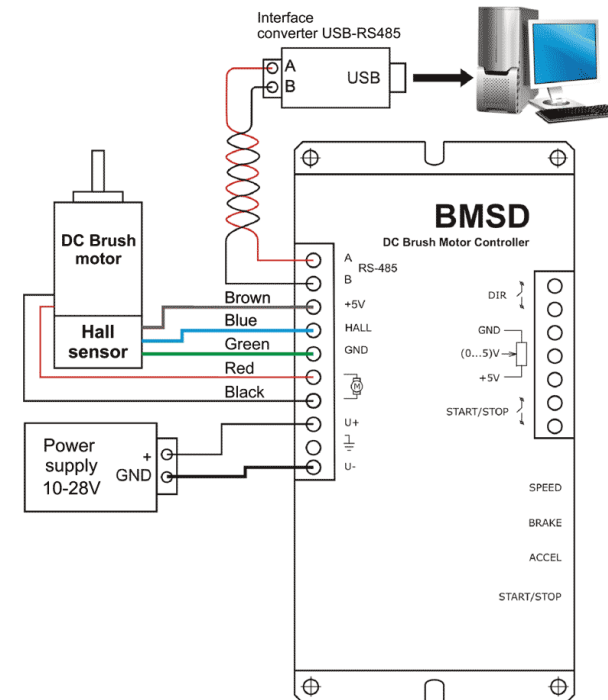


Image 2 - connection example

1. Connect brush motor to the controller according to the scheme - image 2. Motor phases should be connected to the contacts marked "A", "B". Signal wire of hall encoder lines should be connected to the contact "HALL". GND of Hall encoder connects to the contact "GND", supply voltage for Hall encoder connects to the contact "+5V". If there is multichannel encoder, use only single channel.

2. Connect power supply to the contacts U+ and U- according to the specification of the power supply unit.  $\frac{1}{2}$  is the electric ground. Input voltage range 10-28VDC is allowed. Connection wires should be suitable for the motor current. At the maximum speed adjusting 0.98 of power supply voltage will be applied to the motor.

3. If needed make control signal wiring according to the image 3.

- external signal "START/STOP" – clean contact;
- external signal "DIR" – clean contact;
- external voltage source 0-5VDC or external potentiometer to provide analog speed control.

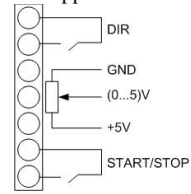
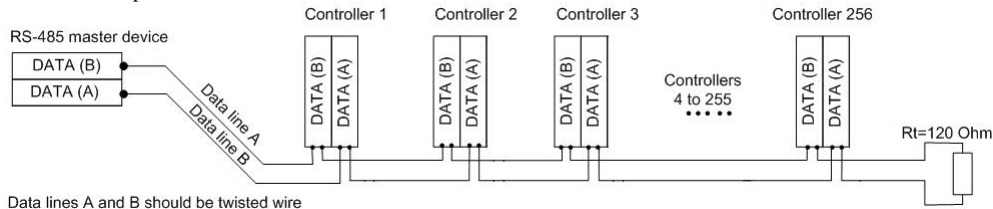


Image 3 – inputs wiring

4. If needed make RS-485 interface wiring and computer connection according to the images 4 and 5.

Connect 2-wire cable to inputs A and B of the controller: data line A – to A input, data B – to B input. It is recommended to use twisted pair for connection A and B data lines. The terminal resistor  $R_t=120$  Ohm is recommended to be used in case of long length of interface cable and in case of interferences.

Up to 256 controllers can be connected serial into the RS-485 network. Actually, the maximum number of slaves in the network depends on the master device.



Data lines A and B should be twisted wire

Image 5 – common interface connection

To connect BMSD controller to a computer interface converter is needed. The most popular are USB/RS-485 or RS-232/RS-485 converters, which allow control BMSD controller by virtual RS-232.

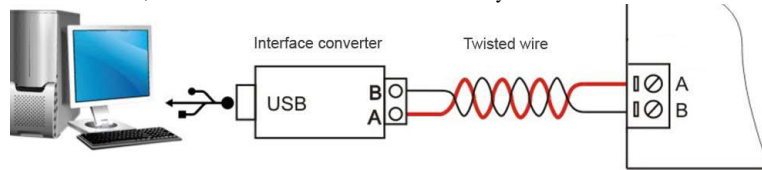


Image 6 – computer connection

## 5. Operation

Controller BMSD can operate as a standalone unit or be controlled via RS-485 communication interface.

Controller modes are performed in the table 2 below.

### 5.1. Operation modes

Table 2.

No	Mode	Enter to the mode	Exit	LED indication
1	Standby	<ul style="list-style-type: none"> <li>As power is on;</li> <li>As button "START/STOP" pressed or input activated (from modes 2-6);</li> <li>By command via RS-485 (from modes 2-6).</li> </ul>		<ul style="list-style-type: none"> <li>Green non-flashing LED light - for all communication address except 0xFF.</li> <li>Green LED of the controller with 0xFF communication address doesn't lit</li> </ul>
2	Setting communication address	Command via RS-485 (from mode 1)	Press a button – exit to standby mode (mode 1)	LED flashing: 0.2s on – 0.2s off 

3	Manual control without speed stabilization	As button "START/STOP" pressed or input activated (from mode 1)	<ul style="list-style-type: none"> <li>Press a button – exit to a standby mode.</li> <li>Hall sensor pulses – exit to mode 4</li> </ul>	LED flashing: 0.1s OFF – 0.9s ON 
4	Manual control with speed stabilization	Hall sensor pulses occurrence from mode 3	<ul style="list-style-type: none"> <li>As button "START/STOP" pressed or input activated – exit to standby mode.</li> <li>Hall sensor pulses absence – exit to mode 3</li> </ul>	LED flashing: 0.1s off – 0.1s on – 0.1s off – 0.7s on 
5	Control by computer without speed stabilization	Command via RS-485	<ul style="list-style-type: none"> <li>RS-485 command – exit to a standby mode.</li> <li>Hall sensor pulses – exit to mode 6</li> </ul>	LED flashing: 0.1s OFF – 0.9s ON 
6	Control by computer with speed stabilization	Hall sensor pulses occurrence from mode 5	<ul style="list-style-type: none"> <li>RS-485 command – exit to standby mode.</li> <li>Hall sensor pulses absence – exit to mode 5</li> </ul>	LED flashing: 0.1s off – 0.1s on – 0.1s off – 0.7s on 
7	Emergency	Overcurrent more than 1 sec	Power Off, and and power On.	LED flashing: 0.2s on – 0.2s off 

### 5.2. Before starting:

- 1) Make sure the power supply is turned off. Please, wire just when power is off. Make wiring according section 4.
- 2) Chose the operation mode – see table 2.

If standalone operation mode chosen (mode 3 or 4), please, chose the speed adjusting method:

- Internal potentiometer - additional connection doesn't require.
- External potentiometer – connect potentiometer to the "SPEED" contacts "(0...5)V" and "+5V" – image 4. The internal potentiometer "SPEED" should be turned to the end right position. The minimum resistance of the potentiometer corresponds to the maximum motor speed. Increasing resistance leads to reducing motor speed.
- Analog signal 0-5VDC – connect the source of analog signal 0-5VDC to the "SPEED" contacts: "-" to the "GND" contact and "+" to the "(0...5)V" contact – image 3. The motor speed is proportional to the signal voltage.

If control via communication interface chosen, please, make communication wires according to the images 5 and 6.

- 3) If needed, connect control elements to the "START/STOP" and "REVERSE" contacts – image 3.

- 5) Turn on the power supply.

### 5.3. Motor control – standalone mode

**1. To start the motor** rotation press "START/STOP" button or activate "START/STOP" signal (clean contact). The LED indicator is blinking when the motor is running.

**2. To stop the motor** press "START/STOP" button or activate "START/STOP" signal (clean contact) when the motor is running.