

The operator should press the “START/STOP” button at the controller that should receive the new address. The 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 on press and hold the “START/STOP” and “REVERSE” buttons, then turn on for a short time “RESET” button; hold the “START/STOP” and “REVERSE” buttons for 10 sec till red LED turns on for a short time. The address reset completed and set to default value 0xFF.

#### **8. Software update**

It is possible to update software of the device independently. You don't need any special equipment, this can be done with the help of “Hyper Terminal” which comes with the Windows operating system and USB – RS485 interface converter.

Software with “Software update manual” is given to the client by request.

#### **9. Delivery in complete sets**

The brushless motor controller BLSD	1 pcs.
Manual BLSD.20.50.000	1 pcs.

#### **10. 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 BRUSHLESS MOTOR CONTROLLER BLSD-20/BLSD-50**

**With RS-485 interface**

**Manual**

**BLSD.20.50.000**

## 1. Product designation

Brushless controllers BLSD-20 and BLSD-50 are electronic devices to operate and control brushless synchronous 3-phase dc motors with Hall encoder. Motor operation parameters are set either by commands via communication interface RS-485 or via controller's inputs.

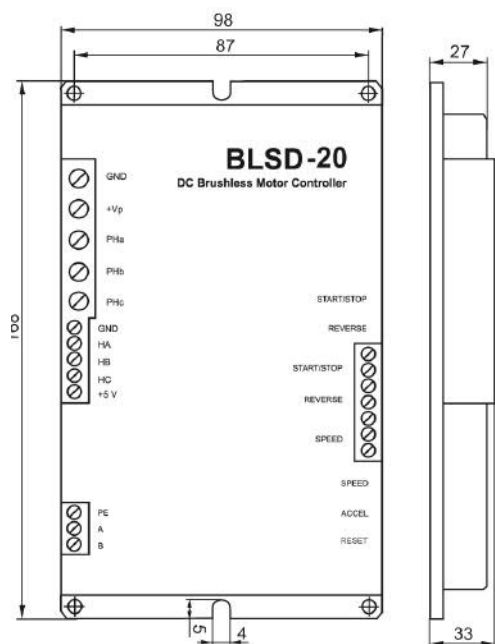
## 2. Technical characteristic

Controllers are designed to control speed, direction, smooth start and stop of brushless motors by commands via communication interface RS-485 or by input signals "START/STOP", "REVERSE", .analog "SPEED" and "ACCELERATION".

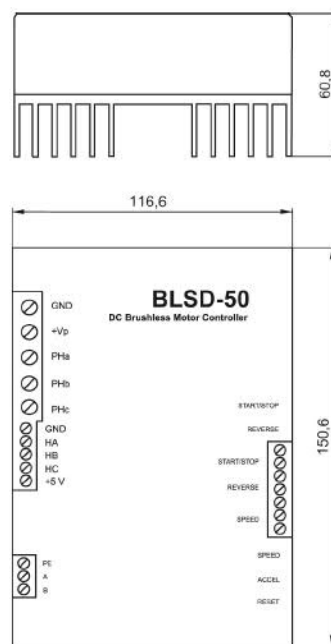
Table 1

Controller	BLSD-20	BLSD-50
Power supply voltage, VDC	24-48	
Maximum current, A	20	50
Acceleration/Deceleration time, s	1/3-8	

### Dimensions:



Img.1 – BLSD-20 dimensions



Img.2 – BLSD-50 dimensions

### Environmental Conditions:

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

## 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;
}
    
```

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

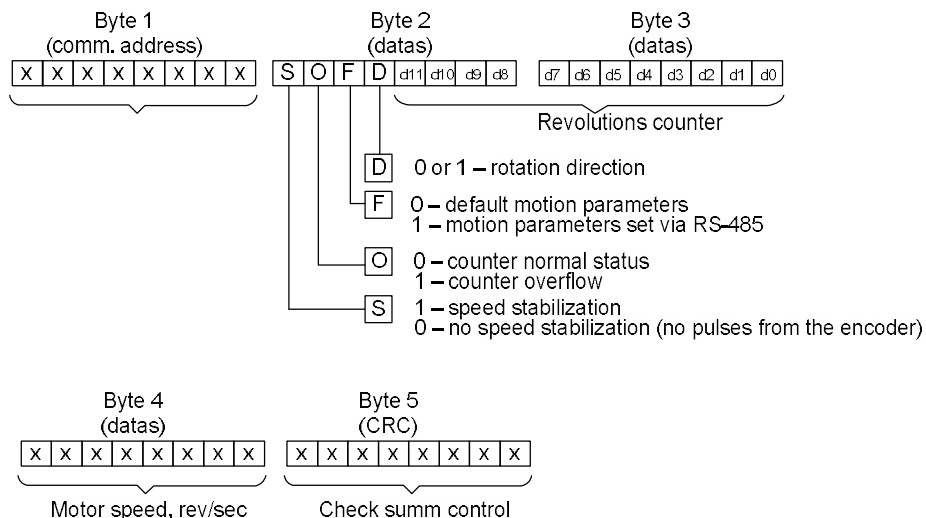
Every controller to use communication interface should have own unique address. The maximum number of controllers in the network is 255. At the moment the power is on, the program in the controller checks if there is valid address (0x00 to 0xFE) in the memory. If there is such valid address in the memory,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



Img. 7 – status scan command reply

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 rated speed, rev/sec	0xA4	0 – 250	0xA4	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

Command data is one byte only, so every data should be send as integer value. Please, mind resolution of data. For example, it is 1 rev/sec for speed command.

### 3. Construction and control elements

BLSD-20 and BLSD-50 are designed as circuit plate with electronics elements, installed on a plate (BLSD-20) or a heatsink (BLSD-50) 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, brushless motor windings and encoder lines, and control circuit connection;
- RS-485 terminals “PE” “A” and “B”. USB plug for a computer connection;
- Buttons “START/STOP”, “REVERSE” and “RESET”;
- Internal preset potentiometers to adjust speed “SPEED”, acceleration and deceleration “ACCEL”;
- LED for indication of the controller status.

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

**Control by commands via RS-485:** The control is realized by commands, transferred from a host controller or a computer.

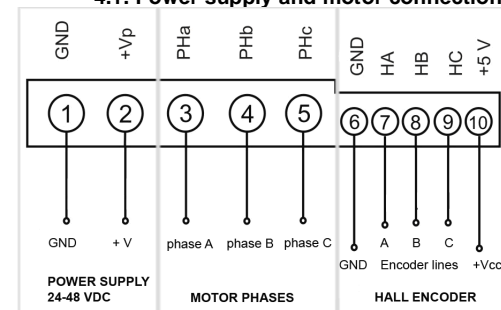
### 4. Assembly and connection.

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.

#### 4.1. Power supply and motor connection



Img. 3.

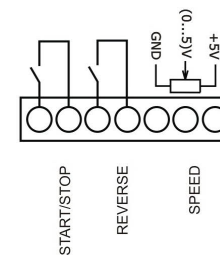
Connect brushless motor to the controller according to the scheme (image 3). Motor phases should be connected to the contacts 3 – 5 “PHa”, “PHb”, “PHc”. Hall encoder lines should be connected to the contacts 7 – 9 “HA”, “HB”, “HC”. GND of Hall encoder connects to the contact 6 “GND”, supply voltage for Hall encoder connects to the contact 10 “+5V”.

Connect power supply to the contacts 1 and 2 “GND” (“-”) and “+Vp” (“+”) according to the specification of the power supply unit. Input voltage range 24-48VDC is allowed. Connection wires should be suitable for the motor current.

#### 4.2. External control signals connection

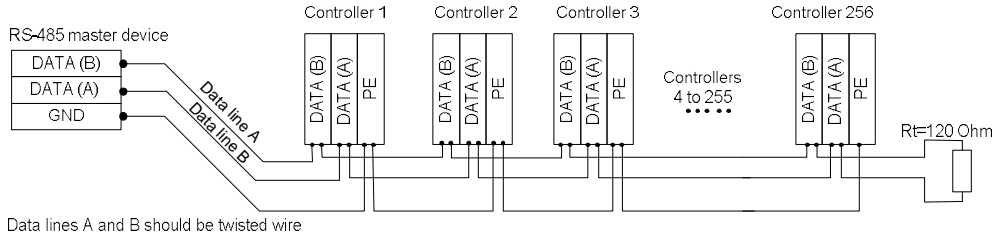
Make control signal wiring according to the image 4.

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



Img. 4

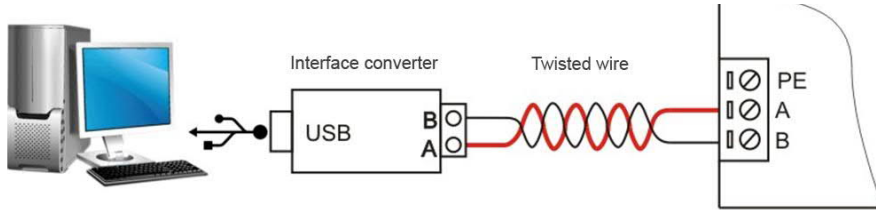
### 4.3. RS-485 communication interface connection



Data lines A and B should be twisted wire

Img.5 – common interface connection

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  $R_f=120$  Ohm is recommended to be used in case of long length of interface cable and in case of interferences. Grounding GND allows reducing interferences. If needed connect GND of master device to GND of interface part of the controller – input PE according to the scheme on the image 5. 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.



Img.6 – connection to a computer

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

### 5. Operation

Controller BLSD can operate as a standalone unit or be controlled via RS-485 communication interface. Controller modes are performed in the table 2 below:

No	Mode	Enter to the mode	LED indication
1	Standby	As power is on; As button “START/STOP” pressed or input activated (from modes 2, 3 or 4); By command via RS-485 (from modes 2, 3 or 4).	<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)	<p>LED flashing: 0.2s on – 0.2s off</p> <p>LED on</p> <p>LED off</p>

Table 2 (continue)

3	Standalone operation	As button “START/STOP” pressed or input activated (from modes 3 or 4)	<p>LED flashing: 0.1s off – 0.1s on – 0.1s off – 0.7s on</p> <p>LED on</p> <p>LED off</p>
4	Control via communication interface	Command via RS-485 (from modes 3 or 4)	

### 5.1. Before starting

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

If standalone operation mode chosen, please, chose the speed adjusting method:

- Internal potentiometer - additional connection doesn't required.
- 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 left 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 4. The motor speed is proportional to the signal voltage.

If control via communication interface chosen, please, make communication wires according to the section “4.3. RS-485 communication interface connection”.

- 3) If needed, connect control elements to the “START/STOP” and “REVERSE” contacts – image 4.
- 4) Make motor and power supply wiring according to the section 4.1.
- 5) Turn on the power supply.

### 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 - port settings:

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 – command frame format

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Header	Controller communication address	Command code	Datas*	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.

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

The reply frame has 5 bytes (1 byte header, 3 bytes data and 1 byte CRC), form is on the image 7.