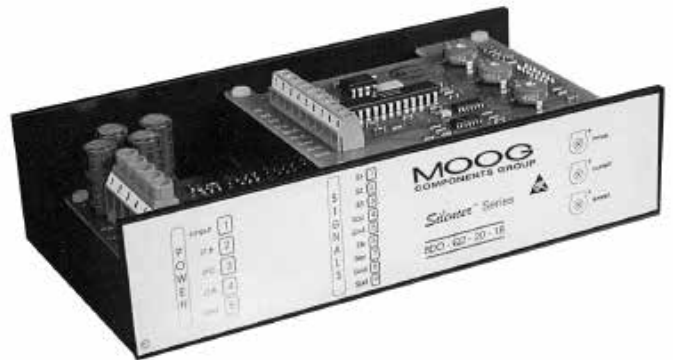


# *Silencer*<sup>®</sup> Series Brushless Controllers

***BDO-Q2-20-18 (20 V, 18 A); BDO-Q2-20-40 (20 V, 40 A)***  
***BDO-Q2-50-18 (50 V, 18 A); BDO-Q2-50-40 (50 V, 40 A)***  
*2-quadrant speed controller for brushless motors*



## ***Instruction Manual***

### **GENERAL**

- The BDO-Q2-Series controllers are 2-quadrant speed controllers for electronically commutating three-phase brushless motors with Hall sensors, which are arranged offset at 120 electrical degrees.
- The speed of the motor is preset by means of either an internal or an external potentiometer.
- The maximum constant current can be adjusted via an on-board potentiometer.
- The direction of rotation of the motor can be preset by means of the **Direction** control input. The controller output stage can be activated and deactivated by means of the **Disable** control input.
- The controller is safeguarded against heat overload by means of an internal thermal cutoff.
- The controller output stage has been constructed using POWER-MOSFET technology, resulting in very high efficiency.

**MOOG**  
COMPONENTS GROUP

## SPECIFICATIONS

<b>ELECTRICAL DATA</b>	<b>BDO-Q2-20-18</b>	<b>BDO-Q2-50-18</b>	<b>BDO-Q2-20-40</b>	<b>BDO-Q2-50-40</b>
Operating voltage <b>-+input and Gnd</b>	12 - 28 VDC	20 - 50 VDC	12 - 28 VDC	20 - 50 VDC
Residual voltage < 5 %				
Maximum constant current (adjustable)	18 A*	18 A*	40 A*	40 A*

\* At higher input voltages, additional heat-sinking may be required in order to achieve maximum current values.

### INPUTS

- Direction of rotation – **(REV)** open collector / TTL / CMOS / switch
- Disable output stage – **(DIS)** open collector / TTL / CMOS / switch

### TEMPERATURE RANGE

Storage -104 to 185°F (-40 to +85°C)  
 Operation -50 to 113°F (-10 to +45°C)

### MOISTURE RANGE

20 to 80% non-condensed

<b>MECHANICAL DATA</b>	<b>BDO-Q2-20-18</b>	<b>BDO-Q2-50-18</b>	<b>BDO-Q2-20-40</b>	<b>BDO-Q2-50-40</b>
Weight	12.91 oz (366 gm)	12.91 oz (366 gm)	13.76 oz (390 gm)	13.76 oz (390 gm)
Dimensions - (L x W x H) -	6.69 x 3.54 x 1.73 in (170 x 90 x 44 mm)			
Mounting -	4 x M4 with a distance between holes of 6.30 x 2.52 in (160 x 64 mm)			
Drill Diameter -	4.5 mm - (4) places - M4 screw			

### ASSEMBLY NOTE

Optimum heat dissipation is achieved by mounting the BDO-Q2-Series controller on a heat sink, and through the use of a thermal conduction paste.

For longer distances between the motor and the control unit, > 12 in (30 cm), shielded cables should be used for the sensor cable and the motor cable.

### SAFETY NOTE

Operating voltages exceeding the specified values, or reverse connection will destroy the controller and will void the product warranty.

Unauthorized opening and improper repairs will put the user in danger and will void the product warranty.

If the controller is brought from a cold environment into the operating environment, there can be condensation. Wait until the controller has reached the ambient temperature of the operating environment, and is absolutely dry before it is put into operation.

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## TERMINATION TABLE

Signal			Power		
Terminal #	Nomenclature	Description	Terminal #	Nomenclature	Description
1	S1	Hall Switch #1	1	Positive Input	Positive Supply Voltage
2	S2	Hall Switch #2	2	Phase B	Motor Phase B
3	S3	Hall Switch #3	3	Phase C	Motor Phase C
4	VCC	Supply for Hall Switches	4	Phase A	Motor Phase A
5	Gnd	Gnd for Hall Switches	5	Gnd	Gnd for Supply Voltage
6	DIS	Control Input-Disable			
7	REV	Control Input-Reverse			
8	GND	Gnd for Dis and Rev			
9	SPD	Set Value Input for Speed			

## CONTROL INPUTS

Control inputs 7 (Reverse), 6 (Disable) can be enabled either by an external switch, an open collector transistor, or by means of TTL / CMOS components. This connection is made to 8 (Gnd).

Control input	Input open or high level	Input on Gnd or low level
Rev	Turning to the right (CCW)	Turning to the left (CW)
Dis	Controller active	Controller inactive

\*Note: For positive stopping of the motor it is advisable to use the **Disable** input rather than setting the speed potentiometer to zero. Some drift may occur even at zero setting of the speed potentiometer; this will not be the case when the **Disable** function is used.

## SELECTING MOTOR DIRECTION-OF-ROTATION

Reversing the direction of motor rotation is easily accomplished. Using a switch, relay contact, or simply a jumper wire, connect the terminal labeled **Rev.** to the terminal labeled **Gnd.**

*NOTE: Do not reverse motor direction while the motor is rotating. The controller is not designed for instantaneous reversing.*

## SPEED CONTROL

Motor speed may be controlled via one of the following three methods (see page 4 and 5 for detail instructions):

1. On-Board Speed Potentiometer
2. External Speed Potentiometer – (Recommend 10k – 10 Turn Precision Potentiometer)
3. External Control Voltage

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The following is a procedure for using each of the speed control methods mentioned on page 3.

#### 1. On-Board Speed Potentiometer

- A. Place a jumper from terminal labeled **GND** to terminal labeled **Spd**.
- B. Rotate the trimpot labeled **Speed** fully **CCW**.
- C. Rotate the trimpot labeled **nmax** fully **CCW**.
- D. Apply the operating input voltage across **+ Input** and **Gnd**, being careful to observe polarity.  
**Do not apply an incremental input voltage, but rather a single step voltage.**
- E. Motor should now be running at full speed. Measure and record speed.
- F. Slowly rotate the **nmax** trimpot **CW** until the motor speed decreases slightly, then slowly rotate the trimpot back **CCW** until the motor is once again running at full speed (see value recorded in step **E**).
- G. The **nmax** trimpot is now “tuned” to the motor currently connected to the controller and will not require readjustment unless a different motor is connected to the controller, or the level of the input voltage is changed.
- H. Motor speed may now be varied by using the **Speed** trimpot.

#### 2. External Speed Potentiometer (Optional)

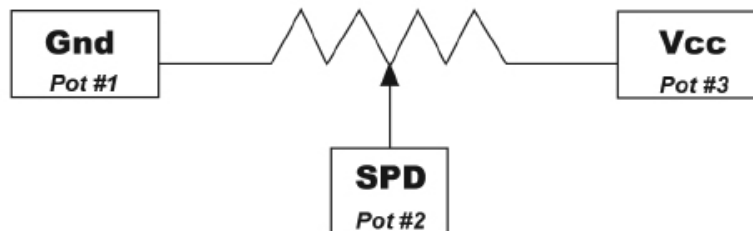
**NOTE: See Figure 1 for connection diagram for External Speed Potentiometer.**

- A. Rotate the **External Speed Potentiometer** fully **CW**.
- B. Rotate the trimpot labeled **Speed** fully **CW**.
- C. Rotate the trimpot labeled **nmax** fully **CCW**.
- D. Apply the operating input voltage across **+ Input** and **GND**, being careful to observe polarity.  
**Do not apply an incremental input voltage, but rather a single step voltage.**
- E. Motor should now be running at full speed. Measure and record speed.
- F. Slowly rotate the **nmax** trimpot **CW** until the motor speed decreases slightly, then slowly rotate the trimpot back **CCW** until the motor is once again running at full speed (see value recorded in step **E**).
- G. The **nmax** trimpot is now “tuned” to the motor currently connected to the controller and will not require readjustment unless a different motor is connected to the controller, or the level of the input voltage is changed.
- H. Motor speed may now be varied by using the **External Speed Potentiometer**.

*NOTE: Pot#1 = Potentiometer Terminal #1, Pot #2 = Potentiometer #2, Pot#3 = Potentiometer Terminal #3*

Figure 1

### Connection Diagram for External Speed Potentiometer



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### 3. External Voltage Control (Optional)

By applying a DC voltage between **9 (Spd)** and **8 (Gnd)**, the following conditions are observed:

- A. 0 to 0.5 volts – **speed = 0.**
- B. 0.5 to 5.0 volts – **speed range in control operation.**
- C. 5.0 to 10.0 volts – **no pulse-width-operation-control works in simple commutation mode.**
- D. Speed potentiometer should be fully **CW**.

*Note: Some power supplies used to supply this external voltage may contain large amounts of ripple. If speed control is **unstable**, please install a **10µF electrolytic capacitor** across **9 (Spd)** and **8 (Gnd)**. **BE SURE TO OBSERVE POLARITY WHEN INSTALLING THIS CAPACITOR; 9=Positive, 8=Gnd.***

## CURRENT LIMITING

Type	Min. Current	Max. Current
BDO-Q2-20-18	6 - 7 A	18 A
BDO-Q2-50-18	6 - 7 A	18 A
BDO-Q2-20-40	12 - 14 A	40 A
BDO-Q2-50-40	12 - 14 A	40 A

*Note: The controller shuts down automatically when the temperature at the inside of the heat sink exceeds 80°C. To restore controller operation the input power to the controller (**+ input and gnd**) must be switched off and back on (after thermal switch has cooled sufficiently).*

## FUSING

Proper overcurrent protection (fusing) is required for the protection of this controller. We recommend a **nontime delay** fuse. This fuse should be connected in series with the **+ Input** line going to the controller and should be of a value less than or equal to the maximum current rating of the controller (Max. Right Position).

**Note: Considerations regarding the power supply:**

Output voltage: **> 12 V and < + input** with a residual voltage of < 5%

Output Current: corresponding to the necessary torque and possible reserves for acceleration

**Note: Procedure for calculating the necessary minimum supply voltage:**

Default: Torque  $M_B$  [mNm]  
Operating speed  $n_B$  [min<sup>-1</sup>]  
Rated voltage of the motor  $U_N$  [V]  
Idling speed with UN  $n_0$  [min<sup>-1</sup>]  
  
Characteristic curve slope  $\frac{\Delta n}{\Delta M}$  [min<sup>-1</sup> mNm]

Result: 
$$V_{cc} = \frac{U_N}{n_0} * (n_B + \frac{\Delta n}{\Delta M} * M_B) + 4V$$

## HOOK-UP PROCEDURE

1. Connect motor connections (**φA, B, and C**).
2. Connect Hall sensors (**S1, S2, and S3**), as well as the Hall voltage supply (**V<sub>cc</sub> and Gnd**) of Hall sensors.
3. Connect the control inputs according to the requirements (**Rev. and Dis.**).
4. Connect the supply voltage (**+ input and gnd**).
5. Set up the speed control for the controller (**depending upon which method of speed control is used - see Speed Control**).
6. After completion of step #5, speed control is now active.
7. Set the maximum current via the on-board speed potentiometer (**I<sub>max</sub>**).

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