Silencer™ 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 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 the **direction** control input. The controller output stage can be activated and deactivated by the **disable** control input.
- The controller is safeguarded against heat overload by an internal thermal cutoff.
- The controller output stage has been constructed using POWER-MOSFET technology, resulting in very high efficiency.

For literature: ***800-336-2112*** • *540-552-3011*
For sales assistance: ***800-577-8685*** • *828-837-5115*
For technical application assistance: ***800-577-8685*** • *828-837-5115*

Peromatic GmbH
Gubelstrasse 28 CH-8050 Zürich Fon +41-(0)43 300 60 60 Fax +41-(0)43 300 60 79
rue Confédération 29 CH-2300 La Chaux-de-Fonds Fon +41-(0)32 927 37 20 Fax +41-(0)32 927 37 22
info@peromatic.ch www.peromatic.ch

SPECIFICATIONS

ELECTRICAL DATA				
	BDO-Q2-20-18	**BDO-Q2-50-18**	**BDO-Q2-20-40**	**BDO-Q2-50-40**
Operating voltage **-+input and Gnd** Residual voltage < 5%	12 - 28 VDC	20 - 50 VDC	12 - 28 VDC	20 - 50 VDC
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 185ºF (-40 to +85°C)
Operation -50 to 113ºF (-10 to +45°C)

MOISTURE RANGE

20 to 80% non-condensed

MECHANICAL DATA

	BDO-Q2-20-18	**BDO-Q2-50-18**	**BDO-Q2-20-40**	**BDO-Q2-50-40**
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.

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SAFETY NOTE *continued*

- 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.

TERMINATION TABLE

Signal

Terminal #	*Nomenclature*	*Description*
1	S1	Hall Switch #1
2	S2	Hall Switch #2
3	S3	Hall Switch #3
4	VCC	Supply for Hall Switches
5	Gnd	Gnd for Hall Switches
6	DIS	Control Input-Disable
7	REV	Control Input-Reverse
8	GND	Gnd for Dis and Rev
9	SPD	Set value input for speed

Power

Terminal #	*Nomenclature*	*Description*
1	Positive Input	Positive Supply Voltage
2	Phase B	Motor Phase B
3	Phase C	Motor Phase C
4	Phase A	Motor Phase A
5	Gnd	Gnd for Supply Voltage

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 occurr 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.**

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SPEED CONTROL

Motor speed may be controlled via one of the following three methods:

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

The following is a procedure for using each of the speed control methods above.

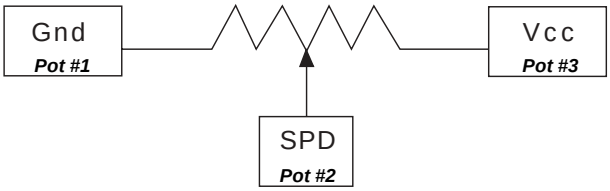
1. On-Board Speed Potentiometer

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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SPEED CONTROL *continued*

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. On-board speed potentiometer must be set 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	Max. CW	Max. CCW
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 **non-time 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^{-1}]
Rated voltage of the motor U_N [V]
Idling speed with UN n0 [min^{-1}]
Characteristic curve slope $\frac{\Delta n}{\Delta M}$ [min^{-1} mNm]

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

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