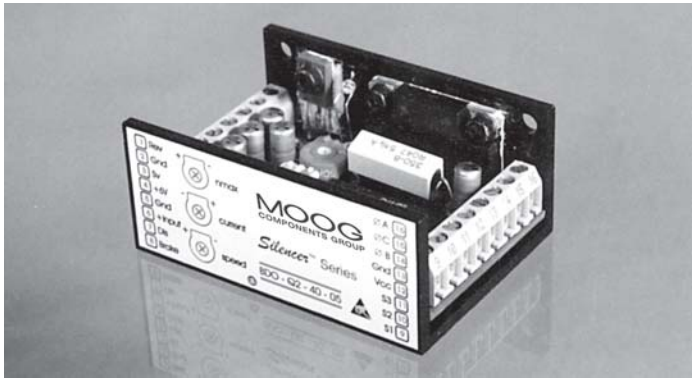
Silencer™ Series Brushless Controllers

BDO-Q2-40-05 (40V, 5A)

2-quadrant speed controller for brushless motors



Instruction Manual

GENERAL

- The BDO-Q2-40-05 controller is a 2-quadrant speed controller for electronically commutating three-phase brushless motors with Hall sensors which are offset at 120 electrical degrees.
- The speed of the motor is set 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 **brake** control input and 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. With a maximum constant current of 5 A, the motor voltage is reduced by a maximum 4 V.

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SPECIFICATIONS

ELECTRICAL DATA	
Operating voltage **-+input and Gnd** Residual voltage < 5%	12 - 40 VDC
Maximum constant current (adjustable) • without additional cooling surfaces (free convection) • with additional convection (< 1.8 K/W)	 0.5 - 3.5 A 0.5 - 5.0 A
Peak current limitation (cycle by cycle)	10.0 A
Supply voltage for Hall sensors	6 V/20 mA

INPUTS

- Direction of rotation – **(REV)** open collector / TTL / CMOS / switch
- Brake - **(BRAKE)** 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

Weight - 4.37 oz. (124g)
Dimensions - (L x W x H) - 3.54 x 1.97 x 1.18 in. (90 x 50 x 30 mm)
Mounting - 4 x M4 with a distance between holes of 3.15 x 1.18 in. (80 x 30 mm)

ASSEMBLY NOTE

Optimum heat dissipation is achieved by mounting the BDO-Q2-40-05 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 > 40 VDC or cross-connection of the + Input and Gnd inputs will destroy the BDO-Q2-40-05 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 BDO-Q2-40-05 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		
Terminal #	*Nomenclature*	*Description*
1	REV	Reverse Motor Direction
2	GND	Signal Ground
3	SV	External Speed Input
4	+6 V	Reference Voltage for Control Inputs
5	GND	Supply Voltage - Ground
6	+INPUT	Supply Voltage - Positive
7	DIS	Controller Disable Input
8	BRAKE	Controller Brake Input
9	S1	Hall Switch #1
10	S2	Hall Switch #2
11	S3	Hall Switch #3
12	VCC	Hall Switch Supply Voltage
13	GND	Hall Switch Ground
14	ØB	Motor Phase B
15	ØC	Motor Phase C
16	ØA	Motor Phase A

CONTROL INPUTS

Control inputs 1 (**Reverse**), 7 (**Disable**) and 8 (**Brake**) can be enabled either by an external switch, an open collector transistor, or by means of TTL/CMOS components. This connection is made to 2 (Gnd).
Note: If the Brake input is not used, please jumper between 8 (Brake) and 2 (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
*Brake	Controller inactive	Controller active

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**

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 **SV**.
B. Rotate the trimpot labeled **Speed** fully **CW**.
C. Rotate the trimpot labeled **nmax** fully **CW**.
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 **CCW** until the motor speed decreases slightly, then slowly rotate the trimpot back **CW** 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)

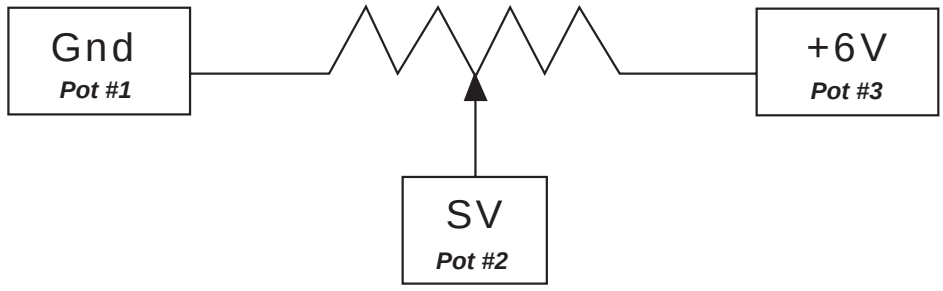
***NOTE:* See *Figure 1* for connection diagram for External Speed Potentiometer.**

A. Rotate the **External Speed Potentiometer** fully **CCW**
B. Rotate the trimpot labeled **Speed** fully **CCW**.
C. Rotate the trimpot labeled **nmax** fully **CW**.
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 **CCW** until the motor speed decreases slightly, then slowly rotate the trimpot back **CW** 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



3. External Voltage Control (optional)

By applying a DC voltage between **3 (SV)** and **2 (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 **CCW**.

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

Current-limiting is available via the on-board current potentiometer. The settings are as follows:
Fully CCW – maximum setting
Fully CW – minimum setting

FUSING

Proper overcurrent protection (fusing) is required for the protection of this controller. We recommend a **5 amp** – **120 volt** – **non-time delay** fuse. This fuse should be connected in series with the **+ Input** line going to the controller.

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

Output voltage: **> 12 V and < 40V** 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:

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

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_{cc} and Gnd)** of Hall sensors.
3. Connect the control inputs according to the requirements **(Rev., Dis., and Brake)**.
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 **(current)**.

ALSO AVAILABLE FROM POLY-SCIENTIFIC

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Silencer™ Brushless DC Motors

- *Sizes 12, 23, 34 and 42*
- *Standard NEMA frames in 1.2" to 4.15" diameter*
- *Speeds up to 20,000 rpm*
- *Continuous torques range from 2.4 to 519 oz-in*
- *Compact size - lengths range from 1.3" to 5.5"*
- *Standard options include gearheads, resolvers, encoders & electronic drivers*

Permanent Magnet DC Brush Motors Series - C23, C34 and C42

- *Sizes 23, 34, and 42*
- *Standard NEMA frames in 1.31 to 4.0" diameter*
- *Long-life, replaceable brushes*
- *Gearmotors available in most frame sizes*
- *Up to 560 oz-in continuous torque*
- *Up to 3,500 oz-in peak starting torque*

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- *Stainless steel shafts*
- *.125" and .187" inch diameters*
- *Continuous torques from 7.5 to 13 oz-in*
- *Encoder and tachometer packages*
- *Up to 1274 oz-in peak starting torque*
- *Weighs only 6.8 oz*

Brushless DC Motors BOF, BON and BI Series

- *Lengths from 1.3" to 2.8"*
- *Continuous torques from 12.6 to 41 oz-in*
- *Speeds up to 20,000 rpm*
- *High torque per dollar ratio*
- *Standard options include electronic drivers, encoders, and gearheads. Hall effect, resolver and sensorless feedback are also available*

Servo Torque Motors

- *Torques from 6 oz-in to 14 lb-ft.*
- *1.1" to 5.25" O.D. standard*
- *Gold commutators available*
- *Tachometer and potentiometer options available*
- *Housed motors or as separate rotor/stator sets*

DC Cube Torque Brush Motors

- *Up to 24 oz-in peak torque*
- *Options include gearheads, brakes, resolvers and potentiometers*
- *Available with rare earth magnets*
- *Available in sizes:* ❑1" x 1" x 1"
  ❑1" x 1" x .75"
  ❑1" x 1" x 1.35"
  ❑.75" x .75" x .75"

Brush and Brushless, Single and Multispeed, Pancake and Housed Resolvers

- *Coupled to R/D converters, they provide a digital interface to computerized motion control systems.*
- *±7' accuracy standard, ±3' available for single speed*
- *400-10,000 Hz frequency range standard*
- *Arc second accuracies are standard for multispeed resolvers*

We also offer:
❑Custom engineering services
❑Limited angle rotation (LAR) (toroidally wound) DC brushless motors

Resolvers and Synchros

Our brushless resolvers are economical, highly accurate motion feedback sensors that can be used to provide position and velocity information for closed-loop electronic control, as well as brushless DC motor commutation. They contain no internal electronics or optics and are unaffected by heat, electrical noise, shock and vibration.

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Moog Components Group is an innovative motion technology products company with design and manufacturing capabilities for slip rings, brush & brushless DC motors and drives, fiber optics, actuators and integrated rotary assemblies.

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