



**BSC 7107  
DC Brushless Control**

**Installation and Operating Manual**

9/97

MN1231

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# Section 1

## General Information

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### **Introduction**

Baldor Series BSC 7107 control is a general purpose brushless DC motor control. This control commutates power into standard 3-phase brushless (BLDC) motors.

The control input line voltage is 120 VAC  $\pm$  10%. This control provides up to 7 amperes of continuous current to the motor. Motors with Hall sensor spacings of 60 and 120 degrees can be used.

The control has two PC boards-an upper and a lower, connected by ribbon cable. A 10-position terminal strip on the upper board connects the control to the motor sensors, the speedpot, and the forward/reverse control switch (optional). The control's upper board also carries the trimpots for minimum speed, maximum speed, and current limit, as well as a means for selecting the sensor spacing.

### **STANDARD FEATURES**

- Closed loop control
- Quiet 15KHz PWM switching frequency
- MOSFET power devices
- Forward/Reverse direction control
- 5K $\Omega$  speedpot with leads, knob and dial for remote mounting
- Internal +6.25 VDC for motor hall-effect sensors
- Anodized chassis mount heatsink

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## **Limited Warranty**

For a period of one (1) year from the date of original purchase, BALDOR will repair or replace without charge controls and accessories which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. BALDOR shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, BALDOR's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to BALDOR with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses.

Goods may be returned only with written notification including a BALDOR Return Authorization Number and any return shipments must be prepaid.


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## **Safety Notice**

This equipment contains voltages that may be as great as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

This equipment may be connected to other machines that have rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

## **PRECAUTIONS**

 **WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.**

 **WARNING: Be sure that you are completely familiar with the safe operation of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.**

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- ⚠ WARNING:** Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.
- ⚠ WARNING:** Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Dangerous voltages are present inside the equipment. Electrical shock can cause serious or fatal injury.
- ⚠ WARNING:** Improper operation of control may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Peak torque of several times the rated motor torque can occur during control failure.
- ⚠ WARNING:** Motor circuit may have high voltage present whenever AC power is applied, even when motor is not rotating. Electrical shock can cause serious or fatal injury.
- ⚠ Caution:** To prevent equipment damage, be certain that the electrical service is not capable of delivering more than the maximum line short circuit current amperes listed in the appropriate control manual, 120 VAC maximum per control rating.
- ⚠ Caution:** Keep the average continuous DC current draw under 7 amperes, and make sure the motor is rotating. A stalled brushless DC motor can quickly overheat the control and/or the motor resulting in damage to either or both devices.

## **Section 2**

### **Receiving & Installation**

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#### **Receiving**

The control is thoroughly tested at the factory and carefully packaged for shipment. When you receive your control, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your control.
2. Verify that the part number of the control you received is the same as the part number listed on your purchase order.
3. If the control is to be stored for several weeks before use, be sure that it is stored in a location that conforms to published storage specifications.

#### **Physical Location**

The location of the control is important. It should be installed in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these elements can reduce the operating life and degrade performance of the control.

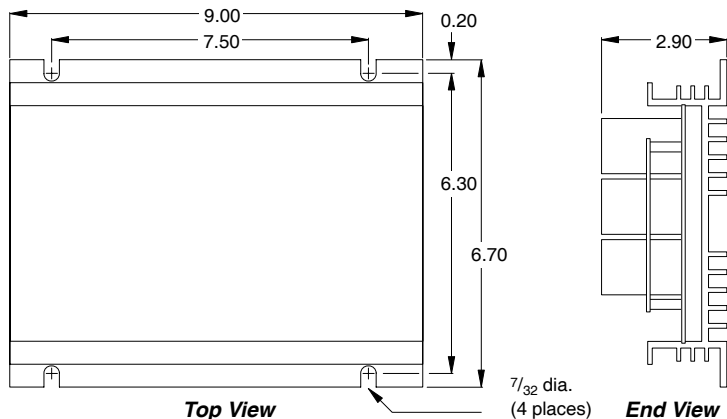
#### **Installation**

##### **Control Installation**

Refer to the mounting dimensions and hole locations shown in Figure 2-1. Mount the control to the mounting surface using appropriate hardware (not provided).



**Figure 2-1 Mounting Diagram**



**AC Power Connection Refer to Figure 2-2.**

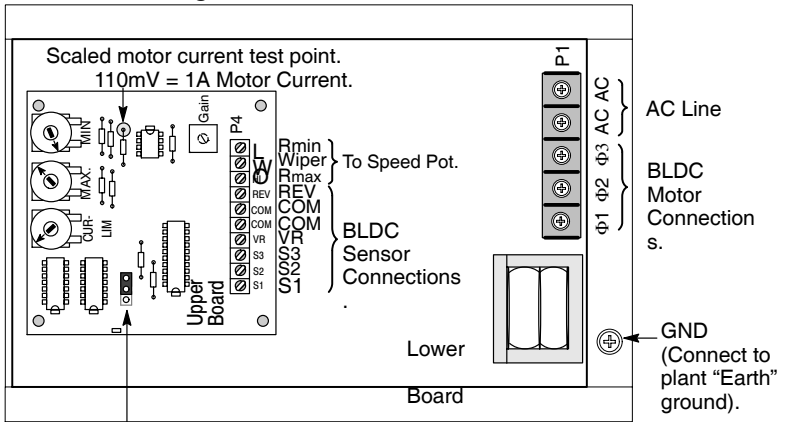
A fused 120 VAC power source is required. A 12 AMP fuse should be used.

1. Be sure the AC source is disconnected (OFF).
2. Be sure the appropriate fuse is installed at the source.
3. Connect the AC power to P1 pins AC and AC.
4. Connect plant earth ground to the chassis connection ⊕

**Speed Potentiometer Refer to Figure 2-2.**

1. Rotate the pot fully CCW (Counter clockwise). Measure the resistance between the wiper and each terminal.
2. Connect the terminal with the most resistance (5K $\Omega$ ) to Rmax (P4 pin HI).
3. Connect the terminal with the least resistance (0K $\Omega$ ) to Rmin (P4 pin LO).
4. Connect the wiper to Wiper (P4 pin W).

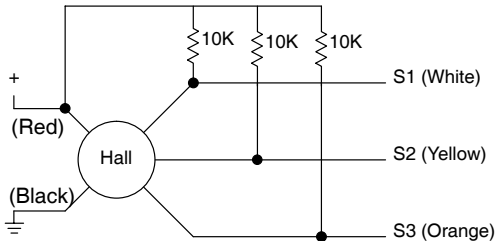
**Figure 2-2 Control Connection Locations**



60° / 120° Jumper



Terminal tightening torque = 4 Lb-in (0.45 Nm)



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## Sensor and Motor Connections *Refer to Figure 2-2.*

Brushless DC motors have eleven (11) wires: three (3) motor phase power wires, three (3) hall sensor wires, two (2) wires for hall sensor power and sensor common, one (1) wire for motor ground and two (2) wires for motor thermal switch.

Note: Baldor BLDC motors have 120° Hall sensor spacing.

1. Verify that the 60°/120° jumper is in the 120° position.
2. Verify that the Speed Potentiometer is set to zero (5KΩ pot is set fully CCW).
3. Place a 0-10A AC AMP meter in series with the source. This allows measurement of AC current during power up testing.
4. Connect the three motor leads to P1 terminals as follows:

Motor Function	P1 Terminal	BSM50A Lead Color	Threaded Connector Pin #
U	Φ1	Red	1
V	Φ3	Black	4
W	Φ2	Blue	3


5. Connect the motor ground to Earth.
6. Connect the three hall sensor wires (S1, S2 and S3) to P4 terminals S1, S2 and S3 of on the upper board.
7. Connect the sensor power lead (red) to P4 terminal strip pin VR on the upper board.
8. Connect the sensor power common lead (black) to P4 terminal strip pin COM on the upper board.

Note: The motor has an internal thermal switch (155°C ±5°C normally closed contact). The BSC7107 does not use this contact so no connection to the thermal switch leads is required.

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## Reverse Operation

Terminal P4-REV is the forward/reverse control. You can reverse motor direction by connecting P4-REV to P4-COM. Use a jumper wire, switch, relay, or an open collector NPN transistor.

 **Caution:** Before reversing directions, make sure the motor is stopped. This control is not designed for plug reversing.

Sometimes it may be necessary to reverse motor direction without using terminal P4-REV. This is done by stopping the motor and exchanging terminals P1-Φ1 with P1-Φ2 on the lower board, and terminals P4-S1 with P4-S3 on the upper board.

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## 1st Time Power Up Procedure *(or after a motor is replaced)*

**⚠ Caution:** If full AC Voltage is applied and the motor connections are wrong, the control will be damaged. Apply 10% of the input voltage to test motor lead connections at the first time power up or after a motor is replaced.

It is strongly recommended that a Variac (AC Rheostat) be used for the first time power up procedure. If full AC power is applied to the control and the motor leads are incorrectly connected (wrong phase) the control will be damaged.

1. Using a Variac (AC Rheostat) apply 10% of the rated AC input voltage to the control.
2. Slowly turn the speedpot CW. Watch for erratic rotation or excessive source current. If either occurs, immediately return the speedpot fully CCW, and turn off the power.
3. Try another phase combination of P1  $\Phi$ 1,  $\Phi$ 2 and  $\Phi$ 3. There are six (6) combinations for connecting the three phase motor leads to P1  $\Phi$ 1,  $\Phi$ 2 and  $\Phi$ 3.
4. Apply power and test again. One combination will work. The correct combination will allow smooth rotation of the motor, and the lowest current draw from the AC source.
5. Remove AC power.
6. Remove the Variac.
7. Connect normal AC input voltage at P1-AC and AC terminals.
8. Apply power and check for proper motor operation.

## Section 3 Adjustments

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### Current Limit Adjustment

The current limit adjustment is factory set at 10 AMPS and you should not have to increase this setting for the Series BSC 7107 control. Rotating the I Limit potentiometer on the upper board CCW decreases the current limit.

To calculate motor current, refer to Figure 2-2 and measure the voltage ( $V_{TP}$ ) at the "Scaled motor current test point". The voltage should be 770mV for a 7 AMP motor.

$$\frac{V_{TP}}{110\text{mv/A}} = \text{MotorCurrent} = \frac{770\text{mv}}{110\text{mv/a}} = 7\text{A}$$

The correct setting of the I Limit potentiometer is 125% of the FLA rating of the motor.

1. Preset the I Limit pot fully CW for maximum FLA.
2. Apply power and run the motor at full or normal running speed.
3. Load the motor to 125% of its FLA rating (or the desired maximum load).
4. Rotate the I Limit pot CCW (clockwise) slowly until the measured motor current begins to decrease.
5. Slowly rotate the I Limit pot CW to just obtain the 125% FLA measurement.

Note: Do not use the Current Limit trimpot as a torque control or to reduce the speed of a motor.

**⚠ Caution: Keep the average continuous DC current draw under 7 amperes, and make sure the motor is rotating. A stalled brushless DC motor can quickly overheat the control and/or the motor resulting in damage to either or both devices.**

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## **Minimum Speed Adjustment**

1. Set the Speed Pot to zero speed (fully CCW).
2. Set the MIN pot on the upper board (Figure 2-2) fully CCW.
3. Apply power to the control.
4. Slowly rotate the MIN CW until the motor begins to rotate. Then turn the pot CCW until the motor just stops. The control will now run with a near-zero deadband.
5. If a non-zero minimum speed is desired, rotate the MIN pot CW to the desired minimum speed setting.

## **Adjusting Closed Loop Gain**

1. Set the MAX pot on the upper board (Figure 2-2) to the approximate position shown in the figure.
2. Set the Speed Pot to maximum speed (fully CW).
3. Set the "Closed Loop Gain" pot (Figure 2-2) to its' fully CCW position.
4. Apply power to the control. The motor should operate at full speed. If not, adjust the MAX pot setting until full motor speed is obtained.
5. Adjust the "Closed Loop Gain" pot CW until the motor speed decreases slightly.

Note: If the "Closed Loop Gain" pot is fully CW and the motor speed does not decrease, rotate the MAX pot CCW just enough to make the motor speed decrease slightly. Then adjust the "Closed Loop Gain" pot CCW just enough so the motor runs at full speed.

## Section 4

### Specifications and Data

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#### Specifications

Input Voltage	120 VAC $\pm$ 10%
Output Voltage (Filtered Output)	0 to 140 VDC
Load Current (Continuous)	7 Amperes
Overload Current	150% for 30 seconds
Speed Range	50:1
Max Speed Trimpot	70 to 100% of Input VAC
Min Speed Trimpot	Adjustable 0–30% OF MAX.
Current Limit Trimpot	Adjustable
Acceleration	Fixed, Fast Start
Motor Hall Spacing (Electrical)	Selectable 60° or 120°
Closed Loop Speed Regulation	$\pm$ 1/2% Of Base Speed
Speed Control	5K $\Omega$ Pot or 0 - 6.2 VDC Isolated Signal
Operating Temperature	32° - 113°F ( 0° - 45°C )

#### Dimensions

Width	6.75 in. (172 mm)
Length	9.00 in. (228 mm)
Depth	2.90 in. (74 mm)
Weight	41 oz. (1.17 Kg)



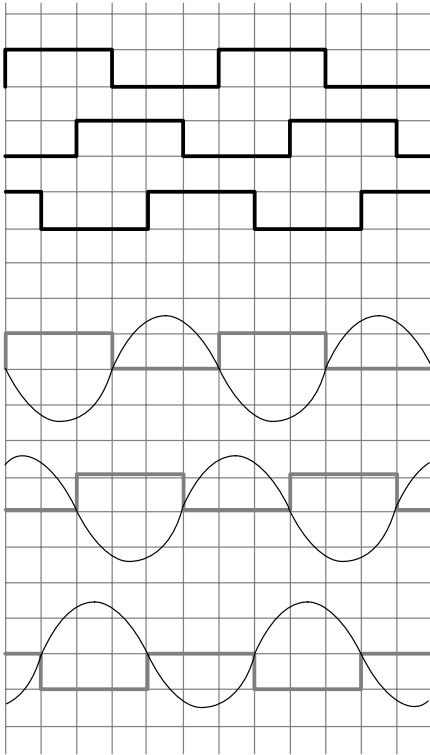
# Hall Signal Timing Diagram

Brushless D.C. Commutation

0 15 30 45 60 75 90 105 120 135 150 165 180  
 0 30 60 60 120 150 180 210 240 270 300 330 360  
 0 60 120 90 240 300 360 420 480 540 600 660 720

- 8 Pole Mechanical Degrees  
 - 4 Pole Mechanical Degrees  
 - Electrical Degrees

## Hall Sensor Leads (Hall generated signal)



**BALDOR<sup>®</sup>**  
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**BALDOR ELECTRIC COMPANY**

**P.O. Box 2400**

**Fort Smith, AR 72902-2400**

**(479) 646-4711**

**Fax (479) 648-5792**

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