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BALDOR

***SCR DC MOTOR CONTROL***

BC141, BC142, BC142-5 & BC142-6 DC CONTROL

# Installation and Operation Manual

10/2008

MN704

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Items Included in this package – Speed Control, factory installed 25 Amp AC Line Fuse*, Installation and Operation Manual, Hardware Bag (contains Main Speed Potentiometer with insulator and mounting hardware, (9) – 0.25” female crimp-on terminals, (4) – 0.11” female crimp-on terminals, and an Enable harness), CE Approved Product Information Card, and Warranty Registration Card.

Items required to operate this control – Plug-In Horsepower Resistor® and Armature Fuse Kit*. Supplied through your distributor. See Section 9, on page 21.

** Fuse holders and fuses not supplied with BC142-5.*

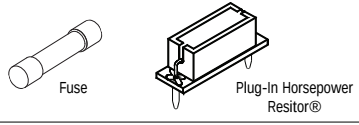


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## 1 SIMPLIFIED INSTALLATION INSTRUCTIONS

IMPORTANT – Read these simplified installation instructions before proceeding. These instructions are to be used as a reference only and are not intended to replace the detailed instructions provided herein. You must read the Safety Warning, on page 6, before proceeding.

*Note: A Plug-In Horsepower Resistor® and Armature Fuse Kit must be installed in order for this product to operate. See Section 9, on page 21. Fuse holders and fuses not supplied with BC142-5.*




1.1 AC Line Connection – Wire the AC line to Terminals "L1" (Line Fuse)* and "L2", as shown in Figure 1, on page 10 and as described in Section 6.1, on page 13.

Catalog No. BC141 is rated for 115 Volt AC line input only. Catalog No. BC142 is rated for 230 Volt AC line input only. Catalog No. BC142-5 and BC142-6 is rated for 115 Volt AC line input (Jumper J1 in the "115" position) and 230 Volt AC line input (Jumper J1 in the "230" position). See Section 7.1, on page 19.

*Notes: 1. The rated AC line voltage (115, 208/230) of the control must match the actual AC line input voltage. 2. If one of the AC line inputs is a neutral (N), wire it to Terminal "L2".*

1.2 Ground Connection – Connect the ground wire (earth) to the control chassis.

1.3 Motor Connection – Connect the motor to Terminals "A+" (Armature Fuse)* and "A-", as shown in Figure 1, on page 10, and as described in Section 6.3, on page 14.

1.4 Jumper Settings – Jumper J1 (on Catalog No. BC142-5 and BC142-6) and Jumper J2 (all models) have been factory set for most applications, as shown in Figure 1, on page 10, and as described in Section 7, on page 19.

** Fuse holders and fuses not supplied with BC142-5.*



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1.5 AC line Fusing* – A 25 Amp AC line fuse is factory installed in the AC Line Fuse Holder, as shown in Figure 1, on page 10. It is recommended that this fuse be changed to a 12 Amp fuse for motors rated 7.5 Amps DC or less. Fuse each conductor that is not at ground potential.

1.6 Plug-In Horsepower Resistor® and Armature Fuse* – It is required that a Plug-In Horsepower Resistor® and Armature Fuse be installed. These are supplied separately in a kit which is based on motor horsepower and voltage. Select the correct kit as described in Section 9, on page 21.

1.7 Trimpot Settings – All trimpots have been factory set for most applications, as shown in Figure 1, on page 10. The trimpots may be readjusted, as described in Section 10, on page 22.

1.8 Diagnostic LEDs – After power has been applied to the control, observe the LEDs to verify proper control operation, as described in Section 11, on page 26.

1.9 Optional Auxiliary Heat Sink (Catalog No. BC143) – Extends the horsepower rating of the control to 1.5 HP for controls with 90 Volt DC output and 3 HP for controls with 180 Volt DC output.

** Fuse holders and fuses not supplied with BC142-5.*



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## 2 SAFETY WARNING – Please read carefully.

Definition of Safety Warning Symbols:



Electrical Hazard Warning Symbol – Failure to observe this warning could result in electrical shock or electrocution.



Operational Hazard Warning Symbol – Failure to observe this warning could result in serious injury or death.



This product should be installed and serviced by a qualified technician, electrician, or electrical maintenance person familiar with its operation and the hazards involved. Proper installation, which includes wiring, mounting in proper enclosure, fusing or other over current protection, and grounding can reduce the chance of electrical shocks, fires, or explosion in this product or products used with this product, such as electric motors, switches, coils, solenoids, and/or relays. Eye protection must be worn and insulated adjustment tools must be used when working with control under power. This product is constructed of materials (plastics, metals, carbon, silicon, etc.) which may be a potential hazard. Proper shielding, grounding, and filtering of this product can reduce the emission of radio frequency interference (RFI) which may adversely affect sensitive electronic equipment. It is the responsibility of the equipment manufacturer and individual installer to supply this Safety Warning to the ultimate end user of this product. (SW effective 11/1992). Be sure to follow all instructions carefully. Fire and/or electrocution can result due to improper use of this product.



This product complies with all CE directives pertinent at the time of manufacture. Installation of a CE approved RFI filter is required (see Section 13.7, on page 28). Additional shielded cable and/or AC line cables may be required along with a signal isolator (Catalog No. BC152).



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## 3 INTRODUCTION

Thank you for purchasing the BC141, BC142, BC142-5 or BC142-6 full-wave variable speed DC motor control. The control, with Surface Mount, (SMT) construction, offers the user the ultimate in reliability and performance at an affordable price. The controls contain a unique patented super-fast Direct-Fed™ current limit circuit that protects the SCR power bridge against direct shorts[1]. The reliability of the control is further enhanced with the use of high-surge, 25 Amp SCRs, and AC line and armature fusing[2, 3]. The control is designed with exclusive Plug-In Horsepower Resistor® [3], which eliminates the need for recalibrating IR Comp and Current Limit when the control is used on various horsepower motors. In addition, the rating of the control can be extended to 1.5 HP for controls with 90 Volt DC output and 3 HP for controls with 180 Volt DC output, by the use of an Auxiliary Heat Sink[4]. Catalog Nos. BC142, BC142-5 and BC142-6 also allow operation of 90 Volt DC motors when used on 208/230 Volt AC line input[5].

The versatility of the control is confirmed by its extensive list of standard features, such as: selectable armature and tach feedback and adjustment trimpots for minimum speed, maximum speed, current limit, IR compensation, and linear acceleration and deceleration. The control includes Auto-Inhibit®, which eliminates surging during rapid AC line switching; pulse transformer triggering, which provides cogless operation at low speed; and superior noise rejection circuitry, which eliminates false starts and blown SCRs. Enable (normally closed) and Inhibit (normally open) functions provide electronic switching of control output.

The output voltage of the control is a linear function of the Main Speed Potentiometer setting. In addition, the control can be used in a voltage following mode by supplying an *isolated* analog input signal to Terminals “P2” (+) and “P1” (-). The control is compact in size (only 4.30” X 3.64” X 1.25”) and easily replaces all competitive speed controls. The control is supplied with a factory installed 25 Amp AC line fuse[3] and a 5 kΩ Main Speed Potentiometer and QD terminals. All models are UL Listed (USA and Canada) and CE Approved.

*Notes:*

1. *Short circuit protected at motor only.*
2. *Baldor Limited Warranty applies. See page 32.*
3. *Plug-In Horsepower Resistor® and Armature Fuse Kit supplied separately (Fuse holders and fuses not supplied with BC142-5). See Sections 8 and 9, on pages 20 - 22.*
4. *Catalog No. BC143. See Section 13.1, on page 28.*
5. *Step-Down operation.*



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## 3.1 Standard Features

1. Plug-In Horsepower Resistor® – Eliminates the need to calibrate the control for IR Compensation and Current Limit when used on various horsepower motors.
2. Auto-Inhibit® – Allows the control to be rapidly switched “on” and “off” using the AC line.
3. Inhibit and Enable – Allows the control to be turned “on” and “off” using electronic switching.
4. Trimpots – Minimum Speed (MIN), Maximum Speed (MAX), IR Compensation (IR), Current Limit (CL), Acceleration (ACCEL), and Deceleration (DECEL).
5. Jumpers – AC Line Input Voltage Selection (J1 (Catalog No. BC142-5 and BC142-6)), Motor Voltage and DC Tachometer Selection (J2).
6. Protection Features – MOV transient protection. Short Circuit protected (at motor only).
7. Diagnostic LEDs – Power On (PWR ON) and Current Limit (CL).
8. Catalog No. BC141 operates on 115 Volt AC line input with 90 Volt DC motors.
9. Catalog No. BC142 operates on 230 Volt AC line input with 180 Volt DC motors or 90 Volt DC motors (step-down). - Jumper Selectable.
10. Catalog No. BC142-5 and BC142-6 can operate on 115 Volt AC line input with 90 Volt DC motors and 230 Volt AC line input with 180 Volt DC motors or 90 Volt DC motors (step-down). - Jumper selectable.
11. Armature or DC Tachometer feedback.
12. Built-in AC line and armature fusing.
13. Main Speed Potentiometer (5 kΩ).
14. SMT construction.


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## TABLE 1 – ELECTRICAL RATINGS

| Catalog Number | AC Line Voltage (±15%, 50/60Hz) (Volts AC) | Motor Voltage (Volts DC) | Rating without Auxiliary Heat Sink | | | Rating with Auxiliary Heat Sink | | | Field Voltage (Volts DC) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Maximum AC Line Current (RMS Amps) | Maximum DC Load Current (Avg. Amps) | Maximum Horsepower (HP (kw)) | Maximum AC Line Current (RMS Amps) | Maximum DC Load Current (Avg. Amps) | Maximum Horsepower (HP (kw)) | |
| BC141 | 115 | 0 - 90 | 12.0 | 8.0 | .75 (.6) | 24.0 | 16.0 | 1.5 (1.1) | 50, 100 |
| BC142 | 230 | 0 - 180 | 12.0 | 8.0 | 1.5 (1.1) | 24.0 | 16.0 | 3 (2.3) | 100, 200 |
| | | 0 - 90* | 12.0 | 8.0 | .75 (.6) | 24.0 | 16.0 | 1.5 (1.1) | 100 |
| BC142-5 | 115 | 0 - 90 | 9.0 | 6.0 | .75 (.6) | 18.0 | 12.0 | 1.5 (1.1) | 50, 100 |
| | 230 | 0 - 180 | 9.0 | 6.0 | 1.5 (1.1) | 18.0 | 12.0 | 3 (2.3) | 100, 200 |
| | | 0 - 90* | 9.0 | 6.0 | .75 (.6) | 18.0 | 12.0 | 1.5 (1.1) | 100 |
| BC142-6 | 115 | 0 - 90 | 12.0 | 8.0 | .75 (.6) | 24.0 | 16.0 | 1.5 (1.1) | 50, 100 |
| | 230 | 0 - 180 | 12.0 | 8.0 | 1.5 (1.1) | 24.0 | 16.0 | 3 (2.3) | 100, 200 |
| | | 0 - 90* | 12.0 | 8.0 | .75 (.6) | 24.0 | 16.0 | 1.5 (1.1) | 100 |

* Step-down operation.

## TABLE 2 – GENERAL PERFORMANCE SPECIFICATIONS

| Description | Specification | Factory Setting |
|---|---|---|
| Speed Range (Ratio) | 50:1 | — |
| Armature Feedback Load Regulation (0 - Full Load, 50:1 Speed Range) (% Base Speed) | 1 | — |
| Tachometer Feedback Load Regulation (0 - Full Load, 50:1 Speed Range) (% Set Speed) | 1 | — |
| Line Voltage Regulation (at Full Load, ± 10% Line Variation) (% Speed) | 0.5 | — |
| Control Linearity (% Speed vs. Dial Rotation) | 2 | — |
| Acceleration (ACCEL) Trimpot Range (Seconds) | 0.2 – 10 | 2 |
| Deceleration (DECEL) Trimpot Range (Seconds) | 0.2 – 10 | 2 |
| Maximum Speed (MAX) Trimpot Range (% Base Speed) | 50 – 110 | 100 |
| Minimum Speed (MIN) Trimpot Range (% Base Speed) | 0 – 30 | 0 |
| Current Limit (CL) Trimpot Range (% Full Load) | 0 – 200 | 150 |
| IR Compensation (IR) Trimpot Range (at Specified Full Load @ 90, 180 Volts DC Output) (Volts DC) | 0 – 24, 48 | 3, 6 |

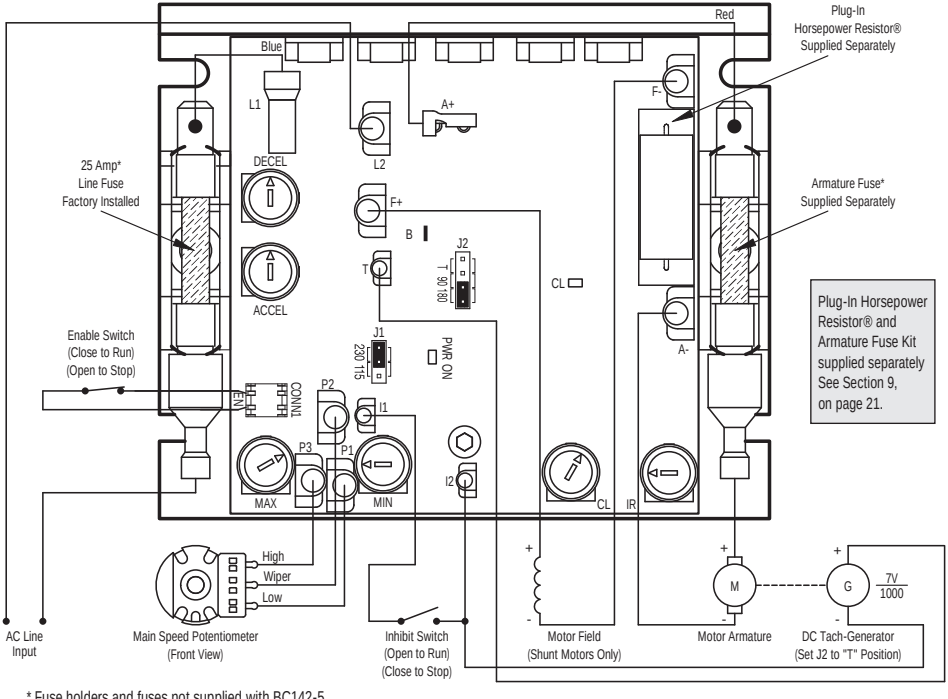
*Notes:*

1. *Step-down operation: motor may have reduced brush life.*
2. *Performance is for SCR rated permanent magnet motors only. Lower performance can be expected with other motor types. Factory setting is for 3% load regulation. To obtain superior regulation, see Section 10.6, on page 25.*



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FIGURE 1 – CONTROL LAYOUT & GENERAL CONNECTION DIAGRAM (Catalog No. BC142-6 Shown)

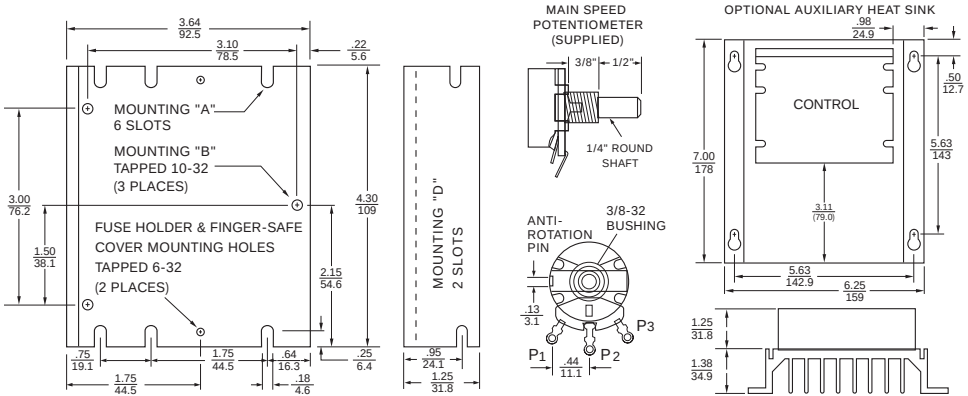



* Fuse holders and fuses not supplied with BC142-5.



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FIGURE 2 – MECHANICAL SPECIFICATIONS (Inches/mm)




## 4 APPLICATION INFORMATION

4.1 Motor Type – The control is designed for permanent magnet (PM) and Shunt Wound DC motors. Controls operated on 115 Volt AC line input are designed for 90 Volt SCR rated motors. Controls operated on 230 Volt AC line input are designed for 180 and 90 Volt SCR rated motors. Use of higher voltage motors will result in a reduction of the available maximum speed. Also, if the motor is not an SCR rated type, the actual AC line current at full load should not exceed the motor's DC nameplate current rating.

4.2 Torque Requirements – The motor selected for the application must be capable of supplying the necessary torque. In order to ensure the motor is not overloaded, a DC ammeter should be connected in series with the armature. Be sure the current under full load does not exceed the motor nameplate rating.



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4.3 Acceleration Start – The control contains an adjustable acceleration start feature which allows the motor to smoothly accelerate from zero speed to full speed over a time period of 0.2 - 10 seconds. The acceleration trimpot (ACCEL) is factory set for 2 seconds.

4.4 Limitation In Use – The controls are designed for use on machine applications.

4.5 Armature Switching – Do not wire the control for armature switching without taking proper precautions. See Section 12.2, on page 27.



WARNING! Do not switch the armature in and out of circuit or catastrophic failure will result. If armature switching is required for reversing or dynamic braking, use Catalog Nos. BC204, BC200, or BC201.

4.6 Step-Down Transformer and AC Line Switching – When using a step-down transformer (460 Volts AC to 230 Volts AC), be sure the output current rating of the transformer is at least 3 times the current rating of the motor. Do not switch the primary side of the transformer to disconnect power or catastrophic failure can result. Always disconnect the control from the secondary side of the transformer.



CAUTION! Do not use this control in an explosive atmosphere. Be sure the control is used within its ratings. Follow all instructions carefully.

## 5 MOUNTING INSTRUCTIONS

It is recommended that the control be mounted on a flat surface with adequate ventilation. Leave enough room to allow for AC line, motor connection, and other wiring that is required. Care should be taken to avoid extreme hazardous locations where physical damage can occur. When mounting the control in an enclosure, the enclosure should be large enough to allow for proper heat dissipation so that the ambient temperature does not exceed 45 °C (113 °F). See Figure 2, on page 11. If the optional Auxiliary Heatsink is used, mount the control in such a manner that there is unrestricted air flow through the heatsink cooling fins.



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## 6 WIRING INSTRUCTIONS

WARNING! Read Safety Warning, on page 6, before using this control. Disconnect the main power when making connections to the control.

Important Application Note: To avoid erratic operation, do not bundle the AC line and motor wires with signal or control wiring. Also, do not bundle motor wires from multiple controls in the same conduit. Use shielded cables on all signal wiring over 12" (30 cm). The shield should be earth grounded on the control side only. Wire the control in accordance with the National Electrical Code requirements and other local codes that may apply.

TABLE 3 – MINIMUM SUPPLY WIRE SIZE REQUIREMENTS

| Maximum Motor Current (Amps DC) | 90 - 130 Volt DC Motors (Maximum HP) | 180 Volt DC Motors (Maximum HP) | Minimum Wire Size (Cu) | | | |
|---|---|---|---|---|---|---|
| | | | Maximum 50 Ft. | | Maximum 100 Ft. | |
| | | | AWG | $mm^2$ | AWG | $mm^2$ |
| 6 | .5 | 1 | 16 | 1.3 | 14 | 2.1 |
| 12 | 1 | 2 | 14 | 2.1 | 12* | 3.3* |
| 16 | 1.5 | 3 | 12* | 3.3* | 12* | 3.3* |

* Maximum recommended wire size.

6.1 AC Line Connection – Wire the AC line to Terminals "L1" (Line Fuse)* and "L2", as shown in Figure 1, on page 10. If one of the AC line inputs is a neutral (N), wire it to Terminal "L2".

CAUTION! The rated AC line voltage (115, 208/230) of the control must match the actual AC line input voltage. See Section 7.1, on page 19.

Catalog No. BC141 operates on 115 Volt AC line input only. Catalog No. BC142 operates on 208/230 Volt AC line input only. Catalog BC142-5 and BC142-6 operates on 115 Volt AC line input when Jumper J1 is set to the "115" position and operates on 208/230 Volt AC line input when Jumper J1 is set to the "230" position (factory setting).

** Fuse holders and fuses not supplied with BC142-5.*



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6.2 Ground Connection – Connect the ground wire (earth) to the control chassis.

6.3 Permanent Magnet (PM) Motor Connection – Wire the motor armature positive lead (+) to Terminal "A+" (Armature Fuse*) and the negative lead (-) to Terminal "A-", as shown in Figure 1, on page 10. On Catalog Nos. BC142, BC142-5 and BC142-6, be sure Jumper J2 is set to the corresponding motor voltage, as described in Section 7.2, on page 20. Be sure the correct Plug-In Horsepower Resistor® is installed, as described in Section 9, on page 21.

** Fuse holders and fuses not supplied with BC142-5.*

6.4 Motor Field Connection (Shunt Wound Motors Only)

6.4.1 Full Voltage Field – Wire the field positive (+) lead to Terminal "F+" and the field negative lead (-) to Terminal "F-", as shown in Figure 1, on page 10, and as described in Table 4.

6.4.2 Half Voltage Field – For 90 Volt DC motors with 50 Volt DC fields and 180 Volt DC motors with 100 Volt DC fields, wire the field positive lead (+) to Terminal "F+" and the negative lead (-) to Terminal "L1" (Line Fuse*), as described in Table 4.

*Notes:*

1. *Do not connect motor armature leads to Terminals "F+" and "F-".*
2. *Do not use Terminals "F+" and "F-" for any purpose other than to power the field of a shunt wound motor.*
3. *Shunt wound motors may be damaged if the field remains energized without armature rotation for an extended period of time.*

TABLE 4 – FIELD CONNECTION (Shunt Wound Motors Only)

| Catalog No. | AC Line Input Voltage (Volts AC) | Armature Voltage (Volts DC) | Field Voltage (Volts DC) | Terminal Connections |
|---|---|---|---|---|
| BC141 | 115 | 0 - 90 | 100 | F+, F- |
| | | | 50 | F+, L1 |
| BC142 | 208 / 230 | 0 - 180 | 200 | F+, F- |
| | | 0 - 90* | 100 | F+, L1 |
| BC142-5<br>BC142-6 | 115 | 0 - 90 | 100 | F+, F- |
| | | | 50 | F+, L1 |
| | 208 / 230 | 0 - 180 | 200 | F+, F- |
| | 208 / 230 | 0 - 90* | 100 | F+, L1 |

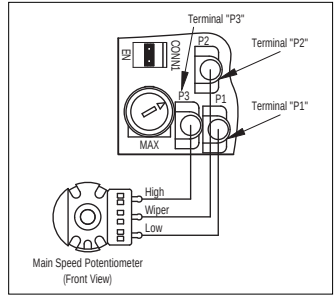
* Step-down operation.



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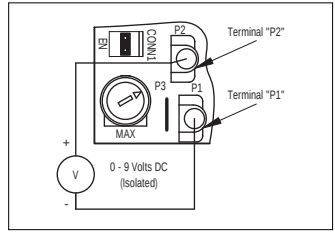
6.5 Remote Main Speed Potentiometer Connection – The control is supplied with a Main Speed Potentiometer to control motor speed. Connect the low side of the potentiometer to Terminal "P1". Connect the wiper of the potentiometer to Terminal "P2". Connect the high side of the potentiometer to Terminal "P3". See Figure 3.

FIGURE 3 – REMOTE MAIN SPEED POTENTIOMETER CONNECTION




6.6 Voltage Following Connection – An *isolated* 0 - 9 Volt DC analog signal input can be used to control motor speed in lieu of the Main Speed Potentiometer. The control output voltage will linearly follow the analog signal input. The signal input must be isolated from the AC line. Connect the signal input positive lead (+) to Terminal "P2" and the negative lead (-) to Terminal "P1", as shown in Figure 4. The source impedance of the signal input should be 10 kΩ or less. The MAX Trimpot is not operational in voltage following mode. Turn the MIN Trimpot, on the control, to zero output (full counterclockwise rotation) and use auxiliary trimpots, if necessary, to scale and/or limit the input voltage.

FIGURE 4 – VOLTAGE FOLLOWING CONNECTION




CAUTION! Do not earth ground any input terminals.

*Notes:*

1. *If an isolated signal input is not available, or if using a 4 - 20 mA DC signal input, install the optional plug-on Catalog No. BC152 Signal Isolator. This will also allow direct connections to process controllers and microprocessors.*
2. *If multiple follower motors are to be controlled from a single leader motor or a single Main Speed Potentiometer, install the optional Catalog No. BC145 Signal Isolator.*
3. *Terminal "F-" may be used in lieu of Terminal "P1".*



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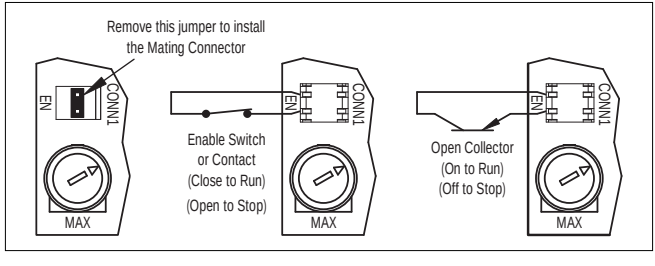
6.7 Enable Circuit Connection – The control can be started and stopped with an Enable Circuit (close to run), as described below.

⚠ WARNING! The Enable Circuit is never to be used as a Safety Disconnect since it is not fail-safe. Use only the AC line for this purpose.

6.7.1 Enable Switch or Contact Wired to the Enable Connector – Using the wired mating connector that is supplied with the control, connect the switch or contact to the Enable connector (CONN1), as shown in Figure 5. When the switch or contact is closed, the motor will accelerate to the Main Speed Potentiometer setting. When the switch or contact is opened, the motor will decelerate to stop. An open collector (PNP) can be used in lieu of a switch or contact.

*Notes: 1. To use the Enable Circuit, remove the jumper that is factory installed on CONN1. 2. The deceleration time can only be made longer than the normal coasting time of the load.*

FIGURE 5 – ENABLE SWITCH OR CONTACT WIRED TO THE ENABLE CONNECTOR



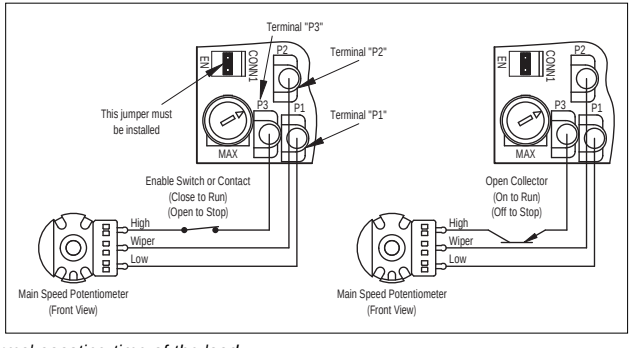

6.7.2 Enable Switch or Contact Wired to the Main Speed Potentiometer – Connect the switch or contact in series with the Main Speed Potentiometer high side and Terminal "P3" on the control, as shown in Figure 6, on page 17. Be sure the jumper is installed on the Enable Connector (CONN1). When the switch or contact is closed, the motor will accelerate to the Main Speed Potentiometer setting. When the switch or contact is opened, the motor will decelerate to the MIN Trimpot setting


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(factory set to 0 Volts DC). If the MIN Trimpot is set to other than 0 Volts DC, the motor will run at the MIN speed setting when the switch or contact is opened. An open collector (PNP) can be connected in lieu of a switch or contact.

*Note: The deceleration time can only be made longer than the normal coasting time of the load.*

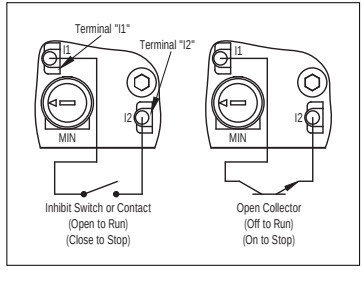
FIGURE 6 – ENABLE SWITCH OR CONTACT WIRED TO THE MAIN SPEED POTENTIOMETER




6.8 Inhibit Circuit Connection – The control can be stopped and started with an Inhibit circuit (close to stop). Wire the switch or contact to Terminals I1 and I2, as shown in Figure 7. When the switch or contact is closed, the motor will coast to stop. When the switch or contact is opened, the motor will accelerate to the Main Speed Potentiometer setting. An open collector (NPN) can be connected in lieu of a switch or contact.

⚠ WARNING! The Inhibit Circuit is never to be used as a Safety Disconnect since it is not fail-safe. Use only the AC line for this purpose.

FIGURE 7 – INHIBIT SWITCH OR CONTACT WIRED TO THE INHIBIT TERMINALS






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6.9 DC Tachometer Connection – A DC tachometer can be used for load regulation of 1% of the set speed. Note: Jumper J2 must be set to the "T" position for tachometer operation. Connect the tachometer as follows.

Application Notes – 1. The tachometer input circuit is designed for a 7 Volt or 50 Volt per 1000 RPM DC tachometer used with an 1800 RPM motor. 2. Initially set the IR Comp Trimpot fully counterclockwise. Once the tachometer is connected, the IR Comp Trimpot may be increased for additional speed stabilization.

6.9.1 Seven (7) Volt per 1000 RPM Tachometer – Connect the tachometer positive lead (+) to Terminal "T" and the negative lead (-) to Terminal "I2", as shown in Figure 8.

6.9.2 Fifty (50) Volt per 1000 RPM Tachometer – Connect the tachometer positive lead (+) to Terminal "B" and the negative lead (-) to Terminal "I2", as shown in Figure 9.

6.9.3 Other Tachometer Voltages – The tachometer input circuit is designed for a 7 Volt or 50 Volt per 1000 RPM DC tachometer used with an 1800 RPM motor. For a tachometer other than 7 Volts or 50 Volts per 1000 RPM, or for a motor other than 1800 RPM, an external 1/2 Watt resistor (RT) must be installed. Install RT in series with the

FIGURE 8 – DC TACHOMETER CONNECTION (7 VOLTS PER 1000 RPM)

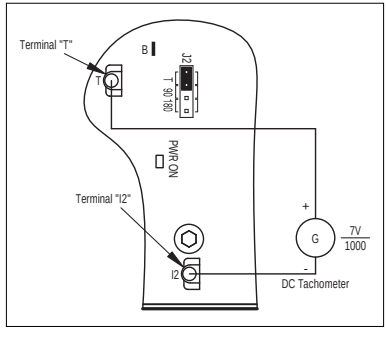
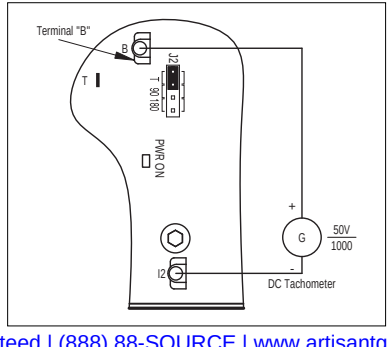



FIGURE 9 – DC TACHOMETER CONNECTION (50 VOLTS PER 1000 RPM)






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tachometer. Connect one end of RT to Terminal “T”, connect the other end of RT to the tachometer positive lead (+), and connect the negative lead (-) to Terminal “I2”. See Figure 10.

The value of RT (Ω) can be calculated using the following formula: RT = (1.3 X VT X S) - 16000 Ω

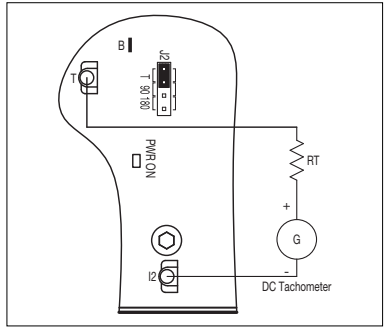
Where “VT” is the tachometer voltage (in Volts per 1000 RPM) and “S” is the base speed of the motor (in RPM).

Example: If a 20 Volt per 1000 RPM tachometer is to be used with a 3600 RPM motor:

RT = (1.3 X 20 X 3600) - 16000 = 77600 Ω

Choose the closest 1/2 Watt resistor value, which is 75000 Ω (75 kΩ).

FIGURE 10 – OTHER DC TACHOMETER CONNECTION




## 7 SETTING SELECTABLE JUMPERS

The control has selectable jumpers which must be set before it can be used. See Figure 1, on page 10, for the location of jumpers.

### 7.1 AC Line Input Voltage Selection (Jumper J1 (Catalog No. BC142-5 and BC142-6)) –

Jumper J1 is factory set to the “230” position for 208/230 Volt AC line input. For 115 Volt AC line input, set Jumper J1 to the “115” position. See Figure 11, on page 20.

*Notes:*

1. *Jumper J1 is installed on Catalog No. BC142-5 and BC142-6 only.*
2. *When Jumper J1 is set to the “115” position, Jumper J2 must be set to the “90” position (or the “T position if using a tachometer).*



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7.2 Motor Voltage and DC Tachometer Selection – Jumper J2 is factory set to the “90” position on Catalog No. BC141, for 90 Volt DC motors, and set to the “180” position, on Catalog Nos. BC142, BC142-5 and BC142-6, for 180 Volt DC motors. To set Catalog No. BC142, BC142-5 and BC142-6 for step-down operation (208/230 Volts AC line input and 90 Volt DC output), set Jumper J2 to the “90” position). To set the control for tachometer connection, set Jumper J2 to the “T” position (all models). See Figure 12.

FIGURE 11 – AC LINE INPUT VOLTAGE SELECTION (JUMPER J1)

| J1 Set for 208/230 Volt AC Line Input (Factory Setting) | J1 Set for 115 Volt AC Line Input |
|---|---|
|  |  |



*Notes:*

1. *On Catalog No. BC141, the “180” position is not available on Jumper J2.*
2. *On Catalog No. BC142-5 and BC142-6, do not set the output voltage to 180 Volts DC when the AC line input is set to 115 Volts.*

FIGURE 12 – MOTOR VOLTAGE & DC TACHOMETER SELECTION (JUMPER J2)

| Catalog No. BC141 | | Catalog Nos. BC142, BC142-5 and BC142-6 | | |
|---|---|---|---|---|
| J2 Set for 90 Volt Motor (Factory Setting) | J2 Set for Tachometer | J2 Set for 180 Volt Motor (Factory Setting) | J2 Set for 90 Volt Motor (Step-Down) | J2 Set for Tachometer |
|  |  |  |  |  |



8 AC LINE FUSING*

A 25 Amp AC line fuse is factory installed in the AC line fuse holder as shown in Figure 1, on page 10. It is recommended that a 12 Amp AC line fuse be installed for motors rated 7.5 Amps DC or less. Fuses should be normal blow ceramic 3AG, MDA, or equivalent. On domestic 230 Volt AC lines, separate branch circuit protection

** Fuse holders and fuses not supplied with BC142-5.*



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for each line must be used. The optional Barrier Terminal Board (Catalog No. BC147) contains prewired AC line and armature fuse holders, as described in Section 13.2, on page 28.

The AC Line Fuse protects the control against catastrophic failure. If the AC Line Fuse blows, the control is mis-wired, the motor is shorted or grounded, or the control is defective.

*Note: Fuse each AC line conductor that is not at ground potential.*

## 9 PLUG-IN HORSEPOWER RESISTOR® & ARMATURE FUSE KIT*

The appropriate Plug-In Horsepower Resistor® and Armature Fuse are supplied as a prepackaged kit as shown in Table 5, on page 22. Choose the Catalog No. containing the appropriate Plug-In Horsepower Resistor® and Armature Fuse based on motor horsepower and voltage.

9.1 Plug-In Horsepower Resistor® – A Plug-In Horsepower Resistor® (supplied separately) must be installed to match the control to the motor horsepower and voltage. Install the Plug-In Horsepower Resistor® as shown in Figure 1, on page 10. Select the correct Plug-In Horsepower Resistor® as shown in Table 5, on page 22.

*Application Notes:*

1. *The Plug-In Horsepower Resistor® is used to calibrate the IR Compensation and Current Limit based on motor horsepower and voltage. The Plug-In Horsepower Resistor® eliminates the need to recalibrate IR Compensation and Current Limit in most applications.*
2. *Be sure the Plug-In Horsepower Resistor® is inserted completely into the mating sockets.*

9.2 Armature Fuse* – It is recommended that an Armature Fuse (supplied separately) be installed in the armature fuse holder as shown in Figure 1, on page 10. Select the correct fuse as shown in Table 5, on page 22. Fuses should be normal blow ceramic 3AG, MDA, or equivalent. The optional Barrier Terminal Board (Catalog No. BC147) contains prewired AC line and armature fuse holders, as described in Section 13.2, on page 28.

The Armature Fuse provides overload protection for the motor and control. The Armature Fuse required can be calculated by multiplying the maximum DC Motor Current times 1.7.

** Fuse holders and fuses not supplied with BC142-5.*



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TABLE 5 – PLUG-IN HORSEPOWER RESISTOR® & ARMATURE FUSE KIT SELECTION

| 90 - 130 Volt DC Motors (HP) | 180 Volt DC Motors (HP) | Approximate Motor Current (Amps DC) | Plug-In Horsepower Resistor® and Armature Fuse Kit Catalog No. | Plug-In Horsepower Resistor® Value (Ohms) | Armature Fuse Rating (Amps) |
|---|---|---|---|---|---|
| 1/100 | 1/50 | .2 | BR1000 | 1 | .5 |
| 1/50 | 1/25 | .3 | BR0510 | .51 | .5 |
| 1/30 | 1/15 | .33 | BR0350 | .35 | .5 |
| 1/20 | 1/10 | .5 | BR0250 | .25 | .75 |
| 1/15 | 1/8 | .8 | BR0251 | .25 | 1 |
| 1/12 | 1/6 | .85 | BR0180 | .18 | 1.25 |
| 1/8 | 1/4 | 1.3 | BR0100 | .1 | 2 |
| 1/6 | 1/3 | 2 | BR0101 | .1 | 2.5 |
| 1/4 | 1/2 | 2.5 | BR0050 | .05 | 4 |
| 1/3 | 3/4 | 3.3 | BR0035 | .035 | 5 |
| 1/2 | 1 | 5 | BR0025 | .025 | 8 |
| 3/4 | 1½ | 7.5 | BR0015 | .015 | 12 |
| 1* | 2* | 10 | BR0010 | .01 | 15 |
| 1½* | 3* | 15 | BR0006 | .006 | 25 |

* Indicates an Auxiliary Heat Sink (Catalog No. BC143, or equivalent) must be used.

## 10 TRIMPOT ADJUSTMENTS

The control contains trimpots which have been factory set for most applications. Some applications may require readjustment of the trimpots in order to tailor the control for a specific requirement. Readjust the trimpots as described below. See Figure 1, on page 10, for the location of trimpots.



Warning! If possible, do not adjust trimpots with the main power applied. If adjustments are made with the main power applied, an insulated adjustment tool must be used and safety glasses must be worn. High voltage exists in this control. Electrocution can result if caution is not exercised. Safety Warning, on page 6, must be read and understood before proceeding.

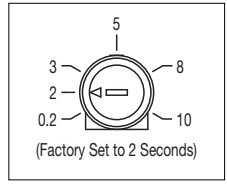


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*Note: In order for the IR Compensation and Current Limit settings to be correct, the proper Plug-In Horsepower Resistor® must be installed for the particular motor and input voltage being used.*
*See Section 9, on page 21.*

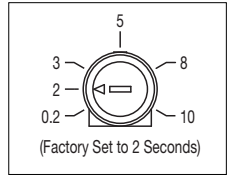
10.1 Acceleration Trimpot (ACCEL) – The ACCEL Trimpot is provided to allow for a smooth start over an adjustable time period each time the AC power is applied or the Main Speed Potentiometer is adjusted to a higher speed. The ACCEL Trimpot has been factory set to 2 seconds, which is the amount of time it will take for the motor to accelerate from zero speed to full speed. To increase the acceleration time, rotate the ACCEL Trimpot clockwise. To decrease the acceleration time, rotate the ACCEL Trimpot counterclockwise. See Figure 13.

FIGURE 13
ACCEL TRIMPOT RANGE




10.2 Deceleration Trimpot (DECEL) – The DECEL Trimpot controls the amount of ramp-down time when the Main Speed Potentiometer is adjusted to a lower speed. The DECEL Trimpot has been factory set to 2 seconds, which is the amount of time it will take for the motor to decelerate from full speed to zero speed. To increase the deceleration time, rotate the DECEL Trimpot clockwise. To decrease the deceleration time, rotate the DECEL Trimpot counterclockwise. See Figure 14.

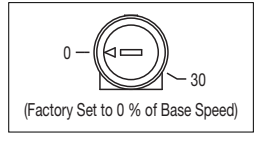
FIGURE 14
DECEL TRIMPOT RANGE




*Note: The deceleration time cannot be made less than the natural coast time of the motor and actual load.*

10.3 Minimum Speed Trimpot (MIN) – The MIN Trimpot sets the minimum speed of the motor when the Main Speed Potentiometer is set fully counterclockwise. The MIN Trimpot is factory set to 0 % of base motor speed. To increase the minimum speed, rotate the MIN Trimpot clockwise. To decrease the minimum speed, rotate the MIN Trimpot counterclockwise. See Figure 15.

FIGURE 15
MIN TRIMPOT RANGE



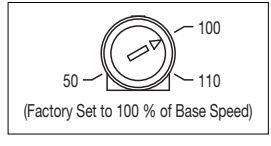



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*Note: Readjusting the MIN Trimpot will affect the maximum speed setting. Therefore, it is necessary to readjust the MAX Trimpot if readjusting the MIN Trimpot. It may be necessary to repeat these adjustments until both the minimum and maximum speeds are set to the desired levels.*

10.4 Maximum Speed Trimpot (MAX) – The MAX Trimpot sets the maximum speed of the motor when the Main Speed Potentiometer is set fully clockwise. The MAX Trimpot is factory set to 100 % of base motor speed. To increase the maximum speed, rotate the MAX Trimpot clockwise. To decrease the maximum speed, rotate the MAX Trimpot counterclockwise. See Figure 16.

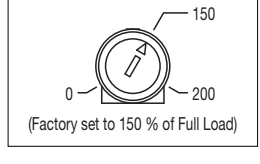
FIGURE 16
MAX TRIMPOT RANGE




CAUTION! Do not set the maximum speed above the rated motor RPM since unstable motor operation may occur.

10.5 Current Limit Trimpot (CL) – The CL Trimpot sets the current limit (overload), which limits the maximum current (torque) to the motor. The CL also limits the AC line inrush current to a safe level during startup. The CL Trimpot is factory set to 1.5 times the full load rating of the motor. To increase the current limit, rotate the CL Trimpot clockwise. To decrease the current limit, rotate the CL Trimpot counterclockwise. Some applications require a lower torque limiting value so as not to damage the process material or the drive train. See Figure 17.

FIGURE 17
CL TRIMPOT RANGE




*Note: The correct value Plug-In Horsepower Resistor® must be installed for the CL to operate properly. Calibration of the CL Trimpot is normally not required when the proper Plug-In Horsepower Resistor® is installed.*

CAUTION! Adjusting the CL above 150% of motor rating can cause overheating and demagnetization of some PM motors. Consult motor manufacturer.


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To Recalibrate the CL Trimpot:

1 Disconnect the AC power and wire a DC ammeter in series with either motor armature lead.

*Note: If only an AC ammeter is available, wire it in series with either AC line input lead.*

2 Set the Main Speed Potentiometer to approximately 30 - 50 % clockwise position.

3 Set the CL Trimpot fully counterclockwise. The CL LED will illuminate red.

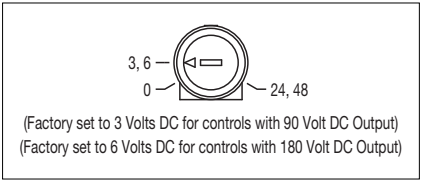
4 Load the motor shaft in accordance with application requirements.

5 Apply power and rotate the CL Trimpot clockwise until the desired current reading is observed on the ammeter. Factory Current Limit setting is 1.5 times the full load rating of the motor (with a DC ammeter wired in series with the motor armature). If using an AC ammeter wired in the AC line input, the factory Current Limit setting will read 0.75 times the full load rating of the motor.

*Note: On cyclical loads, it may be normal for the CL LED to momentarily flash.*

10.6 IR Compensation Trimpot (IR) – The IR Trimpot sets the amount of compensating voltage required to keep the motor speed constant under changing loads. If the load does not vary substantially, the IR Trimpot may be set to a minimum level (approximately 1/4 of full clockwise rotation). The IR Trimpot is factory set to provide 3 Volts of compensation for controls with 90 Volt DC output and 6 Volts of compensation for controls with 180 Volt DC output. To increase the amount of compensating voltage, rotate the IR Trimpot clockwise. To decrease the amount of compensating voltage, rotate the IR Trimpot counterclockwise. See Figure 18.

FIGURE 18 – IR TRIMPOT RANGE




*Notes:*

1. *The correct value Plug-In Horsepower Resistor® must be installed for the IR Compensation to operate properly. Calibration of the IR Trimpot is normally not required when the proper Plug-In Horsepower Resistor® is installed.*



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2. *Excessive IR Compensation will cause the motor to become unstable, which causes cogging.*

3. *For tachometer feedback applications, set the IR Trimpot fully counterclockwise. See Section 6.9, on page 18.*

To Recalibrate the IR Trimpot:

1 Set the IR Trimpot to approximately 25 % rotation.

2 Run the motor unloaded at approximately 1/3 speed and record the RPMs.

3 Run the motor with the maximum load and adjust the IR Trimpot so that the motor speed under load equals the unloaded speed recorded in step 2.

4 Remove the load and recheck the RPMs.

5 If the unloaded RPM has changed, repeat steps 2 - 4 for more exact regulation. The control is now compensated to provide minimal speed change due to changing loads.

## 11 DIAGNOSTIC LEDs

The control is designed with PC board mounted LEDs to display the control's operational status. See Figure 1, on page 10, for the location of the LEDs.

11.1 Power On (PWR ON) – The PWR ON LED will illuminate green when the AC line is applied to the control.

11.2 Current Limit (CL) – The CL LED will illuminate red when the control goes into current limit, indicating that the current limit set point has been reached (set by the CL Trimpot). See Section 10.5, on page 24.

## 12 SWITCHING CIRCUITS

12.1 AC Line Switching – The control can be turned "on" and "off" using the AC line (no waiting time is required). Auto-Inhibit® circuitry automatically resets critical components each time the AC line is interrupted. This, along with Acceleration Start and CL, provides a smooth start each time the AC line is applied.

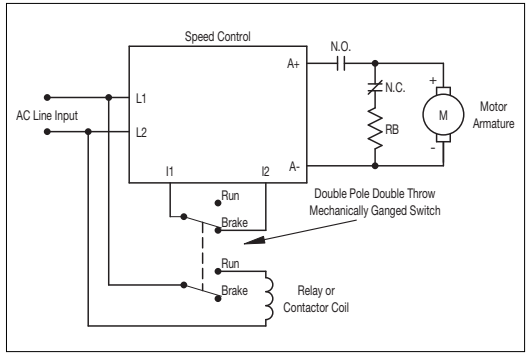


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WARNING! Do not disconnect and reconnect the motor armature with the AC line applied or catastrophic failure will result. See Section 12.2.

12.2 Armature Switching and Dynamic Braking – If the armature is to be disconnected and reconnected with the AC power applied, connect a relay (or contactor) and a brake resistor (RB) in the armature circuit. The Inhibit Circuit must be simultaneously activated when braking. Wire a double pole double throw (DPDT) mechanically ganged switch to the Inhibit Terminals and the relay (or contactor) coil, as shown in Figure 19.

FIGURE 19 – TYPICAL DYNAMIC BRAKE CIRCUIT CONNECTION




When the switch is in the "Brake" position, the relay is deenergized and allows the motor voltage, through the N.C. contact, to be dissipated through RB and dynamically brake the motor. Simultaneously, the Inhibit is activated and the control output is electronically "extinguished", which eliminates arcing.

When the switch is in the "Run" position, the N.C. contact opens, the N. O. contact closes, the Inhibit is deactivated, and the motor begins to accelerate (according to the setting of the ACCEL Trimpot) to the Main Speed Potentiometer setting.

WARNING! The Inhibit Circuit (I1, I2) is never to be used as a Safety Disconnect since it is not fail-safe. Use only the AC line for this purpose.



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## 13 OPTIONAL ACCESSORIES

13.1 Auxiliary Heat Sink (Catalog No. BC143) – Doubles the horsepower rating of the control.

13.2 Barrier Terminal Board (Catalog No. BC147) – Converts the quick-connect terminals of the control to a barrier terminal block. Contains PC board mounted line and armature fuse holders (fuses supplied separately). Plugs onto the quick-connect terminals of the control.

13.3 Signal Isolator (Catalog No. BC152) – Provides isolation between non-isolated signal sources and the control. Plugs onto the quick-connect terminals of the control.

13.4 Dial Plate and Knob Kit (Catalog No. BC149) – Provides indication of the Main Speed Potentiometer position (0 - 100 %).

13.5 DIN Rail Mounting Kit (Catalog No. BC218)

13.6 Current Sensing Overload Protector (Catalog No. BC146) – Provides overload current sensing and protection of DC motors and speed controls rated 1/8 - 3 HP by sensing armature current. Operates on 115 or 230 Volt AC line input.

13.7 RFI Filter (Catalog No. BC24-LF) – Provides RFI and EMI suppression. Rated 24 Amps at 230 Volts AC, 50/60 Hz. Complies with CE Directive 89/336/EEC (EN55022 and/or EN55011) relating to the EMC Class A Industrial Standard. Remote mountable.



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