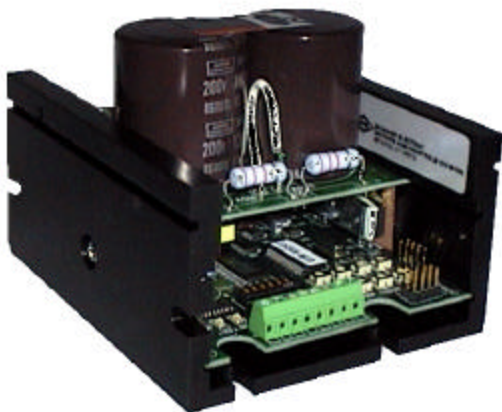


**INSTALLATION & OPERATION  
MANUAL**  
**SECO<sup>®</sup> AC Drives**  
**BRONCO<sup>®</sup> AC 1610 SERIES**



**Seco**  
*AC/DC Drives*



## ENGINEERING CHANGES

Superior Electric reserves the right to make engineering refinements on all its products. Such refinements may affect information given in instructions, Therefore, USE ONLY THE INSTRUCTIONS THAT ARE PACKED WITH THE PRODUCT.

<b>RECORD OF REVISION</b>		
Revision	Date	Description
A	8/26/98	Initial Release
B	10/12/98	Add voltage selection jumper Figure 2-1, Revise Figure 4-2b (connect enable and start), correct typographical errors
C	9/13/00	Add 2HP unit information/Specifications and revise corporate id.

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## Receipt of Shipment

All equipment is tested before shipment, and is shipped in good condition. Any damages or shortages evident when the equipment is received must be immediately reported to the commercial carrier who transported the equipment. If required, assistance is available from the nearest Superior Electric Representative. Always refer to the Superior Electric order number, model number, and serial number when contacting Superior Electric.

**NOTE:** *The information contained here is accurate at the time of publication. Superior Electric reserves the right to make design changes to motor controls described in this manual at anytime and without notice.*



**Figure 1-1**  
**BRONCO® AC 1610 Series (typical)**

# 1.0 GENERAL INFORMATION

This manual outlines installation, operation and troubleshooting practices for the BRONCO® AC 1610 Series, Chassis Mount, Motor Controller. (See Figure 1-1). Section 1 contains a brief description of the product and an overview of its features. Complete specifications, also in Section 1, provide easily referenced information concerning electrical, mechanical and environmental specifications.

Section 2 describes the steps necessary to place your Bronco AC Controller into operation. Mounting information, general wiring guidelines and connections to the unit are covered in Section 3. Operation of your Bronco AC unit is covered in Section 4. Descriptions of user controls, setup information, and potentiometers are also covered in this section.

Section 5, Troubleshooting, provides basic troubleshooting information including expected voltage readings. It also provides a troubleshooting guide to use in case the Bronco AC fails to operate properly.

Before installing and operating your Bronco AC control product, it is extremely important that you thoroughly read and understand this manual. Your Bronco AC product will deliver years of reliable, trouble-free, and most importantly, safe operation if you heed the cautions and warnings outlined in this section, and follow the subsequent instructions in the remainder of this manual.

Throughout this manual two very important symbols will be used to identify hazardous and potentially dangerous situations. The symbols are the electrical shock indicator and the exclamation point. Both are always surrounded by a triangle as shown.



**The electrical shock symbol shown to the left is used to indicate situations where ELECTRICAL SHOCK hazards may exist. These warnings must be followed to ensure that YOU avoid electrocution which could result in serious injury or death.**



The exclamation point symbol shown to the left is used to indicate situations other than electrical hazards which may be potentially dangerous to either YOU or to the product. Follow these warnings carefully to avoid injury to you and damage to the product.



The National Electrical Code (Publication NFPA No. 70) requires that a fused main disconnect switch be installed between the incoming AC line and the drive system or, if used, the power transformer. (Specifically, this includes the controller.) Serious injury or death may result if a disconnect switch is not provided.



The Bronco AC controller is at line voltage when AC power is connected to the unit. The main power feed must be disconnected by a power switch before it is safe to touch the internal parts. Serious personal injury or death may result if this procedure is not observed.



The Bronco AC unit is combined with user chosen components to form a drive package. The user is responsible for proper selection of parts and subsequent operation. The Bronco AC controller should be installed, adjusted and serviced only by qualified personnel who are familiar with the operation of all major components in the system. Serious personal injury or death, and/or equipment damage, may result if this procedure is not followed.



#### **AC POWER APPLICATION**

**To limit excessive AC inrush current, do not apply the AC line voltage more than once per 90 seconds (i.e. wait for the green LED to extinguish before re-applying AC power).**

## **1.1 CONTROLLER**

The Bronco AC motor speed controller converts incoming AC line voltage into adjustable frequency AC voltage which is used to control a conventional three phase AC induction or synchronous motor. The BAC1610 series controllers may be used in applications within the following range:

- 1/8 -2 HP NEC rating
- 115/230 VAC Single Phase Input, 230 VAC Three Phase Output.
- See unit specific specifications in Table 1.

The controller is designed to be integrated into a drive system selected and wired by the user. The control functions required are:

- Speed adjust potentiometer
- Start switch, or relay contact
- Enable switch, relay, or jumper
- Run/Jog switch, or relay contact\*
- Forward/Reverse switch, or relay contact\*

\* If the function is not required the input can be left open/not connected. See Figures 4-2a & 4-2b for connection of these inputs to the controller.

Function	Manufacturer	Examples
Stop/Enable DPDT switch	C&K Eaton Apem	7213 or 7215 series w / B,K,G, or L contacts A233 or A235 series w / B or G contacts ST2-7 or ST2-8 series w / B, g, or N contact
FWD/REV or Run/Jog SPDT switches	C&K Eaton Apem	7101 series w / B,K,G, or L contacts A123 series w / B or G contacts ST1-1 series w / B, G, or N contact
Control relays	Various	Rated to switch less than 10 mA @ 5 VDC

## 1.2 FEATURES AND SPECIFICATIONS

The Bronco AC controller standard features are summarized in Table 1.

**TABLE 1 - BRONCO AC RATINGS AND SPECIFICATIONS**

MODEL	Output Power
BAC1610S	1/8 to 1/2 HP, 2.2 A, 230V, 3-phase
BAC1610H	1/4 to 1.0 HP, 4.2 A, 230V, 3-phase
BAC1610T	1/2 to 2.0 HP, 6.8 A, 230V, 3-phase

### SPECIFICATIONS - All Models – BRONCO AC 1610 Series

#### Ratings

AC line input Voltage	
• BAC1610S / H	94-126 VAC, Single phase, or 187-253 VAC, Single phase, Jumper selectable.
• BAC1610T	187-253 VAC, Single phase
AC line input Current	
• BAC1610S	7.2 Amps (115 VAC) or 4.8 Amps (230 VAC) maximum
• BAC1610H	13.5 Amps (115 VAC) or 9 Amps (230 VAC) maximum
• BAC1610T	15.7 Amps maximum (230 VAC)
AC line frequency	60Hz (115 VAC), 50/60 Hz (230 VAC), ± 4% variation



Output Voltage	
<ul style="list-style-type: none"> <li>120 VAC Input</li> <li>230 VAC Input</li> </ul>	0 to 2 x Input Voltage, 3-phase, 2 - 120 Hz 0 to Input Voltage, 3-phase, 2 - 120 Hz
Service Factor	1.0
Duty	Continuous
Max Load Capacity	150% for 1 min., 200% for 3 sec.
Fusing requirements	
<ul style="list-style-type: none"> <li>BAC1610S/H</li> </ul>	External fuses (fast acting, 20A, 250V) such as ABC20 are strongly recommended in <u>each</u> AC line. Fuse option ( <b>BACFUSE</b> ) is available. It provides fuses and holders which mount directly to the drive.
<ul style="list-style-type: none"> <li>BAC1610T</li> </ul>	External fuses (fast acting, 30A, 250V) such as a GBB 30A, 250V are strongly recommended in <u>each</u> AC line.

### Operating Conditions

Ambient Temperature	0-50°C, 32-122°F
Relative Humidity	5-95% non-condensing
Altitude	to 3300 ft. (1000m)

### Performance Characteristics

Speed Range	6-60Hz or 6-120Hz, 5-50Hz or 5-100Hz
Output Frequency	
<ul style="list-style-type: none"> <li>Setting Resolution</li> <li>Accuracy (stability)</li> <li>Linearity</li> </ul>	$\leq 1\%$ of maximum (base) frequency $\leq 2\%$ of maximum (base) frequency $\leq 2.5\%$ linearity in output frequency
Typical Speed Regulation (% of motor Base speed)	(Exact specifications are dependent on individual motor characteristics)
<ul style="list-style-type: none"> <li>For 95% load change</li> <li><math>\pm 10\%</math> Line change</li> <li>Motor Heating Cold to Normal</li> <li>Temperature change 0 – 50 deg C</li> </ul>	$\leq 3.5\%$ , 6 – 60 Hz $\leq 1\%$ $\leq 1.5\%$ $\leq 1\%$

### Adjustments

Current Range	25%, 50%, 75%, 100% of Maximum current (selected by CURRENT SELECT jumper)
Max Speed	Infinitely variable from 50% to 100% of motor speed
Min Speed	Infinitely variable from 0-40% of Motor Base Speed
Slip Compensation	Infinitely variable from 0-6% increase in frequency at 100% rated current

Voltage Boost	Infinitely variable from 0-30% increase in voltage at 0 HZ, 0% at 30 Hz
Acceleration Rate	0.3 - 30 Seconds (Independent of Base Frequency)
Deceleration Rate	0.3 - 30 Seconds (Independent of Base Frequency)
Internal Jog Speed	Infinitely variable from 10-40% of Base Frequency

## Protection

Bus Under Voltage	70% of rated AC input voltage
Bus Over Voltage	125% of rated AC input voltage
Peak Over Current	200% of rated output current
Timed Over Current	150% for 60 seconds, 200% for 3 seconds
Input AC Transients	MOV protection
Inrush Current	NTC type surge limiting <b>CAUTION! To limit excessive AC inrush current, do not apply the AC line voltage more than once per 90 seconds (i.e. wait for the green LED to extinguish before re-applying AC power).</b>
Fault Trip Reset	A fault may be reset by: (1) momentarily removing the ENABLE\ connection to GND (2) cycling the AC power
IxT Reset Time	After <b>any</b> IxT fault, the drive will remain in the tripped state for <b>60 seconds</b> to allow the drive and motor to cool. During this 60 second interval, the drive cannot be reset.

## Fault Indicators (Inside unit on PCB)\*

Status LED, Green	ON = Ready                      Flashing = Running
Fault LED, Red	ON indicates a fault condition. When a fault occurs, the <u>Green</u> LED will blink periodically to indicate the type of fault:  1 = Short Circuit (BAC1610T units only), 2 = Peak Overcurrent (I > 200%), 3 = Timed Over Current (IxT), 4 = Bus Over Voltage, 5 = Bus Under Voltage.

\* See Table 4 in Section 5 for more information on fault indicators (codes).

## 2.0 EXPRESS START UP PROCEDURE

The following instructions define the minimum steps necessary to make your **Bronco AC 1610 series Motor Controller** operational.



**Always disconnect the power to the Bronco AC before connecting or disconnecting the motor leads. FAILURE TO DO THIS WILL RESULT IN A SHOCK HAZARD AND MAY DAMAGE THE DRIVE.**

**Always operate the Bronco AC with the Motor and unit enclosure GROUNDED.**

The Bronco AC unit has been adjusted by the factory to satisfy most applications. The factory default settings are as follows:

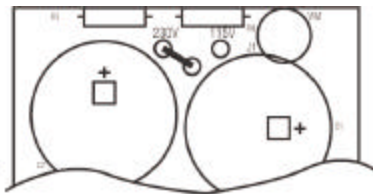
Max Speed (MAX)	60Hz	Min Speed (MIN)	0Hz
Accel. time (ACCEL)	3-4 sec.	Decel. time (DECEL)	3-4 sec.
Boost (BOOST)	3-4%	Jog speed (JOG)	3Hz
Slip Comp. (SLIP)	0%	Maximum Current	100%

If these settings satisfy your application skip steps 4 and 5 .

1. Install the Bronco AC unit as described in Section 3.0
2. Select the desired AC input voltage for your application via the Voltage selection jumper, J1, 115 or 230 nominal. See Figure 2-1 for location of the voltage selection jumper. Voltage selection not available for BAC1610T.



**BAC1610H**



**BAC1610S**

**Figure 2-1**  
**AC Voltage Selection Jumper (J1)**

3. Wire the motor per Figure 3-5.
4. The controller has been factory set for the maximum current and horse power rating as shown on the unit nameplate. If you wish to use a lower maximum current refer to section 4.3.2.
5. Set the desired Max speed, Min speed, Accel time, Decel time, Internal jog speed, Boost value, and Slip compensation using the appropriate potentiometers as described in Section 4.3.3.
6. The User Setup switches have been preset to satisfy most applications **(Only change these settings if required!)** and as defined in Section 4.4. The factory default settings are:

SW1 - Ramp to Stop	SW4 - Max Freq. = 1 X Base Freq.
SW2 - Internal Jog Pot.	SW5 - PWM frequency = 7KHz
SW3 - Base Frequency = 60Hz	SW6 - Reverse Enabled
7. Connect the power source to the AC input terminal strip. Be sure to follow the instructions for connecting the AC input and ground in Sections 3.1.6, 3.2, and Figure 3-5.
8. Read and understand Section 4.0 "Operation" prior to operating the Bronco AC unit. Pay particular attention to Sections 4.1 and 4.2.

#### NOTES:

1. If the motor operates erratically, refer to Section 5, "Troubleshooting".
2. The motor will rotate in the "FORWARD" direction. If the motor direction is not correct, switch off power to the unit, wait a minimum of 90 seconds, reverse any two motor lead connections, and then reapply power.



**CAUTION: Dangerous voltages exist on exposed terminals and components. This is an open chassis unit, designed for installation inside an appropriate, user supplied, enclosure to protect personnel from inadvertent contact and resulting shock hazard.**

## 3.0 INSTALLATION

These procedures describe installation of the BRONCO AC controller.



In cases where the motor speed controller is integrated into a customer-designed drive system, the buyer is responsible for the correct choice of required associated equipment. Incorrectly specified components may cause improper operation and/or damage to the motor speed controller.



Only qualified maintenance personnel should install the controller. They should be familiar with drive systems including operation – and with the possible hazards resulting from improper installation practices. Serious personal injury and/or equipment damage could result if this warning is not observed.



The user is responsible for installation of the entire drive system, in accordance with the National Electrical Code, Publication NFPA No. 70; with Electrical Standards for Metalworking Machine Tools, NFPA No. 79; and with all local and national codes which apply. Serious personal injury, death and/or equipment damage could result if this procedure is not followed.



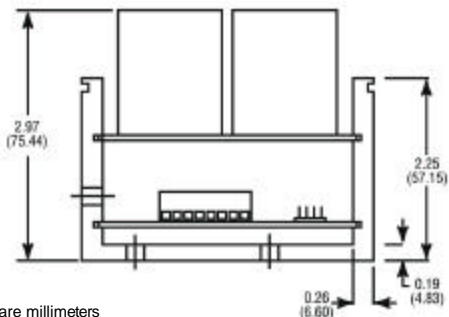
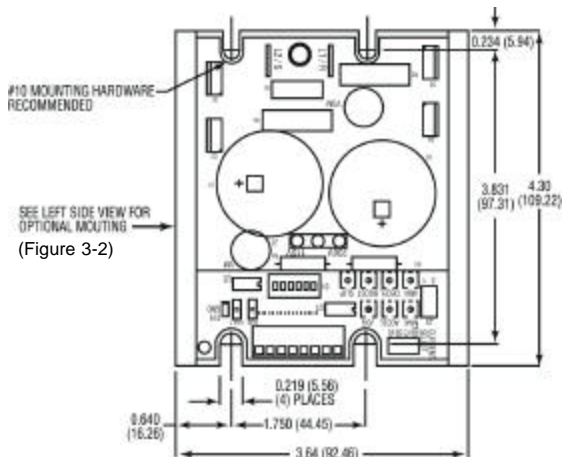
**NONE** of the inputs to the unit are to be used as **EMERGENCY STOP** in **ANY** application. Although activation of certain inputs will cease motion or disable motor current, these are **NOT** designed as fail-safe E-STOP inputs. Relying exclusively on inputs to cease motion which could cause dangerous conditions is a violation of Machine Safety Codes (ref. IEC 204-1). Measures such as removal of AC input power, mechanical stops, and fail-safe brakes must be used in these situations.



The motor may continue to rotate upon removal of power to the unit. It is your responsibility to ensure that no dangerous motion occurs due to gravity loading or free-running motors upon unit shutdown. Fail-safe brakes may be interfaced to the unit to prevent such dangerous conditions.

### 3.1 CONTROLLER MOUNTING

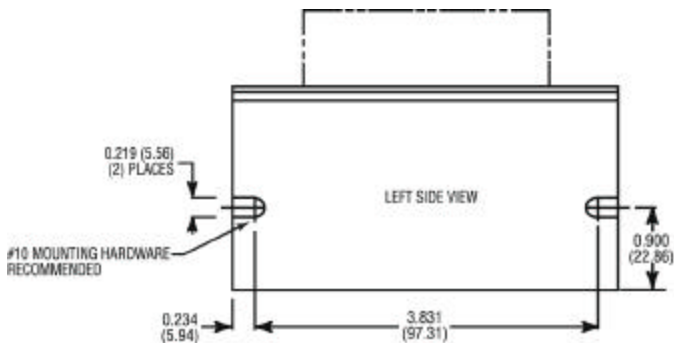
Drill patterns and dimensions for the BAC1610S unit are shown in Figure 3-1.



Dimensions in brackets are millimeters

**Figure 3-1**  
**BAC1610S Dimensions**

Figure 3.2 provides dimensions and mounting hole drill pattern information for the BAC1610S alternate side mounting configuration.

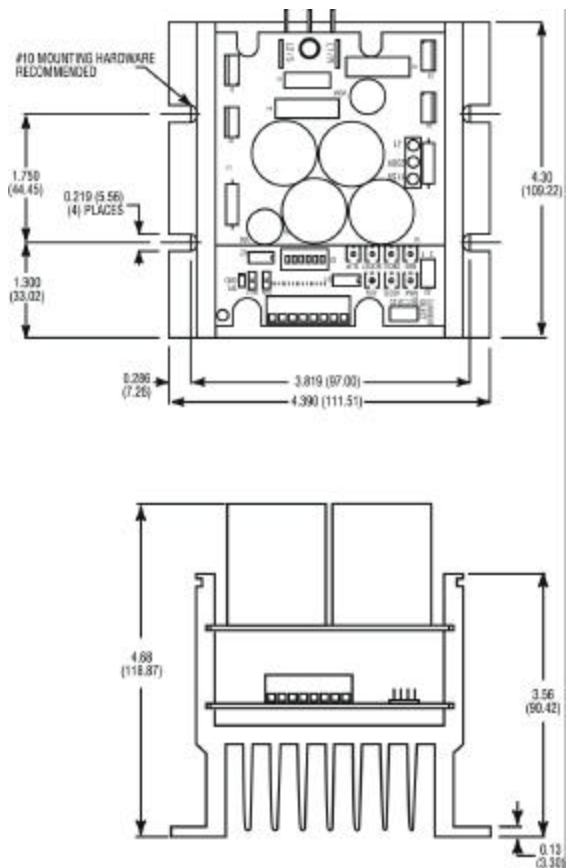


Dimensions in brackets are millimeters.

**Figure 3-2**  
**BAC1610S Alternate Side Mount Dimensions**

Be certain that the mounting area provides the environmental conditions noted in the following paragraphs.

Drill patterns and dimensions for the BAC1610H unit are shown in Figure 3-3.



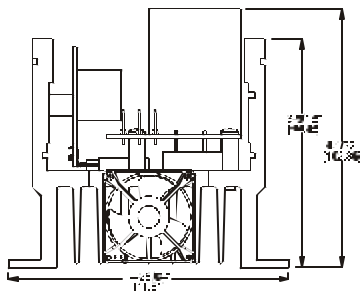
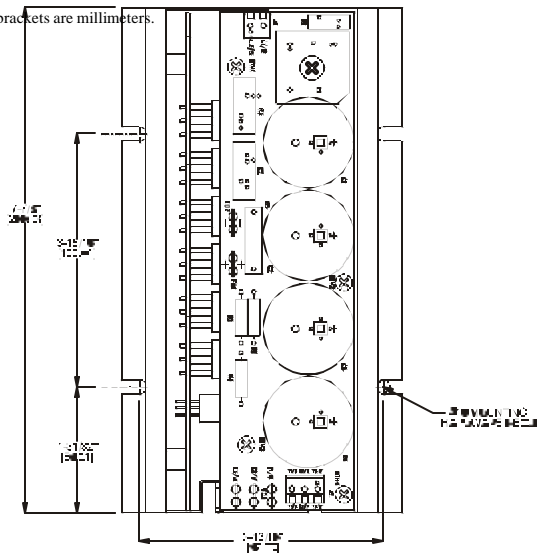
Dimensions in brackets are millimeters.

**Figure 3-3**  
**BAC1610H Dimensions**



Drill patterns and dimensions for the BAC1610T unit are shown in Figure 3-4.

Dimensions in brackets are millimeters.



Dimensions in brackets are millimeters.

**Figure 3-4**  
**BAC1610T Dimensions**

### **3.1.1 AMBIENT TEMPERATURE**

Ambient temperature should not exceed 50°C (122°F).

### **3.1.2 ALTITUDE**

Altitude should not exceed 1000 meters (3300 feet) unless the BRONCO AC has been specially rated for high altitudes. Consult factory for de-rating factor for high altitude operation.

### **3.1.3 AIR CONTAMINANTS**

Ambient air should not be contaminated with caustic chemical vapors, excessive dust, dirt, or moisture. If such conditions exist, the proper enclosure and cooling methods recommended for such conditions should be used.

### **3.1.4 MOUNTING CLEARANCES**

Adequate clearance should be allowed for easy access to terminals and adjustments and to facilitate cooling, inspection, and maintenance. Recommended spacing between units and/or enclosure is 3 inches. A minimum of 4 inches of open, unrestricted space is recommended above and below the unit for proper cooling air flow.

### **3.1.5 MOUNTING AREA**

Mounting area should be free of vibration and have sufficient clear air circulation.

### **3.1.6 GROUND CONDUCTOR**

An equipment ground conductor (that is, ground wire) must be connected to the controller case ground connection point (See Figure 3-5). This conductor must run unbroken to a drive system ground wire connection point, grounding bus or grounding terminal block, as local usage determines.

Separate equipment grounding conductors from other major components in the system must also be run unbroken to a central connection point. These components include:

- Motor
- Drive Enclosure
- Isolation Transformer case, if used
- Operator control panel, if not included on the drive enclosure

## 3.2. INSTALLATION WIRING

Be sure that the AC power supplied is the voltage and frequency called for on the controller's name plate and the AC input jumper is set accordingly. See Figure 2-1. All BAC1610 units are shipped with 230VAC selected. Also be sure that the power line is capable of supplying at least the number of AC amperes indicated on the Ratings chart, in Section 1.2, without voltage reduction. Improper voltage may damage the equipment, and insufficient current will cause erratic operation of the drive. Typical connections are shown in Figure 3-5.

AC Power Terminal Markings:	<b>L1 / R</b>	<b>L2 / S</b>	
Motor Connection Terminal Markings:	<b>T1 / U</b>	<b>T2 / V</b>	<b>T3 / W</b>

### 3.2.1 WIRING CODES

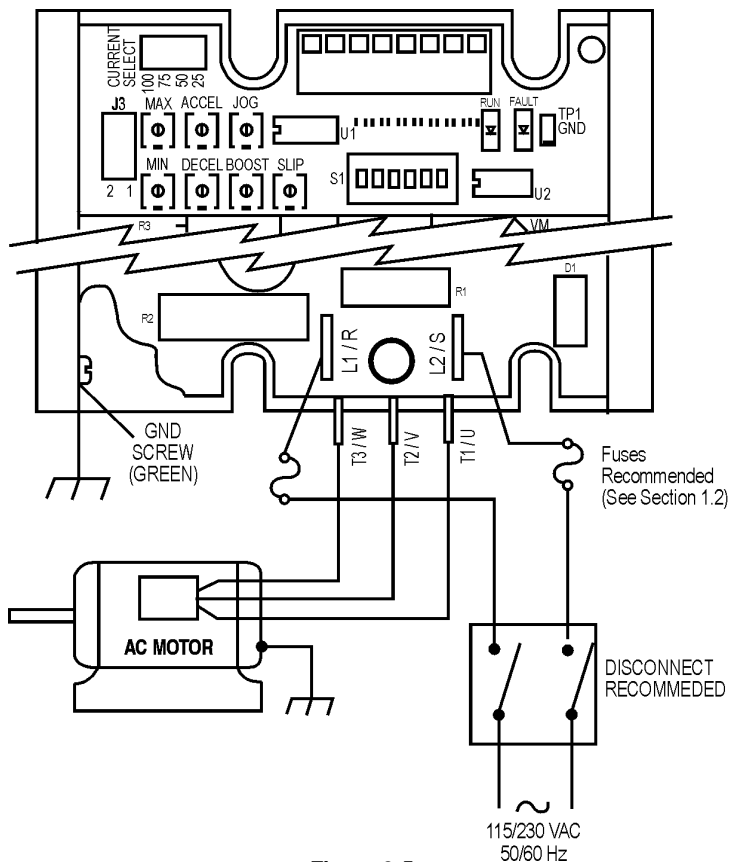
All interconnection wiring should be installed in conformance with the National Electrical Code published by the National Fire Protection Association as well as any other applicable local codes.

### 3.2.2 SHIELDED CABLE

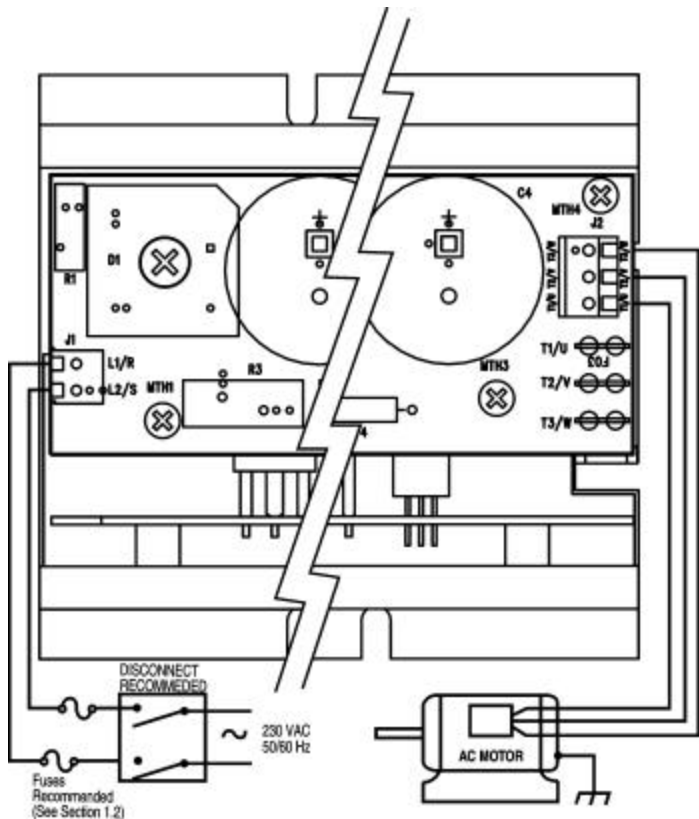
Shielded cable is recommended for the speed potentiometer, and all low-level signal circuits to eliminate the possibility of electrical interference. Connect the shield to chassis ground at the controller end of the cable only. See Figure 3-5 for chassis ground location.



**Follow the applicable wiring diagram provided in Figures 3-5a and 3-5b. When connecting the motor, pay particular attention to the marking on the motor leads. It is possible to damage the Controller and motor if incorrect connections are made.**



**Figure 3-5a**  
**BAC1610S and BAC1610H Connections**



**Figure 3-5b**  
**BAC1610T Connections**

Note: See figure 4-4 in Section 4.5, Dynamic Braking, for external dynamic braking resistor connections.

## 4.0 OPERATION

### 4.1 SPEED ADJUST POTENTIOMETER

The user supplied, 2K - 10Kohm Speed Adjust Potentiometer (See Figures 4-2a and 4-2b) varies speed by controlling motor voltage and frequency after the controller has been started.

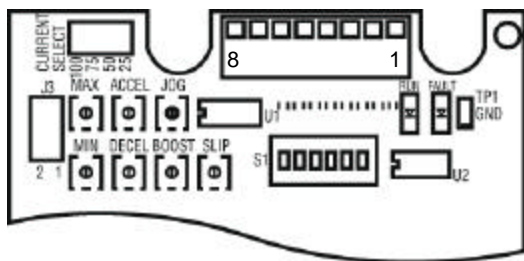
### 4.2 START/STOP

The controller can be wired for push button (3 wire) START/STOP as shown in Figure 4-2a. The controller will operate when the user supplied START button is momentarily pushed. The controller will stop when the user supplied STOP button is momentarily pushed. The START pushbutton is a normally open contact, and the STOP pushbutton is a normally closed contact. If AC Line voltage is removed, the START button must be momentarily pushed to re-start the unit.

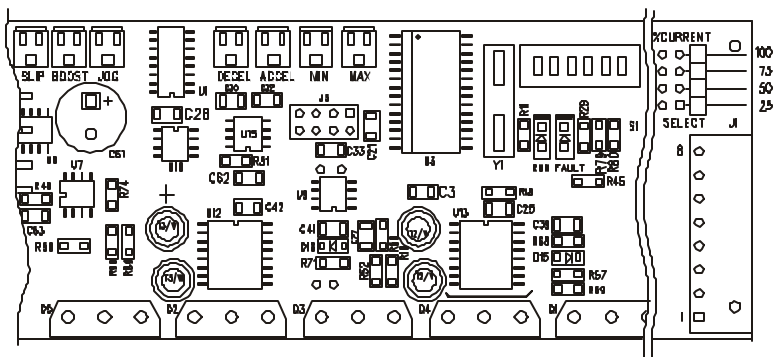
It is possible to use a 2-wire (maintained contact, J1-5 to J1-3) START/STOP circuit, in which case the unit will start when AC power is applied if the START SWITCH is closed. See Figure 4-2b



**LINE VOLTAGE is connected to the controller when the START/STOP SWITCH is in the STOP position. Disconnect the AC line voltage from the controller before attempting to wire or service the controller.**



**Figure 4-1a**  
**User Adjustment Locations for BAC1610S and BAC1610H Units**



**Figure 4-1b**  
**User Adjustment Locations for BAC1610T Units**  
**(Inside side view of controller)**

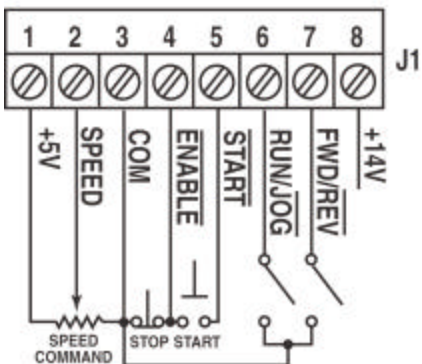


Figure 4-2a  
Remote Operator Controls Interface  
3-Wire START/STOP

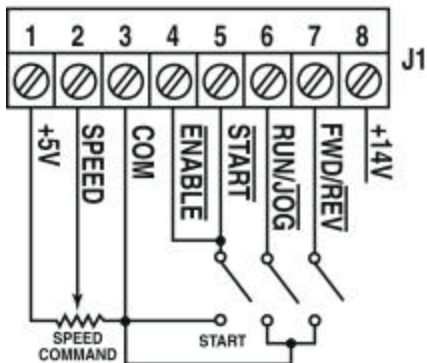


Figure 4-2b  
Remote Operator Controls Interface  
2-Wire START/STOP



## 4.3 INITIAL SETTINGS (All Models)

The following procedure should be followed to check if jumper connections have been made correctly and that potentiometers are adjusted correctly.

All controllers have been tested at the factory under actual motor load. Factory settings for potentiometers are indicated in the procedure.

See Figure 4-1a or 4-1b for location of jumpers and potentiometers.

### 4.3.1 LINE VOLTAGE SELECTION

BAC1610S and 1610H Series controllers operate on a 115/230 VAC single phase, 50/60 Hz supply. They are shipped with the AC Input select jumper in the 230VAC position. Be sure to set the jumper for the appropriate line voltage. See Figure 2-1. BAC1610T Series controllers operate on a 230 VAC single phase, 50/60 Hz power supply.

### 4.3.2 CURRENT SCALING

The controller has been factory set for the maximum current and horsepower rating shown on the name plate. Connections may be made for a lower maximum current rating to accommodate smaller motors by moving the CURRENT SELECT jumper to match the current rating of the motor to be used as follows:

**Table 2. Current Scaling**

% of Max. Current Rating	Current Select Jumper Position	Motor Current Amperes RMS		
		BAC1610S	BAC1610H	BAC1610T
25%	25	0.53	1.05	1.07
50%	50	1.05	2.10	3.04
75%	75	1.58	3.15	5.10
100% (factory default)	100	2.10	4.20	6.80

Note: This input is only read at power up. To use a different setting, remove AC power, wait until the green and red LED's turn off, change the setting, then re-apply the AC power.

### 4.3.3 POTENTIOMETER SETTINGS

The following potentiometer settings should be checked before AC power is applied. The factory settings indicated are set when the controller is tested with a simulated motor load. During start-up it may be necessary to modify them for a specific drive application. Clockwise (CW) rotation of a potentiometer increases a setting and counter-clockwise (CCW) rotation decreases the setting. Refer to Figure 4-1a and 4-1b for potentiometer locations.

### **4.3.3.1 Maximum Speed (MAX)**

The factory setting is at 100% of rated speed. Motor speed can be adjusted to between 50% and 100% of rated speed by adjusting the MAX potentiometer clockwise.

### **4.3.3.2 Minimum Speed (MIN)**

This potentiometer sets the minimum motor speed available when the operator's SPEED ADJUST potentiometer is at zero. The factory setting at full CCW allows the operator to control motor speed down to zero speed. The minimum speed may be increased from 1.8 Hz to 40% of BASE SPEED by turning the MIN potentiometer clockwise.

### **4.3.3.3 Acceleration Time (ACCEL)**

The factory setting represents a time of 3 - 4 seconds to accelerate the motor to top speed. Turning the ACCEL potentiometer clockwise will increase the time required to accelerate the motor to top speed from 0.3 to 30 seconds.

### **4.3.3.4 Deceleration Time (DECEL)**

The factory setting represents a time of 3 - 4 seconds to decelerate the motor from top speed. Turning the DECEL potentiometer clockwise will increase the time required to decelerate the motor from top speed. The range is from 0.3 to 30 seconds.

### **4.3.3.5 Internal Jog Speed (JOG)**

The factory setting represents a setting of 3Hz. Internal Jog Speed can be adjusted from 10 to 40% of base frequency.

### 4.3.3.6 Boost (BOOST)

This potentiometer is used to set the Boost percentage. Boost is defined as an increase in voltage at the minimum output frequency, which is linearly reduced to 0% at 30Hz. The factory setting of full CCW represents a setting of 3 to 4% Boost. Full CW rotation gives a Boost value of 30% at 2Hz.

To avoid over heating of the motor use the lowest Boost setting possible to start the motor. Excessive Boost can damage the motor or cause unnecessary peak overcurrent or IxT shutdowns.

### 4.3.3.7 Slip Compensation (SLIP)

This control provides a means of improving motor speed regulation. The factory setting provides 0% compensation. To compensate for motor slip losses, run the motor at the required speed with no motor load, then increase the load to maximum and adjust, SLIP COMP, to obtain the same motor speed as with no load.



**Excessive slip compensation can cause instability.**

## 4.4 USER SETUP

The BRONCO AC utilizes a 6 position DIP switch (Figure 4-3) to provide easy set up of the various user configurations. The factory default setting is switches 1-6 in the ON/UP position. The following is a description of each switch position:



**Figure 4-3 User Setup Dip Switches (S1)**

## Ramp - Position 1

Selects Ramp to Stop (at rate set by deceleration potentiometer) or Coast to Stop, when Stop is commanded.

SW1 ON = Ramp To Stop  
SW1 OFF = Coast to Stop

## JOG Select – Position 2

Selects either the internal JOG Potentiometer or the Main Speed Potentiometer as the source for the JOG Speed command.

SW2 ON = Internal JOG Pot  
SW2 OFF = Main Speed Pot

## Base Frequency – Position 3

Selects either 50 Hz or 60 Hz as the base frequency of operation.

SW3 ON = Base Frequency 60 Hz  
SW3 OFF = Base Frequency 50 Hz

Note: This input is only read at power up. To use a different setting, remove AC power, wait until the green and red LED's turn off, change the setting, then re-apply the AC power.

## Max. Frequency – Position 4

Sets the maximum frequency at either 1 time or 2 times the base frequency set by SW3.

SW4 ON = 1X Base Frequency  
SW4 OFF = 2X Base Frequency

Note: This input is only read at power up. To use a different setting remove AC power, wait until the green and red LED's turn off, change the setting, then re-apply the AC power.

## **PWM Frequency – Position 5\***

Sets the carrier frequency of the PWM wave form. 7 KHz and 14 KHz carrier frequencies are available. If 14KHz is used there is less audible noise but some de-rating is required.

SW5 ON = 7KHz

SW5 OFF = 14KHz (derate to 85% current)

Note: This input is only read at power up. To use a different setting, remove AC power, wait until the green and red LED's turn off, change the setting, then re-apply the AC power.

## **Reverse Enable – Position 6**

Enables/Disables the reverse setting of the FOR/REV switch.

SW6 ON = Reverse Enable

SW6 OFF = Reverse Disable

\* Fixed at 7KHz for the BAC1610T.

## **4.5 DYNAMIC BRAKING (BAC1610T only)**

### **4.5.1 INTRODUCTION**

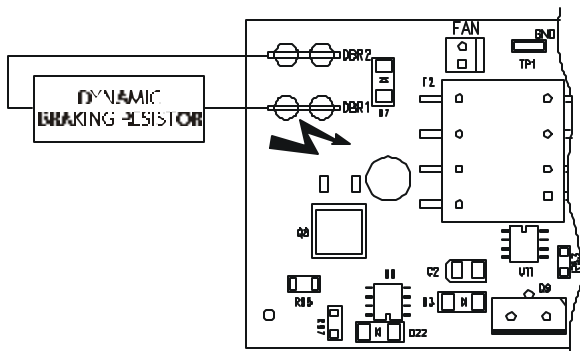
The Dynamic brake option, available on BAC1610T units, provides a method of dissipating the energy “generated” back into the drive during deceleration or when the load is overhauling the motor. The electronic module monitors the DC bus voltage in the drive and when the DC voltage reaches a set level the Braking Resistor(s) are switched across the DC bus by an IGBT to keep the DC voltage below the overvoltage trip level. See Figure 4-4 for DB Resistor connections.

### **4.5.2 APPLICATIONS REQUIRING DYNAMIC BRAKING**

Any application that has an overhauling load or requires a deceleration faster than “Coast-to-Rest” may require the use of dynamic braking. Typical applications with a large inertia and low friction, such as fans and centrifuges, will require the energy dissipation feature of dynamic braking to meet normal deceleration requirements.

### 4.5.3 DYNAMIC BRAKING OPTIONS

Model number BAC1610T contains the dynamic braking electronics installed in the unit. An external dynamic braking resistor kit, part number DBA270-56, is available with a resistor and an external thermal detection device. The external dynamic braking resistor comes in a NEMA 1 enclosure which must be mounted separately from the BAC1610T unit. Connections for the external dynamic braking resistor are shown below.



**Figure 4-4**  
**External Dynamic Braking Resistor Connections**

## 5.0 TROUBLESHOOTING

### 5.1 VOLTAGE READINGS

The following voltage readings are typical for BRONCO® AC controls under normal operating conditions. These readings should be made with a Simpson Model 260 V.O.M. or equivalent.

**Table 3. Voltage Readings**

TERMINALS	FUNCTION	MEASUREMENT
L1 to L2	AC Voltage Input	94 - 126 or 187 - 253 VAC rms
J1-3 to J1-8	VCC	14.50 ± 0.7 V
J1-3 to J1-1	VDD	5.00 ± 0.25 V
J1-3 to J1-2	SPEED COMMAND	0-5 V, varies with Pot. Setting
J1-3 to J1-4	ENABLE	5 V when stopped 0 V if running or starting
J1-3 to J1-5	START	5 V when stopped or running 0 V if starting
J1-3 to J1-6	JOG	5 V when running 0 V when jogging
J1-3 to J1-7	FWD/REV	5 V for forward 0 V for reverse

### 5.2 TROUBLESHOOTING GUIDE

#### **WARNING:**

Motors connected to the Bronco AC can develop high torque and large amounts of mechanical energy.

Keep clear of the motor shaft and all parts mechanically linked to the motor shaft.

Turn off all power to the Bronco AC before performing work on parts mechanically coupled to the motor.

If installation and operating instructions have been followed carefully, this unit should operate correctly. If the motor fails to operate properly, the following checklist will help in locating and correcting the problem.



## In General:

Check all installation wiring carefully for wiring errors or poor connections.

Check to see that the proper voltage levels are being supplied to the unit.

Be sure that the motor is a correct model for use with this unit.

## Fault Indicators (Inside unit on PCB)

There are two indicator LEDs located on the Bronco AC main circuit board (upper right corner). These LEDs provide information on the drive operation as follows:

Status LED, Green

ON = Ready

Flashing = Running

Fault LED, Red

ON indicates a fault condition. When a fault occurs, the Green LED will blink periodically to indicate the type of fault.

Table 4 contains a list of Faults, LED blink rate, and possible corrective actions.

Table 4. Fault Codes and Possible Corrective Actions

Fault Code (Blinks)	Description	Possible Cause/Solution
1	Short Circuit (BAC1610T only)	<ul style="list-style-type: none"> <li>* Check the motor wiring for a phase-to-phase or a phase-to-ground short circuit.</li> <li>* Check the wiring insulation for a short circuit to the conduit or motor frame.</li> <li>* Check for short circuits in the drive (Hi-Pot test, consult the factory first).</li> <li>* If the drive runs for some time before faulting: Check for blockage of the cooling fins and provide increased ventilation or, Reduce the ambient temperature of the drive or, Provide airflow across the drive's fins for cooling.</li> </ul>
2	Peak Overcurrent ( $I > 200\%$ ),	<ul style="list-style-type: none"> <li>* Reduce the load or eliminate "shock loading" on the motor.</li> <li>* Is the Rotor locked? Remove load, obstruction, or release brake.</li> <li>* Is the Current Select jumper set too low? Move jumper to next higher setting.</li> <li>* If fault occurs when stopping or decelerating, increase the Deceleration time.</li> <li>* If fault occurs when starting or accelerating, increase the Acceleration time.</li> <li>* If the fault occurs when starting or running, reduce the Boost setting.</li> <li>* If the motor speed is unstable before faulting, reduce the Slip Compensation.</li> </ul>
3	Timed Over Current (IxT)	<ul style="list-style-type: none"> <li>* Reduce the steady-state load on the motor.</li> <li>* Increase the cycle time between drive/motor overloading (process change).</li> <li>* Is the Current Select jumper set too low? Move jumper to next higher setting.</li> <li>* Is Boost set too high? Decrease the Boost setting.</li> <li>* If the motor speed is unstable before faulting, reduce the Slip Compensation.</li> <li>* Is the motor under sized (HP too low) for the application?</li> </ul>

4	Bus Over Voltage	<ul style="list-style-type: none"> <li>* Has a momentary power surge occurred? If yes, reset the drive and continue.</li> <li>* Is the AC line voltage within the specified operating range? If not: Correct the AC line voltage from the distribution network or decrease the AC line voltage with a POWERSTAT<sup>®</sup> or a transformer.</li> <li>* Check for secure mechanical connection to the AC lines at L1/R and L2/S.</li> <li>* If fault occurs when decelerating or stopping, increase the deceleration time.</li> <li>* Does the fault occur when the load is removed suddenly? If yes: Remove the load more slowly or Increase the deceleration time.</li> <li>* If fault occurs immediately after rapid acceleration, decrease the load inertia.</li> </ul>
5	Bus Under Voltage	<ul style="list-style-type: none"> <li>* Has a momentary power failure occurred? If yes, reset the drive and continue.</li> <li>* Is the AC line voltage within the specified operating range? If not: Correct the AC line voltage from the distribution network or increase the AC line voltage with a POWERSTAT<sup>®</sup> or a transformer.</li> <li>* Check for secure mechanical connection to the AC lines at L1/R and L2/S.</li> <li>* Check for faulty circuit breaker or AC contactor.</li> <li>* Are other drives/motors or processes pulling the line down or is the line impedance too high? Move the AC connections to some other point.</li> <li>* If the fault occurs when starting or accelerating: Increase the acceleration time or Decrease the boost setting.</li> </ul>

**Note: All Bronco AC units must be returned to the factory for repair, they are not field repairable.**

# APPENDIX A CE Compliance Installation Requirements and Information

Certain practices must be followed when installing the Bronco® AC BAC1610 series drives in order to meet the CE Electromagnetic Compatibility (EMC) Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC as amended by 93/68/EEC). The Bronco AC 1610 family of products are components intended for installation within other electrical systems or machines. The system or machine builder must ensure their system or end product complies with all applicable standards required for that equipment, including overall CE certification. Following these practices will help ensure (but cannot guarantee) that the machine in which these components are utilized will meet overall CE requirements.

## Electromagnetic Compatibility Directive

In order to meet the various EMC Standards, all wiring must be done in accordance with the practices shown in Figure 1.

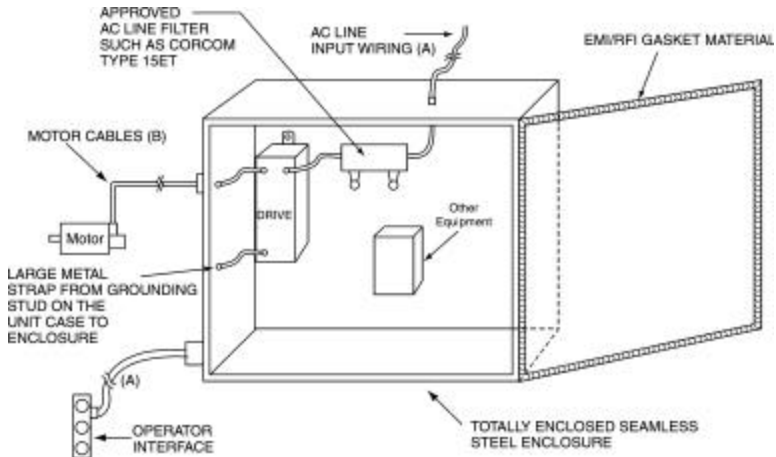
To meet these requirements, the unit must be placed inside a metal enclosure, as shown in Figure 1.

## Standards

EN55011, Class A:	for Radiated and Conducted Emissions
EN50082-2/1995:	for Immunity

## Low Voltage Directive

- 1) These drives are to be operated in a pollution degree 2 environment as described in standard EN50178.
- 2) All of the control inputs and outputs are connected to the main input power. Control inputs and outputs will need a level of protection against direct contact as required by the standards governing the overall system or machine and its intended operating environment. It is the machine-builder's responsibility to provide this protection, as needed.
- 3) All cautions and warnings listed throughout the operators manual **MUST** be followed to insure safe system operation.



- (A) All wiring runs through metal jacketed conduit which are attached to the enclosure with clamps making sound electrical contact.
- (B) Motor cable to be a twisted bundle containing three phase conductors around a central ground conductor surrounded by a copper braided shield such as Olfex type VSD or equivalent. The shield is bonded to the enclosure bare metal surface using shield grounding connectors such as Olfex Skintop MS-SC or equivalent.

Notes:

- 1) All metal mating surfaces within the enclosure, and any mounting plates should be cleaned of paint, anodizing and coating material for proper electrical bonding. This includes mounting of the drive, line filter, and any other equipment.
- 2) If mounting plates are used, proper electrical contact to the main enclosure must be maintained. Using copper straps with length-to-width ratios less than 3 is optimum.

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## WARRANTY AND LIMITATION OF LIABILITY

Superior Electric (the "Company"), Bristol, Connecticut, warrants to the first end user purchaser (the "purchaser") of equipment manufactured by the Company that such equipment, if new, unused and in original unopened cartons at the time of purchase, will be free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from the Company's factory or a warehouse of the Company in the event that the equipment is purchased from the Company or for a period of one year from the date of shipment from the business establishment of an authorized distributor of the Company in the event that the equipment is purchased from an authorized distributor.

**THE COMPANY'S OBLIGATION UNDER THIS WARRANTY SHALL BE STRICTLY AND EXCLUSIVELY LIMITED TO REPAIRING OR REPLACING, AT THE FACTORY OR A SERVICE CENTER OF THE COMPANY, ANY SUCH EQUIPMENT OR PARTS THEREOF WHICH AN AUTHORIZED REPRESENTATIVE OF THE COMPANY FINDS TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP UNDER NORMAL USE AND SERVICE WITHIN SUCH PERIOD OF ONE YEAR. THE COMPANY RESERVES THE RIGHT TO SATISFY SUCH OBLIGATION IN FULL BY REFUNDING THE FULL PURCHASE PRICE OF ANY SUCH DEFECTIVE EQUIPMENT.** This warranty does not apply to any equipment which has been tampered with or altered in any way, which has been improperly installed or which has been subject to misuse, neglect or accident.

**THE FOREGOING WARRANTY IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE,** and of any other obligations or liabilities on the part of the Company; and no person is authorized to assume for the Company any other liability with respect to equipment manufactured by the Company. The Company shall have no liability with respect to equipment not of its manufacture. **THE COMPANY SHALL HAVE NO LIABILITY WHATSOEVER IN ANY EVENT FOR PAYMENT OF ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, WITHOUT LIMITATION, DAMAGES FOR INJURY TO ANY PERSON OR PROPERTY.**

Written authorization to return any equipment or parts thereof must be obtained from the Company. The Company shall not be responsible for any transportation charges.

**IF FOR ANY REASON ANY OF THE FOREGOING PROVISIONS SHALL BE INEFFECTIVE, THE COMPANY'S LIABILITY FOR DAMAGES ARISING OUT OF ITS MANUFACTURE OR SALE OF EQUIPMENT, OR USE THEREOF, WHETHER SUCH LIABILITY IS BASED ON WARRANTY, CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE, SHALL NOT IN ANY EVENT EXCEED THE FULL PURCHASE PRICE OF SUCH EQUIPMENT.**

Any action against the Company based upon any liability or obligation arising hereunder or under any law applicable to the sale of equipment, or the use thereof, must be commenced within one year after the cause of such action arises.

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These products are sold subject to the standard Limitation of Liability and/or Warranty of Superior Electric.

**The right to make engineering refinements on all products is reserved. Dimensions and other details are subject to change.**

## Distribution Coast-To-Coast

Seco AC/DC drive products are available nationally through an extensive authorized distributor network. These distributors offer literature, technical assistance and a wide range of models off the shelf for fastest possible delivery and service.

In addition, Seco AC/DC drive sales and application engineers are conveniently located to provide prompt attention to customers' needs. Call Seco AC/DC drives customer service for ordering and application information or for the address of the closest authorized distributor for Seco AC/DC drive products.

### In U.S.A. and Canada

383 Middle Street

Bristol, CT 06010

Tel: 860-585-4500

Fax: 860-589-2136

Customer Service: 1-800-787-3532

Product Application: 1-800-787-3532

Product Literature Request: 1-800-787-3532

Fax: 1-800-766-6366

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