

## Focus 1

1/4 to 2HP Single Phase,  
Uni-Directional  
Non-Regenerative  
DC Drive

## User Guide

P/N: FOCUS1-UG

Revision: A1

Date: Feb 10, 2005

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## **General Information**

The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation or adjustment of the optional operating parameters of the equipment or from mismatching the variable speed drive with the motor.

The contents of this User Guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specifications of the product or its performance, or the contents of the User Guide, without notice.

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# Customer Support

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359 Lang Boulevard, Building B  
Grand Island, New York 14072  
U.S.A. Telephone: (716) 774-1193

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You can FAX questions and comments to Control Techniques Just send a FAX to the number listed above.

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If you have Internet capabilities, you also have access to technical support using our website. The website includes technical notes, frequently asked questions, release notes and other technical documentation. This direct technical support connection lets you request assistance and exchange software files electronically.

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Control Techniques' products are backed by a team of professionals who will service your installation. Our technical support center in Grand Island New York is ready to help you solve those occasional problems over the telephone. Our technical support center is available 24 hours a day for emergency service to help speed any problem solving. Also, all hardware replacement parts, if needed, are available through our customer service organization.

When you call, please be prepared to provide the following information:

- The type of controller or product you are using
- What you were doing when the problem occurred
- How you tried to solve the problem

Need on-site help? Control Techniques provides service, in most cases, the next day. Just call Control Techniques' technical support center when on-site service or maintenance is required.

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Authorized Control Techniques distributors may place orders directly with our Customer Service department. Contact the Customer Service department at this number for the distributor nearest you.

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 <b>WARNING</b>
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“Warning” indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

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 <b>CAUTION</b>
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“Caution” indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.

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<b>CAUTION</b>
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“Caution” used without the safety alert symbol indicates a potentially hazardous situation that, if not avoided, may result in property damage.

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# **Safety Considerations**

## **Safety Precautions**

This product is intended for professional incorporation into a complete system. If you install the product incorrectly, it may present a safety hazard. The product and system may use high voltages and currents, carry a high level of stored electrical energy, or are used to control mechanical equipment that can cause injury.

You should give close attention to the electrical installation and system design to avoid hazards either in normal operation or in the event of equipment malfunction. System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. Read and follow this safety information and instruction manual carefully.

## **Enclosure**

This product is intended to be mounted in an enclosure that prevents access except by trained and authorized personnel and prevents the ingress of contamination. This product is designed for use in an environment classified as pollution degree 2 in accordance with IEC664-1. This means that only dry, non-conducting contamination is acceptable.

## **Setup, Commissioning and Maintenance**

It is essential that you give careful consideration to changes to drive settings. Depending on the application, a change could have an impact on safety. You must take appropriate precautions against inadvertent changes or tampering. Restoring default parameters in certain applications may cause unpredictable or hazardous operation.

## **Safety of Machinery**

Within the European Union all machinery in which this product is used must comply with Directive 89/392/EEC, Safety of Machinery.

The product has been designed and tested to a high standard, and failures are very unlikely. However the level of integrity offered by the product's control function – for example stop/ start, forward/reverse and maximum speed – is not sufficient for use in safety-critical applications without additional independent channels of protection. All applications where malfunction could cause injury or loss of life must be subject to a risk assessment, and further protection must be provided where needed.

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**General warning**

Failure to follow safe installation guidelines can cause death or serious injury. The voltages used in this unit can cause severe electric shock and/or burns, and could be lethal. Extreme care is necessary at all times when working with or adjacent to this equipment. The installation must comply with all relevant safety legislation in the country of use.

**AC supply isolation device**

The AC supply must be removed from the drive using an approved isolation device or disconnect before any servicing work is performed, other than adjustments to the settings or parameters specified in the manual. The drive contains capacitors, which remain charged to a potentially lethal voltage after the supply has been removed.

**Grounding (Earthing, equipotential bonding)**

The drive must be grounded by a conductor sufficient to carry all possible fault current in the event of a fault. The ground connections shown in the manual must be followed.

**Fuses**

Fuses or over-current protection must be provided at the input in accordance with the instructions in the manual.

**Isolation of control circuits**

The installer must ensure that the external control circuits are isolated from human contact by at least one layer of insulation rated for use at the applied AC supply voltage.

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# **Introduction**

This is the User's Guide for Focus 1 (Non-regenerative) series of DC Drives. The Focus 1 is a 2nd generation product of the long-standing Focus series. The Focus 1 was introduced back in 1980. The Focus 1 non-regen drive remains as a popular single-phase, uni-directional analog drive for DC motors with power ranges from ¼ to 2HP.

Your Focus 1 is a general purpose non-regenerative DC motor speed controller that is powered from either 115Vac or 230Vac single phase power. A non-regenerative (single quadrant) drive is one that can provide motoring torque for acceleration and to overcome rated loads. There are a great many applications where non-regenerative drives provide the most economical solution. A non-regenerative drive however cannot slow down a motor faster than the motors normal coasting rate (unless a Dynamic Braking stop is commanded) nor can it stop overhauling load situations. For more demanding applications, a sister drive- the Focus 3 Regen (regenerative model), offers full four quadrant operation for bi-directional motor control and controlled deceleration as well as opposition to overhauling loads.

Focus 1 drives come in two basic model variations- with and without enclosure.

## **Chassis Model**

The model without an enclosure is denoted as a chassis model. The chassis model is intended for mounting within a User supplied cabinet and where the User intends to provide remote Start/Stop and Speed control signals.

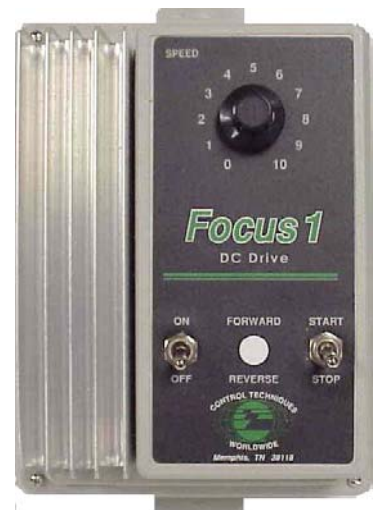


## **Enclosed Model**

The Enclosed version comes to you already in a NEMA 1 enclosure that would allow the User to mount the Focus on a wall or machine surface. The Enclosed version has Power On/Off Switch, a spring to center Start/Stop switch and the Speed Control adjustment right on the front cover for convenient operation. For additional environmental protection, a NEMA 4/12 option kit is available.

For a complete overview of the Focus 1 product line and available options, visit our website at: [www.emersonct.com](http://www.emersonct.com) or click the link below:

**Focus 1 Catalog Section**



# Motor Compatibility

The Focus 1 was designed to run standard 90 Vdc or 180 Vdc Shunt Wound or Permanent Magnet DC motors in one direction. The Focus 1 can run motors with other characteristics (such as Universal motors) but one must review those requirements to insure compatibility. Universal motors have commutator brushes but typically plug into the AC power line. Universal motors are often used in tools such as Drills, Saws, Shop VAC's, Routers, etc and typically direction cannot be reversed.

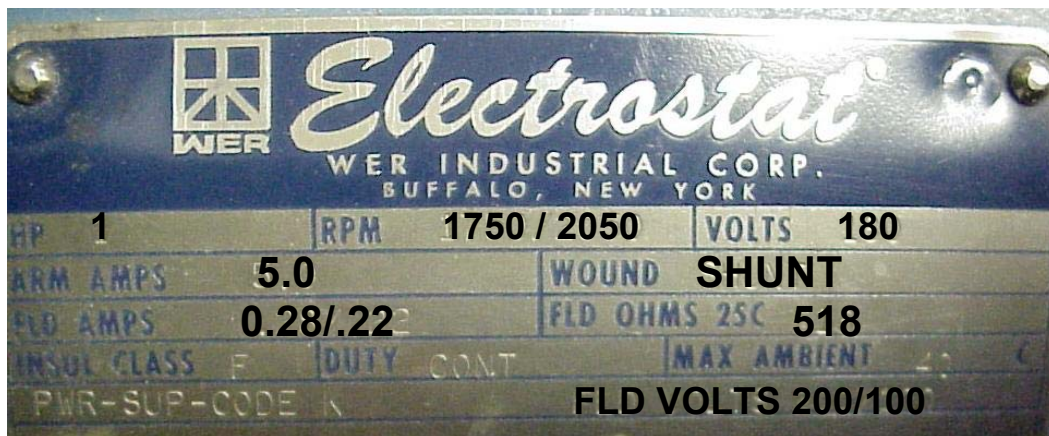
**Shunt Wound Motors** that are controlled by single phase DC drives typically have 4 power wires. Two of these are the Armature leads typically designated A1 & A2 or A+ & A-. The other two power wires are the shunt field leads and typically designated F1 & F2 or F+ & F-. The Focus 1 can supply up to **1 Amp** for shunt field excitation (field current requirements beyond 1A may damage field rectifier diodes). If your motor does not have Field Current information on the nameplate, you can determine compatibility by measuring your motors Field resistance using a calibrated ohmmeter.

## **Motors with:**

**90v Armatures** typically require 100 Vdc for field excitation. In these cases, the Focus 1 requires 120vac input power and must be internally set for this input level. The motor Field resistance should not be less than 100 ohms when cold.

**180v Armatures** typically require 200 Vdc for field excitation. In these cases, the Focus 1 requires 240vac input power and must be internally set for this input level. The motor Field resistance should not be less than 200ohms when cold.

The motor nameplate information is key to determining compatibility. As seen below, the motor below easily falls in the range of the Focus 1 operated from a 240vac supply. The drive will supply 180v for the armature and 200v for the field ( this motor indicates there are 2 field windings and for 200vdc they must be wired in series ). The field current requirement is 0.28A which is well under the 1A maximum.



**240v Armatures** typically require 150 Vdc for field excitation. In these cases, the Focus 1 requires 240vac input power and must be internally set for this input level. The motor field resistance should not be less than 150 ohms when cold and will require a series resistor to drop the additional field supply voltage. Consult Control Techniques Technical Support for additional information.

# Motor Compatibility

## Motors with:

**Permanent Magnet Motors** typically have only 2 power wires. These are the Armature leads and typically designated A1 and A2 or A+ and A-. The Focus 1 is compatible with most all PM motors having either 90v or 180v armatures.

		Armature Voltage	Armature Current
EMERSON Industrial Controls			
PART NO.	3156 - 420	RPM	1725
HP	1	V	180
TIME RATING	CONT	TEMP	40 °C
K V	93	K T	7.8
WOUND	PM	FR	6
MOD	5BPB56SAA24B	SERIAL NO.	OAN

Permanent Magnets

# **Speed Control**

## **Armature Voltage Feedback**

The Focus 1 varies the speed of the motors mentioned above as a function of the Speed potentiometer setting (or external speed command signal) by simply varying the output Armature voltage (field excitation if used typically remains constant). Armature Voltage Feedback (or simply Armature Feedback) does not require any special motor mounted speed feedback device and is therefore inherently quite reliable and is capable of providing up to 1% speed regulation.

## **Quick Stops**

A non-regenerative drive cannot stop a motor faster than the motors normal coasting rate unless a Dynamic Braking resistor is employed. The DB option provides a rather quick stopping action and provides motor turning resistance when the drive is not in the RUN condition. The Focus 1 can be outfitted with a Dynamic Braking resistor should this requirement be desired.

**Note:** DB Resistors require Contactor Option - See [Options](#)

## **Power Outages**

### **Shunt Wound Motors**

Should a power outage occur, the drive would turn off and the motor would coast to rest. If a Dynamic Braking resistor were employed there would typically be enough decaying field strength to enable some faster stopping action but this should be tested from full speed to determine if power outage stopping time is sufficient should this factor be a safety consideration for your application.

### **Permanent Magnet Motors**

Should a power outage occur, the drive would turn off and the motor would coast to rest. If a Dynamic Braking resistor were employed, full Dynamic Braking force would be exerted because the field is maintained by the motors internal permanent magnets. Therefore, there would be motor turning resistance during power outages as well.

## General Information

## Introduction

The purpose of this manual is to provide the user with the information needed to install, start-up, and maintain the Focus 1 drive. This instruction manual should be read in its entirety, paying special attention to the warning and caution notices, before installation and before performing any start-up or drive maintenance.

## Receiving

The user is responsible for inspecting the equipment thoroughly before accepting the shipment from the freight company. Check the items received against the purchase order. If any items are obviously damaged, do not accept delivery until the damage has been noted on the freight paperwork.

## Inspection

Before installation and start-up of the drive, inspect the unit for mechanical integrity (i.e. loose parts, wires, etc). If physical damage was sustained during shipment, leave the shipping container intact and notify the freight agent. After unpacking, check the drive nameplate catalog number against the purchase order. See page 15 for nameplate location.

## Storing

Store the drive in its shipping container prior to installation. If the drive isn't used for a period of time, store according to the following instructions in order to maintain warranty coverage:

Clean, dry location  
Ambient Temperature Range: -40°C to 70°C  
:-40°F to 160°F  
Humidity: 95%, Non-condensing

## WARNING

Improper procedures can result in personal injury or equipment damage. Only qualified electrical maintenance technicians familiar with electronic drives and their standard safety precautions should be permitted to install, start-up, or maintain this apparatus.

## **PERFORMANCE FEATURES**

- **Solid State Full Wave Power Bridge** -Uses generously rated power semiconductors for Maximum reliability and long life.
- **Inner Current Loop Regulator** - Inherent high bandwidth capability for fast response.
- **Fusing** - Both AC lines fused for maximum protection in case of short circuit.
- **AC Line Filter and Transient Voltage Suppressor Network** - Eliminates interaction between other drives or AC equipment.
- **Current Limit Ranges** - Selectable current limit ranges to match the drive to the motor being used. Provides smooth acceleration of high inertia loads.
- **Speed Regulator** - 1 % accuracy armature voltage feedback with IR compensation
- **Current (Torque) Regulator** -  
2% accuracy armature current regulator allows the user to control motor torque instead of speed.
- **Circuit Board Indicator** – A Light emitting diode (LED) on the control board indicate when the drive is active in the Run Mode.
- 
- **UL/cUL** - All Focus 1 Drives are UL/cUL listed.

### **WARNING**

- *One cannot make a connection to ground or a grounded device to any terminal or connection point to the Focus 1 Non-Regenerative Drive without causing drive damage. Such failures unfortunately cannot be warranted.*
- See [Ways of Achieving Isolation](#) on page 60 of this manual

The Focus 1 comes in two basic model variations- with and without enclosure.

### Chassis Model

The model without an enclosure is denoted as a chassis model. The chassis model is intended for mounting within a User supplied cabinet and where the User intends to provide remote Start/Stop and Speed control signals.

### Enclosed Model

The Enclosed version comes to you already in a NEMA 1 enclosure that would allow the User to mount the Focus on a wall or machine surface. The Enclosed version has a Power On/Off and spring to center Start/Stop switches and the Speed Control adjustment on the front cover for convenient operation.

## Nameplate Information



**Enclosed Unit**



**Part #**

**Serial #**



**Chassis Unit**



Always record the drive **Model Number**, **Part Number** and **Serial Number** for future warranty situations and spare parts. A good location to record these is on the [Start-up Guide Worksheet](#) on page #41.

# Specifications

## Ratings

Catalog Part #	Enclosure	HP	AC Input		DC Output			
			1Ø	Max	Armature	Armature	Field	Field
			Volts	Amps	Volts	Amps	Volts	Amps
2400- 8001W	Chassis	¼ -1	120	14	90	10	100	1
		½-2	240	14	180	10	200	1
2400- 8000W	NEMA 1	¼ -1	120	14	90	10	100	1
		½-2	240	14	180	10	200	1

## **PERFORMANCE SPECIFICATIONS**

Service Factor	1.0
Speed Regulation (95% Load Change):	
Armature Voltage	1% of Max. Speed with IR Compensation
All other variables (voltage regulated)	15% of Base Speed
Speed Range:	30:1
Efficiency:	
Control Only	98%
Drive System (motor and control)	86% typically

## **DRIVE OPERATING CONDITIONS**

Altitude (without derating)	3300Feet or 1000meters
Ambient Temperature:	
Chassis Models	0-55 <sup>0</sup> C (32 to 130° F )
Enclosed (NEMA 4/12)	0-40 <sup>0</sup> C (32 to 104° F )

## **INTERNAL ADJUSTMENTS (POTENTIOMETERS)**

<b><u>Potentiometer Function</u></b>	<b><u>Range</u></b>
Maximum Speed	70-115% of Rated Speed (~60vdc-105vdc w/120vac input) (~120vdc-210vdc w/240vac input)
Minimum Speed	0-30% of Maximum Speed
IR Compensation	0-20% of Rated Voltage

## **Internal Factory Settings**

Current Limit	Fixed at 150% of Selected Range
Acceleration Time	Fixed 2-3 seconds (linear)
Deceleration Time	Fixed 2-3 seconds (linear)

## **CUSTOMER SELECTIONS (JUMPERS)**

<b><u>Function</u></b>	<b><u>Range</u></b>
Input Voltage	120/240Vac
Control Mode	Speed / Torque
Current Feedback range	High / Medium / Low
Armature Voltage level	90 Vdc/180 Vdc
Optional "M" Contactor	Yes/No

## OPERATOR FUNCTIONS

	<u>Chassis</u>	<u>Enclosed</u>
Speed Adjustment (Speed Pot)	Standard	Standard
Start/Stop	Customer Supplied	Standard
Forward/Reverse	Optional	Optional

## CONTROL CIRCUIT SPECIFICATIONS

Logic Control Power	24 Vdc
Speed Potentiometer	5000 ohms
Input Signal Requirement	10 Vdc @ 0.2mA (44Kohm input resistance)
Control Circuit Isolation	Optional

## FOCUS 1 OPTIONS

### CATALOG NUMBER

### DESCRIPTION

2400-9001

**M-Contactor Kit**

F3DB124  
F3DB0524  
F3DB112

Dynamic  
Braking  
Kits

{  
¾ -1HP @ 240V  
½ HP @ 240V  
¾ -1HP @ 120V

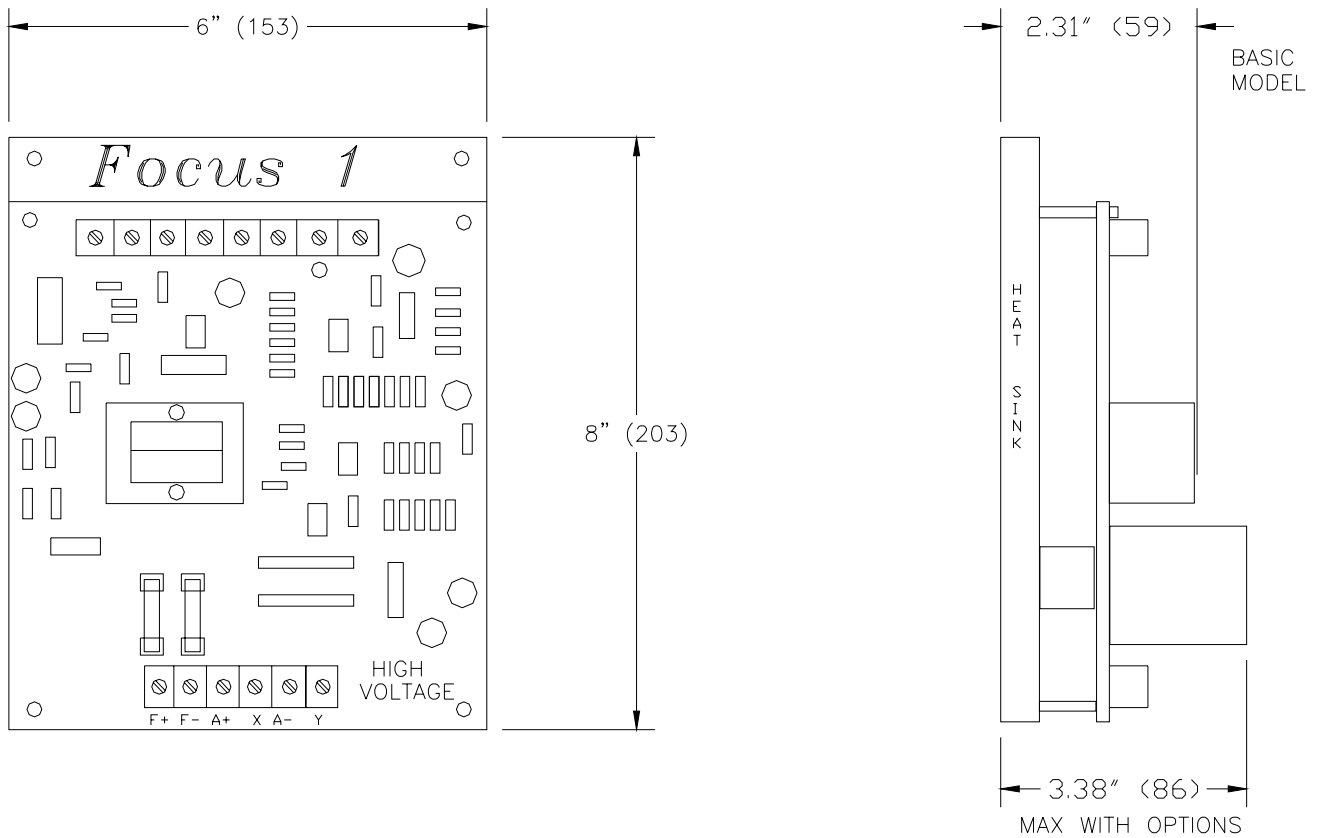
F3TS  
F3NSBD  
2950-9066  
2950-9068  
6160-9001

Toggle Switch, NEMA 4 /12  
Signal Isolation Board  
Remote Operator Station ( 3 Function )  
Remote Operator Station ( 5 Function )  
Ten-Turn Precision Potentiometer  
Remote Percent Speed Meter Kit

# Focus 1 Chassis Dimensions

## Chassis

Suitable for mounting in a user's enclosure where internal temperatures will not exceed 55°C or 130°F.

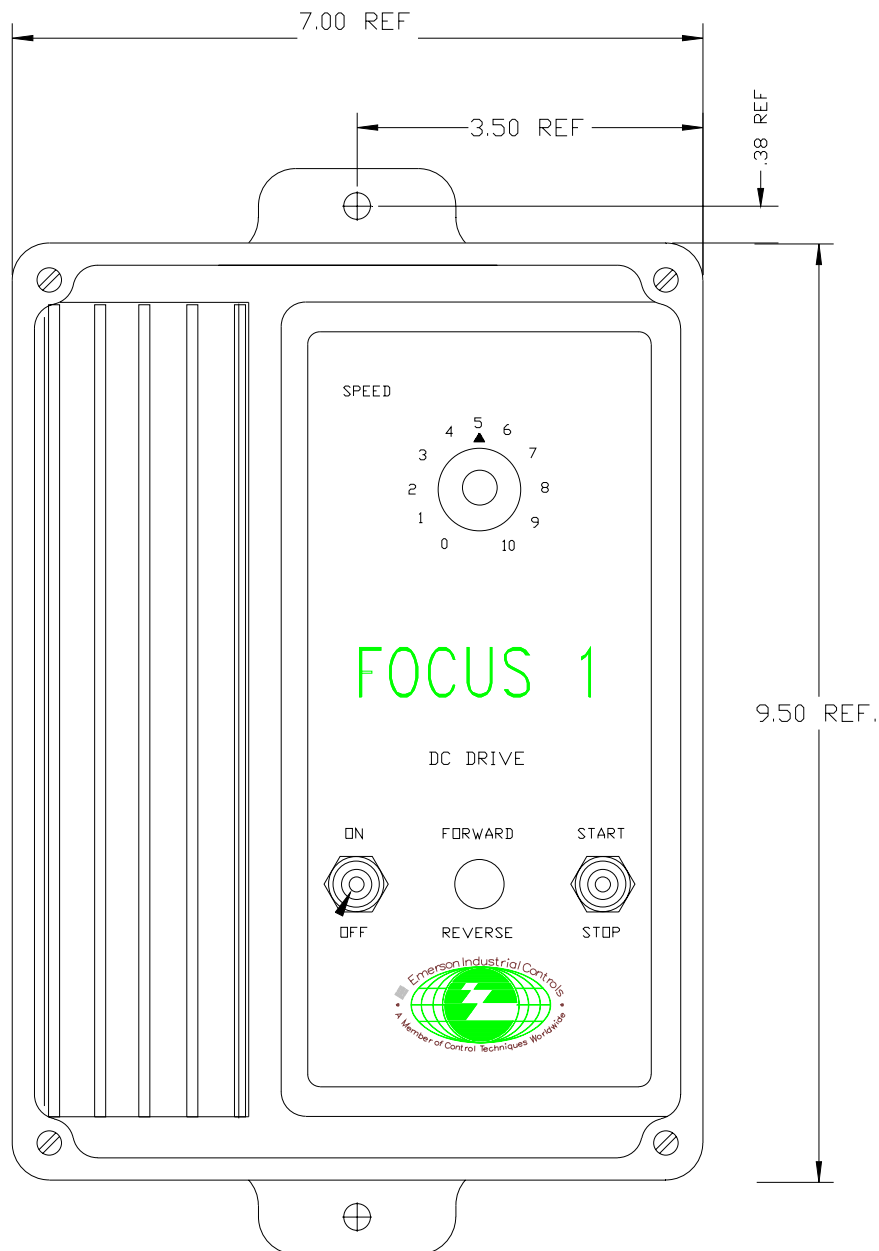


**2400-8001W**

# Focus 1 Enclosed Dimensions

## NEMA 1

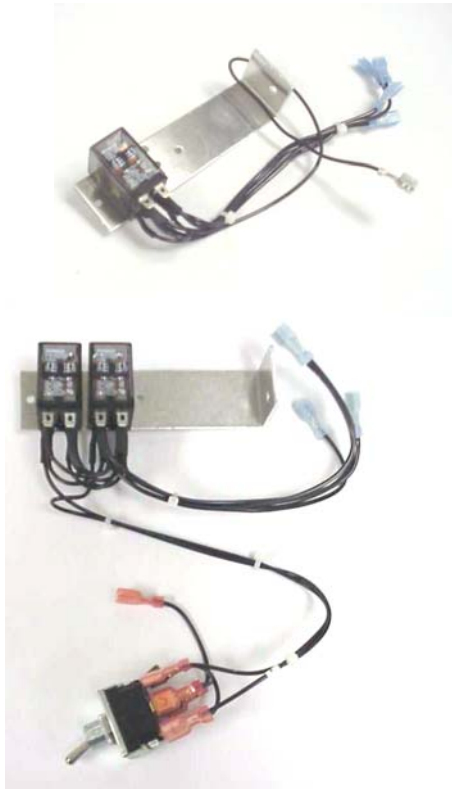
Suitable for most well ventilated factory areas where industrial equipment is installed. Locations subject to steam vapors, oil vapors, flammable or combustible vapors, chemical fumes, and corrosive gases or liquids should be avoided unless an appropriate enclosure has been supplied. Ambient temperature is not to exceed 40°C (104 °F).



**Depth 5 inches maximum**

**2400-8000W**

# Focus 1 Option Kits



## Focus 1 Contactor Kit – P/N 2400-9001

This Kit includes a magnetic contactor that can be mounted either in the Focus 1 enclosed unit or on the chassis mount unit. It provides a positive disconnect of the motor armature when the controller is stopped, preventing motor rotation in the event of SCR mis-fire due to line noise. This kit may also be required by local and/or National Electrical Codes. This kit also includes the DB (dynamic braking) poles, an auxiliary normally open contact and all connection wires.

## Focus 1 Reversing Kit – P/N 2400-9001

This Kit includes a magnetic contactor that can be mounted either in the Focus 1 enclosed unit or on the chassis mount unit. It provides a positive disconnect of the motor armature when the controller is stopped, preventing motor rotation in the event of SCR mis-fire due to line noise. This kit may also be required by local and/or National Electrical Codes. This kit also includes the DB (dynamic braking) poles, an auxiliary normally open contact and all connection wires.



**Requires contactor kit**

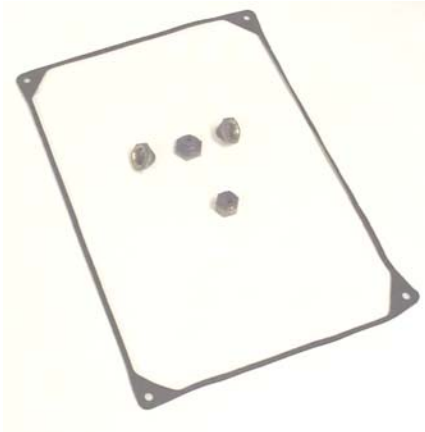
## Focus 1 Dynamic Braking Kit **PN– See Table Below**

For use with Focus 1 Contactor Kits. Dynamic braking provides rapid motor stopping by quickly dissipating the stored energy in the rotating motor and load. These resistors have been sized in accordance with Nema specifications for dynamic braking.

**“Providing 3 stops in rapid succession with the load inertia equal to the motor inertia, then cooling forever.”**

AC Input	HP (Typical)	Part Number
120 Vac	1/4-1/3	F3DB1524
	1/2	F3DB224
	3/4-1	F3DB112
240 Vac	1/2	F3DB0524
	3/4-1	F3DB224
	1.5	F3DB1524
	2	F3DB224

# Focus 1 Option Kits



## **Focus 1 Nema 4/12 Kit– P/N 2400-900**

This Kit is used to convert the standard Nema 1 enclosure to a Nema 4/12 rating suitable for “wash down” environments. Included in the kit is a gasket to seal the connection between the upper and lower enclosure sections, three boot seals for the switches for the Start / Stop, AC power On/Off and optional Fwd / Rev switches, and a shaft-sealing not for the speed potentiometer.



## **Signal Isolator Board – P/N F3NSBD**

This option is used in applications where isolation is required between an external control signal and the motor controller (which may or may not be at earth ground potential). It can be utilized to isolate a variety of voltage or current signals (see specifications below). It may also be used simply to isolate the speed adjustment pot, and the pot power supply is included. This option can be mounted in the enclosure or in a piece of plastic track (included with kit).

### **Specifications:**

#### **Input Power:**

17- 30 Vdc @ 50mA Max. (for control circuitry)

#### **Control Relay (CRR):**

24 Vdc @ 12.1 mA (JP5 = 24 Vdc)  
120 Vac @ 20 mA (JP5 = 120 Vac)  
Contact Type/Rating – 2 Form A / 1A @ 250 Vac

#### **Isolation Voltage:**

240 Vac Power Systems  
2000 Vac Hi-Pot for 1 Minute

#### **Inputs:**

Voltage Ranges:

5,12,26,52,98 & 208 Vdc, 180 Ohms/volt

Current Ranges:

0-5 mA, 1-5 mA, 910 Ohms input impedance

0-20 mA, 4-20 mA, 250 Ohms input impedance

Speed Pot:

5Kohms, 2W (Includes +10 Vdc power supply for potentiometer)

#### **Output:**

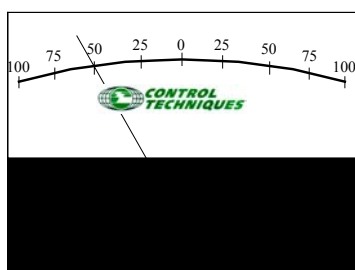
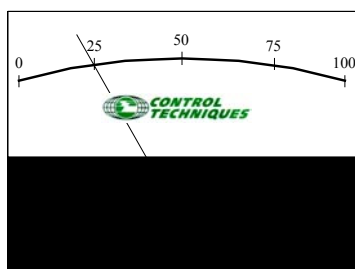
0 to +10 Vdc (Uni-polar)

## Focus Family Options



### Remote Operator Station – P/N 2950-9068 /2950-9066

These NEMA 1 operator stations can be used to remotely control Focus 1 Motor Controllers. Two models are available as shown. Both units include a Speed Potentiometer, a green normally open start button and a red normally closed stop button. The 2450-9068 also includes two 2 position switches with two contacts, 1 normally open, 1 normally closed.



### Remote Percent Meters – P/N See Accessories Catalog

This meter may be used to remotely display the motor speed in percent of maximum speed. Included is a calibration board. It is available in left zero (unidirectional applications) or 0-center (bi-directional applications) Meters supplied loose for customer mounting.

P/N	Meter
M1	Meter 0 - 100
M2	Meter 0 - 150
M3	Meter 100 –0 -100
M4	Meter 150 –0 -150

P/N	Calibration board
C1	Cal+/-10vdc
C2	Cal-90vdc
C3	Cal-180vdc



### Ten-Turn Precision Speed Potentiometer – P/N 6160-9001

This is a multi-turn speed potentiometer. It provides a vernier scale for precise and repeatable speed setting. A locking tab is provided to prevent in advertent speed changes. It may be mounted in the Focus 1 enclosure or the Remote Operator Station described above.



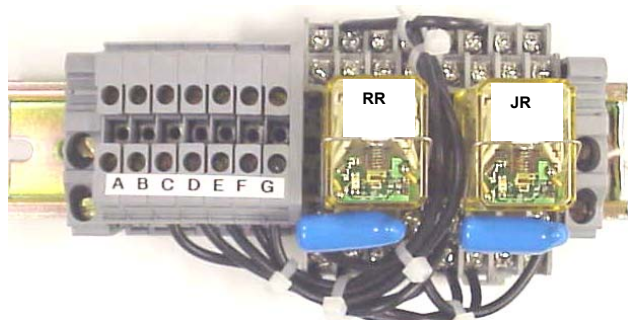
### **Speed Potentiometer – P/N SpdPot**

This potentiometer can be used for either a remote speed command potentiometer or a remote current limit potentiometer.

The following kits are available for the Focus series of drives. They are designed to provide a 120-Vac interface for applications requiring remotely mounted industrial operator devices (i.e. [Operator Stations](#) shown on previous page).

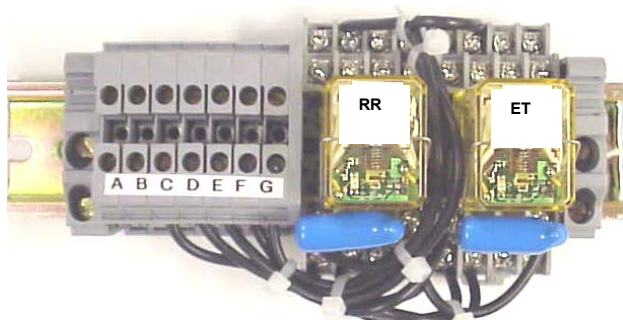
### **120Vac Interface – P/N ACIF-2R-Focus**

This kit provides 120vac interface to a Focus 1 to provide a three wire Start / Stop pushbutton arrangement and either a Jog pushbutton or a Forward / Reverse selector function.



### **120Vac Interface – P/N ACIF-2R-R/S-ET**

This kit includes a System Ready/External Trip function similar to that described in the Suggested System Interface section - [see Application Safety](#)



**These options are used with the chassis mount controls and include Din rail for panel mounting in the customer's enclosure, other configurations available – Consult Factory.**

# Customer Connections & Start-Up

## NOTE

Read this manual in its entirety, paying particular attention to the *Warnings* and *Cautions* in each section before installing, starting, or maintaining this drive.

### **CAUTION**

Improper procedures can result in personal injury or equipment damage. Only qualified electrical maintenance technicians familiar with electronic drives and their standard safety precautions should be permitted to install, start-up, or maintain this apparatus.

## Start-up Guidelines

STEP 1:	<a href="#">Receiving &amp; Inspection</a>	Page 13
STEP 2:	Drive Installation . . .	Page 25
STEP 3:	<a href="#">Power Wiring</a>	Pages 26-28
STEP 4:	<a href="#">Control Wiring</a>	Pages 29-31
STEP 5:	<a href="#">Jumper Programming</a>	Pages 33-36
STEP 6:	<a href="#">Potentiometer Adjustments</a>	Pages 38-40
STEP 7:	<a href="#">Start-up of Drive</a>	Page 41-48

### **WARNING**

Installation of this equipment must be done in accordance with the National Electrical Code and all other applicable regional or local codes. Proper grounding, conductor sizing, and short circuit protection must be installed for safe operation. Improper installation or operation of this control may cause injury to personnel or damage to equipment.

### **WARNING**

Hazardous voltages may be present on external surfaces of ungrounded controls. This can result in personal injury or equipment damage.

### **WARNING**

When performing visual inspections and maintenance, the incoming AC power must be turned off and locked out. Hazardous voltages will be present until the AC power is turned off. The drive contactor ( if used ) does not remove hazardous voltages when opened.

## **Incoming Power Requirements**

A remote fused AC line disconnects or circuit breaker installed ahead of the control is required by the NEC (National Electrical Code). The control is designed to accept single-phase AC line voltage.

### **Grounding**

The control must be connected to earth ground either via mounting screws provided by an enclosure or chassis-installed screw or by using the Earth Ground lug provided on the drive heatsink, for safety of operating personnel. The ground wire should be of the same gauge as the AC Input wires and must be connected to the panel or enclosure frame for personal safety.

## **Wiring Guidelines for Focus DC Drives**

Check drive nameplate data for conformance with AC power source and motor

HP	AC Input				DC Output			Shunt	Field	
	Fusing		Max	Wire	Armature	Armature	Wire	Field	Field	Wire
		Volts	Amps	AWG	Volts	Amps	AWG	Volts	Amps	AWG
1/4 -1	15	120	14	#14	90	10	#14	100	1	#14
1/2-2	Amp 250Vac	240	14		180	10		200	1	

### **Notes:**

**All wiring based on 75°C copper wire, types FEPW, RH, RHW, THHW, THW, THWN, XHHW, USE, ZW**

**Wire gauge size based on 30°C maximum ambient and no more than three conductors in a raceway or cable and 1.25 service factor.**

**Please refer to National Electric Code Table 310-16 for additional information.**

**Wiring must also meet *any* Local Codes.**

**Do not place knife switches, polarity reversing switches, reversing contacts in the armature or field circuits.**

During normal operation, keep all covers in place and cabinet doors shut.

### **Motor Thermal Switch**

For Motor Thermostat wiring, see the “Control Wiring” section.

### **Wrong Motor Rotation**

If the motor rotates in the wrong direction, one of the following changes will correct it:

#### **Only With Power Removed**

- Exchange A1 and A2 output Motor Armature leads.
- or
- Exchange F1 and F2 Motor Shunt field leads.

## **Installation of Option Kits**



**Do not** install option kits until you have verified the basic operation as outlined in the Start-Up section.

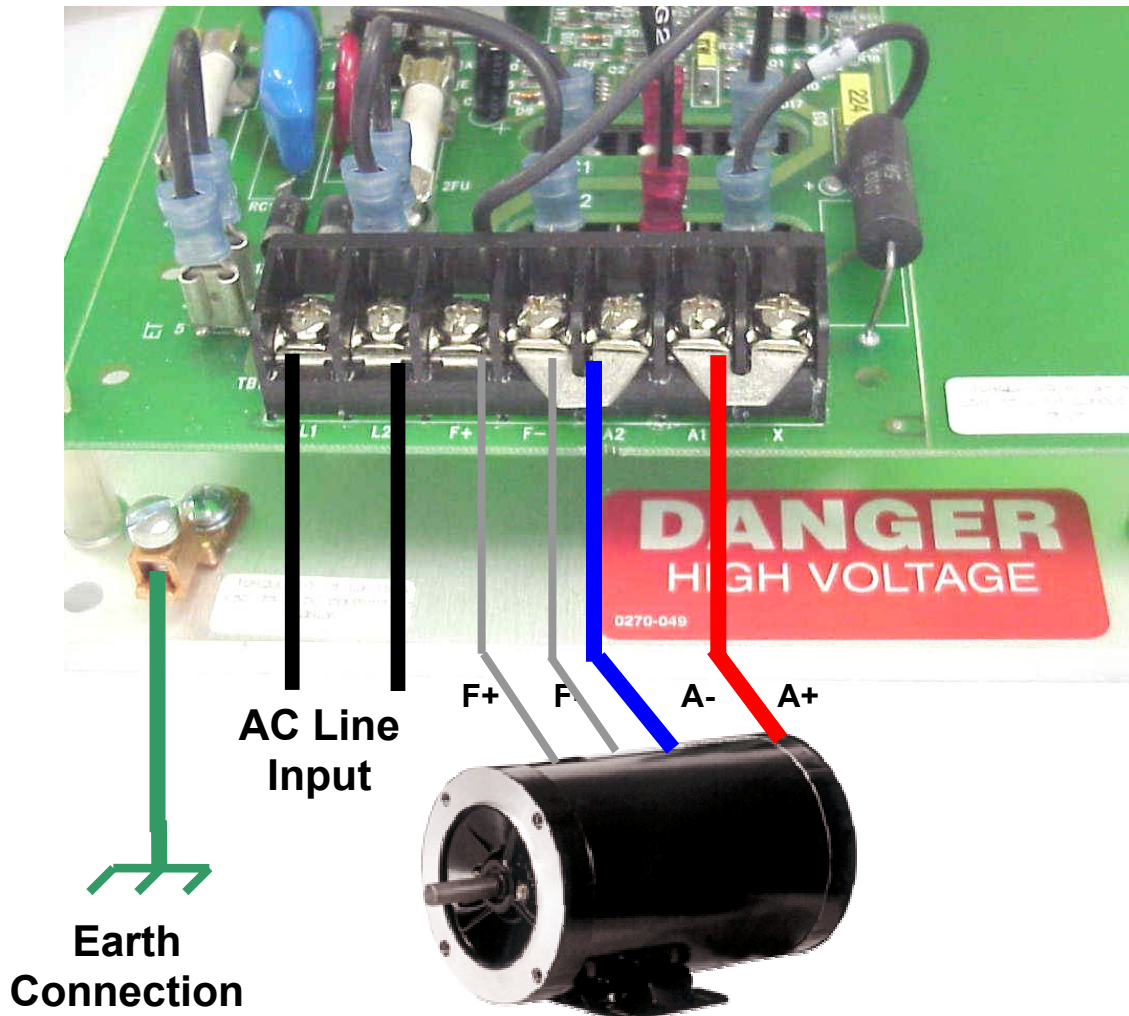
Pre-installation of option kits before verification of basic drive operation will make troubleshooting much more difficult. Option kits are often installed incorrectly and one cannot determine if the drive was functional before kits were installed.

### **WARNING**

**When making any wiring or jumper changes, the incoming AC power must be turned off and locked out. Hazardous voltages will be present until the AC power is turned off. The drive contactor ( if used ) does not remove hazardous voltages when opened.**

# Drive Power Wiring

## Focus 1 Models



**A+ & A- are the motor Armature leads**

**F+ & F- are a shunt wound motors Field leads  
( they will not be present on  
Permanent Magnet or Universal Motors )**

## Control Wiring

### TERMINAL CONNECTIONS (TB2) & DESCRIPTIONS

### Pin Number

- 1 **Forward:** Connected to “quick connect” 1 as a tie point for the Motor Reversing Contactor Kit forward / reverse switch, or the motor contactor Kit
- 2 **Reverse:** Connected to “quick connect” 1 as a tie point for the Motor Reversing Contactor Kit forward / reverse switch.
- 3 **+24 Vdc Supply:** Powers the logic inputs to the drive. It is not intended for it to be used to power external circuits. External use will void warranty.
- 4 **Run Relay Contact:** Relay common connection for seal-in circuit.
- 5 **Run Relay:** When +24 Vdc is applied to this terminal, the Run relay picks up, the Speed loop and the Current loop are enabled, and the clamp on the SCR firing circuits is released.
- 5A **Motor Thermal tie-point:** No connection internal  
see **Application Safety**
- 6 **+10 Vdc Speed pot supply voltage:** Maximum load is 5ma
- 7 **Standard Speed command input:** Typically this input is connected to the wiper of the speed pot wiper. Input impedance: 40Kohm.
- 8 **Minimum Speed connection:** This sets a minimum motor speed when the speed potentiometer is used (does not set a minimum speed when an isolated 0 to 10vdc speed reference is used).

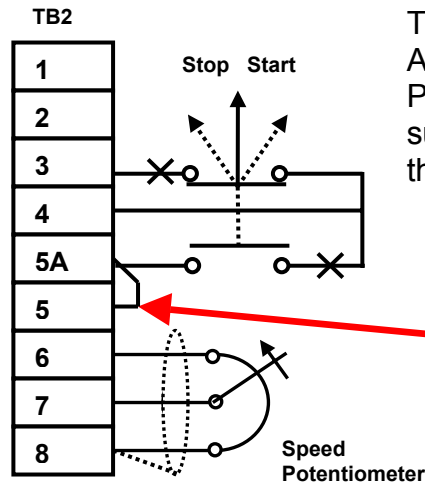
**The Focus 1 drive control circuitry is not isolated \*. No points in the control circuitry, including common, should be connected to earth ground unless specifically shown on the supplied wiring diagrams. No grounding connections should be made on the terminal block. Improper connections to ground, including speed potentiometer connections, will result in immediate control failure and will void the factory warranty.**



# Terminal Strip Connections

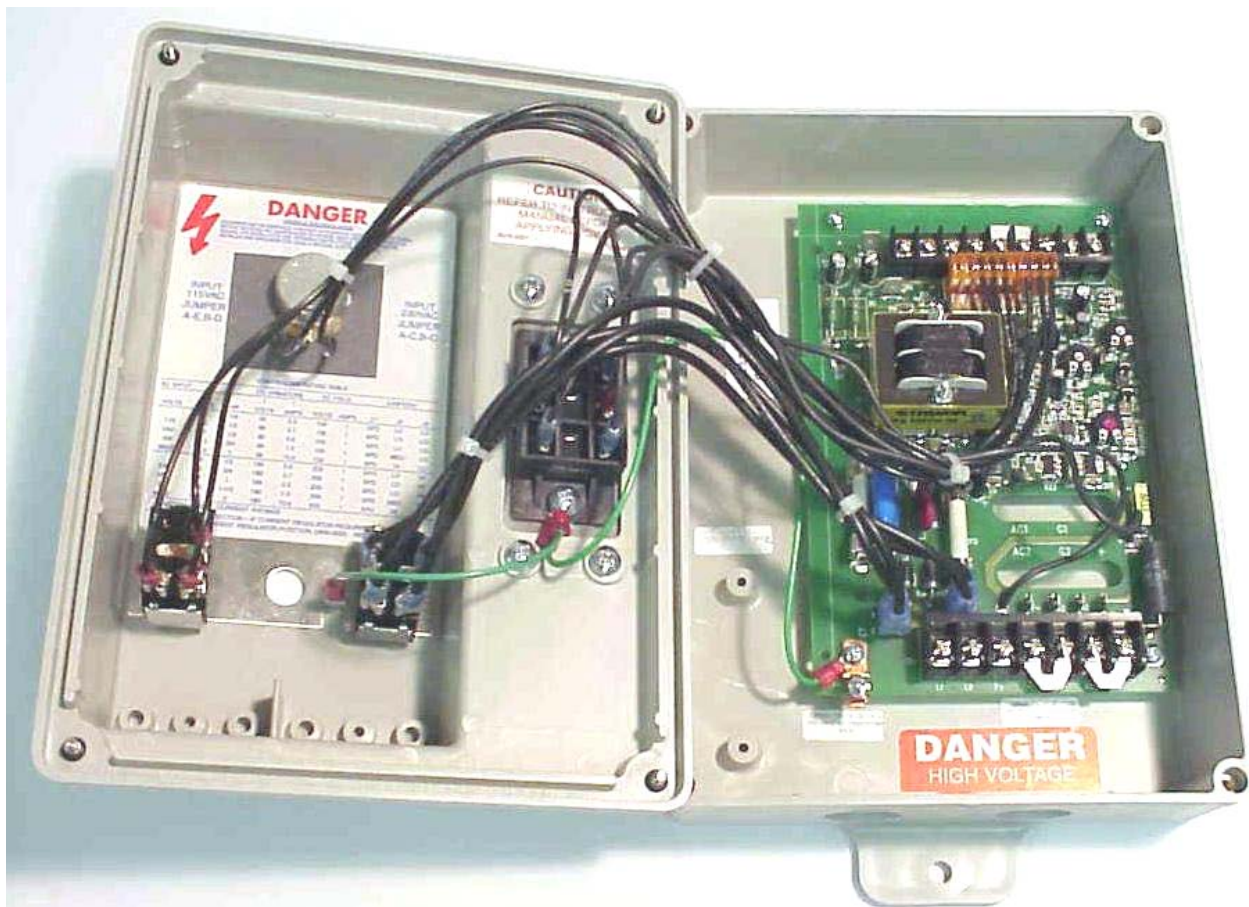
## Enclosed Model

### Standard Start / Stop & Speed Potentiometer Connections



The Start/Stop Switch And the Speed Potentiometer are supplied as shown on the drive cover

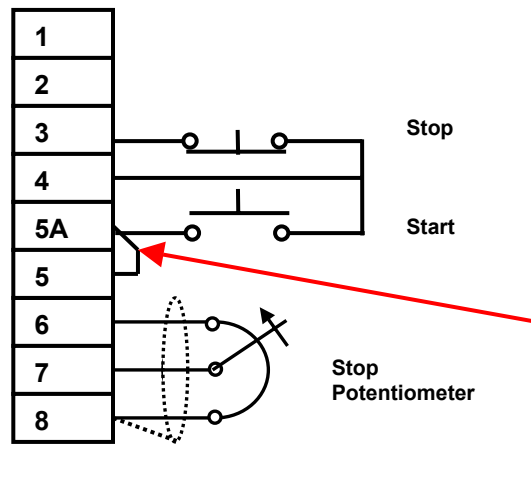
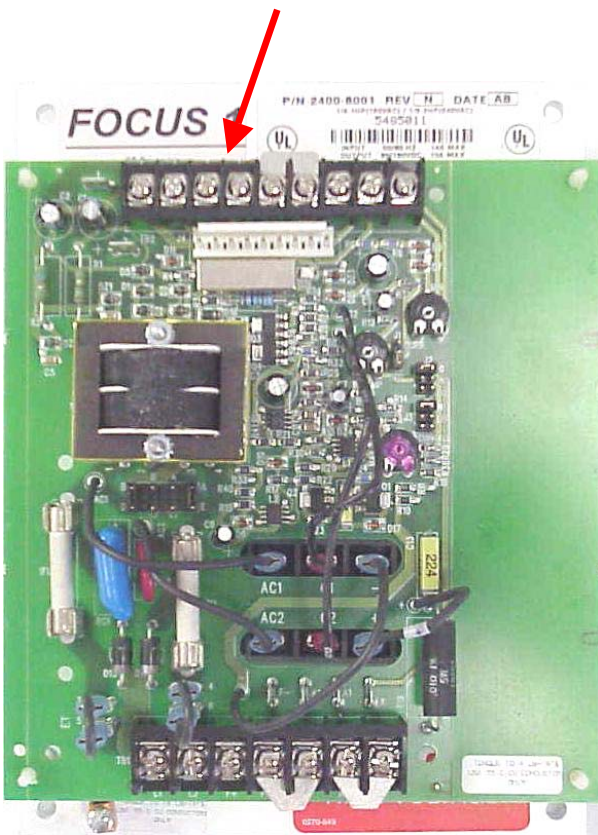
Drive will not start without this. This is intended for system interlock- see Application Safety



# Chassis Model

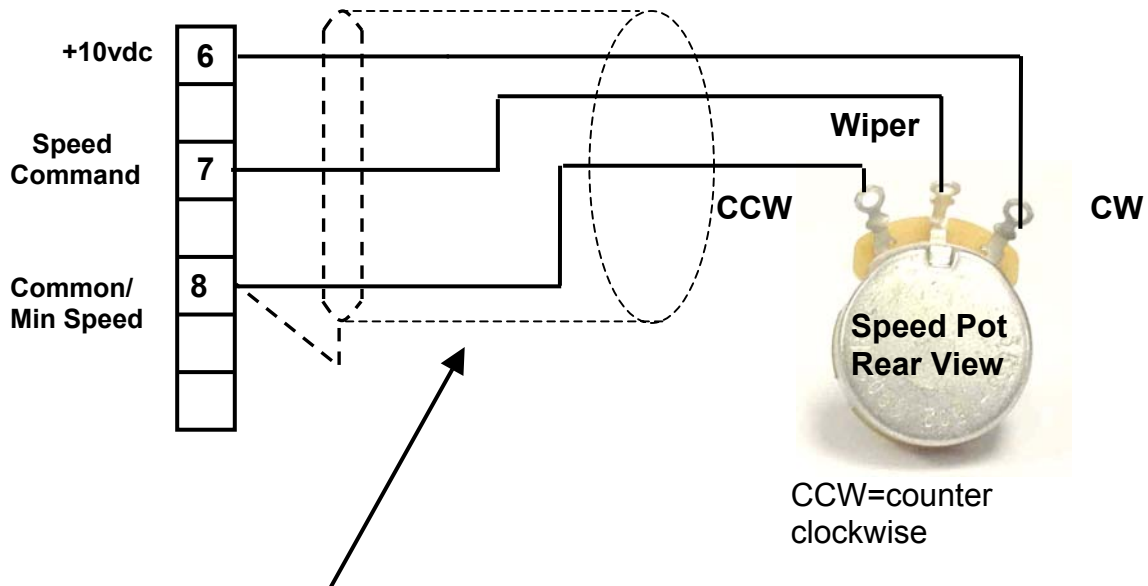
The Chassis Model has no operator devices connected to the drive control terminal strip. The only connections made are connections from terminal #3 to #4 which is required for three wire Start/Stop controls.

The Speed Potentiometer is supplied "loose" with the drive.



Drive will not start without this. This is intended for system interlock- see Application Safety

## Standard Unipolar Speed Potentiometer Wiring



Cable should be 3 conductor with overall shield w/pot end tied off and dressed. Cable and pots are available from:  
**Control Techniques Service Center @ 1-800-367-8067**

Cable P/N 3CONCBL-XXX (XXX in feet)

Speed Potentiometer P/N **SpdPot**

### **⚠ WARNING**

Do Not Connect shield to Earth. This will result in permanent damage to the Drive and **will not be covered** under WARRANTY

# Customer Jumper Selections

## Jumper Programming

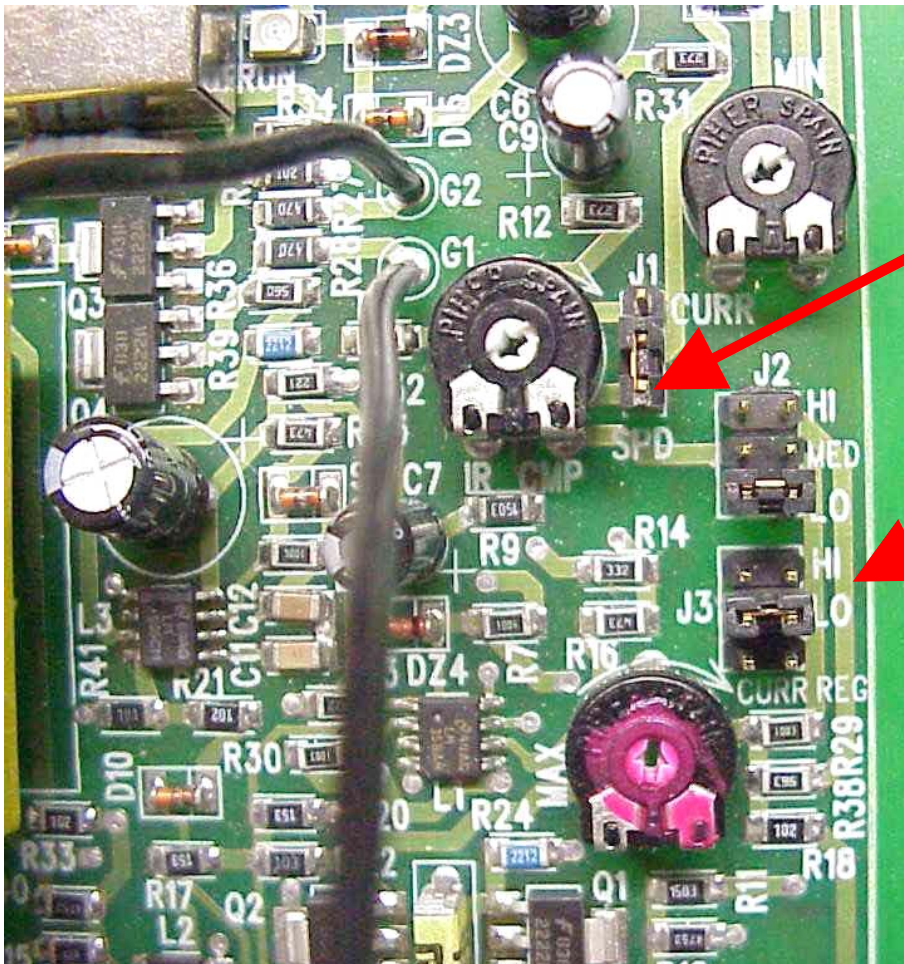
### ⚠ WARNING

Equipment damage and/or personal injury may result if jumper programming is attempted while control is operational. Always lock out power at the remote disconnect before changing jumper positions.

*See page 33 for jumper locations*

<u>JUMPER</u>	<u>DESCRIPTION</u>	<u>RANGE</u>	<u>FACTORY SETTING</u>
J1	Speed or Current Control Mode (see next page)	<b>Speed</b> or Current ( <b>SPD</b> ) (CUR)	<b>Speed</b>
J3	Armature Voltage Level Selector	LOW (90 Vdc) or <b>HI (180 Vdc)</b>	<b>HI (180 Vdc)</b>

*Use care when setting J3 as the upper 2 pins are to be set when J1 is in the SPD position.*



J1

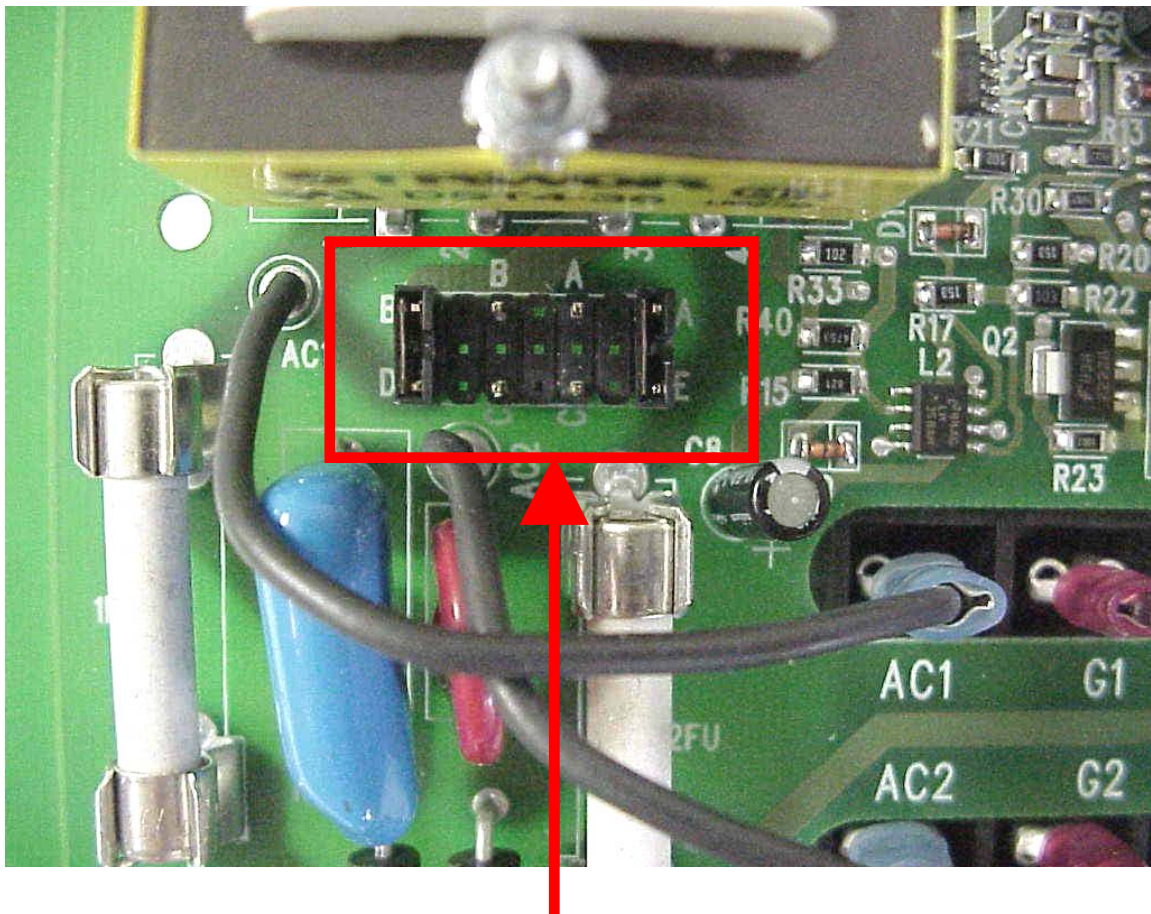
J3



## Input Voltage Selection

Input Line Voltage	Jumper Positions
120Vac	A to E and B to D
240Vac	<b>A to C</b> and <b>B to C</b>

Items in **BOLD RED** are factory set positions



This photo shows the drive settings for **115vac** operation



### Caution

Application of 240vac to a unit set up for 115vac ( as shown above ) will damage the drive and void the warranty.

### **⚠ WARNING**

When making any wiring or jumper changes, the incoming AC power must be turned off and locked out. Hazardous voltages will be present until the AC power is turned off. The drive contactor ( if used ) does not remove hazardous voltages when opened.

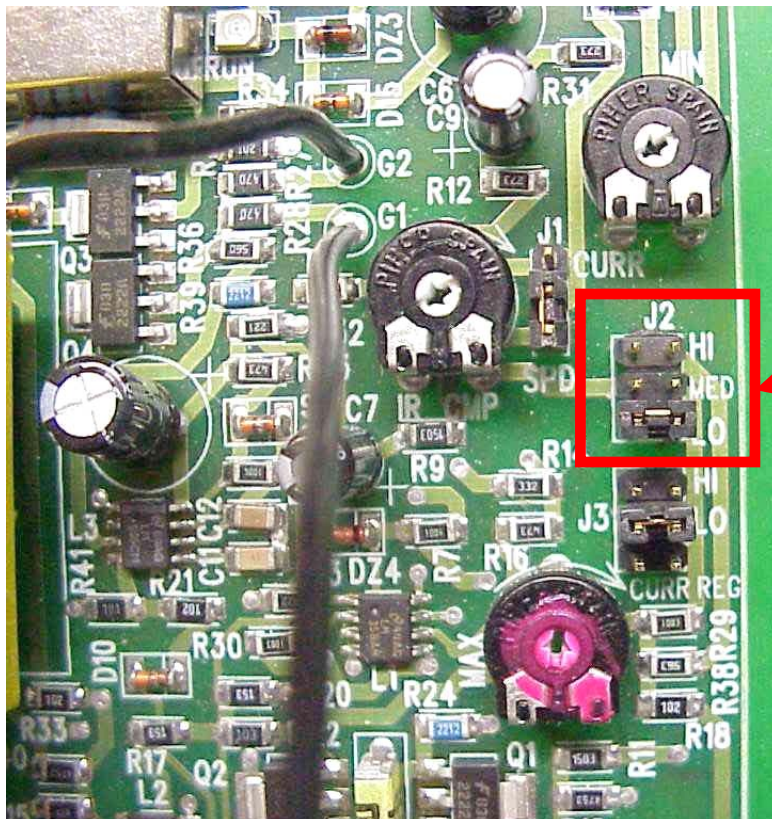
## Current Feedback Range (J2)

For 115vac Operation on 90vdc motors

Motor HP Range	DC Output Current (Amps)	J2 Jumper Position
1/4	2.6	Lo
1/3	3.7	Lo
1/2	5.5	Lo
3/4	7.5	Med
1	10	<b>Hi</b>

For 230vac Operation on 180vdc motors

Motor HP Range	DC Output Current (Amps)	J2 Jumper Position
1/2	2.6	Lo
3/4	3.7	Lo
1	5.5	Lo
1-1/2	7.5	Med
2	10	<b>Hi</b>



**J2 -- Max Output Current**

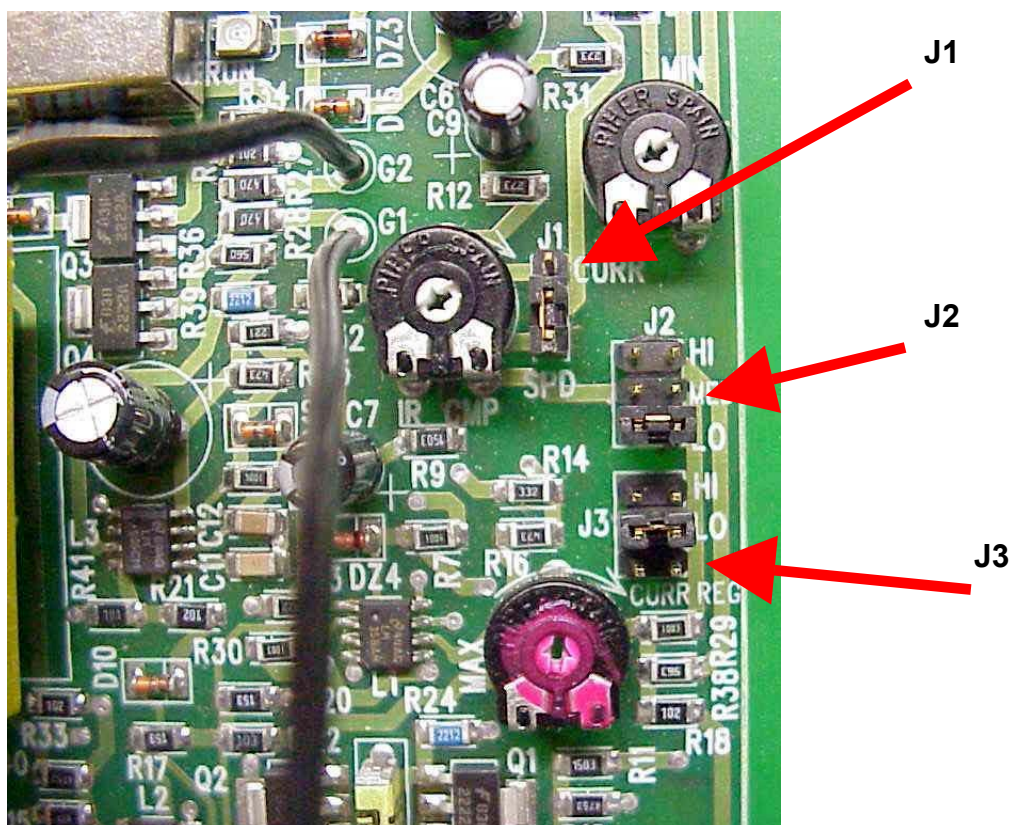
Select based on motor Armature requirements

## Current Control Mode

Focus 1 Drives can be configured to operate in the Current Control Mode which is often referred to as making the drive a “**Current Regulator**”. Since motor torque is directly proportional to the armature current, a drive configured as a Current Regulator is often referred to as a “**Torque Regulator**”.

**If using the Focus drive as Torque Regulator, make the following adjustments:**

- J1: Select current (**CUR**) control ( upper two pins )
- J2: Select the appropriate current feedback range.
- J3: Select **CURR REG**, lower two pins.



### **⚠ WARNING**

In Torque control mode, the motor speed is determined by how much load there is on the motor and the torque level set on the drive. If torque in the motor (as set by the Drive) is set to a level higher than what is required to move the load, the motor will accelerate in speed until either the load from the motor increases to the level set by the drive or the drive reaches its maximum output voltage (as set by the line voltage).

In the case of a lightly loaded motor,

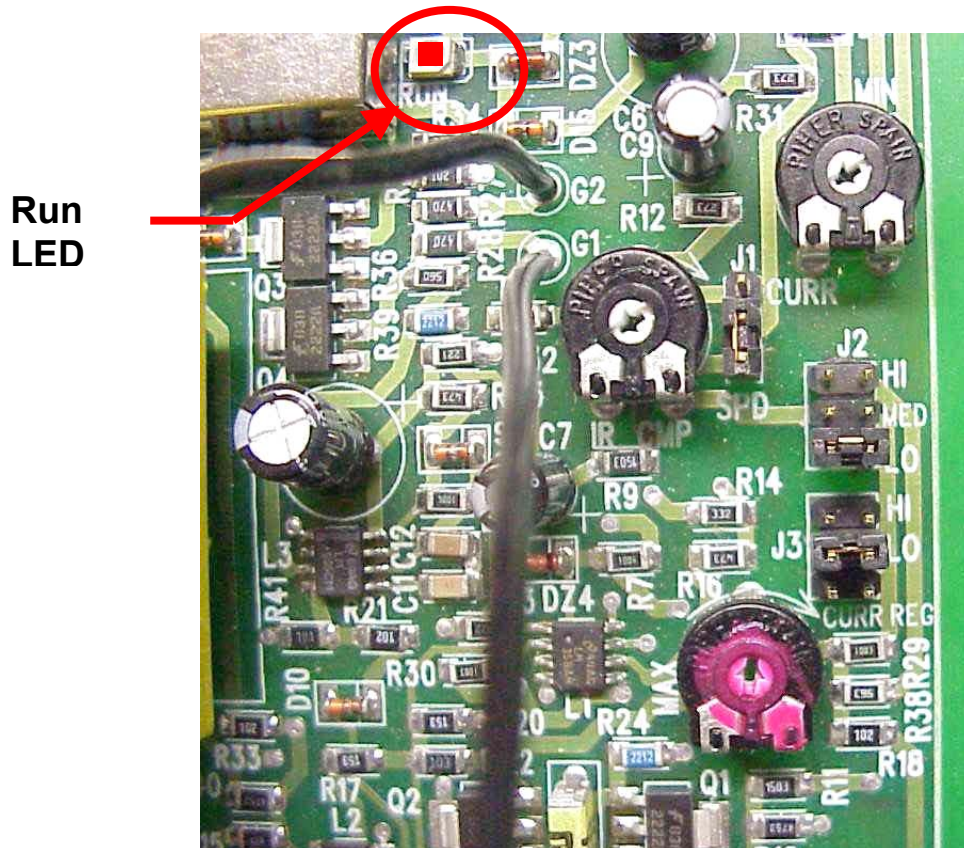
the motor could accelerate to almost **twice-base** speed under these conditions.

*In this mode the user be aware of this and **MUST** PROVIDE OVERSPEED PROTECTION. A contact from an OverSpeed sensor could be placed in the System Interlocks-*

*see Application Safety*

## **LED Status Indicators**

**Run LED** – This red led will illuminate any time the run relay is energised



## **Basic Customer Adjustments**

### **Maximum Speed (MAX SPD)**

The MAX SPD pot sets the maximum motor speed (80-120% of motor base speed) allowed. It is factory preset to the midway position. **Note:** Do not exceed motor nameplate maximum speed rating. With the motor running, turn the speed pot on the drive enclosure cover/operator control panel fully clockwise while monitoring actual motor RPM or by measuring the Armature Voltage on A+ & A-. Then, adjust the MAX SPD pot on the control board to set the desired maximum motor speed. Do not exceed the motors Armature Voltage nameplate rating.

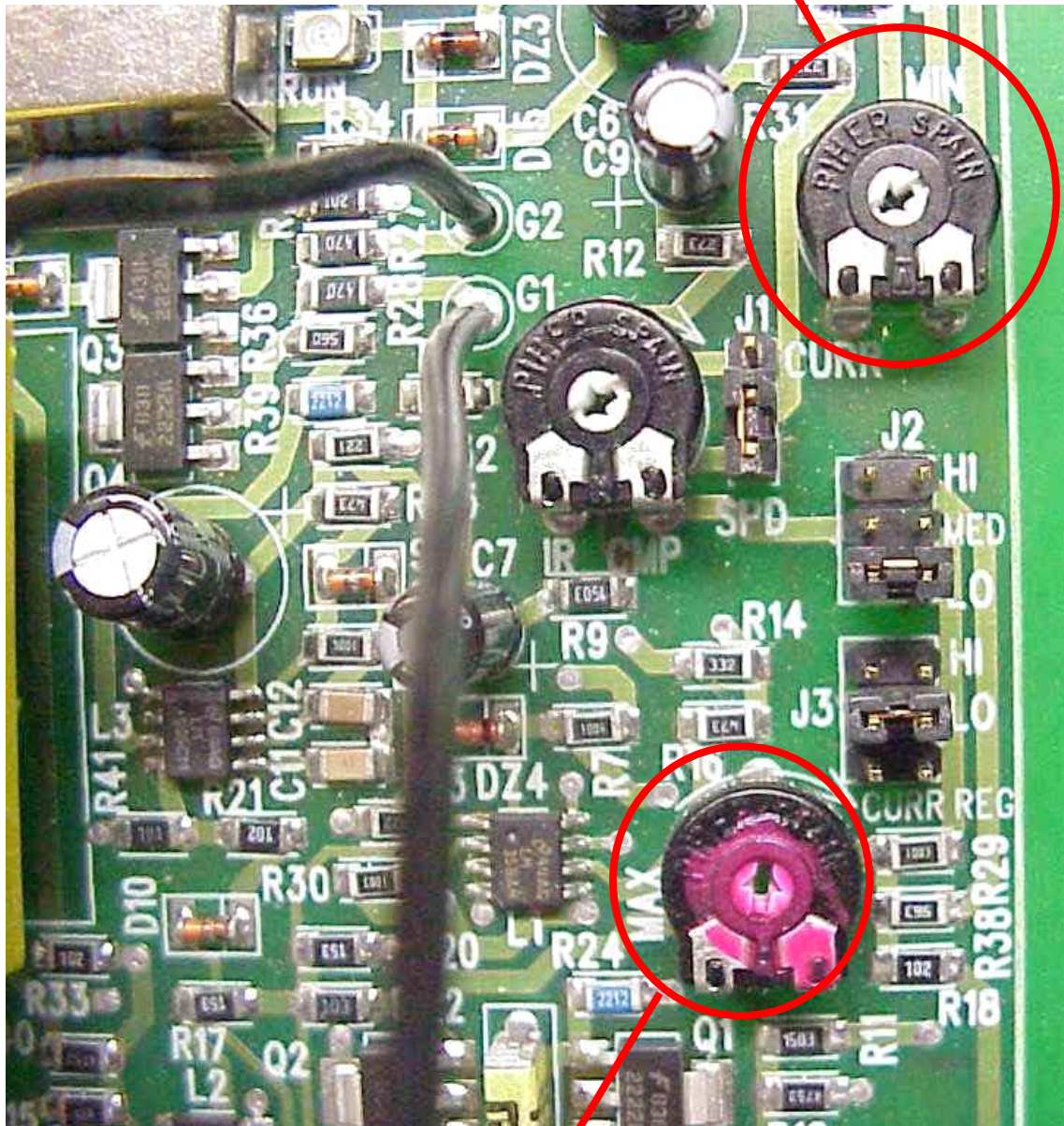
### **Minimum Speed (MIN SPD)**

The MIN SPD pot sets the minimum speed (0-30% of maximum speed setting) at which the motor will run. It is factory preset at its full counterclockwise position. With the motor running, turn the speed pot on the drive enclosure cover/operator control panel fully counterclockwise. Adjust the MIN SPD pot clockwise until the desired lowest motor speed is reached.

## Basic Customer Adjustments

### MIN SPD

Adjust for minimum Motor speed



### MAX SPD

Adjust for maximum Motor speed

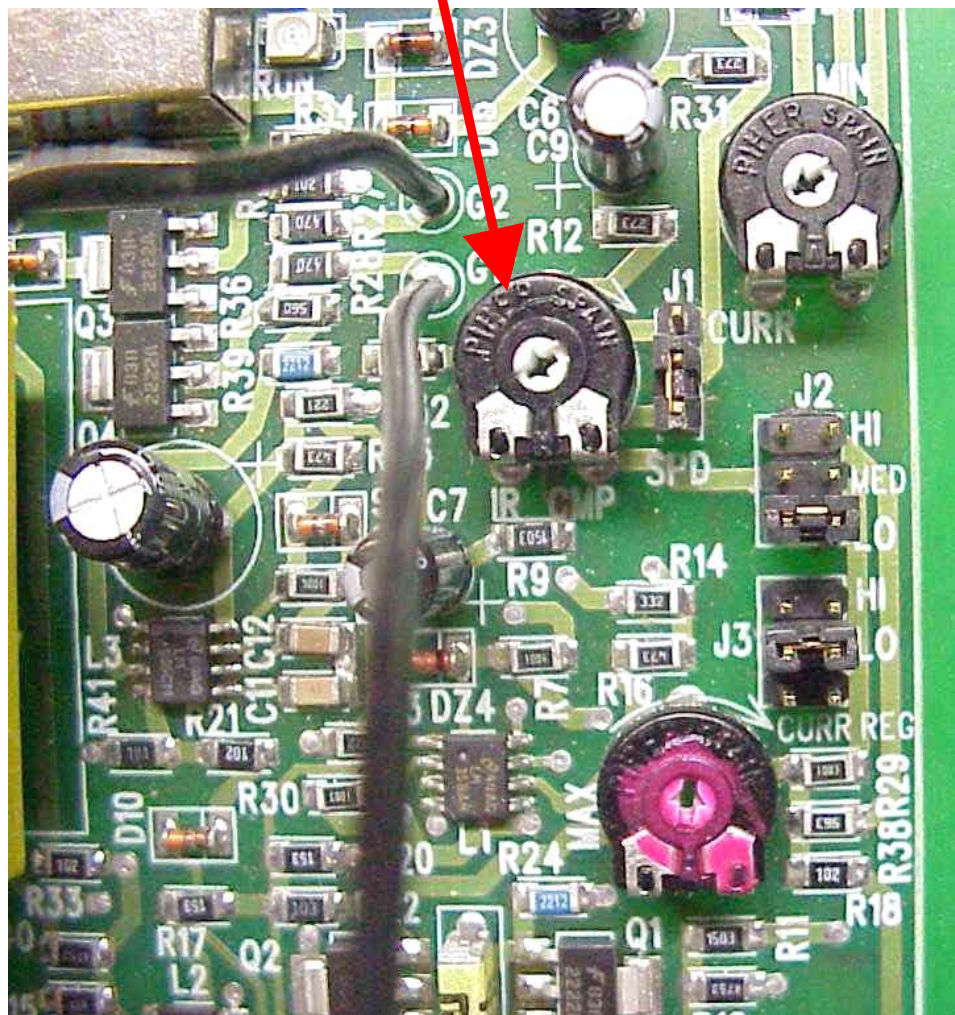
## Additional Tuning Adjustments

### Internal Resistance Compensation ( IR COMP )

Compensation pot is used to overcome the motor's natural tendency to slow down as the load increases. If the motor slows down excessively as it is loaded, adjust the IR COMP pot clockwise to recover speed lost during the loaded condition. The motor will oscillate in speed or "*hunt*" if the IR COMP pot is adjusted too far clockwise. If this pulsing of speed occurs, adjust the IR COMP pot counter clockwise until the motor speed stabilizes.

#### IR Comp

Adjust for motor speed  
droop due to load



# Start-up Guide Worksheet

## WARNING

Improper procedures can result in personal injury or equipment damage. Only qualified electrical maintenance technicians familiar with electronic drives and their standard safety precautions should be permitted to install, start-up, or maintain this apparatus.



**At this point all INPUT POWER must be OFF !**

Obtain the following information:

### Focus Drive Model

☐ 2400-8000

☐ 2400-8001

Drive Serial Number \_\_\_\_\_

Drive Part Number \_\_\_\_\_

a) AC Input Line Voltage

☐ 240 Vac

☐ 120 Vac

b) Motor Nameplate Information: Armature Voltage \_\_\_\_\_ Vdc

Armature Current \_\_\_\_\_ A

Field Voltage \_\_\_\_\_ Vdc

Field Current \_\_\_\_\_ A

Rated RPM \_\_\_\_\_ rpm

### Regulation Mode

☐ **Speed** ( most common case )

☐ Torque ( [read first !](#) )

Focus drives come to you factory set for Speed Regulation mode which is the most common case. Even if your application requires Torque control, **we would strongly suggest** that you first run your motor Speed Control initially. After you have verified proper operation in the Speed mode, you could then switch over to Torque mode after reading about the Current Regulation Mode.

# Focus 1 Jumper Setup Worksheet

Refer to the data recorded on the previous page for this worksheet

Refer to your motor nameplate data.

---

**STEP 1** Does your motor have a shunt field winding?  
If No go to STEP 5 otherwise go on.

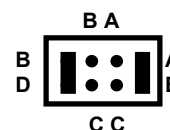
---

**STEP 2** Is your motor field current greater than 1.1A?  
If No, go to STEP 3  
If Yes **STOP** The Focus 1 Field Supply rectifier will be damaged!!!  
Call Tech Support for a solution.

---

**STEP 3** If your motor field voltage is 100 Vdc,  
then you must use **120 Vac for Input Power** -----  
**Set JP3 to Low** then go to STEP 7

Transformer Programming

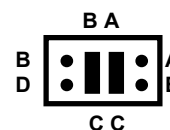


If you must use **240 Vac** ----- Call Tech Support for a solution  
otherwise go to STEP 4

---

**STEP 4** If your motor field voltage is 200 Vdc,  
then you must use **230 Vac for Input Power** ----  
**Set JP3 to Hi** then go to STEP 7

Transformer Programming

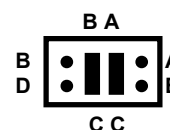


otherwise **STOP** ---- Call Tech Support for a solution

---

**STEP 5** If your motor armature voltage is greater than 110 Vdc,  
hen you should use **230 Vac for Input Power** ----  
**Set JP3 to Hi** then go to STEP 7

Transformer Programming

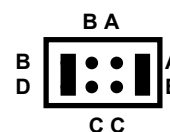


If you must use 120 Vac ---- Call Tech Support for a solution  
otherwise go to STEP 7

---

**STEP 6** If your motor armature voltage is less than 110 Vdc,  
then you must use **115 Vac for Input Power** -----  
**Set JP3 to Lo** then go to STEP 7

Transformer Programming



## **Armature Current Programming - (J2) Current Feedback Range**

### **STEP 7**

**Set jumper J2** to the range that matches up most closely with your motors Armature Amp rating from the table below:

<b>FOCUS Catalog Number</b>	<b>DC Output Current (A)</b>	<b>J2 Jumper Position</b>
2400-8000	5.5	Lo
<b>or</b>	7.5	MED
2400-8001	10	<b>HI</b>

### **WARNING**

**When making any wiring or jumper changes, the incoming AC power must be turned off and locked out. Hazardous voltages will be present until the AC power is turned off. The drive contactor ( if used ) does not remove hazardous voltages when opened.**

## **Application Safety**

When applying a motor drive in a manufacturing process, one must understand that the motor drive merely provides the energy for a motor to turn and it will do so without regard upon activation and command. There could be failure modes in any external interface equipment and/or the Focus drive itself that could cause the motor to turn suddenly at any speed or cause it to fail to stop on command without warning. When considering Operator safety **the Installer must** include and employ additional equipment to provide safeguards to insure Operator safety.

**Consult all NEC and OSHA machine safety recommendations and guidelines.**

These safeguards are the sole responsibility of the **Installer**. For these reasons, the **Installer** must envision all, implement all and test or simulate all failure methods. The Installer is responsible for his/her resulting implementation to insure safe and reliable operation of the installation.

In addition, the **Installer** should provide the End User of his Installed system with a System User's Manual and instruct the User/Operator on correct/safe operation. Instruction should include the demonstration and purpose of safety features that you the **Installer** has included and the importance of periodic testing to insure they do indeed operate as designed. The **Installer** should instruct, inform and warn his End User customer against bypassing the safety permissives the **Installer** has provided.

**NOTE:** Without the use of the Contactor option, P/N 2400-9001 (or the Reversing Contactor option, P/N 2400-9002, if reverse is required) potential motor movement in the event of a power line disturbance (causing an SCR (power device) to misfire) can occur since the motor is connected directly to the power circuit even when the drive is disabled. It is highly recommended that one of these contactor kits be used to guard against such occurrences.

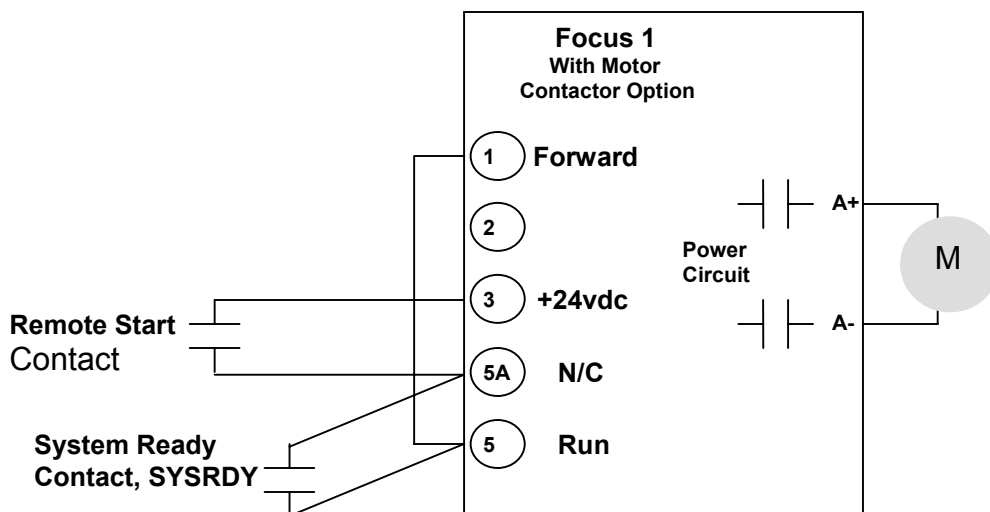
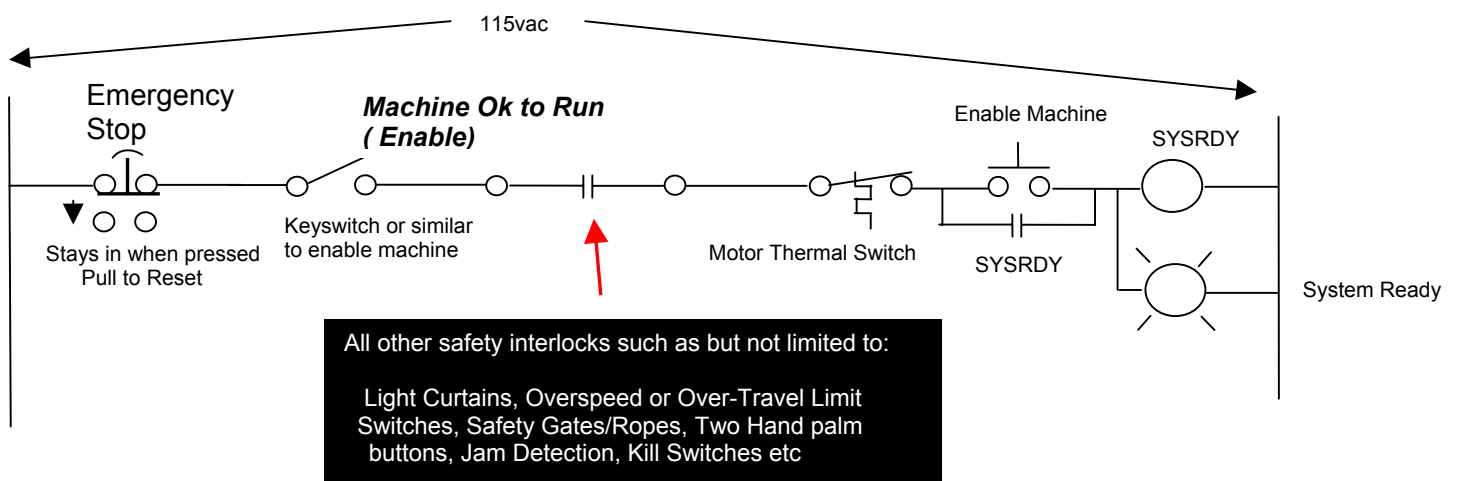
### **WARNING**

When making any wiring or jumper changes, the incoming AC power must be turned off and locked out. Hazardous voltages will be present until the AC power is turned off. The drive contactor ( if used ) does not remove hazardous voltages when opened.

## System Interface Suggestion

A fundamental basic system interface suggestion would be to always employ a method to supply a “permissive” or System Enable to allow the drive system to work if all things on the machine are alright. This interface would provide a method to keep the System disabled if certain key safety permissives are not satisfied. The **installer** should instruct, inform and warn his End User customer against bypassing the safety permissives the Installer has provided. The System Enable function would also have the ability to disable the drive if it was in operation and some safety device were tripped or if the Operator encountered a need to request an Emergency Stop for instance.

The external relay logic system outlined below would provide a basic yet effective method of supplying an overall System Enable for a Focus Drive installation.



**NOTE:** Without the use of the Contactor option, 2400-9001 (or the reversing contactor option, 2400-9002, if reverse is required) potential motor movement in the event of a power line disturbance (causing an scr (power device) to misfire) can occur since the motor is connected directly to the power circuit even when the drive is disabled. It is highly recommended that one of these contactor kits be used.

The circuit above shows the System Ready Contact being used. This contact along with the **Focus 1 Contactor option** (2400-9001 kit) completely disconnects the motor from the drive power section when the remote start and / or if the System Ready contacts open.

## Initial Start-Up

The following procedure is to verify proper operation of the drive in its simplest form as a basic speed regulator with no option kits installed. It is assumed that the drive is in its “*out of box*” condition with respect to jumper programming with the exception of what was just changed in the previous pages, jumper setup worksheet.

## Installation of Option Kits



**Do not** install option kits until you have verified the basic operation as outlined in the Start-Up section.

Pre-installation of option kits before verification of basic drive operation will make troubleshooting much more difficult. Option kits are often installed incorrectly and one cannot determine if the drive was functional before kits were installed.

### **WARNING**

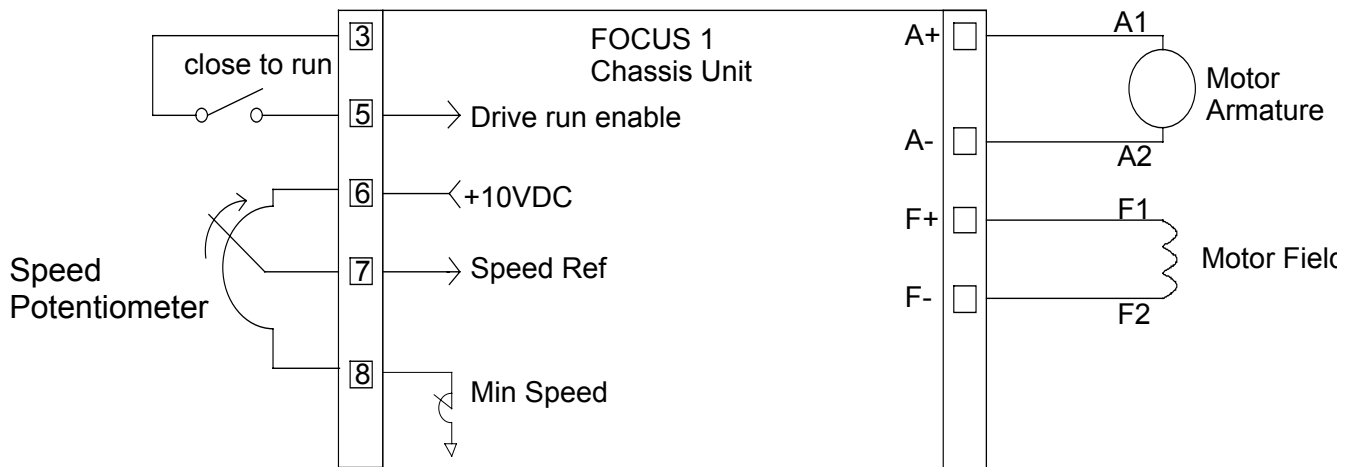
When making any wiring or jumper changes, the incoming AC power must be turned off and locked out. Hazardous voltages will be present until the AC power is turned off. The drive contactor ( if used ) does not remove hazardous voltages when opened.

# Initial Start-Up con't

A minimal number of connections are made to the terminal strip (see diagrams below). If the drive is an enclosed unit with operator devices (start/stop and speed pot) only the jumper from terminal block TB2-5 to TB2-5A needs to be made- this is a temporary connection only intended for System Interlock - **see Application Safety**

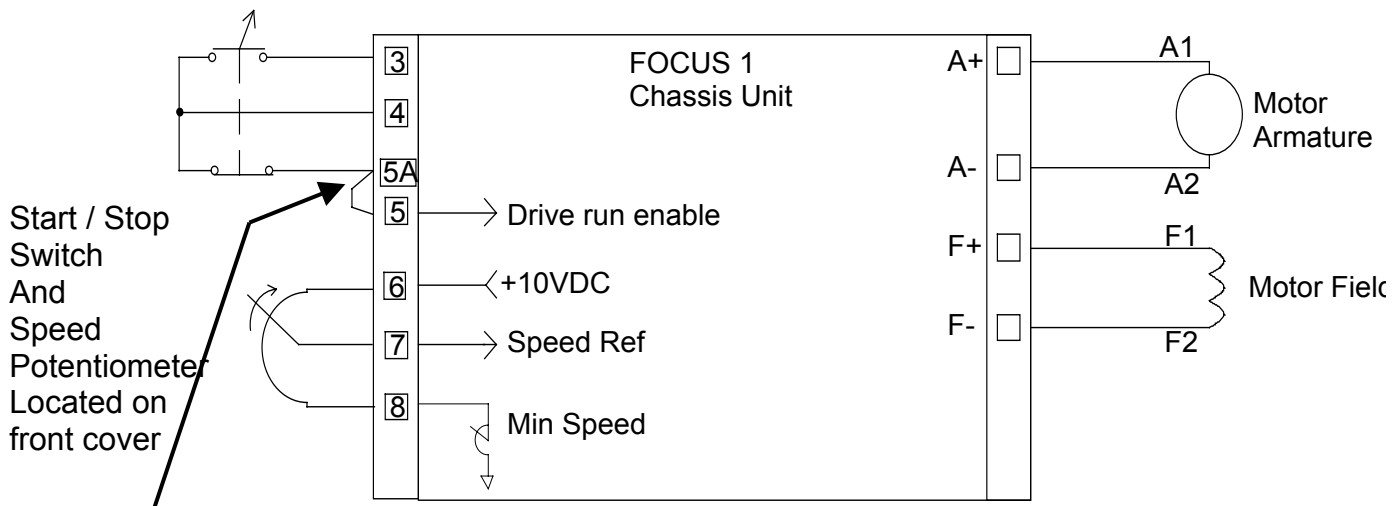
- a) **Regulation Mode:** In this procedure, **leave jumper in speed regulation** (JP2 = SPD).

## For Chassis Units Only



**Note:**  
Permanent Magnet Motors do not have Field F1 & F2, connections

## For Enclosed Units Only



**Drive will not start without this. This is intended for system interlock- see Application Safety**

# Initial Start-Up con't


1. Adjust Speed pot (enclosed unit) approximately 1/3 turn clockwise (from full CCW position)

## **Power can now be Applied !**

2. Start drive. Run light (red) should be illuminated.
  3. **Slowly** adjust Speed pot clockwise (~1/4 turn) while watching motor shaft. Verify that the motor rotates in the desired direction and that the motor slowly accelerates to about 30% of rated speed. If the motor rotates in the wrong direction, stop drive, **REMOVE AC POWER** and then reverse the field leads, F1 and F2. Re-apply power and repeat this step.
  4. Stop Drive and **Turn off AC Power**.
- 

## Basic Setup for Current (Torque) Regulator

1. Only do the next Step if the Drive is to be configuration as of Current or Torque Regulator. Otherwise Drive can now be set-up for terminal strip connections as required by the particular application. Refer to pages 30 for typical **Terminal Strip Connections**.
2. If the drive is to be set-up as a Current (torque) Regulator, set jumper JP1 and JP3 to "CURR" position .
3. The standard speed command input (TB2-#7) is now the drive current reference. The accel / decel time (fixed) on the control board will now control the rate of change of current.

 Note that the drive is now controlling motor torque and **NOT** speed, therefore if the current reference is set to a higher level than the torque required by the load, the motor will run to speeds in excess of rated motor speed. In applications where this **over-speed** condition can occur (such as a web break in a simple re-winder) an external over-speed protection device must be added to the system.

# Focus 1 Trouble Shooting Guide

## IMPORTANT SAFEGUARDS

All work on the drive should be performed by personnel familiar with it and its application. Before performing any maintenance or troubleshooting, read the instructions and consult the system diagrams. Only minor adjustments should be necessary on initial start-up, depending on the application. In addition, some common sense maintenance needs to be followed.

### **WARNING**

MAKE SURE THAT ALL POWER SOURCES HAVE BEEN DISCONNECTED BEFORE MAKING CONNECTIONS OR TOUCHING INTERNAL PARTS. LETHAL VOLTAGES EXIST INSIDE THE CONTROL ANYTIME INPUT POWER IS APPLIED, EVEN IF THE DRIVE IS IN A STOP MODE. A TURNING MOTOR GENERATES VOLTAGE IN THE DRIVE EVEN IF THE AC LINE IS DISCONNECTED. EXERCISE CAUTION WHEN MAKING ADJUSTMENTS WITH THE CONTROL DRIVING A MOTOR. NEVER INSTALL OR REMOVE ANY PC BOARD WITH POWER APPLIED TO THE CONTROL

**KEEP IT CLEAN:** The control should be kept free of dust, dirt, oil, caustic atmosphere and excessive moisture.

**KEEP IT COOL:** The control should be located away from machines having a high ambient temperature. On panel mount controls, air flow across heatsinks must not be restricted by other equipment within the enclosure.

**KEEP CONNECTIONS TIGHT:** The equipment should be kept away from high vibration areas that could loosen connections or cause chafing of wires. All interconnections should be re-tightened at time of initial start-up and at least every six months.

### **WARNING**

THE DC MOTOR MAY BE AT LINE VOLTAGE EVEN WHEN IT IS NOT IN OPERATION. THEREFORE, NEVER ATTEMPT TO INSPECT, TOUCH OR REMOVE ANY INTERNAL PART OF THE DC MOTOR (SUCH AS THE BRUSHES) WITHOUT FIRST MAKING SURE THAT ALL AC POWER TO THE CONTROL AS WELL AS THE DC POWER TO THE MOTOR HAS BEEN DISCONNECTED.

The motor should be inspected at regular intervals and the following checks must be made:

- A. See that both the inside and outside of the motor are not excessively dirty. This can cause added motor heating, and therefore, can shorten motor life.
- B. If a motor blower is used, make sure that the air passages are clean and the impeller is free to rotate. If air filters are used, they should be cleaned at regular intervals or replaced if they are disposable. Any reduction in cooling air will increase motor heating.
- C. Inspect the commutator and brushes. Replace the brushes if needed. Make sure that the proper brush grade is used.
- D. The motor bearing should be greased per the manufacturer's instructions as to type of grease and maintenance frequency. Over greasing can cause excessive bearing heating and failure. Consult the instructions supplied with the motor for more details.

# **TROUBLESHOOTING OVERVIEW**

Fast and effective troubleshooting requires well-trained personnel supplied with the necessary test instruments as well as a sufficient stock of recommended spare parts. Capable electronic technicians who have received training in the control operation and who are familiar with the application are well qualified to service this equipment.

## **Suggested Training**

- A. Study the system instruction manual and control drawings.
- B. Obtain practical experience during the system installation and in future servicing.
- C. Train in the use of test instruments.

## **Maintenance Records**

It is strongly recommended that the user keeps records of downtime, symptoms, results of various checks, meter readings, etc. Such records will often help a service engineer locate the problem in the minimum time, should such services be required.

## **General Troubleshooting**

The most frequent causes of drive failure are:

- A. Loose or broken wire connections.
- B. Circuit grounding within the interconnections or the power wiring.
- C. Mechanical failure at the motor.

DO NOT make adjustments or replace components before checking all wiring. Also monitor all LED indicator lights before proceeding with troubleshooting checks, and check for blown fuses.

It should be noted that modern solid state electronic circuitry is highly reliable. Often problems, which appear to be electrical, are actually mechanical. It is advised that the motor be checked in the event of any drive problems. Refer to the motor owner's manual for maintenance and repair procedures.

## **Notes for a Troubleshooting Technician**

A minimum knowledge of system operation is required, but it is necessary to be able to read the system schematics and connection diagrams.

An oscilloscope may be needed to locate problem areas and to make adjustments. However, the majority of problems can be solved by using a multimeter and by parts substitution.

### **WARNING**

**WHEN A TEST INSTRUMENT IS BEING USED, CARE MUST BE TAKEN TO INSURE THAT ITS CHASSIS IS NOT GROUNDED EITHER BY A GROUNDING PLUG CONNECTION OR BY ITS CASE BEING IN CONTACT WITH A GROUNDED SURFACE. EXTREME CARE MUST BE TAKEN WHEN USING THE OSCILLOSCOPE SINCE ITS CHASSIS WILL BE ELECTRICALLY HOT TO GROUND WHEN CONNECTED TO THE CONTROL SYSTEM.**

## Oscilloscope Safety

There are instances where a simple digital multimeter is not sufficient to trouble shoot a DC Drive and an oscilloscope must be used. This note will explain how to properly connect to the drive.

Focus 1, Focus 2 and Focus 3N non-regenerative drives are known as “**hot**” chassis type drives. What this means is that the control circuit is connected directly to the motor terminals which are in turn tied to the power line through the SCR's within the drive.

The significance of this is that it is important that no point within the drive circuitry comes into contact with earth ground. If this should occur it would effectively result in the power line to be connected directly to earth ground through the control circuitry (needless to say, destroying the Drive Control Board, blowing fuses etc).

When using a typical oscilloscope powered by the 115vac power line or a battery powered scope being powered with an AC/DC adapter **or any similar line powered electronic instrument** special care must be exercised. By design, the (earth) ground pin on the power plug is tied directly to the ground clip on the scope probe (and also to the case of the scope). In order to use the oscilloscope to look at various control signals and the motor armature voltage, this connection must be somehow eliminated.

This Troubleshooting Information is intended for use by Qualified Electronic Technicians versed in Motor Drives and Industrial Power devices. The procedures outlined in these guides expect that the troubleshooter understands the hazards of working with High Voltage and High power devices and has basic troubleshooting skills and a working knowledge of troubleshooting equipment

**One must not attempt using this information if their knowledge or skills do not include working with Motor Drives and High Voltage AC Line power.**

## Typical Line Power Oscilloscope



Earth Ground Pin  
Is Tied internally  
to ground clip on  
probe



## Portable Battery Powered Oscilloscope

Use of a battery powered oscilloscope **without** an AC/DC adapter is the best method to observe drive waveforms.

When using a dual channel oscilloscope make sure that you use only 1 scope ground lead – remove the scope ground lead on the other probe.

## For AC Line Powered Oscilloscopes

### Preferred Method- Differential Channel Method

1. The scope could be set up to look at signals **differentially** using two probes. In this mode you would NOT use the ground clips on the probes- remove them from the probes. This allows the scope to be grounded without causing damage to the drive and without the scope case becoming HOT to the line supply levels. You would need to explore the Scopes differential mode to accomplish Channel A-B display.



***NOTE: When the following methods #2 and #3 are used, the case/chassis of the scope will be floating above ground at what ever the voltage level the drive is at with respect to earth ground. This could be as high as 250vac for a Focus drive. Care must be taken as not to touch the case and earth ground, a severe electrical shock can occur which could be life threatening. It is also important to set the scope on something non-conductive, like a rubber mat. Care must be taken so that the scope case does not come into contact with earth ground when using these methods.***

#### **Isolation Transformer Method**

2. The next preferred method #2 uses a small isolation transformer to power the scope, this will effectively eliminate the earth ground connection.



#### **Least Preferred Method**

3. The least preferred method ( yet most widely used ) involves cutting off the Earth ground pin on the power plug, or use of a “cheater” adapter which has no ground pin. Use of the adapter is probably the better approach since cutting off the ground pin may void the warranty on the oscilloscope.



When using a dual channel oscilloscope make sure that you use only 1 scope ground lead – remove the scope ground lead on the other probe.

## **BASIC TROUBLESHOOTING**

This paragraph contains a basic list of symptoms of an improperly functioning control. Included in the list are possible causes and corrective measures for each symptom described.



**BEFORE PROCEEDING WITH ANY MAINTENANCE OR TROUBLE-SHOOTING ACTIVITY, ALL POWER SOURCES MUST BE DISCONNECTED.**

### **CONTROL APPEARS TO BE DEAD:**

- A. Terminals TB2-5 and -5A on the main PC board not jumpered together - install either a jumper or the Motor Thermostat between these terminals.
- B. No AC power - apply AC power and measure L1 and L2 for correct voltage.
- C. Blown line fuses - replace line fuses.
- D. Loose connections -turn off AC power and tighten connections.
- E. Control incorrectly wired - recheck all wiring.
- F. Defective Start/Stop switch, component on main PC board, or rectifier cube - replace bad components as required. ( [See Critical Components](#) )
- G. Speed potentiometer set to zero - slowly advance from zero to begin motor rotation.

### **LINE FUSES BLOW OR MAIN CIRCUIT BREAKER TRIPS WHEN APPLYING AC POWER:**

- A. Control is wired to AC voltage exceeding control rating -rewire control to proper AC voltage or use step-down transformer.
- B. Rectifier cube, field diodes on main PC board, motor winding or suppressor network shorted, or a short to ground is present - locate and remove short.
- C. Improper wiring or jumper programming during installation.
- D. Defective main PC board component - replace as required. ( [See Critical Components](#) )
- E. Motor shaft jammed - determine cause and correct.
- F. Excessive carbon dust from brushes in motor - determine cause and correct.

### **FUSES BLOW WHEN SPEED POTENTIOMETER IS ADVANCED FROM ZERO:**

- A. Motor is overloaded - reduce load as required.
- C. Motor is defective - consult motor instruction manual and repair or replace motor as required.

### **MOTOR DOES NOT REACH FULL SPEED:**

- A. Motor is overloaded - correct overload condition.
- B. Maximum Speed potentiometer (MAX) is set too low -adjust MAX potentiometer clockwise.
- C. Low AC line voltage (more than 10% below nominal) -check AC line voltage and correct.
- D. Incorrect jumper programming of JP2 - follow programming procedure
- E. Defective rectifier cube - replace as required. ( [See Critical Components](#) )
- F. Motor brushes worn - replace as specified in motor instruction manual.

**MOTOR RUNS IN WRONG DIRECTION:**

- A. The A1 and A2 output leads to the motor are incorrectly wired - exchange these leads.
- B. On shunt wound motors only the shunt field F1 and F2 leads are incorrectly wired – exchange these leads.

**MOTOR DOES NOT MAINTAIN SPEED UNDER LOAD:**

- A. IRCOMP potentiometer is set too low - adjust clockwise
- B. Motor is overloaded - correct overload condition.
- C. Incorrect jumper programming – check jumpers.
- D. Defective component on main PC board – replace (**See Critical Components**)
- E. Motor brushes worn - replace as specified in motor instruction manual.

**MOTOR DOES NOT COME TO FULL STOP:**

- A. Minimum Speed potentiometer (MIN) is set too high -readjust
- B. Defective speed or torque potentiometer, component on regulator PC board, Start/Stop switch, or rectifier cube -replace as required.  
(**See Critical Components**)

**NO SPEED CONTROL:**

- F. Defective rectifier cube - replace as required (**See Critical Components**)
- G. Defective component on main PC board - replace as required.  
(**See Critical Components**)
- H. Incorrectly wired or defective speed potentiometer - check the wiring.
- I. Incorrect jumper programming - check jumper programming.
- J. If the control (after rechecking all the wiring for proper and secure connections) is still inoperative, make the following voltage checks. Double check to make sure that armature leads A1 and A2 are not grounded.
- K. High resistance ground on motor armature

**VOLTAGE CHECK CHART**

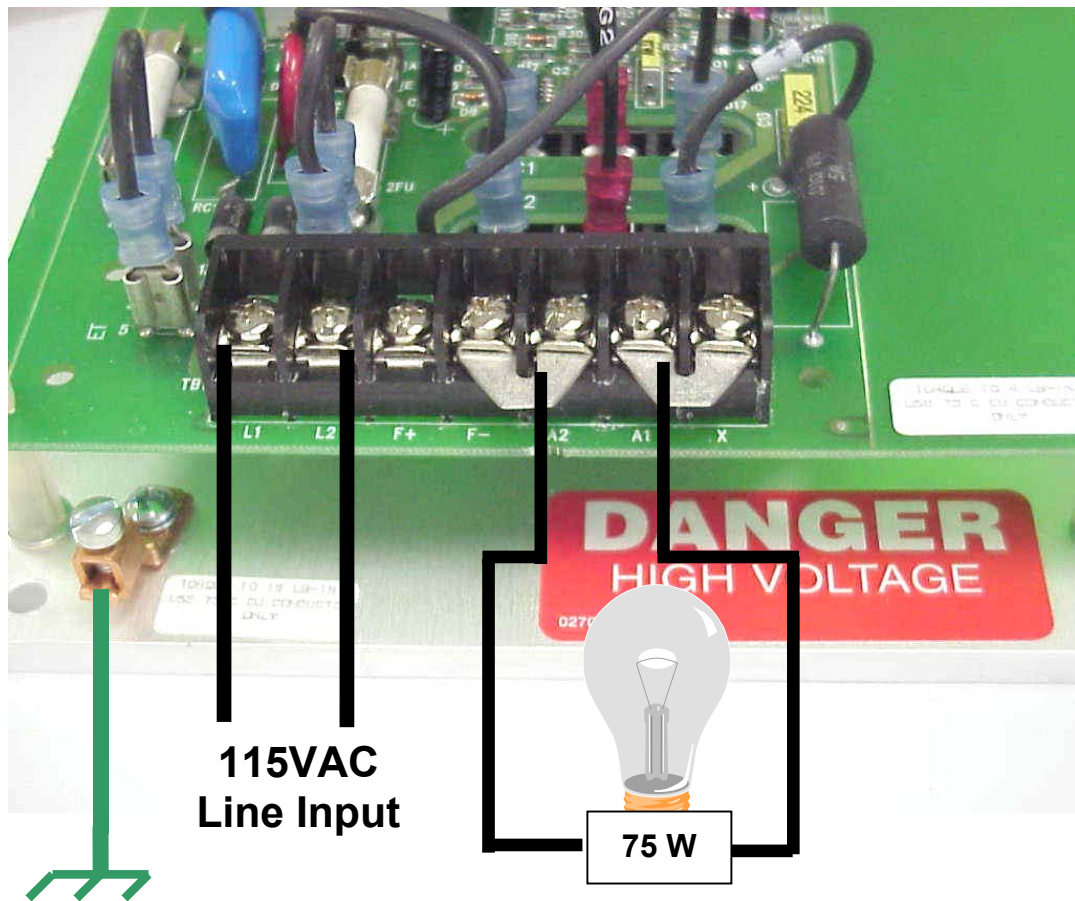
Step	Function	Normal Voltage Readings		Terminal or Point	Probable Cause
1 with AC Power "on"	Voltage to Rectifiers	120 Vac ±10%	240 Vac ± 10%	AC1 AC2 On power cube	Blown Fuses
2*	Speed command	0 to +10 Vdc	0 to +10 Vdc	10-12	Defective speed adjustment potentiometer or circuit board assembly
3	Field Supply Voltage	100 Vdc	200 Vdc	+F1 -F2	Defective field diodes defective encapsulated bridge rectifier assembly
4*	Armature Voltage	0-90 Vdc	0-1 80 Vdc	+A1 -A2	Defective encapsulated bridge rectifier ass'y, or circuit board assembly

\*Depends on the setting of the speed adjustment knob

## **Basic Test Setup – Light Bulb Test**

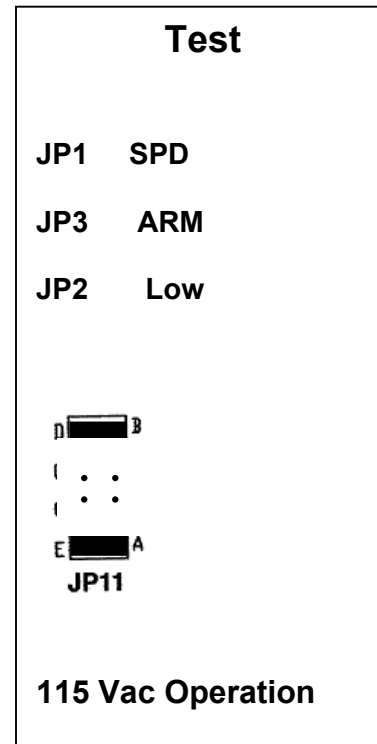
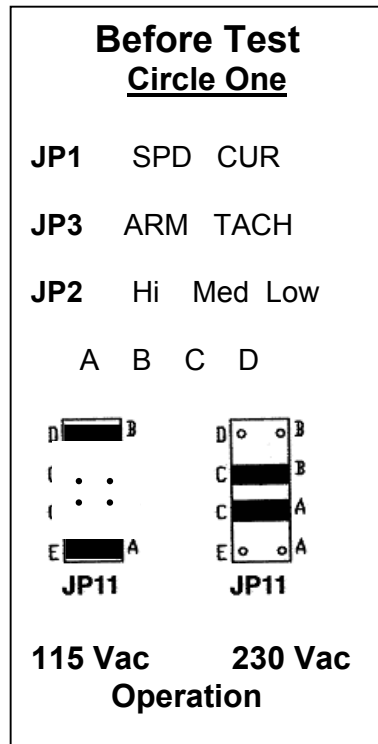
It is fairly easy to test Focus Drives on the bench. One does not have to use a motor to verify basic operation. When working properly, the Focus basically creates a variable voltage much like a light dimmer except the output is DC. The easiest way to check a Focus on the bench without a motor is to connect the Armature output to a resistive load. One could use a **75 watt** light bulb screwed into a light bulb socket base as shown below.

### **Basic Test Power Wiring**



In order to test the Focus, one would need to setup the input for 115 Vac operation and for basic Armature Voltage feedback. The drive should also be set for the lowest current setting. Therefore before testing, one should record the settings before test so that they could be reset back after the test.

## Record Drive Set-up **BEFORE** performing Light bulb test



### **Basic Armature Circuitry Checkout**

After the Focus is wired as shown on the previous page and the jumper set as indicated above, 115 Vac power could be applied and the Focus should cause the light bulb to vary in brightness from nothing to full brightness. One could measure the voltage across the bulb and it should be about 90 Vdc at maximum brightness. This would verify the basic Start/Stop, Speed command, Power Supply, Regulator and Power Sections.

### **Field Supply Checkout**

If one wants to check the Field Supply, power should be removed and the light bulb moved over to the F+ and F- terminals (use a 75 W bulb or less for the field. **Use of greater than 75 W could permanently damage the Field rectifiers**). Then upon application of power, the light bulb should light to full brightness and the voltage across the light bulb should measure about 100 Vdc.

If the Focus passes these basic tests, the drive should be OK and the drive should be able to run a good motor at least in Armature Voltage feedback (JP4 in ARM). Reset jumpers back to the **“Before Test Recorded Settings”** except for JP4 and re-check.

If the motor has a shunt field, it should measure at least:

**200 ohms if Nameplate indicates 200 Vdc Field**  
**100 ohms if Nameplate indicates 100 Vdc Field**

# **Application Notes**

In order to provide continuing support for the Focus products (as well as all of our other products): ( if this is being viewed electronically, click on any blue item for link )

**Application Notes** (CTANXXX)

**Technical Notes** (CTTNXXX)

**Replacement Instructions** (CTRIXXX)

and kit **Instruction Sheets** (CTISXXX) are posted on our web site

These documents provide a wide variety of information instantly available day or night. Below is a list of currently available **Application Notes** :

Click on DC Drives if on website

<b>Application Note #</b>	<b>Rev</b>	<b>Drive Family</b>	<b>Topic</b>
<a href="#">CTAN 204</a>	1.0	Focus 1	Power Wiring Guidelines
<a href="#">CTAN 215</a>	1.0	Focus Family	Earth Grounding & Isolation
<a href="#">CTAN 243</a>	1.0	Focus 1	Multiple Drives Running in Tandem
<a href="#">CTAN 244</a>	1.0	Focus 1	Isolated Master Reference Board

Replacement Instruction for Control Board (CTRI1210) can be found at our website at: [www.emersonct.com](http://www.emersonct.com) or click the link below:

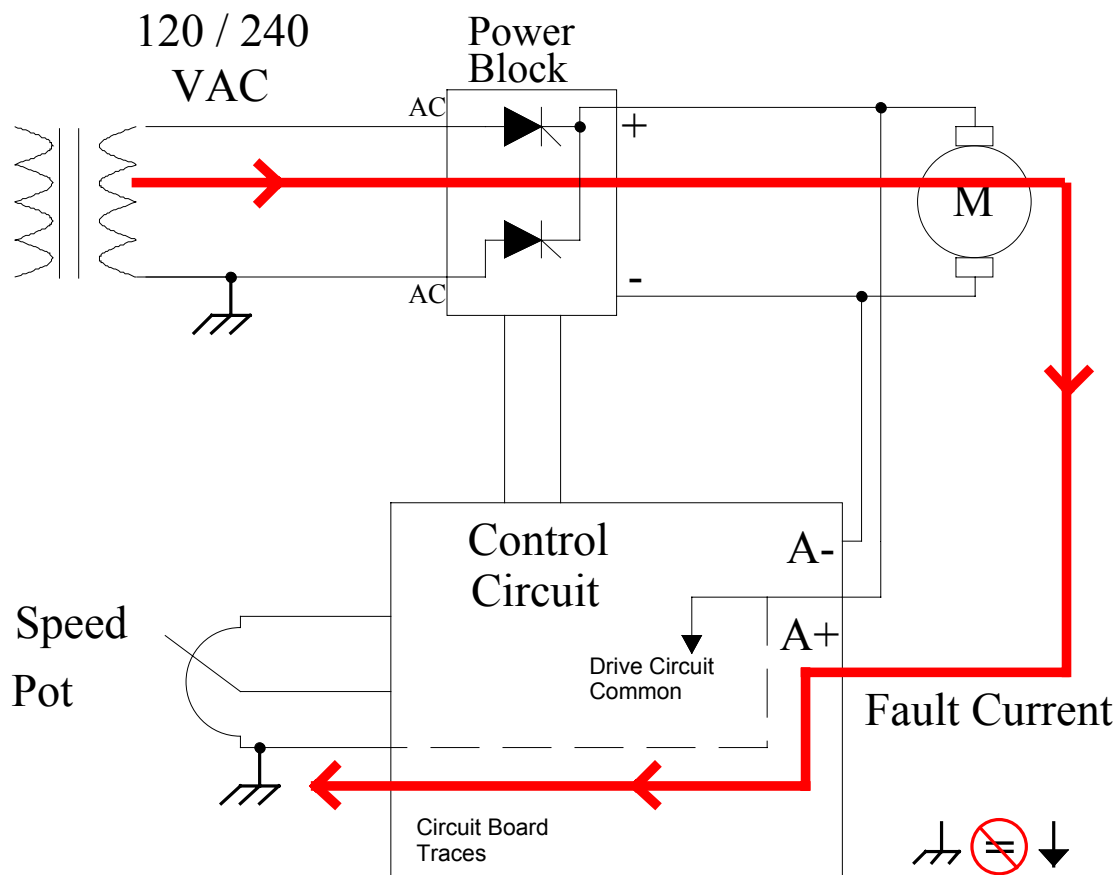
**[CTRI219](#)**

# CTAN #215

## Ways of Achieving Isolation

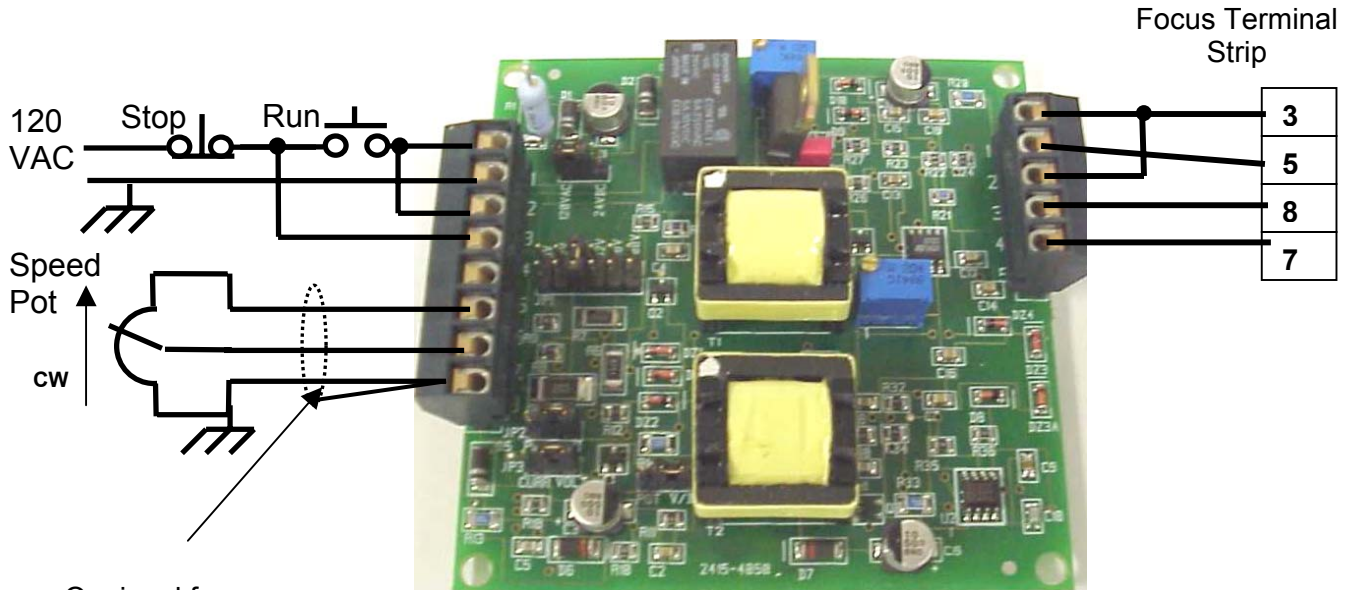
## Non-Regenerative DC Drives

Focus non-regenerative motor controllers are not isolated from the power circuit. Essentially, circuit common on the control card is connected directly to the A+ terminal of the motor. Therefore, **NO** terminal connection on the control terminal strip (TB2) can be connected to earth ground in any way, even momentarily. Any earth ground on these terminals will effectively short out the power line through the circuit board traces.



## Solutions to Applications Requiring Control Inputs to be Earth Grounded

### Solution #1 – Focus 3 Signal Isolator Board

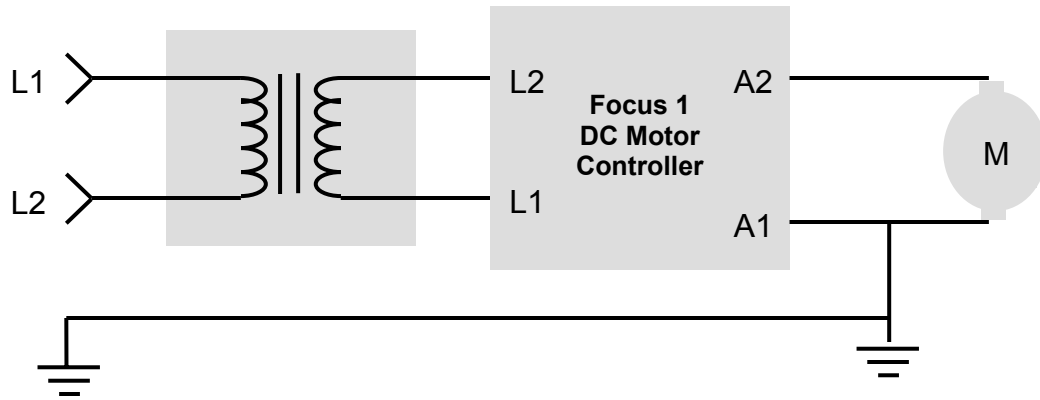


Or signal from a  
PLC or computer  
DCS system where  
isolation is unknown  
or must be  
maintained

**F3NSBD**

This option is used in applications where isolation is required between an external control signal and the motor controller (which may or may not be at earth ground potential). It can be utilized to isolate a variety of voltage or current signals (see specifications below). It may also be used simply to isolate the speed adjustment pot, and the pot power supply is included! This option can be mounted in the enclosure or in a piece of plastic track (included with kit).

## Solution #2 – Isolation Transformer



**DO NOT CONNECT GROUND**  
**TO TRANSFORMER SECONDARY**

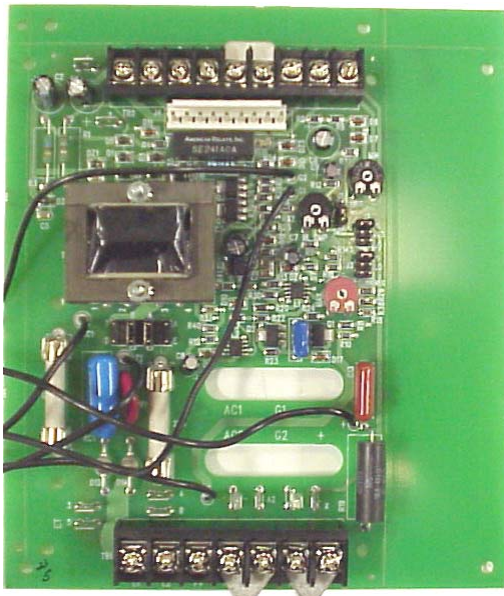
**Transformer KVA = 1.5 x Rated Armature Current x 120 Vac (or 240)**

**Example:** Your DC Motor has a 10 A armature

**KVA = 1.5 x 10 A x 120 Vac = 2.4 KVA (use 2.5 KVA)**

# Critical Components and Replacement Parts

## Main Control Board



This control board is used on both the all Focus 1 models:

Replacement Instructions for Control Board (CTR1219) can be found at our website at: [www.emersonnct.com](http://www.emersonnct.com) or click the link below:

**CTR1219**

**2400-4100**

### Speed Adjust Pot

**3533-0502 –  
Potentiometer**

**3549-002 - Knob**



### Switches

**3550 – 005 Start / Stop**



**3550-004 Power On/Off  
20 A, 250 Vac**



**3550-003 Fwd / Rev**



### Power Block

**3720 – 004**



### Fuses

**3705-032**

**15 A, 250 Vac**



These components are stocked and sold through the North American Service Center. To order please contact sales @ 1-800-367-8067

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