
590 DRV Digital DC Drive

Product Manual

Version 3 Software

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WARNING!

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Chapter 1 INTRODUCTION

SCOPE

This manual covers the 590 DRV Digital series of regenerative and non-regenerative DC motor controllers.

OVERVIEW OF THE 590 DRV DIGITAL DRIVE

The 590 DRV Digital drive is a DC motor controller package containing a 590 Digital DC drive, DC contactor, AC supply fusing to protect the DC drive's thyristors and a control power transformer. For models rated 7.5 through 100 HP (500 VDC armature applications), all parts are mounted in a rugged, black anodized aluminum chassis. The components for all higher horsepower models mount on a panel. 500 through 900 HP models include a separate, external thyristor stack.

The 590 DRV Digital drive controls the DC output voltage and current for DC shunt field and permanent magnet motors. Models rated through 100 HP accept standard, three-phase, 208/230/380/415/460 volts AC, 50/60 Hz supplies; for models rated 125 through 900 HP, the supply is limited to 230/460 VAC.

The 590 DRV Digital drive is available as a four-quadrant, regenerative or a two-quadrant, non-regenerative drive. Each includes full transient and overload protection and uses highly advanced electronic control of motor acceleration and deceleration of speed and torque. Regenerative drives include two fully controlled thyristor bridges for forward and reverse control of speed and torque. Non-regenerative units have one thyristor bridge for operation in only one direction of rotation.

The Man Machine Interface [MMI] display simplifies start up and troubleshooting by automatically displaying the first fault. It is a powerful diagnostic tool with access to all alarms and most parameters within the drive. Light emitting diode [LED] indicators on the front panel display the drive's operating status.

You can configure the drive software either through the MMI or with ConfigEd Lite, a configuration program compatible with most IBM compatible personal computers (PCs) running Windows™.

NOTE. 590 DRV Digital DC drives rated through 300 HP are Underwriter Laboratory (UL®) approved for use in the United States and Canada.



Figure 1.1 - 590 DRV Digital DC Drive

STANDARD FEATURES

Main Features

Microprocessor Control: a 16 bit microprocessor controls the drive and offers:

- Real-time fiber optic communications
- Complex control algorithms not possible with simple analog devices
- Control circuitry built around standard software blocks.

Digital Accuracy: All setpoints and variables are accessible either through analog inputs or digitally over a serial computer communications link. Speed and current loops are processed digitally giving greater control accuracy and repeatability than analog drives.

Feedback Options: the drive supports four types of speed feedback:

- Armature voltage feedback (standard), which requires no feedback device, connections or isolator
- Analog AC or DC tachometer generators
- Wire-ended electrical encoders
- Plastic (5701) or glass (5901) fiber optic Microtach encoders

Field Regulator: a full-wave, half-controlled, single-phase thyristor bridge with transient and overload protection powers the motor field. The regulator provides either a fixed voltage or fixed current source, depending on the selected mode of operation. The field current mode can also provide field weakening for systems requiring extended speed range or constant horsepower control.

On-board Fuse Protection and Contactor: each drive has AC thyristor fuses and a DC contactor. Regenerative models have DC output fuse protection.

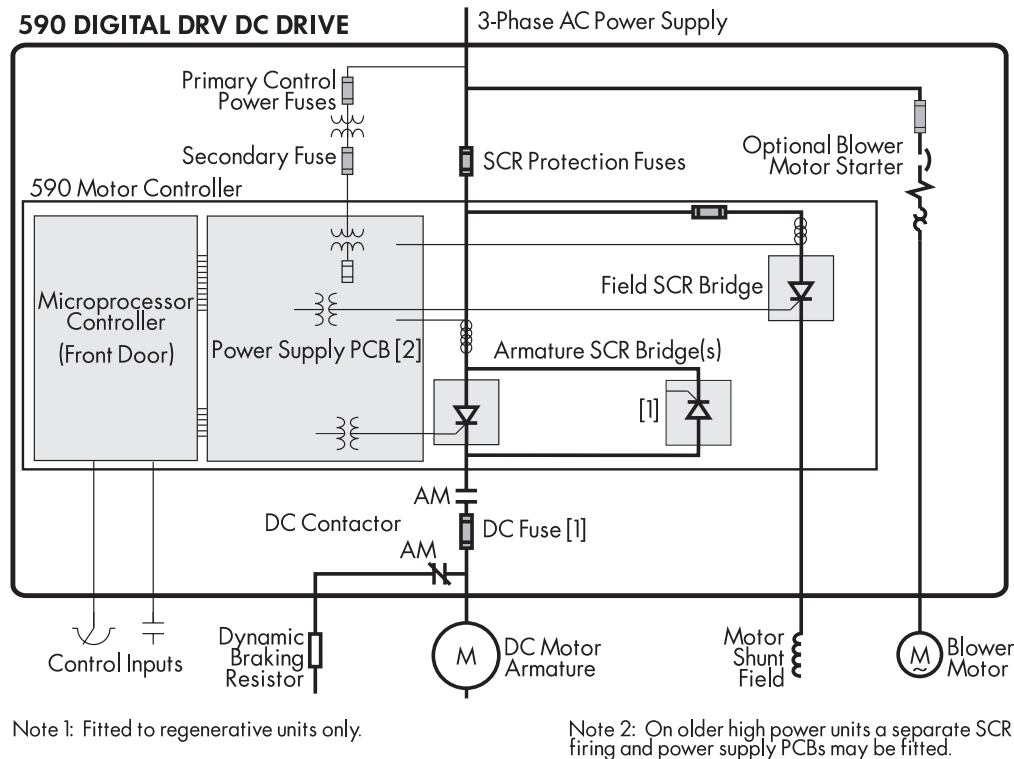


Figure 1.2 - 590 DRV Digital DC Drive Block Diagram

Other Features

- **Power Isolation:** the 590 DRV Digital drive's control circuitry is electrically isolated from the power circuitry, enhancing system interconnection and safety.
- **Phase Rotation Insensitivity:** the supply power can be connected in any phase order to the drive's main input supply.

Caution

While the 590 DRV Digital drive is not sensitive to phase rotation, the auxiliary 120 VAC between drives is. Do *not* tie the neutral wires from different 120 VAC sources together if the phases are rotated from drive to drive.

- **Frequency Auto Ranging:** the control circuitry automatically adjusts to accept supply frequencies from 40-70Hz and possesses high noise immunity from supply born interference.
- **Man-Machine Interface (MMI):** a two-line alphanumeric liquid crystal display (LCD) automatically displays the first fault the drive registers. A four button keypad greatly enhances troubleshooting, tuning and commissioning. Drive inputs and outputs and drive parameters are accessible through the LCD and the keypad and through the software package SAM.

- **Drive Status Indicators:** six LED's indicate the drive's alarm and run status.
- **Simple Calibration:** switch selectable calibration of armature voltage, armature current and field current. Fine tuning is performed through drive software.
- **Current Loop Autotune:** a built in AUTOTUNE routine automatically tunes drive current loop.

The drives are designed for simple, economical panel mounting. Disconnecting and reconnecting the controller, if necessary, is simplified by plug-in connectors. Standardized parts helps reduce the variety of spares needed to maintain a multi-drive system.

UNPACKING & SPECIAL HANDLING

Read this section before you remove the 590 DRV Digital drive from its packing materials. Though engineered for heavy industrial use, you can damage the unit by handling it improperly.

Remove the foam cover and fold back the antistatic plastic wrap from around the drive. Carefully remove any other packing material from around the drive and place it out of the way. Save the box and foam inserts for use should you ever need to return the drive. Improper packaging can lead to transit damage.

WARNING!

The 590 DRV Digital drive weighs more than 50 lbs. Be certain you can safely lift and move this weight before attempting to remove it from its container.

Using proper lifting techniques, remove the drive from its packing case. Do not attempt to lift or move the drive by its terminal connections as they are not designed for that purpose. Lift the drive instead by the solid metal frame on which it is constructed (see Figure 1.3). Lay the drive on a flat surface with the access panel covers up and make sure that you do not damage any protruding terminal connections.



Figure 1.3 - Top Hand-hold Location

Chapter 2 IDENTIFICATION

This chapter contains photographs of the 590 DRV Digital drive and the 590 controller showing the locations of labels, fuses and other components.

COMPONENT IDENTIFICATION

Figures 2.3, 2.4, 2.5, and 2.6 identify the parts contained in 590 DRV Digital drives rated 7.5 through 100 HP. These parts are discussed in the succeeding chapters. Figure 2.3 shows the fuses, transformer, and contactor in the power chassis. Figure 2.4 shows the location of the labels on the back side of the controller mounting bracket. Figure 2.5 identifies the components on the controller's power supply board. Figure 2.6 shows a controller with a 3-part power supply board. This configuration is used in all 330 amps (200 HP at 500 VDC) and larger DRVs. Figure 2.7 shows the inside of the 590 controller after the power supply board is removed.

LABELING

Labels are affixed to each 590 DRV Digital drive. These labels lists electrical requirements, fuse replacement information, terminal tightening torque ratings, safety warnings and the unit's model and serial numbers.

Nameplate Label

For 7.5 through 100 HP models, the nameplate label is on the left side of the power chassis (see Figure 2.1) as you face a mounted drive. A duplicate label is also inside the unit on the back side of the controller mounting plate. Both list the drive's model and catalog number, revision number, serial number, corresponding manual number and electrical rating information. Make sure you have all the nameplate label information available when contacting Eurotherm Drives for service assistance.

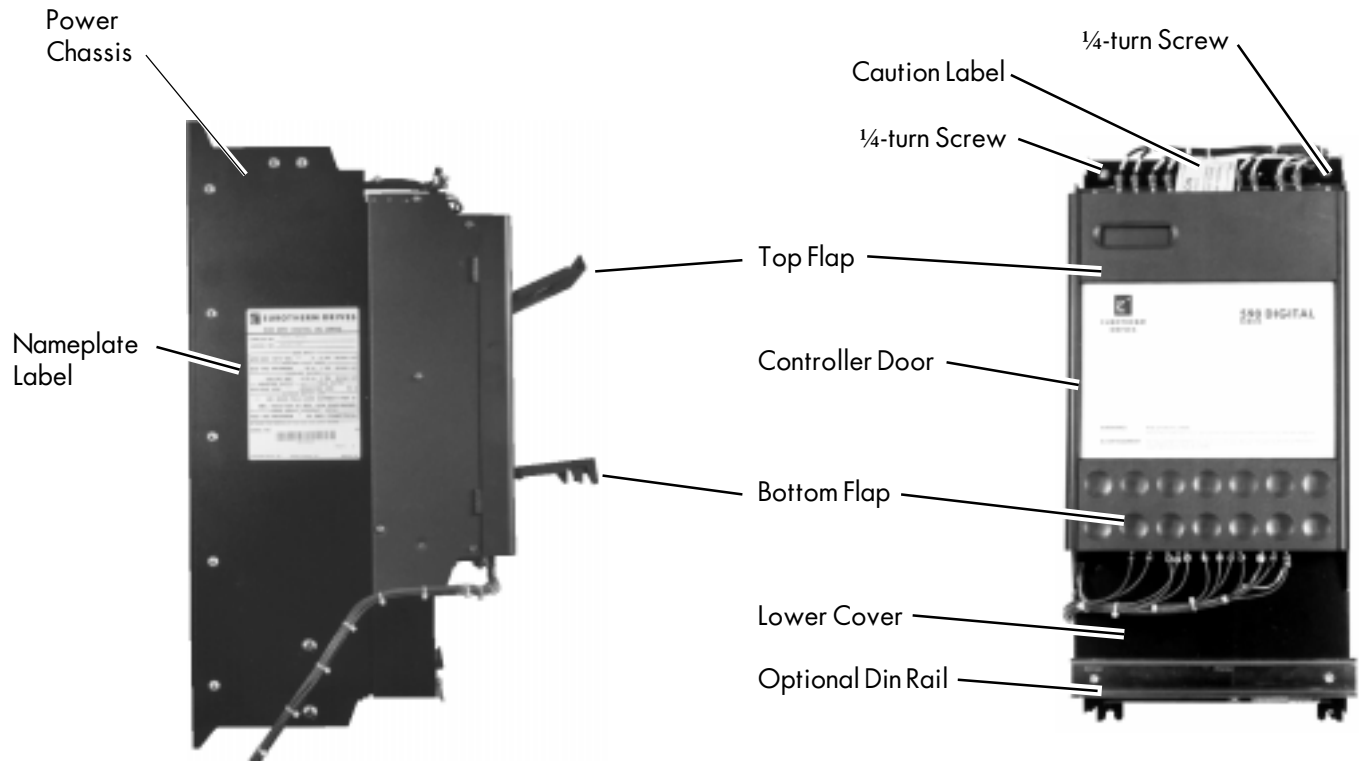


Figure 2.1- 590 DRV Digital DC Drive Front and Side Views (30 HP Unit Shown)

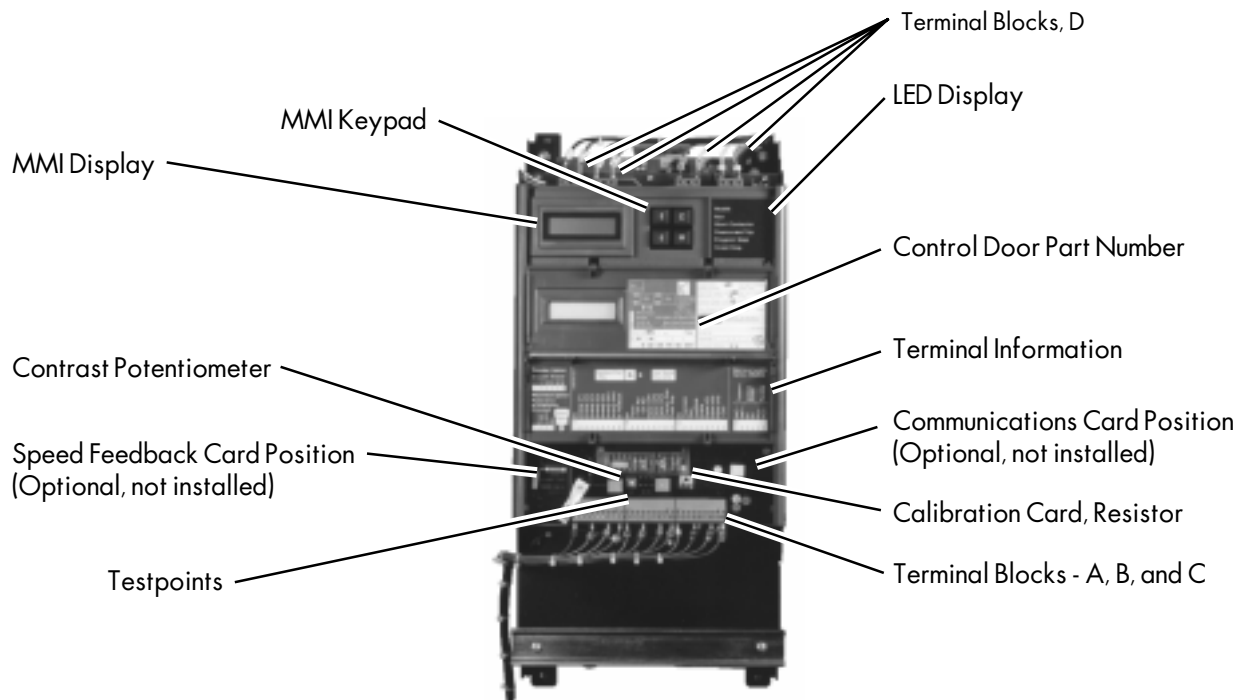


Figure 2.2 - 590 DRV Digital DC Drive with Cover Panels Open (30 HP Model Shown)

Fuse Replacement Label

The fuse replacement label for 7.5 through 100 HP models is located on the back side of the controller mounting panel (see Figure 2.4). It is visible when the top section of the DRV (including the controller) is lowered for access to the fuses and drive terminations. To access this area, loosen the two ¼-turn screws at the top of the drive section, just above the controller. Gently lower the top section until it comes to rest. If working on a bench, insert a spare bolt in each of the hinge slots at the base of the top section to provide protection against the drive closing unexpectedly. Refer to this label when replacing fuses and make sure the replacement fuses meet the label requirements.

NOTE. Figure 2.4 shows a 7.5 to 30 HP DRV chassis mounted to a back panel and opened to display the labels. The unit is oriented so that the operator is looking down at the labels. Wiring has been removed for clarity.

Terminal Tightening Torque Label

The terminal tightening torque label (see Figure 2.4) for 7.5 through 100 HP models is located below the fuse replacement label. Refer to it when making electrical connections to avoid overtighten the terminals.

Connector Kit Label

The connector kit label (see Figure 2.4) is located next to the terminal tightening torque label. It lists the catalog numbers of connector kits used for connecting power wires to the drive. It also lists the appropriate cable rating for each size power terminal.

LABELING ON HIGH HORSEPOWER MODELS

The nameplate label, fuse replacement schedule and terminal torque label for higher horsepower models (models rated 150 HP and above) are located on the DRV mounting panel.

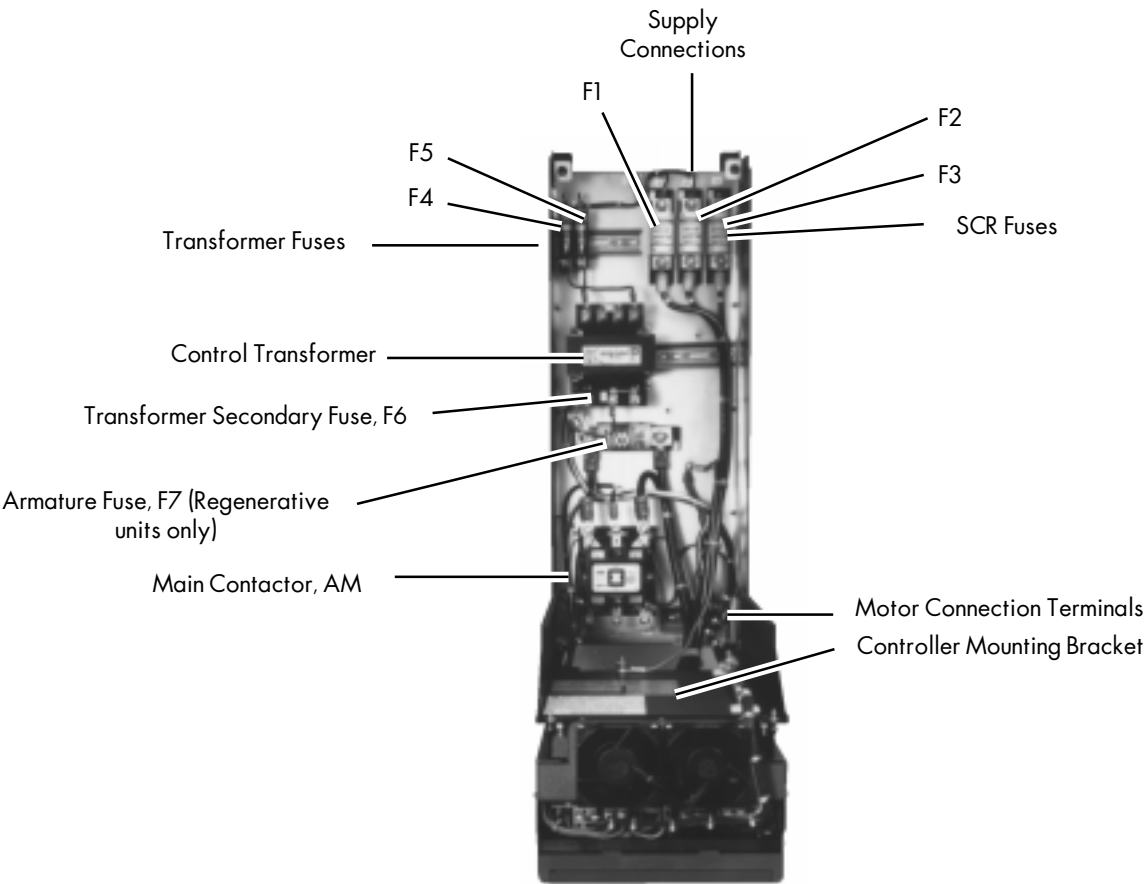


Figure 2.3 - Power Chassis (30 through 100 HP Units)

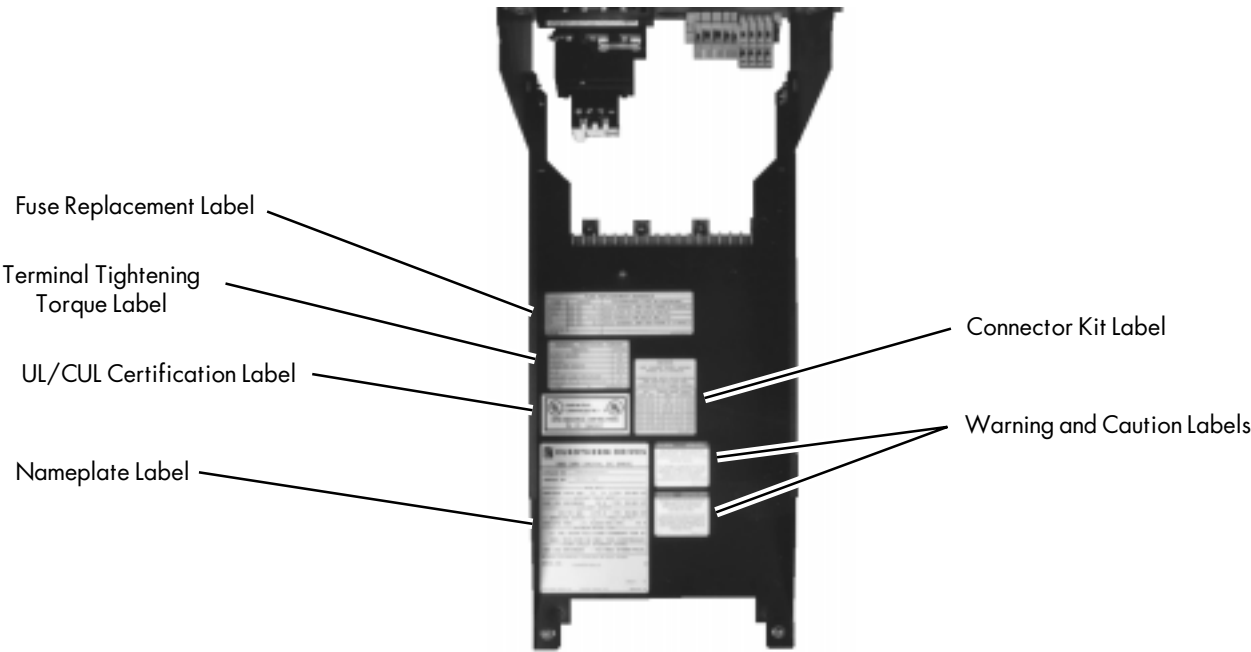


Figure 2.4 - Label Location On Controller Mounting Plate (30 through 100 HP Units)

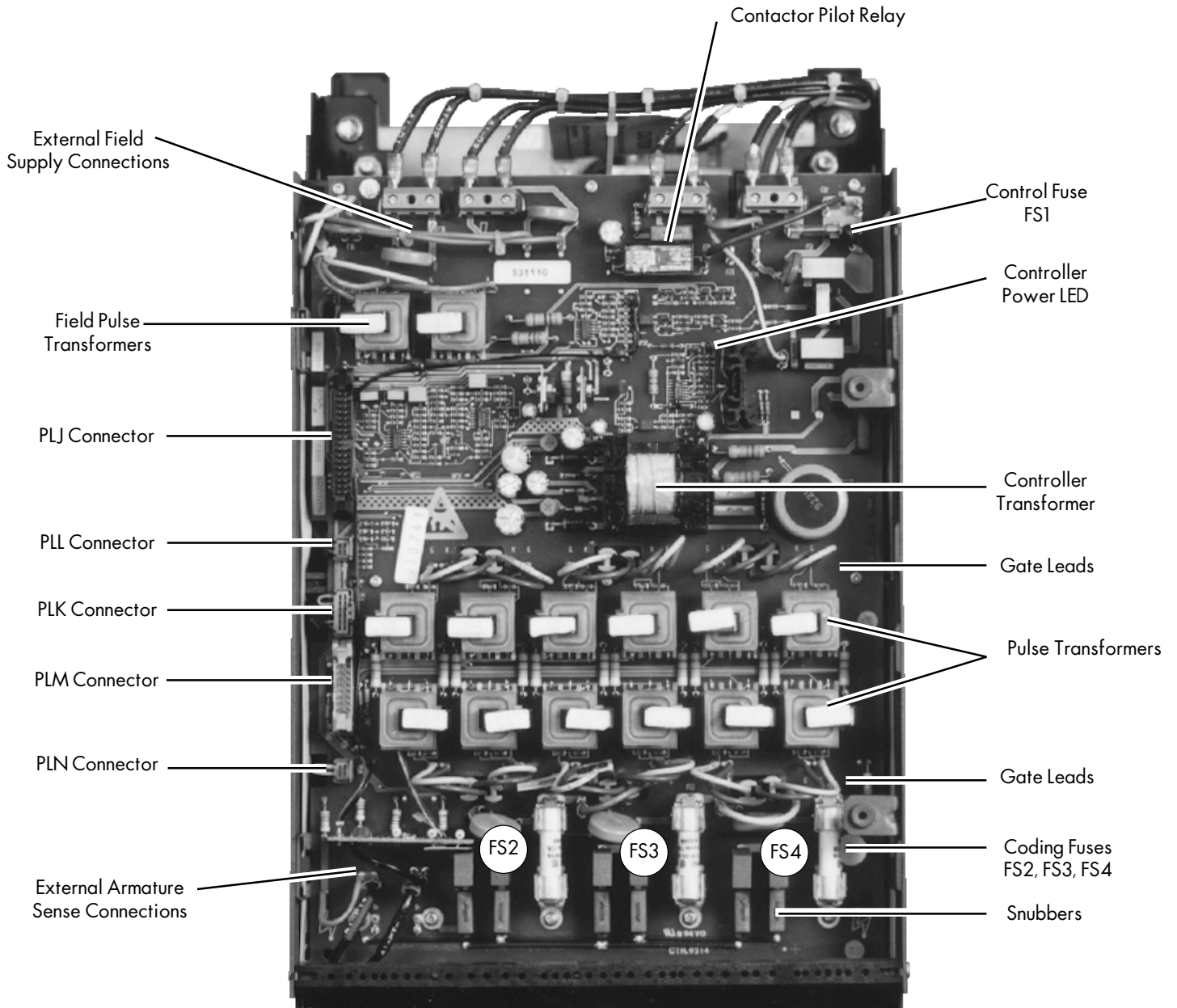


Figure 2.5 - Power Supply Board - AH385851U002 - Regen
AH385851U003 - Non-regen (not shown)

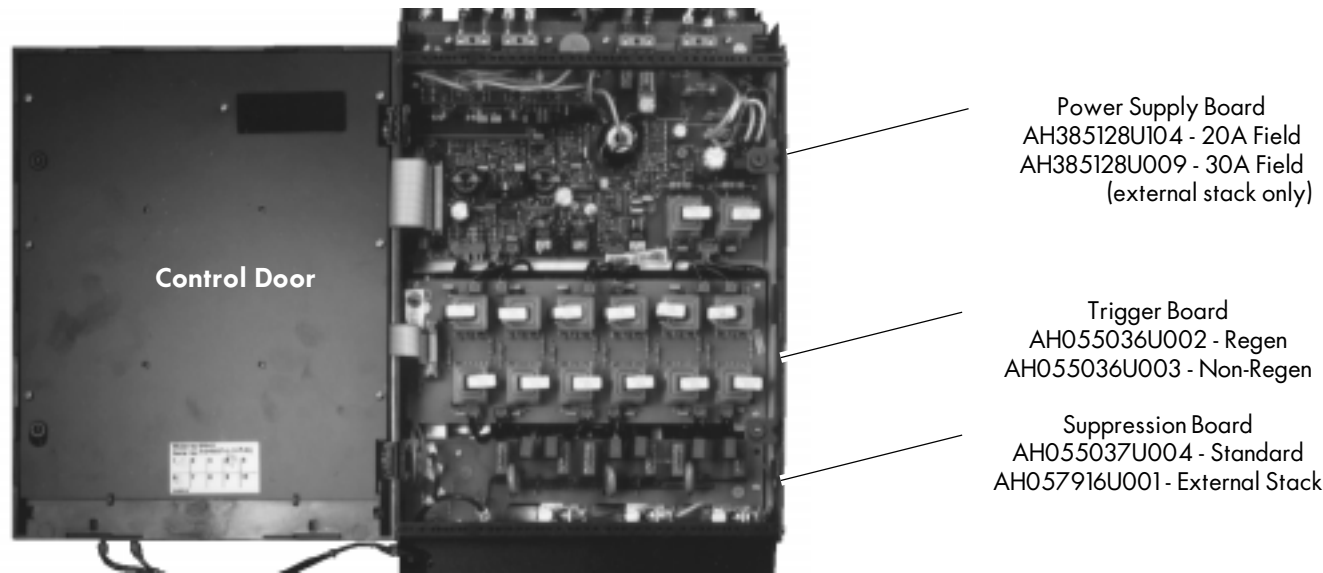


Figure 2.6 - Three-part Power Supply Drives [Used on
DRVs Rated 330 Amps (200 HP) and Larger]

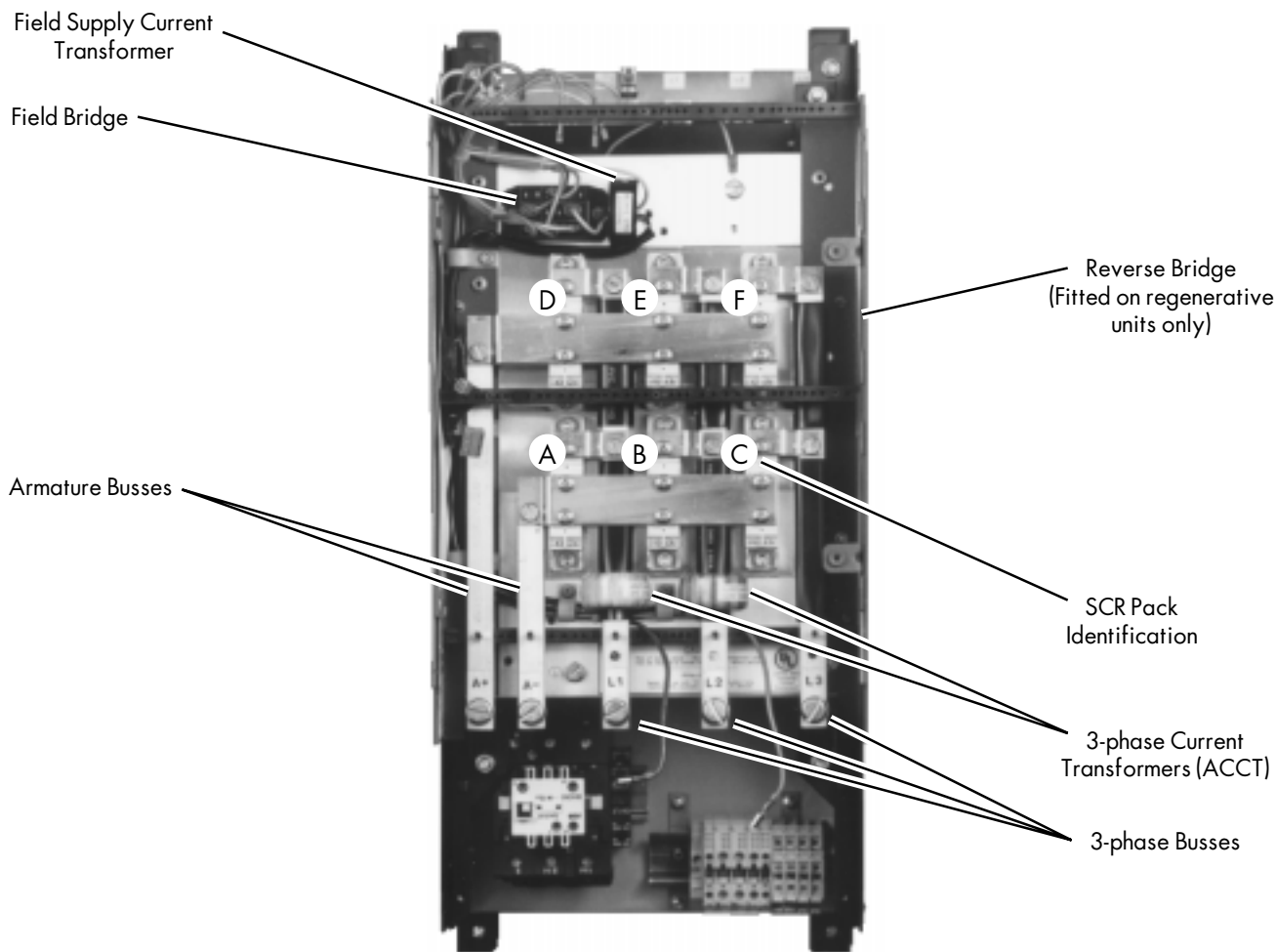


Figure 2.7 - SCRs and Power Busses (Power Supply Board Removed)

Chapter 3 INSTALLATION AND WIRING

The 590 DRV Digital drive is designed to be relatively simple to install. You should review these procedures *before* beginning them. If you do not understand the instructions or are unsure of your ability to perform the procedures, contact Eurotherm Drives Customer Service.

RECOMMENDED TOOLS

Installing a 590 DRV Digital drive requires a few standard hand tools. A socket wrench to fit either ¼-20 or M6 (as applicable) bolts and nuts is needed to mount the drive to the panel. Screwdrivers and a wire crimping tool are needed to make various electrical connections. For installing DRVs larger than 162 amps, wrenches are needed to make some of the electrical connections. Below is a list of some of the required tools.

| | |
|---------------------------------------|--|
| Socket wrench with a 6 inch extension | |
| Deep sockets | M10, M13, M17, 7/16", ½" |
| Screwdrivers | Phillips #2, Flat blade - 0.5 x 3.0 mm, 0.6 x 3.5 mm, 0.8 x 4.0 mm |
| Small wire cutters | |

VENTILATION AND COOLING REQUIREMENTS

The drive must be able to dissipate the heat generated during use. Therefore, mount the unit in a manner that allows a free flow of cool air vertically through the drive. Reserve a minimum 1½"(38mm) clearance on the left side of the drive to give the cover panels room to open properly. For 7.5 through 60 HP rated models, allow a minimum of 4"(100mm) of clear space above and below the drive to ensure adequate free air flow. Leave an additional 2"(50mm) clearance above and below models rated 75 through 100 HP. Refer to the technical illustrations at the end of this chapter for fan clearances required on all force fan ventilated units.

When mounting drives one above the other, allow at least 7"(175mm) between the top and bottom drives. Each drive requires the same clearance as required when used singly. When mounting drives next to each other, leave 1½"(38mm) left to right between units.

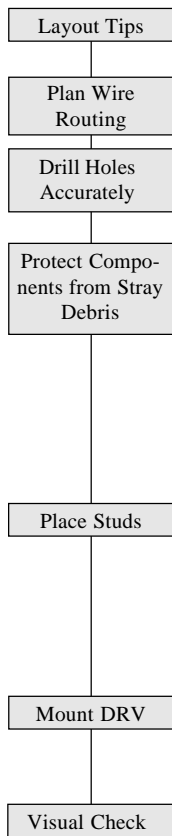
Make sure the unit is not mounted on or next to equipment that will cause the drive to overheat. Normal maximum ambient operating temperature is 113°F (45°C). Above this limit, the controller must be derated. The maximum ambient operating temperature is 131°F (55°C).

The table below lists the heat dissipation in Watts of 590 DRV Digital drives through 400 horsepower (at 500 VDC). The "*" in the catalog number designates either "R" or "N" (for regenerative or non-regenerative).

| Catalog Number | Motor Rating, HP at 500V | Motor FLC, Amps | Total Watts | Catalog Number | Motor Rating, HP at 500V | Motor FLC, Amps | Total Watts |
|----------------|--------------------------|-----------------|-------------|----------------|--------------------------|-----------------|-------------|
| 955D-8*751 | 3 | 5 | 68 | 955D-8*62 | 60 | 90 | 316 |
| 955D-8*751 | 5 | 9 | 76 | 955D-8*752 | 75 | 123 | 458 |
| 955D-8*751 | 7.5 | 13 | 88 | 955D-8*13 | 100 | 164 | 607 |
| 955D-8*22 | 15 | 27 | 135 | 955D-8*1253 | 125 | 205 | 673 |
| 955D-8*22 | 20 | 34 | 164 | 955D-8*153 | 150 | 246 | 866 |
| 955D-8*32 | 25 | 43 | 161 | 955D-8*23 | 200 | 330 | 1130 |
| 955D-8*32 | 30 | 51 | 195 | 955D-8*253 | 250 | 405 | 1413 |
| 955D-8*42 | 40 | 67 | 267 | 955D-8*33 | 300 | 480 | 1625 |
| 955D-8*62 | 50 | 83 | 291 | 955D-8*43 | 400 | 648 | 1722 |

Figure 3.1 - Heat Dissipation Loads

MOUNTING INSTRUCTIONS



The 590 DRV Digital drive is designed to mount directly onto a vertical, flat surface. Refer to the technical illustrations for your model at the end of this chapter for mounting centers and hardware recommendations. 7.5 through 100 HP models are designed with the incoming three-phase supply connections at the top and the motor, and cooling blower and control connections at the bottom. Units rated 125 through 400 HP have AC main input and DC armature terminations located at the bottom of their panels and terminals mounted on the left for the motor field connections and optional motor blower connections. Keep terminal locations in mind when mounting the drive to accommodate proper wire routing.

NOTE. Holes for the mounting bolts or screws must be placed accurately.

When drilling mounting holes, cover any DRVs or any other components already mounted to the panel to protect them from stray metal filings.

Mounting 7.5 through 100 HP Units

Insert the mounting studs from the back side of the panel. Attach lock washers and nuts part way onto the lower mounting studs. They will help keep the drive in place when mounting.

WARNING!

The 590 DRV Digital drive units weighs more than 50 lbs. Use proper lifting techniques when moving.

Lower the bottom slots of the 590 DRV Digital drive onto the studs, making sure the studs are between the washers and the panel. Once the drive is resting on the bottom studs, lean it back onto the top two studs. Attach lock washers and nuts on the top studs and finger tighten. Finger tighten the lower studs as well to hold the drive in place. Finally, use the socket wrench to tighten all four nuts securely.

Visually check the drive and its housing for packing material, mounting debris, or any other material that could damage and/or restrict the operation of the equipment.

WIRING PROCEDURES

Wiring the 590 DRV is not difficult. Be sure to use proper terminals and ensure that all wiring and protection devices are sized properly. Observe *all* warning messages. Failure to follow safety precautions can lead to equipment damage, injury or death.

WARNING!

Make sure all wiring connections meet or exceed applicable local and national electrical codes. Be sure to fit branch circuit and motor overload protection.

The wiring procedures in this manual apply to a 590 DRV Digital drive configured for general purpose speed control operation. Wiring configurations for custom systems or for optional applications are too numerous and complex to include here. For system configurations, refer to the schematics packaged with those systems.

NOTE. Figure 3.20, located on the fold-out page at the end of this chapter, shows the connections described in the following sections. The balloons **(A)** in the left margin of the following text help locate the circuit in the figures.

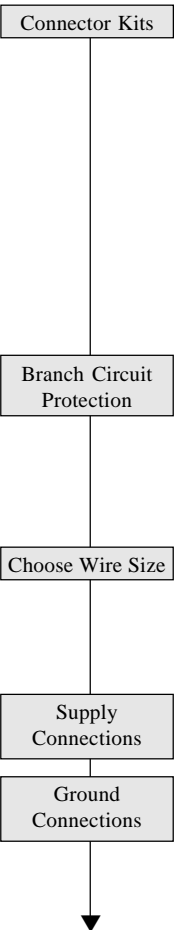
Incorrect wiring is a common cause of start up problems. If you have questions about wiring procedures, contact Eurotherm Drives Customer Service.

WARNING!

Whenever working on wiring connections, completely isolate all power supplies from the drive on which you are working.

A label on the inside of the DRV or on the DRV mounting panel lists the tightening torques for all user terminals. Do *not* overtighten connections when installing wires.

Power Wiring



Incoming AC supply and output motor connections are shown in Figure 3.2 and 3.3. If you need electrical terminals for motor and supply connections, Eurotherm Drives has UL-approved crimp terminal kits available in the following armature current ranges:

| Amps | Terminal Kit Catalog No. |
|------|--------------------------|
| 13 | 955-CK13 |
| 35 | 955-CK35 |
| 50 | 955-CK50 |
| 66 | 955-CK66 |
| 98 | 955-CK98 |
| 122 | 955-CK122 |
| 164 | 955-CK164 |

Caution

The semiconductor fuses fitted to *all* 590 DRVs protect only the SCRs in the drive and do *not* provide branch circuit protection. You *must* fit branch circuit protection to the incoming power supply.

The power wires must have a minimum rating of 1.1 x FULL LOAD CURRENT. For UL requirements, the wires must be rated for 1.25 x FULL LOAD CURRENT. Control wiring must be 18 gauge or larger.

Supply Connections

The 590 DRV Digital drive has ground terminals for each incoming and outgoing supply. A substantial connection must be made to the incoming supply ground terminal near terminals L1, L2, and L3 (Figure 3.2). The ground terminals at the bottom of the drive can be used for armature ground and grounding the auxiliary 120 VAC loads.

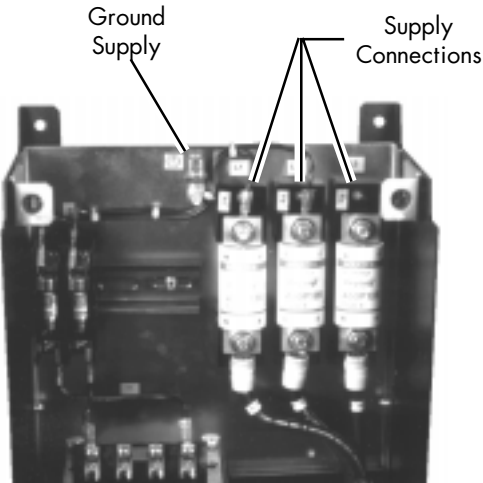


Figure 3.2 - Three Phase Connections (30 through 100 HP Models)

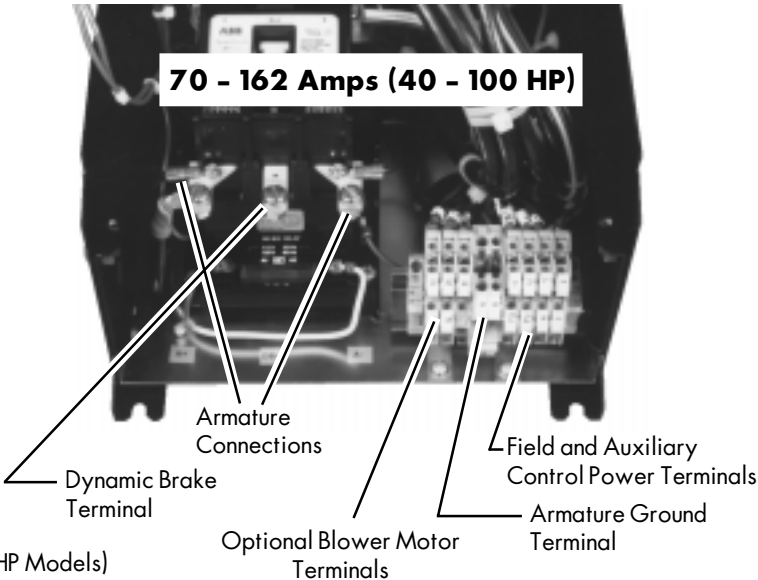
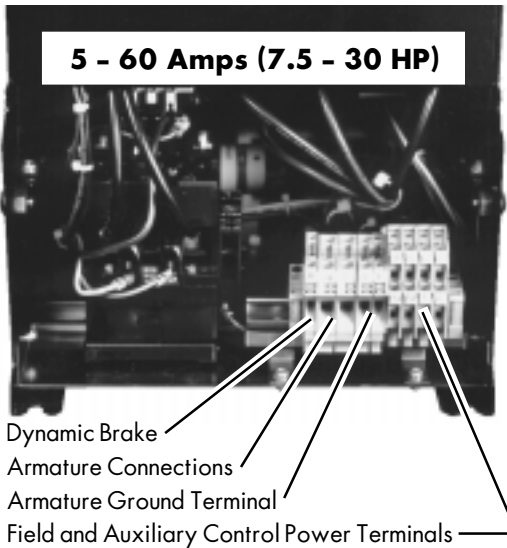
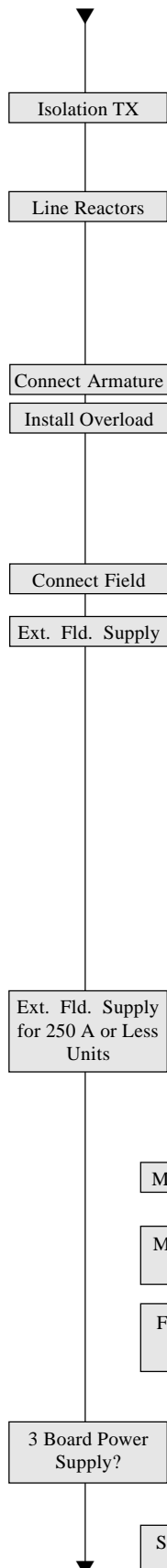


Figure 3.3 - Motor Connections (30 through 100 HP Models)



Connect the main AC power supply to terminals L1, L2, and L3 (see Figure 3.2) through the correctly sized branch circuit protection and an AC line reactor or dedicated drive isolation transformer. Eurotherm Drives stocks a series of reactors designed to connect to the 590 DRV Digital AC supply terminals. The part numbers for the reactors are:

| Reactor Rating (RMS) | Reactor Part No. |
|----------------------|------------------|
| 35 amp | CO055192 |
| 70 amp | CO055193 |
| 110 amp | CO055253 |
| 180 amp | CO055255* |

* Requires interposing terminals between the DRV supply and the reactor.

Armature Connections

Connect the motor armature to terminals A+ and A– (Figure 3.3). To comply with national and local electrical codes, external DC overload protection *must* be provided.

B

If you are using dynamic braking to stop the motor, connect the negative armature lead through a suitably rated dynamic brake resistor to terminal DB+.

Motor Field Connections

C

If you are supplying the drive field regulator internally or from the main supply, connect the motor field (–) to terminal F– and field (+) to terminal F+ (Figure 3.3).

D

If the drive's field regulator requires an external field supply (for example when a 240 volt field is required on a 240 volt armature motor), connect the supply wires to terminals FL1 for phase L1 and FL2 for L2.

Caution

An "out-of-phase" external supply can blow fuses and cause faulty operation. The AC field supply is normally fed internally from L1 and L2. Some motors require field voltages greater than the mains supply at L1, L2, and L3. This external field supply must be "in phase" with the main supply. The supply connection to terminal FL1 must be in phase with the supply on terminal L1 and FL2 must be in phase with the supply on L2.

Depending on the drive's field regulator rating, reconnect the field supply jumpers on the controller power board as described below:

1. FOR MODELS RATED THROUGH 150 HP or 250 A (units rated for a 10 A field, maximum):
 - Verify that power is disconnected, then move the RED wire from internal terminal F16 to internal terminal F19 and move the YELLOW wire from F8 to F18 (see Figure 3.4).

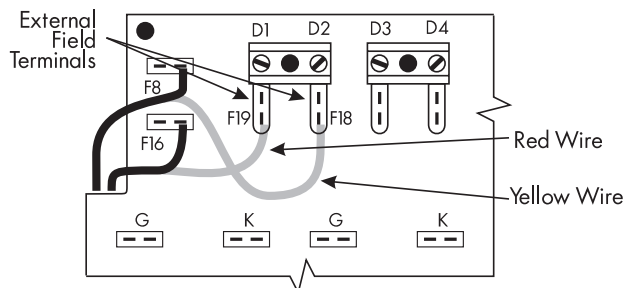


Figure 3.4 - External Field Supply Jumper Connections for Units Rated through 250A

- Externally protect the supply with suitable branch circuit protection fuses rated for the supply voltage. The external fuse rating should not exceed 10 A.
- When using an external field supply for drives fitted with three-board power supplies, refer to Appendix L for the field controller jumper connections.

2. FOR MODELS RATED 200 to 400 HP, or 330 to 675 A, (units rated for a 20 A field, maximum):

WARNING!

Terminals FL1 and FL2 for DRV's rated 330 to 675 A are at line voltage and may present a shock hazard.

- Verify that power is disconnected, then move the RED wire from its existing position to internal terminal F8, and the YELLOW wire from its existing position to internal terminal F16 (see Figure 3.5).

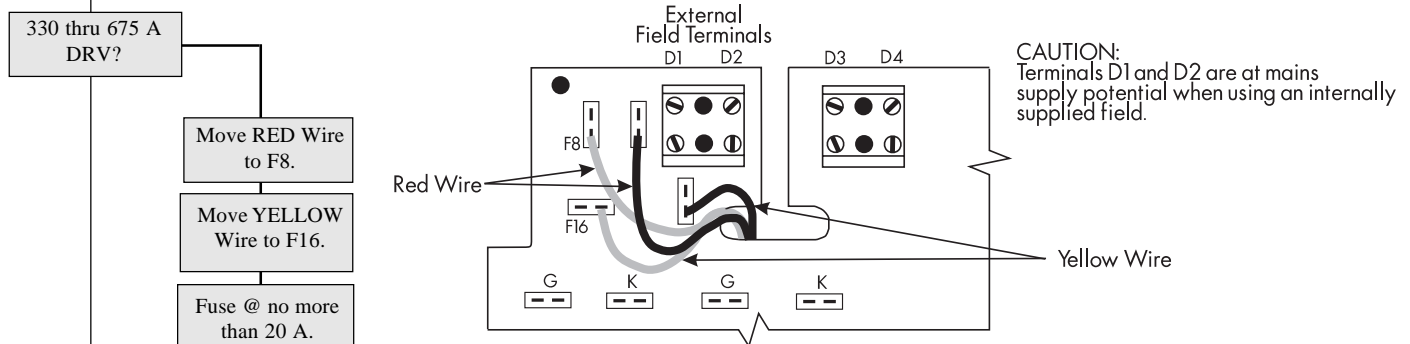


Figure 3.5 - External Field Supply Jumper Connections for Units Rated 330 through 675 A.

- Externally protect the supply with suitable branch circuit protection fuses rated for the supply voltage. The external fuse rating should not exceed 20 A.
3. FOR EXTERNAL STACK CONTROLLERS or 500 to 1000 HP MODELS (units equipped for a 30 A field, maximum), SEE Appendix L.

Control Wiring

The control wiring described in the following section should be bundled and routed to the left side of the controller (see Figure 3.6) so the control door is free to open for access to the power supply board. Leave about 1½" of slack in the control wiring harness and trail the wiring down and leftward without straining the connections. Route the wire harness diagonally down to the lower left mounting foot of the DRV. This permits opening the control door and folding the drive open without putting stress on the wires.

An optional 10 inch piece of 7.5 mm deep DIN rail can be mounted to the lower cover (see Figure 3.6). This option is designed to hold potentiometer boards, relays or other signal devices. To prevent exceeding the overall 590 DRV Digital drive depth limit of 11.5 inches, the depth of these components must not exceed three inches.

Wire harnesses from these devices should be kept tight to the devices and routed to the left side of the drive with the drive harness. Be sure that any devices or harnesses mounted on the DRV do not interfere with any devices mounted on the panel below when the unit is hinged down for service and maintenance access.

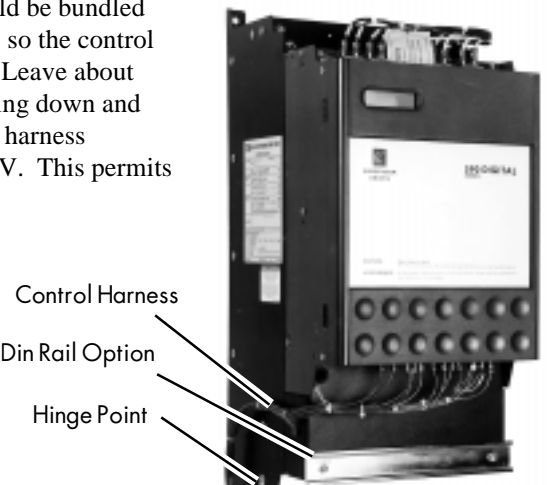
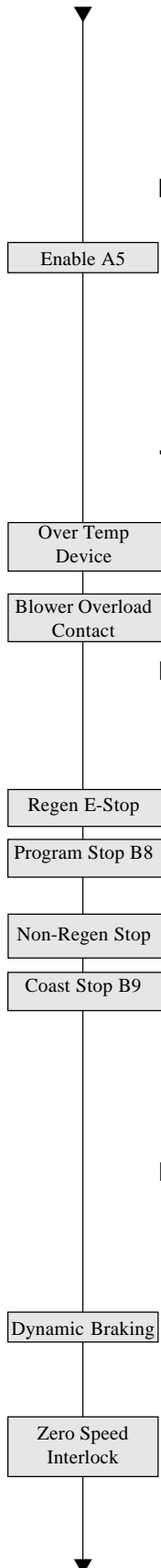


Figure 3.6 - Wire Harness Routing

**WARNING!**

The connectors to terminal blocks A, B and C must be isolated signal voltages. Never perform high voltage resistance or dielectric strength tests without first completely disconnecting the drive from the circuit being tested.

Enable

Terminal C5 (ENABLE) is connected to terminal C9 (+24V) internally through a normally-opened auxiliary contact on the DRV main contactor. The drive remains disabled until the main contactor poles are closed.

WARNING!

The drive *must* be disabled and power should be removed before servicing the equipment. First stop the drive and make sure the main contactor has deenergized, then remove power.

Thermistor

Terminals A1 and C1 are zero volt signal connections common to the return of the drive's +24 VDC internally regulated supply. If the motor is fitted with overtemperature sensing devices such as thermistors or thermostats, connect the devices in series between terminals C1 (0V) and C2 (THERMISTOR). If the motor has an external blower motor, wire an auxiliary contact from the blower starter's overload trip circuitry in series with the motor's over temperature device and terminals C2 and C1.

Program And Coast Stop

For a regenerative emergency stop (regen units only), connect terminal B8 (PROGRAM STOP) to terminal C9 (+24 VDC) through a normally-opened contact of an emergency stop relay. Also connect terminal B9 (COAST STOP) to terminal C9 through a time-delayed off, normally-opened contact on the same emergency stop relay. Activating the E-Stop circuit removes +24 VDC from B8 and regenerates the motor power back into the main supply. The delayed-off contact on B9 (COAST STOP) acts as a fail safe, allowing the drive to coast to a stop after the time delay.

For non-regenerative drives or for coast stopping with regenerative models, permanently jumper terminal B8 to B9 and connect terminal B9 to +24 VDC (terminal C9) through a non-delayed, normally-opened contact of the emergency stop relay. Upon activating an emergency stop condition, the drive will coast stop immediately.

WARNING!

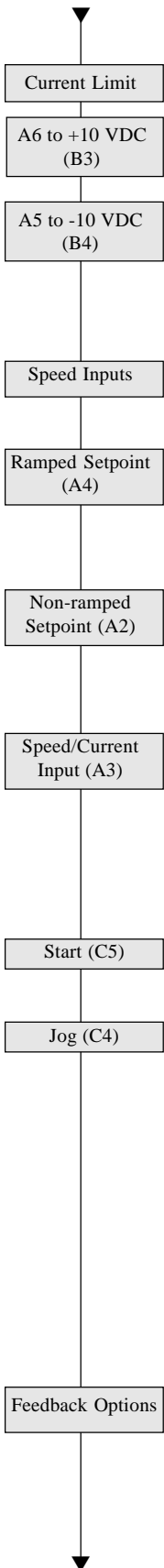
The emergency stop relay should not be considered part of the normal sequencing of the system and should be triggered only in circumstances involving equipment damage or safety.

Dynamic Braking

The drive will dynamic brake if wired for coast stopping and a properly sized resistor is connected as shown in Figure 3.20. The contactor in all 590 DRV Digital drives through 250 HP includes a normally closed, dynamic braking DC contactor pole. It is rated to carry full load armature current upon closing. The start-stop circuitry should be designed to prevent the motor from restarting and the pole from opening until *after* the motor reaches zero speed.

NOTE. The dynamic brake contactor pole is rated to make, but not interrupt DC motor current. To avoid damaging the contact, interlock the drive's ZERO SPEED output signal to the DRIVE START logic to prevent the drive from restarting until the motor has reached standstill.

For regenerative or non-regenerative drives, dynamic braking may be used as an alternative, emergency stopping method. The wiring scheme is shown at the lower left in Figure 3.20.



Current Limit

For most applications, connect terminal A6 (ANALOG INPUT 5) to terminal B3 (+10 VDC REFERENCE) and connect terminal A5 (ANALOG INPUT 4) to terminal B4 (-10 VDC REFERENCE).

(K)

This sets the drive's positive and negative current limit clamps to +100% and -100% respectively for forward and reverse motor operation and allows you to adjust the MAIN CURRENT LIMIT parameter from 0 to 200%. If you need to control the main current limit externally, connect a 10kW potentiometer between terminal B3 (+10 VDC REFERENCE) and terminal B1 (0 VDC). Connect the wiper to terminal A6. You can then adjust the current limit from 0 to 200% if SETUP PARAMETERS::CURRENT LOOP::MAIN CURR. LIMIT is set to 200.00%.

Speed Demand

For normal operation, connect the speed demand signal to terminal A4 (RAMP SETPOINT). This input is scaled so that +10 VDC input equals maximum forward speed demand (+100%), and -10 VDC input equals maximum reverse speed demand (-100%).

(L)

Connect the ends of an external 10kW potentiometer to terminal B3 (+10 VDC REFERENCE) and terminal B4 (-10 VDC REFERENCE) and the wiper to terminal A4. For non-reversing applications, the speed demand needs only to operate between 0 and +10 VDC. Connect the high, or clockwise end of the potentiometer to B3 and the low or counterclockwise end to the 0 VDC terminal, A1 (SIGNAL GROUND).

Terminal A2 (SPEED SETPOINT NO. 1) is an additional, non-ramped speed demand input which sums with the drive's other speed inputs. Connect your speed demand to this terminal for non-ramped speed control.

Terminal A3 (SPEED SETPOINT NO. 2 or CURRENT DEMAND) is a hardwired input which functions either as a non-ramped speed or current demand. The state of control terminal C8 (I DMD. ISOLATE) determines the operating mode of the input. When tied to +24 VDC (terminal C9), A3 is a direct current demand input to the drive's current loop. When terminal C8 is left open-circuited, A3 is a non-ramped speed demand input and sums with the other drive speed loop inputs.

Start/Stop Input

(M)

Connecting terminal C9 through a normally-open contact to terminal C3 (RUN) provides normal start/stop control. When the contact is open, the drive will attempt to perform a controlled stop; when it is closed, the drive will start.

Jog Input

(N)

Terminal C4 (JOG) is connected through a normally-open contact to terminal C9 for jog applications. Interlock the jog relay contact with the run relay coils as shown at **(I)** in Figure 3.20.

Armature Current Feedback Terminal

(O)

You can connect a meter to terminal A9 (ARMATURE CURRENT) to monitor the motor DC armature current. The output is hardwired and *not* software configurable. Refer to Appendix A for the terminal's output rating and signal scaling. This connection is optional.

Speed Feedback

The 590 DRV Digital drive accepts the following types of speed feedback signals:

- armature voltage feedback
- analog AC or DC tachometer generator feedback
- wire-ended electrical encoder feedback
- plastic (5701) or glass (5901) fiber optic Microtach encoder feedback.

Armature voltage feedback, the default, does not require a feedback device, external isolator or any external connections. All other types of speed feedback requires external connections from the feedback device to a separately ordered controller mounted option board. The part numbers for each type of feedback option board is listed below. Appendix A contains technical information on each.

Feedback Board

| | part no. |
|---|---------------|
| • Switchable Analog Tachometer Generator Board | AH385870U001 |
| • +5 VDC Encoder Receiver Board | AH38777 5U005 |
| • +12 VDC Encoder Receiver Board | AH38777 5U012 |
| • +15 VDC Encoder Receiver Board | AH38777 5U015 |
| • +24 VDC Encoder Receiver Board | AH38777 5U024 |
| • 5701 Microtach (Plastic Fiber Optic) Feedback | AH058654U001 |
| • 5901 Microtach (Glass Fiber Optic) Feedback | AH386025U001 |

Feedback Receiver Board Installation

Each speed feedback board mounts on the lower left portion of the control door as shown in Figure 3.10. Terminal assignments for each option board are listed in Appendix A and in the documentation shipped with the boards.

To install the receiver board on the drive control board:

1. Remove the packaging from the feedback receiver board.

Caution

Encoder and Microtach receiver boards contain electrostatic discharge (ESD) sensitive parts. Observe static control precautions when handling and installing the board.

2. Align the 10 pin connector on the option board with the controller pins on the lower left of the control board.
3. Carefully push the receiver board onto the pins taking care not to bend the pins. All four white support standoffs should engage the control board. If installing a switchable analog tachometer generator calibration board, be sure to connect the jumper on the right side of the board to its mating jack on the switchable calibration card.
4. Refer to Appendix A for specific instructions on terminating the feedback device to the receiver option board.

Analog Tachometer Generators

All drives rated *through* 400 horsepower are shipped with a switchable calibration card. If you are using an analog tachometer generator as speed feedback, you *must* order the analog tachometer generator board (AH385870U001), which scales the tachometer generator feedback signal. DRVs rated 500 horsepower and *above* are shipped with a resistor calibration card which scales the drive to the motor's parameters and also calibrates analog speed feedback signals.

NOTE. If a resistor calibration card option is used *and* the drive uses an analog tachometer generator as feedback, a switchable tachometer generator feedback board is not needed.

When using the resistor calibration card, tachometer generator connections are made to terminals A1 and A4. Connect the positive tachometer generator output signal wire to terminal A4. Refer to Appendix A for scaling instructions.

- P** The switchable tachometer calibration board option supports both AC and DC analog tachometers generators with a calibration range of 10 to 209 volts. The calibration resistors and the board switch settings coarsely scale the speed feedback signal. Adjust parameters in the MMI for fine tuning (refer to Chapter 3). Refer to Appendix A for wiring and technical information on the analog tachometer feedback card.
- Q**

The signal cable for the analog tachometer generator *must* be shielded over its entire length.

NOTE. Ground the tachometer generator shield at the drive end only to avoid ground loops.

Feedback Board
Part Nos.

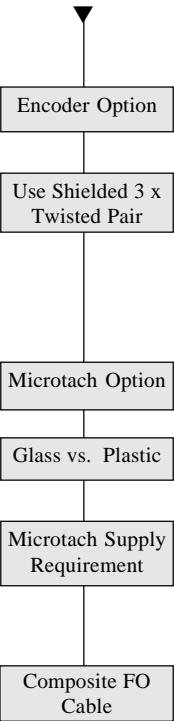
Feedback Board
Installation

Must use Switch
Cal Card if Using
Switch Tach
Board

Resistor Cal Card?
Connect Tach to
A3 and A4

Use Shielded
Cable

Ground Shield at
DRV Only



Wire-ended Electrical Encoders

R

The drive can accept a standard, 4-channel, quadrature complimentary, wire-ended electrical encoder signal as speed feedback. Four feedback boards are available, each having a different supply voltage rating. Complimentary line driver encoders are recommended. Refer to Appendix A for typical encoder connection listings.

NOTE. When using an wire-ended electrical encoder as feedback, be sure to use three channel, twisted, shielded cable and to ground the shield at the drive end only. Belden 8777 cable is recommended.

Microtachs

S

Fiber optic encoders (or Microtachs) come in either glass or plastic. While the glass Microtachs (5901) can transmit a feedback signal over a long range without a repeater, they require a special termination tool to properly cut and polish the glass fiber optic cable. The 5701 Microtach is used with plastic fiber optic cable which needs only a set of pliers for termination. The signal range for plastic, however, is limited and may require a Microtach repeater. Repeater part numbers are listed in Appendix A.

Each type of Microtach requires its own receiver board, listed above, and may be powered directly from the drive's +24 VDC supply.

1/2" diameter composite plastic fiber optic cable is available. The cable includes two 16 AWG conductors with a plastic fiber optic conductor sheathed in a protective plastic coating. This cable is recommended when running plastic fiber optic cable within conduit. Refer to Appendix A for part numbers.

HARDWARE SETTINGS

After wiring the drive, it must be properly calibrated and the control transformer must be correctly tapped.

Drive Calibration

Either of two types of calibration cards scale the drive to the motor's armature voltage, armature current and field current. One card uses solder-in resistors, the other uses adjustable switches. The calibration board plugs into the 590 DRV main control door under the lower, hinge-up access panel as shown in Figure 3.7.

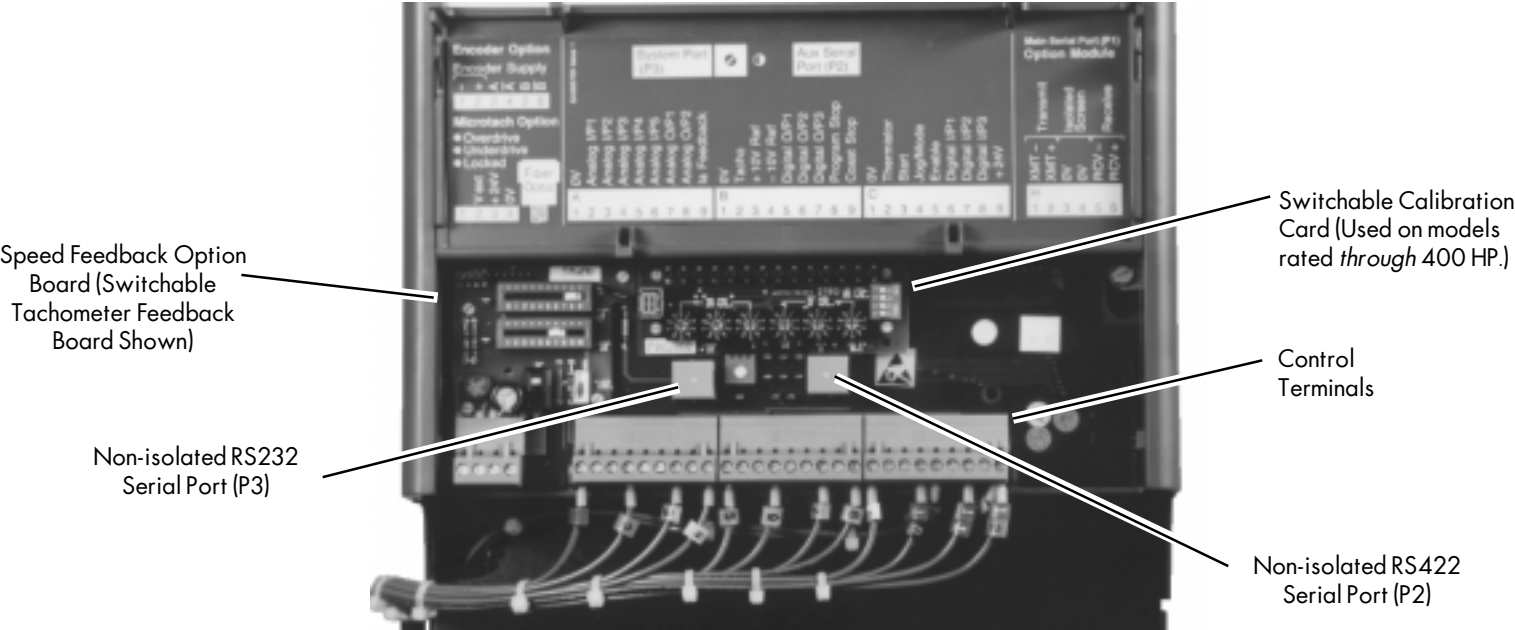


Figure 3.7 - Calibration Cards Location (Switchable Calibration Card Shown)

Must use Switch
Tach Board if
Using Switch Cal
Card

A switchable calibration card ships with all 590 DRV Digital drives rated through 400 HP. Models rated 500 HP and above ship with a resistor calibration card. You can order the resistor card on lower horsepower models as an option.

NOTE. The drive *must* use the switchable tachometer generator feedback board if using the switchable calibration card.

WARNING!

Do *not* swap calibration boards or change any board settings while applying power to the 590 DRV Digital drive. Do *not* interchange calibration boards or switch the calibration settings without first verifying that they match the motor's nameplate rating. Mechanical damage and injury to personnel can result.

Resistor Calibration Card (AH058529U001)

Resistor values on the card scale the controller to the motor armature current, AC of DC tachometer generator feedback, armature voltage feedback, field current, and field voltage. Use the formulas below to determine the correct resistor values for your application.

Calibration resistors should be of good quality metal film type, 2 percent tolerance, ¼ watt (or better). Actual resistance values should measure within ±10 percent of the calculated values.

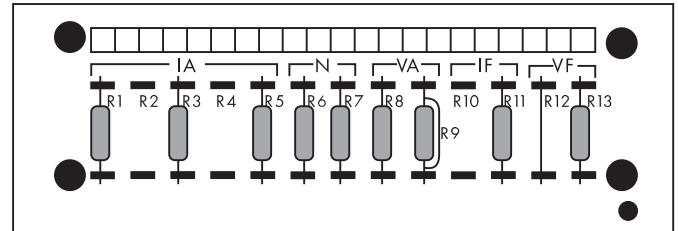


Figure 3.8 - Resistor Calibration Board

1. Armature current calibration

The parallel connection of resistors R1, R2, R3, R4, and R5 calibrates the drive to the motor armature current. The combined value R_{IA} of all these resistors is calculated as follows:

$$R_{IA} = \frac{2200 \text{ W}}{(\text{Full Load Current} - 1)}$$

You can verify this value by using the formula:

$$1/R_{IA} = 1/R1 + 1/R2 + 1/R3 + 1/R4 + 1/R5$$

NOTE. The armature current calibration scaling resistors for external stack controllers (models rated 500 HP and greater) are fitted on the suppression board. See drawing HC352526 at the end of Appendix F for the resistor location and sizing.

Caution

Use ½ watt, metal film type, 2 percent tolerance resistors for current calibration on external stack controllers. Double this wattage rating for each 450 A of armature current.

2. Tachometer generator calibration

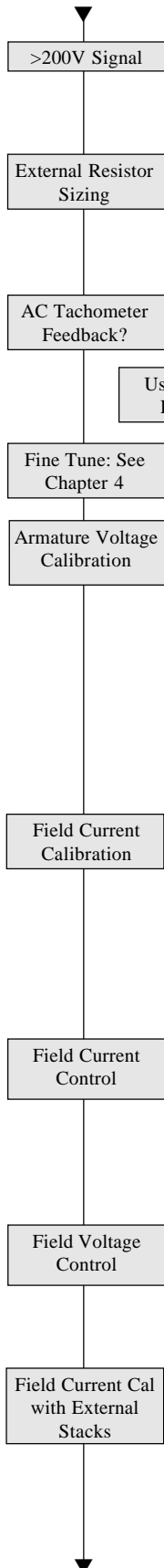
- a. For full speed tachometer generator voltage up to 200 volts:

$$R6 + R7 = (\text{Tachometer Generator Volts} - 10) \text{ kW}$$

Armature Current
Calibration

Tachometer
Generator
Calibration

<200V Signal.



- b. For full speed tachometer generator output larger than 200 volts, an external resistor (R_E) is required in series with tachometer generator connection to terminal B2. The suggested values for R_6 and R_7 are:

$$R_6 = 120 \text{ kW}$$

$$R_7 = 68 \text{ kW}$$

$$R_E = \frac{(\text{Tachometer Generator Volts} - 200)}{5} \text{ kW}$$

The external resistor must be large enough to dissipate the power, P_{RE} , determined below.

$$P_{RE} = (\text{Tachometer Generator Volts} - 200) \times 5 \text{ milliwatts}$$

- c. The controller accepts only a DC signal as tachometer generator feedback. Accordingly, motors with AC tachometer generators require a full-wave diode bridges to rectify the AC tachometer generator voltage output into DC.
- d. Fine tuning is performed within the software (refer to the *Calibrate Speed Feedback* section in Chapter 5).
3. Armature voltage feedback calibration

$$R_8 + R_9 = \frac{(\text{Armature Voltage} - 100)}{10} \text{ kW}$$

The minimum allowable armature voltage is 100V with R_8 and R_9 having no resistance (0W).

NOTE. If necessary, refine the calibration by adjusting SETUP PARAMETERS:: CALIBRATION:: ARMATURE V CAL in the MMI.

4. Field current calibration

WARNING!

If using field current control, this resistor must be calibrated correctly; otherwise, equipment damage and possible injury to personnel may result.

Field current is scaled by resistors R_{10} and R_{11} connected in parallel. The combined value of these resistors is calculated as follows:

$$R_{IF} = \frac{3000}{(\text{Full Field Current})} \text{ W}$$

NOTE. Calibrate the field current for 0.2 Amps (15 kW) when running the drive in field VOLTAGE CONTROL mode to set a small detection threshold for field loss alarm sensing.

The combined value of the parallel resistors can be verified by the formula:

$$R_{IF} = \frac{R_{10} \times R_{11}}{R_{10} + R_{11}} \text{ W}$$

When using an external stack controller (500 HP and larger rated models), the field current calibration resistor is calculated with the formula:

$$R_{IF} \text{ external stack} = \frac{4000}{\text{Full Field Current}} \text{ W}$$

NOTE. If necessary, change SETUP PARAMETERS:: CALIBRATION:: FIELD I CAL in the MMI.

5. Field voltage calibration.

Calibrating the drive for the motor field voltage is not required; however, resistors R12 and R13 are connected in series and must total 100 kW to assure best performance.

Switchable Calibration Card (AH385457U001)

The switchable calibration card is shipped on all models rated through 400 HP. The card, shown below in Figure 3.9, calibrates the drive for the motor armature voltage, armature current, and field current.

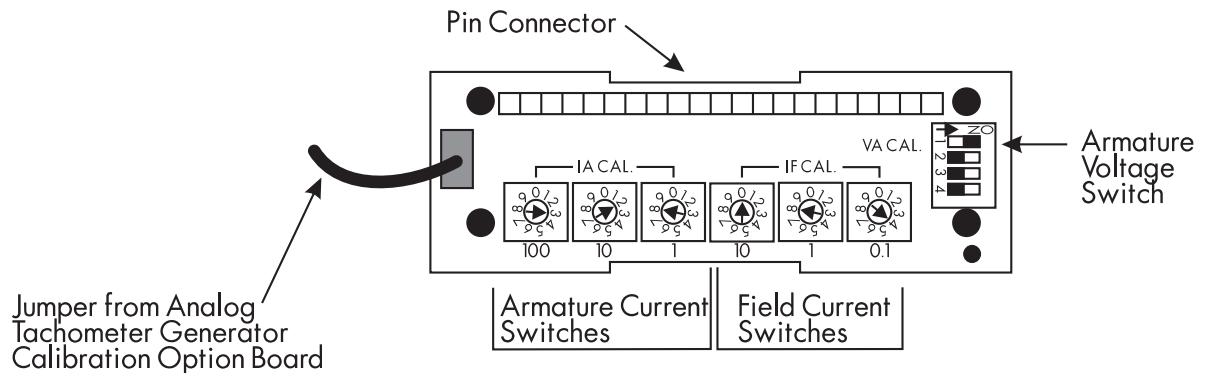


Figure 3.9 - Switchable Calibration Card

To calibrate the drive:

1. Set the armature voltage to the motor's nameplate rating. Use the four-position switch on the right end of the calibration board to select the setting. The default setting is 500 volts. Use Figure 3.10 to select different voltages.

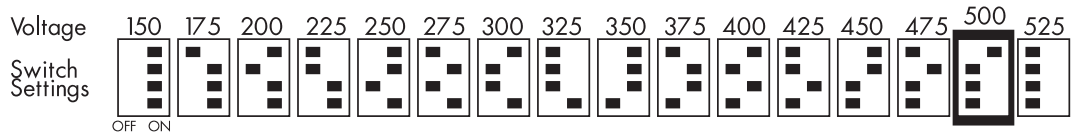


Figure 3.10 - Armature Voltage Switch Settings

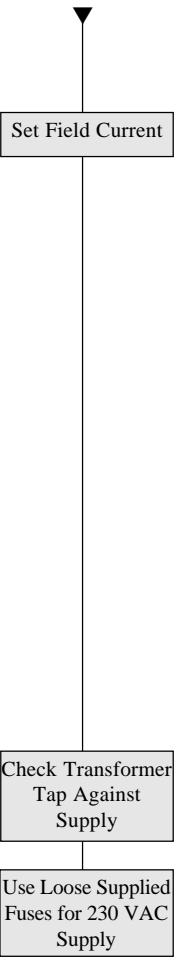
Armature voltage can be set from 150 through 525 volts. The switches step through the range in 25 volt increments. Choose the setting closest to the motor's armature voltage rating. When in doubt, set it to the next highest setting.

NOTE. Change SETUP PARAMETERS::CALIBRATION:: ARMATURE V CAL in the MMI to refine the calibration for the required armature voltage, if necessary. No change is needed for 500 volt armatures. For 240 armatures, choose the 250 volt settings and set ARMATURE V CAL to 1.0417 ($250 \div 240$). Refer to Appendix B for detailed instructions using the MMI to adjust parameters.

2. Set the armature current to the motor's nameplate rating minus one (1) amp. Armature current is set in units of amps using the left three rotary switches for hundreds, tens, and ones. The range for these switches is from 1 to 720 amps. Turn the rotary switches to the appropriate settings for your motor. Figure 3.9 is set for a 329 amp motor.

WARNING!

Do not exceed the drive or motor rating; such action could cause equipment damage. Do not change the calibration settings when the main contactor is energized.



3. Set the field current to the motor's nameplate rating. Field current is set in units of amps, using the right three rotary switches for tens, ones, and tenths. As with armature current, the range depends on the type of drive. The overall range is from 0.1 - 19.9A with 590 DRV Digital drive models. Turn the rotary switches to the appropriate setting for your motor. Figure 3.9 is set for a 8.4 amp field. Use SETUP PARAMETERS:: CALIBRATION:: FIELD I CAL in the MMI.

NOTE. Some motors list two field currents. Always choose the "hot" field current when calibrating the drive.

WARNING!

The field current settings must match the motor nameplate rating value or the motor could overspeed and lead to mechanical damage and/or injury to personnel.

WARNING!

Do not exceed the field circuitry rating of the controller when setting the field current. 590 DRV Digital drives through 270 amp armatures are limited to 10 amp fields. Drives up to 675 amp armatures have field circuitry rated to 20 amps. Above 675 amps, the controllers have 30 amp field circuitry.

Control Transformer

The 590 controller within the DRV derives its control power through a DRV mounted control transformer connected to one phase of the incoming main three phase power. This transformer must be tapped to match the incoming supply voltage. Models rated 7.5 through 100 HP accept 208/230/380/415/460 volts AC, 50/60 Hz supplies. The default connection is for 460 volts. When other supplies are used, move the wire at position H6 to the position for the desired voltage, as shown in left of Figure 3.11.

For models rated 125 through 900 HP, the control transformer primary supply is limited to 230/460 VAC and are shipped with the tap set for 480 VAC. These drives are shipped with two sets of primary fuses (F4 and F5). For 230 volt supplies, use the loose fuses provided with the DRV and tap the primary of the transformer as shown in the right of Figure 3.11.

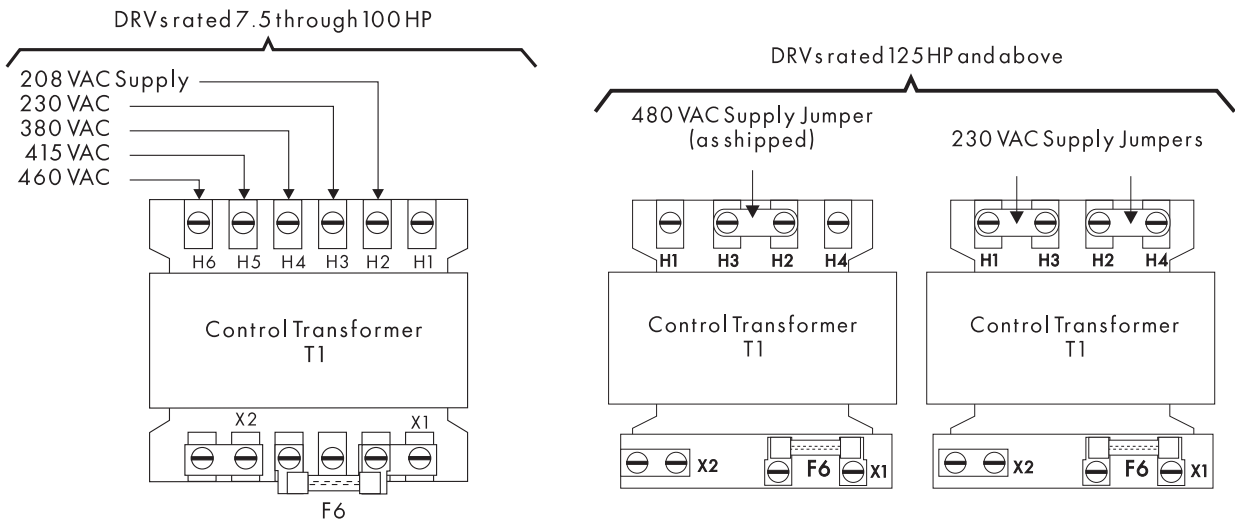
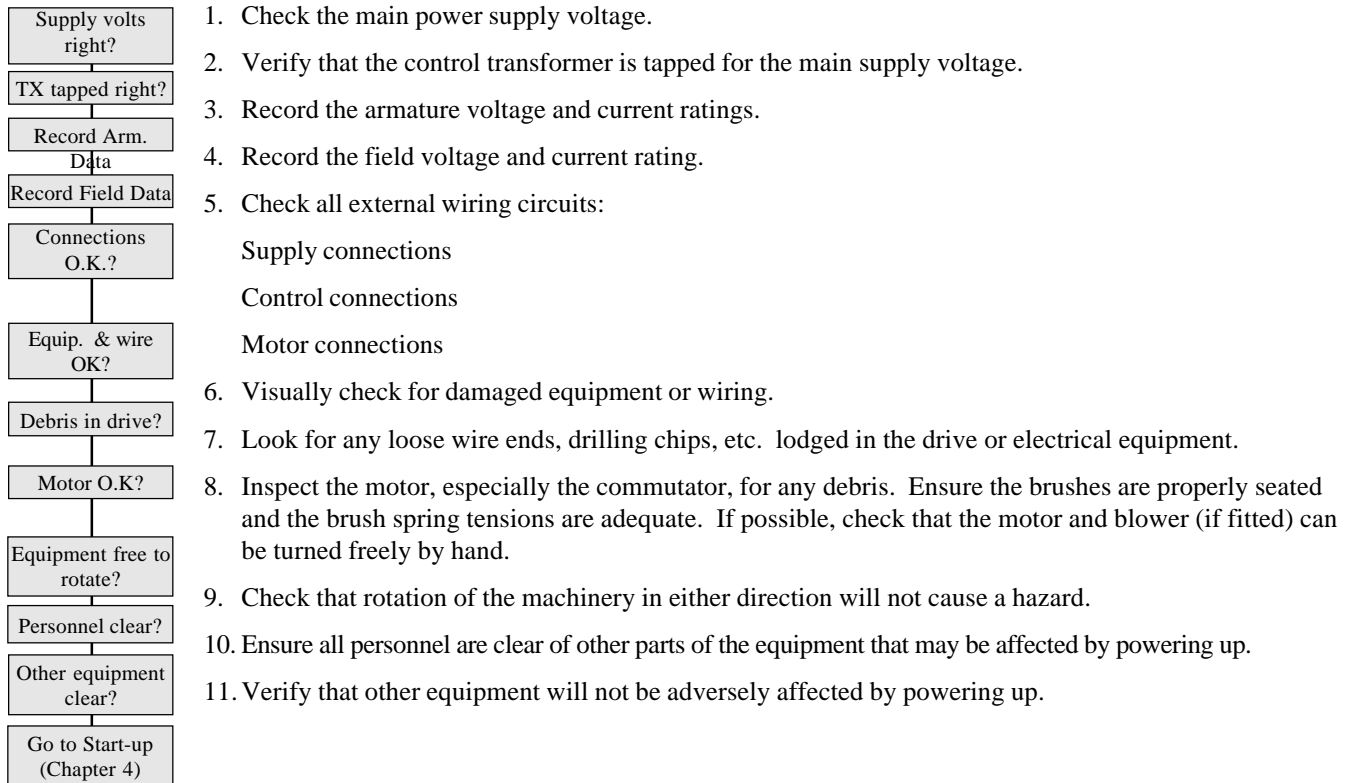


Figure 3.11 - Control Transformer Settings

FINAL INSPECTIONS

After installing and wiring the drive, complete the following checks. They will assure the drive and motor can be safely powered up without injuring personnel or damaging equipment.



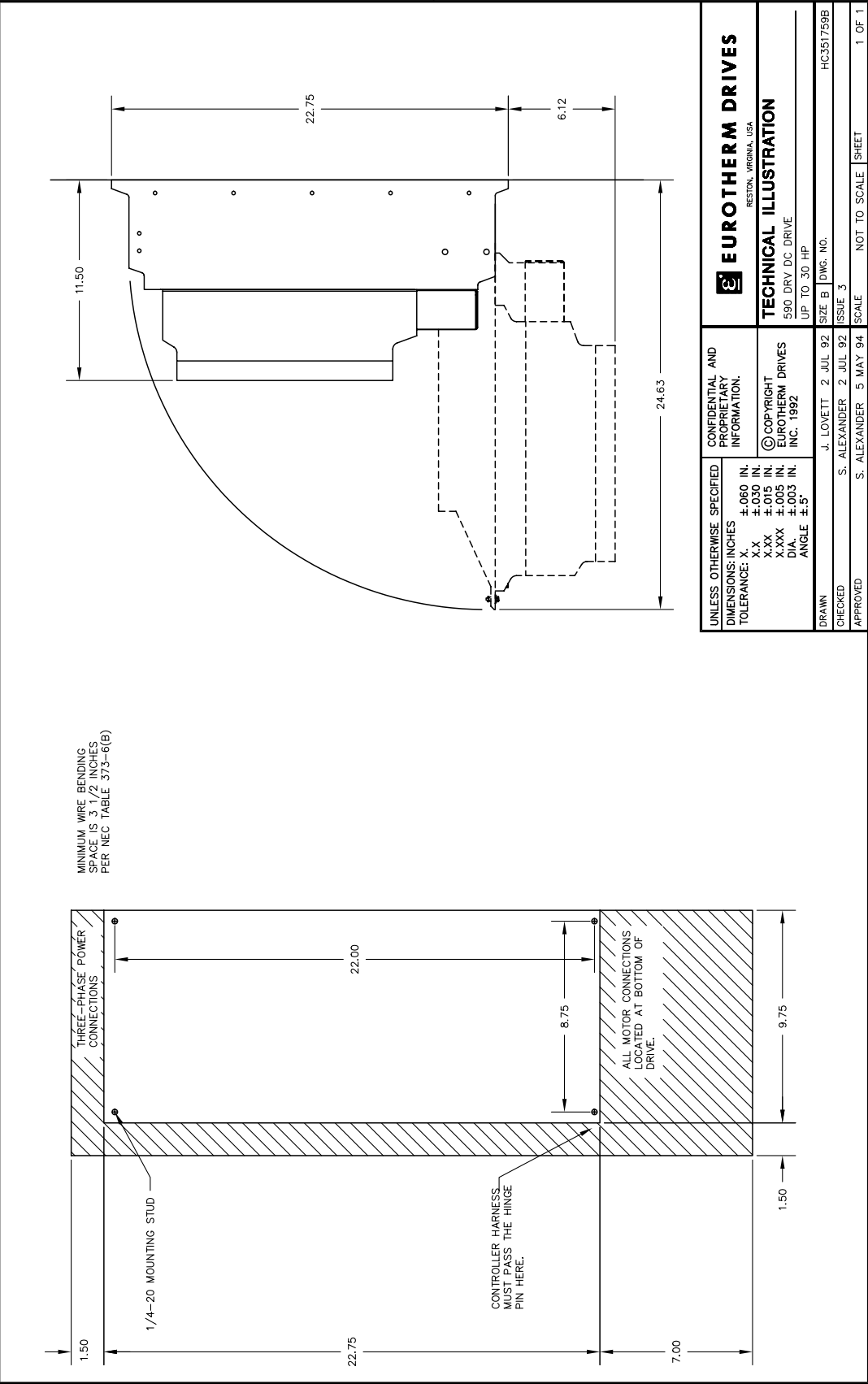


Figure 3.12 -
30 Hp @ 500 VDC
15 Hp @ 240 VDC

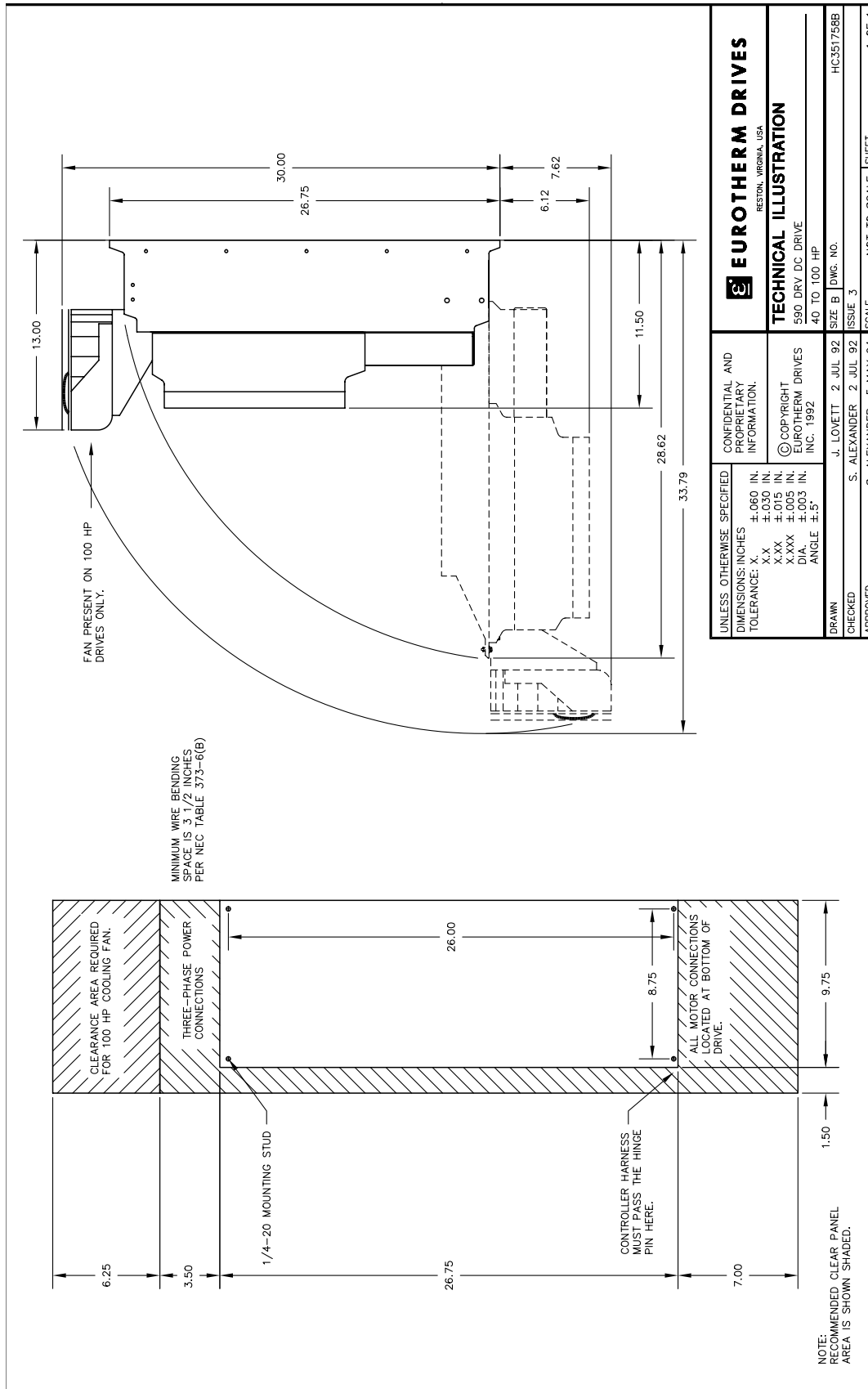


Figure 3.13 -
100 Hp @ 500 VDC
50 Hp @ 240 VDC

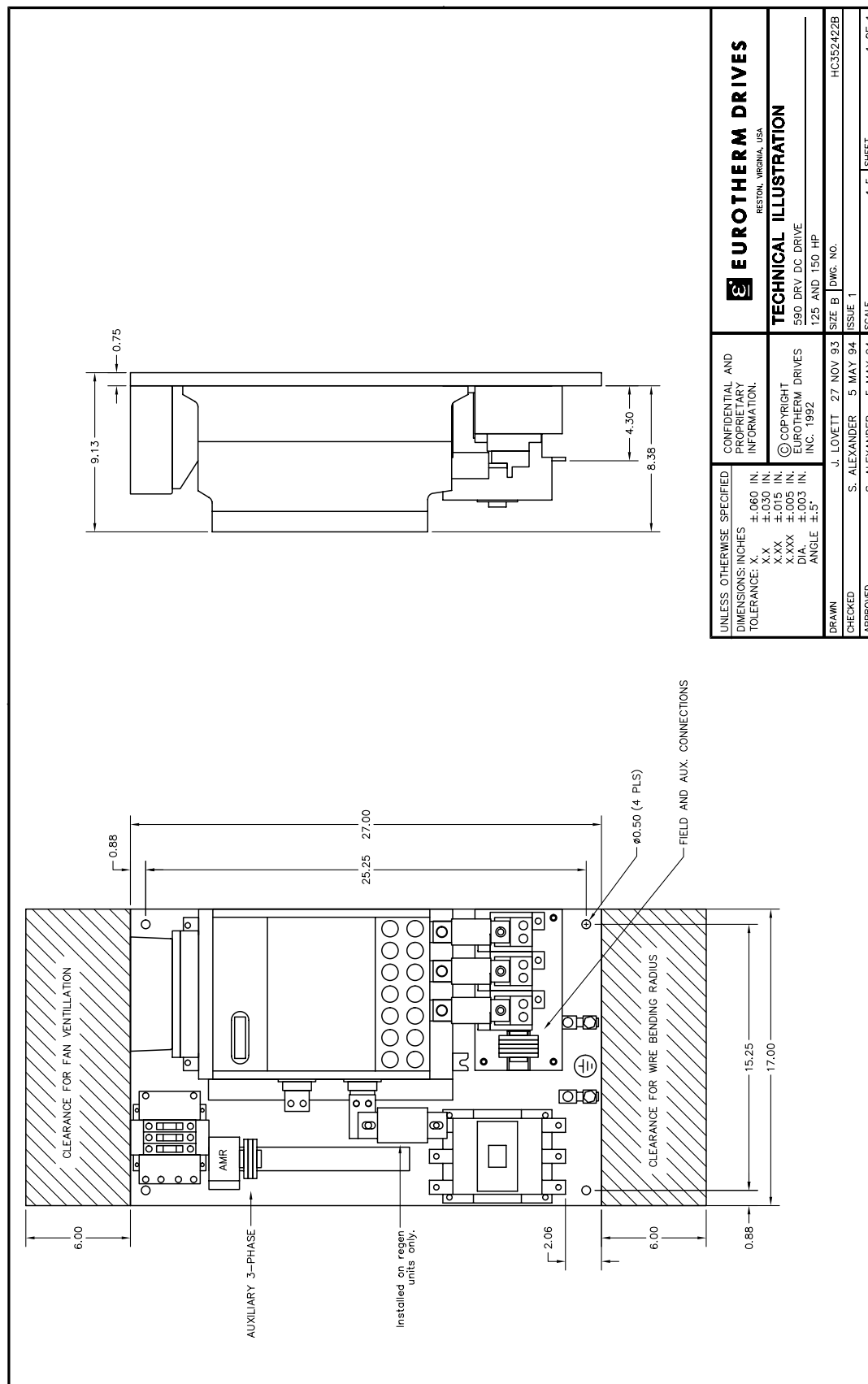


Figure 3.14 -
150 Hp @ 500 VDC
75 Hp @ 240 VDC

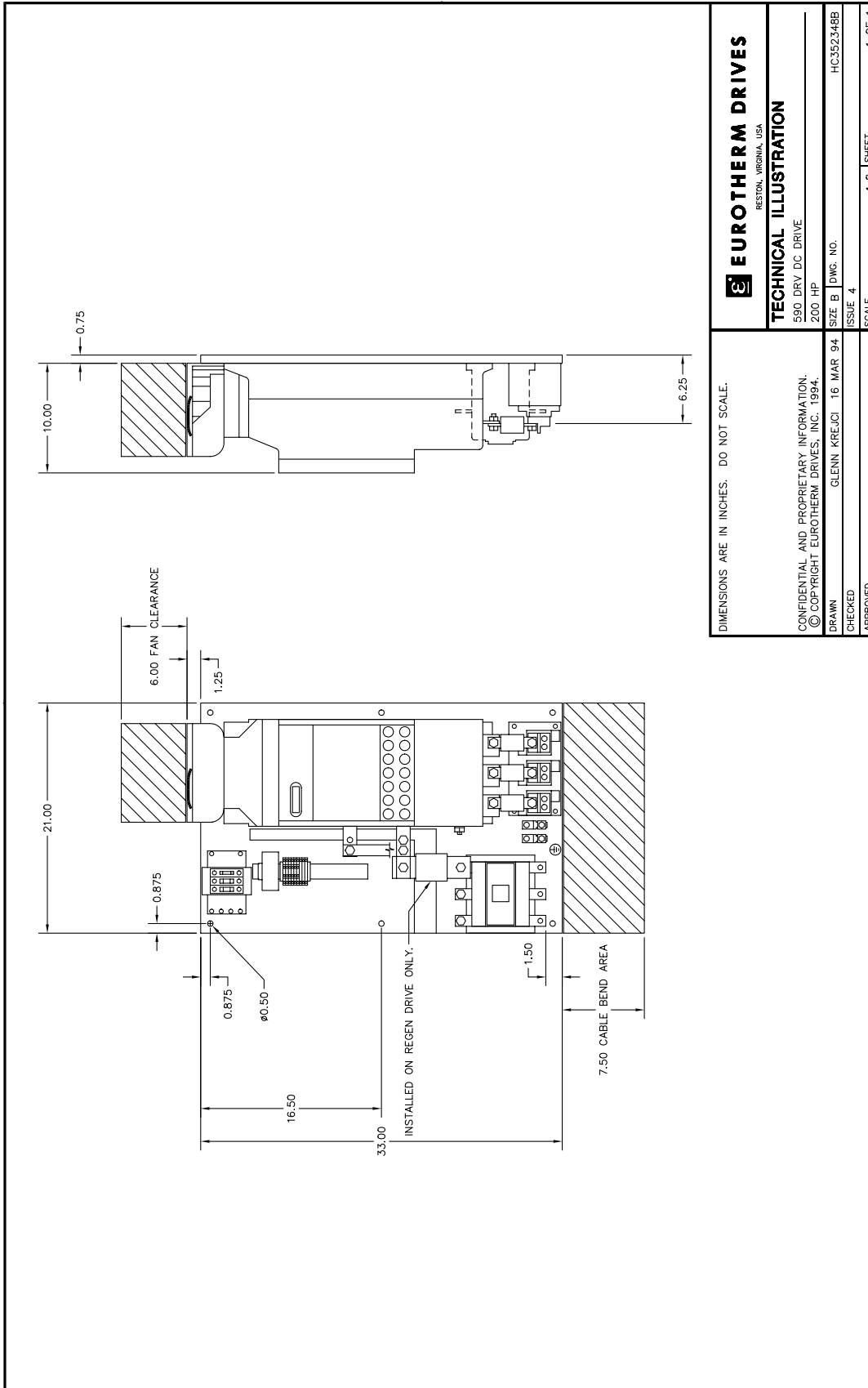


Figure 3.15 -
200 Hp @ 500 VDC
100 Hp @ 240 VDC

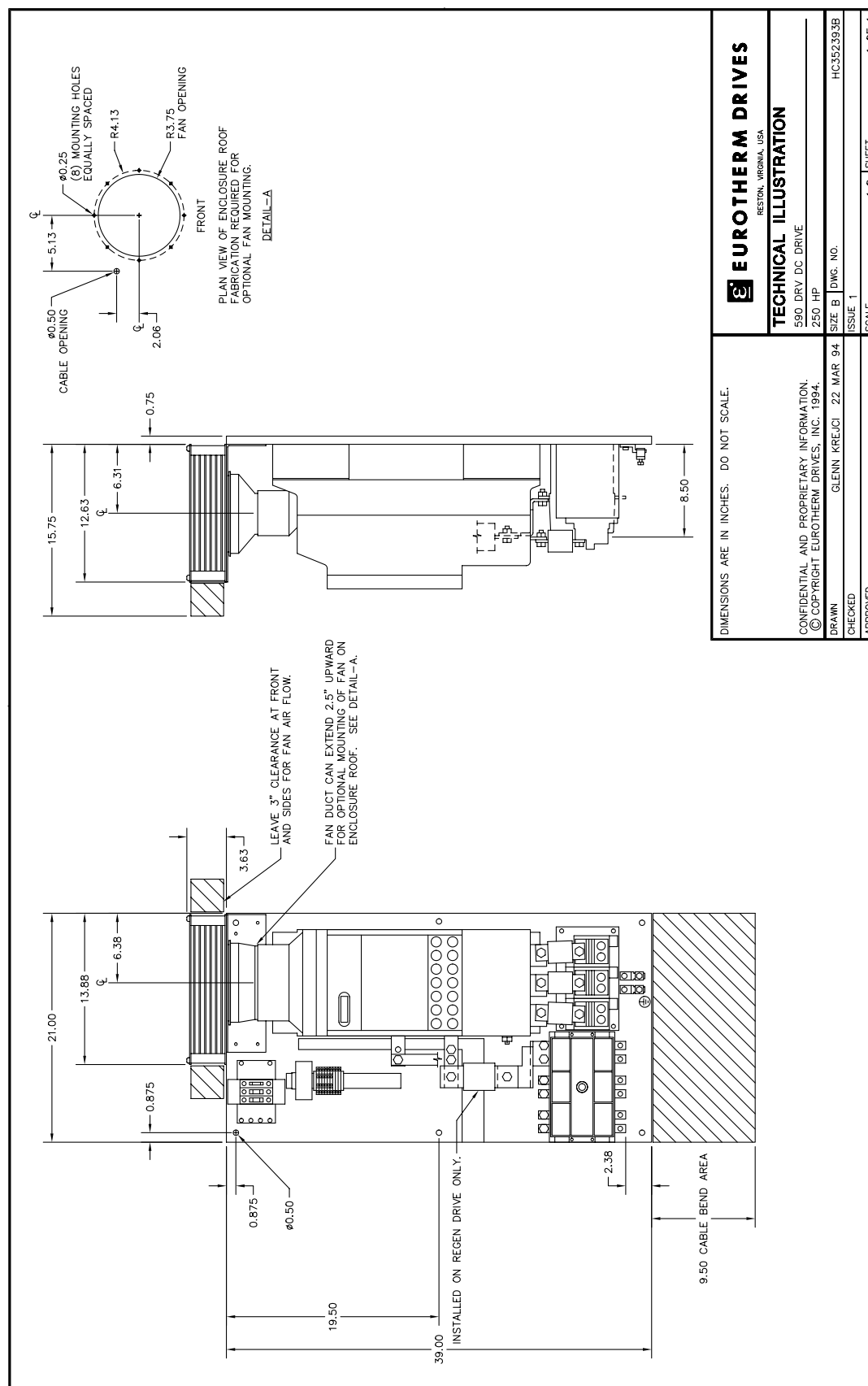


Figure 3.16 -
250 Hp @ 500 VDC
125 Hp @ 240 VDC

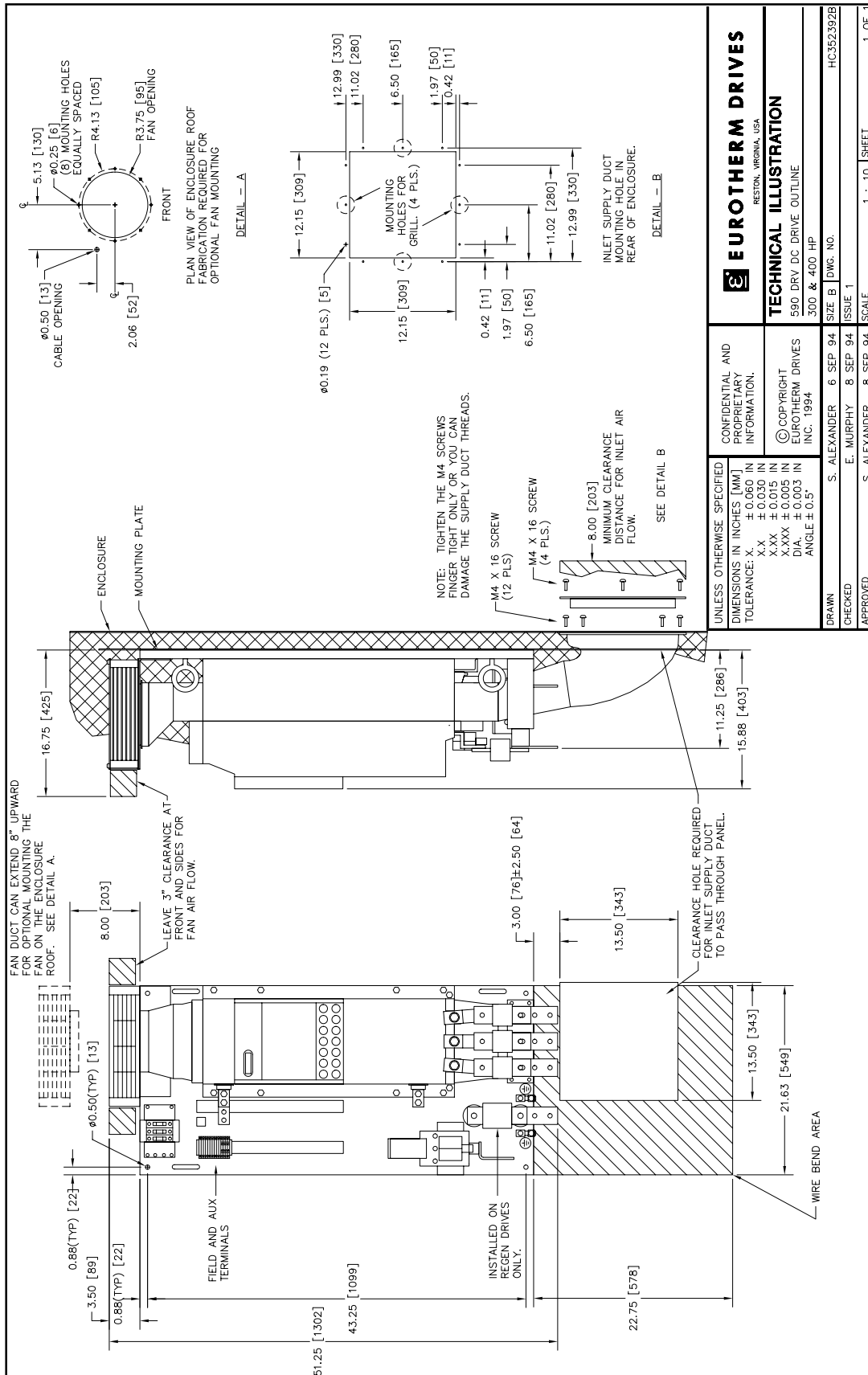


Figure 3.17 -
400 Hp @ 500 VDC
200 Hp @ 240 VDC

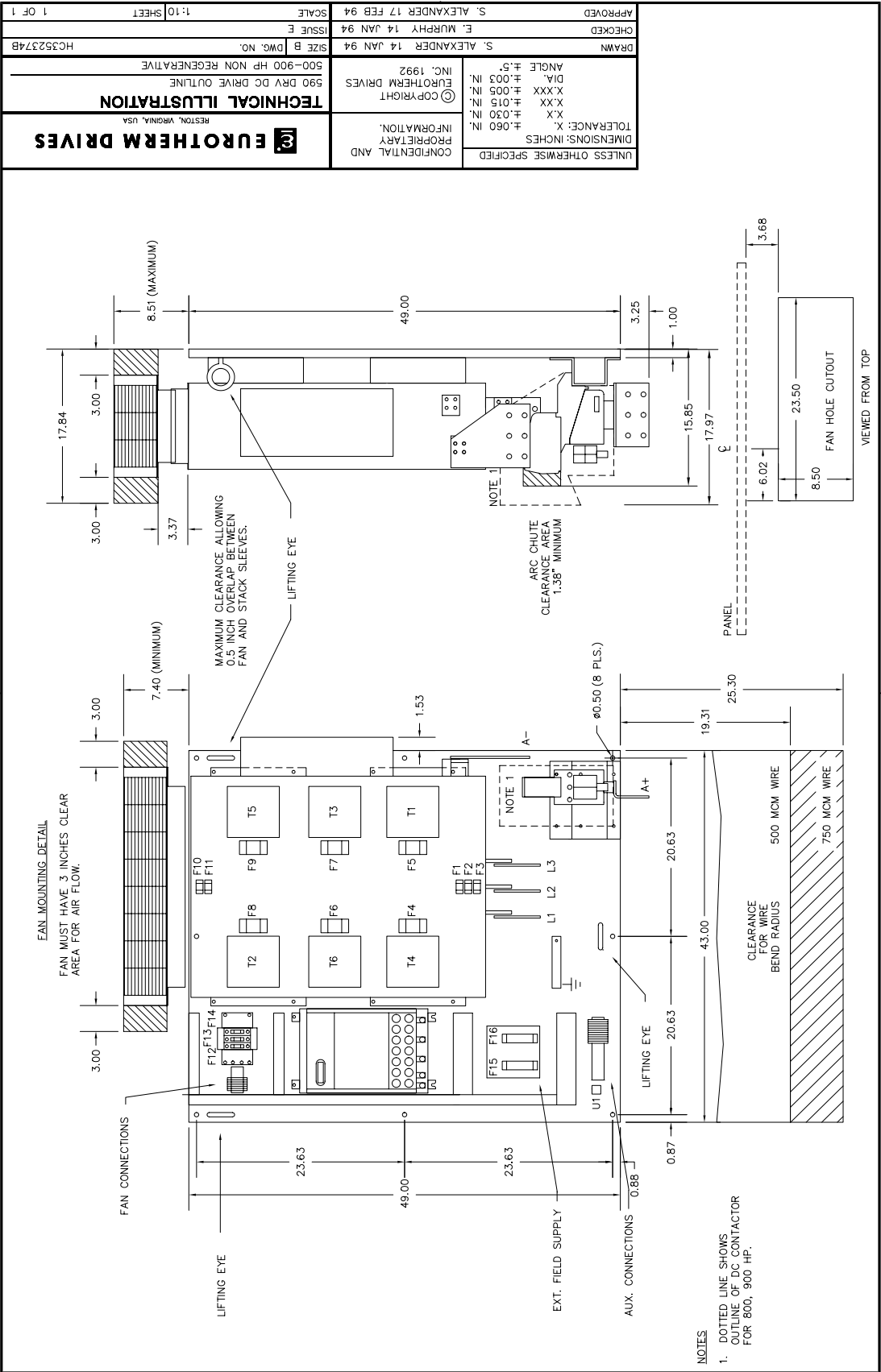


Figure 3.18 -
Non-regenerative
500 - 900 Hp
@ 500 VDC
250 - 450 Hp
@ 240 VDC

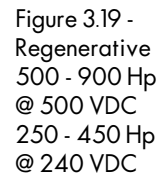
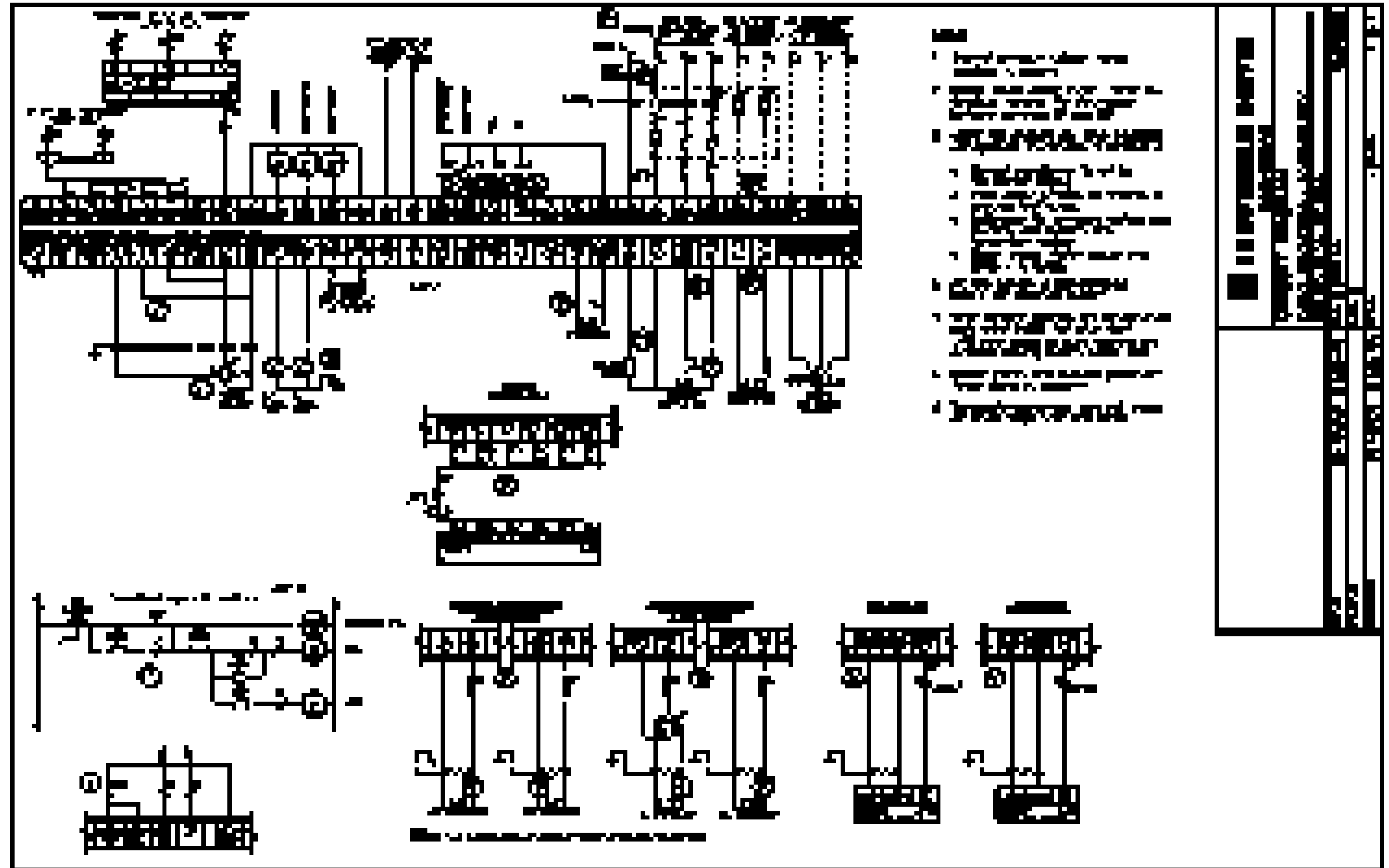


Figure 3.20 - Wiring Circuit Diagram for 590 DRV Digital Drive



Chapter 4 START UP AND ADJUSTMENT

The 590 DRV Digital drive is shipped with a default configuration designed to control a shunt or permanent magnet field DC motor. You can adjust the drive's parameters or change its configuration to achieve optimum performance and perform specific control applications.

The drive can be tuned or configured using the drive's MMI, or by using a computer running the software package ConfigEd Lite. This chapter guides the user through the start up procedure using the MMI.

Follow these procedures only *after* installing and wiring your 590 DRV Digital drive (see Chapter 3). Review Appendix B to become familiar with the MMI before proceeding.

When an instruction refers to a MMI procedure, the menu levels are shown as a path with double colons “:: ” delimiting each lower menu level, for example:

SETUP PARAMETERS:: RAMPS:: ACCEL TIME

RECOMMENDED TOOLS

Equipment recommended to set up your 590 DRV Digital drive and tune a motor include:

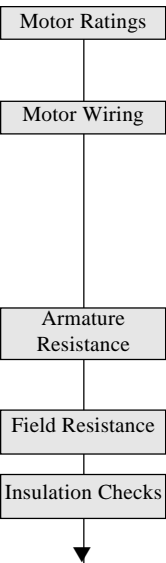
- IBM compatible PC with Microsoft Windows™ 3.0 or greater to run ConfigEd Lite
- Oscilloscope to monitor armature current waveform and speed feedback
- Voltmeter to monitor motor armature and field voltage and check control signal levels
- Ohmmeter to check signal continuity
- Clamp-on, Hall effect ammeter to measure armature and field currents
- Digital hand tachometer to check line or motor speed

WARNING!

Confirm all wiring connections are correct before attempting start up procedures.

CHECK MOTOR

After wiring and installing the 590 DRV Digital drive, make these motor checks *before* applying power.

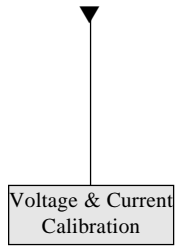


1. Check and record nameplate information from the motor for future reference.
2. Verify that the motor wiring agrees with the motor installation drawings, if available. Be sure to check the motor field wiring. Some motors have two winding fields which require a series or parallel connection depending on the supply and torque requirements. Verify that the drive field supply output does not exceed the voltage rating of the motor field. If this voltage exceeds the field rating, supply the field power externally with the correct AC supply (refer to Figure 3.4 or 3.5 in Chapter 3).
3. Use an ohmmeter to check insulation and continuity on the motor's armature and field. Use the following as a guide for measuring continuity and resistance through the armature and field:

Armature resistance < 1 W (about 3 W for motors rated under 10 HP).

Field resistance =
$$\frac{\text{Motor nameplate field voltage}}{\text{Motor nameplate field current}}$$

Insulation checks help ensure that there are no shorts in the motor. Use an ohmmeter set to its highest setting and measure the resistance between each conductor and ground. All readings should be greater than 10 MW . If available, use a megger to check for insulation faults in the motor armature and field windings.

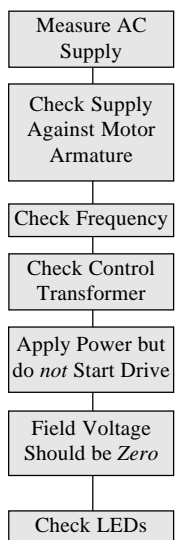
**WARNING!**

Disconnect or isolate motor connections from the controller before performing a megger insulation, or high voltage tests on the motor windings.

4. Make sure *all* settings on the 590 DRV Digital drive calibration card are set to the correct values for your motor dataplate information (see the calibration card information in Chapter 3). Standard 590 DRV Digital drives up *through* 400 HP come equipped with a switch selectable calibration card; higher horsepower models require the resistor-adjustable calibration card.

CHECK SUPPLY**WARNING!**

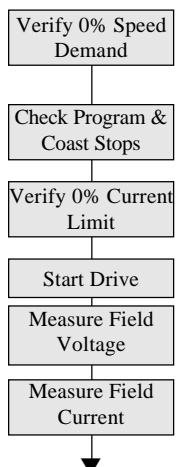
Measure and verify the power supply to the drive *before* applying power to the input of the drive.



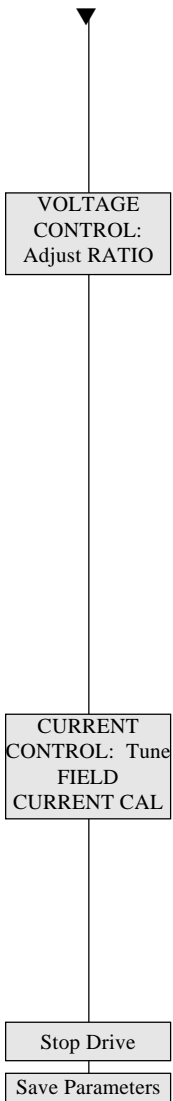
1. Measure each leg of the three-phase power supply to ensure they are within $\pm 10\%$ of motor supply requirements. The controller has multiple ratings. Check whether the supply is suitable to attain the maximum desired armature voltage. Generally, the maximum armature voltage for a three phase DC drive is 110% of the AC supply voltage. A 240 VDC armature motor requires a 230 VAC supply; 500 VDC motor needs a 480 VAC supply. Consult the factory for other ratings.
2. If a frequency meter is available, measure the incoming line frequency. The frequency should not vary more beyond the acceptable range of 40 to 70 Hz.
3. Verify that the control transformer inside the 590 DRV Digital drive is tapped for the supply voltage.
4. Connect power but do *not* start the drive. The drive should now receive control power and the MMI display should read 590 DC DRIVE:: MENU LEVEL. Check the motor field voltage with a voltmeter once power is on. If the drive is supplying voltage to the motor field, the field should not receive power until the drive is started.
5. Check that the six diagnostic LED's show a normal stop condition (that is, the RUN and START LEDs are off with the other four LEDs illuminated) and that the motor is free to rotate. The PROGRAM and COAST STOP inputs (terminals B8 and B9) should be TRUE.

INITIAL DRIVE START**WARNING!**

Before starting the drive for the first time, make sure that your motor is uncoupled from the load, or ensure that the motor load can move without causing mechanical damage or danger to personnel.



1. Give a 0% speed demand to the drive. Check all drive speed reference inputs in the MMI under DIAGNOSTICS:: SETPOINT SUM OUTPUT and SPEED SETPOINT. Ensure that the total speed setpoint to the drive is zero.
2. Set SETUP PARAMETERS:: CURRENT LOOP:: CURRENT LIMIT to 0.00%.
2. Ensure the PROGRAM STOP and COAST STOP LEDs are on (+24 VDC at terminals B8 and B9).
3. Set SETUP PARAMETERS:: CURRENT LOOP:: CURRENT LIMIT to 0.00%.
4. Start the drive by energizing terminal C3 (START/RUN). If the drive is wired to supply power to the motor field, measure the field voltage with a DC voltmeter and verify that it matches the motor nameplate rating. Measure the motor field current if a Hall effect current meter is available. If the motor field voltage or current is incorrect, follow the steps below to tune in the correct field supply.

**WARNING!**

Failure to set up the field supply correctly can cause dangerous overspeed conditions resulting in serious equipment damage or injury to personnel. Do not continue the start up procedure until the DC field supply is within its required rating.

FIELD IN VOLTAGE CONTROL:

- i. Set the field control mode to voltage control by setting SETUP PARAMETERS:: FIELD CONTROL:: FLD CTRL MODE IS to VOLTAGE CONTROL. Check that the motor field current setting is calibrated for 0.2 amps. If using a resistor calibration card, make certain the field voltage calibration resistors R12 and R13 total to 100 kW.
- ii. Measure the field voltage on terminals F- and F+ and verify that it equals the motor nameplate rating.
- iii. Adjust SETUP PARAMETERS:: FIELD CONTROL:: VOLTAGE VARIABLES:: RATIO OUT/IN until the voltage equals field voltage rating on the motor nameplate label.
- iv. Measure the motor field current if a Hall effect current meter is available.

NOTE. Because a DC motor's field impedance increases with temperature, the field current of a motor in voltage control can read lower than the nameplate rating when the field is initially powered. The current should rise to its nominal value as the motor warms up.

FIELD IN CURRENT CONTROL:

- i. Set the field control mode to current control by setting SETUP PARAMETERS:: FIELD CONTROL:: FLD CTRL MODE IS to CURRENT CONTROL

NOTE. FLD CTRL MODE IS *must* be set to CURRENT CONTROL when operating the motor in field weakening mode.

- ii. Measure the motor field current if a Hall effect current meter and adjust SETUP PARAMETERS:: CALIBRATION:: FIELD I CAL until the measured field current equals the field current rating on the motor nameplate label.

5. Stop the drive.

6. If any changes were made to the drive's parameters settings, SAVE PARAMETERS.

ADJUST CURRENT LOOP (AUTOTUNE)**Caution**

This is an essential step in setting up your 590 DRV Digital drive and *should not* be overlooked.

The AUTOTUNE function tunes the current loop automatically and sets the proportional gain, integral gain, and the discontinuous/continuous breakpoint for optimum drive response for a given motor. The drive cannot achieve peak performance without properly setting these parameters. Perform a complete AUTOTUNE procedure at least once with each controller/motor combination, or if the motor armature or field windings have been rewound.

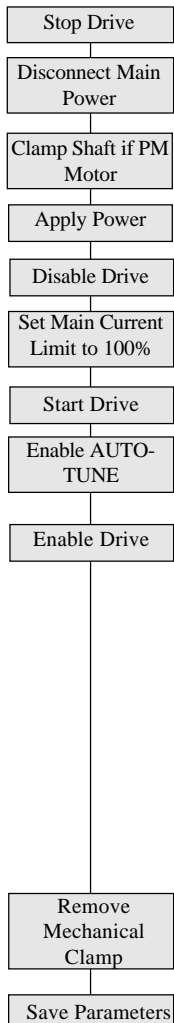
NOTE. AUTOTUNE may not work on motors with either very long or very short time constants (for example, very short time constant permanent magnet motors). In these instances the current loop must be tuned manually. Contact Eurotherm Drives Customer Service for assistance.

AUTOTUNE can be used for shunt-wound, compound-wound, and permanent magnet motors. The shaft on compound-wound and permanent magnet motors must be locked for AUTOTUNE to work. For shunt wound motors, the shaft may need to be clamped if a residual field causes the motor to rotate during AUTOTUNE. Any rotation of the motor during the AUTOTUNE procedure causes AUTOTUNE to abort.

AUTOTUNE Procedure

WARNING!

Make sure it is safe to power and turn the motor and that operation of the motor and the drive will not pose a danger to personnel or equipment.



1. Stop the drive (remove the START/RUN signal) then disconnect the main supply power.
2. The motor shaft may need to be clamped to prevent rotation during the AUTOTUNE procedure. If you are using a permanent magnet motor, it *must* be clamped.
3. Turn on the main supply power. Make sure the PROGRAM STOP and COAST STOP LEDs are on (+24 VDC at terminals B8 and B9).
4. Disable the drive by removing +24 VDC from terminal C5 (ENABLE). This can also be done with the MMI under SETUP PARAMETERS:: AUX I/O.
5. Set SETUP PARAMETERS:: CURRENT LOOP:: CURRENT LIMIT to 100%, the MMI default setting.
6. Start the drive, then enable AUTOTUNE by setting SETUP PARAMETERS:: CURRENT LOOP:: AUTOTUNE to ON. The drive should start but should not generate motor current.
7. Enable the armature current. At this point, the drive performs the AUTOTUNE function automatically, setting the following parameters:
 - a. SETUP PARAMETERS:: CURRENT LOOP:: PROP. GAIN
 - b. SETUP PARAMETERS:: CURRENT LOOP:: INT. GAIN
 - c. SETUP PARAMETERS:: CURRENT LOOP:: DISCONTINUOUS

These parameters give optimum performance of the current loop and should *not* be adjusted outside the AUTOTUNE algorithm.
8. Once AUTOTUNE is finished, the main contactor should open automatically, signaling the end of the procedure. The controller returns to a safe, stopped condition with the HEALTH, RUN and START CONTACTOR LED's turned off. If the motor rotates during the procedure, AUTOTUNE ceases automatically causing an AUTOTUNE FAILURE alarm. Removing the RUN or ENABLE signals during AUTOTUNE also aborts this procedure (in both cases, the armature current is disabled and the main contactor opens).
9. Remove the clamp, if fitted, from the motor.
10. SAVE PARAMETERS when finished.

Armature Current Waveform Check

Because there is no field voltage, the drive conducts full load current through the armature during an AUTOTUNE. You can monitor the armature current waveform with an oscilloscope to verify correct operation of the controller. Attach the oscilloscope leads to the Armature Current test point and the Sig. Ground test point. Refer to Figure 5.21 in Chapter 5 for the drive's test point locations. At full rated current, the armature current signal should average 5.0 volts. There should be six current pulses per mains cycle at all times. The pulses should be uniformly shaped and evenly spaced (see Figure 5.1), each with a width of 2.8 mS on 60 Hertz supplies, and 3.3 mS on 50 Hertz supplies.

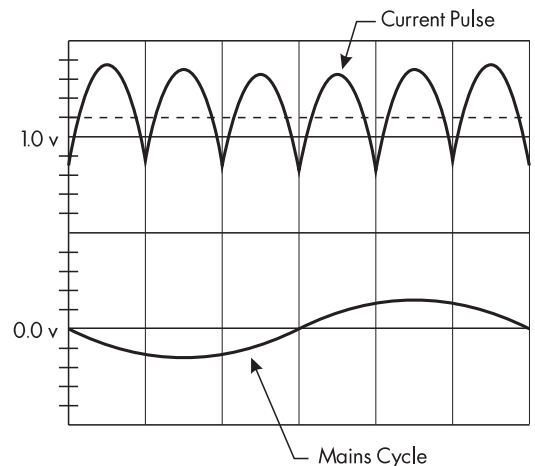
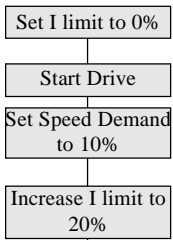


Figure 4.1- Armature Current Waveform

MOTOR ROTATION CHECK

This procedure verifies that the motor shaft rotates in control and in the desired direction.



1. Set SETUP PARAMETERS:: CURRENT LOOP:: CURRENT LIMIT to 0%.
2. Start the drive and set your drive speed reference potentiometer to +1.0 VDC or +10%. Make certain that any trim speeds or additional setpoints are set to 0%. Check that DIAGNOSTICS:: SPT. SUM OUTPUT is indeed +10%. You can monitor all the drive's speed references under SETUP PARAMETERS:: SPEED LOOP:: SETPOINTS.
3. Slowly increase SETUP PARAMETERS:: CURRENT LOOP:: CURRENT LIMIT to approximately 20%.
4. The motor speed should increase to 10% speed in the desired direction. If the feedback or field polarity is incorrect, the motor will either run away, or run in control in the wrong direction. If either situation occurs, stop the drive, disconnect the main supply and external field supply (if used) and check the following:
 - a. For motors fitted with analog DC tachometer generators:
 - Did the motor run away in the correct direction? Reverse the tachometer generator wires.
 - Did the motor run away in the wrong direction? Reverse the field connections.
 - Did the motor rotate in the wrong direction but at the correct speed? Reverse both the field and tachometer generator connections.
 - b. For motors fitted AC tachometer generators:
 - Did the motor run away in the correct direction or in the wrong direction? Reapply power and check the speed setpoint. Because an AC tachometer generator provides a unipolar output regardless of direction of rotation, the drive is limited to speed control in one direction only.

This speed reference *must* be positive. If the motor ran away in reverse, provide a positive speed reference and reverse the field connections.

Caution

A runaway condition always exists when using an AC tachometer generator on a regenerative model DC controller, even if the speed reference is always positive. To avoid this problem, use the 591SP (non-regenerative) drive on a motor with an AC tachometer generator. Or, use the regenerative 590 DRV Digital drive and disable the drive's reverse bridge thyristors under SETUP PARAMETERS:: CURRENT LOOP:: REGEN MODE.

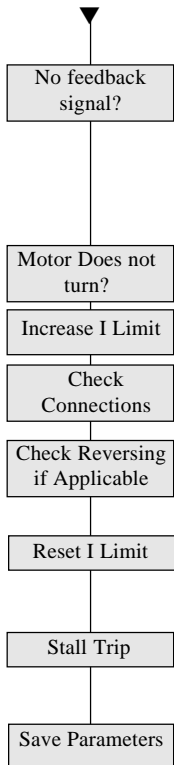
- Did the motor rotate in the wrong direction but at the correct speed? Reverse the field connections.
- c. For motors fitted with 5701/5901 Microtachs or wire-ended electrical encoders:
 - Did the motor run away in the correct direction? Reconnect the drive supply and change the feedback sign by setting SETUP PARAMETERS:: SPEED LOOP:: ENCODER SIGN to POSITIVE or NEGATIVE as required.
 - Did the motor run away in the wrong direction? Reverse the field leads.
 - Did the motor rotate in the wrong direction but at the correct speed? Reverse the field connections, reconnect the drive supply and reverse the feedback sign by setting ENCODER SIGN to POSITIVE or NEGATIVE as required.

Caution

When changing set up parameters (such as feedback polarity), be certain to save the change before disconnecting control power or the set up will be lost.

NON-regen *only*
for AC Tachs

Microtach/
Encoder



5. If the motor continues to run away after checking the feedback sign and field polarity check whether the drive actually receives its speed feedback signal. Monitor **DIAGNOSTICS:: TACH VOLTS** when using an analog tachometer generator. For Microtach or wire-ended encoders, check **DIAGNOSTICS:: ENCODER RPM**. Verify the connections and supply wiring to the feedback device if it fails to generate a feedback signal. If the drive trips on either **SPEED FEEDBACK** alarm or **ENCODER FAILED** alarm, verify that the **SPDFBK ALARM LEVEL**, **ENCODER RPM** and **ENCODER LINES** parameters are properly set.

6. If the motor does not turn at all, increase the **CURRENT LIMIT** to 50% or greater and monitor **DIAGNOSTIC:: CURRENT FEEDBACK**. If **CURRENT FEEDBACK** still reads 0.00%, turn the power off and check the armature connections. If the problem persists, refer to Chapter 7 for detailed troubleshooting information.

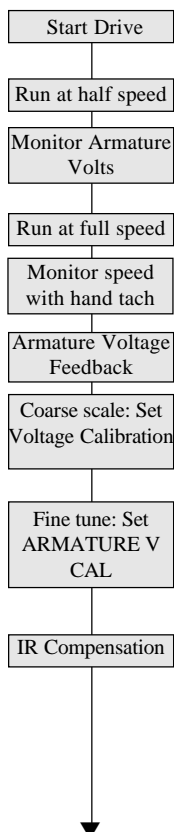
7. If the drive is regenerative and the application requires reverse rotation, provide a negative speed demand, start the drive and verify that the motor runs in the reverse direction.

8. After you have correctly set the direction of rotation, reset **CURRENT LIMIT** to the desired value. If in doubt, set **CURRENT LIMIT** to 110% to correspond to 110 % full load current. If **CURRENT LIMIT** is set to a maximum 200%, and the motor runs into an overload condition, the current limit automatically reduces on an inverse time curve from the overload level down to 110% full load current.

NOTE. The motor may overheat if it continues to rotate while at current limit. Thermal protection should be provided. If the motor is overloaded and there is insufficient controller current to maintain rotation, the motor will stall, and the controller will trip out on the **STALL TRIP** alarm if this alarm is enabled.

9. Stop the drive then **SAVE PARAMETERS**.

SPEED FEEDBACK CALIBRATION



Start the drive, gradually increase the speed demand signal to 50% and monitor **DIAGNOSTICS:: TERMINAL VOLTS**. Measure the armature voltage on the drive output with a DC voltmeter. **TERMINAL VOLTS** should read within 10% of the actual value. For example, when measuring armature volts at terminals A+ and A- with a voltmeter, a 500 VDC armature should read 250 VDC at 50% speed demand and **TERMINAL VOLTS** should be within 45 to 55%. If the reading is outside this range, check the drive's voltage calibration before continuing.

Increase the speed demand to 100% and check the shaft speed accuracy with a hand tachometer. Measure the armature voltage. If fine adjustment is needed, adjust the drive's calibration according to the speed feedback selection.

1. ARMATURE VOLTAGE FEEDBACK

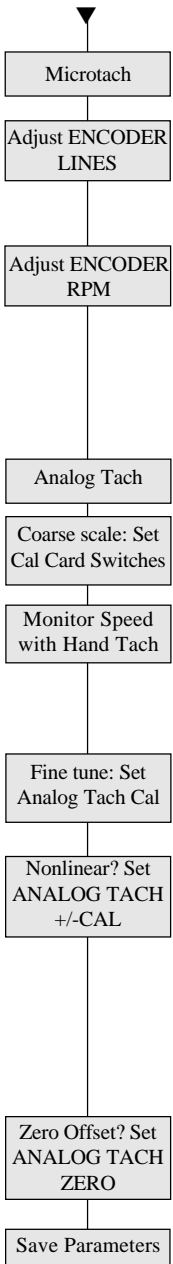
Armature voltage feedback uses the motor's back EMF as speed feedback and is the drive's default feedback setting. It requires no feedback device, isolator or additional external connections. The scaling parameter, **SETUP PARAMETERS:: CALIBRATION:: ARMATURE V CAL**, fine tunes the drive's armature voltage calibration and has a range of 1.1000 to 0.9800, corresponding to -10% to +2% trim. Changes outside this range require re-calibration as described in Chapter 3.

IR COMPENSATION SETUP

Properly setting the **IR COMPENSATION** parameter, or motor loss compensation, improves the speed accuracy when running in armature voltage feedback.

- Run the motor without a load. Monitor the actual speed with a hand tachometer.
- With the same speed setpoint, run the motor at full load and monitor the actual speed again with a hand tachometer.
- Adjust **IR COMPENSATION** until the full load speed is the same as the no load speed.

NOTE. Too much **IR COMPENSATION** causes instability.



2. MICROTACH or WIRE-ENDED ELECTRICAL ENCODERS

- Ensure that the CALIBRATION:: ENCODER LINES parameter equals the pulses per revolution rating of the encoder (1000 for Microtachs). You can read the feedback encoder rpm under DIAGNOSTICS:: ENCODER RPM in the MMI or in SAM under the FEEDBACK software block.
- Adjust the calibration parameter SETUP PARAMETERS:: CALIBRATION:: ENCODER RPM to accurately tune the motor rotational speed to the roll speed with a hand tachometer. Either feedback device gives an absolute rotational speed for which adjustment is unnecessary; however, the process may require an accurately set speed calibration. Speed match the motor through the ratio calculation:

$$\text{New ENCODER Rpm Setting} = \text{Present ENCODER Rpm Setting} \times \frac{\text{Desired Rpm}}{\text{Measured Rpm}}$$

3. AC/DC ANALOG TACHOMETER GENERATOR

- Settings on the analog tachometer generator feedback option card or resistor values on the resistor calibration card give a coarse scaling of the analog tachometer generator feedback voltage. Fine tune the feedback by adjusting drive software parameters.

Use a hand tachometer to measure the motor speed and adjust SETUP PARAMETERS:: CALIBRATION:: ANALOG TACH CAL to scale the overall feedback. Speed match the motor through the ratio calculation:

$$\text{New ANALOG TACH CAL Setting} = \frac{\text{Present ANALOG TACH CAL Setting} \times \text{Desired Rpm}}{\text{Measured Rpm}}$$

The gain range varies from 1.1000 to 0.9800, or -10% to +2% trim. Changes outside this range require a re-calibration of the feedback calibration card as described in Appendix A.

- Use CALIBRATION:: ANALOG TACH -CAL and ANALOG TACH +CAL to tune out a nonlinear analog tachometer generator response *only*. Adjust ANALOG TACH +CAL for a non-linearity at the positive high volt (full speed forward) end of the response curve; change ANALOG TACH -CAL to tune out a non-linearity at the negative high volt (full speed reverse) end. These parameters vary over a range of 1.1000 to 0.9800, but are generally left at 1.0000.

NOTE. It is usually unnecessary to change the ANALOG TACH -CAL and the ANALOG TACH +CAL parameters from their default value of 1.0000, except in cases of extreme non-linearity. For a tachometer whose observed accuracy is within the tachometer's rated accuracy, adjustment is not recommended and will complicate speed calibration.

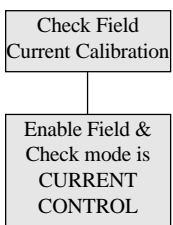
- Some tachometer generators generate a nonzero voltage at zero speed. Use ANALOG TACH ZERO to tune out the offset.

4. SAVE PARAMETERS when finished.

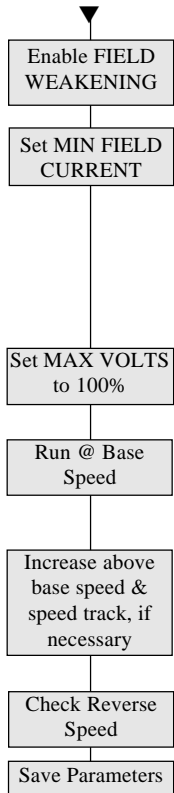
SETUP FOR FIELD WEAKENING

If the motor requires field weakening to achieve top speed, follow these steps.

NOTE. Field weakening requires tachometer generator, wire-ended or Microtach encoder speed feedback.



1. With no power supplied to the drive, set the field current calibration on the switchable or resistor calibration card as described in Chapter 3. Many field weakened motor give the field current as two values, a minimum and a maximum, indicating the field weakened range of the motor. Calibrate the motor field for the larger of these two values.
2. Set SETUP PARAMETERS:: FIELD CONTROL:: FIELD CTRL MODE IS to CURRENT CONTROL and verify the field is enabled by monitoring parameter SETUP PARAMETERS:: FIELD CONTROL:: FIELD ENABLE.



3. Verify that SETUP PARAMETERS:: FIELD CONTROL:: FLD CURRENT VARS:: FLD WEAK VARS:: FLD WEAK ENABLE is ENABLED:
4. Ensure that SETUP PARAMETERS:: FIELD CONTROL:: FLD CURRENT VARS:: FLD WEAK VARS:: MIN FLD CURRENT is set correctly for the motor to reach top speed. MIN FLD CURRENT is calculated using the formula:

$$(\text{minimum field current} \div \text{maximum field current}) \times 90\%$$

This sets MIN FLD CURRENT 10 percent lower than the field calculated to reach full speed. The minimum and maximum field currents are found on the motor nameplate label. The 10 percent cushion should overcome any inaccuracies in the nameplate data.

5. Adjust the maximum armature volts to 100 percent using parameter SETUP PARAMETERS:: FIELD CONTROL:: FLD CURRENT VARS:: FLD WEAK VARS:: MAX VOLTS.
6. Run the drive up to base speed. Monitor DIAGNOSTICS:: TERMINAL VOLTS to verify that the armature voltage is approximately equal to the value calculated in the previous step.
7. Increase speed above base speed by adjusting the speed potentiometer, checking that the motor armature volts remain constant while the field gradually decreases. Gradually increase to maximum speed, monitoring armature volts at maximum speed. Adjust the speed using the appropriate speed feedback calibration parameters, for example ANALOG TACH CAL when using analog tachometer generator feedback.
8. For regenerative, reversing drives, check the maximum reverse speed. Correct any asymmetry in a reversing drive by adjusting SETUP PARAMETERS:: CALIBRATION:: ZERO SPD. OFFSET.
9. Stop the drive and SAVE PARAMETERS.

ADJUST SPEED LOOP

After calibrating the motor speed, tune the speed loop proportional gain (PROP. GAIN) and integral time constant (INT. TIME CONST) settings for optimum speed response. For this procedure, monitor the speed feedback with an oscilloscope at the Analog Tach test point pin on the control board (refer to Figure 5.19 in Chapter 5).

NOTE. Adjust the speed loop only *after* tuning the current loop with AUTOTUNE. Make certain the motor is connected to the load it will normally be running.

PROP. GAIN scales the output based upon the input speed error. Increasing PROP. GAIN improves response time but also increases overshoot. INT. TIME CONST eliminates steady-state error. Reducing INT. TIME CONST improves response, but will cause instability if set too short.

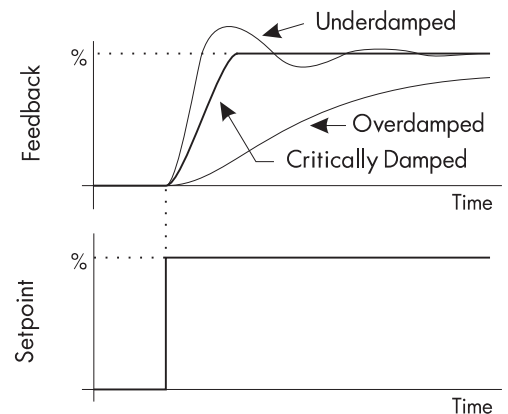
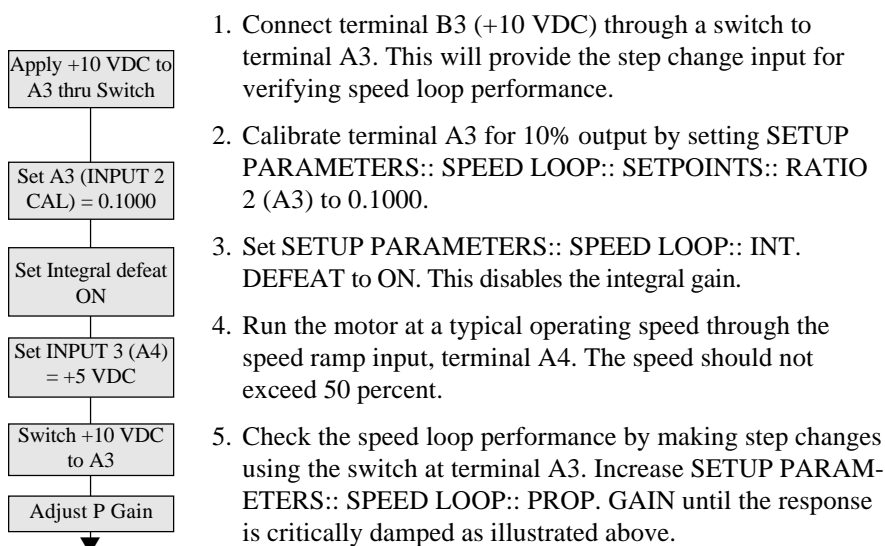
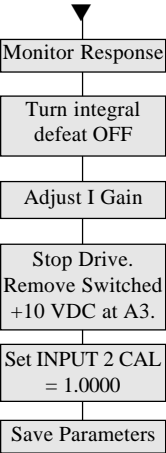


Figure 4.2 - Response to Step Input



- 6. Once stable proportional control is attained, set SETUP PARAMETERS:: SPEED LOOP:: INT. DEFEAT to OFF.
 - 7. Check the speed loop performance by making step changes using the switch at terminal A3. Reduce SETUP PARAMETERS:: SPEED LOOP:: INT. TIME CONST until the response is critically damped.
- NOTE. The default value for INT. TIME CONST is 0.5 seconds. That value may be too small for large inertia loads and cause the system to be unstable from the start.
- 8. Stop the drive and remove the switched signal from terminal A3.
 - 9. Reset the calibration for terminal A3 back to 100% by setting SYSTEM:: CONFIGURE I/O:: ANALOG INPUTS:: ANIN 2 (A3) to 1.0000, then run normally.
 - 10. SAVE PARAMETERS.

OTHER PARAMETERS

Other parameters, for example ramp rates, may be important for the process. Different ramp rates are available for various conditions:

| Condition | Parameter Name | Menu |
|-------------------------------|-------------------------------------|-------------|
| Speed Setpoint Change | RAMP ACCEL TIME and RAMP DECEL TIME | RAMPS |
| Jog Acceleration/Deceleration | RAMP RATE | JOG/SLACK |
| Controlled Stop Deceleration | STOP TIME | STOP RATES |
| Fast Stop Deceleration | PROGRAM STOP TIME | STOP RATES |
| Electronic MOP Control | INCREASE RATE and DECREASE RATE | RAISE/LOWER |

Appendix C fully discusses the functionality and scaling of all drive parameters.

RECORDING PARAMETERS

It is important to have a hard copy of your drive parameters. This copy might consist of writing down the information on a chart, saving the parameters to a computer disk, or printing the parameters using an external computer. The parameter list in Appendix C has two empty columns for manually recording the drive parameters.

To save the parameters as either a hexadecimal ASCII file or as a text file ready for printing, connect a computer to the P3 serial port. Use a telecommunications program, such as Procomm™, Windows Terminal™, or other terminal emulation programs. Refer to "Using Microsoft® Windows™ to Document and Clone 590 DRV Digital Drives" (HA352155) for detailed instructions using Windows Terminal™ for uploading and downloading drive parameters. Appendix G also contains general information for using P3 to upload and download drive parameters.

PASSWORD PROTECTION

To safeguard the parameters you have set with the MMI, you can configure the 590 DRV Digital drive in a password-protected mode. At the initial power up, the DISPLAY PASSWORD command is automatically cleared to zero. If the controller password is set at any value other than zero, the MMI is in a restricted mode and the MMI display can be displayed but not altered.

Entering a Password

- To access the password configuration procedure from the main menu:
- PASSWORD
 - M to enter the Password sub-menu
 - M to enter the ENTER PASSWORD sub-menu
 - ▲ to enter the password on the screen.

Changing a Password

All 590 DRV Digital drives are shipped with the default password 0x0000 which is displayed in the MMI. If the default password does not work, contact your supplier for the new password. Once you have entered the correct code, you may use the CHANGE PASSWORD function to set your own restricted password.

- PASSWORD
- M to enter Password sub-menu
- ▲ to CHANGE PASSWORD
- M to enter the CHANGE PASSWORD sub-menu
- ▲ to enter a different value (password)
- E to back out one step
- ▲ to move to CLEAR PASSWORD display
- M to clear the password

This clears from view the password you have entered, protecting the settings from those without access to the password.

With password protection installed in your 590 DRV, the parameters available through the MMI can be viewed but not be altered without first entering that password. To edit parameters, you must reenter the password and repeat the procedure described above.

NOTE. Be sure to record the new password. If you lose your password, you will be unable to change parameters.

4-Button Reset

A 4-Button Reset loads the drive's default parameters into the drive's operating memory; erasing all customized settings and connections. It is often used to reset the drive when troubleshooting procedures fail. See Appendix B for more information on using the MMI and performing a 4-Button Reset.

Chapter 5 TROUBLESHOOTING

The most valuable tools for finding and resolving faults are the MMI and the LED display. You can also monitor alarms and troubleshoot faults remotely through a computer interface if a RS422 serial communications option card (AH385826U001) is installed on the drive.

INITIAL TROUBLESHOOTING PROCEDURE

Most drive problems are encountered during commissioning or soon after start-up. Problems frequently result from incorrect installation or errors in configuring the drive. If you encounter a problem upon initial start up of your 590 DRV Digital drive, review the installation procedures in Chapter 3 and the start up and adjustment procedures in Chapter 4. If you have reviewed your installation and initial start up procedures and all seems to be in order, proceed to the troubleshooting methods in this chapter.

Use the flowchart in Figure 5.1 to begin troubleshooting.

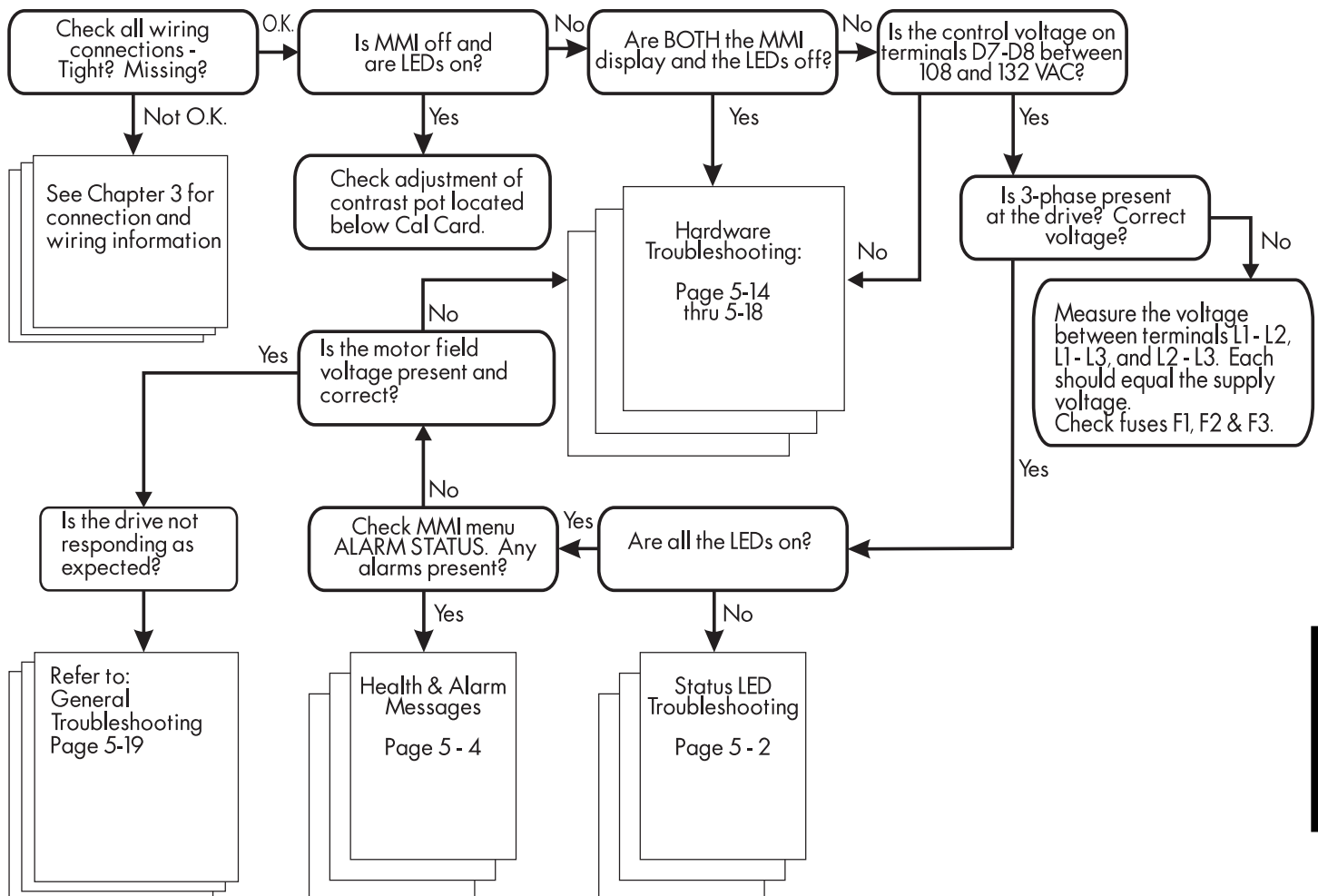


Figure 5.1 - Initial Troubleshooting Procedure

Recommended Tools

You will need the following tools for most troubleshooting procedures:

- Voltmeter
- Megger

If available, the following tools can provide more detailed information for problem-solving:

- Oscilloscope
- Hand tachometer

You may also need screwdrivers and/or wrenches to restore electrical connections that are incorrect or have come loose.

STATUS LED TROUBLESHOOTING

Six light emitting diode [LED] indicators are located just to the right of the MMI display. The LEDs indicate six status conditions on the drive: health, run, start contactor, overcurrent trip, program stop, and coast stop.

LED Functions

The HEALTH and RUN LEDs are software driven. The health LED turns ON when control power is applied and remains ON if the drive passes all 18 diagnostic alarm points the drive continuously monitors while running. If an alarm fault occurs, the drive's MMI displays the associated alarm message and the HEALTH LED turns off. The RUN LED turns ON after the following sequence occurs: the drive receives start command through the RUN or JOG input (terminals C3 or C4), the drive is healthy, the thyristor bridge circuit enables and the start contactor energizes. The RUN LED turns OFF whenever the drive is disabled. This LED also turns OFF if the drive's internal start relay de-energizes, or if a fault occurs.

The four remaining LEDs— START CONTACTOR, OVERCURRENT TRIP, PROGRAM STOP, and COAST STOP— are hardware driven. The START CONTACTOR LED is ON whenever the drive's internal start relay is energized. PROGRAM STOP and COAST STOP are ON whenever +24 VDC is connected to terminals B8 (PROGRAM STOP) and B9 (COAST STOP). These terminals are normally switched to terminal C9 +24 VDC through an external emergency stop relay.

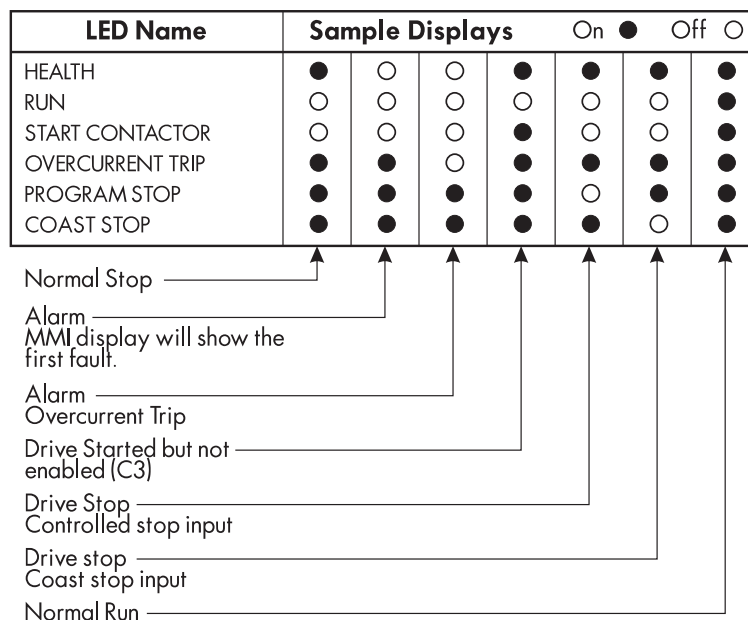


Figure 5.2 - Sample LED Status Modes

All six LEDs are ON under normal running conditions. Figure 5.2 shows the LED states after common actions and other faults occur. An unlit LED indicates a problem that prevents controller operation and requires user attention. The table in Figure 5.3 shows what to check when an LED is off.

| LED NAME | MEANING WHEN OFF | POSSIBLE CAUSE | CORRECTIVE ACTION |
|------------------|--|--|---|
| HEALTH | Fault has occurred and is shown by the other LED status' and the MMI display. | Any of the drive's possible fault conditions. | Check the MMI for alarms. Go to the ALARM MESSAGES section for troubleshooting tips. |
| RUN | The drive is not enabled or in the RUN state. | The thyristor bridge is disabled | Check all enable input (terminal C5) circuitry. |
| | | The main contactor is de-energized. | Check for loose wires from the drive to the contactor coil. |
| | | Another alarm is present. | Go to the ALARM MESSAGES section for troubleshooting tips. |
| START CONTACTOR | The start contactor is open. | 24 VDC signal is not present at terminal C3. | Check the RUN circuitry. |
| OVERCURRENT TRIP | Armature current has exceeded 300 percent full load. | The armature is calibrated wrong. | Check the armature current calibration on the calibration board. |
| | | Mechanical binding on the motor is preventing free movement. | Inspect motor couplings, linkages, bearings, etc. |
| | | Field voltage too low. | Check field supply and verify motor field voltage. |
| PROGRAM STOP | 24 VDC signal not present at terminal B8. The main contactor will drop out once the motor has completed a controlled stop. | Emergency stop is engaged or other external logic or safety interlocks are preventing 24 VDC from being present at B8. | Ensure the "B" terminal block is fully engaged on the control door. Check all safety interlocks in the external logic. |
| | | 24 VDC supply has failed. | Check for 24 VDC at terminal C9 or the external 24 VDC supply if used. |
| COAST STOP | 24 VDC signal not present at terminal B9. The main contactor is de-energized and the motor will coast to a stop. | Emergency stop is engaged or other external logic or safety interlocks are preventing 24 VDC from being present at B9. | Ensure the "B" terminal block is fully engaged on the control door. Check all safety interlocks in the external logic. |
| | | 24 VDC supply has failed. | Check for 24 VDC at terminal C9 or the external 24 VDC supply if used. |

Figure 5.3 - Status LED Troubleshooting Procedures

HEALTH, ALARM MESSAGES AND THE TRIP RESET

The controller continuously monitors 19 alarms while the drive is running. These alarms are gated together to provide an overall "controller healthy" logic variable. This variable corresponds to the ALARM STATUS software block output HEALTHY (tag number 122).

The default shipped drive configuration of the 590 DRV Digital drive tags the HEALTHY logic parameter to digital O/P 2 (terminal B6).

If a fault occurs while the controller is running, HEALTHY switches FALSE and the drive immediately inhibits the thyristor firing circuit. The drive then deenergizes the main contactor and the MMI displays the *last* fault registered, or the fault which interrupts controller operation. If TRIP RESET (parameter tag 305 set under the SETUP PARAMETERS:: INHIBIT ALARMS menu) is TRUE, the HEALTHY output remains FALSE until the RUN input (terminal C3) switches LOW, as shown in the left portion of Figure 5.4.

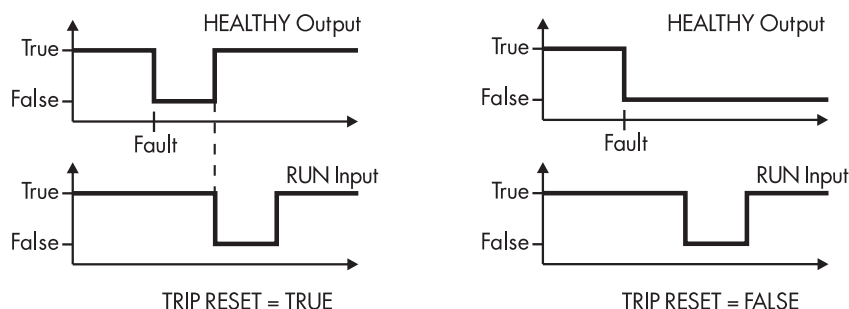


Figure 5.4 - HEALTHY Output Logic

If a restart is attempted without first clearing the fault, HEALTHY will again switch FALSE and the drive will not enable the thyristors and reenenergize the main contactor. If TRIP RESET is FALSE, the drive cannot restart regardless of the state of the RUN input or whether or not the fault is cleared.

The tables in Figures 5.5 through 5.10 describe the different alarms the MMI displays when the drive trips out on a fault, the fault's symptoms and recommended corrective action.

| DISPLAY MESSAGE | MEANING | POSSIBLE CAUSE | CORRECTIVE ACTION |
|-----------------------------------|---|---|--|
| *** ALARM *** 3 PHASE FAILED | One or more phases of the 3 phase supply is missing, or below 208 volts. | Supply voltage low or a phase is missing. | Check 3 phase input voltages L1, L2, L3. |
| | | Blown fuse. | Check fuses F1, F2, F3, FS4, FS5, and FS6 and external line fuses. Check armature current calibration does not exceed drive rating. |
| | | Loose wiring. | Check all power wiring for tightness. |
| | | Defective power supply pcb. | Replace power supply pcb. |
| *** ALARM *** ACCTS FAILED | ACCT (Alternating Current Current Transformer) armature feedback sensing hardware interlock not made. | Plug PLK not inserted or output wires of ACCT severed. | Insert PLK in socket on power supply PCB. Check output wires of ACCT. |
| *** ALARM *** AUTOTUNE ABORTED | Enable, or Start/Run commands removed before AUTOTUNE procedure completed. | Wrong AUTOTUNE sequence followed. | Repeat AUTOTUNE procedure. |
| | | AUTOTUNE incomplete. (After 2 minutes drive will time out if still in AUTOTUNE mode). | Repeat AUTOTUNE procedure. If problem persists contact Eurotherm Drives customer service. |
| *** ALARM *** CAL CARD | Calibration hardware interlock not made. | Calibration card missing or improperly fitted. | Check that calibration card is fully inserted on mounting pins on control door. |

Figure 5.5 - Alarm Messages

| DISPLAY MESSAGE | MEANING | POSSIBLE CAUSE | CORRECTIVE ACTION |
|---------------------------------|---|---|--|
| *** ALARM *** AUTOTUNE ERROR | Motor rotation detected during Autotune process (speed feedback greater than 20%), or Field current detected during AUTOTUNE. (Field current greater than 6%). | Residual motor flux when field regulator disabled. | Lock motor armature and repeat AUTOTUNE procedure. |
| | | Series field winding connected in motor. | Series fields are not recommended for regenerative drives and the series field winding should normally be left open circuit. If a series field is required, either lock the motor shaft or temporarily disconnect the series field and repeat the AUTOTUNE procedure. |
| | | Permanent magnet motor. | Lock motor armature and repeat AUTOTUNE procedure. |
| | | Separately supplied field. | Disable external field supply and repeat AUTOTUNE procedure. |
| | | Old style power chassis with field diode bridge. | On older units fitted with a diode bridge field supply the field wiring must be disconnected to achieve zero current for AUTOTUNE purposes. |
| *** ALARM *** ENCODER FAILED | Feedback hardware removed or not fitted when ENCODER FEEDBACK has been selected, or Microtach feedback has fiber optic overdrive, underdrive, or phase lock alarm when Encoder Feedback has been selected (see Microtach Feedback). | Encoder or Microtach feedback option card incorrectly fitted to control door. | Check that encoder or Microtach feedback card is properly fitted to the control door. If using an analog tachometer or armature voltage feedback, make sure that the SPEED FEEDBACK SELECT parameter is set to ANALOG TACH or ARM VOLT FBK. |
| | | Fiber optic cable too long or cable distorted (bend radius too small for example) resulting in too weak a signal at Microtach receiver [under drive]. | Check the fiber optic cable run for bends, kinks and continuity. Ensure that the cable installation does not exceed bend radius of fiber optic cable. |
| | | Fiber optic cable too short resulting in too strong a signal at Microtach receiver [over drive]. | PLASTIC CABLE: back cable slightly out of hardened input receiver and retighten. GLASS CABLE: attenuate fiber optic signal with longer cable run or by setting (if used) the 5702 or 5904 repeater launch power to lower setting. |
| *** ALARM *** FIELD FAILED | Field current below 6% in Current Control Mode, or below 12% in Voltage Control Mode. | Field circuit open or shorted. | Check integrity of wiring from drive to motor. Check for continuity, proper termination and insulation wear. |
| | | Using permanent magnet motor. | Disable field using parameter FIELD ENABLE in SETUP PARAMETERS::FIELD CONTROL. |
| | | Drive field current miscalibrated. | Repeat field supply set up procedure in Chapter 5 [see INITIAL DRIVE START and SETUP FOR FIELD WEAKENING]. |
| | | Field supply fuse blown. | Check FS4, FS5 or external AC field supply fuses if fitted. Verify motor rating plate current does not exceed drive field current output capability. Check motor field winding resistance. Using a megger, check field wiring for a possible short to ground. |
| | | Field thyristor block defective. | Replace defective field thyristor block. |
| | | Power supply board failed. | Disable field fail alarm by setting SETUP PARAMETERS::INHIBIT ALARMS::FIELD FAIL to INHIBIT. Set MAIN I LIMIT to 0.00%, then start drive and measure field voltage and current. If present, replace power supply board. |
| | | External field supply connected incorrectly. | Check the external field supply phasing [see WIRING PROCEDURES in Chapter 3]. |

Figure 5.6 - Alarm Messages (Continued)

| DISPLAY MESSAGE | MEANING | POSSIBLE CAUSE | CORRECTIVE ACTION |
|---------------------------------|---|---|--|
| *** ALARM *** FIELD OVER I | Field over current. Field current exceeds 120% (alarm only operates if field is in Current Control Mode). | Drive field current miscalibrated. | Repeat field supply set up procedure. |
| | | External field supply connected incorrectly. | Check the external field supply phasing (see Chapter 3). |
| *** ALARM *** HEATSINK TRIP | Heatsink thermostat open; drive overheated. | Fan failure or obstruction. | Check drive fan rotating (when fans fitted). |
| | | Fan fuse blown. | Check FSI. |
| | | Plug PLN not fully inserted. | Check heatsink plug PLN fully inserted in power supply pcb. |
| | | Inadequate enclosure ventilation. | Check enclosure fan and filter. Check location of drive meets manual installation requirements. |
| | | Extreme ambient temperature. | Measure enclosure internal temperature. Fit ventilation fans or air conditioning if ambient exceeds drive specification [see VENTILATION & COOLING REQUIREMENTS in Chapter 3]. |
| | | Drive miscalibrated. | Check drive calibration. Mis-calibration can cause overheating. |
| INITIALIZING IA FBK CAL FAIL | Armature current feedback calibration fail during the power-up self test. | Armature current feedback current transformers miswired. | Check ACCT wiring and PLK jumpers on the power supply board. |
| | | Control board defective. | Replace control board. |
| *** ALARM *** MISSING PULSE | Missing armature current pulse. Irregular armature current waveform detected. (Armature current must be 1.5 times the discontinuous current level and missing pulse must be present for 60 seconds for alarm to operate). NOTE. Ripple from the speed loop can cause unstable current. | Drive not AUTOTUNEd (Unstable current loop). | Perform the AUTOTUNE procedure. |
| | | SCR gate connection loose. | Check SCR gate connections from the trigger board to the SCR gate leads. |
| | | SCR defective. | Check SCRs with an ohmmeter: See SCR Troubleshooting in this chapter. |
| | | SCR firing pcb defective. | Replace the pcb. |
| | | Motor has opened or shorted coil. | Check the motor with an ohmmeter and megger for insulation and continuity. |
| | | Coupling between motor and feedback device slipping | Stop drive and isolate power. Check coupling tightness. |
| | | Feedback device noisy or defective. | Replace tachometer generator if noise is present while observing feedback with an oscilloscope. |
| | | Bottom two LEDs on the 5701 or 5901 Microtach receiver board are out. | Weak feedback signal intensity; check connections, fiber optic wire integrity, and transmission distances. |
| | | Speed loop gain too high. | Retune drive speed loop. |

Figure 5.7 - Alarm Messages (Continued)

| DISPLAY MESSAGE | MEANING | POSSIBLE CAUSE | CORRECTIVE ACTION |
|------------------------------|--|--|---|
| *** ALARM *** OVER I TRIP | Armature over current trip. Armature current has exceeded 300% of calibration value. | Drive not AUTOTUNEd (Unstable current loop). | The drive AUTOTUNE procedure MUST be followed for the motor the drive is to control. Repeat the AUTOTUNE procedure. |
| | | Drive incorrectly calibrated. | Check the calibration settings. |
| | | Manual tuning of drive leaves current loop unstable. | Current loop response may be manually adjusted only AFTER AUTOTUNing is complete. Check current loop response. THIS IS NOT RECOMMENDED! |
| | | Coupling between motor and feedback device slipping. | Stop drive and isolate power. Check coupling tightness. |
| | | Motor armature faulty. | Check motor resistance to ground. Check for armature shorts. |
| | | Loss of 3 phase supply during regeneration. | Check 3-phase supply branch circuit protection and SCR fuses, F1, F2, and F3. |
| | | ENABLE (A5) activating before DRIVE START when using a DC contactor. | Activate ENABLE (A5) with auxiliary contact off DC contactor. Check for other wires at terminal A5. |
| | | Control Door or Power Supply PCB faulty. | Replace defective board. |
| *** ALARM *** OVER SPEED | Drive speed feedback exceeded 125% of calibrated value. | Improperly set maximum speed parameters. | Use hand tachometer to ensure proper speed and adjust the speed calibration parameter. |
| | | Wrong type of feedback selected in SPD FDBK SELECT parameter in MMI. | Change parameter to match feedback type. |
| | | Calibration board set incorrectly for analog tachometer generator feedback. | Verify calibration resistors, R6 and R7 or the switchable calibration board settings. Check AC/DC tach switch. |
| | | Improper calibration of drive speed feedback, encoder ppr selection for example. | Recalibrate the speed feedback. Set ENCODER LINES to proper ppr of feedback encoder. |
| | | Improper tuning of speed loop parameters drive overshooting or unstable. | Retune drive speed loop (see Chap 5). |
| | | Coupling between motor and feedback device slipping. | Stop drive and isolate power. Check tightness of coupling. |
| | | Feedback device noisy or defective. | Replace tachometer generator. Use scope & check for noise. |
| | | Bottom two LEDs on the 5701 or 5901 Microtach receiver board are out. | Weak feedback signal intensity; check signal dB, connections, fiber optic wire integrity, and transmission distances. |
| | | Field weakening parameters incorrectly set. | Reconfigure the field weakening parameters as described in Chapter 5. |
| | | Drive operating as current regulator. | Check external speed loop adjustments. |

Figure 5.8 - Alarm Messages (Continued)

| DISPLAY MESSAGE | MEANING | POSSIBLE CAUSE | CORRECTIVE ACTION |
|----------------------------------|--|--|--|
| *** ALARM *** OVER VOLTS (VA) | Armature voltage exceeded 120% of calibrate value. | Drive miscalibrated for motor armature voltage. | Check armature voltage calibration matches motor nameplate information |
| | | Drive miscalibrated for field voltage ratio [voltage mode] or field current [current or field weakening mode]. | Check field calibration of drive. Check field current not exceeding motor name plate data. |
| | | Armature open circuit. | Check armature wiring. Check armature fuse F7 (regenerative units only). |
| | | Motor maximum speed set incorrectly causing armature voltage to exceed nameplate rating | Change maximum speed parameter to match the nameplate rating. |
| | | Field weakening parameters set incorrectly if using an extended speed range motor. | Change field weakening parameters for use with an extended speed range motor. See Chapter 5. |
| *** ALARM *** PHASE LOCK | Drive SCR firing phase lock loop unable to lock to supply waveform. | One or more phases of supply low, too high or missing. | Check all three phases of the supply, other equipment on the same supply may be generating voltage in a missing phase. Check fuses F1, F2, F3, FS4, FS5 and FS6. |
| | | Supply waveform badly distorted. | Install line chokes and/or isolation transformers if not present with drive. |
| | | Power supply pcb or control door defective. | Replace the power supply board. |
| | | Supply frequency outside 45-65 Hz range. | Change supply for one within the 45 to 65 Hz range. |
| *** ALARM *** SPD FEEDBACK | Difference between armature voltage and speed feedback signals exceeded speed feedback alarm threshold setting, or Tachometer feedback signal wrong polarity. | Wrong polarity speed feedback signal. | Reverse tachometer leads, or swap encoders connections. |
| | | Armature volts miscalibrated. | Check armature voltage calibration resistors, R8 and R9, on calibration card or the switchable calibration board settings are correct. |
| | | Tachometer generator miscalibrated. | Check tachometer calibration resistors, R6 and R7, on calibration card are calibrated for the proper feedback voltage at motor top speed. |
| | | Armature voltage sensing leads miswired or damaged. | Check wiring of armature voltage sensing wires AS+, AS- from DC contactor to power supply board. |
| | | Coupling between motor and feedback device slipping. | Stop drive and isolate power. Check tightness of coupling. |
| | | Feedback device noisy or defective. | Replace tachometer generator if noise is observed on the feedback signal with an oscilloscope. |
| | | Bottom two LEDs on the 5701 or 5901 Microtach receiver board are out. | Weak feedback signal intensity; check connections, fiber optic wire integrity, and transmission distances. |
| | | Motor has opened or shorted coils. | Check the motor for insulation and continuity. |
| | | Analog tachometer feedback wires or shield came loose or shorted to ground. | Reconnect the wiring. |

Figure 5.9 - Alarm Messages (Continued)

| DISPLAY MESSAGE | MEANING | POSSIBLE CAUSE | CORRECTIVE ACTION |
|-----------------------------|--|---|---|
| *** ALARM *** STALL TRIP | Drive stall trip has operated NOTE. The stall trip operates when: Arm. current > Stall Threshold, and the motor is At Zero Speed for a time longer than the Stall Trip Delay (default = 10s). | Stall timer set too short for load acceleration. | Increase stall trip delay and/or stall trip threshold if STALL TRIP is being used. |
| | | Field current below motor nameplate if the drive is in field current control mode. | Confirm motor field current with DC clamp on meter or current meter. Check drive field calibration. |
| | | Field connection miswired. | Check motor field wiring is in accordance to motor prints. |
| | | Motor unable to deliver sufficient torque. | Check motor not undersized for load requirements. |
| | | Mechanical binding of the motor. | Check for mechanical problems which may cause the motor to stall out. |
| | | Field voltage is not set correctly if the drive is in field voltage control mode. | Adjust the RATIO OUT/IN parameter in the field calibration settings section. |
| *** ALARM *** THERMISTOR | Motor thermistor / thermostat input open or high impedance, motor over temperature. | Motor thermal protection device not wired to drive or thermistor/thermostat open circuited. | Check A1 and A2 connections to drive. Jumper A1 to A2 if motor not fitted with thermal protection device (thermistor/thermostat). |
| | | Blower motor rotating in wrong direction (force ventilated motors). | Check direction of fan agrees with arrow on motor blower assembly, or motor manual. |
| | | Blower filter clogged. | Clean or replace filter. |
| | | Motor operating at low speed/high current. | TEFC motors do not generate sufficient flow of air to provide sustained full load current at low speed. Check gearing and /or reduce mechanical load. Use a higher power motor or provide additional cooling method independent of motor RPM. |
| | | Drive miscalibrated. | Check motor armature and current calibration matches motor name plate information. |
| | | Field miswired. | Check motor field wiring matches motor wiring diagram for field supply. |

Figure 5.10 - Alarm Messages (Continued)

SYMBOLIC ERROR MESSAGES

Symbolic error messages are caused by internal software or hardware errors and will have no obvious meaning to the end user. If a symbolic message appears, cycle power on the controller to clear the fault. If the message repeats, call Eurotherm Drives Customer Service.

| DISPLAY MESSAGE | MEANING | POSSIBLE CAUSE | CORRECTIVE ACTION |
|-----------------|---|---------------------------------|--|
| 0xF003 | Pre-Ready Fault | Coding not present | Replace power board or chassis. If using an external stack, check the coding supply first. |
| 0xF100 | CAM Full | | Call Eurotherm Drives Customer Service. |
| 0xFF01 | Internal software error in slot-read() | | Call Eurotherm Drives Customer Service. |
| 0xFF02 | Unimplemented micro opcode | | Call Eurotherm Drives Customer Service. |
| 0xFF03 | Aux power fail | Controller power supply failure | Check the 120 volt supply to the controller. |
| 0xFF04 | "Trap" software interrupt | | Call Eurotherm Drives Customer Service. |
| 0xFF05 | Internal software error in slot-read-pass() | | Call Eurotherm Drives Customer Service. |
| 0xFF05 | Internal software error in slot-write() | | Call Eurotherm Drives Customer Service. |

Figure 5.11 - Symbolic Error Messages

ALARM PROCESS

The hexadecimal code for the first alarm is saved in HEALTH STORE. HEALTH STORE resets when the drive is restarted. The alarm is also saved in LAST ALARM and stored until another fault trips out the drive or if the control power is removed. All subsequent alarms are not displayed.

The first alarm as well as any subsequent alarms are stored in HEALTH WORD. HEALTH WORD is updated continuously and shows the *current* condition of all alarms. As an alarm is cleared, HEALTH WORD reflects the new condition of all remaining alarms.

You can monitor HEALTH WORD, HEALTH STORE, and LAST ALARM in the MMI under the ALARM STATUS menu.

Alarm Status

This table lists the bit assignments of the MMI alarms in HEALTH WORD and HEALTH STORE in hexadecimal format. The table also indicates whether you can override the alarm with the SETUP PARAMETERS:: INHIBIT ALARMS menu and lists the delay time of each alarm, if any.

| Bit | MMI Alarm | Description | Hex Value | Inhibit? | Delay Time |
|-----|----------------|---|-----------|----------|------------|
| 0 | OVERSPEED | motor overspeed | 0x0001 | no | --- |
| 1 | MISSING PULSE | unstable or missing armature current pulses | 0x0002 | no | 0.75 sec |
| 2 | FIELD OVER I | motor field overcurrent | 0x0004 | no | --- |
| 3 | HEATSINK TRI | heatsink over temperature | 0x0008 | no | --- |
| 4 | THERMISTOR | motor over temperature | 0x0010 | no | 15 sec |
| 5 | OVERVOLTS (VA) | motor armature overvolts | 0x0020 | no | --- |
| 6 | SPEED FEEDBACK | speed feedback failure | 0x0040 | yes | 0.1 sec |
| 7 | ENCODER FAILED | encoder or microtack signal failure | 0x0080 | yes | --- |

| Bit | MMI Alarm | Description | Hex Value | Inhibit? | Delay Time |
|-----|---------------------|---|-----------|----------|------------|
| 8 | FIELD FAILED | field current too low | 0x0100 | yes | --- |
| 9 | 3 PHASE FAILED | 3 phase supply input not present | 0x0200 | no | --- |
| 10 | PHASE LOCKED | AC synchronization failed | 0x0400 | no | 0.5 sec |
| 11 | 5703 RECEIVER ERROR | P3 port receiver error (noisy or failed) | 0x0800 | yes | --- |
| 12 | STALL TRIP | motor stall trip timed-out | 0x1000 | yes | --- |
| 13 | OVER I TRIP | motor armature overcurrent | 0x2000 | no | --- |
| 14 | CAL CARD | calibration card not fitted | 0x4000 | no | --- |
| 15 | ACCTS FAILED | external ACCTs not connected | 0x8000 | no | --- |
| -- | AUTOTUNE ERROR | autotune operational error (shaft rotate) | ----- | no | --- |
| -- | AUTOTUNE ABORT | autotune execute aborted or timed-out | ----- | no | --- |

This example shows how HEALTH WORD, HEALTH STORE, and LAST ALARM are updated.

During operation, the controller trips on P3 PORT ALARM (0x0800), the drive loses three-phase power when an SCR fuse blows (0x0200) and the motor overheats causing the thermistor to open (0x0010). HEALTH WORD is:

$$0x0800 + 0x0200 + 0x0010 = 0x0A10.$$

| | | |
|-------------|--------------|---------------|
| HEALTH WORD | HEALTH STORE | LAST ALARM |
| 0x0A10 | 0x0800 | P3 PORT ALARM |

During troubleshooting, the motor cools down and the thermistor closes.

| | | |
|-------------|--------------|---------------|
| HEALTH WORD | HEALTH STORE | LAST ALARM |
| 0x0A00 | 0x0800 | P3 PORT ALARM |

The P3 PORT ALARM is cleared and the drive is restarted and immediately trips with a 3 PHASE FAILED alarm.

| | | |
|-------------|--------------|----------------|
| HEALTH WORD | HEALTH STORE | LAST ALARM |
| 0x0200 | 0x0200 | 3 PHASE FAILED |

The fuse is replaced and three-phase power is turned on.

| | | |
|-------------|--------------|----------------|
| HEALTH WORD | HEALTH STORE | LAST ALARM |
| 0x0000 | 0x0200 | 3 PHASE FAILED |

The drive is restarted.

| | | |
|-------------|--------------|----------------|
| HEALTH WORD | HEALTH STORE | LAST ALARM |
| 0x0000 | 0x0000 | 3 PHASE FAILED |

NOTE. Before restarting a drive after troubleshooting the first alarm, it is good practice to monitor HEALTH WORD to assure all alarms have been cleared. This can reduce down time.

DRIVE DIAGNOSTICS

Many signals can be monitored in the MMI display. The diagnostic parameters are "read-only" and are very useful for tracing configuration problems. The following tables contain a description of each parameter and its range. Parameters denoted with an asterisk (*) are the controller's analog or digital I/O. The drive has been shipped with its I/O tagged to the parameter listed in the description field.

| Parameter | Description | Tag | Range |
|------------------|--|-----|--------------------|
| ACTUAL NEG I LIM | Overall negative current limit value | 61 | ± 200% |
| ACTUAL POS I LIM | Overall positive current limit value | 67 | ± 200% |
| ANIN 1 (A2)* | Speed setpoint no. 1. | 50 | ± 10V |
| ANIN 2 (A3) | Hardwired. Speed setpoint no. 2 or current demand if C8 = ON. | 51 | ± 10V |
| ANIN 3 (A4)* | Speed setpoint no. 3 (ramped). | 52 | ± 10V |
| ANIN 4 (A5)* | Speed setpoint no. 4 or negative current clamp if C6 = ON | 53 | ± 10V |
| ANIN 5 (A6)* | Main current limit or positive current clamp if C6 = ON | 54 | ± 10V |
| ANOUT 1 (A7)* | Scaled speed feedback. | 55 | ± 10V |
| ANOUT 2 (A8)* | Total speed setpoint. | 56 | ± 10V |
| AT CURRENT LIMIT | Current demand is being restrained by the overall current limit | 42 | TRUE / FALSE |
| AT STANDSTILL | AT ZERO SPEED and "AT ZERO SETPOINT" | 79 | TRUE / FALSE |
| AT ZERO SETPOINT | At zero speed demand | 78 | TRUE / FALSE |
| AT ZERO SPEED | At zero speed feedback | 77 | TRUE / FALSE |
| BACK EMF | Calculated motor back EMF including IR compensation | 60 | ± 150% |
| CURRENT DEMAND | Current loop demand (speed error PI output or external current demand clamped by all the current limits) | 299 | ± 200% |
| CURRENT FEEDBACK | Scaled and filtered armature current | 298 | ± 300% |
| DIGIN 1 (C6)* | Symmetrical current clamps / Asymmetrical (bipolar) current clamps (ON = Bipolar). | 71 | ON / OFF |
| DIGIN 2 (C7)* | Ramp hold input (ON = Hold). | 72 | ON / OFF |
| DIGIN 3 (C8)* | Current demand isolate; giving speed or current mode of operation. (ON = Current mode) | 73 | ON / OFF |
| DIGOUT 1 (B5)* | At zero speed. | 74 | ON / OFF |
| DIGOUT 2 (B6)* | Drive healthy. Health is also displayed on a front panel LED and is always ON when the start is low | 75 | ON / OFF |
| DIGOUT 3 (B7)* | Drive ready to run (all alarms healthy and mains synchronization achieved) | 76 | ON / OFF |
| DRIVE ENABLE | Drive speed and current loop are enabled / disabled | 84 | ENABLED / DISABLED |
| DRIVE START | Controller start / run command | 82 | ON / OFF |
| ENABLE (C5) | Electronic enable / disable terminal (ON = Enabled) | 70 | ON / OFF |
| ENCODER | Encoder speed feedback in RPM | 206 | ± 6000 RPM |
| INVERSE TIME O/P | Inverse time clamp output level | 203 | 0 to 200% |
| JOG INPUT (C4) | Jog / Take-up slack terminal | 69 | ON / OFF |
| NEG I CLAMP | Negative current clamp | 88 | ± 200% |
| OPERATING MODE | Indicates whether the drive is in RUN, JOG 1, STOP, etc. | 212 | |
| PID CLAMPED | Indicates the PID output has reached either the positive or negative limit. | 416 | TRUE/FALSE |

Figure 5.12 - Diagnostic Parameters

| Parameter | Description | Tag | Range |
|-----------------|---|-----|-----------------------|
| PID ERROR | Displays the difference between the setpoint (INPUT 1) and the feedback signal (INPUT 2) in the PID function block. | 415 | ± 105.00% |
| PID OUTPUT | Output of the PID function block. | 417 | ± 315.00% |
| POS I CLAMP | Positive current clamp | 87 | ± 200% |
| PROGRAM STOP | State of program stop (terminal B8). When B8 is at 24V then "PROGRAM STOP" is FALSE and the program stop front panel LED is also ON | 80 | TRUE / FALSE |
| RAISE/LOWER O/P | Value of the raise / lower ramp function | 264 | ± 300% |
| RAMP OUTPUT | Setpoint ramp output | 85 | ± 100% |
| RAMPING | If the difference between the ramp input and the ramp output is greater than the "RAMP THRESHOLD", then "RAMPING" is TRUE | 113 | TRUE / FALSE |
| SPEED DEMAND | Speed loop total setpoint after the ramp-to-zero block | 89 | ± 105% |
| SPEED ERROR | Speed loop error | 297 | ± 150% |
| SPEED FEEDBACK | Speed loop feedback | 207 | ± 150% |
| SPEED SETPOINT | Speed loop total setpoint including the ramp output before the ramp-to-zero function | 63 | ± 150% |
| SPT. SUM OUTPUT | Setpoint summation output | 86 | ± 200% (default 105%) |
| STALL TRIP | Armature current is above "STALL THRESHOLD" and "AT ZERO SPEED" but not AT ZERO SETPOINT | 112 | OK / FAILED |
| START (C3) | Start / Run terminal | 68 | ON / OFF |
| TACH INPUT [B2] | Scaled analog tachogenerator feedback | 308 | ± 110% |
| TERMINAL VOLTS | Scaled terminal volts | 57 | ± 125% |

Figure 5.13 - Diagnostic Parameters (Continued)

HARDWARE TROUBLESHOOTING

This section contains troubleshooting information and a flowchart for identifying and correcting hardware problems in the 590 DRV Digital drive.

NOTE. Repair of the 590 DRV is limited basic part replacement only. Troubleshooting and electronic component replacement at the board level is *not* recommended. Only the control and power boards, the control fuse F1 and the SCR packs are designed to be replaced. Refer to Chapter 6, Service and Maintenance, for drive assembly and disassembly instructions.

Caution

Completely isolate power before making any wiring changes, replacing fuses, or making any jumper changes.

Control Power Missing

The 590 drive derives its control power from an internal power supply circuit requiring a 110 VAC supply with a frequency range of 40 to 70 Hz. This power is normally supplied off one phase of the main drive supply through a DRV mounted control transformer. For DRVs rated through 100 HP, this control transformer has multiple primary taps for supplies of 208/230/380/415 and 460 VAC. For models rated above 125 through 900 HP, the primary of the control transformer is limited to 230/460 VAC.

The flowchart in Figure 5.14 shows the troubleshooting procedure for correcting a missing or low control power supply. The control power is missing when the drive's LCD display and its LED's are all out.

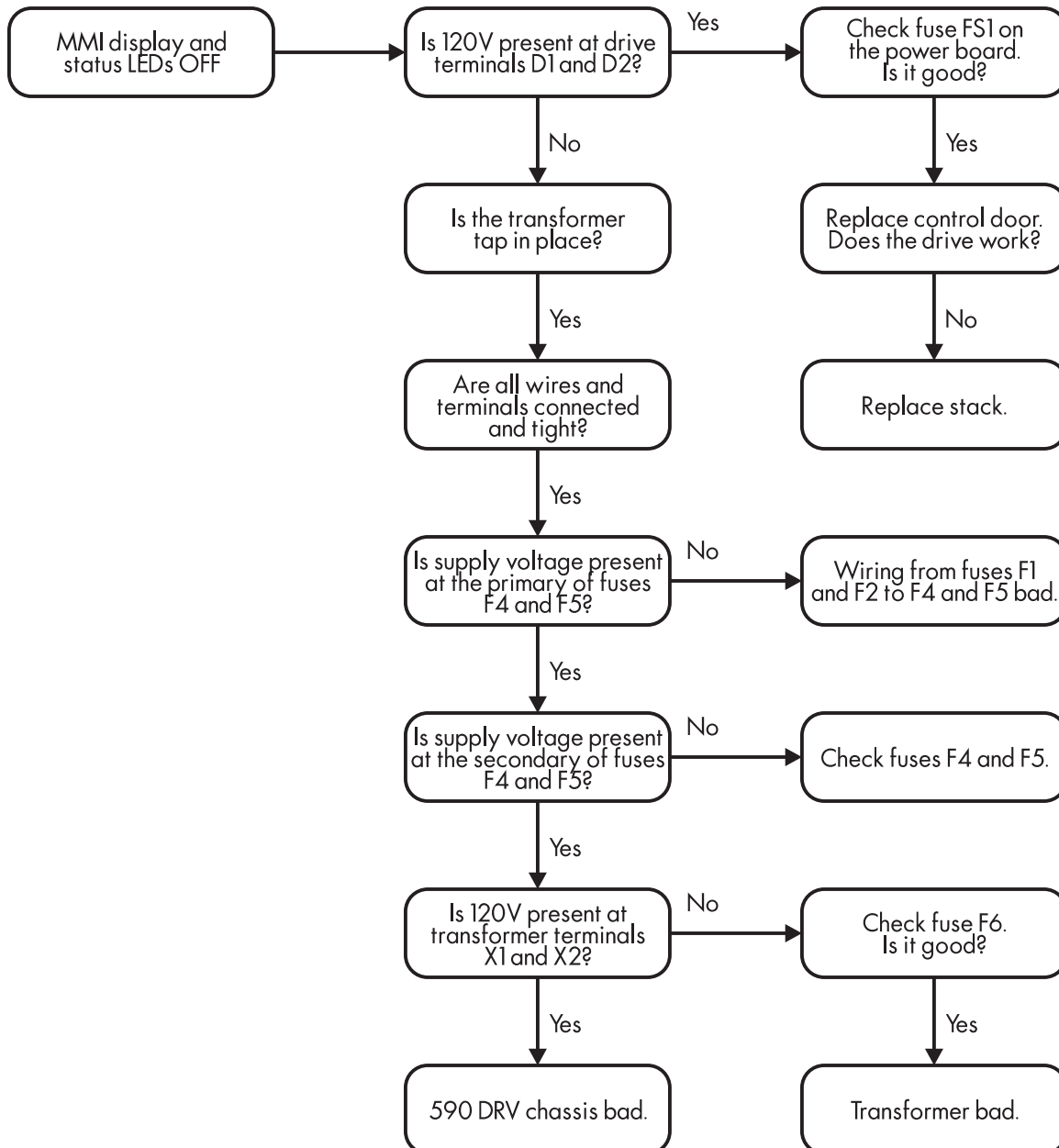


Figure 5.14 - Control Power Troubleshooting Flowchart

Field Fail Procedure

If the motor field supply fails while the drive is running a motor, the drive should trip on either an OVERSPEED alarm, or a FIELD FAILED alarm.

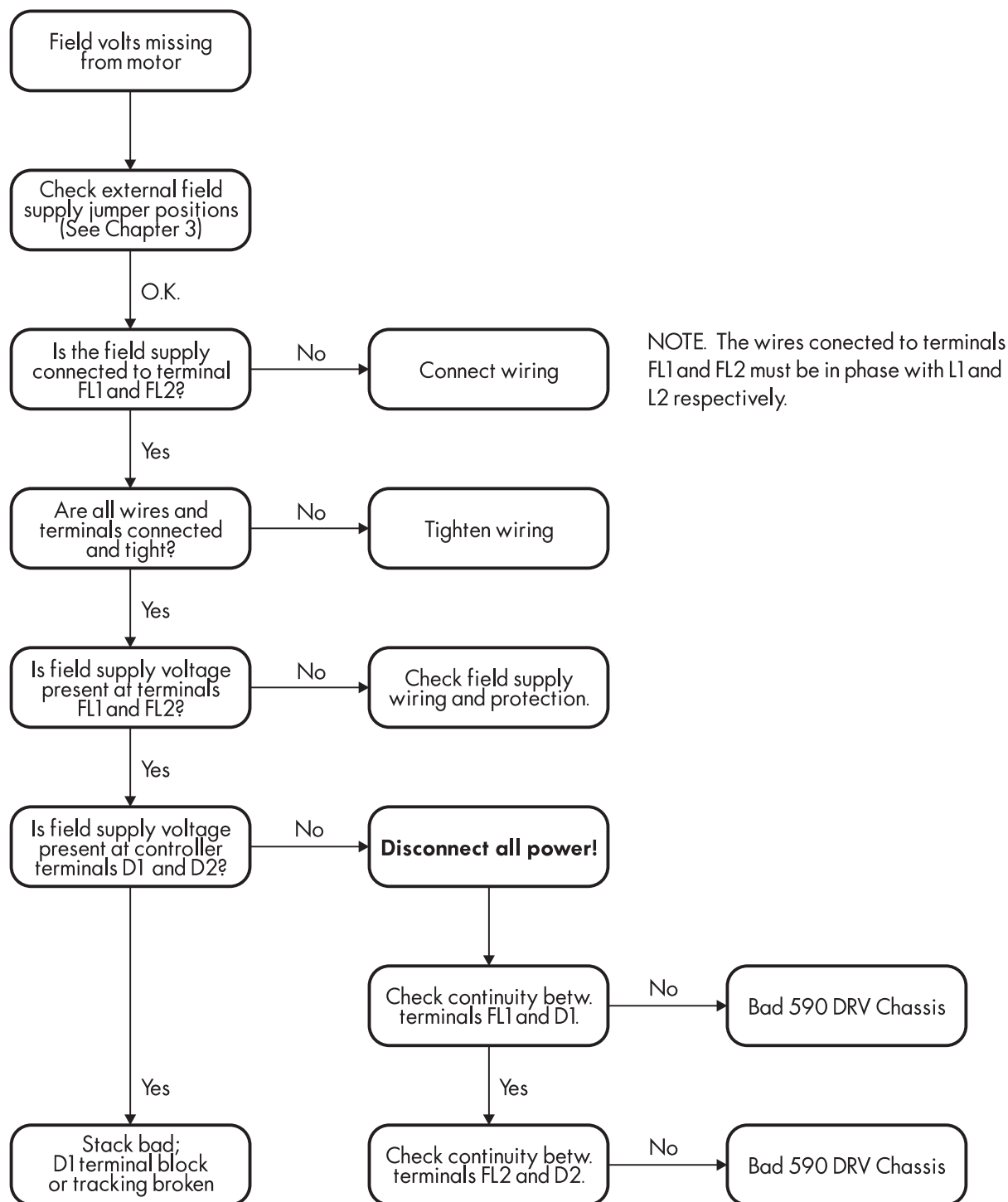


Figure 5.15 - Field Power Troubleshooting Flowchart

Contractor Failed Procedure

This flowchart is used for troubleshooting problems associated with the main contactor, AM, including wiring. Refer to the Schematic Diagrams in Appendix L when troubleshooting.

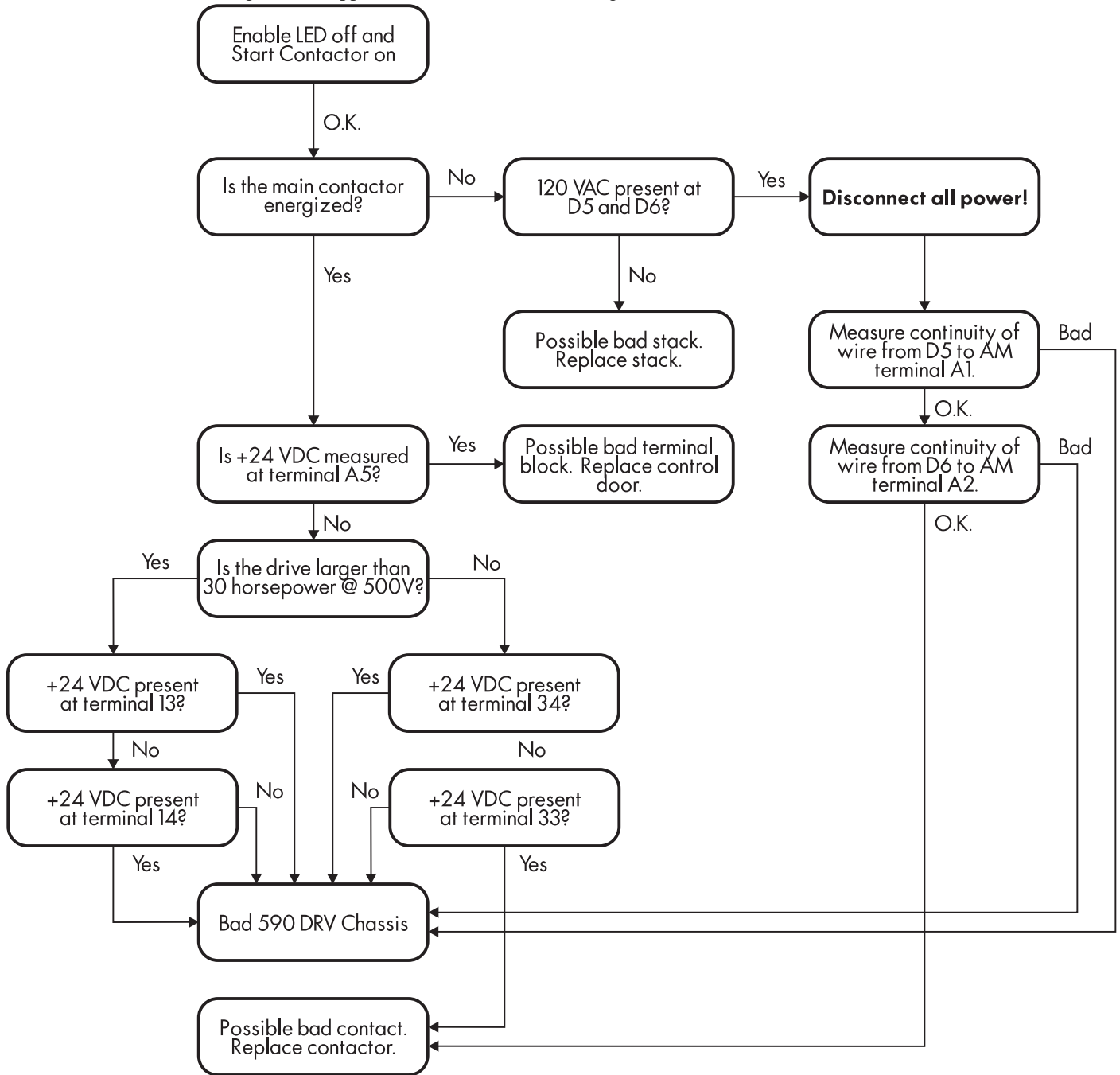


Figure 5.16 - Troubleshooting Flowchart for Faulty DC Contactor

SCR Troubleshooting

Non-regenerative drives contain three SCR packs, A, B, and C. Each SCR pack contains two thyristors. Three additional SCR packs (D, E, and F) mount above SCR packs A, B and C for regenerative drives. The layout of the SCR packs is shown in Figure 5.17 as they appear on the drive heatsink, from left to right.

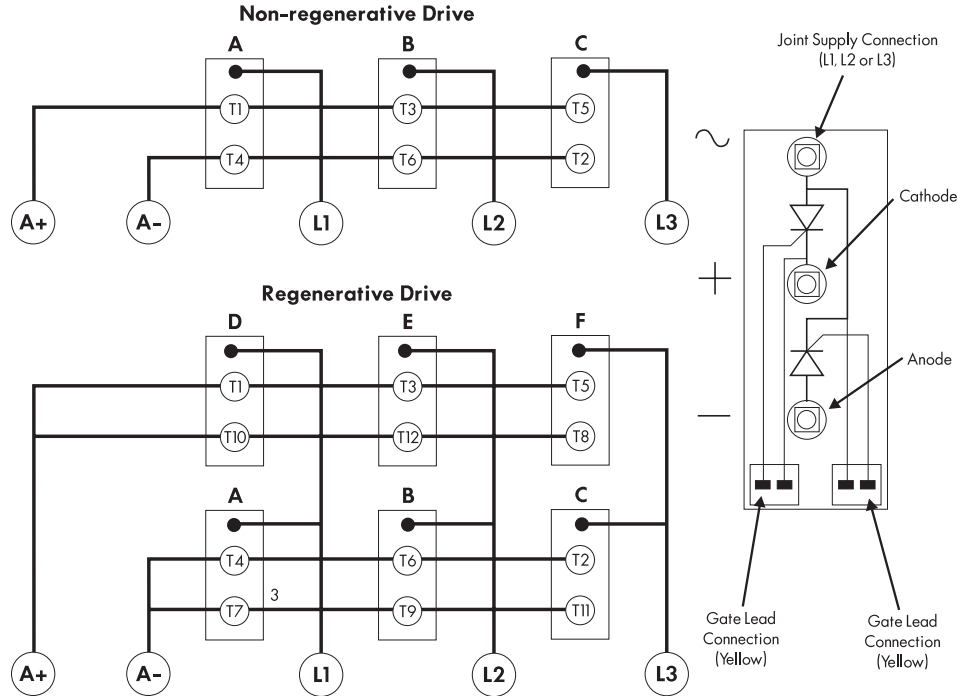


Figure 5.17 - SCR Layout

Use the tables in Figure 5.18 to determine which SCR pack is bad. The tables show the SCR being tested and the SCR pack that contains it. Measure the resistance between each armature and supply terminal. A good SCR will measure greater than one MW when read from the armature to the supply terminal. Reverse the leads and repeat these measurements between the supply and armature terminals. Bad (shorted) SCRs should measure zero to one kW.

Remove the power supply board (see Chapter 7) and measure the resistance between the gate and the cathode. It should measure between 18 and 40 Ω if good. A schematic of the SCR pack appears in the right of Figure 5.17. The outer most terminals connected to yellow leads at the bottom of each SCR pack are the thyristor gate terminations.

| Non-regenerative Drives | | | |
|-------------------------|--------|--------|--------|
| TERMINAL | L1 | L2 | L3 |
| A+ | T1 (A) | T3 (B) | T5 (C) |
| A- | T4 (A) | T6 (B) | T2 (C) |

| Regenerative Drives | | | |
|---------------------|------------|------------|------------|
| TERMINAL | L1 | L2 | L3 |
| A+ | T1/T10 (D) | T3/T12 (E) | T5/T8 (F) |
| A- | T4/T7 (A) | T6/T9 (B) | T2/T11 (C) |

Figure 5.18 - SCR Test Charts

Motor Checks

Several alarm messages are caused by problems with the motor. Most motor problems relate to insulation breakdown, overtemperature and armature brush and commutation problems. Check the motor armature and field with a megger to ensure that the motor winding insulation has not degraded and shorted one conductor to another or to ground. Continuity checks require an ohmmeter for determining whether motor windings or leads have opened or shorted. Continuity measurements should be less than one Ω . Insulation measurements should be greater than 10 $M\Omega$.

NOTE. Armature resistance for motors less than 10 HP (7.5 KW) can measure up to 3 Ω .

Caution

Disconnect the motor leads from the drive before using a megger to check for motor ground faults.

Also check the motor commutator for flashover. Clean the commutator and motor brushes if worn or dirty. If the motor is fitted with a blower, change or clean the blower filter regularly.

CONFIGURATION ERRORS AND GENERAL TROUBLESHOOTING

Many of the problems are associated with configuration errors. You can avoid them by carefully following the configuration guidelines in Appendix C and Appendix D.

Use the software block diagram (located on the inside cover) to track signals when troubleshooting software problems. Refer to the drawing at the end of Appendix D for a more detailed software block diagram. Trace the signal from its start and monitor it at each point along the path using the MMI display. That should uncover mis-tagged parameters, unwanted offsets, and mis-calibrated parameters.

The software package ConfigEd Lite displays drive configurations in graphical form on a personal computer (PC) monitor. You can track down configuration errors easily by referring to this graphical representation of your configuration. Use the ConfigEd Lite PRINT function to obtain a hard copy (refer to the ConfigEd Lite manual RG352747).

Caution

Because you can make configuration changes through the drive MMI, the configuration downloaded in your 590 DRV may not match the ConfigEd Lite file on your PC. Be certain to update your drive configuration data files with the ConfigEd Lite UPDATE command *before* printing out your configuration.

Common Performance Problems

Parameter Toggles Between Two Conditions

This problem occurs when two parameters write to a third parameter. The two parameters overwrite each other and fight for control of the problem parameter.

No SPEED DEMAND

If all the analog signals are connected to the proper terminals and have the correct sign, I DMD. ISOLATE may be set incorrectly. Monitor terminal C8; if it is OFF, at 0 VDC, terminal C8 may have been tagged for a nonstandard function. Monitor parameter SETUP PARAMETERS::CURRENT LOOP::I DMD. ISOLATE. It should be DISABLED for speed control. If I DMD. ISOLATE is ENABLED, only a signal at terminal A3, ANALOG I/P 2, will create a current demand needed to turn the motor.

SPEED SETPOINT has an Unwanted Offset

Terminal A8, TOTAL SPEED SETPOINT, is compiled from SETPOINTS 1 through 4. Monitor each setpoint individually in SETUP PARAMETERS::SPEED LOOP::SETPOINTS. If one is incorrect, i.e. has been left at an undesired value, simply "dial it" back to zero.

Signal Does Not Get Through the RAMP

When parameter RAMP HOLD is ON, the ramp output is held to its last input value. Set RAMP HOLD to OFF to allow the signal to change.

TEST POINTS

The drive has various test points located on the control board which can be used for signal monitoring with an oscilloscope. Test points locations are shown in Figure 5.19. The table in Figure 5.20 shows the signal test point assignments and their scaling ranges.

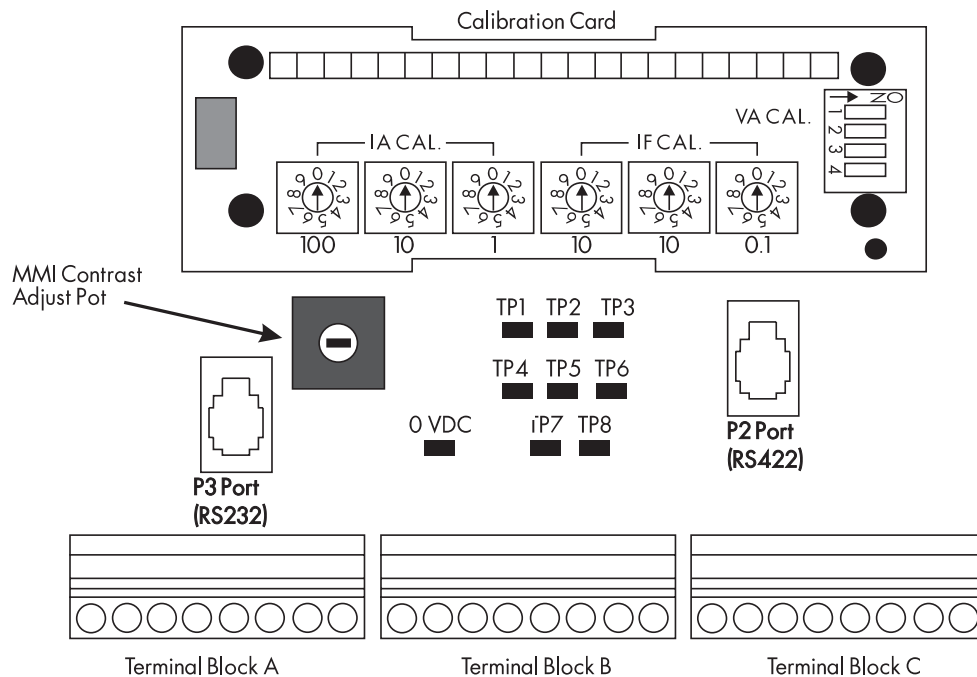


Figure 5.19 - Drive Status LEDs and Test Point Locations

| Test Point | Description | Range |
|------------|--|-------------------------------|
| TP1 | Armature current feedback | ± 2.2 volts $= \pm 200\%$ |
| TP2 | Buffered analog tachometer | ± 10 volts $= \pm 100\%$ |
| TP3 | Armature volts (% of calibration card setting) | ± 10 volts $= \pm 100\%$ |
| TP4 | Field current | 4 volts = 100% |
| TP5 | Not used | |
| TP6 | Overcurrent trip (transition on a trip) | 12 volts to -15 volts |
| TP7 | Internal diagnostic for Eurotherm Drives use | |
| TP8 | Not used | |
| 0 V | Signal common | 0 volts |

Figure 5.20 - Drive Test Point Descriptions and Scaling

CONTACTING CUSTOMER SERVICE

If you have reviewed your installation and start up procedures and followed the troubleshooting guide but still cannot solve a persistent problem, contact Eurotherm Drives Customer Service at (704) 588-3246. Make certain you have the following information available before calling:

| Information | Source |
|---|---|
| Catalog number, revision number, serial number | 590 DRV Serial Number Label (located on the left side of the drive heatsink base); |
| Horsepower, armature current and voltage, field current and voltage, full speed; | Motor Nameplate |
| Voltage per 1000 RPM (analog device), counts per revolution (digital device); | Speed Feedback Device Nameplate |
| Applications Information | System Drawings. |

Also, make certain to have information available on your particular application and the operating environment. When you are in contact with our service department, describe the problem in detail, the steps you have taken to rectify it and the results of your efforts.

Chapter 6 SERVICE AND MAINTENANCE

Because of its solid state design, the 590 DRV Digital drive has few items requiring service or maintenance. Service typically is a matter of replacing fuses, checking electrical contacts, and isolating problems in the overall system application.

Caution

Service procedures must be performed by qualified personnel with an understanding of the dangers inherent in high voltage applications and the precautions necessary when servicing industrial equipment. The customer is responsible for assessing the technical competency of in-house service personnel.

CONTACTING EUROTHERM DRIVES FOR SERVICE

Before calling Eurotherm Drives Customer Service, make sure you have the following information available:

Information

Catalog number, revision number, serial number

Motor horsepower, armature current and voltage, field current and voltage, base and top speed ratings

Speed voltage feedback per 1000 RPM (analog device), or counts per revolution (digital device)

Applications information

Source

590 DRV Digital drive serial number label (located on the left side of the drive heatsink base);

Motor nameplate

Speed feedback device nameplate

System drawings.

Warranty information

Detailed warranty information is contained in the Standard Conditions of Sale document IA058393C which is included with each order. Warranty information also precedes the *Contents* section of this manual.

Required tools and equipment

Tools needed for routine service operations include basic hand tools — screwdrivers, wrenches, etc. Each procedure has a list of the required tools.

SERVICE PROCEDURES

WARNING!

Only qualified service personnel should attempt to repair or replace parts in the 590 DRV.

WARNING!

Isolate the entire 590 DRV drive from electrical power before attempting to work on its components.

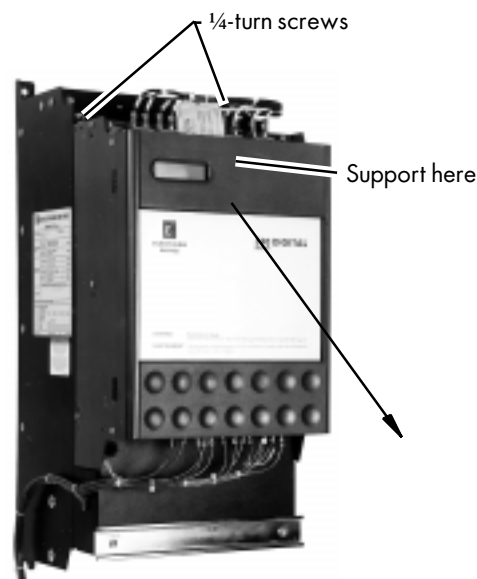


Figure 6.1 - Opening the 590 DRV

To access the internal parts of the power section, loosen the two ¼-turn screws holding the controller top to the drive at the top of the controller case.

WARNING!

Loosening the ¼-turn screws while the 590 DRV is mounted vertically will allow the controller section to pivot downward. Support the controller section while loosening the screws and lower it gently to its fully open position.

If you are working on the 590 DRV on a workbench, insert a spare M8 or 5/16-18 bolt through each of the hinge slots at the bottom of the drive to prevent the controller from dropping onto the power section while you are working inside.

Once finished inside, remove the extra bolts being used as stops (if applicable) and return the controller section to its position covering the base. Secure the controller section by tightening the ¼-turn screws.

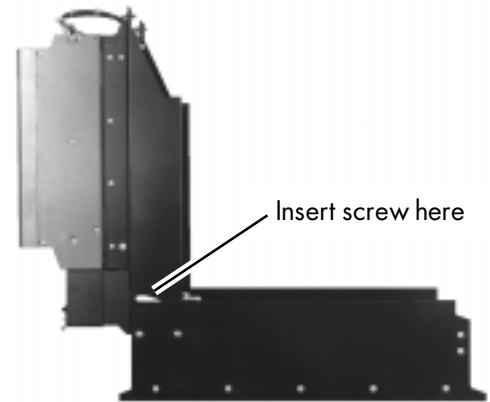


Figure 6.2 - Securing the 590 DRV Open

PREVENTIVE MAINTENANCE

Users should perform regular preventive maintenance every six months to ensure long life and continued usefulness of the 590 DRV. Keep the drive and its components clean, check auxiliary fans if fitted, and make sure connections and mounting bolts have not loosened from vibration.

Required tools

This procedure requires a torque wrench and a torque screwdriver.

Procedure

The red, white, and blue control wires can be checked by gently attempting pulling the wires out of the terminals. The terminals should hold the wires firmly in place. The 14 gauge black wires connected to the top green terminal D1 through D4 and connected to the bottom terminals (F+, F-, FL1, and FL2) can also be checked by hand.

All the remaining wires should be checked with a torque wrench. The torque specification label on the drive lists the tightening torque specifications.

1. Remove the lower cover.
2. Inspect all visible wiring and terminals for evidence of burning and/or abrasion.
3. Verify the tightness of:
 - a. Power and ground wires connected to the controller. (TORQUE)
 - b. All connections to the DC contactor. (TORQUE)
 - c. Connections on both sides of the control terminals.
 - d. Control and field wires at the top green terminals, D1 through D8.
4. Open the chassis by loosening the two ¼-turn screws.



Figure 6.3 - 590 DRV with Lower Cover Removed

5. Inspect all wiring and terminals for evidence of burning and abrasion.
6. Verify the tightness of:
 - a. Line and load fuse connections to fuses F1, F2, F3, F4, F5, and F7 (*if fitted*). (TORQUE)
 - b. The three ground stud connections. (TORQUE)
 - c. Control transformer connections.
7. Remove any loose debris.
8. Close the drive and lock in place with the ¼-turn screws.
9. Re-attach the lower cover.

REMOVING LOWER COVER

Required Tools

This procedure requires a #2 Phillips screwdriver.

Procedure

Removing the Lower Cover

1. Remove the two (2) 8-32 x 3/8 Phillips head screws (A) holding the lower cover in place.
2. Slide the cover down to disengage the lances and then remove it from the chassis.

Caution

The "drive enable" harness is routed through the slot on the left side of the lower cover. Take care not to snag the harness when removing the cover.

NOTE. The lower cover is held in place by two lances (B). When replacing the cover, slide the cover up into the lances and then tighten the screws.

Replacing the Lower Cover

3. Route the "drive enable" harness through the slot.

Caution

Do not crimp or mash the enable harness between the lower cover and the frame when replacing the lower cover.

4. Place the cover on the frame and slide it up until it engages the lances.
5. Install the two screws to hold the bottom of the cover in place.

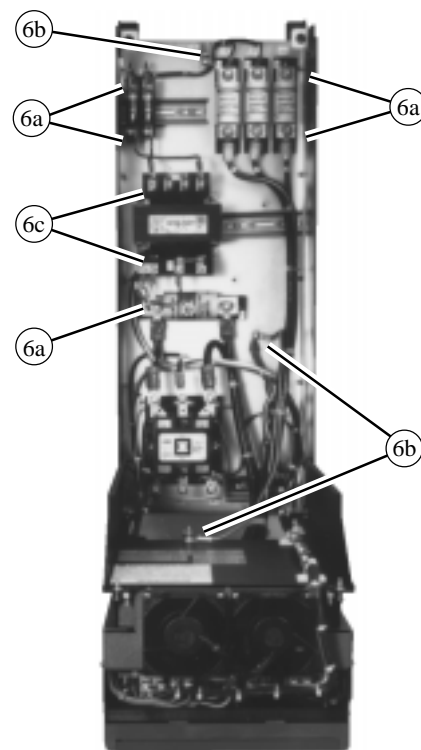


Figure 6.4 - Inside Power Section

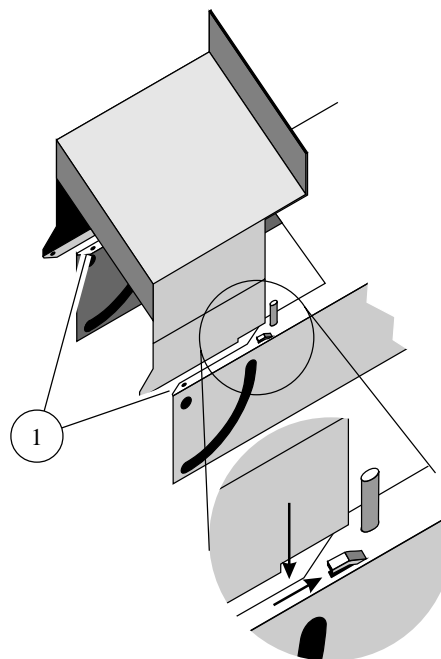


Figure 6.5 - Lower Cover Detail

CHANGING THE CONTROLLER DOOR

Required Tools

This procedure requires a 3/16 inch flat blade screwdriver.

Procedure

1. Disconnect the control wire terminals, terminal blocks A, B, and C, from the control door.
2. Loosen the two captive screws holding the door closed. They are located under the top and bottom flaps.
3. Open the door.
4. Disconnect the two ribbon connectors at the left side of the power supply board. To release the connectors, push the locking tabs away from the ribbon cable.
5. Push the screwdriver into the slot of the top hinge. Use inward pressure to release the hinge from the locking lance. Pull the door out of the slot slightly to keep it out of the lance.
6. Repeat step 4 for the bottom hinge.
7. Now that both hinges are released, pull the door gently away from the chassis. The door must be pulled evenly out of the slots or it will bind in place.
8. Repeat this procedure in the reverse order to install the control door.

NOTE. Remember to switch the calibration cards to save the original door's calibration settings.

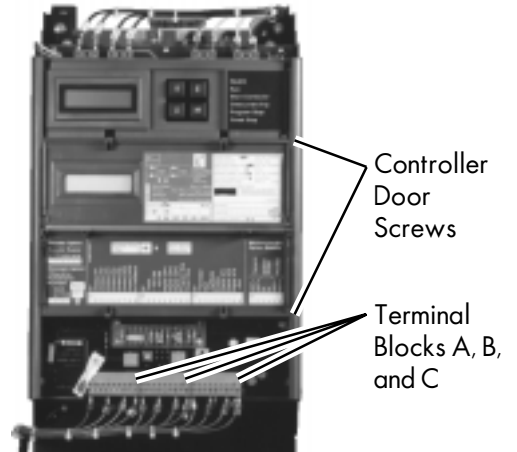


Figure 6.6 - Controller Door Screws

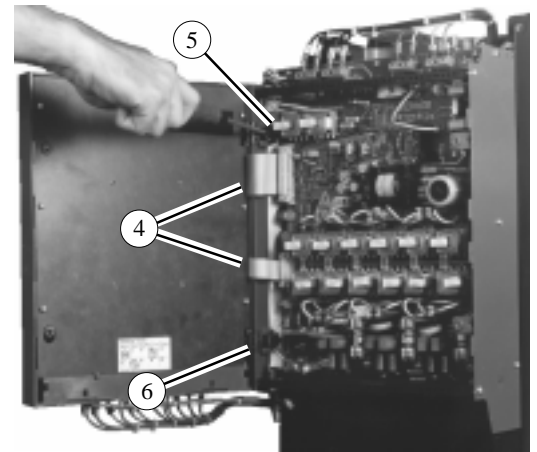


Figure 6.7 - Removing the Control Door

REPLACING THE CONTROLLER

Required Tools

This procedure requires a #2 Phillips head screwdriver, 7/16 deep socket, 10mm and 13mm sockets, and a small flat blade screwdriver.

Procedure

1. Disconnect the control wire terminals, terminals A, B, and C, from the controller door and remove the lower cover.
2. Disconnect the three 3-phase wires (A), two armature wires, and the ground wire (B). The ground wire is held in place with a M6 hex head screw. The other wires are secured with M8 hex head screws.

NOTE. Older controllers and replacement drives are supplied with slotted head screws. Save the hex head screws for use with the 590 DRV and return the slotted head screws.

3. Disconnect the eight wires connected at the top of the controller in green terminals D1 through D8 (C).
4. Remove the four 1/4-20 nuts (D) holding the controller to the chassis.
5. Reverse the order of these steps when installing a replacement controller.

NOTE. Remember to switch the calibration cards to save the original door's calibration settings.

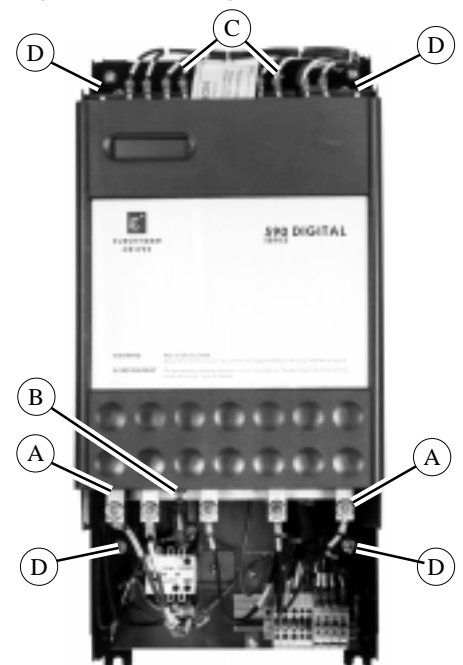


Figure 6.8 - Controller Mounting Screws

REMOVING THE POWER SUPPLY BOARD

This procedure shows how to remove and reattach the power supply board.

Required Tools

Removing the power supply board requires a #2 Phillips head screwdriver, a flat blade screwdriver, and a pair of needle nose pliers.

Procedure

1. Use electrostatic discharge safety procedures to eliminate static charges from the technician, tools, and work area.
2. Remove the controller door (see the controller door procedures).
3. Remove the two support bars (A) held in place by the phillips head screws. Flat head screws are located on the left side (B). Do not remove the screws retaining the power supply board. The top support bar is removed in Figure 6.9.
4. Disconnect the following wires:
 - a. Field, contactor, and controller supply wires (C) in terminal blocks D1 through D8 at the top of the drive.
 - b. Armature sense wires (D) from the 0.10 male tabs.

Caution

Be careful not to loosen the terminal blocks from the PC board.

- c. The YELLOW and BROWN wires (E) (*field supply*) attached to stake F16 and the RED and VIOLET wires (F) (*field supply*) attached to stake F8 at the upper left part of the board.
 - d. The GREY wire (G) (*negative field supply*) attached to stake F6 (near terminal D3). The ORANGE wire (H) (*positive field supply*) attached to stake F7 (near terminal D4) at the upper left part of the board.
 - e. The RED, ORANGE, and YELLOW wires (I) (*field gate wires*) connected to stakes G, K, and G at the upper left part of the board.
 - f. The YELLOW/GREEN wire (J) (*RFI ground*) at the upper right part of the board.
 - g. The BROWN, BLUE, and YELLOW/GREEN wires (K) (*fan supply*) connected to stakes F27, F24, and F23 respectively (*if fitted*).
 - h. Connectors PLL, PLK, and PLM (L) on the left side of the board (*if necessary*).
 - i. The VIOLET wire (M) (*field supply*) adjacent to fuse FS2 and the BROWN wire (N) (*field supply*) adjacent to fuse FS3 at the lower part of the board.
5. Remove the SCR gate lead pairs using the needle nose pliers. Grasp the center of the PINK gate lead guide (O) with the pliers and gently pull away from the board. The gate lead guides hold both gate leads in place.

WARNING!

Do not pull the gate lead pairs out by the wires. This can damage the guide and make the gate leads unusable.

NOTE. When replacing a gate lead guide, the RED wire must face to the center of the hole. For example, after two gate lead guides are in place, the red wires must be next to each other.

6. Remove the screws at the top (3) (P), center (3) (Q), and bottom (5) (R) of the board.

Caution

Be careful to capture the lock washers on the five (5) bottom screws.

7. Now the board is free to be removed. Slide the board as far to the right as it will go. Tilt the left side of the board up and then lift the board out of the chassis. Make sure none of the loose wires catch on the board or components as you lift the board out of the chassis.

Caution

This board has several sensitive and surface mount components which can be damaged if mishandled.

8. To reinstall the power supply board (or a replacement), reverse the order of the steps. Be sure to pull the wires (identified in Figure 6.9 as J, L, M, and N) through the board before fastening it in place.

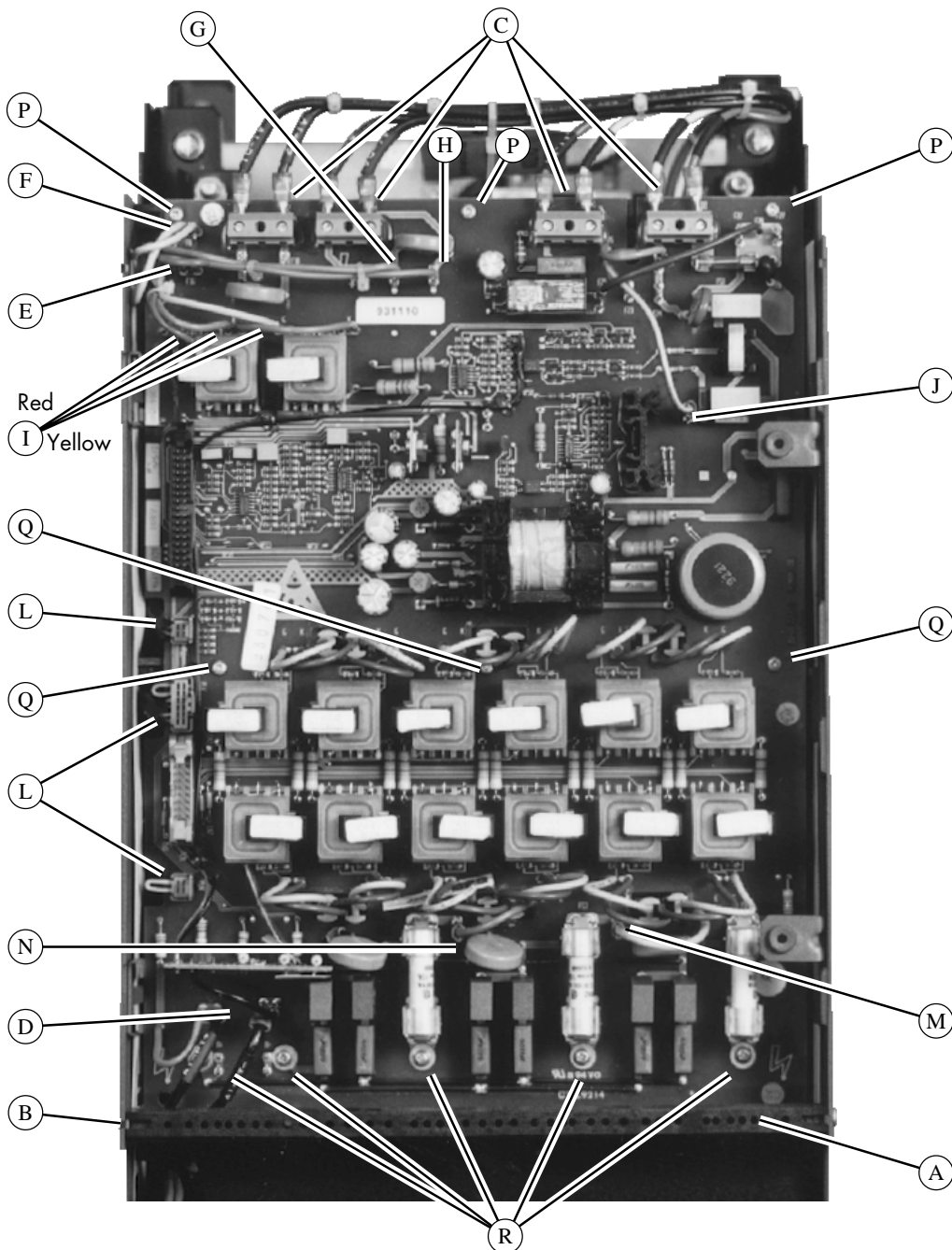


Figure 6.9 - Inside View of 590 Controller

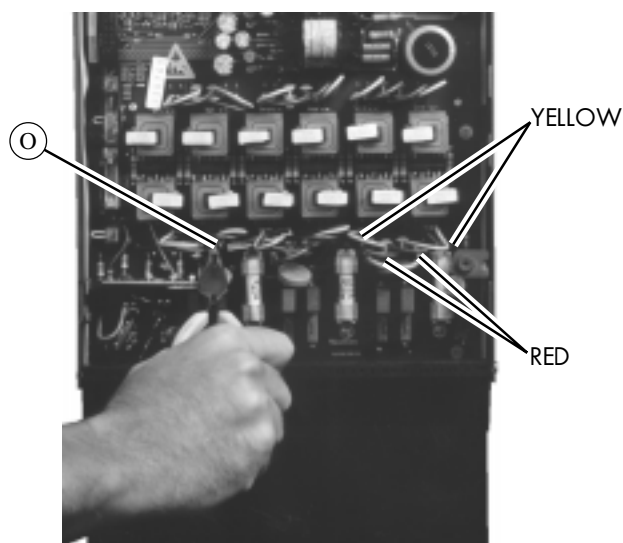


Figure 6.10 - Gate Lead Guides

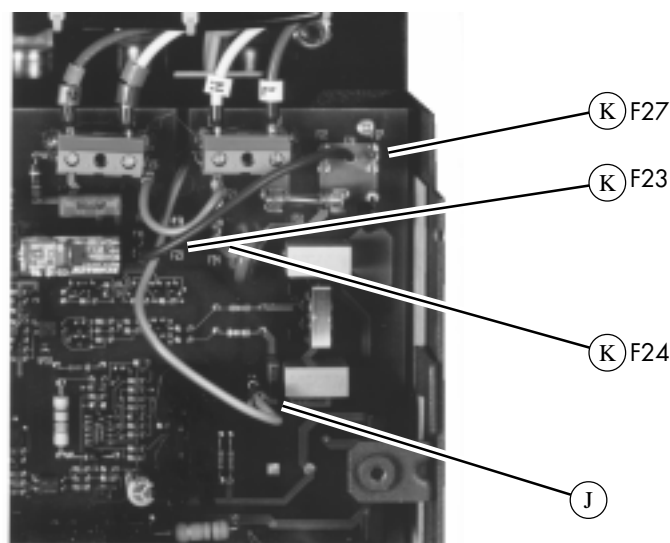


Figure 6.11 - Fan and Ground Connections

REPLACING SCRS

NOTE. Before attempting to replace an SCR, perform the SCR troubleshooting procedure in Chapter 7 to identify the defective SCR.

For illustrative purposes, SCR letter F is assumed to be defective in the following procedure.

Required Tools

Replacing SCRs requires a #2 Phillips head screwdriver, a 3/8 inch flat blade screwdriver, and a 4mm Allen wrench.

Procedure

1. Remove the center PC board support (A) to expose the top bank of SCRs. It is held in place by two Phillips head screws (B). This step is only required when replacing SCRs D, E, or F.

Caution

When installing the PC board support, the two pieces of insulating paper must also be put into position. They are held in place by the PC board support.

2. Disconnect the slotted head screw holding the customer armature buss bar (C) to the SCR buss bar (D). Capture the lock washer. Non-regenerative drives connect both customer buss bars to the SCR buss bar. Both buss bars must be disconnected.
3. Remove the armature buss bar(s) across the top of the SCR bank with the defective SCR (D). Save the six (6) M5 x 10 Phillips head screws (E).

NOTE. Regenerative drives have one armature buss bar across the top of an SCR bank. Non-regenerative drives have both armature bus bars attached to the top of the SCR bank.

4. Remove the appropriate buss bar (F) connecting the SCR to the 3-phase buss bar. It is held in place by one (1) M5 x 10 Phillips head screw (G) and one (1) M6 x 10 slotted head screw (H). Capture the M6 lock washer.
5. Remove two (2) M5 x 18 socket head screws (I) holding the defective SCR in place. This requires a 4 mm Allen wrench.

6. Repeat this procedure in the reverse order when replacing SCRs. The tightening torques for installing SCRs and reassembling the buss bars are:

| | | |
|-------------------------|-----------------------|--------------------------------|
| SCR mounting screws | M5 x 18 socket head | 3.3 - 4.4 lb-ft (4.5 - 6.0 Nm) |
| SCR buss bar screws | M5 x 10 Phillips head | 1.8 - 2.6 lb-ft (2.4 - 3.5 Nm) |
| 3-phase buss bar screws | M6 x 10 slotted head | 1.8 - 2.6 lb-ft (2.4 - 3.5 Nm) |

Caution

All connections must be made using the correct tightening torque. Overtightening could strip the threads in the heatsink or the SCR making them unusable.

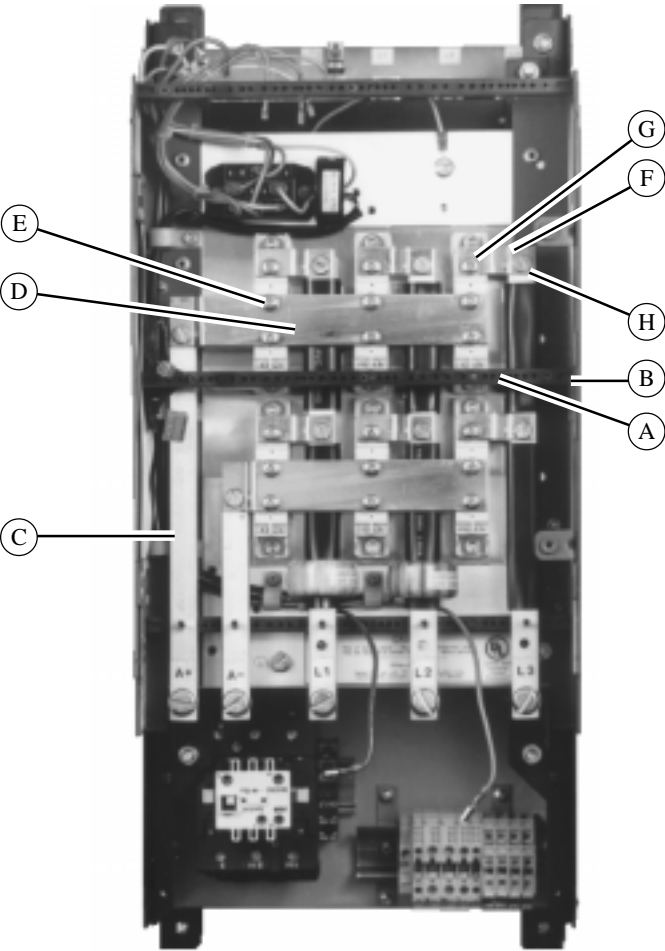


Figure 6.12 - Power Supply Board Removed

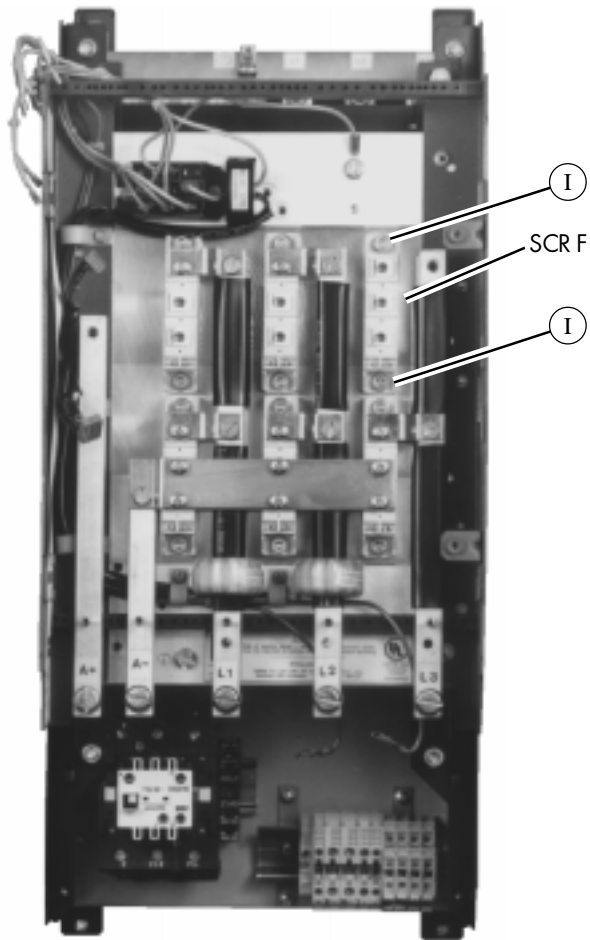


Figure 6.13 - SCR Bussing Removed for SCR F