RELIANCE ELECTRIC

Installing and Operating the Three-Phase Input Three-Phase Output GV3000 AC V*S Drive

1/4 to 10 HP at 460 VAC

For proper GV3000 operation, a pulse tachometer must be properly installed. See Table 3.6 for terminal wiring connections.

Instruction Manual D2-3287-2

Rockwell Automation

The information in the user's manual is subject to change without notice.

Read this manual in its entirety before installing and powering the controller. Observe all **DANGER**, **WARNING**, and **CAUTION** advisories; theses advisories point out potentially hazardous procedures and conditions. All three types of advisories are enclosed in a box to call attention to them.

- A **DANGER** alerts a person that severe bodily injury or loss of life could occur if procedures are not followed.
- A **WARNING** alerts a person to potential bodily injury if procedures are not followed.
- A **CAUTION** alerts a person that if procedures are not followed, damage to, or destruction of the equipment could result.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

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1.0 RECEIVING THE EQUIPMENT

DANGER

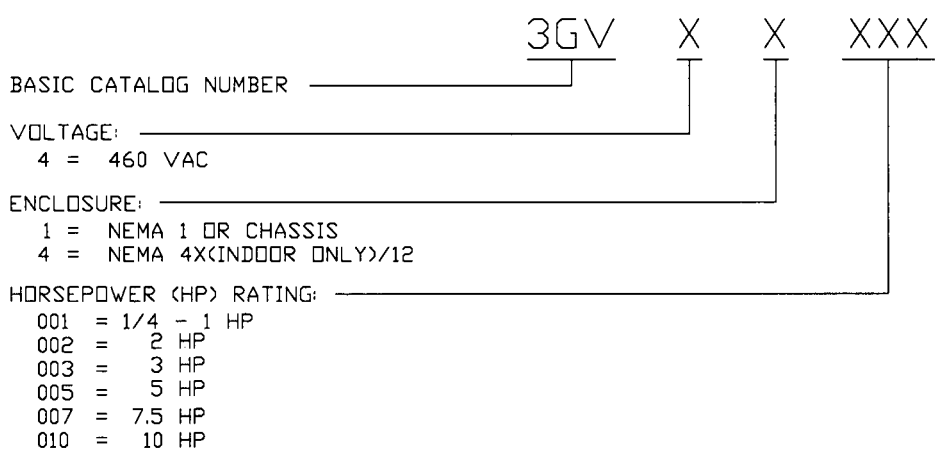
ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

The products described in this instruction manual are manufactured by Reliance® Electric Industrial Company.

1.1 Identify the Controller by Model Number

Each Reliance Electric GV3000 AC V*S® Controller can be positively identified by its model number (standard controller) or sales order number (customer specified controller). This number appears on the shipping label and is stamped on the controller nameplate. Refer to this number whenever discussing the equipment with Reliance Electric personnel.

The standard model number matrix describes the controller as follows:



1.2 Receive And Accept The Shipment

Reliance Electric's terms of sale, in all instances, are F.O.B. point of origin. The user is responsible for thoroughly inspecting the equipment before accepting shipment from the transportation company.

If all the items called for on the bill of lading or on the express receipt are not included or if any items are obviously damaged, do not accept the shipment until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight or express agent within 15 days of receipt and request that he make an inspection of the shipment. Keep the entire shipment intact it its original shipping container.

The user is responsible for making claim against the Carrier for any shortage or damage occurring in transit. Claims for loss or damage in shipment must not be deducted from the Reliance Electric invoice, nor should payment of the invoice be withheld while awaiting adjustment of such claims since the Carrier guarantees safe delivery.

1.3 File a Return Request

1. To return equipment, send a written request to Reliance Electric within ten days of receipt.
2. Do not return equipment without a numbered Equipment Return Authorization (ERA) from Reliance Electric.
3. Reliance Electric reserves the right to inspect the equipment on site.

1.4 Store the Controller until Installation

After receipt inspections, repack the controller in its original shipping container until installation. If a period of storage is expected, store in the original shipping container with its internal packing. To ensure satisfactory operation at startup and to maintain warranty coverage, store the equipment:

- in its original shipping container in a clean, dry, safe place.
- within an ambient temperature range of −10°C to 65°C
- within a relative humidity range of 5 to 95% without condensation.
- away from a highly corrosive atmosphere. In harsh environments, cover the shipping/storage container.

1.5 GV3000 General Description

The GV3000 controller is a high performance, variable speed, AC controller. It provides closed loop flux-vector operation with speed feedback provided by a pulse tachometer. The GV3000 provides high performance regulation of motor speed, torque and direction. The torque reference selected can be either speed control (speed loop output or terminal block analog input), or torque control. The GV3000 performs a torque control self-tuning procedure in vector mode with a proper parameter selection. (Refer to *Section 5, Starting Self Tuning*, or *Section 6, Parameter U.008.*)

The GV3000 is available in NEMA 1 or NEMA 4X(Indoor Only)/12 (watertight/dust-tight) enclosures in horsepower ranges of 1/4 -1,2,3,5,7.5,and 10 HP at nominal AC input voltage of 460 VAC.

The drive is controlled from one of three possible sources - from the front panel/keypad, remote devices wired to the GV3000's control terminal block, or with the use of a personal computer (PC). All GV3000 control parameter settings are accomplished by either entry through the keypad while in the PROGRAM mode or when using a PC. Using a PC to control and configure the GV3000 requires a specified minimum level of PC hardware and software. It also requires the use of Reliance configuration software and a communications cable (See Controller Options).

Meter-like displays of drive RPM, Volts, Amps, Hertz, kiloWatt, Torque, and Speed Reference are available by selecting the desired DISPLAY mode. Keypad operation is defined in Section 4.

(For controller operation theory, refer to Section 7, "Controller Operation".)

1.6 Standard Features

- NEMA 1 or NEMA 4X(Indoor Only)/12 enclosure
- Programmable closed-loop flux vector operation
- Keypad and display:
  - start/stop
  - speed adjustment
  - forward/reverse
  - run/jog reference
  - parameter adjustments
  - automatic speed adjustment (AUTO mode) or manual speed reference (MANUAL mode)
  - Monitor and display of; (RPM, Volts, Amps, Hertz, kiloWatts, torque, or speed)
  - diagnostic fault monitoring

- Non-volatile elapsed time meter function (Parameter setting)
- Ability to follow a 0-20mA, or +/−10VDC analog input signal for AUTO mode speed control. Accuracy of input is +/−10 bit resolution. Parameter adjustments for software gain and offset of the input.
- Carrier frequency selection for reduced motor acoustic noise.
- Reduced susceptibility to nuisance trips
- C of U.L., IEC classified.
- 15 Hz speed loop response bandwidth
- 8 isolated digital inputs (three inputs are configurable)
- Pulse tachometer feedback
- Self tuning to determine pulse tach PPR and no load current of torque control loop.

1.7 GV3000 Programmable Features

There are many programmable features offered by the GV3000 that are accessible by enabling or "turning on" certain parameters, or a by enabling a combination of parameters.

Some of them are:

- IGBT Switching
  2,4 or 8 kHz (carrier frequency selection)
- Speed Reference Input
  0 to +/−10VDC, 0 to 20mA, or 4 to 20 mA
- Isolated Digital Inputs for
  start/stop, reset, run/jog, function loss, forward/reverse,
  multispeed, MOP increment/decrement, and second ramp change.
- Pulse Tachometer Feedback
- Fault Indication and FaultLlog
- C of U.L./IEC listed
  electronic motor overload (meets NEC/CEC requirements)
- Programming Lockout
- Terminal Block Input Configuration
- Analog Reference Input Gain and Offset
- Inverse Analog Reference
- Reverse Disable
- S-Curve Functionality
- RPM Display Scaling
- Elapsed Time Meter
- Vector Torque Control Self-Tuning

1.8 GV3000 Parameters

Parameters are arranged and numbered according to their specific task in the GV3000 controller's software configuration. Two (2) parameter subject list configurations and a fault error log are accessible by the user:

- **First Menu List:**
  General controller parameters (P.---):
  P.000 - P.006 (1st menu short list)
- Error log entries (Err):
  9.xxx - 0.xxx, Clr (Error log can hold 10 entries)
- **Second Menu List (Password Enabled):**
  General controller parameters (P.---):
- P.000 - P.052 (P.000 - P.006 from the 1st menu and P.007 - P.052 after password enabling)
- Error log entries (Err):
  9.xxx - 0.xxx, Clr (Error log can hold 10 entries)
- Vector parameters (U.---):
  U.000 - U.013 (Vector parameters only)
- Factory Settings (F.---) : (**Not** adjustable by the user.)

1.9 Controller Options

The following kit options are available for use with GV3000 Controllers. See Table 2.1.

Table 2.1 - GV3000 Kits.

Kit Description	Controller Nominal HP	Model Number	Factory or Field Installed?	Instruction Manual
Snubber Resistor	1HP	2SR40535(1)	Both	D2-3291
	2HP	2SR40535(1) 2SR40800(2)		
	3HP	2SR40535(1) 2SR40800(2) 2SR41600(2)		
	5HP	2SR40800(2) 2SR41600(2) 2SR42400(3)		
	7.5HP	2SR41600(2) 2SR42400(3)		
	10HP	2SR41600(2) 2SR42400(3)		
Line Regeneration Unit	1-5HP	1RG22008 (8 Amp)	Both	N/A
	7.5-10HP	M3345-41BM00 (15 Amp)		
Motor Encoder Cable	All	2TC4025(4) 2TC4075(4) 2TC4100(5) 2TC4300(5)	Field	D2-3305

(1) Cabinet Style A. Refer to Instruction Manual D2-3291.

(2) Cabinet Style B. Refer to Instruction Manual D2-3291.

(3) Cabinet Style C. Refer to Instruction Manual D2-3291.

(4) For use with Reliance NEMA Vector Inverter Duty Motors. (Tachometer connector and exposed wire pairs). Refer to Instruction Manual D2-3305.

(5) For use with Reliance NEMA Vector Inverter Duty Motors. (Exposed wire pairs on both ends). Refer to Instruction Manual D2-3305.

1.9.1 Additional controller options

The following cables and software are also available for personal computer communications with the controller.

Controller Option	Part Number	Description
Software Configuration Executive 3000	2CE3000	• Create, store, upload, and download drive configurations • Monitor and change drive parameters on line • Compare configuration file on the computer to the configuration of the controller • Read and reset faults
Interface Cable 25-pin to 9-pin	61C127	• Used to connect the personal computer to the controller
Interface Cable 9-pin to 9-pin	2CA3000	• Used to connect the personal computer to the controller
Interface Cable 25-pin to 9-pin	2CA3001	• Short 25-pin to 9-pin adapter cable

1.10 Dangers, Warnings and Cautions:

Dangers, Warnings, and Cautions point out potential trouble areas. All three of these precautions are enclosed in a box to call attention to them.

DANGER

A *DANGER* ALERTS A PERSON OF A CONDITION WHICH COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

A *WARNING* ALERTS A PERSON OF A CONDITION WHICH COULD RESULT IN POTENTIAL BODILY INJURY IF PROCEDURES ARE NOT FOLLOWED.

CAUTION: A ***caution*** alerts a person of a condition which could result in damage to, or destruction of the equipment.

2.0 CONTROLLER SPECIFICATIONS

2.1 Controller Ratings

The GV3000 is intended to operate from a three-phase AC power source at the rated voltage listed on the controller nameplate. It can operate on a 50 or 60Hz line frequency. The controller provides three-phase variable voltage and variable frequency to the motor. NEMA 1 and 4X(Indoor Only)/12 controller current ratings, power loss and operating specifications are listed in Table 2.1.

Table 2.1 - GV3000 Controller Application Data

Controller Three Phase Input Power Ratings						
Model NEMA 1 NEMA 4X/12	**3GV41001 3GV44001**	**3GV41002 3GV44002**	**3GV41003 3GV44003**	**3GV41005 3GV44005**	**3GV41007 3GV44007**	**3GV44010 3GV44010**
Horsepower HP	1 HP	2 HP	3HP	5HP	7.5 HP	10 HP
Input Voltage	460 VAC ± 10%					
Input KVA	2.0	3.3	5.1	7.9	10.7	13.4
Input Amps [maximum]	2.5	4.2	6.4	9.9	13.4	16.8
Output Amps [maximum]	2.1	3.4	5.3	8.2	11.1	13.9
Power loss Watts [Full Load]	60	100	140	180	210	250

Controller Operating Specifications	
AC Line Distribution System Capacity (maximum): For 460 VAC Units -	1000 KVA , three-phase with 25,000 amps symmetrical fault current capacity with a line impedence of less than 8%.
Acceleration Adjustment Range:	0.1 to 999.9 seconds (within the capability of current)
Atmosphere:	5 to 95% non-condensing humidity
Analog Speed Reference Accuracy	0.5%
Carrier Frequency:	2kHz, 4kHz, or 8kHz, software selectable
Current Limit Adjustment:	U.006 to 150% (based on controller nameplate rating)
Control Method:	All Digital Flux Vector , Sinusoidal Pulse Width Modulated (PWM)
Displacement Power Factor:	0.96
Elevation:	To 3000 feet (1000 Meters) above sea level without derating. For every 300 feet (91.4 meters) from 3300 to 10,000 Feet (1001 to 3033 meters), derate the current by 1%. Consult your Reliance Electric sales Office for operation above 10,000 feet (3033 meters).
Line Frequency:	50 +/−5Hz or 60 +/- 5Hz
Line Voltage Variation:	−10% to + 10%
Line Dip Ride Through:	Fixed at 500 milliseconds
Maximum Pulse Tach Input Frequency:	125kHz
Motor Poles	2, 4, 6, or 8 Poles

Table 2.1 - GV3000 Controller Application Data (continued)

Overcurrent IET:	200% load (based on controller nameplate rating)
Overload Current Rating:	150% for one minute (based on controller nameplate rating)
Service Factor:	1.0
Speed Control Range:	1:600 with 1024 PPR
Speed Control Response:	15Hz
Speed Feedback:	15V differential quadrature, pulse tachometer incremental (512 PPR, 1024 PPR, 2048 PPR, 4096 PPR)

WARNING

THIS CONTROLLER IS CAPABLE OF OPERATING AT AND MAINTAINING ZERO SPEED. THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONAL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES TO INDICATE THAT THE CONTROLLER IS OPERATING OR MAY OPERATE AT OR NEAR ZERO SPEED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Speed Adjustable Range:	From 0 RPM to Maximum Speed
Speed Regulation:	0.1% for a 20 milliseconds period
Speed Setpoint Resolution:	+/−1 RPM, with local keypad +/−4095 of rated RPM with PC
Temperature : **Ambient -** **Storage -**	 0° C to 40° C (32° F to 104° F) for enclosed controllers 0° C to 40° C (32° F to 104° F) for open chassis controllers −40° C to 65° C (−40° F to 149° F)
Torque Control Response:	180−220 Hz
Torque Linearity:	+/− 3% with optimal parameter setting (See Parameter U.005 in Section 6)
Zero Speed Control with:	0 - +/− 150% torque generation capability

2.2 Controller Input/Output Specifications

The controller input/output specifications are subject to some of the parameter settings which can be adjusted for user specified applications. The controller contains an internal isolated 24 VDC power supply to provide the required voltage for control signals. Enabling or disabling a control signal requires applying 24 VDC into an 8mA input load. All of control signals (except Function Loss and Digital Input RAMP1/2) are *only* active when the control source is the terminal block (REMOTE mode). Function Loss and digital input for RAMP1/2 are *always* active in LOCAL or REMOTE modes (Refer to *Section 6, Adjusting Parameters* for information on all controller parameters. Refer to *Section 3, Installation and Wiring* for all controller installation information.*)*

The controller requires pulse tachometer feedback from the motor shaft for proper operation. The controller's pulse tachometer inputs require either a 512, 1024 , 2048, or 4096 PPR (pulse per revolution) quadrature tachometer with differential channel A and B outputs.

Drive Configuration and monitoring can also performed with a personal computer using Configuration Executive 3000 software. (Refer to manual D2-3303, Configuration Executive 3000 for more information.)

Controller input and output specifications are listed in Table 2.2.

Table 2.2 - GV3000 Controller Input and Output Specifications

Controller Inputs	
Speed Reference Input	5Kohm Potentiometer (0 to +/−10 VDC @50 Kohm input impedance) or 0-20 mA (@ 250 ohm input impedance) with 10 bit resolution. (Jumper selectable by jumper J4; refer to *Section 3, Table 3.6, Terminals 12 - 15* on the control terminal block.) NOTE: *The controller provides +15 VDC buffered through a 1.875 Kohm resistor.*
Stop	Open Contact (Contact must be closed when drive is running. An open contact turns the controller "off". The drive will remain and/or be held off as long as contact is open.
Start	Open to Closed Contact Transition - momentary or fixed contact closure (Edge-sensitive control input signal which must see an open to closed transition.)
IET Reset	Closed Contact = No Function Loss (Contact must be closed when drive is running. An open contact turns the controller "off", and causes a "FL" fault. The drive will remain and/or be held off as long as the contact is open.)
Function Loss	Closed Contact - Jog START contact must remain closed (or maintained) for JOG.
Programmable Inputs (Qty 3) [Forward/Reverse] [Ramp 1 and 2] [Remote/Local] [MOP] [Multi-speed Presets]	Depending on parameters P.007 and P.008, terminals 17 (Input 8), 18 (Input 7) and 19 (Input 6) can be a combination of the control signals listed. Refer to Parameter P.007 and P.008 for programmable combinations.
Pulse Tachometer	Pulses per revolution: 512, 1024, 2048, or 4096 PPR. Differential inputs: A, A not, B, B not Input impedance: 10K to common Series 100 ohm, 3900 pF RC termination A to A not and B to B not Quadrature Phasing: 90° +/− 45° The controller provides a 15 VDC (Internally limited for 240mA) power supply for pulse tachometer operation.
Controller Outputs	
Analog Output	0 to 10 VDC or 4-20mA scaled signal selected in Parameter P.012 as speed or torque feedback
Dynamic Braking Signal	Dynamic braking control signal which can be used with some types of optional Dynamic Braking Kits.
IET/ Controller Running	250 VAC/ 30 VDC, 5 Amp resistive relay output (1Form A and 1 Form B contact - IET or Controller Running specified by P.013.)
Controller Communications	
RS-232 Interface	A single RS-232-C port for serial communications : RECV, XMIT, COMMON. Requires :Configuration Executive 3000 Software These signals are accessible at the terminal block or through the 9-pin D-Shell connector. Refer to Figure 3.4 for terminal block locations

2.3 Motor Applications

The controller and motor must be sized for the load and speed requirements of the specific application. To obtain Motor Nameplate Horsepower, the controller's (sine wave) output ampere rating, at the carrier frequency selected, should be equal to or greater than the motor nameplate current. If the Motor Nameplate Amperes are HIGHER than the controllers (sine wave) output ampere rating, the motor HORSEPOWER should be DERATED by the ratio of controller (sine wave) output ampere rating to the motor nameplate current.

Per NEC, a motor thermostat, internal to the motor, must be installed; or, a motor overload relay, sized to protect the motor, must be connected between the motor and the controller output. The *electronic* motor overload parameter can be used, and must be enabled to provide this protection. Refer to P.040 in Section 6.

If the motor will be operated at speeds below one-half the motor's base speed, the motor overload relay will not protect the motor. A motor thermostat, internal to the motor, is required because it monitors the actual temperature of the motor windings.

3.0 INSTALLATION AND WIRING

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING TO THE NATIONAL ELECTRICAL CODE (NEC) AND ALL OTHER APPLICABLE LOCAL CODES. WIRING, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

CAUTION: Use of power correction capacitors on the output of the controller can result in erratic operation of the motor, nuisance tripping, and/or permanent damage to the controller. Remove power factor capacitors before proceeding. Failure to observe this precaution could result in damage to, or destruction of the equipment.

3.1 Planning and Location

Planning before installation is necessary to ensure that the controller environment and operation conditions are satisfactory. Read and follow the recommendations advised in this section before proceeding with the installation.

1. Verify that the controller can be kept clean and cool.
2. Check that the controller will be away from oil, coolants, or other airborne contaminants.
3. Check that the temperatures within the vicinity of the controller are between 0° to 40°C (32° to 104°F).
4. Check that the relative humidity is between 5 and 95% noncondensing.
5. Do not install above 3300 feet (1000 meters) without derating. For every 300 feet (91.4 meters) above 3300 feet, derate the current rating by 1%. Consult Reliance Electric Sales for operation above 10,000 feet.
6. Check that the area chosen will allow the space required for air flow around the controller.

3.2 Controller Mounting

The dimensional size of GV3000 Controller Models will vary depending horsepower rating (HP). Refer to Figures 3-1 and 3-2 to determine the appropriate dimensional size for a given GV3000 Controller Model. When mounting a controller, adhere to the guidelines and physical diagrams for the specific horsepower type.

3.2.1 GV3000 Controller Mounting (460 VAC 1,2,3, and 5 HP)

1. In the location selected, mount the controller vertically using the four (4) mounting holes provided on the controller base. See Figure 3.1.
2. Use the following as reference to provide adequate clearances for air ventilation:
   - At least 4 inches from the sides and 4 inches from the top and bottom of the controller to adjacent non-heat producing equipment, such as a cabinet wall.
   - At least 4 inches from the sides and 10 inches from the top and bottom of adjacent controllers. For best air movement with three or more controllers, do not mount the controllers in a vertical stack (i.e. offset (stagger) the controllers).

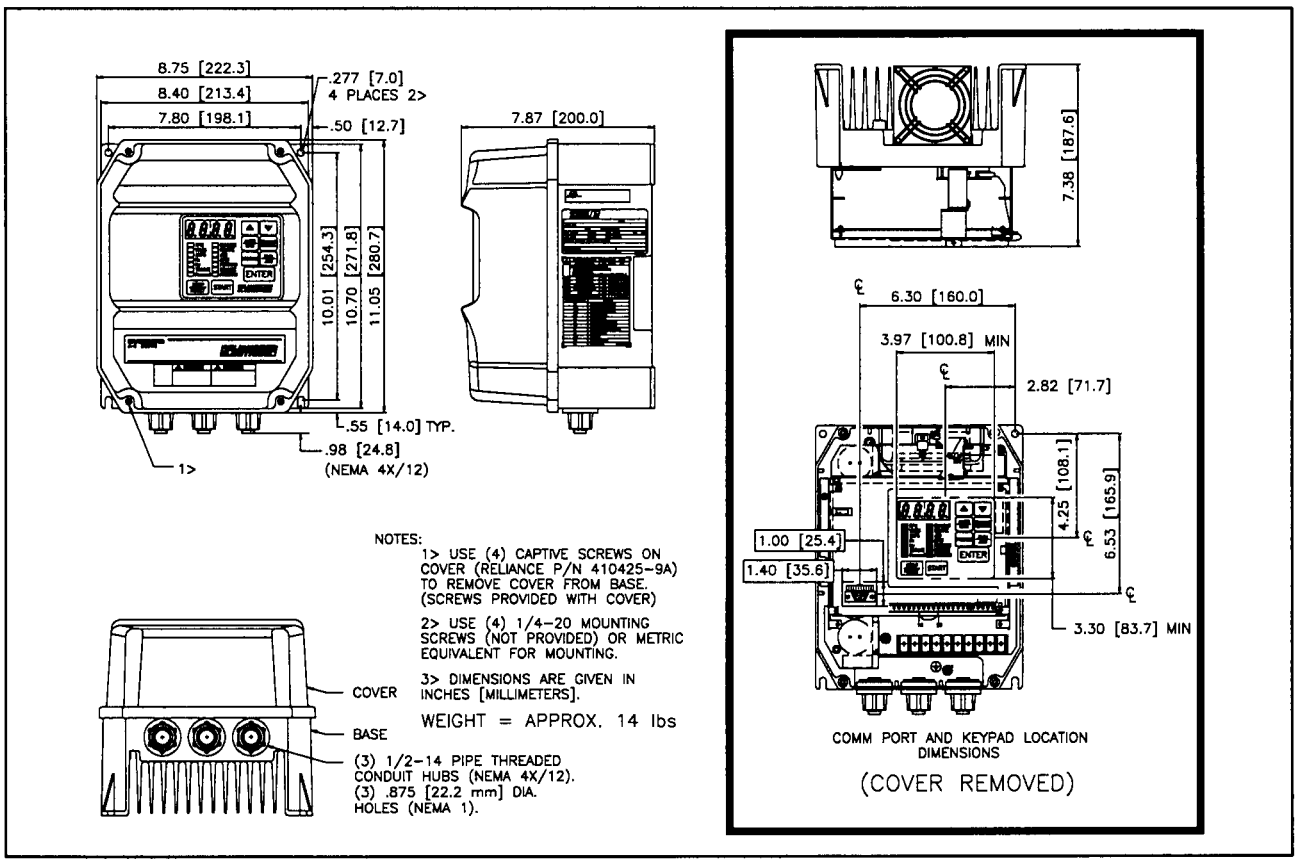


Figure 3.1 - GV3000 Physical Dimensions (460 VAC 1,2,3 and 5 HP).

3.2.2 Controller Mounting (460 VAC 7.5 and 10 HP).

1. In the location selected, mount the controller vertically using the four (4) mounting holes provided on the controller base. See Figure 3.2.
2. Use the following as reference to provide adequate clearances for air ventilation:
   - At least 4 inches from the sides and 4 inches from the top and bottom of the controller to adjacent non-heat producing equipment, such as a cabinet wall.
   - At least 4 inches from the sides and 10 inches from the top and bottom of adjacent controllers. For best air movement with three or more controllers, do not mount the controllers in a vertical stack (i.e. offset (stagger) the controllers).

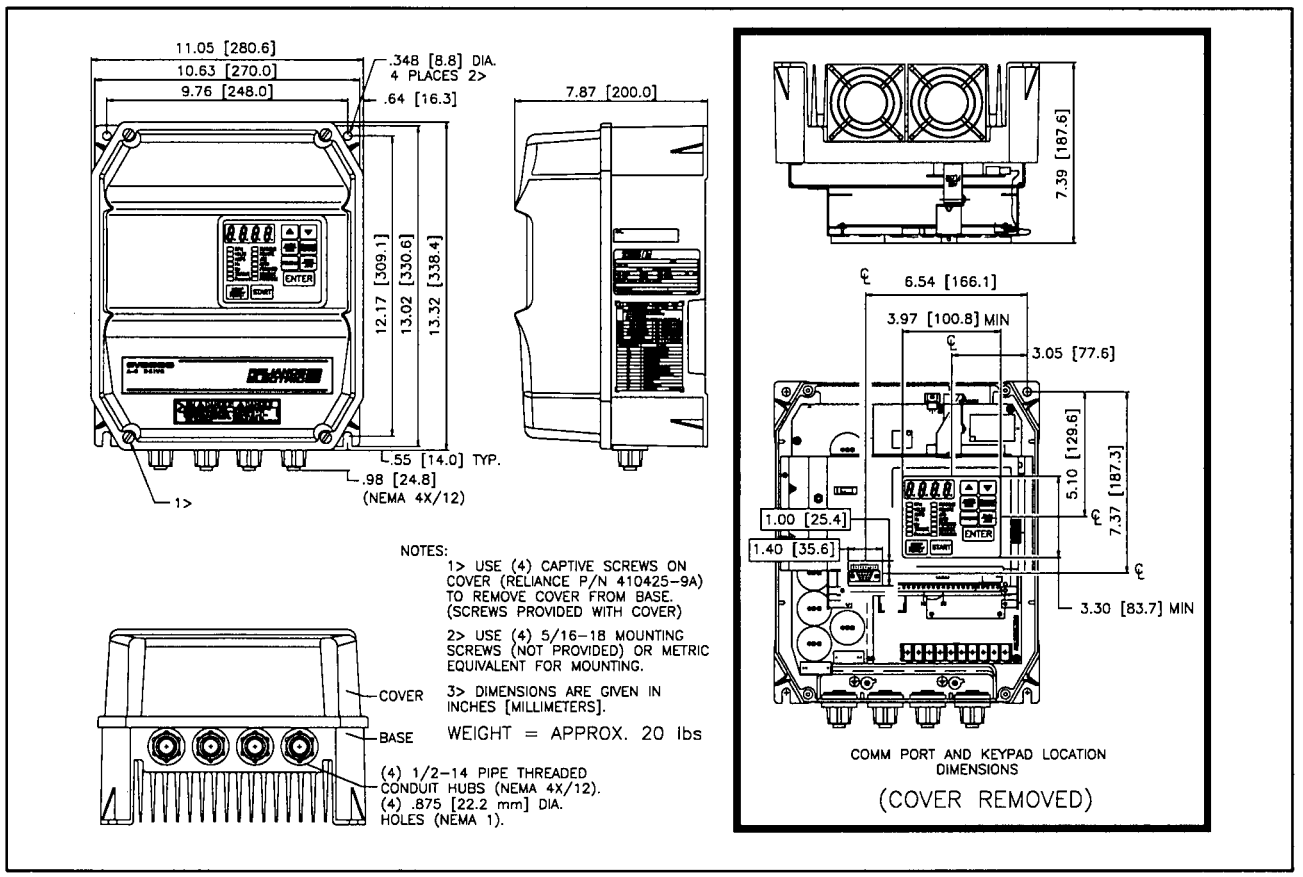


Figure 3.2 - GV3000 Physical Dimensions (460 VAC 7.5 and 10 HP).

3.3 Install an External Input Disconnect

DANGER

THE NEC/CEC REQUIRES THAT UPSTREAM BRANCH PROTECTION BE PROVIDED TO PROTECT INPUT POWER WIRING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Install an input disconnect in the incoming power line according to the NEC/CEC guidelines.
2. Size the disconnect according to the inrush current as well as any additional loads the disconnect may supply.

NOTE: *Coordinate the trip rating for the in-rush current (10-12 times full load current) with that of a transformer (if used). See Transformer and Reactor Installation (If Needed), later in this section.*

3.4 Install A-C Branch Circuit Protection

DANGER

THE NEC/CEC REQUIRES THAT UPSTREAM BRANCH PROTECTION BE PROVIDED TO PROTECT INPUT POWER WIRING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

NOTE: *The input fuse ratings listed in Table 3.1 are applicable for one drive per branch circuit. No other load can be applied to that fused branch circuit.*

1. Install user-supplied branch circuit protection according to the NEC/CEC guidelines.
2. According to the values given in Table 3.1, size the branch circuit protection for the specific controller model.

Table 3.1 - Three-Phase A-C Input Line Branch Circuit Protection.

Model Number	Horsepower (Hp)	Input Voltage (VAC)	Input A-C Fuse Rating (A)(2)
3GV41001 3GV44001	1/4 - 1	460	6
3GV41002 3GV44002	2		8
3GV41003 3GV44003	3		12
3GV41005 3GV44005	5		25
3GV41007 3GV44007	7.5		25
3GV41010 3GV44010	10		35

NOTE: (1) The recommended fuse type is UL Class J, 600V, time-delay.

3.5 Transformer and Reactor Installation (If Needed)

Transformers can be either autotransformers or isolation transformers. Isolation transformers help eliminate:

- Damaging A-C line voltage transients from reaching the controller.
- Line noise from the controller back to the incoming power.
- Damaging currents, which could develop if a point inside the controller becomes grounded.

3.5.1 Input Transformers

If an input transformer is installed ahead of the controller, adhere to the following:

1. A power disconnecting device must be installed between the power line and the primary of the transformer.
2. If the power disconnecting device is a circuit breaker, the circuit breaker trip rating must be coordinated with the inrush of current (10 to 12 times full load current) of the transformer.
3. An input transformer rated more than 1000 KVA for 460 VAC with less than 5% impedance should NOT be used directly ahead of the controller without additional impedance between the controller and the transformer.

CAUTION: Distribution system capacity above the maximum recommended system KVA (1000KVA for 460VAC) requires using an isolation transformer, a line reactor, or other means of adding similar impedance to the drive power input. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

CAUTION: When the A-C line is shared directly with other SCR rectified drives, a line reactor or optional DB kit may be required to alleviate excess D-C bus voltage. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

3.5.2 Output Reactors

In applications requiring the use of an output reactor on the controller, contact your Reliance Electric Sales Office for assistance.

3.6 Grounding

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING TO THE NEC/CEC AND ALL OTHER APPLICABLE CODES. WIRING, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Remove the four (4) captive screws and remove the cover. When installing the cover on the controller, refer *to Section 5: Cover Installation for Nema 4X(Indoor Only)/12 Controller.*
2. Run a suitable equipment grounding conductor unbroken from the controller ground terminal (See Figure 3.2) to the earth ground conductor. See Table 3.2 for recommended wire sizes.
3. Connect a suitable equipment grounding conductor to the motor frame, the remote control station (if used), and the transformer. Run each conductor **unbroken** to the earth ground.

3.7 Controller Wiring

Size and install all wiring in conformance with the NEC/CEC and all other applicable local codes. If not already done, loosen the four (4) captive screws on the cover and remove the cover from the controller base. Refer to Figures 3-3 and 3-4 for jumper and wiring locations on GV3000 controllers. Follow all recommended wire sizes and tightening torque specifications.

CAUTION: Do not route signal and control wiring with power wiring in the same conduit. This may cause interference with controller operation. Failure to observe this precaution could result in damage to, or destruction of the equipment.

NOTE: *As a general rule, route the signal wiring and control wiring in separate conduits to prevent interference with controller operation.*

WARNING

THE GV3000 CONTROLLER IS NOT EQUIPPED WITH A COAST-STOP PUSHBUTTON. THE USER MUST INSTALL A HARDWIRED, OPERATOR-ACCESSIBLE PUSHBUTTON THAT PROVIDES A POSITIVE INTERRUPT AND SHUTS DOWN THE DRIVE. (USE TERMINALS 16 AND 20. SEE FIGURE 3.2 AND 3.4). FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

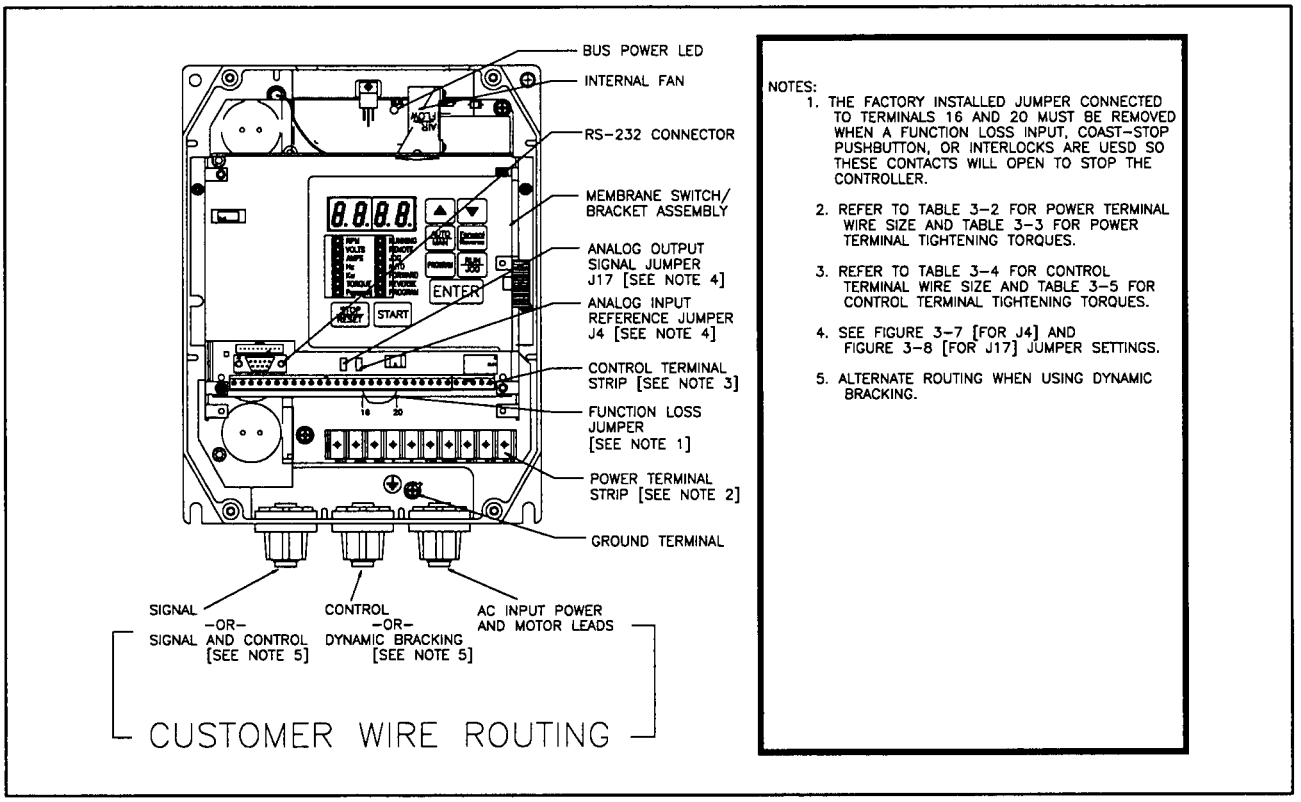


Figure 3.3 - GV3000 Wiring Locations(460 VAC 1,2,3 and 5 HP).

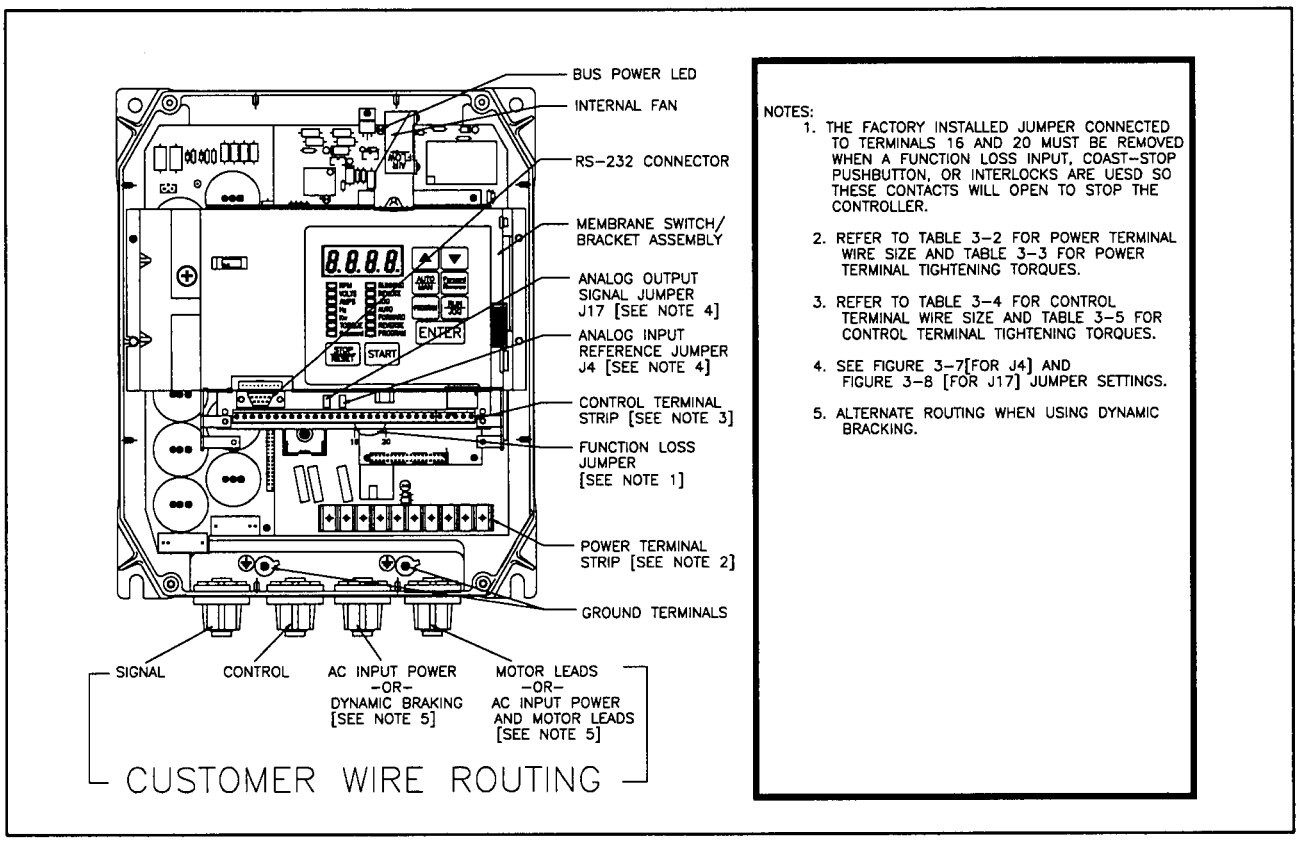


Figure 3.4 - GV3000 Wiring Locations (460 VAC 7.5and 10 HP).

3.7.1 Power Wiring

Size and install all wiring in conformance with the NEC/CEC and all other applicable local codes. Refer to Figure 3.3 when making wire connections to the power terminal strip. See Table 3.2 for recommended wires sizes and Table 3.3 for power terminal tightening torque.

1. Verify that the input power to the controller corresponds to the controller nameplate voltage and frequency and that the plant supply is of sufficient capacity to support the input current requirements. (Refer to Specifications, Section 2.)
2. Provide a transformer between the plant power supply and the controller if the correct input line voltage is not available. (Refer to Transformer and Reactor Installation in this section.)
3. Size upstream branch circuit protection (fuses) according to Table 3.1.

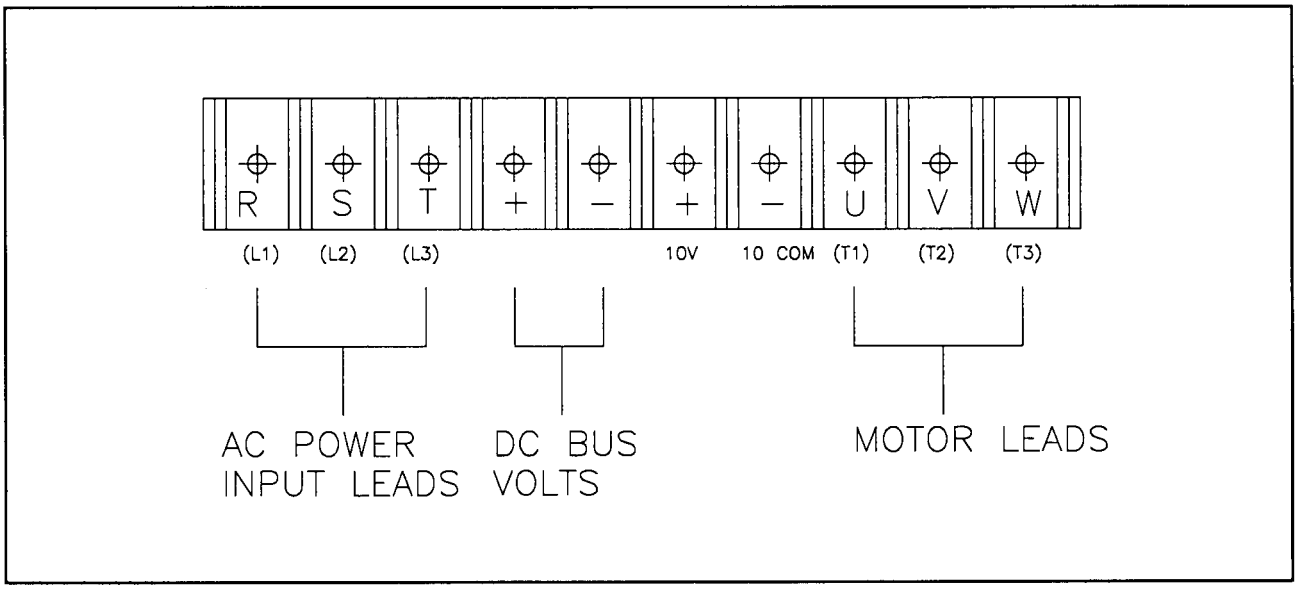


Figure 3.5 - Power Terminal Strip Wiring

4. Refer to Table 3.2 and size the input and output wiring to handle the rated current. (Refer to Table 2.1 for maximum controller current.)

Table 3.2 - Recommended Power Wire Size[1,2]

Wiring	Terminal	Wire Size
Input power	R(L), S(L), T(L)	14 AWG
Output power	U(T), V(T), W(T)	
DC Bus	-, +	
DB Power	+10 VDC, 10 COM	
GND Terminal	GND Stud	

Notes: 1) The user is responsible for the following NEC/CEC and all applicable local codes with respect to wire sizes used with the controllers.

2) Use only copper wire.

5. Use the appropriate terminal torque as listed in Table 3.3 for wire connections to the power terminal.

Table 3.3 - Power Terminal Tightening Torque (in-lbs) Specifications.

Power Terminals	Torque
R(L), S(L), T(L) U(T), V(T), W(T) -, + 10 VDC, 10 COM GND Stud	9 min. - 12 max. in-lbs

CAUTION: Do not route signal wiring with power wiring in the same conduit. This may cause interference with controller operation. Failure to observe this precaution could result in damage to, or destruction of the equipment.

6. Wire the power input leads. Route AC input power leads through the bottom right (far right) opening of the controller base, as indicated in Figures 3-3 and 3-4, to the output terminals R(L1), S(L2), and T(L3).

3.7.2 Control and Signal Wiring

Size and install all wiring in conformance with the NEC/CEC and all other applicable local codes. Refer to Figure 3.6 and Table 3.6 when making wire connections to the control terminal strip. See Table 3.4 for recommended wires sizes and Table 3.5 for control terminal tightening torque.

NOTE: *Asserted contact or switch means that it's closed while an unasserted contact or switch means that it's open.*

CAUTION: Make sure electrical commons are not intermixed in the controller. Failure to observe this precaution could result in damage to, or destruction of the equipment.

1. For all signal wiring, use twisted pair wire having two or three twists per inch.

   NOTE: *If using shielded twisted pair wire rather than twisted wire, the shields should not attach to any ground point; they should "float".*

2. For distances of up to 1000 feet, use a minimum of #20 AWG wire. For distances of more than 1000 feet, contact your Reliance Electric Sales Office.
3. Refer to Table 3.4 and size control and signal wiring.

Table 3.4 - Recommended Control and Signal Wire Sizes.

Terminal	Wire Size
1-31	14-20AWG

4. Use the appropriate terminal torque as listed in Table 3-5 for wire connections to the Control and Signal Terminal Block.

Table 3.5 - Control and Signal Terminal Block Tightening Torque (in-lbs) Specifications.

Terminal	Wire Size
1-31	7 in-lbs. max.

5. Route the signal wiring (RS-232, Pulse Tach, Analog Output and, Analog Speed Reference) and control wiring (Digital Inputs, Dynamic Braking Control, and Status Relays) to the controller as follows:

   Refer to Figures 3-3 and 3-4.

   For GV3000 (460 VAC 1,2,3 and 5 HP) controllers, route the wiring as follows:

   Without Dynamic Braking Option:

   - Route all signal wiring through the opening at the bottom left (far left) of the controller.
   - Route all control wiring through the opening at the bottom center of the controllers.

   With Dynamic Braking Option:

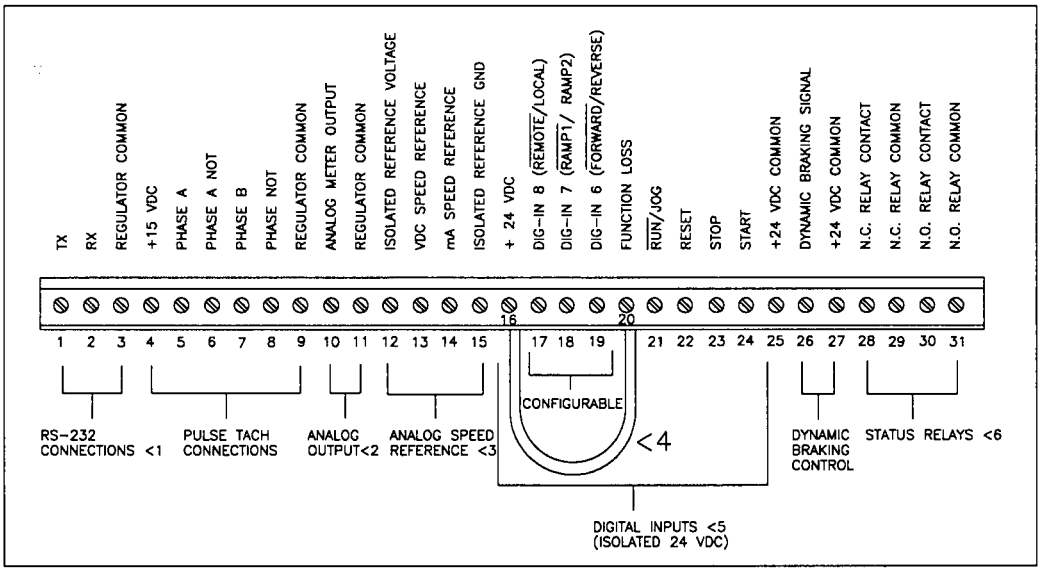
   - Route all signal wiring (along with the control wiring) through the opening at the bottom left of the controllers.

   For GV3000 (460 VAC 7.5 and 10 HP) controllers, route the wiring as follows:

   - Route all signal wiring through the opening at the bottom left (far left) of the controller.
   - Route all control wiring through the second opening (from the left) at the bottom center of the controllers.

6. Refer to Table 3.6 for all signal and control wiring connections.

   NOTE: *The factory-installed jumper between terminals 16 and 20 (Refer to Figure 3.4) must be removed when installing a coast-stop pushbutton as shown in Table 3.6.*



NOTES:

<1. CONNECTIONS TO THE RS-232 SHOULD ONLY BE MADE WHEN NOT USING PC COM PORT (J8) AND AN OPERATOR INTERFACE MODULE (OIM). THE CONTROL TERMINAL, PC COM PORT AND, THE OIM USE THE SAME TRANSMIT AND RECEIVE LINES.

<2. PROPER JUMPERING J17 REQUIRED FOR SELECTING A VOLTAGE SOURCE (0-10 VDC) OR A SINKING CURRENT (0-20 mA) AT THE ANALOG OUTPUT.

THE OUTPUT MUST ALSO BE CONFIGURED, VIA PARAMETER P.024, FOR AN INDICATION OF SPEED AND DIRECTION OR PERCENT TORQUE.

<3. PROPER JUMPERING OF J4 IS REQUIRED FOR SELECTING A VOLTAGE (+/- 0-10 VDC) OR CURRENT (+/- 0-20 mA) SOURCE FOR THE ANALOG SPEED REFERENCE.

<4. A FACTORY JUMPER CONNECTED TO TERMINALS 16 AND 20 MUST BE REMOVED WHEN A USER INSTALLED FUNCTION LOSS INPUT, A COAST-TO-STOP PUSHBUTTON, OR OTHER INTERLOCK IS INSTALLED SO THAT THE CONTACT WILL OPEN TO STOP THE CONTROLLER.

<5. TERMINALS 19, 18 AND, 17 (DIGITAL INPUTS 6, 7 AND 8) ARE CONFIGURABLE USING PARAMETERS P.007, P.008 AND P.031 THRU P.037. FACTORY DEFAULT SETTINGS SHOWN IN PARENTHESES.

<6. RELAY CONTACT CLOSURE IS CONFIGURABLE, VIA PARAMETER P.013, TO INDICATE EITHER AN INSTANTANEOUS ELECTRONIC TRIP OR CONTROLLER RUNNING.

ALL CUSTOMER WIRING COMES IN AT THE BOTTOM OF THE CONTROL TERMINAL STRIP

Figure 3.6 - Control Terminal Wiring Locations.

Table 3.6 - Control Terminal Wiring.

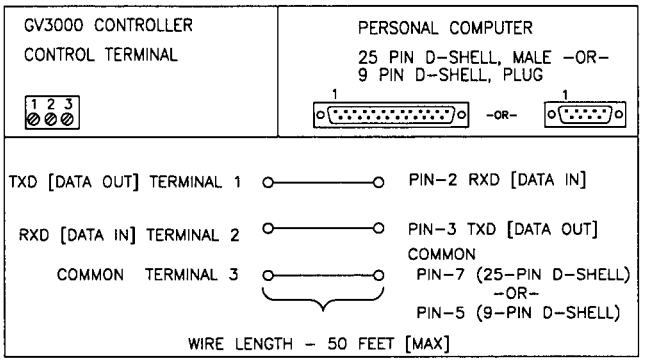
Terminal Number	Description	See Parameters/Remarks
	RS-232 Connections	Notes: *RS-232 communication between the GV3000 controller and a personal computer requires the use of Reliance Configuration Executive 3000 Software. Refer to Instruction manual D2-3303, Configuration Executive 3000, for additional hardware and software requirements.*
1 2 3	RS-232 Transmit RS-232 Receive RS-232 Signal Common (Regulator common)	

Table 3.6 - Control Terminal Wiring (Continued)

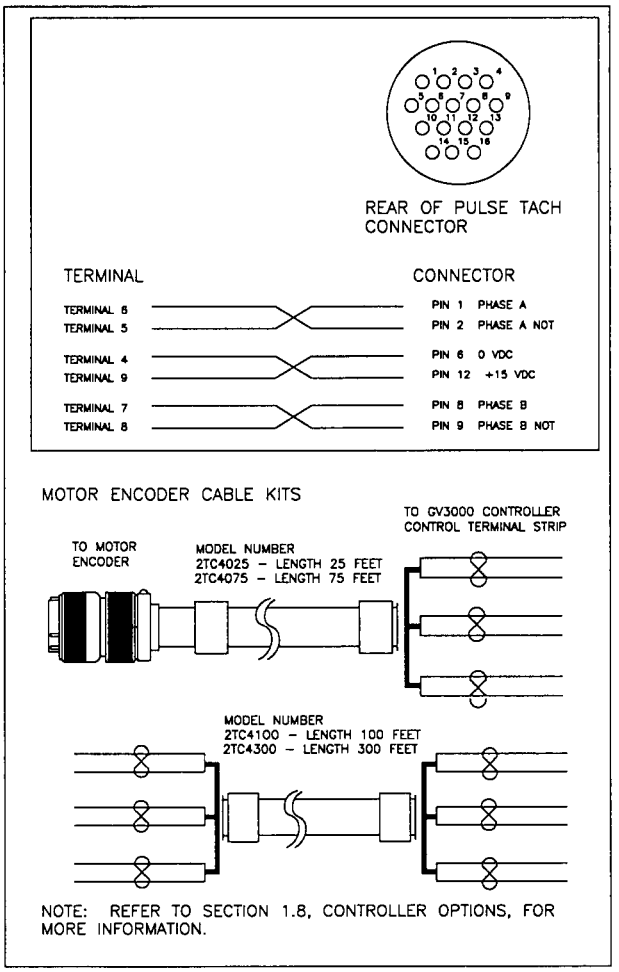
Terminal Number	Description	See Parameters/Remarks
	Pulse Tach Connections	**WARNING** **THE SETTING OF THE VARIABLES U.001 (PULSE TACHOMETER SELECTION), U.002 (MOTOR POLE NUMBER), U.003 (MOTOR BASE FREQUENCY) AND U.005 (MOTOR RATED SPEED) DETERMINE MOTOR MAXIMUM SPEED. THESE VARIABLES MUST BE SET BY A QUALIFIED PERSON WHO UNDERSTANDS THE SIGNIFICANCE OF SETTING THEM ACCURATELY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.** P.050 - Restore Default Settings U.001 - (Pulse tachometer selection), U.002 - (Motor pole number) U.003 - (Motor base frequency) U.005 - (Motor rated speed)
4	Pulse Tach Supply +15 VDC	
5	Pulse Tach Phase A Differential Input	
6	Pulse Tach Phase A Not Differential Input	
7	Pulse Tach Phase B Differential Input	
8	Pulse Tach Phase B Not Differential Input	
9	Pulse Tach Common (Regulator Common)	

Table 3.6 - Control Terminal Wiring (Continued)

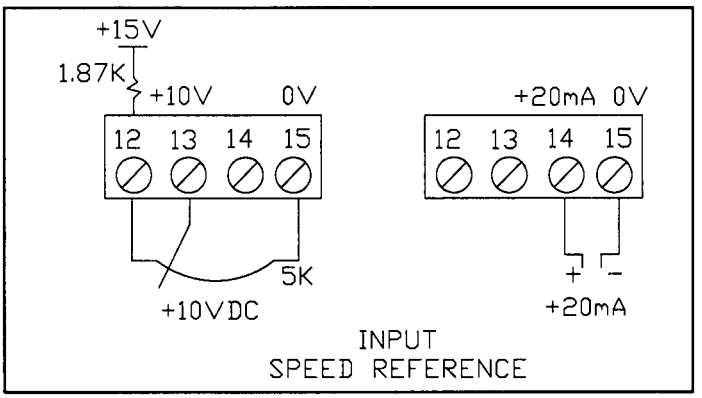
Terminal Number	Description	See Parameters/Remarks
	Analog Output	P.012 - Terminal Block Analog Output Source selection (Speed or Torque) Proper jumpering of J17 (Refer to Analog input and output jumper settings following this table.)
10 11	(0-10 VDC) -or- (4-20 mA) Analog output reference (Regulator common)	
	Analog Speed Reference	P.000 - Operation Control P.009 - Terminal Block Analog Speed Reference Offset P.010 - Terminal Block Analog Speed Reference Gain P.011 - Terminal Block Analog Speed Reference Invert Selection Proper jumpering of J4 (Refer to Analog input and output jumper settings following this table.)
12 13 14 15	Isolated Reference Voltage (Isolated +15 VDC) +/- 10 VDC Analog Speed Reference Input Voltage 0 - 20mA Analog Speed Reference Input Current Isolated Speed Reference common (Voltage/Current)	

Table 3.6 - Control Terminal Wiring (Continued).

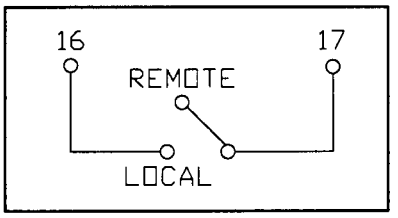
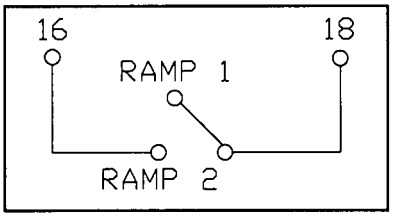
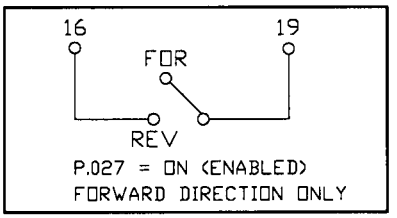
Terminal Number	Description	See Parameters/Remarks
	Digital Inputs (6, 7, and 8) (Digital Inputs 6,7 and 8 are configurable.) The diagrams provided below reflect the factory settings only for Digital inputs 6,7 and 8.	P.000 - Operation Control P.006 - Expand to Second Menu List (requires password) P.007 - Terminal Block Digital Input Configure (Selects and assigns control function to Digital input 6, Digital input 7, and Digital input 8. P.008 - Terminal Block Speed Reference Selection (Analog, MOP, or Multi-speed presets) NOTES: *Based on the Selections made in P.000, P.007 and P.008, the following parameters can also affect digital inputs 6,7,and 8*: P.023 - MOP Reference Rate for Increment/Decrement P.024 - MOP Reset P.031 through P.038 - Multi-Speed Presets 1 through 8
16 17	+24 VDC Isolated supply Digital Input (8) - Factory setting: REMOTE/LOCAL	P.000 - Operation Control Source. Only active when P.000 = rE  Terminal 17 Asserted = Local control
18	Digital Input (7) - Factory setting: RAMP1/RAMP2	P.001 - Acceleration Time (Ramp1) P.002 - Deceleration Time (Ramp1) P.017 - Acceleration Time (Ramp2) P.018 - Deceleration Time (Ramp2)  Terminal 18 Asserted = Ramp2
19	Digital Input (6) - Factory setting: FORWARD/REVERSE	P.027 - Reverse Disable  Terminal 19 asserted = Reverse Direction NOTE: *From the Pulse Tach end of the motor, a clockwise rotation indicates a Forward motor direction.*

Table 3.6 - Control Terminal Wiring (Continued).

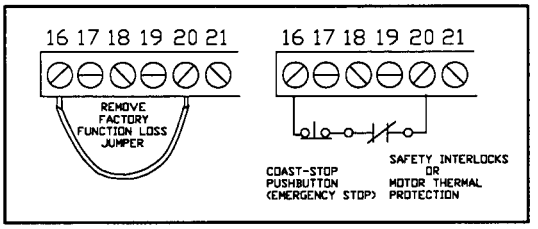
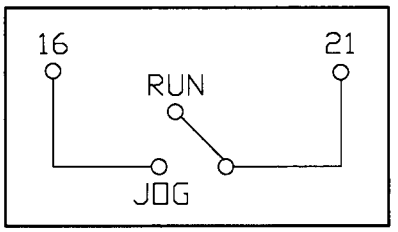
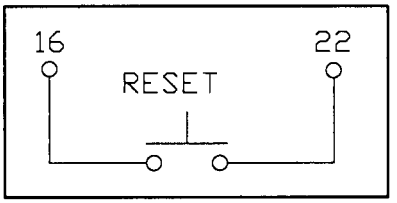
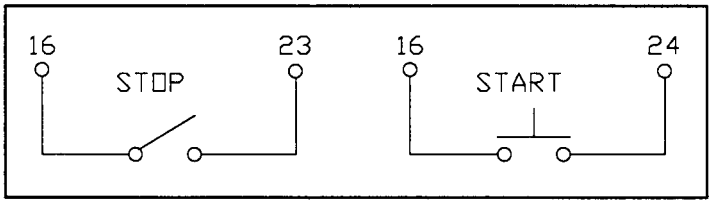
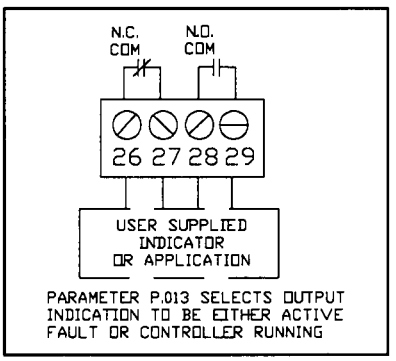
Terminal Number	Description	See Parameters/Remarks
	Digital Inputs (1,2,3,4,5)	P.000 - Operation Control
20	Digital Input (5) - FUNCTION LOSS	**WARNING** **THE CONTROLLER IS NOT EQUIPPED WITH A COAST-STOP PUSHBUTTON. THE USER MUST INSTALL A HARDWIRED OPERATOR ACCESSIBLE PUSHBUTTON THAT PROVIDES A POSITIVE INTERRUPT AND SHUTS DOWN THE DRIVE. (USE TERMINALS 16 AND 20 FOR THE FUNCTION LOSS INTERRUPT.) FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.** P.026 - Function Loss Selection  Terminal 20 Asserted = No Function Loss
21	Digital Input (4) - RUN/JOG	P.020 - Jog Speed Reference P.021 - Jog Ramp Acceleration Time P.022 - Jog Ramp Deceleration Time  Terminal 21 Asserted = Jog Operation
22	Digital Input (3) - RESET	 Terminal 22 Asserted Transition = Reset

Table 3.6 - Control Terminal Wiring (Continued).

Terminal Number	Description	See Parameters/Remarks
23 24	Digital Input (2) - STOP Digital Input (1) - START	P.025 - Stop Type Selection (coast or ramp)  Terminal 23 Unasserted = Stop Terminal 24 Assert Transition = Start
25	24 VDC Isolated common	
	Dynamic Braking	
26 27	Dynamic Braking control signal Dynamic Braking control common	Used with Dynamic Braking Kit Model Number 2DB4010. Refer to the kit instruction manual for proper installation with controller.
	IET/Controller Running Relays	Both Form A and B contacts rated for 250 VAC/30 VDC at 5 Amps Resistive or 2 Amps Inductive load. P.013 - Output Relay Configuration NOTE: *Depending on the setting of P.013, the relay coil will energize (Normally Open Contact CLOSES and the Normally Closed Contact OPENS) with either:* *an active (IET) fault* *-or-* *Controller running*
28 29 30 31	Form B - Normally Closed Contact Form B - Normally Closed Contact common Form A - Normally Open Contact Form A - Normally Open Contact common	

3.8 Analog Input Speed Reference and Analog Output Jumper Setting

Located on the regulator board (Refer to Figures 3-3 and 3-4) are the analog speed reference jumper (J4) and the analog output jumper (J17). The analog speed reference jumper provides for a jumper-selectable +/- 10 VDC or 0 - 20 mA speed input with software programmable gain (P.010), offset (P.009) adjustment, and signal inversion (P.011). The analog output jumper provides for a jumper-selectable 0-10 VDC or 4-20 mA scaled output signal software selectable (P.012) for either speed or torque. (Refer to Section 6 for more information on parameters P.009. P.010, P.011 and P.012.)

NOTE: *If the position of the analog speed reference jumper (J4) is changed, the software does not recognize that the input reference has been changed from a 10 VDC to 20 mA, or vice versa. The software also does not recognize a polarity change for either voltage or current input reference. Verify the input reference polarity (P.011) and that calculations for the reference gain (P.010) and offset (P.009) parameters are correct before starting the drive.*

The position of the analog output jumper (J17) does not have to be recognized by the software. The jumper is used only to select a scaled 0-10 VDC source voltage or 4-20 mA sink current to represent speed or torque.

3.8.1 To Change the analog input speed reference jumper J4:

DANGER

AFTER DISCONNECTING INPUT POWER WAIT FIVE MINUTES AND CHECK WITH A VOLTMETER TO INSURE THAT DC BUS VOLTAGE CAPACITORS ARE DISCHARGED. VOLTMETER SHOULD READ ZERO VOLTS DC. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Turn off power supplied to the controller.
2. If not already done, loosen the four (4) attaching screws and remove the cover from the controller.
3. Verify at the + and - power terminals that the D-C Bus voltage is zero (0) VDC. (Refer to Figure 3.5.)
4. Locate jumper J4 on the controller's regulator board. Refer to Figures 3-3 and 3-4.
5. Locate pin 1 of jumper J4 on the regulator board.

   Move the jumper to the desired setting as shown in Figure 3.7.

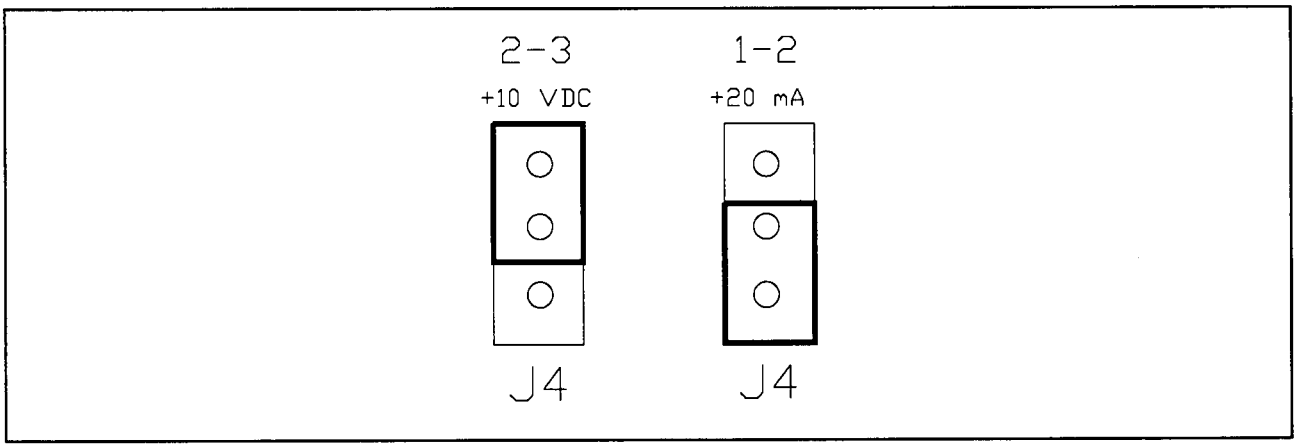


Figure 3.7 - Analog Input Speed Reference Jumper Setting (J4).

6. After moving jumper J4, verify (with each move) that parameters P.011 (reference polarity), P.009 (reference offset) and P.010 (reference gain) are correctly set.

3.8.2 To Change the analog output jumper J17:

DANGER

AFTER DISCONNECTING INPUT POWER WAIT FIVE MINUTES AND CHECK WITH A VOLTMETER TO INSURE THAT DC BUS VOLTAGE CAPACITORS ARE DISCHARGED. VOLTMETER SHOULD READ ZERO VOLTS DC. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Turn off power supplied to the controller.
2. If not already done, loosen the four (4) attaching screws and remove the cover from the controller.
3. Verify at the + and - power terminals that the DC Bus voltage is zero (0) VDC. (Refer to Figure 3.3.)
4. Locate jumper J17 on the controller's regulator board. Refer to Figure 3.2.
5. Locate pin 1 of jumper J17 on the regulator board.
6. Move the jumper to the desired setting as shown in Figure 3.6.

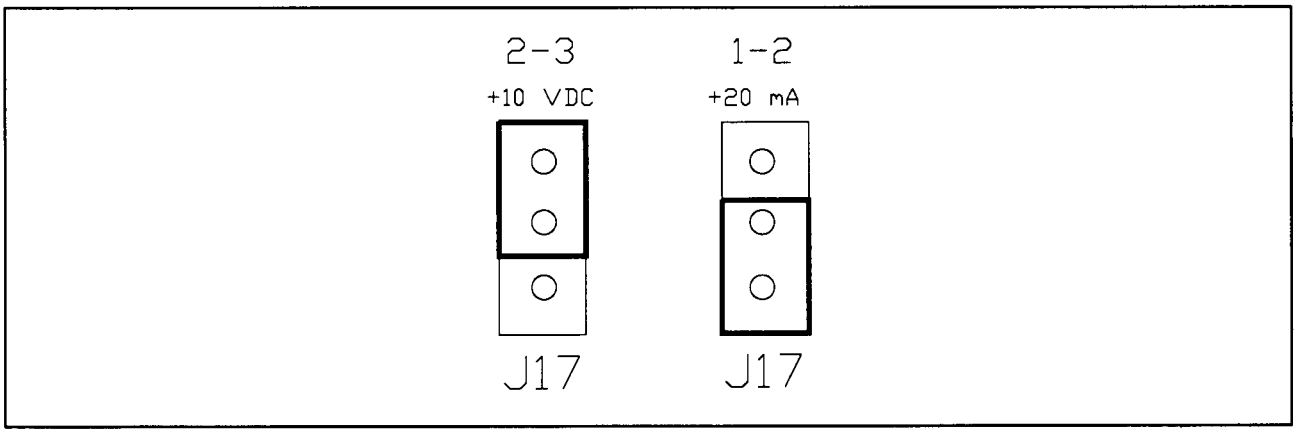


Figure 3.8 - Analog Output Jumper Setting (J17).

7. After moving jumper J17, verify (with each move) that parameter (P.012) is correctly set for either speed or torque.

3.9 Optional Dynamic Braking Wiring

1. Route the dynamic braking power and control signal wiring (if required) through the opening at the bottom center opening of the controller.
2. Install the dynamic braking kit according to the kit instruction manual.

3.10 RS-232 Wiring (NEMA 1)

Located on the regulator board (Refer to Figures 3-3 and 3-4) is the controller's RS-232 communications connector(J8). NEMA 1 controller covers contain an access door for easy cable installation. Simply raise the access door in the cover and attach the communication cable to the controller's RS-232 connector (J8). Two communications cables are available; a 12 feet D-shell 9 pin to 9 pin cable (615184 - 1A) and a 1 Foot D-shell 9 pin to 25 pin adaptor cable (615184 - 2A). RS-232 communication between the GV3000 controller and a personal computer also requires the use of Reliance Configuration Executive 3000 Software. Refer to Instruction manual D2-3303, Configuration Executive 3000, for additional information.

3.11 Motor Preparation

1. Install the motor according to the motor instruction manual.
2. Verify that the motor is the appropriate size to use with the controller.
3. Verify that the total lead lengths on each phase does not exceed 250 feet per phase.
4. Verify that the motor is properly aligned with the driven machine to minimize unnecessary motor loading from shaft misalignment.
5. If the motor is accessible while running, install a protective guard around all exposed rotating parts.

NOTE: *In applications requiring the use of an output reactor on the controller, contact your Reliance Electric Sales Office for assistance.*

4.0 USING THE GV3000 KEYPAD

The GV3000 front panel keypad/display is used to program and operate the controller. It can display seven different output displays, along with parameter numbers and their values by switching from "Display Mode" to "Program Mode". Figure 4.1 shows the keypad and gives a description of each key and indicator:

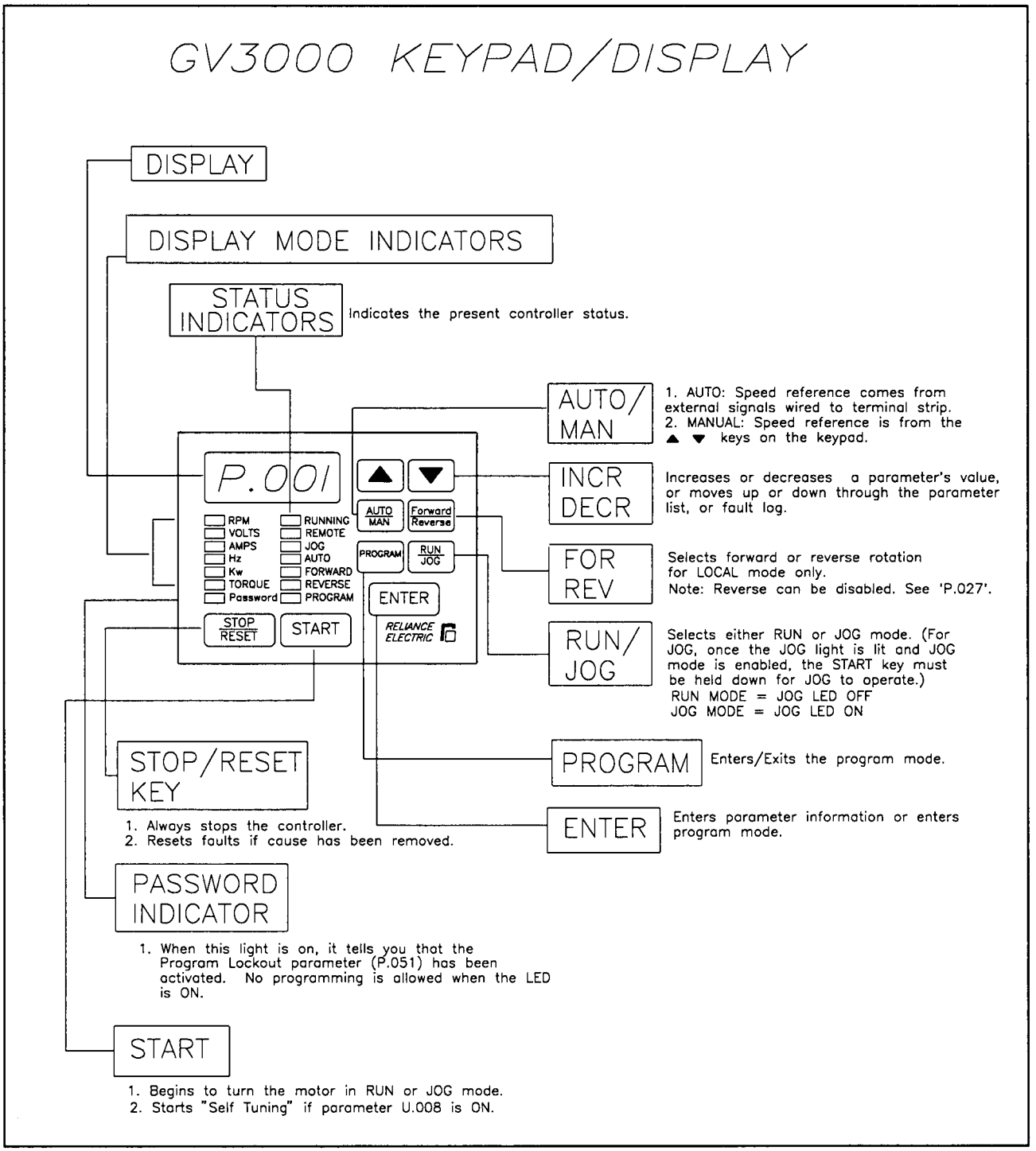


Figure 4.1 - GV3000 Front Panel Keypad/Display.

4.1 To View or Change Parameters in the First Menu List (Parameters P.000 - P.006):

Displays and keypad actions for changing parameters in the first menu list is shown in Figure 4.2.

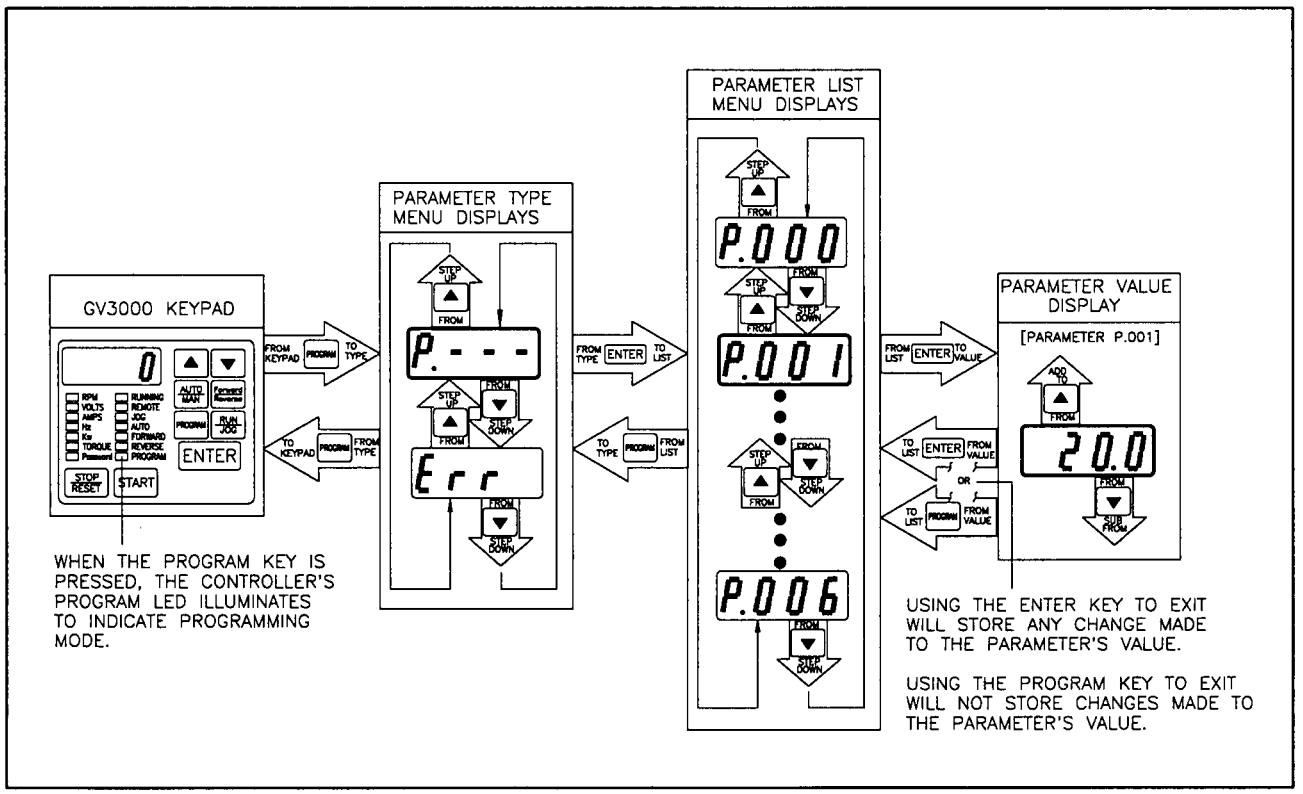


Figure 4.2 - First Menu List Parameter Displays

Action	Display/Notes
1. Press the PROGRAM key.	Display shows "P.---" and the PROGRAM LED goes on.
2. If the display does not show "P.---", move the ▲ or ▼ key until it does.	
3. Press the ENTER key.	Display shows "P.000", first parameter number in First Menu General Parameter List, or the last parameter number already accessed.
4. Press the ▲ key to move up through the first menu list containing Parameters P.000 through P.006.	▲ key: Display shows "P.000", "P.001", etc.
5. Once the desired parameter is displayed, press the ENTER key.	Display shows the parameter "value".
6. Press the ▲ key to increase the value, or the ▼ key to decrease the value.	
7. Press the ENTER key to enter the value.	Note: *The value will not be retained into memory unless the ENTER key has been pressed.*
8. Go to the next Parameter Number, and so on.	
9. Press the PROGRAM key twice, to exit the PROGRAM mode.	The PROGRAM LED goes OFF.

4.2 To View or Change Parameters in the Second Menu List (Parameters P.007 - P.052 and U.000 - U.013):

Displays and keypad actions for changing parameters in the second menu list is shown in Figure 4.3.

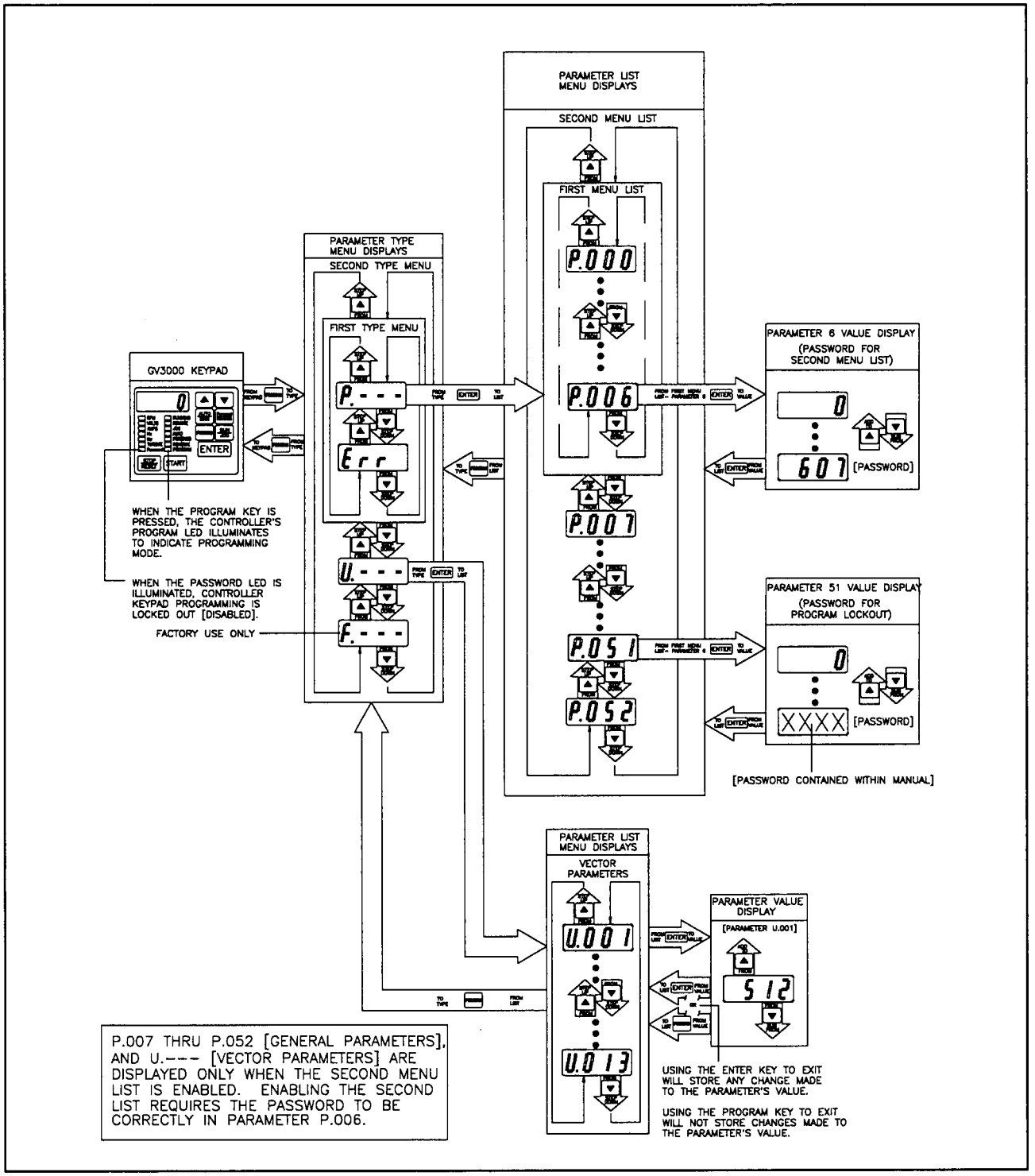


Figure 4.3 - Second Menu List Parameter Displays

1. The password must be entered into P.006 before access to the second menu list is allowed. Follow the instructions below *"To Enter the Password for the Second Menu List"*.
2. Change parameters the same way as for the First Menu List Parameters.

WARNING
IT IS THE USER MANAGEMENT'S RESPONSIBILITY TO DISTRIBUTE THE SECURITY ACCESS CODES WITH DISCRETION WITHIN THEIR ORGANIZATIONAL LEVELS. RELIANCE IS NOT RESPONSIBLE FOR UNAUTHORIZED PASSWORD ACCESS VIOLATIONS WITHIN THE USER'S ORGANIZATION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

- **To Enter the Password for the Second Menu List:**

Action	Display/Notes
1. Press the PROGRAM key.	Display shows "P.---" and the PROGRAM LED goes on.
2. If the display does not show "P.---", move the ▲ or ▼ key until it does.	
3. Press the ENTER key.	Display shows "P.000", first parameter number in First Menu General Parameter List, or the last parameter number already accessed.
4. Press the ▲ key to move up through the first menu list until P.006 is displayed.	Display shows "P.006".
5. Press the ENTER key.	Display shows "0".
6. Press the ▲ key to increase the value until "607" is displayed. This is the password number.	(Holding down the key ▲ will increase the scroll speed). Display shows "607".
7. Press the ENTER key to enter the value.	The password has been entered. You can now access Parameters in the Second Menu List, P.000 through P.052, or Vector Parameters U.000 through U.013.

4.3 Display Modes

Press the PROGRAM key until the PROGRAM LED goes out. The following display modes can be accessed as instructed below:

1. RPM Display Mode:	Displays the controller speed in RPM.
2. VOLTS Display Mode.	Displays the controller output volts
3. AMPS Display Mode.	Displays the controller output amps.
4. HZ Display Mode.	Displays the controller output frequency.
5. KW Display Mode.	Displays the controller output KW.
6. TORQUE Display Mode.	Displays the controller output torque.
7. Speed Reference Display Mode.	Displays the speed reference from the selected control source.

4.3.1 To View a Display Mode:

If you have just powered up, you are already in the default display mode, RPM. The RPM LED is ON, and the PROGRAM LED is NOT ON. Simply press the ENTER key to move from display mode to display mode. Each display mode LED will light -- RPM, VOLTS, AMPS, etc.--- when you have entered that mode.

If you are in PROGRAM mode (the PROGRAM LED is ON), press the PROGRAM key to exit the PROGRAM mode and enter the Display Mode. Press the ENTER key to move from Display Mode to Display Mode.

4.3.2 To View the SPEED REFERENCE Display Mode:

The SPEED REFERENCE from the selected control source can be viewed as follows:

Action	Display/Notes
1. Enter the Display Mode.	NOTE: *If the speed reference is positive, then all six LEDs are lit. If the speed reference is negative, the RPM LED remains OFF, and all other five display mode LEDs remain ON.*
2. Press the ENTER key until you move through all display modes, and all six display mode LEDs are lit.	

4.4 Program Lockout

Programming of parameters can be disabled by accessing Parameter P.051, "Program Lockout". Note: Similar to a hardware ON/OFF switch, you need to repeat the following steps to then "re-enable" programming.

WARNING
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4.4.1 To Disable Programming

Action	Display/Notes
1. Follow instructions for ***"To View or Change Parameters in the Second Menu List."***	Parameter P.051 is in the second menu list. The password for Parameter P.006 must first be entered to access P.051. If the password has already been entered for P.006, bring up P.051 on the display.
2. Access P.051 on the display.	Display shows "P.051".
3. Press the ENTER key.	Display shows "0".
4. Press the ▲ key until the number "1044" is displayed.	Display shows "1044".
5. Press the ENTER key.	Display shows "P.051". If the PASSWORD LED is lit, the ability to change parameter values has been disabled.

4.5 To View Fault Codes, Clear the Error Log, or View the Error Log Time Stamp:

If a fault code is flashing on the display, (for example, "FL"), press the STOP/RESET key . If the fault occurs again, remove the cause of the fault. The fault log only stores the first ten faults. Any faults to occur after ten will not be logged. Make sure the error log is cleared often.

The error log contains the first ten (10) faults generated by the controller. They will be listed in the order of last-error-first to first-error-last, and will look like "2.FL", "1.DC", etc. Errors stored in the log can also be cleared from the log.

Displays and keypad actions for viewing faults codes, error log, and time stamp is shown in Figure 4.4.

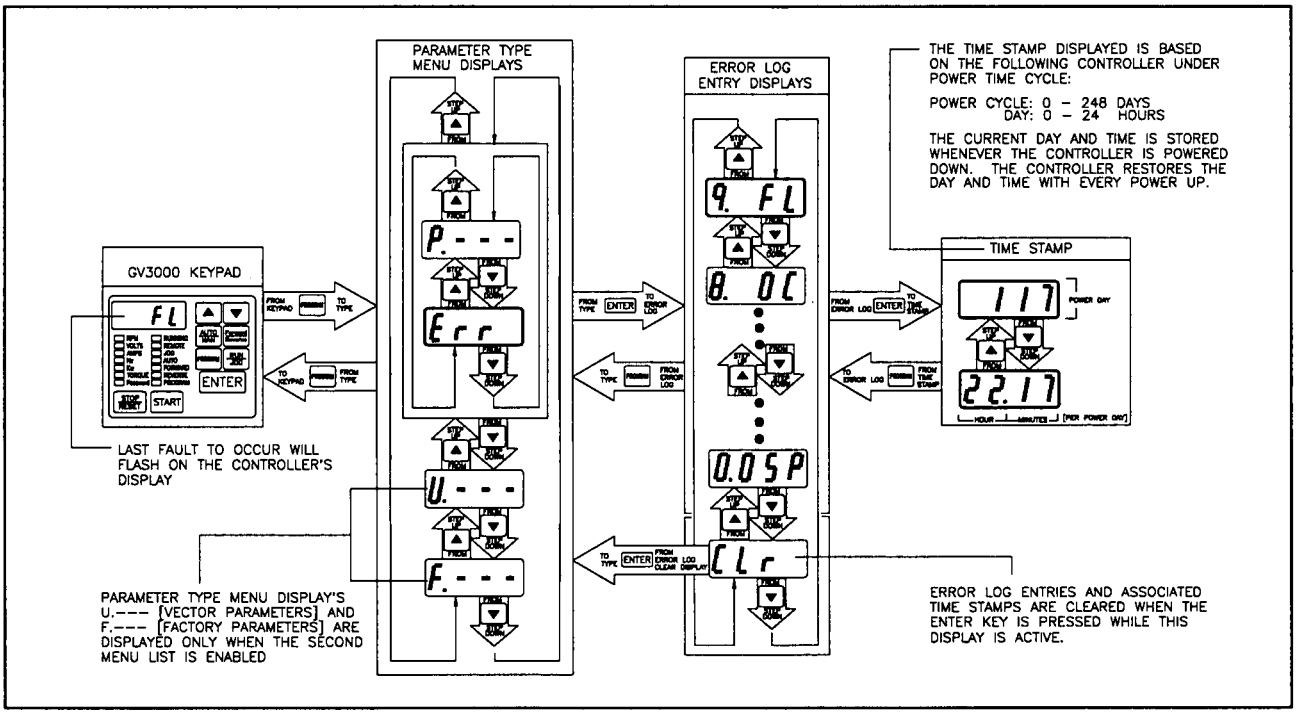

Figure 4.4 - Error Log and Time Stamp Displays

Action	Display/Notes
1. Press the PROGRAM key.	Example: Display shows "P.---". The PROGRAM LED goes ON.
2. Press the ▼ key until "ERR" is displayed.	Example: Display shows "ERR".
3. Press the ENTER key.	Example: Display shows the last fault to have occurred.
4. Scroll through the fault code list by pressing the ▲ or ▼ key.	Note: When "CLR" is displayed, pressing the ENTER key will clear the error log. When a fault code is displayed, pressing the ENTER key will display the number of days since the last power-up, and then pressing the ▲ or ▼ key will show HRS.MIN.

5.0 START THE CONTROLLER

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD START AND ADJUST IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

5.1 Startup CheckList ☑

1. Turn OFF, lockout or tag input power to the controller.

DANGER

AFTER DISCONNECTING INPUT POWER, WAIT FIVE MINUTES AND CHECK WITH A VOLTMETER AT TERMINALS (+) AND (−) TO INSURE THAT DC BUS CAPACITORS ARE DISCHARGED. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

2. Verify that DC bus volts is zero at terminals (+) and (−).

WARNING

THE GV3000 CONTROLLER IS NOT EQUIPPED WITH A COAST-STOP PUSHBUTTON. THE USER MUST INSTALL A HARDWIRED, OPERATOR-ACCESSIBLE PUSHBUTTON THAT PROVIDES A POSITIVE INTERRUPT AND SHUTS DOWN THE DRIVE. *(USE TERMINALS 16 AND 20.)* FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

3. Verify that the user-installed COAST-STOP pushbutton is installed. You must remove the factory installed jumper at terminals 16 and 20 for the COAST-STOP pushbutton to work.
4. Remove any debris from around the controller.
5. Check that there is adequate clearance around the controller.
6. Check and verify that the wiring to the control terminal strip and power terminals is correct.
7. Check that the terminals are tightened properly to the appropriate torque specifications given in Tables 3.3 and 3.5.
8. Check that user-supplied branch circuit protection is installed and correctly rated.
9. Check that the incoming AC power is rated correctly.
10. Check the motor installation and length of motor leads.
11. Disconnect any power correction capacitors connected to the motor.
12. Uncouple the motor from any driven machinery to initially start the controller.
13. Check that the rating of the transformer (if used) matches the controller requirements, and is connected for the proper voltage.
14. Verify that a properly sized ground wire is installed and that a suitable earth ground is used. Check for and eliminate any grounds between the motor frame and the motor power leads. Verify that all ground leads are run unbroken.

5.2 Starting the Controller

5.2.1 Preparations for Self Tuning

Self tuning is a procedure required for vector operation and run by the controller that determines the proper no load current value for parameter U.006 and determines the pulse tach PPR value for U.001. These values are necessary so that rated motor torque, speed, and horsepower can be developed in the vector mode.

NOTE: *Self tuning can only be run on motors with a base frequency of less than or equal to 60 Hz.*

DANGER

THE SUBSEQUENT STEPS REQUIRE ROTATING PARTS AND/OR ELECTRICAL CIRCUITS TO BE EXPOSED. STAY CLEAR IF UNIT MUST BE RUNNING OR DISCONNECT AND LOCKOUT OR TAG POWER SOURCE IF CONTACT MUST BE MADE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Turn power ON.
2. Check all general Parameter Settings (P.000 - P.052 as applicable) and verify that they are set correctly.
3. Check that the following Vector Parameter values are correct before initiating self tuning:

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT THE MAXIMUM OPERATING SPEED OF THE DRIVE. OVERSPEED DETECTION IN THE DRIVE DETERMINES WHEN THE DRIVE SHUTS DOWN AND IS FACTORY SET TO 130% OF MAXIMUM SPEED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

   a. U.002 (motor pole number)
   b. U.003 (motor base speed)
   c. U.004 (motor rated amps)
   d. U.005 (motor rated speed)

4. Verify that the motor is unloaded.
5. The controller must not be running. Press the STOP/RESET key.
6. Clear the error log of all errors. (Refer to "To View Fault Codes, Clear the Error Log, or View the Error Log Time Stamp", in Section 4.5.)
7. Set P.000 = 0 for Local operation, or =1 for Remote operation.

5.2.2 How to Stop the Self Tuning Procedure:

When self tuning is enabled (Parameter U.008 is turned ON), you can abort it by setting U.008 to OFF. If self tuning is STARTED (display shows "S_AC"), press the STOP/RESET key.

5.2.3 What Happens if a Fault Occurs During Self-Tuning?

1. If a stop is commanded and self-tuning is aborted, the drive will shut off, and coast to stop. An error message ("SF") is displayed.
2. Once self-tuning is stopped, parameter U.008 will be updated to OFF, and the drive is taken out of the self tuning mode.

5.2.4 Starting Self Tuning

1. Enable the Self-Tuning parameter. Set U.008 = ON.
2. Exit the PROGRAM mode and enter the DISPLAY mode. (Press the PROGRAM key twice when in the parameter list. The display should show "S_EN" when the PROGRAM mode is exited, and the DISPLAY mode is entered.)

WARNING
THE MOTOR WILL ROTATE DURING THE SELF-TUNING PROCEDURE. STAY CLEAR OF ROTATING MACHINERY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

3. Press the START key on the keypad. The display will show "S_AC" when self tuning is running. The controller will ramp up to 90% of the motor base frequency and perform self tuning calculations.

NOTE: *If self tuning aborts, and "SF" is displayed during self tuning, refer to Section 7 for a complete action chart for troubleshooting.*

4. Once self tuning is completed, the motor will ramp down to a stop, and Parameters U.001 (Pulse Tachometer Selection) and U.006 (Percent Motor Magnetizing Amps) will be automatically updated. The display will return to the normal display mode. The self tuning enable parameter, U.008, will be updated to "OFF".
5. Parameter U.009 will indicate the self-tuning result. Refer to Section 6, U.009 for a list of result codes.

5.3 Basic Controller Checks

1. Make sure that the controller interlocks installed around the driven machine are operational.
2. Check that any installed motor thermal overload switch and the controller's electronic motor thermal overload parameter (P.040) is enabled ("ON").
3. Press the START key. The motor should ramp to the preset speed at the acceleration rate set by P.001. The acceleration rate is the number of seconds from zero to rated RPM (U.005).
4. While the controller is in the RUN mode (the RUNNING LED is lit), check the display modes RPM, VOLTS, and AMPS and verify that they are reading correctly.

For REMOTE MODE: If using a remote speed reference, check using the SPEED REFERENCE DISPLAY MODE that the speed reference is correct (+/−10VDC, or 0-20mA).

Take into account any values set into P.010 (Analog Reference Gain) and P.009 (Analog Reference Offset) that have scaled the speed reference.

5.4 Tuning the Speed Regulator

NOTE: *Tuning the speed regulator may not be required for the application.*

1. Turn OFF, lock out or tag input power to the controller.
2. Connect the application load to the motor.
3. Turn Power ON.
4. Press the controller START key.
5. Adjust U.012 (Speed Regulator Proportional Gain) or U.013 (Speed Regulator Integral Gain) if necessary.

   U.012 is the proportional gain of the speed regulator, which determines how smoothly and quickly the controller responds to request for speed changes. A typical value is 2.0. Larger values result in faster response, but may show less stability. If the motor speed "overshoots" the speed setpoint when changes to the speed reference are made, or if the motor speed is unstable, reduce the value of U.012.

5.5 Final Adjustments

When operation is satisfactory:

1. Turn OFF, lock out and tag power to the controller. Verify that the D-C bus has discharged to 0 VDC at terminals (+) and (−).
2. Replace the controller cover (if removed) and secure.
3. Make a note of final parameter settings in Tables 8.1, 8.2 and 8.3.

5.6 Cover Installation, NEMA 4X (Indoor Only)/12

In order to maintain integrity of the NEMA 4X/12 enclosure, some care must be taken when re-installing the cover:

1. Run the (4) captive screws down, sequentially, to ensure even compression of the gaskets. Do not exceed 20 inch-pounds of torque on these screws.

6.0 ADJUSTING PARAMETERS

DANGER

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6.1 Introduction to Parameters

The GV3000 software allows access to many parameters that are adjustable by using the keypad. The factory preset values will suit a wide range of applications. To configure the controller for a specific application, you must bring up each appropriate parameter on the display and adjust as necessary. Tables 8-1 through 8-3 give a complete list of all available parameters, and their factory preset values. It also provides a space to check off, or enter values as they are modified for recordkeeping.

6.2 Parameter Menus and Password Entry

To simplify the configuration process, the controller software parameter list is divided into two menu lists. The first menu contains seven parameters (P.000 through P.006). Parameters P.000 through P.006 are most commonly used for simple applications.

WARNING

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P.006 permits access to the second menu, and requires a password to be entered to get there. You cannot change or access general Parameters P.007 through P.052 or any vector Parameters U.000 through U.013 unless the correct password is entered into Parameter P.006.

The second menu list (P.007 through P.052) allows access to more parameters to adjust the controller for more complex applications. These functions can be safety related and should be used only with a thorough understanding of how they may affect motor operation.

After entering the correct password into P.006, you can also obtain access to the Vector Parameters U.000 through U.013. This group of parameters is accessible by pressing the ◆ key after "P.---" is displayed in PROGRAM mode, and then pressing the ENTER key.

The error log is located after the vector parameter group "U.---", and is shown as "ERR" on the display. For more information on entering the error log, or clearing errors, refer to Section 4.5: "To View Fault Codes, Clear the Error Log, or View the Error Log Time Stamp".

Factory Set Parameters (displayed as "F.---") follow the error log, but cannot be accessed without a special service password. This password is not available to customers.

6.3 Configuring the Controller

Displays and keypad actions for configuring the controller is shown in Figure 6.1.

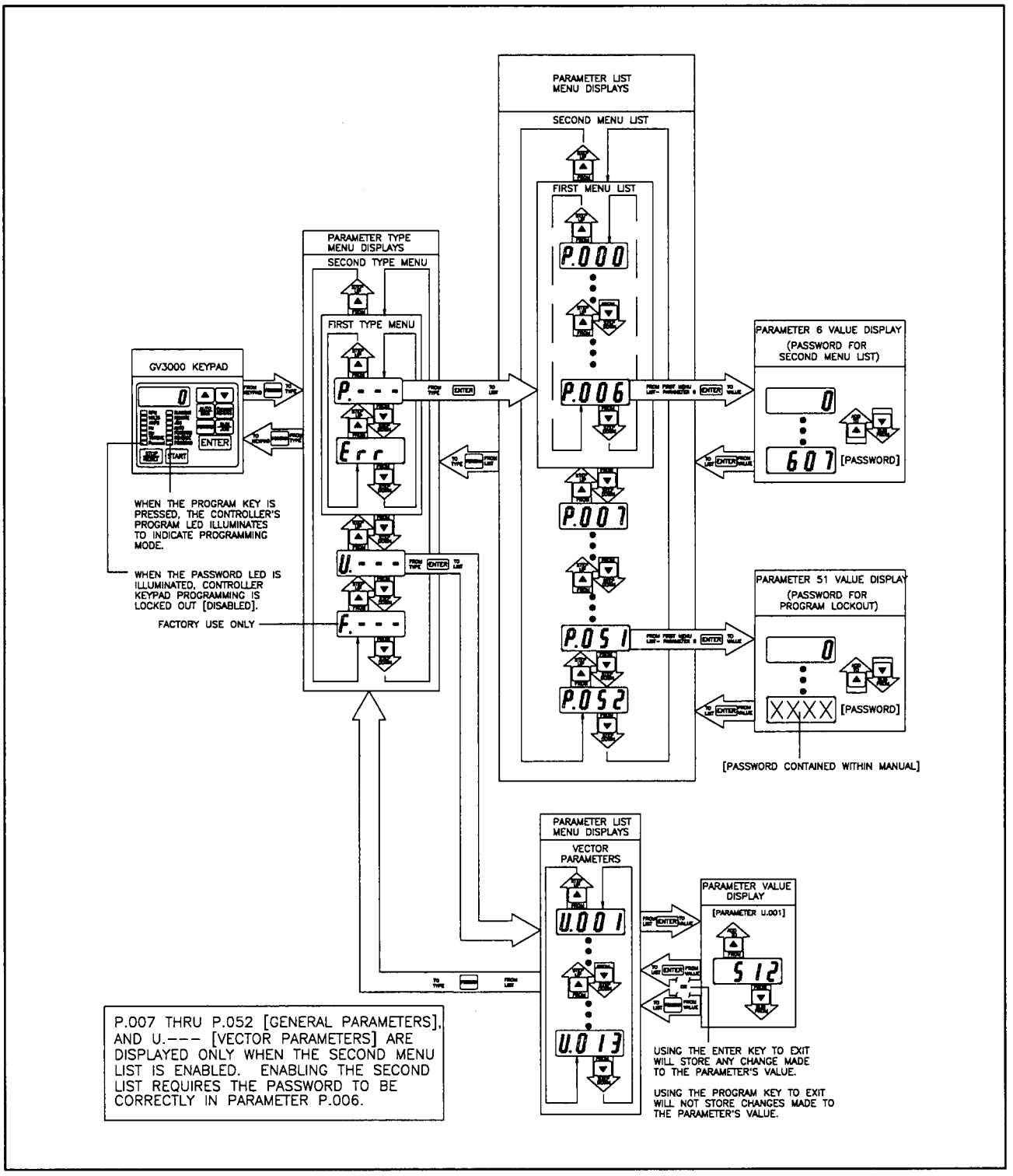

Figure 6.1 - Configuring the Controller

Refer to Figure 6.1.

1. Turn the power to the controller **ON** and wait for the controller to complete its self-diagnostic test.
2. Press the **STOP** key to confirm the controller is in the STOP mode.
3. Press the **PROGRAM** key. The display looks like: **[P.---]**
4. Press the **ENTER** key. The display looks like: **[P.000]**
5. NOTE: Parameter P.051 (Program Lockout) will disable the PROGRAM mode if the correct password was entered. Program Lockout is indicated if the PASSWORD LED is lit. If you cannot modify any parameters, check that the Program Lockout is disabled, and if it is, re-enter the password and verify that the PASSWORD LED goes out.
6. Using the ▲ and the **ENTER** keys, change parameters P.000 through P.005 if needed. Refer to Section 4.5 : "To View or Change Parameters in the First Menu List".
7. If you need access to the second menu list to modify general parameters P.007 through P.052, and any vector parameters, U.000 through U.013, enter the password into parameter P.006:
   a. Locate P.006 on the display: **[P.006]**
   b. Press the **ENTER** key.
   c. Using the ▲ key, scroll until the display shows: **[607]**
   d. Press the **ENTER** key.
   e. Display will show **[P.006]** again.
8. You can now scroll through parameters P.007 through P.052 and modify them as needed. Refer to Section 4.5: "To View or Change Parameters in the Second Menu List."
9. To change any Vector Parameters:
   a. Make sure the correct password has been entered into parameter P.006.
   b. Press the **PROGRAM** key. The following is displayed:
   c. Press the ▼ key one time until the following is displayed:
   d. Press the **ENTER** key to access the Vector parameters. Scroll through the list and change the vector parameters as necessary. Refer to Section 4.5: "To View or Change Parameters in the Second Menu List."
10. To return to the display mode, press the **PROGRAM** key two times.

6.4 General Parameters - First Menu List

P.000 **Operation Control Source**

Parameter Selection:

LOCL = Local Front Panel/Keypad

rE = Terminal Block Remote Inputs

PC = Not available

OP = Not available

Initial Setting:

LOCL

Description:

P.000 selects the operation control source. If LOCL is selected, all commands come directly from the front panel keypad. If REMOTE is selected, the controller will follow commands from the terminal strip remote inputs. The REMOTE LED on the keypad front panel will light.

P.001 **Acceleration Time (RAMP 1)**

Adjustment Range:

0.1 - 999.9 seconds

Initial Setting:

20.0 (20 seconds)

Description:

Acceleration time is the time in which the motor goes from zero speed to rated speed (U.005) after starting. The acceleration rate depends on the speed setting. If the motor load inertia is high or the current limit (P.005) setting is too low, actual motor acceleration time will be longer than the programmed time set in P.001. For Jog Acceleration Time, see P.021.

P.002 **Deceleration Time (RAMP 1)**

Adjustment Range:

0.1 - 999.9 seconds

Initial Setting:

20.0 (20 seconds)

Description:

Deceleration time is the time in which the motor decreases from rated speed (U.005) to zero speed when performing a ramp stop (P.025).

NOTE: *Motor load inertia and input line conditions can extend the deceleration time to a value greater than the preset time. With very fast deceleration times, regenerative motor voltage may charge up the DC bus voltage, causing a high bus voltage (HU) fault trip. To avoid a fault trip condition, reset the deceleration time for a longer period. If a deceleration time faster than the acceptable range is required, installing an optional Snubber Resistor Kit or regenerative braking module may prevent the trip.*

P.003 Minimum Speed Setting

Adjustment Range:

0 - P.004 Maximum Speed (RPM)

Initial Setting:

150

Description:

DANGER

THE DRIVE IS CAPABLE OF OPERATING AT AND MAINTAINING ZERO SPEED. THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONNEL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES TO INDICATE THAT THE DRIVE IS OPERATING OR MAY OPERATE AT OR NEAR ZERO SPEED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Minimum speed is the minimum allowed speed in RPM.

P.004 Maximum Speed Setting

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT THE MAXIMUM OPERATING SPEED OF THE DRIVE. OVERSPEED DETECTION IN THE DRIVE DETERMINES WHEN THE DRIVE SHUTS DOWN AND IS FACTORY SET TO 130%. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Adjustment Range:

10 - U.005 Motor Rated Speed (RPM)

Initial Setting:

1722

Description:

Maximum speed is the maximum allowed speed in RPM.

NOTE: *It is recommended that when changing the maximum speed value (P.004), also rescale the rpm display mode parameter (P.028) to the same value so that when you look at the RPM display mode, it corresponds to the maximum speed.*

The controller is equipped with fixed overspeed protection at 130% of maximum speed.

P.005 Current Limit

Adjustment Range:

U.006 - 150%

Initial Setting:

150

Description:

P.005 represents current limit as the stator current limit in respect to the motor rated amps.

For vector operation, torque is not proportional to the stator current, and therefore, current limit is not linear to the amount of torque produced. The amount of torque produced is not only a function of the stator current limit, but also of the magnetizing current percent. Changing the current limit rating affects the maximum attainable torque the motor can produce. The following equation shows how maximum torque is reached:

$$\text{Max Torque} = \frac{I_{limit} - I_{mag}}{10{,}000 - I_{mag}} \times 100$$

Where:

I_{limit} = Current limit percent

I_{mag} = Magnetizing current percent

$$= \frac{\text{No load current}}{\text{Rated current}} \times 100$$

P.006 Expand to Second Menu List

WARNING
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Adjustment Range:

0 - 32767

Initial Setting:

0

Password: 607

Description:

The first menu list (P.000 through P.005) contains most parameters needed to be viewed or adjusted on an operator's level. None of the second menu parameters can be changed or viewed unless the correct password is entered into P.006. If the password is not entered, when you scroll through the parameters, at P.006, the list will complete its cycle and return to P.000. Once the password is entered correctly at P.006, the list will now scroll up to P.052 and also allows access to the vector parameter group (U.---) as well.

☞ **To enter the password to expand to the second menu list:**

1. Enter the PROGRAM mode.
2. Access P.006 on the display.
3. Press the ENTER key.
4. Using the ▲ key, scroll the number from 0 until the number 607 is displayed.
5. Press the ENTER key. (The display will show "P.006" after pressing the ENTER key.)
6. Second Menu List parameters can now be accessed and modified. Entering the password again will disable the password.

NOTE: *If you access P.006 after entering the password, the value will go back to showing zero, even though you can now access the second menu long list. The zero value is to prevent unauthorized password use. The last state when the controller is powered down will remain when powered back up.*

6.5 General Parameters - Second Menu List

P.007 **Terminal Block Digital Input Configure**

Parameter Selection:

	Digital Input 6: Terminal 19	Digital Input 7: Terminal 18	Digital Input 8: Terminal 17
0 =	DIG6=FWD/REV	DIG7=RAMP1/2	DIG8=REM/LOC
1 =	Not used	DIG7=FWD/REV	DIG8=RAMP1/2
2 =	Not used	DIG7=FWD/REV	DIG8=REM/LOC
3 =	Not used	DIG7=RAMP1/2	DIG8=REM/LOC
4 =	Not used	Not used	DIG8=FWD/REV
5 =	Not used	Not used	DIG8=RAMP1/2
6 =	Not used	Not used	DIG8=REM/LOC
7 =	Not used	Not used	Not used

Refer to Table 3.6 for Control Terminal block wiring.

Initial Setting:

(All inputs are assigned:)

0 = DIG6=FWD/REV
DIG7=RAMP1/2
DIG8=REM/LOC

Description:

This parameter selects how digital inputs 6, 7, and 8 are to be used. Depending on what is selected for P.008, Terminal Block Speed Reference Selection, will limit the selection of P.007. This is because what is selected for P.008 may use one or more of digital inputs 6 through 8.

A negated (open) or asserted (closed) input will select the following for the three input choices:

	Open (Unasserted)	Closed (Asserted)
FWD/REV	Forward	Reverse
RAMP1/2	Ramp 1	Ramp 2
REM/LOC	Remote	Local

RAMP1/2 = Allows you to specify two separate accel(decel) rates, and instantly select between the two. Note that this is a remote switch between two separate (paired) rates. It does not select between one accel rate, and a different decel rate. Ramp 1 uses accel or decel rates based on P.001/P.002. Ramp 2 uses accel or decel rates based on P.017/P.018. NOTE: The digital input for RAMP1/2 is *always* active in LOCAL or REMOTE modes.

FWD/REV = Allows you to select between open or closed digital input state. If the selected speed reference value is negative (<0), and the FWD/REV input is closed (which allows Reverse direction), then the resulting speed reference will be positive, or forward.

REM/LOC = Allows you to temporarily switch from a remote running condition to local keypad operation without breaking the 2-wire control run signal. The following example shows how this input can be utilized.

WARNING

IF A MAINTAINED START CONTACT IS USED IN REMOTE MODE, SWITCHING FROM LOCAL TO REMOTE WILL CAUSE THE CONTROLLER TO START AND THE MOTOR WILL ROTATE IF THE REMOTE START CONTACT IS CLOSED. STAY CLEAR OF ROTATING MACHINERY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

REM/LOC INPUT EXAMPLE:

The controller is stopped and started using an external 2-wire control signal. The controller is in "Remote" mode (P.000 = rE), and is being given a maintained start command. The REM/LOC option (2 is selected for P.007) so that an external "REM/LOC" switch mounted externally switch the controller from REMOTE to LOCAL or from LOCAL to REMOTE. This external switch is in the "REMOTE" position. The following happens:

1. The front panel STOP/RESET key is pressed, and the motor stops.
2. "LOCAL" is selected using the externally wired "REM/LOC" switch.
3. Control of the drive is done locally through the front panel. (This could be for trouble-shooting purposes, or for looking at or changing parameter values).
4. The "REM/LOC" switch is switched back to the "REMOTE" position. The controller RUNS immediately because there is already an asserted remote start signal.
5. The controller is now running in the REMOTE mode.

NOTE: *A default value of 0 for P.007, will limit P.008 to a parameter selection of 0. You must change P.007 to some value other than 0, in order to change P.008 to some value other than 0. See Table 6.1 and the selection example in P.008 Description.*

P.008 Terminal Block Speed Reference Selection

Parameter Selection:

0 = Analog Reference (digital inputs 6, 7, and 8 are unused)

1 = MOP Selection (uses terminal block digital input 6 for the MOP increment function, and digital input 7 for the MOP decrement function)

2 = Two (2) Multi-speed Presets (uses terminal block digital input 6, but leaves inputs 7 and 8 free)

3 = Four (4) Multi-speed Presets (uses terminal block digital inputs 6 and 7, but leaves input 8 free)

4 = Eight (8) Multi-speed Presets (uses all terminal block digital inputs 6, 7, and 8)

Initial Setting:

0 = Analog Reference

Description:

This parameter selects the source of the terminal block speed reference. The parameter entry is also dependent on what is selected for Parameter P.007. Selection of Parameter P.007 determines what the configurable digital inputs 6, 7 , and 8 are used for. The acceptable values for P.007 are based on what is selected for P.008 and are shown in Table 6-1.

Table 6.1 - Digital Input Limits Matrix Selection.

P.007 Selection Choices	P.008 Selection Choices				
	0	1	2	3	4
0	✓				
1	✓		✓		
2	✓		✓		
3	✓		✓		
4	✓	✓	✓	✓	
5	✓	✓	✓	✓	
6	✓	✓	✓	✓	
7	✓	✓	✓	✓	✓

Table 6.1 indicates the acceptable combinations for Parameters P.007 and P.008. A blank cell indicates that the combination is not acceptable due to conflicts where inputs are already assigned.

P.007 and P.008 Selection Example:

- You want to select the MOP as the speed reference source. From the *parameter selection* range shown for P.008, this means that the value for P.008 must be equal to 1.
- Now configure the value needed for P.007. Since the MOP uses digital inputs 6 and 7, this only leaves values for P.007 to be equal to 4, 5, 6, or 7.
- Go to the P.008 = 1 column, and notice that 0,1,2, or 3 selection choices for P.007 cannot be made. Following the column down, notice that 4,5,6, or 7 selection choices for P.007 CAN be made.

P.009 Terminal Block Analog Input Speed Reference Offset

Adjustment Range:

−250 to +250

NOTE: Units = 1023 counts = +10V
Approximately 102 = 1V of offset

Initial Setting:

0

Description:

The analog input speed reference offset parameter is used to scale the zero speed reference input to match external equipment. Normally, the zero speed reference is either 0 VDC or 0 mA. The offset and gain parameters can be used to convert the 0-20mA signal to a 4-20mA signal usually used on equipment.

To adjust: Set P.000 = rE (1) or press the AUTO/MAN key until the AUTO LED is ON. Then use the Speed Reference Display Mode (see Section 4) to display the speed reference (displayed as RPM) from the selected control source Local or Remote. P.008 must be 0 to select analog input as the speed reference.

Figure 6.2 shows an example of how the analog input saturates at minimum and maximum speed.

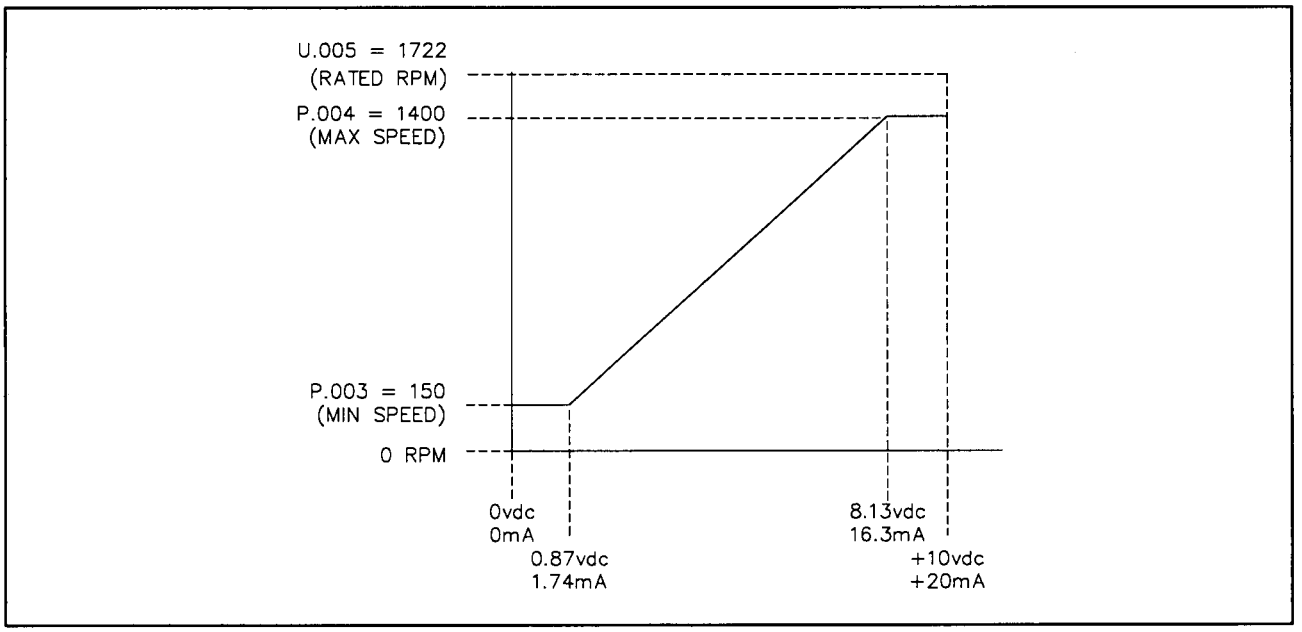


Figure 6.2 - Relationship of Analog Input Speed Reference to Minimum and Maximum Speed.

P.010 Terminal Block Analog Input Speed Reference Gain

Adjustment Range:

−.750 - 1.250

Initial Setting:

1.000

Description:

The analog speed reference gain parameter is used to scale the speed reference input to match external equipment.

To adjust: Set P.000 = rE (1) or press the AUTO/MAN key until the AUTO LED is ON. Then use the Speed Reference Display Mode (see Section 4) to display the speed reference (displayed as RPM) from the selected control source Local or Remote. P.008 must be 0 to select the analog input as the speed reference.

Figure 6.2 shows an example of how the analog input saturates at minimum and maximum speed.

P.011 Terminal Block Analog Input Speed Reference Invert Selection

Parameter Selection:

OFF =

0-20mA:	0mA=0
	20mA = + Motor Rated RPM (U.005)
0-10VDC:	0VDC = 0
	+10VDC = + Motor Rated RPM (U.005)
−10VDC to 10VDC:	−10VDC = - Motor Rated RPM (U.005)
	+10VDC = + Motor Rated RPM (U.005)

ON = (Inverted)

0-20mA:	0mA=0
	20mA = - Motor Rated RPM (U.005)
0-10VDC:	0VDC = 0
	+10VDC = - Motor Rated RPM (U.005)
−10VDC to 10VDC:	−10VDC = + Motor Rated RPM (U.005)
	+10VDC = - Motor Rated RPM (U.005)

Initial Setting:

OFF

Description:

When this parameter is enabled (ON), the analog speed reference input becomes inverted.

NOTE: *If the terminal block analog input is selected as the torque reference (U.000 = 1), then substitute + or − 150% torque limit for + or − Motor Rated RPM.*

P.012 Terminal Block Analog Output Source Selection

Parameter Selection:

0 = Speed Loop feedback

1 = Torque/Current feedback

Initial Setting:

0

Description:

0 = Speed Feedback:

This selection specifies the analog output source to be speed feedback. Refer to Table 6.2:

Table 6.2 - Speed Feedback Analog Output Values.

Speed Feedback	Analog Output (4-20mA)	Analog Output (0-10V)
−2 x (rated RPM)	4mA	0.0 V
− rated RPM	8mA	2.5 V
−1/2 rated RPM	10mA	3.75 V
0	12mA	5.0 V
+1/2 rated RPM	14mA	6.25 V
+ rated RPM	16mA	7.5 V
+2 x (rated RPM)	20mA	10.0 V

NOTE: *Rated RPM is Motor Rated Speed (U.005).*

1 = Torque/Current Feedback:

This selection specifies the analog output source to be torque feedback. Refer to Table 6.3.

Table 6.3 - Torque/Current Feedback Analog Output Values.

Torque Feedback	Analog Output (4-20mA)	Analog Output (0-10V)
−300%	4mA	0.0 V
−150%	8mA	2.5 V
−75%	10mA	3.75 V
0%	12mA	5.0 V
+75%	14mA	6.25 V
+150%	16mA	7.5 V
+300%	20mA	10.0 V

P.013 Output Relay Configuration

Parameter Selection:

0 = Output Relay is energized to show state of active IET (instantaneous electronic trip)

1 = Output relay is energized to show state of controller running (NOTE: This is asserted 1/2 second before motor turns.)

Initial Setting:

0

Description:

This parameter specifies whether the output relays, wired to the terminal block terminals 28, 29, 30 and 31, indicate the state of an active IET controller fault, or that the controller is running.

Example for use: An indicator light may be wired to these contacts, to indicate the present operating state of the controller.

P.014 Trim Reference Source Selection

Parameter Selection:

0 = No Trim Reference Used

1 = Terminal Block Analog Input

2 = Options Port Trim Reference Register (Reserved for later versions)

3 = Maximum Speed

4 = Torque Current Feedback

Initial Setting:

0 = No trim reference

Description:

This parameter specifies the source for the trim reference. Trim reference offsets the speed reference. See Figure 6.3.

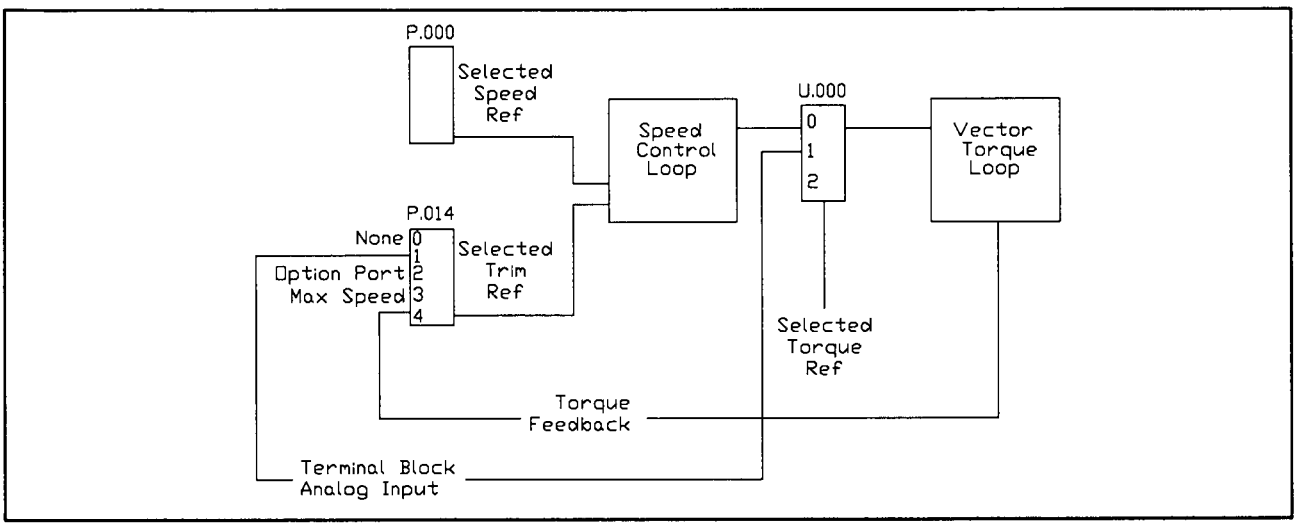


Figure 6.3 - Trim Reference Source Selection.

P.015 Trim Gain Percentage

Adjustment Range:

– 99.9 to +99.9 %

Initial Setting:

0.0

Description:

Trim gain is a percentage of the selected trim reference entering the speed regulator. See Figure 6.4. A value of 1.0 is an increment of 1% gain.

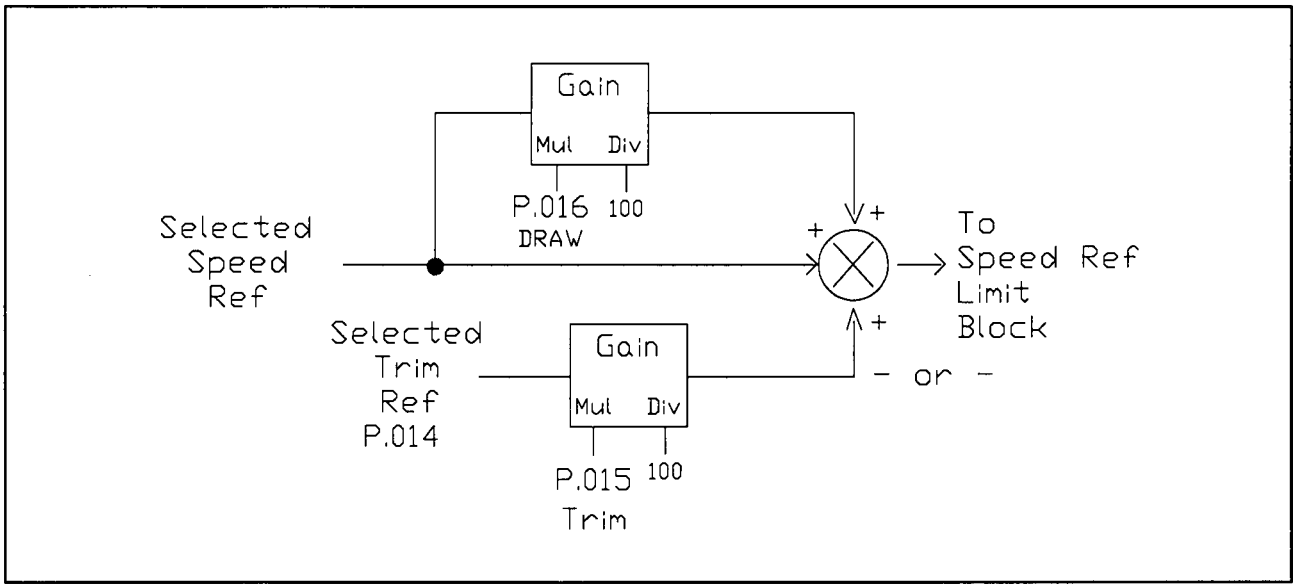


Figure 6.4 - Draw and Trim Gain.

P.016 Draw Gain Percentage

Adjustment Range:

– 99.9 to +99.9 %

Initial Setting:

0.0

Description:

Draw gain adds a percentage of the selected speed reference entering the speed regulator. (See Figure 6.5.) This parameter will allow multiple drive sections with a common line reference, but with different values for draw gain, to run at different speeds depending on the percent draw. A value of 1.0 is an increment of 1% gain.

P.017 Draw Gain Percentage

Adjustment Range:

0.1 to 999.9 seconds

Initial Setting:

20.0

Description:

This parameter sets the acceleration time when a second ramp selection is configured as a digital input. When RAMP 2 acceleration time digital input is asserted, the RAMP 2 deceleration rate also takes effect. Refer to P.007, Terminal Block Digital Input Configure, for digital input selection parameters.

P.018 Second Ramp Deceleration (RAMP 2)

Adjustment Range:

0.1 to 999.9 seconds

Initial Setting:

20.0

Description:

This parameter sets the deceleration time when a second ramp selection is configured as a digital input. When RAMP 2 deceleration time digital input is asserted, the RAMP 2 acceleration rate also takes effect. Refer to P.007, Terminal Block Digital Input Configure, for digital input selection parameters.

P.019 S-Curve Selection

NOTE: *This parameter does not apply to the Jog Acceleration (P.021) or Deceleration (P.022) Parameters.*

Parameter Selection:

OFF = Use Linear Accel/Decel Function

ON = Use S-Curve Accel/Decel Function

Initial Setting:

OFF

Description:

When S-Curve accel/decel is selected, the accel or decel ramp times begins and ends slowly, creating an "S-Curve" function. The portion of the accel time which makes up the non-linear "S" portion will be a fixed 20% of the programmed accel time at the beginning (bottom), and 20% at the end (top) of the accel curve. The linear portion makes up 60% of the programmed accel time. The S-Curve accel/decel function is shown in Figures 6.5 and 6.6.

NOTE: *The accel and decel times must be set the same for the S-Curve ramp to function the same for accel as decel. If the decel rate is set lower than the accel rate, the decel time specified may not be met.*

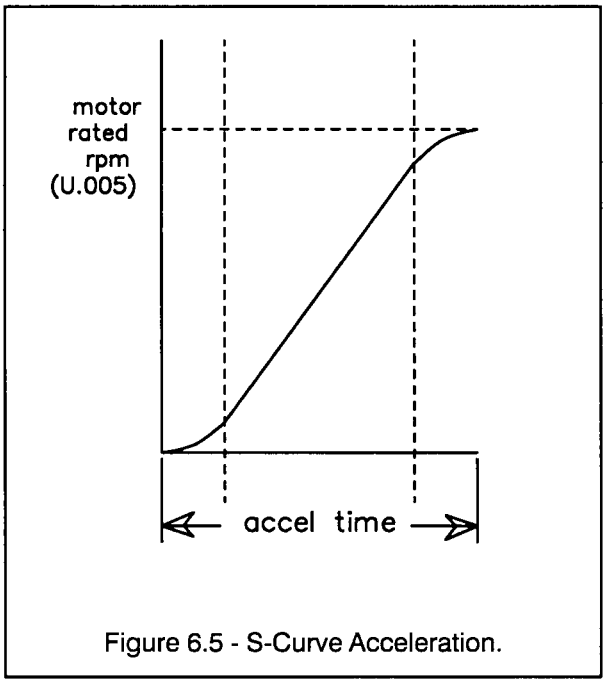


Figure 6.5 - S-Curve Acceleration.

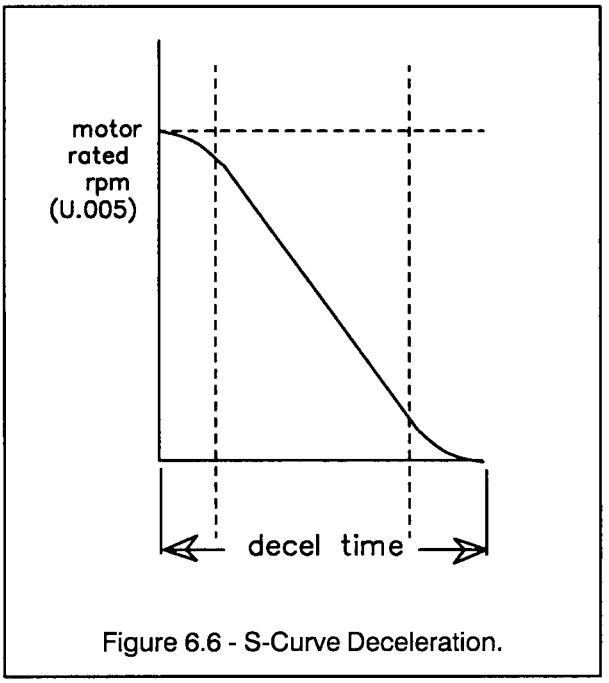


Figure 6.6 - S-Curve Deceleration.

P.020 **Jog Speed Reference**

Adjustment Range:

Minimum Speed (P.003) to Maximum Speed (P.004)

Initial Setting:

150 (RPM)

Description:

Jog speed is the setpoint while in jog mode. Jog reference is activated when the START key is maintained "ON", and the JOG mode has been selected.

P.021 **Jog Ramp Acceleration Time**

Adjustment Range:

0.1 - 999.9 seconds

Initial Setting:

20.0

Description:

The jog acceleration time is the amount of time (seconds) it takes to go from zero speed to rated speed (U.005) while in JOG mode.

P.022 Jog Ramp Deceleration Time

Adjustment Range:

0.1 - 999.9 seconds

Initial Setting:

20.0

Description:

The jog deceleration time is the amount of time (seconds) it takes to go from rated speed (U.005) to zero speed while in JOG mode.

P.023 MOP Reference Rate

Adjustment Range:

0.1 - 999.9 seconds

Initial Setting:

20.0

Description:

The MOP (electronic Motor Operated Pot) reference rate sets the amount of time (seconds) for the MOP to go from zero speed to rated speed (U.005), or from rated speed (U.005) to zero speed.

P.024 MOP Reset

Parameter Selection:

0 = Reset MOP setpoint after IET (Instantaneous Electronic Trip)

1 = Reset MOP setpoint during each stop

2 = Do not Reset MOP setpoint

NOTE: *When the speed reference selection (P.008) remains the MOP, if the controller is powered down, and powered back up, the MOP function setpoint will always be reset to equal minimum speed (P.003). When the MOP function is set and then disabled by using Parameter P.008 (Terminal Block Speed Reference Selection), the last value prior to being disabled will be retained.*

Initial Setting:

0

Description:

This parameter determines when and if the MOP setpoint is reset to minimum speed (P.003). The MOP provides a digital speed reference which can be incremented and decremented using terminal block digital inputs.

P.025 STOP Type Selection

WARNING

THE CONTROLLER IS NOT EQUIPPED WITH A COAST-STOP PUSHBUTTON. THE USER MUST INSTALL A HARDWIRED, OPERATOR-ACCESSIBLE PUSHBUTTON THAT PROVIDES A POSITIVE INTERRUPT AND SHUTS DOWN THE DRIVE. USE TERMINALS 16 AND 20. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING

IF P.025 IS = 1 (SELECTED FOR RAMP STOP), THEN PARAMETER U.000 MUST BE = 0. THE SPEED LOOP OUTPUT MUST BE USED AS THE TORQUE REFERENCE SELECTION WHEN RAMP STOP IS USED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Parameter Selection:

0 = Coast to Rest Stop

1 = Ramp to Rest Stop (If P.025 is = 1, then U.000 must be = 0.)

Initial Setting:

0

Description:

When parameter "0" is selected, pressing the STOP key or giving an external STOP command, causes the motor to coast to rest. With parameter selection of "1", pressing the STOP key or sending an external STOP command, causes the motor to ramp to rest within a time equal to or greater than the preset deceleration time (P.002).

P.026 Function Loss Selection

Parameter Selection:

0 = Fault trip (IET) occurs at function loss

1 = Coast to Rest stop without an IET output at function loss.

Initial Setting:

0

Description:

WARNING

THE CONTROLLER IS NOT EQUIPPED WITH A COAST-STOP PUSHBUTTON. THE USER MUST INSTALL A HARDWIRED, OPERATOR-ACCESSIBLE PUSHBUTTON THAT PROVIDES A POSITIVE INTERRUPT AND SHUTS DOWN THE DRIVE. (USE TERMINALS 16 AND 20 FOR FUNCTION LOSS INTERRUPT). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

If parameter "0" is selected, a function loss signal causes the controller to stop, resulting in the following:

- The motor will coast to rest.
- The function loss error code ("FL") will be displayed.
- The internal speed reference will be reset to zero.
- The output relay will be asserted, if P.013 is configured for IET output.
- The IET trip must be reset using the STOP/RESET key before the controller can be restarted.

If parameter "1" is selected, a function loss signal causes the controller to stop, resulting in the following:

- The motor will coast to rest.
- The internal speed reference will be reset to zero.
- The output relay will NOT be asserted.
- The controller can be restarted with the START button, after the cause of the fault has been removed.

P.027 Reverse Disable

Parameter Selection:

OFF = Forward/Reverse Enabled from Selected Control Source

ON = Reverse Disabled from Selected Control Source

Initial Setting:

OFF

Description:

If "OFF" is selected, the forward/reverse input will allow forward or reverse rotation of the motor. When "ON" is selected, reverse rotation is not allowed. This is true from any selected control source.

P.028 RPM Display Mode Scaling

NOTE: *To enter the RPM Display Mode:*

1. Press the PROGRAM key until ("P.---") is displayed.
2. Press the PROGRAM key again (the PROGRAM LED will go out.)
3. The RPM LED is lit. The display is now in RPM Display Mode.

Adjustment Range:

10 - 9999

Initial Setting:

1722

Description:

This parameter defines the scaling value (speed or any engineering unit) to be used when in the "RPM" display mode.

Whatever value is set into this parameter will, in effect, become the maximum *displayed* value for the local setpoint, or become the maximum *displayed* value for the RPM display mode. The RPM value displayed when in RPM Display Mode is:

$$\frac{\text{Current Operating Speed x P.028}}{\text{P.004 (Max Speed)}}$$

RPM Display Mode Example:

Example: You need the display to be scaled to show the maximum speed as 800 gallons/minute.

Parameter P.003 is set equal to = 150

Parameter P.004 is set equal to = 1722

1. Set Parameter P.028 = 800.
2. Enter the RPM Display Mode.
3. Start the controller. (Press the START key).
4. When run up to rated speed, the RPM display mode shows that maximum speed is 800 gallons/minute.

P.029 Elapsed Time Meter Readout

Adjustment Range:

0 - 9999 days

Initial Setting:

N/A

Description:

This parameter displays the number of days (24 hour period) since the controller has been first under power or since the elapsed time meter parameter was last reset. (See P.030.)

P.030 Elapsed Time Meter Reset

Parameter Selection:

OFF = No action.

ON = Reset the elapsed time meter to zero (0). (Parameter P.029 will be reset = 0.)

Initial Setting:

OFF

Description:

Resets Parameter P.029 to a zero value. This parameter is set to OFF after the reset operation is carried out.

P.031 - P.038 Multi-Speed Preset #1 through Multi-Speed Preset #8

Adjustment Range:

Minimum Speed (P.003) - Maximum Speed (P.004)

Initial Setting:

150

Description:

Parameters P.031 through P.038 allow setting of up to eight different preset speed profiles. The multi-speed presets are configured using Parameters P.007 and P.008 which define the digital inputs 6,7, and 8 assignments. P.008 must be set to values of either 2,3, or 4 for multi-speed presets. Refer to the Digital Assignment Matrix in Table 6.4 and in Figure 6.7.

Table 6.4 - Multi-Speed Preset Digital Input Matrix.

0 = Digital Input Open 1 = Digital Input Closed

Digital Inputs (Terminals) 8 (17) 7 (18) 6 (19)			Multi-Speed Preset Parameters
0	0	0	**P.031**
0	0	1	**P.032**
0	1	0	**P.033**
0	1	1	**P.034**
1	0	0	**P.035**
1	0	1	**P.036**
1	1	0	**P.037**
1	1	1	**P.038**

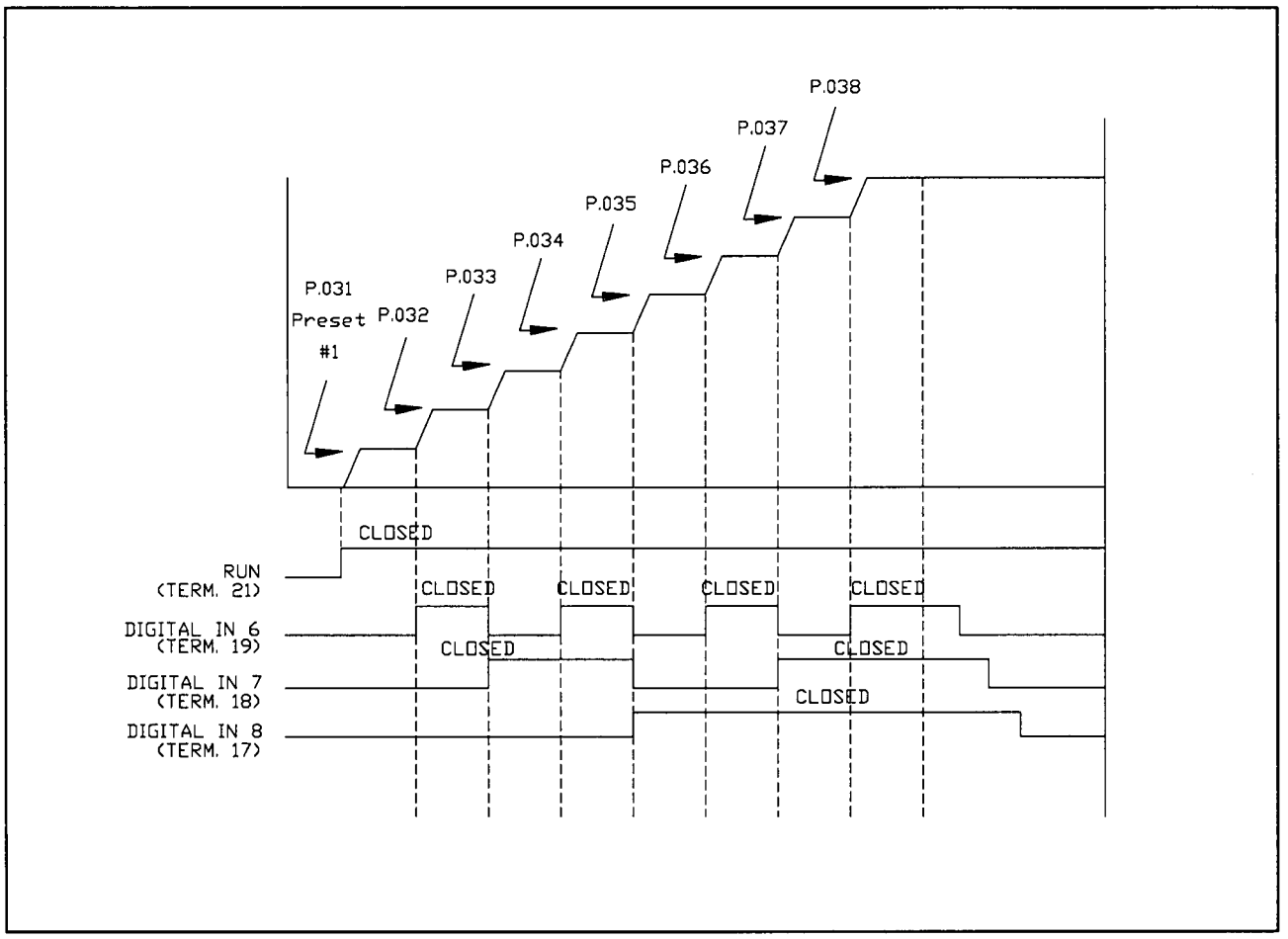


Figure 6.7 - Typical Multi-Speed Preset Operation.

P.039 **Reserved for Later Use**

P.040 Electronic Motor Thermal Overload

CAUTION: This parameter should always be set equal to on. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Parameter Selection:

OFF = Electronic Motor Thermal Overload is Disabled

ON = Electronic Motor Thermal Overload is Enabled

Initial Setting:

ON

Description:

When this parameter is "ON", the controller will trip if the thermal overload time is exceeded (60 seconds at 150% of motor rated current). The overcurrent amount is automatically calculated by the controller software based on the motor rated amps (U.004) and the drive panel rated amps (factory set).

P.041 - P.046 Reserved for Later Use

P.047 Carrier Frequency Selection

Parameter Selection:

2 = 2 kHz Carrier Frequency

4 = 4 kHz Carrier Frequency

8 = 8 kHz Carrier Frequency

Initial Setting:

8

Description:

The carrier frequency can compensate for acoustic noise by adjusting the switching frequency of the transistors in the inverter section. The carrier frequency controls the width of the pulse and keeps the current smooth to the motor.

Keeping the carrier frequency at 8 kHz will ordinarily provide the quietest motor operation.

P.048 Controller Type Selection

Parameter Selection:

UEC = Vector Control

Initial Setting:

UEC

Description:

N/A

P.049 Default Type Selection

Parameter Selection:

USA = USA Default Settings

EUr = European Default Settings

JPn = Japan Default Settings

Initial Setting:

USA

Description:

Sets the factory initial default settings for each controller type. Refer to Tables 8.1 through 8.3 for default settings.

P.050 Restore Default Settings

Parameter Selection:

OFF = No Action

ON = Reset Parameters to Default Settings

Initial Setting:

OFF

Description:

This parameter, when set equal to "ON", will reset all parameters to the default settings type as selected in P.049. After the parameter values have been restored, P.050 will be set to equal "OFF" by the controller.

P.051 Program Lockout

Adjustment Range:

0 - 32767

Initial Setting:

0

Password:

1044

Description:

This parameter requires the correct password to be entered in order to prevent parameter modification from the keypad front panel. To disable parameter programming:

1. Access P.051 on the display.
2. Press the ENTER key. Display shows "0".
3. Increment the value to 1044.
4. Press the ENTER key. Display shows "P.051".
5. The front panel "PASSWORD" LED will be lit to indicate that you cannot modify any parameters.

To return back to enable programming, re-enter the password by repeating the steps above. Whatever state this parameter is in when power is removed, will remain the state when power is returned.

P.052 Software Version

Description:

Displays the software version number. This parameter is not adjustable by the user.

6.6 Vector Operation Parameters

U.000 **Torque Reference Source Selection**

Parameter Selection:

0 = Use Speed Loop Output
NOTE: *If U.000 is 1, then P.025 must be = 0 (coast stop).*

1 = Terminal Block Analog Input (See *Note 1*)

2 = Reserved for Later Use

WARNING
IF P.025 IS = 1 (SELECTED FOR RAMP STOP), THEN PARAMETER U.000 MUST BE = 0. THE SPEED LOOP OUTPUT MUST BE USED AS THE TORQUE REFERENCE SELECTION WHEN RAMP STOP IS USED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

NOTE 1: *The analog input is conditioned with offset and gain parameters (P.009 and P.010) and the signal can be inverted using the analog input invert (P.011) parameter.*

Initial Setting:

0

Description:

This parameter specifies the source for the torque reference. The source of the torque reference can be either the output of the speed loop (default), or the analog input (the controller regulates only torque with this selection and the current limit parameter - P.005 - is not applied).

U.001 Pulse Tachometer Selection

WARNING

THE SETTING OF PARAMETERS U.001 (PULSE TACHOMETER SELECTION), U.002 (MOTOR POLES), U.003 (MOTOR BASE FREQUENCY), AND U.005 (MOTOR RATED SPEED) DETERMINE THE MOTOR MAXIMUM SPEED. THESE PARAMETERS MUST BE SET BY A QUALIFIED PERSON WHO UNDERSTANDS THE SIGNIFICANCE OF SETTING THEM ACCURATELY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING

DO NOT USE A 4096 PPR TACHOMETER WITH A 2-POLE MOTOR. OVERSPEED AND MOTOR DAMAGE CAN RESULT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

NOTE: *If torque control self tuning is performed, then the value of this parameter is automatically set when self tuning is successful.*

Parameter Selection:

512 = 512 PPR

1024 = 1024 PPR

2048 = 2048 PPR

4096 = 4096 PPR

Initial Setting:

1024

Description:

Parameter U.001 selects the number of pulses per revolution (PPR) of the tachometer being used. The PPR must be selected based on a 125 kHz maximum input frequency limitation. The pulse tachometer PPR selection affects the minimum and the maximum operational speed in RPM and also affects the speed range.

The maximum input frequency can be calculated by the formula:

$$Fmax = \frac{U.005 \times U.001}{60}$$

where, Fmax is the maximum frequency in Hz.

U.002 Motor Poles Number

WARNING

THE SETTING OF PARAMETERS U.001 (PULSE TACHOMETER SELECTION), U.002 (MOTOR POLES), U.003 (MOTOR BASE FREQUENCY), AND U.005 (MOTOR RATED SPEED) DETERMINE THE MOTOR MAXIMUM SPEED. THESE PARAMETERS MUST BE SET BY A QUALIFIED PERSON WHO UNDERSTANDS THE SIGNIFICANCE OF SETTING THEM ACCURATELY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING

DO NOT USE A 4096 PPR TACHOMETER WITH A 2-POLE MOTOR. OVERSPEED AND MOTOR DAMAGE CAN RESULT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

NOTE: *This parameter must be entered before Parameter U.005 (Rated RPM). Parameter U.005 is limited by the number of motor poles entered into Parameter U.002.*

Parameter Selection:

2 = 2 Poles

4 = 4 Poles

6 = 6 Poles

8 = 8 Poles

Initial Setting:

4

Description:

This parameter identifies the number of poles in the motor. If it is unknown, the number of poles can be obtained from data from the motor nameplate as follows:

1. Obtain the motor rated RPM as listed on the motor nameplate.
2. Obtain the motor rated frequency as listed on the motor nameplate.
3. Figure the RPM value at 60 Hz as follows:

$$\textit{RPM @ 60 Hz} = \frac{60}{\text{Motor Base Frequency (Hz) (U.003)}} \times \text{Rated RPM (U.005)}$$

4. Figure the number of motor poles needed by looking up the value computed for *RPM @ 60 Hz*:

Range of RPM@60Hz:	Number of Poles:
3600 - 3240	2
1800 - 1620	4
1200 - 1080	6
900 - 810	8

U.003 Motor Base Frequency

WARNING

THE SETTING OF PARAMETERS U.001 (PULSE TACHOMETER SELECTION), U.002 (MOTOR POLES), U.003 (MOTOR BASE FREQUENCY), AND U.005 (MOTOR RATED SPEED) DETERMINE THE MOTOR MAXIMUM SPEED. THESE PARAMETERS MUST BE SET BY A QUALIFIED PERSON WHO UNDERSTANDS THE SIGNIFICANCE OF SETTING THEM ACCURATELY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

NOTE: *This parameter must be entered before Parameter U.005 (Rated RPM). Parameter U.005 is limited by the motor base frequency.*

Adjustment Range:

30.0 - 120.0 Hz

Initial Setting:

60.0

Description:

Enter the motor base frequency in Hz directly from the motor nameplate.

U.004 Motor Rated Amps

CAUTION: This parameter must be equal to the rated amps found on the motor nameplate. Overcurrent or excess heating of the motor could result. Failure to observe this precaution could result in damage to, or destruction of the equipment.

Adjustment Range:

1/4- 1HP:	U.004 = 0.7 amps - 3.1 amps
2HP:	U.004 = 1.1 amps to 4.7 amps
3HP:	U.004 = 1.5 amps to 6.4 amps
5HP:	U.004 = 2.1 amps to 9.3 amps
7.5HP:	U.004 = 3.1 amps to 14.0 amps
10HP:	U.004 = 3.6 amps tp 16.7 amps

Initial Setting:

7.1

Description:

Enter the motor rated amps directly from the motor nameplate.

U.005 Motor Rated Speed (RPM)

WARNING

THE SETTING OF PARAMETERS U.001 (PULSE TACHOMETER SELECTION), U.002 (MOTOR POLES), U.003 (MOTOR BASE FREQUENCY), AND U.005 (MOTOR RATED SPEED) DETERMINE THE MOTOR MAXIMUM SPEED. THESE PARAMETERS MUST BE SET BY A QUALIFIED PERSON WHO UNDERSTANDS THE SIGNIFICANCE OF SETTING THEM ACCURATELY. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

NOTE: *This parameter must be set prior to activating the torque control self tuning (U.008).*

Adjustment Range:

1 - 4000 RPM : The actual adjustment range changes based on the values for U.002 and U.003. See the table below:

Pole Number (U.002)	Base Frequency 60 Hz (U.003)	Base Frequency 50 Hz (U.003)
2	3240 - 3596	2700-2997
4	1620 - 1798	1350 - 1498
6	1080 - 1198	900 - 999
8	810 - 899	675 - 749

In general, the value range for U.005 will be from:

$$\frac{U.003 \times 120}{U.002} \times .900 \quad \text{to} \quad \frac{U.003 \times 120}{U.002} \times .999$$

Initial Setting:

1722

Description:

Enter the motor rated RPM directly from the motor nameplate.

U.006 Motor Percent Magnetizing Amps

CAUTION: This parameter must be equal to the rated amps found on the motor nameplate. Overcurrent or excess heating of the motor could result. Failure to observe this precaution could result in damage to, or destruction of the equipment.

NOTE: *This parameter is automatically generated when self-tuning is performed. (See Parameter U.008.)*

Adjustment Range:

10.0 - 80.0

Initial Setting:

54.5

Description:

U.006 is the percent of magnetizing current with respect to motor rated amps.

If the motor nameplate shows the no load current data or the magnetizing current, then this parameter value can be figured using the following formula. If this data does not appear on the motor nameplate, it is recommended that self-tuning (see Parameter U.008) be performed to automatically calculate the result.

$$\text{Motor Percent Magnetizing Amps} = \frac{\text{Magnetizing Amps}}{\text{Motor Rated Amps}} \times 100$$

U.007 Reserved for Later Use

U.008 Torque Control Self-Tuning

CAUTION: Motor must **not** be loaded during the self-tuning operation, or incorrect parameter values will result. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Refer to Section 5.2.4: Starting Self-Tuning. This parameter will be reset to "OFF" when self tuning is completed or aborted. This parameter will only enable self tuning, not start the procedure.

Parameter Selection:

ON = Enable Self Tuning

OFF = Disable Self Tuning

Initial Setting:

OFF

Description:

Self Tuning is a procedure performed by the controller that "tunes" or determines the pulse tachometer PPR selection for Parameter U.001, and also determines the magnetizing current percent ratio for Parameter U.006.

Determining the pulse tachometer PPR may be necessary since the PPR is not always listed on the motor or tachometer nameplate. Determining the magnetizing current ratio is necessary in vector operation so that the proper no load current, or magnetizing current is set. The proper magnetizing current is required so that rated motor torque, speed, and horsepower can be developed in the vector mode.

Refer to *Section 5: Starting Self-Tuning* for more information on the operation of self-tuning and the steps required to begin the procedure.

U.009 Results of Torque Control Self-Tuning

Parameter Output:

0 = *Self-Tuning operation was successful.*

1 = *User initiated a normal stop.* Self-Tuning operation aborted.

2 = *Emergency stop or fault stop occurred during Self-Tuning.* Self-Tuning operation aborted.

3 = *Motor or pulse tach direction in reverse.* Motor must rotate in clockwise direction facing motor/tach end. The pulse tachometer leads might also be reversed if the motor direction is correct.

4 = *Pulse tachometer PPR out of range.* The result of the determination of the pulse tachometer PPR was not one of the 4 selections of U.001. The pulse tachometer leads might also be reversed.

5 = *Magnetizing current percent out of range.* The measured no load current was not within 10% to 80% of rated current.

6 = *Bus voltage error.* Bus voltage out of range.

7 = *Current limit exceeded.* Self-Tuning should be run with the motor unloaded, and without being connected to any inertia load.

NOTE: *Display will show "SF", with a fault entry into error log showing the cause(s) of the fault(s) for any values of 1 through 7. Refer to Section 7, Troubleshooting, "SF" fault for a result other than zero.*

Initial Setting:

N/A

Description:

This parameter shows the results of the Self-Tuning operation. Normally, self-tuning should be successful and U.009 value will be 0.

U.010 Reserved for Later Use

U.011 Reserved for Later Use

U.012 Speed Regulator Proportional Gain Setting

Adjustment Range:

0.01 - 99.9

Initial Setting:

2.0

Description:

With the default value, the drive should perform satisfactorily. However, with increased inertia loads, this gain parameter may need to be adjusted.

This parameter affects the dynamic performance of the speed regulation of the motor. It is the proportional gain of the PI amplifier in the speed loop.

U.013 Speed Regulator Integral Gain Setting

Adjustment Range:

0.02 - 327.67 radians/second

Initial Setting:

2.0 radians/second

Description:

NOTE: It is not recommended that this parameter be adjusted under most applications.

With the default value, the drive should perform satisfactorily. However, with increased inertia loads, this gain parameter may need to be adjusted.

This parameter affects the dynamic performance of the speed regulation of the motor. It is the lead frequency of the PI amplifier in the speed loop.

7.0 TROUBLESHOOTING AND FAULT CODES

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

7.1 Controller Operation

The GV3000 is a digital AC controller using closed loop vector control (Refer to Figure 7.1). Vector control offers the same dynamic performance to an AC motor as that achieved with a DC motor. Torque is constant across the motor's base speed range in both forward and reverse direction. The controller ,under microprocessor system control, uses two control loops, speed and torque, to obtain vector performance.

Under the speed control loop, the speed reference (requested speed) can be an internal or an external source. The speed loop's feedback is provided by a pulse tach attached to the motor's shaft. The actual speed of the motor being calculated as the rate of change of position from the tach. An error signal derived from the difference between the requested and actual motor speed is implemented digitally (speed controller) to generate the torque command signal for the controller's torque control loop. The torque, in this case, will vary to maintain the motor at the requested speed.

Under torque control, the torque reference (requested torque) accepts a torque signal from the speed loop or from a selected torque reference. The torque control requires calculations and execution of motor equations based on given motor parameters to develop slip. The motor parameters required are magnetizing current (no load phase currents), motor nameplate data, and relative position of the rotor with time. Motor magnetizing currents are measured internally by the GV3000 controller while the rotor relative position is performed using a pulse tach. The torque control then provides information for the microprocessor system to generate the switching of the IGBT which, in turn, generates the motor phase voltages (PWM).

When the controller is configured for torque, it should be added that since only torque, not speed, is being regulated, that an overspeed condition can result given certain motor/load conditions. A value of thirty percent (30%) over maximum speed will cause an instantaneous electronic trip in the controller.

7.1.1 Power Circuit Operation

As shown in Figure 7.2, AC power is supplied to the controller's base board at power terminals R, S, and T where three MOV suppressors limit voltage transients to within the maximum voltage range of a diode power module. This suppressed three-phased AC voltage passes through the diode power module which full-wave rectifies the AC into a DC voltage. The DC voltage is then sent to power terminals + and − (as DC Bus Volts) and to the capacitor board. On the capacitor board, the DC voltage is fed into a bank of capacitors for power and noise filtering. Upon returning to the base board, the filtered DC voltage is then applied to sensors (DC bus voltage and current), sent to an internal power supply and an IGBT (insulated-gate bipolar transistor) inverter bridge.

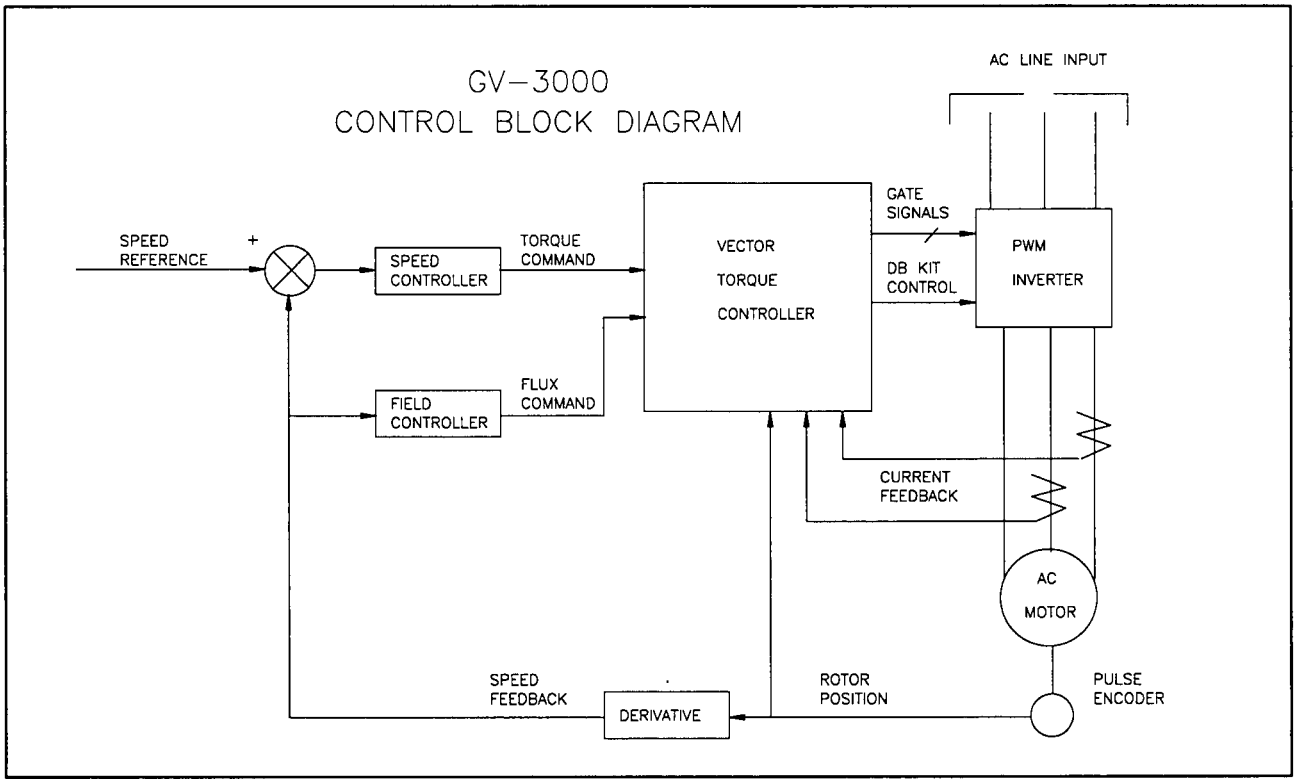


Figure 7.1 - Block Diagram of the GV3000 Vector Control.

The filtered DC bus voltage and current feedback signals are sent through the daughter board for control usage by the controller's regulator board.

The internal power supply uses the filtered DC voltage to develop the isolated voltages and currents necessary for controller operation. These voltages also include the supply voltage for the Dynamic Braking Kit. Dynamic braking control voltage is made available for the Kit at the base board's + (10 VDC) and – (10 com) power terminals. An isolated sawtooth voltage signal, developed by the internal supply, is sent to the controller's Daughter Board. The Daughter Board uses the isolated signal to create a isolated +15 VDC voltage for the Regulator Board's external speed reference.

The IGBT inverter is switched by gating signals to transform the filtered DC voltage into a three-phase PWM (Pulse-width Modulated) voltage signal. The gating signals are sent through the daughter board and are delivered to the IGBT inverter via isolated drivers on the base board. The IGBT's PWM output voltage corresponds to the variable voltage and variable frequency source selected for the motor. Two of the three PWM voltage output lines (Phase U and V) are sent through the daughter board for phase current sensing. The phase current feedback signals, from the daughter board, are applied to the regulator board of control usage. Upon returning to the Base board, the two PWM voltage output lines, along with the third output line (Phase W) are sent to controller's power terminals U, V and W.

In summary, a constant DC voltage is developed by rectifying and filtering the incoming AC power line voltage. A PWM three-phase voltage is then produced from this constant voltage using an IGBT inverter corresponding to the variable voltage and frequency selected for the motor.

7.1.2 Controller Regulator Operation

Controller regulator operation is directed by a microprocessor system resident on the regulator board. The operation is divided into two sections, the membrane switch/bracket assembly (keypad) and the regulator board. All controller operation directed by the system is based on selected or adjustable parameters programmed into the microprocessor system by the user through the keypad. Keypad (switch) data ,via a ribbon cable, enters the controller's regulator board through connector J9 where it enters a latching shift register for multiplexing into the microprocessor system. After isolating receivers, the control wiring data (via the control terminal strip) is also multiplexed to the microprocessor system through the latching shift register.

Power circuit feedback signals, a jumper selected external speed reference, and an internal heat sensor are all scaled and delivered to the regulator's microprocessing system through A/D conversion . The bus voltage and current, and phase current feedback signals are used to provide trip free (fault) characteristics, over/under voltage detection, and overcurrent detection during controller operation. The external (analog) speed reference, parameter selected, can be either +/– 0-10 VDC signal from an 5K ohm potentiometer or 0-20mA process control signal by properly jumpering J4.

A heat sensor is provided for over temperature detection and indicates that the inside ambient temperature of the controller is over specified limits.

The regulator's microprocessing system also receives information from a pulse tach attached to the motor. The pulse tach information is required by the microprocessor system for vector control. The pulse tach provides two signals and their complements to the regulator board for better noise reduction.

Under control from the microprocessing system, the regulator system delivers:

- PWM gating signals to the IGBT
- provides form A and B contacts for IET/Controller running indications
- Display data for a four-character display and fourteen indicator LED's
- An analog output
- A dynamic braking signal

The regulator board's microprocessor system sends PWM gating signals through the daughter board to isolated driver's on the base board. On the Base board, the gating signals are delivered to isolated driver's and sent to switch the IGBT. The switching of the IGBT (directed by the gating signals) produces the PWM signal that corresponds to the selected frequency and voltage requested for the motor. The IGBT can be switched at either 2, 4 or 8KHz carrier frequency. A low carrier frequency will minimize the controller heating but also increase acoustic noise, while a higher carrier frequency maximizes controller heating, but decreases acoustic noise.

The form A and B contacts are directed under parameter control. A form A or B transition can indicate a fault has occurred or that the controller is operating. The contacts are rated for 5 Amps resistive load at 250 VAC/30 VDC and are made available through the control terminal strip.

The four-character display is used to indicate the controller's display modes, parameters, parameter values, and fault codes. The fourteen LED's give the user an "at a glance" indication of controller operational status and mode of control. Physical placement of the display and LED indicators on the regulator board permits viewing through the membrane switch and bracket assembly.

The analog output is a scaled voltage (0-10 VDC) or current (4-20mA) signal proportional to either actual motor speed (RPM) or motor torque/current (%TORQUE). The current selection (via jumper J17) requires a user supplied external power supply for operation. The analog output signal is available through the control terminal strip.

The regulator board's microprocessor system provides an interfacing signal for use by an optional dynamic braking kit. The signal goes through an isolating driver, made available through the control terminal block.

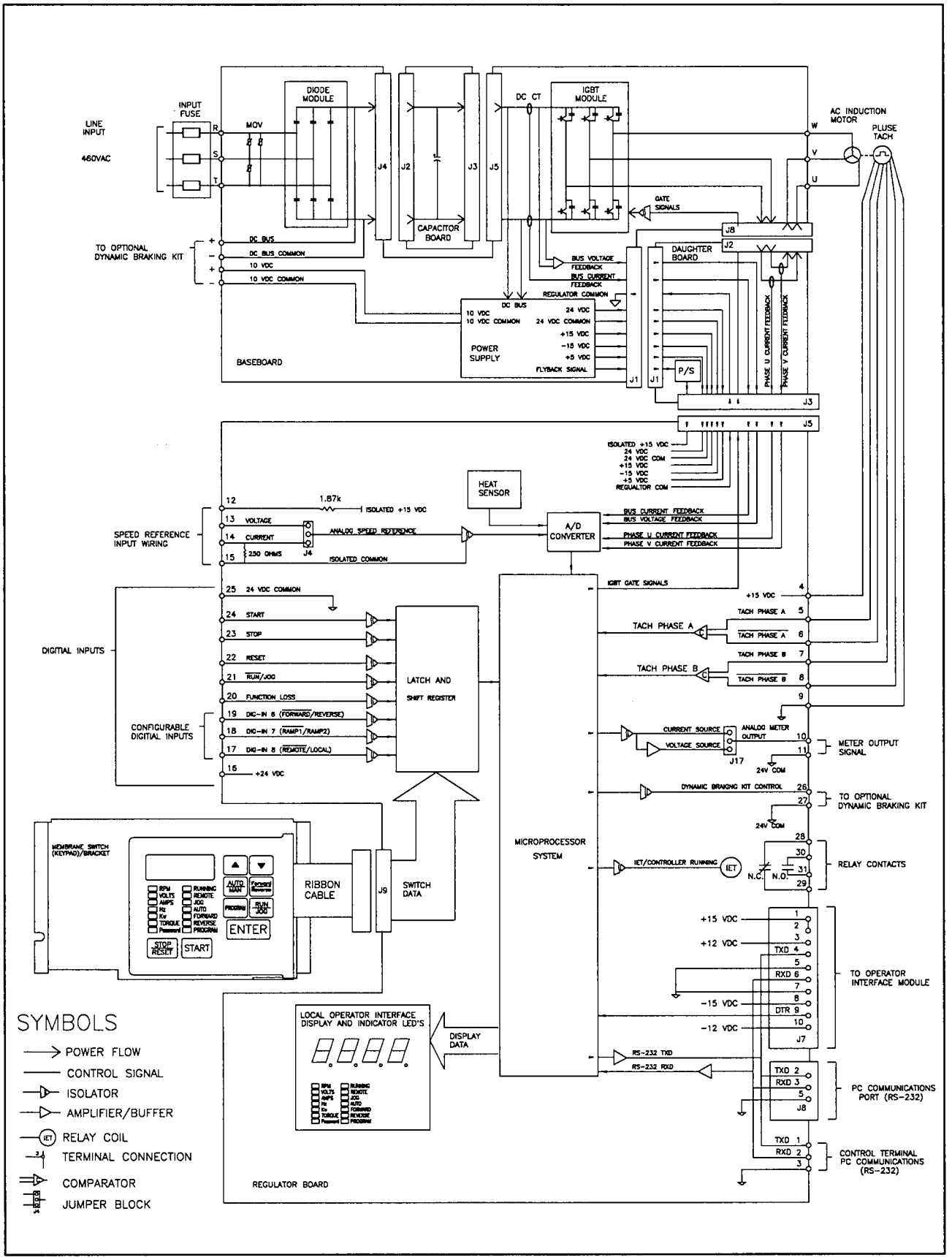


Figure 7.2 - Typical System Block Diagram.

7.2 Fault Codes

The GV3000 controller displays fault codes to assist in troubleshooting should a fault occur during self-tuning or during controller operation. If a fault condition occurs while the drive (controller with motor) is self-tuning or running, the controller will provide a coast-to-stop and the fault type will flash on the controller display as a 2 or 3-digit alphabetical code.

The fault is then entered into the error log. The error log is accessible through the keypad and is displayed as "ERR" on the display. If a fault occurs when performing self-tuning, a SF (self-tuning fault) will be entered into the error log and the type of fault will be indicated in the Parameter value of U.009 (Results of Torque Control Self-Tuning).

7.2.1 How to Access and Read the Error Log and Time Stamp

Faults codes are entered into the error log in sequential order if more than 1 fault should occur. The front panel will only display the first fault to occur, however, the other faults will be logged into the error log. (The error log must be accessed to see any additional faults.) After ten faults have occurred, no more subsequent faults will be entered in the error log. There is NO visual indicator to the user that the error log is completely filled and has stopped logging errors.

The faults entered into the error log are numbered sequentially. If first an over current (steady state) were to occur, it would be displayed in the error log as [0. OC]. If next a thermal overload fault were to occur (and the first error was not yet cleared), it would be displayed in the error log as [1. OH], and so on.

The last fault to occur will appear first when accessing the error log. For example, if the last fault was a low bus fault, and the error has 9 entries, then the error log would display [9. LU] when the error log is first accessed.

Each fault code contained in the error log has an associated time stamp. The time stamp contain the day (based on a 0 to 248 day counter) and the time (based on a 24 hour clock providing both hours and minutes). Refer to "*To Access the Error Log Time Stamp*".

A single error entry in the log cannot be cleared. Only the entire error log and time stamp of each fault can be cleared.

Faults are retentive (stored) to the error log if a power loss occurs.

Table 7.1 list fault codes, descriptions, causes, and possible actions.

Displays and key board actions for viewing the controller's error log is shown in Figure 7.3.

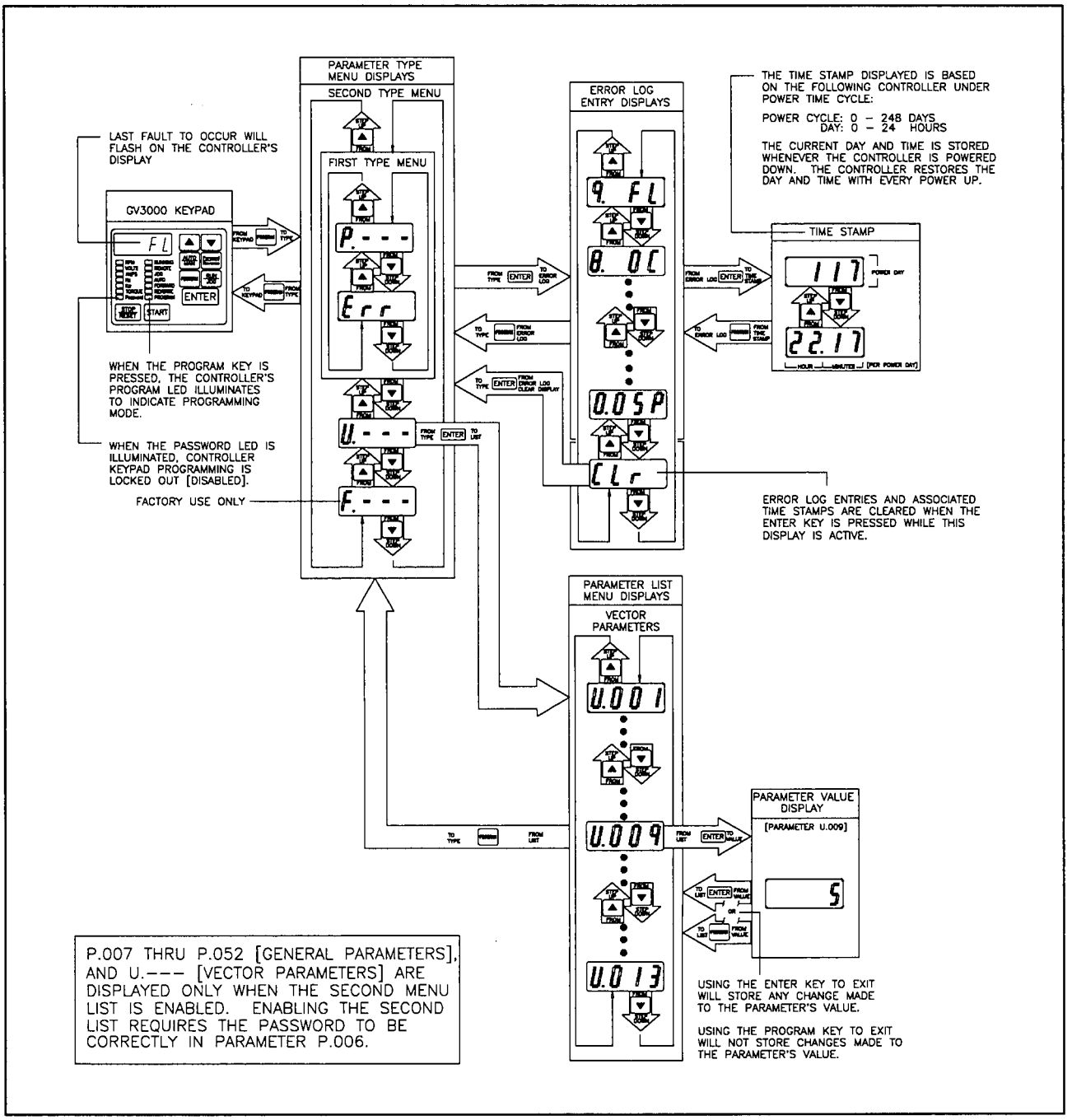


Figure 7.3 - Error Log Displays

7.2.1.1 To Access the Error Log:

NOTE: *This procedure assumes that you have already entered the password for the second menu list (P.006).*

Action	Display/Notes
1. Press the **PROGRAM** key.	Display shows [**P.---**] - General parameters. The **PROGRAM LED** goes **ON**.
2. Press the **DOWN ARROW** key.	Display shows [**U.---**] - Vector parameters.
3. Press the **DOWN ARROW** key.	Display shows [**Err**] - Error log entries.
4. Press the **ENTER** key.	Display shows the error log entry - "last fault to occur", not necessarily, the flashing error displayed when the detected fault stopped the controller. For example, the flashing display code is [HU], while the last fault shown in the error log is [6. OC]. All errors in the log, from the last fault displayed [example 6. OC], to the flashing fault code on the display, occurred to cause the controller to stop.
NOTE: *If interested in the approximate time that a fault occurred, refer to* "To Access the Error Log Time Stamp".	
5. Press the **PROGRAM** key.	Display shows [**P.---**] - General parameters.
6. Press the **UP ARROW** key.	Display returns to the flashing fault code display or, if the **RESET** key was pressed, a [**0**] display.
7. Press the **PROGRAM** key.	

7.2.1.2 To Access the Error Log Time Stamp:

NOTE: *The following procedure assumes that access has been obtained to the error log.*

Action	Display/Notes
1. Pressing the **UP ARROW** key or **DOWN ARROW** key.	Display will step through error log entries.
2. Press the **ENTER** key.	Example: Display shows [**117**] - Day Time Stamp. NOTE: *The day entry of the time stamp can be 0-248 days.*
3. Press the **DOWN ARROW** key.	Example: Display shows [**22.17**] - Time Stamp. NOTE: *Time is recorded on a 24 hour clock bases. The first two digits represents hours while the last two digits represents minutes.*
4. Press the **PROGRAM** key. (Returning to error log.)	Display shows the error log entry prior to/associated with the last viewed time stamp.
5. Repeating steps 1 through 4 on any error log entry.	This will let you view the time stamp associated with each error log fault code entry.

7.2.2 How to Access and Read the Results from Torque Self-Tuning:

A result code is entered into vector parameter U.009 with each performance of self-tuning. When a fault occurs during self-tuning, the display may or may not show a blinking self-tuning fault code. If more than 1 fault should occur during self-tuning, the front panel will only display the first fault code. All other faults will be logged into the error log in sequential order including the self-tuning fault code. Therefore, the error log must be accessed to see any additional faults. There is NO visual indicator to the user that the error log contains any additional fault codes which occurred during self-tuning.

7.2.2.1 To Access the Self-Tuning Result code (displayed in Parameter U.009):

NOTE: *This procedure assumes that you have already entered the password for the second menu list (P.006).*

Action	Display/Notes
1. Press the **PROGRAM** key.	Display shows [**P.---**] - General parameters. The **PROGRAM LED** goes **ON**.
2. Press the **DOWN ARROW** key.	Display shows [**U.---**] - Vector parameters.
3. Press the **ENTER** key.	Display shows [**U.000**] - the first Vector parameter.
4. Pressing the **UP ARROW** key or **DOWN ARROW** key.	Display will step through the vector parameter list.
NOTE: *Step through the vector parameter list until the display shows [**U.009**] - (results of torque control self-tuning).*	
5. Press the **ENTER** key.	Display shows [**example: 5**] - the result of self-tuning. (Refer to Table 7.1 for more information on self-tuning result codes.)
6. Press the **PROGRAM** key.	Display shows [**U.009**] - Returns to vector parameter list.
7. Press the **PROGRAM** key.	Display shows [**U.---**].
8. Press the **DOWN ARROW** key.	Display shows [**Err**] - Error Log.
NOTE: *After checking vector parameter U.009 for the self-tuning result code, always check the error log for additional fault entries.*	

Table 7.1 - Troubleshooting IET Fault Codes.

FL - Function Loss	
Cause	**Action**
• Function loss input on control terminal is opened	Check that motor interlocks are connected. (Refer to Section 3, control wiring) Motor thermal switch has opened. Check that there is a connection between terminals 16 and 20 on the control terminal strip. (Refer to Section 3, control wiring)
HU - High DC Bus Voltage	
Cause	**Action**
• Input voltage too high	Check input line voltage and, if necessary, add a transformer (See Section 3.)
• Deceleration time too short	Parameter P.002 (deceleration time) is set too fast (small) given the maximum speed (P.004) setting, and motor inertia load. Increase the deceleration time. If problems still exist, consider adding a dynamic braking kit to the controller.
LU - Low DC Bus Voltage	
Cause	**Action**
• Input voltage too low	Check input line voltage. If necessary, add a transformer (See Section 3.) Input voltage line dip exceeded the 500ms limit. NOTE: *If the drive was running when the fault occurred and the line dip does not exceed the 500 ms limit, the drive will automatically restart.*
OC - Overcurrent (steady state) **OCA - Overcurrent (Accelerating)** **OCd - Overcurrent (decelerating)**	
Cause	**Action**
• Bad Motor	Check the motor for correct operation.
• Ground Fault • Phase to Phase short	Check input and output wiring. (Refer to Section 3, Installation and Wiring)
• Parameter settings **(OCA - specific)** **(OCd - specific)**	Check that parameters U.001 (pulse tach select), U.002 (motor pole number), U.003 (motor base frequency), U.004 (motor rated amps) and U.006 (Percent motor magnetizing amps) are set correctly. NOTE: *If magnetizing amps is not provided on the motor nameplate, perform self-tuning.* Parameter U.012 (speed regulator Proportional gain) may be incorrect. Parameter U.013 (speed regulator Integral gain) may be incorrect. If a fault does not occur, the gain may still be set incorrectly. The motor speed may be unstable and/or the motor may exhibit a washing machine effect (i.e. forward rotation then reverse rotation) Parameter P.001 (acceleration time) may be incorrect given the maximum speed (P.004) setting and motor inertia load. Parameter P.002 (deceleration time) may be incorrect given the maximum speed (P.004) setting and motor inertia load.
• Pulse tach wired incorrectly wrong tach PPR	Check that pulse tach is wired correctly. (Refer to Section 3 for pulse tach wiring information.)

Table 7.1 - Troubleshooting IET Fault Codes. (Continued)

OF - Overfrequency	
Cause	**Action**
• Controller has exceeded maximum allowable output frequency. Maximum frequency is 132 Hz.	Check that parameters U.001 (Pulse Tach select), U.002 (Motor Pole number), and U.003 (Motor base frequency) are set correctly.
OH - Overtemperature	
Cause	**Action**
• Controller internal temperature has exceeded specified limit.	Check that outside ambient temperature is within controller specification. Check that internal and external fans are operational.
OL - Electronic Thermal Overload	
Cause	**Action**
• Excess motor current	Check that parameter U.004 (motor rated amps) is set correctly. Check that controller is sized correctly for the motor. (Motor Horsepower (HP) should not exceed the controller HP rating. (See Section 2 for more information.))
• Loss of phase connection	Check the controller output lines to the motor.
OSP - Overspeed	
Cause	**Action**
• The controller is equipped for a 130% maximum speed protection.	Check that parameters U.001 (Pulse Tach select), U.002 (Motor Pole number), U.003 (Motor base frequency), and U.005 (motor rated speed) are set correctly. Parameters U.012 (speed regulator proportional gain) and U.013 (speed regulator integral gain) may be set too high. Adjust both to remove condition.
PH - Motor Phase Loss	
Cause	**Action**
• Loss of a motor phase (line) from the controller to the motor	Check the U, V, and W phase connections from the controller to the motor. Replace any damaged line(s).

Table 7.1 - Troubleshooting IET Fault Codes. (Continued)

SF - Self-Tuning	
Cause	**Action**
NOTE: *The following causes represent the numbers displayed as the self tuning result in Parameter U.009.*	
• 1 - user stop • 2 - Emergency stop fault during self tuning	A user stop has been pressed, or a fault occurs during self-tuning. (Once the motor stops, clear the faults (both parameter and hardware) and again perform self-tuning.)
• 3 - Motor or pulse tach direction reverse	The motor is rotating in wrong direction. (Motor rotation should be in a clockwise direction from the tach end of the motor). If the motor rotation is correct, check that the pulse tach is wired correctly. (Refer to Section 3, control wiring.) Change controller U and V phases with one another, if tach wiring is correct.
• 4 - Pulse tach PPR	Check that the pulse tach's PPR is one of the four tach PPR's allowed for usage with the controller. If not one of the four, replace the tach. Check that the pulse tach is wired correctly. (Refer to Section 3, control wiring.)
• 5 - Motor magnetizeing amps ratio out of range	Check that parameters U.002 (Motor Pole number), U.003 (Motor base frequency), U.004 (Motor rated Amps), and U.005 (motor rated speed) are set correctly.
• 6 - DC Bus voltage out of range	If the line voltage is within limits, contact Reliance.
• 7 - Current limit detected	Check that parameters U.002 (Motor Pole number), U.003 (Motor base frequency), U.004 (Motor rated Amps), and U.005 (motor rated speed) are set correctly.

7.3 Verify DC Bus voltage

DANGER

AFTER DISCONNECTING INPUT POWER WAIT FIVE MINUTES AND CHECK WITH A VOLTMETER TO INSURE THAT DC BUS VOLTAGE CAPACITORS ARE DISCHARGED. THE VOLTMETER SHOULD READ ZERO VDC. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Before servicing the controller:

1. Turn OFF, and lock out and tag power to the controller.
2. Verify that there is no voltage entering the controller at power terminals R(L1), S(L2), and T(L3) as shown in Figure 7.4.
3. Verify at DC Bus terminals (+) and (−), on the power terminal strip, that the DC Bus voltage has fallen to zero VDC. This will take a few minutes. See Figure 7.4 for location of the DC Bus.

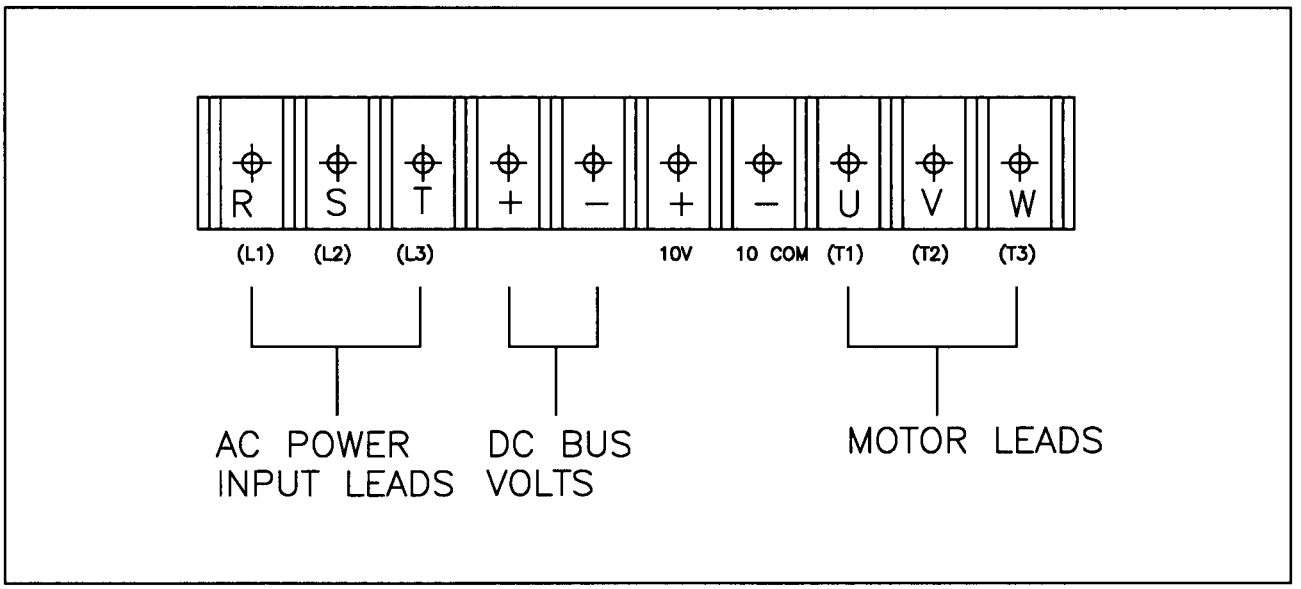


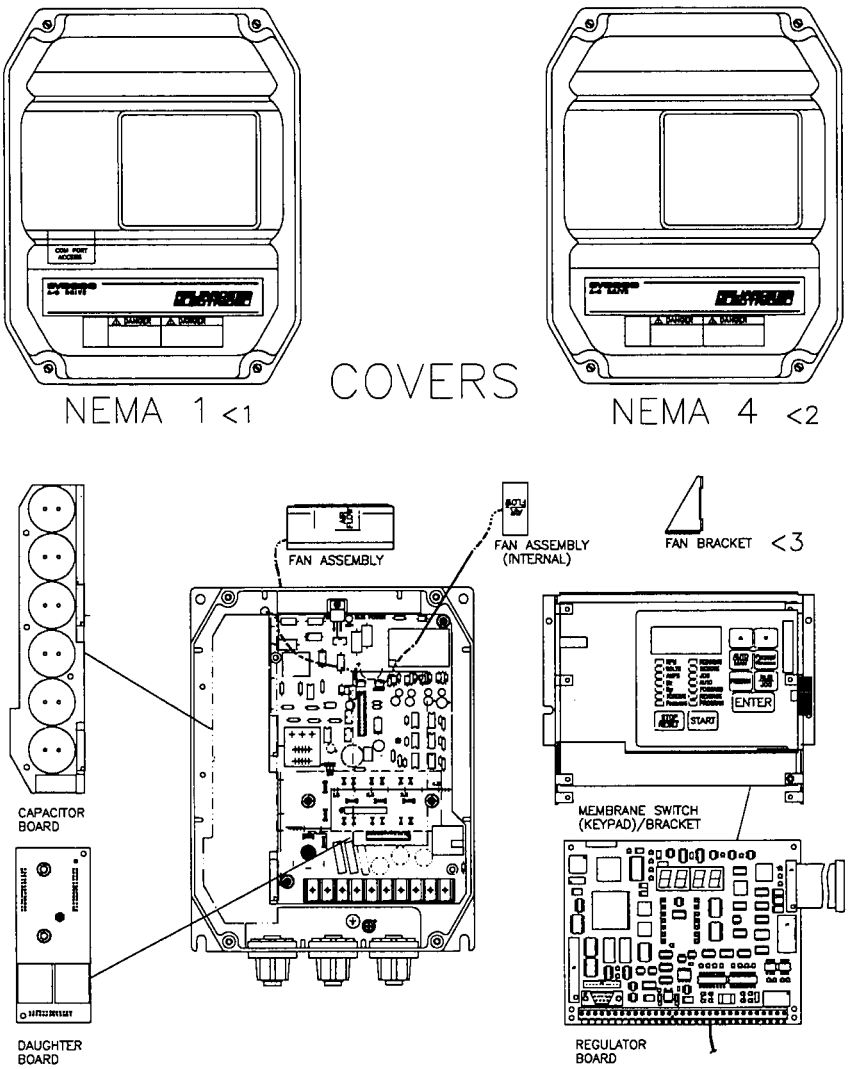
Figure 7.4 - Power Terminal Strip.

4. Table 7.2 contains a list of GV3000 Replacement Parts. Refer to Figures 7.5 and 7.6 or replacement parts location and additional information.

Table 7.2 - Replacement Parts List For GV3000 Controller

Description	Part Number	Quantity per Horsepower					
		1	2	3	5	7.5	10
Fan Assembly	615161-S			1	1	2	2
NEMA 1 Cover	805531-1R	1	1	1	1		
	805538-1R					1	1
NEMA 4X Cover/ gasket	805532-1R	1	1	1	1		
	805539-1R					1	1
Membrane Switch (keypad)/ bracket	709576-1R	1	1	1	1		
	709577-1R					1	1
Regulator PCB	0-56921-200	1	1	1	1	1	1
Capacitor PCB	0-56928-30	1	1	1			
	0-56928-50				1		
	056934-100					1	1
Fan Assembly Internal		1	1	1	1	1	1
Daughter PCB	0-56926-20	1	1				
	0-56926-50			1	1		
	0-56935-100					1	1

REPLACEMENT PARTS



NOTES:

<1. NEMA 1 COVER IS VENTED AND CONTAINS COMMUNICATIONS ACCESS DOOR.

<2. NEMA 4X COVER IS NOT VENTED AND SUPPLIED WITH BASE AND KEYPAD GASKETS.

<3. REMOVE THE INTERNAL FAN ASSEMBLY BRACKET BEFORE DISCARDING OLD MEMBRANE SWITCH/BRACKET. THE FAN BRACKET IS NOT SUPPLIED AND MUST BE REUSED WITH THE REPLACEMENT MEMBRANE SWITCH/BRACKET.

Figure 7.5 - GV3000 Replacement Parts Locations (460 VAC 1,2,3, and 5 HP).

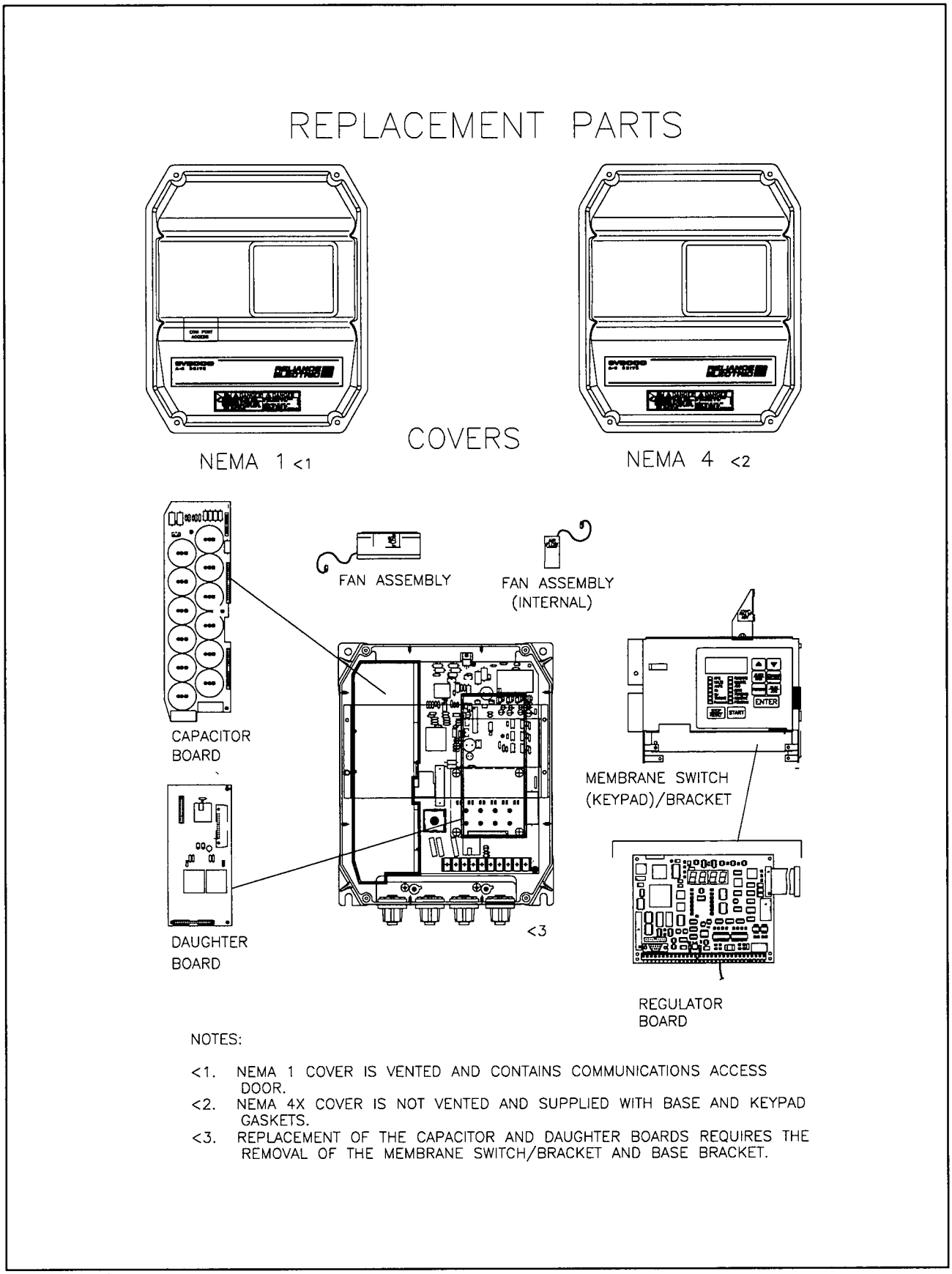


Figure 7.6 - GV3000 Replacement Parts Locations (460 VAC 7.5 and 10 HP)

8.0 PARAMETER QUICK REFERENCE GUIDE

Table 8.1 - First Menu Parameters (P.---) - Short List

Parameter Number		Parameter Description	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
First Menu - General Parameters	P.000	Operation Control	**LOCL**= LOCAL front panel keypad **rE** = REMOTE (Terminal Block Inputs) **PC** = N/A **OP** = N/A	LOCL		
	P.001	Acceleration Time (Seconds)	0.1 - 999.9 seconds	20.0		
	P.002	Deceleration Time (Seconds)	0.1 - 999.9 seconds	20.0		
	P.003	Minimum Speed (RPM)	0 - Maximum Speed (P.004)	150		
	P.004	Maximum Speed (RPM)	10- Motor Rated Speed (U.005)	1722		
	P.005	Current Limit	U.006-150%	150		
	P.006	Second Menu and Password Enable NOTE: After entering password number, P.006 will change back to zero.	607 = Second Menu Enable/Disable	0		

Table 8.2 - Second Menu Parameters (P.---)

Parameter Number		Parameter Description	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
First Menu - General Parameters	P.007	Terminal Block Digital Input Configure NOTE: *The REM/LOC digital input allows you to temporarily switch from a REMOTE running condition to LOCAL operation without breaking the 2-wire control RUN signal.* NOTE: *For second RAMP times see P.017 (accel) and P.018 (decel).* NOTE: *You first must assign the digital inputs (setting P.007 to some value other than 0) before P.008 will allow being changed to something other than 0.*	**0** = Digital Input 6 = FWD/REV Digital Input 7 = RAMP1/2 Digital Input 8 = REM/LOC **1** = Digital 7 = FWD/REV Digital 8 = RAMP1/2 **2** = Digital 7 = FWD/REV Digital 8 = REM/LOC **3** = Digital 7 = RAMP1/2 Digital 8 = REM/LOC **4** = Digital 8 = FWD/REV **5** = Digital 8 = RAMP1/2 **6** = Digital 8 = REM/LOC **7** = Digital Inputs 6- 8 are defined by P.008, or not used.	0		
	P.008	Terminal Block Speed Reference Selection (See P.007 to configure digital inputs 6, 7, and 8.)	**0** = Analog Reference **1** = MOP (Uses terminal block digital inputs 6=Increment, 7=decrement) **2** = 2 Multi-speed Presets (uses terminal block digital input 6) **3** = 4 Multi-speed Presets (uses terminal block digital inputs 6 and 7) **4** = 8 Multi-speed Presets (uses terminal block digital inputs 6-8).	0 = Analog Reference		
	P.009	Terminal Block Analog Input Speed Reference Offset	**−250 to 250** (NOTE: *Units = 1023 counts = +10V. Approx. 102 = 1V offset.*)	0		
	P.010	Terminal Block Analog Speed Reference Gain	**0.750 - 1.250**	1.000		

Table 8.2 - Second Menu Parameters (Cont'd.)

Parameter Number		Parameter Description	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
Second Menu - General Parameters (Cont.)	P.011	Terminal Block Analog Speed Reference Invert Selection (Input becomes inverted when enabled.) NOTE: *If the terminal block analog input is selected as the torque reference (U.000=1), then substitute +/− 150% torque limit for +/− motor rated RPM (U.005).*	**OFF** = • 0-20mA: 0mA=0, 20mA=+ motor rated RPM • 0-10VDC: 0VDC=0, +10VDC= + motor rated RPM • −10 VDC to 10VDC: −10VDC= - motor rated RPM, +10VDC= + motor rated RPM **ON** = • 0-20mA: 0mA=0, 20mA= - motor rated RPM • 0-10VDC: 0VDC=0, +10VDC=- motor rated RPM • −10VDC to 10VDC: −10VDC= + motor rated RPM, +10VDC=− motor rated RPM	OFF		
	P.012	Terminal Block Analog Output Source Selection	**0** = Speed Loop Feedback **1** = Torque/Current Feedback	0		
	P.013	Output Relay Configuration (See terminal block terminals 28-31)	**0** = relay energized is state of active IET fault **1** = relay energized is state of controller running	0		
	P.014	Trim Reference Source Selection	**0** = No Trim Reference **1** = Terminal Block Analog Input **2** = N/A **3** = Maximum Speed (P.004) **4** = Torque Current Feedback	0		
	P.015	Trim Gain Percentage	− 99.9% to +99.9%	0.0		
	P.016	Draw Gain Percentage	− 99.9% to +99.9%	0.0		
	P.017	Second Ramp Acceleration Time (Seconds)	0.1 - 999.9 seconds	20.0		
	P.018	Second Ramp Deceleration Time (Seconds)	0.1 - 999.9 seconds	20.0		
	P.019	S-Curve Selection (NOTE: *This selection does not apply to the Jog Accel or Decel Parameters.)*	**OFF** = Use Linear Accel/Decel Function **ON** = Use S-Curve Function	OFF		

Table 8.2 - Second Menu Parameters (Cont'd.)

Parameter Number		Parameter Description	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
Second Menu - General Parameters (Cont.)	P.020	Jog Speed Reference (RPM)	Min Speed (P.003) - Maximum Speed (P.004)	150		
	P.021	Jog Ramp Acceleration Time (Seconds)	0.1 - 999.9 seconds	20.0		
	P.022	Jog Ramp Deceleration Time (Seconds)	0.1 - 999.9 seconds	20.0		
	P.023	MOP Reference Rate (Seconds)	0.1 - 999.9 seconds	20.0		
	P.024	MOP Reset	0 = Reset MOP setpoint after IET 1 = Reset MOP setpoint during each stop 2 = Do not reset MOP setpoint	0		
	P.025	STOP Type Selection	0 = Coast to rest stop 1 = Ramp to rest stop	0		
	P.026	Function Loss Selection	**0** = Fault trip at Function Loss NOTE: *You must press the STOP/RESET key to restart the drive. This selection causes the output relay to be asserted.* **1** = Coast to Rest Stop without Output at Function Loss. The output relay is not asserted.	0		
	P.027	Reverse Disable	Off = Controller will run in reverse direction On = Controller will not run in reverse direction. (The REVERSE LED will not light.)	OFF		
	P.028	RPM Display Mode Scaling (Used to scale the RPM display mode value to any Engineering Unit.)	10 - 9999 Example: Current Speed x P.028 P.004 (Maximum Speed) = Value displayed when RPM mode is selected.	1722		
	P.029	Elapsed Time Meter Readout	0 - 9999 days	N/A		

Table 8.2 - Second Menu Parameters (Cont'd.)

Parameter Number		Parameter Description	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
Second Menu - General Parameters (Cont.)	P.030	Elapsed Time Meter Reset (Resets the meter to zero.)	**OFF** = No action. **ON** = Reset elapsed time meter to zero (0). (P.029 will be reset = 0.)	OFF		
	P.031	Multi-speed Preset #1	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.032	Multi-speed Preset #2	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.033	Multi-speed Preset #3	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.034	Multi-speed Preset #4	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.035	Multi-speed Preset #5	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.036	Multi-speed Preset #6	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.037	Multi-speed Preset #7	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.038	Multi-speed Preset #8	P.003 (Min Speed) - P.004 (Max Speed)	150		
	P.039	Reserved for later use				
	P.040	Electronic Motor Thermal Overload	**OFF** = Electronic Motor Thermal Overload is disabled **ON** = Electronic Motor Thermal Overload is enabled	ON		
	P.041 - P.046	Reserved for later use				
	P.047	Carrier Frequency Selection (If values are entered from the options port, they will be 0, 1, and 2 instead of 2, 4, and 8.)	**2** = 2 kHz Carrier Frequency **4** = 4 kHz Carrier Frequency **8** = 8 kHz Carrier Frequency	8		
	P.048	Controller Type Selection	UEC = Vector Control	VEC		
	P.049	Default Type Selection	USA = USA defaults EUr = Europe defaults JPn = Japan defaults	USA		
	P.050	Restore Default Settings	**OFF** = No action. **ON** = Reset Parameters to default settings.	OFF		
	P.051	Program Lockout	1044 = Disable/Enable programming	0		
	P.052	Software Version	N/A	N/A		

Table 8.3 - Vector Control Parameters (U.---).

Parameter Number		Parameter Description	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
Vector Control Parameters	U.000	Torque Reference Source Selection	**0** = Use Speed Loop Output **1** = Terminal Block Analog Input **2** = N/A	0		
	U.001	Pulse Tachometer Selection NOTE: This parameter is automatically calculated during Self Tuning (P.008).	**512** = 512 PPR **1024** = 1024 PPR **2048**= 2048 PPR **4096** = 4096 PPR	1024		
	U.002	Motor Pole Number	**2** = 2 poles **4** = 4 poles **6** = 6 poles **8** = 8 poles	4		
	U.003	Motor Base Frequency (Hz)	Enter from motor nameplate. 30.0 - 120.0 Hz	60		
	U.004	Motor Rated Amps (A)	Enter from motor nameplate.	7.1		
	U.005	Motor Rated Speed (RPM)	Enter from motor nameplate.	1722		
	U.006	Motor Percent Magnetizing Amps (Percent of magnetizing current with respect to rated current.) NOTE: *This parameter is automatically calculated during Self Tuning (U.008).*	10.0% - 80.0%	54.5		
	U.007	Reserved for later use				
	U.008	Torque Self-Tune Selection Self tuning will calculate values for Parameters U.001 and U.006.	**OFF** = Disable self-tuning. **ON** = Begin self-tuning after START command. NOTE: *Motor MUST NOT BE LOADED during Self-Tuning!*	OFF		

Table 8.3 - Vector Control Parameters (Cont'd).

Parameter Number		Parameter Description	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
Vector Control Parameters (Cont.)	U.009	Torque Self Tune Result	0 = Torque self tuning was successful 1 = User initiated a normal ramp stop sequence 2 = Emergency coast stop or fault stop 3 = Motor or pulse tach direction reverse 4 = Pulse tach PPR out of range 5 = Motor magnetizing current percent ratio out of range 6 = Bus voltage out of range 7 = Current limit exceeded	Output dependent on result.		
	U.010	Reserved for later use				
	U.011	Reserved for later use				
	U.012	Speed Regulator PGain Setting	0.01 - 99.99	2.0		
	U.013	Speed Regulator IGain Setting	0.02 - 327.67	2.0		

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