INSTALLATION & OPERATION MANUAL

SECO® SV3000 Series AC Motor Drives

1 - 10HP 460 VAC, 15 - 40HP 460 VAC, 50 - 100HP 460 VAC
Version 2.0 Software

Seco

AC/DC Drives

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For your safety and for proper operation, please take time to carefully read all instructions before installing and operating this unit.

1 Introduction

This instruction manual contains installation, operating and troubleshooting procedures and a complete technical description of the SV3000 Digital AC Flux Vector drive.

1.1 General Description

The SV3000 inverter drive is designed to operate NEMA type B AC induction motors.

The SV3000 series will operate on 380 - 460 VAC power (±10%).

The control circuitry uses a Digital Signal Processor to provide enhanced performance and more standard features. Benefits include complete digital control of operation, customer application settings and time-saving diagnostic fault monitoring and data logging. Potentiometer adjustments and jumpers previously used in inverters are replaced by programmable parameters, enabling both easy set-up and simple and exact duplication of all customer application settings.

A control keypad with 12 keys and a two line 16 character alphanumeric backlighted LCD display allows setup, programming, and monitoring of all inverter parameters. The key pad may be used to operate the inverter with RUN FWD, RUN REV, JOG and STOP keys. With a simple parameter change, external operator's controls can be connected to the customer terminal strip for complete external control from a Remote Operator's Station or customer supplied operator's controls.

Two methods of braking are available, DC injection braking and dynamic braking. A Dynamic Braking circuit is built in to the 1 - 15 HP models. Dynamic Braking may be specified on larger units.

A RS485 serial communications port is standard and conforms to ANSI x 3.28 - 2.5 - A4 protocol. The port may be used to set parameters, control operation and monitor information in the inverter.

All parameters in the inverter may be secured so that access is available only to those in possession of a "security code." Inverters are shipped without a security code, and the user can program in a security code to restrict access to the inverter parameters. If a security code is lost or forgotten, Warner Electric can assist customers in regaining access to the inverter.

NOTE:

For best operating performance and to avoid problems caused by electrical noise the installation should follow these guidelines.

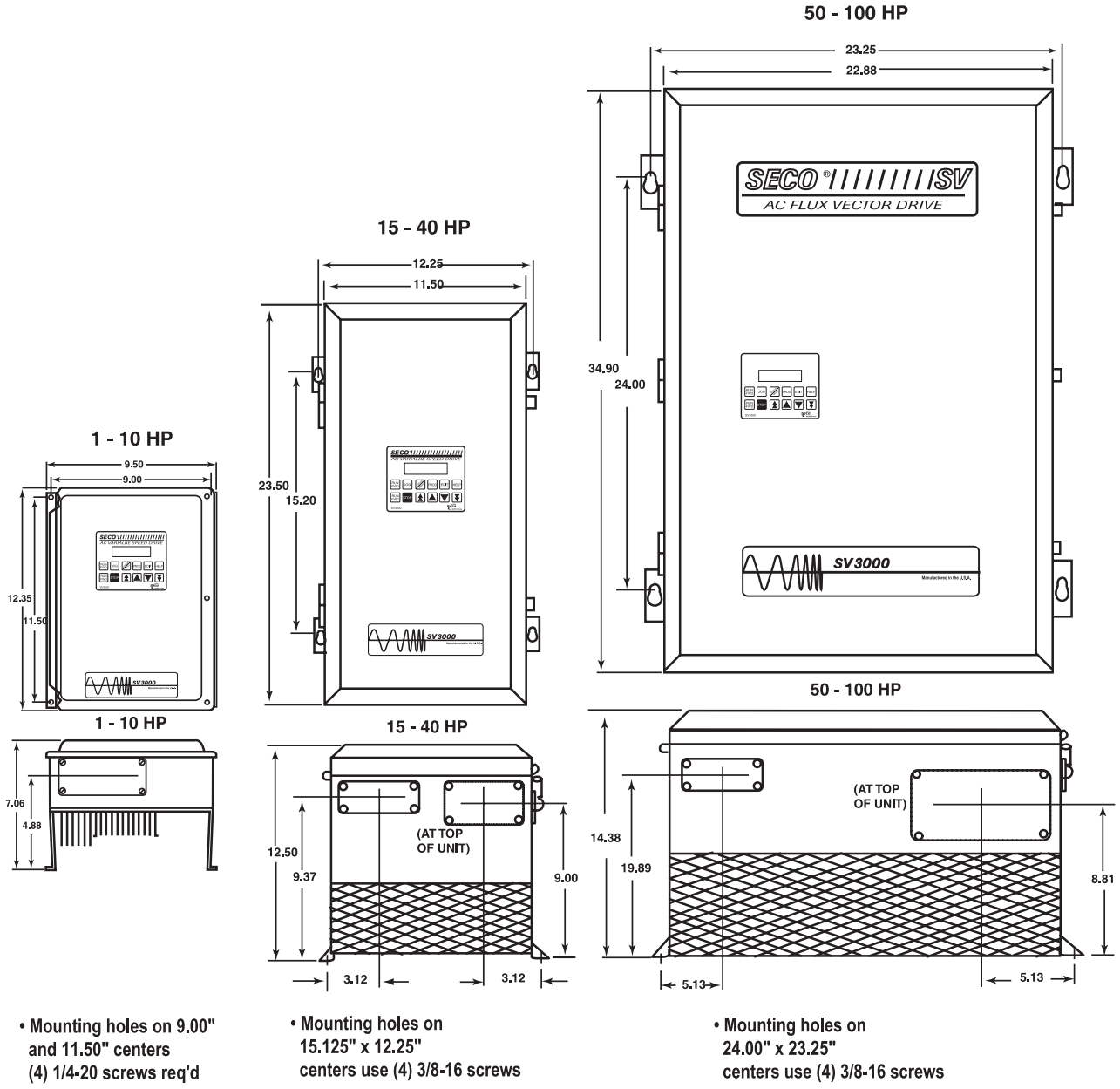
a) Use separate conduits for AC power wiring, motor wiring, and all control wiring. For best protection, the motor leads should use shielded cable or be placed in a metal conduit. In either case, both ends of the shield or conduit need to be solidly connected to a good earth ground.

b) Use twisted pair shielded cable for control wiring, connect the shield to earth ground at one only. (Preferably at the signal source). The other end of the shielded cable must be sufficiently insulated as to maintain isolation from earth ground. This will eliminate any unwanted ground loops between different equipment grounds.

c) Both the motor and the drive need a good connection to earth ground. The ground connection for the motor should go directly from the motor to ground and not be connected first to the drive and then to ground.

d) Any relays connected to the drive or with wiring running close to the drive should have their coils snubbered.

1.2 SV3000 Dimensions



NOTE: Add 2.05" to depth for disconnect option for 15-40 HP and 50-100 HP models.

Fig. 1A SV3000 Dimensions

1.3 Model Numbers

	Standard Performance - Constant Torque		Enhanced Performance - Constant Torque [2]	
HP	**Chassis/Panel Mount**	**Enclosed [1]**	**Chassis/Panel Mount**	**Enclosed [1]**
1	SV3401-00000	SV3401-01000	SV3401-10000	SV3401-11000
2	SV3402-00000	SV3402-01000	SV3402-10000	SV3402-11000
3	SV3403-00000	SV3403-01000	SV3403-10000	SV3403-11000
5	SV3405-00000	SV3405-01000	SV3405-10000	SV3405-11000
7.5	SV3407-00000	SV3407-01000	SV3407-10000	SV3407-11000
10	SV3410-00000	SV3410-01000	SV3410-10000	SV3410-11000
15	SV3415-00000	SV3415-01000	SV3415-10000	SV3415-11000
20	SV3420-00000	SV3420-01000	SV3420-10000	SV3420-11000
25	SV3425-00000	SV3425-01000	SV3425-10000	SV3425-11000
30	SV3430-00000	SV3430-01000	SV3430-10000	SV3430-11000
40	SV3440-00000	SV3440-01000	SV3440-10000	SV3440-11000
50	SV3450-00000	SV3450-01000	SV3450-10000	SV3450-11000
60	SV3460-00000	SV3460-01000	SV3460-10000	SV3460-11000
75	SV3475-00000	SV3475-01000	SV3475-10000	SV3475-11000
100	SV341A-00000	SV341A-01000	SV341A-10000	SV341A-11000

NOTE: SV3000 models 1-15 HP have Internal Dynamic Braking.

	Standard Performance - Constant Torque with Dynamic Braking [3]		Enhanced Performance - Constant Torque with Dynamic Braking [2, 3]	
HP	**Chassis/Panel Mount**	**Enclosed [1]**	**Chassis/Panel Mount**	**Enclosed [1]**
20	SV3420-00100	SV3420-01100	SV3420-10100	SV3420-11100
25	SV3425-00100	SV3425-01100	SV3425-10100	SV3425-11100
30	SV3430-00100	SV3430-01100	SV3430-10100	SV3430-11100
40	SV3440-00100	SV3440-01100	SV3440-10100	SV3440-11100
50	SV3450-00100	SV3450-01100	SV3450-10100	SV3450-11100
60	SV3460-00100	SV3460-01100	SV3460-10100	SV3460-11100
75	SV3475-00100	SV3475-01100	SV3475-10100	SV3475-11100
100	SV341A-00100	SV341A-01100	SV341A-10100	SV341A-11100

[1] 1 - 10 HP enclosures are NEMA 4/12. 15 - 75 HP enclosures are NEMA 12, 100 HP is NEMA 1.

[2] Enhanced Performance Models include an internal encoder interface board. The AC motor used must include a motor-mounted encoder.

[3] The internal dynamic braking electronics can only be installed at the factory. In addition, a DB fuse and a DB thermal device are installed in the drive. Select the correct DB resistor in a NEMA 1 enclosure as matched to the horsepower of the drive.

The last three digits of the model number are used to designate options that may be incorporated in the SV3000 series of drives.

1.4 Standard Features

- Micro-processor control using a Digital Signal Processor for highest performance and more features.
- Constant Torque over 20:1 speed range without an encoder.
- Full torque at zero speed available with encoder feedback.
- Key pad alphanumeric display in plain language.
- Menu driven programming and "HELP" key for easy drive set-up.
- Speed or Torque Control with speed over-ride.
- Dynamic Braking standard through 15 HP.
- DC Injection Braking is standard.
- Seven Pre-set Speeds and Jog with Independent Accel and Decel.
- User Programmable Analog and Digital Inputs and Outputs.
- DC Drive Simulation available during decel, operates just like a DC Non-regenerative drive.
- IGBT Design results in Compact Package.
- New PWM Carrier modulation reduces harmonics and noise (patent pending).
- Automatically tunes SV3000 to match the motor and system to the Application.
- Full monitoring of drive parameters with last three faults and Fault Log.
- NEMA 4/12 Enclosure or chassis available 1 through 10 HP and NEMA 12 or chassis 15 - 75 HP. 100 HP is NEMA 1 or chassis.
- Multi-level security code to prevent unauthorized parameter changes.
- Serial Communications standard on all units.
- Start a Spinning Motor feature.
- Coast-to-Rest or Decelerate-to-Rest Stop Modes.
- Three Skip Frequencies with Adjustable Windows.
- Master-Follower operation with either Analog inputs or new fully automatic high speed follower.
- Fuses included on all units for additional protection and increased reliability.
- Full 5 Year Warranty.

1.5 Optional Features

The SV3000, 1 - 15 HP, has an internal Dynamic Braking resistor, but for applications requiring greater braking or resistance to overhauling loads, an external Dynamic Braking option is available. For 20 - 100 HP SV3000 drives, an external Dynamic Braking option which includes the necessary electronic circuitry is available or a version of the SV3000 with internal dynamic braking electronic circuitry is available.

1.6 SV3000 General Specifications

Service Conditions

AC Line Input:	380 to 460 volts, ±10%, three phase
AC Line Input Frequency:	48 to 62 Hz.
Ambient Temperature:	0°C to 40°C enclosed units 0°C to 55°C chassis units
Humidity:	5 to 95% non-condensing
Altitude:	To 3300 ft. without derating

Operating Conditions

Output Voltage:	0 to input voltage
Output Frequency:	0 to 120 Hz, .02 Hz increments
Maximum Load Capacity:	150% for 1 minute
Line Protection:	Fuses, M.O.V.'s and capacitors

Performance

Speed Holding:	1% of base speed over 20:1 motor speed range with no feedback device .01% of base speed down to zero speed with encoder feedback
Resolution:	.025% with Analog Input .01% with Digital input
Starting Torque:	150% at 3 Hz - Standard Performance
Overload Capacity:	150% for 60 seconds

Basic Adjustments

Max Speed:	0 to 120 Hz
Min Speed:	0 to Max Speed
Accel Time:	0.1 to 3200 Seconds
Decel Time:	0.1 to 3200 Seconds
Jog Speed:	0 to 100% of Base Speed (Separate Accel/Decel)
Max Torque Motoring:	10 - 150%
Max Torque Braking:	10 - 150%
Readout:	Engineering Units (RPM, etc.)

Other Adjustments

Seven Preset Speeds

Three Skip Frequencies and Windows

Selection Modes

DC Injection Braking Selection

S Ramp Accel and Decel Selection

Catch a Spinning Motor Selection

Communications Set-up

Master-Follower Selection

Master-Follower Source Selection

Analog Inputs

Local Analog Input:	Controls Speed or Torque Scalable 0-10 VDC max, unipolar or bipolar
User Analog Input:	Controls other parameters Scalable 0-10 VDC max Follower Input Source
Remote Analog Input:	Controls Speed or Torque Scalable 0-20 mA, (4-20mA, default) Current input reversible (through scaling)

Analog Outputs

Meter Output:	0-10 VDC Speed or Torque (12 bit)
User Output:	Scalable 0-10 VDC max (12 bit) Selectable to indicate Status Parameter Value

Digital Inputs

User Input:	Selects Coast or Decel to Stop Selects Speed or Torque Selects Master or Follower Selects Zero Torque Selects Forward Digital Inputs are +5 to +24 VDC

Digital Outputs

User Relay:	Program to indicate Status Parameters (Form C)
Fault Relay:	Indicates a Drive Fault (Form A) 250 VAC at 5 Amps
User Output:	Open collector programmable to indicate Status Parameters (Max output 50 V, 100 mA)

Diagnostics

Status Display:

- Motor Speed
- Set Speed
- Motor Torque
- Motor Amps
- Motor Frequency
- DC Bus Volts
- Status of Input Signals
- Last Three Faults Type
- Drive Conditions at Last Fault
- I^2t Accumulator
- Hours Run
- DB Accumulator
- Speed Error
- Motor Volts
- Input Watts (Power)
- Input Power Factor
- Total kW-H

Motor Requirements

Type:	AC Induction Motor 2, 4, 6, 8, 10 pole 380 to 460 volts

Encoder (Enhanced Models)

Type:	Incremental, 1024 ppr preferred Programmable for 60 to 2048 ppr 2 channel quadrature 5 VDC differential Power supply, +5 VDC, 200 mA max Max frequency 200 kHz

Stopping Modes

Coast to Rest
Ramp to Rest
DC Drive Simulation (motor coasts from high to low speed)

Braking Modes

Integral Dynamic Braking (1 - 15 HP only)
Optional Dynamic Braking (20 - 100 HP)
DC Injection Braking
Regenerative to Common DC Bus System (Consult Factory for details)

Communications

Serial Port #1:	RS485, isolated, ANSI 3.28X protocol
Serial Port #2:	Synchronous serial RS485 port for high speed multi-motor Master/Follower operation

Start Modes

Manual:	By operators controls
Automatic:	At Power Up or after a Fault
Automatic:	By Serial Communications

Other Features

Auto Tune:	Control to Motor and Control System PID Gains
Security:	Multi-Level programmable Security Codes
Read Out:	2 Line by 16 Character back-lit LCD display English, Spanish, French and German language display

Warner Electric SV3000 uses a high performance micro processor to monitor and control the magnetic flux in a conventional AC induction motor. Control of the flux allows the motor to develop full torque over a wide speed range. The advanced circuitry, computing and measuring techniques used by the Warner Electric SV3000 do not require an encoder on the motor shaft when performance similar to an armature voltage feedback DC drive is needed. When very precise speed control and torque control down to zero speed is needed, an encoder mounted on the motor shaft can be used by the SV3000.

When a motor mounted encoder is connected to an SV3000 with the optional encoder interface card, the drive performance surpasses that of most DC drives and approaches servo performance. Zero speed regulation from no load to full load and high dynamic performance in both directions with no dead band at zero speed is possible.

Design Concept Power Electronics

- Insulated-Gate Bipolar Transistors (IGBT) form the inverter bridge power circuit and give high power and high speed switching, but require only low drive energy.
- Auto-protecting IGBT gate drive circuits give fast phase to phase and phase to ground short circuit protection.
- A fast response, flux balancing current transducer is used for current control and protection within the adjustable speed drive.
- A Switch Mode Power Supply (SMPS) provides auxiliary voltage supplies for the control circuits and allows the inverter to operate over a wide input voltage range. The SMPS provides isolated supplies to drive the IGBT's.

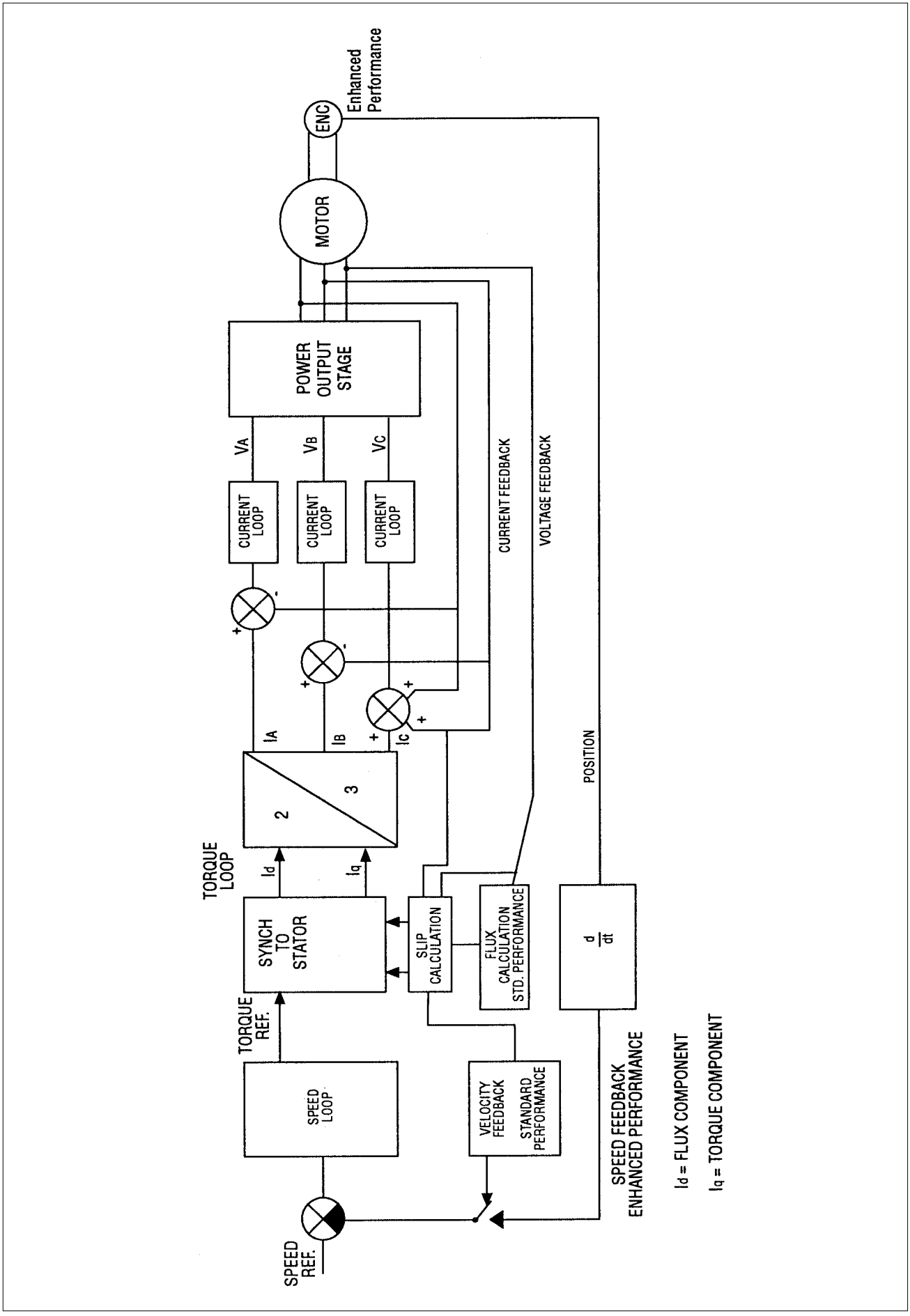


Fig. 1B Block Diagram

1.6.1 Electrical Specifications

HP 460 VAC	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100
Rated Input AC Line Amps	2.6	4.9	6.9	10.4	11.0	13.1	22.3	28.6	32.4	38.3	51.0	62.2	73.7	95.1	119
Rated Output Amps (RMS)	1.8	3.4	4.8	7.6	11.0	14.0	21.0	27.0	34.0	40.0	52.0	65	77	96	124
Peak Output Amps (RMS)	2.7	5.1	7.2	11.4	16.5	21.0	31.5	40.5	51.0	60.0	78.0	97.5	115.5	144	186
Rated Output KVA	1.4	2.7	4.3	6.0	9.1	11	16.7	21.5	27.1	31.8	41.4	51.8	61.4	76.5	98.8
Heat Loss (Watts 1990	50	75	100	150	175	240	440	498	615	724	886	1012	1200	1465	
@ 6KHz)															
Braking Torque, Internal	150%	100%	70%	50%	40%	30%	20%	Ext. DB	Ext. DB	Ext. DB	Ext. DB	Ext. DB	Ext. DB	Ext. DB	Ext. DB
DB Resistor															
Input Power Factor	0.95*	0.95*	0.95*	0.95*	0.86	0.86	0.88	0.87	0.92	0.82	0.88	0.92	0.92	0.91	0.92
Type of Ventilation	Internal Fan							Internal and External Fan							

* Indicates Displacement Power Factor

1.7 AC Motor Operation

The synchronous speed of an AC motor is a function of the applied frequency and the number of poles in the motor according to the following formula:

$$\text{Synchronous Speed} = \frac{\text{Frequency} \times 120}{\text{Number of Poles}}$$

Using the above formula to calculate the synchronous speed of a four pole motor operating on 60 Hz yields:

$$\text{Synchronous Speed} = \frac{60\text{Hz} \times 120}{4 \text{ Poles}} = 1800 \text{ RPM}$$

The synchronous speed is the speed of the rotating magnetic field in the air gap of the motor. The actual rotor speed of the induction motor will be slightly less than the synchronous speed due to the slip required to produce torque at the shaft of the induction motor. This reduction in speed (or slip) is typically 3 to 5% for a fully loaded NEMA Design B motor.

Here are calculations for 2, 6 and 8 pole AC induction motors.

$$\text{Synchronous Speed} = \frac{60\text{Hz} \times 120}{2 \text{ Poles}} = 3600 \text{ RPM}$$

$$\text{Synchronous Speed} = \frac{60\text{Hz} \times 120}{6 \text{ Poles}} = 1200 \text{ RPM}$$

$$\text{Synchronous Speed} = \frac{60\text{Hz} \times 120}{8 \text{ Poles}} = 900 \text{ RPM}$$

1.8 AC Motor Specifications

The SV3000 series requires a three phase AC induction motor.

1.8.1 Mechanical Specifications

AC motors of open construction or totally enclosed construction may be used. While any AC motor may be operated at variable speeds, not all are suitable for CONTINUOUS operation at reduced speeds under load. In general, to achieve greater than a 2:1 speed range at full load, a motor must be a specially selected inverter duty motor either totally enclosed non-ventilated, or have a separately powered blower. It is the user's responsibility to determine suitability of existing motors.

Warner Electric offers a line of totally enclosed non-ventilated and blower cooled motors which offer 20:1 speed range "open loop" and 1000:1 with encoder feedback. Please contact your local distributor or sales office for further details.

If a motor with an integral brake is to be used, the brake coil must be separately excited and controlled by a suppressed contactor. The brake coil should not be connected to the output of the SV3000.

1.8.2 Electrical Specifications

Motor voltage and frequency rating must match the output of the SV3000 drive. Typically, motor rating should be 460 VAC, 3 phase, 60 Hz. By parameter changes, other motors may be used.

Motors should be 2, 4, 6, 8 or 10 pole design. Refer to section 2.11 for details on operation of motors other than 4 pole.

Generally, the HP of the motor determines the HP of the drive required, but certain motor designs require higher full load current than others. Therefore, it is important to ensure that the FULL LOAD AMP rating of the motor is equal to or less than the full load amp rating of the drive to be used. See section 1.6.1 for drive data.

The motor should be of NEMA design "B" for best performance. AC motors of designs "A," "C," or "D" may also be used. The SV3000 is not suitable for use with synchronous-type AC motors.

2 Installation

The SV3000 inverter is a high performance digital drive. To achieve the maximum performance of which the drive is capable, it is essential to follow the recommendations specified in the following sections. Please read all of Section 2 before installing the SV3000.

2.1 Safety Precautions

DANGER!

DANGEROUS HIGH VOLTAGES ARE PRESENT IN THIS EQUIPMENT, PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY RESULT IF PROPER SAFETY PROCEDURES ARE NOT FOLLOWED!

1. **This equipment must be installed, adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of both electrical and mechanical equipment involved.**
2. **Circuit breakers or disconnects feeding this equipment must be locked open before wiring or servicing. If no lockout device exists, remove fuses and tag box to prevent unauthorized personnel from reapplying power.**
3. **To insure safety, all equipment, motors, controllers, etc., must be properly grounded.**
4. **The National Electrical Code requires that an approved circuit disconnecting device be installed in incoming power lines ahead of this equipment, mounted in a location readily accessible to personnel installing or working on this equipment.**
5. **The user is responsible for understanding and conforming with the National Electrical Code and other applicable local codes which govern installation of this equipment and associated motor, operator's controls, transformers, etc. External motor overload protection must be provided to comply with the National Electrical Code.**

WARNING!

1. **Do not connect any external circuits other than as shown on the interconnection diagram supplied with the equipment. If your installation requires the use of accessory equipment other than as shown, consult the factory for proper interconnection instructions.**
2. **Do not allow wires to ground on chassis when making connections to the terminal strip. Remove only enough insulation to make a firm connection and make certain that loose strands do not short between terminals or the chassis.**
3. **This equipment is designed to operate from 380 to 460 VAC three phase power. If the correct voltage is not available for the unit, an appropriately sized transformer must be installed.**
4. **Be certain to check that the motor is connected for the correct voltage (380, 415, or 460 VAC, three phase).**
5. **DO NOT MEGGER OR HI-POT this equipment without first consulting the factory.**

CAUTION!

EQUIPMENT MALFUNCTION MAY BE CAUSED BY OTHER PLANT EQUIPMENT OPERATING IN THE VICINITY OF THIS EQUIPMENT.

1. **The use of Power Factor Correction Capacitors on this equipment may cause erratic operation and/or nuisance tripping. If Power Factor Correction Capacitors must be used, consult the factory for proper application.**
2. **Erratic operation and/or nuisance tripping may be caused by power line disturbances from welders or other high power, high frequency equipment, or by the switching of highly inductive or capacitive devices such as brake coils or Power Factor Correction Capacitors. In this case, operation may be improved by installing isolation transformers or powering equipment from a different source.**

2.2 Receiving and Unpacking

This equipment is carefully packaged to protect it from damage caused by normal handling during shipment. However, extreme shocks or loads caused by dropping, mishandling or stacking may cause damage to the inverter. Unpack the equipment as soon as it is received and carefully inspect it for possible damage.

If shipping damage is found, notify the carrier and Warner Electric immediately. Since equipment is shipped by Warner Electric F.O.B. shipping point, ownership transfers when the equipment leaves the factory. Therefore, all shipping damage claims must be filed by the consignee directly with the shipping carrier. Warner Electric will assist with information necessary to file the claim.

2.3 Mounting Location and Specification

Select a location for the inverter in accordance with the following considerations:

1. The inverter is designed for mounting upright on a vertical surface to promote air flow through the heatsinks by natural (or forced) convection. To allow adequate ventilation around the drive, be sure to provide at least four inches of free space around each side of the drive.
2. Do not mount the inverter on wood or other combustible surfaces. "Hot Spot" temperature of the inverter back panel may exceed 100°C (212°F) under normal operating conditions.
3. To insure proper cooling, the inverter requires the free circulation of clean, dry air over the heatsinks. The maximum ambient air temperature for chassis mounted units is 55°C (131°F) and 40°C (104°F) for NEMA 4/12 enclosed units. Do not locate the inverter over, on, or near a heat source, or in direct sunlight.
4. The inverter must not be mounted where it will experience excessive shock or vibration.
5. Select a dry location where the inverter will not be subjected to dripping or splashing liquids.
6. When mounting the inverter, take extreme care to prevent metal chips from the drilling of conduit holes or mounting holes from entering the inverter. Remove the conduit mounting plate from the unit to assist in keeping metal particles from getting into the enclosure. Either cover the inverter or remove it from the enclosure before drilling. Also, remove all metal chips from the inside of the enclosure with a brush or a vacuum cleaner.

   Conduit and conduit fittings connected to the SV3000 enclosure must be UL/CSA listed or recognized and must have the same environmental type rating as the enclosure.

2.4 Electrical System Considerations

Output (Motor) Contactors

If contactors are installed between the drive's output and the motors, they must be operated only when the drive is stopped.

Power Factor Correcting Capacitors

Power factor correcting capacitors must not be connected to the drive output. If they are already connected at the motor terminals, they must be disconnected.

2.5 Fusing Specifications

Fuses are included on all chassis and enclosed units as listed in the following chart. **WARNING: To properly protect the inverter, the fuses supplied must be replaced with the factory specified fuses or an equivalent. Failure to do so could result in voiding the warranty.** If in doubt on the type of fuses to use, please consult the factory.

2.5.1 AC Line Fuses Specifications

Drive HP	Rating/Type	Part Number	Drive HP	Rating/Type	Part Number
1	6 A / KTK-6	PFU1013-07	15	30A/KTK-30	PFU1013-01
2	6 A / KTK-6	PFU1013-07	20	40A/KBH40	PFU2048-00
3	15 A / KTK-15	PFU1013-00	25	50A/KBH50	PFU2048-13
5	15 A / KTK-15	PFU1013-00	30	70A/KBH70	PFU2048-15
7.5	20 A / KTK-20	PFU1013-06	40	70A/KBH70	PFU2048-15
10	20 A / KTK-20	PFU1013-06	50	90A/KBH90	PFU2048-17
			60	100A/KBH100	PFU2048-01
			75	150A/KBH150	PFU2048-18
			100	175A/KBH175	PFU2048-03

2.6 Installation Wiring

All wiring used to connect to the SV3000 should be sized to meet the regulations of local electrical codes and NEC standards. Input power wiring, motor wiring and control wiring should be run in separate conduits to avoid problems that might be caused by electrical noise on the output wires affecting operation of the drive, in addition low level control circuitry must be wired using shielded twisted pair conductor cable with the shield connected to earth ground at one end only. (Preferably at the signal source). The other end of the shielded cable must be sufficiently insulated as to maintain isolation from earth ground. This will eliminate any unwanted ground loops between different equipment grounds. The types of signals that require the use of shielded cable include analog input signals (0 - ±10 VDC, 4 - 20 mA, 20 - 4 mA, 0 - 20 mA), digital input signals (serial communications or digital pulse trains) and feedback signals.

The proper use of shielded cable will reduce the introduction of electrical noise to the AC inverter and prevent problems that can cause velocity irregularities, intermittent fault trips, fuse blowing and component failures. The leads going to the motor need to be totally separated from any other leads connected to the drive. The motor leads should either use shielded cable or be placed in metal conduit. In either case, both ends of the shield or conduit need to be solidly connected to a good earth ground. The AC line connections to the drive should also be in a separate conduit or shielded.

2.7 Grounding Requirements

The SV3000, AC Motor and all other system components must be grounded in accordance with the National Electrical Code and all other applicable local standards. **Both the motor and the drive need a good connection to earth ground to avoid drive problems particularly WDT trips. The ground connection for the motor should go directly from the motor to ground and not be connected first to the drive and then to ground.**

2.8 Isolation Transformers

While the AC inverter normally does not need to be used with an isolation transformer, in some applications an isolation transformer increases system performance and reliability. When the plant voltage must be stepped up or down or when the proposed AC line has a low impedance (SV3000 is connected to a large distribution transformer), an isolation transformer is required. The isolation transformer should not be more than five (5) times that recommended for the Drive HP. The KVA rating and the common transformer sizes can be found in the following chart:

460 VAC Primary – 460 VAC Secondary							
Three Phase NEMA 1 Enclosed, Dry Type, ±5% Primary Taps, 60 Hz							
Drive HP	**Drive KVA Rating**	**KVA**	**Part Number**	**Drive HP**	**Drive KVA Rating**	**KVA**	**Part Number**
1	1.4	3	TRT44-003	15	16.7	20	TRT44-020
2	2.7	3	TRT44-003	20	21.5	27	TRT44-027
3	4.3	6	TRT44-006	25	27.1	34	TRT44-034
5	6.0	7.5	TRT44-007	30	31.8	40	TRT44-040
7.5	9.1	11	TRT44-011	40	41.4	51	TRT44-051
10	11.0	15	TRT44-015	50	49.5	63	TRT44-063
				60	58.7	63	TRT44-063
				75	75.8	93	TRT44-093
				100	94.8	118	TRT44-118

2.9 AC Line Impedance

The inverter should not be connected to a power line with a capacity of more than five (5) times the rating for the drive. Use additional line impedance (line reactors) or an isolation transformer. Check section 2.8 for the proper transformer KVA rating for the specific HP of the SV3000.

2.10 Line Reactors (Input/Output)

Unusually long cable runs (in excess of 330 feet [100 meters]) between the drive and the motor may give rise to spurious drive tripping due to the capacitance of the cable. This problem can usually be eliminated by adding inductors (chokes) in series with the motor leads. The table below is a general guide to the inductance and current rating of inductors for the different HP sizes of SV3000 inverters. The PTR5013-XX series are open frame inductors intended for mounting within an enclosure and the PTR5013-2XX series are inductors in a NEMA 1 enclosure.

HP	Inductor Value (mH)	Max. Current Ratings (A)	Watts Loss	Part Number (Open)	Part Number (NEMA 1)
1	12.0	2	11	PTR5013-00	PTR5013-200
2	6.50	3	11	PTR5013-02	PTR5013-202
3	6.50	4	19	PTR5013-03	PTR5013-203
5	2.75	8	38	PTR5013-04	PTR5013-204
7.5	2.50	10	38	PTR5013-05	PTR5013-205
10	1.50	15	44	PTR5013-06	PTR5013-206
15	0.90	25	94	PTR5013-07	PTR5013-207
20	0.75	35	112	PTR5013-08	PTR5013-208
25	0.75	35	112	PTR5013-09	PTR5013-209
30	0.50	50	138	PTR5013-10	PTR5013-210
40	0.50	50	138	PTR5013-11	PTR5013-211
50	0.375	75	206	PTR5013-12	PTR5013-212
60	0.375	75	206	PTR5013-13	PTR5013-213
75	0.275	100	338	PTR5013-14	PTR5013-214
100	0.200	132	362	PTR5013-15	PTR5013-215

2.11 AC Motor Considerations

Extreme care should be exercised in the selection of the AC motor to be used with an AC inverter. The application criteria for the load to be driven should be reviewed when selecting the motor. Constant torque speed range, minimum speed, maximum speed, duty cycle, feedback requirements, accel/decel requirements, C-face or foot mount, as well as the usual HP, voltage and current requirements need to be considered when matching a motor and AC inverter to an application.

In addition to selecting the correct AC motor and control to meet the application requirements it is important to consider motor thermal protection (motor overload relay or thermostat can be connected between TB1 - 12 and TB1 - 11 to trip drive on External Fault) and to provide the correct starter and protection for a motor mounted blower if specified.

Applications that use motors larger or smaller than the inverter HP, explosion-proof motors, AC motors other than 4 pole-1800 RPM, motors with feedback devices and many others need to be addressed before the drive components are purchased. **The SV3000 can not be used with synchronous motors or on applications with more than one motor per drive.** If further questions remain, please consult the Application Engineering department at the factory for technical assistance.

2.11.1 AC Motor Rating

Standard AC induction motors are designed to operate at constant speed. Their inherent self-cooling capability does not allow continuous operation at reduced speeds unless the torque rating is reduced.

Also, although the inverter produces a near-sinusoidal waveform, motor losses are somewhat increased when operated from an inverter. This produces additional heat in the motor.

For improved motor protection at low speeds, an internal motor thermal switch is recommended.

If using a motor of the next larger size (HP) than the drive HP rating, derate the drive by 10%. This must be done because of the lower power factor of the oversize motor when operated below its full load rating.

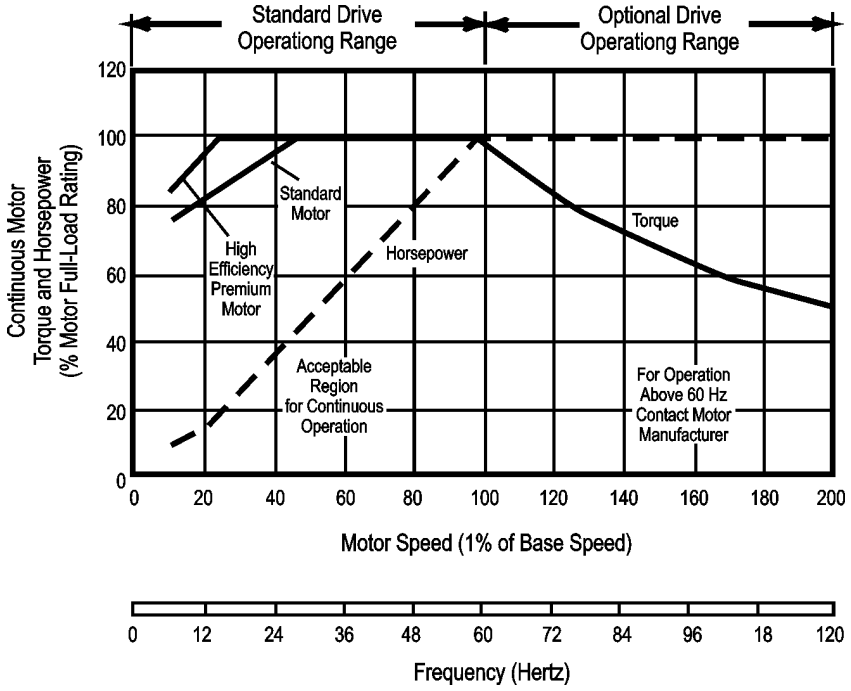


Fig. 2A Typical Motor Derating Characteristics

WARNING!

A contactor or switch connected between the drive and its motor must not be turned off or on while the drive and its motor are operating. Consult Warner ELectric if you require this type of operation.

2.12 Control Terminal Locations/Definitions

The terminal connection on the standard SV3000 are divided into five distinct terminal strips and three telephone-type plug-in receptacles. Figure 2B illustrates the connection layout.

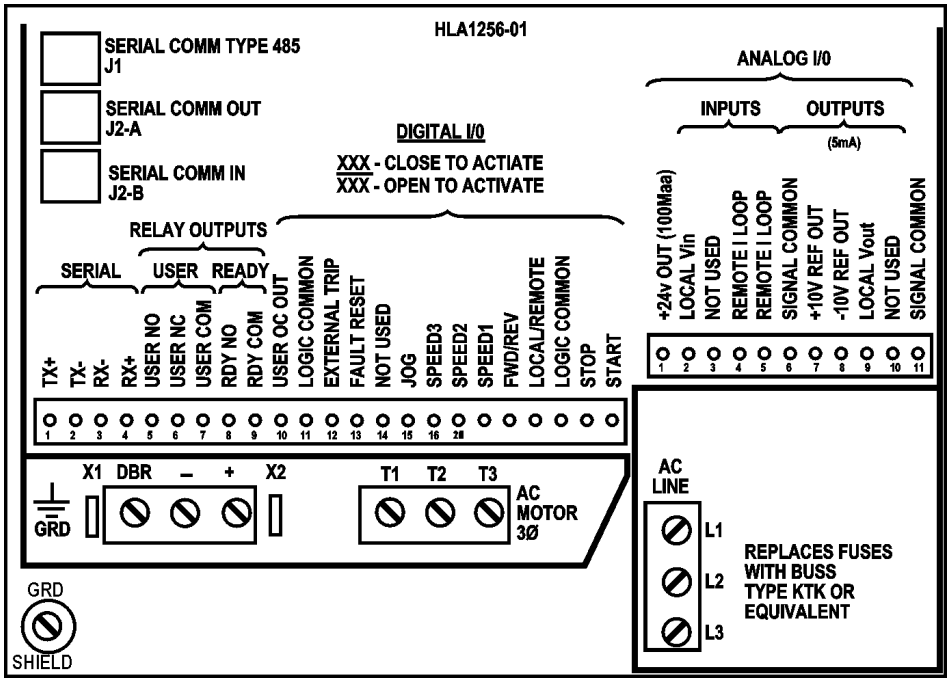


Fig. 2B SV3000 Control Board Terminal Connections

TB 1 – Digital Inputs, Relay Outputs and Serial Communications

Terminal Function	Designation	Terminal Number	Description
Serial	TX+	TB 1 - 1	Serial Link Transmit +
	TX-	TB 1 - 2	Serial Link Transmit -
	RX-	TB 1 - 3	Serial Link Receive -
	RX+	TB 1 - 4	Serial Link Receive +
Relays and Open Collector Outputs	User N/O	TB 1 - 5	User Programmable (Pr427) Relay - Normally Open
	User N/C	TB 1 - 6	User Programmable (Pr427) Relay - Normally Closed
	User Com	TB 1 - 7	User Programmable (Pr427) Relay - Common
	Rdy N/O	TB 1 - 8	Ready Relay - Normally Open
	Rdy Com	TB 1 - 9	Ready Relay - Common
	User OC Out	TB 1 - 10	User Programmable (Pr430) Open Collector Output (50V, 100mA sink to Logic Common- max.)
Digital Inputs	Logic Common (LCOM)	TB 1 - 11	Logic common connection to use with operator's inputs
	External Trip Input	TB 1 - 12	External Trip MUST be connected to Logic Common to run. External Trip Fault will occur when this connection is open.
	(Fault Reset) Input	TB 1 - 13	Normally open contact, momentarily connect to Logic Common to reset a fault. **A STOP keypad command will also clear a fault.**
	User Programmable Input	TB 1 - 14	This input has four selectable functions as set by Pr426 Uin: Coast-to-Rest Disable / (Enable), Master/ (Follower), (Zero Torque), (Speed)/Torque or Forward. Connecting this input to Logic Common will force the option in parenthesis. For the default value, "Coast-to-Rest," connecting this input to Logic Common will change the method of stopping from Decel Ramp to "Coast-to-Rest" when any STOP command is initiated.
	(Jog)	TB 1 - 15	Connecting this input to Logic Common makes the drive run at Jog Speed. Direction is set by TB 1 - 19, Forward/Reverse. The jog parameters are Pr005 Jog Speed, Pr006 Jog Accel and Pr007 Jog Decel.
	(Speed 3, 2, 1)	TB 1 - 16, 17, 18	Connections to LCOM select which Preset Speed is active when LOCAL selected. Active Preset Speed 0 1 2 3 4 5 6 7 Sp.1 (18) - 1 - 1 - 1 - 1 Sp.2 (17) - - 1 1 - - 1 1 Sp.3 (16) - - - - 1 1 1 1 All open selects Pr000 as reference. 1 = Tied to LCOM, - = Open connection.

TB 1 – Digital Inputs, Relay Outputs and Serial Communications (continued)

Terminal Function	Designation	Terminal Number	Description
	Forward/ (Reverse)	TB 1 - 19	Forward/(Reverse) – When the connection is open, the motor will run in the NEMA defined Forward direction. When tied to LCOM, the motor will turn in the reverse direction.
	Local/ (Remote)	TB 1 - 20	Local/(Remote) – When this input is left open, the active analog input is voltage. When tied to LCOM, the active analog input is current. (Remote input overrides Speed 3, 2, 1 Input.)
	Logic Common (LCOM)	TB 1 - 21	Logic common connection to use with operator's inputs.
	Stop	TB 1 - 22	Stop – Normal Run mode is connected to LCOM. When Open a STOP will be initiated and stop in the mode set by parameter Pr202. The Decel Ramp is set by Pr004 or by the Preset Speed Decel in the Preset Menu Parameters if Preset Speeds are used. **THE DRIVE WILL NOT RUN IF THIS IS OPEN.**
	(Start)	TB 1 - 23	(Start) – A momentary connection to LCOM will "START" the drive and continue running until a "STOP" or Fault occurs. If in "Jog" mode (TB 1 - 15 tied to LCOM), a connection to LCOM must be maintained to Jog the motor.

( ) = The function is active when tied to LCOM (Logic common).

DIGITAL OUTPUT CONNECTIONS

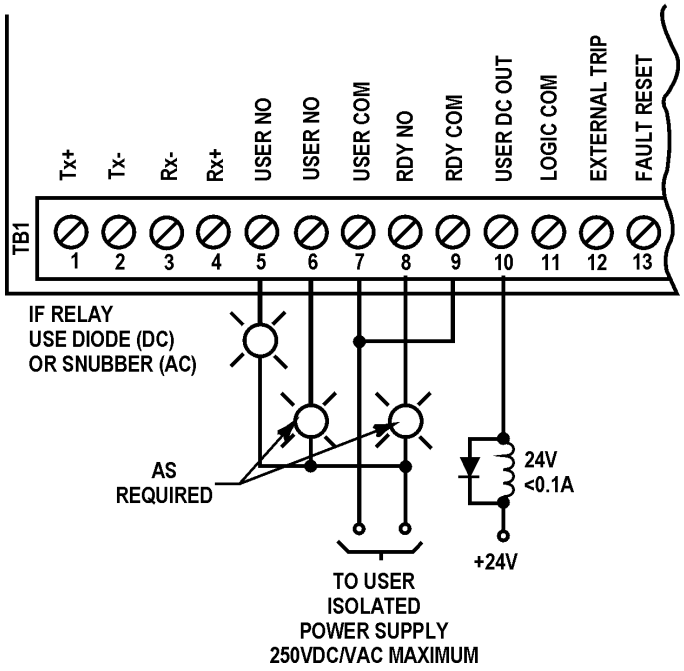


Fig. 2C Digital Output Connections

TB 2 – Analog Inputs and Outputs, Power Supply Outputs

Terminal Function	Designation	Terminal Number	Description
Power Supply Output	+24 VDC	TB 2 - 1	+24 VDC Unregulated Power Supply, 100 mA Max. Output
DC Voltage Input	Local Vin	TB 2 - 2-	0-10 VDC reference input when Pr203 Setpoint is set to analog to set speed and Local/Remote is set to Local, Pr401 Direction Control determines whether this is a unipolar or bipolar voltage input.
	User Program-mable Vin	TB 2 - 3	Parameters Pr413 User Vin, Pr414 UVin HI, Pr415 UVin LO and Pr416 UVin Mode determine the function and scaling of this input (unipolar 0 - +10 VDC).
DC Current Input	Remote I Loop +, and Remote I Loop-	TB 2 - 4, 5	Reference input when Local/Remote input is connected to Logic Common and a current input is used. Pr408-410 scale the current loop input. See Section 6.6 for more details.
DC Power Supply Outputs	Signal Common SCOM	TB 2 - 6	Analog Common
	+10 V Reference	TB 2 - 7	+10 VDC Reference Output 5 mA Max. Output
	-10 V Reference Output	TB 2 - 8	-10 VDC Reference Output 5 mA Max. Output
DC Voltage Outputs	Local Vout	TB 2 - 9	Parameter Pr420 Local Vout selects whether this analog output is Speed or Torque. The output is bipolar ±10 VDC.
	User Program-mable Vout	TB 2 - 10	Parameters Pr423 User Vout, Pr424 UVout HI and Pr425 UVout LO determine the function and scaling of this output. The output is bipolar 0 to ±10 VDC.

TB DBR – External Dynamic Braking Resistor / Common Bus Connection

Terminal Function	Designation / Terminal #	Description
External DB Resistor or Common Bus Connection See Fig 4D for connection diagram	DBR – +	For 1 - 15 HP Drives, an internal DB resistor is provided, but if a larger DB resistor is required for additional braking, the DB resistor is connected to DBR "R" and "+". The two wires connected to the internal DB resistor must be unplugged and the X2 wire plugged in to X2 and the X1 wire plugged in to X1. When the external DB resistor is used, an external thermal device is required and must be interfaced to the Stop input on the drive. For 20 - 100 HP drives, connect the DB resistor and thermal device to DBR "R" and "+." External DB kits are available from Warner Electric. When connecting two or more drives together on a "Common DC Bus" (1 - 15 HP), disconnect the wire from X2 on the internal DB resistor and plug it into X2. Leave wire X1 on the internal DB resistor. Connect " – " and " + " to the external DC bus. Consult factory before use.

2.13 Operator Connections

To insure proper operation, dry contacts or switches must be used to select functions located on Digital Input TB 1. The terminal strip input would either be left open (Logic "1" state) or connected to Digital Common (Logic "0" state) to initiate or prevent a function from occurring.

All low level signals must be shielded properly to prevent the possibility of misoperation due to the pick up of electrical noise.

2.14 Remote Operator Station

The SV3000 will accept a number of remote operator stations available from Warner ELectric. Each remote station contains different combinations of functions or enclosure ratings. Some of the suitable remote stations include:

R1000 – Start/Stop, Run/Jog, Auto/Manual, Forward/Reverse, Speed Potentiometer. NEMA 4.
R1001 – Start/Stop, Run/Jog, Auto/Manual, Speed Potentiometer. NEMA 4.
R1002 – Start/Stop, Run/Jog, Forward/Reverse, Speed Potentiometer. NEMA 4.
R8005 – Start, Stop, Speed Potentiometer. NEMA 12.
R8011 – Start, Stop, Auto/Manual, Speed Potentiometer. NEMA 12.

Individual wiring diagrams are furnished with the remote stations. Using a remote operator station requires programming the SV3000 to respond to terminal strip control. See Section 3.10-4, for details. Shielded cable is required. All of the remote operator connections are isolated and are at low voltage levels.

2.15 Remote Keypad and Display

A Remote Keypad (part number SV3999-02) is available for use with chassis mounting SV3000 drives. This Option Kit consists of a keypad, interface board, 5 foot cable and mounting gasket. It is designed to allow the keypad and display to be mounted up to 5 feet from the drive. This allows the Operators Controls to be mounted on the door of an enclosure containing a chassis mounting drive. Consult Seco for more details.

2.16 Analog Outputs

The SV3000 provides two user-programmable analog outputs. These outputs may be used for connection to an analog (Dial and pointer) or digital voltmeter for remote indication of various functions or operating conditions of the drive. The outputs are 0 to 10 volts DC, bi-polar.

The output on terminal TB 2 - 9 is factory set to correspond to SPEED. Alternatively, it may be user set to indicate TORQUE by changing parameter Pr420 from "SPEED" to "TORQUE."

If local VOUT signal TB2-9 is representing speed (default), then when drive speed = MAX, the output value on TB2-9 will be +10.0V. When drive speed = MIN, the output voltage will be 0V.

If local VOUT signal TB2-9 is representing TORQUE, (Pr420 set to TORQUE) then 10V on TB2-9 corresponds to 150% of Pr 300 Motor Amps, 6.66V = 100% TORQUE and 0.0v = 0 TORQUE.

The output on terminal TB 2 - 10 is factory set to correspond to MOTOR TORQUE (Pr503), but may be user set by parameter Pr423 to relate to any of parameters Pr500 through Pr512. These could include:

SPEED (P500)	TORQUE (P503)	MOTOR CURRENT (P504)
MOTOR VOLTAGE (P506)		DC BUS VOLTS (P510)

See Section 6.6 for an explanation of how to scale User Vout.

Specifications of Analog Outputs-

0 to 10 Volts, DC bi-polar

Maximum load - 5 mA

Resolution - 12 bits

Accuracy - ±.0.5%

2.17 Digital Outputs

The SV3000 has two user programmable digital outputs, relay contacts on TB1-5,-6,-7 programmed by Pr 427 (select) and Pr 428 (set) and an open collector on TB1-10 programmed by Pr 430 (select) and Pr 431 (set). Parameters Pr 500 through Pr 514 may be programmed to the digital outputs. To program the relay output, set the STATUS value to be monitored to Pr 427. Set the value at which the relay switches into Pr 428. This value is in absolute units - Amp, RPM, % etc.

To program the open collector output, set the STATUS value to be monitored into Pr 430. Set the value at which the transistor will switch into Pr 431. For example, if it is required to get relay actuation when CURRENT (Pr 504) is > 100%, set Pr 427 = 504, Pr 428 = 100.0.

3 Power-Up Procedures

Before attempting to apply AC power to the SV3000 or installing the system wiring, please read Chapter 2, Installation, completely, for instructions on proper installation requirements.

After the drive has been physically mounted as specified in Sections 2.3, Mounting Location and Specifications, and wired per the requirements of the National Electrical Code and all applicable local regulations, read through Chapter 3, Power-Up Procedures, for proper start-up instructions.

3.1 Pre-Power Checks

Before applying AC power to the SV3000, please complete the following steps.

1. Review Section 2.1, Safety Precautions, in this manual before applying AC power to the drive.
2. Visually inspect the drive to assure all boards, plugs and wires are installed correctly and there are no loose connections.
3. Check that the proper fuses are installed and that the voltage to be applied matches that specified on the label mounted on the drive. If necessary, open the AC line ahead of the connection to the SV3000 and measure the three phases to assure the AC voltage is correct.
4. Connect the input power leads and motor leads to the SV3000 as shown in Fig 3A. Wiring must be in accordance with National Electric Code and all local codes.

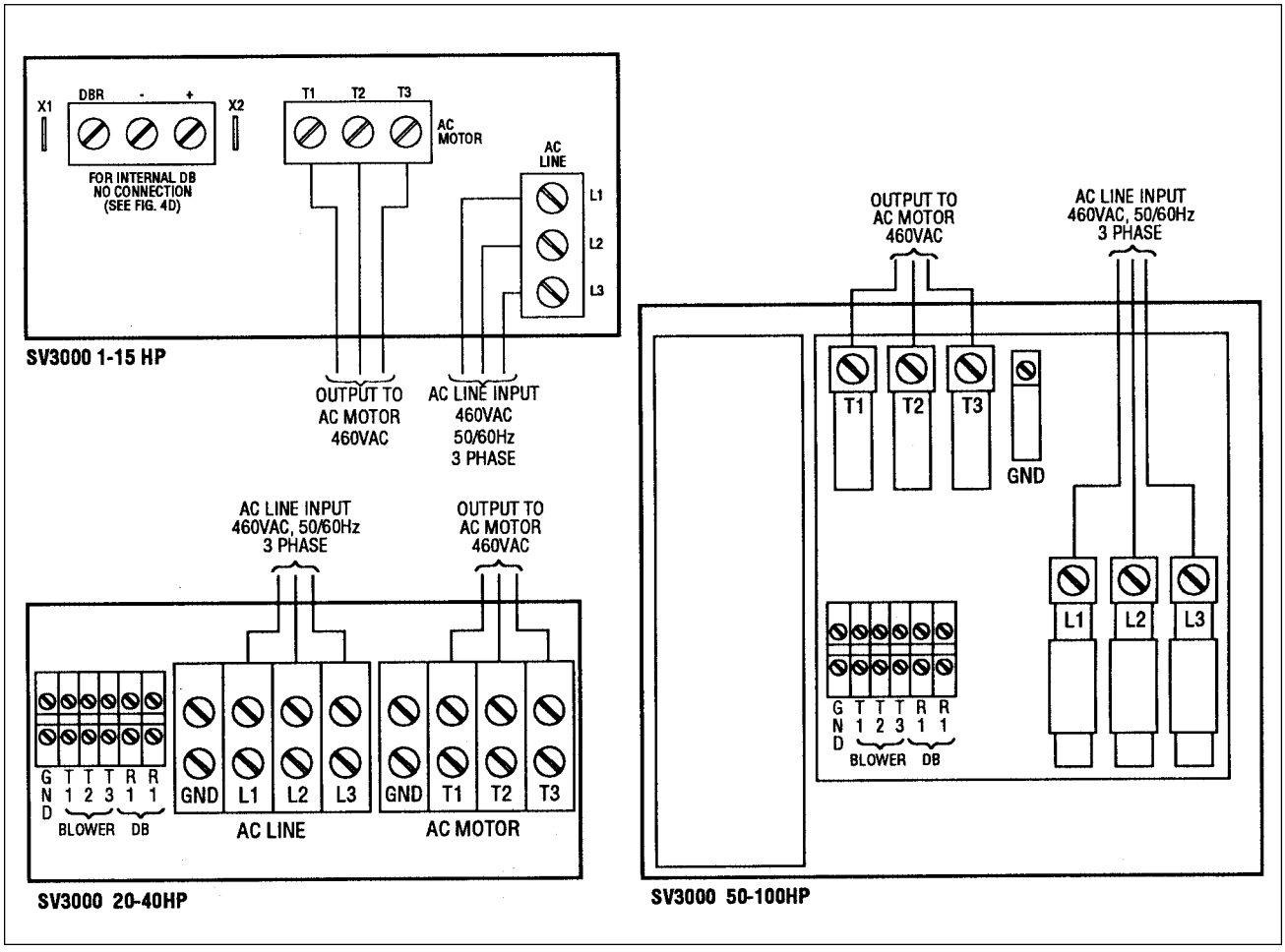


Fig. 3A Input and Output Connections
1-15 HP / 20-40HP / 50-100HP

The table on page 12 lists current requirements for each horsepower version of the SV3000.

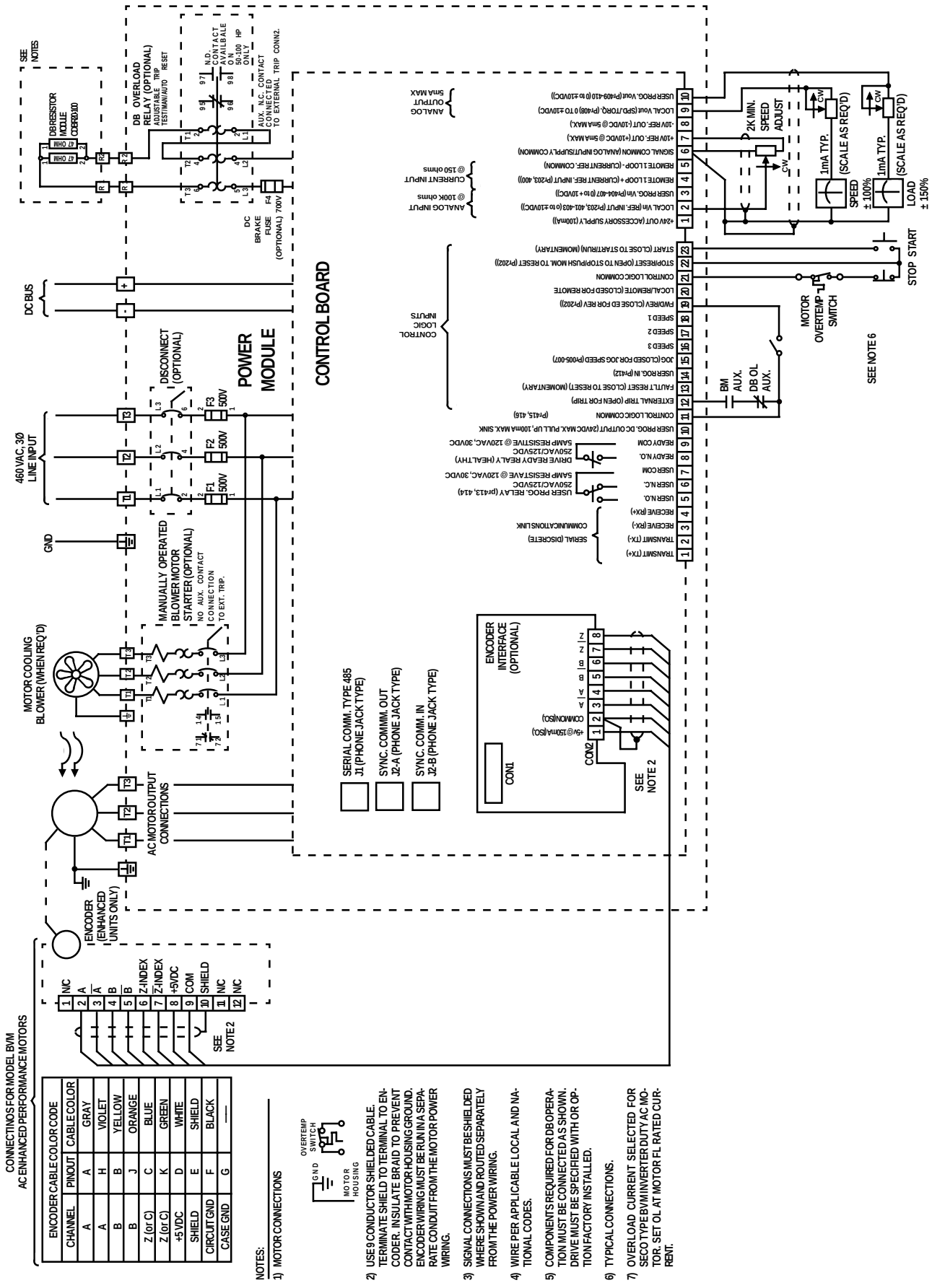


Fig. 3B Typical Connection Diagram

3.2 Applying Power to the Drive

1. If possible, the inverter should first be started with the motor shaft uncoupled from the load. If not, be certain that the motor can turn in either direction without damaging equipment or causing personal injury.
2. The default value of Pr204 Keypad Enable (Enable) activates the RUN FWD and JOG Keys. Use the operators on the keypad for the initial drive/motor start-up.
3. When power is applied, starting the drive requires the following connections to be made to TB 1 - 11 or 21, Logic Common (L COM). Complete terminal connection information is provided in Section 2.12, Terminal Locations/Definitions.
   • TB 1 - 12 External Trip (Open to force External Trip)
   • TB 1 - 22 Stop (Open to Stop drive)
   In addition to the Stop Key on the Keypad, provide some method of interrupting the Stop connection TB 1 - 22 (Stop) to TB 1 - 21 (L COM) to be able to stop the drive during start-up if the actual terminal-connected control circuitry is not yet available or operational.
4. Apply input power to the inverter and check that the proper voltage is applied to terminals L1, L2, and L3. If the voltage measured does not fall within the proper range (380 - 460 VAC ±10% 50/60 Hz), **DO NOT OPERATE THE INVERTER. IMMEDIATELY SHUT OFF THE POWER! THE CORRECT VOLTAGE LEVEL MUST BE PRESENT BEFORE ATTEMPTING TO OPERATE THE INVERTER!**

When shipped from the factory, each SV3000 drive is now set up to match an appropriate Warner Electric AC motor. If you are using the correct Warner Electric motor (see Appendix 1 for the list), you do not need to perform a Tune Test. If you are not using a Warner Electric motor or your motor is not on the list in Appendix 1, you will need to perform the Tune Test – see Section 3.9.

3.3 Keypad Operation

The operator's keypad, which is used in conjunction with the LCD alphanumeric readout, provides simple operating and programming control for the SV3000. Below is a pictorial of the keypad. The keypad "Keys" used in normal operating modes (STOP and RUN modes) are defined first and then the "Keys" as they are used in parameter viewing and programming modes of operation are defined.

Fig. 3C SV3000 Operator's Keypad

3.4 Keypad Operations Mode (STOP and RUN Modes)

Keypad Key	Function
RUN FWD	Starts the drive in the Forward direction when pressed momentarily. If the drive is running in the Reverse direction when RUN FWD is pressed, it will decelerate to zero speed, and accelerate in the Forward direction. (If Pr213 Forward/ Reverse Mode is set to ALWAYS). If in JOG Mode, the drive will run the Forward direction only when the RUN FWD key is pressed.
RUN REV	Starts the drive in the Reverse direction when pressed momentarily. If the drive is running in the Forward direction when RUN REV is pressed, it will decelerate to zero speed, and accelerate in the Reverse direction. (If Pr213 Forward/Reverse Mode is set to ALWAYS). When shipped from the Factory the Key is not active. Set Pr213 if Reversing is required. If in JOG mode, the drive will run in the Reverse direction only when the RUN REV key is pressed.
JOG	Selects JOG mode when the drive is stopped. When in the JOG mode, the display will show it on the first line where the reference source is displayed. Pressing either the RUN FWD or RUN REV key will cause the drive to ramp up to the preset JOG speed (Pr005) at the preset JOG accel rate (Pr006). When the RUN FWD or RUN REV key is released, the drive will ramp down at the preset JOG decel rate (Pr007). To exit JOG mode, press the JOG key again.
STOP	Stops the drive when pressed momentarily. Ramp to Stop is Default mode. Parameter Pr202 (Stop Mode) can change the method of stopping. **If a Fault has occurred, pressing the STOP key will reset the Fault.**
▲	In the Stopped mode, pressing the UP key will increase the digital set speed. While running, pressing the UP key will increase the speed of the drive. The setting resolution is one unit. The setpoint cannot be incremented beyond the value set by Pr002. Its default value is 1800 RPM.
▲▲	In the Stopped mode, pressing the DOUBLE UP key will increase the digital set speed. While running, pressing the DOUBLE UP key will increase the speed of the drive. The setting resolution is one hundred units. The setpoint cannot be incremented beyond the value set by Pr002. Its default value is 1800 RPM.
▼	In the Stopped mode, pressing the DOWN key will decrease the digital set speed. While running, pressing the DOWN key will decrease the speed of the drive. The setting resolution is one unit. The setpoint cannot be decremented below the value set by Pr001. Its default value is 0 RPM.
▼▼	In the Stopped more, pressing the DOUBLE DOWN key will decrease the digital set speed. While running, pressing the DOUBLE DOWN key will decrease the current speed of the drive. The setting resolution is one hundred units. The setpoint cannot be decremented below the value set by Pr001. Its default value is 0 RPM.
STATUS / MENU	In the Run or Stopped mode, the Status key displays one of the four drive status windows. Pressing the Status key will cause the display to move to the next status window.
HELP	Pressing the HELP key will cause the display to sequence through the following two messages, "PUSH PROGRAM TO CHANGE VALUES" and "PUSH STATUS FOR MORE INFO." It will also give a brief description of any current fault.

3.4 Keypad Operations Mode (PROGRAM Mode) (continued)

Keypad Key	Function
PROG	Pressing this key will enter the PROGRAM mode. Pressing this key at any time while in the PROGRAM mode will exit the PROGRAM mode and return the readout to the RUN or stopped mode at the first Status window. If PROG mode is exited while EDITing a parameter, the original value of the parameter will be retained. The drive can be started and stopped while in the PROGRAM mode.
STATUS MENU	In the PROGRAM mode, pressing this key will move the display to the next menu heading. If in Menu 600, the display will "wrap-around" and Menu 000, Main, will be displayed.
▲	In the PROGRAM mode, pressing the UP key will scroll the display upwards through each parameter within a selected menu.
▼	In the PROGRAM mode, pressing the DOWN key will scroll the display down through each parameter within a selected menu.
EDIT	In the PROGRAM mode, pressing the EDIT key will allow the parameter displayed to have its data value changed by either the UP or DOWN Arrow keys. Pressing the EDIT key the second time will store the new data value and exit the EDIT mode. If while EDITing it is decided to keep the original value of the parameter, simply exit the PROG mode by pushing the PROG key.
HELP	In PROGRAM mode, pressing the HELP key has two modes of operation. In PROGRAM mode but not in EDIT, pressing the HELP key will cause the display to sequence through the following two messages: "Push EDIT to change value" and "Push MENU for next MENU." In PROGRAM and EDIT modes, pressing the HELP key will sequence through a longer explanation of the parameter on the second line of the display and then "EDIT to Accept."

3.5 Keypad Display

The two (2) line by sixteen (16) character alphanumeric display on the SV3000 will display the following operational information. (Factory Default values shown.)

Display at Power On:
(With no faults)

```
SP0:  1800 RPM
      stopped
```

Pressing the Status key will change the display to:

```
Actual:     0%
Set Torq:   0%
```

Pressing the Status key again:

```
Last Fault:  NF
```

Pressing the Status key again:

```
Speed:  1800 RPM
```

Pressing the Status key once again will return the display to the Power On display.

```
SP0:   1800 RPM
       stopped
```

Depending on the operation occuring at that moment, the second line of the Power On display will also show any of the following displays. (Other display combinations are possible):

SP0: 1800 RPM accel fwd	SP0: 1800 RPM run fwd	SP0: 1800 RPM accel rev
SP0: 1800 RPM run rev	SP0: 1800 RPM fault	

When in the third, or Status Display with the analog speed bar indication, the second line can be changed by using the UP or DOWN Arrow keys to display various Status values. The DOWN Arrow key will change from SPEED to SET SPEED to SET TORQUE to MOTOR I and so forth as shown here. At REPAIR DATE, pressing the DOWN Arrow key again "rolls" the display around to the SPEED Status Display. The UP Arrow key will scroll back up the list of Status Display Values.

SPEED: 0 RPM	SET SP: 1800	SPEED ERR: 0%
MOTOR TORQUE: 0%	MOTOR I: 0.00	MOTOR HZ: 0
MOTOR V: 460	R MOTOR: 100	IN WATTS: 500
INPUT PF: -9	BUS VOLTS: 670	IXT: ACCUM: 0%
DB ACCUM: 0%	TOTAL KWH:	HOURS RUN: 0
INS: 000000000000 (1)	LAST FAULT: NF	FAULT 2: NF
FAULT 3: NF	FLT VOLTS: 0	FLT FREQ: 0
F MODE: stopped	FLT CUR: 0.00	FLT TIME: 0
SW REV: 2.01	DRIVE SIZE: 2	

The analog bar readout will continue to display actual speed regardless of the Status information displayed on the second line of the readout.

These same Status Display values are located as read-only parameters in Menu 500, Status Parameters.

(1) Represents Status of Inputs to TB 1 - 12 (M.S.B.) through TB 1 - 23 (L.S.B.) 1 = Active and 0 = Not Active. (See Sect. 3.16.1)

3.6 Keypad Parameter Viewing and Editing

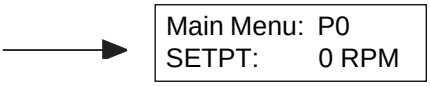
The SV3000 Parameters are divided into seven separate Menus by operational groups. The most common parameters are grouped into Menu 000, Main Menu.

To enter the Main Menu, press the PROG key and a Main Menu parameter will be displayed. To view the parameters and their values in that menu, press either the UP or DOWN Arrow key.

To Edit, or change the value of a parameter, move to that parameter with the UP or DOWN Arrow Keys and then press the EDIT key. If the parameter is a programmable parameter and not protected by a Security Code, the value can be changed by the UP, DOUBLE UP, DOWN or DOUBLE DOWN Arrow keys. The single arrow keys will change the value by units of one and the double arrow keys will change by units of one hundred.

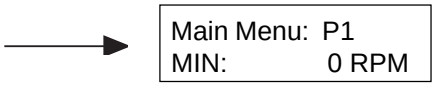
Steps to View/Edit Parameters

1. Press the PROG key to enter the Program Mode. This is the first display after applying AC power and entering the PROG mode.



The last Main Menu parameter to be viewed will be displayed if Program Mode has already been entered.

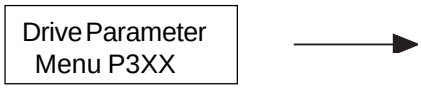
2. To view the other parameters in the Main Menu, press either the UP or DOWN Arrow key. UP Arrow

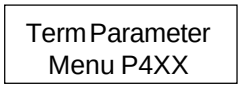


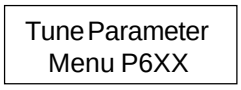
The UP Arrow key moves from Pr001 to Pr002 through Pr015, and the DOWN Arrow key moves the opposite direction in descending numerical order.

3. To change Parameter Menus, press the Status/Menu key. From the Main Menu, Preset Menu 100 is next.

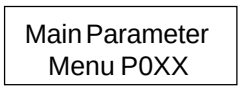
Pressing the Status Menu key will scroll through the complete Parameter Menu headings





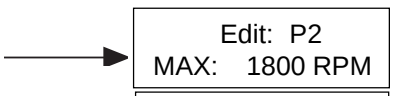


Pressing the Status/Menu key again will "roll" around to the Main Menu.

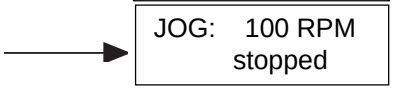


4. To view the parameters in any Parameter Menu, move to that Parameter Menu heading with the Status/Menu key and then press either the UP or DOWN Arrow keys. To move through that menu, press the UP Arrow key to move in a numerically ascending order (Pr100, Pr101 . . . Pr127) or the DOWN Arrow key to move in a numerically descending order (Pr127, Pr126 . . . Pr100).

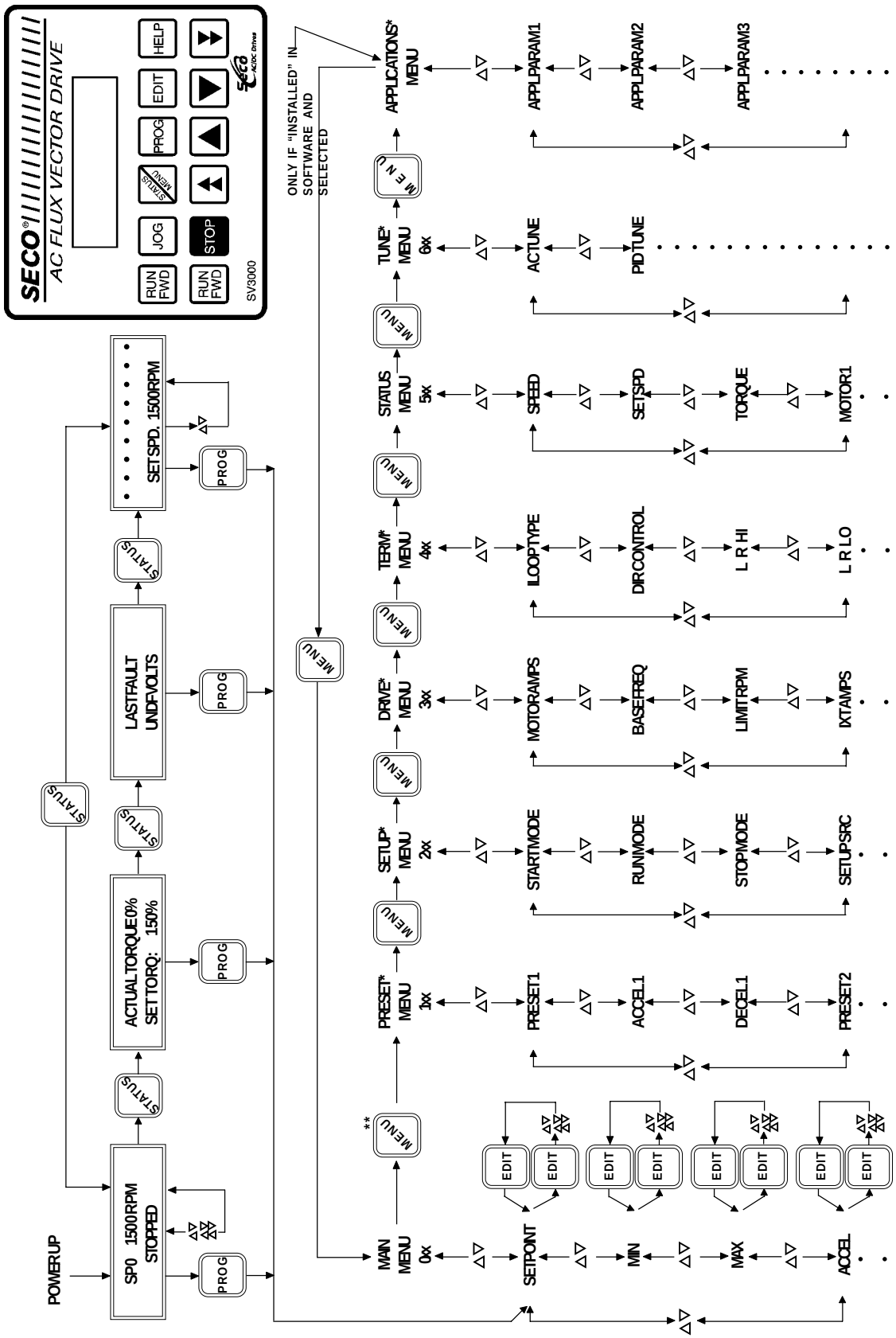
5. To Edit a parameter value, move to the parameter that is to be changed and press the EDIT key.



6. To leave the PROGRAM Mode, press the PROG key at any time. The first Status display will be shown. NOTE: **If PROGram mode is exited while EDITing (i.e., EDIT not pushed to exit the EDIT mode) the value that was being edited will be lost and the original value retained**.



3.6.1



* ALL PARAMETERS CAN BE EDITED SIMILAR TO WHAT IS SHOWN FOR THE MAIN MENU (EXCEPTION OF THE STATUS MENU WHICH DOES NOT ALLOW EDITING).

** PUSHING "MENU" WHILE IN A MENU WILL GO TO THE DESCRIPTION OF THE NEXT MENU.

Fig. 3D SV3000 Menu System

3.7 Main Menu Parameter Specifications and Definitions

3.7.1 Main Menu Specifications

Parameter Name	Parameter Number	Default Value	Minimum Value	Maximum Value	Edit in Run Mode
Setpoint:	Pr000	0	Pr001	Pr002	Yes
Min RPM:	Pr001	0	0 [1]	Pr002-1	Yes
Max RPM:	Pr002	Pr013	Pr001+1	(Note 2)	Yes
Accel:	Pr003	3.0	0.1	3,200	Yes
Decel:	Pr004	3.0	0.1	3,200	Yes
Jog RPM:	Pr005	100	0	Pr013	Yes
Jog Accel:	Pr006	3.0	0.1	999	Yes
Jog Decel:	Pr007	3.0	0.1	999	Yes
I Limit:	Pr008	Rated Overload	1	Rated Overload	Yes
Eng Char (1):	Pr009	"R"	0x20 [3]	0x7f [3]	Yes
Eng Char (2):	Pr010	"P"	0x20 [3]	0x7f [3]	Yes
Eng Char (3):	Pr011	"M"	0x20 [3]	0x7f [3]	Yes
Eng Dec Point:	Pr012	0	0	3	Yes
Eng Scale:	Pr013	1800	100	9999	Yes
Security:	Pr014	Off	Off	On	Yes
		On			
Deflt This Menu:	Pr015	No	No	Yes	No
		Yes			

1) See section on DIR CONTROL for the minimum allowable value of the minimum value parameter.
2) Twice value of Pr302 Base Frequency. in User Engineering units.
3) See Engineering Characters Display, Section 3.11.3.

3.7.2 Main Menu Definitions

Pr000, Setpoint:	Programmed Digital Set Speed of motor. Programmed in RPM (factory default or in Engineering Scale Units, Pr013.
Pr001, Min. RPM:	Sets the Minimum Speed of the motor.
Pr002, Max. RPM:	Sets the Maximum Speed of the motor. Also see Pr303.
Pr003, Accel:	The time, in seconds, to accelerate the motor from zero RPM to base speed set by Pr302.
Pr004, Decel:	The time, in seconds, to decelerate the motor from Base Speed to zero RPM.
Pr005, Jog RPM:	Jog Speed, in RPM, that motor will run when Jog mode is used.
Pr006, Jog Accel: Base Speed.	Jog Acceleration Rate, in seconds, to accelerate the motor from zero RPM to
Pr007, Jog Decel:	Jog Deceleration Rate, in seconds, to decelerate the motor from Base Speed to zero RPM.
Pr008, I Limit:	Current Limit value of the drive in RMS amps. Value can be changed to limit current output of the drive. Value is limited to and defaults to the rated overload current of the drive. Minimum value is I field(Pr606). If necessary, when I field is changed I limit will be changed automatically.

(Continued on next page)

Pr009, Eng Char (1):	Allows user selected alphanumeric characters to be used. R for RPM is the default. (See Section 3.11.3)		
Pr010, Eng Char (2):	Allows user selected alphanumeric characters to be used. P for RPM is the default. (See Section 3.11.3)		
Pr011, Eng Char (3):	Allows user selected alphanumeric characters to be used. M for RPM is the default. (See Section 3.11.3)		
Pr012, Eng Dec Point:	If desired, places the decimal point in display.	Pr012 Value	Display Decimal Point Placement
		0	1800
		1	180.0
		2	18.00
		3	1.800

Pr013, Eng Scale:	The value to be displayed when the motor is running at Base Speed (Pr302). Default is1800 for a 4 pole motor and displaying RPM.
Pr014, Security:	Three digit number Security Code to protect unauthorized parameter changes. First digit determines which parameter menu and above menus protected by the security code.
Pr015, Deflt This Menu:	This parameter will reset all of the Main Menu parameters to their original factory set values.

3.8 SV3000 Operating Tips

Viewing and Storing Parameters

- When pressing the PROG key, the parameter displayed will be the last parameter used in the Main Menu, Level 0. If it is the first time the PROG key has been used since power up, the first parameter, Setpoint Pr0, will be displayed.
- To return to a lower level parameter menu heading, keep pressing the STATUS/MENU key until the desired menu heading is displayed.
- When "Editing" or changing a parameter value, always remember to press the EDIT key to store the value. If the PROG key is pressed, the drive will exit the program mode and the latest change will not be stored but revert to the previous value.

Defaulting Parameter Values

- If changes to parameters are made from their factory default values and it is desired to retain their values, set parameter Pr220 Set User Defaults to store the new values. In case of improper parameter changes, resetting parameter Pr223 Default All User will restore all the parameters to the user set values. Defaulting the parameters to Pr222 Default All Factory would restore all parameters to the original factory set values and any user changes would have to be manually re-entered.
- If only the parameters in a single menu need to be restored to their original factory values, use the Default This Menu parameter found near the end of each menu. **CAUTION: This operation will restore only that menu's parameter values to the original factory set values and not the user set values.**
- Defaulting the parameters to either factory or user defined values is also protected by the security code. If a security code is defined, entering the correct security code is required to default the parameters.
- Defaulting the parameters to Factory Default values will require the Tune Test (Section 3.9) to be performed before the motor is run.

Security Codes

- To protect parameter values from either accidental or intentional improper changes, a security code will allow all parameters to be viewed, but only certain menus to be programmable. The first digit of the three digit security code determines which level and higher that are "locked" out. For example, a security code of 147 will allow programming parameters in only the Main Menu, Level 0. Parameters in Menu level 100 (147) and higher will be protected by the security code.
- If a security code protected parameter is attempted to be "Edited," the display will ask for the current security code and disallow the change if not entered correctly. If the security code is lost, contact Warner Electric Applications Engineering for the method to clear the security code.
- When using the serial link, the security code does not prevent parameter changes.

Technical Support

- For Applications Engineering and Technical After-Sales Support, call Warner Electric at (860) 787-3532 or fax to (860) 589-2136.

3.9 Tuning and Set-Up — IMPORTANT

The SV3000 Flux Vector AC drive controls current in the AC motor and needs to know the value of stator resistance, motor slip and magnetizing current. The tuning procedure measures these values when the motor is connected to the drive.

If the drive is used with a different motor, the tuning procedure must be carried out before trying to run the motor. If the values in Menu 6 are changed to the Factory Default values then the tuning procedure must be carried out.

Before proceeding with the AC Tune Test the following questions should be considered.

Does the drive have to hold back the load when at rest?

If the load tries to move the drive when at rest (such as a crane or elevator) portions of the Tune Test will not be valid. Use the test to determine stator resistancce and slip, but skip over the field current and system gain tests. Calculate these values manually as described later.

Are there restrictions on how far the load can travel?

The AC Tune Test may cause the load to travel beyond its limits in either direction. Use the test to determine stator resistance and slip, but skip over the field current and system gain tests. Calculate these values manually as described later.

Are there restrictions on which direction the load can travel?

If the load cannot travel freely in both directions the AC Tune Test should be run initially with the load uncoupled. If an encoder is being used, the test will determine the correct phasing. If an encoder is not being used, you will have to phase the motor after the test has been run. The motor can then be coupled and the test re-run.

Tuning Procedure

The motor should preferably be at room temperature during the tuning process.

Apply power to your SV3000 drive controller. Your SV3000 is setup for a 460 VAC(Pr301), 60 Hz(Pr302), 1800 RPM(Pr303), 4 Pole motor(Pr310).

Press "PROG" then "STATUS/MENU" to get to drive Parameter Menu-P2XX.

Press the UP arrow key to Pr222 Default all Factory. Press "EDIT" and then the UP arrow key ("D" changes to "E"), press "EDIT" again. This defaults all parameters to their Factory set values. Wait until this process is complete, then proceed with the Tune Test.

TO RUN AC TUNE TEST

Have the following basic data ready.

The AC Tune test will ask you to set the following basic data, most of which can be found on the nameplate of the motor. The test will allow you to accept the default values or to edit them as required.

Motor Current

The nameplate motor current – also found under "MTR AMPS" (Pr300). This value defaults to the drive's rating for constant torque applications.

Motor Voltage

The nameplate motor voltage – also found under "MOTOR VOLTS" (Pr301). This value defaults to the drive's rated line voltage (460V) and need not be changed if your motor voltage is the same as the input supply.

Motor Frequency

The nameplate base frequency of the motor – also found under "BASE FREQ" (Pr302). Normally this is the Factory Default value, 60 Hz, so no adjustment is necessary. European motors may have a frequency of 50 Hz.

Motor Speed

The nameplate speed of the motor in RPM. The default value is 1780 RPM. Note that this is not the synchronous speed but rather the rotor speed at rated slip. If the nameplate motor speed is not known, enter the synchronous speed (1800 RPM for a four pole motor).

Test Motor Speed

The maximum motor speed that should be allowed during the AC Tune Test. This limit will protect the motor and load. The value should be the lower of the motor nameplate rating and the maximum operating speed of the load. The default value is 400 RPM.

Test Acceleration Time

The acceleration time during the AC Tune Test. The default value is 10 seconds.

Test Torque Level

The torque level during the AC Tune Test expressed as a percentage of motor torque. The default value is 40%.

Press "STATUS/MENU" several times to get to Tune Parameter Menu – P6XX.

Press the UP arrow key to:

Tune Menu: P600 AC Tune: D

Press "EDIT" and the UP arrow key (the "D" changes to "E") and press "EDIT" again. This enables the uncoupled tuning procedure. The tuning procedure starts automatically.

The Tune Test identifies the correct magnetising field current for standard performance units and also the correct phasing and encoder connections for enhanced units.

The flow of the test is outlined in the following charts. Your input is required at points indicated. Follow the screens as shown and press the appropriate keys when requested.

It is possible to do the AC Tune Test with the motor coupled to the load, but a more accurate value for Field Current will be obtained if the motor can be uncoupled during this part of the test.

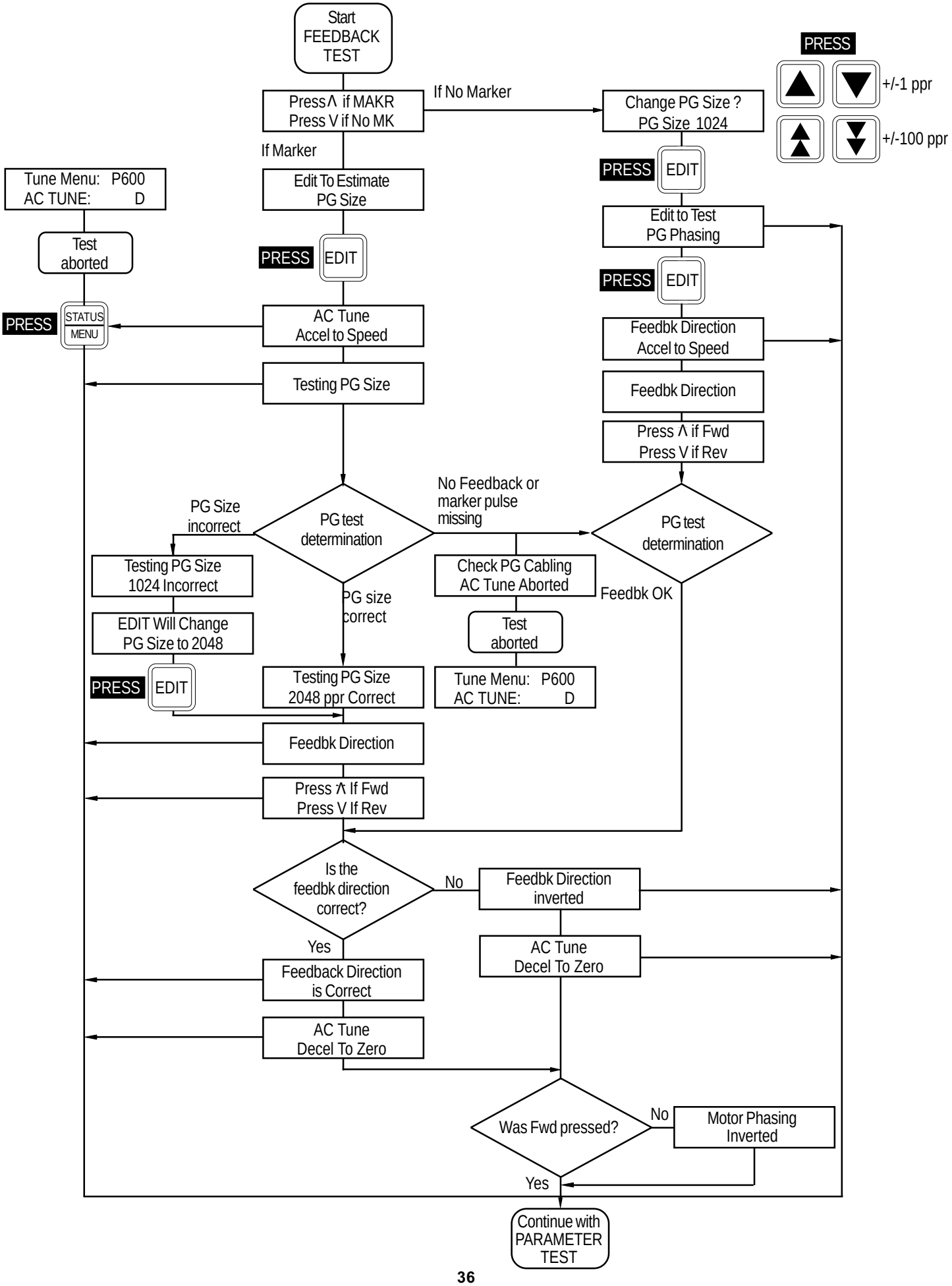
Start the test, follow the procedure until the SV3000 identifies a value for Field Current, then abort the test by pressing Status key. Couple the motor, re-do the AC Tune Test and continue until the screen says "EDIT to estimate Field Current" press Down arrow key once and continue through the test.

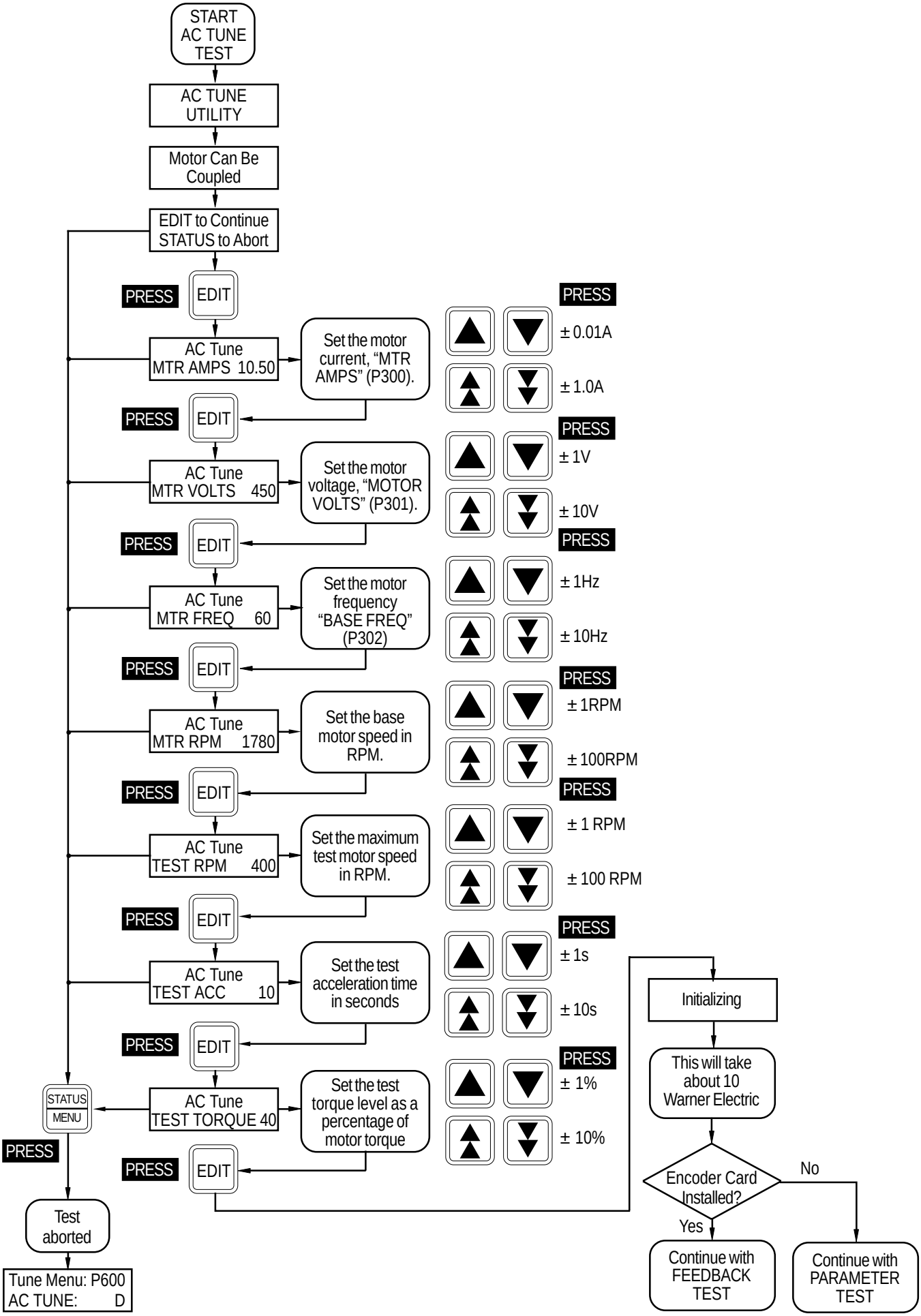
NOTE:

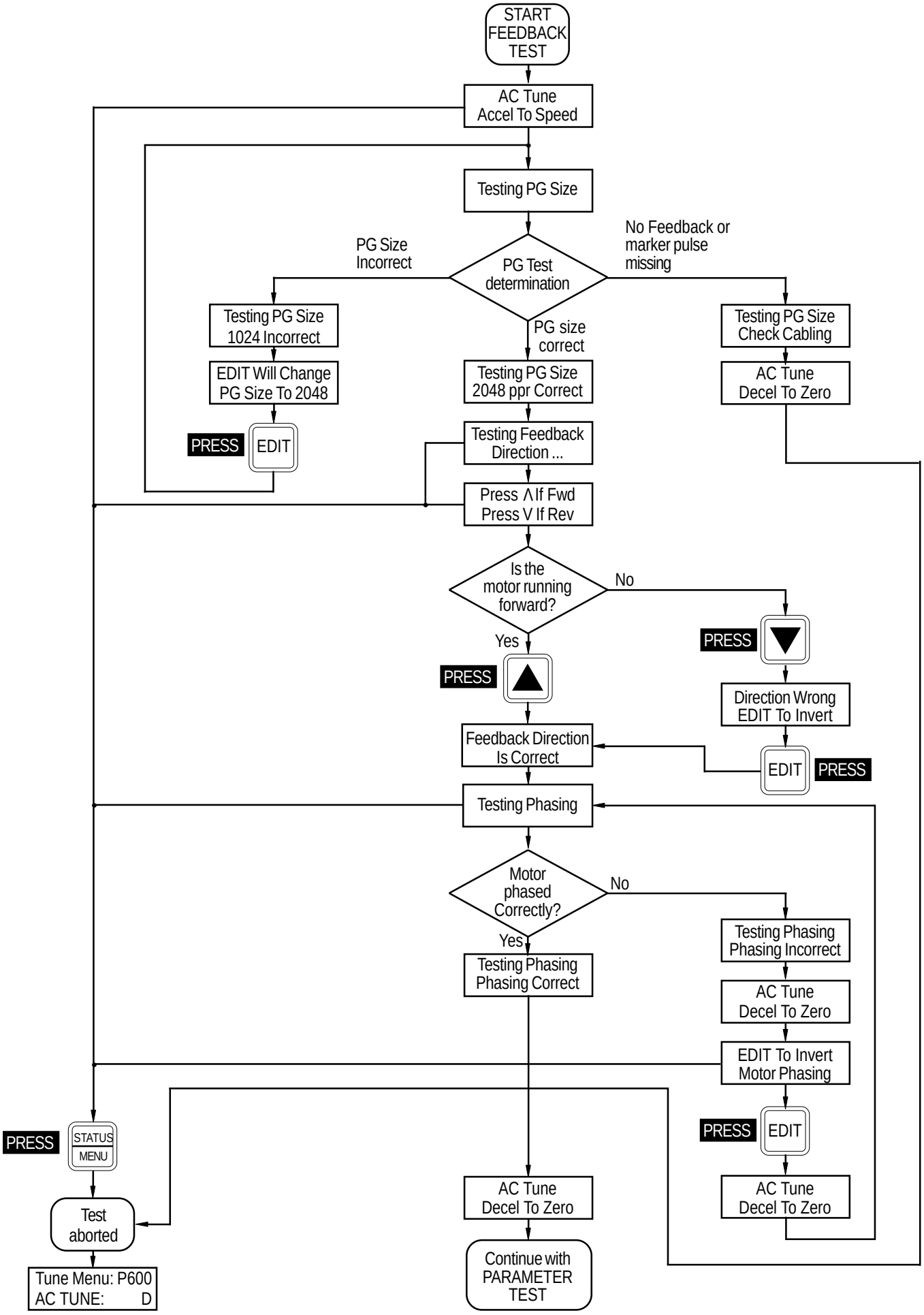
To abort the test at any time, press the "STATUS/MENU" key.

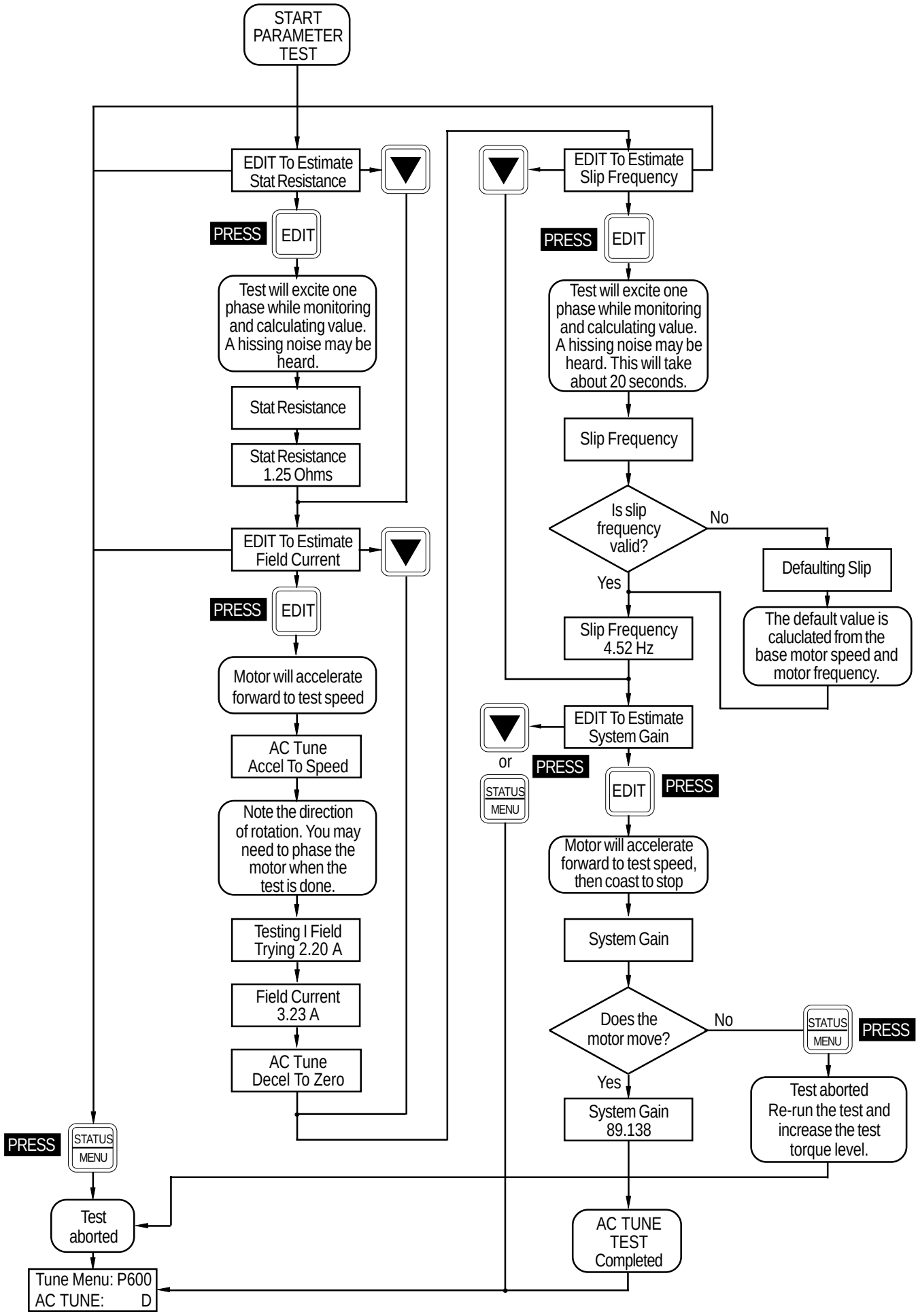
To continue with the indicated test, press the "EDIT" key.

To skip over the indicated test, press the down arrow key.


Start FEEDBACK TEST
Press Λ if MAKR
Press V if No MK
If No Marker
If Marker
Change PG Size ?
PG Size 1024
PRESS
+/-1 ppr
+/-100 ppr
Tune Menu: P600
AC TUNE: D
Edit To Estimate PG Size
PRESS EDIT
Edit to Test PG Phasing
PRESS EDIT
Test aborted
PRESS STATUS MENU
AC Tune Accel to Speed
Feedbk Direction Accel to Speed
Testing PG Size
Feedbk Direction
Press Λ if Fwd
Press V if Rev
PG test determination
PG Size incorrect
No Feedback or marker pulse missing
PG test determination
Testing PG Size 1024 Incorrect
Check PG Cabling AC Tune Aborted
Feedbk OK
EDIT Will Change PG Size to 2048
PG size correct
Test aborted
PRESS EDIT
Testing PG Size 2048 ppr Correct
Tune Menu: P600
AC TUNE: D
Feedbk Direction
Press Λ If Fwd
Press V If Rev
Is the feedbk direction correct?
No
Feedbk Direction inverted
Yes
AC Tune Decel To Zero
Feedback Direction is Correct
AC Tune Decel To Zero
Was Fwd pressed?
No
Motor Phasing Inverted
Yes
Continue with PARAMETER TEST


START AC TUNE TEST
AC TUNE UTILITY
Motor Can Be Coupled
EDIT to Continue STATUS to Abort
PRESS
EDIT
AC Tune MTR AMPS 10.50
Set the motor current, "MTR AMPS" (P300).
PRESS
± 0.01A
± 1.0A
AC Tune MTR VOLTS 450
Set the motor voltage, "MOTOR VOLTS" (P301).
± 1V
± 10V
AC Tune MTR FREQ 60
Set the motor frequency "BASE FREQ" (P302)
± 1Hz
± 10Hz
AC Tune MTR RPM 1780
Set the base motor speed in RPM.
± 1RPM
± 100RPM
AC Tune TEST RPM 400
Set the maximum test motor speed in RPM.
± 1 RPM
± 100 RPM
AC Tune TEST ACC 10
Set the test acceleration time in seconds
± 1s
± 10s
AC Tune TEST TORQUE 40
Set the test torque level as a percentage of motor torque
± 1%
± 10%
STATUS MENU
Test aborted
Tune Menu: P600
AC TUNE: D
Initializing
This will take about 10 Warner Electric
Encoder Card Installed?
No
Yes
Continue with FEEDBACK TEST
Continue with PARAMETER TEST


START FEEDBACK TEST
AC Tune Accel To Speed
Testing PG Size
PG Size Incorrect
PG Test determination
No Feedback or marker pulse missing
PG size correct
Testing PG Size 1024 Incorrect
EDIT Will Change PG Size To 2048
PRESS
EDIT
Testing PG Size 2048 ppr Correct
Testing PG Size Check Cabling
AC Tune Decel To Zero
Testing Feedback Direction ...
Press ^ If Fwd Press V If Rev
Is the motor running forward?
No
Yes
PRESS
PRESS
Direction Wrong EDIT To Invert
Feedback Direction Is Correct
EDIT
PRESS
Testing Phasing
Motor phased Correctly?
No
Yes
Testing Phasing Phasing Incorrect
Testing Phasing Phasing Correct
AC Tune Decel To Zero
EDIT To Invert Motor Phasing
PRESS
STATUS MENU
PRESS
EDIT
Test aborted
AC Tune Decel To Zero
AC Tune Decel To Zero
Tune Menu: P600
AC TUNE: D
Continue with PARAMETER TEST


START PARAMETER TEST
EDIT To Estimate Stat Resistance
PRESS
EDIT
Test will excite one phase while monitoring and calculating value. A hissing noise may be heard.
Stat Resistance
Stat Resistance 1.25 Ohms
EDIT To Estimate Field Current
PRESS
EDIT
Motor will accelerate forward to test speed
AC Tune Accel To Speed
Note the direction of rotation. You may need to phase the motor when the test is done.
Testing I Field Trying 2.20 A
Field Current 3.23 A
AC Tune Decel To Zero
EDIT To Estimate Slip Frequency
PRESS
EDIT
Test will excite one phase while monitoring and calculating value. A hissing noise may be heard. This will take about 20 seconds.
Slip Frequency
Is slip frequency valid?
No
Defaulting Slip
The default value is caluclated from the base motor speed and motor frequency.
Yes
Slip Frequency 4.52 Hz
EDIT To Estimate System Gain
or
PRESS
STATUS MENU
PRESS
EDIT
PRESS
Motor will accelerate forward to test speed, then coast to stop
System Gain
Does the motor move?
No
STATUS MENU
PRESS
Test aborted Re-run the test and increase the test torque level.
Yes
System Gain 89.138
PRESS
STATUS MENU
Test aborted
Tune Menu: P600
AC TUNE: D
AC TUNE TEST Completed

When Tuning an enhanced unit (a unit that operates with an encoder) occasionally the message "CHECK" MANUAL TUNING

While the AC Tune Test will automatically tune most applications, the procedure may not work optimally in a small number of applications. Certain installations such as those with high inertia loads or older motors may need some degree of manual tuning.

To manually tune your drive, follow the flow chart given here. Calculations and their explanations are given below.

System Gain The system gain calculation requires the following information.

I motor rated motor current in amps. This value may be read from the motor nameplate and corresponds to "MTR AMPS" (Pr300).

I field motor field current in amps. This value is identified by the AC Tune test and may be read in "I FIELD" (Pr606).

I trip Trip current of the drive in amps. This value can be found in Table of Current Ratings which follows.

I_{qrated} Rated torque – producing current of the motor. This value is calculated as follows:

$$I_{qrated} = \sqrt{(I\ motor)^2 - (I_{FIELD})^2}$$

I_{qmax} Maximum torque producing current of the control. This value is calculated as follows:

$$I_{qmax} = \sqrt{(I_{trip})^2 - (I_{FIELD})^2}$$

Motor RPM Rated speed of motor in RPM. This value may be read from the motor nameplate.

Motor HP Rated horsepower of the motor. This value may be read from the motor nameplate.

Kt Motor torque constant. This value is calculated as follows:

$$Kt = \frac{Motor\ HP \bullet 5252}{Motor\ RPM \bullet I_{qrated}}$$

Jr Rotor Inertia of the motor in lb. ft. sec.^{2}. This value may be obtained from the motor manufacturer or Warner Electric Applications Engineering may assist you in finding this value.

Js Inertia of the system as reflected back to the motor shaft in lb. ft. sec.^{2}. Applications may help you to find this value.

Jt Total inertia in lb. ft. sec.^{2}. This value is determined as follows:

$$Jt = Jr + Js$$

System Gain The system gain is calculated according to the following formula. Enter the value in "SYS GAIN" (Pr602).

$$System\ Gain = \frac{I_{qmax} \bullet Kt}{8\ \text{þ} \bullet Jt}$$

Slip Frequency The slip calculation requires the following information:

Motor Frequency: Base frequency of the motor. This value may be read from the motor nameplace and corresponds to "BASE FREQ" (Pr302).

Motor Poles: Number of motor poles

Synchronous RPM: Synchronous speed of the motor in RPM. This value may be calculated as follows:

$$Synchronous\ RPM = \frac{120 \bullet Motor\ Frequency}{Motor\ Poles}$$

Motor RPM: Rated speed of the motor in RPM. This value may be read from the motor nameplate.

The slip frequency is calculated in accordance with the following formula:

$$\text{Slip Frequency} = \frac{\text{Synchronous RPM - Motor RPM} \bullet \text{Motor Frequency}}{\text{Synchronous RPM}}$$

Approximate Value for Field Current

$$\text{I Field} = \frac{\text{Motor Amps} \quad (\text{Pr300})}{3}$$

Table of Current Ratings

HP @ 460V	Continuous Current (Amps)	Overload Current (Amps)	Trip Current (Amps)
1	3.2	4.8	6.4
2	4.6	6.9	9.2
3	6.1	9.1	12.2
5	10	15	20
7.5	12.8	19.2	25.6
10	20	30	40
15	24	36	48
20	30	45	60
25	36	54	72
30	48	72	96
40	60	90	120
50	70	105	140
60	80	120	160
75	108	162	216
100	128	192	256

3.10 SV3000 Quick Start

This section will allow quick start-up of the SV3000 for many applications where the standard parameter settings and minimal terminal connections are required to meet the needs of the application. Be sure to read through 3.1 through 3.8 before continuing with the SV3000 startup.

1. Follow the safety and installation instructions as specified in Section 2, INSTALLATION. Before applying AC input power to the SV3000, verify that the proper voltage is available.
2. Check all terminal connections for loose connectors or loose wires. Re-verify the proper motor wiring for the voltage being applied. To operate the SV3000 without feedback and the speed set through the keypad, the only required terminal connections are from TB1-12 External Trip to TB1-11 Logic Common and TB1-22 Stop to TB1-21 Logic Common (TB1-11 and TB1-21 are both Logic Common and reference the same point, so either can be used).
3. Keypad Operation Mode

   This table defines the minimum required terminal connections for Keypad operation of the drive.

Function	Terminal #	Description
Logic Common (LCOM)	TB 1 - 11	Logic common connection to use with operator's inputs.
External Trip Input	TB 1 - 12	External Trip MUST be connected to Logic Common to run. External Trip Fault will occur when this connection is open.
Logic Common (LCOM)	TB 1 - 21	Logic common connection to use the operator's inputs.
Stop	TB 1 - 22	Stop – Normal Run mode is connected to Logic Com mon. When Open, a STOP will be initiated and the motor will stop in the method set by Parameter Pr202. The Decel Ramp rate is set by Pr004. The Stop Key will also initiate a STOP command. THE DRIVE WILL NOT RUN IF THIS INPUT IS OPEN.

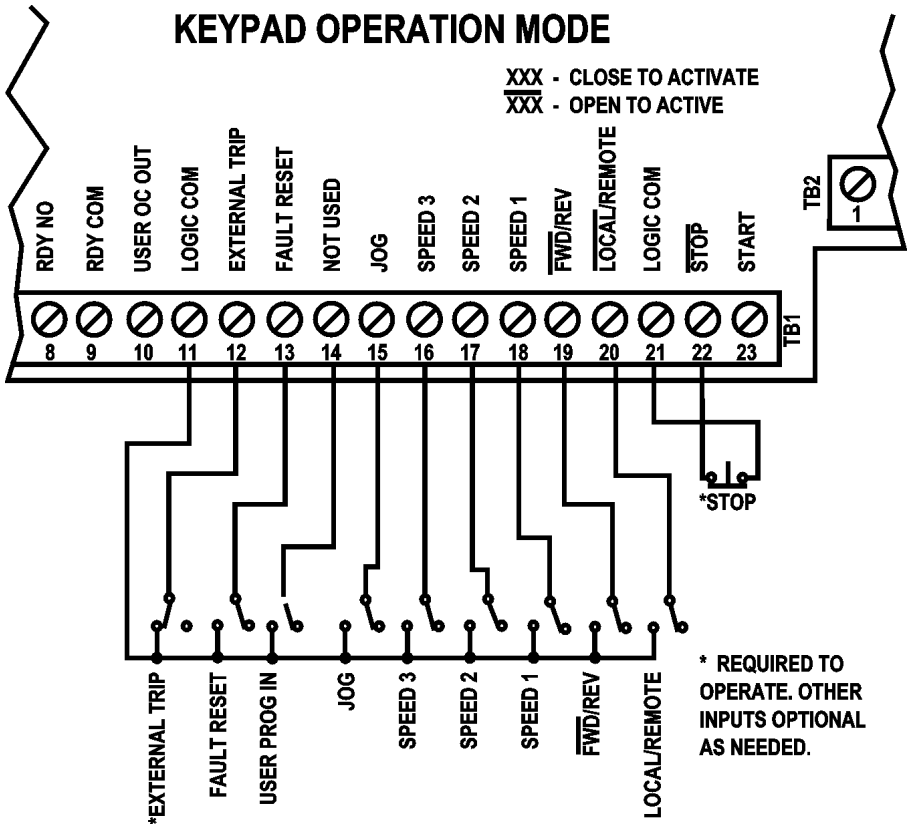


Fig. 3E Keypad operation mode

4. Terminal Operation Mode

This table defines the minimum required terminal connections for Terminal operation of the drive.

Function	Terminal #	Description
Logic Common (LCOM)	TB 1 - 11	Logic common connection to use with operator's inputs.
External Trip Input	TB 1 - 12	External Trip MUST be connected to Logic Common to run. External Trip Fault will occur when this connection is open.
(Jog)	TB 1 - 15	For Jog mode, connect this input to Logic Common. The motor will only run when the Start Input, TB 1 - 23, is connected to Logic Common in the direction set by Forward/(Reverse), TB 1 - 19.
Forward/(Reverse)	TB 1 - 19	When this input is open, the motor will run in the Forward direction. When connected to Logic Common, the motor will run in the Reverse direction if Pr213 is set.
Logic Common (LCOM)	TB 1 - 21	Logic common connection to use with operator's inputs.
Stop	TB 1 - 22	Stop – Normal Run mode is connected to Logic Common. When Open, a STOP will be initiated and the motor will stop in the method set by Parameter Pr202. The Decel Ramp rate is set by Pr004. The Stop Key will also initiate a STOP command. **THE DRIVE WILL NOT RUN IF THIS INPUT IS OPEN.**
(Start)	TB 1 - 23	When Start is momentarily connected to Logic Common, the motor will start and continue to run until a Stop or Fault occurs. If in Jog mode (TB 1 - 15 tied to Logic Common), the motor will run only when the Start input is connected to Logic Common.
Speed Potentiometer Connections		To set the speed of the motor with a Speed Potentiometer (2K - 10K, 2W), connect as follows:
Local Vin	TB 2 - 2	Pot. Wiper Input
+10 VDC	TB 2 - 7	Pot. CW / Forward Motor Rotation
-10 VDC	TB 2 - 8	Pot. CCW / Reverse Motor Rotation
Signal Common	TB 2 - 6	Pot. Common

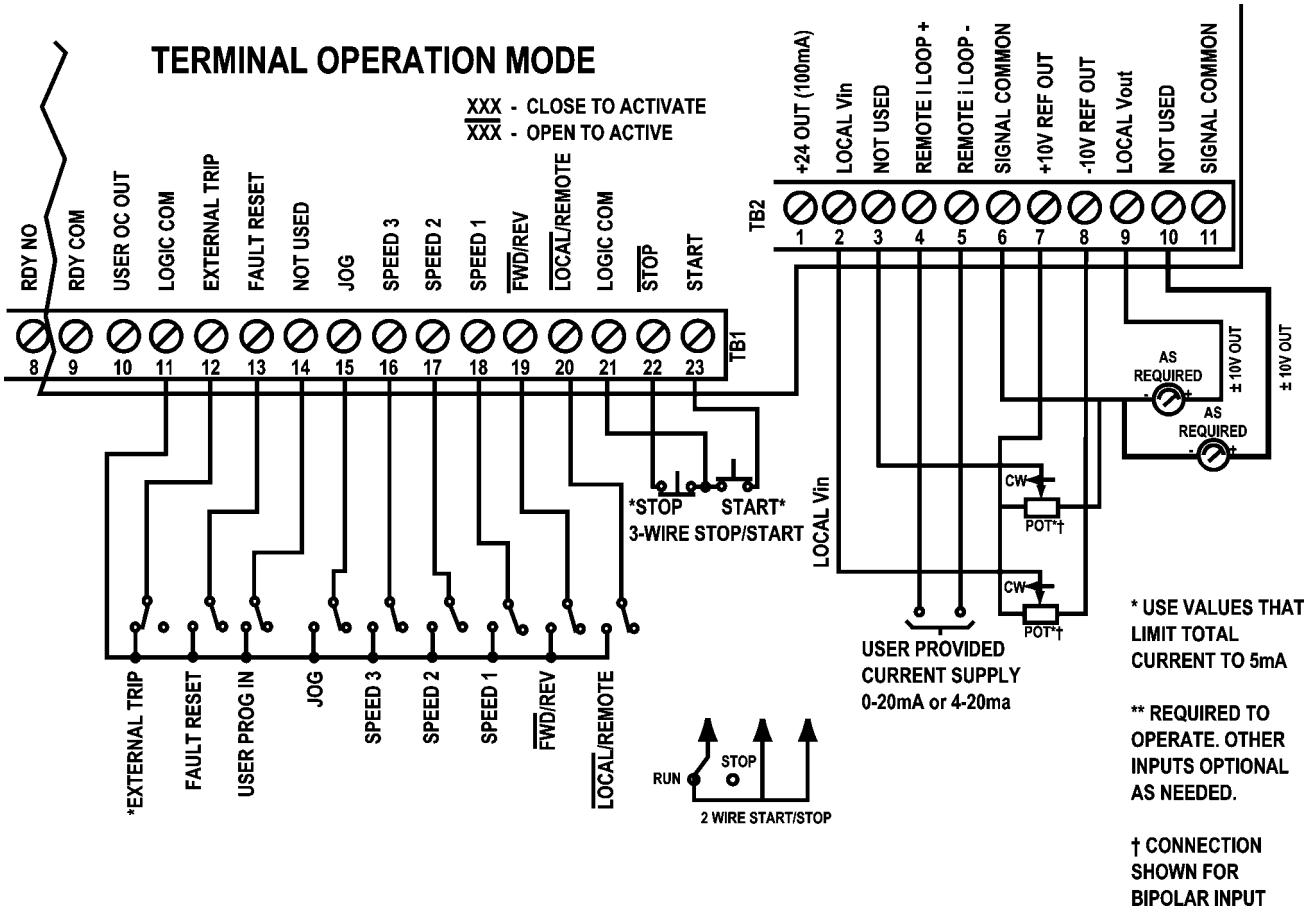


Fig. 3F Terminal Connections - Use shielded wire for all control wiring.

5. Apply AC power to the drive and the following will appear on the display if there are no faults:

SP0: 1800 RPM stopped

6. Perform the Tuning and Set-Up (see Section 3.9) before proceeding.
7. The standard default parameter settings will be sufficient for many applications and the parameters that are more commonly varied have all been located in the first parameter menu, Main Menu, Level 0. See Section 3.7 for complete details on the Main Menu (Default values for Main Menu parameters shown in Section 3.7.1 Main Menu Specifications).
8. To change any MAIN MENU parameters follow this procedure (or see Section 3.6).
   - Press the PROG key.
   - Use MENU key to reach desired Menu.
   - Use the UP or DOWN Arrow key to reach the desired parameter.
   - Press the EDIT key.
   - Use the UP or DOWN Arrow keys (Single Arrow changes by units of 1, Double Arrow keys by units of 100) to change to the new value.
   - Press the EDIT key to store the new parameter.
   - Go to any other parameter to change, press the Status/Menu key to move to a new Menu (if going to a new menu heading, press any of the Arrow keys to view the parameters in that menu) or press the PROG key to exit the programming move.
9. Use the RUN RWD key to start the motor and increase the Setpoint with the UP Arrow key (Single increases by 1 RPM and the Double Arrow key increases by 100 RPM) and check the direction of rotation of the motor. If incorrect, stop the drive by pressing the STOP key or opening the terminal Stop connection. Remove AC input power and wait for ten minutes. Reverse any two motor phases, T1, T2 or T3.
10. Reapply AC input power and confirm proper motor rotation. Use the Arrow keys to set speed and the Status/Menu to view the three Status Displays (Section 3.5 Keypad Display).

3.11 Main Menu Parameter Specifications and Definitions

3.11.1 Main Menu Specifications

Parameter Name	Parameter Number	Default Value	Minimum Value	Maximum Value	Edit in Run Mode
Setpoint:	Pr000	0	Pr001	Pr002	Yes
Min RPM:	Pr001	0	0 [1]	Pr002-1	Yes
Max RPM:	Pr002	Pr013	Pr001+1	(Note 2)	Yes
Accel:	Pr003	3.0	0.1	3,200	Yes
Decel:	Pr004	3.0	0.1	3,200	Yes
Jog RPM:	Pr005	100	0	Pr013	Yes
Jog Accel:	Pr006	3.0	0.1	999	Yes
Jog Decel:	Pr007	3.0	0.1	999	Yes
I Limit:	Pr008	Rated Current	I field	Rated Current	Yes
Eng Char (1):	Pr009	"R"	0x20 [3]	0x7f [3]	Yes
Eng Char (2):	Pr010	"P"	0x20 [3]	0x7f [3]	Yes
Eng Char (3):	Pr011	"M"	0x20 [3]	0x7f [3]	Yes
Eng Dec Point:	Pr012	0	0	3	Yes
Eng Scale:	Pr013	1800	100	9999	No
Security:	Pr014	Off	Off	On	No
		On			
Deflt This Menu:	Pr015	No	No	Yes	No
		Yes			

1) See section on DIR CONTROL for the minimum allowable value of the minimum value parameter.
2) Twice value of Pr302 Base Frequency. in User Engineering units.
3) See Eng. Characters Display, Section 3.11.3.

3.11.2 Main Menu Definitions

Pr000, Setpoint:	Programmed Digital Set Speed of motor. Programmed in RPM (factory default) or in Engineering Scale Units, Pr013.
Pr001, Min. RPM:	Sets the Minimum Speed of the motor.
Pr002, Max. RPM:	Sets the Maximum Speed of the motor. Also see Pr302.
Pr003, Accel:	The time, in Warner Electric, to accelerate the motor from zero RPM to base speed set by Pr302.
Pr004, Decel: RPM.	The time, in Warner Electric, to decelerate the motor from Base Speed to zero
Pr005, Jog RPM:	Jog Speed, in RPM, that motor will run when Jog mode is used.
Pr006, Jog Accel:	Jog Acceleration Rate, in Warner Electric, to accelerate the motor from zero RPM to Base Speed.
Pr007, Jog Decel: Speed to zero RPM.	Jog Deceleration Rate, in Warner Electric, to decelerate the motor from Base
Pr008, I Limit:	Current Limit value of the drive in RMS Amps. Value can be changed to limit current output of the drive. Value is limited to and defaults to the rated overload current of the drive. Minimum value is I field (Pr606). If necessary, when I field is changed I limit will be changed automatically.

(Continued on next page)

Pr009, Eng Char (1):	Allows user selected alphanumeric characters to be used. R for RPM is the default. (See Section 3.11.3).		
Pr010, Eng Char (2):	Allows user selected alphanumeric characters to be used. P for RPM is the default. (See Section 3.11.3).		
Pr011, Eng Char (3):	Allows user selected alphanumeric characters to be used. M for RPM is the default. (See Section 3.11.3)		
Pr012, Eng Dec Point:	If desired, places the decimal point in display.	Pr012 Value	Display Decimal Point Placement
		0	1800
		1	180.0
		2	18.00
		3	1.800

Pr013, Eng Scale:	The value to be displayed when the motor is running at Base Speed (Pr302). Default is1800 for a 4 pole motor and displaying RPM.
Pr014, Security:	Three digit number Security Code to protect unauthorized parameter changes. First digit determines which parameter menu and above menus protected by the security code.
Pr015, Deflt This Menu:	This parameter will reset all of the Main Menu parameters to their original factory set values.

3.11.3 Engineering Unit Display

The following is a list of the available characters for Engineering Unit Display:

(space) ! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [/] ^_' a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~

3.12 Preset Menu Parameter Specifications and Definitions

3.12.1 Preset Menu Specifications

Parameter Name	Parameter Number	Default Value	Minimum Value	Maximum Value	Edit in Run Mode
PSI RPM:	Pr100	0	-Pr002	Pr002	Yes
PSI Accel:	Pr101	3.0	0.1	3,200	Yes
PSI Decel:	Pr102	3.0	0.1	3,200	Yes
PS2 RPM:	Pr103	0	-Pr002	Pr002	Yes
PS2 Accel:	Pr104	3.0	0.1	3,200	Yes
PS2 Decel:	Pr105	3.0	0.1	3,200	Yes
PS3 RPM:	Pr106	0	-Pr002	Pr002	Yes
PS3 Accel:	Pr107	3.0	0.1	3,200	Yes
PS3 Decel:	Pr108	3.0	0.1	3,200	Yes
PS4 RPM:	Pr109	0	-Pr002	Pr002	Yes
PS4 Accel:	Pr110	3.0	0.1	3,200	Yes
PS4 Decel:	Pr111	3.0	0.1	3,200	Yes
PR5 RPM:	Pr112	0	-Pr002	Pr002	Yes
PR5 Accel:	Pr113	3.0	0.1	3,200	Yes
PS5 Decel:	Pr114	3.0	0.1	3,200	Yes
PS6 RPM:	Pr115	0	-Pr002	Pr002	Yes
PS6 Accel:	Pr116	3.0	0.1	3,200	Yes
PS6 Decel:	Pr117	3.0	0.1	3,200	Yes
PS7 RPM:	Pr118	0	-Pr002	Pr002	Yes
PS7 Accel:	Pr119	3.0	0.1	3,200	Yes
PS7 Decel:	Pr120	3.0	0.1	3,200	Yes
Skip Freq 1:	Pr121	10	10	120	Yes
Skip 1 Band:	Pr122	0	0	30	Yes
Skip Freq 2:	Pr123	10	10	120	Yes
Skip 2 Band:	Pr124	0	0	30	Yes
Skip Freq 3:	Pr125	10	10	120	Yes
Skip 3 Band:	Pr126	0	0	30	Yes
Deflt This Menu:	Pr127	No	No	Yes	Yes
		Yes			

3.12.2 Preset Menu Definitions

Pr100, PS1 RPM: Pr103, PS2 RPM: Pr106, PS3 RPM: Pr109, PS4 RPM: Pr112, PS5 RPM: Pr115, PS6 RPM: Pr118, PS7 RPM:	Seven digitally programmable preset speeds that are selected by connecting Logic Common, TB 1 - 21 to Speed 3, 2, and 1, TB 1 - 16, 17 and 18. See table on page 19.
Pr101, PS1 ACC: Pr104, PS2 ACC: Pr107, PS3 ACC: Pr110, PS4 ACC: Pr113, PS5 ACC: Pr116, PS6 ACC: Pr119, PS7 ACC:	Individually set acceleration rates for the seven preset speeds. Time is programmed in seconds and is the time that the motor will take to accelerate from zero RPM to base speed as set in Pr302.
Pr102, PS1 DEC: Pr105, PS2 DEC: Pr108, PS3 DEC: Pr111, PS4 DEC: Pr114, PS5 DEC: Pr117, PS6 DEC: Pr120, PS7 DEC:	Individually set deceleration rates for the seven preset speeds. Time is programmed in Warner Electric and is the time that the motor will take to decelerate from base speed to zero RPM.
Pr121, SKIP FREQ 1: Pr123, SKIP FREQ 2: Pr125, SKIP FREQ 3:	Three independently set frequencies that will prevent the motor from running continuously at specific frequencies. The width of the band is set by the three Skip Bands.
Pr122, SKIP 1 BAND: Pr124, SKIP 2 BAND: Pr126, SKIP 3 BAND:	The width, in Hertz, of the speeds at which the motors will not be allowed to run continuously. The value programmed will determine the total Skip Band. The maximum value of 30 Hz would be ±15 Hz around the frequency set by the Skip Frequency parameter.
Pr127 DEFLT MENU: factory set values.	This parameter will reset all of the Preset Menu parameters to their original

3.13 Setup Menu Parameter Specifications and Definitions

3.13.1 Setup Menu Specifications

Parameter Name	Parameter Number	Default/Serial [1] Comm Ref	Minimum Value	Maximum Value	Edit in Run Mode
Start Mode:	Pr200	MAN 0 LINE 1	MAN	LINE	No
Run Mode:	Pr201	M SPEED 0 S SPEED 1 TORQ 2	M SPEED	TORQ	No
Stop Mode:	Pr202	DECEL 0 COAST 1 DC INJECT 2 DC HOLD 3	DECEL	DC HOLD	No
Setpoint Source:	Pr203	KEYPAD 0 ANALOG 1	KEYPAD	ANALOG	Yes
Keypad Enable:	Pr204	ENA(BLE) 0 DIS(ABLE) 1 DAL(disable all) 2	ENABLE	DISABLE	Yes
Synchronous Serial:	Pr205	OFF 0 SEND 1 RECEIVE 2	OFF	RECEIVE	No
Slave Source:	Pr206	ANA(log) 0 SCI 1	ANAlog	SCI	No
ON Delay	Pr207	0.10 sec	0.10 sec	99.99 sec	No
AD Delay	Pr208	0	0.10 sec	99.99 sec	Yes
Ratio: Num	Pr209	1	1	9999	Yes
Ratio: Den	Pr210	1	1	9999	Yes
Spinning Motor:	Pr211	D(isable) 0 E(nable) 1	D(isable)	E(nable)	Yes
S Ramp:	Pr212	0	0	100	Yes
F R Mode:	Pr213	No Rev 0 Always 1 Stopped 2 Jog 3	Always	No Rev	Yes
Inj Brake Time:	Pr214	2	1	99	Yes
Inj Brake I:	Pr215	30%	0	100	Yes
Trip Restarts:	Pr216	0	0	7	Yes
Restart Time:	Pr217	10	1	99	Yes
Bus Regulator:	Pr218	OFF 0 MID 1 HIGH 2 LOW 3	OFF	LOW	Yes
Language:	Pr219	ENGL(ish) 0 SPAN(ish) 1 FREN(ch) 2 GERM(an) 3	ENGL(ish)	SPAN(ish)	No

(Continued on next page)

Parameter Name	Parameter Number	Default/Serial [1] Comm Ref	Minimum Value	Maximum Value	Edit in Run Mode
Set User Deflt:	Pr220	N(o) Y(es)	N(o)	Y(es)	No
Deflt This Menu:	Pr221	N(o) Y(es)	N(o)	Y(es)	No
Deflt All FACT:	Pr222	N(o) Y(es)	N(o)	Y(es)	No
Deflt All USER:	Pr223	N(o) Y(es)	N(o)	Y(es)	No

[1] When multiple values are listed in the Default Parameter column, the first value is the FACTORY default value and the other values show the optional selections.

NOTE: If a "DEFAULT ALL FACTORY" (Pr222) is performed in the SV3000, it must be followed by an "AC TUNE TEST" operation in order to fully clear out the memory of the drive. A complete Tune Test is not required, it is only necessary to Enable the Test and then to Abort by pressing the STATUS key. If TUNE enable is not performed and the drive is powered down and up, there will be a "MEMORY CRC" Fault until the Tune is enabled.

3.13.2 Setup Menu Definitions

Pr200, Start Mode:	Starting the drive in Manual mode requires a Start input. In Line mode, the drive will start automatically when AC power is applied.
Pr201, Run Mode:	Selects the basic operational mode of the drive. In MSpeed drive is in Master mode under speed control. In SSpeed the drive is in Slave mode. In Torque the drive is in Torque mode using INT TORQ or analog input.
Pr202, Stop Mode:	Stop mode determines how the drive responds to a Stop input. Choices are Decel Ramp (Default will follow the time set by the appropriate decel parameter), Coast-to-Rest, DC Injection braking (a DC current is applied to the motor for the time entered into Pr214. Time starts when the Stop input is recognized) and DC Hold will Ramp down as in "Decel" mode but then apply a DC current from the time the motor stops for as long as programmed into Pr214. For both types of DC Injection braking, Pr215 will set the percentage of current allowed.
Pr203, Setpoint Source:	Sets whether the reference input is from the keypad (default) or the analog input when LOCAL is selected.
Pr204, Keypad Enable:	When the Keypad is disabled, the RUN FWD, RUN REV and JOG keys are non-functional. Keypad Enabled is the factory default state. DAL (disable all) disables the JOG, RUN FWD, RUN REV and STOP keys. Digital inputs or serial commands must be used to control the drive.
Pr205, Synchronous Serial:	Sets the synchronous serial function to OFF, SEND or RECEIVE. Only one drive The Master can be set to SEND in a synchronous serial network.
Pr206, Slave Source:	Source of the slave setpoint reference signal. If set to ANA(log) and the drive is a slave, the analog input signal selected by the "Remote" digital input (TB1-20) is the slave reference signal. If set to SCI and the drive is a slave, the synchronous serial input is the slave reference signal.
Pr207 ON DEL: Pr208 AD DEL:	Reads out and sets the delay time after the drive is given a start command and before the drive is commanded to change speed. See Section 6.11 for more details.
Pr209 Ratio NUM: Pr210 Ratio DEN:	These parameters set the numerator and denominator of the overall speed ratio when the drive is in the slave mode and following a master reference. If no scaling is required, both values should be set to 1. See Section 6.1 for more details.
Pr211, Spinning Motor:	When this is "Enabled," the drive will start a motor that is coasting.
Pr212, S Ramp:	This parameter will change the accel/decel ramp from a constant linear ramp (0%) to a maximum "S-curve" type profile (100%).
Pr213, Forward/ Reverse Mode:	Four modes of recognizing a command for Reverse direction. "Always" will respond immediately to a "Reverse" command. "Stopped" will only recognize a "Reverse" command when the drive is stopped and "No Reverse" (default) will ignore any request for "Reversing" and always run in the Forward direction. "Jog" will only reverse when in "Jog" mode.
Pr214, Injection Brake Time: Pr215, Injection Brake Current:	These two parameters set the time in Warner Electric that the injection Braking current will be applied while stopping as set in Pr202 Stop Mode.
Pr216, Trip Restarts: Pr217, Restart Time:	These two parameters determine how many times the drive will automatically try to "restart" after a fault trip and the total time in Warner Electric after the fault trip before the "restart" is attempted. (See Section 6.7)
Pr218, Bus Reg:	This parameter reduces the drive torque setting during deceleration to prevent the bus voltage rising and the drive tripping on over voltage. See Section 6.8 for more details.

(Continued on next page)

Pr219, Language:	The alphanumeric readout can provide information in four languages, English (Default), Spanish, German and French.
Pr220, Set User Default:	When the User has set the parameter values to suit their specific application, setting Pr220 will allow these parameters to be saved automatically. They can be recalled by Pr223 Default All User.
Pr221, Default This Menu:	When set, Pr221 will reset the Setup Menu 200 parameters to their FACTORY default values.
Pr222, Default All FACTORY:	When set, Pr222 will reset ALL of the Parameter Menus to their FACTORY: default values. Note: Tuning and Set-Up (Section 3.9) must be performed if parameters are set to Factory Default.
Pr223, Default ALL USER:	When set, Pr223 will reset ALL of the Parameter Menus to the USER-defined default values.

3.14 Drive Menu Parameter Specifications and Definitions

3.14.1 Drive Menu Specifications

Parameter Name	Parameter Number	Default/Serial [2] Comm Ref	Minimum Value	Maximum Value	Edit in Run Mode
Motor Amps:	Pr300	(Note [1])	30% of Max Value	(Note [1])	No
Motor Volts:	Pr301	460	10	999	No
Base Freq:	Pr302	60	10	120	No
Limit RPM:	Pr303	1800	1	7200	No
IxT Amps:Pr304	105	10	105	No	
IxT Fault:	Pr305	TRIP	TRIP	FOLD	No
Max F Torq:	Pr306	100	0	100	Yes
Max R Torq:	Pr307	100	0	100	Yes
Max F Brake:	Pr308	100	0	100	Yes
Max R Brake:	Pr309	100	0	100	Yes
No. of Poles:	Pr310	4	2	10	No
Torq. Source:	Pr311	INT 0 EXT 1	INT	EXT	No
Int Torq:	Pr312	10	0	150	No
Serial Baud:	Pr313	96 (00) 0 48 (00) 1 24 (00) 2 12 (00) 3 192 (00) 4	96 (00)	12 (00)	Yes
Serial Addr:	Pr314	1	1	99	Yes
Ser. Parity:	Pr315	8 NONE 0 8 EVEN 1 8 ODD 2 7 ODD 3 7 EVEN 4	EVEN	NONE	Yes
Check Sum:	Pr316	EN CHK 1 DIS CHK 0	ON	OFF	Yes
MDROP Mode:	Pr317	D E			
Deflt This Menu:	Pr318	NO YES	NO	YES	No

[1] Function of Drive Size (usually rated overload current).

[2] When multiple values are listed in the Default Parameter column, the first value is the FACTORY default value and the other values show the optional selections.

3.14.2 Drive Menu Definitions

Pr300, Motor Amps:	Parameter value that scales current output to match the actual AC motor being used. Ranges from rated overload current for that drive rating down to 30% of nominal.
Pr301 Motor Volts:	Rated voltage of motor at Base Frequency.
Pr302, Base Frequency:	Frequency at which the motor will run at base speed. Standard value in North and South America is 60 Hz and 50 Hz in Europe.
Pr303, Limit RPM: at unsafe speeds.	Maximum allowable speed of the motor or of application, whichever is lower. This will protect the motor/load from being operated
Pr304, IxT Amps: Pr305, IxT Fault:	Specifies the current level at which the I^2T sustained overcurrent protection is activated. This protects the drive and motor from prolonged overcurrent conditions. When the drive's current demand exceeds the IxT limit the drive will begin accumulating I^2T, an IxT WARNING will occur and the display will flash.
Pr306, Max Forward Torque: Pr307, Max Reverse Torque: Pr308, Max Forward Braking: Pr309, Max Reverse Braking:	The maximum allowable torque available in each of the four quadrants of operation. Each parameter is a percentage (0-100%) of Pr008 Current Limit.
Pr310, # of Motor Poles:	The number of poles in the AC motor used. For an 1800 RPM base speed motor this is 4. (3600 RPM = 2, 1200 RPM = 6, 900 RPM = 8, 720 RPM = 10).
Pr311, Torque Source:	Source of the Torque setpoint in Torque Mode. If set to INT the setpoint is Pr312. If set to EXT, the setpoint is determined by local or remote analog input and INT TORQ (Pr312).
Pr312, Internal Torque:	INT TORQ is the requested operating torque when in Torque mode and TORQ SOURCE (Pr311) set to INT. The largest value that can be entered is 100%, this sets operating torque to all the torque available given the I limit (Pr008) setting. With TORQ SOURCE set to EXT the requested operating torque in torque mode is $\frac{\text{INT TORQ}}{100} \times \frac{\text{analog input}}{10.0\ \text{V}}$ Assuming Pr008 = Pr300 This value can be adjusted externally using Local Vin voltage (TB2-2).
Pr313, Serial Baud: Pr314, Serial Address: Pr315, Serial Parity: Pr316, Check Sum:	These parameters set up the drive to match the source of the serial communications signal. Enables or disables the check sum of the write command.
Pr317, MDROP Mode:	When MDROP Mode is enabled (set to E) multiple SV3000 drives may be connected together to communicate with the host computer. When in this mode the SV3000 will tri-state its transmitter when it is not transmitting. When MDROP Mode is disabled (set to D) only one drive is allowed in the network to communicate with the host computer. When in this mode the SV3000 will keep its transmitter line driver on all the time.
Pr318, Default This Menu:	When set, Pr318 will reset the Drive Menu 300 parameters to their FACTORY default values.

3.15 Term Menu Parameter Specifications and Definitions

3.15.1 Term Menu Specifications

Parameter Name	Parameter Number	Default/Serial [1] Comm Ref	Minimum Value	Maximum Value	Edit in Run Mode
Spare:	Pr400	DISABLE	DISABLE	ENABLE	Not Used
Dir Control:	Pr401	AUTO MIN >0, 0 AUTO MIN <0 1 UNIP(OLAR) 2 BIP(OLAR) 3	AUTO	BIPOLAR	Yes
L HI:	Pr402	1800 RPM	0	32767	Yes
L LO:	Pr403	0	-32767	32767	Yes
L Offset	Pr404	DONE 0 Z SET 1 P SET 2 M SET 3 NOMINAL 4	DONE	NOMINAL	Yes
L Offset V	Pr405	0	-4000	+4000	Yes
L POS X	Pr406	32767	0	80,000	Yes
L NEG X	Pr407	32767	0	80,000	Yes
R HI	Pr408	1800 RPM	1	32767	Yes
R LO	Pr409	0 RPM	0	32767	Yes
R Offset	Pr410	DONE 0 Z SET 1 P SET 2 NOM 4 20 (mA) 3 NOM 0 20 (mA) 4	DONE	NOM 0 20(mA)	Yes
R Offset V:	Pr411	6553	-40000	40000	Yes
R POS X:	Pr412	26213	0	80000	Yes
User Vin	Pr413	OFF	Pr000	Pr312	Yes
UVin HI	Pr414	100%	-100	100	Yes
UVin LO	Pr415	0%	-100	100	Yes
UVin Mode	Pr416	SCALE 0 TRIM 1	SCALE		
UVin OS	Pr417	DONE 0 Z SET 1 P SET 2 NOMINAL 3			
UVin OV	Pr 418	0	-40000	40000	Yes
UVin PX	Pr419	32767	0	80000	Yes
LOCAL Vout	Pr420	SPEED 0 TORQUE 1 PTR 2			
L Vout Hi	Pr421	100	0	100	Yes
L Vout Lo	Pr422	0	0	100	Yes
User Vout	Pr423	Pr503	Pr500	Pr512	Yes
U Vout Hi	Pr424	100	0	100	Yes
U Vout Lo	Pr425	0	0	100	Yes

[1] When multiple values are listed in the Default Parameter column, the first value is the FACTORY default value and the other values show the optional selections.

3.15.1 Term Menu Specifications (Continued)

Parameter Name	Parameter Number	Default/Serial [1] Comm Ref	Minimum Value	Maximum Value	Edit in Run Mode
Uin	Pr426	NONE 0 COAST CTL 1 SLAVE CTL 2 ZERO TORQ 3 SPEED TORQ 4 FORWARD 5			Yes
User Relay	Pr427	Pr500	Pr500	Pr514	Yes
URelay Set	Pr428	1750	0	9999	Yes
URelay CLR	Pr429	1700	0	999999	Yes
U Out	Pr430	Pr500	Pr500	Pr514	
U Out Set	Pr431	1750	0	999999	Yes
U Out CLR	Pr432	1700	0	999999	Yes
Deflt This Menu	Pr433	No	No	Yes	Yes
LVout PTR UVout PTR	Pr434 Pr435	**FACTORY USE ONLY**			

[1] When multiple values are listed in the Default Parameter column, the first value is the FACTORY default value and the other values show the optional selections.

3.15.2 Term Menu Definitions

Pr400, Spare	No Longer Used
Pr401, Direction Control:	When using an analog voltage or current input, this parameter determines how the direction is controlled and the minimum and maximum values are set. See Section 6.6 for a more detailed description of the operation of Parameters Pr401 to Pr433 and the scaling and control of the analog inputs.
Pr402, L Hi	Local scale Hi See Section 6.6 for more details.
Pr403, L Low	Local scale Lo See Section 6.6 for more details.
Pr404, L Offset	Set Offset + gain See Section 6.6 for more details.
Pr405, L Offset	Local Offset See Section 6.6 for more details.
Pr406, L Pos X	Local Pos gain See Section 6.6 for more details.
Pr407, L Neg X	Local Neg gain See Section 6.6 for more details.
Pr408, R Hi	Remote Scale Hi See Section 6.6 for more details.
Pr409, R Lo	Remote Scale Lo See Section 6.6 for more details.
Pr410, R Offset	Set Offset + gain See Section 6.6 for more details.
Pr411, User Vout Low Scaling:	Remote offset See Section 6.6 for more details.
Pr412, R Pos X	Remote Positive gain See Section 6.6 for more details.
Pr413, User Vin	User Vin scales See Section 6.6 for more details.
Pr414, User Vin Hi	User Vin Hi % scale See Section 6.6 for more details.
Pr415, User Vin Lo	User Vin Lo % scale See Section 6.6 for more details.
Pr416, UVin Mode	User Vin mode selection See Section 6.6 for more details.
Pr417, UVin OS	User Vin set offset gain See Section 6.6 for more details.
Pr418, UVin OV	User Vin set offset See Section 6.6 for more details.
Pr419, UVin Px	User Vin set gain See Section 6.6 for more details.
Pr420, Local Vout	Selects the voltage output on TB2-9 Local Vout to represent Speed or Torque. PTR is for Factory Use only.
Pr421, L Vout Hi	Local Vout HI % Scale See Section 6.6 for more details.
Pr422, L Vout Lo	Local Vout % Scale See Section 6.6 for more details.

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Pr423, User Vout	This specifies the parameter to be reflected in the User Vout analog output on TB2-10, the parameters that can be selected are Pr500-Pr512: MOTORTORQ, MOTOR I, R MOTORTOR, IN WATTS, BUS VOLTS, IxT ACCUM, DB ACCUM, SPEED, SET SP.
Pr424, User Vout Hi scaling:	This determines the value of the parameter in Pr423 that will give a 10 VDC output signal from TB2-10.
Pr425, User Vout Lo scaling:	This determines the value of the parameter in Pr423 that will give a 0 VDC output signal from TB2-10.
Pr426, User Digital Input:	A selection of operations that the digital input to TB1-14 will provide when tied to Logic common. Selections include Coast-to-Rest, Slave, Zero Torque, Speed Control in Torque Mode or Forward. See Section 6.6 for details.
Pr427, User Relay:	This sets the Status Value parameter (500 level) that will control the Form-C relay contacts on TB1-5, 6 and 7.
Pr428, User Relay Setpoint:	This sets the value at which the User Relay will "pick-up" for the parameter set in Pr427.
Pr429, User Relay Clear:	This sets the value at which the User Relay will "drop-out" for the parameter set in Pr427.
Pr430, User Output Source:	This sets the Status Value parameter (500 level) that will control the Open collector output at TB1-10.
Pr431, User Output Setpoint:	This sets the value at which the Open collector output will "switch" to common for the parameter set in Pr430.
Pr432, User Output Clear:	This sets the value at which the Open collector output will "turn-off" for the parameter set in Pr430.
Pr433, Default This Menu:	When set, Pr433 will reset the Term Menu 400 parameters to their FACTORY default values.

3.16 Status Value Parameter Definitions

Pr500, Speed:	Motor speed in Pr013 Engineering Units (Default is RPM).
Pr501, Set Sp:	Set speed in Pr013 Engineering Units (Default is RPM).
Pr502, Speed Error:	Shows the percentage error of motor speed to set speed
Pr503, Motor Torq:	Output motor torque in percentage (%) of rated motor torque.
Pr504, Motor I:	Motor current in Amps.
Pr505, Motor Hz:	Output frequency in Hertz (Hz).
Pr506, Motor V	Motor Voltage in volts.
Pr507, RMOTORTOR	In Torque Mode, display shows percentage of requested motor torque whether drive is on or off. When drive is on commanded torque will equal requested torque unless drive has reached speed over-ride limit. In Speed Mode a value of 100% is motor torque developed at MTR AMPS (Pr300).
Pr508, IN WATTS	Estimated input power in watts.
Pr509, INPUT PF	Estimated input power factor.
Pr510, BUS VOLTS	Measured bus voltage. Under voltage trip point is set as a percentage of Pr301. Overvoltage trip point is 800V.
Pr511, IxT ACCUM	Shows the percentage of time leading to a Timed Overcurrent Trip when the value reaches 100%.
Pr512, DB ACCUM	Value of the dynamic braking duty cycle accumulator. This accumulator counts up whenever the dynamic braking duty cycle is above 7%, and it counts down whenever the duty cycle is below 7%. If dynamic braking is on continuously, the accumulator will reach 100% in 5 Warner Electric.
Pr513, TOTAL kw-H reset.	Total power consumption in kilowatt-hours since initial installation. This counter will roll over to zero at 999,999 hrs. and cannot be
Pr514, HOURS RUN	Number of hours the drive has been run since its initial installation. This counter will roll over to zero at 999,999 hrs. and cannot be reset.
Pr515, INS	This parameter shows the present status of terminal TB 1 inputs TB1 - 12 (M.S.B.) through TB1 - 23 (L.S.B.). 1 = Active, 0 = Not Active. See Section 3.16.1
Pr516, LAST FAULT	Record of Last Fault (NF if no fault).
Pr517, FAULT 2	Record of Next to Last Fault (NF if no fault).
Pr518, FAULT 3	Record of 2nd to Last Fault (NF if no fault).
Pr519, FLT VOLTS	Bus voltage at the time of the last fault as indicated by Pr510.
Pr520, FLT FREQ	Output Frequency at the time of the last fault.
Pr521, F MODE	Run/Stop status at the time of last fault.
Pr522, F CURR	Motor current at the time of the last fault.
Pr523, F TIME	Hours run at the time of the last fault.
Pr524, SW REV	Software Revision number
Pr525, DRIVE SIZE	Drive Horsepower Rating. Changes automatically with MTR AMPS.

3.16.1 Description of "INS: 001000010010"

The position of each digit of the INS value corresponds to a point on TB1 terminal strip. The digit that is left most in the INS value (a 0 in this example) corresponds to TB1 pin 12 and the value that is right most is TB1 pin 23. The value displayed corresponds to the active state of the input, not to whether it is connected to common. The table below gives the displayed value for each digit when connected to common and when unconnected.

DIGIT	TB1 PIN	CONNECTED		UNCONNECTED	
		FUNCTION	DISPLAY VALUE	FUNCTION	DISPLAY VALUE
(LEFT) 0	12	External Trip OK	1	Fault - External Trip	0
1	13	Fault Reset (momentary)	1	none	0
2	14	User Prog Input (see Pr412)	1	User Prog In (see Pr412)	0
3	15	Jog Mode	1	RUN mode	0
4	16	Preset #3 select=1 (see Section 3.13.2)	1	Preset #3 select=0 (see Section 3.13.2)	0
5	17	Preset #2 select=1 (see Section 3.13.2)	1	Preset #2 select=0 (see Section 3.13.2)	0
6	18	Preset #1 select=1 (see Section 3.13.2)	1	Preset #1 select=0 (see Section 3.13.2)	0
7	19	Reverse Direction	1	Forward Direction	0
8	20	Remote (Iloop) select	1	local (analog/digital) sel't	0
9	21	COMMON	x	COMMON	x
10	22	RUN	0	STOP	1
11	23	START (momentary except Jog)	1	none	0

NOTE: The only one that displays a "0" when connected is the STOP input.

3.17 Tune Menu Parameter Specifications and Definitions

3.17.1 Tune Menu Specifications

Parameter Name	Parameter Number	Default Value	Minimum Value	Maximum Value	Edit in Run Mode
ID AC Tune	Pr600	Disable Enable	Disable	Enable	No
Sys ωn[1]	Pr601	10	1	200	Yes
Sys Gain	Pr602	0.00	0	999	Yes
Car Freq	Pr603	6	6	8	No
Motor PPR	Pr604	1024	0	2096	No
Stator Res	Pr605	0.00	0	32.767	Yes
I field	Pr606	Note 2	0	300	Yes
Slip Freq	Pr607	0.00	0	32.767	Yes
Leakage	Pr608	0.000	0.000	9.0000	Yes
KA Cmd	Pr609	0.000	0.000	99999.000	Yes
KV Cmd	Pr610	0.000	0.000	99999.000	Yes
KP FBK	Pr611	0.000	0.000	99999.000	Yes
KD FBK	Pr612	0.000	0.000	99999.000	Yes
Inv Dir	Pr613	PGN, MTNO	PGNMT0	PGNMT3	
Set T	Pr614	0.5	0	10 sec	Yes
H MASK	Pr615	Factory Use Only			
S MASK	Pr616	Factory Use Only			
Lowpass Freq.	Pr617	Factory Use Only			
Notch Freq.	Pr618	Factory Use Only			
Open Loop	Pr619	Factory Use Only			
DZ State	Pr620	Factory Use Only			

[1] Sys "ω"n can be increased to about 30 for standard performance and about 50 for enhanced performance.

[2] Default is 40% of Pr 300.

Standard Performance Operation
Set MOTOR PPR (Pr604) to zero for operation without an encoder. Cycle power on the drive to reset the drive when changing between operation with and without an encoder. Standard performance or transducerless operation is selected whether an encoder card is present or not.
Enhanced Performance Operation (Encoder and Encoder card present)
To select operation with an encoder (or Pulse Generator) set the value in Pr604 to the size of the pulse generator in pulses per revolution (PPR). Cycle the power on the drive to reset the operation to Enhanced Performance. If Enhanced Performance operation is selected and an encoder or encoder card is not present a Pulse Generator Fault will be indicated.
Note:
Watch for the LCD Display to go blank to verify power down when cycling power on and off since it takes time to discharge the power supplies.
If the encoder has a marker pulse, the AC Tune Utility will test the encoder size.

3.17.2 Tune Menu Definitions

Parameter Name	Parameter Number	Description
AC Tune Test	Pr600	Enables the ID Test routine for determining motor parameters and establishing the AC Vector control. This test is run with the motor uncoupled. Refer to Section 3.9 for further information.
SYS WN	Pr601	System natural frequency. This value should be specified to determine the "tightness" of the motor response. Normal values range from 10 to 60, with higher values representing increased response. Entering a value will cause the PID tuning gains "KP FBK" and KV to be recalculated.
SYS GAIN	Pr602	System gain, as determined by the PID Tuning test. Entering a value will cause the PID tuning gains "KP FBK" and "KV FBK" to be recalculated.
CAR FREQ	Pr603	Carrier frequency. If this value is changed, power to the drive must be be cycled in order for the value to take effect.
MOTOR PPR	Pr604	The size of the pulse generator in pulses per revolution. This value is determined by the AC Tune Test if a pulse generator is being used.
STATOR R	Pr605	Stator resistance, as calculated by the AC Tune Test if operating without a transducer (encoder).
I FIELD	Pr606	Field current, as calculated by the AC Tune Test. This value is reset to 40% of Pr300 when Pr300 is changed.
SLIP FREQ	Pr607	Slip frequency, as calculated by the AC Tune Test.
LEAKAGE	Pr608	Motor leakage inductance as identified by the AC Tune Test.
KA Cmd	Pr609	Derivative command gain of PID control, set to zero during Tuning or when SYS GAIN or SYS Wn are changed.
KV Cmd	Pr610	Proportional command gain of PID control set by the AC Tune Test, recalculated when SYS GAIN or SYS Wn are changed.
KP Cmd	Pr611	Proportional feedback gain of PID control set by the AC Tune Test, recalculated when SYS GAIN or SYS Wn are changed.
KD Cmd	Pr612	Derivative feedback gain of PID control set by the AC Tune Test, recalculated when SYS GAIN or SYS Wn are changed.
Invert Dir	Pr613	Sets direction of motor rotation and encoder phasing during the AC Tune Test. May be set manually. See Section 6.9.
Set T	Pr614	Sets Time Delay of starting and stopping in slave mode. See Section 6.10.
H Mask	Pr615	For Factory use only.
S MASK	Pr616	For Factory use only.
Low Pass Freq.	Pr617	For Factory use only.
Notch Freq.	Pr618	For Factory use only.
Open Loop	Pr619	For Factory use only.
DZ State	Pr620	For Factory use only.

4 Dynamic Braking

4.1 Introduction

The Dynamic Braking feature on an AC Drive provides a method of dissipating the energy "generated" back into the AC Drive during deceleration or when the load is overhauling the motor. The electronic module monitors the DC Bus voltage in the AC Drive and when the DC voltage reaches a set level the Braking Resistor(s) are switched across the DC Bus by an IGBT to keep the DC voltage below the Overvoltage Trip level.

4.2 Applications Requiring Dynamic Braking

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

4.3 SV3000 Dynamic Braking Features

Dynamic Braking

Dynamic Braking is a standard feature on the SV3000 for 1-15 HP drives. For severe DB applications, an external DB module is available, mounted in a NEMA 1 enclosure, that includes the DB resistor(s), AC line contactor, DB fuse and thermal device. The thermal device must be wired to drop out the AC contactor if the thermal trips. For 20-100 HP drives Dynamic Braking electronic circuitry must be factory installed and an external Dynamic braking module must be used. The external DB module, supplied in a NEMA 1 enclosure, contains the DB resistor(s), DB fuse, and a DB thermal device. The thermal trip must be wired into the External Trip input or to the optional AC contactor.

Braking Torque:	Set by the DB resistor (see Section 4.4.1)
Braking Duty Cycle:	5 Warner Electric every 2 minutes (Typical)
DB Protection:	By thermal trip

DB braking on an AC drive will dissipate the energy absorbed by the drive from the AC motor during deceleration or by an overhauling load. Whenever the DC bus reaches 750 VDC, the DB electronics will begin pulsing the DB resistor(s) across the DC bus. If the DC bus reaches 800 VDC, the SV3000 will trip on an Overvoltage.

4.3.1 SV3000 1 - 15 HP

The 1 - 15 HP models contain the Dynamic Braking electronics, Dynamic Braking fuse and Dynamic Braking resistor inside the standard model. For greater braking capacity an external Dynamic Braking Kit is available with a larger resistor and an external thermal device and fuse. The external Dynamic Braking Kit comes in a NEMA 1 enclosure.

4.3.2 SV3000 20 - 100 HP

20 - 100 HP models require an external Dynamic Braking Kit that contains the resistors, thermal device, a fuse and the control electronics.

Later versions of SV3420-341A are available with internal braking control electronics. Figure 4E shows connections to Brake Resistor Modules.

4.4 SV3000 Dynamic Braking Specifications

4.4.1 SV3000 1 - 15 HP

SV3000 1 - 15 HP Internal DB Ratings							
HP Rating	1.0	2.0	3.0	5.0	7.5	10.0	15.0
Rated Brake Torque %	150	100	70	50	40	30	20
Braking Duty Cycle	5 seconds every 2 minutes (Typical)						

SV3000 1 - 15 HP External DB Ratings							
HP Rating	1.0	2.0	3.0	5.0	7.5	10.0	15.0
DB Kit Part #	CDMDB03	CDMDB03	CDMDB03	CDMDB10	CDMDB10	CDMDB10	CDMDB10
Rated Brake Torque %	150	150	150	150	150	150	150
Braking Duty Cycle	5 seconds every 2 minutes (Typical)						

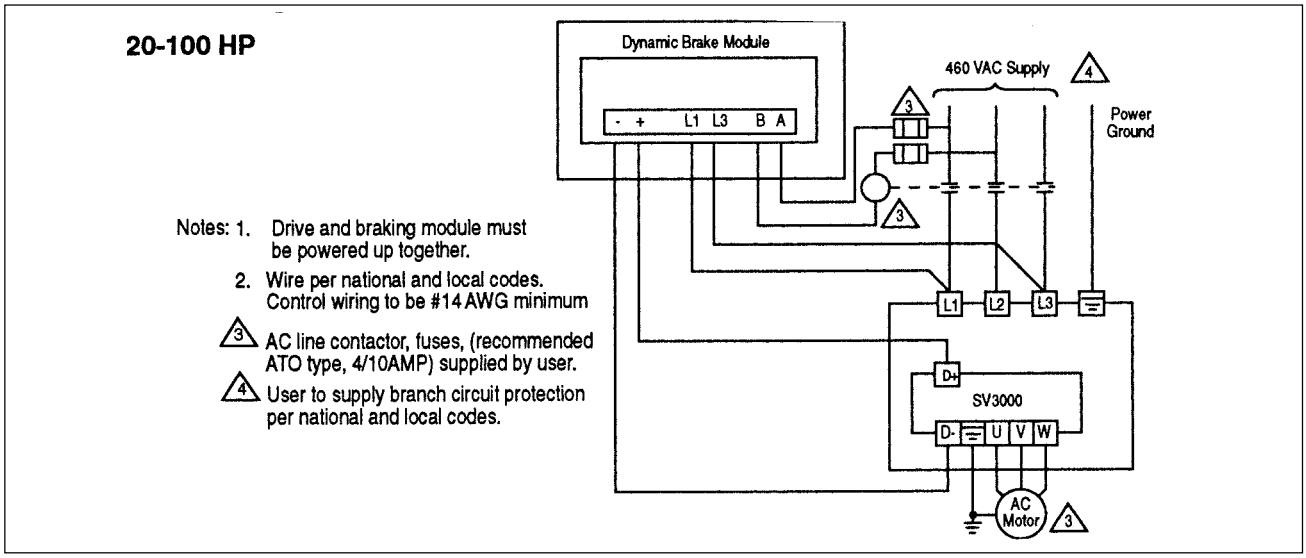


Figure 4A. Dynamic Braking, 20-100 HP

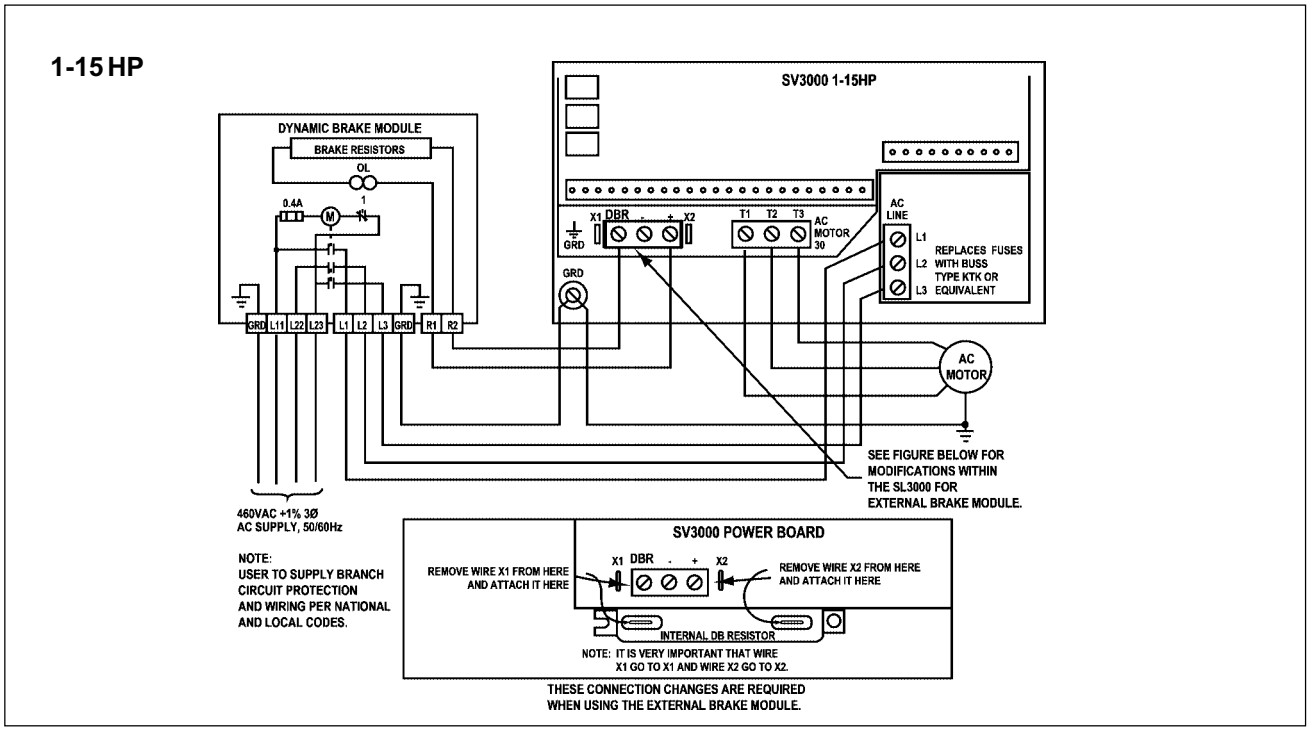
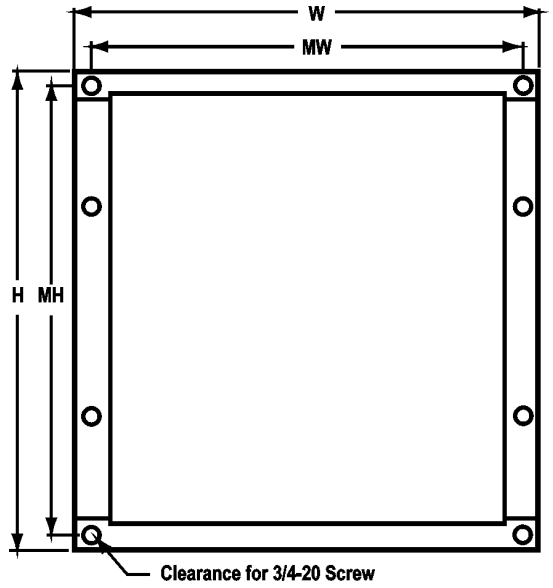
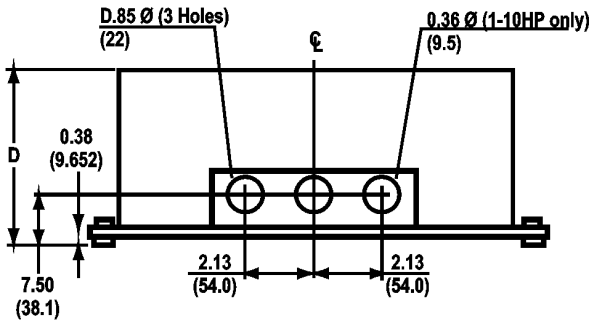


Figure 4B. Dynamic Braking, 1-15 HP

External Dynamic Braking Module





	Dimensions in/(mm)				
	W	H	D	WM	MH
1-15HP	14.00 (355.6)	15.00 (381.0)	5.44 (138.1)	13.25 (336.6)	14.25 (362.0)
20-40HP	24.00 (609.6)	31.00 (787.4)	9.88 (250.8)	23.00 (584.2)	30.00 (762.0)

Figure 4C. Dynamic Braking Module Dimensions

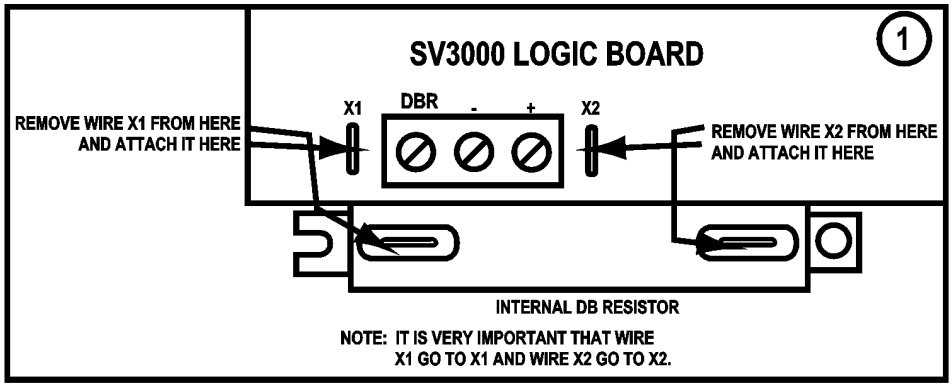
Dynamic Braking Model Numbers		
HP	ExternalDynamic Braking Module (1) NEMA 1 Enclosure	AC Contactor (Supplied Loose)
1-3	CDMDB03	Included in DB Module
5-15	CDMDB10	Included in DB Module
20-40	CDBRK40	ARE5018-XX[1]

[1] For 20 or 25 HP use ARE 5018-03 AC contactor
For 30 or 40 HP use ARE 5018-06 AC contactor

The 1-15 HP SV3000 drives have an internal DB resistor that will be sufficient for most applications. For applications with high cycle rates, large inertia and quick deceleration requirements or overhauling loads for a high percentage of the machine cycle, the external DB module will provide more DB braking capability. Please consult the factory for Applications Engineering for application support.

(1) The CDMDB03 and CDMDB10 include the DB resistor(s), AC contactor and a thermal device mounted in a NEMA 1 enclosure. The CDBR20, CDBR30, AND CDBR40 include the DB resistor(s), thermal device and DB fuse mounted in a NEMA 1 enclosure. The AC contactor is available as a loose item as extra protection to disconnect the AC input from the drive in case of a DB fault.

Figure 4D shows connections for external dynamic braking and Common Bus arrangements on SV3000 1-15 HP.



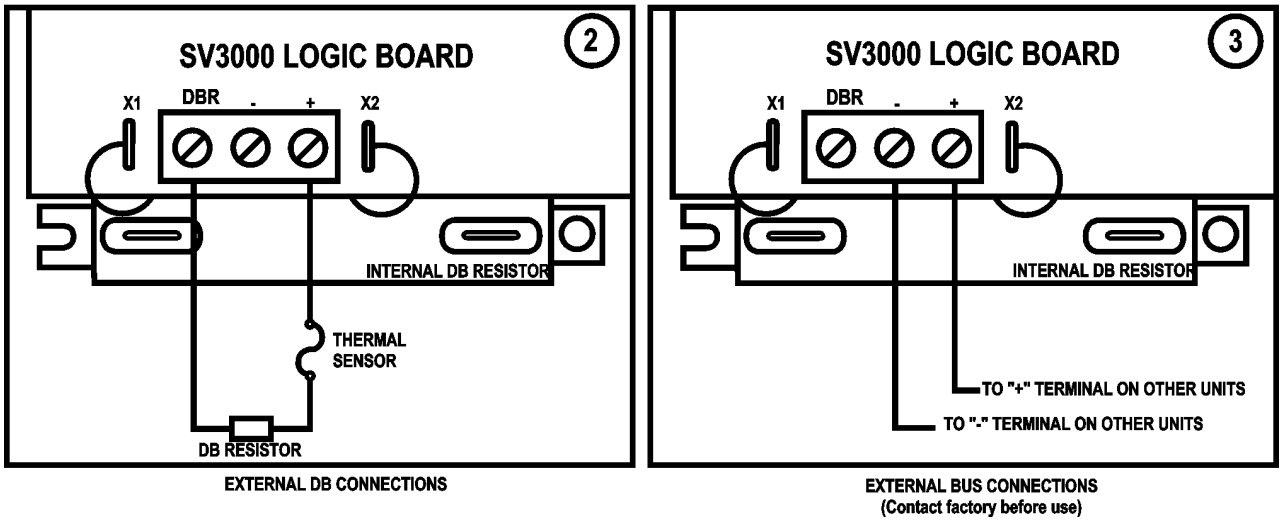
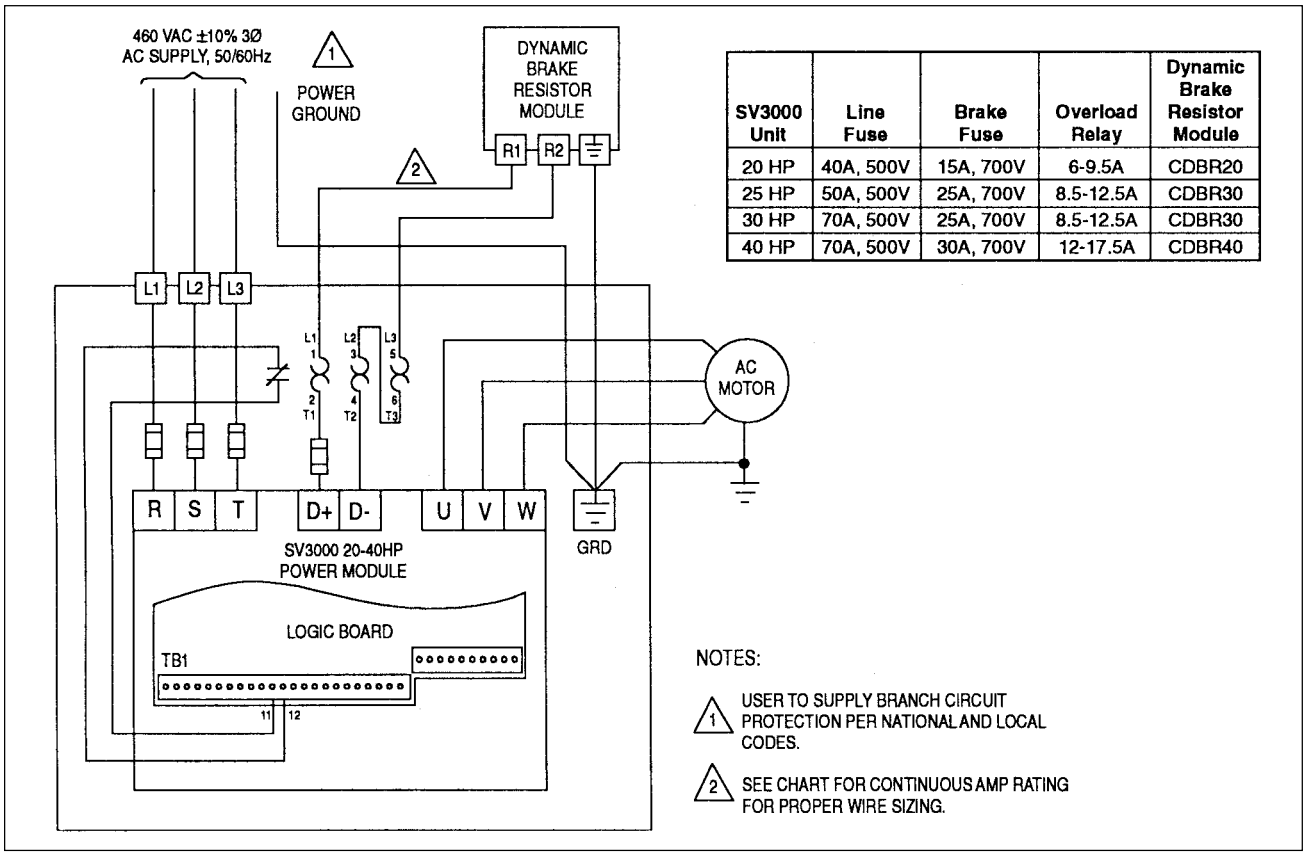


Figure 4D. External Connections



SV3000 Unit	Line Fuse	Brake Fuse	Overload Relay	Dynamic Brake Resistor Module
20 HP	40A, 500V	15A, 700V	6-9.5A	CDBR20
25 HP	50A, 500V	25A, 700V	8.5-12.5A	CDBR30
30 HP	70A, 500V	25A, 700V	8.5-12.5A	CDBR30
40 HP	70A, 500V	30A, 700V	12-17.5A	CDBR40

Figure 4E. External Brake Resistor Module

4.4.2 SV3000 15 - 40 HP

The following table shows the ratings for the 20 - 40 HP external DB capabilities.

SV3000 20 - 40 HP External DB Ratings				
HP Rating	20	25	30	40
DB Kit Part #	CDBRK40	CDBRK40	CDBRK40	CDBRK40
Rated Brake Torque %	150	150	150	150
Braking Duty Cycle	5 seconds every 2 minutes (Typical)			

4.5 Dynamic Braking Set-up and Operation

4.5.1 Installation

4.5.1.1 SV3000 1 - 15 HP

The use of the internal DB Resistor requires no customer installation or adjustments for DB operation. The type of stopping mode is determined by the value in parameter Pr202 (Stop Mode). The default value is Decel which sets a linear decel ramp as programmed into parameter Pr004 Decel (default = 3 seconds).

The external DB Kit requires the mounting of an external NEMA 1 enclosure and the connections to the drive of the DB resistor(s) and thermal trip device. Please refer to Figure 4B for proper instructions on installation. The internal DB resistor must be disconnected for proper operation. Proper installation of the DB Kit is essential for the protection of the drive and optimum performance of the AC Drive system.

4.5.1.2 SV3000 20 - 100 HP

The external DB Kit requires the factory installation of the electronics module and the mounting of an external NEMA 1 enclosure and the connections to the drive of the DB resistor(s) and thermal trip device. Please refer to Figure 4A for instructions on installation. Proper installation of the DB Kit is essential for the protection of the drive and optimum performance of the AC Drive system.

4.5.2 DB Operation

After installation and the desired setting of parameter Pr202 (Stop Mode) (if different from default value of Decel Ramp) the DB does not require any additional customer attention.

The DB capability to maintain speed with an overhauling load or stop or decelerate the motor/load and prevent an Overvoltage Trip depends on the DB Kit used, inertia and friction of the load, motor speed, HP of the Drive, deceleration rate programmed, current limit/torque parameter settings, and duty cycle.

5 Serial Communications

This chapter describes serial communication capabilities of the SV3000. It will explain:

- How to connect an external computer to monitor and control the SV3000.
- How to establish a network of SV3000 drives.
- The communication protocol and how to communicate to the drive.

5.1 Overview

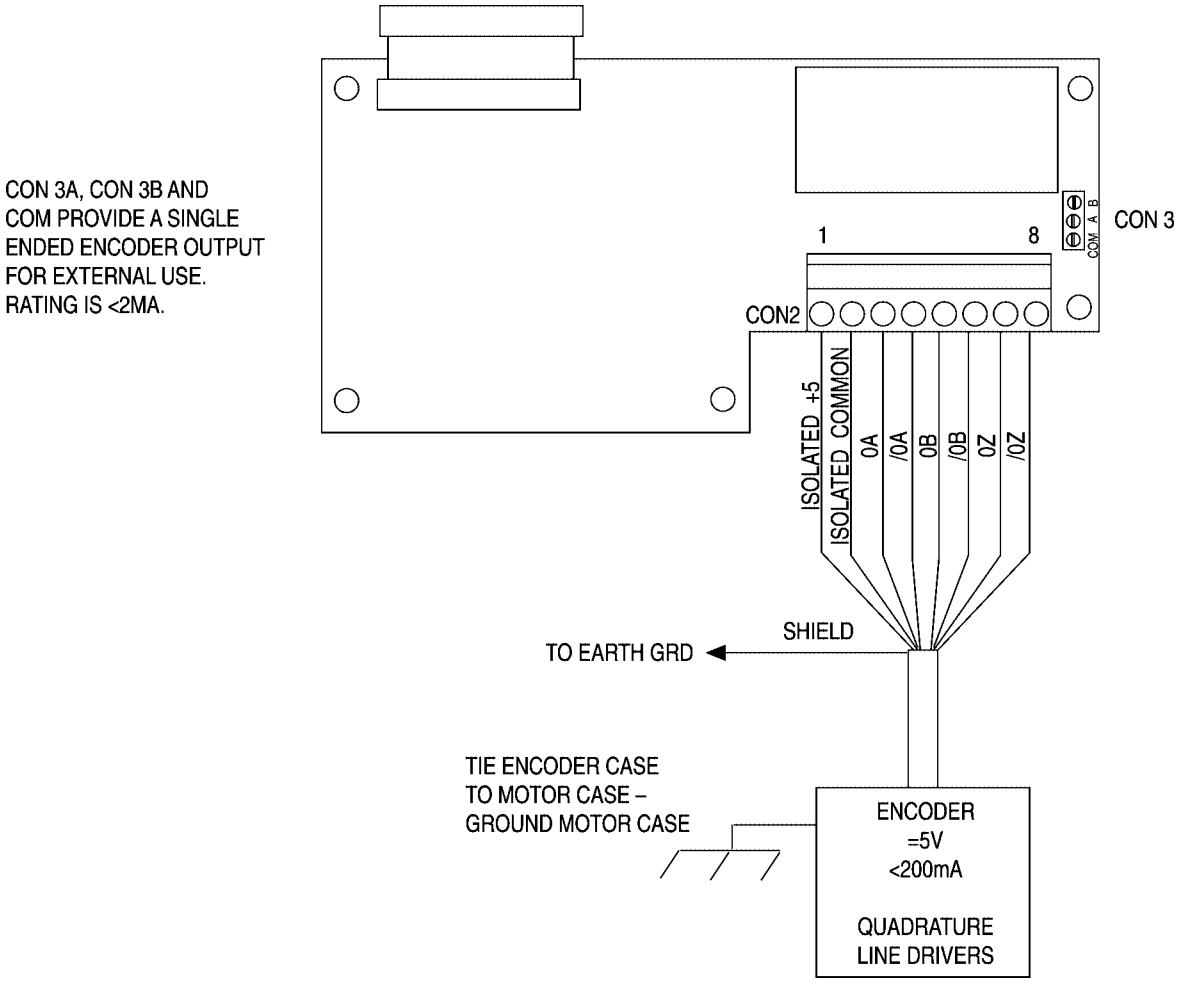
You can use an external computer to remotely set up, monitor, and control the operation of the SV3000 connecting them serially. As many as 99 drives can be linked together in a network, permitting coordination of integrated systems by a host computer. The standard EIA RS-485 serial connections (up to 10 drives) allow reliable communication over relatively long distances. (Maximum cable length cannot exceed 1200 meters.)

Optional fiber-optic converters (up to 99 drives) can be used for superior, error-free communications over extensive distances with fiber-optic cables. The communication protocol is an industrial standard, "ANSI-x3.28-2.5-A4."

5.2 RS-485 Connections

The SV3000 has two EIA RS-485 serial connections: (1) four screw terminals for wires and (2) a standard RJ-11 phone connector. The connectors are tied in parallel. These differential connections provide greater noise immunity than single-ended RS-232 connections. High-speed optical isolation provides further noise protection. You can connect an RS-232 device by using an RS-485 to RS-232 adaptor.

The serial connections are shown below:



5.3 Networking

Multiple drives can be connected together to form a Drives network. A network allows a host computer, a monitor and control as many as 99 drives.

Each drive must have a unique address, "SERIAL ADDR" (Pr314).

Remove resistor R94 "TERM R" from all drives EXCEPT the last one (See Figure 5A).

It is recommended that communication first be tested from the host to a single drive, rather than attempting to test the entire network at once. This will permit the host software and serial connections to be tested first.

5.4 Communication Protocol

The communication protocol that allows a host computer to talk to the SV3000 is the ANSI-x3.28-2.5-A4 protocol.

The protocol defines the format and syntax of commands sent to the drive by the host.

5.4.1 Commands

This protocol has two basic commands:

Read Command:

Allows the computer to read the value of any parameter.

Write Command:

Allows the computer to write a value to any parameter that is write accessible.

The syntax of these commands is given in detail in the next sections.

Character Format

Each character consists of 10 or 11 bits, depending upon the number of data bits and parity as set in "BITS PAR" (Pr315). The bits are defined as follows:

"BITS PAR"

7 ODD or 7 EVEN	<START>	<DATA1>	<DATA2>	<DATA3>	<DATA4>	<DATA5>	<DATA6>	<DATA7>	<PAR>	<STOP>
8 NONE	<START>	<DATA1>	<DATA2>	<DATA3>	<DATA4>	<DATA5>	<DATA6>	<DATA7>	<DATA8>	<STOP>
8 ODD or 8 EVEN	<START>	<DATA1>	<DATA2>	<DATA3>	<DATA4>	<DATA5>	<DATA6>	<DATA7>	<DATA8>	<PAR>	<STOP>

Start bit (logic 0)

Data bits (ASCII format)

Parity bit (even or odd):

With even parity: Set to logic 1 if the character data consist of an even number of bits with logic 1

With odd parity: Set to logic 1 if the character data consist of an odd number of bits with logic 1

With no parity: The parity bit is not transmitted

Stop bit (logic 1)

The speed at which the character bits are transmitted is called the baud rate and is expressed in bits per second.

For communication to occur, both the host computer and the SV3000 must use the same baud rate, parity, and number of data bits. These items are selectable in the SV3000, refer to the descriptions of parameters "SERIAL BAUD" (Pr313) and "BITS PAR" (Pr315).

5.4.2 Read Command

The read command allows the host computer to read the value of any drive parameter.

To Issue a Read Command:

The read command consists of a maximum of nine characters and has the following format:

<EOT>	**ADD**				**PAR**			**<ENQ>**

<EOT> ADD1 ADD1 ADD2 ADD2 PAR1 PAR2 PAR3 <ENQ>

<EOT>

Initialize the Communication Link (1 character)

The ASCII control character <EOT> (^D, ASCII value 0C04) is sent to initialize all the drives on the serial network.

ADD

Send the Drive Address (4 characters)

The address of the drive to read from. The drive address is set in the drive by "SERIAL ADDR" (Pr314) and can range from 1 to 99. For data integrity, each digit is sent twice. Four characters are always sent, even for drive addresses 1 through 9. For example, if addressing drive 3, send 0033; if addressing drive 12, send 1122.

PAR

Send the Parameter Number (1 to 3 characters)

The parameter number to be read. Parameter numbers range from 000 to 999. Send only the number of digits necessary to convey the number (sending zeroes is not required, although you can if you want). For example, to read parameter Pr000, send 0; to read parameter 13, send 13; to read parameter 213, send 213.

<ENQ>

End the Message (1 character)

The ASCII control character <ENQ> (^E, ASCII value 0x05) is sent to terminate the message.

Successful Drive Response to Read Command

The drive will respond with the following if the read command was successful:

<STX>	**PAR**				**VAL**			**<ETX>**	**<BCC>**
<STX>	PAR1	PAR2	PAR3	±	VAL1	VAL2	VAL3. . VAL8	<EXT>	<BCC>

<STX>

Start of the Message (1 character)

The ASCII control character <STX> (^B, ASCII value 0x02) is sent to indicate the start of the reply.

PAR

Parameter Number (1 to 3 characters)

The requested parameter number is echoed. See above.

VAL

Value of the Parameter (2 to 9 characters)

The value of the requested parameter. The first character is the sign of the data ('+' or ' - '). The remaining eight characters consist of from 1 to 8 value digits, including a decimal point, if necessary.

ETX

End of the Requested Data (1 character)

The ASCII control character <ETX> (^C, ASCII value 0x03) is sent to indicate that the drive has finished sending the requested data.

BCC

Block Checksum (1 character)

The final character is a block checksum that permits the host to perform error checking on the data it receives. This checksum is always sent.

The checksum is calculated by performing a binary exclusive or of all characters in the parameter number (PAR), the parameter value (VAL), and the character <ETX>. If the resulting character is an

ASCII control character (less than 0x20), the result is added to 0x20.

Unsuccessful Drive Response to Read Command

The drive will respond with the following if the requested parameter number is invalid or unrecognizable.

<STX>	**PAR**			**<EOT>**
<STX>	PAR1	PAR2	PAR3	<EOT>

<STX>

Start of the Message (1 character)

The ASCII control character <STX> (^B, ASCII value 0x02) is sent to indicate the start of the reply.

PAR

Parameter Number (1 to 3 characters)

The requested parameter number is echoed. See above.

<EOT>

End of the Message (1character)

The ASCII control character <EOT> (^D, ASCII value 0x04) is sent to indicate the end of the message.

Repeated Read Command

Once a parameter has been read, it can be re-read any number of times by sending the ASCII control character <NAK> (^U, ASCII value 0x15).

Sequential Read Command

Once a parameter has been read, parameters can be read sequentially in either direction. To read the next parameter number (PAR + 1), send the ASCII control character <ACK> (^F, ASCII value 0x06). To read the previous parameter number (PAR-1), send the ASCII control character <BS. (^H, ASCII value 0x08).

5.4.3 Write Command

The write command allows the host computer to write a value to any drive parameter that is write accessible.

The write command consists of two portions: (1) a drive log-on portion and (2) the parameter write portion. The first time a drive is addressed for writing, both portions of the command must be sent. Once a parameter has been written, it is not necessary to re-issue the log-on command. As long as no other drive has been written to in between, further data can be sent to the drive by sending only portion (2), the parameter write command.

To Issue a Write Log-On:

The log-on command consists of five characters and has the following format:

<EOT>	ADD1	ADD1	ADD2	ADD2

<EOT>

Initialize the Communication Link (1 character)

The ASCII control character <EOT> (^D, ASCII value 0x04) is sent to initialize all the drives on the serial network.

ADD

Send the Drive Address (4 characters)

The address of the drive to write to. The drive address is set in the drive by "SERIAL ADDR" (Pr314) and can range from 1 to 99. For data integrity, each digit is sent twice. Four characters are always sent, even for drive addresses 0 through 9. For example, if addressing drive 03, send 0033; if addressing drive 12, send 1122.

Note: Address 0 is specially reserved for global write. Any data written with address 0 selected is received and used by all drives. The drives do not send any acknowledgement.

To Issue a Write Command:

The write command consists of a maximum of 12 characters and has the following format:

<STX>	**PAR**			**VAL**						**<EXT>**	**<BCC>**
<STX>	PAR1	PAR2	PAR3	±	VAL1	VAL2	VAL3	VAL4	. .VAL8	<EXT>	<BCC>

<STX>

Start the Message (1 character)

The ASCII control character <STX> (^B, ASCII value 0x02) is sent to indicate the start of the message.

PAR

Send the Parameter Number (1 to 3 characters)

The parameter number to be written to. Parameter numbers range from 000 to 999. Send only the number of digits necessary to convey the number (sending zeros is not required, although you can if you want). For example, to write parameter Pr000, send; to write parameter 13, send 13; to write parameter 213, send 213.

VAL

Send the New Value of the Parameter (2 to 9 characters)

The value of the requested parameter. The first character is the sign of the data ('+' or '-'). If the data is positive or the sign is meaningless, a space character <SP> (ASCII value 0x20) can be sent. The remaining eight characters consist of from 1 to 8 value digits, including a decimal point, if necessary. If the resolution of the value is greater than the allowable resolution of the parameter, the drive will round the value up.

Note: Enumerated values start from 0 (0, 1, 2, 3, . . .).

Refer, for example, to "UIN" (Pr426). Its values are NONE (=0), COAST CTL (=1), SLAVE CTL (=2), ZERO TORQ (=3), SPEED TORQ (=4), and FORWARD (+5).

EXT

Indicate the End of the Data (1 character)

The ASCII control character <ETX> (^C, ASCII value 0x03) is sent to indicate that the host has finished sending the new value data.

BCC

Block Checksum (1 character)

The final character is a block checksum that permits the drive to perform error checking on the data it receives.

The checksum is calculated by performing a binary exclusive or of all characters in the parameter number (PAR), the parameter value (VAL), and the character <ETX>. If the resulting character is an ASCII control character (less than 0x20), the result is added to 0x20.

The checksum can be disabled. If disabled, any character can be used to replace the checksum character to complete the write command.

Successful Drive Response to Write Command

If the write command was received and implemented successfully, the drive will respond with the ASCII control character <ACK> (^F, ASCII value 0x06).

Unsuccessful Drive Response to Write Command

If the parameter number is invalid or unrecognizable or the data or block checksum is in error, or the value is out of range, or the parameter is not run-accessible while motor is running, the drive will respond with the ASCII control character <NAK> (^U, ASCII value 0x15). In this case no data in the drive is changed.

5.5 Drive Control Parameters

Drive motion can be controlled by a host computer over the serial communication link. The following commands are provided for drive motion control:

Parameter Number	Command	Function	Hard Wired Equivalent
900	Write a 1	Start	Close "Start" input (TB1-23) momentarily
901	Write a 1	Stop	Open "Run Enable" input (TB1-22) momentarily
902	Write a 1	Forward	Open "Reverse" input (TB1-19)
903	Write a 1	Reverse	Close "Reverse" input (TB1-19)
904	Write a 1	Remote	Close "Remote" input (TB1-20)
904	Write a 0	Local	Open "Remote" input (TB1-20)
905	Write a 1	User Closed	Close "USER" input (TB1-14)
905	Write a 0	User Opened	Open "USER" input (TB1-14)
910	Write a 1	Fault Reset	Close "Fault Reset" input (TB1-13) momentarily

Note: Commands 900, 901, 902, 903, and 910 can be read to see if the command has been processed yet. When a 0 value is found the command has been processed.

Note: On power up, the initial state of Forward/Reverse, Remote/Local, and User closed/User open is determined by the state of the digital inputs.

5.6 Drive Fault Status Parameters

The following commands are provided to read the present fault and to force faults for testing purposes:

Parameter Number	Command	Hard Wired Equivalent
911	Read Hardware Fault Code	Returns present hardware fault
912	Read Software Fault Code	Returns present software fault
913	Write Hardware Fault Code	Momentarily forces hardware fault
914	Write Software Fault Code	Momentarily forces software fault

Hardware Fault Code

0	No Fault
1	PEAK I LIMIT (POC)
2	AMBIENT OVERTEMP (AOT)
4	HEATSINK TEMP (HSOT)
8	IOC TRIP (IOC)
16	LOGIC PS FAULT TRIP (PSF)
32	EXT FAULT TRIP (EXT)
64	WATCHDOG TIMER (WDT)
256	PG CARD FAULT (PGC)

Software Fault Code

0	NO FAULT
1	MEMORY CRC (CRC)
2	IXT CURRENT RUNAWAY (IXTT)
8	MOTOR RUNAWAY (RUN)
16	MOTOR NOT WIRED (NOMO)
32	I LOOP LOSS (ILL)
64	OVERVOLTS REGEN (OVR)
128	OVERVOLTAGE TRIP (OVD)
256	EXCESSIVE_DB (EXDB)
512	FBK MARKER FAULT (MOMA)
1024	HW FAULT XXX (LEM)
4096	MEMORY OUT (MOUT)
8192	UNDERVOLT TRIP (UV)
16384	SERIAL RECEIVE (SERR)
32768	FWD REV (DIR)

5.7 Drive Readout Parameters

The following locations are readouts that can be examined serially. They cannot be examined through the screen.

In addition, the Pr500 parameters can be examined serially.

Parameter Number	Name	Description
915	Motor On	1 when motor on, 0 when motor off
916	Stat	See below:
917	Start stop	1 when start command is present and the drive could turn on and move at any time, 0 when drive is off or will be turning off
918	Run select	0 when forward selected, 1 when reverse is selected. The drive may run in the opposite direction depending on "FR Mode" (Pr213) and speed source selected.
919	Jog sel	0 when jog mode not selected, 1 when jog mode is selected
920	Ana source	0 when "Local CMD" analog input selected, 1 when "remote CMD" analog input selected.
921	BCD in	Shows BCD speed that is selected by 2 inputs, 1 = "PS1" (Pr100), 2 = "PS2" (Pr103), and etc.

Code in stat	Meaning	Description
0	stopped	drive is off
1	jog stop	drive is off "JOG" (Pr005) is selected
2	accel fwd	accelerating in forward direction
3	accel rev	accelerating in reverse direction
4	decel fwd	decelerating in forward direction
5	decel rev	decelerating in reverse direction
6	run fwd	maintaining speed in forward direction
7	run rev	maintaining speed in reverse direction
8	dc brake	dc injection braking to stop
9	dc hold	dc injection braking to stop
10	jog fwd	maintaining "JOG" (Pr005) speed in forward direction
11	jog rev	maintaining "JOG" (Pr005) speed in reverse direction
12	uv auto restart	drive faulted and will auto restart when restart under voltage condition goes away
14	run torq	drive on and in torque mode
15	fault	drive tripped with fault
16	fault restart	drive faulted and will be auto restarting
17	auto restarting	drive will be auto restarting
18	tuning	drive in AC Tune Test or Open Loop Test

6 Applications

6.1 Master-Follower

a. Analog

To follow an analog reference signal at a pre-set ratio the SV3000 must be configured for analog set point control as described in Section 3-13.

Set the following parameter.

Pr206 to **ANALOG**

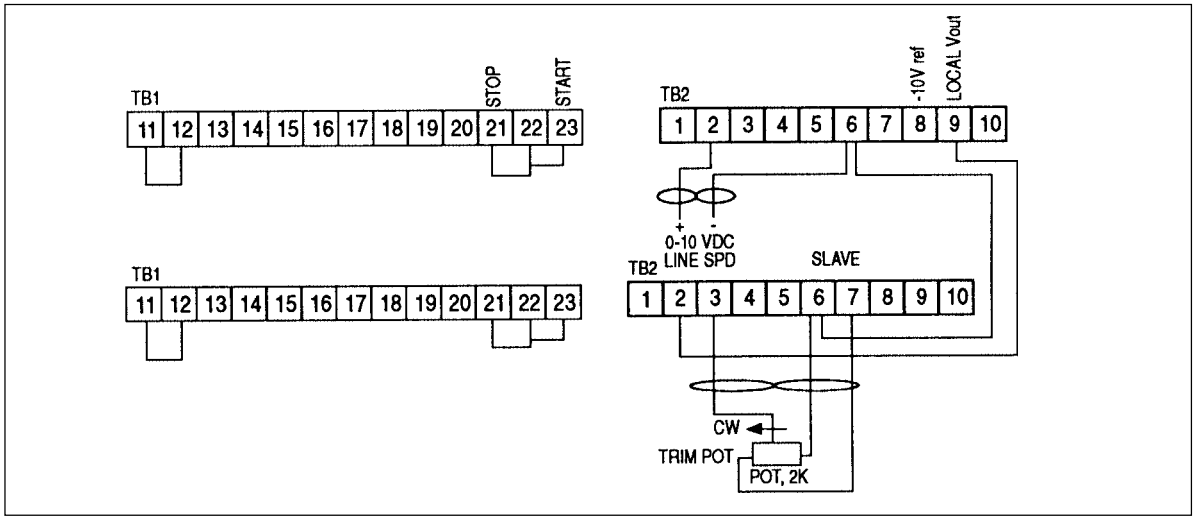
Pr209 and Pr2010 to desired ratio in accordance with the following formula:

$$\text{Overall Speed Ratio} = \frac{\text{RATIO NUM (Pr209)}}{\text{RATIO DEN (Pr210)}}$$

Pr201 to **SSPEED**

The slave drive will follow the master reference signal with the ratio and scaling selected. The ratio can be programmed to be changed by an analog voltage with the user programmable analog input Pr413 UVIN (see Section 6.6). If the drive must be switched out of the slave mode, use the programmable digital input TB1-14 and set Pr426 to slave control.

The following shows Master/Slave (Analog) connections with 2-wire start/stop and analog trim. The Master is following a line speed reference.



Parameter Setup

Master	**Slave**	
Factory settings	Pr205	SSPEED
	Pr206	ANA(log)
	Pr209	RATIO NUM
	Pr210	RATIO DEN
	Pr414	Set for trim/scale @ +10V input
	Pr415	Set for trim/scale @ +0V input
	Pr416	Set either trim or scale
	Pr413	209

The slave drive will follow the master reference signal with the ratio dialed in using the trim pot. The ratio can be changed digitally from the keypad. In this case, the trim pot would not be needed. If the slave drive must be switched out of slave mode, use the digital programmable input TB1-14 and set Pr 424 to slave control.

b. Digital

To set a Slave SV3000 to follow the speed of a Master SV3000, set Pr201 on the Master SV3000 to MSPEED and set Pr201 on the Slave SV3000 to SSPEED. Connect J2A-J2B on units to each other using a length of RJII phone cable, the common connections on each unit (TB1-11) must also be connected together to improve noise immunity.

Set the Slave SV3000 Pr209 and Pr210 Ratios to obtain the required overall speed ratio (value between 0.001 - 1.999). See Section 6.1.1.

The slave drive will follow speed if the master drive is using the pre-set ratio. As before, the ratio may be controlled by an analog voltage.

Up to 20 slave drives may be connected in parallel to one master drive. If multiple drives are used, resistors R15 and R16 must be removed except on the last slave.

6.1.1 Setup Parameters

Pr205 Synchronous Serial
This parameter specifies the drive's role in a Master/Slave network using Synchronous Serial control.

Off
Set to Off if the drive is a stand-alone drive and is not part of a master/slave network.

Send
If set to Send the drive is the master in a serial master/slave network. The drive will transmit synchronous serial signals to slave drives from port J2-A. Only one master drive is permitted in a network.

Receive
If set to receive, the drive is a slave (follower) in a master/slave serial network. If part of a serial network, the drive will receive synchronous serial signals from a master drive through port J2-B.

Pr206 Slave Source
This parameter sets the source of the slave signal. It is only used if the drive is part of a master/slave network, and must be set for a slave drive. The slave signal is scaled by the ratio established by RATIO NUM (Pr209) and RATIO DEN (Pr210).

When in slave mode the slave drive will stop if the "Run Enable" input (TB1-22) is removed or the "Stop" key is pressed.

A(nalog)
If set to A(nalog) and the drive is a slave, the drive will treat the analog input signal selected by the "Remote" digital input (TB1-20) as the source.

SCI
If set to SCI, the synchronous serial communications interface will be the input (if the drive is a slave.)

RATIO NUM (Pr209)
The numerator of the overall speed ratio. The overall speed ratio scales the commanded speed of the drive. The ratio functions at all times and can be used to specify the speed of a slave drive with respect to a master. If no scaling is required, this value must be set to 1. The ratio is determined as follows:

$$\text{Overall Speed Ratio} = \frac{\text{RATIO NUM (Pr209)}}{\text{RATIO DEN (Pr210)}}$$

If, for example, you want the drive to run at one third of the speed of the master, set Pr209 to 1 and set RATIO DEN (Pr210) to 3. If you want the drive to run at 80% of the speed of the master set RATIO NUM to 4 and RATIO DEN to 5.

The value of Pr209 can be set externally using the "User Vin" voltage input (TB2-3). Refer to "User Vin" (Pr413). If you are using an external voltage input, it is recommended that Pr209 and Pr210 be set to 1000 for a ratio of 1 and to Pr209 = 80 and Pr210 = 100 for a drive running at 80% of the master.

RATIO DEN (Pr210)
The denominator of the overall speed ratio. The overall speed ratio scales the commanded speed of the drive. The ratio functions at all times and can be used to specify the speed of a slave drive with respect to a master. If no scaling is required, this value must be set to 1. The ratio is determined as follows:

$$\text{Overall Speed Ratio} = \frac{\text{RATIO NUM (Pr209)}}{\text{RATIO DEN (Pr210)}}$$

If, for example, you want the drive to run at one third of the speed of the master, set Pr209 to 1 and set RATIO DEN (Pr210) to 3. If you want the drive to run at 80% of the speed of the master set RATIO NUM to 4 and RATIO DEN to 5.

The value of Pr209 can be set externally using the "User Vin" voltage input (TB2-3). Refer to "User Vin" (Pr413).

6.2 DC Drive Simulation

A non-regenerative DC drive coasts when changing from a higher to a lower speed. The SCR's are turned off when the armature or tach feedback voltage is higher than the Set Speed voltage. Deceleration rate is set by the load inertia and friction. Most AC drives continue to conduct current through the motor when decelerating from a high to a low speed. This current is taken to the bus capacitors and can cause the drive to trip on overvoltage if the deceleration time set in the drive is shorter than the natural deceleration time of the load.

DC drive operation can be simulated by setting Braking Torque parameters Pr308 and Pr309 to zero and enabling Start a Spinning Motor (Pr211). Motor will coast from a high speed to a lower speed.

6.3 Start a Spinning Motor (Pr211)

The feature allows the drive to be energized onto a motor whose shaft is rotating without causing a trip. When the drive receives a Run signal, the drive scans the motor frequency and synchronizes itself to the motor frequency. On systems where there is no mechanical load on the motor when it is overrunning, a change of speed may be observed during the scanning operation. It may take up to 5 seconds to reconnect the drive depending on system and dynamic conditions.

6.4 S Curve Enable (Pr212)

This function will limit the rate of change of the acceleration (jerk) of a motor/load system while accelerating or decelerating. The value programmed in parameter Pr212 represents the nonlinear percentage of the selectyed programmed accel or decel ramp. For example, if S-Curve is set at 50% and ACCEL Pr003 is set at 10 sec., then 5 sec. of the accel ramp would be nonlinear and 5 sec. would be linear.

6.5 Torque with Speed override:

When running in the torque mode of operation, the speed that the motor/load will run will be either the "natural" speed provided by running the torque at its setting or the speed programmed in Pr002, "MAX:RPM", whichever is lower. In most instances, the speed will be a direct result of the application and the amount of torque selected. If, however, the load is reduced or the torque is increased too far, then the speed will naturally rise until it hits the value set by the MAX speed parameter. At this point, the drive essentially reverts back to a speed control mode until either the set torque demand is reduced or the load increased. This function can be extended to provide for an active speed override or limit set by using the user analog input UVIN. First, edit the value in the MAX parameter Pr002 to equal the highest value desired for the max speed when the analog input (potentiometer or other process signal) is at 10V. Next, set parameter Pr413 to Pr002. This will allow a MAX speed that can go from MIN+1 to the programmed MAX value by varying the analog input to the UVIN analog point

6.6 Analog Input/Output Parameter Description

DIR CONTROL Pr401

This parameter specifies the polarity and scaling of the setpoint for both operator panel and local/remote analog input signal setpoint control. It determines how the minimum and maximum setpoint values are determined and how the drive direction is controlled.

When "DIR CONTROL" is changed, the drive may limit the values of "MIN," "MAX," "L Lo," "L Hi," "R Lo," "R Hi," to ensure their consistency with the selected mode. "MIN" is always limited to be less than "MAX." You may have to adjust these parameters.

The following table shows how the set-point is controlled:

	Speed Set-Point LOCAL CMD			Speed Set-Point REMOTE CMD	
DIR CONTROL	Max. Positive	Zero	Max. Negative	Max. Positive	Zero
AUTO & Min(Pr001)>0	Max(Pr002)	Min	Min(Pr001)	Max(Pr002)	Min(Pr001)
AUTO & Min(Pr001)<0	Max(Pr002)	0	Min(Pr001)	Max(Pr002)	0
Uni(polar)	L Hi (Pr402)	L Lo	L Lo (Pr403)	R Hi (Pr408)	R Lo (Pr409)
BIP(olar)	L Hi (Pr402)	0	L Lo (Pr403)	R Hi (Pr408)	R Lo (Pr409)

Note changing DIR CONTROL may cause parameters to be changed by the program. The following conditions are always forced to be true by the program.

1) MAX > = 0 and MAX > MIN

2) R Lo > = 0 and RHi > R Lo

3) In UNI(polar) L Lo > = 0 and L Hi > L Lo

4) In BIP(olar) L Lo < = 0 and L Hi > L Lo

This parameter is also to determine the torque command when the torque set-point source is LOCAL CMD (TB2-2) or REMOTE CMD (TB2-4 and TB2-5). See table below:

	Torque Set-Point LOCAL CMD			Torque Set-Point REMOTE CMD	
DIR CONTROL	Max. Positive	Zero	Max. Negative	Max. Positive	Zero
AUTO & Min(Pr001)>0	Max Torque	0	0	Max Torque	0
AUTO & Min(Pr001)<0	Max Torque	0	Max Torque	Max Torque	0
Uni(polar)	Max Torque	0	0	Max Torque	0
BIP(olar)	Max Torque	0	Max Torque	Max Torque	0

Note: Max Torque = Full Torque x INT TORQ(Pr312) / 100
Note: For 10V = 100% TORQUE, ILIMIT (Pr008) = MOTOR AMPS (Pr300)

L Hi Pr402

Used in the local (voltage) analog input. This value corresponds to the maximum input voltage (nominally 10 VDC). It is used only in unipolar and bipolar modes ("DIR CONTROL" (P401) set to UNIP or BIP). The number of decimal places displayed is determined by "ENG DEC POINT" (P012). This value can be affected by the changing of either "DIR CONTROL" (P401) or "L LO" (P403).

L LO Pr403

Used in scaling the local (voltage) analog input. This value corresponds to the minimum input voltage (nominally 0 VDC or -10 VDC). It is used only in unipolar and bipolar modes ("DIR CONTROL" (P401) set to UNIP or BIP). The number of decimal places displayed is determined by "ENG DEC POINT" (P012). This value can be affected by changing either "DIR CONTROL" (P401) or "L HI" (P402).

L OFFSET P404

This parameter allows the user to calibrate the local (voltage) analog input to accommodate signals that are not 0 or + 10VDC. The user can specify the zero, maximum, and minimum points of the input signal and the drive will automatically calculate the correct offset and gains. A nominal setting is provided for easy setup when the precise calibration is not necessary. The factory default is NOMINAL, although DONE is displayed.

DONE / Z SET / P SET / M SET:

To calibrate the local (voltage) input, follow these steps:

1) Set the potentiometer or other signal source to provide what you want to call zero volts.

2) Change "L OFFSET" to Z(ero) SET. The drive will learn the given input voltage as its zero point. The parameter will change back to DONE.

3) Set the fully positive voltage you want to call maximum volts (nominally 10 V).

4) Change "L OFFSET" to P(lus) SET. The drive will learn the input voltage as its "plus" voltage. The parameter will change back to DONE.

5) If you are going to be using a negative local voltage, then set the fully negative voltage you want to call minimum volts (nominally -10V).

6) Change "L OFFSET" to M(inus) SET. The drive will learn the input voltage as its "minus" voltage. The parameter will change back to DONE.

NOMINAL

If set to nominal, the local analog input is scaled based on the range 0 to ± 10 VDC. The input signal is presumed to be of the same range.

L Offset V Pr405

The offset to the LOCAL CMD (voltage) analog input (TB2-2) based on 32767 equalling 10 VDC. This value is determined automatically when the "L Offset" routine is run with the value Z SET. It can also be entered directly.

L Pos X Pr406

The positive gain of the LOCAL CMD (voltage) analog input (TB2-2), based on 32767 equalling a 10 volt spread (0 to 10V). This value is determined automatically when the "L Offset" routine is run with the value P SET. It can also be entered directly.

L Neg X Pr407

The negative gain of the LOCAL CMD (voltage) analog input, based on 32767 equalling a 10 volt spread (0 to 10V). This value is determined automatically when the "L Offset" routine is run with the value M SET. It can also be entered directly.

R Hi Pr408

Used in scaling the REMOTE CMD (current) analog input (TB2-4 and 5). This value corresponds to the maximum input (nominally 20 mA). It is used only in unipolar and bipolar modes ("DIR CONTROL" [Pr401] is set to UNIP or BIP). The number of decimal places displayed is determined by "ENG DEC POINT" (Pr012). This value can be affected by the changing of either "DIR CONTROL" (Pr401) or "R Lo" (Pr409).

R Lo Pr409

Used in scaling the REMOTE CMD (current) analog input (TB2-4 and 5). This value corresponds to the minimum input (nominally 0 mA or 4 mA). It is used only in unipolar and bipolar modes ("DIR CONTROL" [Pr401] is set to UNIP or BIP). The number of decimal places displayed is determined by "ENG DEC POINT" (Pr012). This value can be affected by the changing of either "DIR CONTROL" (Pr401) or "R Hi" (Pr408).

R OFFSET Pr410

This parameter allows the user to calibrate the REMOTE CMD (current) analog input (TB2-4 and 5) to accomodate signals that are not 0 to 20 mA or 4 to 20 mA. The user can specify the zero and maximum points of the input signal and the drive will automatically calculate the correct offset gain. Nominal settings are provided for easy setup when the precise calibration is not necessary. The factory default is NOM4 20, although DONE will be displayed.

DONE / Z SET / P SET / NOM4 20 / NOM0 20:

To calibrate the remote (current) input, follow these steps:

1) Set the signal source to provide the minimum current.
2) Change "R OFFSET" to Z(ero) SET. The drive will learn the given input current as its "zero" point (0 mA or 4mA). The parameter will change back to DONE.
3) Set the fully positive current you want to call maximum current (nominally 20 mA).
4) Change "R OFFSET" to P(lus) SET. The drive will learn the input current as a "plus" current. The parameter will change back to DONE.

NOM4 20 (mA):

If set to NOM4 20, the remote analog input is scaled based upon the range 4 to 20 mA. The input signal is presumed to be of the same range.

NOM 20 (mA):

If set to NOMO 20 the remote analog input is scaled based upon the range 0 to 20 mA. The input signal is presumed to be of the same range.

R Offset V Pr411

The offset to the REMOTE CMD (current) analog input (TB2-4+5) is based on 32767 equalling 20 mA. This value is determined automatically when the "R OFFSET" routine is run with the value Z SET. This value can also be entered directly.

R POS X Pr412

The positive gain of the REMOTE CMD (current) analog input (TB2-4 and 5) based upon 32767 equalling a 20 mA spread (0 to 20 mA). This value is determined automatically when the "R OFFSET" routine is run with the value P SET. This value can also be entered directly.

User Vin Pr413

The USER VIN parameter can be used to scale/trim other internal parameters. The parameters that can be modified through the UVIN are:

OFF (default value – UVIN is non-functional)

Pr005 JOG	Pr008 I Limit	
Pr100 PS1 setpoint	Pr103 PS2 setpoint	
Pr106 PS3 setpoint	Pr109 PS4 setpoint	
Pr112 PS5 setpoint	Pr115 PS6 setpoint	
Pr118 PS7 setpoint	Pr209 Ratio Num	Pr002 MAX. RPM
Pr304 IxT Amps	Pr306-309 Quadrant Control	
Pr312 Int Torq	Pr000 Setpoint	

The setpoint (Pr000) parameter can not be used to scale or trim an analog voltage input (Local Vin).

UVin Hi Pr414

Used to scale the "User Vin" analog input signal (TB2-3). This value corresponds to a 10 VDC signal and represents a percentage of the "User Vin" parameter value.

For example, if "User Vin" is set to Pr005 ("JOG"), and the value of "JOG" is 100 RPM and the value of "UVin HI" is 55% then a 10 VDC user input will correspond to 55 RPM.

The number of decimal places displayed is automatically determined by the parameter selected in "User Vin" (Pr413).

UVin Lo Pr415

Used to scale the "User Vin" analog input signal (TB2-3). This value corresponds to a 0 VDC signal and represents a percentage of the "User Vin" parameter value.

For example, if "User Vin" is set to Pr005 ("JOG"), and the value of "JOG" is 100 RPM and the value of "UVin Lo" is 3% then a 0 VDC user input will correspond to 3 RPM.

The number of decimal places displayed is automatically determined by the parameter selected in "User Vin" (Pr413).

UVin Mode Pr416

Selects the user input mode to determine how to use the "User Vin" analog input signal (TB2-3). In both modes the input voltage is scaled according to "UVin Hi" (Pr414) and "UVin Lo" (Pr415) to determine a scaled result.

If, for example, "User Vin" is set to Pr005 ("JOG") the value of "JOG" is 100 RPM, the value of "UVin Lo" is 5% and the value of "UVin Hi" is 100% then a 0 VDC user input corresponds to 5 RPM and a 10 VDC signal corresponds to 100 RPM.

SCALE

If set to SCALE the user input is treated as a scaling multiplication signal. The scaled result, obtained as above, is used directly as the current operating value for the specified parameter. This scaled value does not overwrite the value already set up for the parameter specified in "User Vin."

For example, if "User Vin" is set to Pr005 ("JOG"), the value of "JOG" is 100 RPM, and the value of "UVin Lo" is 0%, and the value "UVin Hi is 100%, then a 0 VDC user input will correspond to 10 RPM. If the signal is set to 7 VDC then the Jog speed "JOG" will be used as 70 RPM, although the parameter "JOG" will still display 100 RPM.

TRIM

If set to TRIM, the user input is treated as a trimming scale addition. The scaled result, obtained as above, is used as an offset to the current operating value for the specified parameter. This scaled value does not overwrite the value already set up for the parameter specified in "User Vin."

For example, if "User Vin" is set to Pr005 ("JOG"), the value of "JOG" is 100 RPM, and the value of "UVin Lo" is -10%, and the value "UVin Hi" is 10%, then a 0 VDC user input will correspond to -10 RPM and a 10 VDC signal will correspond to 10 RPM plus the offset of 100 RPM. If the signal voltage is 10 VDC then the Jog speed "JOG" will be used as 110 RPM (100 RPM plus the offset of 100 RPM x 10%). Similarily, if the signal voltage is -10 VDC, the jog speed will be 90 RPM. The parameter "JOG" will still display 100 RPM.

UVin OS Pr417

This parameter allows the user to calibrate the "User Vin" analog input signal (TB2-3) to accommodate signals that are not 0 to 10 VDC. The user can specify the zero and maximum points of the input signal and the drive will automatically calculate the correct offset and gain. A nominal setting is provided for easy setup when precise calibration is not necessary. The factory default is "NOMINAL" although "DONE" is displayed.

DONE / Z SET / P SET / NOMINAL

To calibrate the user analog input, follow these steps:

1) Set the signal source to provide what you want to call zero reference.
2) Change "UVin OS" to Z(ero) SET. Push EDIT key. The drive will learn the given input voltage as its zero point. The parameter will change back to "DONE."
3) Set the fully positive voltage you want to call maximum reference (Nominally 10 VDC).
4) Change "L OFFset" to "P(lus) SET." Push EDIT key. The drive will learn the input voltage as its "plus" voltage. The parameter will change back to "DONE."

NOMINAL

If set to NOMINAL, the user analog input is scaled based on the range 0 to 10 VDC. The input signal is presumed to be of the same range.

UVin OV Pr418

The offset to the user analog input, based on 32767 equalling 10 VDC. This value is determined automatically when the "UVin OS" routine is run with the value Z SET. It can also be entered directly.

UVin PX Pr419

The positive gain of the user analog input, based on 32767 equalling a 10 VDC spread (o to 10 V). This value is determined automatically when the "UVin OS" routine is run with the value P SET. It can also be entered directly.

Local V Out Pr420

Selects the signal to be reflected in the "Local Vout" analog output (TB2-9). "Local Vout" may be set to "SPEED" (Pr500), "TORQ" (Pr503), or PTR (Factory Use only).

LV Out Hi Pr421

LV Out Lo Pr422

Used to adjust the scale of the analog output.

If "Local Vout" is set to Speed (Pr500) the analog output is scaled as follows:

10 volts = "MAX" (Pr002) x "LVout Hi" / 100

0 volts = "MAX" (Pr002) x "LVOut Lo" / 100

-10 volts = - "MAX" (Pr002) x "LVOut Hi" / 100 + ("MAX" (Pr002) x "LVOut Lo" / 50)

Normally "LVOut Hi" is set to 100 and "LVOut Lo" is set to zero, in this case.

10 volts = "MAX" (Pr002)

0 volts = 0

-10 volts = -"MAX" (Pr002)

If "Local Vout" is set to "TORQ" (Pr503) the analog voltage is scaled as follows:

10 volts = 200% x "LVOut Hi" / 100

0 volts = 200% x "LVOut Lo" / 100

-10 volts = -200% x "LVOut Hi" / 100 + (200% x "LVOut Lo" / 50)

Normally "LVOut Hi" is set to 100 and "LVOut Lo" is set to zero, in this case

10 volts = 200%

0 volts = 0

-10 volts = -200%

USER VOUT (Pr423)
USER VOUT HI (Pr424)
USER VOUT LO (Pr425)

USER VOUT specifies the parameter to be reflected in the "User Vout" analog output (TB2-10). The parameters that can be selected are shown below in the order in which they appear in the menu.

MOTORTORQ (PR503)
MOTOR I (Pr504)
RMOTORTOR (Pr507)
IN WATTS (Pr508)
INPUT PF (Pr509)
BUS VOLTS (Pr510)
IxT ACCUM (Pr511)
DB ACCUM (Pr512)
Pr599 Factory Use Only
SPEED (Pr500)
SET SP (Pr501)

For MOTTORQ and RMOTORTOR the analog output is scaled as follows:

10 volts = 200% x "LVOut Lo" / 100
0 volts = 200% x "LVOut Lo" / 100
-10 volts = -200% x "LVOut Hi" / 100 + (200% x "LVOut Lo" / 50)
Normally "LVOut Hi" is set to 100 and "LVOut Lo" is set to zero, in this case:
10 volts = 200%
0 volts = 0
-10 volts = -200%

For all other parameters:

10 volts = "LVOut Hi"
0 volts = "LVOut Lo"
-10 volts = "LVout Hi" + "LVOut Lo x 2

The number of decimal places of "UVOut Hi" and "UVOut Lo" are the same as the parameter selected.

UIN Pr426

Specifies the action to be taken when the User digital input (TB1-14) is set.

NONE
User Digital input is not used

COAST CTL
When User Digital input (TB1-14) is set, the drive will coast to rest when a "Stop" command is issued.

SLAVE CTL
When User Digital input (TB1-14) is set the drive will be in Slave Mode regardless of the "RUN MODE" setting, when clear the drive will be in the Master Mode regardless of the "RUN MODE" setting.

ZERO TORQ
If in the torque mode and the User Digital input (TB1-14) is set, the drive torque will go to zero.

SPEED TORQ
When the User Digital input (TB1-14) is set, the drive will enter the torque mode. If clear, the drive will enter the speed mode. This is an alternate method of setting "RUN MODE" (Pr201).

FORWARD
When "FORWARD" is selected, the "User" digital input (TB1-14) becomes a forward input and the forward/reverse fault is enabled. The Reverse digital input (TB1-19) is used for reverse.

USER RELAY Pr427
UR SET Pr428
UR CLR Pr429

"User Relay" specifies the function or parameter that will control the "User" relay output (TB1-5, TB1-6, TB1-7). "UR SET" controls the turn-on point and "UR CLR" controls the turn-off point. The function or parameters that can be chosen are shown below in the order in which they appear in the menu.

SPEED (Pr500)
SET SP (Pr501)
SPEED ERR (Pr502)
MOTORTORQ (Pr503)
MOTOR I (Pr504)
MOTOR HZ (Pr505)
MOTOR V (Pr506)
RMOTORTOR (Pr507)
IN WATTS (Pr508)
INPUT PF (Pr509)
BUS VOLTS (Pr510)
IxT ACCUM (Pr511)
DB ACCUM (Pr512)
TOTAL KW-H (Pr513)
HOURS RUN (Pr514)
MTRON

The only function setting is MTRON. When set to MTRON, the User Relay energizes immediately when the drive is given a start command and current is established in the motor windings. It opens when the drive is stopped.
"UR SET" and "UR CLR" do nothing when MTRON is selected.

When a parameter setting is chosen, the User Relay goes on and off when the value of the parameter is as shown below.
Energizes
Value> = "URSET" or Value < = -"URSET"
De-energizes
Value < "UR CLR" or Value > = -"UR CLR"
If the value is between "UR SET" and "UR CLR" the relay stays in its last state. If the value is between - "UR SET" and -"UR CLR" , the relay stays in its last state. The number of decimal places displayed is automatically determined by the parameter selected in "User Relay."

The program forces "UR SET" to be greater than or equal to "UR CLR." When changing "UR SET", the program may automatically change "UR CLR." When changing "UR CLR", the program may automatically change "UR SET."

USER OUT Pr430
UO SET Pr431
UO CLR Pr432
"User Output" specifies the function or parameter that will control the "User O.C." open collector output (TB1-10). "UO SET" controls the turn-on point (open collector output low) and "UO CLR" controls the turn-off point (open collector output open). The function or parameters that can be chosen are shown below in the order in which they appear in the menu.

SPEED (Pr500)
SET SP (Pr501)
SPEED ERR (Pr502)
MOTORTORQ (Pr503)
MOTOR I (Pr504)
MOTOR HZ (Pr505)
MOTOR V (Pr506)
RMOTORTOR (Pr507)
IN WATTS (Pr508)
INPUT PF (Pr509)
BUS VOLTS (Pr510)
IxT ACCUM (Pr511)
DB ACCUM (Pr512)
TOTAL KW-H (Pr513)
HOURS RUN (Pr514)
MTRON

The only function setting is MTRON. When set to MTRON, the open collector output will turn on (open collector output low) immediately when the drive is given a start command and current is established in the motor windings. It turns off (open collector output high) when the drive is turned off.
"UO SET" and "UO CLR" do nothing when MTRON is selected.

When a parameter setting is chosen, the User O.C. open collector output goes on and off when the value of the parameter is as shown below.

On
Value > = "UOSET" or Value < = -"UOSET"
Off
Value < = "UO CLR" or Value > = -"UO CLR"
If the value is between "UO SET" and "UO CLR" the open collector output stays in its last state. If the value is between -"UO SET" and -"UO CLR", the output stays in its last state. The number of decimal places displayed is automatically determined by the parameter selected in "USER OUT."

The program forces "UO SET" to be greater than or equal to "UO CLR." When changing "UO SET", the program may automatically change "UO CLR." When changing "UO CLR", the program may automatically change "UO SET."

DEFLT MENU Pr433
Enables the loading of factory defaults for this menu only. To restore parameters in this menu to their factory default values, set this value to "YES." After the defaults have been loaded, the value will automatically revert to "NO."

6.7 Trip Restart

The Trip Restart feature works as follows:

If the SV3000 experiences a fault and the drive trips, and if the Trip Restart (Pr216) is set to any number between one and seven, the drive will attempt to restart after a time period set by Restart Time (Pr217).

When the drive attempts to restart and the fault is still present, the drive cannot start successfully. The number of Restart attempts is set by Pr216.

If the drive starts and runs correctly but a fault occurs within 10 minutes of the restart, the Trip Restart counter is still active.

If the drive starts correctly and no other faults occur within 10 minutes, the Restart counter is reset to zero. The Ready Relay only de-energizes after all the Restart attempts (Pr216) have failed and the drive does not start successfully.

6.8 Bus Regulator Pr218

Parameter Pr218 "BUS REG" enables the bus voltage regulator when set to LOW, MID, or HIGH. Whenever the bus voltage rises above the levels shown below, for example while decelerating, the drive will reduce its torque limit to prevent an overvoltage trip. Set this value to "OFF" to disable the bus voltage regulator.

	230 V Unit	460 V Unit
HIGH	375 VDC	750 VDC
MID	362 VDC	725 VDC
LOW	350 VDC	700 VDC

6.9 Invert Direction Pr613

INVERT is used to set the encoder (or pulse generator) phasing and motor direction. INVERT is set automatically by the AC Tune Utility. It can also be set manually to invert the motor encoder or motor direction as shown below.

INVERT setting	Means
PGN MTN 0	pulse generator not inverted and motor not inverted
PGN MTI 1	pulse generator not inverted and motor inverted
PGI MTN 2	pulse generator inverted and motor not inverted
PGI MTI 3	pulse generator inverted and motor inverted

To invert motor direction manually:
Change PGN MTN 0 to PGI MTI 3
or
Change PGI MTI 1 to PGN MTN 0
or
Change PGN MTI 1 to PGI MTN 2
or
Change PGI MTN 2 to PGN MTI 1
If the pulse generator is phased wrongly, the motor will rotate slowly and draw full current.

To correct a pulse generator phasing error manually:
1) Watch the direction of rotation when the drive rotates slowly. Then turn it off.
2) If the motor rotates in the right direction, invert the pulse generator only as shown below.

Change PGN MTN 0 to PGN MTN 2
or
Change PGI MTN 2 to PGN MTN 0
or
Change PGN MTI 1 to PGI MTI 3
or
Change PGI MTI 3 to PGN MTI 1

2) If the motor rotates in the wrong direction, invert the motor only as shown below:

Change PGN MTN 0 to PGI MTI 1
or
Change PGN MTI 1 to PGN MTN 0
or
Change PTI MTN 2 to PGI MTI 3
or
Change PGI MTI 3 to PGI MTN 2

6.10 SET T Pr614

SET T is used when "STOP MODE" (Pr202) = DECEL and when jogging or using preset speeds in slave mode.

"STOP MODE" (Pr202) = DECEL
SET T sets the time delay after the drive has been commanded to stop and before it is turned off.

"SLAVE MODE"
After jogging or running at a preset speed, the drive is brought to a stop before switching to following the "SLAVE_SOURCE" (Pr206). After the drive is commanded to a stop, the program waits "SET T" before switching to "SLAVE_SOURCE: (Pr206).

6.11 ON DEL Pr207

AD DEL Pr208

ON DEL is a readout of the minimum delay after the drive is given a start command and before the drive is commanded to change speed. This delay is necessary to give the field flux in the motor time to build up before the motor is commanded to change speed. This value is read-out only and cannot be changed. ON DEL varies with MTR AMPS (Pr300), I field (Pr606), SLIP FREQ (Pr607) and whether or not an encoder is being used.

AD DEL is a set-up that allows additional time delay to be added after the drive is given a start command and before the drive is commanded to change speed. The total delay after the drive is started and before the drive is commanded to move is ON DEL + AD DEL.

AD DEL is useful when there is a synchronous serial master and slave(s) and all drives are given a start command simultaneously. The master should not move until all the slaves are ready. To ensure this:
1) Set AD DEL in slaves to zero
2) Check ON DEL in all slaves and find the largest value.
3) Set AD DEL in master so that:
ON DEL(in master) + AD DEL(in master) = largest ON DEL(in slaves)
Do not set AD DEL in master < 0

7 Enhanced Performance Drive

To achieve higher performance with a wide band width and torque at low speed, the SV3000 must be operated with an encoder on the AC motor to provide speed and position feedback.

7.1 Encoder Specification

Type: Incremental, 1024 ppr preferred
Programmable for 60 to 2048 ppr
2 channel quadrature
5 VDC differential
Power supply, +5 VDC, 200 mA max
Max frequency 200 kHz

7.2 Connection

Connect the encoder as shown in Figure 7A

CON 3A, CON 3B AND COM PROVIDE A SINGLE ENDED ENCODER OUTPUT FOR EXTERNAL USE. RATING IS <2MA.

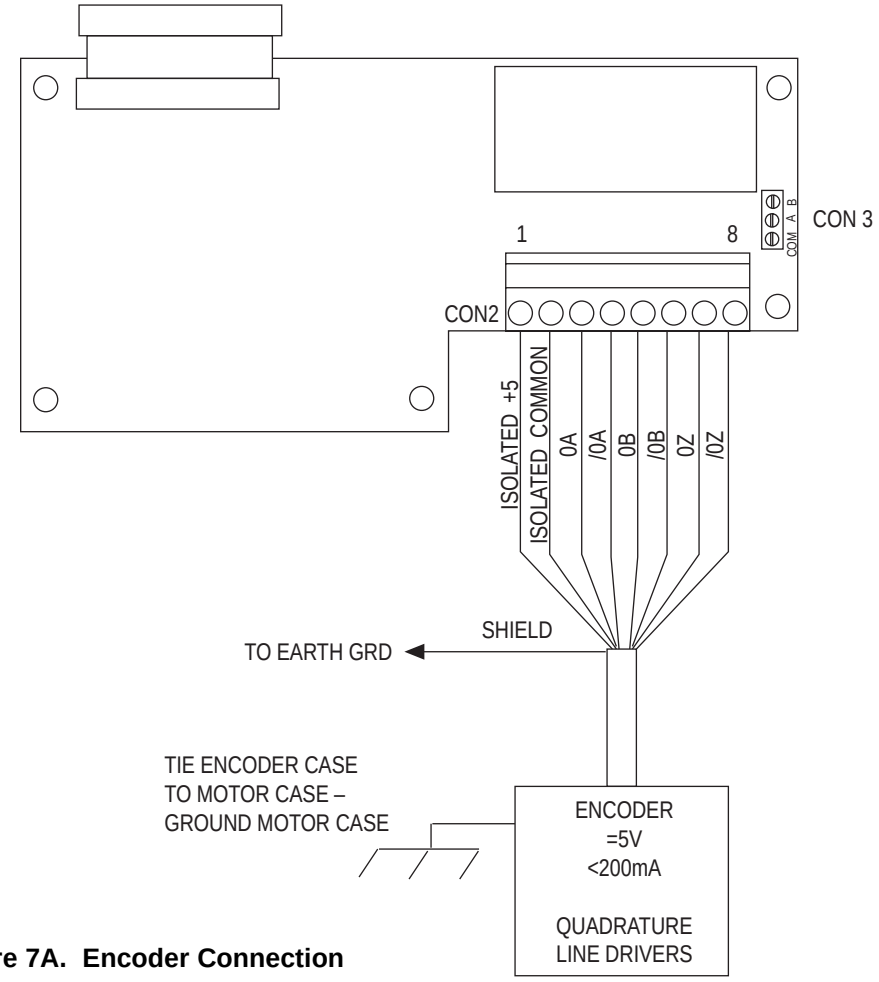


Figure 7A. Encoder Connection

7.3 Tuning and Set-Up - IMPORTANT

The SV3000 Flux Vector AC drive controls current in the AC motor and needs to know the value of stator resistance, motor slip and magnetizing current. The tuning procedure measures these values when the motor is connected to the drive.

If the drive is used with a different motor, the tuning procedure must be carried out before trying to run the motor.

To set the SV3000 for enhanced performance (encoder feedback), put the jumper J1 on the encoder board, on the top two pins. To set the SV3000 for standard performance, put jumper J1 on the bottom two pins. The drive can also be set for standard performance by setting Pr604 to zero. For enhanced performance, set Pr604 to the correct number of encoder pulses.

Tuning Procedure – See Section 3.9 for full details

8 Diagnostics/Troubleshooting

DANGER!

DANGEROUS HIGH VOLTAGES ARE PRESENT IN THIS EQUIPMENT! PERSONAL INJURY AND/OR EQUIPMENT DAMAGE MAY RESULT IF PROPER SAFETY PROCEDURES ARE NOT FOLLOWED!

1. This equipment must be installed, adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of both electrical and mechanical equipment involved.
2. Circuit breakers or disconnects feeding this equipment must be locked open before wiring or servicing. If no lockout device exists, remove the fuses and tag the box to prevent unauthorized personnel from reapplying power.
3. Dangerous high voltages may be present in this equipment even after power has been removed. Before attempting to service this equipment, connect a 1000 VDC voltmeter across the Bus. Do not attempt to service any components until this voltage has completely discharged to zero. This may take several minutes.
4. When using an oscilloscope or other AC line powered test equipment, an isolation transformer must be used to isolate test equipment ground from earth and the power line.
5. Exercise extreme caution when using oscilloscopes and other test equipment as the instrument case may be at high potential with respect to ground. Set the instrument on an insulated surface only. Keep one hand behind your back while adjusting the equipment. Do not make instrument connections or touch the instrument case while power is applied to the drive or voltage is present across the Bus.
6. When making voltage checks or adjustments to the drive, keep one hand behind your back. Do not use your other hand to brace yourself against the controller, panel, or enclosure. Personal injury could result if you accidentally touch a component at line potential.

WARNING!

DO NOT MEGGER OR HI-POT this equipment without first consulting Warner Electric.

CAUTION!

EQUIPMENT MALFUNCTION MAY BE CAUSED BY OTHER PLANT EQUIPMENT OPERATED IN THE VICINITY OF THIS EQUIPMENT!

1. The use of Power Factor Correction Capacitors on this equipment may cause erratic operation and/or nuisance tripping. If Power Factor Correction Capacitors must be used, consult Warner Electric Application Engineering.
2. Erratic operation and/or nuisance tripping may be caused by power line disturbances from welders or other high power, high frequency equipment or by the switching of highly inductive or capacitive devices such as brake coils or Power Factor Correction Capacitors. In this case, operation may be improved by installing isolation transformers or powering the equipment from a different power source.
3. Erratic operation and/or nuisance tripping may be caused by radio transmitters operated in the vicinity of this equipment. Exercise caution when using portable transmitters while adjusting or troubleshooting this equipment.

8.1 Definitions of Fault Messages

The following is a list of the diagnostic fault messages that will be displayed on the alphanumeric display when a fault condition occurs. The "Ready" relay will drop out and the form-A contact on TB 1 - 8 and 9 will open.

Fault Message on Readout	Status Screen Code	Description of Fault
Ext. Fault Trip Input Open	EXT	When the External Trip input, TB 1 - 12 is open, not connected to Logic Common, TB 1 - 11, this fault Trip will occur.
Excessive DB	EXDB	Dynamic Braking has been above 7% duty cycle for an accumulated time of more than 5 seconds.
IxT Warning Excessive Load	IxTW	When the output current exceeds the Pr303 Timed Overcurrent Start Point, this Warning message will occur.
FWD REV Check FR Inputs	DIR	This fault is only checked when "UIN" is set to FORWARD. It is designed to stop the drive if the proper direction to run is not set. Fault occurs if both For and Rev inputs are both open or closed.
IxT Current Trip Excessive Load	IxTT	This fault Trip occurs when 100% of the drive's IxT limit is reached.
IOC Trip Check for Shorts	IOC	Instantaneous Overcurrent Trip caused by excessive current flowing in the IGBT inverter output bridge. Probable causes include short circuit, low impedance ground fault or excessive shock load.
Peak I Limit Stalled Motor?	POC	This trip occurs when any motor phase exceeds 200% of rated current.
Overvoltage Trip Load Overhauling	OVR	Indicates that BUS VOLTAGE has exceeded safe limit while regenerating.
Overvoltage Trip Load Decel	OVD	Indicates that BUS VOLTAGE has exceeded safe limit while DECELERATING.
Undervolt Trip Check AC Input	UV	DC Bus voltage is too low, usually indicating that the AC input is too low.
Watchdog Timer Program Problem	WDT	Microprocessor has detected an internal problem and has tripped the drive to prevent further operation. See Section 2.6 and 2.7.
Heatsink Overtemp Check Fan	HSOT	If heatsink temperature exceeds safe operating point, this fault will occur. Possible causes are clogged or non-operational cooling fan.
Ambient Overtemp	AOT	Internal enclosure temperature has exceeded safe operating point. Possible causes are ambient temperature too high, or lack of clearance around enclosure for proper ventilation. See Section 2.3.
HW Fault Consult Manual	LEM	If POWER-UP SELF TEST procedure detects excessive current, the drive will display this fault.
I Loop Loss I Out of Range	ILL	Drive is programmed for 4-20 mA speed reference and that reference has dropped more than 1 ma below its minimum value. Fault only occurs when Remote Command input is used.
Logic PS Fault Consult Manual	PSF	Internal drive power supply has been overloaded or has failed. Check for incorrect connections to user terminals.
Motor Not Wired Check Wiring	NOMO	The SV3000 has detected an open circuit on the Motor terminals when attempting to run. Check for loose or absent connections, open phase in motor, or incorrect placement of a contactor between drive and motor.

8.1 Definitions of Fault Messages (Continued)

Fault Message on Readout	Status Screen Code	Description of Fault
FBK Marker Fault	MOMA	In "Encoder Feedback" mode, the number of encoder pulses detected is not correct. Check Encoder. Check for loose connections or poor shielding from electrical noise.
Serial Receive Check Ser. Cable	SERR	In serial communications mode of operation, a problem has occurred on the receive (RX) lines. Check for loose connections or incorrect cable or connector.
Serial Transmit Check Ser. Cable	SERT	In serial communications mode of operation, a problem has occurred on the transmit (TX) lines. Check for loose connections or incorrect cable or connector.
Memory Fault Consult Manual	CRC	Microprocessor has detected an error in its internal memory and has tripped the drive to prevent further operation. Contact factory for instructions.
Motor Runaway	RUN	Indicates drive was running at 1.5 times "LIMIT RPM" (Pr303).
Memory Out CRC See Manual	MOUT	Indicates nonvolatile memory checksum was OK at power up, but that one or more parameters were out of the acceptable range. The parameters are set in range automatically by the program so this fault indicates that the non-volatile memory has been corrupted. Check all setups against a hard copy. Run AC Tune Utility at least through initialization. If AC Tune Utility is not run, the MEMORY OUT fault can not be permanently cleared. On power up or when the drive is started, it will be back. This fault may occur if the program chips are changed.
PG Card Fault	PGC	Fault occurs if transducer (encoder) operation is selected ("MOTOR PPR" (Pr604) is nonzero) and the encoder card is not detected.

9 Replacement Parts

9.1 Part Numbers

Description / Qty.	Part Number / HP					
	1	2	3	5	7.5	10
Fuse, Power Supply / 1	PFU2040-12					
Fuse, Line / 3	PFU1013-07		PSU1013-00		PSU1013-06	
Power Supply Board / 1	C37112-00	C37112-01	C37112-02	C37112-03	C37112-04	C37112-05
Logic Board / 1	C37114-00					
IGBT Power Device / 1	ATR5001-00		ATR5001-01	ATR5001-02		ATR5001-03
Bridge Diode / 1	PSI5016-01				PSI5016-00	
Digital Display / 1	ALI3003-01					
Keypad / 1	ASW2044-00					
Choke / 2	NOT USED ON 1 - 5 HP				PTR5016-00	
Fuse Board / 1	A37136-00					
Fan, Internal/ 1-1.5HP, 2-7.5 & 10HP	AFA1027-00					
Fan, External / 1	NOT USED ON 1 - 2 HP			AFA1028-00		
DB Resistor / 1	PRE2025-02					
Conduit Plate / 1	FBR1234-00					
Front Cover / 1	FFP1063-00					

Appendix 1

SV3000 AC drives are now set up at the factory to match an appropriate Warner Electric AC motor. The following table shows which motor each drive is tuned for.

Drive Model Number	Motor Model Number	HP	RPM	Frame Size	Enclosure
SV3401-xxxxx	BVM01 & -01	1	1800	143TC	TENV
SV3402-xxxxx	BVM02 & -01	2	1800	182TC	TENV
SV3403-xxxxx	BVM03 & -01	3	1800	184TC	TENV
SV3405-xxxxx	BVM05 & -01	5	1800	213TC	TENV
SV3407-xxxxx	BVM07 & -01	7.5	1800	254TC	TENV
SV3410-xxxxx	BVM10 & -01	10	1800	256TC	TENV
SV3415-xxxxx	BVM15 & -01	15	1800	256TC	TEBC
SV3420-xxxxx	BVM20 & -01	20	1800	256TC	TEBC
SV3425-xxxxx	BVM25 & -01	25	1800	284TC	TEBC
SV3430-xxxxx	BVM30 & -01	30	1800	286TC	TEBC
SV3440-xxxxx	BVM40 & -01	40	1800	324TC	TEBC
SV3450-xxxxx	BVM50 & -01	50	1800	326TC	TEBC
SV3460-xxxxx	BVM60 & -01	60	1800	364TC	TEBC
SV3475-xxxxx	BVM75 & -01	75	1800	365TC	TEBC
SV341A-xxxxx	BVM100 & -01	100	1800	405TS	TEBC

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	Q7000 Regenerative DC Drives with options	**SL3000** V/Hz AC Drives
Danaher Motion - Engineered Systems Center	**Rapidtrak** Rod-less linear actuators	**EMP** Engineered Motion Products
	E2000 Linear actuators	**Stepper** Motion control systems
	Servo Motion Control Systems	**Fusion®** Vector/Servo/Motion Controller
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