Seco
AC/DC Drives

Installation & Operation Manual
SECO® AC Drive
SL3000 Series AC Motor Drives
1 - 5 HP 230 VAC, 1 - 15 HP 460 VAC

Danaher MOTION
Engineered
Systems
Center

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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.

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SL3000 SERVICE MANUAL

1. Introduction

This instruction manual contains installation, operating and troubleshooting procedures and a complete technical description of the SECO SL3000 Digital AC Drive.

1.1 General Description

The SL3000 inverter drive is designed to operate NEMA type B AC induction motors.

The SL3000 series will operate on 200 - 230 VAC or 380 - 460 VAC power (±10%).

The control circuitry uses a micro-processor to provide 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 back lighted LCD display allows setup, programming, and monitoring of all inverter parameters. The keypad may be used to operate the inverter with RUN FWD, RUN REV, JOG and STOP keys. With a

simple parameter change, external operators controls can be connected to the customer terminal strip for complete external control from a Remote Operators Station or customer supplied operators controls.

Two methods of baking are available, DC injection braking and dynamic braking. A Dynamic Braking circuit is built into the 1 - 5 HP 230V and 1 - 15 HP 460V models. Dynamic Braking may be added to larger units.

An 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, Danaher Motion Engineered Systems Center can assist customers in regaining access to the inverter.

1.2 SL3000 Dimensions

1 - 5 HP 230V
1 - 15HP 460V

9.5
9.0
12.35
11.50
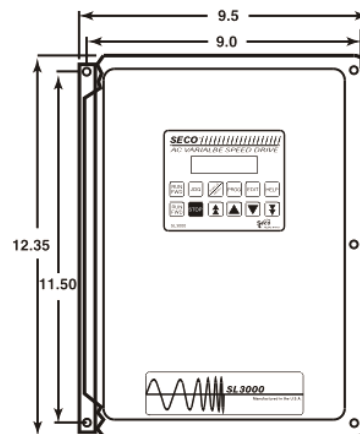
• Mounting holes on 900"
  and 11.50" centers
  (4) 1/4-20 screws req'd
• Unit Depth:
  Enclosed 7.06"
  Chassis 7.06"

7.06
4.88
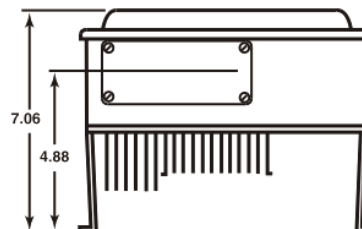
1.3   Model Numbers

230V	Constant Torque	
HP	Chassis/Panel Mount	Enclosed[1]
1	SL3201-00000	SL3201-01000
2	SL3202-00000	SL3202-01000
3	SL3203-00000	SL3203-01000
5	SL3205-00000	SL3205-01000
460V		
	Chassis/Panel Mount	Enclosed[1]
1	SL3401-00000	SL3401-01000
2	SL3402-00000	SL3402-01000
3	SL3403-00000	SL3403-01000
5	SL3405-00000	SL3405-01000
7.5	SL3407-00000	SL3407-01000
10	SL3410-00000	SL3410-01000
15	SL3415-00000	SL3415-01000

NOTE: SL3000 models 1-5 HP 230V and 1-15HP 460V have Internal Dynamic Braking.

1.4 Standard Features

- Micro-processor control for highest performance and more features.

- Constant Torque over 10:1 speed range with inverter duty motor.

- Key pad alphanumeric display in plain language.

- Menu driven programming and "HELP" key for easy drive set-up.

- Speed Control.

- Dynamic Braking Standard.

- DC Injection Braking Standard.

- Seven Pre-set Speeds and Jog with Independent Accel and Decel.

- Digital Outputs

- IGBT Design results in Compact Package.

- PWM Carrier Modulation reduces harmonics and noise

- Full monitoring of drive parameters with last three faults and fault Log.

- NEMA 4/12 Enclosure or chassis available 1 - 5 HP 230V and 1 - 15 HP 460V.

- Multi-level security code to prevent unauthorized parameter changes.

- Serial Communications standard on all units.

- Coast-to-Rest or Decelerate-to-Rest Stop Modes

- Three Skip Frequencies with Adjustable Windows.

- Fuses included on all units for additional protection and increased reliability.

- Full 5 Year Warranty.

1.5 Optional Features

SL3000, 1-5 HP 230V and 1-15 HP 460V, units have an internal Dynamic Braking resistor, but for applications requiring greater braking or resistance to overhauling loads, an external Dynamic Braking option is available.

1.6 SL3000 General Specifications

Service Conditions

AC Line Input:	200 - 230 volts, 380 - 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

Operation Conditions

Output Voltage	0 to input voltage
Output Frequency:	0 to 320 Hz, .1 Hz increments
Maximum Load Capacity:	150% for 1 minute
Line Protection:	Fuses, M.O.V.'s and capacitors

Performance

Speed Holding	2-4% of base speed over 10:1 motor speed range (motor dependent)
Resolution:	.2% with Analog Input
	.1 Hz with Digital Input
Starting Torque:	150% at 3 Hz - Standard Performance
Overload Capacity:	150% for 60 seconds

Basic Adjustments

Max Speed:	0 to 320 Hz
Min Speed:	0 to Max Speed
Accel Time:	0.1 to 255 Seconds
Decel Time:	0.1 to 255 Seconds
Jog Speed:	0 to 100 % of Base Speed (Separate Accel/Decel)
Max Current:	150%
Voltage Boost:	0 - 30%
Slip Compensation:	0 - 20 Hz
Readout:	Engineering Units (RPM, etc.)

Other Adjustments

Seven Preset Speeds
Three Skip Frequencies and Windows

Selection Modes

DC Injection Braking Selection
Communications Set-up

Analog Inputs
Local Analog Input: Controls Speed
Scalable 1-10 VDC max., unipolar or bipolar

Remote Analog Input: Controls Speed
Scalable 0-20 mA, (4-20mA, default)
Current input reversible (through scaling)

Analog Outputs
Meter Output: 0-10 VDC Speed or Torque (40 mv resolution)

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	DB Accum
	Motor Amps	
	Motor Frequency	
	DC Bus Volts	
	Status of Input Signals	
	Drive Conditions at Last Fault	
	I^2t Accumulator	
	Hours Run	

Motor Requirements
Type: AC Induction Motor
200 to 230 volts, 380 to 360 volts

Stopping Modes
Coast to Rest
Ramp to Rest

Braking Modes
Integral Dynamic Braking (1 - 5 HP 230V, 1 - 15 HP 460V only)

DC Injection Braking
Regenerative to Common DC Bus System (Consult Factory for details)

Communications
Serial Port #1   RS485 ANSI 3.28X protocol

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

Other features
Security: Multi-Level programmable Security Codes

Read Out: 2 Line by 16 Character back-lit LCD display
English, Spanish, French and language display

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.
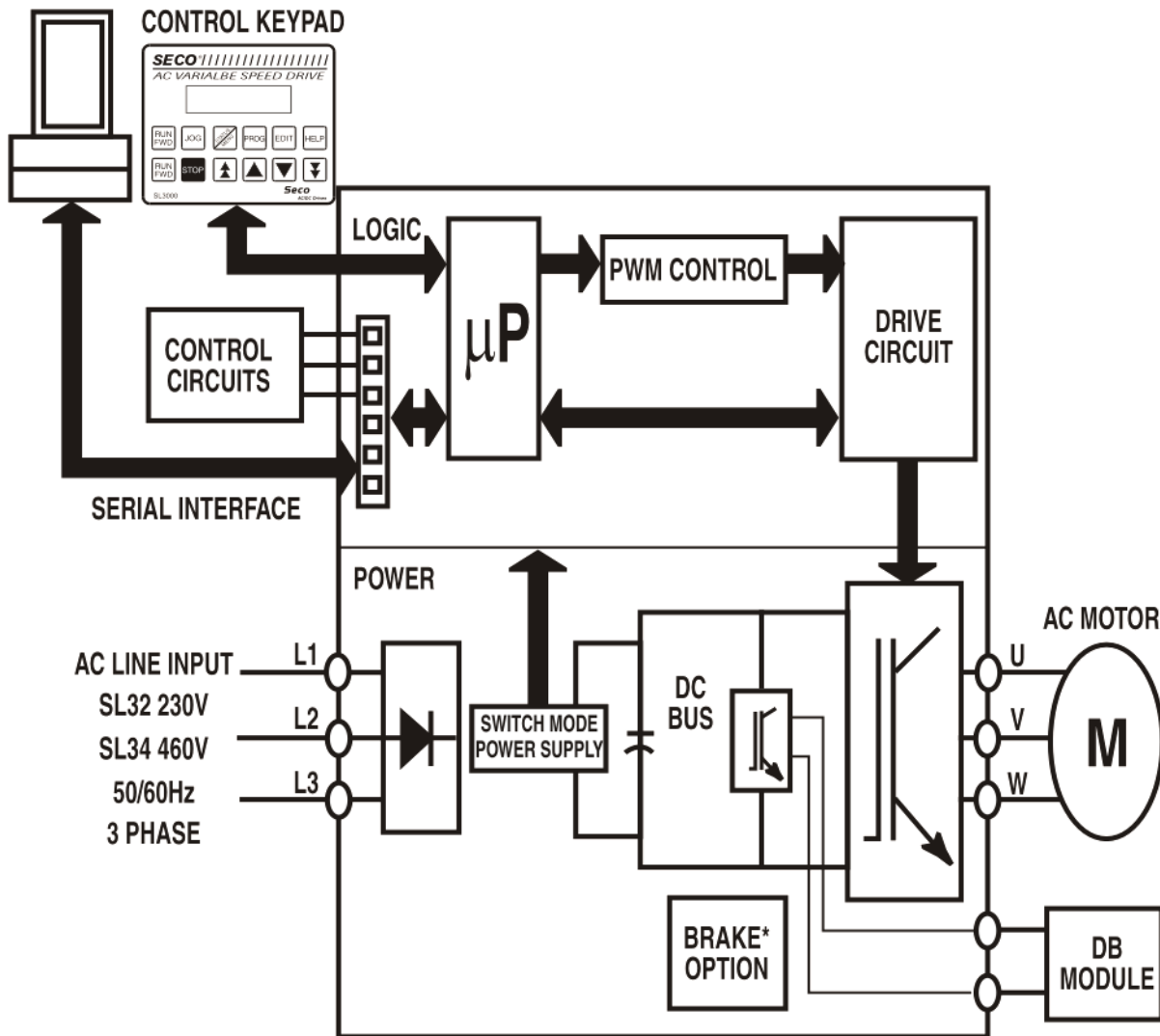
1.6.1 Electrical Specifications

HP 230 VAC	1	2	3	5
Rated Input AC Line Amps	5.6	11.2	15.8	23.3
Rated Output Amps	3.6	6.8	9.6	15.2
Peak Output Amps (RMS)	5.4	10.2	14.4	22.6
Rated Output KVA	1.4	2.7	3.8	6.0
Heat Loss (Watts @6KHz)	50	75	100	150
Braking Torque, Internal DB Resistor	150%	100%	70%	50%
Input Power Factor	0.95*	0.95*	0.86	0.86
Type of Ventilation			External Fan	

*Indicates Displacement Power Factor

HP 230 VAC	1	2	3	5	7.5	10	15
Rated Input AC Line Amps	2.6	4.9	6.9	10.4	11.0	13.1	22.3
Rated Output Amps	1.8	3.4	4.8	7.6	11.0	14.0	21.0
Peak Output Amps (RMS)	2.7	5.1	7.2	11.4	16.5	21.0	31.5
Rated Output KVA	1.4	2.7	3.8	6.1	8.7	11.1	16.7
Heat Loss (Watts @6KHz)	50	75	100	150	175	240	440
Braking Torque, Internal DB Resistor	150%	100%	70%	50%	40%	30%	20%
Input Power Factor	0.95*	0.95*	0.86	0.86	0.88	0.87	0.88
Type of Ventilation	Internal Fan		Internal and External Fans				

*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 operation 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.

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

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

$$\text{Synchronous Speed} = \frac{60\text{Hz} \times 120}{8 \text{ Poles}} = 90 \text{ RPM}$$

1.8 AC Motor Specifications

The SL3000 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 or existing motors.

Danaher Motion Engineered Systems Center offers a line of totally enclosed non-ventilated and blower cooled motors which offer 20:1 speed range under some conditions with this drive. 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 SL3000.

1.8.2 Electrical Specifications

Motor voltage and frequency rating must match the output of the SL3000 drive. Typically, motor rating should be 230 to 360 VAC, 3 phase, 60 Hz. By parameter changes, other motors may be used.

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 then EMA design "B" for best performance. AC motors or designs "a", "C", or "D" may also be used. The SL3000 is suitable for use with synchronous-type AC motors.

2 Installation

The SL3000 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 SL3000.

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 Danaher Motion Engineered Systems Center 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 200 to 230 VAC or 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 (230 or 460 VAC, three phase).**

5. **DO NOT MEGGER OR HI-POT This equipment without first consulting Danaher Motion Engineered Systems Center.**

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 Danaher Motion Engineered Systems Center 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 nominal 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 Danaher Motion Engineered Systems Center immediately. Since equipment is shipped by Danaher Motion Engineered Systems Center F.O.B. shipping pint, ownership transfers when the equipment leaves Danaher Motion Engineered Systems Center. Therefore, all shipping damage claims must be filed by the consignee directly with the shipping carrier, Danaher Motion Engineered Systems Center 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 lease 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 SL3000 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 Danaher Motion Engineered Systems Center 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

460V Drive HP	Rating/Type	Part Number	230V Drive HP	Rating/Type	Part Number
1	6A/KTK-6	PFU1013-07	1	10A/ABC-10	PFU1019-00
2	6A/KTK-6	PFU1013-07	2	15A/ABC-15	PFU1019-03
3	15A/KTK-15	PFU8101-00	3	20A/ABC-20	PFU1019-01
5	15A/KTK-15	PFU1013-00	5	30A/GBB-30	PFU1032-17
7.5	20A/KTK-20	PFU1013-06			
10	20A/KTK-20	PFU1013-06			
15	30A/KTK-30	PFU1013-01			

2.6 Shielded Cable Requirements

All wiring used to connect to the SL3000 should be sized to meet the regulations of local electrical codes and NEC standards. Low level control circuitry must be wired using shielded cable with the shield connected at both ends to earth ground. The types of signals that require the use of shielded cable include analog input signals (0 - ±10VDC, 4-20mA, 20-4 mA, 0-20mA), 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. All relay, starter, and solenoid coils used within the enclosure of the SL3000 must be suppressed to avoid electrical interference with the drive's functions. For 115 VAC or 230 VAC coils, use suppressor part number PCA1028-00 or equivalent. An equivalent would consist of a 100 ohm/1 watt resistor and 0.47 microfarad, 600 volt capacitor in a common package, or connected in series. For coil voltages higher than 230 VAC, consult Danaher Motion Engineered Systems Center for information.

2.7 Grounding Requirements

The SL3000, AC Motor and all other system components must be grounded in accordance with the National Electrical Code and all other applicable local standards.

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 (SL3000 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:

Three Phase NEMA 1 Enclosed, Dry Type, ±5% Primary Taps, 60 Hz							
Drive HP	Drive KVA Rating	KVA	230V Pri/230V Sec Part Number	Drive HP	Drive KVA Rating	KVA	460V pri/460V Sec Part Number
1	2.4	3	TRT22-03	1	1.4	3	TRT44-003
2	4.5	6	TRT22-006	2	2.7	3	TRT44-003
3	6.4	7.5	TRT22-007	3	4.3	6	TRT44-006
5	9.7	11	TRT22-011	5	6.0	7.5	TRT44-007
				7.5	9.1	11	TRT44-011
				10	11	15	TRT44-015
				15	16.7	20	TRT44-020

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 SL3000.

2.10 Line Reactors (Input/Output)

Usually 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 SL3000 inverters. The PTR5013-3XX series are open frame inductors intended for mounting within an enclosure and the PTR5013-4XX series are inductors in a NEMA 1 enclosure.

460V HP	Inductor Value (mH)	Max. Current Ratings (A)	Watts Loss	ESC Part # (Open)	ESC Part # (NEMA 1)
1	6.5	6	19	PTR5013-03	PTR5013-203
2	2.5	6	16	PTR5013-302	PTR5013-402
3	1.50	10	25	PTR5013-303	PTR5013-403
5	0.80	15	32	PTR5013-304	PTR5013-404
7.5	0.45	25	40	PTR5013-305	PTR5013-405
10	0.4	35	70	PTR5013-306	PTR5013-406
15	0.25	50	82	PTR5013-307	PTR5013-407

230V HP	Inductor Value (mH)	Max. Current Ratings (A)	Watts Loss	ESC Part # (Open)	ESC Part # (Open)
1	6.5	6	19	PTR5013-03	PTR5013-203
2	2.5	6	16	PTR5013-302	PTR5013-402
3	1.50	10	25	PTR5013-303	PTR5013-403
5	0.8	15	32	PTR5013-304	PTR5013-404

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 and many others need to be addressed before the drive components are purchased. If further ques-tions 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.

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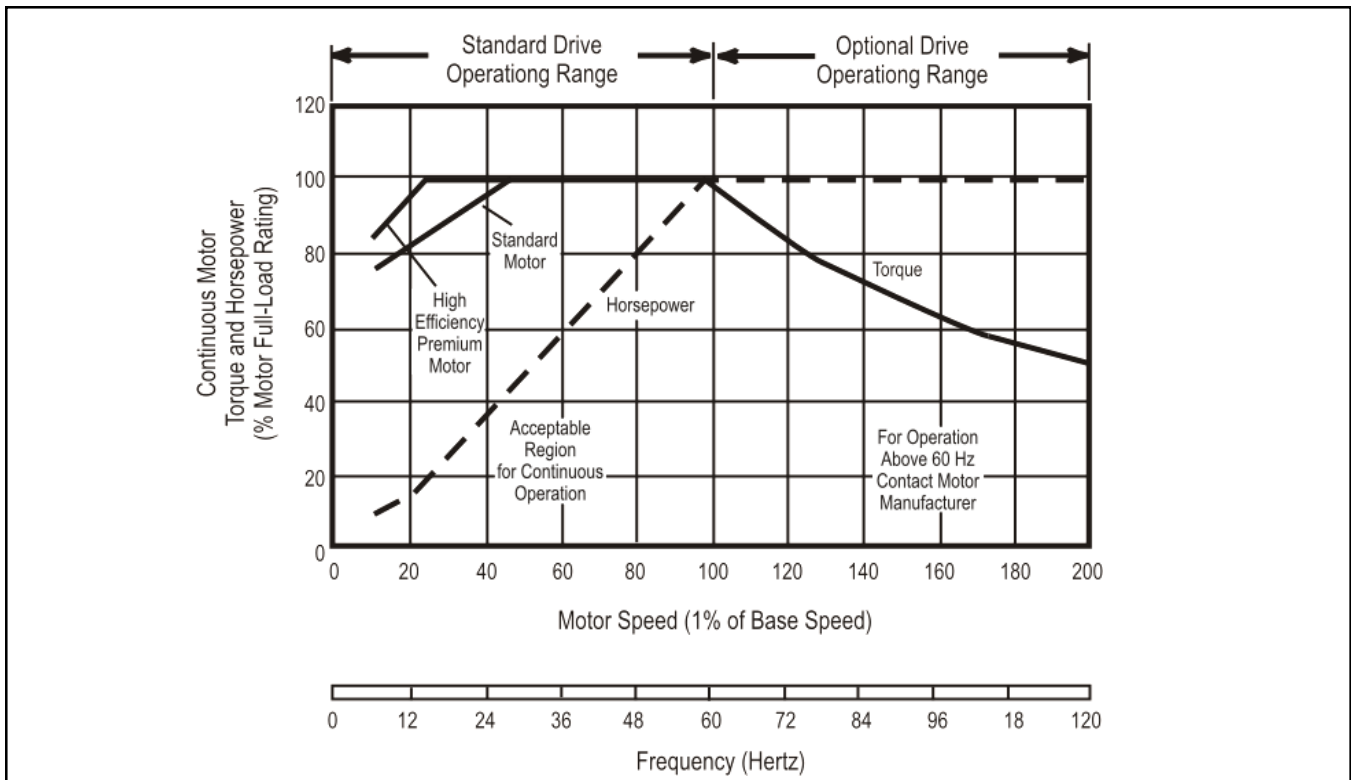
Fig. 2A Typical Motor Derating Characteristics

> **WARNING!**
> A contactor or switch connected between the drive an dits motor must not be turned off or on while the drive and its motor are operating. Consult Danaher Motion Engineered Systems Center if you require this type of operation.

2.12 Control Terminal Locations/Definitions

The terminal connection on the standard SL3000 are divided into five distinct terminal strips and a telephone-type plug-in receptacle. Figure 2B illustrates the connection layout.
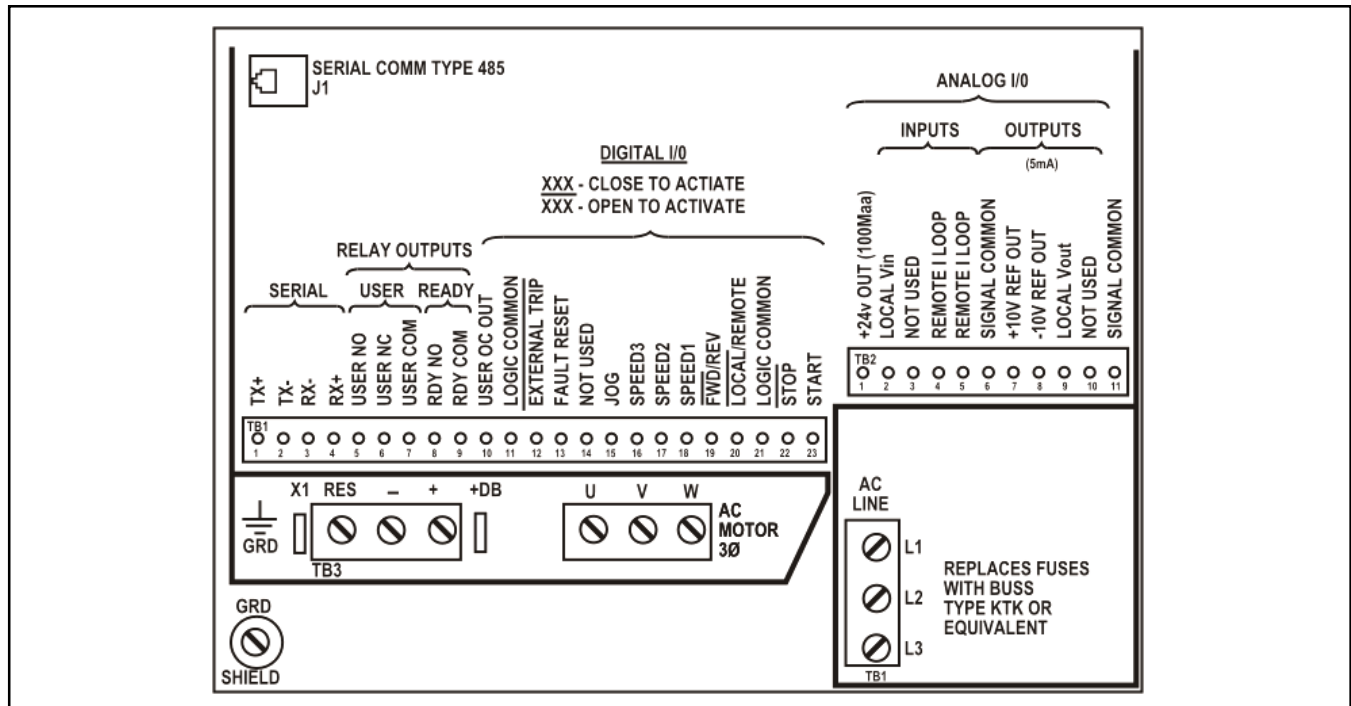
Fig. 2B SL3000 Control Board Terminal Connections

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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 Line Receive +
Relay and Open Collector Outputs	User N/O	TB 1 - 5	User Programmable (Pr413) Relay - Normally Open
	User N/C	TB 1 - 6	User Programmable (Pr413) Relay - Normally Closed
	User Com	TB 1 -7	User Programmable (Pr413) 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 (Pr415) Open Collector (50V, 100mA sink to Logic Common - max.)
Digital Inputs	Logic Common (LCOM)	TB 1 - 11	Logic common connection to use with operator's input
	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 Rest) Input	TB 1 - 13	Normally open contract, momentarily connect to Logic Common to reset a fault. **A STOP keypad command will also clear a fault.**
	(Jog)	TB 1 - 15	Connecting this input to Logic Common puts the drive in "Jog" mode. When Jog is connected to common, the drive jogs in the direction selected by TB1-19 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.

	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. (This input overrides Speed 3, 2, 1 Input.)

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

Terminal Function	Designation	Terminal Number	Description
Digital Inputs	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.

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

DIGITAL OUTPUT CONNECTIONS
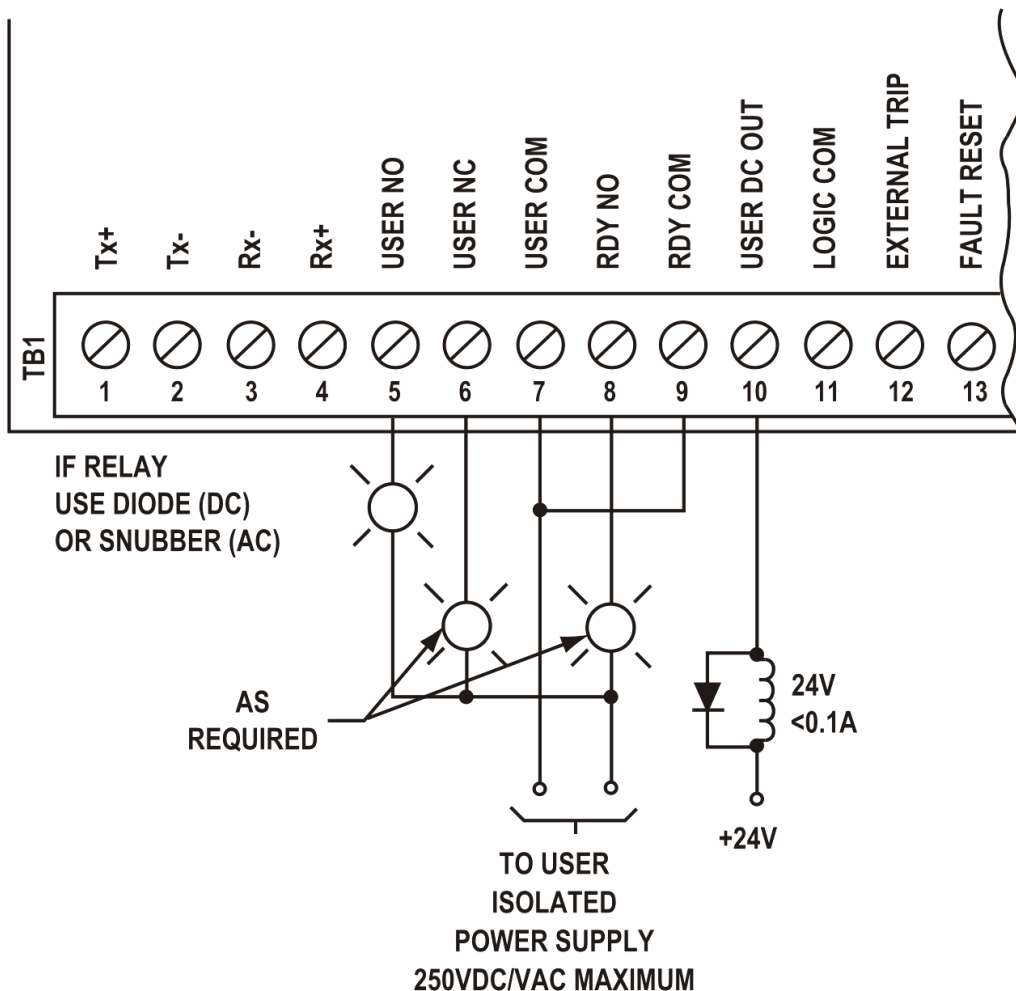
Fig. 2C Digital Output Connections

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.
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. Pr400 Current Loop Input Type sets either 4 - 20 mA or 0 - 20 mA.
DC Power Supply Outputs	Signal Common SCOM	TB 2 - 6 and TB 2 - 11	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	Local Vout	TB 2 - 9	Parameter Pr409 Local Vout selects whether this analog output is Speed or Torque. The output is 0 - 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 - 5 HP 230V and 1-10 HP 460V Drives, an internal DB resistor is provided, but if a larger DB resistor is required for additional braking, the DB resistor is connected to BDR "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. When connecting two or more drives together on a "Common DC Bus" (1 - 5 HP 230 V or 1 - 10 HP 460V), 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 mis-operation due to the pack up of electrical noise. Snubbers must be used on all relay or contactor coils near or connected to the SL3000 drive to prevent electrical noise from affecting the operation of the SL3000.

2.14 Remote Operator Station

The SL3000 will accept a number of remote operator stations available from Danaher Motion Engineered Systems Center. 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, Fun/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 SL3000 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 Analog Outputs

The SL3000 provides a use-programmable analog output. This output may be used for connection to an analog (Dial and pointer) or digital voltmeter for remote indication of Speed or Torque. The outputs are 0 to 10 volts DC.

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 Pr409 from "SPEED" to "TORQUE."

If local V_{OUT} 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 V_{OUT} signal TB2-9 is representing TORQUE, (Pr409 set to TORQUE) then 10V on TB2-9 corresponds to 150% of Pr300 Motor Amps, 6.66V = 100% TORQUE and 0.0v = 0 TORQUE.

Specifications of Analog Outputs-
0 to +10 Volts, DC
Maximum load - 5mA
Resolution - 40mv
Accuracy - ±0.5%

2.16 Digital Outputs

The SL3000 has two user programmable digital outputs, relay contacts on TB1-5, -6, -7 programmed by Pr413 (select) and Pr414 (set) and an open collector on TB1-10 programmed by Pr415 and Pr416 (set). To program the relay output, set Pr413 to Speed or Torque. Set the value at which the relay switches into Pr414. This value is in absolute units - Amp, or RPM.

To program the open collector output, set the Speed or Torque value to be monitored into Pr415. Set the value at which the transistor will switch into Pr416. For example, if it is required to get relay actuation when SPEED (Pr500) is > 1000 RPM, set Pr413 = 500, Pr414 = 1000.

3 Power-Up Procedures

Before attempting to apply AC power to the SL3000 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 SL3000, 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 SL3000 and measure the three phases to assure the AC voltage is correct.
4. Connect the input power leads and motor leads to the SL3000 as shown in Fig. 3A. Wiring must be in accordance with National Electric Code and all local codes.

Fig. 3A Input and Output Connections SL3000 Series

The table on page 12 lists current requirements for each horsepower version of the SL3000.

DC BUS

POWER MODULE

CONTROL BOARD

DISCONNECT (OPTIONAL)

230 or 460 VAC, 3Ø LINE INPUT

GND

MANUALLY OPERATED BLOWER MOTOR STARTER (OPTIONAL) NO AUX. CONTACT CONNECTION TO EXT. TRIP.

MOTOR COOLING BLOWER (WHEN REQD)

AC MOTOR

AC MOTOR OUTPUT CONNECTIONS

SERIAL COMM. TYPE 485 J1 (PHONE JACK TYPE)

TB1

1	TRANSMIT (TX+)	SERIAL (DISCRETE) COMMUNICATIONS LINK
2	TRANSMIT (TX-)	
3	RECEIVE (RX-)	
4	RECEIVE (RX+)	
5	USER N.O.	USER PROG. RELAY (Pr41, 414)
6	USER N.C.	250VAC/125VDC, 5AMP RESISTIVE @ 120VAC, 30VDC
7	USER COM	
8	READY N.O.	DRIVE READY RELAY (HEALTHY) 250VAC/125VDC, 5AMP RESISTIVE @ 120VAC, 30VDC
9	READY COM	
10	USER PROG. DC OUTPUT (24VDC MAX, PULL UP, 100mA MAX, SINK)
11	CONTROL LOGIC COMMON

CONTROL LOGIC INPUTS

12	EXTERNAL TRIP (OPEN FOR TRIP)
13	FAULT RESET (CLOSE TO RESET) (MOMENTARY)
14	NOT USED
15	JOG (CLOSED FOR JOG SPEED)
16	SPEED 3
17	SPEED 2
18	SPEED 1
19	FWD/REV (CLOSED FOR REV)
20	LOCAL/REMOTE (CLOSED FOR REMOTE)
21	CONTROL LOGIC COMMON
22	STOP/RESET (OPEN TO STOP/PUSH MOM. TO RESET)
23	START (CLOSE TO START/RUN) (MOMENTARY)

BM AUX.

FWD

REV

MOTOR OVERTEMP SWITCH

SEE NOTE 3

STOP START

TB2

1	+24V OUT (ACCESSORY SUPPLY [100mA])
2	LOCAL Vin (REF. INPUT 0 to ±10VDC)	ANALOG INPUT @ 100K ohms
3	NOT USED
4	REMOTE I LOOP + (CURRENT REF. INPUT)	CURRENT INPUT @ 150 ohms
5	REMOTE I LOOP - (CURRENT REF. COMMON)
6	SIGNAL COMMON (ANALOG INPUT/SUPPLY COMMON)
7	+10V REF. OUT (+10VDC @ 5mA MAX.)
8	-10V REF. OUT (-10VDC @ 5mA MAX.)
9	LOCAL Vout (SPD./TORQ. 0 to ±10VDC)	ANALOG OUTPUT 5mA MAX.
10	NOT USED
11	SIGNAL COMMON

2K MIN. SPEED ADJUST.
CW
CW
1mA TYP. (SCALE AS REQD)
SPEED ±100%

NOTES:

1) SIGNAL CONNECTIONS MUST BE SHIELDED WHERE SHOWN AND ROUTED SEPARATELY FROM THE POWER WIRING.

2) WIRE PER APPLICABLE LOCAL AND NATIONAL CODES.

3) TYPICAL CONNECTIONS

4) OVERLOAD CURRENT SELECTED FOR DANAHER MOTION ENGINEERED SYSTEMS CENTER TYPE BVM INVERTER DUTY AC MOTOR. SET OL AT MOTOR FL RATED CURRENT.
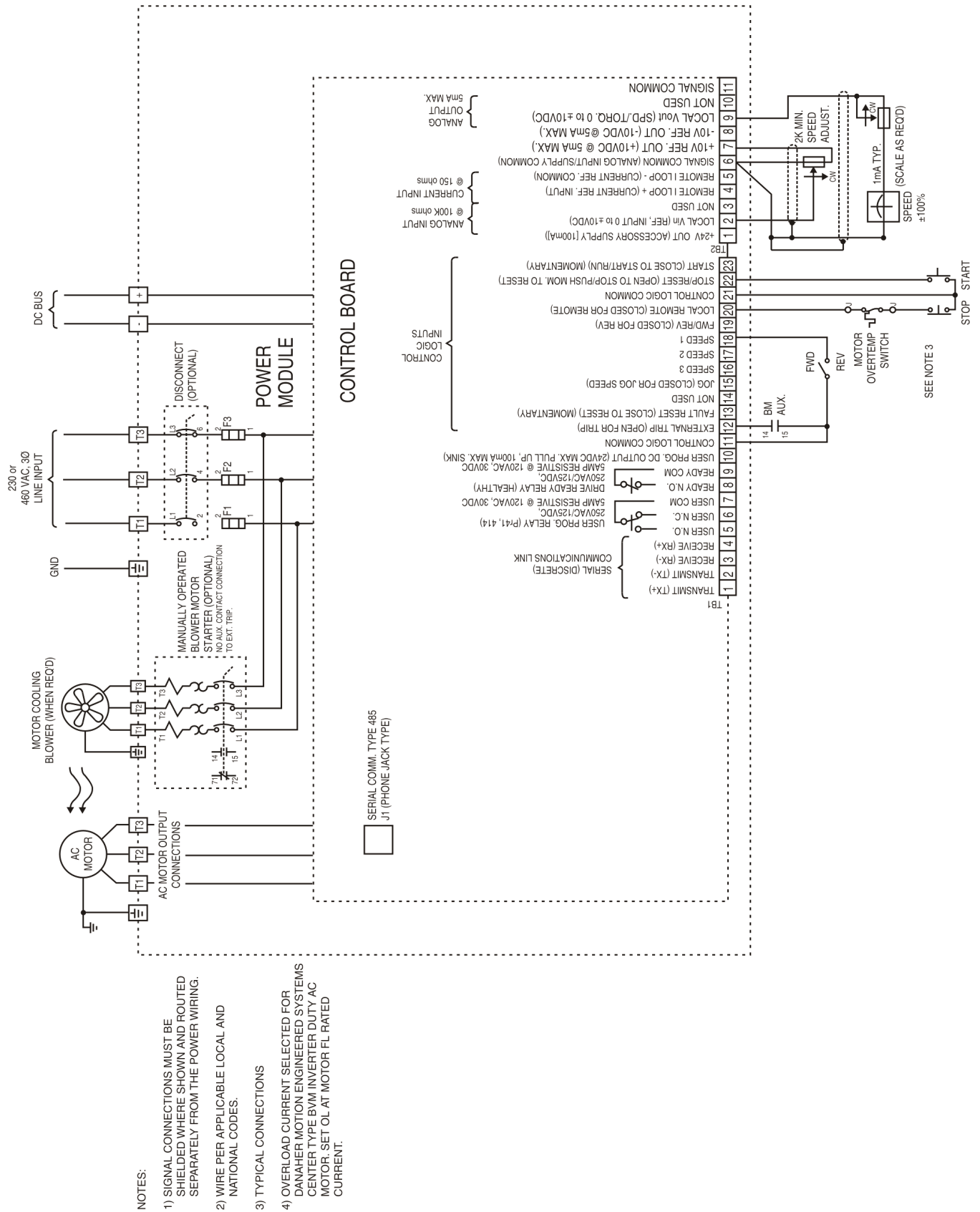
Fig. 3B Typical Connection Diagram

22

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, RUN REV 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 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 (200-230VAC ±10% 50/60 Hz for SL3200 series units; 380 - 460VAC +/- 10% 50/60 Hz for SL3400 series units).

DO NOT OPERATE THE INVERTER. IMMEDIATELY SHUT OFF THE POWER! THE CORRECT VOLTAGE LEVEL MUST BE PRESENT BEFORE ATTEMPTING TO OPERATE THE INVERTER!

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 SL3000. 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.
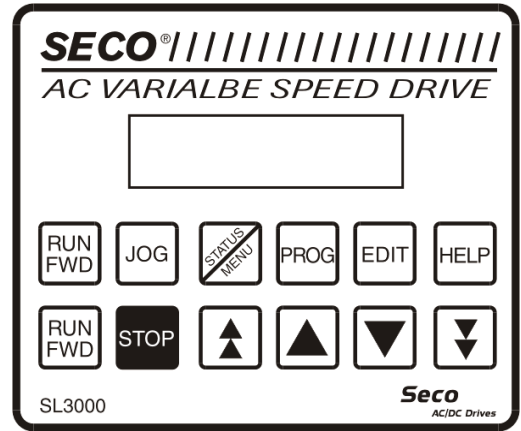
Fig. 3C SL3000 Operator's Keypad

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 Pr210 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 Pr210 Forward/Reverse Mode is set to ALWAYS). When shipped from the Factory the Key is not active. Set Pr210 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 mode, 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 three 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 (STOP and RUN Modes)

Keypad Key   **Function**

PROG	When in the Stopped mode, 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 will be retained.
STATUS / MENU	In the PROGRAM mode, pressing this key will move the display to the next menu heading. If in Menu 500, 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 SL3000 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:

```
Last Fault:  NF

```

Pressing the Status key again displays Analog speed bar:

```
|

```

 and Status values

```
Set Pt: 1800 RPM
```

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

```
SP0:  1800 RPM
       stopped
```

Depending on the operation occurring 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		SP0: 1800 RPM		SP0: 1800 RPM
accel		run fwd		accel rev

SP0: 1800 RPM		SP0: 1800 RPM
run rev		fault
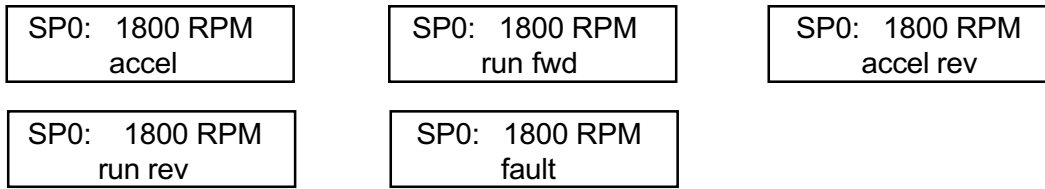
When in the third, or Status Display with the analog speed bar indication, the second line can be changed by using the UP or DOWN Arrow keys to display various Status values. The DOWN Arrow key will change from SPEED to SET SPEED to SET TORQUE to MOTOR Amps and so forth as shown here. At DRIVE SIZE, pressing the DOWN Arrow key again "rolls" the display around the SPEED Status Display. The UP Arrow key will scroll back up the list of Status Display Values.

SPEED: 0 RPM	←→	SET SP: 1800 RPM	←→	TORQ: 0%
MOTOR AMPS: 0.0	←→	MOTOR HZ: 0	←→	BUS VOLTS: 670
	←→	IXT: ACCUM: 0%	←→	D B ACCUM: 0%
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: 1.10	←→	DRIVE SIZE: 2 HP
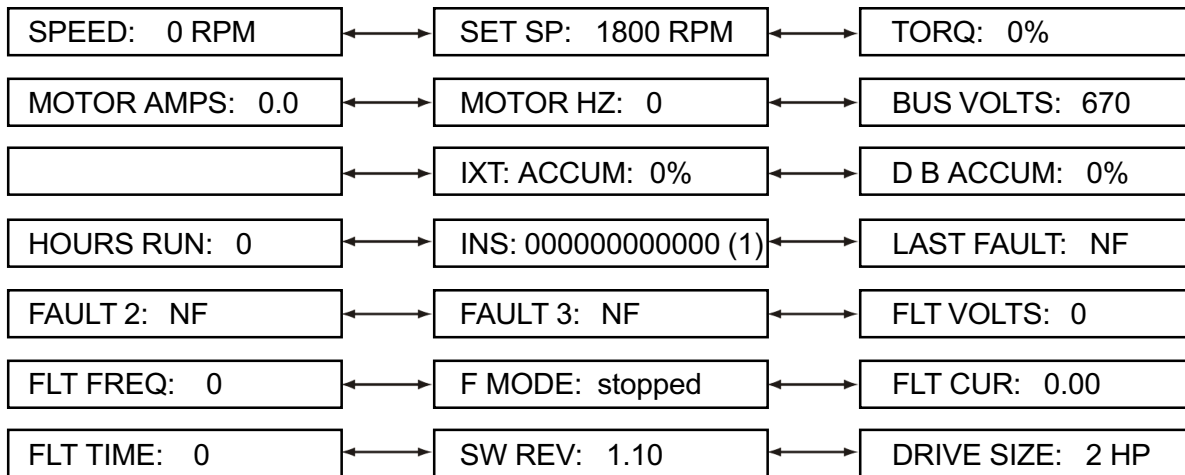
The analog bar readout will continue to display actual speed regardless of the Status information displayed on the second line of the readout.

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 SL3000 Parameters are divided into six 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.

```
Main Menu: P0
SETPT:      0 RPM
```

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

```
Main Menu: P1
MIN:        0 RPM
```

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.

```
Preset Parameter
Menu P1XX
```

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

```
Setup Parameter
Menu P2XX
```

```
Drive Parameter          Term Parameter
Menu P3XX        →       Menu P4XX
```

```
Status Values
Menu P5XX        →
```
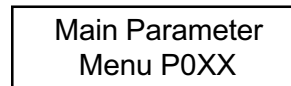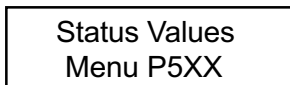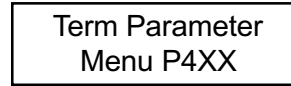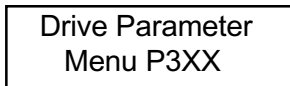
Pressing the Status/Menu key again will "roll" around to the Main Menu.

```
Main Parameter
Menu P0XX
```

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.

```
Edit:  P2
MAX:   1800 RPM
```
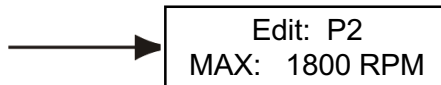
6. To leave the PROGRAM Mode, press the PROG key at any time. The first Status display will be shown. NOTE: **If PROGram mode is exited while EDITing (i.e., EDIT not pushed to exit the EDIT mode) the value that was being edited will be lost and the original value retained.**
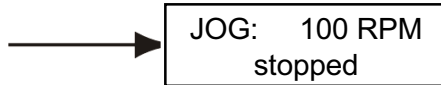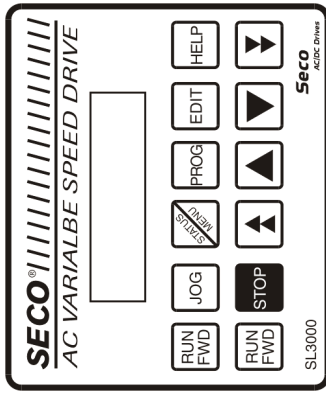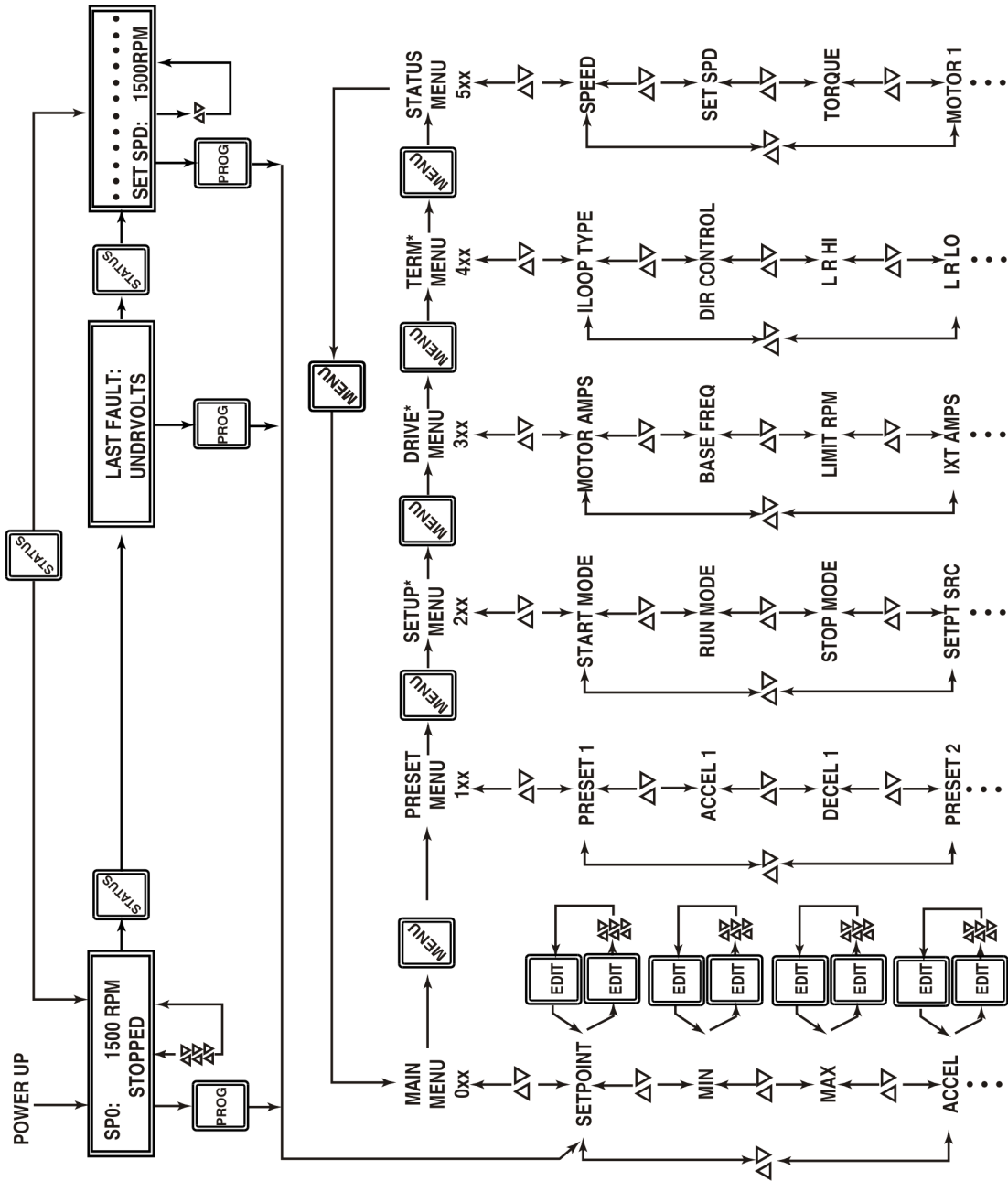
```
JOG:     100 RPM
         stopped
```

3.6.2

Fig. 3D SL3000 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	255	Yes
Decel:	Pr004	3.0	0.1	255	Yes
Jog RPM:	Pr005	100	0	Pr013	Yes
Jog Accel:	Pr006	3.0	0.1	255	Yes
Jog Decel:	Pr007	3.0	0.1	255	Yes
Not Used:	Pr008				
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
SecurityPr014	Pr014	Clear	Set	Yes	
		Set			
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) $\dfrac{325}{Pr302}$ x Pr013 in User Engineering Units.

3) See Eng. 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
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:	Jog Acceleration Rate, in seconds, to accelerate the motor from zero RPM to Base Speed.
Pr007, Jog Decel:	Jog Deceleration Rate, in seconds, to decelerate the motor from Base Speed to zero RPM.
Pr008, Not Used:	

Pr009, Eng Char (1):	Allows user selected alphanumeric characters to be used. R for <u>R</u>PM is the default. (See Section 3.11.3)		
Eng Char (2):	Allows user selected alphanumeric characters to be used. P for R<u>P</u>M is the default. (See Section 3.11.3)		
Pr011, Eng Char (3):	Allows user selected alphanumeric characters to be used. M for RP<u>M</u> 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 (Pr301). Default is 1800 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   SL3000 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 Pr216 Set User Defaults to store the new values. In case of improper parameter changes, resetting parameter Pr219 Default All User will restore all the parameters to the user set values. Defaulting the parameters to Pr218 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.

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 Danaher Motion Engineered Systems Center Applications 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 Danaher Motion Engineered Systems Center at (704)-588-5693 or fax to (704)-588-5695.

3.10 SL3000 Quick Start

This section will allow quick start-up of the SL3000 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 SL3000 start-up.

1. Follow the safety and installation instructions as specified in Section 2, INSTALLATION. Before applying AC input power to the SL3000, 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 SL3000 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

Function	Terminal #	Description
Logic Common (LCOM)	TB 1 - 11	Logic Common connection to use with operator's inputs.
External Trip Input	TB1 - 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 Common. When Open, a STOP will be initiated and the motor will stop in the method set by Parameter Pr205. 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.**

minimum required terminal connection for keypad operation of the drive.
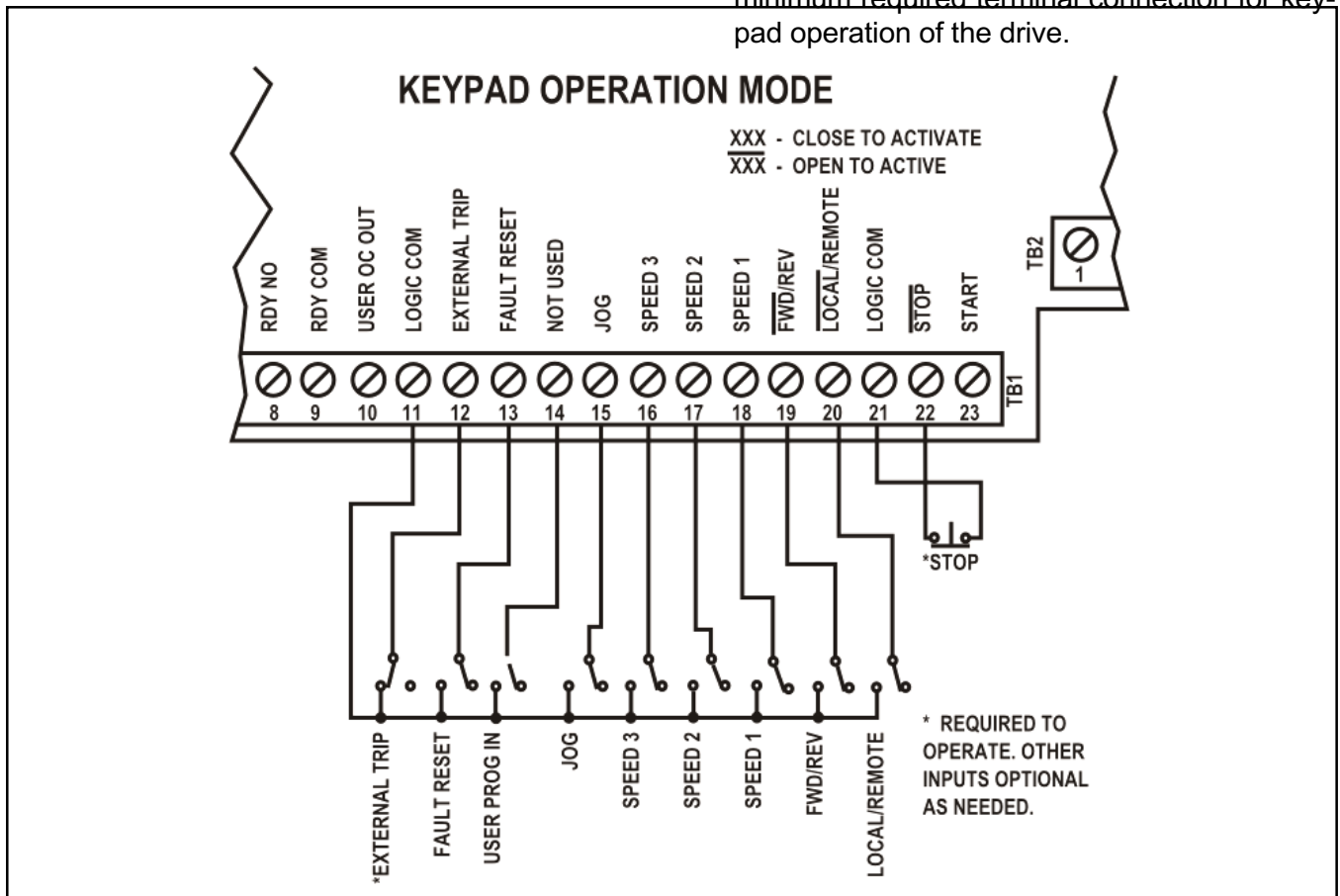
Fig. 3E Keypad operation mode

4. Terminal Operation Mode

This table defines the minimum required terminal connection 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	TB1 - 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, connect this input to Logic Common. When jog is connected to common, the drive jogs in the direction selected by Forward/Reverse (TB1-19)
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 Pr210 is set.
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 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 i momentarily connected to Logic Common, the motor will start and continue to run until a Stop or Fault occurs.
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 if FWD/REV required
Signal Common	TB 2 - 6	Pot. Shield or Pot. CCW if FWD only

TERMINAL OPERATION MODE

XXX - CLOSE TO ACTIVATE
XXX - OPEN TO ACTIVE
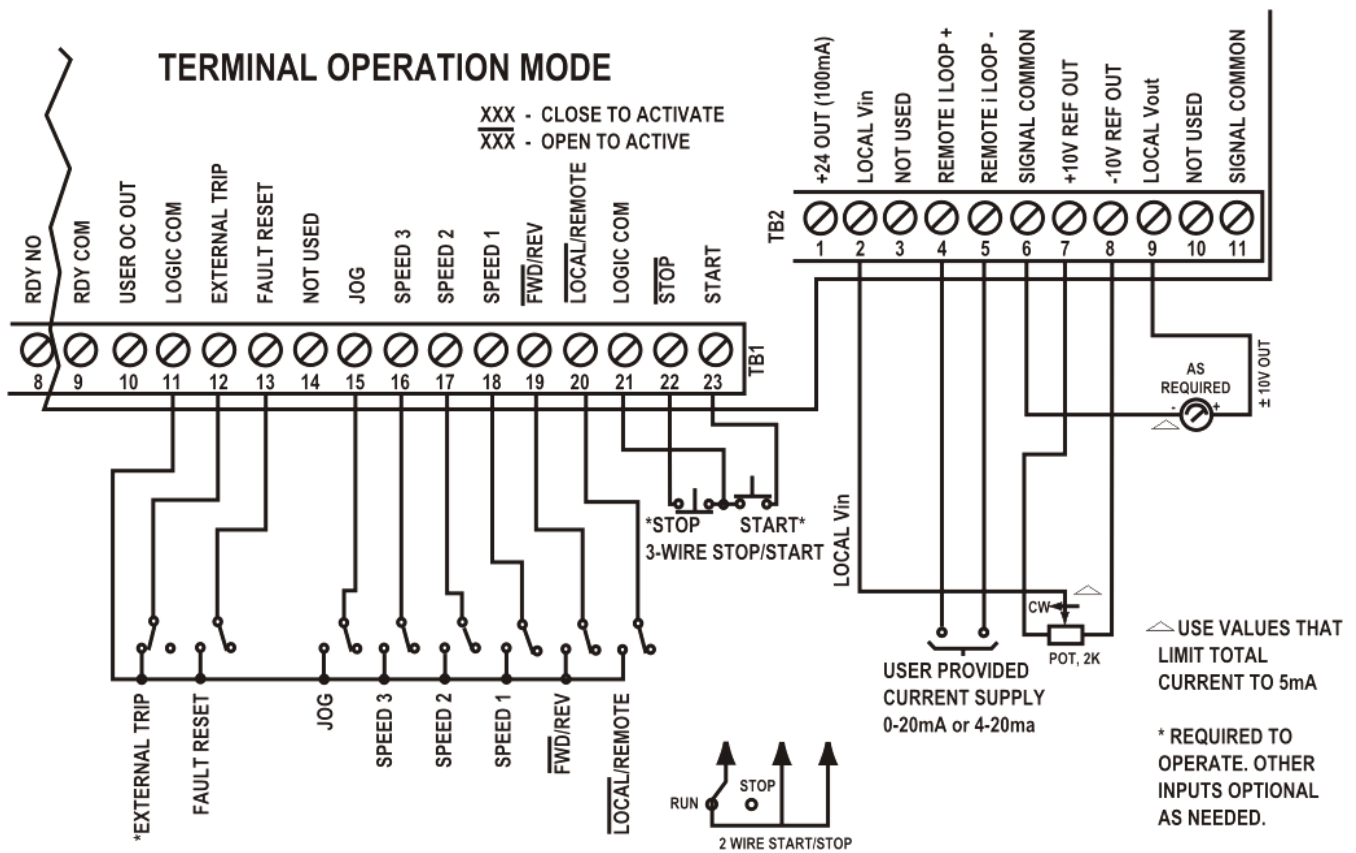
Fig. 3F Terminal Connections - Use shielded wire for all control wiring.

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. 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).

7. 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 mode.

8. Use the RUN FWD 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 to 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.

9. 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	255	Yes
Decel:	Pr004	3.0	0.1	255	Yes
Jog RPM:	Pr005	100	0	Pr013	Yes
Jog Accel:	Pr006	3.0	0.1	255	Yes
Jog Decel:	Pr007	3.0	0.1	255	Yes
Not Used:	Pr008				
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
SecurityPr014	Pr014	Clear	Set	Yes	
		Set			
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) $\dfrac{325}{Pr302}$ x Pr013 in User Engineering Units.

3) See Eng. 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
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:	Jog Acceleration Rate, in seconds, to accelerate the motor from zero RPM to Base Speed.
Pr007, Jog Decel:	Jog Deceleration Rate, in seconds, to decelerate the motor from Base Speed to zero RPM.
Pr008, Not Used:	

(Continued on next page)

Pr009, Eng Char (1):	Allows user selected alphanumeric characters to be used. R for R<u>P</u>M is the default. (See Section 3.11.3)		
Eng Char (2):	Allows user selected alphanumeric characters to be used. P for R<u>P</u>M is the default. (See Section 3.11.3)		
Pr011, Eng Char (3):	Allows user selected alphanumeric characters to be used. M for RP<u>M</u> 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 (Pr301). Default is 1800 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 Main Menu Parameter Specifications and Definitions
3.12.1 Main Menu Specifications

Parameter Name	Parameter Number	Default Value	Minimum Value	Maximum Value	Edit in Run Mode
PSI RPM:	Pr100	0	-Pr001	Pr002	Yes
PSI Accel:	Pr101	3.0	0.1	255	Yes
PSI Decel:	Pr102	3.0	0.1	255	Yes
PS2 RPM:	Pr103	0	-Pr001	Pr002	Yes
PS2 Accel:	Pr104	3.0	0.1	255	Yes
PS2 Decel:	Pr105	3.0	0.1	255	Yes
PS3 RPM:	Pr106	0	-Pr001	Pr002	Yes
PS3 Accel:	Pr107	3.0	0.1	255	Yes
PS3 Decel:	Pr108	3.0	0.1	255	Yes
PS4 RPM:	Pr109	0	-Pr001	Pr002	Yes
PS4 Accel:	Pr110	3.0	0.1	255	Yes
PS4 Decel:	Pr111	3.0	0.1	255	Yes
PS5 RPM:	Pr112	0	-Pr001	Pr002	Yes
PS5 Accel:	Pr113	3.0	0.1	255	Yes
PS5 Decel:	Pr114	3.0	0.1	255	Yes
PS6 RPM:	Pr115	0	-Pr001	Pr002	Yes
PS6 Accel:	Pr116	3.0	0.1	255	Yes
PS6 Decel:	Pr117	3.0	0.1	255	Yes
PS7 RPM:	Pr118	0	-Pr001	Pr002	Yes
PS7 Accel:	Pr119	3.0	0.1	255	Yes
PS7 Decel:	Pr120	3.0	0.1	255	Yes
Skip Freq 1:	Pr121	0	0	300	Yes
Skip 1 Band:	Pr122	0	0	10	Yes
Skip Freq 2:	P123	0	0	300	Yes
Skip 2 Band:	Pr124	0	0	10	Yes
Skip Freq 3:	Pr125	0	0	300	Yes
Skip 3 Band:	Pr126	0	0	10	Yes
Deflt This Menu:	Pr127	No / Yes	No	Yes	Yes

3.12.2 Main 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 16.
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 seconds 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 10 Hz would be ±5 Hz around the frequency set by the Skip Frequency parameter.
Pr127 DEFLT MENU:	This parameter will reset all of the Preset Menu parameters to their original factory set values.

3.13 Main Menu Parameter Specifications and Definitions
3.13.1 Main Menu Specifications

Parameter Name	Parameter Number	Default [1] Value	Minimum Value	Maximum Value	Edit in Run Mode
Start Mode:	Pr200	MAN LINE	MAN	LINE	No
Run Mode:	Pr201	SPEED	speed		No
Stop Mode:	Pr202	DECEL COAST DC INJECT DC HOLD	DECEL	DC HOLD	No
Setpoint Source:	Pr203	KEYPAD ANALOG	KEYPAD	ANALOG	Yes
Keypad Enable:	Pr204	ENA(BLE) DIS(ABLE)	ENABLE	DISABLE	Yes
Not Used	Pr205				
Not Used	Pr206				
Not Used	Pr207				
Not Used	Pr208				
Not Used	Pr209				Yes
F R Mode	Pr210	No Rev	Always	No Rev	Yes
Inj Brake Time:	Pr211	2	0	99	Yes
Inj Brake I:	Pr212	0	0	10	Yes
Trip Restarts:	Pr213	0	0	7	Yes
Language:	Pr215	ENGL(ish) SPAN(ish) FREN(ch)	ENGL(ish)	SPAN(ish)	No
Set User Deflt:	Pr216	N(o) Y(es)	N(o)	Y(es)	No
Deflt This Menu:	Pr217	NO YES	NO	YES	No
Deflt All FACT:	Pr218	N(o) Y(es)	N(o)	Y(es)	No
Deflt All USER	Pr219	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.

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:	This parameter determines how the drive responds to a Stop input. Default is Speed mode.
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 Pr211. 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 Pr211. For both types of DC Injection braking, Pr212 will set the level 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.
Pr210, Forward/ Reverse Mode:	Three 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.
Pr211, Injection Brake Time: Pr212, Injection Brake Current:	These two parameters set the time in seconds and the level of the Injection Braking current that will be applied while stopping as set in Pr202 Stop Mode.
Pr213, Trip Restarts: Pr214, 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 seconds after the fault trip before the "restart" is attempted. (See Section 6.8)
Pr215, Language:	The alphanumeric readout can provide information in Three languages, English (Default), Spanish, and French.
Pr216, Set User Default:	When the User has set the parameter values to suit their specific application, setting Pr216 will allow these parameters to be saved automatically. They can be recalled by Pr219 Default All User.
Pr217, Default This Menu:	When set, Pr217 will reset the Setup Menu 200 parameters to their FACTORY default values.
Pr218, Default All FACTORY:	When set, Pr218 will reset ALL of the Parameter Menus to their FACTORY default values.
Pr219, Default ALL USER:	When set, Pr219 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 [2] Value	Minimum Value	Maximum Value	Edit in Run Mode
Motor Amps:	Pr300	(Note[1])	0.1	(Note[1])	No
Motor Volts	Pr301	230 or 460	120	480	No
Base Freq:	Pr302	60	50	300	No
Limit RPM:	Pr303	1800	600	28800	No
I x T Amps:	Pr304	105	10	105	No
I x T Fault:	Pr305	TRIP FOLD	TRIP	FOLD	No
No. of Poles:	Pr310	4	2	10	No
Slip Factor:	Pr311	0.0	0.0	20.0	No
Boost Factor:	Pr312	0	0	30	No
Serial Baud:	Pr313	96 (00) 48 (00) 24 (00) 12 (00)	12 (00)	96 (00)	Yes
Serial Addr:	Pr314	1	1	32	Yes
Ser. Parity:	Pr315	EVEN NONE	NONE	EVEN	Yes
Ser. Bits:	Pr316	7	7	8	Yes
Check Sum:	Pr317	ON OFF	ON	OFF	Yes
Deflt This Menu:	Pr318	NO YES	NO	YES	No

[1] Function of Drive Size.

[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 nominal for that drive rating down to 0.1 Amp
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:	Maximum allowable speed of the motor or of application, which-ever is lower. This will protect the motor/load from being operated at unsafe speeds.
Pr304, IxT Amps: Pr305, IxT Fault:	Percentage of Full Load Current at which the drive will begin counting towards a Timed Overcurrent Tripo. Minimum time until tripo is 60 seconds. Pr305 determines whether the drive will "Trip" when the Timed Overcurrent Point is reached or "Foldback" the allowable current to prevent a fault tripo. The speed will decrease as the allowable torque decreases.
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, Slip Compensation Factor:	Sets the amount of increase of frequency when full load current is flowing. Slip compensation improves speed regulation as the load changes.
Pr312, Voltage Boost:	Sets the level of voltage (torque) boost allowed. Boost is used to overcome motor losses at low speed and to increase the starting torque available.
Pr313, Serial Baud: Pr314, Serial Address: Pr315, Serial Parity: Pr316, Serial Bits: Pr317, Check Sum:	These parameters set up the drive to match the source of the serial serial communications signal.
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 [1] Value	Minimum Value	Maximum Value	Edit in Run Mode
ILoop Type:	Pr400	4-20 mA	4-20 mA 0-20 mA	0-20 mA	No
Dir Control:	Pr401	AUTO UNIP(OLAR) BIP(OLAR)	AUTO	BIPOLAR	No
L/R HI:	Pr402	1800	-2 x (Pr002)	2 x (Pr002)	No
L/R LO:	Pr403	0	-2 x (Pr002)	2 x (Pr002)	No
Not Used:	Pr404				
Not Used:	Pr405				
Not Used	Pr406				
Not Used	Pr407				
Not Used	Pr408				
LOC Vout:	Pr409	Speed	Torque	Speed	Yes
User Relay:	Pr413	Speed	Torque	Torque	Yes
URelay Set:	Pr414	19	1% of Pr002 +1	Pr002	Yes
User Out:	Pr415	Speed	Torque	Torque	Yes
U Out Set:	Pr416	100	1% of Pr002 +1	Pr002	Yes
Deflt This Menu:	Pr417	No Yes	No	Yes	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.

3.15.2 Term Menu Definitions

Pr400, Current Input Type:	Set the Current Loop input for either 4-20 mA or 0-20 mA. If inverted input required, set with Pr401, 402, 403. (Current-Loop selected by connecting Local/Remote input/to Com).
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. In Auto, 0 VDC, 4 mA or 0 mA will run at the value in Pr001 and +10 VDC or 20 mA will run at the value in Pr002, In Unipolar, 0 VDC, 4 mA or 0 mA will run at the value in Pr403 and +10 VDC or 20 mA will run at the value in Pr402 sets the speed or torque with an input of ±10 VDC or 20 mA and Pr403 sets the speed or torque with an input of 0 VDC or 4 mA or 0 mA. See Section 6.7 for a more detailed description.
Pr402, Local/Remote High Scaling:	When Pr401 is set to either Unipolar or Bipolar, this parameter sets the speed with the maximum input, +10 VDC or 20 mA.
Pr409, Local Vout:	This determines the parameter tracked by the analog voltage output from TB 2 - 9 Local Vout. 0 - + 10 V
Pr413, User Relay:	This sets the Status Value parameter (500 level) that will control the Form-C relay contacts on TB 1 - 5, 6 and 7.
Pr414, User Relay Setpoint:	This sets the value at which the User Relay will "pick-up: for the parameter set in Pr413.
Pr415, User Output Source:	This sets the Status Value parameter (500 level) that will control the Open collector output at TB 1 - 10.
Pr416, User Output Setpoint:	This sets the value at which the Open collector output will "switch" to common for the parameter set in Pr415.
Pr417, Default This Menu:	When set, Pr417 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).
Pr503, Torq:	Motor torque in percentage (%)of rated motor torque.
Pr504, Motor Amps	Motor current in Amps
Pr505, Motor Hz:	Output frequency in Hertz (Hz).
Pr510, Bus Volts:	DC Bus Voltage in volts. Undervoltage trip point is set as a percentage of Pr301 and overvoltage trip point is 800V on 460V units or 400V on 230V units.
Pr511 IxT Accum:	Shows the percentage of time leading to a Timed Overcurrent Trip when the value reaches 100%.
Pr512 DB Accum:	Shows the percentage of time leading to a Timed DB Accum Trip. Trips when reaches 100%.
Pr515, INS:	This parameter shows the present status of terminal TB 1 inputs TB 1 - 12 (M.S.B.) thru TB 1 - 23 (L.S.B.)/ 1 = Active and 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 is no fault).
Pr518, Fault 3:	Record of 2nd to last fault (NF if no fault)
Pr519, Fault Volts:	DC Busvoltage at the time of the last fault as indicated by Pr510.
Pr520, Fault Freq:	Output frequency at the time of the last fault.
Pr521, Fault Mode:	Run/Stop status of the drive at the time of a fault.
Pr522, Fault Cur:	Motor current at the time of the last fault.
Pr523, Fault Time:	Hours running at the time of the last fault.
Pr524, SW Rev:	Software revision number.
Pr525, Drive Size:	Horsepower (HP) rating of the drive.

3.15.1 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	Not Used			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)	1	none	0

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

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   SL3000 Dynamic Braking Features

Dynamic Braking

Dynamic Braking is a standard feature on the SL3000 for 1-15 HP 460VAC and 1 - 5 HP 230 VAC 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 compactor, DB fuse and thermal device. The thermal device must be wired to drop out the AC contactor if the thermal trips.

Braking Torque: Set by the DB Resistor (see Section 4.4.1)
Braking Duty Cycle: 5 seconds 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 on 460V units or 375VDC on 230V units, the DB electronics will begin pulsing the DB resistor(s) across the DC bus. If the DC bus reaches 800 VDC or 400 VDC, the SL3000 will trip on an Overvoltage fault.

4.3.1 SL3000 1 - 15 HP 460V, 1 - 5 HP 230V

These models contain the Dynamic Braking electronics, 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.

4.4 SL3000 Dynamic Braking Specifications
4.4.1 SL3000 1 - 10 HP

SL3000 1 - 15 HP Internal DB Ratings

HP Rating	1.0	2.0	3.0	5.0	7.5	10.0
Rated Brake Torque %	150	100	70	50	40	30
Braking Duty Cycle	5 seconds every 2 minutes (Typical)					

SL3000 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)						

1-5 HP 230 VAC

1-15 HP 460 VAC

Dynamic Brake Control Module Model No.	Continuous AMP Rating	Brake Resistor Rating
CDBRK20	8A	23.5 OHM, 2KW
DCBRK30	12.5A	15.66 OHM, 3KW
CDBRK40	17.5A	11.75 OHM, 4KW
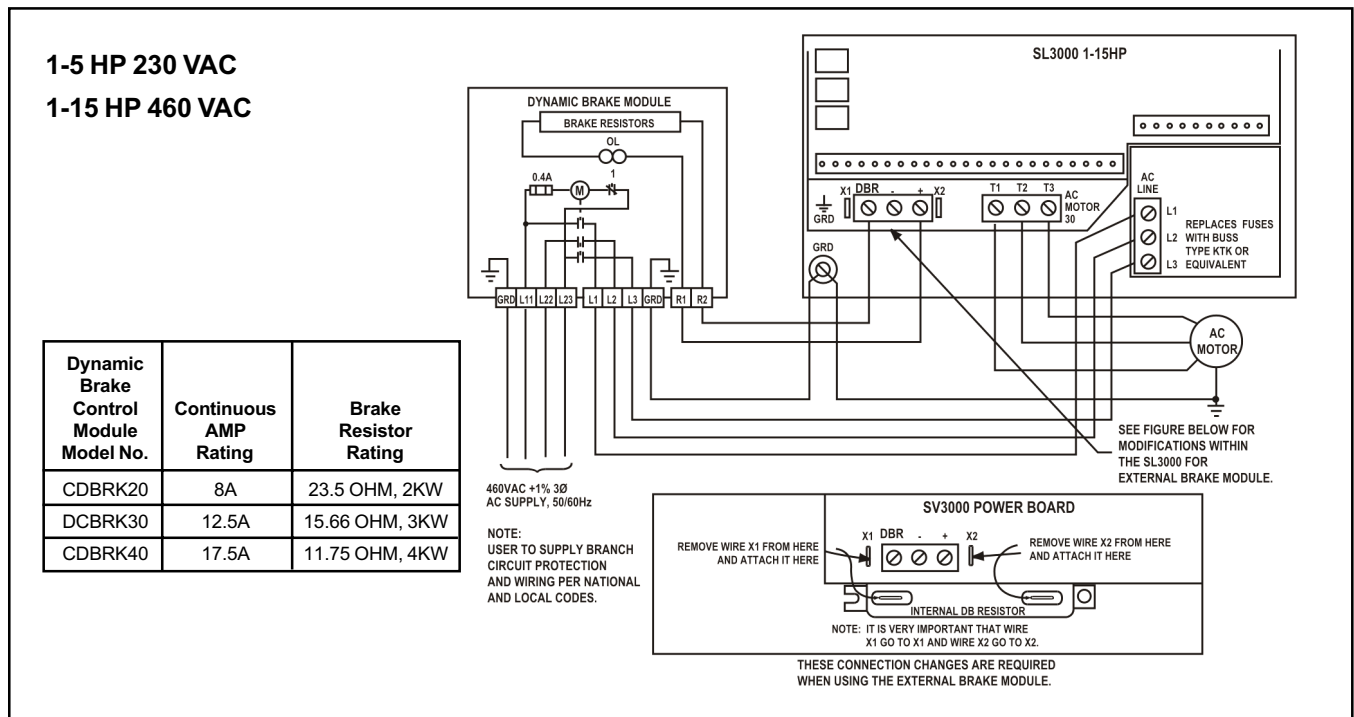
Figure 4B. Dynamic Braking, 1-15 HP
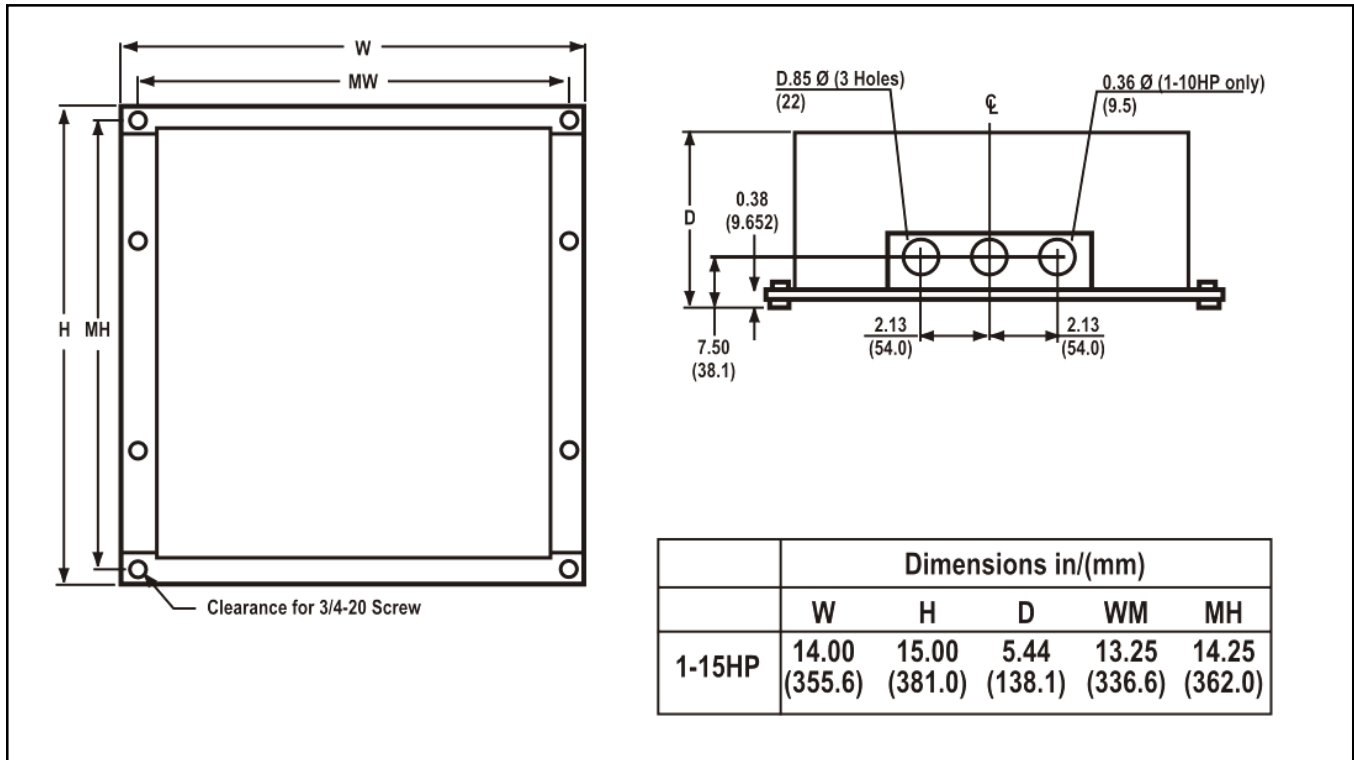
Figure 4C. Dynamic Braking Module Dimensions

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)

Dynamic Braking Model Numbers		
HP	**External Dynamic Braking Module (1) NEMA 1 Enclosure**	**AC Contactor (Supplied Loose)**
1-3	CDMDB03	Included in DB Module
5-15	CDMDB10	Included in DB Module

1-10 HP 460 VAC and 1 - 5 HP 230 VAC SL3000 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 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 SL3000 1 - 10 HP.
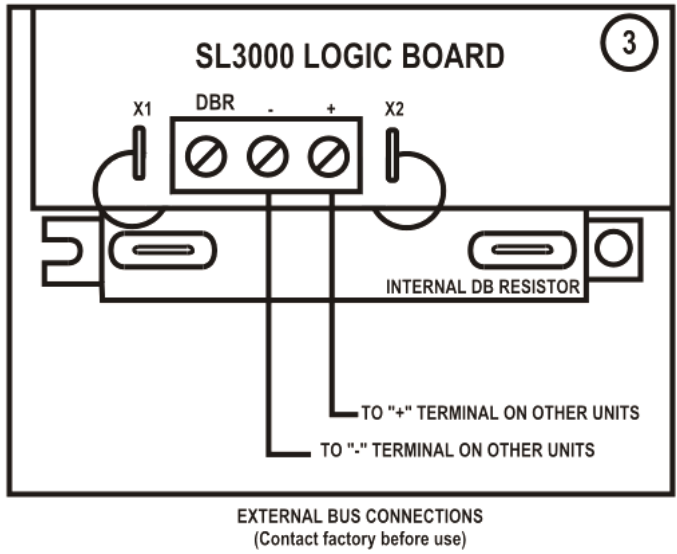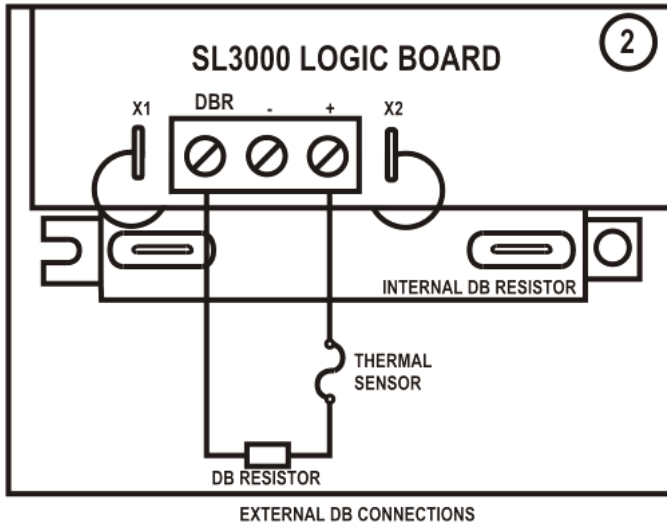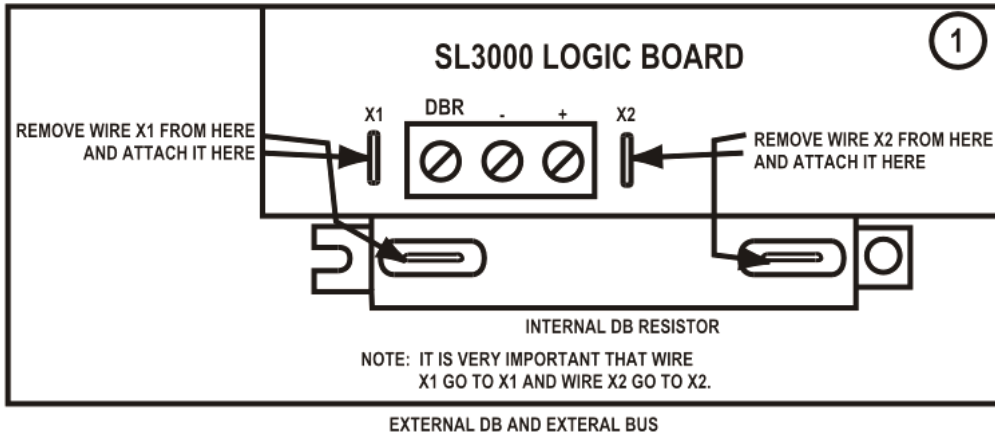
Figure 4D. External Connections

4.5   Dynamic Braking Set-up and Operation
4.5.1   Installation
4.5.1.1 SL3000 1 - 15 HP 460 VAC or 1 - 5 HP 230 VAC

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.

4.5.2   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 SL3000. It will explain:
- How to connect an external computer to monitor and control the SL3000
- How to establish a network of SL3000 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 SL3000 connecting them serially. As many as 32 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. The communication protocol is an industrial standard, "ANSI-x3.25-2.5-A4."

5.2   RS-485 Connections

The SL3000 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. You can connect an RS-232 device by using an RS-485 to RS-232 adaptor.

The serial connections are shown below:

Remove R94 121 ohm terminating resistor in every SL3000 except the one farthest from the host.

Note: 4-wire RJ-11 phone connector required

To another SL3000

To other drives in network (10 SL3000s Maximum)

Host Computer

If more than one SL3000:
1) "MDROP MODE" (P317) = E and
2) Pull up and down resistors are required.

If only one SL3000
1) "MDROP MODE" (P317) = D and
2) Pull up resistor is recommended to avoid Host receiving garbage when SL3000 is off. Pull down resistor is always required to establish ground reference for SL3000 serial port.

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 32 drives.

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

Remove resistor R6 "TERM R" from all drives EXCEPT the last one (See Fig 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 SL3000 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 Parameters Pr315 (Serial Parity) and Pr316 (serial Bits). The bits are defined as follows:

"BITS PAR"

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 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 SL3000 must use the same baud rate, parity, and number of data bits. These items are selectable in the SL3000, refer to the descriptions of parameters "SERIAL BAUD" (Pr313) and "BITS PAR" (Pr315 and Pr316).

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 ASCI 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 read from. The drive address is set in the drive by "SERIAL ADDR" (Pr314) and can range from 1 to 32. 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** (3 characters)
>
> The parameter number to be read. Parameter numbers range from 000 to 999. For example, to read parameter Pr000, send 000; to read parameter 13, send 013; 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	<ETX>	<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.

EXT

> **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 (3 characters)

The requested parameter number is echoed. See above.

<EOT>

End of the Message (1 character)

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 Line (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 fro 1 to 32. 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 acknowledgment.

To Issue a Write Command

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

<STX> PAR   VAL   <ETX> <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 (3 characters)

The parameter number to be written to. Parameter numbers range from 000 to 999. For example, to write parameter Pr000, send 000; to write parameter 13, send 013; 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.

ETX

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 check sum can be disabled. If disabled, a Carriage Return (CR) 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 black 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)
910	Write a 1	Fault Reset	Close "Fault Reset" input (TB1-13) momentarily

Note: Commands 900, 091, 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	Hardwired 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	Not Used
32	EXT FAULT TRIP (EXT)
64	Not Used
128	STOP OPEN (STOP)

Software Fault Code

0	NO FAULT
1	MEMORY OUT OF BOUNDS (MOFB)
2	IXT TRIP (IXT)
8	Not Used
16	Not Used
32	I LOOP LOSS (ILL)
64	Not Used
128	OVERVOLTAGE TRIP (OVT)
256	EXCESSIVE_DB (DB)
512	Not Used
1024	Not Used
4096	Not Used
8192	UNDERVOLT TRIP (UVT)
16384	SERIAL FAULT (SF)
32768	Not Used

6   APPLICATIONS

6.1   DIR CONTROL

The DIR CONTROL parameter, Pr401, serves two purposes. The first is to set how the motor changes direction. Its second feature allows much more scaling capability for the analog input.

The following gives a brief description of the DIRection control function:

Pr404	DIRECTION CONTROL VALUE	Minimum value of P1 "MIN: "
AUTO	RUN F/R key or terminal input	0
UNIPolar	RUN F/R key or terminal input	0
BIPolar	sign of setpoint	-MAX

DIR CONTROL and local analog input scaling (both LVIN and Iloop)
When using the analog inputs (LVIN and Iloop, see section 6.6 for User Vin scaling) the DIR CONTROL parameter, Pr401, sets the scaling of the analog input according to the following table:

DIR CONTROL value	+10.0V set by	0V set by
AUTO	Pr002 "MAX: "	Pr001 "MIN: "
UNIPolar	Pr402 "LR HI: "	Pr403 "LR LO: "
BIPolar	Pr402 "LR HI: "	Pr403 "LR LO: "

Example:

AUTO: Desired to have 10V = 1800 and 0V = 0. (Factory default settings.)

    Pr401   "DIR CTRL: " = AUTO
    Pr402   "LR HI: " = NOT USED
    Pr403   "LR LO: " = NOT USED
    P1   "MIN: " = 0
    P2   "MAX: " = 1800

UNIP: Desired 5V = 1800 RPM, 0V = 0 RPM, maximum speed = 2200 RPM

    Pr401   "DIR CTRL: " = UNIP
    Pr402   "LR HI: " = 3600
    Pr403   "LR LO: " = 0
    Pr001   "MIN: " = 0
    Pr002   "MAX: " = 2200

BIP: Desired 5V = -900, 0V = 100, max speed = 1500, min speed of -1000.

    Pr401   "DIR CTRL: " = BIP
    Pr402   "LR HI: " = -1900
    Pr403   "LR LO: " = 100
    Pr001   "MIN: " = -1000
    Pr002   "MAX: " = 1500

Calculations: 1) Total span from 5V to 0V is -1000; -900 - 100 = -1000

    2) Equivalent span to LR HI setpoint (10.0V) = twice the span to 5V (5 x 2 = 10) therefore LR HI = 2 x -1000 + 100.
    The addition of the 100 is due to the 100 unit offset at 0V.
    Another method is: the value @ 5V is -900 and the span for an additional 5V is -1000 therefore the value at 10.0V must be -900 + -1000 = -1900.

    3) LR LO = 100

BIPolar NOTE: It is important to remember that when operating in BIPolar mode the MIN parameter, Pr001, sets the highest reverse speed not the minimum speed, which if truly bipolar would always be 0.

6.2 TRIP RESTART

The Trip Restart feature works as follows:

If the SL3000 experiences a fault and the drive trips, and if the Trip Restart (Pr213) is set to any number between one and seven, the drive will attempt to restart after a time period set by Restart Time (Pr214).

When the drive attempts to restart and the fault is still present, the drive cannot start success-fully. The number of Restart attempts is set by Pr213.

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.

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 a 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 Danaher Motion Engineered Systems Center.

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 Danaher Motion Engineered Systems Center 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 TB1-8 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, TB1-12 is open, not connected to Logic Common, TB1-100, this fault Trip will occur.
Stop Open	STOP	Drive was given a start command and TB1-22 was not connected to Logic Common.
IxT Warning Excessive Load	IxTW	When the output current exceeds the Pr303 Timed Overcurrent Start Point, this Warning message will occur.
IxT Foldback Excessive Load	IxTF	When Pr307 Timed Overcurrent Fault Selection is set to Fold, this Warning will occur when the current exceeds 80% of the Timed Overcurrent Accumulator Value, Pr507.
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.
Mem. out of Bounds	MOFB	Micro-processor has detected an error in its internal memory and has tripped the drive to prevent further operation.
Overvoltage Trip Load Decel	OVT	Indicates that BUS VOLTAGE has exceeded safe limit while DECELERATING.
Undervolt Trip Check AC Input	UVT	DC Bus voltage is too low, usually indicating that the AC input is too low.
Excessive DB	DB	This fault occurs when the dynamic braking circuit operating limit has been reached. Increasing the deceleration time may help.
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.
4-20 mA Loop Loss I out of Range	ILL	Drive is programmed for 4-20 mA speed reference and that reference has dropped below 4 mA. If 0-20 mA input is used, change Pr400 to 0-20.
Serial Fault	SF	A problem in the Serial Communications routine has been detected.

9 Replacement Parts

9.1 Part Numbers

Description / Qty.	Part Number / HP @ 460 VAC						
	1	**2**	**3**	**5**	**7.5**	**10**	**15**
Fuse, Power Supply / 1	PFU2040-12						
Fuse, Line / 3	PFU1013-07		PFU1013-00		PFU1013-06		PFU1013-01
Power Supply Board / 1	C37112-00	C37112-01	C37112-01	C37112-03	C37112-04	C37112-05	C37112-06
Logic Board / 1	C37114-00						
IGBT Power Device / 1	ATR5001-00		ATR5001-01	ATR5001-02		ATR5001-0	
Bridge Diode / 1	PDI5016-01			PDI5016-00			
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 - 15 HP, 2-7.5 - 15 HP	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						

Distribution Coast-To Coast

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

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

In U.S.A. and Canada

DANAHER MOTION ENGINEERED SYSTEMS CENTER
- Customer Service, Product Application, Product Support: 704-588-5693
- Fax: 704-588-5695

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Charlotte, NC 28273

Seco AC/DC Drives	BRONCO® AC and DC Drives	M4000 DC Adjustable Speed Drives
	SE2000 DC Drives with options	SV3000 Flux Vector AC Drives
	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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