



SP600 AC Drive User Manual Version 2.0

0.5 to 25 HP @ 230 VAC

0.5 to 50 HP @ 460 VAC

0.5 to 50 HP @ 600 VAC



NEMA 4X/12

NEMA 1

Instruction Manual D2-3485-5

Rockwell
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The information in this manual is subject to change without notice.

Throughout this manual, the following notes are used to alert you to safety considerations:



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.

The thick black bar shown on the outside margin of this page will be used throughout this instruction manual to signify new or revised text or figures.



ATTENTION: Only qualified personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this document in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: DC bus capacitors retain hazardous voltages after input power has been removed. After disconnecting input power, wait five minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The drive can operate at and maintain zero speed. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audible or visual alarms, or other devices to indicate that the drive is operating, or may operate, at or near zero speed. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The drive contains ESD- (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing, or repairing the drive. Erratic machine operation and damage to, or destruction of, equipment can result if this procedure is not followed. Failure to observe this precaution can result in bodily injury.

ATTENTION: The user must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuitry must disable the system in case of improper operation. Uncontrolled machine operation may result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

ATTENTION: The user is responsible for conforming with all applicable local and national codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

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This manual is intended for qualified electrical personnel familiar with installing, programming, and maintaining AC drives.

This manual contains information on:

- Installing and wiring the SP600 drive
- Programming the drive
- Troubleshooting the drive

The latest version of this manual is available from http://www.reliance.com/literature/literature_main.html.

1.1 Manual Conventions

Parameter names: In most instances, parameter names are shown as the parameter name followed by the parameter number. For example: PI Control (125).

1.2 Getting Assistance from Reliance Electric

If you have any questions or problems with the products described in this instruction manual, contact your local Reliance Electric sales office.

For technical assistance, call 1-864-284-5444. Before calling, please review the troubleshooting section of this manual and check the standard drives website for additional information. When you call this number, you will be asked for the drive model number and this instruction manual number. Also, please have your product version number ready (refer to chapter 13).

The SP600 AC drive is a pulse-width-modulated (PWM) drive that provides general purpose (sensorless vector or volts/hertz) regulation for a broad range of applications requiring adjustable speed control of motors.

This chapter provides information about the SP600 AC drive, including:

- Information on identifying the drive
- Descriptions of NEMA ratings
- Descriptions of features
- Information on CE filters and requirements for CE compliance
- A description of drive connections and communication options

2.1 Identifying the Drive by Model Number

Each SP600 AC drive can be identified by its model number, as shown in figure 2.1. The model number is on the shipping label and the drive nameplate. The model number includes the drive and any factory-installed options. Model numbers and drive power ratings are provided in table 2.1.

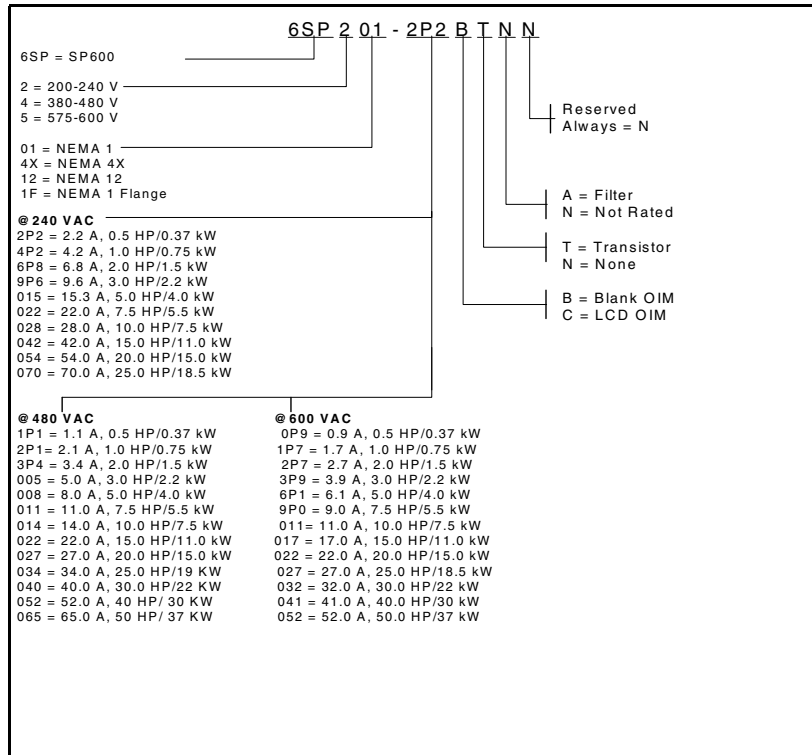


Figure 2.1 – Identifying the Drive by Model Number

2.2 Identifying the Drive by Frame Size

Throughout this manual, drives are identified either by horsepower or frame size. Refer to tables 2.1 and 2.2 for the definition of each frame size.

Table 2.1 – Identifying the NEMA 1 Drive by Frame

Frame	240 V	480 V	600 V
A ¹	.5 - 1.0 HP	.5 - 1.0 HP	.5 - 1.0 HP
B	2 - 3 HP	2 - 5 HP	2 - 5 HP
C	5 HP	7.5 - 10 HP	7.5 - 10 HP
D	7.5 - 15 HP	15 - 30 HP	15 - 30 HP
E	20 - 25 HP	40 - 50 HP	40 - 50 HP

¹ Note these ratings with internal filters are shipped as a B-size frame.

Table 2.2 – Identifying the NEMA 4x/12 Drive by Frame

Frame	NEMA Rating	240 V	480 V	600 V
B4	4x/12	.5 - 3.0 HP	.5 - 5.0 HP	.5 - 5.0 HP
D4	4x/12	5 - 15 HP	7.5 - 30 HP	7.5 - 30 HP
E	4x	20 - 25 HP	40 - 50 HP	40 - 50 HP
E	12	20 - 25 HP	40 - 50 HP	40 - 50 HP

2.3 Power Enclosure Ratings

Each of the SP600 AC drives has one of these enclosure ratings:

- NEMA 1: Vented. Intended for general-purpose indoor applications.
- Flange NEMA 1: Intended for through-the-panel mounting. IP20/NEMA 1, front side; NEMA 4X, heatsink backside.
- IP20: Open. Debris label removed from the top of the drive.
- NEMA 4X/IP66: Intended for use in indoor environments that require a dust-tight and drip-tight corrosion-resistant enclosure. Protects against heavy jet spray.
- NEMA 12: Dust-tight and drip-tight.

Tables 2.3, 2.4, and 2.5 list the drives and their power ratings.

Table 2.3 – 208/240 VAC Power Ratings

NEMA 1, NEMA 4, Flange Model Number ¹	Nominal Power Ratings				Input KVA		Input Amps		Output Amps@ 4 kHz ²						Watts Loss @ 4 kHz Full Load & Full Speed		
	110% OL Duty		150% OL Duty		208 VAC	240 VAC	208 VAC	240 VAC	208 VAC Input		240 VAC Input		3		External ³ Watts	Internal ⁴ Watts	Total Watts
	HP	kW	HP	kW	Cont. 1 min	sec	Cont. 1 min	sec	Cont. 1 min	sec	Cont. 1 min	sec	Cont. 1 min	sec			
	HP	kW	HP	kW	Cont. 1 min	sec	Cont. 1 min	sec	Cont. 1 min	sec	Cont. 1 min	sec	Cont. 1 min	sec	Cont. 1 min	sec	
6SP2yz-2P2xxxx	0.5	0.37	0.33	0.25	1.1	1.2	2.9	2.5	2.5	2.7	2.7	2.2	2.4	3.3	12.2	19.2	31.4
6SP2yz-4P2xxxx	1.0	0.75	0.75	0.55	2.0	2.3	5.6	4.8	4.8	5.5	7.4	4.2	4.8	6.4	30.7	20.5	51.2
6SP2yz-6P8xxxx	2.0	1.5	1.5	1.1	3.6	4.2	10.0	8.7	7.8	10.3	13.8	6.8	9.0	12.0	44.6	22.6	67.2
6SP2yz-9P6xxxx	3.0	2.2	2.0	1.5	5.1	5.8	14.0	12.2	11.0	12.1	16.5	9.6	10.6	14.4	67.3	25.4	92.7
6SP2yz-015xxxx	5.0	4.0	3.0	3.0	5.8	6.7	16.0	13.9	17.5	19.2	26.2	15.3	17.4	23.2	141.3	33.2	174.5
6SP2yz-022xxx	7.5	5.5	5.0	4.0	8.4	9.7	23.3	20.2	25.3	27.8	37.9	22.0	24.2	33.0	205.7	34.2	239.9
6SP2yz-028xxxx	10	7.5	7.5	5.5	10.7	12.4	29.8	25.8	32.2	37.9	50.6	28.0	33.0	44.0	270.4	48.1	318.5
6SP2yz-042xxxx	15	11	10	7.5	16	16	39.8	38.5	43	55.5	74	42	46.2	63	385.6	40.3	425.9
6SP2yz-054xxxx	20	15	15	11	17.1	19.8	57.5	49.8	62.1	72.4	96.6	54	63	84	494.7	44.8	539.5
6SP2yz-070xxxx	25	18.5	20	15	25.9	26.7	72	64.2	78.2	93.1	124	70	81	108	650.8	51.6	702.3

1 For NEMA 1 drives, replace “yz” in the model number with 01. For NEMA 4X drives, replace “yz” with 4X. For NEMA 12 drives, replace “yx” with 12.

2 For higher carrier frequencies, refer to chapter 12, parameter 151.

3 Watts dissipated directly through the heat sink.

4 Watts dissipated by the control structure of the drive and will be dissipated into the cabinet regardless of mounting style.

Table 2.4 – 400/480 VAC Power Ratings

NEMA 1, NEMA 4, Flange Model Number ¹	Nominal Power Ratings				Input KVA		Input Amps		Output Amps @ 4 kHz ²						Watts Loss @ 4 kHz Full Load & Full Speed		
	110% OL Duty		150% OL Duty		400 V	480 V	400 V	480 V	400 VAC Input		480 VAC Input		External ³ Watts	Internal ⁴ Watts	Total Watts		
	HP	KW	HP	KW	Cont.	1 min	3 sec	Cont.	1 min	3 sec	Cont.	1 min				3 sec	
6SP4yz-1P1xxx	0.5	0.37	0.33	0.25	1.1	1.1	1.6	1.3	1.3	1.4	1.9	1.1	1.2	1.6	11.5	17.9	29.4
6SP4yz-2P1xxxx	1.0	0.75	0.75	0.55	1.8	2.9	2.5	2.4	2.1	2.4	3.2	2.1	2.4	3.2	27.8	19.5	47.3
6SP4yz-3P4xxxx	2.0	1.5	1.5	1.1	3.0	3.2	4.3	3.8	3.5	4.5	6	3.4	4.5	6.0	43.6	21.6	65.2
6SP4yz-005xxxx	3.0	2.2	2	1.5	4.5	4.7	6.5	5.6	5.0	5.5	7.5	5.0	5.5	7.5	64.6	24.0	88.6
6SP4yz-008xxxx	5.0	4	3	2.2	8.4	8.4	11.3	9.8	8.7	9.9	13.2	8.0	8.8	12	99.5	28.2	127.7
6SP4yz-011xxxx	7.5	5.5	5	4.0	7.9	7.9	10.5	9.4	11.5	13	17.4	11	12.1	16.5	140.0	27.8	167.8
6SP4yz-014xxxx	10	7.5	7.5	5.5	10.4	10.4	14.1	12.4	15.4	17.2	23.1	14	16.5	22	193.3	32.0	225.3
6SP4yz-022xxxx	15	11	10	7.5	16.6	16.6	20.4	19.8	22	24.2	33	22	24.2	33	305.4	34.2	339.6
6SP4yz-027xxxx	20	15	15	11	20.6	20.6	28.1	24.5	30	33	45	27	33	44	432.9	42.9	475.8
6SP4yz-034xxxx	25	18.5	20	15	25.9	25.9	35	31.2	37	40.5	54	34	40.5	54	353.7	40.3	394.0
6SP4yz-040xxxx	30	22	25	18.5	39.7	39.7	40.7	36.7	43	51	68	40	51	68	388.9	41.3	430.2
6SP4yz-052xxxx	40	30	30	22	39.3	39.7	56.7	47.7	60	66	90	52	60	80	500.8	50.6	551.4
6SP4yz-065xxxx	50	37	40	30	47.8	49.6	68.9	59.6	72	90	120	65	78	104	632.0	58.3	690.3

¹ For NEMA 1 drives, replace "yz" in model number with 01. For NEMA 4X drives, replace "yz" with 4X. For NEMA 12 drives, replace "xy" with 12.

² For higher carrier frequencies, refer to chapter 12, parameter 151.

³ Watts dissipated directly through the heat sink.

⁴ Watts dissipated by the control structure of the drive and will be dissipated into the cabinet regardless of mounting style.

Table 2.5 – 600 VAC Power Ratings

NEMA 1, NEMA 4, Flange Model Number ¹	Nominal Power Ratings						Input KVA	Input Amps	Output Amps@ 4 kHz ²			Watts Loss @ 4 kHz Full Load & Full Speed		
	110% OL Duty		150% OL Duty		HP	kW			Cont.	1 min	3 sec	External ³ Watts	Internal ⁴ Watts	Total Watts
	HP	kW	HP	kW										
6SP5yz-0P9xxx	0.5	0.37	0.33	0.25	1.3	1.3	0.9	1.0	1.4	11.5	17.9	29.4		
6SP5yz-1P7xxx	1	0.75	0.75	0.50	2.0	1.9	1.7	2.0	2.6	27.8	19.5	47.3		
6SP5yz-2P7xxx	2	1.5	1.5	1.0	3.1	3.0	2.7	3.6	4.8	43.6	21.6	65.2		
6SP5yz-3P9xxx	3	2.2	2	1.5	4.5	4.4	3.9	4.3	5.8	64.6	24.0	88.6		
6SP5yz-6P1xxxx	5	4	3	2.0	7.8	7.5	6.1	6.7	9.1	99.5	28.2	127.7		
6SP5yz-9P0xxxx	7.5	5.5	5	3.75	8.0	7.7	9	9.9	13.5	140.0	27.8	167.8		
6SP5yz-011xxxx	10	7.5	7.5	5.5	10.1	9.8	11	13.5	18	193.3	32.0	225.3		
6SP5yz-017xxxx	15	11	10	7.5	15.9	15.3	17	18.8	25.5	305.4	34.2	339.6		
6SP5yz-022xxxx	20	15	15	11	20.0	20.8	22	25.5	34	432.9	42.9	475.8		
6SP5yz-027xxxx	25	18.5	20	15	24.7	24.8	27	33	44	332.5	42.4	374.9		
6SP5yz-032xxxx	30	22	25	18.5	29.3	29.4	32	40.5	54	396.8	43.4	440.2		
6SP5yz-041xxxx	40	30	30	22	37.4	37.6	41	48	64	478.9	51.8	530.7		
6SP5yz-052xxxx	50	37	40	30	47.5	47.7	52	61.5	82	642.7	59.8	702.5		

¹ For NEMA 1 drives, replace "yz" in model number with 01. For NEMA 4X drives, replace "yz" with 4X. For NEMA 12 drives, replace "xy" with 12.

² For higher carrier frequencies, refer to chapter 12, parameter 151.

³ Watts dissipated directly through the heat sink.

⁴ Watts dissipated by the control structure of the drive and will be dissipated into the cabinet regardless of mounting style.

2.4 Overview of SP600 Drive Features

This section provides an overview of the features in the SP600 AC drive.

2.4.1 Analog Inputs

There are two general-purpose analog inputs that can be configured as either voltage (+/-10 VDC) or current (4-20 mA) inputs using parameter 320.

The analog inputs provide input signals that can be used to:

- Provide a value to Speed Ref A (91)
- Provide a trim signal to Speed Ref A (91)
- Provide a reference when the terminal block has assumed manual control of the reference (TB Man Ref Sel (96))
- Provide the reference and feedback for the process PI loop (PI Ref Sel (126) and PI Feedback Sel (128))
- Provide an external value for the current limit and DC braking level (Current Limit Sel (147) and DC Brake Lvl Sel (157))

Refer to the parameter descriptions in chapter 12 for more information about configuring the analog inputs.

2.4.2 Analog Output

The drive has one analog output that can be used as a voltage signal (0 to 10 V) to annunciate a wide variety of drive operating conditions and values. Select the source for the analog output by setting Analog Out1 Sel (342).

Refer to parameter 342 in chapter 12 for the analog output source options.

2.4.3 Digital Outputs

The SP600 drive provides two relay outputs for external annunciation of a variety of drive conditions. Each relay is a Form C (1 N.O. - 1 N.C. with shared common) device whose contacts and associated terminals are rated for a maximum of 250 VAC or 220 VDC.

See parameters 380 and 384 in chapter 12 for the drive conditions that can be annunciated.

2.4.4 Multiple Control Modes

The SP600 drive provides a number of user-selectable control modes to suit different applications:

- Sensorless Vector
- Sensorless Vector Economizer
- Custom Volts per Hertz
- Fan and Pump Volts per Hertz

See the parameter description for Torque Perf Mode (53) in chapter 12 for the details of operation of each control mode.

2.4.5 Multiple Stop Methods

There are several stop methods that can be selected using drive parameter 155:

- Coast to Stop
- Brake to Stop
- Ramp to Stop
- Ramp to Hold

Refer to the parameter descriptions in chapter 12 for more information about these stop mode selections.

Another stop method, dynamic braking, uses an optional internal or external DB braking resistor to dissipate stopping energy. See parameters 161 to 163 for more information about this feature.

2.4.6 Multiple Speed Control Methods

The purpose of speed regulation is to allow the drive to adjust to certain operating conditions, such as load change, and compensate for these changes in an attempt to maintain motor shaft speed within the specified regulation percentage.

The Speed Mode parameter (80) selects the speed regulation method for the drive and can be set to one of three choices:

- Open Loop - No speed control is offered
- Slip Comp - Slip compensation is active
- Process PI - The PI loop sets the actual speed based on process variables

Refer to parameter 80 in chapter 12 for more information.

2.4.7 Auto/Manual Reference Selection

You can override the selected “auto” reference by either toggling a function key on the OIM or asserting a digital input (Digital In“x” Sel (361 to 366)) that has been configured for Manual. This provides a source for local speed reference control even if a process input signal is the primary speed reference source.

Refer to the parameter descriptions in chapter 12 or section 9.8.3, Customizing the Function Keys, in chapter 9 for more information.

2.4.8 Seven Preset Frequency Setpoints

There are seven preset frequency parameters (101 to 107) that are used to store a discrete frequency value. This value can be used for a speed reference or process PI reference. When used as a speed reference, they are selected via the digital inputs or the DPI (network) reference command. Refer to the parameter descriptions in chapter 12 for more information.

2.4.9 Motor-Operated Potentiometer (MOP) Function

The Motor-Operated Pot (MOP) function is one of the sources for the frequency reference (selected in parameter 90). The MOP function uses digital inputs to increment or decrement the speed reference at a programmed rate.

The MOP has these components:

- MOP Rate parameter (195)
- Save MOP Ref parameter (194)
- MOP Frequency parameter (11)
- MOP increment input (parameters 361 to 366)
- MOP decrement input (parameters 361 to 366)

2.4.10 Auto Restart (Reset/Run)

The Auto Restart feature, enabled in parameter 174 (Auto Rstrt Tries), provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows for automatic restart in applications where the drive is used in remote or "unattended" operation.

Important: Only certain faults are allowed to be auto reset. Faults that indicate possible drive malfunction are not resettable. Caution should be used when enabling this feature, since the drive will attempt to issue its own start command based on user-selected programming. Table 13.6 in chapter 13 lists the drive faults and whether they are auto-resettable.

Refer to the descriptions of parameters 174 and 175 in chapter 12 for more information about using the Auto Restart feature.

2.4.11 Autotune

The Autotune feature, enabled in parameter 61 (Autotune), identifies the motor flux current and stator resistance for use in Sensorless Vector Control and Economizer modes (selected in parameter 53). The result of the flux current test procedure is stored in the Flux Current parameter (5), and the product of Flux Current Ref (63) and stator resistance is stored in IR Voltage Drop (62).

There are three options for autotuning:

- Static - the motor shaft will not rotate during this test.
- Dynamic - the motor shaft will rotate during this test.
- Calculate - tuning data is selected based on the motor nameplate data entered.

The static test determines only stator resistance, while the dynamic Autotune procedure determines both the stator resistance and motor flux current.

IR Voltage Drop (62) is used by the drive to provide additional voltage at all frequencies to offset the voltage drop developed across the stator resistance. An accurate calculation of the IR Voltage Drop will ensure higher starting torque and better performance at low speed operation.

If it is not possible or desirable to run the Autotune tests, there are two other methods for the drive to determine the IR Voltage Drop and Flux Current parameters. One method retrieves the default parameters stored in the power EEPROM, and the other method calculates them from the user-entered motor nameplate data parameters.

If the stator resistance and flux current of the motor are known, you can calculate the voltage drop across the stator resistance and directly enter these values into the Flux Current and IR Voltage Drop parameters.

Refer to the description of the Autotune parameter (61) in chapter 12 for more information about using this feature.

2.4.12 Drive Protection Current Limit

There are six ways that the drive protects itself from overcurrent or overload situations:

- Instantaneous overcurrent trip
- Software instantaneous trip
- Software current limit
- Heatsink temperature protection
- Overload protection (see Drive Overload Protection, section 2.4.13)
- Thermal manager

2.4.13 Drive Overload Protection

The drive thermal overload protects the drive power stage while maintaining performance as long the drive temperature and current ratings are not exceeded.

The drive monitors the temperature of the power module based on a measured temperature and a thermal model of the IGBT. As the temperature rises, the drive may lower the PWM frequency to decrease the switching losses in the IGBT. If the temperature continues to rise, the drive may reduce current limit to try to decrease the load on the drive. If the drive temperature becomes critical, the drive generates a fault.

If the drive is operated in a low ambient condition, the drive may exceed rated levels of current before the monitored temperature becomes critical. To guard against this situation, the drive thermal overload also includes an inverse time algorithm. When this scheme detects operation beyond rated levels, current limit may be reduced or a fault may be generated.

2.4.14 Motor Overload Protection

The motor thermal overload function (enabled in parameter 238) uses an inverse time (IT) algorithm to model the temperature of the motor. This curve is modeled after a Class 10 protection thermal overload relay that produces a theoretical trip at 600% motor current in 10 seconds and continuously operates at full motor current.

The following parameters are used to set the overload feature:

- Motor NP LFA (42)
- OL Factor (48)
- Motor OL Hertz (47)
- Fault Config 1 (238)

Refer to parameter 42 in chapter 12 for more information about this feature.

2.4.15 Shear Pin Fault

This feature allows you to program the drive to fault if the drive output current exceeds the programmed current limit (see parameter 238). As a default, exceeding the set current limit is not a fault condition. However, if you want to stop the process in the event of excess current, the Shear Pin feature can be activated. By programming the drive current limit value and enabling the electronic shear pin, the drive will fault if excess current is demanded by the motor.

2.4.16 Drive Peripheral Interface (DPI)

SP600 drives support Drive Peripheral Interface (DPI) communication protocols for the primary interface and drive control. DPI is an enhanced serial communications protocol that provides high functionality and high performance.

The serial DPI connection is used for devices such as Operator Interface Modules (OIMs), PC interface tool (VS Utilities), and network communications modules.

2.4.17 Network Data Transfer via Datalinks

A Datalink (see parameters 300 to 317) is one of the mechanisms used by SP600 drives to transfer data to and from a programmable controller via the optional network communications modules (DeviceNet or ControlNet). In the case of ControlNet, Datalinks allow a parameter value to be changed without using an Explicit Message or Block Transfer.

Each Datalink (A, B, C, or D) transfers two 16-bit values (A1, A2). If a 32-bit value needs to be transferred, each of the two 16-bit Datalinks must be set to the same parameter. One Datalink transfers the lower 16 bits; the other, the upper 16 bits.

For example, to set up the drive to receive accel and decel times from the connected PLC you would make the following parameter settings:

Data In A1 (300) = 140 (the parameter number of Accel Time 1)
Data In A2 (301) = 142 (the parameter number of Decel Time 1)

Refer to parameters 300 through 317 in chapter 12 and the appropriate network communications manual for more information about using Datalinks.

2.4.18 Programmable Parameter Access Levels and Protection

The SP600 drive allows you to limit the number of parameters that can be viewed on the LCD OIM using an Access Level password. See section 11.3.5 for more information about this password.

You can also protect parameters from unauthorized changes by activating the Write Protect password. See section 11.4 for more information about this password.

2.4.19 User Sets

2.4.19.1 Normal Mode

After a drive has been configured for a given application, you can store a copy of all of the parameter settings in a specific EEPROM area known as a user set. Up to three user sets can be stored in the drive's memory to be used for backup, batch switching, or other needs. All parameter information is stored. You can then recall this data to the active drive operating memory as needed. Each user set can also be identified with a user-selected name.

You can use this feature using any of the following methods:

- Set parameters Load Frm Usr Set (198) and Save To User Set (199). Refer to the parameter descriptions in chapter 12.
- Program the function keys on the LCD OIM. (Refer to section 9.8.3 for this procedure.)
- Access the Memory Storage menu on the LCD OIM. See section 9.7.2.

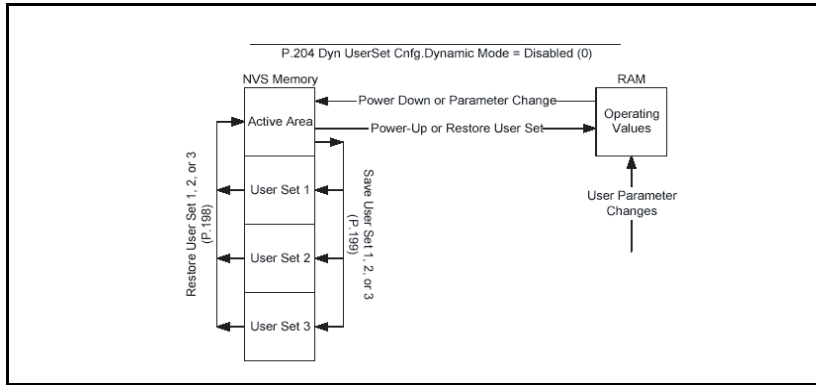


Figure 2.2 – Normal Mode Operation

2.4.19.2 Dynamic Mode

Dynamic Mode Operation allows User Sets to be loaded by utilizing digital input states or by writing a value to a user set select parameter (205). In this mode, the active area will no longer exchange data with any User Set, but the operating memory will be directly loaded with any one of the three User Sets.

Important: User Sets must be properly setup in Normal Mode before they can be loaded and used in Dynamic Mode.

The method of writing the user set select parameter (205) value will allow a communications network to control which User Set is in use. Digital inputs can be configured to allow local control of User Sets from the drive's Terminal Block. Up to two digital inputs can be defined to allow selection of any combination of the three User Sets. Digital Inputs can be configured through Parameters 361 through 366.

The Dynamic Mode Operation User Set operation is enabled and disabled by a configuration parameter (204).

Important: Parameter writes are only recorded in the operating memory and not copied to non-volatile storage. Changes made to parameter values while Dynamic Mode is active will not be saved.

Parameter changes or power loss while Dynamic Mode is disabled (Normal Mode) will still automatically save changed data to active area non-volatile storage. Loading of User Set data to operating memory can occur only while the drive is in a stop condition. If a Dynamic Mode command from digital inputs occurs while the drive

is running, the transfer of the selected User Set data will not occur until the drive is stopped, assuming that the Dynamic Mode and the transfer command are both still active when the drive stops. A Dynamic Mode command from the user set select parameter (205) while the drive is running will be immediately rejected.

Typical Setup / Operation:

- Step 1. While in normal mode (Dyn UserSet Cnfg (204) = x0), enter data into drive and save to User Set using Save to User Set (199). Repeat for each needed User Set. Check that Dynamic User Set related Digital Inputs (parameters 361-366) and Datalink Inputs (parameters 300-307) are programmed the same in each.
- Step 2. Enable Dynamic User Set Mode (Dyn UserSet Cnfg (204) = x1).
- Step 3. Test restoring each programmed user Set via digital Inputs or DynUsrSetSel (205). If a Fault or Type 2 Alarm occurs (Drive Alarm 2 (212) is non-zero), the User Set causing the error is loaded (see Dyn UserSet Actv (206) for indication). Return to Normal Mode (Dyn UserSet Cnfg (204) = x0), correct the Digital Input or Datalink definition(s), and save to the User Set that was loaded. Repeat step 2.
- Step 4. Begin normal drive operation. Remember that User Sets can only be loaded while the drive is stopped.

At power-up, the drive will load operating memory with the values contained in the active non-volatile storage as part of initialization. If Dynamic Mode is Enabled, the selected User Set data will be loaded and processed after drive initialization completes but before the drive is allowed to become active. If Dynamic Mode is active and drive power is removed, User Set data will not be saved and any parameter changes will be lost.

When Dyn UserSet Cnfg (204) is set to Enabled, the drive will immediately transfer the selected User Set to operating memory as determined by digital inputs or DynUsrSetSel (205). The drive will verify that the User Set digital input configuration is identical in all three sets.

To avoid operational conflict between User Set values, all digital inputs must be set identically in each user set. If the digital inputs in each user set are not set identically, a Type 2 alarm is generated. The condition(s) must be corrected before the drive can become active.

Load Frm Usr Set (198) and Save to User Set (199) commands are not permitted in Dynamic Mode because these operations define data transfer between the active memory and the User Sets.

Disabling Dynamic Mode will cause the drive to operate in Normal Mode and parameter values will be transferred from operating memory into the active non-volatile storage area.

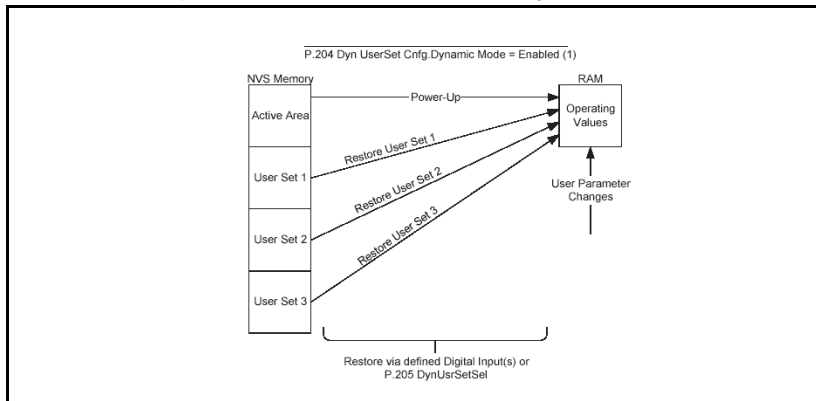


Figure 2.3 – Dynamic Mode Operation

2.4.20 Process PI Loop

The internal process PI function provides closed-loop process control with proportional and integral control action. The PI function reads a process variable input to the drive and compares it to a desired setpoint stored in the drive. The algorithm will then adjust the output of the process PI regulator thereby changing drive output frequency to try to make the process variable equal the setpoint. Refer to the descriptions of parameters 124 to 138 in chapter 12 for more information.

2.4.21 S Curve

The S Curve function of SP600 drives allows control of the "jerk" component of acceleration and deceleration through adjustment of the S Curve parameter (146). Jerk is defined as the rate of change of acceleration and/or deceleration. By adjusting the percentage of the S Curve applied to the normal accel/decel ramps, the ramp takes the shape of an "S" allowing a smoother transition that produces less mechanical stress and smoother control for light loads.

2.4.22 Three Skip Bands (Avoidance Frequencies)

The skip band function (see parameters 84 to 87 in chapter 12) provides three skip bands (also called avoidance frequencies) that the drive will ramp through but will not continuously run within. You can set the skip frequency (center frequency) and bandwidth of each band. This function is used to avoid mechanical resonance operating setpoints.

2.4.23 Flying Start

The flying start feature (enabled in parameter 169) is used to start into a rotating motor as rapidly as possible and resume normal operation with a minimal impact on load or speed. This action will prevent an overcurrent trip and significantly reduce the time for the motor to reach its desired frequency. Since the motor is "picked up" smoothly at its rotating speed and ramped to the proper speed, little or no mechanical stress is present.

2.4.24 Voltage Class

The voltage class (see parameter 202 in chapter 12) identifies the general input voltage to the drive. This general voltage includes a range of actual operating voltages. A 400 volt class drive will have an acceptable input voltage range of 380 to 480 VAC. There are also the 200 volt class drives with a range of 200 to 240 volts operation.

While the hardware remains the same for each class, other variables, such as factory defaults and power unit ratings, will change. In most cases, all drives within a voltage class can be reprogrammed to accommodate a motor within its voltage class. This can be done by resetting the Voltage Class parameter (202) to a different setup within the voltage class.

As an example, consider a 480 volt drive. This drive comes with factory default values for 480 V, 60 Hz, with motor data defaulted for U.S. motors (HP rated, 1750 RPM, etc.) By setting the Voltage Class parameter to "low voltage" (this represents 400 V in this case) the defaults are changed to 400 V, 50 Hz settings with motor data for European motors (kW rated, 1500 RPM, etc.).

2.4.25 Motor Cable Lengths

The length of cable between the drive and motor may be limited for various application reasons. The primary areas of concern are:

- Reflected wave
- Cable charging

The reflected wave phenomenon, also known as transmission line effect, produces very high peak voltages on the motor due to voltage reflection. While Reliance Electric drives have patented software that limits the voltage peak to 2 times the DC bus voltage and reduce the number of occurrences, many motors have inadequate insulation systems to tolerate these peaks.

Caution should be taken to understand the effects and restrictions when applying the drive to extended motor lead length applications. Proper cable type, motor and drive selection is required to minimize the potential risks.

2.4.26 Economizer Mode

Economizer mode consists of operating the drive in sensorless vector control mode with an energy saving function (E-SVC). When the drive is in this mode and operating at steady state output frequency, the output voltage is automatically adjusted as the load is increased or decreased. This is done so that minimum current is supplied to the motor thereby optimizing its efficiency. By adjusting the output voltage, the flux producing current is reduced, but only if the total drive output current does not exceed 75% of motor rated current. In this mode the flux current is not allowed to be less than 50% of the selected flux current parameter value.

2.4.27 Fan Curve

When Torque Perf Mode (53) is set to Fan/Pump V/Hz the relationship between frequency and voltage is a square function where the voltage is proportional to frequency. The fan curve provides the option to generate voltage that is a function of the stator frequency squared up to the motor nameplate frequency. Above base frequency, the voltage is a linear function of frequency. At low speed, the fan curve can be offset by the Run Boost (70) parameter to provide necessary starting torque.

2.5 CE Conformity

Some SP600 drive models contain input line filters and DC bus chokes. These components are essential to meet CE certification requirements.

These SP600 drives are CE compatible, but internal or external filters will be required to meet the standards outlined in section 2.5.1.

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. The SP600 AC drive complies with the EN standards listed below when installed according to the user manual.

CE Declarations of Conformity are available online at:
<http://www.reliance.com/certification>.

Important: SP600 AC drives rated for 575 VAC input do not comply with CE standards.

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

EMC Directive (89/336/EEC)

- EN61800-3 (Second Environment) Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods

General Notes

To be CE-compliant, the motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.

AC drives may cause radio interference. The user is required to take measures to prevent interference in addition to the essential requirements for CE compliance listed in section 2.6.1, if necessary.

If the adhesive label is removed from the top of the drive, the drive must be mounted in a cabinet with side openings less than 12.5 mm (0.5 in) and top openings less than 1.0 mm (0.04 in) to maintain compliance with the Low Voltage Directive.

Conformity with CE EMC requirements does not guarantee that the entire machine or installation will comply with the requirements. Many factors can influence total machine/installation compliance.

Use of line filters in ungrounded systems is not recommended. SP600 drives can generate conducted low frequency disturbances (harmonic emissions) on the AC supply system.

2.5.1 Essential Requirements for CE Compliance

All conditions listed below must be satisfied for SP600 drives to meet the requirements of EN61800-3 for the Second Environment (Industrial).

- Standard SP600 CE-compatible drive.
- Grounding as described in section 5.2 of this manual.
- Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
- All shielded cables should terminate with the proper shielded connector.
- Conditions in table 2.6.

Table 2.6 – SP600 Drives EN1800-3 (Second Environment) Compatibility

Frame ¹	Drive Description	Restrict Motor Cable to 40 m (131 ft.)	Internal Filter Option	External Filter	Input Ferrite ²
A	Drive Only	✓		✓	
	with any Comm Option	✓		✓	
	with ControlNet	✓		✓	✓
B	Drive Only	✓	✓		
	with any Comm Option	✓	✓		
	with ControlNet	✓	✓		✓
C	Drive Only	✓			
	with any Comm Option	✓			
	with ControlNet	✓			✓
D	Drive Only	✓			
	with any Comm Option	✓			
	with ControlNet	✓			✓
E	Drive Only	✓			
	with any Comm Option	✓			
	With ControlNet	✓			✓

¹ See table 2.2 for frame size definitions.

² Input cables through a Ferrite Core (Frames A, B, and C Fair-Rite #2643102002 or equivalent, Frame D Fair-Rite #2643251002 or equivalent.).

2.6 Drive Connections

Figure 2.4 shows the locations of the drive terminal blocks and connectors used to set up and operate the drive on NEMA 1 drives.

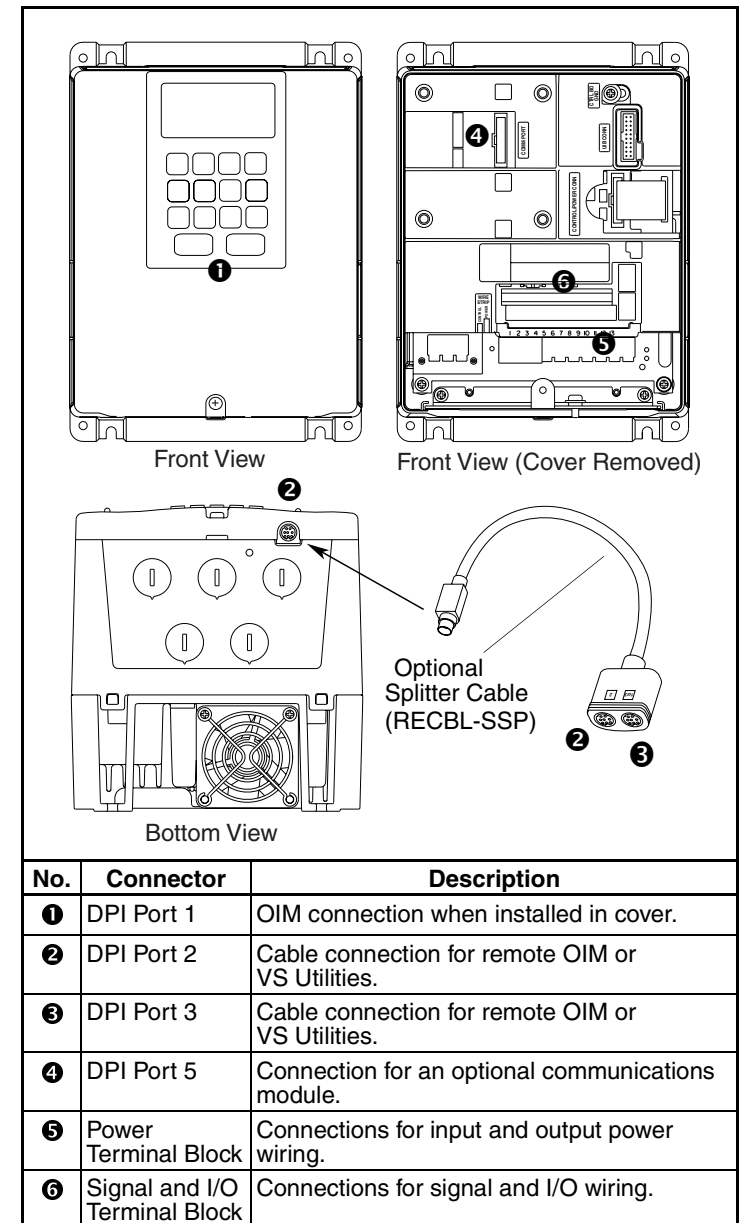
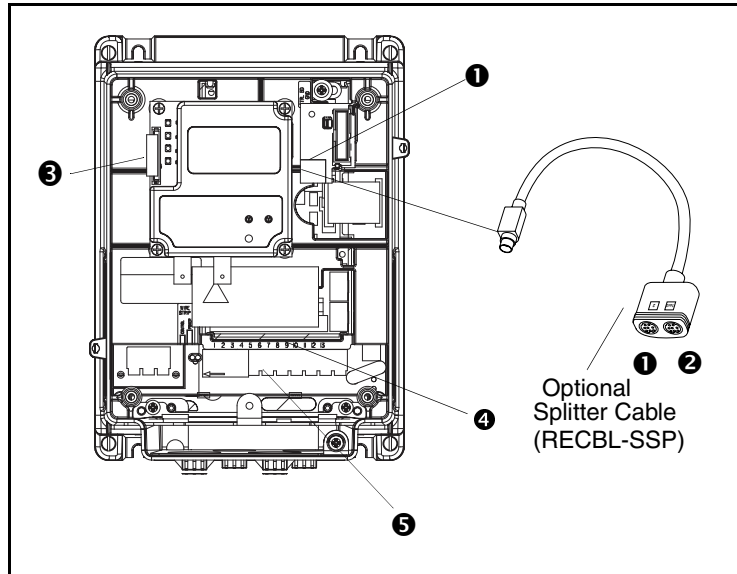


Figure 2.4 – Drive Connections (NEMA 1 Drives)

Figure 2.5 shows the locations of the drive terminal blocks and connectors used to set up and operate the drive on NEMA 4 drives. The NEMA 4 drive has a different location for the DPI serial connector (❶) than on the NEMA 1 drive.



No.	Connector	Description
❶	DPI Port 2	Cable connection for remote OIM or VS Utilities.
❷	DPI Port 3	Cable connection for remote OIM or VS Utilities.
❸	DPI Port 5	Connection for an optional communications module.
❹	Signal and I/O Terminal Block	Connections for signal and I/O wiring.
❺	Power Terminal Block	Connections for input and output power wiring.

Figure 2.5 – Drive Connections (NEMA 4 Drives)

2.7 Drive Communication Options

The flat-ribbon cable connector (labeled ④ in figure 2.4 and ⑤ in figure 2.5) is a parallel bus connection port that provides a means of attaching optional communication modules such as the DeviceNet Network Communication module to the SP600 AC drive.

The optional module is mounted inside the drive. Refer to the appropriate module instruction manual for more information. See 2.7 for a list of available communication options.

Table 2.7 – Communication Options Model Numbers and Instruction Manual Numbers

Description	Model Number	Instruction Manual
DeviceNet Communication Module	RECOMM-DNET	D2-3478
Profibus Communication Module	RECOMM-PBUS	D2-3479
Interbus Communication Module	RECOMM-IBUS	D2-3480
ControlNet Communication Module	RECOMM-CNET	D2-3497
EtherNet/IP Communication Module	RECOMM-ENET	D2-3510
RS485 DF1 Communication Module	RECOMM-485	D2-3514

2.8 Remote Operator Interface

The SP600 drive can be controlled and monitored using a remote LCD OIM (Operator Interface Module). Note that you must set parameters 89 and 90 to “DPI Port 2” to enable control from the remote keypad.

Table 2.8 – Remote OIM Model Numbers and Instruction Manual Numbers

Description	Model Number	Instruction Manual
Remote NEMA 4X LCD OIM	RE4LCD-PNL	D2-3490
Remote Small NEMA 4X LCD OIM	RE4ALCD	D2-3525

2.8.1 Connecting the Remote OIM or VS Utilities to the Drive

NEMA 1 Drives

The remote OIM or VS Utilities (via the Serial Converter, see section 2.10) connects to DPI port 2 at the bottom of the drive frame (labeled ② in figure 2.4).

NEMA 4 Drives

The connector for the remote OIM or VS Utilities is located inside the drive. You must route the cable through the bottom conduit holes in the drive and connect it to DPI port 2 as shown in figure 2.6.

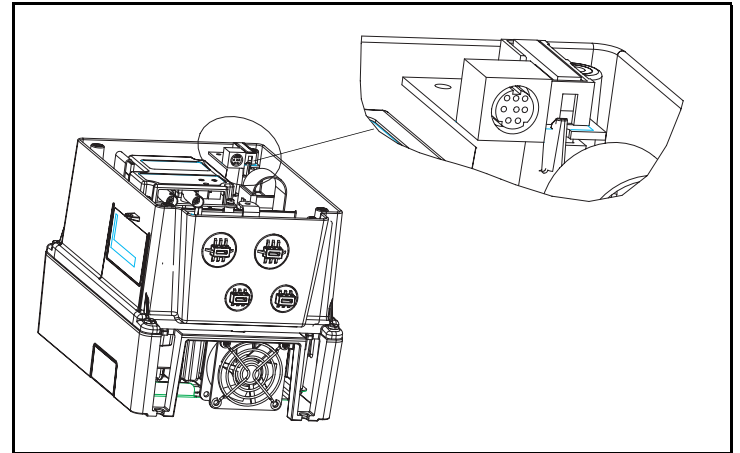


Figure 2.6 – DPI Port 2 on NEMA 4 Drives

2.9 PC-Based Utility

The SP600 drive can be configured using a PC-based software utility such as VS Utilities. This program enables you to upload and download parameter configurations.

Table 2.9 – PC-Based Utility Model Number and Instruction Manual Number

Description	Model Number	Instruction Manual
VS Utilities	RECOMM-VSU232	D2-3488
Serial Converter for DPI Drives (included with VS Utilities)	RECOMM-232	D2-3477

Mounting the Drive

This chapter provides information that must be considered when planning a SP600 AC drive installation and provides drive mounting information. Installation site requirements, drive requirements, and wiring requirements are presented.



ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

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

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: Do not submerge NEMA 4X/12 drives in water. Use a waterproof cable gland for the cable lead-in section. After wiring is complete, mount the front cover and bottom cover carefully to avoid damaging the gasket. The front cover mounting screws are made of stainless steel. Replacement screws must be stainless steel and of the same length. Failure to observe this precaution could result in damage to, or destruction of the equipment.

3.1 General Requirements for the Installation Site

It is important to properly plan before installing a SP600 AC drive to ensure that the drive's environment and operating conditions are satisfactory.

Note that no devices are to be mounted behind the drive. If air-cooled devices are mounted near the drive, the hot air exhaust may raise the ambient temperature level above what is allowed for safe operation of the drive.

The area behind the drive must be kept clear of all control and power wiring. Power connections may create electromagnetic fields that may interfere with control wiring or components when run in close proximity to the drive.

Read the recommendations in the following sections before continuing with drive installation.

3.1.1 Verifying Power Module AC Input Ratings Match Available Power

SP600 drives are suitable for use on a circuit capable of delivering up to a maximum of 200,000 rms symmetrical amperes and a maximum of 600 volts (nominal based on drive rating).



ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in section 4.4.

3.1.1.1 Unbalanced or Ungrounded Distribution Systems



ATTENTION: SP600 drives contain protective MOVs and common mode capacitors that are referenced to ground. To guard against drive damage, these devices should be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: To avoid electric shock hazard, verify that the voltage on the bus capacitors has discharged before removing/installing jumpers. Measure the DC bus voltage at the +DC terminal of the Power Terminal Block and the -DC test point. The voltage must be zero.

To disconnect the MOVs and common mode capacitors, remove the jumper(s) shown in figures 3.1 and 3.2 and table 3.1.

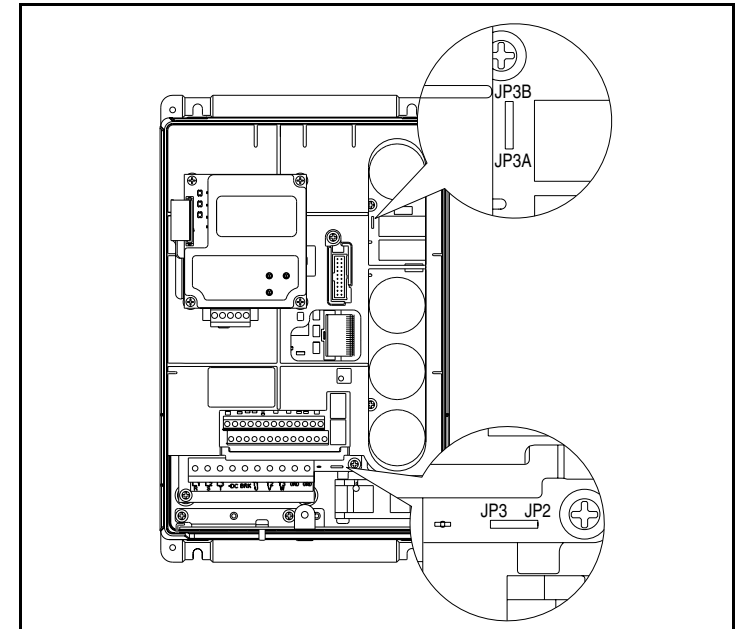


Figure 3.1 – Typical Jumper Locations (C Frame Shown)

Table 3.1 – MOV and Common Mode Capacitor Jumpers

Frame	Jumper	Removes
A	N/A	
B	JP6-JP5	Common Mode Capacitors to Ground
C and D	JP3B – JP3A	Common Mode Capacitors to Ground
E	JP3 – JP4	Common Mode Capacitors to Ground

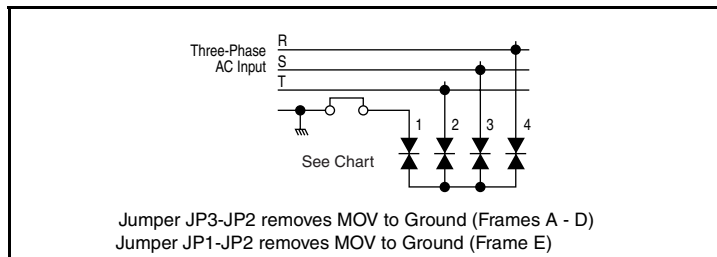


Figure 3.2 – Phase-to-Ground MOV Removal

3.1.1.2 Input Power Conditioning

Certain events on the power system supplying a drive can cause component damage or shortened product life. These conditions are divided into two basic categories:

All Drives

- The power system has power factor correction capacitors switched in and out of the system either by the user or by the power company.
- The power source has intermittent voltage spikes in excess of 6000 volts. These spikes could be caused by other equipment on the line or by events such as lightning strikes.
- The power source has frequent interruptions.

2. 5 HP or Less Drives

In addition to the conditions listed under All Drives:

- The nearest supply transformer is larger than 100 kVA or the available short circuit (fault) current is greater than 100,000 A.
- The impedance in front of the drive is less than 0.5%.

If any or all of these conditions exist, it is recommended that the user install a minimum amount of impedance between the drive and the source. This impedance could come from the supply transformer itself, the cable between the transformer and drive, or an additional transformer or reactor.

3.1.2 Making Sure Environmental Conditions are Met

Before deciding on an installation site, consider the following guidelines:

- Verify that NEMA 1 drives can be kept clean, cool, and dry.
- The area chosen should allow the space required for proper air flow as defined in section 3.1.3.
- Be sure that NEMA 1 drives are away from oil, coolants, or other airborne contaminants.
- Do not install the drive more than 3300 feet above sea level without derating output power. For every 300 feet above 3300 feet, derate the output current 1%.
- Verify that the drive location will meet the temperature and environmental requirements in table A.3 in Appendix A.

3.1.3 Minimum Mounting Clearances

Be sure there is adequate clearance for air circulation around the drive. SP600 NEMA 1 drives are rated at 50°C. NEMA 4 drives are rated 40°C and can be mounted with minimum side clearance. For best air movement, do not mount SP600 AC drives directly above each other.

Note that no devices are to be mounted behind the drive. This area must be kept clear of all control and power wiring. See figure 3.3 for recommended air flow clearances.

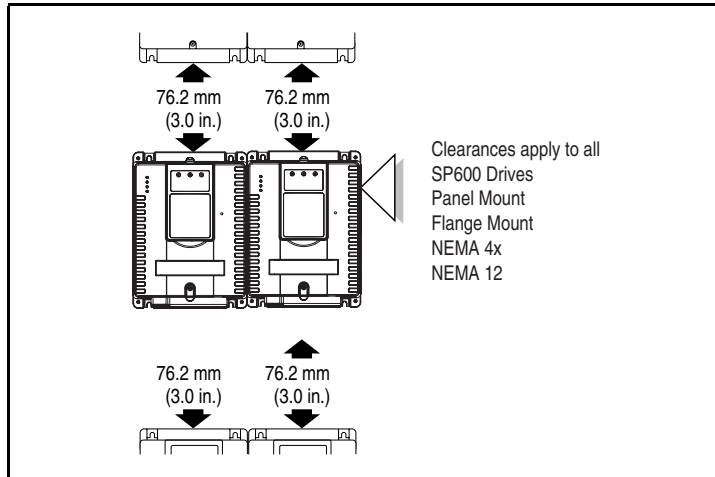


Figure 3.3 – Minimum Mounting Clearances

3.1.4 Drive Dimensions and Weights

Overall dimensions and weights are illustrated in figures 3.4 - 3.5 as an aid to calculating the total area required by the SP600 AC drive.

Table 3.2 – SP600 Frames

Output Power		Frame Size								
HP ND (HD)	kW ND (HD)	208-240V AC Input			400-480V AC Input			600V AC Input		
		Not Filtered	Filtered	IP66	Not Filtered	Filtered	IP66	Not Filtered	Filtered	IP66
0.5 (0.33)	0.37 (0.25)	A	B	B4	A	B	B4	A	-	B4
1 (0.75)	0.75 (0.55)	A	B	B4	A	B	B4	A	-	B4
2 (1.5)	1.5 (1.1)	B	B	B4	A	B	B4	A	-	B4
3 (2)	2.2 (1.5)	B	B	B4	B	B	B4	B	-	B4
5 (3)	4 (3)	-	C	D4	B	B	B4	B	-	B4
7.5 (5)	5.5 (4)	-	D	D4	-	C	D4	C	-	D4
10 (7.5)	7.5 (5.5)	-	D	D4	-	C	D4	C	-	D4
15 (10)	11 (7.5)	-	D	D4	-	D	D4	D	-	D4
20 (15)	15 (11)	-	E	E4	-	D	D4	D	-	D4
25 (20)	18.5 (15)	-	E	E4	-	D	D4	D	-	D4
30 (25)	22 (18.5)	-	-	-	-	D	D4	D	-	D4
40 (30)	30 (22)	-	-	-	-	E	E4	E	-	E4
50 (40)	37 (30)	-	-	-	-	E	E4	E	-	E4

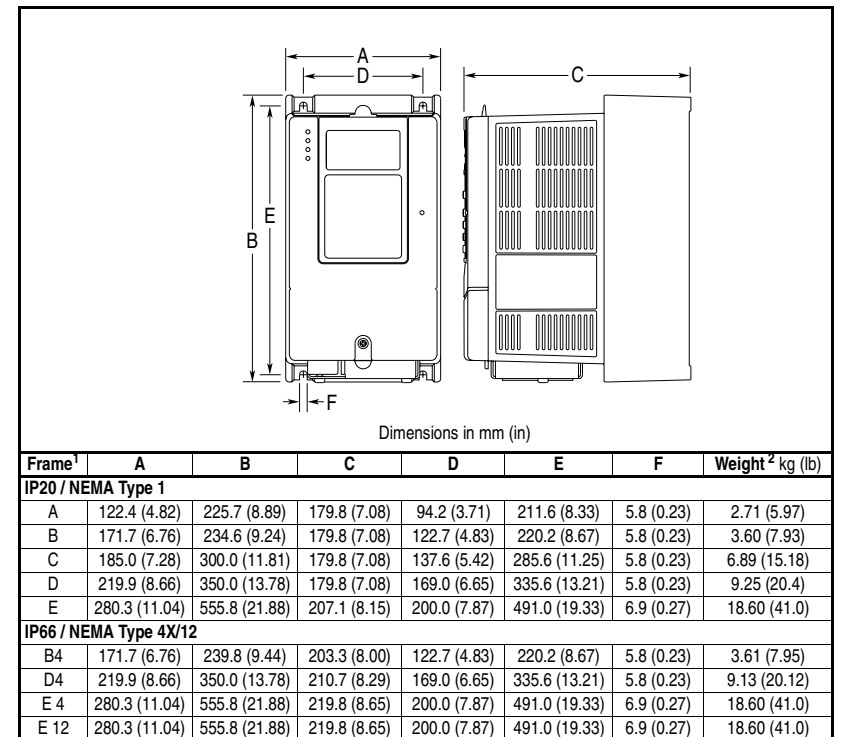
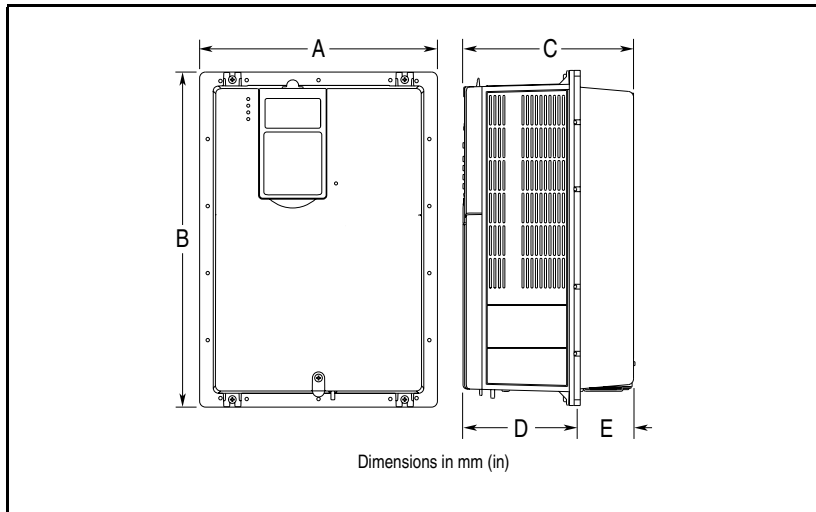


Figure 3.4 – Panel-Mount Drive Dimensions

¹ See table 3.2.

² Weights include OIM and standard I/O.



Frame ¹	A	B	C	D	E	Weight ² kg (lb)
Flange Mount						
A	156.0 (6.14)	225.8 (8.89)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	5.22 (11.5)
B	205.2 (8.08)	234.6 (9.24)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	7.03 (15.5)
C	219.0 (8.62)	300.0 (11.81)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	12.52 (27.6)
D	248.4 (9.78)	350.0 (13.78)	178.6 (7.03)	117.2 (4.61)	55.6 (2.19)	18.55 (40.9)
E	280.3 (11.04)	555.8 (21.88)	207.1 (8.15)	130.0 (5.12)	89.9 (3.54)	18.60 (41.0)

Figure 3.5 – Flange-Mount Drive Dimensions

¹ See table 3.2.

² Weights include OIM and standard I/O.

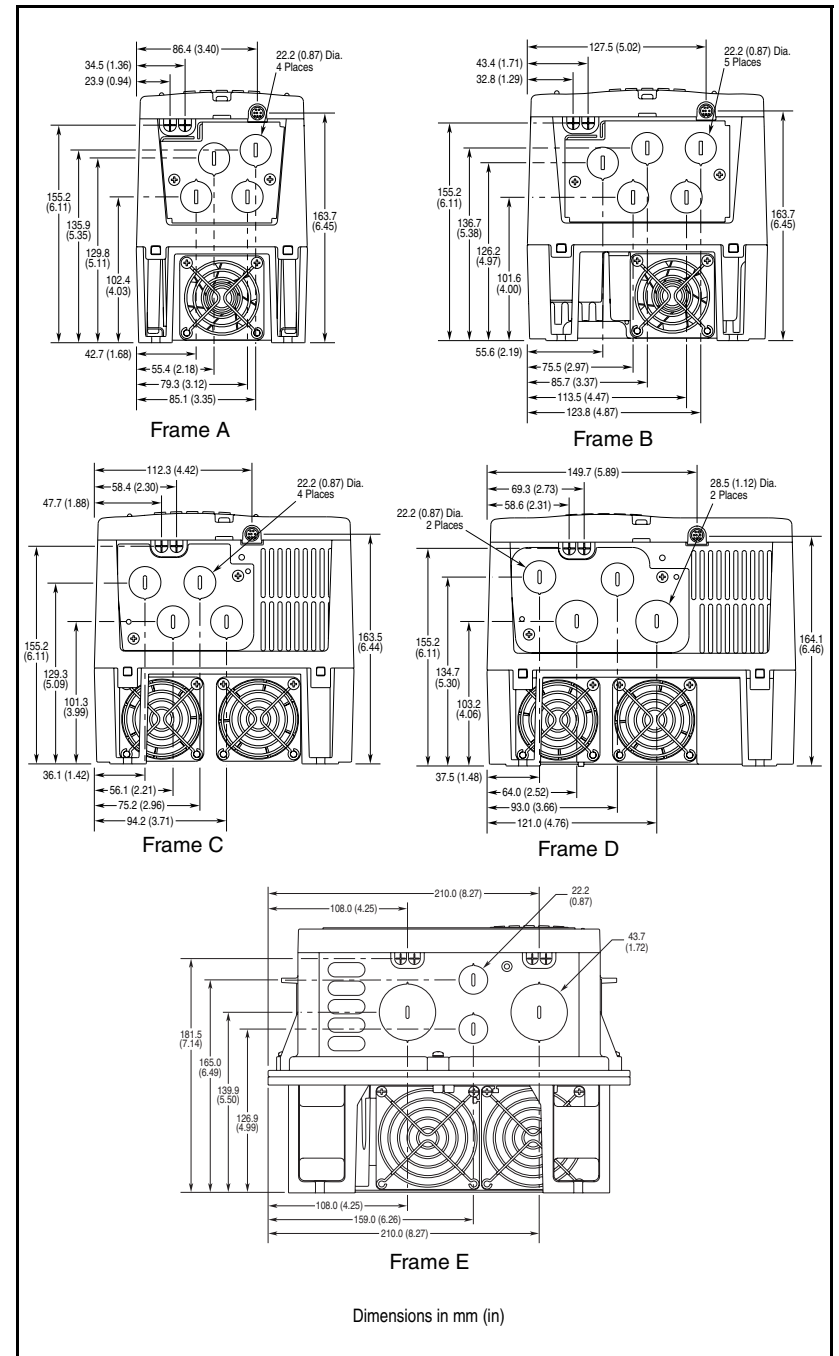


Figure 3.6 – SP600 IP20/ Nema Type 1 Bottom View Dimensions

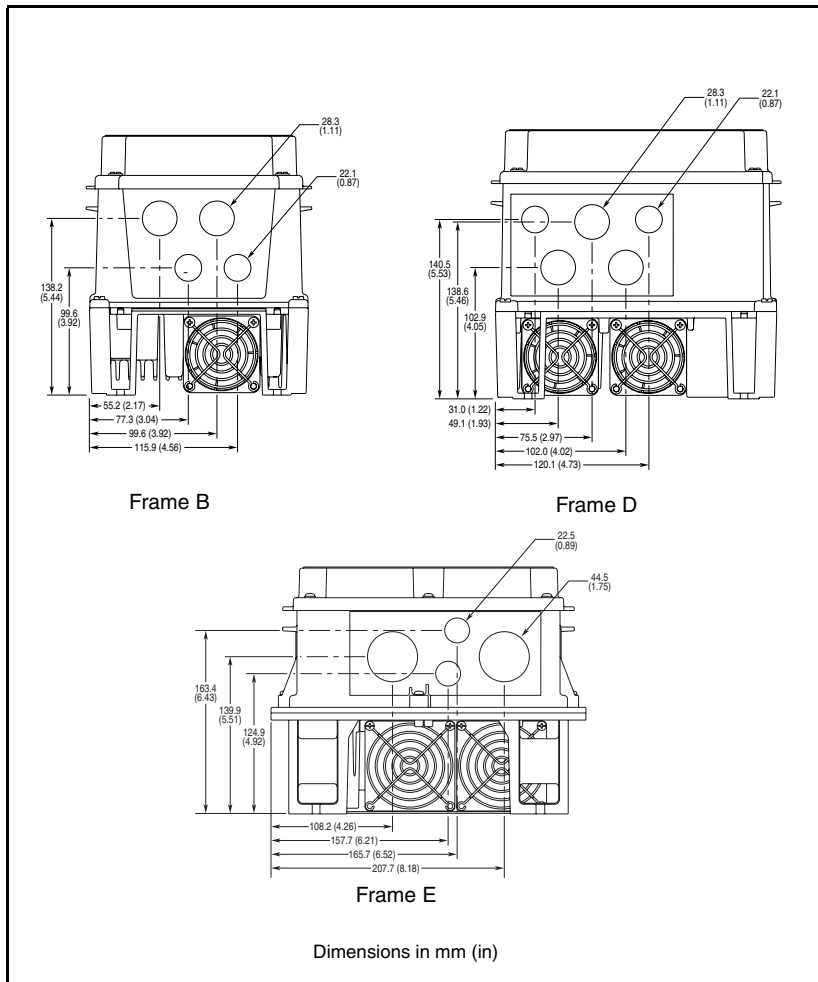


Figure 3.7 – SP600 IP66 (NEMA Type 4X/12) Bottom View Dimensions

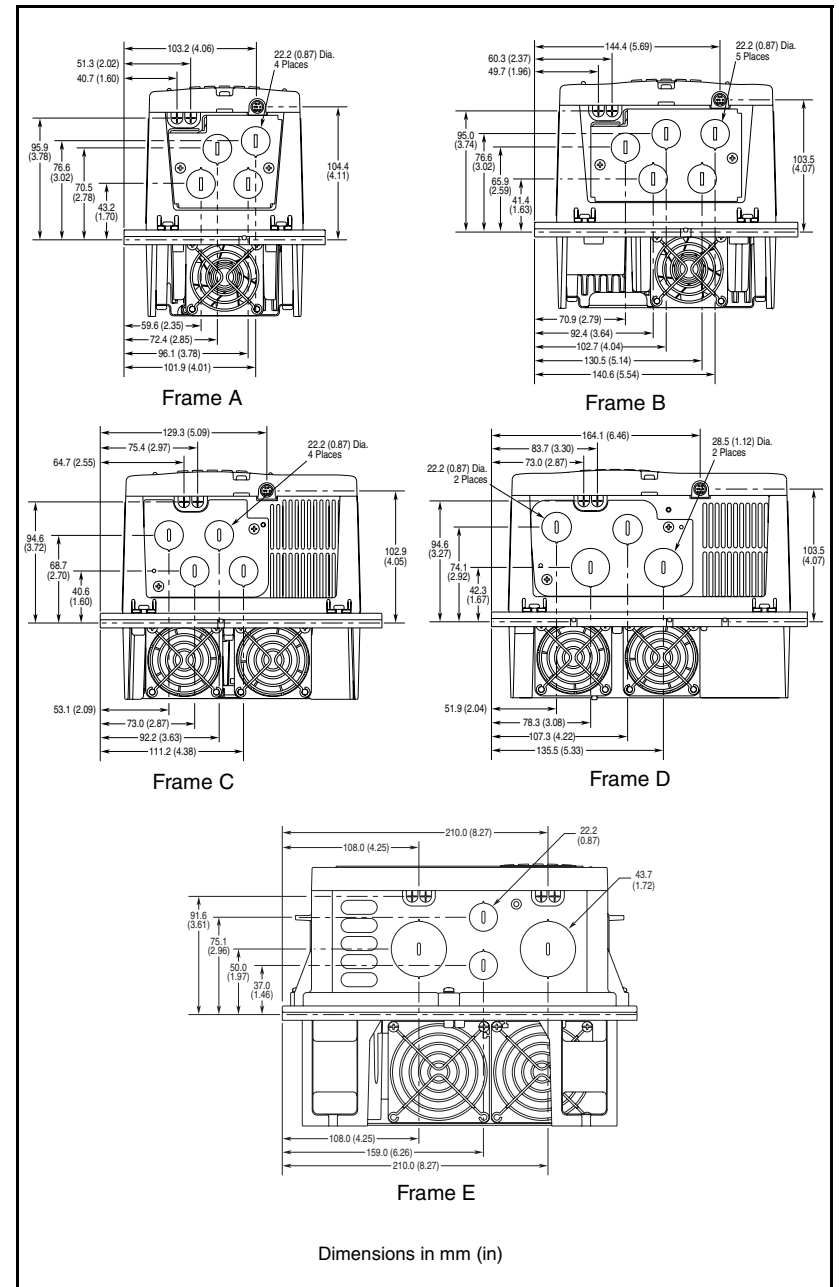


Figure 3.8 – SP600 Flange-Mount Bottom View Dimensions

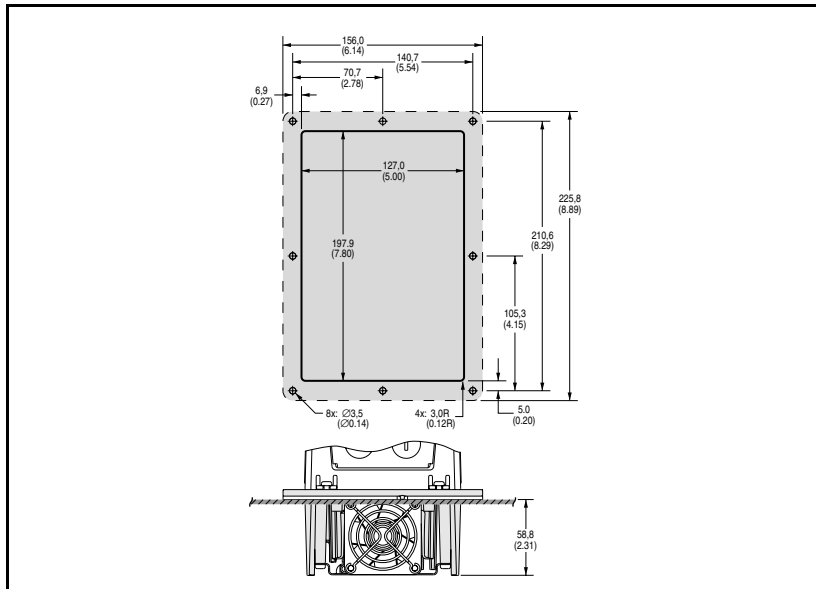
3.2 Mounting the Drive

Refer to figures 3.4 and 3.5 for drive mounting dimensions. See figures 3.9 to 3.12 for flange-mount cutout dimensions. AutoCad™ dimension drawings (.dxf) can be obtained from the www.reliance.com website.

Attach the drive to the vertical surface using the mounting holes provided.

Panel-mount drives: Drives should be mounted using 10-32 bolts. Use washers under the bolt heads.

Flange-mount drives: Use the fasteners supplied with the drive.



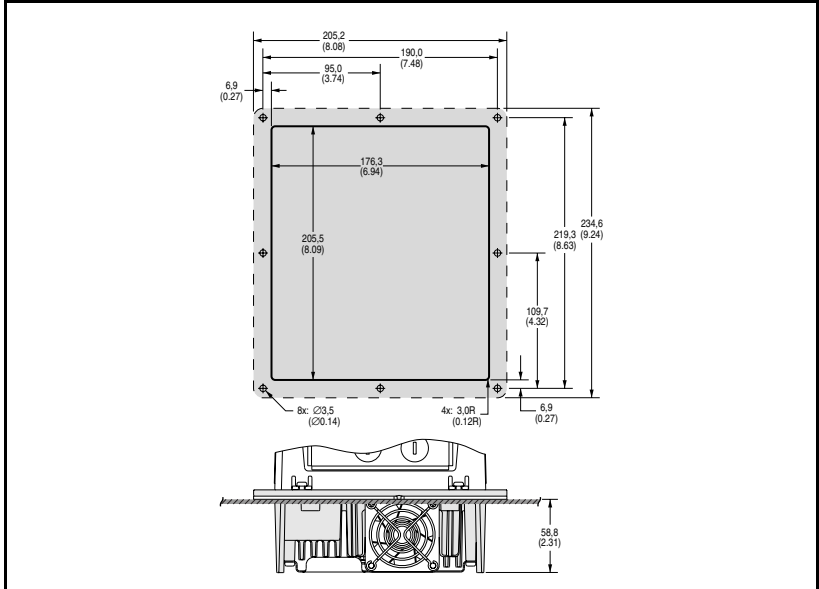


Figure 3.10 – B-Frame Flange-Mount Cutout Dimensions

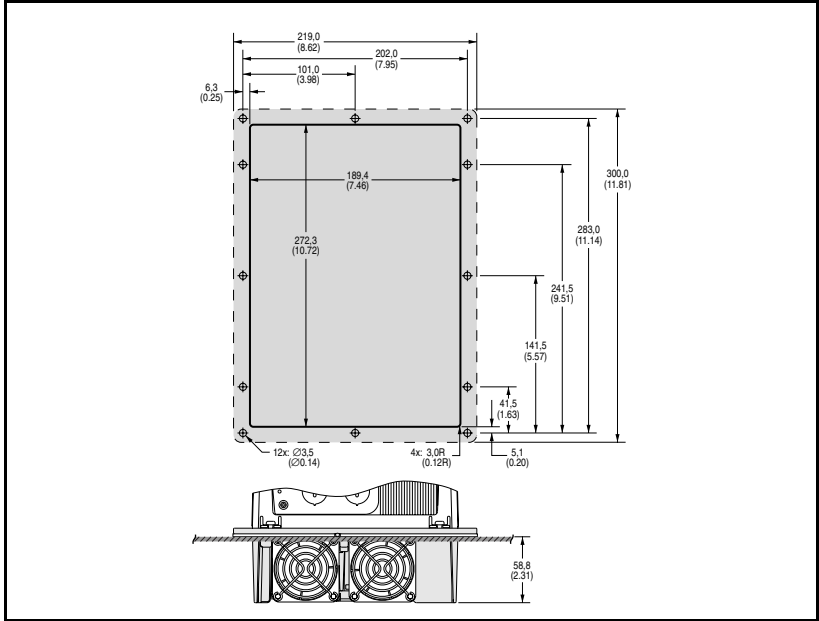


Figure 3.11 – C-Frame Flange-Mount Cutout Dimensions

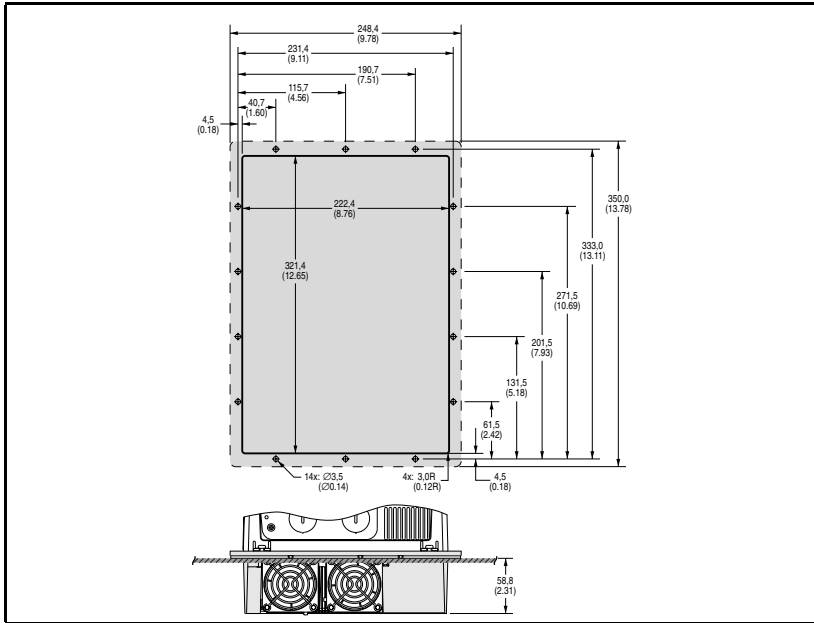


Figure 3.12 – D-Frame Flange-Mount Cutout Dimensions

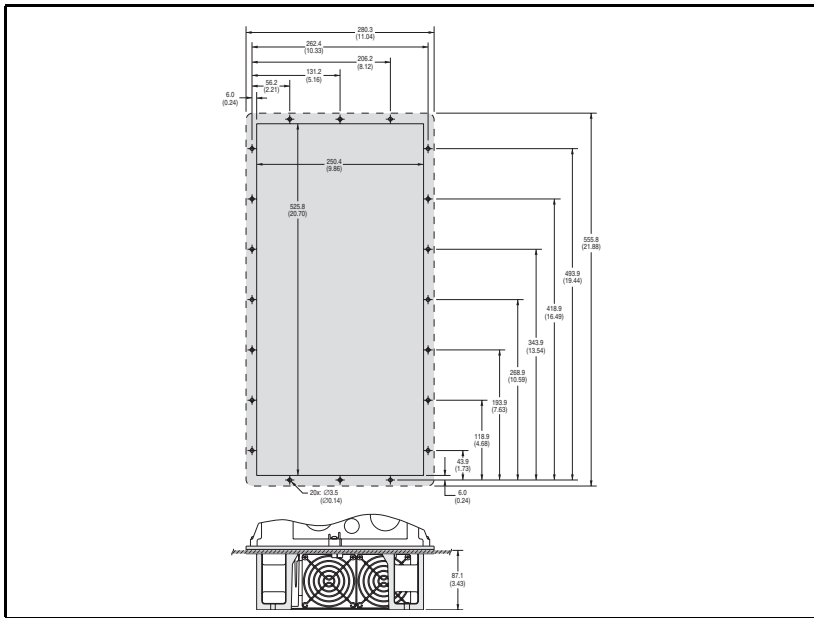


Figure 3.13 – E-Frame Flange-Mount Cutout Dimensions

3.2.1 Verifying the Drive's Watts Loss Rating

When mounting the drive inside another enclosure, determine the watts loss rating of the drive from tables 2.4 through 2.6. These tables list the typical full load power loss watts value @ 4 kHz carrier frequency. Ensure that the enclosure is adequately ventilated and the ambient air is within the specified temperature range:

- NEMA 1: 0° to 50°C (32° to 122°F)
- NEMA 4X: 0° to 40°C (32° to 104°F).

Wiring Requirements for the Drive



ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Wire size should be determined based on the size of conduit openings, and applicable local, national, and international codes, such as NEC/CEC. Evaluate wire sizes, branch circuit protection, and E-stop wiring (see section 7.1) before continuing with the drive installation.

4.1 Power Wiring



ATTENTION: National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits.

As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than or equal to 15 mils (0.4 mm/0.015 in). See table 4.1.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas.** Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches, and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations, or a high degree of communications/networking are also good candidates for shielded cable.

Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics, and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket. See table 4.1.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

Table 4.1 – Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	<ul style="list-style-type: none"> • Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90° C (194° F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	<ul style="list-style-type: none"> • Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90° C (194° F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	<ul style="list-style-type: none"> • Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight-resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

4.1.1 Power Wire Sizes

Input power wiring should be sized according to applicable codes to handle the drive's continuous-rated input current. Output wiring should be sized according to applicable codes to handle the drive's continuous-rated output current. See table 4.2 for the range of power wire sizes that the terminals can accommodate.

Table 4.2 – Power Terminal Block Specifications

Name	Description	Frame	Wire Size Range ¹		Torque
			Max	Min	
Power Terminal Block	Input power and motor connections	A, B & C	3.5 mm ² (12 AWG)	0.3 mm ² (22 AWG)	0.6 N-m (5 in-lb)
		D	8.4 mm ² (8 AWG)	0.8 mm ² (18 AWG)	1.4 N-m (12 in-lb)
		E	25.0 mm ² (3 AWG)	2.5 mm ² (14 AWG)	2.71 N-m (24 in-lb)
SHLD Terminal	Terminating point for wiring shields	All	---	---	1.6 N-m (14 in-lb)

¹ Maximum/minimum sizes that the terminal block will accept. These are not recommendations.

4.1.2 Using Input/Output Contactors

Input Contactor Precautions



ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If an input device is used, operation must not exceed one cycle per minute or drive damage will occur.

ATTENTION: The drive start/stop/enable control circuitry includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. An auxiliary braking method may be required.

Output Contactor Precaution



ATTENTION: To guard against drive damage when using output contactors, the following information must be read and understood. One or more output contactors may be installed between the drive and motor(s) for the purpose of disconnecting or isolating certain motors/loads. If a contactor is opened while the drive is operating, power will be removed from the respective motor, but the drive will continue to produce voltage at the output terminals.

Disconnecting a motor under load can cause damage to the contactor as well as the drive because the DV/DT (change in voltage/Change in time) is severe causing a rapid increase in current at the contacts and the resultant current draw from the drive. If at all possible, a control scheme should attempt to send a stop to the drive to minimize any energy being sent to the motor before opening the contactors. In addition, reconnecting a motor to an active drive (by closing the contactor) could produce excessive current that may cause the drive to fault. If any of these conditions are determined to be undesirable or unsafe, an auxiliary contact on the output contactor should be wired to a drive digital input that is programmed as "Enable." This will cause the drive to execute a coast-to-stop (cease output) whenever an output contactor is opened, helping to prevent the drive from operating without the contactors' prior closure.

4.2 Control and Signal Wire

The terminal block on the Main Control board provides terminals for 24VDC power for the eight remote control inputs as well as the terminals for the analog input/output signals. Refer to tables 4.3 and 4.4 for signal and control wiring specifications.

Table 4.3 – Recommended Signal and Control Wire

Signal Type	Wire Type(s)	Description	Minimum Insulation Rating
Analog I/O	Belden 8760/9460 (or equiv.)	0.750 mm ² (18 AWG), twisted pair, 100% shield with drain ¹ .	300V, 75-90° C (167-194°F)
	Belden 8770 (or equiv.)	0.750 mm ² (18 AWG) 3-conductor, shielded for remote pot only.	
Unshielded Control	Per US NEC or applicable national or local code	-	300V, 60° C (140°F)
Shielded Control	Multi-conductor shielded cable such as Belden 8770 (or equiv.)	0.750 mm ² (18 AWG), 3-conductor, shielded.	

¹ If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

Table 4.4 – I/O Terminal Block Specifications

Name	Description	Wire Size Range ¹		Torque
		Maximum	Minimum	
I/O Terminal Block	Signal and control connections	1.5 mm ² (16 AWG)	0.05 mm ² (30 AWG)	0.5 N-m (4.4 in-lb)

¹ Maximum/minimum that the terminal block will accept. These are not recommendations.

4.3 Recommended Motor Lead Lengths

Important: To reduce line disturbances and noise, motor lead length should not exceed 200 feet for any non-Reliance Electric motor or any non-inverter duty motor.

The length of cable between the drive and motor may be limited for various application reasons. The primary areas of concern are:

- Reflected wave
- Cable charging

When total lead length exceeds 200 feet, nuisance trips can occur caused by capacitive current flow to ground. Note that these capacitively-coupled currents should be taken into consideration when working in areas where drives are running. If the motor lead length must exceed these limits, the addition of output line reactors (see section 6.3.1) or other steps must be taken to avoid problems.

Your application may be restricted to a shorter lead length due to:

- the type of wire (shielded or unshielded)
- the placement of wire (for example, in conduit or a cable tray)
- the type of line reactor
- the type of motor (voltage class, 1000 V, 1200 V, or 1600 V)
- carrier frequency

Figure 4.1 illustrates how to calculate motor lead lengths. The examples shown assume a maximum lead length of 200 feet.

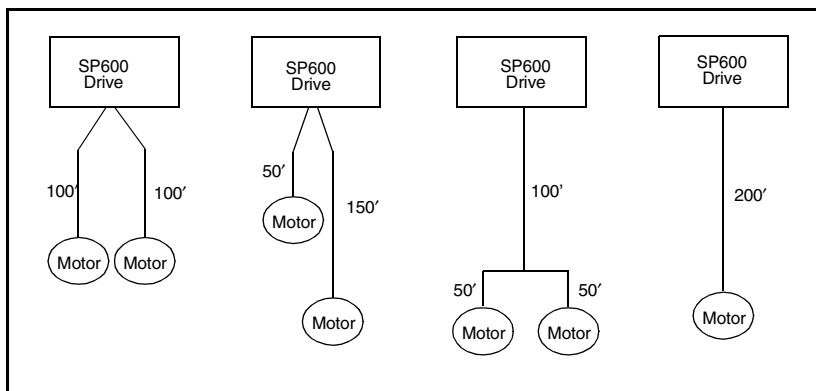


Figure 4.1 – How to Calculate Motor Lead Lengths

Motor lead lengths in excess of 200 feet are possible provided proper conditions are met. See table A.8 in Appendix A.

4.3.1 Reflected Wave Compensation

You must understand the effects and restrictions when applying the drive to extended motor lead length applications. Proper cable type, motor and drive selection is required to minimize the potential risks.

The reflected wave phenomenon, also known as transmission line effect, produces very high peak voltages on the motor due to voltage reflection. Voltages in excess of twice the DC bus voltage, (650 V DC nominal @480 V input) result at the motor and can cause motor winding failure.

While Reliance Electric drives have patented software that limits the voltage peak to 2 times the DC bus voltage and reduce the number of occurrences, many motors have inadequate insulation systems to tolerate these peaks.

The correction software modifies the PWM modulator to prevent PWM pulses less than a minimum time from being applied to the motor. The minimum time between PWM pulses is 10 microseconds. The modifications to the PWM modulator limit the overvoltage transient to 2.25 per unit volts line-to-line peak at 600 feet of cable.

- 400 V Line = 540V DC bus (max) x 2.25 = 1200 V
- 480 V Line = 715V DC bus (max) x 2.25 = 1600 V
- 600 V Line = 891V DC bus (max) x 2.25 = 2000 V

Parameter 56 is used to enable or disable this feature. Refer to the parameter description in chapter 12 for more information.

Figure 4.2 shows the inverter line-to-line output voltage (top trace) and the motor line-to-line voltage (bottom trace) for a 10 HP, 460 V AC inverter, and an uploaded 10 HP AC induction motor at 60 Hz operation. 500 ft. of #12 AWG PVC cable connects the drive to the motor.

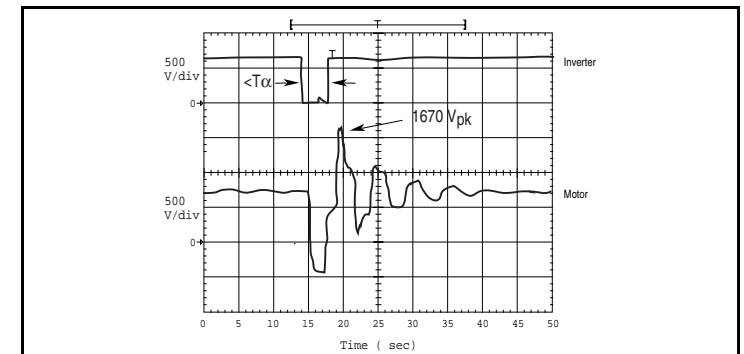


Figure 4.2 – Inverter and Motor Line-to-line Voltages

Initially, the cable is in a fully charged condition. A transient disturbance occurs by discharging the cable for approximately 4 ms. The propagation delay between the inverter terminals and motor terminals is approximately 1 ms. The small time between pulses of 4 ms does not provide sufficient time to allow the decay of the cable transient. Thus, the second pulse arrives at a point in the motor terminal voltage's natural response and excites a motor overvoltage transient greater than 2 pu.

The amplitude of the double pulsed motor overvoltage is determined by a number of variables. These include the damping characteristics of the cable, bus voltage, and the time between pulses, the carrier frequency, modulation technique, and duty cycle.

Figure 4.3 shows the per unit motor overvoltage as a function of cable length. This is for no correction versus the modulation correction code for varied lengths of #12 AWG PVC cable to 600 feet for a 4 kHz and 8 kHz carrier frequencies. The output line-to-line voltage was measured at the motor terminals in 100 feet increments.

Without the correction, the overvoltage increases to unsafe levels with increasing cable length for both carrier frequencies.

The patented modulation correction code reduces the overvoltage for both carrier frequencies and maintains a relatively flat overvoltage level for increasing cable lengths beyond 300 feet.

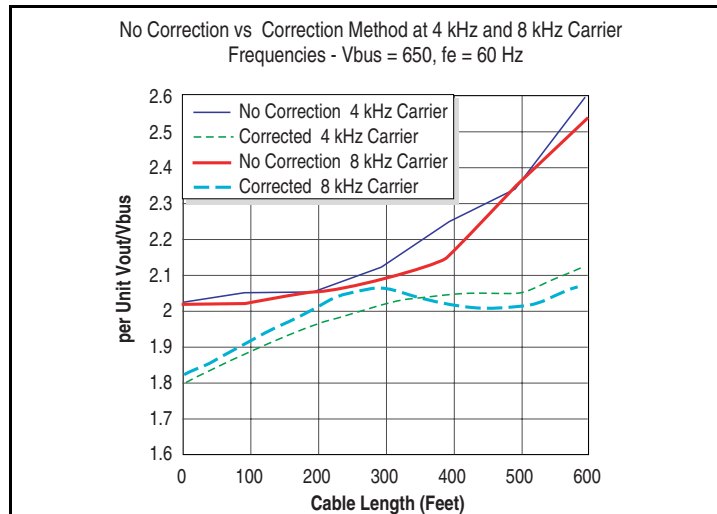


Figure 4.3 – Motor Overvoltage as a Function of Cable Length

4.4 Selecting Input Line Branch Circuit Protection



ATTENTION: Most codes require that upstream branch circuit protection be provided to protect input power wiring. Install the fuses or circuit breakers recommended in tables 4.5 through 4.7. Do not exceed the fuse or circuit breaker ratings. Failure to observe this precaution could result in a dangerous condition and/or damage to equipment.

Input line branch circuit protection fuses or circuit breakers must be used to protect the input power lines. Tables 4.5, 4.6, and 4.7 provide recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. The input fuse or circuit breaker ratings listed in the tables are applicable for one drive per branch circuit. No other load may be applied to that circuit. Sizes listed are the recommended sizes based on 40° C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2¹, EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T or J must be used.²

Circuit Breakers

The circuit breakers listed in tables 4.5 through 4.7 are for inverse time circuit breakers.

¹ Typical designations include, but may not be limited to the following: Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

² Typical designations include: Type CC - KTK-R, FNQ-R;
Type J - JKS, LPJ; Type T - JJS, JJN

Table 4.5 – SP600 208/240 VAC Input Recommended Protection Devices

Model Number	HP		Dual Element Time Delay Fuse		Non-time Delay Fuse		Circuit Breaker ¹
	ND	HD	Min ²	Max ³	Min ²	Max ³	Max ⁴
208 VAC Input							
6SP201-2P2	0.5	0.33	6	6	6	10	15
6SP201-4P2	1	0.75	10	10	10	17.5	15
6SP201-6P8	2	1.5	15	15	15	30	30
6SP201-9P6	3	2	20	25	20	40	40
6SP201-015	5	3	20	35	20	70	70
6SP201-022	7.5	5	25	50	25	100	100
6SP201-028	10	7.5	35	70	35	125	125
6SP201-042	15	10	60	100	60	175	175
6SP201-054	20	15	80	125	80	200	200
6SP201-070	25	20	90	175	90	300	300
240 VAC Input							
6SP201-2P2	0.5	0.33	4	4.5	6	8	15
6SP201-4P2	1	0.75	6	9	10	15	15
6SP201-6P8	2	1.5	15	15	15	25	25
6SP201-9P6	3	2	20	20	20	35	35
6SP201-015	5	3	20	30	20	60	60
6SP201-022	7.5	5	25	45	25	80	80
6SP201-028	10	7.5	35	60	35	110	110
6SP201-042	15	10	50	90	50	150	150
6SP201-054	20	15	60	100	60	200	200
6SP201-070	25	20	90	150	90	275	275

¹ Circuit Breaker - inverse time breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum

² Minimum protection device size is the lowest rated device that supplies maximum protection without nuisance tripping.

³ Maximum protection device size is the highest rated device that supplies drive protection. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

⁴ Maximum allowable by US NEC. Exact size must be chosen for each installation.

Table 4.6 – SP600 400/480 VAC Input Recommended Protection Devices

Model Number	kW		Dual Element Time Delay Fuse		Non-time Delay Fuse		Circuit Breaker ¹
	ND	HD	Min ²	Max ³	Min ²	Max ³	Max ⁴
400 VAC Input							
6SP401-1P1	0.37	0.25	3	3	3	5	15
6SP401-2P1	0.75	0.55	4	6	4	8	15
6SP401-3P4	1.5	1.1	6	6	6	12	15
6SP401-005	2.2	1.5	10	10	10	20	20
6SP401-008	4	3	15	17.5	15	30	30
6SP401-011	5.5	4	15	25	15	45	40
6SP401-014	7.5	5.5	20	30	20	60	60
6SP401-022	11	7.5	30	45	20	80	80
6SP401-027	15	11	40	60	40	120	120
6SP401-034	18.5	15	45	80	45	125	125
6SP401-040	22	18.5	60	90	60	150	150
6SP401-052	30	22	80	125	80	225	240
6SP401-065	37	30	90	150	90	250	280
Model Number	HP		Dual Element Time Delay Fuse		Non-time Delay Fuse		Circuit Breaker ¹
	ND	HD	Min ²	Max ³	Min ²	Max ³	Max ⁴
480 VAC Input							
6SP401-1P1	0.5	0.33	3	3	3	4	15
6SP401-2P1	1	0.75	6	6	3	8	15
6SP401-3P4	2	1.5	6	6	6	12	15
6SP401-005	3	2	10	10	10	20	20
6SP401-008	5	3	15	15	15	30	30
6SP401-011	7.5	5	15	20	15	40	40
6SP401-014	10	7.5	20	30	20	50	50
6SP401-022	15	10	25	45	25	80	80
6SP401-027	20	15	35	60	35	100	100
6SP401-034	25	20	40	70	40	125	125
6SP401-040	30	25	50	90	50	150	150
6SP401-052	40	30	60	110	60	200	200
6SP401-065	50	40	80	125	80	250	250

¹ Circuit Breaker - inverse time breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum

² Minimum protection device size is the lowest rated device that supplies maximum protection without nuisance tripping.

³ Maximum protection device size is the highest rated device that supplies drive protection. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

⁴ Maximum allowable rating by US NEC. Exact size must be chosen for each installation.

Table 4.7 – SP600 600 VAC Input Recommended Protection Devices

Model Number	HP		Dual Element Time Delay Fuse		Non-time Delay Fuse		Circuit Breaker ¹
	ND	HD	Min ²	Max ³	Min ²	Max ³	Max ⁴
6SP501-0P9	0.5	0.33	3	3	3	3.5	15
6SP501-1P7	1	0.75	3	6	3	6	15
6SP501-2P7	2	1.5	4	6	4	10	15
6SP501-3P9	3	2	6	8	6	15	15
6SP501-6P1	5	3	10	12	10	20	20
6SP501-9P0	7.5	5	10	20	10	35	35
6SP501-011	10	7.5	15	20	15	40	40
6SP501-017	15	10	20	35	20	60	60
6SP501-022	20	15	25	45	25	80	80
6SP501-027	25	20	35	60	35	100	100
6SP501-032	30	25	40	70	40	125	125
6SP501-041	40	30	50	90	50	150	150
6SP501-052	50	40	60	110	60	200	200

¹ Circuit Breaker - inverse time breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum

² Minimum protection device size is the lowest rated device that supplies maximum protection without nuisance tripping.

³ Maximum protection device size is the highest rated device that supplies drive protection. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

⁴ Maximum allowable rating by US NEC. Exact size must be chosen for each installation.

Finding Wire-Routing Locations and Grounding the Drive

This chapter shows entry areas where wiring is to be routed in and out of the drive and how to properly ground it.

5.1 Routing Input, Motor Output, Ground, and Control Wiring for the Drive

All wiring must be installed in conformance with applicable local, national, and international codes, such as NEC/CEC. Signal wiring, control wiring, and power wiring must be routed in separate conduits to prevent interference with drive operation.

Note that no wires are to be routed behind the drive. Use grommets, when hubs are not provided, to guard against wire chafing.

Figure 5.1 shows the wire routing, grounding terminal, and power terminal blocks of the SP600 AC drives.



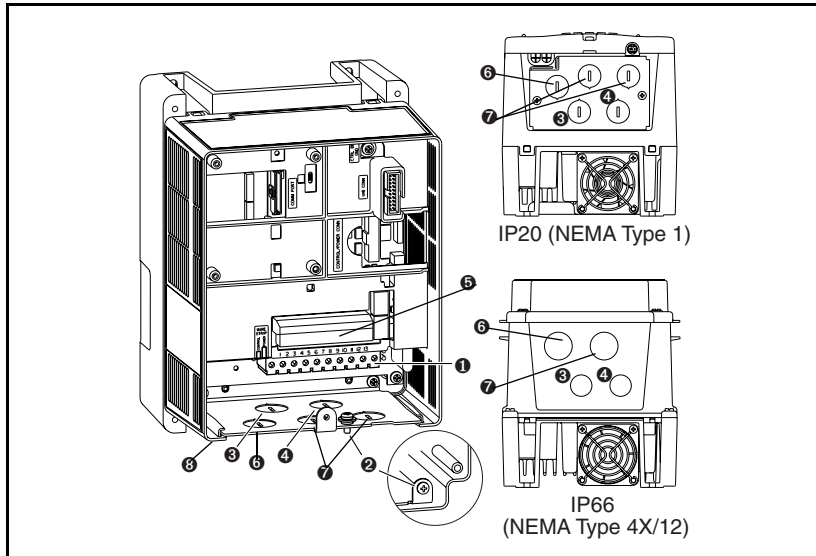
ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Do not route more than three sets of motor leads through a single conduit. This will minimize cross-talk that could reduce the effectiveness of noise reduction methods. If more than three drive/motor connections per conduit are required, shielded cable must be used. If possible, each conduit should contain only one set of motor leads.

If additional wiring access is needed, the Cable Entry Plate (item — in figure 5.1) on all drive frames can be removed. Simply loosen the screws securing the plate to the heat sink and slide the plate out.



ATTENTION: Unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages. Also, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled to eliminate the possible shock hazard from cross-coupled motor leads. Failure to observe these precautions could result in bodily injury.



①	Power Terminal Block
②	SHLD Terminal
③	Suggested entry for incoming line wiring
④	Suggested entry for motor wiring
⑤	I/O Terminal Block (Signal and Control)
⑥	Suggested entry for communication wiring
⑦	Suggested entry for I/O and control wiring
⑧	Cable Entry Plate

Figure 5.1 – Typical Wire Routing and Terminal Block Locations (5 HP Drive Shown)

Important: Use the plugs supplied with IP66 (NEMA Type 4X/12) rated drives to seal unused holes in the cable entry area.

5.2 Grounding the Drive



ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

The drive Safety Ground - PE terminal must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

For installations within a cabinet, a single safety ground point or ground bus bar connected directly to building steel should be used. All circuits including the AC input ground conductor should be grounded independently and directly to this point/bar.

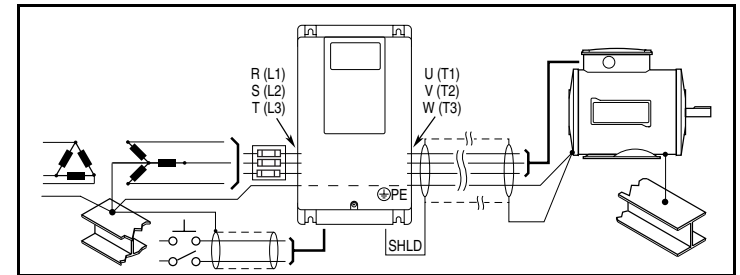


Figure 5.2 – Typical Grounding

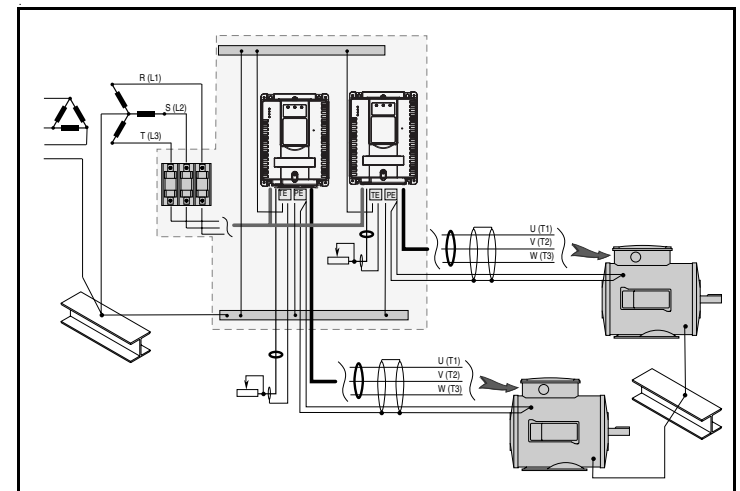


Figure 5.3 – Single-Point Grounding/Panel Layout

Safety Ground - PE

This is the safety ground for the drive that is required by code. This point must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar (see figures 5.2 and 5.3). Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Shield Termination - SHLD

The SHLD terminal located on the cable entry plate provides a grounding point for the motor cable shield. Refer to figure 5.1 for location.

The **motor cable** shield should be connected to this terminal (drive end) and the motor frame (motor end). A shield-terminating cable gland may so be used.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

RFI Filter Grounding

Using an optional RFI filter may result in relatively high ground leakage currents. Therefore, **the filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked.

Installing Power Wiring



ATTENTION: The user is responsible for conforming with all applicable local and national codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

This chapter provides instructions on output wiring to the motor and installing AC input power wiring. Refer to figure 6.5 for a description of the power terminal block.

6.1 Removing and Replacing the Cover



ATTENTION: DC bus capacitors retain hazardous voltages after input power has been removed. After disconnecting input power, wait five minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

6.1.1 Removing and Replacing the Cover on NEMA 1 Drives

Removing the Cover

Follow these steps to remove the drive cover on **NEMA 1 drives**:

- Step 1. Loosen the cover screw (refer to figure 6.1).
- Step 2. Lift the cover straight off the drive to avoid damaging the connector pins.

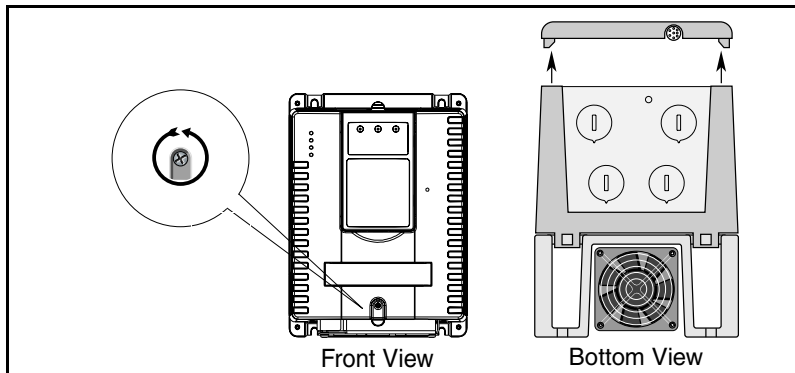


Figure 6.1 – Removing the Drive Cover (NEMA 1 Drives)

Replacing the Cover

Follow these steps to replace the drive cover on **NEMA 1 drives**:

- Step 1. Place the cover straight on the drive to avoid damaging the connector pins.
- Step 2. Tighten the cover screw.

6.1.2 Removing and Replacing the Cover on NEMA 4x/12 Drives

Removing the Cover

Follow these steps to remove the drive cover on **NEMA 4x/12 drives**:

- Step 1. Remove any user-supplied locks from the drive.
- Step 2. Loosen the four cover screws (refer to figure 6.2). Frame E has a total of 10 screws that need to be loosened.
- Step 3. Lift the cover straight off the drive to avoid damaging the connector pins.

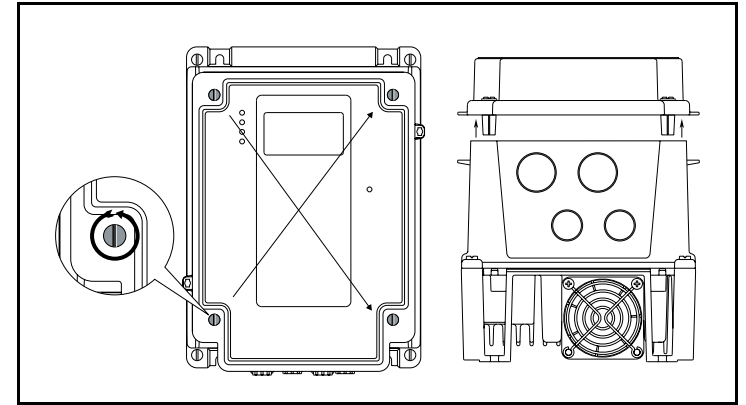


Figure 6.2 – Removing the Drive Cover (NEMA 4x/12 Drives) Frames B4 and D4 shown.

Replacing the Cover



ATTENTION: Mount the front cover and bottom cover carefully to avoid damaging the gasket. The front cover mounting screws are made of stainless steel. Replacement screws must be stainless steel and of the same length. Tighten the screws to the specifications shown on the underside of the cover. Failure to observe this precaution could result in damage to, or destruction of the equipment.

Use the following steps to replace the drive cover on **NEMA 4x/12 drives**.

- Step 1. Place the cover straight on the drive to avoid damaging the connector pins.
- Step 2. Working in a diagonal pattern around the drive, tighten the cover screws until resistance is met. Repeat this procedure to ensure the screws are securely tightened. Refer to the arrows in figure 6.2 for the tightening pattern.
The recommended tightening torque is 7.0 (0.79 N-m).
- Step 3. Replace any additional locks. Refer to section 6.1.2.1, Locking the Cover.

Important: Use the plugs supplied with IP66 (NEMA 4X/12) rated drives to seal unused holes in the conduit entry plate. Completely seat the plug inner rim for the best seal. See figure 6.3.

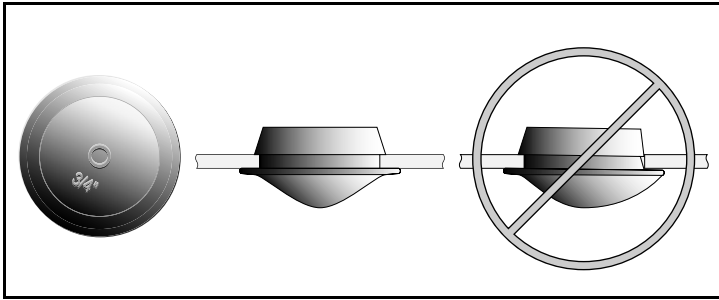


Figure 6.3 – Installing Plugs in Unused Holes in Conduit Entry Plate on NEMA 4X/12 Drives

6.1.2.1 Locking the Cover

The NEMA 4x/12 SP600 drive provides two sets of slots for use with user-supplied locks. Refer to figure 6.4.

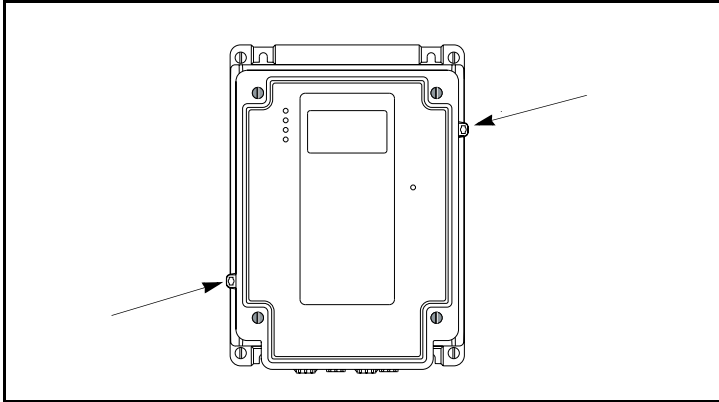


Figure 6.4 – Location of Slots for User-Supplied Locks on NEMA 4x/12 Drives

6.2 Installing Output Power Wiring



ATTENTION: Do not route signal and control wiring with power wiring in the same conduit. This can cause interference with drive operation. Failure to observe these precautions could result in damage to, or destruction of, the equipment

ATTENTION: Unused wires in conduit must be grounded at both ends to avoid a possible shock hazard caused by induced voltages. Also, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled to eliminate the possible shock hazard from cross-coupled motor leads. Failure to observe these precautions could result in bodily injury.

To connect the AC output power wiring from the drive to the motor:

Step 1. Wire the three-phase AC output power motor leads by routing them according to drive type. See figure 5.1 for wire routing locations. Maximum power wiring sizes are shown in table 4.2.

Do not route more than three sets of motor leads through a single conduit. This will minimize cross-talk that could reduce the effectiveness of noise reduction methods. If more than three drive/motor connections per conduit are required, shielded cable must be used. If possible, each conduit should contain only one set of motor leads.

Step 2. Connect the three-phase AC output power motor leads to terminals U/T1, V/T2, and W/T3 on the power terminal block. See figure 6.5.

Step 3. Tighten the three-phase AC output power terminals to the proper torque according to drive type as shown in table 6.1.

Table 6.1 – Terminal Tightening Torques

Horsepower Rating	Maximum Tightening Torque
0.5 HP - 5 HP @ 240 V 0.5 HP - 10 HP @ 480/600 V	0.6 N-m (5 in-lb)
7.5 HP - 10 HP @ 240 V 15 HP - 30 HP @ 480/600 V	1.4 N-m (12 in-lb)
40 HP - 50 HP @ 480 V	2.7 N-m (27 in-lb)

6.3 Installing Input Wiring

Sections 6.3.1 to 6.3.4 describe incoming line components and how to install them.

6.3.1 Installing an Optional Transformer and Reactor

Input isolation transformers might be needed to help eliminate:

- Damaging AC line voltage transients from reaching the drive.
- Line noise from the drive back to the incoming power source.
- Damaging currents that could develop if a point inside the drive becomes grounded.

Observe these guidelines when installing an isolation transformer:

- A power disconnecting device must be installed between the power line and the primary of the transformer.
- If the user-installed power disconnecting device is a circuit breaker, the circuit breaker trip rating must be coordinated with the in-rush current (10 to 12 times full load current) of the transformer.
- Do not use an input isolation transformer rated more than 1000 KVA for 480 / 600 VAC (500 KVA for 208 VAC) with less than 5% impedance directly ahead of the drive without additional impedance between the drive and the transformer.

Table 6.2 shows recommended inductance and line reactor ratings.

Table 6.2 – AC Line Reactors

Drive HP	Line Reactor Inductance ($\pm 10\%$)			Fundamental Amp Rating		
	240 V	480 V	600 V	240 V	480 V	600 V
0.5 to 1	3.0 mH	12.0 mH	20.0 mH	4	2	2
2 to 3	1.5 mH	6.5 mH	9.0 mH	12	4	4
5	0.8 mH	3.0 mH	5.0 mH	18	8	8
7.5	0.5 mH	2.5 mH	3.0 mH	25	12	8
10	0.4 mH	1.5 mH	2.5 mH	35	18	12
15	0.3 mH	1.2 mH	1.5 mH	45	25	18
20	0.25 mH	0.8 mH	1.2 mH	55	35	25
25	0.20 mH	0.8 mH	1.2 mH	80	35	25
30	-	0.7 mH	0.8 mH	-	45	35
40	-	0.5 mH	0.7 mH	-	55	45
50	-	0.4 mH	0.5 mH	-	80	55

6.3.2 Installing Branch Circuit Protection



ATTENTION: Most codes require that upstream branch protection be provided to protect input power wiring. Failure to observe this precaution could result in severe bodily injury or loss of life.

Install the required branch circuit protection according to the applicable local, national, and international codes (such as NEC/CEC). The fuses or approved circuit breaker must be installed in the line before the drive input terminals. Fuse and circuit breaker values are provided in tables 4.5 through 4.7.

6.3.3 Installing the Required External/Separate Input Disconnect

An input disconnect must be installed in the line before the drive input terminals in accordance with local, national, and international codes, such as NEC/CEC. The disconnect should be sized according to the in-rush current as well as any additional loads the disconnect might supply. The trip rating for the in-rush current (10 to 12 times full load current) should be coordinated with that of the input isolation transformer, if used.

6.3.4 Installing Power Wiring from the AC Input Line to the Drive's Power Terminals

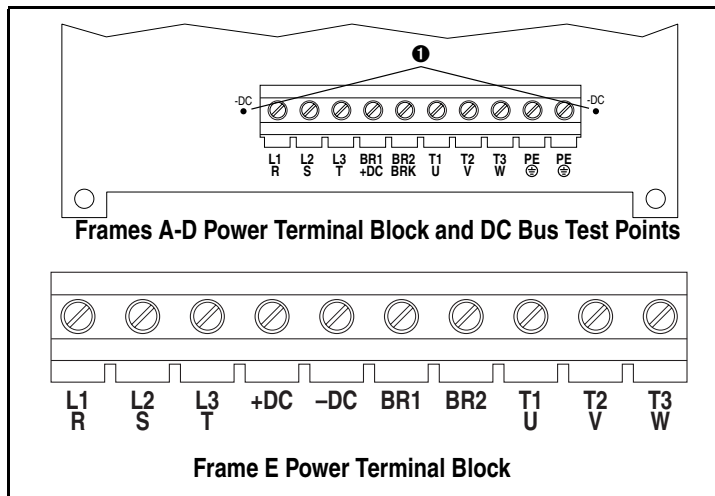


ATTENTION: Protect the contents of the cabinet from metal chips and other debris while drilling the conduit openings. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

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

To connect AC input power to the drive:

- Step 1. Wire the AC input power leads by routing them according to drive type. Refer to figure 5.1. Maximum power wiring sizes are listed in table 4.2.
- Step 2. Connect the three-phase AC input power leads to the appropriate terminals. Connect the AC input power leads to terminals R/L1, S/L2, T/L3 on the power terminal block.
- Step 3. Tighten the AC input power terminals to the proper torque as shown in table 6.1



Terminal	Description	Notes
R	R (L1)	AC line input power
S	S (L2)	AC line input power
T	T (L3)	AC line input power
+DC ¹ or BR1	DB (+)	Dynamic brake resistor connection (+)
BRK1 ¹ or BR2	DB (-)	Dynamic brake resistor connection (-)
U	U (T1)	To motor
V	V (T2)	To motor
W	W (T3)	To motor
PE	PE Ground	
PE	PE Ground	
-DC	DC Bus (-)	❶ May be located to the left or right of the Power Terminal Block.

Figure 6.5 – Power Terminal Block

¹ Early versions of the power terminal block are labeled +DC and BRK. Later versions are labeled BR1 and BR2.

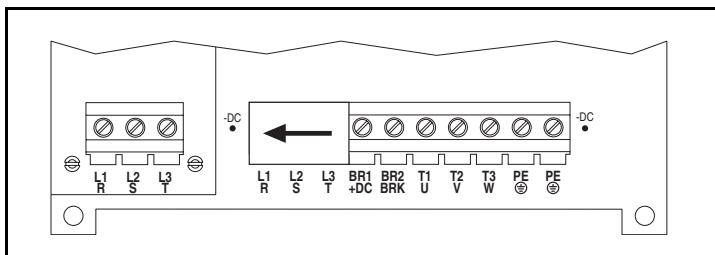


Figure 6.6 – Power Input Terminals on the Internal RFI Filter Option

6.4 Dynamic Braking Connections

A dynamic brake consists of the 7th internal braking transistor and an optional dynamic brake resistor. Reference “SP600 AC Drive Dynamic Braking Guide,” manual number D2-3489, for a more detailed discussion of dynamic braking.

The internal dynamic braking circuit senses rising DC bus voltage and shunts the excess energy to the dynamic brake resistor. The 7th transistor is either ON or OFF, connecting the dynamic brake resistor to the DC bus, or isolating the resistor from the DC bus. It is important to properly size the braking resistor value. To determine the minimum resistance value possible based on drive rating, see table 6.3.

Note that the resistor wattage is application-dependent and should be sized to inertia, deceleration, and duty cycle requirements.

Figure 6.7 shows a simplified dynamic braking schematic.

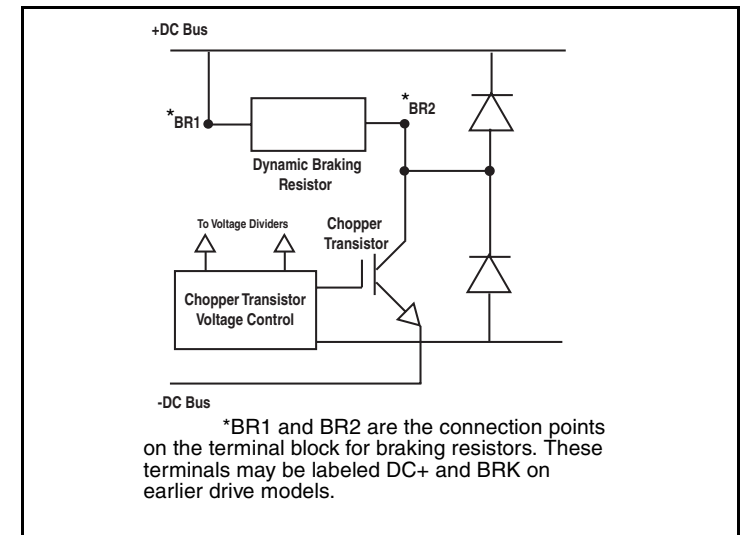


Figure 6.7 – Simplified Dynamic Braking Schematic



ATTENTION: AC drives do not offer protection for externally mounted braking resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from overtemperature, or the protective circuit shown in figure 6.8, or an equivalent, must be supplied.

ATTENTION: Equipment damage may result if a drive-mounted (internal) resistor is installed and parameter 163 is set to 1 (External Res). Thermal protection for the internal resistor will be disabled, resulting in possible device damage

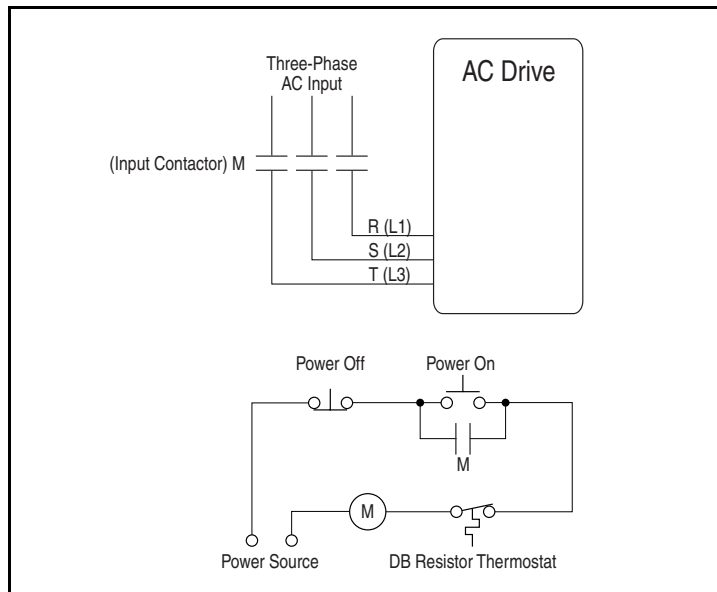


Figure 6.8 – Protective Circuit for External Resistor Packages

When using the braking resistor connections, parameter 163 (DB Resistor Type) must be set to one of the following selections:

- **0 = Internal:** Refers to DB plate-style resistor options kits that can be mounted directly to the heatsink chassis of the drive (for example, 6SP2-DB1-A).
- **1 = External:** Refers to externally-mounted resistors. These could be panel, cage, or other type of mounting, and are not specifically designed by Rockwell Automation to mount directly to the SP600 AC drive.

Table 6.3 – Braking Resistor Capacity

Drive Rating (Normal Duty)	Motor kW	Bus Voltage (VDC)	SP600 Absolute Minimum Resistance (Zero Tolerance)	Suggested Resistance with 10% Tolerance (SP600)	Peak Power (kW) During On Time	Resulting Braking Torque (expressed in% of rated motor torque)
240 V, 0.5 HP	0.37	395	30.38	131	1.08	293%
240 V, 1 HP	0.75	395	30.38	66	2.15	287%
240 V, 2 HP	1.5	395	30.38	61	2.33	155%
240 V, 3 HP	2.2	395	30.38	49	2.89	132%
240 V, 5 HP	4	395	27.43	33	4.30	107%
240 V, 7.5 HP	5.5	395	20.90	24	5.91	107%
240 V, 10 HP	7.5	395	20.90	24	5.91	79%
240 V, 15 HP	11	395	11.20	15	9.46	85%
240 V, 20 HP	15	395	9.00	14	10.13	68%
240 V, 25 HP	18.5	395	9.00	10	14.18	76%
400 & 480 V, 0.5 HP	0.37	790	61.72	502	1.13	305%
400 & 480 V, 1 HP	0.75	790	61.72	306	1.85	247%
400 & 480 V, 2 HP	1.5	790	61.72	163	3.48	232%
400 & 480 V, 3 HP	2.2	790	61.72	131	4.33	197%
400 & 480 V, 5 HP	4	790	61.72	97	5.85	146%
400 & 480 V, 7.5 HP	5.5	790	66.95	70	8.11	147%
400 & 480 V, 10 HP	7.5	790	66.95	73	7.77	104%
400 & 480 V, 15 HP	11	790	39.90	45	12.61	115%
400 & 480 V, 20 HP	15	790	27.82	45	12.61	84%
400 & 480 V, 25 HP	19	790	24.60	30	18.91	101%
400 & 480 V, 30 HP	22	790	29.10	30	18.91	84%
400 & 480 V, 40 HP	30	790	18.7	21	29.7	111%
400 & 480 V, 50 HP	37	790	18.7	21	29.7	89%
600 V, 0.5 HP	0.37	987.5	106.12	874	1.01	274%
600 V, 1 HP	0.75	987.5	106.12	471	1.88	251%
600 V, 2 HP	1.5	987.5	106.12	255	3.48	232%
600 V, 3 HP	2.2	987.5	106.12	209	4.24	193%
600 V, 5 HP	4	987.5	72.74	120	7.39	185%
600 V, 7.5 HP	5.5	987.5	72.74	82	10.81	197%
600 V, 10 HP	7.5	987.5	72.74	82	10.81	144%
600 V, 15 HP	11	987.5	43.62	48	18.47	168%
600 V, 20 HP	15	987.5	43.62	48	18.47	123%
600 V, 25 HP	18.5	987.5	Future	Future	Future	Future
600 V, 30HP	22	987.5	Future	Future	Future	Future
600 V, 40 HP	30	987.5	Future	Future	Future	Future
600 V, 50 HP	37	987.5	Future	Future	Future	Future

Installing Control Wiring

This chapter describes how to wire the signal and I/O terminal strip for stop, speed feedback, and remote control signals. Wiring of the terminal block is detailed in table 7.1.

7.1 Stop Circuit Requirements



ATTENTION: You must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation can result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

Depending upon the requirements of the application, the SP600 AC drive can be configured to provide either a coast-to-rest or a ramp-to-rest operational stop without physical separation of the power source from the motor. A coast-to-rest stop turns off the transistor power device drivers. A ramp-to-rest stop fires the transistor power device drivers until the motor comes to a stop, and then turns off the power devices.

In addition to the operational stop, you must provide a hardwired emergency stop external to the drive. The emergency stop circuit must contain only hardwired electromechanical components. Operation of the emergency stop must not depend on electronic logic (hardware or software) or on the communication of commands over an electronic network or link.

Note that the hardwired emergency stop you install can be used at any time to stop the drive.

7.1.1 User-Initiated Stopping



ATTENTION: Note the following about stop commands:

- A stop command from any attached OIM will always be enabled regardless of the value of Logic Source Sel.
- Network stop commands are effective only when Logic Source Sel is set to Network or All Ports.
- Terminal block stop commands are effective only when Logic Source Sel (89) is set to Terminal Blk or All Ports.

Failure to observe these precautions could result in severe bodily injury or loss of life.

The terminal block Drive Enable, if configured, and Function Loss inputs are always active. The terminal block Stop input must be closed only when the terminal block is the control source. See figure 7.1.

7.2 Wiring the Signal and Control I/O

The drive has six logic inputs that are configurable using parameters 361 to 366. The logic inputs can be 24 volts AC or DC.

There are two relay outputs that are configurable using parameters 380 to 387, two analog inputs, and one analog output.

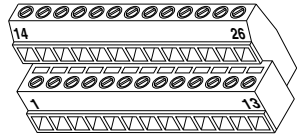
Important points to remember about I/O wiring:

- Always use copper wire.
- Wire with an insulation rating of 600 V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled “(-)” or “Common” **are not** referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.

Wire the drive’s signal and control I/O to the terminal block as shown in table 7.1.

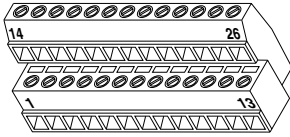
Table 7.1 – Wiring Signal and Control I/O to the Terminal Block



No.	Signal	Factory Default	Description	Related Param.						
1	Digital In1 Sel	Stop – CF (CF = Clear Fault)	11.2 mA @ 24V DC 19.2V minimum on state 3.2V maximum off state Important: Use only 24V DC, not suitable for 115V AC circuitry. Inputs can be wired as sink or source.	361 - 366						
2	Digital In2 Sel	Start								
3	Digital In3 Sel	Auto/Man								
4	Digital In4 Sel	Speed Sel 1								
5	Digital In5 Sel	Speed Sel 2								
6	Digital In6 Sel	Speed Sel 3								
7	24V Common	–	Drive supplied power for Digital In1-6 inputs. 150mA maximum load.							
8	Digital In Common	–								
9	+24V DC	–								
10	+10V Pot Reference	–	2 k ohm minimum load.							
11	Digital Out 1 – N.O. ¹	NOT Fault	<table border="0"> <tr> <td><u>Max Resistive Load</u></td> <td><u>Max Inductive Load</u></td> </tr> <tr> <td>250 VAC/30 VDC</td> <td>250 VAC/30 DC</td> </tr> <tr> <td>50 VAC / 60 Watts</td> <td>25 VAC / 30 Watts</td> </tr> </table>	<u>Max Resistive Load</u>	<u>Max Inductive Load</u>	250 VAC/30 VDC	250 VAC/30 DC	50 VAC / 60 Watts	25 VAC / 30 Watts	380 - 387
<u>Max Resistive Load</u>	<u>Max Inductive Load</u>									
250 VAC/30 VDC	250 VAC/30 DC									
50 VAC / 60 Watts	25 VAC / 30 Watts									
12	Digital Out 1 Common ¹									
13	Digital Out 1 - N.C.	Fault								
			<u>Minimum DC Load</u> 10 μA, 10 mV DC							
14	Analog In 1 (– Volts)	⁽²⁾ Voltage – Reads value at 14 & 15	Non-isolated, 0 to +10V, 10 bit, 100k ohm input impedance. ³	320 - 327						
15	Analog In 1 (+ Volts)									
16	Analog In 1 (– Current)		Non-isolated, 4-20mA, 10 bit, 100 ohm input impedance. ³							
17	Analog In 1 (+ Current)									
18	Analog In 2 (– Volts)	⁽²⁾ Voltage – Reads value at 18 & 19	Isolated, bipolar, differential, 0 to +10V unipolar (10 bit) or ±10V bipolar (10 bit & sign), 100k ohm input impedance. ⁴							
19	Analog In 2 (+ Volts)									
20	Analog In 2 (– Current)		Isolated, 4-20mA, 10 bit & sign, 100 ohm input impedance. ⁽⁴⁾							
21	Analog In 2 (+ Current)									
22	Analog Out (– Volts) 10V Pot Common	⁽²⁾ Output Freq	0 to +10V, 10 bit, 10k ohm (2k ohm minimum) load. Referenced to chassis ground. Common if internal 10V supply (terminal 10) is used.	341 - 344						
23	Analog Out (+ Volts)									

Table 7.1 – Wiring Signal and Control I/O to the Terminal Block (Continued)

No.	Signal	Factory Default	Description	Related Param.
24	Digital Out 2 – N.O. ¹	Run	See description at No.s 11-13.	380 - 387
25	Digital Out 2 Common			
26	Digital Out 2 – N.C. ¹	NOT Run		



- ¹ Contacts shown in unpowered state. Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.
- ² These inputs/outputs are dependent on a number of parameters. See “Related Parameters.”
- ³ Differential Isolation - External source must be less than 10V with respect to PE.
- ⁴ Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.

7.3 I/O Wiring Examples



ATTENTION: Configuring an analog input for 0-20 mA operation and driving it from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

ATTENTION: Hazard of personal injury or equipment damage exists when using bipolar input sources. Noise and drift in sensitive input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

Table 7.2 – I/O Wiring Examples

Input/Output	Connection Example	Required Parameter Settings
Potentiometer Unipolar Speed Reference 10k Ohm Pot. Recommended (2k Ohm minimum)	Analog Input 1 	Select Speed Reference source: Param. 090 = 1 "Analog In 1" Adjust Scaling: Param. 091, 092, 322, 323 Check Results: Param. 016
Joystick Bipolar Speed Reference ±10V Input	Analog Input 2 	Set Direction Mode: Param. 190 = 1 "Bipolar" Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Bipolar Speed Reference ±10V Input	Analog Input 2 	Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Unipolar Speed Reference 0 to +10V Input	Analog Input 2 	Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017
Analog Input Unipolar Speed Reference 4-20 mA Input	Analog Input 2 	Configure Input for Current: Param. 320, Bit #2 = 1 "Current" Adjust Scaling: Param. 091, 092, 325, 326 Check Results: Param. 017

Table 7.2 – I/O Wiring Examples (Continued)

Input/Output	Connection Example	Required Parameter Settings
Analog Output Unipolar 0 to +10V Output. Can Drive a 2k Ohm load (25 mA short circuit limit)		Select Source Value: Param. 342 Adjust Scaling: Param. 343, 344
2-Wire Control Non-Reversing or Reversing with a Digital Input set to 6	Internal Supply 	Disable Digital Input 1: Param. 361 = 0 "Not Used" or 6 Set Digital Input 2: Param. 362 = 7 "Run"
2-Wire Control Reversing	External Supply 	Set Digital Input 1: Param. 361 = 9 "Run Reverse" Set Digital Input 2: Param. 362 = 8 "Run Forward"
3-Wire Control	Internal Supply 	Use factory default parameter settings.
3-Wire Control	External Supply 	Use factory default parameter settings.
Digital Output Form C Relays Energized in Normal State.		Select Source: Param. 380, 384

Table 7.3 – Parameter Configuration for Figure 7.1 Wiring Example

Param. Number	Description	Value	Default
89	Logic Source Sel	Terminal Block	Local OIM
90	Spd Ref A	Anlg #1	Local OIM
91	Spd Ref A Hi	60 Hz	Same as Max Speed
92	Spd Ref A Lo	0 Hz	0.0 Hz
96	TB Man Ref	Anlg #2	Anlg #2
97	TB Man Ref Hi	60 Hz	Same as Max Speed
98	TB Man Ref Lo	0 Hz	0.0 Hz
320	Analog Conf	xxx.xx01	xxx.xx01
322	Anlg In 1 Hi	20 mA	20 mA
323	Anlg In 1 Lo	4 mA	4 mA
325	Anlg In 2 Hi	10 V	10 V
326	Anlg In 2 Lo	0 V	0 V
361	Dig In 1 Sel	Stop	Stop
362	Dig In 2 Sel	Start	Start
363	Dig In 3 Sel	Function Loss	Function Loss
364	Dig In 4 Sel	Jog	Jog
365	Dig In 5 Sel	Manual	Manual
366	Dig In 6 Sel	Speed Sel 1	Speed Sel 1

7.5 Speed Reference Control

The following sections describe methods of obtaining the drive speed reference.

7.5.1 Auto Reference Sources

The drive speed reference can be obtained from a number of different sources. The source is determined by drive programming and the condition of the Speed Select Digital Inputs or reference select bits of a drive command word.

The default source for a speed reference is the selection programmed in Speed Ref A Sel (parameter 90). If Speed Select digital inputs are defined on the terminal block, the drive could use other parameters as the speed reference source.

If none of the logic inputs are configured as a speed select source, the speed reference source is channeled to Speed Ref A Sel (90).

7.5.2 Manual Reference Sources

The manual reference source can be provided by:

- the terminal block
- an OIM connected to the local port
- remote OIM (port 2 or 3)
- the network port.

The manual reference overrides any auto reference selected. By configuring the LCD OIM's function keys, an LCD OIM can provide a reference from preset speeds 1-7 or from DPI reference ports.

For a terminal block to select a manual source (TB Man Ref Sel (096)), one of its six digital inputs must be configured as "AUTO/MAN" and must be closed. (See figure 7.4)

When Manual Ref Preload (193) is set to 1 = Enabled, the drive automatically loads the present Auto reference value into the OIM when Manual is selected. See the parameter description in chapter 12 for more information.

7.5.3 Changing Reference Sources

The selection of the active Speed Reference can be made through digital inputs, DPI command, Jog key, or Auto/Manual OIM operation. See figure 7.3.

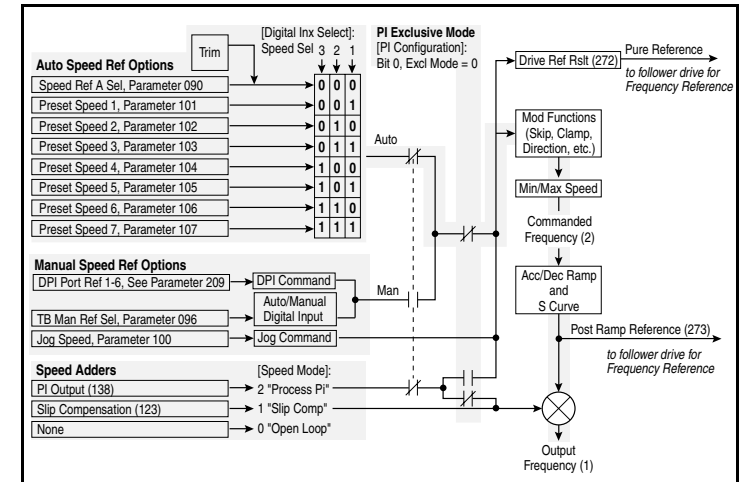


Figure 7.3 – Speed Reference Control Flowchart

7.5.4 Auto/Manual Control

The Auto/Manual input is not part of the logic commands controlled by parameter 89 (Logic Source Sel). The Auto/Manual input affects the speed reference source only.

In Auto reference mode, the reference source is determined by terminal block inputs (if configured) or a parameter (Speed Ref A Sel). Only one port at a time can control (own) the reference source.

In Manual reference mode, the reference source for the drive is based on the port that commanded it most recently. The last source that commands Manual reference mode will determine the reference used by the drive.

The Auto/Manual function is available through the terminal block and LCD OIM function keys. If configured on the terminal block, it is possible to have the digital input in the "Manual" position but have Manual being controlled from another port. Because it is an edge-sensitive signal, the digital input would have to be switched to "Auto" and then back to "Manual" to re-acquire Manual reference control.

The Jog reference will bypass the Auto/Manual while it is asserted from the control source. When the Jog reference is released, the control source reverts to the source that was in effect before the Jog reference was asserted.

7.6 Remote OIM Configuration

If a remote OIM is connected as the user interface for speed reference or logic control, Logic Source Sel (89) and Speed Ref A Select (90) must be configured for the connection port to which the remote OIM is attached. Typically, a remote OIM is connected to port 2 or port 3.

Figure 7.4 - Speed Reference Selection Z-Fold Here



Figure 7.4 – Speed Reference Selection

Completing the Installation

This chapter provides instructions on how to perform a final check of the installation before power is applied to the drive.



ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should start and adjust it. Read and understand this manual in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

8.1 Checking the Installation



ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: You must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation can result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

To verify the condition of the installation:

- Step 1. Turn off, lock out, and tag the input power to the drive. Wait five minutes.
- Step 2. Verify that the DC bus voltage is zero. See section 13.1.
- Step 3. If a function loss coast-stop pushbutton has been installed, verify that it has been wired correctly.
- Step 4. Remove any debris, such as metal shavings, from around the drive.
- Step 5. Check that there is adequate clearance around the drive.
- Step 6. Verify that there is nothing mounted behind the drive.

- Step 7. Verify that the wiring to the terminal strip and the power terminals is correct.
- Step 8. Check that the wire size is within terminal specification and that the terminals are tightened properly.
- Step 9. Check that user-supplied branch circuit protection is installed and correctly rated.
- Step 10. Check that the incoming power is rated correctly.
- Step 11. Check the motor installation and length of motor leads.
- Step 12. Disconnect any power correction capacitors connected between the drive and the motor.
- Step 13. Check that the rating of the transformer (if used) matches the drive requirements and is connected properly.
- Step 14. Verify that a properly sized ground wire is installed and a suitable earth ground is used. Check for and eliminate any grounds between the motor frame and the motor power leads. Verify that all ground leads are unbroken.
- Step 15. Uncouple the motor from any driven machinery.

8.2 Powering Up after Installation is Complete

To verify that the drive is installed correctly and is receiving the proper line voltage:

- Step 1. Turn the drive's input power disconnect to the On position.
- Step 2. Apply power to the drive.
- Step 3. Follow the start-up procedure in chapter 10.

Using the LCD OIM

The LCD Operator Interface Module (OIM) is a keypad/display that enables you to program, monitor, and control the drive.

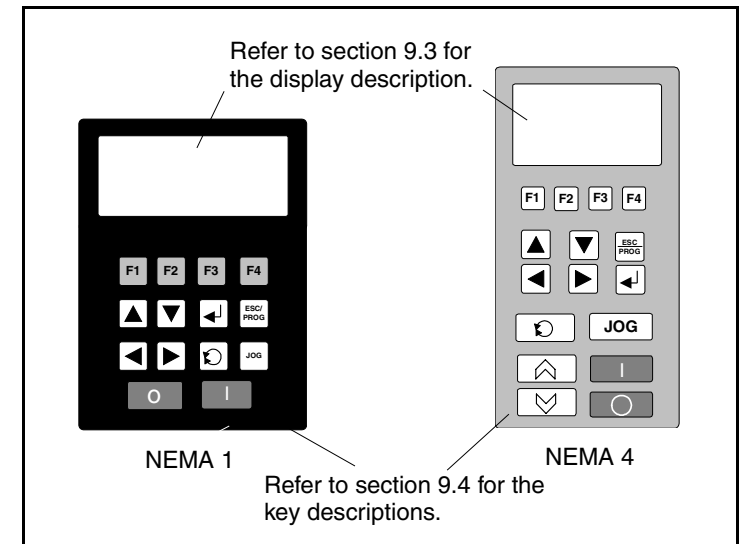


Figure 9.1 – SP600 LCD OIM

9.1 Connections

The LCD OIM can be used in the following ways:

Drive mounted - The OIM connects directly to the drive using DPI port 1.

Hand-held - A NEMA 4 remote-mount OIM is available. The maximum cable length is 32 feet using extender cables. Connect the cable to either DPI port 2 or 3.

Remote mounted - A NEMA 4 remote-mount OIM is available, or a cable (RECBL-LCD) can be used to convert the standard OIM for remote-mounted use (NEMA 1 drives only). The maximum cable length is 32 feet using extender cables. Connect the cable to either DPI port 2 or 3.

See figure 2.2 in chapter 2 for the connection points on the drive.

9.2 Installing and Removing the Local LCD OIM (NEMA 1 Drives Only)

To **install** the local LCD OIM, slide the OIM into the slot on the front of the drive until it clicks into place.

To **remove** the local LCD OIM, press the tab at the top of the drive to release the OIM while pushing the OIM from the bottom to slide it out of the drive.

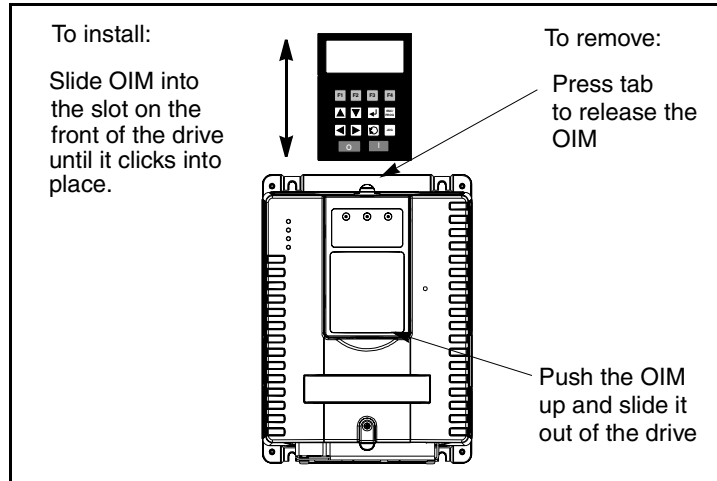


Figure 9.2 – Installing and Removing the Local LCD OIM (NEMA 1 Only)

9.2.1 Removing the Local LCD OIM While the Drive is Powered

If the local LCD OIM is the selected control source, removing the OIM while the drive is powered will cause a drive fault.

If the local LCD OIM is not the selected control source, but is the reference source, removing the OIM while the drive is powered will result in a zero reference value. When the OIM is replaced, the drive will ramp to the reference level supplied by the OIM.



ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

If the local LCD OIM is not the selected control source or reference source, removing the OIM while the drive is powered will have no effect on drive operation.

9.3 Display Description

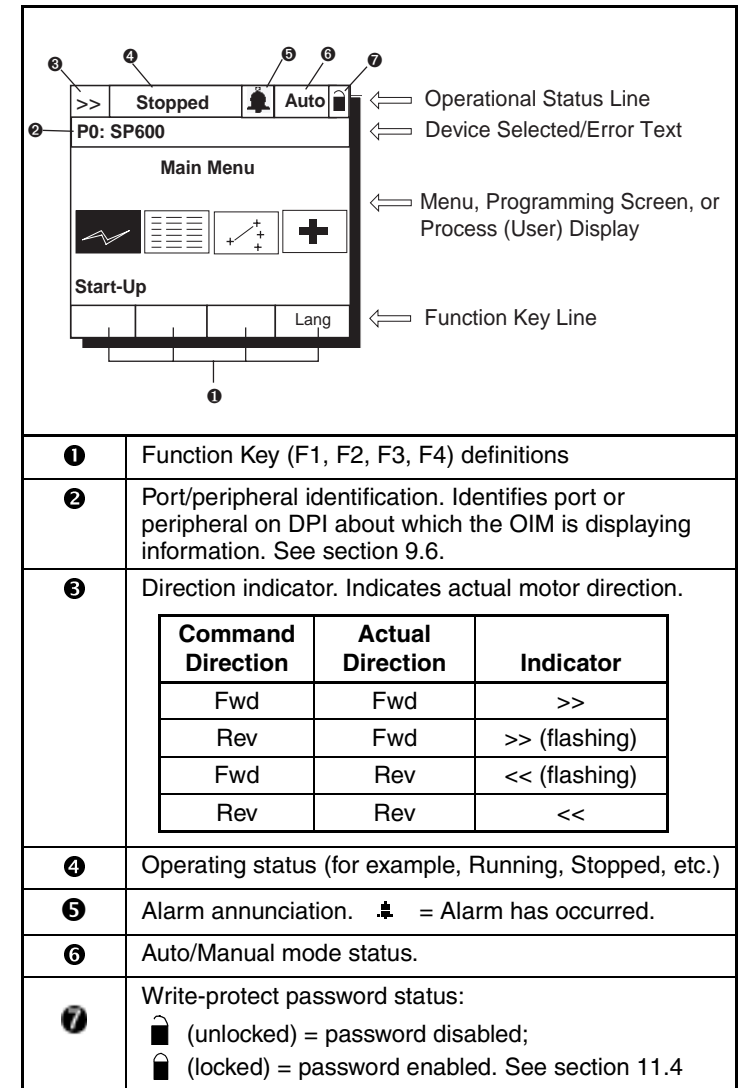















Figure 9.3 – The Display (Main Menu Shown)

9.3.1 Key Descriptions

Table 9.1 – Key Functions

Key	Function
	Scroll through options or user function keys, move cursor to the left.
	Scroll through options or user functions keys, move cursor to the right.
	Scroll through options, increase a value, or toggle a bit.
	Scroll through options, decrease a value, or toggle a bit.
	Exit a menu, cancel a change to a parameter, or toggle between program and process (user) display screens.
	Enter a menu, select an option, or save changes to parameter value
	Change motor direction if the OIM is the control source.
	Jog the drive if the OIM is the control source.
	Stop the drive. Clear a fault if the OIM is the control source.
	Start the drive if the OIM is the control source.
	F1 though F4: Predefined or user-configured functions. The definition of each key is shown directly above the key on the display. See item ζ in figure 9.3.
	Increase speed if drive is configured for local OIM control (for example, Speed Ref A Sel = 18).
	Decrease speed if drive is configured for local OIM control (for example, Speed Ref A Sel = 18).

9.4 LCD OIM Menu Structure

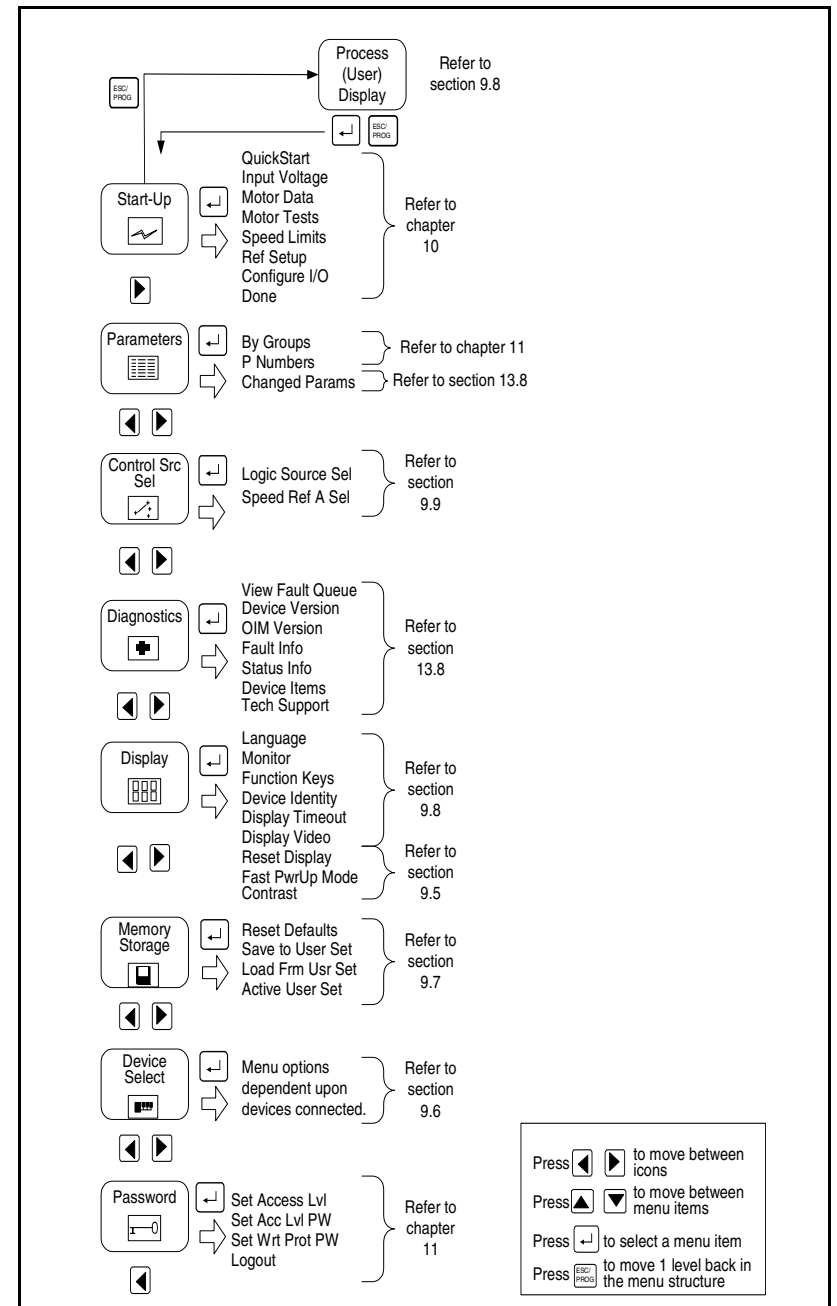


Figure 9.4 – LCD OIM Menu Structure

9.5 Powering Up and Adjusting the LCD OIM

The first time the LCD OIM is powered up, you will be prompted to select a language for the display text. If the Start-Up routine has not been completed, the Start-Up menu is displayed immediately following the language selection screen.

On subsequent power ups, if both of these requirements have been met, the Main Menu is displayed after the initialization screen.

9.5.1 Selecting the Fast Power Up Feature

The fast power up feature bypasses the initialization screen at power up, and the Main Menu is displayed immediately. To select this feature, select Fast PwrUp Mode from the Display menu.

9.5.2 Adjusting the Screen Contrast

To adjust the screen contrast, select Contrast from the Display menu.

9.5.3 Resetting the Display

To return all the options for the display to factory-default values, select Reset Display from the Display menu.

9.6 Selecting a Device in the System

The LCD OIM can access and display data from any active drive or peripheral device on the network. The drive (port 0) is the default device selected.

To select a device, select the Device Select icon from the Main Menu. The options listed depend on what is connected to the network.

The name and DPI port number of the device being accessed is shown on the OIM's display (see figure 9.3).

9.7 Using the LCD OIM to Program the Drive

The LCD OIM enables you to view and adjust parameters in the drive or in peripheral devices connected to the drive. The parameters available for viewing or adjustment depend on the device selected. See section 9.6 for information about selecting a device.

The method of viewing and adjusting parameters is the same regardless of the device selected.

9.7.1 Viewing and Adjusting Parameters

Refer to chapter 11 for information on how to access the parameters in the drive.

Each parameter screen contains the following information:

- Parameter number
- Parameter name
- Current parameter value and units
- Parameter range
- **F1 key defined as a toggle to enable you to view the parameter's current value and the factory-default value**

See figure 9.5 and table 9.2 for instructions on how to adjust the parameter values.

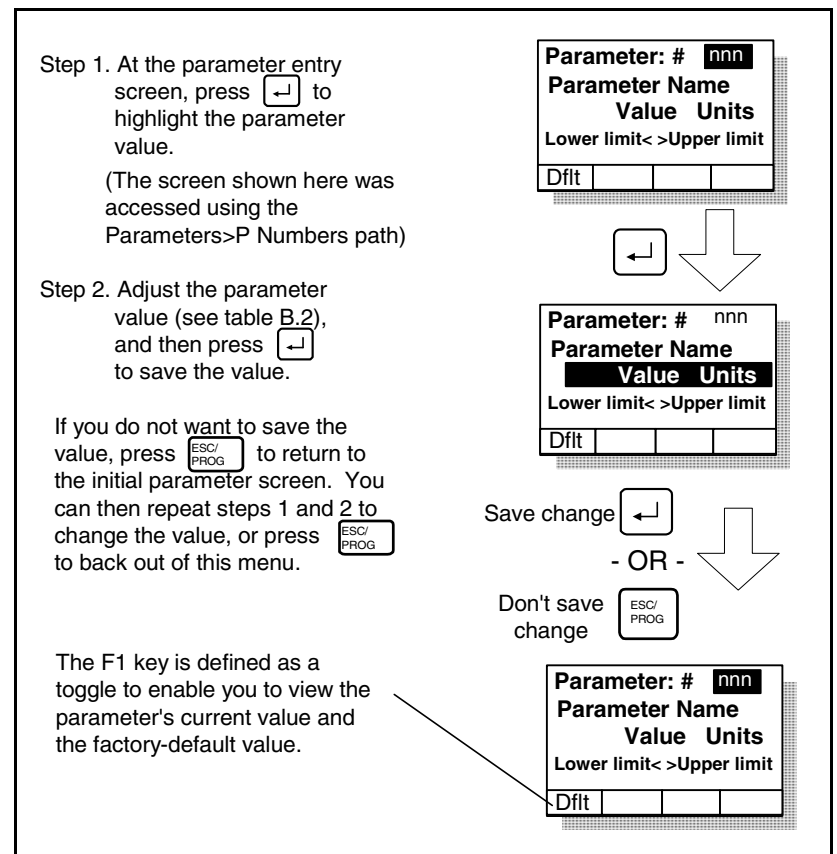


Figure 9.5 – Adjusting Parameters

Table 9.2 – How to Adjust Each Parameter Type

Parameter Type	How to Adjust
Numbered List	Use ▲▼ to advance through the list of options.
Bit	Use ◀▶ to move the cursor to the bit location you want to change. Use ▲▼ to change the value of the bit.
Numeric	Use ▲▼ to increase or decrease the value. - Or - Use ◀▶ to move the cursor from digit to digit, and use ▲▼ to increase or decrease the value of the digit.

To restore all parameters to their factory-default values, select Reset Defaults from the Memory Storage menu.

To see which parameters have been adjusted from their default values, select Changed Params from the Parameters menu. This procedure is described in section 13.8.4 of this manual.

Note that parameter values are retained through a line dip or power shutdown.

9.7.2 Loading and Saving User Sets

Up to three drive configurations, called user sets, can be saved and recalled for use at any time in the SP600 drive. When the drive is shipped from the factory, all user sets have the same factory default values. Resetting the drive parameters to their default values does not affect the contents of the user sets.

Saving a User Set

A user set can only be saved when the dynamic user set configure parameter (204) is programmed to “disable.” Please refer to section 2.4.19 for more information. To **save** the current drive configuration, select Save to User Set from the Memory Storage menu. Then select user set 1, 2, or 3 as the area in which to store data. See figure 9.6.

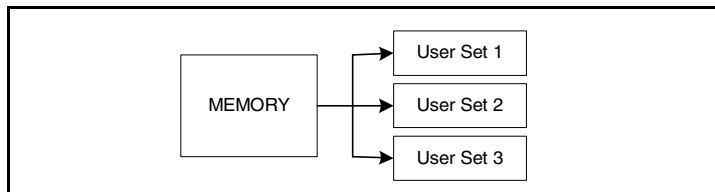


Figure 9.6 – Save to User Set

This function can be assigned to a function key on the OIM. Refer to section 9.8.3 for this procedure.

Assigning a Custom Name to a User Set

You have the option of changing the name of the user set when you save it. To assign a custom name to a user set, follow the procedure in figure 9.7.

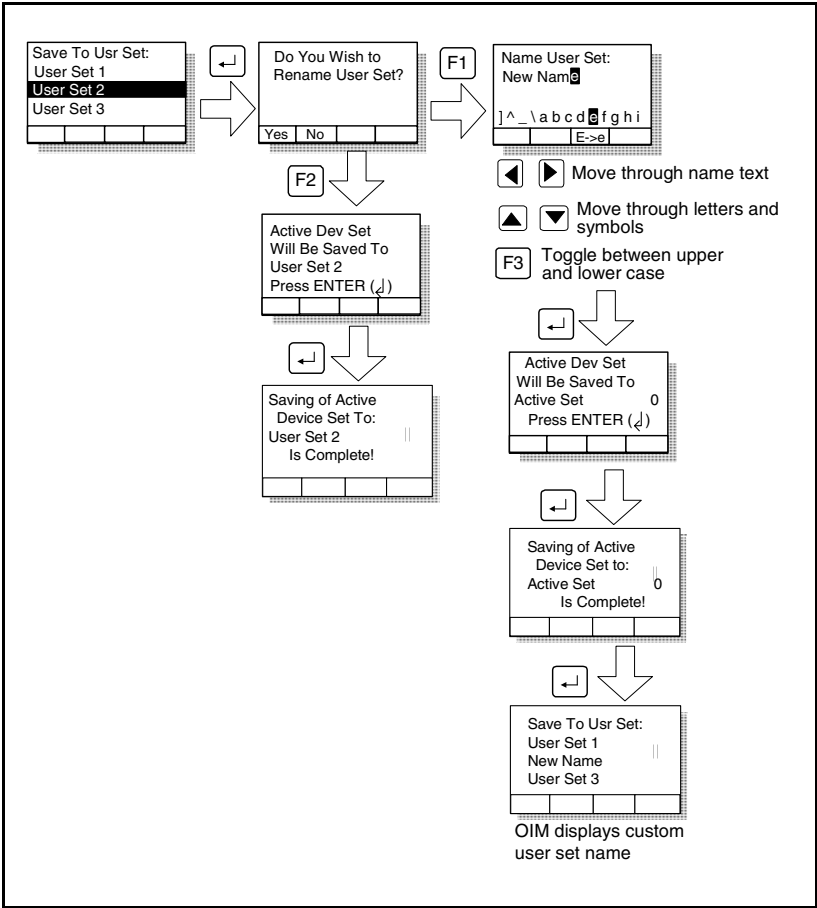


Figure 9.7 – Assigning a Custom Name to a User Set

Loading From a User Set

When the dynamic user set configure parameter (204) is programmed to “disable,” then to recall, or **load**, a user set, select Load Frm Usr Set from the Memory Storage menu. Then select user set 1, 2, or 3 as the area from which to retrieve data. See figure 9.8.

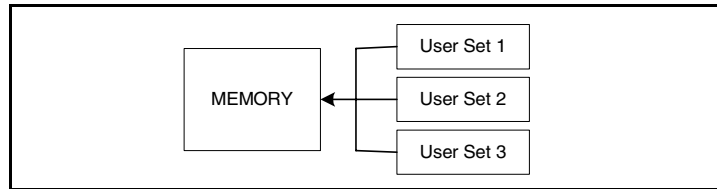


Figure 9.8 – Load From User Set


This function can be assigned to a function key on the OIM. Refer to section 9.8.3. Refer to section 2.4.19 to learn more about user sets and the ability to recall user sets automatically using digital inputs or a selection parameter.

Identifying the Active User Set

To **identify** which user set is active, select Active User Set from the Memory Storage menu. The name of the last user set to be loaded into the drive will be displayed. “Active Set” means factory defaults have been restored. You can also view the active user set when in the dynamic mode by reading the value of parameter 206 (not used when dynamic user sets parameter is disabled).

9.8 Monitoring the Drive Using the Process Display Screen on the LCD OIM

The process display screen enables you to monitor up to three process variables. You can select the display, parameter, scale, and text for each process variable being displayed.

The  key toggles between the programming screen and the process display screen. From the Main Menu screen, press F1 or F2 to select the process display screen. In addition, the process display screen becomes active if no keys have been pressed before the display timeout period expires. See section 9.8.4 for information

about setting the display timeout period.

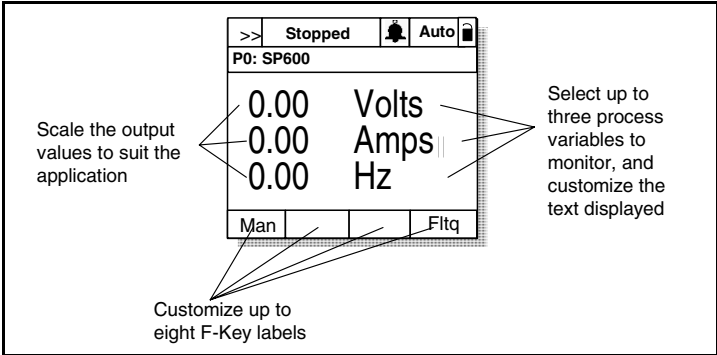


Figure 9.9 – Process (User) Display Screen

9.8.1 Displaying and Changing the OIM Reference

You can display the reference value that the OIM is sending to the drive by pressing the up or down arrow key once when the process display screen is active. See figure 9.10. The OIM reference can be used for the speed reference, PI reference, or trim reference.

To change the displayed reference, press and hold down either the up or down arrow key until the desired value is displayed. Release the key to return to the process display screen.

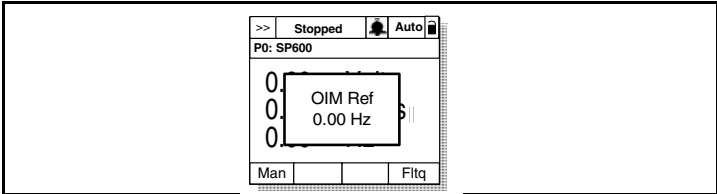


Figure 9.10 – OIM Reference Displayed

Note that changing the value of the OIM reference does not affect the value of any other port reference.

The value of the OIM reference is saved through a power cycle if parameter 192 (Save OIM Ref) is set to Save at Power Down.

9.8.2 Customizing the Process Display Screen

To customize the process display screen, select Monitor from the Display menu. See figure 9.11.

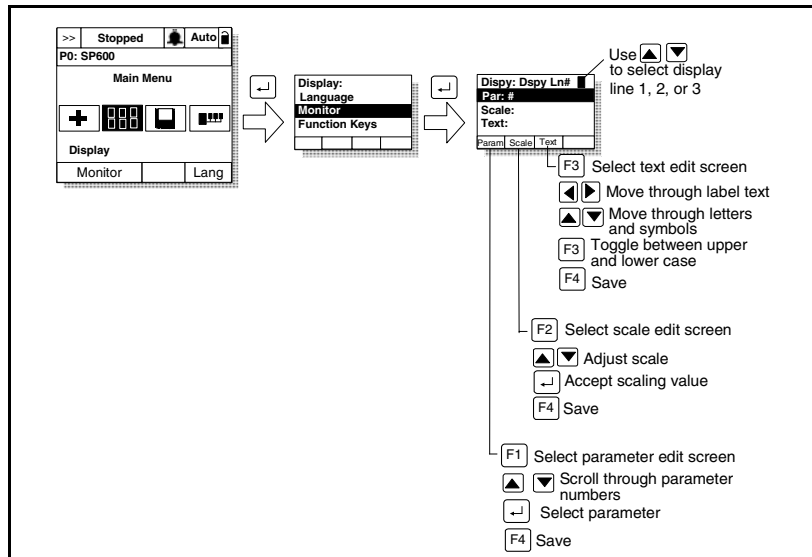


Figure 9.11 – Customizing the Process Display Screen

9.8.3 Customizing the Function Keys

The function keys (F1, F2, F3, and F4, also called F-Keys) on the OIM can be customized to perform several pre-configured functions when the process display screen is active.

Up to eight function keys can be configured. Pressing ◀ ▶ while the display screen is active toggles between each set of four functions.

As shipped from the factory, the F1 key is configured for the Auto/Manual selection function and the F4 key is configured for the Clear Fault Queue function.

To assign a function to an F-Key, select the Display icon from the Main Menu as shown in figures 9.12 and 9.13.

The F-Key definitions are the same for all OIMs connected to the drive, regardless of the port used.

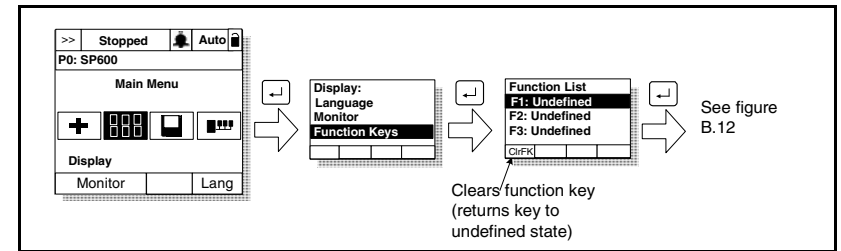


Figure 9.12 – Accessing the Function Key Configuration Screens

Select from the list of preconfigured functions:

Undefined (default)

Load User Set 1-3: Loads the specified user set into active drive memory. The drive responds as if a value had been entered in Load Frm User Set (198), or Load Frm User Set was selected from the OIM's Memory Storage menu.



ATTENTION: Loading a user set with LevelSense Start (168) set to Enable can result in the drive starting immediately when all start conditions are met.

When this function is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Save User Set 1-3: Saves the active configuration to drive memory. The drive responds as if a value had been entered in Save to User Set (199) or Save to User Set was selected from the OIM's Memory Storage menu.

Acc/Dec Change: Toggles between the display of Acc/Dec rate 1 and Acc/Dec rate 2 (The value the drive is configured to go to, not the current value being used by the drive). This selection is based on the active value of the rate parameters (140-143). Therefore, when any of these parameters change, the actual acc/dec rates will dynamically change.


Preset Speed 1-6: Toggles the selected preset speed on and off and grants Manual reference control. Returns to Auto reference when the function is toggled.

Auto/Manual: Toggles between Auto and Manual reference control.

The text above the function key will change to indicate the command that will be issued when the key is pressed.



ATTENTION: When switching from Auto to Manual or Manual to Auto, the drive will ramp to the reference level provided by the new source at the rate specified in Accel Time 1 (140), Decel Time 1 (142), Accel Time 2 (141), or Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

View Fault Queue: Displays the Fault Queue screen (see chapter 13). Press  to return to the process display screen.

Next: (Reserved for future use.)

9.8.3.1 Customizing the Function Key Label Text

You can customize the text for each function key label (up to five characters). See figure 9.13.

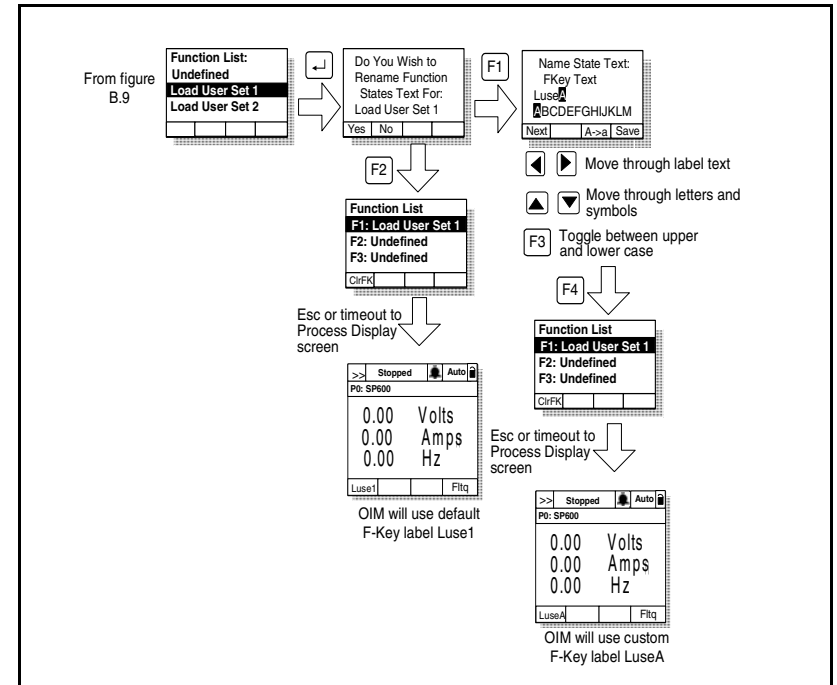



Figure 9.13 – Customizing the Function Key Label Text

9.8.4 Setting the Display Timeout Period

When the OIM is inactive (that is, no keys have been pressed) for a user-specified period of time, the process display screen becomes active. To return to the previously active screen, press any key. To return to the Main Menu, press .

To set the display timeout period, select Display Timeout from the Display menu. The timeout period can range from 10 to 1200 seconds (20 minutes).

This feature can also be disabled by pressing the F1 key while in the display time screen.

Note that each OIM connected to the drive can have a different timeout period.

9.8.5 Selecting Reverse Video for the Process Display Screen

To select normal or reverse video for the process display screen, select Display Video from the Display menu. See figure 9.14 for sample screens.

Note that each OIM connected to the drive can have a different display mode.

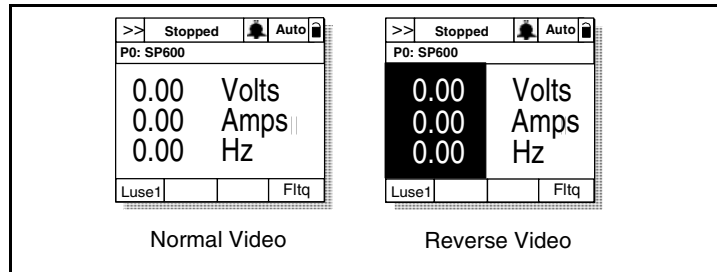


Figure 9.14 – Selecting Reverse Video for the Process Display Screen

9.9 Controlling the Drive From the LCD OIM

When the OIM is the selected control source, it can be used to control the drive:

- Start (Run)
- Stop
- Clear Faults
- Jog
- Select direction

Note that pressing two OIM keys at the same time will cause no command to be sent to the drive. For example, attempting to change direction while jogging from the same OIM will cause the drive to stop.

9.9.1 Selecting the Logic and Reference Source



ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Parameters 89 (Logic Source Sel) and 90 (Ref Source Sel) are used to select the drive control and speed reference sources. These parameters are grouped in the Control Src Select menu. See figure 9.15.

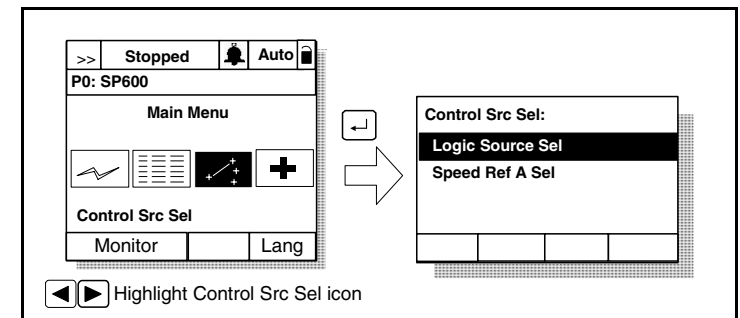


Figure 9.15 – Selecting the Control and Reference Source

Both of these parameters can also be accessed individually through the Parameters menu.

Refer to chapter 12 for a description of the parameters.

9.9.2 Starting the Drive


When the OIM is the selected control source, pressing issues a start command to the drive.


9.9.3 Stopping the Drive

Pressing will issue a stop command to the drive.

Important: Stop commands from any attached OIM will always be enabled.


9.9.4 Changing Motor Direction

When the OIM is the selected control source, pressing  toggles motor direction.

When  is pressed, the motor ramps down to 0 Hz and then ramps up to the set speed in the opposite direction.

If the drive is running when the direction is changed, the reference to the motor changes based on Accel/Decel time.

9.9.5 Jogging the Drive

When the OIM is the selected control source, pressing  sends a jog command to the motor as long as the key is pressed.

Starting Up the Drive Using the LCD OIM



ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this chapter in its entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Incorrect values for some of the parameters in the Start-Up routines can cause the drive to operate improperly. Verify that the values of these parameters are appropriate for your application. Failure to observe this precaution could result in bodily injury.

For standard applications, the Start-Up routines on the LCD OIM enable you to configure the most commonly used parameters through a series of steps. This helps you set up the drive as quickly as possible.

For advanced applications, you may need to adjust additional parameters in the parameter list using either the LCD OIM or VS Utilities software.

10.1 Preparing for Start-Up

Before performing Start-Up, you must:

- be qualified to configure the drive and be familiar with the operation of AC drives.
- be familiar with the operation of the LCD OIM.
- have completed all hardware installation as described in chapters 3 through 8 of this manual.
- properly connect the drive to the motor.

10.2 Running the Start-Up Routines

To access the Start-Up routines, select the Start-Up icon from the main menu as shown in figure 10.1.

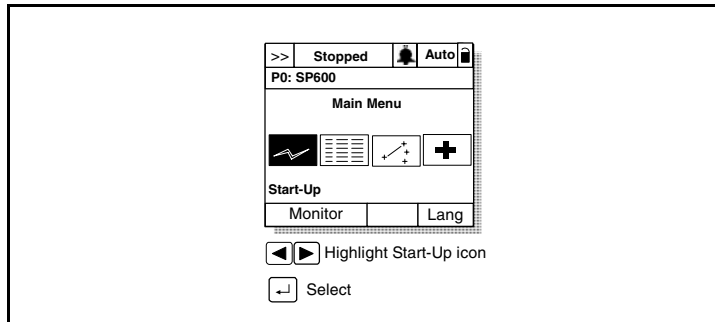


Figure 10.1 – Accessing the Start-Up Routines

The Start-Up menu screen contains 8 selections. The first 7 menu items contain the most commonly used parameters associated with each function. See figure 10.2.

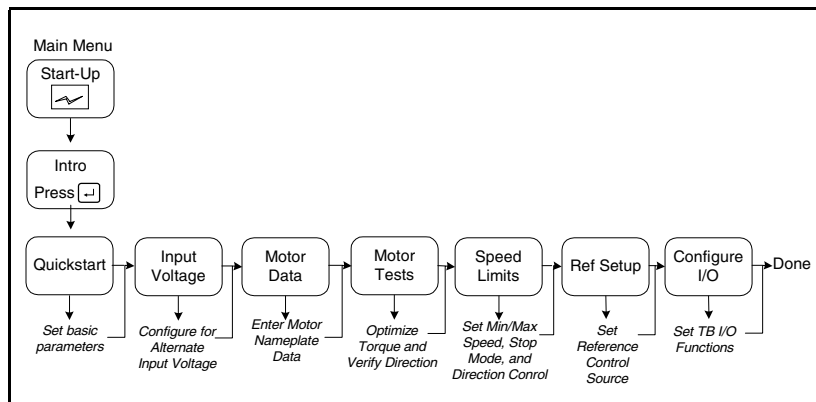



Figure 10.2 – Start-Up Menu

The Start-Up routine automates the process of entering values of selected parameters by taking you to the next parameter after you accept a parameter value. As each item in the list is completed, you are automatically advanced to the next step.

Important: Parameter values are saved as they are changed.

Pressing  or aborting the Start-Up routine will not undo the changes.

You do not have to configure all of the parameters in all 7 menus. The first menu selection, Quickstart, contains the minimum basic parameters that must be configured before running the drive. These parameters are listed in table 10.1.

Table 10.1 – Quickstart Parameters

Parameter No.	Parameter Name	Default
155	Stop Mode A	Ramp
42	Motor NP FLA	Drive-dependent
81	Minimum Speed	0.0 Hz
82	Maximum Speed	60.0 Hz
140	Accel Time 1	10.0 sec
142	Decel Time 1	10.0 sec
90	Speed Ref A Sel	OIM
362	Digital In2 Sel	Start

The drive's default configuration assumes the following:

- US Voltage Class (202)
- Motor Nameplate Base Freq (43) = 60 Hz
- Control Mode (53) = Sensorless Vector

Note: The default start/stop and reference control are configured for OIM operation.

Logic and reference sources (89, 90) = Local OIM

If your application requires adjustment to parameters beyond those listed in table 10.1, you can adjust parameters individually through the Parameters menu (see section 11.3), or you can adjust the parameters in any or all of the next 6 selections in the Start-Up menu:

Input Voltages

- 400/480 V, 200/240 V, or 575 V

Motor Nameplate Data

- Motor Power Units
- Motor Power
- Motor FLA
- Motor Volts
- Motor Hertz
- Motor RPM

Motor Tests

- Direction
- Autotune



ATTENTION: Rotation of the motor in an undesired direction can occur during the Autotune procedure (Autotune (61) = Rotate Tune). Disconnect the motor before proceeding. Failure to observe this precaution can result in damage to, or destruction of, the equipment.

Speed Limits

- Minimum, Maximum
- Direction Limit
- Stop Mode

Reference Setup

- OIM, Terminal Block, Network, Other

Configure I/O

- Digital Inputs/Outputs
- Two-/Three-Wire Start
- Analog Outputs

As you adjust the parameters in the Start-Up routines, record them in Appendix E.

When you have completed adjusting all of the parameters in the Start-Up routines that your application requires, select the last item in the menu, Done.

Exiting Before Completing the Start-Up Routines

To exit the Start-Up routines, press the F4 key (Exit). When you select the Start-Up icon from the main menu again, you will be prompted to either continue or restart the Start-Up routines. If you select “continue,” you will be returned to the point at which you exited.

10.3 Other Start-Up Considerations

The following sections describe other factors you must consider before starting up the drive.

10.3.1 Sensorless Vector Performance

If sensorless vector operation is required, Torque Performance (53) must be set to SVC operation (parameter 53 = 0 or 1). Autotune (61) must be reviewed to determine the appropriate method of autotuning.

10.3.2 Operation Over Wide Speed Ranges (>120 Hz)

The SP600 drive can operate at output frequencies of up to 400 Hz. For wide speed ranges, autotuning may not be able to accurately adapt to the motor dynamics. Hardware overcurrent faults may occur, and manual tuning may be necessary. Consult technical support if this occurs.

10.3.3 Start/Stop Control

The default configuration is for keypad control. You can start and stop the drive from the local OIM. See figure 10.3.

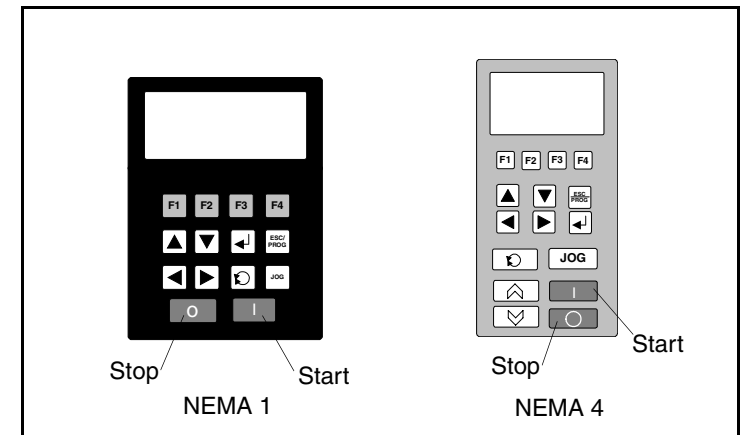


Figure 10.3 – Start/Stop Control using the Local OIM

To configure the drive for two-wire or three-wire Start/Stop control, you must configure a terminal block input to either the Run function (2-wire) or Start function (3-wire). See figure 10.4 and section 7.5 for I/O wiring examples.

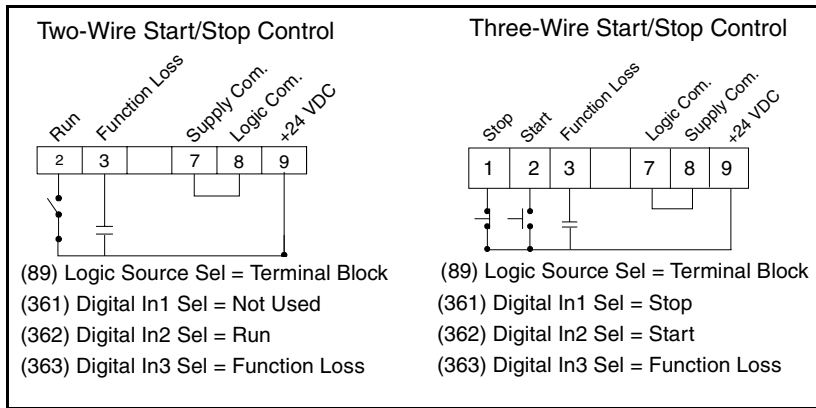


Figure 10.4 – Two-Wire and Three-Wire Start/Stop Control

10.3.4 Speed Reference Source

The default configuration is for keypad reference source. If you want to use an analog reference input for control, you must configure the analog reference inputs. The example below shows speed reference from an analog voltage input. Analog inputs can also be configured for 4 to 20 mA.

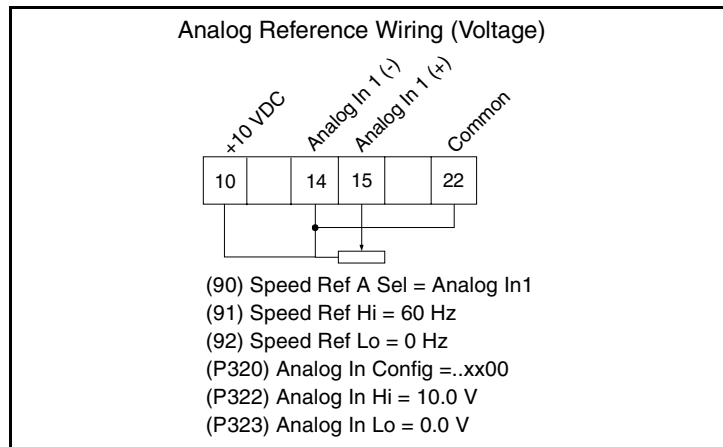


Figure 10.5 – Analog Speed Reference

Programming Basics

To program the drive for a specific application, you adjust the appropriate parameters. The parameters are used to define characteristics of the drive.

This chapter provides an overview of parameter types and how they are organized. Parameter descriptions are provided in chapter 12.

11.1 About Parameters

There are three types of parameters:

- **Numbered List Parameters**

Numbered list parameters allow a selection from two or more options. The LCD OIM displays a text message for each item.

Example: Speed Ref A Sel (90)

- **Bit Parameters**

Bit parameters have individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.

Example: Drive Status 1 (209)

- **Numeric Parameters**

These parameters have a single numerical value (for example, 0.1 volts).

Example: Maximum Freq (55)

Parameters are also either configurable or tunable, or read-only.

Configurable parameters can be adjusted or changed only while the drive is stopped.

Tunable parameters can be adjusted or changed while the drive is running or stopped.

Read-only parameters cannot be adjusted.

11.2 How Parameters are Organized

Parameters are organized into seven files:

- Monitor
- Motor Control
- Speed Command
- Dynamic Control
- Utility
- Communication
- Inputs & Outputs

Each file contains parameters that are grouped by their function. A file can contain several groups of parameters. See figure 11.1.

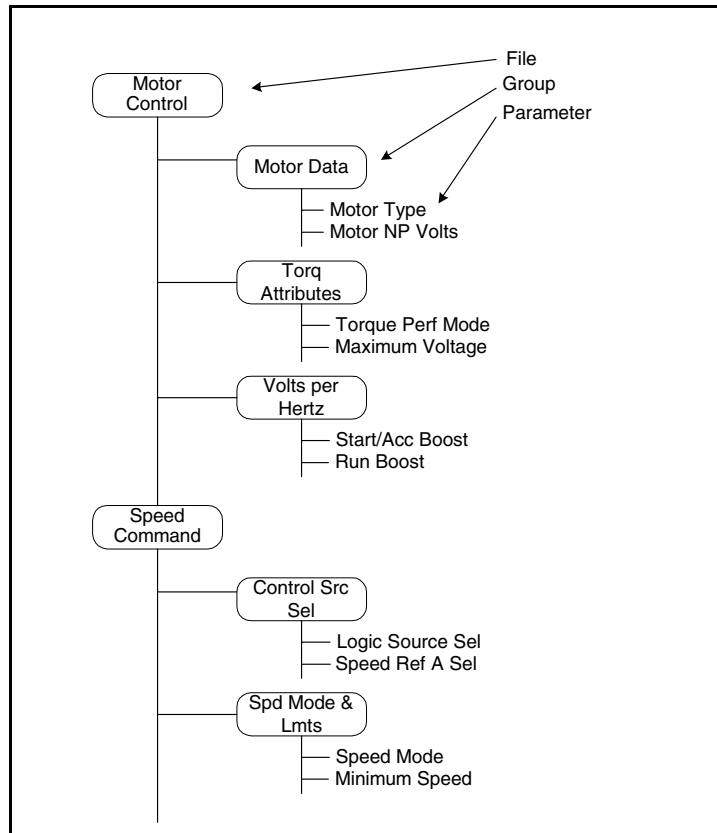


Figure 11.1 – Example of Parameter Organization

11.3 Accessing the Parameters

Important: See chapter 9 for information on modifying parameters using the LCD OIM.

Parameters are programmed and viewed using the LCD OIM or VS Utilities software.

The LCD OIM displays parameters by group, by individual parameter number, and parameters that have changed from their default value.

To access parameters using the LCD OIM, select the Parameters icon from the main screen. See figure 11.2.

See instruction manual D2-3488 for information on accessing and modifying parameters using VS Utilities software.

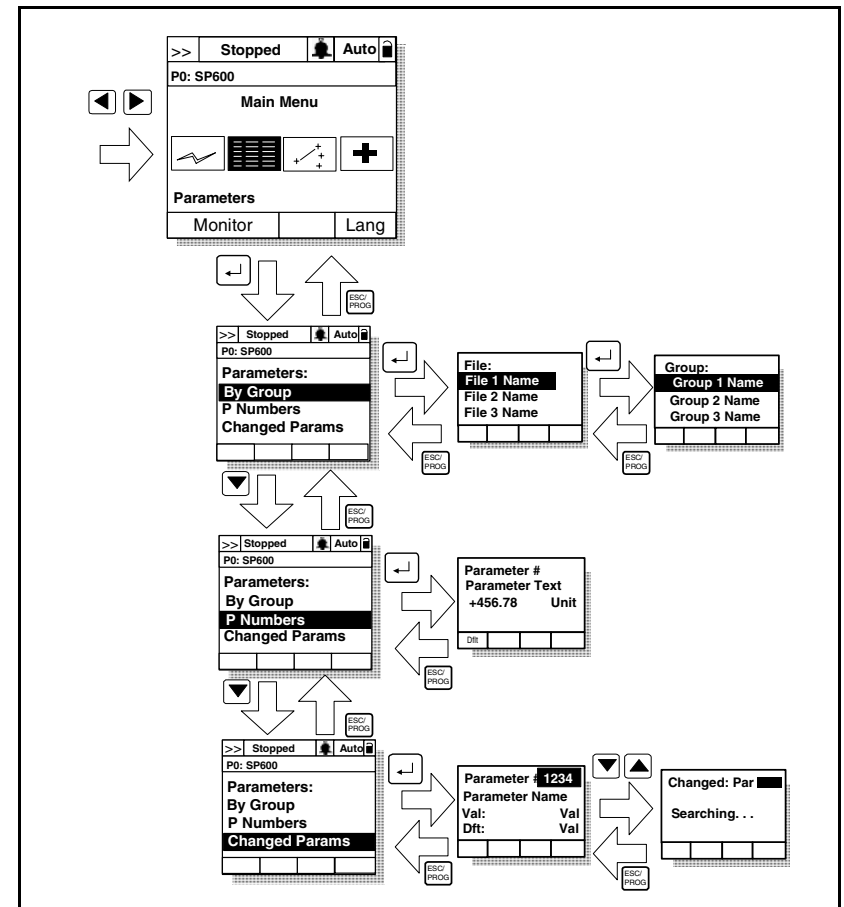


Figure 11.2 – Accessing the Parameters Using the LCD OIM

11.3.1 Accessing Parameters By Group

To access parameters by group, select By Groups from the Parameters menu on the LCD OIM. Refer to figure 11.2. The LCD OIM will first display a list of files. Select the file in which the desired parameter group is located.

Chapter 12 and Appendix E provide the File>Group path for each parameter.

11.3.2 Accessing Parameters by Number

To access parameters by number, select P Numbers from the Parameters menu on the LCD OIM. Refer to figure 11.2.

Using this option, you can view the parameters within the selected access level:

- The Advanced level allows you to view all parameters.
- The Standard level allows you to view a subset of the Advanced level.
- The Basic level allows you to view a subset of the Standard level.

Note that the LCD OIM will not display any parameter that is not within the selected access level.

Refer to section 11.3.4 for more information about selecting access levels.

11.3.3 Accessing Changed Parameters

The Changed Parameters selection provides a method of viewing only those parameter that are different from the default configuration. To access the changed parameters, select Changed Params from the Parameters menu on the LCD OIM. Refer to figure 11.2.

11.3.4 Selecting the Parameter Access Level

The SP600 AC drive provides three levels of access to the parameters: Basic (0), Standard (1), and Advanced (2). See figure 11.3.

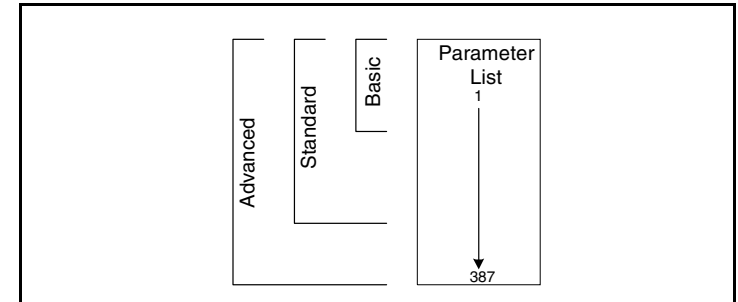


Figure 11.3 – Parameter Access Levels

The **Advanced** level allows access to all of the parameters.

The **Standard** level allows access to a subset of the Advanced level and is used for more sophisticated applications than the Basic level.

The **Basic** level allows access to a subset of the Standard level and contains only the most commonly used parameters.

Table 11.1 and the parameter descriptions in chapter 12 provide the access level assigned to each parameter.

The active access level is displayed in Parameter Access Level (196).

To select the parameter access level using the LCD OIM, select the Password icon from the main menu. See figure 11.4.

This option is not supported in the VS Utilities software.

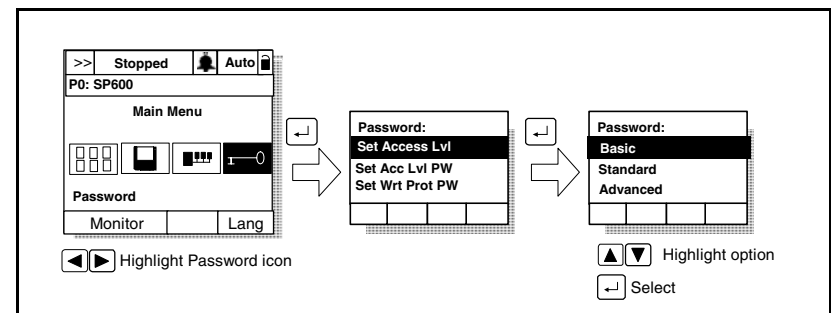


Figure 11.4 – Selecting the Parameter Access Level

11.3.5 Using the Parameter Access Level Password to Restrict Access to Other Parameter Levels



ATTENTION: It is the user's responsibility to determine how to distribute the access level password. Reliance Electric is not responsible for unauthorized access violations within the user's organization. Failure to observe this precaution could result in bodily injury.

The LCD OIM provides the option to restrict access to other parameter levels. This feature requires the use of a user-defined password when an attempt to change the access level is made.

To set the access level password, select the Password icon from the main menu. See figure 11.5. The password value can range from 1 to 9999. A value of 0 disables the password (factory default).

Important: You must either select Logout or return to the process display screen to activate the password.

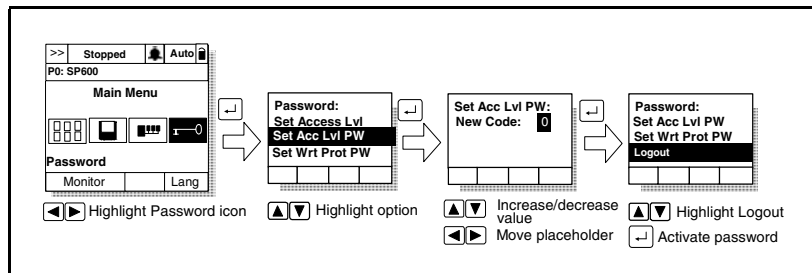


Figure 11.5 – Setting the Access Level Password

When you enter the password, you can change access levels until you select Logout or return to the process display screen, which re-activates the password. Refer to section 9.8 in chapter 9 for information about the process display screen.

Note that once the password is enabled, you will also be prompted to enter the password to access the Set Acc Lvl PW option.

This option is not supported in the VS Utilities software.

If There is More Than One OIM Connected to the Drive

Note that setting or changing the access level password on one OIM will set or change the access level password for all OIMs connected to the drive.



11.4 Using the Write-Protect Password to Ensure Program Security



ATTENTION: It is the user's responsibility to determine how to distribute the write-protect password. Reliance Electric is not responsible for unauthorized access violations within the user's organization. Failure to observe this precaution could result in bodily injury.

Parameter values can be password-protected using the LCD OIM. When the password is enabled, parameter values can be displayed. However, if there is an attempt to change a parameter value, a password pop-up box will appear on the OIM screen to prompt for the user-defined password.

To set the write-protect password, select the Password icon from the main menu. See figure 11.6. The password value can range from 1 to 9999. A value of 0 disables the password (factory default).

When the password is enabled, the lock symbol on the screen changes from  to .

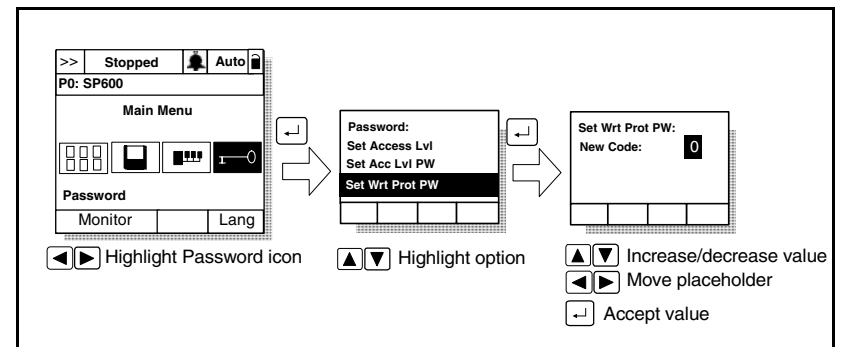


Figure 11.6 – Setting the Write-Protect Password

When you enter the password, you can adjust parameters until you select Logout or return to the process display screen, which re-activates the password. Refer to section 9.8 in chapter 9 for information about the process display screen.

This option is not supported in the VS Utilities software.

If There is More Than One OIM Connected to the Drive

Important: Setting the write-protect password value to zero on one OIM will disable the write-protect password on all connected OIMs.

Setting the write-protect password in one OIM will not affect any other OIM connected to the drive unless a write-protect password has also been set in the other OIMs. In this case, the last password value entered becomes the password value for all password-protected OIMs. (Each OIM cannot have a different password value.)



For example, if the write-protect password has been set to 5555 for the local OIM, someone using a remote OIM with no write-protect password set can still program all of the parameters. If the write-protect password is then set to 1111 on the remote OIM, you will be required to enter 1111 on the local OIM to program the parameters.

Parameter Descriptions

The following information is provided for each parameter listed in table 12.1 along with its description:

Parameter Number:	Unique number assigned to each parameter.
Parameter Name:	Unique name assigned to each parameter.
Range:	Predefined parameter limits or selections. Note that a negative Hz value indicates reverse rotation.
Default:	Factory default setting.
Access:	Parameter access level. 0 = Basic (reduced parameter set) 1 = Standard (reduced parameter set) 2 = Advanced (full parameter set)
Path:	Menu selections to reach specified parameter. The path is indicated in this manner: File>Group
See also:	Associated parameters that may provide additional or related information.

What the Symbols Mean

Symbol	Meaning
	32-bit parameter
	Drive must be stopped before changing parameter value.

The parameters are presented in numerical order. Appendix B contains a list of parameters by name cross-referenced to parameter number.

Table 12.1 – Parameter List

No.	Parameter Name	Access Level	No.	Parameter Name	Access Level
1	Output Freq	0	69	Start/Acc Boost	2
2	Commanded Freq	0	70	Run Boost	2
3	Output Current	0	71	Break Voltage	2
4	Torque Current	1	72	Break Frequency	2
5	Flux Current	1	80	Speed Mode	2
6	Output Voltage	0	81	Minimum Speed	0
7	Output Power	0	82	Maximum Speed	0
8	Output Power Fctr	2	83	Overspeed Limit	2
9	Elapsed MWh	2	84	Skip Frequency 1	2
10	Elapsed Run Time	1	85	Skip Frequency 2	2
11	MOP Frequency	1	86	Skip Frequency 3	2
12	DC Bus Voltage	1	87	Skip Freq Band	2
13	DC Bus Memory	2	89	Logic Source Sel	0
16	Analog In1 Value	1	90	Speed Ref A Sel	0
17	Analog In2 Value	1	91	Speed Ref A Hi	1
26	Rated kW	0	92	Speed Ref A Lo	1
27	Rated Volts	0	96	TB Man Ref Sel	1
28	Rated Amps	0	97	TB Man Ref Hi	1
29	Control SW Ver	0	98	TB Man Ref Lo	1
40	Motor Type	2	100	Jog Speed	0
41	Motor NP Volts	1	101	Preset Speed 1	0
42	Motor NP FLA	1	102	Preset Speed 2	2
43	Motor NP Hertz	1	103	Preset Speed 3	2
44	Motor NP RPM	1	104	Preset Speed 4	2
45	Motor NP Power	1	105	Preset Speed 5	2
46	Mtr NP Pwr Units	2	106	Preset Speed 6	2
47	Motor OL Hertz	2	107	Preset Speed 7	2
48	Motor OL Factor	2	117	Trim In Select	2
53	Torque Perf Mode	2	118	Trim Out Select	2
54	Maximum Voltage	2	119	Trim Hi	2
55	Maximum Freq	2	120	Trim Lo	2
56	Compensation	2	121	Slip RPM @ FLA	2
57	Flux Up Mode	2	122	Slip Comp Gain	2
58	Flux Up Time	2	123	Slip RPM Meter	2
61	Autotune	0	124	PI Configuration	2
62	IR Voltage Drop	1	125	PI Control	2
63	Flux Current Ref	1	126	PI Reference Sel	2


 = Read-Only Parameter

Table 12.1 – Parameter List (Continued)

No.	Parameter Name	Access Level	No.	Parameter Name	Access Level
127	PI Setpoint	2	190	Direction Mode	0
128	PI Feedback Sel	2	192	Save OIM Ref	2
129	PI Integral Time	2	193	Man Ref Preload	2
130	PI Prop Gain	2	194	Save MOP Ref	2
131	PI Lower Limit	2	195	MOP Rate	2
132	PI Upper Limit	2	196	Param Access Lvl	0
133	PI Preload	2	197	Reset To Defaults	0
134	PI Status	2	198	Load Frm Usr Set	1
135	PI Ref Meter	2	199	Save To User Set	1
136	PI Fdback Meter	2	200	Reset Meters	1
137	PI Error Meter	2	201	Language	2
138	PI Output Meter	2	202	Voltage Class	2
140	Accel Time 1	0	203	Drive Checksum	2
141	Accel Time 2	2	204	Dyn UserSet Cnfg	2
142	Decel Time 1	0	205	DynUsrSetSel	2
143	Decel Time 2	2	206	Dyn UserSet Actv	2
146	S Curve %	0	209	Drive Status 1	2
147	Current Lmt Sel	2	210	Drive Status 2	2
148	Current Lmt Val	0	211	Drive Alarm 1	1
149	Current Lmt Gain	2	212	Drive Alarm 2	1
150	Drive OL Mode	1	213	Speed Ref Source	2
151	CarrierFrequency	0	214	Start Inhibits	2
155	Stop Mode A	0	215	Last Stop Source	2
156	Stop Mode B	2	216	Dig In Status	2
157	DC Brake Lvl Sel	1	217	Dig Out Status	2
158	DC Brake Level	1	218	Drive Temp	2
159	DC Brake Time	1	219	Drive OL Count	2
160	Bus Reg Gain	2	220	Motor OL Count	2
161	Bus Reg Mode A	2	224	Fault Frequency	2
162	Bus Reg Mode B	2	225	Fault Amps	2
163	DB Resistor Type	1	226	Fault Bus Volts	2
168	LevelSense Start	2	227	Status 1 @ Fault	2
169	Flying Start En	2	228	Status 2 @ Fault	2
170	Flying StartGain	2	229	Alarm 1 @ Fault	2
174	Auto Rstrt Tries	1	230	Alarm 2 @ Fault	2
175	Auto Rstrt Delay	1	234	Testpoint 1 Sel	2
184	Power Loss Mode	1	235	Testpoint 1 Data	2
185	Power Loss Time	1	236	Testpoint 2 Sel	2

Table 12.1 – Parameter List (Continued)

No.	Parameter Name	Access Level	No.	Parameter Name	Access Level
237	Testpoint 2 Data	2	322	Analog In 1 Hi	0
238	Fault Config 1	2	323	Analog In 1 Lo	0
240	Fault Clear	2	324	Analog In 1 Loss	2
241	Fault Clear Mode	2	325	Analog In 2 Hi	2
242	Power Up Marker	2	326	Analog In 2 Lo	2
259	Alarm Config 1	2	327	Analog In 2 Loss	2
271	Drive Logic Rslt	2	341	Anlg Out Absolut	2
272	Drive Ref Rslt	2	342	Analog Out1 Sel	1
273	Drive Ramp Rslt	2	343	Analog Out1 Hi	1
286	Manual Mask	2	344	Analog Out1 Lo	1
288	Stop Owner	2	361	Digital In1 Sel	0
298	Manual Owner	2	362	Digital In2 Sel	1
300	Data In A1 - Link A Word 1	2	363	Digital In3 Sel	1
301	Data In A2 - Link A Word 2	2	364	Digital In4 Sel	1
302	Data In B1 - Link B Word 1	2	365	Digital In5 Sel	1
303	Data In B2 - Link B Word 2	2	366	Digital In6 Sel	1
304	Data In C1 - Link C Word 1	2	380	Digital Out1 Sel	1
305	Data In C2 - Link C Word 2	2	381	Dig Out1 Level	1
306	Data In D1 - Link D Word 1	2	382	Dig Out1 OnTime	2
307	Data In D2 - Link D Word 2	2	383	Dig Out1 OffTime	2
310	Data Out A1 - Link A Word 1	2	384	Digital Out2 Sel	1
311	Data Out A2 - Link A Word 2	2	385	Dig Out2 Level	1
312	Data Out B1 - Link B Word 1	2	386	Dig Out2 OnTime	2
313	Data Out B2 - Link B Word 2	2	387	Dig Out2 OffTime	2
314	Data Out C1 - Link C Word 1	2			
315	Data Out C2 - Link C Word 2	2			
316	Data Out D1 - Link D Word 1	2			
317	Data Out D2 - Link D Word 2	2			
320	Anlg In Config	0			
321	Anlg In Sqr Root	2			

1 Output Freq

Range: +/-400.0 Hz [0.1 Hz]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

Displays the output frequency present at T1, T2, and T3 (U, V, and W). This value includes reference, slip compensation, and IR compensation.

2 Commanded Freq

Range: +/- 400.0 Hz [0.1 Hz]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

Displays the value of the pre-ramp reference frequency command.

3 Output Current

Range: 0.0 to Drive Rated Amps x 2 [0.1 Amps]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

Displays the total output current present at T1, T2, and T3 (U, V, and W), which includes torque and flux components.

4 Torque Current

Range: Drive Rating x -2 to +2 [0.1 Amps]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

Displays the amount of current that is in phase with the fundamental voltage component. This is the torque-producing component of the output current.

5 Flux Current

Range: Drive Rating x -2 to +2 [0.1 Amps]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

Displays the amount of current that is out of phase with the fundamental voltage component. This is the magnetizing component of the output current.

6 Output Voltage

Range: 0.0 to Drive Rated Volts [0.1 VAC]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

Displays the output voltage present at terminals T1, T2, and T3 (U, V, and W).

7 Output Power

Range: 0.0 to Drive Rated kW x 2 [0.1 kW]
Default: Read Only
Access: 0 **Path:** Monitor>Metering
See also:

Displays the output power present at T1, T2, and T3 (U, V, and W).

8 Output Powr Fctr

Range: 0.00 to 1.00 [0.01]
Default: Read Only
Access: 2 **Path:** Monitor>Metering
See also:

Displays the output power factor.

9 Elapsed MWh

32

Range: 0.0 to 429,496,729.5 MWh [0.1 MWh]
Default: Read Only
Access: 2 **Path:** Monitor>Metering
See also:

Displays the accumulated output energy of the drive.

10 Elapsed Run Time

32

Range: 0.0 to 429,496,729.5 Hr [0.1 Hr]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

Displays the accumulated time the drive has been outputting power.

11 MOP Frequency

Range: +/- 400.0 [0.1 Hz]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also: 194, 195

Displays the setpoint value of the signal at the MOP (Motor-Operated Potentiometer) function. The setpoint can be retained after power down or stop by setting parameter 194.

12 DC Bus Voltage

Range: Voltage rating-dependent [0.1 VDC]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also:

Displays the present DC bus voltage level.

13 DC Bus Memory

Range: Voltage rating-dependent [0.1 VDC]
Default: Read Only
Access: 2 **Path:** Monitor>Metering
See also:

Displays a six-minute average of the DC bus voltage level.

16 Analog In1 Value**17 Analog In2 Value**

Range: 4.000 to 20.000 mA [0.001 mA]
-/+10.0 V [0.1 V]
Default: Read Only
Access: 1 **Path:** Monitor>Metering
See also: 320

Displays the value of the signal at the analog inputs. This value does not include user-programmed scaling information (for example, Analog In1 Hi). The value displayed depends on the setting of Analog In Config (320).

Value of:	If Parameter 320 = .xx00	If Parameter 320 = .xx11
Analog In1	volts (terminals 14/15)	mA (terminals 16/17)
Analog In2	volts (terminals 18/19)	mA (terminals 20/21)

26 Rated kW

Range: 0.37 to 15.0 kW [0.1 kW]
Default: Read Only
Access: 0 **Path:** Monitor>Drive Data
See also:

Displays the drive power rating in kilowatts.

27 Rated Volts

Range: 208 to 600 V [0.1 VAC]
Default: Read Only
Access: 0 **Path:** Monitor>Drive Data
See also: 202

Displays the drive input voltage class (208, 240, 400, etc.). This value will reflect the option selected in parameter 202 (Voltage Class) and correspond to the connected input voltage.

28 Rated Amps

Range: 1.1 to 32.2 Amps [0.1 Amps]
Default: Read Only
Access: 0 **Path:** Monitor>Drive Data
See also:

Displays the drive rated output current. This value corresponds to the drive nameplate continuous output.

29 Control SW Ver

Range: 0.000 to 65.256 [0.001]
Default: Read Only
Access: 0 **Path:** Monitor>Drive Data
See also: 196

Displays the Main Control board software version.

40 Motor Type

Range: 0 = Induction
1 = Synchr Reluc¹
2 = Synchr PM¹
Default: 0 = Induction
Access: 2 **Path:** Motor Control>Motor Data
See also:

¹May conflict with DC Brake feature. See Parameters 157-159. Selection of 1 or 2 requires that parameter 53 be set to Custom V/Hz = (2).

Set to match the type of motor connected.

41 Motor NP Volts



Range: 0.0 to Drive Rated Volts [0.1 VAC]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also:

Set to the motor nameplate rated volts. The motor nameplate base voltage defines the output voltage when operating at rated current, rated speed, and rated temperature.

42 Motor NP FLA



Range: 0.0 to Rated Amps x 2 [0.1 Amps]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also: 47, 48

Set to the motor nameplate rated full load amps. The motor nameplate FLA defines the output amps when operating at rated voltage, rated speed, and rated temperature. It is used in the motor thermal overload and in the calculation of slip.

This parameter, set in the start-up procedure, is adjustable from 0 - 200% of drive rating and should be set for the actual motor FLA rating.

About the Motor Thermal Overload Function

The operation of the overload is actually based on three parameters: Motor NP FLA (42), Motor OL Factor (48), and Motor OL Hertz (47). The motor nameplate full load amps is then multiplied by the motor overload factor to allow you to re-define the continuous level of current allowed by the motor thermal overload function.

Since the motor thermal overload function cannot distinguish individual currents in a multi-motor application, it is suggested that it be disabled in these cases. This can be done by setting the correct bit in Fault Config (238) to zero to disable the motor thermal overload.

Motor Overload Hz (47) is used to allow you to adjust the response of the motor thermal overload to lower motor speeds (lower output frequencies) where a higher degree of protection may be required due to decreased motor cooling.

43 Motor NP Hertz



Range: 5.0 to 400.0 Hz [0.1 Hz]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also:

Set to the motor nameplate rated frequency. The motor nameplate base frequency defines the output frequency when operating at rated voltage, rated current, rated speed, and rated temperature.

44 Motor NP RPM



Range: 60 to 24000 RPM [1 RPM]
Default: 1750 RPM
Access: 1 **Path:** Motor Control>Motor Data
See also:

Set to the motor nameplate rated RPM. The motor nameplate RPM defines the rated speed when operating at motor nameplate base frequency, rated current, base voltage, and rated temperature. This is used to calculate slip.

45 Motor NP Power



Range: 0.00 to 100.00 [0.01]
Default: Based on Drive Type
Access: 1 **Path:** Motor Control>Motor Data
See also: 46

Set to the motor nameplate rated power. The motor nameplate power is used with the other nameplate values to calculate default values for motor parameters to assist the commissioning process. This may be entered in horsepower or in kilowatts as selected in parameter 46.

46 Mtr NP Pwr Units



Range: 0 = Horsepower
1 = kiloWatts
Default: Based on Drive Type
Access: 2 **Path:** Motor Control>Motor Data
See also:

Set to the power units shown on the motor nameplate. This parameter determines the units for parameter 45.

47 Motor OL Hertz



Range: 0.0 to 400.0 Hz
Default: Motor NP Hz/3
Access: 2 **Path:** Motor Control>Motor Data
See also: 42, 220

Sets the output frequency below which the motor operating current is derated. This allows the motor thermal overload to generate a fault below rated current. Note that for all settings of overload Hz other than 0.0, the overload capacity is reduced to 70% when output frequency is zero.

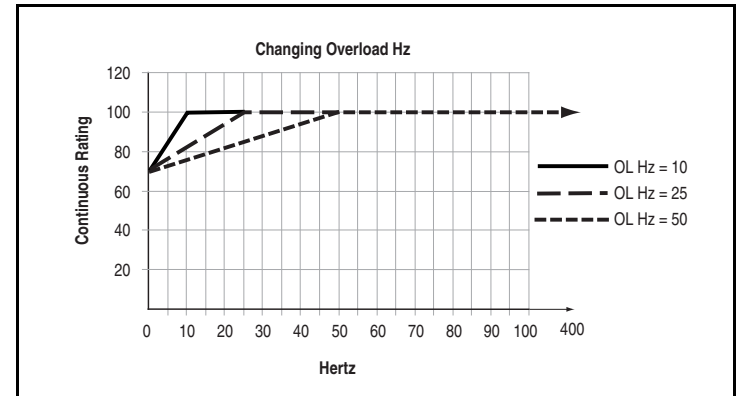


Figure 12.1 – Motor OL Hertz (47)

48 Motor OL Factor



Range: 0.20 to 2.00 [0.01]
Default: 1.00
Access: 2 **Path:** Motor Control>Motor Data
See also: 42, 220

Sets the continuous current operating level for the motor.

The parameter can be used to raise the level of current that will cause the motor thermal overload to trip. The effective overload factor is a combination of parameters 47 and 48.

Motor FLA x OL Factor = Operating Level (Continuous)

53 Torque Perf Mode



Range: 0 = Sensrls Vect
1 = SV Economize
2 = Custom V/Hz
3 = Fan/Pmp V/Hz

Default: 0 = Sensrls Vect

Access: 2 **Path:** Motor Control>Torq Attributes

See also: 62, 63, 69, 70

Specifies the method of motor torque production.

0 = Sensrls Vect maintains consistent magnetizing current up to base speed, and voltage increases as a function of frequency and load.

1 = SV Economize enables an energy-saving function that allows the drive to automatically adjust output voltage as the load changes. By adjusting the output voltage, the flux-producing current is reduced, but only if the total drive output current does not exceed 75% of motor rated current. In this mode, the flux current is not allowed to be less than 50% of the selected flux current parameter value. This is done so that minimum current is supplied to the motor thereby optimizing its efficiency.

2 = Custom V/Hz allows for tailoring the volts/hertz curve by adjusting Maximum Voltage (54), Maximum Freq (55), Run Boost (70), Break Voltage (71), and Break Frequency (72). Refer to figure 12.2.

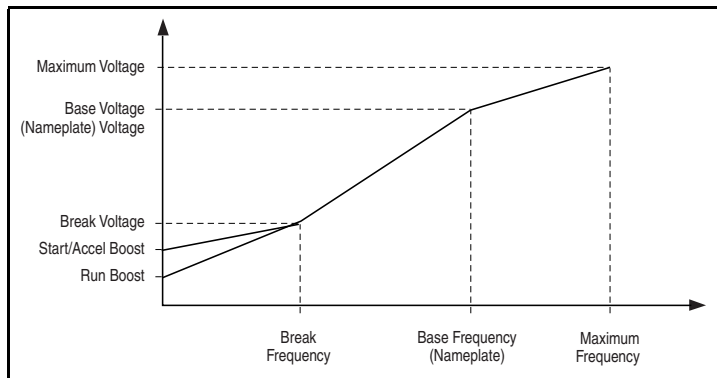


Figure 12.2 – Custom V/Hz Curve

3 = Fan/Pmp V/Hz sets a fan load volts per hertz curve profile exponential to base frequency and linear from base to maximum frequency. At low speed, the fan curve can be offset by the Run Boost parameter (70) to provide necessary starting torque. Refer to figure 12.3.

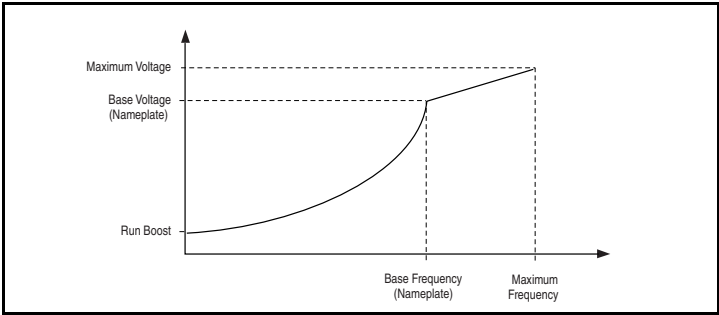


Figure 12.3 – Fan/Pump Curve

54 Maximum Voltage

Range: (Rated Volts x 0.25) to Rated Volts [0.1 VAC]
Default: Drive Rated Volts
Access: 2 **Path:** Motor Control>Torq Attributes
See also:

Sets the highest voltage the drive will output.

55 Maximum Freq



Range: 5.0 to 400.0 Hz [0.1 Hz]
Default: 130.0 Hz
Access: 2 **Path:** Motor Control>Torq Attributes
See also: 82, 83

Sets the maximum allowable frequency the drive will output. Note that is not maximum speed, which is set in parameter 82. Refer to figure 12.4.

Maximum Speed (82) + Overspeed Limit (83) must be ≤ Maximum Freq (55).

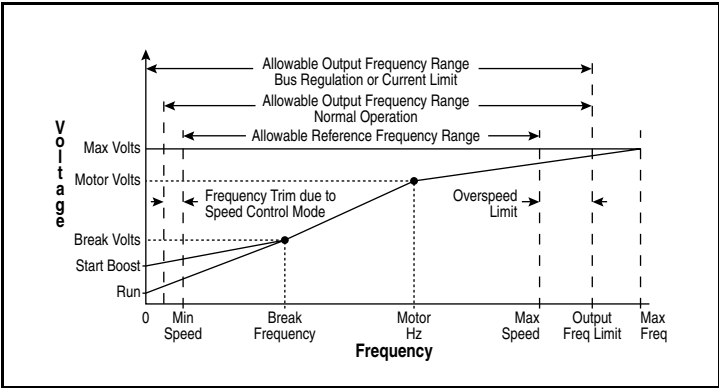


Figure 12.4 – Speed Limits

56 Compensation

Range: See figure 12.5
Default: See figure 12.5
Access: 2 **Path:** Motor Control>Torq Attributes
See also:

Enables/disables the compensation correction options.

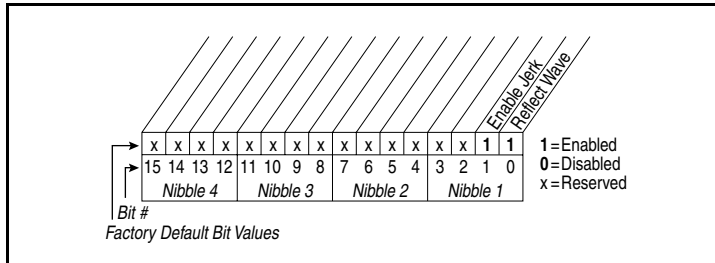


Figure 12.5 – Compensation (56)

Bit 0 - Reflect Wave

- Enables/disables reflected wave correction software, which reduces overvoltage transients from the drive to the motor. For lead lengths beyond 300 feet, enable this feature.

Bit 1 - Enable Jerk

- Enables/disables the jerk limit in the current limiter that helps to eliminate overcurrent trips on fast accelerations. Disable this feature if your application requires the actual acceleration of the motor to be faster than .25 sec.

57 Flux Up Mode

Range: 0 = Manual
1 = Automatic
Default: 0 = Manual
Access: 2 **Path:** Motor Control>Torq Attributes
See also: 53, 58

Flux-up current is the amount of DC current equal to current limit so that full flux can be established in the motor prior to acceleration.

0 = Manual: Flux is established for Flux Up Time (58) before acceleration. The flux-up time can be a user value set in parameter 58.

1 = Auto: Flux is established for a calculated time period based on motor nameplate data. Flux Up Time (58) is not used.

58 Flux Up Time

Range: 0.00 to 5.00 Sec [0.01 Sec]
Default: 0.0 Sec
Access: 2 **Path:** Motor Control>Torq Attributes
See also: 53, 58

Sets the amount of time the drive will apply DC current to the motor to achieve stator flux. When a start command is issued, DC current equal to current limit level is used to build stator flux before accelerating.

61 Autotune

Range: 0 = Ready
1 = Static Tune
2 = Rotate Tune
3 = Calculate
Default: 3 = Calculate
Access: 0 **Path:** Motor Control>Torq Attributes
See also: 53, 62, 63

Enables a manual or automatic method for setting IR Voltage Drop (62) and Flux Current Ref (63). These values will affect sensorless vector performance. Valid only when Torque Perf Mode (53) is set to Sensrls Vect or SV Economize.

0 = Ready: The parameter returns to this setting following a Static Tune or Rotate Tune. It also permits manually setting IR Voltage Drop (62) and Flux Current Ref (63).

1 = Static Tune: A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of IR Voltage Drop. A start command is required following the initiation of this setting. The parameter returns to 0 = Ready following the test, at which time another start transition is required to operate the drive in normal mode. Used when the motor cannot be uncoupled from the load.



2 = Rotate Tune: A temporary command that initiates a Static Tune followed by a rotational test for the best possible automatic setting of Flux Current Ref. A start command is required following initiation of this setting. The parameter returns to 0 = Ready following the test, at which time another start transition is required to operate the drive in normal mode.



ATTENTION: Rotation of the motor in an undesired direction can occur during this procedure (Autotune (61) = Rotate Tune). To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding.

Important: Rotate Tune is used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure.

If the drive fails to Autotune and generates a drive fault:

- Step 1. Press any function (F) key to acknowledge the fault.
- Step 2. Press the ESC key to return to the Main Menu.
- Step 3. Select the Diagnostics Menu ()
- Step 4. Select View Fault Queue.
- Step 5. Clear the fault using .
- Step 6. Return to parameter 61 to re-start the Autotune procedure.


3 = Calculate: This setting uses motor nameplate data to automatically set IR Voltage Drop and Flux Current Ref. When the drive is initially powered up, the Autotune (61) parameter defaults to Calculate. With this setting, any changes made by the user to Motor NP Power (45), Motor NP Volts (41), or Motor NP Hertz (48) activates a new calculation, which updates the IR Voltage Drop (62) and Flux Current (5) parameters. This calculation is based on a typical motor with those nameplate values. The Autotune parameter does not reset to zero after this calculation is performed. Calculations will continue to be performed every time motor nameplate values are changed.

62 IR Voltage Drop

Range: 0.0 to Motor NP Volts x 0.25 [0.1 VAC]
Default: Based on Drive Rating
Access: 1 **Path:** Motor Control>Torq Attributes
See also: 53

The value of volts dropped across the resistance of the motor stator at rated motor current. Used only when Torque Perf Mode (53) is set to Sensrls Vect or SV Economize. This value is set by the Autotune procedure (61).

63 Flux Current Ref

 **Range:** 0.00 to Motor NP FLA [0.01 Amps]
Default: Based on Drive Rating
Access: 1 **Path:** Motor Control>Torq Attributes
See also: 53

The value of amps for full motor flux. Used only when Torque Perf Mode (53) is set to Sensrls Vect or SV Economize. This value is set by the Autotune procedure (61).

69 Start/Acc Boost

Range: 0.0 to Motor NP Volts x 0.25 [0.1 VAC]
Default: Motor NP Volts x 0.25
Access: 2 **Path:** Motor Control>Volts per Hertz
See also: 53, 70, 83

Sets the voltage boost level for starting and acceleration when Custom V/Hz mode is selected in Torque Perf Mode (53). After acceleration has stopped, the output volts/hertz is set by the steady state operating curve. See figure 12.7.

70 Run Boost

Range: 0.0 to Motor NP Volts x 0.25 [0.1 VAC]
Default: Motor HP Volts x 0.25
Access: 2 **Path:** Motor Control>Volts per Hertz
See also: 53, 69, 83

Sets the boost level for steady state or deceleration when Fan/Pmp V/Hz or Custom V/Hz modes are selected in Torque Perf Mode (53). This boost level applies in the range from zero to Break Frequency (72). See figure 12.7.

71 Break Voltage

Range: 0.0 to Motor NP Volts [0.1 VAC]
Default: Motor NP Volts x 0.25
Access: 2 **Path:** Motor Control>Volts per Hertz
See also: 53, 72, 83

Sets the voltage the drive outputs at Break Frequency (72) and defines the volts per hertz ratio at the break frequency. Applies only if Fan/Pump or Custom V/Hz is selected in parameter 53 (Torque Perf Mode). See figure 12.7.

72 Break Frequency

Range: 0.0 to 400.0 Hz
Default: Motor NP Freq
Access: 2 **Path:** Motor Control>Volts per Hertz
See also: 53, 71, 83

Sets the frequency the drive will output at Break Voltage (71). Applies only if Fan/Pump or Custom V/Hz is selected in parameter 53 (Torque Perf Mode). See figure 12.7.

80 Speed Mode



Range: 0 = Open Loop
1 = Slip Comp
2 = Process PI

Default: 0 = Open Loop

Access: 2 **Path:** Speed Command>Spd Mode & Limits

See also: 124 -138

Sets the method of speed regulation. See figure 12.6.

0 = Open Loop provides no speed compensation due to load variations. This is strict volts per hertz output as a function of the speed reference.

1 = Slip Comp provides for frequency output adjustment as a function of load. The amount of compensation is defined by the value of Slip RPM @ FLA.

2 = Process PI allows for the output motor speed (frequency) to be adjusted based on the outer control loop regulator.

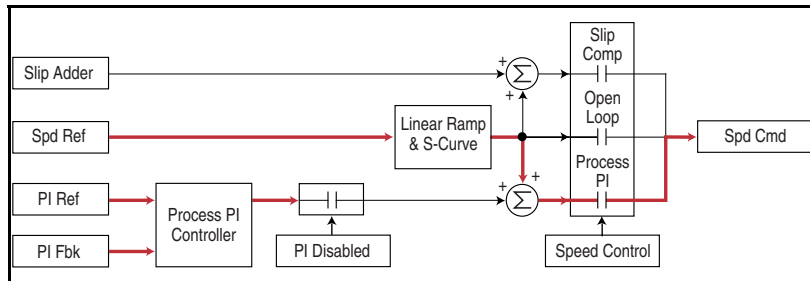


Figure 12.6 – Speed Control Method

81 Minimum Speed



Range: 0.0 to Maximum Speed [0.1 Hz]

Default: 0.0 Hz

Access: 0 **Path:** Speed Command>Spd Mode & Limits

See also: 83, 92, 95

Sets the low limit for the speed reference after scaling is applied. See figure 12.7.



ATTENTION: The drive can operate at and maintain zero speed. The user is responsible for assuring safe conditions for operating personnel by providing suitable guards, audible or visual alarms, or other devices to indicate that the drive is operating or may operate at or near zero speed. Failure to observe this precaution could result in severe bodily injury or loss of life.

82 Maximum Speed

<input type="checkbox"/>	Range: 5.0 to 400.0 Hz [0.0 Hz]
	Default: 50.0 or 60.0 Hz (dependent on voltage class)
	Access: 0 Path: Speed Command>Spd Mode & Limits
	See also: 55, 83, 91, 202

Sets the high limit for the speed reference after scaling is applied. See figure 12.7.



ATTENTION: The user is responsible for ensuring that driven machinery, all drive-train mechanisms, and application material are capable of safe operation at the maximum operating speed of the drive. Overspeed detection in the drive determines when the drive shuts down. See figure 12.7. Failure to observe this precaution could result in bodily injury.

83 Overspeed Limit

<input type="checkbox"/>	Range: 0.0 to 20.0 Hz [0.1 Hz]
	Default: 10.0 Hz
	Access: 2 Path: Speed Command>Spd Mode & Limits
	See also: 55, 82

Sets the incremental amount of the output frequency (above Maximum Speed) allowable for functions such as slip compensation. See figure 12.7.

Maximum Speed (82) + Overspeed Limit (83) must be \leq to Maximum Frequency (55)

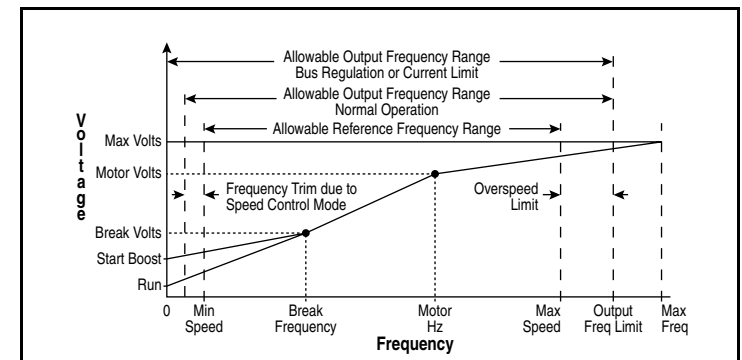


Figure 12.7 – Speed Limits

84 Skip Frequency 1
85 Skip Frequency 2
86 Skip Frequency 3

Range: -/+400.0 Hz
Default: 0.0 Hz
Access: 2 **Path:** Speed Command>Spd Mode & Limits
See also: 87

Sets the center of a frequency band at which the drive will not operate continuously (also called an **avoidance frequency**). Requires that both Skip Frequency 1, 2, or 3, and Skip Frequency Band (87) be set to a value other than 0.

87 Skip Freq Band

Range: 0.0 to 30.0 Hz [0.1 Hz]
Default: 0.0 Hz
Access: 2 **Path:** Speed Command>Spd Mode & Limits
See also: 84, 85, 86

Determines the bandwidth around a skip frequency (half the band above and half the band below the skip frequency). This value applies to all skip frequencies.

If the commanded drive frequency is greater than or equal to the skip (center) frequency and less than or equal to the high value of the band (skip plus 1/2 band), the drive will set the output frequency to the high value of the band. See (A) in figure 12.8.

If the commanded drive frequency is less than the skip (center) frequency and greater than or equal to the low value of the band (skip minus 1/2 band), the drive will set the output frequency to the low value of the band. See (B) in figure 12.8.

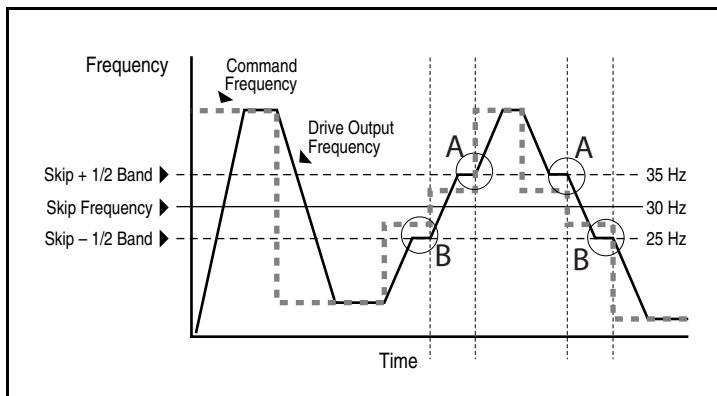


Figure 12.8 – Skip Freq Band (87)

89 Logic Source Sel



Range: 0 = Terminal Blk
1 = Local OIM
2 = DPI Port 2
3 = DPI Port 3
4 = Reserved
5 = Network
6 = Reserved
7 = All Ports

Default: 1 = Local OIM

Access: 0 **Path:** Speed Command>Control Src Select

See also: 90



ATTENTION: Changing parameter 89 to Terminal Blk or Network while LevelSense Start is enabled may start the drive if a start command is on from the newly selected logic source.

When LevelSense Start is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

ATTENTION: Note the following about stop commands:

- A stop command from any attached OIM will always be enabled regardless of the value of Logic Source Sel.
- Network stop commands are effective only when Logic Source Sel is set to Network or All Ports.
- Terminal block stop commands are effective only when Logic Source Sel is set to Terminal Blk or All Ports.

Failure to observe these precautions could result in severe bodily injury or loss of life.

Important: The drive is shipped from the factory configured for local OIM (keypad) control. For drive control from the terminal block inputs, Logic Source Sel (89) must be set to 0 = Terminal Blk.

Logic Source Sel (89) defines the control source for the following logic commands (see figure 12.9):

- Start
- Clear Faults
- Stop
- Jog
- Direction
- Run

0 = Terminal Blk: Hardware I/O control

1 = Local OIM: Drive-mounted OIM

2 = DPI Port 2: DIN connector DPI port

3 = DPI Port 3: DIN port 2 split with option cable

4 = Reserved

5 = Network: Communications interface

6 = Reserved

7 = All Ports: All control sources active

Important: Asserting the terminal block input assigned to the OIM control function overrides parameter 89. You can switch control from the terminal block to the OIM by configuring Digital Inx Sel (361-366) to the OIM control function. This switching will affect logic control and the speed reference source. Refer to the parameter 361-366 description for detail.

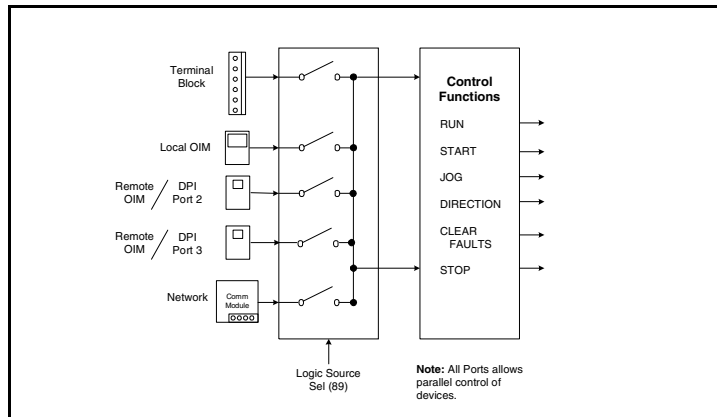


Figure 12.9 – Logic Source Sel (89)

90 Speed Ref A Sel



Range:	1 = Analog In 1 2 = Analog In 2 3-8 = Reserved 9 = MOP Level 10 = Reserved 11 = Preset Spd 1 12 = Preset Spd 2 13 = Preset Spd 3 14 = Preset Spd 4 15 = Preset Spd 5 16 = Preset Spd 6 17 = Preset Spd 7 18 = Local OIM 19 = DPI Port 2 20 = DPI Port 3 21 = Reserved 22 = Network 23 = Reserved
Default:	18 = Local OIM
Access:	0 Path: Speed Command>Speed References Speed Command>Control Src Select
See also:	2, 91-92, 101-107, 117-120, 192-194, 213, 272, 273, 361-366, 320-327

Selects the source of the speed reference to the drive unless Preset Speed 1-7 (101-107) is selected.

Note that the manual mode select and logic select of OIM Control can override the reference control source. See figure 12.10.



ATTENTION: Removing and replacing the LCD OIM while the drive is running may cause an abrupt speed change if the LCD OIM is the selected reference source, but is not the selected control source. The drive will ramp to the reference level provided by the OIM at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142) and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

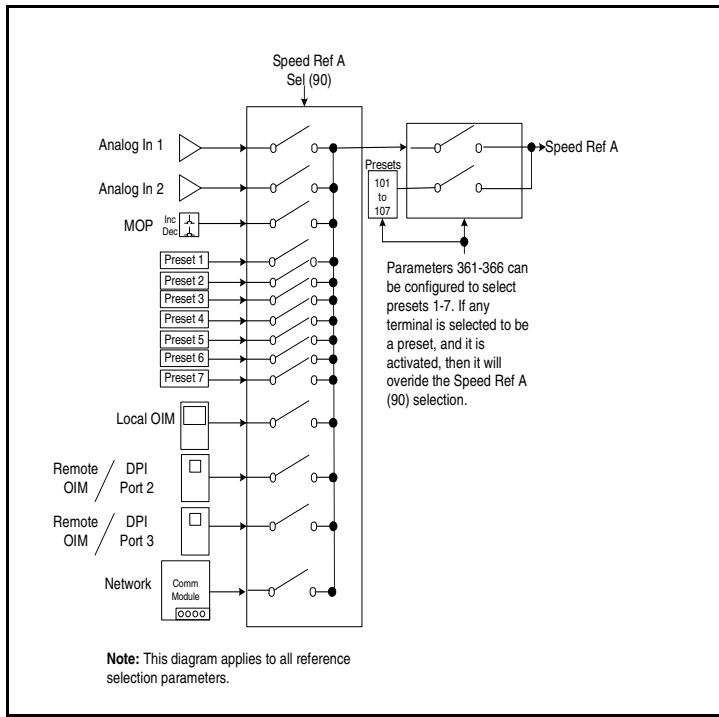


Figure 12.10 – Reference Selection

91 Speed Ref A Hi

Range: -/+ Maximum Speed [0.1 Hz]
Default: Maximum Speed
Access: 1 **Path:** Speed Command>Speed References
See also: 82

Analog input reference scaling. Scales the upper value of the Speed Ref Sel (90) selection when the source is an analog input.

Important: Parameter 91 corresponds to Analog In 1 Hi (322) or Analog In 2 Hi (325) depending on the analog input assigned as a source. See figure 12.51.

92 Speed Ref A Lo

Range: -/+ Maximum Speed [0.1 Hz]
Default: 0.0 Hz
Access: 1 **Path:** Speed Command>Speed References
See also: 81

Analog input reference scaling. Scales the lower value of the Speed Ref A Sel (90) selection when the source is an analog input.

Important: Parameter 92 corresponds to Analog In 1 Lo (323) or Analog In 2 Lo (326) depending on the analog input assigned as a source. See figure 12.51.

96 TB Man Ref Sel

Range: 1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level
10 = Reserved
11 = Preset Spd 1
12 = Preset Spd 2
13 = Preset Spd 3
14 = Preset Spd 4
15 = Preset Spd 5
16 = Preset Spd 6
17 = Preset Spd 7
Default: 2 = Analog In 2
Access: 1 **Path:** Speed Command>Speed References
See also: 97, 98, 361-366

Specifies the manual speed reference source when a digital input is configured for manual mode selection. See parameters 361-366.

97 TB Man Ref Hi

Range: -/+ Maximum Speed [0.1 Hz]
Default: Maximum Speed
Access: 1 **Path:** Speed Command>Speed References
See also: 96

Analog input reference scaling. Scales the upper value of the TB Man Ref Sel (96) selection when the source is an analog input. Parameter 97 should be set in conjunction with Analog In 1 Hi (322) or Analog In 2 Hi (325) depending on the appropriate analog input used. See figure 12.51.

98 TB Man Ref Lo

Range: -/+ Maximum Speed [0.1 Hz]
Default: 0.0 Hz
Access: 1 **Path:** Speed Command>Speed References
See also: 96

Analog input reference scaling. Scales the lower value of the TB Man Ref Sel (96) selection when the source is an analog input. Parameter 98 should be set in conjunction with Analog In 1 Lo (323) or Analog In 2 Lo (326) depending on the appropriate analog input used. See figure 12.51.

100 Jog Speed

Range: -/+ Maximum Speed [0.1 Hz]
Default: 10.0 Hz
Access: 0 **Path:** Speed Command>Discrete Speeds
See also:

Sets the output frequency when a jog command is issued. The jog function can be activated from the terminal block or OIM keypad.

-
- 101 Preset Speed 1**
 - 102 Preset Speed 2**
 - 103 Preset Speed 3**
 - 104 Preset Speed 4**
 - 105 Preset Speed 5**
 - 106 Preset Speed 6**
 - 107 Preset Speed 7**

Range: -/+ Maximum Speed [0.1 Hz]
Default: See table 12.2
Access: 101=0 **Path:** Speed Command>Discrete Speeds
102 -107=2
See also: 90

Provides an internal fixed speed command value when Speed Ref A is set to one of the Preset Speed (1-7) internal references. Alternatively, one of the internal preset speed setpoint values can be selected via logic control if any of the Digital Inx Sel (361-366) are configured to be Speed Sel 1, 2, or 3.

Table 12.2 – Default Values for Preset Speeds 1-7

Parameter No.	Parameter Name	Default
101	Preset Speed 1	5.0 Hz
102	Preset Speed 2	10.0 Hz
103	Preset Speed 3	20.0 Hz
104	Preset Speed 4	30.0 Hz
105	Preset Speed 5	40.0 Hz
106	Preset Speed 6	50.0 Hz
107	Preset Speed 7	60.0 Hz

117 Trim In Select



Range: 1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level
10 = Reserved
11 = Preset Spd 1
12 = Preset Spd 2
13 = Preset Spd 3
14 = Preset Spd 4
15 = Preset Spd 5
16 = Preset Spd 6
17 = Preset Spd 7
18 = Local OIM
19 = DPI Port 2
20 = DPI Port 3
21 = Reserved
22 = Network
23 = Reserved

Default: 2 = Analog In 2

Access: 2 **Path:** Speed Command>Speed Trim

See also: 90

Specifies which analog input signal is being used as a trim input. See figure 12.11.

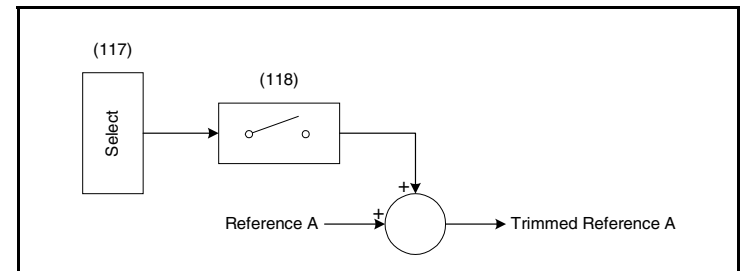


Figure 12.11 – Trim Input Select

118 Trim Out Select



Range: See figure 12.12
Default: See figure 12.12
Access: 2 **Path:** Speed Command>Speed Trim
See also: 117, 119, 120

Specifies if Ref A speed reference is to be trimmed.

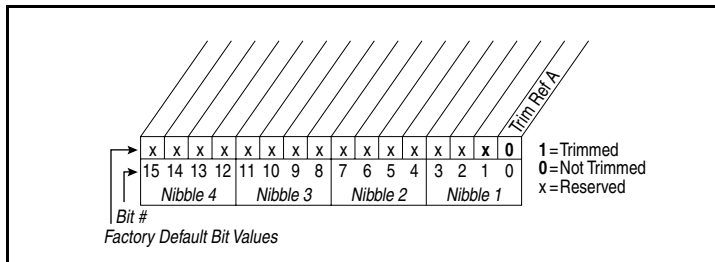


Figure 12.12 – Trim Out Select (118)

119 Trim Hi

Range: -/+ Maximum Speed [0.1 Hz]
Default: 60.0 Hz
Access: 2 **Path:** Speed Command>Speed Trim
See also: 82, 117

Analog reference scaling. Scales the upper value of the Trim In Select (117) selection when the source is an analog input. This value should be set in conjunction with Analog In 1 Hi (322) or Analog In 2 Hi (325). See figure 12.51.

120 Trim Lo

Range: -/+ Maximum Speed [0.1 Hz]
Default: 0.0 Hz
Access: 2 **Path:** Speed Command>Speed Trim
See also: 117

Analog reference scaling. Scales the lower value of the Trim In Select (117) selection when the source is an analog input. This value should be set in conjunction with Analog In 1 Lo (323) or Analog In 2 Lo (326). See figure 12.51.

121 Slip RPM @ FLA

Range: 0.0 to 1200.0 RPM
Default: Based on Motor NP RPM
Access: 2 **Path:** Speed Command>Slip Comp
See also: 61, 80, 122, 123

Sets the amount of slip compensation to be added to the drive output at 100% motor load. If parameter 61 (Autotune) = 3 (Calculate), changes made to this parameter will not be accepted.

Important: Parameters in the Slip Comp Group (121-123) are used to enable and tune the slip compensation regulator. To allow the slip compensation regulator to control drive operation, Speed Mode (80) must be set to 1 (Slip Comp).

122 Slip Comp Gain

Range: 1.0 to 100.0 [0.1]
Default: 40.0
Access: 2 **Path:** Speed Command>Slip Comp
See also: 80, 121, 122

Sets the response time of slip compensation. Increasing the value will increase the slip compensation response.

Important: Parameters in the Slip Comp Group (121-123) are used to enable and tune the slip compensation regulator. To allow the slip compensation regulator to control drive operation, Speed Mode (80) must be set to 1 (Slip Comp).

123 Slip RPM Meter

Range: 0.0 to 300.0 RPM
Default: Read Only
Access: 2 **Path:** Speed Command>Slip Comp
See also: 80, 121, 122

Displays the present amount of slip adjustment being added to the motor commanded frequency.

Important: Parameters in the Slip Comp Group (121-123) are used to enable and tune the slip compensation regulator. To allow the slip compensation regulator to control drive operation, Speed Mode (80) must be set to 1 (Slip Comp).

124 PI Configuration



Range: See figure 12.13
Default: See figure 12.13
Access: 2 **Path:** Speed Command>Process PI
See also: 80, 125-138

Selects specific features of the PI regulator. See Appendix D.

Important: Parameters in the Process PI Group are used to enable and tune the PI Loop. To allow the PI Loop to control drive operation, parameter 80 (Speed Mode) must be set to 2 (Process PI).

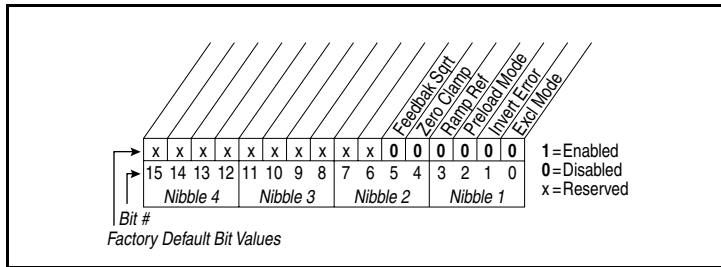


Figure 12.13 – PI Configuration (124)

Bit 0 - Excl Mode (Exclusive Mode)

- Enabled = Selects speed regulation. The PI output can be used as the total speed reference command.
- Disabled = Selects trim regulation. The PI output is summed with Speed Ref A to generate the total speed command.

Bit 1 - Invert Error

- Enables/disables the option to invert the sign of the PI error signal. Enabling this feature creates a decrease in output for an increasing error and an increase in output for a decreasing error.

Bit 2 - Preload Mode

- Enabled = Initializes the PI integrator to the commanded speed while the PI is disabled.
- Disabled = The PI integrator is loaded with the PI Preload (133) while the PI is disabled.

Bit 3 - Ramp Ref

- Enables/disables ramping the PI reference from the PI Feedback to the PI Reference. This is used to preload the PI reference with the actual PI feedback signal at time of enable. This will result in a smooth ramping of the PI output. The ramp time used is set by the active ramps (parameters 140-143).

Bit 4 - Zero Clamp

- Enables/disables option to limit operation so that the output frequency of the PI regulator always has the same sign as the master speed reference. This limits the possible drive action to one direction only. Output from the drive will be from zero to maximum frequency forward or zero to maximum frequency reverse.

Bit 5 - Feedback Sqrt (Square Root Feedback)

- Enables/disables the option of using the square root of the feedback signal as the PI feedback.

125 PI Control

Range:	See figure 12.14
Default:	See figure 12.14
Access:	2 Path: Speed Command>Process PI
See also:	124-138

Controls the PI regulator. You can control the bits from a Datalink network parameter or an assigned digital input.

PI control allows the drive to take a reference signal (setpoint) and an actual signal (feedback) from an external transducer such as position, flow, or pressure, so that the motor speed can be adjusted to maintain control over the external variable.

Proportional control (P) adjusts the output based on the size of the error (larger error = proportionally larger correction).

Integral control (I) adjusts the output based on the duration of the error. The integral control by itself is a ramp output correction. This type of control gives a smoothing effect to the output and will continue to integrate until zero error is achieved.

By itself, integral control is slower than many applications require, and, therefore, is combined with proportional control (PI).

There are two ways the PI regulator can be configured to operate (see parameter 124):

- Process trim, which takes the output of the PI regulator and sums it with a master speed reference to control the process.
- Process control, which takes the output of the PI regulator as the speed command. No master speed reference exists, and the PI output directly controls the drive output.

Note that Speed Mode (80) must be set to Process PI (2).

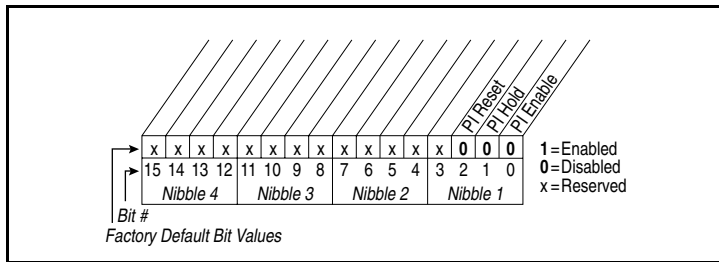


Figure 12.14 – PI Control (125)

The functions below can be controlled via digital input selection functions (361-366):

Bit 0 - PI Enable

- Enables/disables the operation of the PI loop.

Bit 1 - PI Hold

- Enabled = The integrator for the outer control loop is held at the current level; that is, it will not increase.
- Disabled = The integrator for the outer PI control loop is allowed to increase.

Bit 2 - PI Reset

- Enabled = The integrator for the outer PI control loop is reset to zero.
- Disabled = The integrator for the outer PI control loop integrates normally.

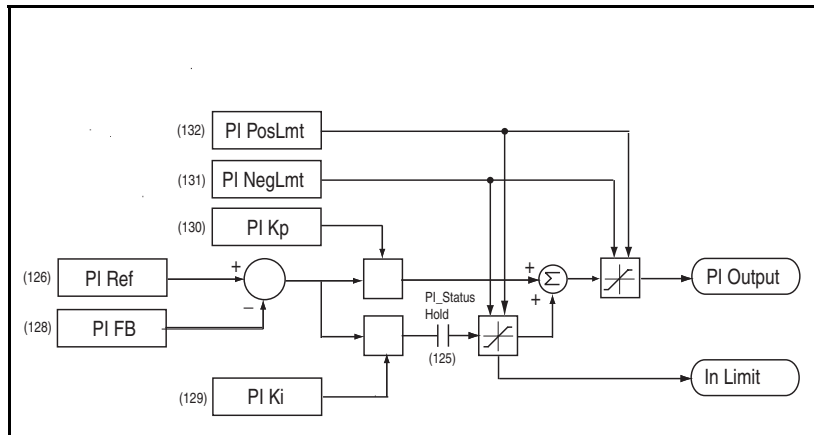


Figure 12.15 – PI Regulator

126 PI Reference Sel

Range: 0 = PI Setpoint (127)
1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level
10 = Master Ref
11 = Preset Spd 1
12 = Preset Spd 2
13 = Preset Spd 3
14 = Preset Spd 4
15 = Preset Spd 5
16 = Preset Spd 6
17 = Preset Spd 7
18 = Local OIM
19 = DPI Port 2
20 = DPI Port 3
21 = Reserved
22 = Network
23 = Reserved

Default: 0 = PI Setpoint (127)
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Selects the source of the outer control loop process PI reference signal.

127 PI Setpoint

Range: -/+100.00% of Maximum Process Value [0.01%]
Default: 50.00%
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Provides an internal register value for the process setpoint when PI Reference Sel (126) is set to PI Setpoint.

128 PI Feedback Sel

Range: 0 = PI Setpoint
1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level
10 = Master Ref
11 = Preset Spd 1
12 = Preset Spd 2
13 = Preset Spd 3
14 = Preset Spd 4
15 = Preset Spd 5
16 = Preset Spd 6
17 = Preset Spd 7
18 = Local OIM
19 = DPI Port 2
20 = DPI Port 3
21 = Reserved
22 = Network
23 = Reserved

Default: 2 = Analog In 2

Access: 2 **Path:** Speed Command>Process PI

See also: 124-138

Selects the source of the outer control loop process PI feedback signal.

129 PI Integral Time

Range: 0.00 to 100.00 Sec [0.01 Sec]

Default: 2.00 Sec

Access: 2 **Path:** Speed Command>Process PI

See also: 124-138

Specifies the time required for the integral component to reach 100% of PI Error Meter (137). The shorter the integral time, the faster the integration will react to process errors. Not functional when the PI Hold bit of PI Control (125) = 1 (Enabled).

130 PI Prop Gain

Range: 0.00 to 100.00 [0.01]

Default: 1.00

Access: 2 **Path:** Speed Command>Process PI

See also: 124-138

Sets the value for the proportional gain component of the PI regulator. The PI Hold bit and the PI Enable bit of PI Control (125) must be equal to 1(Enabled) for the PI regulator to be active.

PI Error x PI Prop Gain = PI Output

131 PI Lower Limit

Range: -/+400.0 Hz
Default: -Maximum Freq
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Sets the lower limit of the process PI output. This value must be less than the value set in PI Upper Limit (132).

132 PI Upper Limit

Range: -/+400.0 Hz [0.1 Hz]
Default: +Maximum Freq
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Sets the upper limit of the process PI output. This value must be greater than the value set in PI Lower Limit (131).

133 PI Preload

Range: -/+400.0 Hz [0.1 Hz]
Default: 0.0 Hz
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Sets the value used to load into the PI Integrator while the PI regulator is disabled. This allows better dynamic starting performance at the time the regulator is enabled. Refer to figure 12.16.

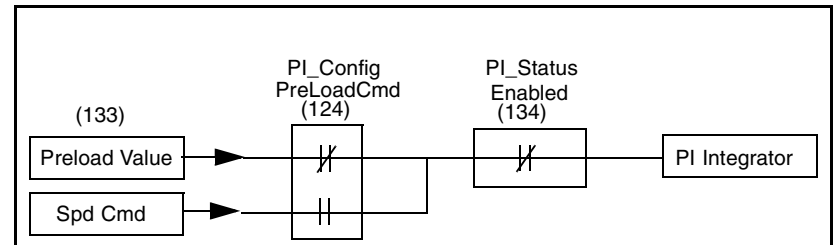


Figure 12.16 – PI Preload Value

134 PI Status

Range: See figure 12.17
Default: Read Only
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Displays the present state of the process PI regulator. See parameter 125 for control of the PI regulator functions.

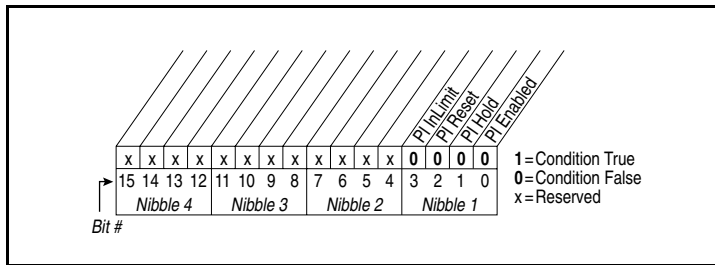


Figure 12.17 – PI Status (134)

Bit 0 - PI Enabled

- Indicates whether or not the process PI loop is enabled.

Bit 1 - PI Hold

- Is set to 1 to indicate when a digital input is configured for PI Hold and is turned on, or the PI Hold bit is set in PI Control (125).

Bit 2 - PI Reset

- Is set to 1 to indicate when the PI Integrator is being reset to zero.

Bit 3 - PI InLimit

- Is set to 1 to indicate when the PI output equals positive limit or negative limit.

135 PI Ref Meter

Range: -/+100.00% [0.01%]
Default: Read Only
Access: 2 **Path:** Speed Command>Process PI
See also: 124 - 138

Displays the present value of the process PI reference signal.

136 PI Fdback Meter

Range: -/+100.00% [0.01%]
Default: Read Only
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Displays the present value of the process PI feedback signal.

137 PI Error Meter

Range: -/+100.00% [0.01%]
Default: Read Only
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Displays the present value of the process PI error signal.

138 PI Output Meter

Range: -/+100.0 Hz [0.1 Hz]
Default: Read Only
Access: 2 **Path:** Speed Command>Process PI
See also: 124-138

Displays the present value of the process PI output signal.

PI Output \approx PI Error x PI Prop Gain + PI Error/PI Integral Gain

140 Accel Time 1**141 Accel Time 2**

Range: 0.1 to 3600.0 Sec [0.1 Sec]
Default: 10.0 Sec
Access: 140=0 **Path:** Dynamic Control>Ramp Rates
141=2
See also: 142, 143, 146, 361-366

The Accel Time parameters set the rate at which the drive ramps to its output frequency after a start command or during an increase in command frequency (speed change). The rate established is the result of the following equation:

Maximum Frequency - Minimum Frequency / Accel Time = Accel Rate

Two accel times exist to enable acceleration rate changes “on the fly” using a network command, digital input, or F-Key on the LCD OIM, if configured (see chapter 9 for information on configuring F-Keys).

142 Decel Time 1**143 Decel Time 2**

Range: 0.1 to 3600.0 Sec [0.1 Sec]
Default: 10.0 Sec
Access: 142=0 **Path:** Dynamic Control>Ramp Rates
143=2
See also: 142, 143, 146, 361-366

Sets the rate of deceleration for all speed decreases.

Max Speed / Decel Time = Decel Rate

Two decel times exist to enable deceleration rate changes “on the fly” using a network command, digital input, or F-Key on the LCD OIM, if configured (see chapter 9 for information on configuring F-Keys).

146 S Curve %

Range: 0 to 100% [1%]
Default: 0%
Access: 0 **Path:** Dynamic Control>Ramp Rates
See also: 140 - 143

Sets the percentage of acceleration or deceleration time that is applied to the ramp as an S curve. Time is entered as a percentage of accel or decel time, and ramp times are extended, 1/2 at the beginning and 1/2 at the end of the ramp.

For example: Accel = 10 sec
S-Curve % = 25%

2.5 seconds will be added to the accel time, 1.25 seconds of rounding at each end of the ramp.

147 Current Lmt Sel

Range: 0 = Curr Lim Val
1 = Analog In 1
2 = Analog In 2
Default: 0 = Cur Lim Val
Access: 2 **Path:** Dynamic Control>Load Limits
See also: 148, 149

Selects the source for the adjustment of current limit (i.e., parameter, analog input, etc.). Allows for external current limit via analog inputs.

If an analog input is selected (1, 2), Analog Inx Lo = 0% limit,
Analog Inx Hi = 150% limit.

148 Current Lmt Val

Range: Based on Drive Type [0.1 Amps]
Default: Based on Drive Type (approximately 150% of Drive Rated Amps)
Access: 0 **Path:** Dynamic Control>Load Limits
See also: 147, 149

Sets the current limit value when Current Lmt Sel (147) = Cur Lim Val.

149 Current Lmt Gain

Range: 0 to 5000 [1]
Default: 200
Access: 2 **Path:** Dynamic Control>Load Limits
See also: 147, 148

Sets the responsiveness of the current limit.

150 Drive OL Mode

Range: 0 = Disabled
1 = Reduce CLim
2 = Reduce PWM
3 = Both-PWM 1st
Default: 3 = Both-PWM 1st
Access: 1 **Path:** Dynamic Control>Load Limits
See also: 219

Selects the drive's response to increasing drive temperature. The drive could reduce current limit, PWM carrier, or both. A fault or alarm will also be activated when an overload is detected.

151 CarrierFrequency

Range: 2 - 10 kHz [1 kHz]
Default: 4 kHz
Access: 0 **Path:** Dynamic Control>Load Limits
See also: 146, 149

Sets the carrier frequency for the PWM output. Drive derating may occur at higher carrier frequencies. For derating information, refer to Appendix A.

155 Stop Mode A
156 Stop Mode B

Range: 0 = Coast
1 = Ramp
2 = Ramp to Hold
3 = DC Brake

Default: 155: 1 = Ramp
156: 0 = Coast

Access: 155=0 **Path:** Dynamic Control>Stop/Brake Modes
156=2

See also: 157-159, 361-366



ATTENTION: The user must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation may result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

Selects the active stop mode. Stop Mode A is active unless Stop Mode B is selected by a digital input. This function allows the user to switch between two possible stop modes using an external logic signal. Refer to figure 12.18.

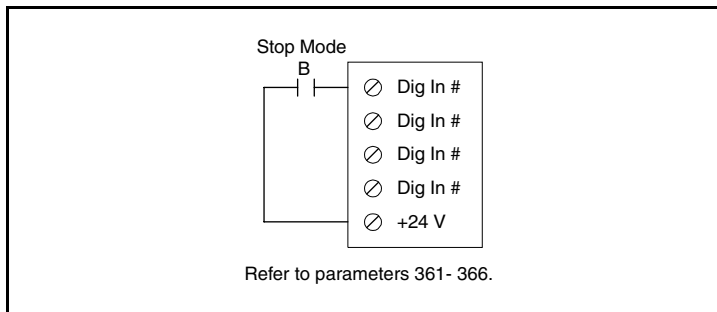


Figure 12.18 – Selecting Stop Mode B

0 = Coast: When Stop Mode A (155) is set to Coast, the drive acknowledges the Stop command by shutting off the output transistors and releasing control of the motor. The load/motor will coast or free spin until the mechanical energy is dissipated.

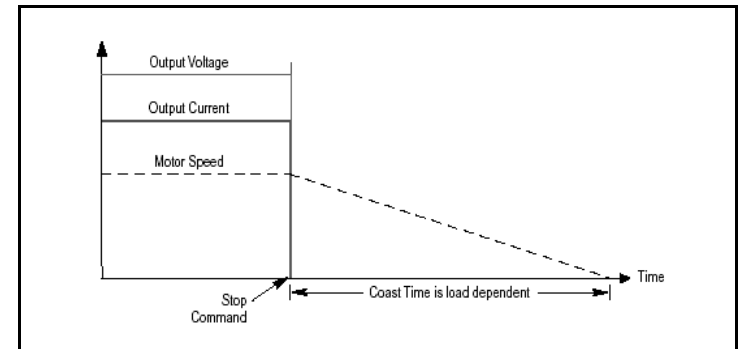


Figure 12.19 – Coast to Stop (Stop Mode A = 0)

1 = Ramp: When Stop Mode A (155) is set to Ramp, the drive ramps the frequency to zero based on the deceleration time programmed into Decel Time 1 (142) or Decel Time 2 (143). The “normal” mode of machine operation can use Decel Time 1. If a faster deceleration than normal mode is required, Decel Time 2 can be activated with a faster rate selected. When Ramp is selected, the drive acknowledges the Stop command by decreasing or “ramping” the output voltage and frequency to zero in a programmed period (Decel Time), maintaining control of the motor until the drive output reaches zero. The output transistors are then shut off.

The load/motor should follow the decel ramp. Other factors such as bus regulation and current limit can alter the decel time and modify the ramp function.

Ramp mode can also include a “timed” hold brake. Once the drive has reached zero output hertz on a Ramp-to-Stop, and parameters DC Brake Time (159) and DC Brake Level (158) are not zero, the drive applies DC to the motor producing current at the DC Brake Level for the DC Brake Time. The drive output voltage will be zero when the hold time is finished.

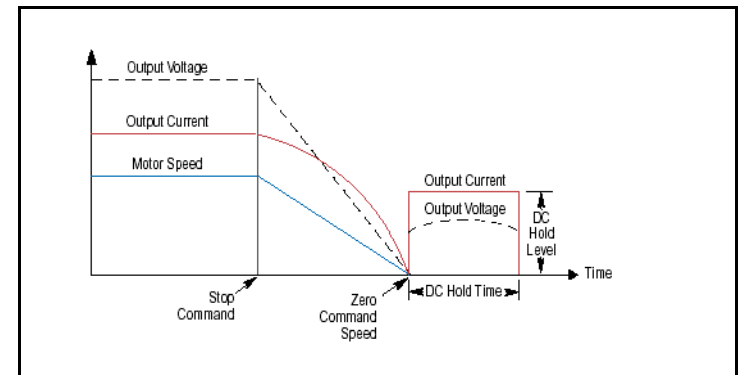


Figure 12.20 – Ramp Stop (Stop Mode A = 1)

2 = Ramp to Hold: When Stop Mode A (155) is set to Ramp to Hold, the drive ramps the frequency to zero based on the deceleration time programmed into Decel Time 1 (142) or Decel Time 2 (143). Once the drive reaches zero hertz, a DC injection holding current is applied to the motor based on the values set in DC Brake Level (158) and DC Brake Lvl Sel (157). The DC hold is removed only by removing the Enable input or by a valid start input.

Motor speed during and after the application of DC depends on the combination of these two parameter settings and the mechanical system. The drive output voltage will be zero when the hold time is finished.

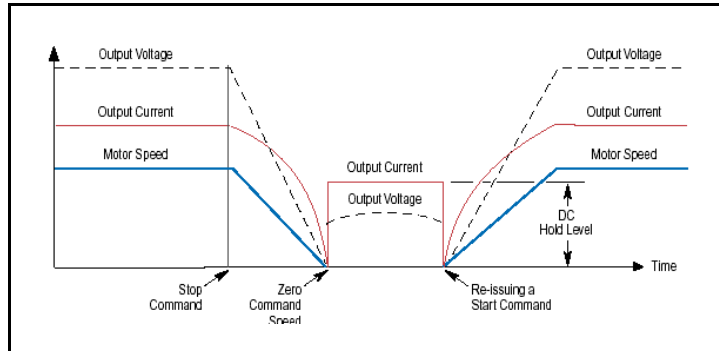


Figure 12.21 – Ramp to Hold (Stop Mode A = 2)

3 = DC Brake - When Stop Mode A (155) is set to DC Brake, the drive acknowledges the Stop command by immediately stopping the output and then applying a programmable DC voltage (DC Brake Level (158)) to one phase of the motor.

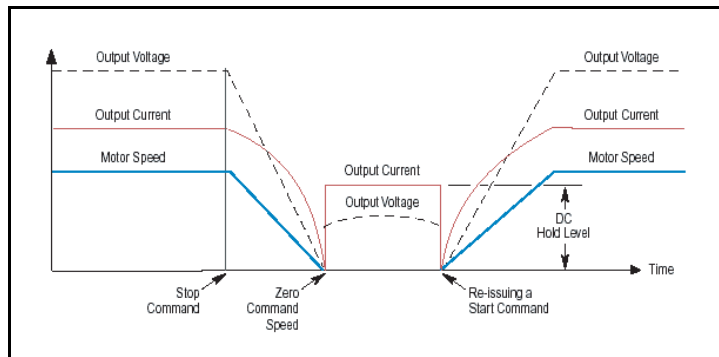


Figure 12.22 – DC Brake (Stop Mode A = 3)

You can also select the amount of time the braking will be applied and the magnitude of the current used for braking with DC Brake Time (159) and DC Brake Level (158). This method of braking will generate up to 40% of rated motor torque for braking and is typically used for low inertia loads.

This DC braking voltage is removed by the following events:

- Opening an Enable digital input
- Reissuing the Start command
- DC brake time expiring

Caution must be used when setting DC Brake Level. Excess motor current could damage the motor. Caution must also be observed since motor voltage will exist even while stopped.

157 DC Brake Lvl Sel

Range: 0 = DC Brake Lvl
1 = Analog In 1
2 = Analog In 2
Default: 0 = DC Brake Lvl
Access: 1 **Path:** Dynamic Control>Stop/Brake Modes
See also: 155, 156, 158, 159

Selects the source for DC Brake Level (158). You can also select the amount of time that braking will be applied (159), as well as magnitude of current (158). This mode of braking will generate up to 40% of the rated motor torque for braking. It is typically used for low inertia loads.

158 DC Brake Level

Range: 0 to (Rated Amps x 1.5) [0.1 Amps]
Default: Rated Amps
Access: 1 **Path:** Dynamic Control>Stop/Brake Modes
See also: 155, 157-159

Sets the DC braking current level used for the DC injection braking mode (parameter 155 = 3).

The DC braking voltage used in this function is created by a PWM algorithm and may not generate the smooth holding force needed for some applications.



ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used to stop the motor. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

159 DC Brake Time

Range: 0.0 to 90.0 Sec [0.1 Sec]
Default: 0.0 Sec
Access: 1 **Path:** Dynamic Control>Stop/Brake Modes
See also: 155 - 158

Sets the amount of time DC brake current is “injected” into the motor.

160 Bus Reg Gain

Range: 0 to 5000 [1]
Default: 450
Access: 2 **Path:** Dynamic Control>Stop/Brake Modes
See also: 161, 162

Sets the responsiveness of the bus regulator. Adjust the value to improve performance of the bus regulator to prevent nuisance overvoltage (bus) faults.

161 Bus Reg Mode A**162 Bus Reg Mode B**

Range: 0 = Disabled
1 = Adjust Freq
2 = Dynamic Brak
3 = Both - DB 1st
4 = Both - Frq 1st

Default: Mode A: 0 = Disabled
Mode B: 0 = Disabled

Access: 2 **Path:** Dynamic Control>Stop/Brake Modes

See also: 160, 163, 361-366



ATTENTION: The Adjust Freq portion of the bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. It forces the output frequency to be greater than commanded frequency while the drive's bus voltage is increasing towards levels that would otherwise cause a fault. However, it can also cause either of the following two conditions to occur:

- Fast positive changes in input voltage (more than a 10% increase within 6 minutes) can cause uncommanded positive speed changes; however, an OverSpeed Limit fault will occur if the speed reaches Max Speed + Overspeed Limit. If this condition is unacceptable, action should be taken to 1) limit supply voltages within the specification of the drive, and 2) limit fast positive input voltage changes to less than 10%. Without taking such actions, if this operation is unacceptable, the adjust freq portion of the bus regulator function must be disabled (see parameters 161 and 162).
- Actual deceleration times can be longer than commanded deceleration times; however, a Decel Inhibit fault is generated if the drive stops decelerating altogether. If this condition is unacceptable, the adjust freq portion of the bus regulator must be disabled (see parameters 161 and 162). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

Note that these faults are not instantaneous and have shown test results that take between 2 and 12 seconds to occur.

Sets the method and sequence of the DC bus regulator voltage control. The choices are dynamic brake, frequency adjust, or both.

You can select separate modes of control for Mode A and Mode B through a configured logic input. When option 3 or 4 is selected, the bus controller will attempt to regulate the bus voltage using the selected technique first and then switch to the secondary method. Mode B can be selected via terminal block assignment.

If a dynamic brake resistor is connected to the drive, Bus Reg Mode A and Bus Reg Mode B must be set to option 2, 3, or 4.

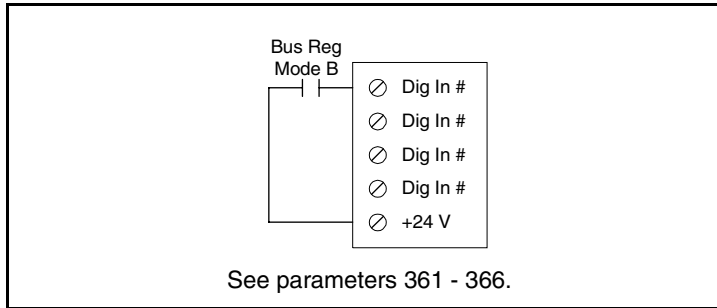


Figure 12.23 – Selecting Bus Reg Mode B

163 DB Resistor Type

Range:	0 = Internal Res 1 = External Res 2 = None
Default:	0 = Internal Res
Access:	1 Path: Dynamic Control>Stop/Brake Modes
See also:	161, 162

Selects whether the internal or an external DB resistor option will be used. The internal resistor is the SP600-specific DB option that mounts internally to the drive's frame. An external DB resistor is panel-mounted separately from the drive. If a dynamic brake resistor is connected to the drive, Bus Reg Mode A & B must be set to option 2, 3, or 4.



ATTENTION: AC drives do not offer protection for externally mounted braking resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from overtemperature, or the protective circuit shown in figure 12.24, or an equivalent, must be supplied.

ATTENTION: Equipment damage may result if a drive-mounted (internal) resistor is installed and parameter 163 is set to 1 (External Res). Thermal protection for the internal resistor will be disabled, resulting in possible device damage.

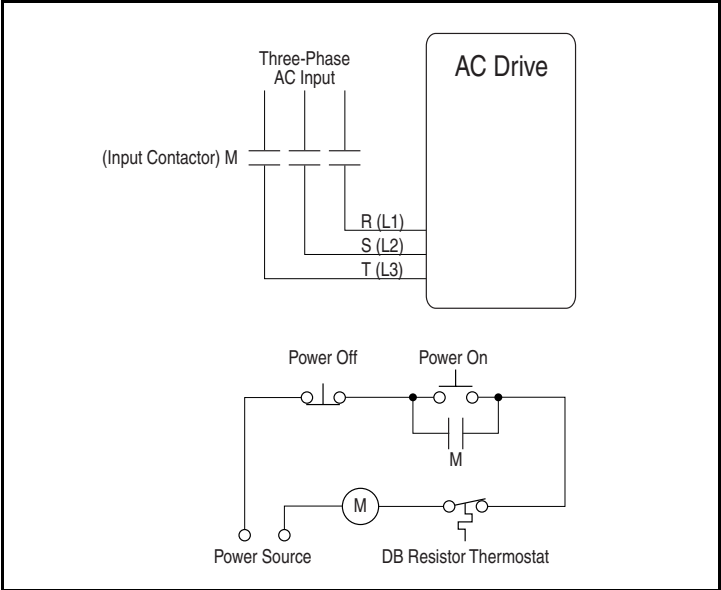


Figure 12.24 – Protective Circuit for External Resistor Packages

168 LevelSense Start

Range: 0 = Disabled
1 = Enabled
Default: 0 = Disabled
Access: 2 **Path:** Dynamic Control>Stop/Restart Modes
See also: 160, 163



ATTENTION: Be aware of the following:

- Setting parameter 168 to 1 (Enabled) immediately applies output power to the motor when all start conditions are met.
- If the drive is running from the terminal block, LevelSense Start is enabled, and a fault occurs, the drive coasts to rest and generates a fault. In this case, resetting and clearing the fault immediately restarts the drive without any change to the start or stop input states.

When this function is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Enables/disables a feature to issue a start or run command and automatically resume running at commanded speed after drive input power is restored.

0 = Disabled: The drive starts on the open-to-closed transition of the control source start input while no start inhibit conditions are present. (Edge-sensitive detection.)

1 = Enabled: The drive starts while the control source start input is closed and no start inhibit conditions are present. (Level-sensitive detection.) In this case, if the drive is powered up and the input is closed, the drive will automatically start.

Note that this feature (LevelSense Start) requires a digital input configured for run or start and a valid start contact.

169 Flying Start En

Range: 0 = Disabled
1 = Enabled
Default: 0 = Disabled
Access: 2 **Path:** Dynamic Control>Stop/Restart Modes
See also: 170

Enables/disables the function which allows the drive to start into a spinning motor at actual RPM when a start command is issued.

Normally, when a drive is started in its normal mode, it initially applies a frequency of 0 Hz and ramps to the desired frequency. If the drive is started into an already spinning motor in this manner without Flying Start enabled, large currents will be generated and an overcurrent trip may result.

In Flying Start mode, the drive's response to a start command will be to identify the motor's speed and apply a voltage that is synchronized in frequency, amplitude and phase to the counter emf of the spinning motor. The motor will then accelerate to the desired frequency.

170 Flying StartGain

Range: 20 to 32767 [1]
Default: 4000
Access: 2 **Path:** Dynamic Control>Stop/Restart Modes
See also: 169

Adjusts the responsiveness of the flying start function. Increasing the value in this parameter increases the responsiveness of the flying start function.

174 Auto Rstrt Tries

Range: 0 to 9 [1]
Default: 0 (Disabled)
Access: 1 **Path:** Dynamic Control>Stop/Restart Modes
See also: 175



ATTENTION: Equipment damage and/or personal injury may result if parameter 174 is used in an inappropriate application. Do not use this function without considering applicable local, national, and international codes, standards, regulations, or industry guidelines.

ATTENTION: The drive may start immediately after a fault is auto-reset when LevelSense Start (168) is set to Enabled.

When LevelSense Start is enabled, the user must ensure that automatic start up of the driven equipment will not cause injury to operating personnel or damage to the driven equipment. In addition, the user is responsible for providing suitable audible or visual alarms or other devices to indicate that this function is enabled and the drive may start at any moment. Failure to observe this precaution could result in severe bodily injury or loss of life.

Important: The drive will re-start after a reset if the start input is still asserted.

Specifies the maximum number of times the drive attempts to reset a fault and restart when the auto restart feature is enabled.

The auto restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. Only certain faults are permitted to be reset; see chapter 13 for a list and description of drive faults.

When the auto restart feature is enabled (that is, Auto Rstrt Tries is set to a value greater than zero), and an auto-resettable fault occurs, the drive will stop. After the number of seconds in Auto Rstrt Delay (175) has elapsed, the drive will automatically reset the faulted condition. The drive will then issue an internal start command to start the drive.

If another auto-resettable fault occurs, the cycle will repeat up to the number of attempts specified in Auto Rstrt Tries.

If the drive faults repeatedly for more than the number of attempts specified in Auto Rstrt Tries with less than five minutes between each fault, the drive will remain in the faulted state. The fault Auto Rstrt Tries will be logged in the fault queue.

The auto restart feature is disabled when the drive is stopping and during autotuning. Note that a DC Hold state is considered stopping.

The following conditions will abort the reset/run process:

- Issuing a stop command from any control source. (Note that removal of a 2-wire run-fwd or run-rev command is considered a stop command.)
- Issuing a fault reset command from any active source.
- Removing the enable input signal.
- Setting Auto Rstrt Tries to zero.
- Occurrence of a fault that is not auto-resettable.
- Removing power from the drive.
- Exhausting an auto-reset/run cycle.

Note that two autotuning status bits are provided in Drive Status 2 (210): an active status bit and a countdown status bit.

175 Auto Rstrt Delay

Range: 0.5 to 30.0 Sec [0.1 Sec]

Default: 1.0 Sec

Access: 1 **Path:** Dynamic Control>Stop/Restart Modes

See also: 174

Sets the time between restart attempts when the auto restart feature is enabled. Refer to Auto Rstrt Tries (174) for more information about the auto restart feature.

184 Power Loss Mode

Range: 0 = Coast
1 = Decel
Default: 0 = Coast
Access: 1 **Path:** Dynamic Control>Stop/Power Loss
See also: 185

Sets the reaction to a loss of input power. Power loss is recognized when:

- DC bus voltage is $\leq 73\%$ of DC Bus Memory and Power Loss Mode is set to Coast.
- DC bus voltage is $\leq 82\%$ of DC Bus Memory and Power Loss Mode is set to Decel.

0 = Coast: The drive coasts to stop if the bus voltage drops below the threshold level. (Output transistors disabled.)

1 = Decel: Provides inertia ride-through, which may prevent the drive from the need to reconnect to the motor. By recapturing the mechanical energy, converting it to electrical energy, and returning it to the drive, the bus voltage is maintained. As long as there is mechanical energy, the ride-through time is extended, and the motor remains fully fluxed up. If AC input power is restored, the drive can ramp the motor to the correct speed without the need for reconnecting.

185 Power Loss Time

Range: 0.0 to 60.0 Sec [0.1 Sec]
Default: 0.5 Sec
Access: 1 **Path:** Dynamic Control>Stop/Power Loss
See also: 184

Sets the time that the drive will remain in power loss mode before a fault is issued.

190 Direction Mode



Range: 0 = Unipolar
1 = Bipolar
2 = Reverse Dis

Default: 0 = Unipolar

Access: 0 **Path:** Utility>Direction Config

See also: 91, 92, 320 - 327, 361 - 366

Selects the method for control of drive direction.



ATTENTION: Setting parameter 190 to 0 or 1 may cause unwanted motor direction. Verify driven machinery cannot be damaged by reverse rotation before changing the setting of this parameter to 0 or 1. Failure to observe this precaution could result in damage to, or destruction of, equipment.

0 = Unipolar: The drive receives an unsigned reference signal and a separate direction command from a logic source such as a digital input or DPI port device.

Example: Analog speed reference = 0 to 100%

Direction control:

- OIM Forward/Reverse key
- Terminal block

1 = Bipolar: The drive receives a signed reference (-100% to +100%). In this case, the Forward/Reverse key has no effect.

2 = Reverse Dis: The drive receives a signed reference (-100% to +100%); however, regardless of the reference, the drive is not permitted to reverse.

Parameter 190 Selection	Analog Reference	Direction Control
0 = Unipolar	0 to 100%	Logic
1 = Bipolar	-100% to +100%	Reference polarity
2 = Reverse Disable	-100% to +100%	Reverse disabled

Note: Internal reference scaling provides 100% = 32767 internal units.

192 Save OIM Ref

Range: See figure 12.25
Default: See figure 12.25
Access: 2 **Path:** Utility>OIM Ref Config
See also:

Enables a feature to save the present frequency reference value issued by the OIM. This value is saved to drive memory on power loss. The value is then restored to the OIM on power up.

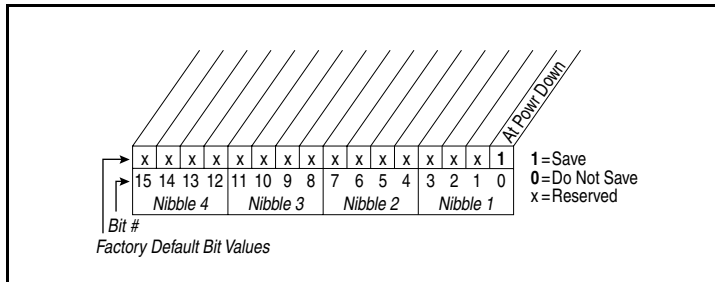


Figure 12.25 – Save OIM Ref (192)

193 Man Ref Preload

Range: 0 = Disabled
1 = Enabled
Default: 1 = Enabled
Access: 2 **Path:** Utility>OIM Ref Config
See also: 320 - 327, 361 - 366

Enables/disables a feature to automatically load the present auto frequency reference value into the OIM when Manual is selected. This allows smooth speed transition from Auto to Manual; you can then adjust the manual speed setpoint starting from the transferred Auto speed level.

0 = Disabled: No preload of the Auto speed setpoint into the manual setpoint. In this case, the motor reference will switch automatically to the internal Manual setpoint.

1 = Enabled: The Manual setpoint will be loaded with the present running speed.

194 Save MOP Ref

Range: See figure 12.26
Default: See figure 12.26
Access: 2 **Path:** Utility>MOP Config
See also:

Enables/disables the feature that saves the present MOP (motor-operated potentiometer) frequency reference at power down and/or at stop. If the drive is re-started or powered up, the setpoint will be restored with the last active MOP output value.

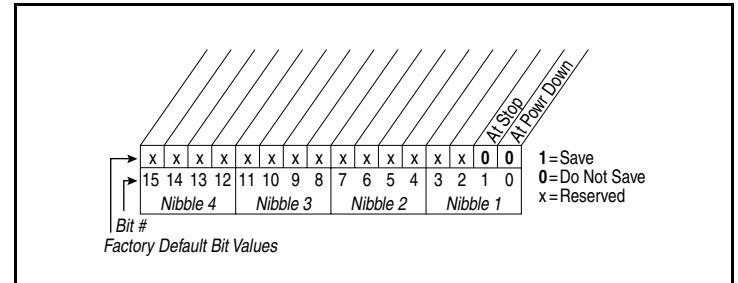


Figure 12.26 – Save MOP Ref (194)

Important: The MOP feature requires that the digital inputs be configured for MOP Inc and MOP Dec (see 361-366).

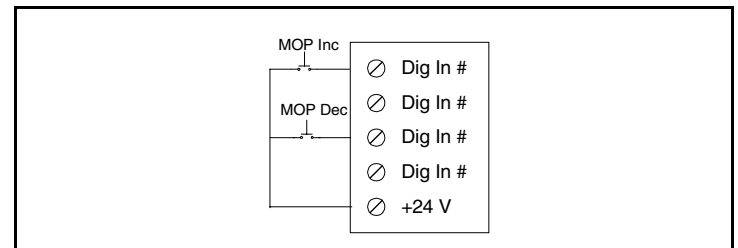


Figure 12.27 – Configuring Digital Inputs for MOP Inc and MOP Dec

195 MOP Rate

Range: 0.2 to Maximum Freq [0.1 Hz/sec]
Default: 1.0 Hz/sec
Access: 2 **Path:** Utility>MOP Config
See also:

Sets the rate of change of the MOP reference in response to a digital input.

196 Param Access Lvl

Range: 0 = Basic
1 = Standard
2 = Advanced
Default: Read Only
Access: 0 **Path:** Utility>Drive Memory
See also:

Displays the present parameter access level. Refer to chapter 11 for more information about parameter access levels.

197 Reset To Defaults

Range: 0 = Ready
1 = Factory
2 = Low Voltage
3 = High Voltage
Default: 0 = Ready
Access: 0 **Path:** Utility>Drive Memory
See also:

Resets all parameter values to defaults (except parameters 196, 201, and 202). Option 1 resets the drive to factory settings. Options 2 and 3 reset the drive to alternate voltage and current ratings as shown:

Class	Drive Voltage		
	230	460	600
Low Voltage	200	400	600
High Voltage	230	460	600

Low voltage class is typical European voltage ratings: volts, frequency, power units.

High voltage class is typical U.S.A. voltage ratings: volts, frequency, power units.

198 Load Frm Usr Set

Range: 0 = Ready
1 = User Set 1
2 = User Set 2
3 = User Set 3
Default: 0 = Ready
Access: 1 **Path:** Utility>Drive Memory
See also: 199

Loads a previously saved set of parameter values from a selected user set location in the drive's non-volatile memory to active drive memory. After data is successfully transferred, the value returns to 0.

The drive has the capability of saving up to three complete sets of drive parameters (configurations). These sets can be restored to drive memory for runtime operation.

An F-Key on the LCD OIM can be configured for this function. Refer to chapter 9.

199 Save To User Set

Range: 0 = Ready
1 = User Set 1
2 = User Set 2
3 = User Set 3
Default: 0 = Ready
Access: 1 **Path:** Utility>Drive Memory
See also: 198

Saves the parameter values in active drive memory to a user set in drive non-volatile memory. After the data is successfully transferred, the value returns to 0.

An F-Key on the LCD OIM can be configured for this function. Refer to chapter 9.

200 Reset Meters

Range: 0 = Ready
1 = MWh
2 = Elapsed Time
Default: 0 = Ready
Access: 1 **Path:** Utility>Drive Memory
See also:

Resets the selected meter to zero.

1 = MWh: Resets Elapsed MWh (9) to zero.

2 = Elapsed Time: Resets Elapsed Run Time (10) to zero.

201 Language

Range: 0 = Not Selected
1 = English
2 = Francais
3 = Espanol
4 = Italiano
5 = Deutsch
6 = Reserved
7 = Portugues

Default: 0 = Not Selected

Access: 2 **Path:** Utility>Drive Memory

See also:

Selects the display language when using an LCD OIM.

202 Voltage Class

Range: 2 = Low Voltage
3 = High Voltage

Default: Based on Drive Type

Access: 2 **Path:** Utility>Drive Memory

See also: 55

Automatically resets the parameters that change the drive voltage rating, current rating, scaling, and motor data to the appropriate defaults based on voltage class. For example, 460 V is typically U.S. rated defaults, and 400 V is typically European rated defaults.

Maximum Frequency (55) will be affected by changing this parameter.

Voltage Class (202)	Drive Voltage		
	230	460	600
2 = Low Voltage	200	400	600
3 = High Voltage	230	460	600

203 Drive Checksum

Range: 0 to 65535 [1]

Default: Read Only

Access: 2 **Path:** Utility>Drive Memory

See also:

Provides a checksum value that indicates whether or not a change in drive programming has occurred (data values only).

204 Dyn UserSet Cnfg



Range: See figure12.28

Default: See figure 12.28

Access: 2 **Path:** Utility>Drive Memory

See also: 205, 206, 361-366

Configures behavior of User Sets. Dynamic switching between sets is permitted from either digital input states of parameter value.

Bit 0 - Dynamic Mode - Specifies User Sets operating mode.

0 = Disabled: Disabled causes normal operation.

1 = Enabled: Enabled selects Dynamic Mode. While enabled, parameters changes are not saved in active non-volatile storage.

Bit 1 - Ctrl Source - Defines which source controls the selection of user sets, while Dynamic Mode is enabled.

0 = Dig. Inputs: Dig. Inputs refers to UserSetBitn defined by Terminal Block Input(s) from Digital In 1-6 Sel (361-366).

1 = DynUsrSetSel: DynUsrSetSel (205) determines the active User Set.

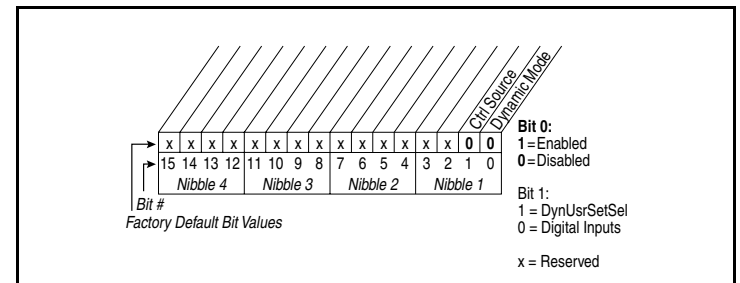


Figure 12.28 – Dyn UserSet Cnfg

205 DynUsrSetSel



Range: See figure12.29

Default: See figure 12.29

Access: 2 **Path:** Utility>Drive Memory

See also: 204, 206

Controls which User Set is in memory when Ctrl Source (bit 1) of DynUsrSetCnfg (204) is set to DynUsrSetSel.

Bit 0 - UserSetBit0

0 = Disabled

1 = Enabled

Bit 1 -UserSetBit1

0 = Disabled

1 =Enabled

Table 12.3 – Dynamic User Set Mode

UserSetBit1	UserSetBit0	UserSet Loaded in Memory
0	0	User Set 1
0	1	User Set 2
1	0	User Set 3
1	1	User Set 3

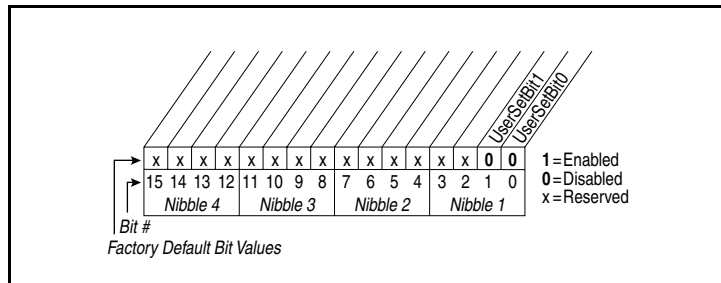


Figure 12.29 – DynUsrSetSel

206 Dyn UserSet Actv

Range: 0 = Normal Mode (Dynamic Mode Disabled)
 1 = User Set 1
 2 = User Set 2
 3 = User Set 3

Default: Read Only

Access: 2 **Path:** Utility>Drive Memory

See also: 204, 205

Displays which User Set was last loaded into active memory. User parameter changes are allowed after a User Set is restored, but will not be detected or annunciated.

209 Drive Status 1

Range: See figure12.30
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 210

Displays the present operating status of the drive.

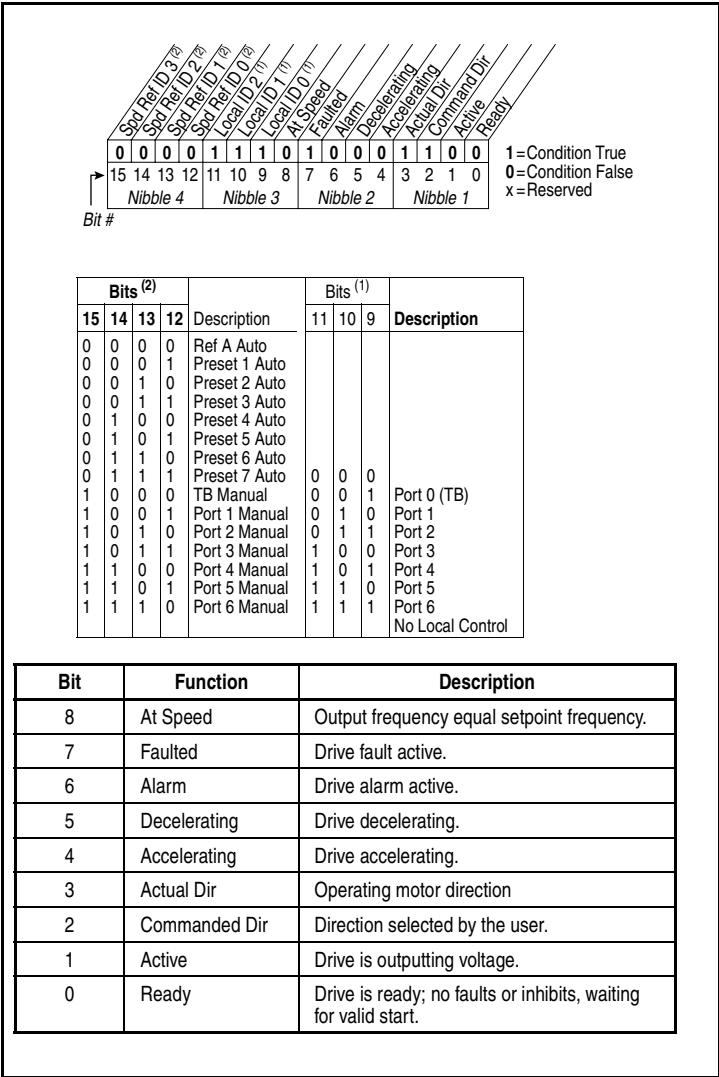


Figure 12.30 – Drive Status 1 (209)

210 Drive Status 2

Range: See figure12.31
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 209

Displays the present operating status of the drive.

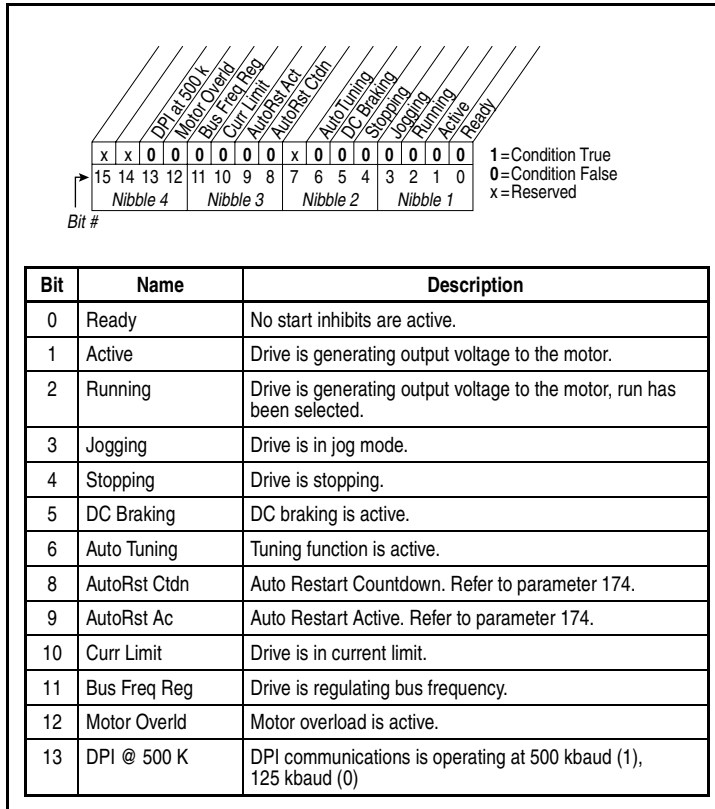


Figure 12.31 – Drive Status 2 (210)

213 Speed Ref Source

Range: 0 = PI Output
 1 = Analog In 1
 2 = Analog In 2
 3-8 = Reserved
 9 = MOP Level
 10 = Jog Speed
 11 = Preset Spd 1
 12 = Preset Spd 2
 13 = Preset Spd 3
 14 = Preset Spd 4
 15 = Preset Spd 5
 16 = Preset Spd 6
 17 = Preset Spd 7
 18 = Local OIM
 19 = DPI Port 2
 20 = DPI Port 3
 21 = Reserved
 22 = Network
 23 = Reserved

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 90, 96, 101

Displays the source of the speed reference of the drive.

214 Start Inhibits

Range: See figure12.34

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also:

Displays the inputs currently preventing the drive from starting.

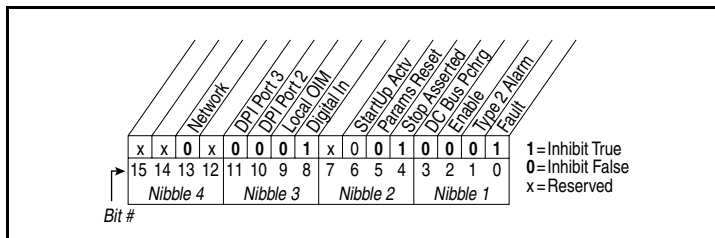


Figure 12.34 – Start Inhibits (214)

215 Last Stop Source

Range: 0 = Pwr Removed
 1 = Local OIM
 2 = DPI Port 2
 3 = DPI Port 3
 4 = Reserved
 5 = Network
 6 = Reserved
 7 = Digital In
 8 = Fault
 9 = Not Enabled
 10 = Sleep
 11 = Jog

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also:

Displays the source that initiated the most recent stop command. It will be cleared (set to 0) during the next start sequence.

216 Dig In Status

Range: See figure12.35

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics
 Inputs & Outputs>Digital Inputs

See also: 361-366

Displays the current state of the digital inputs on the terminal block.

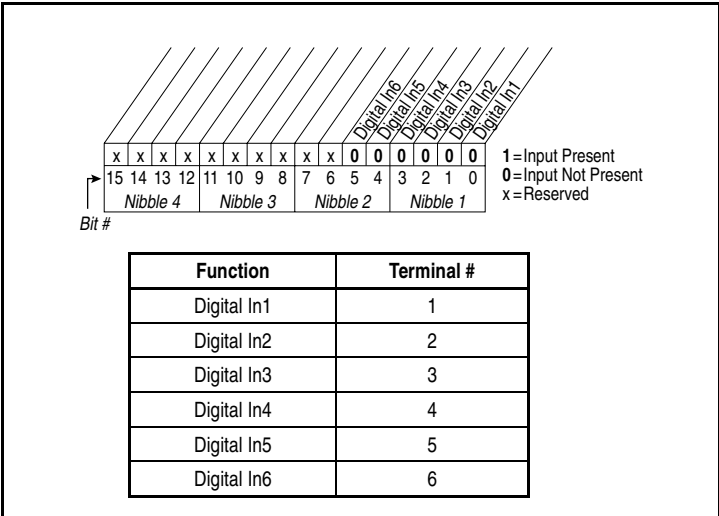


Figure 12.35 – Dig In Status (216)

217 Dig Out Status

Range: See figure 12.36
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
Inputs & Outputs>Digital Outputs
See also: 380-384

Displays the current state of the digital outputs.

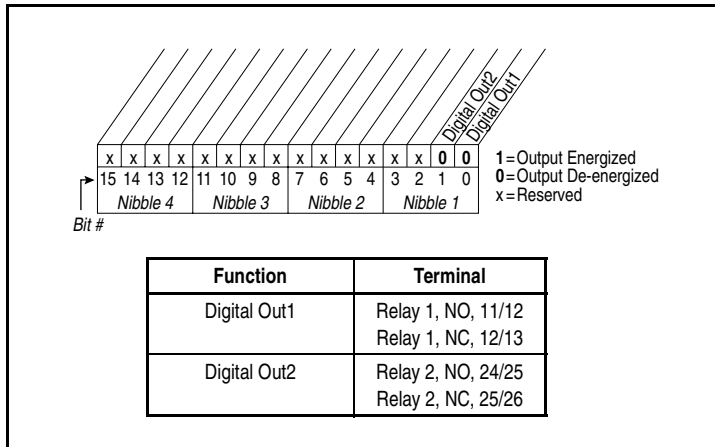


Figure 12.36 – Dig Out Status (217)

218 Drive Temp

Range: -/+100 degC [0.1 degC]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also:

Displays the present operating temperature of the drive power section.

219 Drive OL Count

Range: 0.0 to 100.0% [0.1%]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 150

Displays the accumulated percentage of drive overload. Continuously operating the drive over 100% of its rating will increase the value of Drive OL Count to 100% and cause a drive fault or foldback depending on the setting of Drive OL Mode (150).

220 Motor OL Count

Range: 0.0 to 100.0 % [1.0%]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 47, 48

Displays the accumulated percentage of motor overload. Continuously operating the motor over 100% of the motor overload setting will increase the value of Motor OL Count to 100% and cause a drive fault.

224 Fault Frequency

Range: 0.0 to +/-400.0 Hz [0.1 Hz]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 225-230

Captures and displays the output frequency of the drive at the time of the last fault.

225 Fault Amps

Range: 0.0 to Rated Amps x 2 [0.1 Amps]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 224-230

Captures and displays motor amps at the time of the last fault.

226 Fault Bus Volts

Range: 0.0 to Max Bus Volts [0.1 VDC]
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 224-230

Captures and displays the DC bus voltage of the drive at the time of the last fault.

227 Status 1 @ Fault

Range: See figure12.37
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 209, 224-230

Captures and displays the Drive Status 1 bit pattern at the time of the last fault. See parameter 209 for the bit descriptions.

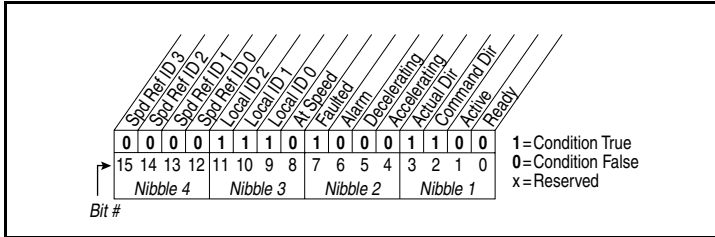


Figure 12.37 – Status 1 @ Fault (227)

228 Status 2 @ Fault

Range: See figure12.38
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 210, 224-230

Captures and displays the Drive Status 2 bit pattern at the time of last fault. See parameter 210 for the bit descriptions.

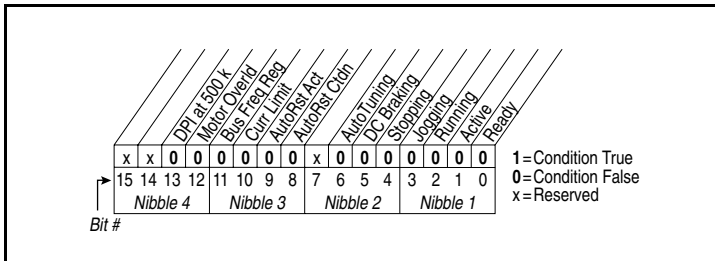


Figure 12.38 – Status 2 @ Fault (228)

229 Alarm 1 @ Fault

Range: See figure12.39
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 211, 224-230

Captures and displays the Drive Alarm 1 at the time of the last fault. See parameter 211 for the bit descriptions.

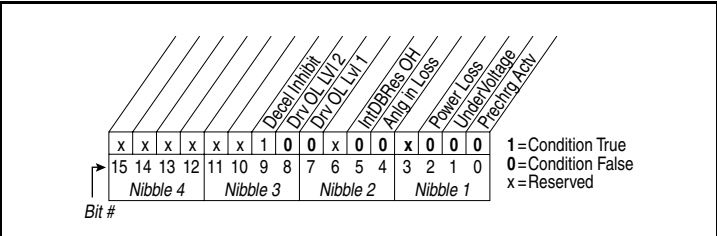


Figure 12.39 – Alarm 1 @ Fault (229)

230 Alarm 2 @ Fault

Range: See figure12.40
Default: Read Only
Access: 2 **Path:** Utility>Diagnostics
See also: 211, 224-230

Captures and displays the Drive Alarm 2 bit pattern at the time of last fault. See section 13.3 for the bit descriptions.

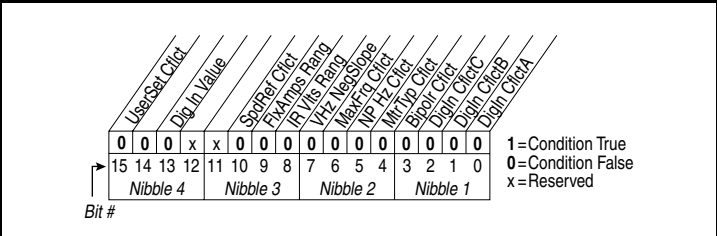


Figure 12.40 – Alarm 2 @ Fault (230)

234 Testpoint 1 Sel

Range: 0 to 65535 [1]
Default: 499
Access: 2 **Path:** Utility>Diagnostics
See also: 235

Selects the function whose value is displayed in Testpoint 1 Data (235). These are internal values that are not accessible through parameters.

Note: This is a factory diagnostic function.

235 Testpoint 1 Data

Range: 0 to 4,294,697,295 [1]
Default: 0
Access: 2 **Path:** Utility>Diagnostics
See also: 234

The present value of the function selected in Testpoint 1 Sel (234).

Note: This is a factory diagnostic function.

236 Testpoint 2 Sel

Range: 0 to 65535 [1]
Default: 499
Access: 2 **Path:** Utility>Diagnostics
See also: 237

Selects the function whose value is displayed in Testpoint 2 Data (237). These are internal values that are not accessible through parameters.

Note: This is a factory diagnostic function.

237 Testpoint 2 Data

Range: 0 to 4,294,967,295 [1]
Default: 0
Access: 2 **Path:** Utility>Diagnostics
See also: 236

The present value of the function selected in Testpoint 2 Sel (236).

Note: This is a factory diagnostic function.

238 Fault Config 1

Range: See figure12.41
Default: See figure12.41
Access: 2 **Path:** Utility>Faults
See also:

Enables/disables annunciation of the faults shown in figure 12.41. See table 13.6 for fault descriptions.

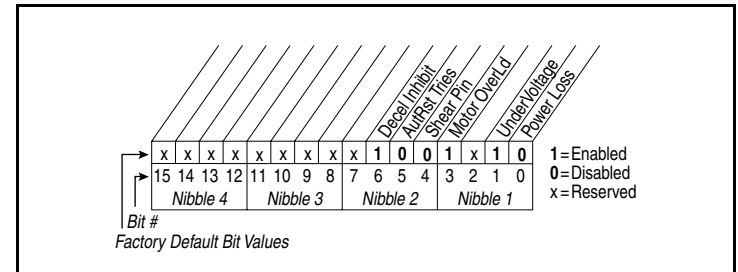


Figure 12.41 – Fault Config 1 (238)

240 Fault Clear

Range: 0 = Ready
1 = Clear Faults
2 = Clr Fit Que
Default: 0 = Ready
Access: 2 **Path:** Utility>Faults
See also:

Resets a fault and clears the fault queue.

241 Fault Clear Mode

Range: 0 = Disabled
1 = Enabled
Default: 1 = Enabled
Access: 2 **Path:** Utility>Faults
See also:

Enables/disables a fault reset (clear faults) attempt from any source. This does not apply to fault codes stored in the fault queue, which are cleared via other actions.

242 Power Up Marker

32

Range: 0.0000 to 4,294,967.2925 Hr [0.0001 Hr]
Default: Read Only
Access: 2 **Path:** Utility>Faults
See also: 244, 246, 248, 250

Displays elapsed hours since initial drive power up. This value will roll over to 0 after the drive has been powered on for more than the maximum value shown.

259 Alarm Config 1

Range: See figure12.42
Default: See figure12.42
Access: 2 **Path:** Utility>Alarms
See also:

Selects alarm conditions that will initiate a drive alarm.

See table 12.3 for alarm descriptions.

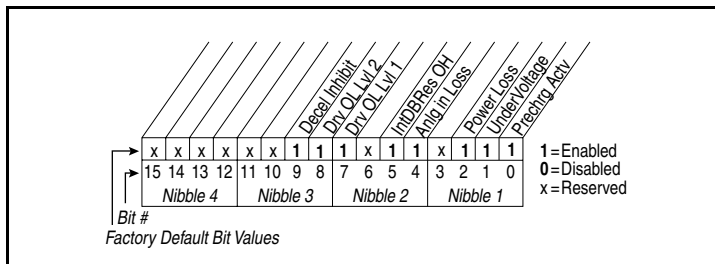


Figure 12.42 – Alarm Config 1 (259)

271 Drive Logic Rslt

Range: See figure12.43
Default: Read Only
Access: 2 **Path:** Communication>Comm Control
See also:

Displays the output state of the logic function control block resulting from the combination of all port requests and masking functions. Each bit or set of bits represent a command to the drive. Bit 6 will always = 0.

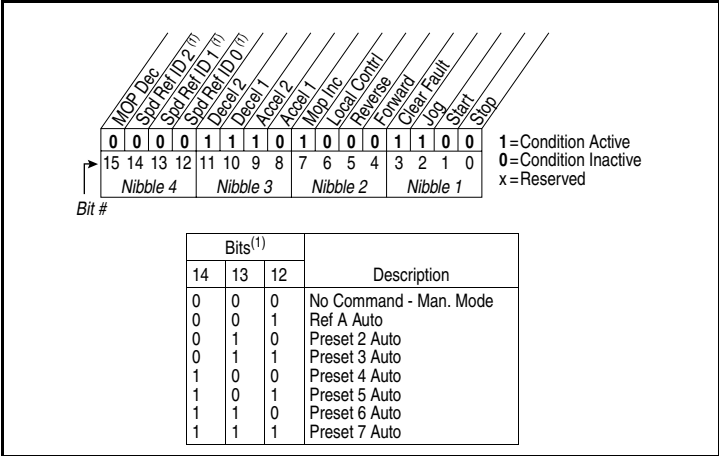


Figure 12.43 – Drive Logic Rslt (271)

272 Drive Ref Rslt

Range: 0 to 32767 [1]
Default: Read Only
Access: 2 **Path:** Communication>Comm Control
See also:

Displays the present frequency reference scaled as a DPI reference for peer-to-peer communications. The value shown is the output prior to the accel/decel ramp and any corrections supplied by slip comp, PI, etc.

273 Drive Ramp Rslt

Range: 0 to 32767 [1]
Default: Read Only
Access: 2 **Path:** Communication>Comm Control
See also:

Displays the present frequency reference scaled as a DPI reference for peer-to-peer communications. The value shown is the value after the accel/decel ramp but prior to any corrections supplied by slip comp, PI, etc.

286 Manual Mask

Range: See figure 12.44
Default: See figure 12.44
Access: 2 **Path:** Communication>Masks & Owners
See also:

Disables manual requests at the port corresponding to bit number.

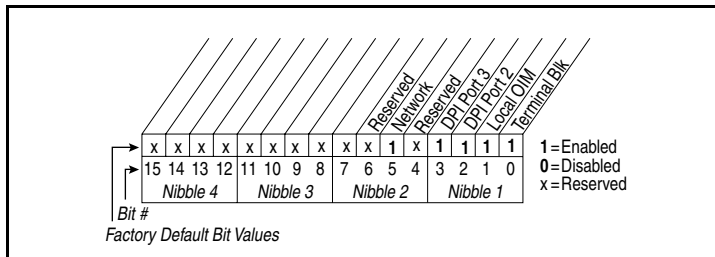


Figure 12.44 – Manual Mask (286)

Example of manual mode selection source:

If:

- Bit 0 = 0 (Terminal block disabled)
- Bit 1 = 1 (Local OIM enabled)

Then manual mode selection can be activated from the OIM but not the I/O terminals.

288 Stop Owner

Range: See figure 12.45
Default: Read Only
Access: 2 **Path:** Communication>Masks & Owners
See also: 276 - 285

Indicates inputs that are presently issuing a valid stop command.

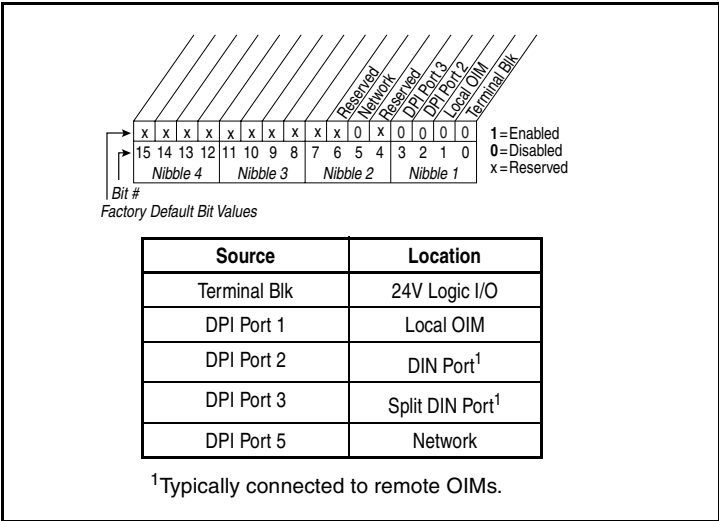


Figure 12.45 – Stop Owner

298 Manual Owner

Range: See figure 12.46
Default: Read Only
Access: 2 **Path:** Communication>Masks & Owners
See also:

Indicates the port that is supplying the manual mode speed reference and control.

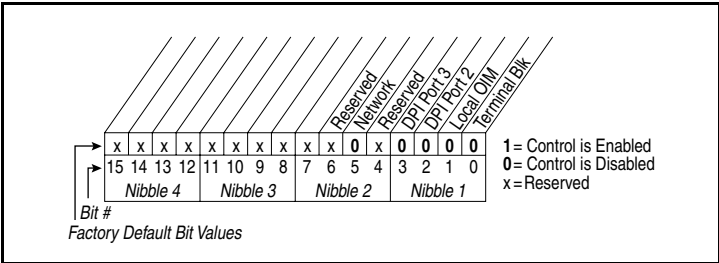


Figure 12.46 – Manual Owner

300 Data In A1 - Link A Word 1
301 Data In A2 - Link A Word 2



Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Selects parameter number whose value will be written from a communications device data table. Refer to figure 12.47.

Parameters that can be changed only while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications module manual for more information about Datalinks.

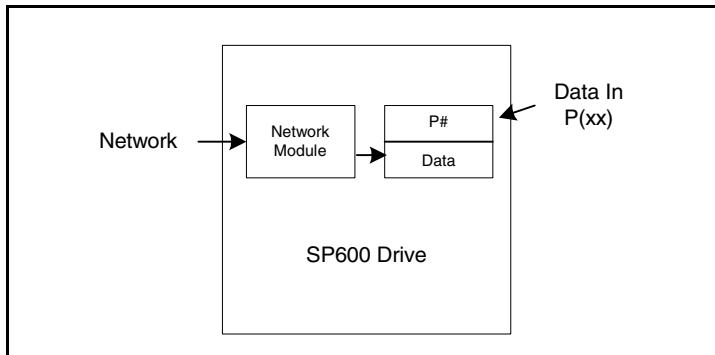


Figure 12.47 – Data Received By the Drive From the Network

302 Data In B1 - Link B Word 1
303 Data In B2 - Link B Word 2



Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written from a communications device data table. Refer to figure 12.47.

Parameters that can be changed only while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications module manual for more information about Datalinks.

304 Data In C1 - Link C Word 1
305 Data In C2 - Link C Word 2



Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written from a communications device data table. Refer to figure 12.47.

Parameters that can be changed only while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications module manual for more information about Datalinks.

306 Data In D1 - Link D Word 1
307 Data In D2 - Link D Word 2



Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written from a communications device data table. Refer to figure 12.47.

Parameters that can be changed only while the drive is stopped cannot be used as Datalink inputs. Entering a parameter of this type will disable the link.

Refer to the appropriate communications module manual for more information about Datalinks.

-
- 310 Data Out A1 - Link A Word 1**
311 Data Out A2 - Link A Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written to a communications device data table. Refer to figure 12.48.

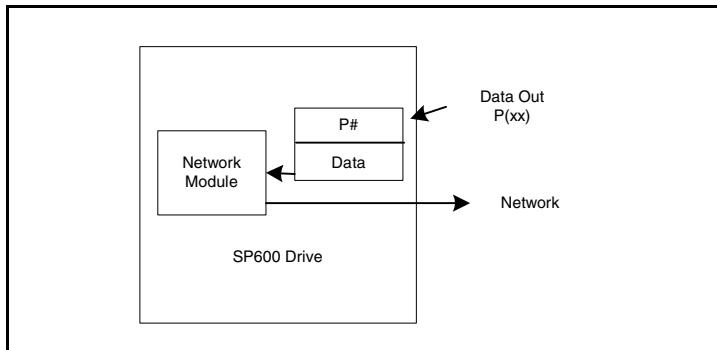


Figure 12.48 – Data Sent By the Drive To the Network

-
- 312 Data Out B1 - Link B Word 1**
313 Data Out B2 - Link B Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written to a communications device data table. See figure 12.48.

-
- 314 Data Out C1 - Link C Word 1**
315 Data Out C2 - Link C Word 2

Range: 0 to 387 [1]
Default: 0 (Disabled)
Access: 2 **Path:** Communication>Datalinks
See also:

Parameter number whose value will be written to a communications device data table. See figure 12.48.

316 Data Out D1 - Link D Word 1

317 Data Out D2 - Link D Word 2

Range: 0 to 387 [1]

Default: 0 (Disabled)

Access: 2 **Path:** Communication>Datalinks

See also:

Parameter number whose value will be written to a communications device data table. See figure 12.48.

320 Anlg In Config



Range: See figure 12.49

Default: See figure 12.49

Access: 0 **Path:** Inputs & Outputs>Analog Inputs

See also: 322, 323, 325, 326

Selects the type of input signal being used for analog input 1 and 2. These inputs can be configured as 10 VDC or 4-20 mA inputs. See scaling parameters 322, 323 (Analog In1) and 325, 326 (Analog In2).

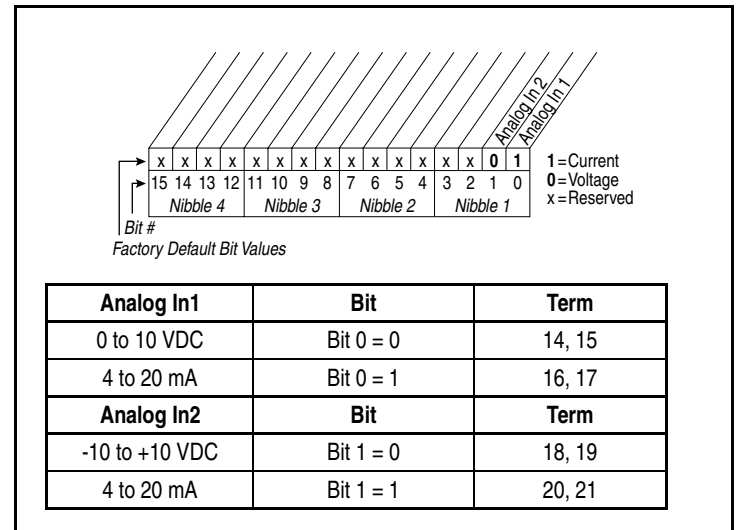


Figure 12.49 – Anlg In Config (320)

321 Anlg In Sqr Root

Range: See figure 12.50
Default: See figure 12.50
Access: 2 **Path:** Inputs & Outputs>Analog Inputs
See also:

Enables/disables the square root function for each analog input.

This function is typically used when measuring the feedback for the process control regulator. The square root function is scaled such that the input range is the same as the output range. For example, if the input is set up as a unipolar voltage input, then the input and output ranges of the square root function will be 0 to 10 volts.

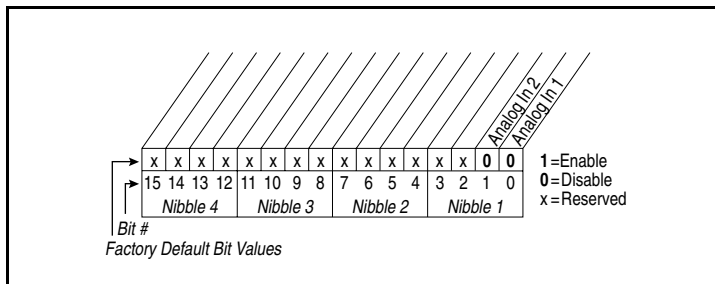


Figure 12.50 – Anlg In Sqr Root (321)

322 Analog In 1 Hi

Range: 4.000 to 20.000 mA [0.001 mA]
+/-10.000 VDC [0.001 V]
0.000 to 10.000 V [0.001 V]

Default: 20.000 mA

Access: 0 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92, 320

The drive scales the value read from the analog input and converts it to scaled units for the drive. The user controls the scaling by setting parameters that associate a low and high point in the input range with a low and high point in the target range.

Analog In 1 Hi sets the highest input value to the analog input 1 scaling block. See figure 12.51.

Analog Input Scaling Example

Assume:

- Speed Ref A Sel = Analog In 1
- Ref Lo (92) = 10 Hz
- Ref Hi (91) = 60 Hz
- Analog In 1 Lo (323) = 0.0 V
- Analog In 1 Hi (322) = 10.0 V
- Analog In Config (320) = xxxx...xx00

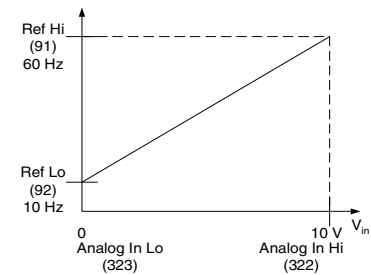


Figure 12.51 – Analog Input Scaling Example

323 Analog In 1 Lo

Range: 4.000 to 20.000 mA [0.001 mA]
-/+10.000 V [0.001 V]
0.000 to 10.000 V [0.001 V]

Default: 4.000 mA

Access: 0 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92, 320

Sets the lowest input value to the analog input 1 scaling block. Refer to Analog In 1 Hi (322) for more information and a scaling example.

324 Analog In 1 Loss

Range: 0 = Disabled
1 = Fault
2 = Hold Input (use last frequency command)
3 = Set Input Lo (use Minimum Speed as frequency command)
4 = Set Input Hi (use Maximum Speed as frequency command)
5 = Go to Preset1 (use Preset 1 as frequency command)
6 = Hold OutFreq (maintain last output frequency)

Default: 0 = Disabled

Access: 2 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92, 190

Selects drive response when an analog signal loss is detected. (1.6 V = signal loss, 1.9 V = end of signal loss; 3.2 mA = signal loss, 3.8 mA = end of signal loss.)

One of the selections (1 = Fault) stops the drive on signal loss. All other choices make it possible for the input signal to return to a usable level while the drive is still running.



ATTENTION: Setting parameter 324 to a value other than 1 allows the input signal to return to a usable level while the drive is running. If a lost analog signal is restored while the drive is running, the drive will ramp to the restored reference level at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142), and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Important: Note that there is no signal loss detection while the input is in bipolar voltage mode (see parameter 190).

325 Analog In 2 Hi

Range: 4.000 to 20.000 mA [0.001 mA]
-/+10.0 V [0.1 V]
0.0 to 10.0 V [0.1 V]

Default: 10 V

Access: 2 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92

Sets the highest input value to the analog input 2 scaling block. See an example of Analog Input #1 scaling in parameter 322.

326 Analog In 2 Lo

Range: 4.000 to 20.000 mA [0.001 mA]
-/+10.0 V [0.1 V]
0.0 to 10.0 V [0.1 V]

Default: 0.000 V

Access: 2 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92

Sets the lowest input value to the analog input 2 scaling block.

327 Analog In 2 Loss

Range: 0 = Disabled
1 = Fault
2 = Hold Input (use last frequency command)
3 = Set Input Lo (use Minimum Speed as frequency command)
4 = Set Input Hi (use Maximum Speed as frequency command)
5 = Go to Preset1 (use Preset1 as frequency command)
6 = Hold OutFreq (maintain last output frequency)

Default: 0 = Disabled

Access: 2 **Path:** Inputs & Outputs>Analog Inputs

See also: 91, 92, 190

Selects drive action when an analog signal loss is detected. (1.6 V = signal loss, 1.9 V = end of signal loss; 3.2 mA = signal loss, 3.8 mA = end of signal loss.)

One of the selections (1 = Fault) stops the drive on signal loss. All other choices make it possible for the input signal to return to a usable level while the drive is still running.



ATTENTION: Setting parameter 327 to a value other than 1 allows the input signal to return to a usable level while the drive is running. If a lost analog signal is restored while the drive is running, the drive will ramp to the restored reference level at the rate specified in Accel Time 1 (140), Accel Time 2 (141), Decel Time 1 (142), and Decel Time 2 (143). Be aware that an abrupt speed change may occur depending upon the new reference level and the rate specified in these parameters. Failure to observe this precaution could result in bodily injury.

Important: Note that there is no signal loss detection while the input is in bipolar voltage mode (see parameter 190).

340 Anlg Out Config

Param 340 is not available in the 6SP series.
It is available in the 6SB extended HP SP600 Drive.
See instruction manual D2-3501 for more information.

341 Anlg Out Absolut

Range: See figure 12.52
Default: See figure 12.52
Access: 2 **Path:** Inputs & Outputs>Analog Outputs
See also: 342

Selects whether the signed value or absolute value of a parameter is used before being scaled to drive the analog output. See parameter 343 for specific signals that can be output.

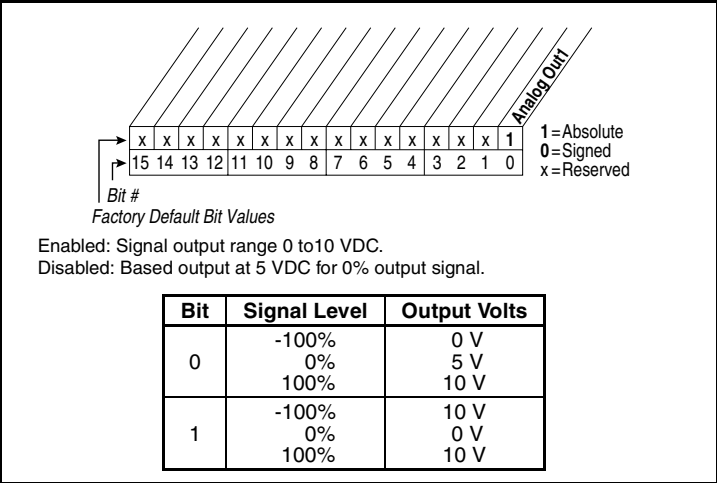


Figure 12.52 – Anlg Out Absolute (341)

342 Analog Out1 Sel

Range: 0 = Output Freq
 1 = Command Freq
 2 = Output Amps
 3 = Torque Amps
 4 = Flux Amps
 5 = Output Power
 6 = Output Volts
 7 = DC Bus Volts
 8 = PI Reference
 9 = PI Feedback
 10 = PI Error
 11 = PI Output
 12 = %Motor OL
 13 = %Drive OL
 14 = Post Rmp Ref

Default: 0 = Output Freq
Access: 1 **Path:** Inputs & Outputs>Analog Outputs
See also: 1 - 7, 12, 135 - 138, 219, 220, 343

Selects the source of the value that drives the analog output. The analog output can be a voltage (0-10 VDC) signal connected to terminals 22 and 23. See also Table 12.4.

343 Analog Out1 Hi

Range: 0.00 to 10.00 Volts [0.01 Volt]
Default: 10.00 Volts
Access: 1 **Path:** Inputs & Outputs>Analog Outputs
See also: 342

Scales the analog output voltage at the source value maximum.

Scaling the Analog Output

You define the scaling for the analog output by entering analog output voltages into Analog Out1 Lo and Analog Out1 Hi. These two output voltages correspond to the bottom and top of the possible range covered by the quantity being output. The output voltage will vary linearly with the quantity being output. The analog output voltage will not go outside the limits defined by Analog Out1 Lo and Analog Out1 Hi. See table 12.4.

Table 12.4 – Analog Output Scaling

Options:	Analog Out1 Lo (344) Value Corresponds to:		Analog Out1 Hi (343) Value Corresponds to:
	Analog Out Absolut (341) = Disabled	Analog Out Absolut (341) = Enabled	
0 Output Freq	–[Maximum Freq]	0 Hz	+ [Maximum Freq]
1 Commanded Freq	–[Maximum Speed]	0 Hz	+ [Maximum Speed]
2 Output Amps	0 Amps	0 Amps	200% Rated
3 Torque Amps	–200% Rated	0 Amps	200% Rated
4 Flux Amps	0 Amps	0 Amps	200% Rated
5 Output Power	0 kW	0 kW	200% Rated
6 Output Volts	0 Volts	0 Volts	120% Rated
7 DC Bus Volts	0 Volts	0 Volts	200% Rated
8 PI Reference	–100%	0%	100%
9 PI Feedback	–100%	0%	100%
10 PI Error	–100%	0%	100%
11 PI Output	–100%	0%	100%
12 %Motor OL	0%	0%	100%
13 %Drive OL	0%	0%	100%

344 Analog Out1 Lo

Range: 0.00 to 10.00 Volts [0.01 Volts]
Default: 0.00 Volts
Access: 1 **Path:** Inputs & Outputs>Analog Outputs
See also: 342, 343

Scales the analog output voltage at the source value minimum.

Refer to Analog Out1 Hi (343) for more information.

- 361 **Digital In1 Sel** - Stop-CF (4)
- 362 **Digital In2 Sel** - Start (5)
- 363 **Digital In3 Sel** - Function Loss (3)
- 364 **Digital In4 Sel** - Jog (10)
- 365 **Digital In5 Sel** - Auto/Manual (18)
- 366 **Digital In6 Sel** - Speed Sel 1 (15)



- Range:**
- 0 = Not Used
 - 1 = Enable
 - 2 = Clear Faults¹
 - 3 = Function Loss
 - 4 = Stop - CF²
 - 5 = Start
 - 6 = Fwd/Reverse²
 - 7 = Run³
 - 8 = Run Forward³
 - 9 = Run Reverse³
 - 10 = Jog
 - 11 = Jog Forward
 - 12 = Jog Reverse
 - 13 = Stop Mode B
 - 14 = Bus Reg Md B
 - 15 = Speed Sel 1⁴
 - 16 = Speed Sel 2⁴
 - 17 = Speed Sel 3⁴
 - 18 = Manual
 - 19 = Reserved
 - 20 = Acc2 & Dec2
 - 21 = Accel 2
 - 22 = Decel 2
 - 23 = MOP Inc
 - 24 = MOP Dec
 - 25 = OIM Control
 - 26 = PI Enable
 - 27 = PI Hold
 - 28 = PI Reset
 - 29 = Reserved
 - 30 = Reserved
 - 31 = Reserved
 - 32 = Reserved
 - 33 = Reserved
 - 34 = Reserved
 - 35 = Reserved
 - 36 = Reserved
 - 37 = Reserved
 - 38 = Reserved
 - 39 = UserSetBit0
 - 40 = UserSetBit1

Default: See table 12.6

Access: 361=0 **Path:** Inputs & Outputs>Digital Inputs
 362-366=1

See also: 96, 100, 124, 140, 156, 162, 194, 380

¹When Digital In"x" Sel is set to option 2 (Clear Faults), the Stop key cannot be used to clear a fault condition.

²Typical 3-wire inputs. These require that only 3-wire functions are chosen. Including 2-wire selections will cause a type 2 alarm.

³Typical 2-wire inputs. These require that only 2-wire functions are chosen. Including 3-wire selections will cause a type 2 alarm.

⁴To access Preset Speed 1, set Speed Ref A Sel to Preset Speed 1. See table 12.5.

Table 12.5 – Speed Select Inputs

Speed Select Inputs			Reference Source
3	2	1	
0	0	0	Speed Ref A Sel (90)
0	0	1	Preset Speed 1 (101)
0	1	0	Preset Speed 2 (102)
0	1	1	Preset Speed 3 (103)
1	0	0	Preset Speed 4 (104)
1	0	1	Preset Speed 5 (105)
1	1	0	Preset Speed 6 (106)
1	1	1	Preset Speed 7 (107)

Assigns an input function to the drive's digital inputs. Note that digital inputs Run, Jog, Stop, Clear-Faults, and Direction control functions are operational only when the terminal block is selected as the control source (Logic Source Sel = Terminal Blk).

Table 12.6 – Default Values for Parameters 361-366

Parameter No.	Default Value
361	4 = Stop - CF
362	5 = Start
363	3 = Function Loss
364	10 = Jog
365	18 = Auto/Manual
366	15 = Speed Sel 1

The input functions are:

1 = Enable: If the input is closed, the drive can run (start permissive). If the input is open, the drive will not start.

If the drive is already running when this input is opened, the drive will coast and indicate "not enabled" on the OIM (if present). This is not considered a fault condition, and no fault will be generated.

If multiple enable inputs are configured, the drive will not run if any of them are open.

2 = Clear Faults: This function allows an external device to reset drive faults through the terminal block if Logic Source Sel (89) is set to Terminal Blk or All Ports. An open-to-closed transition on this input will reset the current fault (if any).

If this input is configured at the same time as Stop-Clear Faults, then only the Clear Faults input can actually cause faults to be reset.

3 = Function Loss: If the function loss input is open, a fault is generated. The function loss input is active at all times regardless of the selected logic control source.

Important: The function loss input is not intended for a fast output power kill. The drive will not fault until the software detects the change of state of this input. If this input function is not configured, the fault will not occur.

4 = Stop - CF (Stop - Clear Faults): An open input will assert a stop command if the terminal block is the control source. While the stop is asserted, the drive ready status will be off. A closed input will allow the drive to start. An open-to-closed transition is interpreted as a clear faults request. The drive will clear any existing faults.

If Start is configured, then Stop-Clear Faults must also be configured to prevent a digital input configuration alarm condition. Stop-Clear Faults is optional in all other circumstances.

5 = Start: An open-to-closed transition generates a run command if the terminal block is the control source.

If Start is configured, then Stop-Clear Faults must also be configured to prevent a digital input configuration alarm condition.

6 = Fwd/Reverse (Forward/Reverse): An open input sets the direction to forward if the terminal block is the control source. A closed input sets the direction to reverse. If the state of the input changes and the drive is running or jogging, the drive will change direction.

If the Fwd/Rev input function is assigned to more than one physical digital input at a time, a digital input configuration alarm will be asserted.

7 = Run: An open-to-closed transition on this input generates a run command if the terminal block is the control source. If the input is open, the drive will stop.


The purpose of this input function is to allow a 2-wire start while the direction is being controlled by some other function.

8 and 9 = Run Forward and Run Reverse: If the terminal block is the control source, an open-to-closed transition on one or both

inputs while the drive is stopped will cause the drive to run unless the Stop - Clear Faults input function is configured and open.

If one or both of these input functions are assigned to more than one physical digital input at a time, a digital input configuration alarm will be asserted.

10 = Jog: An open-to-closed transition on this input while the drive is stopped causes the drive to start (jog) in the current direction. When the input opens while the drive is running (jogging), the drive will stop.


	<p>ATTENTION: If a normal drive start command is received while the drive is jogging, the drive will switch from jog mode to run mode. The drive will not stop, but may change speed and/or change direction. Failure to observe this precaution could result in severe bodily injury or loss of life.</p>
---	---

The drive will not jog while running or while the Stop - Clear Faults input is open. Start has precedence over jog.

11 and 12 = Jog Forward and Jog Reverse: An open-to-closed transition on one or both inputs while the drive is stopped will cause the drive to jog unless the Stop - Clear Faults input function is configured and open. Table 12.7 describes the actions taken by the drive in response to various states of these input functions.

Table 12.7 – Drive Response to Jog Forward and Jog Reverse Inputs

Jog Forward	Jog Reverse	Drive Response
Open	Open	Drive will stop if already jogging, but can be started by other means.
Open	Closed	Drive jogs in reverse direction.
Closed	Open	Drive jogs in forward direction.
Closed	Closed	Drive continues to jog in current direction.

	<p>ATTENTION: If a normal drive start command is received while the drive is jogging, the drive will switch from jog mode to run mode. The drive will not stop, but may change speed and/or change direction. Failure to observe this precaution could result in severe bodily injury or loss of life.</p>
---	---

The drive will not jog while running or while the Stop - Clear Faults input is open. Start has precedence over jog.

If one of these input functions is configured and the other one is not,

table 12.7 still applies, but the unconfigured input function should be considered permanently open.

13 = Stop Mode B: This digital input selects between two different drive stop modes.

If the input is open, then Stop Mode A selects which stop mode to use. If the input is closed, the Stop Mode B selects which stop mode to use. If this input function is not configured, then Stop Mode A selects which stop mode to use.

14 = Bus Regulation Mode B: This digital input function selects how the drive will regulate excess voltage on the DC bus.

If the input is open, then Bus Reg Mode A selects which bus regulation mode to use. If the input is closed, then Bus Reg Mode B selects which bus regulation mode to use. If this input function is not configured, then Bus Reg Mode A selects which bus regulation mode to use.

15-17 = Speed Select 1, 2, 3: One, two, or three digital input functions can be used to select the speed reference used by the drive, and they are called the Speed Select input functions. The current open/closed state of all Speed Select input functions combine to select which source is the current speed reference.

There are 8 possible combinations of open/closed states for the three input functions, and thus 8 possible parameters can be selected. The 8 parameters are: Speed Ref A Sel and Preset Speed 1 through Preset Speed 7.

If the Speed Select input functions select Speed Ref A Sel, then the value of that parameter further selects a reference source. There are a large number of possible selections, including all 6 presets.

If the input functions directly select one of the preset speed parameters, then the parameter contains a frequency that is to be used as the reference.

The Speed Select input function configuration process involves assigning the functionality of the three possible Speed Select input functions to physical digital inputs. The three Speed Select inputs functions are called Speed Select 1, Speed Select 2, and Speed Select 3, and they are assigned to physical inputs using the Digital In"x" Sel parameters.

Table 12.8 describes the various reference sources that can be selected using all three of the Speed Select input functions. If any of the three Reference Select input functions are not configured, then the software will still follow the table, but will treat the unconfigured inputs as if they are permanently open.

Table 12.8 – Effect of Speed Select Input State on Selected Reference

Speed Select 3	Speed Select 2	Speed Select 1	Parameter that determines reference:
Open	Open	Open	Speed Ref A Sel
Open	Open	Closed	Preset Speed 1
Open	Closed	Open	Preset Speed 2
Open	Closed	Closed	Preset Speed 3
Closed	Open	Open	Preset Speed 4
Closed	Open	Closed	Preset Speed 5
Closed	Closed	Open	Preset Speed 6
Closed	Closed	Closed	Preset Speed 7

18 = Manual: The Manual function allows a single control device to assume exclusive control of the manual reference. The most recent peripheral (OIM or terminal block) that makes a manual reference request will be given control of the manual reference setpoint.

If the Manual input function is closed, then the drive will use one of the analog inputs (defined by TB Man Ref Sel) as the reference. If an OIM subsequently requests manual control (that is, Auto/Man F-Key is pressed) and then gives control up (presses Auto/Man F-Key again), then the Auto/Manual digital input must be opened and closed again to regain control of the manual reference.

If this input is open, then the terminal block does not request manual control of the reference. If no control device (including the terminal block) is currently requesting manual control of the reference, then the drive will use the normal reference selection mechanisms.

19 = Reserved

20 = Acc2 & Dec2: A single input function is used to select between Accel Time 1/Decel Time 1 and Accel Time 2/Decel Time2.

If the function is open, the drive will use Accel Time 1 as the acceleration rate and Decel Time 1 as the deceleration rate. If the function is closed, the drive will use Accel Time 2 as the acceleration rate and Decel Time 2 as the deceleration rate.

21, 22 = Accel 2, Decel 2: One input function (called Accel 2) selects between Accel Time 1 and Accel Time 2, and another input function (called Decel 2) selects between Decel Time 1 and Decel Time 2. The open state of the function selects Accel Time 1 or Decel Time 1, and the closed state selects Accel Time 2 or Decel Time 2.

23, 24 = MOP Increment, MOP Decrement: The MOP is a reference setpoint (called the MOP Value) that can be incremented and decremented by external devices. These inputs are used to increment and decrement the Motor Operated Potentiometer (MOP) value inside the drive. The MOP value will be retained through a power cycle.

While the MOP Increment input is closed, the MOP value will increase at the rate contained in MOP Rate. The rate units are Hz per second.

While the MOP Decrement input is closed, MOP value will decrease at the rate contained in MOP Rate. The rate units are Hz per second.

If both the MOP Increment and MOP Decrement inputs are closed, the MOP value will stay the same.

In order for the drive to use the MOP value as the current speed reference, Speed Ref A Sel must be set to MOP.

25 = OIM Control: This input provides a means to override the logic control source selection and can be used to override control from any port, including the All Ports selection.

An open-to-closed transition of this input sets the control source to the local OIM. If no local OIM is present, the control source is set to the remote OIM. If no OIM is present at all, the drive stops.

When control is set to the OIM, the OIM is granted manual reference (the Man Ref Preload (193) configuration is enforced). Subsequent Auto/Manual commands will toggle the OIM in and out of manual mode. The drive's active or stopped state is not affected unless no OIM is present.

On a closed-to-open transition, manual control is released if active, and the selected auto reference is used. The logic source select override is removed. The edge/level-sense start configuration is imposed (LevelSense Start).

26 = PI Enable: If this input function is closed, the operation of the Process PI loop will be enabled.

If this input function is open, the operation of the Process PI loop will be disabled.

27 = PI Hold: If this input function is closed, the integrator for the Process PI loop will be held at the current value; that is, it will not increase or decrease.

If this input function is open, the integrator for the Process PI loop will be allowed to increase or decrease.

28 = PI Reset: If this input function is closed, the integrator for the Process PI loop will be reset to 0.

If this input function is open, the integrator for the Process PI loop will integrate normally.

29-38 = Reserved

39 = UserSetBit0

40 = UserSetBit1

If either UserSetBit0 or UserSetBit1 is not defined, a zero value is used in place of the input to determine which User Set is loaded, while Dynamic Mode is enabled. These bits only affect the drive when Dynamic Mode (204) is active. See table 12.9.

Table 12.9 – Dynamic User Mode

Dynamic User Set Mode		
UserBit1	UserBit0	User Set Loaded In Memory
0	0	User Set 1
0	1	User Set 2
1	0	User Set 3
1	1	User Set 3

Type 2 Alarms

Some digital input programming may cause conflicts that result in a Type 2 alarm. For example, Digital In1 Sel set to 5 (Start) in 3-wire control, and Digital In2 Sel set to 7 (Run) in 2-wire control. These alarms prevent the drive from starting. Refer to chapter 13 for more information about these alarms. Dig In Status (116) indicates the current state of the digital inputs.

380 Digital Out1 Sel

Range:	1 = Fault ¹ 2 = Alarm1 3 = Ready 4 = Run 5 = Forward Run 6 = Reverse Run 7 = Auto Restart 8 = Reserved 9 = At Speed 10 = At Freq ² 11 = At Current ² 12 = At Torque ² 13 = At Temp ² 14 = At Bus Volts ² 15 = At PI Error ² 16 = DC Braking 17 = Curr Limit 18 = Economize 19 = Motor Overld 20 = Power Loss 21 = Input 1 Link 22 = Input 2 Link 23 = Input 3 Link 24 = Input 4 Link 25 = Input 5 Link 26 = Input 6 Link 27 = TB in Manual
Default:	1 = Fault
Access:	1 Path: Inputs & Outputs>Digital Outputs
See also:	1-4, 12, 48, 53, 137, 147, 157, 184, 218, 381-383, 385, 386

¹Any relay programmed as fault or alarm will energize (pick up) when power is applied to the drive and de-energize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will de-energize when the condition is removed.

²Activation level is defined in Dig Out "x" Level (381, 385).

Selects the drive status that will energize an output relay (relay terminals 11, 12, and 13).

1 = Fault: A fault has occurred and stopped the drive.

2 = Alarm: A Type 1 or Type 2 alarm condition exists.

3 = Ready: The drive is powered, Enabled, and no start inhibits exist. It is "ready" to run.

4 = Run: The drive is outputting voltage and frequency to the motor (indicates 3-wire control, either direction).

5 = Forward Run: The drive is outputting voltage and frequency to

the motor (indicates 2–wire control in forward).

6 = Reverse Run: The drive is outputting voltage and frequency to the motor (indicates 2–wire control in reverse).

7 = Auto Restart: The drive is currently executing the Auto Restart or “Run at Power Up” function.

8 = Reserved

9 = At Speed: The output frequency equals or exceeds the commanded speed.

10 = At Freq: The drive output frequency equals or exceeds the programmed limit. Also see Dig Out1 Level (381), Dig Out1 OnTime (382), and Dig Out1 OffTime (383).

11 = At Current: The drive total output current exceeds the programmed limit.

12 = At Torque: The drive output torque current component exceeds the programmed limit.

13 = At Temp: The drive operating temperature exceeds the programmed limit.

14 = At Bus Volts: The drive bus voltage exceeds the programmed limit.

15 = At PI Error: The drive Process PI Loop error exceeds the programmed limit.

16 = DC Braking: The drive is currently executing either a “DC Brake” or a “Ramp to Hold” stop command and the DC braking voltage is still being applied to the motor.

17 = Curr Limit: The drive is currently limiting output current.

18 = Economize: The drive is currently reducing the output voltage to the motor to attempt to reduce energy costs during a lightly loaded situation.

19 = Motor Overld: The drive has detected a motor overload.

20 = Power Loss: The drive has monitored DC bus voltage and sensed a loss of input AC power that caused the DC bus voltage to fall below the fixed monitoring value (73% of DC Bus Memory when power loss mode is set to coast and 82% of DC Bus Memory when power loss mode is set to decel. See parameters 13 and 184).

21 = Input 1 Link: Outputs the state of digital input 1.

22 = Input 2 Link: Outputs the state of digital input 2.

23 = Input 3 Link: Outputs the state of digital input 3.

24 = Input 4 Link: Outputs the state of digital input 4.

25 = Input 5 Link: Outputs the state of digital input 5.

26 = Input 6 Link: Outputs the state of digital input 6.

27 = TB in Manual: Terminal block has manual reference control.

381 Dig Out1 Level

Range: 0.0 to 819.2 [0.1]

Default: 0.0

Access: 1 **Path:** Inputs & Outputs>Digital Outputs

See also: 380

Sets the relay activation level for options 10-15 in parameter 380 (Digital Out1 Sel). Units are assumed to match the selection of parameter 380. (i.e., At Freq = Hz, At Torque = Amps).

382 Dig Out1 OnTime

Range: 0.00 to 600.00 Sec [0.01 Sec]

Default: 0.00 Sec

Access: 2 **Path:** Inputs & Outputs>Digital Outputs

See also: 380

Sets the on delay time for the digital outputs. This is the time between the occurrence of a condition and activation of the relay.

383 Dig Out1 OffTime

Range: 0.00 to 600.00 Sec [0.01 Sec]

Default: 0.00 Sec

Access: 2 **Path:** Inputs & Outputs>Digital Outputs

See also: 380

Sets the off delay time for the digital outputs. This is the time between the disappearance of a condition and de-activation of the relay.

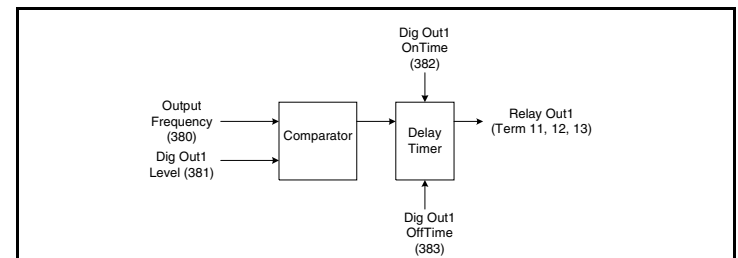


Figure 12.53 – Dig Out1 OffTime (383)

384 Digital Out2 Sel

Range: 1 = Fault¹
2 = Alarm¹
3 = Ready
4 = Run
5 = Forward Run
6 = Reverse Run
7 = Auto Restart
8 = Reserved
9 = At Speed
10 = At Freq²
11 = At Current²
12 = At Torque²
13 = At Temp²
14 = At Bus Volts²
15 = At PI Error²
16 = DC Braking
17 = Curr Limit
18 = Economize
19 = Motor Overld
20 = Power Loss
21 = Input 1 Link
22 = Input 2 Link
23 = Input 3 Link
24 = Input 4 Link
25 = Input 5 Link
26 = Input 6 Link
27 = TB in Manual

Default: 4 = Run

Access: 1 **Path:** Inputs & Output>Digital Outputs

See also: 1 - 4, 12, 48, 53, 137, 147, 157, 184, 218, 381-383, 385, 386

¹Any relay programmed as fault or alarm will energize (pick up) when power is applied to the drive and de-energize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will de-energize when the condition is removed.

²Activation level is defined in Dig Out “x” Level (381, 385).

Selects the drive status that will energize an output relay.

1 = Fault: A fault has occurred and stopped the drive.

2 = Alarm: A Type 1 or Type 2 alarm condition exists.

3 = Ready: The drive is powered, Enabled, and no start inhibits exist. It is “ready” to run.

4 = Run: The drive is outputting voltage and frequency to the motor (indicates 3–wire control, either direction).

5 = Forward Run: The drive is outputting voltage and frequency to the motor (indicates 2–wire control in forward).

6 = Reverse Run: The drive is outputting voltage and frequency to the motor (indicates 2-wire control in reverse).

7 = Auto Restart: The drive is currently executing the Auto Restart or “Run at Power Up” function.

8 = Reserved

9 = At Speed: The output frequency equals or exceeds the commanded speed.

10 = At Freq: The drive output frequency equals or exceeds the programmed limit. Also see Dig Out2 Level (385), Dig Out2 OnTime (386), and Dig Out2 OffTime (387).

11 = At Current: The drive total output current exceeds the programmed limit.

12 = At Torque: The drive output torque current component exceeds the programmed limit.

13 = At Temp: The drive operating temperature exceeds the programmed limit.

14 = At Bus Volts: The drive bus voltage exceeds the programmed limit.

15 = At PI Error: The drive Process PI Loop error exceeds the programmed limit.

16 = DC Braking: The drive is currently executing either a “DC Brake” or a “Ramp to Hold” stop command and the DC braking voltage is still being applied to the motor.

17 = Curr Limit: The drive is currently limiting output current.

18 = Economize: The drive is currently reducing the output voltage to the motor to attempt to reduce energy costs during a lightly loaded situation.

19 = Motor Overld: The drive has detected a motor overload.

20 = Power Loss: The drive has monitored DC bus voltage and sensed a loss of input AC power that caused the DC bus voltage to fall below the fixed monitoring value (73% of DC Bus Memory when power loss mode is set to coast and 82% of DC Bus Memory when power loss mode is set to decel. See parameters 13 and 184).

21 = Input 1 Link: Outputs the state of digital input 1.

22 = Input 2 Link: Outputs the state of digital input 2.

23 = Input 3 Link: Outputs the state of digital input 3.

24 = Input 4 Link: Outputs the state of digital input 4.

25 = Input 5 Link: Outputs the state of digital input 5.

26 = Input 6 Link: Outputs the state of digital input 6.

27 = TB in Manual: Terminal block has manual reference control.

385 Dig Out2 Level

Range: 0.0 to 819.2 [0.1]

Default: 0.0

Access: 1 **Path:** Inputs & Output>Digital Outputs

See also: 384

Sets the relay activation level for options 10-15 in parameter 384 (Digital Out2 Sel). Units are assumed to match the selection in parameter 384 (i.e., At Freq = Hz, At Torque = Amps).

386 Dig Out2 OnTime

Range: 0.00 to 600.00 Sec [0.01 Sec]

Default: 0.00 Sec

Access: 2 **Path:** Inputs & Output>Digital Outputs

See also: 384

Sets the on delay time for the digital outputs. This is the time between the occurrence of a condition and activation of the relay.

387 Dig Out2 OffTime

Range: 0.00 to 600.00 Sec [0.01 Sec]
Default: 0.00 Sec
Access: 2 **Path:** Inputs & Output>Digital Outputs
See also: 384

Sets the off delay time for the digital outputs. This is the time between the disappearance of a condition and de-activation of the relay.

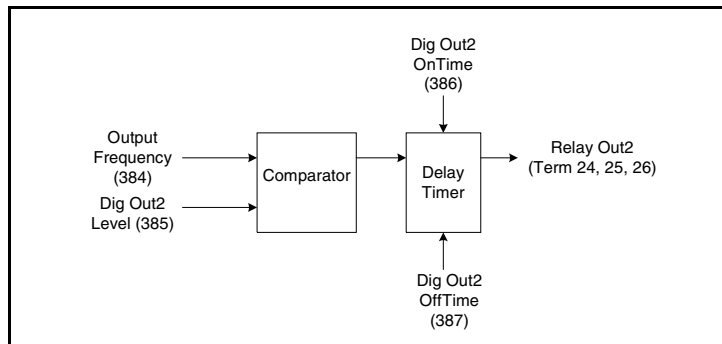


Figure 12.54 – Dig Out2 OffTime (387)

Troubleshooting the Drive



ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

The SP600 drive provides the following ways to determine the status of the drive and to troubleshoot problems that may occur:

- Ready LED on the drive cover
- User-configurable and non-configurable alarms
- User-configurable and non-configurable faults
- Entries in the fault queue
- Drive status parameters

13.1 Verifying that DC Bus Capacitors are Discharged Before Servicing the Drive



ATTENTION: DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five (5) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

The drive's DC bus capacitors retain hazardous voltages after input power has been disconnected. Perform the following steps before touching any internal components.

- Step 1. Turn off and lock out input power. Wait 5 minutes.
- Step 2. Remove the drive's cover.
- Step 3. Verify that there is no voltage at the drive's input power terminals.
- Step 4. Measure the DC bus potential with a voltmeter while standing on a non-conductive surface and wearing insulated gloves. Refer to figure 13.1.

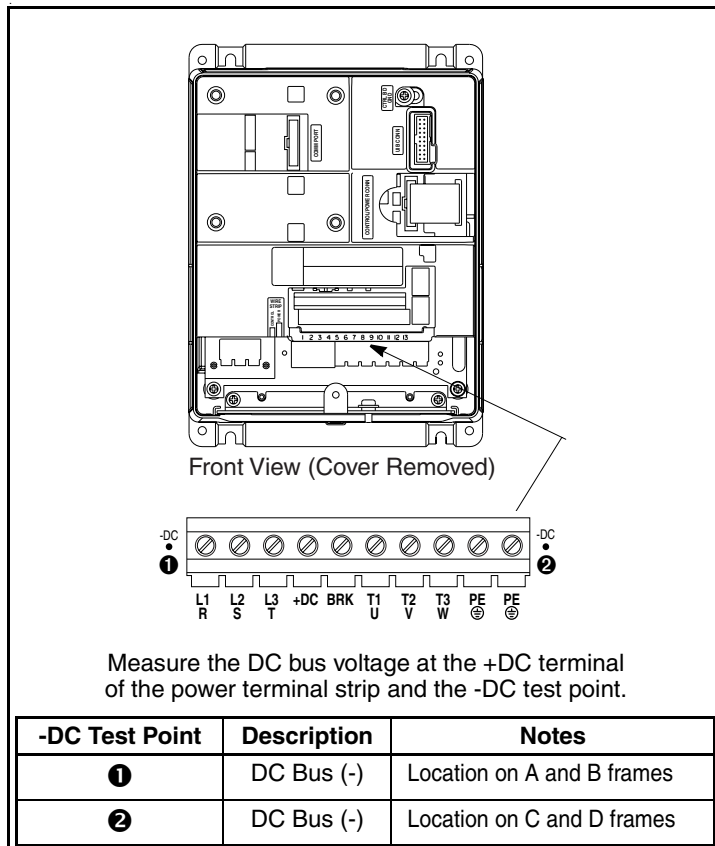


Figure 13.1 – Location of DC Bus Voltage Measuring Points

Step 5. Once the drive has been serviced, reattach the drive's cover.

Step 6. Reapply input power.

13.2 Determining Drive Status Using the Ready LED

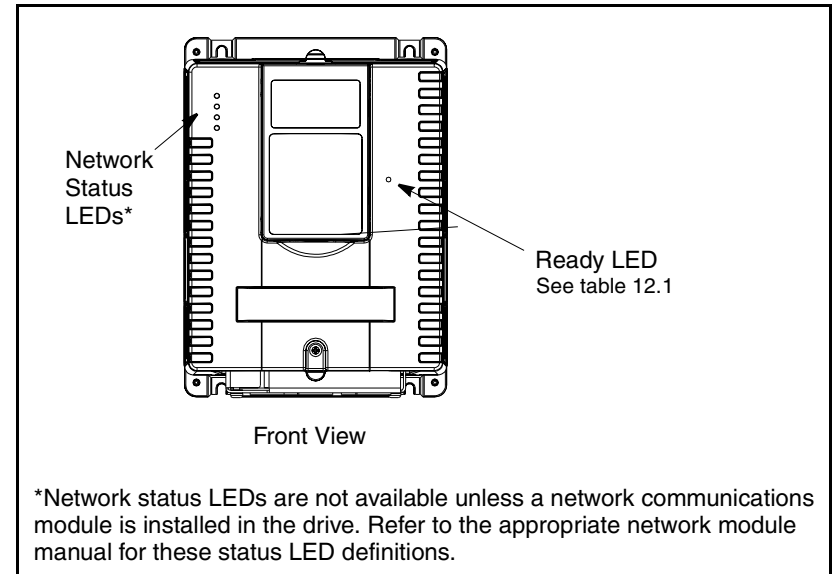


Figure 13.2 – Location of the Ready LED

Table 13.1 – Ready LED Status Definitions

Color	State	Description
Green	Flashing	Drive ready, but not running and no faults are present.
	Steady	Drive running, no faults are present.
Yellow See section 13.3.	Flashing	The drive is not ready. Check parameter 214 (Start Inhibits).
	Steady	An alarm condition exists. Check parameters 211 (Drive Alarm 1) and 212 (Drive Alarm 2).
Red See section 13.4.	Flashing	A fault has occurred.
	Steady	A non-resettable fault has occurred.

13.3 About Alarms

Alarms indicate conditions that may affect drive operation or application performance.

There are two alarm types, as described in table 13.2.

Table 13.2 – Types of Alarms

Type	Alarm Description
①	<p>User-Configurable</p> <p>These alarms alert the operator of conditions that, if left untreated, may lead to a fault condition. The drive continues to operate during the alarm condition.</p> <p>The alarms are enabled or disabled using Alarm Config 1 (259).</p> <p>The status of these alarms is shown in Drive Alarm 1 (211).</p>
②	<p>Non-Configurable</p> <p>These alarms alert the operator of conditions caused by improper programming and prevent the drive from starting until the problem is resolved.</p> <p>These alarms are always enabled.</p> <p>The status of these alarms is shown in Drive Alarm 2 (212).</p>

The drive indicates alarm conditions in the following ways:

- Ready LED on the drive cover (see table 13.1).
- Alarm name and bell graphic on the LCD OIM (see chapter 9).
The alarm is displayed as long as the condition exists. The drive automatically clears the alarm when the condition causing it is removed.
- Alarm status parameters. Two 16-bit parameters, Drive Alarm 1 (211) and Drive Alarm 2 (212), indicate the status of type 1 and type 2 alarms, respectively. Refer to chapter 12 for the parameter descriptions.

13.3.1 Alarm Descriptions

Table 13.3 – Alarm Descriptions





















































































































Alarm	Type	Description																																																																																																				
Analog In Loss	①	An analog input is configured for alarm on signal loss and signal loss has occurred.																																																																																																				
Bipolar Conflict	②	Parameter 190 (Direction Mode) is set to Bipolar or Reverse Dis and one of more of the following digital input functions is configured: Fwd/Rev, Run Fwd, Run Rev, Jog Fwd, or Jog Rev.																																																																																																				
Dig In ConflictA	②	Digital input functions are in conflict. Combinations marked with a  will cause an alarm.																																																																																																				
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Dig In ConflictB	②	Digital input functions are in conflict. Combinations marked with a  will cause an alarm.																																																																																																				
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Dig In ConflictC	②	<p>More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions:</p> <table border="0"> <tr> <td>Forward/Reverse</td> <td>Run Reverse</td> <td>Bus Regulation Mode B</td> </tr> <tr> <td>Speed Select 1</td> <td>Jog Forward</td> <td>Acc2 / Dec2</td> </tr> <tr> <td>Speed Select 2</td> <td>Jog Reverse</td> <td>Accel 2</td> </tr> <tr> <td>Speed Select 3</td> <td>OIM Control</td> <td>Decel 2</td> </tr> <tr> <td>UserSetBit0</td> <td>UserSetBit1</td> <td></td> </tr> </table>	Forward/Reverse	Run Reverse	Bus Regulation Mode B	Speed Select 1	Jog Forward	Acc2 / Dec2	Speed Select 2	Jog Reverse	Accel 2	Speed Select 3	OIM Control	Decel 2	UserSetBit0	UserSetBit1																																																																																						
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UserSetBit0	UserSetBit1																																																																																																					

Table 13.3 – Alarm Descriptions (Continued)

Alarm	Type	Description
DigIn Bad Value	②	Unsupported function selected in Digital In"x" Sel parameters (361-366).
Drive OL Level 1	①	The calculated IGBT temperature requires a reduction in PWM carrier frequency. If Drive OL Mode (150) is disabled and the load is not reduced, an overload fault will eventually occur.
Drive OL Level 2	①	The calculated IGBT temperature requires a reduction in Current Limit. If Drive OL Mode (150) is disabled and the load is not reduced, an overload fault will eventually occur.
Flux Amps Ref Rang	②	Result of autotune procedure (61).
IntDBRes OvrHeat	①	The drive has temporarily disabled the dynamic braking regulator because the resistor temperature has exceeded a predetermined value.
IR Volts Range	②	The drive autotuning default is Calculate and the value calculated for IR Drop Volts is not in the range of acceptable values. This alarm should clear when all motor nameplate data is properly entered.
MaxFreq Conflict	②	The sum of Maximum Speed (82) and Overspeed Limit (83) exceeds Maximum Freq (55). Raise Maximum Freq (55) or lower Maximum Speed (82) and/or Overspeed Limit (83) so that the sum is less than or equal to Maximum Freq (55).
Motor Type Cflct	②	Motor Type (90) has been set to Sync Prm Mag or Sync Reluc, and one or more DC functions (for example, DC Boost, DC Brake, etc.) have been activated. DC injection functions are incompatible with synchronous motors and may demagnetize them.
NP Hz Conflict	②	Fan/pump mode is selected in Torq Perf Mode (53), and the ratio of Motor NP Hertz (43) to Maximum Freq (55) is greater than 26.
Power Loss	①	Drive has sensed a power line loss.
Prechrg Actv	①	Drive is in the initial DC bus precharge state.
Speed Ref Cflct	②	Speed Ref A Sel (90) or PI Reference Sel (126) is set to Reserved.
Under-Voltage	①	The bus voltage has dropped below a predetermined value.

Table 13.3 – Alarm Descriptions (Continued)

Alarm	Type	Description
UserSet Conflict	②	Datalink In is linked to Dyn UserSetSel (205) without the identical condition being present in the other two User sets. This alarm will occur even if the other two User Sets are unused. A digital input is set to UserSetBitx without the identical condition being present in the other two User sets. This alarm will occur even if the other two User Sets are unused.
VHz Neg Slope	②	Custom V/Hz mode has been selected in Torq Perf Mode (53) and the V/Hz slope is negative.

Table 13.4 – Alarm Names Cross-Referenced by Alarm Numbers

No. ¹	Alarm	No. ¹	Alarm
1	Precharge Active	20	Bipolar Conflict
2	UnderVoltage	21	Motor Type Conflict
3	Power Loss	22	NP Hz Conflict
5	Analog In Loss	23	MaxFreq Conflict
6	IntDBRes OvrHeat	24	VHz Neg Slope
8	Drive OL Level 1	25	IR Volts Range
9	Drive OL Level 2	26	FluxAmps Ref Rang
17	Dig In ConflictA	27	Speed Ref Cflct
18	Dig In ConflictB	30	DigIn Bad Value
19	Dig In ConflictC	32	UserSet Conflict

¹Alarm numbers not listed are reserved for future use.

13.4 About Faults

Faults indicate conditions within the drive that require immediate attention. The drive responds to a fault by initiating a coast-to-stop sequence and turning off output power to the motor.

In addition, some faults are auto-resettable, non-resettable, and/or user-configurable as described in table 13.5.

Table 13.5 – Fault Types

Type	Fault Description	
❶	Auto-Reset/Run	If the drive is running when this type of fault occurs, and Auto Rstrt Tries (174) is set to a value greater than 0, a user-configurable timer, Auto Rstrt Delay (175) begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
❷	Non-Resettable	This type of fault normally requires drive or motor repair. The cause of the fault must be corrected before the fault can be cleared. The fault will be reset on power up after repair.
❸	User-Configurable	These faults can be enabled/disabled to either annunciate or ignore a fault condition using Fault Config 1 (238).

The drive indicates faults in the following ways:

- Ready LED on the drive cover (see section 13.2).
- Drive status parameters Drive Status 1 (209) and Drive Status 2 (210).
- Entries in the fault queue (see section 13.4.1).
- Pop-up screen on the LCD OIM. See figure 13.3. The screen displays:
 - Fault number
 - Fault name
 - Time that has elapsed since fault occurred.

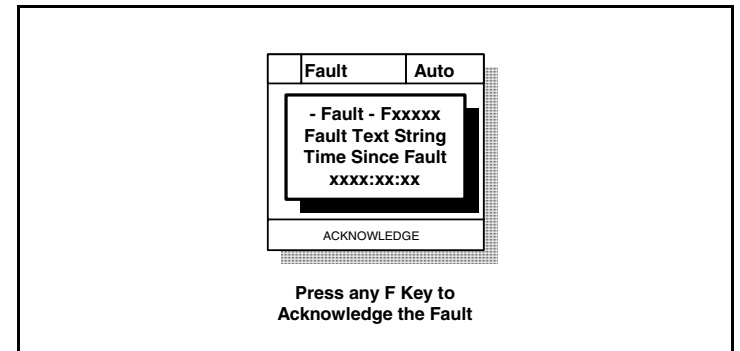


Figure 13.3 – Sample Fault Screen on the LCD OIM

The fault screen is displayed until it is acknowledged by pressing any F-key or cleared in the drive by other means.

13.4.1 About the Fault Queue

The drive automatically retains a history of faults that have occurred in the fault queue. The fault queue is accessed using the OIM or VS Utilities software.

The fault queue holds the four most recent faults. The last fault to occur is indicated in queue entry #1. As new faults are logged into the queue, existing fault entries are shifted (for example, entry #1 will move to entry #2). Once the queue is full, older faults are discarded from the queue as new faults occur.

All entries in the fault queue are retained if power is lost.

The Time Stamp

For each entry in the fault queue, the system also displays a fault code and time stamp value. The time stamp value is the value of an internal drive-under-power timer at the time of the fault. The value of this timer is copied to PowerUp Marker (242) when the drive powers up. The fault queue time stamp can then be compared to the value


in PowerUp Marker to determine when the fault occurred relative to the last drive power up.

The time stamp is cleared when the fault queue is cleared.

Refer to section 13.8.1 for information on accessing the fault queue using the LCD OIM. Refer to instruction manual D2-3488 for information on accessing the fault queue using VS Utilities software.

13.4.2 Clearing Faults

A fault condition can be cleared by the following:

- Step 1. Press  or any F-Key to acknowledge the fault and remove the fault pop-up from the LCD OIM screen.
- Step 2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared.
- Step 3. After corrective action has been taken, clear the fault using one of the following:
 - Set Fault Clear (240) = 1 (Clear Faults).
 - Press F1 (Cflt) from the fault queue screen.
 - Issue a Stop-Clear Faults command from the control source.

Resetting faults will clear the faulted status indication. If any fault condition still exists, the fault will be latched and another entry made in the fault queue.

Note that performing a fault reset does not clear the fault queue. Clearing the fault queue is a separate action. See the Fault Clear (240) parameter description.

13.4.3 Fault Descriptions and Corrective Actions

Table 13.6 describes drive faults and corrective actions. It also indicates if the fault is:

- ① Auto-resettable
- ② Non-resettable
- ③ User-configurable

Table 13.6 – Fault Descriptions and Corrective Actions

Fault	No.	Type	Description	Action
Analog In Loss	29	① ③	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with Anlg In 1, 2 Loss (324, 327).	1. Check parameters. 2. Check for broken/loose connections at inputs.
Anlg Cal Chksum	108	②	The checksum read from the analog calibration data does not match the checksum calculated.	Replace drive.
Auto Rstrt Tries	33	③	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of Auto Rstrt Tries (174). Enable/disable with Fault Config 1 (238).	Correct the cause of the fault and manually clear.
AutoTune Aborted	80		The autotune procedure was canceled by the user.	Restart procedure.
DB Resistance	69		Resistance of the internal DB resistor is out of range.	Replace resistor.

Table 13.6 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Decel Inhibit	24	③	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.	<ol style="list-style-type: none"> 1. Verify input voltage is within drive specified limits. 2. Verify system ground impedance follows proper grounding techniques. 3. Disable bus regulation and/or add dynamic brake resistor and/or extend deceleration time.
Drive OverLoad	64		Drive rating of 110% for 1 minute or 150% for 3 seconds has been exceeded.	Reduce load or extend Accel Time (140).
Excessive Load	79		Motor did not come up to speed in the allotted time.	<ol style="list-style-type: none"> 1. Uncouple load from motor. 2. Repeat Autotune (61).
FluxAmpsRef Rang	78		The value for flux amps determined by the autotune procedure exceeds the programmed Motor NP FLA (42).	<ol style="list-style-type: none"> 1. Reprogram Motor NP FLA (42) with the correct motor nameplate value. 2. Repeat Autotune (61).
Function Loss	2	❶	Function loss input is open.	Check remote wiring.
Ground Fault	13	❶	A current path to earth ground greater than 25% of drive rating.	Check the motor and external wiring to the drive output terminals for a grounded condition.
Heatsink OvrTemp	8	❶	Heatsink temperature exceeds a predefined value of 90°C (195°F).	<ol style="list-style-type: none"> 1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) NEMA Type 1 installations or 50°C (122°F) for Open type installations. 2. Check fan.

Table 13.6 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
HW OverCurrent	12	❶	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current. Motor dynamics cannot be accommodated by autotuning. Manual tuning of the current loop required. Diagnostic Item #51 may need to be reduced. Consult technical support.
Incompat MCB-PB	106	❷	Drive rating information stored on the power board is incompatible with the Main Control board.	Load compatible version files into drive.
IR Volts Range	77		The drive autotuning default is Calculate and the value calculated for IR Drop Volts is not in the range of acceptable values.	Re-enter motor nameplate data.
Motor Overload	7	❶ ❸	❶ Internal electronic overload trip. ❸ Enable/disable with Fault Config 1 (238).	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by Motor NP FLA (42).
OverSpeed Limit	25	❶	❶ Functions such as slip compensation or bus regulation have attempted to add an output frequency adjustment greater than that programmed in Overspeed Limit (83).	Remove excessive load or overhauling conditions or increase Overspeed Limit (83).

Table 13.6 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
OverVoltage	5	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
Parameter Chksum	100	②	The checksum read from the board does not match the checksum calculated.	1. Restore defaults. 2. Reload user set if used.
Params Defaulted	48		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
Phase U to Grnd	38		A phase-to-ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive.
Phase V to Grnd	39			
Phase W to Grnd	40			
Phase UV Short	41		Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive.
Phase VW Short	42			
Phase UW Short	43			
Port 1-6 DPI Loss	81-86		DPI port stopped communicating. An attached peripheral with control capabilities via Logic Source Sel (89) (or OIM control) was removed. The fault code indicates the offending port number (81 = port 1, etc.)	1. If module was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, modules, Main Control board or complete drive as required. 2. Check OIM connection.

Table 13.6 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Port 1-6 Net Loss	71-76		The network module connected to DPI port stopped communicating. The fault code indicates the offending port number (71 = port 1, etc.)	<ol style="list-style-type: none"> 1. Check communication module for proper connection to external network. 2. Check external wiring to module on port. 3. Verify external network fault.
Power Loss	3	① ⑤	DC bus voltage remained below 85% of nominal for longer than Power Loss Time (185). Enable/disable with Fault Config 1 (238).	Monitor the incoming AC line for low voltage or line power interruption.
Power Unit	70		One or more of the output transistors were operating in the active region instead of desaturation. This can be caused by excessive transistor current or insufficient base drive voltage.	<ol style="list-style-type: none"> 1. Check for damaged output transistors. 2. Replace drive.
Pwr Brd Chksum1	104		The checksum read from the EEPROM does not match the checksum calculated from the EEPROM data.	Clear the fault or cycle power to the drive.
Pwr Brd Chksum2	105	②	The checksum read from the board does not match the checksum calculated.	<ol style="list-style-type: none"> 1. Cycle power to the drive. 2. If problem persists, replace drive.
Replaced MCB-PB	107	②	Main Control board was replaced and parameters were not programmed.	<ol style="list-style-type: none"> 1. Restore defaults. 2. Reprogram parameters.
Shear Pin	63	⑤	Programmed Current Lmt Val (148) has been exceeded. Enabled/disable with Fault Config 1 (238).	Check load requirements and Current Lmt Val (148) setting.

Table 13.6 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
SW OverCurrent	36	①	The drive output current has exceeded the software current.	Check for excess load, improper DC boost setting. DC brake volts set too high.
Trnsistr OvrTemp	9	①	Output transistors have exceeded their maximum operating temperature.	1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for NEMA Type 1 installations or 50°C (122°F) for Open type installations. 2. Check fan.
UnderVoltage	4	① ③	DC bus voltage fell below the minimum value of 375V DC at 575V input, 300V DC at 400/480V input or 160V DC at 200/240V input. Enable/disable with Fault Config 1(233).	Monitor the incoming AC line for low voltage or power interruption.
UserSet1 Chksum	101	②	The checksum read from the user set does not match the checksum calculated.	Re-save user set.
UserSet2 Chksum	102	②		
UserSet3 Chksum	103	②		

Table 13.7 – Fault Names Cross-Referenced by Fault Number

No. ¹	Fault	No. ¹	Fault	No. ¹	Fault
2	Function Loss	38	Phase U to Grnd	79	Excessive Load
3	Power Loss	39	Phase V to Grnd	80	AutoTune Aborted
4	UnderVoltage	40	Phase W to Grnd	81-86	Port 1-6 DPI Loss
5	OverVoltage	41	Phase UV Short	100	Parameter Chksum
7	Motor Overload	42	Phase VW Short	101	UserSet1 Chksum
8	Heatsink OvrTemp	43	Phase UW Short	102	UserSet2 Chksum
9	Trnsistr OvrTemp	48	Params Defaulted	103	UserSet3 Chksum
12	HW OverCurrent	63	Shear Pin	104	Pwr Brd Chksum1
13	Ground Fault	64	Drive Overload	105	Pwr Brd Chksum2
24	Decel Inhibit	69	DB Resistance	106	Incompat MCB-PB
25	OverSpeed Limit	70	Power Unit	107	Replaced MCB-PB
29	Analog In Loss	71-76	Port 1-6 Net Loss	108	Anlg Cal Chksum
33	Auto Rstrt Tries	77	IR Volts Range		
36	SW OverCurrent	78	FluxAmpsRef Rang		

¹ Fault numbers not listed are reserved for future use.

13.5 Test Point Codes and Functions

Table 13.8 – Test Point Codes and Functions

Code Selected in Testpoint x Sel (234, 236)	Function Whose Value is Displayed in Testpoint x Data (235, 237)
1	DPI Error Status
2	Heatsink Temperature
3	Active Current Limit
4	Active PWM Frequency
5	Lifetime MegaWatt Hours ¹
6	Lifetime Run Time
7	Lifetime Powered Up Time
8	Lifetime Power Cycles
9	Life MegaWatt Hours Fraction ¹
10	Life MegaWatt Hours Fraction Units ¹
11-99	Reserved for Factory Use

¹ Use the equation below to calculate total Lifetime MegaWatt Hours.

$$\left(\frac{\text{Value of Code 9}}{\text{Value of Code 10}} \times 0.1 \right) + \text{Value of Code 5} = \text{Total Lifetime MegaWatt Hours}$$

13.6 Common Symptoms and Corrective Actions

Table 13.9 – Drive Does Not Start From Start, Run, or Jog Inputs Wired to the Terminal Block

Indication(s)	Cause(s)	Corrective Action
Flashing red Ready LED.	Drive is faulted.	Clear fault: <ul style="list-style-type: none"> • Press OIM Stop key if that OIM is control source. • Cycle power. • Set Fault Clear (240) to 1. • Toggle terminal block stop or terminal block reset digital input if terminal block is the control source.
Incorrect operation from the terminal block.	Incorrect input wiring. <ul style="list-style-type: none"> • 2-wire control requires Run, Run Forward, or Run Reverse input(s). • 3-wire control requires Start and Stop inputs • Jumper from terminal 7 to 8 is required. 	Wire inputs correctly and/or install jumper.
	Incorrect digital input programming. <ul style="list-style-type: none"> • Mutually exclusive choices have been made. • 2-wire and 3-wire programming may be conflicting. • Exclusive functions (i.e., direction control) may have multiple inputs configured. • Stop if factory default and is not wired or is open. • Start or Run programming may be missing. 	Program Digital In"x" Sel (361-366) for correct inputs.
	Logic Source Sel is not set to Terminal Blk.	Set Logic Source Sel to Terminal Blk.

Table 13.9 – Drive Does Not Start From Start, Run, or Jog Inputs Wired to the Terminal Block (Continued)

Indication(s)	Cause(s)	Corrective Action
Incorrect operation from the terminal block. (cont'd)	Analog input does not work.	See Anlg In Config (320). Verify that correct terminals are used for configuration as voltage input or current input.
	Incorrect input logic wiring.	See Dig In Status diagnostic parameter (216). Verify that the input is detected properly.
Flashing yellow Ready LED and DigIn CflctB indication on LCD OIM. Drive Status 2 (210) shows type 2 alarm(s).	<p>Incorrect digital input programming.</p> <ul style="list-style-type: none"> • Mutually exclusive choices have been made. • 2-wire and 3-wire programming may be conflicting. • Exclusive functions (i.e., direction control) may have multiple inputs configured. • Stop if factory default and is not wired or is open. • Start or Run programming may be missing. 	<p>Program Digital In"x" Sel (361-366) to resolve conflicts.</p> <p>Remove multiple selections for the same function.</p> <p>Install stop button to apply a signal at stop terminal.</p> <p>Check start inhibit status in Start Inhibits (214).</p>

Table 13.10 – Drive Does Not Start or Jog From OIM

Indication	Cause(s)	Corrective Action
None	Drive is programmed for 2-wire control and Logic Source Sel (89) = All Ports. OIM start and network start are disabled for 2-wire control.	<p>If 2-wire control is required, no action is necessary.</p> <p>If 3-wire control is required, program Digital In"x" Sel (361-366) for correct inputs.</p>
Flashing or steady red Ready LED.	Active fault.	Reset fault.

Table 13.10 – Drive Does Not Start or Jog From OIM (Continued)

Indication	Cause(s)	Corrective Action
Flashing yellow Ready LED.	Enable input is open.	Close terminal block enable input.
	The terminal block stop input is open and control source is set to All Ports.	Close terminal block stop input.
	Start inhibit bits are set.	Check status in Start Inhibits (214).
Drive Status 1 (209) indicates logic control source.	Logic Source Sel (89) is not equal to the desired OIM (Local OIM, DPI Port 2, or DPI Port 3).	Verify setting of Logic Source Sel (89). The OIM Control digital input effectively sets the control source to the lowest attached OIM port.

Table 13.11 – Drive Does Not Respond to Changes in Speed Command

Indication	Cause(s)	Corrective Action
LCD OIM Status Line indicates “At Speed” and output is 0 Hz.	No value is coming from the source of the command.	<ol style="list-style-type: none"> 1. If the source is an analog input, check wiring and use a meter to check for presence of signal. 2. Check Commanded Freq (2) for correct source.
None	Incorrect reference source has been programmed.	<ol style="list-style-type: none"> 3. Check Speed Ref Source (213) for the source of the speed reference. 4. Reprogram Speed Ref A Sel (90) for correct source.
None	Incorrect reference source is being selected via remote device or digital inputs.	<ol style="list-style-type: none"> 5. Check Drive Status 1 (209), bits 12 - 15 for unexpected source selections. 6. Check Dig In Status (216) to see if inputs are selecting an alternate source. 7. Reprogram digital inputs to correct Speed Sel x option.

Table 13.12 – Drive Does Not Operate in Manual Mode

Indication	Cause(s)	Corrective Action
		Check Manual Mask (286) and Manual Owner (298) for logic verification and disabled source.

Table 13.13 – Motor and/or Drive Will Not Accelerate to Commanded Speed

Indication	Cause(s)	Corrective Action
Acceleration time is excessive.	Incorrect value in Accel Time "x" (140, 141).	Reprogram Accel Time "x" (140, 141).
Drive is forced into current limit, slowing or stopping acceleration.	Excess load or short acceleration time.	Check Drive Status 2 (210), bit 10 to see if the drive is in current limit. Remove excess load or reprogram Accel Time "x" (140, 141).
Speed command source or value is not as expected.	Improper speed command.	Check for the proper speed command using steps 1 through 7 in table 13.11.
Programming is preventing the drive output from exceeding limiting values.	Incorrect programming.	Check Maximum Speed (82) and Maximum Freq (55) to insure that speed is not limited by programming.

Table 13.14 – Motor Operation is Unstable

Indication	Cause(s)	Corrective Action
None	Motor data was incorrectly entered or autotune was not performed.	1. Correctly enter motor nameplate data. 2. Perform static or rotate autotune procedure (61).

Table 13.15 – Drive Will Not Reverse Motor Direction

Indication	Cause(s)	Corrective Action
None	Digital input is not selected for reversing control.	Check Digital In"x" Sel. Choose correct input and program for reverse.
	Digital input is incorrectly wired.	Check input wiring.
	Direction Mode (190) parameter is incorrectly programmed.	Reprogram Direction Mode (190) for analog bipolar or digital unipolar control.
	Motor wiring is improperly phased for reverse.	Switch two motor leads.
	A bipolar analog speed command input is incorrectly wired or signal is absent.	<ol style="list-style-type: none"> 1. Use meter to check that an analog input voltage is present. 2. Check wiring. Positive voltage commands forward direction. Negative voltage commands reverse direction.

Table 13.16 – Stopping the Drive Results in a Decel Inhibit Fault

Indication	Cause(s)	Corrective Action
Decel Inhibit fault screen. LCD status line indicates Faulted.	The bus regulation feature is enabled and is halting deceleration due to excessive bus voltage. Excess bus voltage is normally due to excessive regenerated energy or unstable AC line input voltages. Internal timer has halted drive operation.	<ol style="list-style-type: none"> 1. Reprogram bus regulation (parameters 161 and 162) to eliminate any Adjust Freq selection. 2. Disable bus regulation (parameters 161 and 162) and add a dynamic brake. 3. Correct AC input line instability or add an isolation transformer. 4. Reset drive.

13.7 Replacement Parts

Table 13.17 – OIM Cables

Description	Part Number
LCD OIM Cable for remote use	RECBL-LCD
LCD OIM Extender Cable (0.3 meter)	RECBL-F03
LCD OIM Extender Cable (1 meter)	RECBL-F10
LCD OIM Extender Cable (3 meters)	RECBL-F30
LCD OIM Extender Cable (9.0 meters)	RECBL-F90

Table 13.18 – NEMA 4 Covers

Description	Part Number
B-Frame Cover NEMA 4X/12	6SP4X-CVR-B
D-Frame Cover NEMA 4X/12	6SP4X-CVR-D
E-Frame Cover NEMA 4X	6SP4X-CVR-E
E-Frame Cover NEMA 12	6SP12-CVR-E

13.8 Troubleshooting the Drive Using the LCD OIM

The LCD OIM provides immediate visual notification of alarm or fault conditions as well as the following diagnostic information:

- Entries in the fault queue
- Fault parameters
- Drive status parameters
- List of parameters that have been changed from their default value
- Selected device version and status information
- OIM version information

13.8.1 Accessing the Fault Queue

As described in section 13.4.1, the drive automatically retains a history of the last four faults that have occurred in the fault queue.

To access the fault queue, press the F4 key at the process display screen, or see figure 13.4 to access the fault queue from the Main Menu.

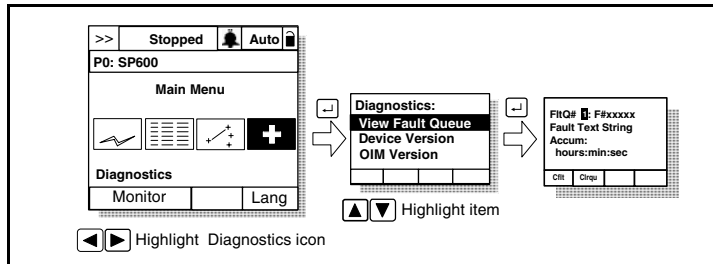


Figure 13.4 – Accessing the Fault Queue

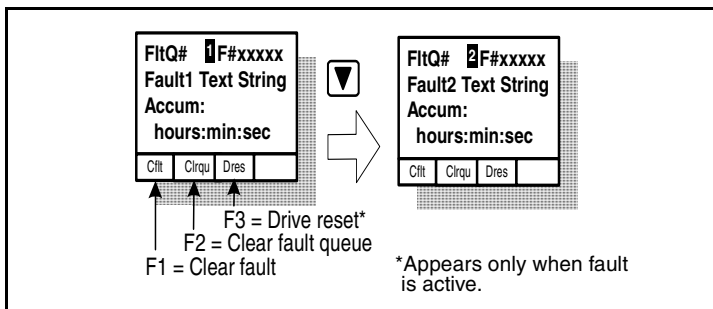


Figure 13.5 – Sample Fault Queue Entry

13.8.2 Accessing the Fault Parameters

The LCD OIM provides quick access to the drive's fault parameters by grouping them in the Fault Info submenu. To access these parameters, see figure 13.6.

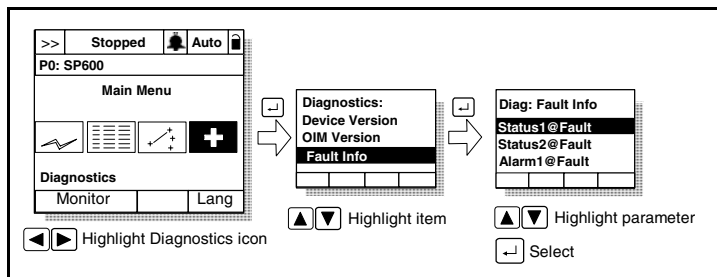


Figure 13.6 – Accessing the Fault Parameters

13.8.3 Accessing the Drive Status Parameters

The LCD OIM provides quick access to the drive status parameters by grouping them in the Status Info submenu. To access these parameters, see figure 13.7.

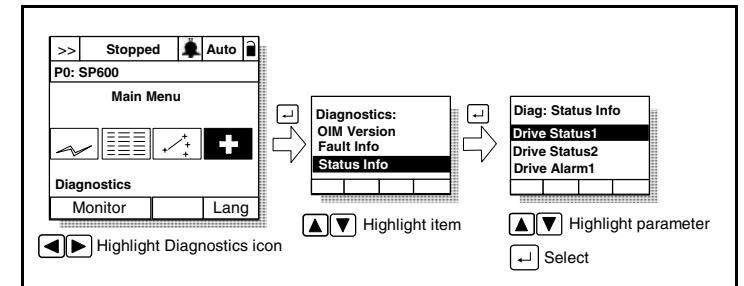


Figure 13.7 – Accessing the Drive Status Parameters

13.8.4 Accessing the List of Changed Parameters

The LCD OIM provides a list of parameters that have been changed from their default value. To access this list, refer to figure 13.8.

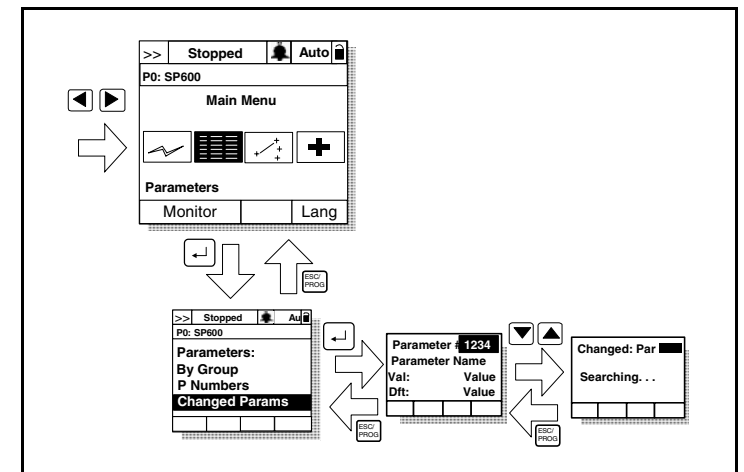


Figure 13.8 – Accessing the List of Changed Parameters

13.8.5 Determining the Product Version

The LCD OIM provides hardware and firmware version information for connected devices, including the OIM, down to the component level.

Device Version

To access the device version information, refer to figures 13.9 and 13.10.

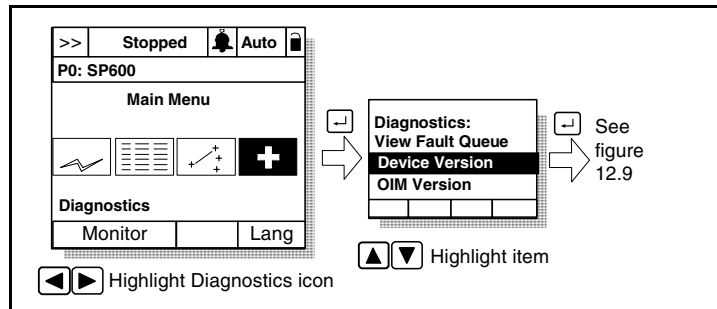


Figure 13.9 – Accessing the Device Version Information

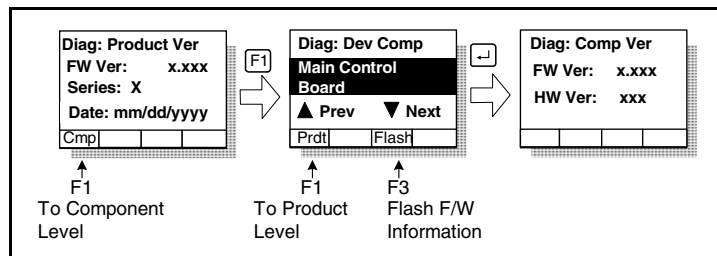


Figure 13.10 – Device Version Screens at Product and Component Levels

OIM Version

The OIM Version selection provides information on the OIM you are using to access this data. See figures 13.11 and 13.12.

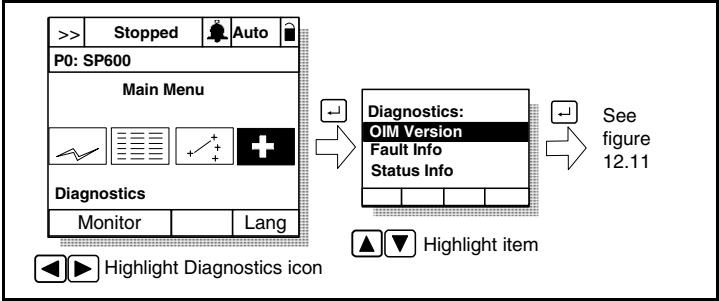


Figure 13.11 – Accessing the OIM Version Information

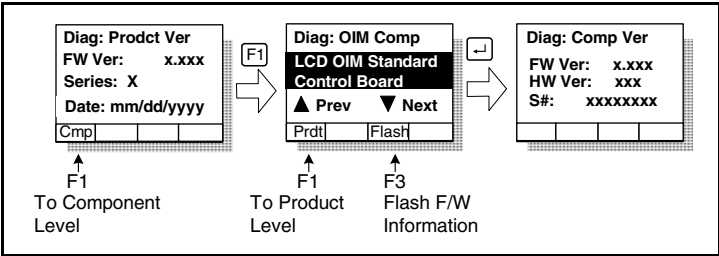


Figure 13.12 – OIM Version Screens at the Product and Component Levels

Device Items

The Device Items selection provides access to a list of diagnostic parameters. These parameters should be adjusted by qualified personnel only. See figure 13.13.

ATTENTION: The parameters in the Device Items menu must be set by a qualified person who understands the significance of setting them accurately. Failure to observe this precaution could result in bodily injury.

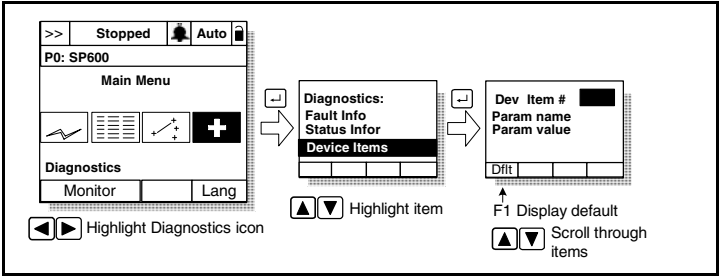


Figure 13.13 – Accessing the Device Item Information

13.8.6 Contacting Tech Support for Assistance





The Tech Support option in the Diagnostics menu provides information regarding technical support.

Technical Specifications

Table A.1 – Protection

	208V Drive	240V Drive	400V Drive	480V Drive	575V Drive
AC Input Overvoltage Trip	247 VAC	285 VAC	475 VAC	570 VAC	690 VAC
AC Input Undervoltage Trip	120 VAC	138 VAC	233 VAC	280 VAC	345 VAC
Bus Overvoltage Trip	350 VDC	405 VDC	675 VDC	810 VDC	1013 VDC
Bus Undervoltage Trip	160 VDC	160 VDC	300 VDC	300 VDC	375 VDC
Nominal Bus Voltage	281 VDC	324 VDC	540 VDC	648 VDC	810 VDC
All Drives					
Heat Sink Thermistor	Monitored by microprocessor overtemp trip				
Drive Overcurrent Trip Software Current Limit Hardware Current Limit Instantaneous Current Limit	20 to 160% of rated current 200% of rated current (typical) 220-300% of rated current (dependent on drive rating)				
Line transients	Up to 6000 volts peak per IEEE C62.41-1991				
Control Logic Noise Immunity	Showering arc transients up to 1500 V peak				
Power Ride-Thru	15 milliseconds at full load				
Logic Control Ride-Thru	0.5 seconds minimum, 2 seconds typical				
Ground Fault Trip	Phase-to-ground on drive output				
Short Circuit Trip	Phase-to-phase on drive output				

Table A.2 – Agency Certification

Type 1, IP30	Flange Type	Type 12, IP52	Type 4X/12, IP66	Certification
✓	✓	✓	✓	 Listed to UL508C and CAN/CSA-C2.2 No. 14-M91
	✓			Listed to UL508C for plenums (Rear heatsink only)
✓	✓	✓	✓	 Marked for all applicable European Directives EMC Directive (89/336/EEC) EN 61800-3 Adjustable Speed electrical power drive systems Low Voltage Directive (73/23/EEC) EN 50178 Electronic Equipment for use in Power Installations
✓	✓	✓	✓	 Certified to AS/NZS, 1997 Group 1, Class A
			✓	 Certified to Criteria C-2, 1983.
The drive is also designed to meet the appropriate portions of the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. IEC 146 - International Electrical Code.				

* Applied noise impulses may be counted in addition to the standard pulse train causing erroneously high (Pulse Freq) readings.

Important: SP600 AC drives rated for 575 VAC input do not comply with CE standards.

Table A.3 – Environment

Altitude	1000 m (3300 ft) max. without derating
Ambient Operating Temperature Without Derating: Open Type, IP20, IP54, NEMA Type 1, and Flange Mount: IP66 and NEMA Type 4X/12:	0 to 50°C (32 to 122°F) 0 to 40°C (32 to 104°F)
Storage Temperature (all const.)	-40 to 70°C (158°F)
Atmosphere	Important: Drive must not be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors, or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
Relative Humidity	5 to 95% non-condensing
Shock	15G peak for 11ms duration (±1.0 ms)
Vibration	0.152 mm (0.006 in.) displacement, 1G peak

Important: Removing the adhesive label from the drive changes the NEMA enclosure rating from Type 1 Enclosed to Open Type.

Table A.4 – Electrical

Voltage Tolerance	See table A.10 for Full Power and Operating Range.
Frequency Tolerance	47 to 63 Hz
Input Phases	Three-phase input provides full rating for all drives. Single-phase operation provides 50% of rated current.
Displacement Power Factor	0.98 across speed range
Efficiency	97.5% at rated amps, nominal line volts.
Maximum Short Circuit Rating	200,000 amps symmetrical.
Actual Short Circuit Rating	Determined by amps interrupting capacity (AIC) rating of installed fuse/circuit breaker.

Table A.5 – Control

Method	Sine-coded PWM with programmable carrier frequency. Ratings apply to all drives. The drive can be supplied as 6-pulse or 12-pulse in a configured package.
Carrier Frequency A to D Frame Drives	2, 4, 8, and 10 kHz. Drive rating based on 4 kHz.
Output Voltage Range	0 to rated motor voltage
Output Frequency Range	0 to 400 Hz.
Frequency Accuracy Digital Input Analog Input	Within $\pm 0.01\%$ of set output frequency. Within $\pm 0.4\%$ of maximum output frequency.
Selectable Motor Control	Sensorless vector with full tuning. Standard V/Hz with full custom capability.
Speed Regulation: Open Loop with Slip Compensation	$\pm 0.5\%$ of base speed across a 40:1 speed range.
Stop Modes	Multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.
Accel/Decel	Two independently programmable accel and decel times. Each time may be programmed from 0 to 3600 seconds in 0.1 second increments.
Intermittent Overload	110% overload capability for up to 1 minute. 150% overload capability for up to 3 seconds.
Current Limit Capability	Proactive Current Limit programmable from 20 to 160% of rated output current. Independently programmable proportional and integral gain.

Table A.5 – Control (Continued)

Electronic Motor Overload Protection	Class 10 protection with speed-sensitive response. Investigated by U.L. to comply with N.E.C. Article 430. U.L. File E59272, volume 12.
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Table A.6 – Control Inputs, Outputs, and Power Supplies

Analog Input 1, Differential Voltage Input Signal level Differential Input resistance Isolation Initial accuracy (@25°C) Resolution Input processing period Terminal block size Protection	0 to +10V 60kΩ ±17V ±0.3% 10 bits (0.1%) 5ms 0.05 mm ² to 1.5 mm ² (30 AWG to 16 AWG) ESD protected (6 kV contact discharge, 8 kV air discharge)
Analog Input 1, Differential Current Input Signal level Differential Input resistance Isolation Initial accuracy (@25°C) Resolution Input processing period Terminal block size Protection	0(4) to 20mA 100Ω ±9V ±0.3% 10 bits (0.1%) 5ms 0.05 mm ² to 1.5 mm ² (30 AWG to 16 AWG) ESD protected (6 kV contact discharge, 8 kV air discharge)
Analog Input 2, Differential Voltage Input Signal level Differential Input resistance Isolation Initial accuracy (@25°C) Resolution Common Mode Rejection Ratio Input processing period Terminal block size Protection	-10V to +10V 88kΩ ±165V ±0.3% 10 bits (0.1%) 70dB up to 500Hz over temperature range 5ms 0.05 mm ² to 1.5 mm ² (30 AWG to 16 AWG) ESD protected (6 kV contact discharge, 8 kV air discharge)

Table A.6 – Control Inputs, Outputs, and Power Supplies (Continued)

<p>Analog Input 2, Differential Current Input Signal level Differential Input resistance Isolation Initial accuracy (@25°C) Resolution Common Mode Rejection Ratio Input processing period Terminal block size Protection</p>	<p>0(4)-20mA 100Ω ±165V ±0.3% 10 bits (0.1%) 70dB up to 500Hz over temp range 5ms 0.05 mm² to 1.5 mm² (30 AWG to 16 AWG) ESD protected (6 kV contact discharge, 8 kV air discharge)</p>
<p>Analog Output Analog output voltage range Loading impedance Accuracy over temperature range Resolution Frequency of output waveform Output processing period Terminal block size Protection</p>	<p>0 to +10V 2kΩ minimum ±2.35% maximum 10 bits (0.1%) 160Hz maximum 5ms 0.05 mm² to 1.5 mm² (30 AWG to 16 AWG) Short circuit proof, ESD protected (6 kV contact discharge, 8 kV air discharge)</p>
<p>Reference Power Supply Output Voltage Potentiometer resistance range Accuracy over temperature range Terminal block size Protection</p>	<p>10V 2kΩ to 10kΩ ±2.35% maximum 0.05 mm² to 1.5 mm² (30 AWG to 16 AWG) Short circuit proof, ESD protected (6 kV contact discharge, 8 kV air discharge)</p>
<p>24V Power Supply Output Voltage Output Current Isolation Terminal block size Protection</p>	<p>24V to 28V 150mA maximum ±25V 0.05 mm² to 1.5 mm² (30 AWG to 16 AWG) Short circuit proof, ESD protected (6 kV contact discharge, 8 kV air discharge)</p>

Table A.6 – Control Inputs, Outputs, and Power Supplies (Continued)

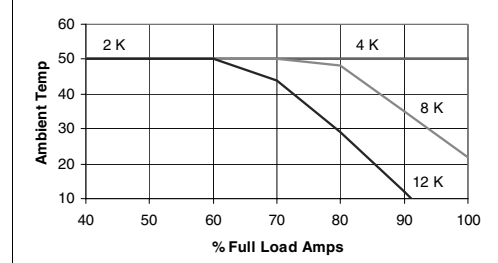
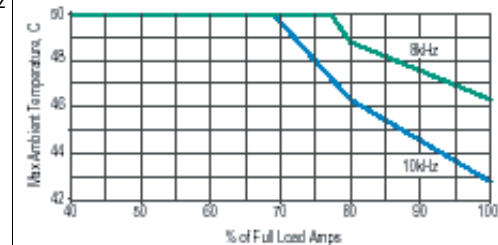
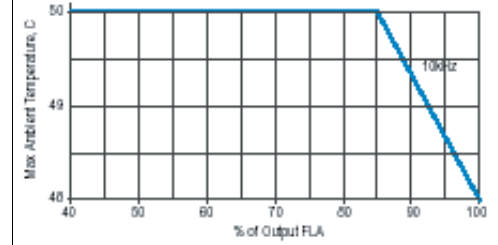
<p>Six Digital Inputs</p> <p>Input voltage Logic thresholds</p> <p>Input resistance Isolation Assertion response (hardware only) Negation response (hardware only) Terminal block size</p> <p>Protection</p>	<p>24V (nominal) logic 0: $V_{in} < 3.2V$; logic 1: $V_{in} > 19.2V$</p> <p>2kΩ $\pm 25V$ 9ms maximum 1ms maximum 0.05 mm² to 1.5 mm² (30 AWG to 16 AWG)</p> <p>Short circuit proof, ESD protected (6 kV contact discharge, 8 kV air discharge)</p>
<p>Two Form C Relay Outputs</p> <p>Maximum Contact Voltage Contact rating for resistive loads Contact switching for resistive loads Contact rating for inductive loads Contact switching for inductive loads Isolation test voltage Terminal block size</p> <p>Protection</p>	<p>250VAC, 220VDC 0.40 A at 125 VAC, 2 A at 30 VDC</p> <p>50 VA, 60 W 0.20 A at 125 VAC, 1 A at 30 VDC 25 VA, 30 W 1900VDC for one minute 0.05 mm² to 1.5 mm² (30 AWG to 16 AWG)</p> <p>Short circuit proof, ESD protected (6 kV contact discharge, 8 kV air discharge)</p>

Table A.7 – Derating Guidelines: SP600 Altitude and Efficiency

Frame	Type	Derate
All	Altitude	
	Efficiency (typical)	

Table A.8 – Derating Guidelines:- SP600 Ambient Temperature/Load

Frame	Class	Enclosure	Freq	Derate
A	400V	Open, NEMA Type 1, IP20, Flange	2-10 kHz	None
B	400V	Open, NEMA Type 1, IP20, Flange	2-10 kHz	None
C	400V	NEMA Type 1, Flange	2-8 kHz	None
			10 kHz	
D	400V	NEMA Type 1, Flange NEMA Type 4X/12 [†]	2-6 kHz	None
			8-10 kHz	
E		NEMA Type 1, Flange NEMA Type 4X/12 [†]	2-4 kHz	None
			6-12 kHz	



* NEMA Type 4X/12 D frame drives have a maximum ambient of 40 degrees C.

† NEMA Type 4X/12 D frame drives have a maximum ambient of 40 degrees C.

Table A.9 – Maximum Motor Lead Lengths

480 V Drive HP	Carrier Freq. (kHz)	1000 V Motor		1200 V Motor		1488 V Motor NEMA MG-1 1988		1600 V Motor	
		Cable Type							
		Shielded	Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded	Unshielded
0.5	2	60	40	175*	60	175*	150*	175*	150*
	4	60	40	175*	60	175*	130	175*	150*
	6	60	40	175*	60	175*	130	175*	150*
	8	60	40	175*	50	175*	130	175*	150*
	10	60	40	175*	50	175*	130	175*	150*
1	2	70	30	275*	55	275*	180	275*	350*
	4	70	30	250*	55	250*	180	250*	300*
	6	70	30	250*	55	250*	170	250*	280
	8	70	30	250*	55	250*	160	250*	260
	10	70	30	200	55	250*	160	250*	240
2	2	70	40	275*	75	275*	500*	275*	500*
	4	70	40	250*	75	250*	400*	250*	400*
	6	70	40	250*	75	250*	360	250*	400*
	8	70	40	240	75	250*	260	250*	400*
	10	70	40	220	75	250*	260	250*	400*
3	2	70	40	220	75	425*	600	425*	600
	4	70	40	220	75	400*	520	400*	600
	6	70	40	220	75	425*	520	425*	600
	8	70	40	220	75	400*	380	400*	600
	10	70	40	220	75	400*	380	400*	600
5	2	80	40	280	80	450*	600	450*	600
	4	80	40	280	80	400*	600	400*	600
	6	80	40	280	80	400*	560	400*	600
	8	80	40	280	80	300*	400	300*	600
	10	80	40	280	80	300*	360	300*	600
7.5	2	50	40	300	60	400*	600	400*	600
	4	50	40	300	60	400*	600	400*	600
	6	50	40	300	60	400*	520	400*	600
	8	50	40	300	60	400*	400	400*	600
	10	50	40	300	60	300*	320	300*	600
10	2	50	40	300	60	400*	600	400*	600
	4	50	40	300	60	400*	600	400*	600
	6	50	40	300	60	400*	560	400*	600
	8	50	40	300	60	400*	400	400*	600
	10	50	40	300	60	300*	380	300*	600
15	2	80	50	600	80	600	600	600	600
	4	80	50	400	80	600	600	600	600
	6	80	50	400	80	600	600	600	600
	8	80	50	400	80	600	500	600	600
	10	80	50	400	80	600	400	600	600
20	2	70	50	600	80	600	600	600	600
	4	70	50	400	80	600	600	600	600
	6	70	50	200	80	600	600	600	600
	8	70	50	160	80	600	600	600	600
	10	70	50	160	80	600	340	600	600
25	2	70	50	600	80	600	600	600	600
	4	70	50	400	80	600	600	600	600
	6	70	50	200	80	600	600	600	600
	8	70	50	160	80	600	600	600	600
	10	70	50	160	80	600	340	600	600

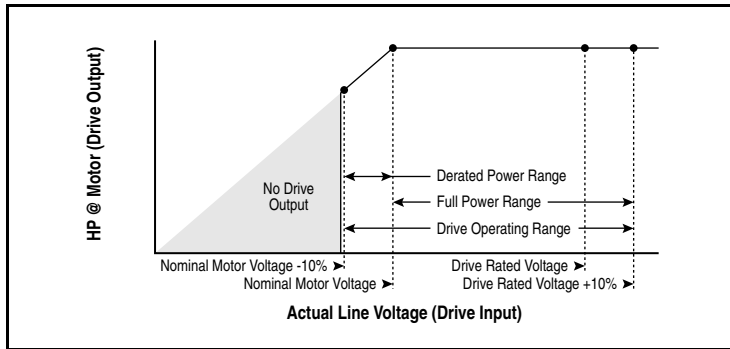
Table A.9 – Maximum Motor Lead Lengths

480 V Drive HP	Carrier Freq. (kHz)	1000 V Motor		1200 V Motor		1488 V Motor NEMA MG-1 1988		1600 V Motor	
		Cable Type							
		Shielded	Unshielded	Shielded	Unshielded	Shielded	Unshielded	Shielded	Unshielded
30	2	70	50	600	80	600	600	600	600
	4	70	50	400	80	600	600	600	600
	6	70	50	200	80	600	600	600	600
	8	70	50	160	80	600	600	600	600
	10	70	50	160	80	600	340	600	600
40	2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	4	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	6	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	8	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	10	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
50	2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	4	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	6	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	8	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	10	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

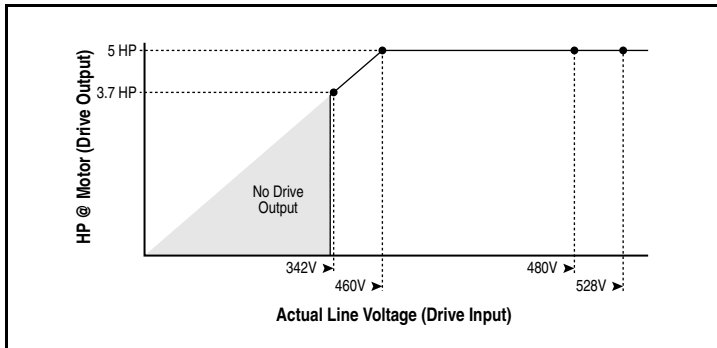
* Lead length limited due to cable charging current.

Table A.10 – Drive Output Power vs. Voltage Input

Drive Rating	Nominal Line Voltage	Nominal Motor Voltage	Drive Full Power Range (Vin)	Drive Operating Range (Vin)
200-240	200	200 [†]	200-264	180-264
	208	208	208-264	
	240	230	230-264	
380-400	380	380 [†]	380-528	342-528
	400	400	400-528	
	480	460	460-528	
500-600	600	575 [†]	575-660	432-660
Drive Full Power Range = Nominal Motor Voltage to Drive Rated Voltage + 10%. Rated current is available across the entire Drive Full Power Voltage Range				
[†] Drive Operating Range = Lowest Nominal Motor Voltage - 10% to Drive Rated Voltage + 10%. Drive Output is linearly derated when Actual Line Voltage is less than the Nominal Motor Voltage				



Example:



Calculate the maximum power of a 5 HP, 460V motor connected to a 480V rated drive supplied with 342V Actual Line Voltage input.

- Actual Line Voltage / Nominal Motor Voltage = $342/460 \times 100\% = 74.3\%$
- $74.3\% \times 5 \text{ HP} = 3.7 \text{ HP}$
- $74.3\% \times 60 \text{ Hz} = 44.6 \text{ Hz}$

At 342V Actual Line Voltage, the maximum power the 5 HP, 460V motor can produce is 3.7 HP at 44.6 Hz.

Parameters Cross-Referenced by Name

The following table lists the complete set of SP600 parameters in alphabetical order.

Parameter Name	No.	Path (File>Group)	Page No.
Accel Time 1	140	Dynamic Control>Ramp Rates	12-37
Accel Time 2	141	Dynamic Control>Ramp Rates	12-37
Alarm 1 @ Fault	229	Utility>Diagnostics	12-69
Alarm 2 @ Fault	230	Utility>Diagnostics	12-69
Alarm Config 1	259	Utility>Alarms	12-72
Analog In 1 Hi	322	Inputs & Outputs>Analog Inputs	12-81
Analog In 1 Lo	323	Inputs & Outputs>Analog Inputs	12-82
Analog In 1 Loss	324	Inputs & Outputs>Analog Inputs	12-82
Analog In 2 Hi	325	Inputs & Outputs>Analog Inputs	12-83
Analog In 2 Lo	326	Inputs & Outputs>Analog Inputs	12-83
Analog In 2 Loss	327	Inputs & Outputs>Analog Inputs	12-84
Analog In1 Value	16	Monitor>Metering	12-7
Analog In2 Value	17	Monitor>Metering	12-7
Analog Out1 Hi	343	Inputs & Outputs>Analog Outputs	12-86
Analog Out1 Lo	344	Inputs & Outputs>Analog Outputs	12-86
Analog Out1 Sel	342	Inputs & Outputs>Analog Outputs	12-85
Anlg In Config	320	Inputs & Outputs>Analog Inputs	12-79
Anlg In Sqr Root	321	Inputs & Outputs>Analog Inputs	12-80
Anlg Out Absolut	341	Inputs & Outputs>Analog Outputs	12-85
Auto Rstrt Delay	175	Dynamic Control>Stop/Restart Modes	12-51
Auto Rstrt Tries	174	Dynamic Control>Stop/Restart Modes	12-50
Autotune	61	Motor Control>Torq Attributes	12-15

Parameter Name	No.	Path (File>Group)	Page No.
Break Frequency	72	Motor Control>Volts per Hertz	12-17
Break Voltage	71	Motor Control>Volts per Hertz	12-17
Bus Reg Gain	160	Dynamic Control>Stop/Brake Modes	12-44
Bus Reg Mode A	161	Dynamic Control>Stop/Brake Modes	12-45
Bus Reg Mode B	162	Dynamic Control>Stop/Brake Modes	12-45
CarrierFrequency	151	Dynamic Control>Load Limits	12-39
Commanded Freq	2	Monitor>Metering	12-5
Compensation	56	Motor Control>Torq Attributes	12-14
Control SW Ver	29	Monitor>Drive Data	12-8
Current Lmt Gain	149	Dynamic Control>Load Limits	12-39
Current Lmt Sel	147	Dynamic Control>Ramp Rates	12-38
Current Lmt Val	148	Dynamic Control>Load Limits	12-39
Data In A1 - Link A Word 1	300	Communication>Datalinks	12-76
Data In A2 - Link A Word 2	301	Communication>Datalinks	12-76
Data In B1 - Link B Word 1	302	Communication>Datalinks	12-76
Data In B2 - Link B Word 2	303	Communication>Datalinks	12-76
Data In C1 - Link C Word 1	304	Communication>Datalinks	12-77
Data In C2 - Link C Word 2	305	Communication>Datalinks	12-77
Data In D1 - Link D Word 1	306	Communication>Datalinks	12-77
Data In D2 - Link D Word 2	307	Communication>Datalinks	12-77
Data Out A1 - Link A Word 1	310	Communication>Datalinks	12-78
Data Out A2 - Link A Word 2	311	Communication>Datalinks	12-78
Data Out B1 - Link B Word 1	312	Communication>Datalinks	12-78
Data Out B2 - Link B Word 2	313	Communication>Datalinks	12-78
Data Out C1 - Link C Word 1	314	Communication>Datalinks	12-78
Data Out C2 - Link C Word 2	315	Communication>Datalinks	12-78
Data Out D1 - Link D Word 1	316	Communication>Datalinks	12-79
Data Out D2 - Link D Word 2	317	Communication>Datalinks	12-79
DB Resistor Type	163	Dynamic Control>Stop/Brake Modes	12-46
DC Brake Level	158	Dynamic Control>Stop/Brake Modes	12-43
DC Brake Lvl Sel	157	Dynamic Control>Stop/Brake Modes	12-43
DC Brake Time	159	Dynamic Control>Stop/Brake Modes	12-44
DC Bus Memory	13	Monitor>Metering	12-7
DC Bus Voltage	12	Monitor>Metering	12-7
Decel Time 1	142	Dynamic Control>Ramp Rates	12-38
Decel Time 2	143	Dynamic Control>Ramp Rates	12-38

Parameter Name	No.	Path (File>Group)	Page No.
Dig In Status	216	Utility>Diagnostics Inputs & Outputs>Digital Inputs	12-65
Dig Out Status	217	Utility>Diagnostics Inputs & Outputs>Digital Outputs	12-66
Dig Out1 Level	381	Inputs & Outputs>Digital Outputs	12-97
Dig Out1 OffTime	383	Inputs & Outputs>Digital Outputs	12-97
Dig Out1 OnTime	382	Inputs & Outputs>Digital Outputs	12-97
Dig Out2 Level	385	Inputs & Outputs>Digital Outputs	12-100
Dig Out2 OffTime	387	Inputs & Outputs>Digital Outputs	12-101
Dig Out2 OnTime	386	Inputs & Outputs>Digital Outputs	12-100
Digital In1 Sel	361	Inputs & Outputs>Digital Inputs	12-87
Digital In2 Sel	362	Inputs & Outputs>Digital Inputs	12-87
Digital In3 Sel	363	Inputs & Outputs>Digital Inputs	12-87
Digital In4 Sel	364	Inputs & Outputs>Digital Inputs	12-87
Digital In5 Sel	365	Inputs & Outputs>Digital Inputs	12-87
Digital In6 Sel	366	Inputs & Outputs>Digital Inputs	12-87
Digital Out1 Sel	380	Inputs & Outputs>Digital Outputs	12-95
Digital Out2 Sel	384	Inputs & Outputs>Digital Outputs	12-98
Direction Mode	190	Utility>Direction Config	12-53
Drive Alarm 1	211	Utility>Diagnostics Utility>Alarms	12-63
Drive Alarm 2	212	Utility>Diagnostics Utility>Alarms	12-63
Drive Checksum	203	Utility>Drive Memory	12-58
Drive Logic Rslt	271	Communication>Comm Control	12-73
Drive OL Count	219	Utility>Diagnostics	12-66
Drive OL Mode	150	Dynamic Control>Load Limits	12-39
Drive Ramp Rslt	273	Communication>Comm Control	12-74
Drive Ref Rslt	272	Communication>Comm Control	12-73
Drive Status 1	209	Utility>Diagnostics	12-61
Drive Status 2	210	Utility>Diagnostics	12-62
Drive Temp	218	Utility>Diagnostics	12-66
Dyn UserSet Cnfg	204	Utility>Drive Memory	12-59
Dyn UserSet Actv	206	Utility>Drive Memory	12-60
DynUsrSetSel	205	Utility>Drive Memory	12-59
Elapsed MWh	9	Monitor>Metering	12-6
Elapsed Run Time	10	Monitor>Metering	12-6

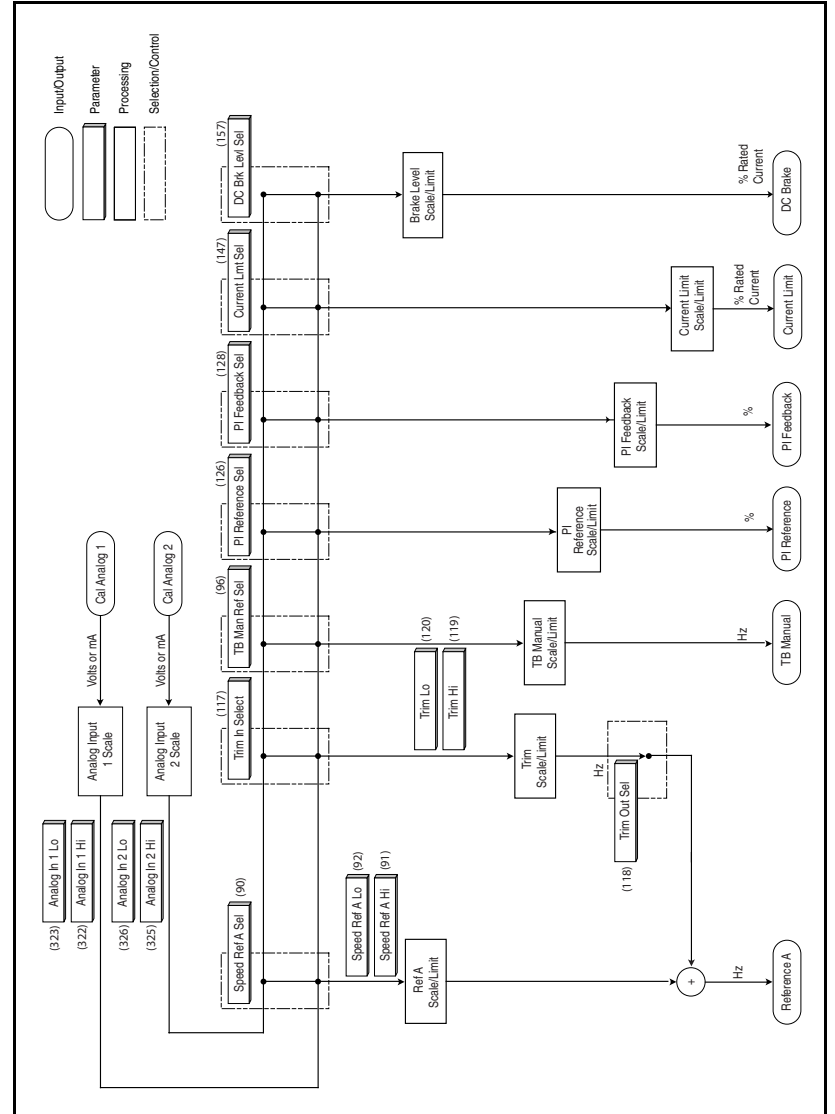
Parameter Name	No.	Path (File>Group)	Page No.
Fault Amps	225	Utility>Diagnostics	12-67
Fault Bus Volts	226	Utility>Diagnostics	12-67
Fault Clear	240	Utility>Faults	12-71
Fault Clear Mode	241	Utility>Faults	12-71
Fault Config 1	238	Utility>Faults	12-71
Fault Frequency	224	Utility>Diagnostics	12-67
Flux Current	5	Monitor>Metering	12-5
Flux Current Ref	63	Motor Control>Torq Attributes	12-16
Flux Up Mode	57	Motor Control>Torq Attributes	12-14
Flux Up Time	58	Motor Control>Torq Attributes	12-15
Flying Start En	169	Dynamic Control>Stop/Restart Modes	12-49
Flying StartGain	170	Dynamic Control>Stop/Restart Modes	12-49
IR Voltage Drop	62	Motor Control>Torq Attributes	12-16
Jog Speed	100	Speed Command>Discrete Speeds	12-26
Language	201	Utility>Drive Memory	12-58
Last Stop Source	215	Utility>Diagnostics	12-65
LevelSense Start	168	Dynamic Control>Stop/Restart Modes	12-48
Load Frm Usr Set	198	Utility>Drive Memory	12-57
Logic Source Sel	89	Speed Command>Control Src Select	12-21
Man Ref Preload	193	Utility>OIM Ref Config	12-54
Manual Mask	286	Communication>Masks & Owners	12-74
Manual Owner	298	Communication>Masks & Owners	12-75
Maximum Freq	55	Motor Control>Torq Attributes	12-13
Maximum Speed	82	Speed Command>Spd Mode & Limits	12-19
Maximum Voltage	54	Motor Control>Torq Attributes	12-13
Minimum Speed	81	Speed Command>Spd Mode & Limits	12-13
MOP Frequency	11	Monitor>Metering	12-7
MOP Rate	195	Utility>MOP Config	12-55
Motor NP FLA	42	Motor Control>Motor Data	12-9
Motor NP Hertz	43	Motor Control>Motor Data	12-10
Motor NP Power	45	Motor Control>Motor Data	12-10
Motor NP RPM	44	Motor Control>Motor Data	12-10
Motor NP Volts	41	Motor Control>Motor Data	12-9
Motor OL Count	220	Utility>Diagnostics	12-65
Motor OL Factor	48	Motor Control>Motor Data	12-11
Motor OL Hertz	47	Motor Control>Motor Data	12-11

Parameter Name	No.	Path (File>Group)	Page No.
Motor Type	40	Motor Control>Motor Data	12-8
Mtr NP Pwr Units	46	Motor Control>Motor Data	12-10
Output Current	3	Monitor>Metering	12-5
Output Freq	1	Monitor>Metering	12-5
Output Power	7	Monitor>Metering	12-6
Output Powr Fctr	8	Monitor>Metering	12-6
Output Voltage	6	Monitor>Metering	12-6
Overspeed Limit	83	Speed Command>Spd Mode & Limits	12-19
Param Access Lvl	196	Utility>Drive Memory	12-56
PI Configuration	124	Speed Command>Process PI	12-30
PI Control	125	Speed Command>Process PI	12-31
PI Error Meter	137	Speed Command>Process PI	12-37
PI Fdback Meter	136	Speed Command>Process PI	12-37
PI Feedback Sel	128	Speed Command>Process PI	12-34
PI Integral Time	129	Speed Command>Process PI	12-34
PI Lower Limit	131	Speed Command>Process PI	12-35
PI Output Meter	138	Speed Command>Process PI	12-37
PI Preload	133	Speed Command>Process PI	12-35
PI Prop Gain	130	Speed Command>Process PI	12-34
PI Ref Meter	135	Speed Command>Process PI	12-36
PI Reference Sel	126	Speed Command>Process PI	12-33
PI Setpoint	127	Speed Command>Process PI	12-33
PI Status	134	Speed Command>Process PI	12-36
PI Upper Limit	132	Speed Command>Process PI	12-35
Power Loss Mode	184	Dynamic Control>Stop/Power Loss	12-52
Power Loss Time	185	Dynamic Control>Stop/Power Loss	12-52
Power Up Marker	242	Utility>Faults	12-72
Preset Speed 1	101	Speed Command>Discrete Speeds	12-26
Preset Speed 2	102	Speed Command>Discrete Speeds	12-26
Preset Speed 3	103	Speed Command>Discrete Speeds	12-26
Preset Speed 4	104	Speed Command>Discrete Speeds	12-26
Preset Speed 5	105	Speed Command>Discrete Speeds	12-26
Preset Speed 6	106	Speed Command>Discrete Speeds	12-26
Preset Speed 7	107	Speed Command>Discrete Speeds	12-26
Rated Amps	28	Monitor>Drive Data	12-8
Rated kW	26	Monitor>Drive Data	12-8

Parameter Name	No.	Path (File>Group)	Page No.
Rated Volts	27	Monitor>Drive Data	12-8
Reset Meters	200	Utility>Drive Memory	12-57
Reset To Defaults	197	Utility>Drive Memory	12-56
Run Boost	70	Motor Control>Volts per Hertz	12-17
S Curve %	146	Dynamic Control>Ramp Rates	12-38
Save MOP Ref	194	Utility>MOP Config	12-55
Save OIM Ref	192	Utility>OIM Ref Config	12-54
Save To User Set	199	Utility>Drive Memory	12-57
Skip Freq Band	87	Speed Command>Spd Mode & Limits	12-20
Skip Frequency 1	84	Speed Command>Spd Mode & Limits	12-20
Skip Frequency 2	85	Speed Command>Spd Mode & Limits	12-20
Skip Frequency 3	86	Speed Command>Spd Mode & Limits	12-20
Slip Comp Gain	122	Speed Command>Slip Comp	12-29
Slip RPM @ FLA	121	Speed Command>Slip Comp	12-29
Slip RPM Meter	123	Speed Command>Slip Comp	12-29
Speed Mode	80	Speed Command>Spd Mode & Limits	12-18
Speed Ref A Hi	91	Speed Command>Speed References	12-24
Speed Ref A Lo	92	Speed Command>Speed References	12-25
Speed Ref A Sel	90	Speed Command>Control Src Select Speed Command>Speed References	12-23
Speed Ref Source	213	Utility>Diagnostics	12-64
Start Inhibits	214	Utility>Diagnostics	12-64
Start/Acc Boost	69	Motor Control>Volts per Hertz	12-17
Status 1 @ Fault	227	Utility>Diagnostics	12-68
Status 2 @ Fault	228	Utility>Diagnostics	12-68
Stop Mode A	155	Dynamic Control>Stop/Brake Modes	12-40
Stop Mode B	156	Dynamic Control>Stop/Brake Modes	12-40
Stop Owner	288	Communication>Masks & Owners	12-75
TB Man Ref Hi	97	Speed Command>Speed References	12-25
TB Man Ref Lo	98	Speed Command>Speed References	12-26
TB Man Ref Sel	96	Speed Command>Speed References	12-25
Testpoint 1 Data	235	Utility>Diagnostics	12-70
Testpoint 1 Sel	234	Utility>Diagnostics	12-70
Testpoint 2 Data	237	Utility>Diagnostics	12-70
Testpoint 2 Sel	236	Utility>Diagnostics	12-70
Torque Current	4	Monitor>Metering	12-5

Parameter Name	No.	Path (File>Group)	Page No.
Torque Perf Mode	53	Motor Control>Torq Attributes	12-12
Trim Hi	119	Speed Command>Speed Trim	12-28
Trim In Select	117	Speed Commands>Speed Trim	12-27
Trim Lo	120	Speed Command>Speed Trim	12-28
Trim Out Select	118	Speed Command>Speed Trim	12-28
Voltage Class	202	Utility>Drive Memory	12-58

Analog Input Selection Path



APPENDIX E

Record of User Settings

No.	Parameter Name	Path (File>Group)	Setting
40	Motor Type	Motor Control>Motor Data	
41	Motor NP Volts	Motor Control>Motor Data	
42	Motor NP FLA	Motor Control>Motor Data	
43	Motor NP Hertz	Motor Control>Motor Data	
44	Motor NP RPM	Motor Control>Motor Data	
45	Motor NP Power	Motor Control>Motor Data	
46	Mtr NP Pwr Units	Motor Control>Motor Data	
47	Motor OL Hertz	Motor Control>Motor Data	
48	Motor OL Factor	Motor Control>Motor Data	
53	Torque Perf Mode	Motor Control>Torq Attributes	
54	Maximum Voltage	Motor Control>Torq Attributes	
55	Maximum Freq	Motor Control>Torq Attributes	
56	Compensation	Motor Control>Torq Attributes	
57	Flux Up Mode	Motor Control>Torq Attributes	
58	Flux Up Time	Motor Control>Torq Attributes	
61	Autotune	Motor Control>Torq Attributes	
62	IR Voltage Drop	Motor Control>Torq Attributes	
63	Flux Current Ref	Motor Control>Torq Attributes	
69	Start/Acc Boost	Motor Control>Volts per Hertz	
70	Run Boost	Motor Control>Volts per Hertz	
71	Break Voltage	Motor Control>Volts per Hertz	
72	Break Frequency	Motor Control>Volts per Hertz	
80	Speed Mode	Speed Command>Spd Mode & Limits	
81	Minimum Speed	Speed Command>Spd Mode & Limits	

No.	Parameter Name	Path (File>Group)	Setting
82	Maximum Speed	Speed Command>Spd Mode & Limits	
83	Overspeed Limit	Speed Command>Spd Mode & Limits	
84	Skip Frequency 1	Speed Command>Spd Mode & Limits	
85	Skip Frequency 2	Speed Command>Spd Mode & Limits	
86	Skip Frequency 3	Speed Command>Spd Mode & Limits	
87	Skip Freq Band	Speed Command>Spd Mode & Limits	
89	Logic Source Sel	Speed Command>Control Src Select	
90	Speed Ref A Sel	Speed Command>Control Src Select Speed Command>Speed References	
91	Speed Ref A Hi	Speed Command>Speed References	
92	Speed Ref A Lo	Speed Command>Speed References	
96	TB Man Ref Sel	Speed Command>Speed References	
97	TB Man Ref Hi	Speed Command>Speed References	
98	TB Man Ref Lo	Speed Command>Speed References	
100	Jog Speed	Speed Command>Discrete Speeds	
101	Preset Speed 1	Speed Command>Discrete Speeds	
102	Preset Speed 2	Speed Command>Discrete Speeds	
103	Preset Speed 3	Speed Command>Discrete Speeds	
104	Preset Speed 4	Speed Command>Discrete Speeds	
105	Preset Speed 5	Speed Command>Discrete Speeds	
106	Preset Speed 6	Speed Command>Discrete Speeds	
107	Preset Speed 7	Speed Command>Discrete Speeds	
117	Trim In Select	Speed Commands>Speed Trim	
118	Trim Out Select	Speed Command>Speed Trim	
119	Trim Hi	Speed Command>Speed Trim	
120	Trim Lo	Speed Command>Speed Trim	
121	Slip RPM @ FLA	Speed Command>Slip Comp	

No.	Parameter Name	Path (File>Group)	Setting
122	Slip Comp Gain	Speed Command>Slip Comp	
123	Slip RPM Meter	Speed Command>Slip Comp	
124	PI Configuration	Speed Command>Process PI	
125	PI Control	Speed Command>Process PI	
126	PI Reference Sel	Speed Command>Process PI	
127	PI Setpoint	Speed Command>Process PI	
128	PI Feedback Sel	Speed Command>Process PI	
129	PI Integral Time	Speed Command>Process PI	
130	PI Prop Gain	Speed Command>Process PI	
131	PI Lower Limit	Speed Command>Process PI	
132	PI Upper Limit	Speed Command>Process PI	
133	PI Preload	Speed Command>Process PI	
140	Accel Time 1	Dynamic Control>Ramp Rates	
141	Accel Time 2	Dynamic Control>Ramp Rates	
142	Decel Time 1	Dynamic Control>Ramp Rates	
143	Decel Time 2	Dynamic Control>Ramp Rates	
146	S Curve %	Dynamic Control>Ramp Rates	
147	Current Lmt Sel	Dynamic Control>Ramp Rates	
148	Current Lmt Val	Dynamic Control>Load Limits	
149	Current Lmt Gain	Dynamic Control>Load Limits	
150	Drive OL Mode	Dynamic Control>Load Limits	
151	CarrierFrequency	Dynamic Control>Load Limits	
155	Stop Mode A	Dynamic Control>Stop/Brake Modes	
156	Stop Mode B	Dynamic Control>Stop/Brake Modes	
157	DC Brake Lvl Sel	Dynamic Control>Stop/Brake Modes	
158	DC Brake Level	Dynamic Control>Stop/Brake Modes	
159	DC Brake Time	Dynamic Control>Stop/Brake Modes	
160	Bus Reg Gain	Dynamic Control>Stop/Brake Modes	
161	Bus Reg Mode A	Dynamic Control>Stop/Brake Modes	
162	Bus Reg Mode B	Dynamic Control>Stop/Brake Modes	

No.	Parameter Name	Path (File>Group)	Setting
163	DB Resistor Type	Dynamic Control>Stop/Brake Modes	
168	LevelSense Start	Dynamic Control>Stop/Restart Modes	
169	Flying Start En	Dynamic Control>Stop/Restart Modes	
170	Flying StartGain	Dynamic Control>Stop/Restart Modes	
174	Auto Rstrt Tries	Dynamic Control>Stop/Restart Modes	
175	Auto Rstrt Delay	Dynamic Control>Stop/Restart Modes	
184	Power Loss Mode	Dynamic Control>Stop/Power Loss	
185	Power Loss Time	Dynamic Control>Stop/Power Loss	
190	Direction Mode	Utility>Direction Config	
192	Save OIM Ref	Utility>OIM Ref Config	
193	Man Ref Preload	Utility>OIM Ref Config	
194	Save MOP Ref	Utility>MOP Config	
195	MOP Rate	Utility>MOP Config	
196	Param Access Lvl	Utility>Drive Memory	
197	Reset To Defaults	Utility>Drive Memory	
198	Load Frm Usr Set	Utility>Drive Memory	
199	Save To User Set	Utility>Drive Memory	
200	Reset Meters	Utility>Drive Memory	
201	Language	Utility>Drive Memory	
202	Voltage Class	Utility>Drive Memory	
204	Dyn UserSet Cnfg	Utility>Drive Memory	
205	DynUsrSetSel	Utility>Drive Memory	
206	Dyn UserSet Actv	Utility>Drive Memory	
234	Testpoint 1 Sel	Utility>Diagnostics	
235	Testpoint 1 Data	Utility>Diagnostics	
236	Testpoint 2 Sel	Utility>Diagnostics	
237	Testpoint 2 Data	Utility>Diagnostics	
238	Fault Config 1	Utility>Faults	
240	Fault Clear	Utility>Faults	
241	Fault Clear Mode	Utility>Faults	
259	Alarm Config 1	Utility>Alarms	
286	Manual Mask	Communication>Masks & Owners	

No.	Parameter Name	Path (File>Group)	Setting
300	Data In A1 - Link A Word 1	Communication>Datalinks	
301	Data In A2 - Link A Word 2	Communication>Datalinks	
302	Data In B1 - Link B Word 1	Communication>Datalinks	
303	Data In B2 - Link B Word 2	Communication>Datalinks	
304	Data In C1 - Link C Word 1	Communication>Datalinks	
305	Data In C2 - Link C Word 2	Communication>Datalinks	
306	Data In D1 - Link D Word 1	Communication>Datalinks	
307	Data In D2 - Link D Word 2	Communication>Datalinks	
310	Data Out A1 - Link A Word 1	Communication>Datalinks	
311	Data Out A2 - Link A Word 2	Communication>Datalinks	
312	Data Out B1 - Link B Word 1	Communication>Datalinks	
313	Data Out B2 - Link B Word 2	Communication>Datalinks	
314	Data Out C1 - Link C Word 1	Communication>Datalinks	
315	Data Out C2 - Link C Word 2	Communication>Datalinks	
316	Data Out D1 - Link D Word 1	Communication>Datalinks	
317	Data Out D2 - Link D Word 2	Communication>Datalinks	
320	Anlg In Config	Inputs & Outputs>Analog Inputs	
321	Anlg In Sqr Root	Inputs & Outputs>Analog Inputs	
322	Analog In 1 Hi	Inputs & Outputs>Analog Inputs	
323	Analog In 1 Lo	Inputs & Outputs>Analog Inputs	
324	Analog In 1 Loss	Inputs & Outputs>Analog Inputs	
325	Analog In 2 Hi	Inputs & Outputs>Analog Inputs	
326	Analog In 2 Lo	Inputs & Outputs>Analog Inputs	
327	Analog In 2 Loss	Inputs & Outputs>Analog Inputs	
341	Anlg Out Absolut	Inputs & Outputs>Analog Outputs	
342	Analog Out1 Sel	Inputs & Outputs>Analog Outputs	
343	Analog Out1 Hi	Inputs & Outputs>Analog Outputs	
344	Analog Out1 Lo	Inputs & Outputs>Analog Outputs	
361	Digital In1 Sel	Inputs & Outputs>Digital Inputs	
362	Digital In2 Sel	Inputs & Outputs>Digital Inputs	
363	Digital In3 Sel	Inputs & Outputs>Digital Inputs	
364	Digital In4 Sel	Inputs & Outputs>Digital Inputs	
365	Digital In5 Sel	Inputs & Outputs>Digital Inputs	
366	Digital In6 Sel	Inputs & Outputs>Digital Inputs	
380	Digital Out1 Sel	Inputs & Outputs>Digital Outputs	
381	Dig Out1 Level	Inputs & Outputs>Digital Outputs	

No.	Parameter Name	Path (File>Group)	Setting
382	Dig Out1 OnTime	Inputs & Outputs>Digital Outputs	
383	Dig Out1 OffTime	Inputs & Outputs>Digital Outputs	
384	Digital Out2 Sel	Inputs & Outputs>Digital Outputs	
385	Dig Out2 Level	Inputs & Outputs>Digital Outputs	
386	Dig Out2 OnTime	Inputs & Outputs>Digital Outputs	
387	Dig Out2 OffTime	Inputs & Outputs>Digital Outputs	

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Analog In 1 Lo (323), 12-82
Analog In 1 Loss (324), 12-82
Analog In 2 Hi (325), 12-83
Analog In 2 Lo (326), 12-83
Analog In 2 Loss (327), 12-84
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