RELIANCE ELECTRIC

GV6000 AC Drive User Manual

Instruction Manual D2-3540

Rockwell Automation

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.

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: 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.

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: Do not install modification kits with power applied to the drive. Disconnect and lock out incoming power before attempting such installation or removal. Failure to observe this precaution could result in severe bodily injury or loss of life.

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.

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 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.

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CHAPTER 1

Introduction

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

This manual contains information on:

- Installing and wiring the GV6000 AC drive
- Programming the drive
- Troubleshooting the drive

1.1 Manual Conventions

Parameter names: In most instances, parameter names are shown as the parameter name followed by the parameter number.

For example: Ramped Speed (22).

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, you can contact Standard Drives Technical Support by e-mail at standarddrives@powersystems.rockwell.com or by phone at 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.

Hardware

This section of the manual contains information regarding hardware components of the GV6000 AC Drive.

CHAPTER 2

About the Drive

This chapter describes how to identify the drive assembly, power module and shows the major drive components.

2.1 Identifying the Drive by Model Number

Each GV6000 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 namplate.The model number includes the drive and any factory-installed options. Model numbers and drive power ratings are provided in figure 2.1.

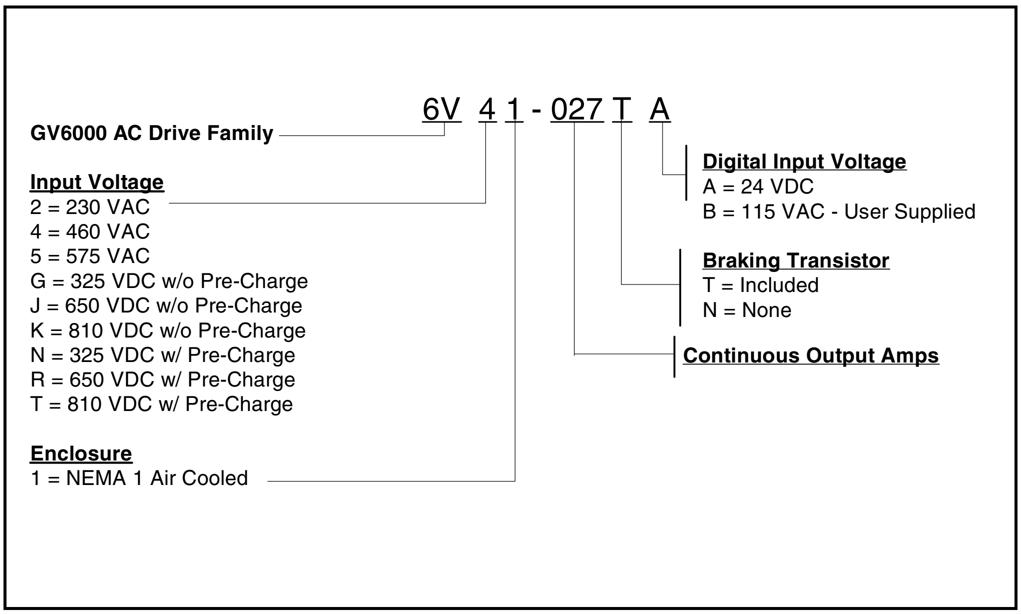


Figure 2.1 – Identifying the Drive by Model Number

2.2 Power Enclosure Ratings

The GV6000 AC Drive has a NEMA 1 enclosure rating. NEMA 1 enclosures are vented and are intended for general purpose indoor applications.

Tables 2.1 through 2.6 list the drives and their power ratings.

Table 2.1 – 240 VAC Power Ratings

Model Number 6V21	Frame	Output Amps						Nominal Power Ratings						External Watts Loss @ 4 kHz @240 VAC	Internal Watts Loss @ 4 kHz @240 VAC	Watts Loss @ 4 kHz @240 VAC
		240 VAC Input			200 VAC Input			110% OL Duty		150% OL Duty		Input Amps @240 VAC	Input Amps @200 VAC			
		Cont	1 Min	3 Sec	Cont	1 Min	3 Sec	kW	HP	kW	HP					
-2P2xx	0	2.2	2.4	3.3	2.5	2.8	3.8	.37	0.5	.25	.33	1.7	1.9	9.0	37	46
-4P2xx	0	4.2	4.8	6.4	4.8	5.6	7.0	.75	1	.55	.75	3.3	3.7	22	39	61
-6P8xx	1	6.8	9	12	7.8	10.4	13.8	1.5	2	1.1	1.5	5.9	6.8	38	39	77
-9P6xx	1	9.6	10.6	14.4	11	12.1	17	2.2	3	1.5	2	8.3	9.5	57	41	98
-015xx	1	15.3	16.8	23	17.5	19.3	26.3	4	5	2.2	3	13.7	15.7	97	82	179
-022xx	1	22	24.2	33	25.3	27.8	38	5.5	7.5	4	5	19.9	23	134	74	208
-028xx	2	28	33	44	32.2	38	50.6	7.5	10	5.5	7.5	25.7	29.6	192	77	269
-042xx	3	42	46.2	63	48.3	53.1	72.5	11	15	7.5	10	38.5	44.5	276	92	368
-052xx	3	52	63	80	56	64	86	15	20	11	15	47.7	51.5	354	82	436
-070xx	4	70	78	105	78.2	93	124	18.5	25	15	20	64.2	72	602	96	698
-080xx	4	80	105	140	92	117	156	22	30	18.5	25	73.2	84.7	780	96	876
-104xx	5	104	115	175	120	132	175	30	40	-	-	98	113	860	107	967
		80	120	160	92	138	175	-	-	22	30	73	84.7	780	96	876
-130xx	5	130	143	175	130	143	175	37	50	-	-	122	141	1132	138	1270
		104	156	175	104	156	175	-	-	30	40	98	133	860	107	967
-154xx	6	154	169	231	177	195	266	45	60	-	-	145	167	1296	200	1496
		130	195	260	150	225	300	-	-	37	50	122	141	1132	138	1270
-192xx	6	192	211	288	221	243	308	55	75	-	-	180	208	1716	277	1993
		154	231	308	177	266	308	-	-	45	60	145	167	1296	200	1496
-260xx	6	260	286	390	260	286	390	66	100	-	-	233	255	1837	418	2255
		205	305	410	205	305	410	-	-	55	75	169	199	1716	277	1993

Note: The alpha “P” in the model number stands for a decimal point in the amp rating. Example: -2P2xxx is equivalent to 2.2 continuous output amps.

Table 2.2 – 480 VAC Power Ratings

Model Number 6V41	Frame	Output Amps 480 VAC Input Cont	480 VAC Input 1 Min	480 VAC Input 3 Sec	400 VAC Input Cont	400 VAC Input 1 Min	400 VAC Input 3 Sec	Nominal Power Ratings 110% OL Duty kW	110% OL Duty HP	150% OL Duty kW	150% OL Duty HP	Input Amps @480 VAC	Input Amps @400 VAC	External Watts Loss @ 4 kHz @480 VAC	Internal Watts Loss @ 4 kHz @480 VAC	Watts Loss @ 4 kHz @480 VAC
-1P1xx	0	1.1	1.2	1.6	1.3	1.4	1.9	.37	0.5	.25	.33	0.9	1.1	11	42	53
-2P1xx	0	2.1	2.4	3.2	2.1	2.4	3.2	.75	1	.55	.75	1.6	1.8	19	44	63
-3P4xx	0	3.4	4.5	6.0	3.5	4.5	6.0	1.5	2	1.1	1.5	2.6	3.2	31	45	76
-5P0xx	0	5.0	5.5	7.5	5.0	5.5	7.5	2.2	3	1.5	2	3.9	4.6	46	46	93
-8P0xx	0	8.0	8.8	12	8.7	9.9	13.2	4	5	2.2	3	6.9	7.9	78	87	164
-011xx	0	11	12.1	16.5	11.5	13	17.4	5.5	7.5	4	5	9.5	10.8	115	79	194
-014xx	1	14	16.5	22	15.4	17.2	23.1	7.5	10	5.5	7.5	12.5	14.4	134	84	218
-022xx	1	22	24.2	33	22	24.2	33	11	15	7.5	10	19.9	20.6	226	99	326
-027xx	2	27	33	44	30	33	45	15	20	11	15	24.8	28.4	303	91	394
-034xx	2	34	40.5	54	37	45	60	18.5	25	15	20	31.2	35	339	102	441
-040xx	3	40	51	68	43	56	74	22	30	18.5	25	36.7	40.7	357	103	459
-052xx	3	52	60	80	56	64	86	30	40	22	30	47.7	53	492	117	610
-065xx	3	65	78	104	72	84	112	37	50	30	40	59.6	68.9	568	148	717
-077xx	4	77	85	116	85	94	128	45	60	37	50	72.3	81.4	722	207	930
-096xx	5	96	106	144	125	138	163	55	75	-	-	90.1	101	821	286	1107
		77	116	154	96	144	168	-	-	45	60	72.3	84.1	722	207	930
-125xx	5	125	138	163	140	154	190	55	100	-	-	117	121	1130	397	1479
		96	144	168	105	157	190	-	-	45	75	90.1	101	821	286	1107
-156xx	6	156	172	234	170	187	225	93	125	-	-	147	165	1402	443	1845
		125	188	250	140	210	280	-	-	75	100	131	136	1130	397	1479
-180xx	6	180	198	270	205	220	289	110	150	-	-	169	199	1711	493	2204
		156	234	312	170	255	313	-	-	100	125	147	165	1402	443	1845
-248xx	6	248	273	372	260	286	390	132	200	-	-	233	255	1930	583	2512
		180	270	360	205	308	410	-	-	110	150	169	199	1711	493	2204

Note: The alpha "P" in the model number stands for a decimal point in the amp rating. Example: -2P2xxx is equivalent to 2.2 continuous output amps.

Table 2.3 – 600 VAC Power Ratings

Model Number 6V51	Frame	Output Amps			Nominal Power Ratings						External Watts Loss @ 4 kHz @600 VAC	Internal Watts Loss @ 4 kHz @600 VAC	Watts Loss @ 4 kHz @600 VAC
		600 VAC Input			110% OL Duty		150% OL Duty		Input KVA @600 VAC	Input Amps @600 VAC			
		Cont	1 Min	3 Sec	kW	HP	kW	HP					
-1P7xx	0	1.7	2	2.6	.75	1	.33	0.5	1.4	1.3	14	40	54
-2P7xx	0	2.7	3.6	4.8	1.5	2	.75	1	2.1	2.1	25	40	65
-3P9xx	0	3.9	4.3	5.9	2.2	3	1.5	2	3.1	3	41	42	83
-6P1xx	0	6.1	6.7	9.2	4	5	2.2	3	5.5	5.3	59	83	142
-9P0xx	0	9	9.9	13.5	5.5	7.5	4	5	8.1	7.8	83	75	157
-011xx	1	11	13.5	18	7.5	10	5.5	7.5	10.2	9.9	109	77	186
-017xx	1	17	18.7	25.5	11	15	7.5	10	16	15.4	177	93	270
-022xx	2	22	25.5	34	15	20	11	15	21	20.2	260	83	343
-027xx	2	27	33	44	20	25	15	20	25.7	24.8	291	95	385
-032xx	3	32	40.5	54	25	30	20	25	30.5	29.4	324	95	419
-041xx	3	41	48	64	30	40	25	30	39.1	37.6	459	109	569
-052xx	3	52	61.5	82	37	50	30	40	49.6	47.7	569	141	710
-062xx	4	62	78	104	45	60	37	50	60.5	58.2	630	195	825
-077xx	5	77	85	116	55	75	-	-	75.1	72.3	1053	308	1361
		63	94	126	-	-	45	60	60.5	58.2	630	195	825
-099xx	5	99	109	126	75	100	-	-	96.9	92.9	1467	407	1874
		77	116	138	-	-	55	75	75.1	72.3	1053	308	1361
-125xx	6	125	138	188	90	125	-	-	122	117	1400	500	1900
		99	149	198	-	-	75	100	96.6	93	1467	407	1874
-144xx	6	144	158	216	110	150	-	-	141	135	1668	612	2280
		125	188	250	-	-	90	125	122	117	1400	500	1900

Note: The alpha "P" in the model number stands for a decimal point in the amp rating. Example: -2P2xxx is equivalent to 2.2 continuous output amps.

Table 2.4 – 325 VDC Power Ratings

Model Number 6VG1/ 6VN1	Frame	Output Amps: 325 VDC Input Cont	325 VDC Input 1 Min	325 VDC Input 3 Sec	280 VDC Input Cont	280 VDC Input 1 Min	280 VDC Input 3 Sec	Nominal Power Ratings: 110% OL Duty kW	110% OL Duty HP	150% OL Duty kW	150% OL Duty HP	Input Amps @325 VDC	Input Amps @280 VDC	Watts Loss @ 4 kHz @ 325 VDC
-154xx	6	154	169	231	177	195	266	45	60	-	-	194.8	169	*
		130	195	260	150	225	300	-	-	37	50	194.8	169	*
-192xx	6	192	211	288	221	243	308	55	75	-	-	243.3	210.6	*
		154	231	308	177	266	308	-	-	45	60	243.3	210.6	*
-260xx	6	260	286	390	260	286	390	66	100	-	-	*	*	*
		205	305	410	205	305	410	-	-	55	75	*	*	*

* Consult Factory.

Table 2.5 – 650 VDC Power Ratings

Model Number 6VJ1/ 6VR1	Frame	Output Amps: 650 VDC Input Cont	650 VDC Input 1 Min	650 VDC Input 3 Sec	540 VDC Input Cont	540 VDC Input 1 Min	540 VDC Input 3 Sec	Nominal Power Ratings: 110% OL Duty kW	110% OL Duty HP	150% OL Duty kW	150% OL Duty HP	Input Amps @ 650 VDC	Input Amps @540 VDC	Watts Loss @ 4 kHz @ 650 VDC
-096xx	5	96	106	144	105	116	158	55	75	-	-	105.3	120.2	*
		77	116	154	85	128	170	-	-	45	60	105.3	120.2	*
-125xx	5	125	138	163	125	138	163	75	100	-	-	137.1	160.3	*
		96	144	168	96	144	168	-	-	55	75	137.1	160.3	*
-156xx	6	156	172	234	170	187	255	90	125	-	-	171	192	*
		125	188	250	140	210	280	-	-	75	100	171	192	*
-180xx	6	180	198	270	205	220	289	110	150	-	-	198	226	*
		156	234	312	170	255	313	-	-	110	125	198	226	*
-248xx	6	248	273	372	260	286	390	132	200	-	-	272	298	*
		180	270	360	205	305	410	-	-	110	150	272	298	*

* Consult Factory.

2.3 Overview of GV6000 Drive Features

This section provides an overview of the features in the GV6000 AC Drive.

2.3.1 Analog Inputs

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

Each analog input can be configured and scaled independently. Analog Input 1 defaults to current. Analog Input 2 defaults to voltage.

2.3.2 Analog Outputs

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

Each output can be configured and scaled independently. Analog Output 1 defaults to current. Analog Output 2 defaults to voltage.

2.3.3 Digital Inputs

There are six general purpose digital inputs. Digital Inputs are configured using the Digital Inx Sel (361-366) parameters (one for each input). These parameters cannot be changed while the drive is running.

2.3.4 Digital Outputs

There are three general purpose digital outputs that can be configured to annunciate a variety of drive operating conditions. The digital outputs are configured as below:

- Digital Output 1 consists of both a normally open contact and a normally closed contact configured in a Form-C arrangement. The normally closed contact is connected to terminals 11 and 12, and the normally open contact is connected to terminals 13 and 12 (Terminal 12 is shared between the normally open and normally closed contact.).
- Digital Output 2 consists of a normally closed contact. This contact is connected between terminals 14 and 15.
- Digital Output 3 consists of a normally open contact. This contact is connected between terminals 16 and 15.

Note: Digital Outputs 2 and 3 are independently programmed and controlled in software but share a common terminal (terminal 15).

2.3.5 Multiple Control Modes

The GV6000 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 (Variable Torque)
- FVC Vector (Flux Vector Control with or without Encoder Feedback)

See the parameter description for Motor Cntl Sel (53) in chapter 11 for details of operation of each control mode.

2.3.6 Auto Restart (Reset/Run)

The Auto Restart feature, enabled in Auto Rstrt Tries (174), 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.

Refer to the descriptions of Auto Rstrt Tries (174) and Auto Restrt Delay (175) in chapter 11 for more information about using the Auto Restart feature.

2.3.7 Multiple Stop Methods

There are several stop methods that can be selected using drive Stop Mode A (155) and Stop Mode B (156):

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

Refer to the parameter descriptions in chapter 11 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 Bus Reg Mode A (161) to DB Resistor Type (163) for more information about this feature.

2.3.8 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 tolerance.

The Feedback Select parameter (80) selects the speed regulation method for the drive, and can be set to one of 3 choices

- Open Loop - Simple frequency output - No feedback.
- Slip Comp - Slip Compensation is active.
- Encoder - Encoder present and connected to the drive.

Refer to Feedback Select (80) in chapter 11 for more information.

2.3.9 Auto/Manual Reference Selection

You can override the selected "auto" reference by 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 11 for more information.

2.3.10 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 11 for more information.

2.3.11 Motor-Operated Potentiometer (MOP) Function

The Motor-Operated Pot (MOP) function is one of the sources for the speed reference (selected in Speed Ref A Sel (90) or Speed Ref B Sel (93). 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)

2.3.12 Autotune

Description of parameters determined by the autotune tests.

Flux Current Test

Flux Current Ref (63) is set by the flux current test. Flux current is the reactive portion of the motor current (portion of the current that is out of phase with the motor voltage) and is used to magnetize the motor. The flux current test is used to identify the value of motor flux current required to produce rated motor torque at rated current. When the flux test is performed, the motor will rotate. The drive accelerates the motor to approximately two-thirds of base speed and then coasts for several seconds.

IR Voltage Drop Test

IR Voltage Drop (62) is set by the IR voltage drop test. IR Voltage Drop is used by the IR Compensation procedure 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. The motor should not rotate during this test.

Leakage Inductance Test

Ixo Voltage Drop (64) is set by the leakage inductance test. This test measures the inductance characteristics of the motor. A measurement of the motor inductance is required to determine references for the regulators that control torque. The motor should not rotate during this test.

Inertia Test

Total Inertia (450) is set by the inertia test. Total Inertia (450) represents the time in seconds, for the motor coupled to a load to accelerate from zero to base speed at rated motor torque. During this test, the motor is accelerated to about 2/3 of base motor speed. This test is performed during the Start-up mode, but can be manually performed by setting [Inertia Autotune] to “Inertia Tune”. The Total Inertia (450) and Speed Desired BW (449) automatically determine the Ki Speed Loop (445) and Kp Speed Loop (447) gains for the speed regulator.

Refer to the description of the Autotune parameter (61) in chapter 11 for more information about using this feature.

2.3.13 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
- Thermal manager

2.3.14 Drive Overload Protection

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

The drive will monitor 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 will generate 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.

2.3.15 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 ten (10) seconds and continuously operates at 100% motor current.

The following parameters are used to set the overload feature:

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

Refer to Motor NP FLA (42) in chapter 11 for more information about this feature.

2.3.16 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 Lmt Val (148) and enabling the electronic shear pin, the drive will fault if excess current is demanded by the motor

2.3.17 Drives Peripheral Interface (DPI)

GV6000 drives support Drive Peripheral Interface (DPI) communication protocols for the primary interface and drive control. The DPI interface 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 communication modules.

2.3.18 Network Data Transfer via Datalinks

A Datalink (see parameters 300 to 317) is one of the mechanisms used by GV6000 drives to transfer data to and from a programmable controller via the optional network interface modules (e.g. 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 (e.g. A1, A2 for Datalink A) 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)

2.3.19 Process PI Loop

The internal process PI function (see parameters 124 to 138) 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 PI Configuration (124) and PI Output Meter (138) in chapter 11 for more information.

2.3.20 S Curve

The S Curve function of GV6000 drives allows control of the "jerk" component of acceleration and deceleration through user adjustment of the S Curve % (146). Jerk is defined as the rate of change of acceleration and/or deceleration. By adjusting the percentage of S Curve applied to the normal accel/decel ramps, the graph of the ramp takes the shape of an "S" allowing a smoother transition that produces less mechanical stress and smoother control for light loads.

Refer to the description of S Curve % (146) in chapter 11 for more information.

2.3.21 Three Skip Bands (Avoidance Frequencies)

The skip band function (see parameters 84 to 87 in chapter 11) 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.

2.3.22 Flying Start

The flying start feature (enabled in Flying Start En (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.

Refer to the description of Flying Start En (169) in chapter 11 for more information.

2.3.23 Voltage Class

The voltage class (see parameter 202 in chapter 11) 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. A 575 volt class will have a range of 475 to 632 volts.

While the hardware remains the same within each class, other variables, such as factory defaults and power unit ratings, will be different. 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 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.).

2.3.24 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 at the motor terminals 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.

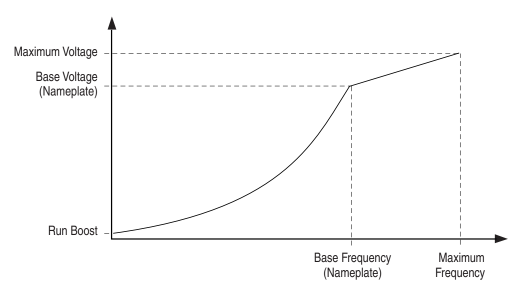
2.3.25 Economizer Mode

Economize 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.

2.3.26 Fan Curve

When Motor Cntl Sel (53) is set to fan/Pump V/Hz, the relationship between frequency and voltage is shown in the following figure. The fan/pump curve generates voltage that is a function of the stator frequency squared up to the motor nameplate frequency. Above base frequency voltage is a linear function of frequency. At low speed, the fan curve can be offset by Run Boost (70) to provide extra starting torque if needed. No extra parameters are needed for fan/pump curve.

The pattern matches the speed vs. load characteristics of a centrifugal fan or pump and optimizes the drive output to those characteristics.



2.3.27 Programmable Parameter Access Levels and Protection

The GV6000 drive allows you to limit the number of parameters that can be viewed on the LCD OIM using an Access Level password. Param Access Lvl (196) is read-only and shows the active access level (Basic, Standard, or Advanced). Each access level can be password protected.

If you are trying to gain access to a particular parameter and the OIM skips over it, you must change the parameter view from "Basic" to "Advanced." This can be accomplished by reprogramming Param Access Lvl (196) to "Advanced"

You can also protect parameters from unauthorized changes by activating the Write Protect password. See section 10.4 for more information about this password.

Writing of passwords can also be enabled/disabled on a port-by-port basis through Write Mask Cfg (596).

2.3.28 User Sets

2.3.28.1 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 11.
- Access the Memory Storage menu on the LCD OIM.

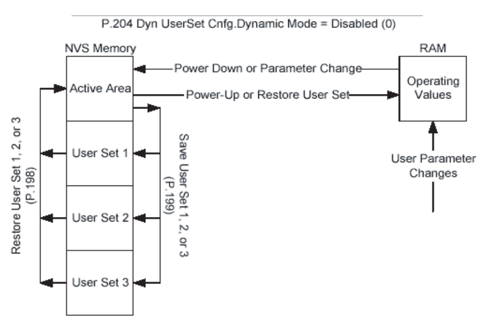


Figure 2.2 – Normal Mode Operation

2.3.28.2Dynamic Mode

> **ATTENTION:** The GV6000 can be configured to use multiple saved parameter (user) sets. Caution must be utilized to ensure that each user set is programmed for proper operation for the application. Recalling an improperly programmed user set may cause rotation of the motor in an undesired direction at unexpected speeds or may cause unpredictable starting of the drive and motor. Failure to observe this precaution could result in damage to equipment, severe bodily injury or loss of life.

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.

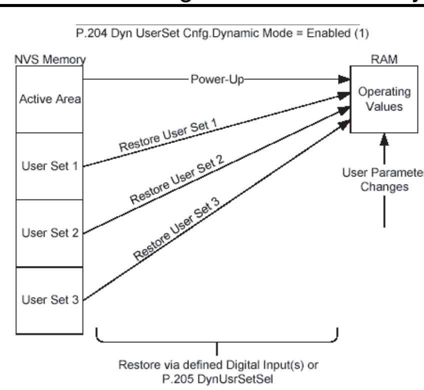


Figure 2.3 – Dynamic Mode Operation

2.4 CE Conformity

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 GV6000 AC Drive 230 VAC and 480 VAC drive ratings comply with the EN standards listed below when installed according to the User and Reference Manual.

Note: GV6000 600 VAC rated drives are not CE compliant.

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

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations.

EMC Directive (89/336/EEC)

- EN61800-3 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 frequency interference. The user is required to take measures to prevent interference, in addition to the essential requirements for CE compliance listed in section 2.4.1, 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 of the drive with CE EMC requirements does not guarantee an entire machine or installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.

Use of line filters in ungrounded systems is not recommended. GV6000 drives can generate conducted low frequency disturbances (harmonic emissions) on the AC supply system.

When operated on a public supply system, the user is responsible for ensuring, by consultation with the distribution network operator and Rockwell Automation, if necessary, that applicable requirements have been met.

2.4.1 Essential Requirements for CE Compliance

All conditions listed below must be satisfied for GV6000 drives to meet the requirements of EN61800-3:

- Standard GV6000 CE-compatible drive.

- Grounding as described in section 3.4 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.

Table 2.6 – GV6000 AC Drive EN1800-3 EMC Compatibility

Frame	**Drive Description**	**Second Environment**[1]	**First Environment Restricted Distribution**
0-6	Drive with any options	• Restrict motor cable to 30 m (98 ft)	• Restrict motor cable to 150 m (492 ft) • Install External filter

1.Motor cable limited to 30 m (98 ft) for installations in the second (industrial) environment without additional external line filters.

2.5 Drive Components and Locations

2.5.1 Terminal Block Locations

Figure 2.2 shows locations for the Power Terminal Block. Table 2.8 identifies the drive connections shown with the corresponding number in figure 2.4.

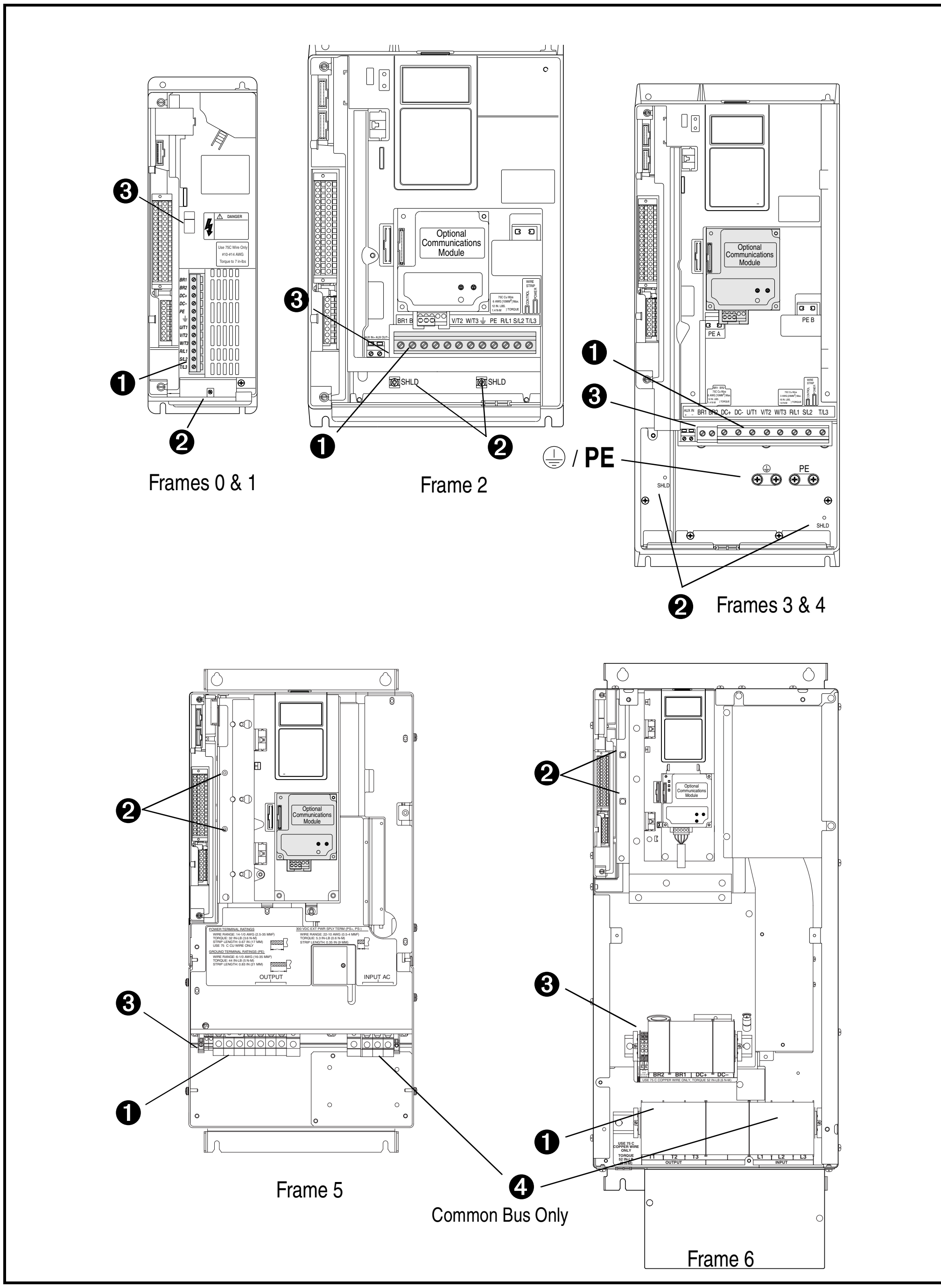


Figure 2.4 – Typical Power Terminal Block Location

Table 2.7 – Power Terminal Block Locations Table

<table>
<tr><th>Number</th><th>Name</th><th>Frame</th><th>Description</th></tr>
<tr><td rowspan="12">❶</td><td rowspan="12">Power Terminal Block</td><td>0 & 1</td><td>Input Power and Motor Connections</td></tr>
<tr><td>2</td><td>Input Power and Motor Connections</td></tr>
<tr><td rowspan="2">3</td><td>Input Power and Motor Connections</td></tr>
<tr><td>BR1, 2 Terminals</td></tr>
<tr><td>4</td><td>Input Power and Motor Connections</td></tr>
<tr><td rowspan="2">5
(75 HP)</td><td>Input power, BR 1, 2, DC+, DC- and motor connections</td></tr>
<tr><td>PE</td></tr>
<tr><td rowspan="3">5
(100 HP)</td><td>Input Power, DC+, DC- and motor</td></tr>
<tr><td>BR1, 2 Terminals</td></tr>
<tr><td>PE</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Input power, DC+, DC-, BR1, 2, PE, motor connections</td></tr>
<tr></tr>
<tr><td>❷</td><td>SHLD Terminal</td><td>0-6</td><td>Terminating point for wiring shields</td></tr>
<tr><td rowspan="2">❸</td><td rowspan="2">Aux Terminal Block</td><td>0-4</td><td rowspan="2">Auxiliary Control Voltage
PS+, PS-[1]</td></tr>
<tr><td>5-6</td></tr>
<tr><td>❹</td><td>Fan Terminal Block
(Common Bus Only)</td><td>5-6</td><td>User Supplied Fan Voltage
(See section 3.1.1.4.)</td></tr>
</table>

1.External control power: UL Installation - 300 VDC, +/- 10%, Non UL Installation - 270-600 VDC, +/- 10%; 0-3 Frame - 40 W, 165 mA, 5 Frame - 80 W, 90 mA.

2.5.2 I/O Control Cassette

Figure 2.5 shows I/O Control Cassette and its terminal block locations. Each GV6000 is provided with a removable I/O Cassette. The I/O cassette is a plastic case which houses the regulator, input/output, and encoder electronics. Table 2.8 identifies the drive connections shown with the corresponding number in figure 2.5.

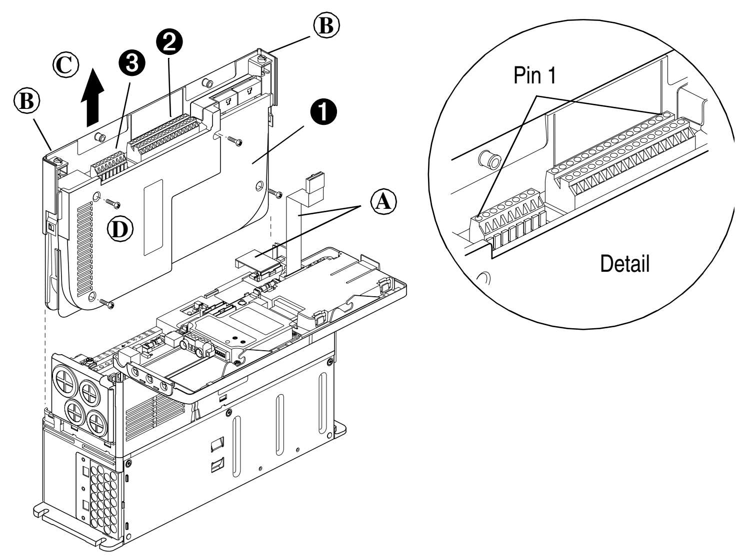


Figure 2.5 – I/O Control Cassette and Terminal Blocks (Frame 0 Shown)

Table 2.8 – I/O Cassette and Terminal Block Locations

Number	Name	Description
❶	I/O Cassette	Removable I/O Cassette
❷	I/O Terminal Block	Signal and control connections
❸	Encoder Terminal Block	Encoder power and signal connections

2.5.2.1 Removing the I/O Control Cassette

Table 2.9 identifies the steps for removing the I/O Control Cassette. Refer to the alpha markers in figure 2.5.

Table 2.9 – Removing the I/O Control Cassette

Step	Description
A	Disconnect the two cable connectors.
B	Loosen the two screws latches.
C	Slide the cassette out.
D	Remove screws securing cassette cover to gain access to the boards.

2.6 Drive Connections

Figure 2.6 shows the locations of the connectors used to set up and operate the drive. Table 2.10 identifies the drive connections shown with the corresponding number in figure 2.6.

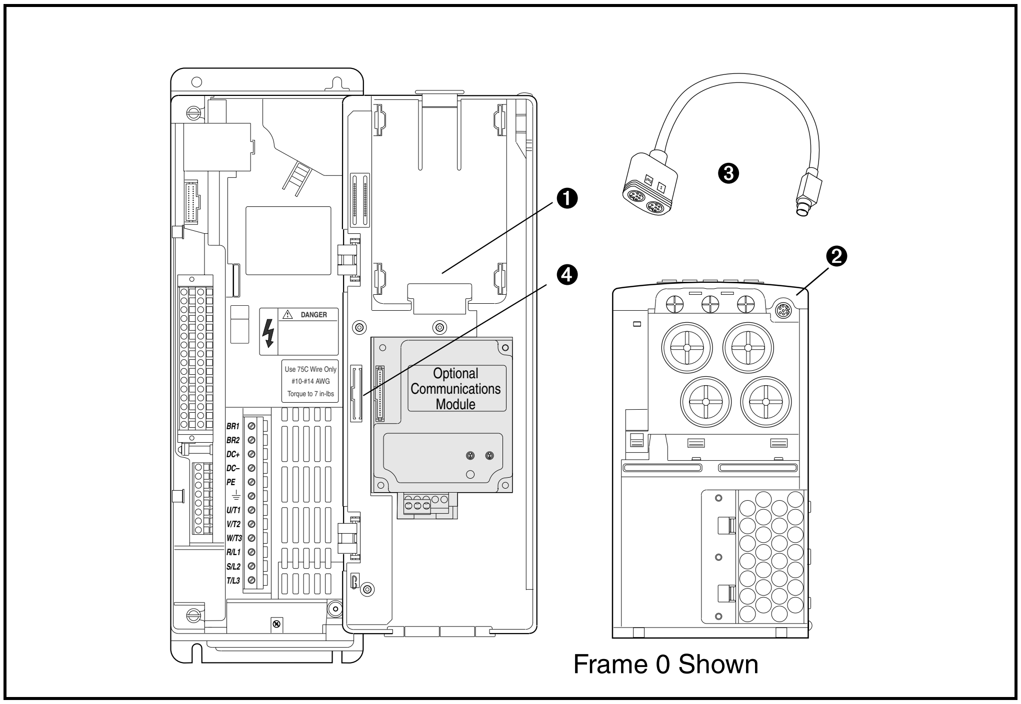


Figure 2.6 – Drive Connections (Frame 0)

Table 2.10 – Drive Connection Descriptions

Number	Connector	Description
❶	DPI Port 1	OIM connection.
❷	DPI Port 2	Cable connection for handheld and remote options.
❸	DPI Port 3 or 2	Splitter cable connected to DPI Port 2 provides additional port.
❹	DPI Port 5	Cable connection for optional communications module.

2.7 Drive Communication Options

The flat-ribbon cable connector (labeled ❹ in figure 2.6) is a parallel bus connection port that provides a means of attaching optional communication modules.

Refer to the appropriate option module instruction manual for more information. See table 2.11 for a list of available communication options.

Table 2.11 – Standard Communication Kits and Options

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
Modbus Communication Module	RECOMM-H485	VT-1001-2
RS-485 DF1 Communication Module	RECOMM-485	D2-3514

2.8 Operator Interface Options

Table 2.12 lists the available operator interface options for the GV6000 AC Drive.

Table 2.12 – Operator Interface Options

Description	Model Number
Standard OIM	6VKYPD-STD
Full Numeric OIM	6VKYPD-FN
Remote Mounted Nema 4 OIM	6VKYPD-N4
Blank OIM	REBLNKOIM
Remote Mounted Nema 1 OIM Bezel Kit	REBZL-N1

2.9 Regulator and Encoder Board Options

Table 2.13 lists the available regulator and encoder board options for the GV6000.

Table 2.13 – Regulator and Encoder Board Option Kits

Description	Model Number
24 VDC Input Regulator Board[1]	6VREG-024A
115 VAC Input Regulator Board[1]	6VREG-115B
Encoder Board[1]	6VENC-OPT

1.The drive is shipped with one of the above regulator boards and the encoder board installed. The user can purchase one of the above kits to field replace a damaged board or to change the digital input voltage from 24 VDC to 115 VAC (or vice versa).

2.10 PC-Based Utilities

The GV6000 AC Drive can be configured using V*S Utilities or V*S Utilities Pro PC-based software utilities. These programs enable the user to upload and download parameter configurations.

Table 2.14 – PC-Based Utility Model Number and Instruction Manual Number

Description	Model Number	Instruction Manual
V*S Utilities (software only)[1]	RECOMM-VSUTIL	D2-3488
V*S Utilities including Serial Converter for DPI Drives	RECOMM-VSU232	D2-3477 D2-3488
V*S Utilities Pro[2] (software only)[1]	RECOMM-PRO[2]	D2-3543[3]
V*S Utilities Pro[2] including Serial Converter for DPI Drives	RECOMM-PRO232[2]	D2-3477 D2-3543[3]

1.The software can be purchased without the serial converter cable by customers that have previously purchased the cable. The serial converter cable (RECOMM-232) is required to provide an interface from a PC to a GV6000 drive.
2.V*S Utilities Pro is an enhanced version of V*S Utilities that offers offline programming capability. Available in fall of 2005.
3.D2-3543 for V*S Utilities Pro will be available in fall of 2005.

CHAPTER 3

Mounting the Drive, Grounding, and Determining Wire Routing Locations

This chapter provides information that must be considered when planning a GV6000 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.

3.1 General Requirements for the Installation Site

It is important to properly plan before installing a GV6000 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 following recommendations before continuing with drive installation.

3.1.1 Verifying Power Module Input Ratings Match Available Power

GV6000 AC Drives are suitable for use on a circuit capable of delivering a maximum of 200,000 rms symmetrical amperes, and a maximum of 600 volts (nominal).

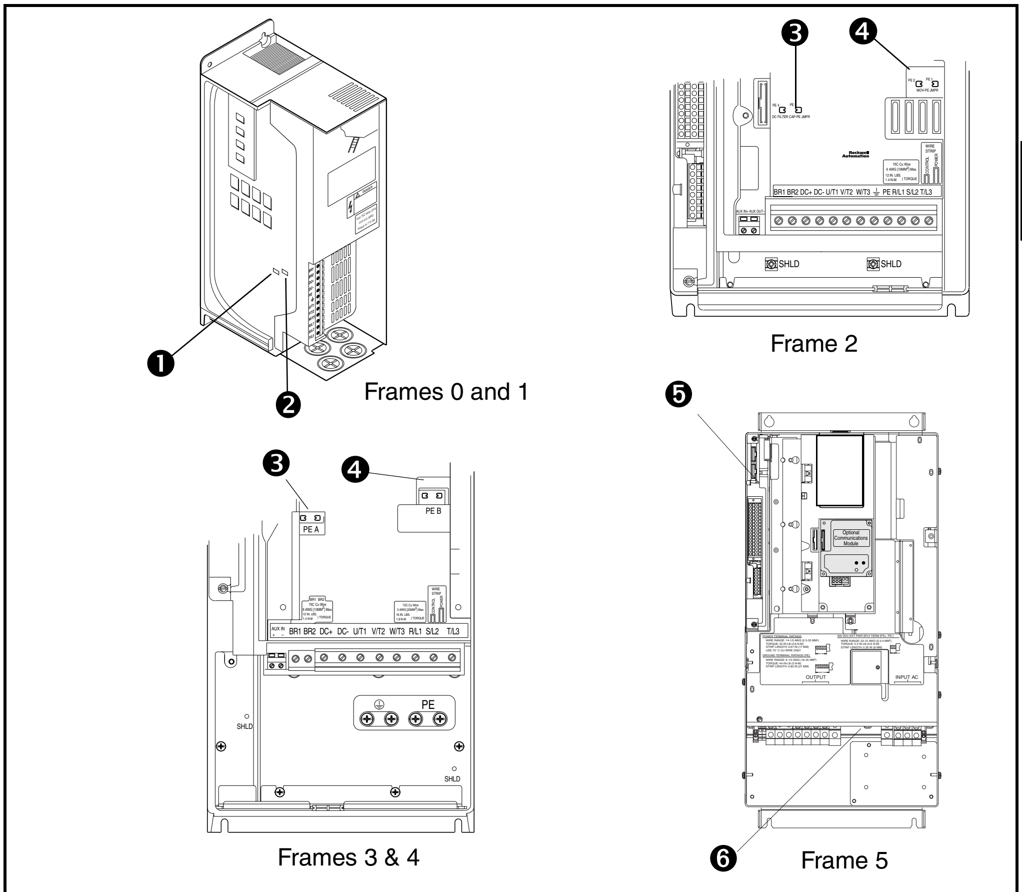
ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in section 4.4.

3.1.1.1 Unbalanced or Ungrounded Distribution Systems

ATTENTION: GV6000 AC Drives contain protective MOV's and common mode capacitors that are referenced to ground. These devices should be disconnected if the drive is installed on an ungrounded distribution system. 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 electrical 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.

For ungrounded distribution systems, disconnect the MOVs and common mode capacitors by removing or disconnecting the jumper(s) shown in figure 3.1.



Frames	Jumper	Component	No.	Action
0-1	PEA	Common Mode Capacitors	❶	Remove the I/O Cassette. Jumpers located on the Power Board.
	PEB	MOV's	❷	
2-4	PEA	Common Mode Capacitors	❸	Jumpers located above the Power Terminal Block.
	PEB	MOV's	❹	
5	Wire	Common-Mode Capacitors	❺	Remove the I/O Cassette. The green/yellow jumper is located on the back of chassis. Disconnect, insulate and secure the wires to guard against unintentional contact with chassis or components.
		MOV's	❻	Note location of the two green/yellow jumper wires next to the Power Terminal Block. Disconnect, insulate and secure the wires to guard against unintentional contact with chassis or components.
		Input Filter Capacitors		
6	Wire	Common-Mode Capacitors		Remove the wire guard from the Power Terminal Block. Disconnect, the three green /yellow wires from the two "PE" terminals. Insulate/secure the wires to guard against unintentional contact with chassis or components.
		MOV's		
		Input Filter Capacitors		

Figure 3.1 – Typical Jumper Locations

3.1.1.2 Input Power Conditioning

Certain events on the power system supplying a drive can cause component damage or shortened product life.

All Drives

- The power source 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 lightening strikes.
- The power source has frequent interruptions.

5 HP of Less Drives (includes all factors in the All Drives category as well)

- The nearest supply transformer is larger than 100kVA 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%.

It is recommended that the user install a minimum amount of impedance between the drive and the source if any of the above conditions exist. This impedance can come from the supply transformer, the cable between the transformer and the drive or an additional transformer or reactor.

3.1.1.3 AC Input Phase Selection for Single Phase Operation (Frames 5 & 6 Only)

> **ATTENTION:** Ensure that all power to the drive has been removed before performing the following. Failure to follow this precaution could result in a shock hazard.

> **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.

Moving the “Line Type” jumper shown in figure 3.2 will allow single or three-phase operation.

Important: When selecting single-phase operation, input power must be applied to the R (L1) and S (L2) terminals only. See Figure 2.4 and Table 2.7 for the terminal block location and Figure 5.2 for the terminal layout.

Note: Single-phase operation provides 50 percent of drive rated current.

3.1.1.4 Selecting/Verifying Fan Voltage (Frames 5 & 6 Only)

> **ATTENTION:** Ensure that all power to the drive has been removed before performing the following. Failure to follow this precaution could result in a shock hazard.

> **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.

Frames 5 and 6 utilize a transformer to match the input line voltage to the internal fan voltage. If your line voltage is different than the voltage class specified on the drive nameplate, it may be necessary to change transformer taps as shown in figure 3.2.

Common Bus (DC input) drives require user supplied 120 or 240 V AC to power the cooling fans. The power source is connected between “0 VAC” and the terminal corresponding to your source voltage. See Figure 2.4 and Table 2.7 for the terminal block location and Figure 5.2 for the terminal layout.

Table 3.1 – Fan VA Ratings (DC Input Only)

Frame	Rating (120V or 240V)
5	100 VA
6	138 VA

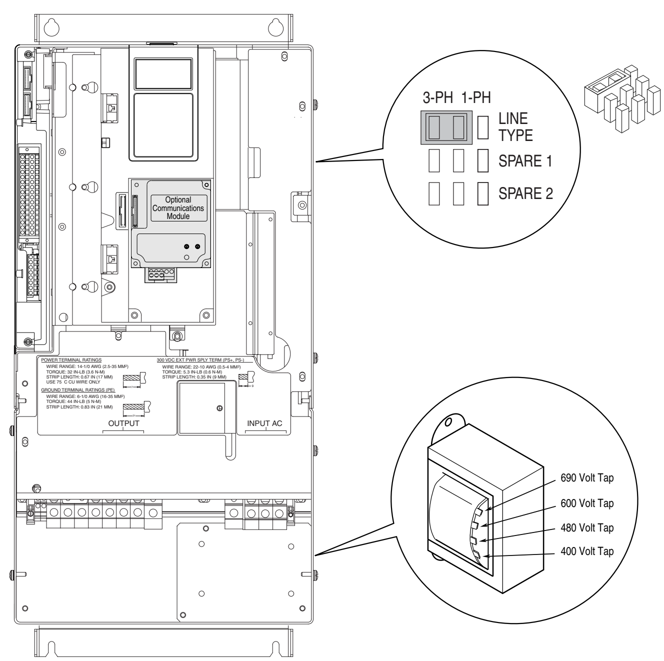


Figure 3.2 – Typical Locations - Phase Select Jumper and Transformer (Frame 5 Shown)

Frame 6 Transformer Tap Access (AC Input Drives Only)

> **ATTENTION:** Ensure that all power to the drive has been removed before performing the following. Failure to follow this precaution could result in a shock hazard.

> **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.

The transformer is located behind the Power Terminal Block shown in figure 3.2. Access is gained by releasing the terminal block from the rail. To release terminal block and change tap:

Step 1. Locate the small metal tab at the bottom of the end block.

Step 2. Press the tab in and pull the top of the block out. Repeat for next block if desired.

Step 3. Select appropriate transformer tap.

Step 4. Replace block(s) in reverse order.

3.1.2 Making Sure Environmental Conditions are Met

Important: Failure to meet the following conditions may result in erratic operation and/or drive damage.

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

- Verify that NEMA 1 enclosure drives can be kept clean and dry.
- The area chosen should allow the space required for proper air flow as defined in section 3.1.3.
- Be sure that the NEMA 1 enclosure is installed away from oil, coolants, or other airborne contaminants.
- Do not install the drive above 1000 meters (3300 feet) without derating output power. For every 91.4 meters (300 feet) above 1000 meters (3300 feet), derate the output current 1%.
- Verify that the drive location will meet the environmental conditions specified in Appendix A.

3.1.3 Minimum Mounting Clearances

Be sure there is adequate clearance for air circulation around the enclosure. For best air movement, do not mount GV6000 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.

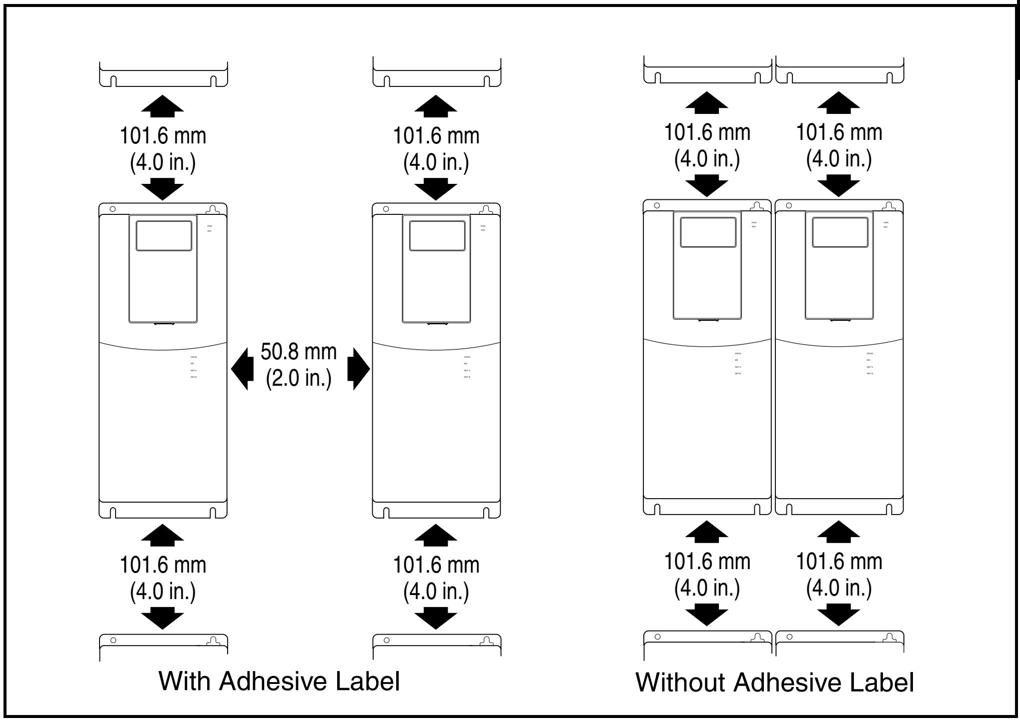
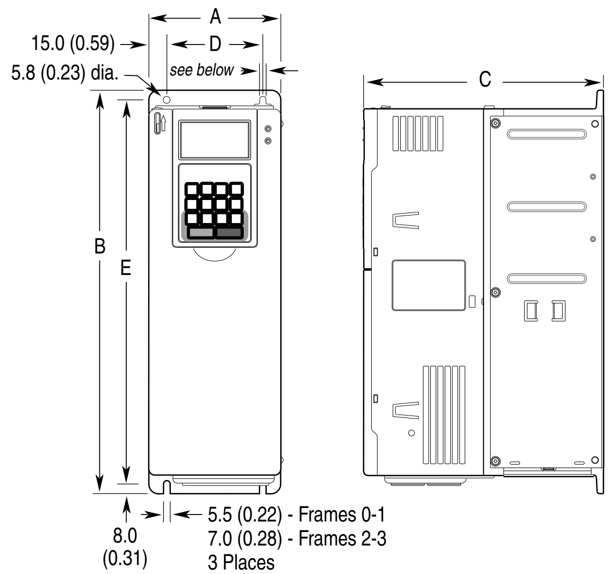


Figure 3.3 – Minimum Mounting Clearances

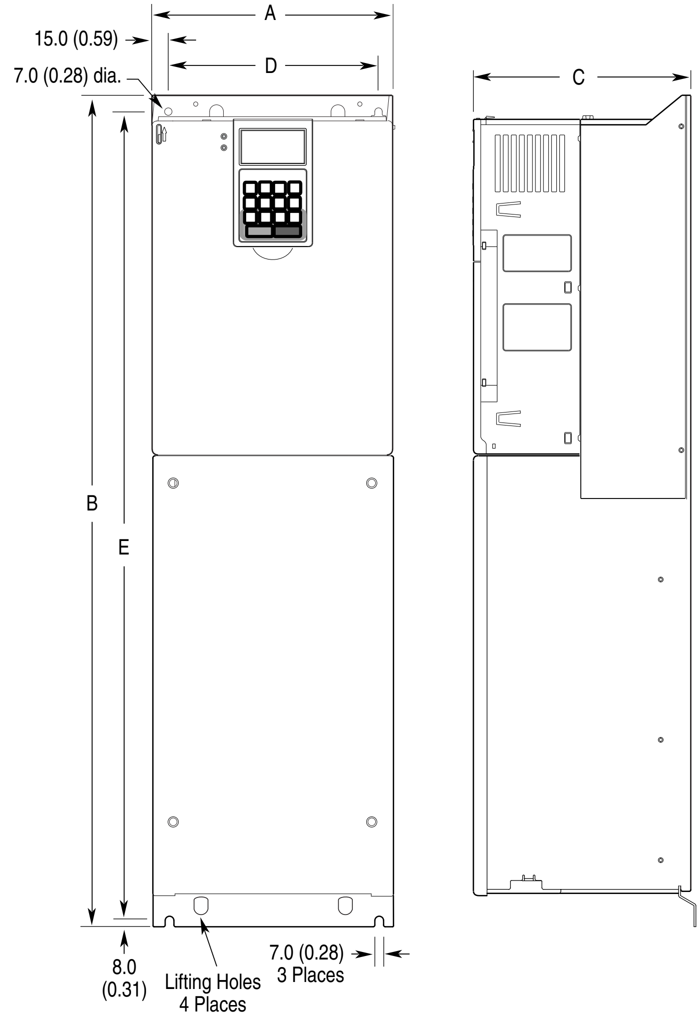
3.1.4 Drive Dimensions and Weights

Overall dimension and weights are illustrated in figures 3.4, 3.5, 3.6 and 3.7 as an aid in calculating the total area required by the GV6000 AC Drive. Weights include OIM and Standard I/O.



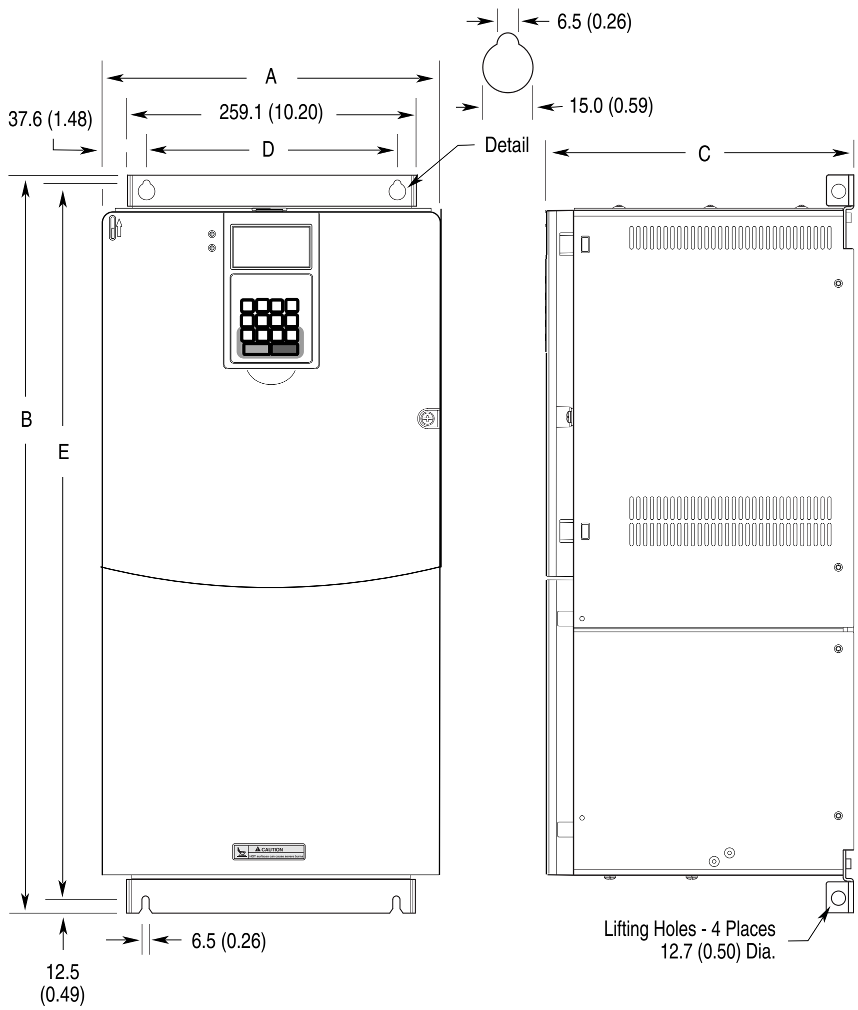
Frame	HP	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	Weight kg(lb)
0	0.5 to 1.0 @ 240 VAC 0.5 to 7.5 @ 480 VAC 1.0 to 7.5 @ 600 VAC	110.0 (4.33)	336.0 (13.23)	200.0 (7.87)	80.0 (3.15)	320.0 (12.60)	5.22 (11.5)
1	2.0 to 7.5 @ 240 VAC 10 to 15 @ 480 VAC 10 to 15 @ 600 VAC	135.0 (5.31)	336.0 (13.23)	200.0 (7.87)	105.0 (4.13)	320.0 (12.60)	7.03 (15.5)
2	10 @ 240 VAC 20 to 25 @ 480 VAC 20 to 25 @ 600 VAC	222.0 (8.74)	342.5 (13.48)	200.0 (7.87)	192.0 (7.56)	320.0 (12.60)	12.52 (27.6)
3	15 to 20 @ 240 VAC 30 to 50 @ 480 VAC 30 to 50 @ 600 VAC	222.0 (8.74)	517.5 (20.37)	200.0 (7.87)	192.0 (7.56)	500.0 (19.69)	18.55 (40.9)

Figure 3.4 – GV6000 Drive Dimensions Frames 0 - 3



Frame	HP	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	Weight kg(lb)
4	25 to 30 @ 240 VAC 60 @ 480 VAC 60 @ 600 VAC	220.0 (8.66)	758.8 (29.87)	201.7 (7.94)	192.0 (7.56)	738.2 (29.06)	24.49 (54.0)

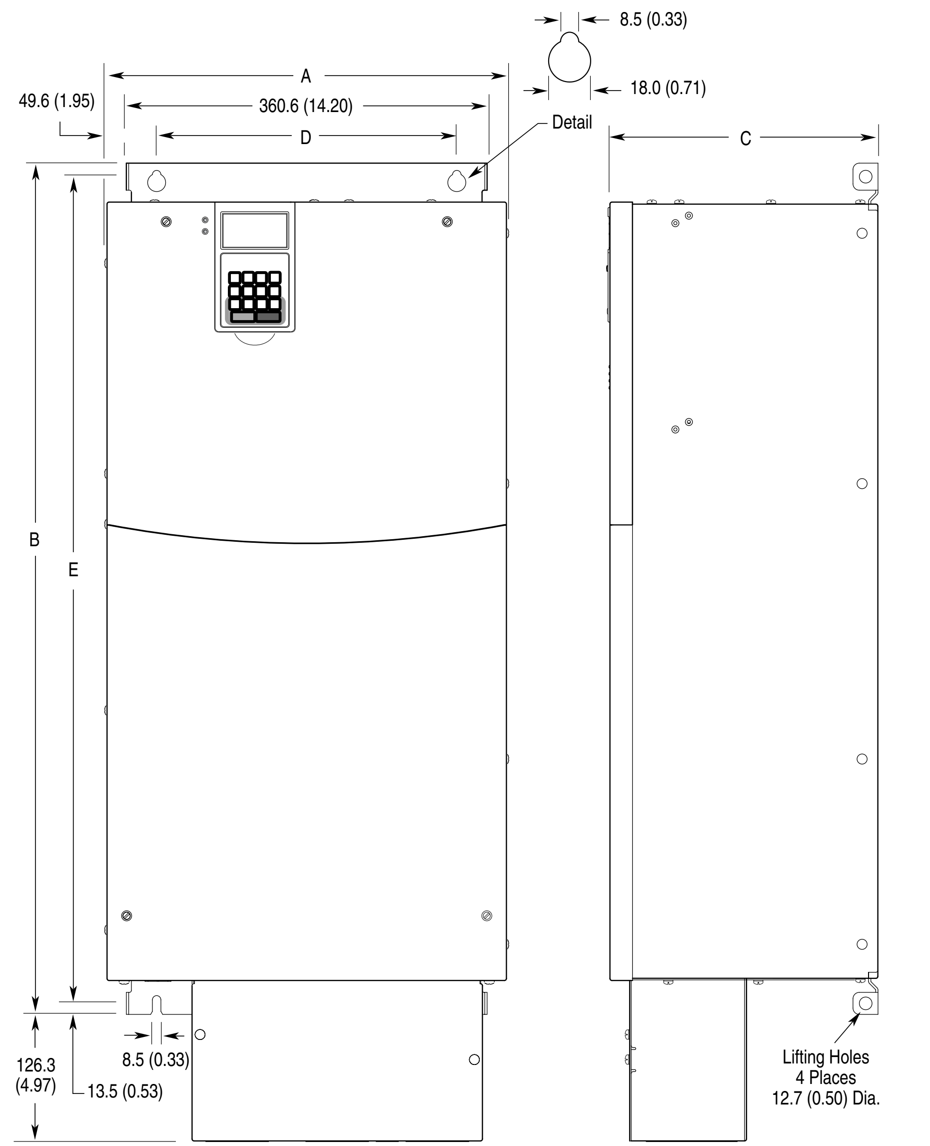
Figure 3.5 – GV6000 Drive Dimensions Frame 4



Frame	HP	A mm (in)	B[1] mm (in)	C mm (in)	D mm (in)	E mm (in)	Weight kg(lb)
5	40 to 50 @ 240 VAC 75 to 100 @ 480 VAC 75 to 100 @ 600 VAC 75 to 100 @ 650 VDC	308.9 (12.16)	644.5 (25.37)	275.4 (10.84)	225.0 (8.86)	625.0 (24.61)	37.19 (82.0)

Figure 3.6 – GV6000 Drive Dimensions Frame 5

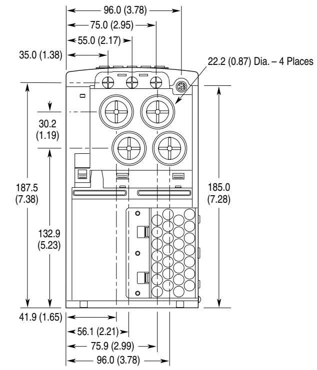
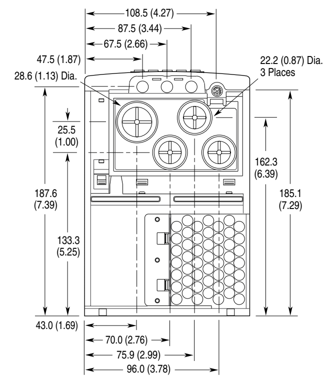
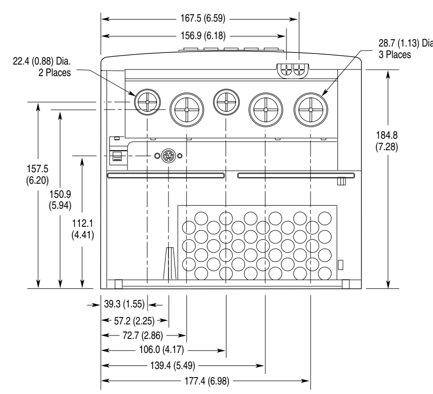
[1]When using the supplied junction box (100 HP drives only), add an additional 45.1 mm (1.78 in.) to this dimension.

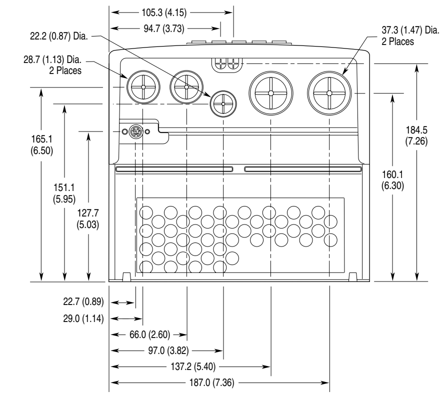
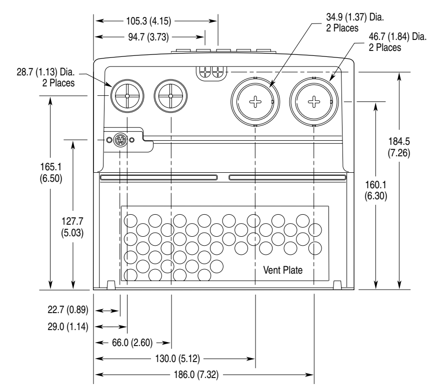
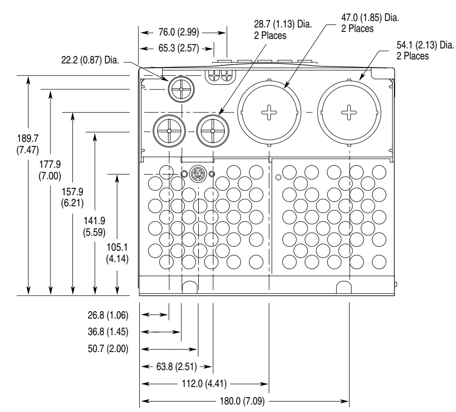


Frame	HP	A mm (in)	B mm (in)	C mm (in)	D mm (in)	E mm (in)	Weight kg(lb)
6	60 to 75 @ 240 VAC 60 to 75 @ 325 VDC 125 to 150 @ 600 VAC 125 to 150 @ 650 VDC	403.9 (15.90)	850.0 (33.46)	275.5 (10.85)	300.0 (11.81)	825.0 (32.48)	71.44 (157.5)
6	100 @ 240 VAC 100 @ 325 VDC	403.9 (15.90)	850.0 (33.46)	275.5 (10.85)	300.0 (11.81)	825.0 (32.48)	85.04 (187.5)
6	200 @ 480 VAC 200 @ 650 VDC	403.9 (15.90)	850.0 (33.46)	275.5 (10.85)	300.0 (11.81)	825.0 (32.48)	88.64 (165.5)

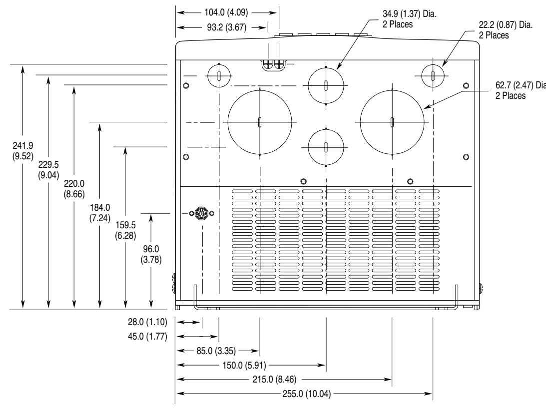
Figure 3.7 – GV6000 Drive Dimensions Frame 6

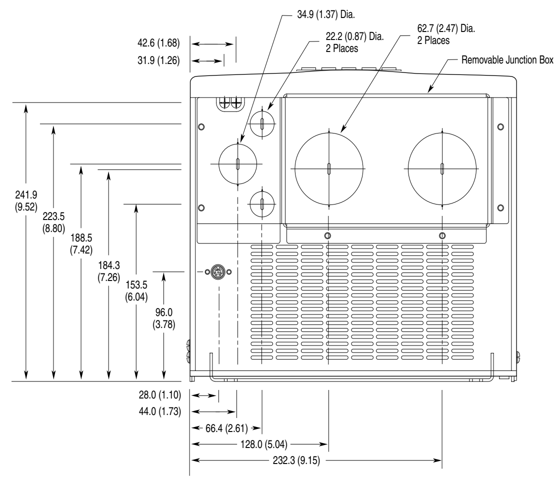
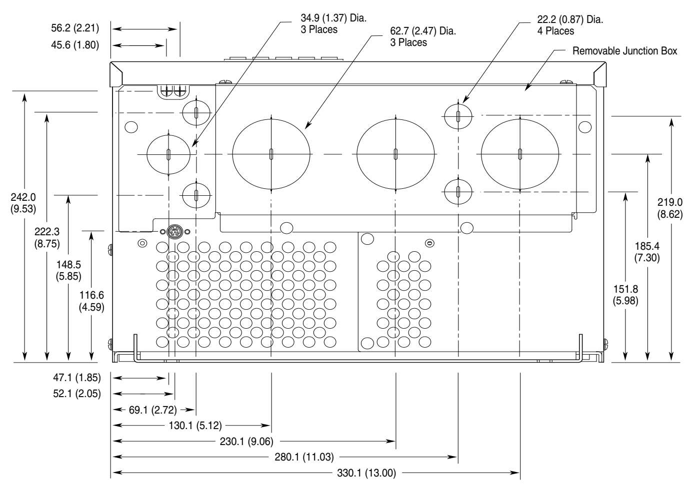
3.1.4.1 Bottom View Dimensions

Frame	Rating	Dimensions
0	All	
1	All	
2	All	

Frame	Rating	Dimensions
3	All except 50HP, 480 V, (37 kW, 400V)	
	50 HP, 480V (37 kW, 400 V) Normal Duty Drive	
4	All	

<table>
<tr><th>Frame</th><th>Rating</th><th>Dimensions</th></tr>
<tr><td rowspan="2">5</td><td>75 HP, 480V,
(55 kW, 400V)
Normal Duty
Drive

75 HP,
650 VDC,
Normal Duty
Drive</td><td>
</td></tr>
<tr><td>100 HP, 480 V
Normal Duty
Drive

100 HP,
650 VDC
Normal Duty
Drive</td><td>
</td></tr>
<tr><td>6</td><td>All</td><td>
</td></tr>
</table>

3.2 Mounting the Drive

Refer to figures 3.4, 3.5, 3.6 and 3.7 for drive mounting dimensions.

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

Note: Drive dimension mounting hole centers are located on rear of drive for reference.

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 2.1 through 2.6. This table lists the typical full load power loss watts value at a carrier frequency of 4 kHz.

3.3 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 chaffing.

Figures 3.8 and 3.9 show the wire routing, grounding terminal and power terminal blocks of the GV6000 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.

> **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.

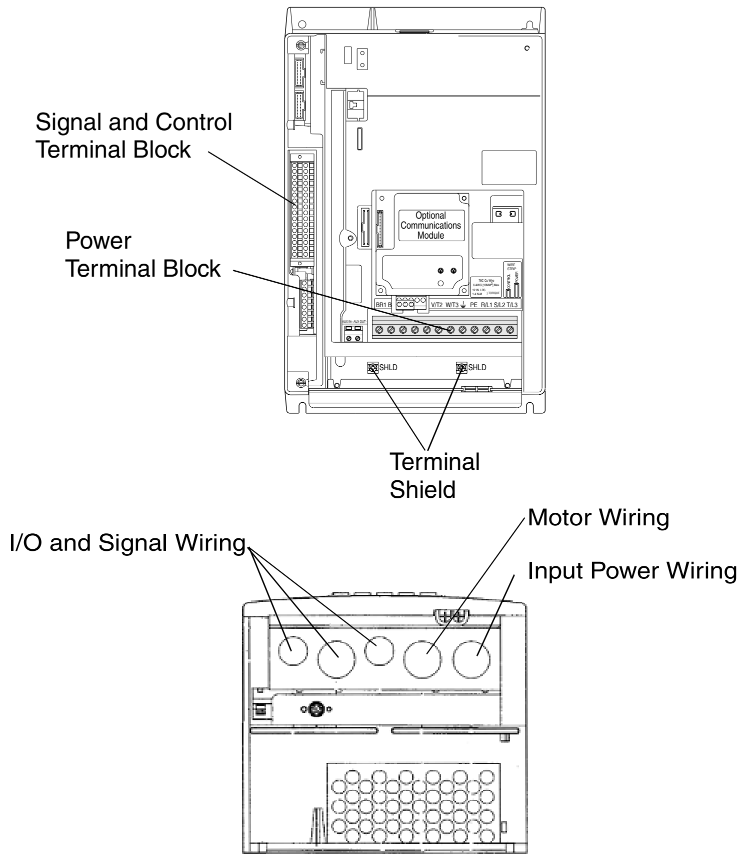


Figure 3.8 – Wire Routing and Terminal Block Locations (Frame 2 Shown)

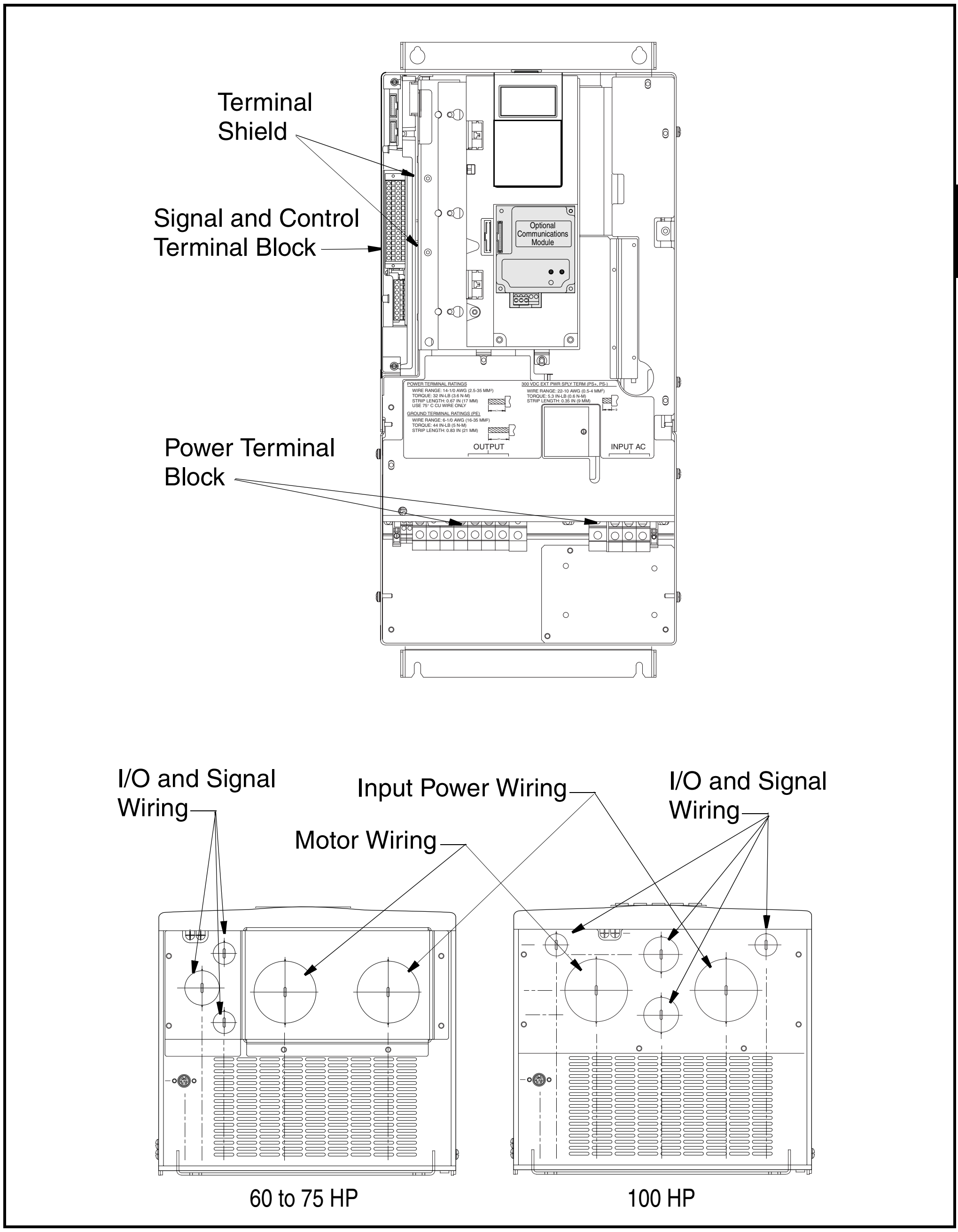


Figure 3.9 – Wire Routing and Terminal Block Locations (Frame 5 Shown)

3.4 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.

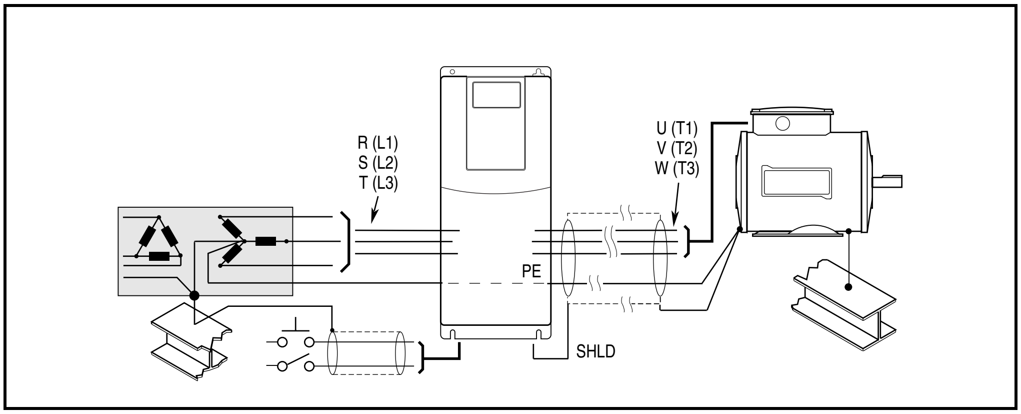


Figure 3.10 – Typical Grounding

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. 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.

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

ATTENTION: 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. Failure to observe this precaution could result in damage to equipment, severe bodily injury or loss of life.

CHAPTER 4

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 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.

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.

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). Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire. 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	• 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	• 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	• 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 5.2 for minimum and maximum wire sizes.

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 AC input disconnect 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 disconnect the AC line from 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 send a stop signal 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.

4.1.3 Common Bus/Precharge Notes

The following notes must be read and understood. Also refer to page 3-5 for additional common bus information.

Important Application Notes

1. If drives without internal precharge are used (Frames 5 and 6 only), then:
   a. precharge capability must be provided in the system to guard against possible damage, and
   b. disconnect switches **Must Not** be used between the input of the drive and a common DC bus without the use of an external precharge device.
2. If drives with internal precharge (Frames 0-6) are used with a disconnect switch to the common bus, then an auxiliary contact on the disconnect must be connected to a digital input of the drive. The corresponding input (parameter 361-366) must be set to option 30, “Prechage Enable.” This provides the proper precharge interlock, guarding against possible damage to the drive when connected to a common DC bus.

4.2 Control and Signal Wiring

> **ATTENTION:** Verify the voltage rating of the I/O Interface board before wiring any user devices. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Table 4.2 – Recommended Signal and Control Wire

Signal Type	Wire Type(s)	Description	Minimum Insulation Rating
		Recommended Signal Wire	
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.	
Encoder/ Pulse I/O	Belden 9728 (or equiv.)	0.196 mm^2 (24 AWG), individually shielded.	
		0.750 mm^2 (18 AWG), twisted pair, shielded.	
EMC Compliance	Refer to EMC Compliance in Section 2.4.		
		Recommended Control Wire for Digital I/O	
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, contained within a cabinet and are not mixed with noisy circuits, the use of shielded wire may not be necessary, but is always recommended.

Table 4.3 – Control Terminal Block Specifications

Name	Frame	Description	Wire Size Range[1] Max	Wire Size Range[1] Min	Torque
I/O Terminal Block	All	Signal & Control Connections	2.1mm (14 AWG)	0.3 mm (22 AWG)	0.6 N-m (5.2 in-lb)
Encoder Terminal Block	All	Encoder Power & Signal Connections	0.75 mm (18 AWG)	0.196 mm (24 AWG)	0.6 N-m (5.2 in-lb)

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

4.3 Meeting Encoder Specifications

GV6000 AC drives can utilize an encoder for closed loop operation. Encoder specifications are provided in table A.6. Drives set up for V/Hz or SVC regulation can utilize an encoder for closed loop speed regulation, but it is not required.

4.4 Recommended Motor Lead Lengths

Important: To reduce nuisance tripping and possible equipment damage, motor lead length should not exceed (91 meters) 300 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:

- Insulation damage due to Reflected wave
- Cable charging

When total lead length exceeds 300 feet, nuisance trips caused by capacitive current flow to ground can occur. 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 reactors 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)
- Drive carrier frequency

Figure 4.1 illustrates how to calculate motor lead lengths. The examples shown assume a maximum lead length of 300 feet.

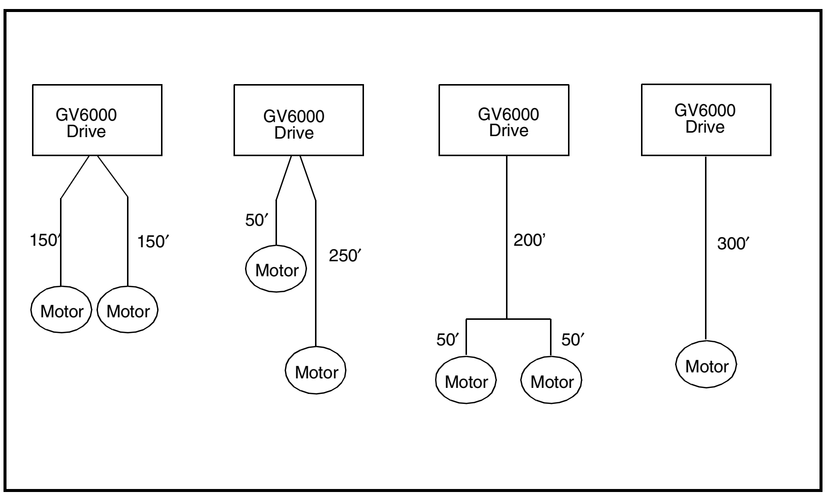


Figure 4.1 – How to Calculate Motor Lead Lengths

4.4.1 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 at the motor terminals 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 11 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 unloaded 10 HP AC induction motor at 60 Hz operation. 500 ft. of #12 AWG PVC cable connects the drive to the motor.

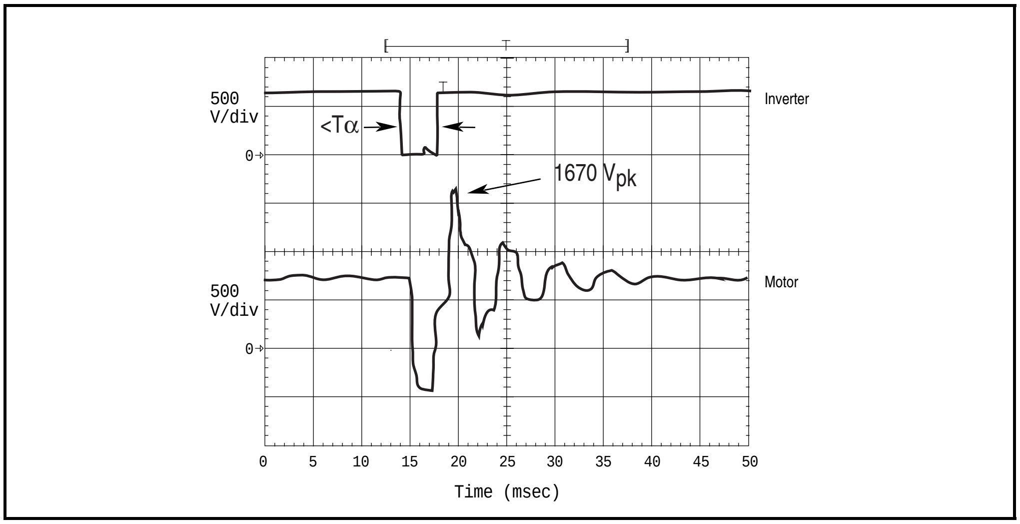


Figure 4.2 – Inverter and Motor Line-to-Line Voltages

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.

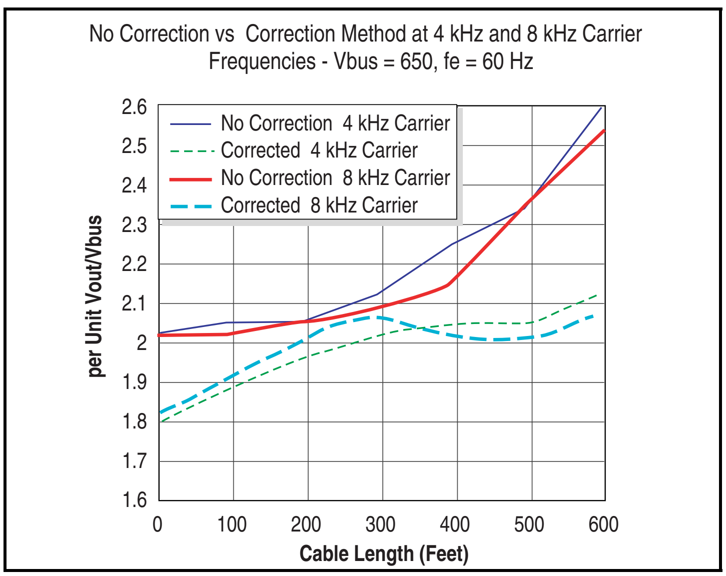


Figure 4.3 – Motor Overvoltage as a Function of Cable Length

4.5 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 4.4 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 4.3, 4.4, 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 & 2[1], EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T or J must be used.

Circuit Breakers

The circuit breakers listed in tables 4.3 through 4.6 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.

IEC and UL - devices are acceptable for IEC and UL installations.

Table 4.4 – AC Line Input Fuse Selection Values (240 VAC)

Model Number 6V21	Frame	Nominal Power Ratings				Dual Element Time Delay Fuse				Non-time Delay Fuse				Circuit Breaker	
		110% OL Duty		150% OL Duty		240 VAC		200 VAC		240 VAC		200 VAC		240 VAC	200 VAC
		kW	HP	kW	HP	Min	Max	Min	Max	Min	Max	Min	Max	A	A
-2P2xx	0	.37	0.5	.25	.33	3	6	3	6	3	10	3	10	15	15
-4P2xx	0	.75	1	.55	.75	5	8	6	10	5	15	6	17.5	15	15
-6P8xx	1	1.5	2	1.1	1.5	10	15	10	15	10	25	10	30	25	30
-9P6xx	1	2.2	3	1.5	2	12	20	12	20	12	35	12	40	35	40
-015xx	1	4	5	2.2	3	20	30	20	35	20	60	20	70	60	70
-022xx	1	5.5	7.5	4	5	25	50	30	50	25	80	30	100	80	100
-028xx	2	7.5	10	5.5	7.5	35	60	40	70	35	100	40	125	100	125
-042xx	3	11	15	7.5	10	50	90	60	100	50	150	60	175	150	175
-052xx	3	15	20	11	15	60	100	80	125	60	200	80	200	200	200
-070xx	4	18.5	25	15	20	90	150	90	175	90	275	90	300	275	300
-080xx	4	22	30	18.5	25	100	180	110	200	100	300	110	350	300	350
-104xx	5	30	40	-	-	125	225	150	250	125	400	150	475	300	350
		-	-	22	30	100	175	125	200	100	300	125	350	300	300
-130xx	5	37	50	-	-	175	275	175	275	175	500	175	500	375	375
		-	-	30	40	125	225	125	225	125	400	125	400	300	300
-154xx	6	45	60	-	-	200	300	225	350	200	600	225	500	450	500
		-	-	37	50	175	275	200	300	175	500	200	500	375	450
-192xx	6	55	75	-	-	225	400	300	450	225	600	300	600	575	600
		-	-	45	60	200	300	225	350	200	600	225	500	450	500
-260xx	6	75	100	-	-	250	450	250	450	250	600	250	600	600	600
		-	-	55	75	350	550	350	550	350	750	350	750	750	750

Table 4.5 – AC Line Input Fuse Selection Values (480 VAC)

Model Number 6V41	Frame	Nominal Power Ratings				Dual Element Time Delay Fuse				Non-time Delay Fuse				Circuit Breaker	
		110% OL Duty		150% OL Duty		480 VAC		400 VAC		480 VAC		400 VAC		480 VAC	400 VAC
		kW	HP	kW	HP	Min	Max	Min	Max	Min	Max	Min	Max	A	A
-1P1xx	0	.37	0.5	.25	.33	3	3	3	3	3	6	3	6	15	15
-2P1xx	0	.75	1	.55	.75	3	6	3	6	3	8	3	8	15	15
-3P4xx	0	1.5	2	1.1	1.5	4	8	6	7	4	12	6	12	15	15
-5P0xx	0	2.2	3	1.5	2	6	10	6	10	6	20	6	20	20	20
-8P0xx	0	4	5	2.2	3	10	15	15	17.5	10	30	15	30	30	30
-011xx	0	5.5	7.5	4	5	15	20	15	25	15	40	15	45	40	45
-014xx	1	7.5	10	5.5	7.5	17.5	30	20	30	17.5	50	20	60	50	60
-022xx	1	11	15	7.5	10	25	50	30	45	25	80	30	80	80	80
-027xx	2	15	20	11	15	35	60	35	60	35	100	35	120	100	120
-034xx	2	18.5	25	15	20	40	70	45	80	40	125	45	125	125	125
-040xx	3	22	30	18.5	25	50	90	60	90	50	150	60	150	150	150
-052xx	3	30	40	22	30	60	110	70	125	60	200	70	200	200	200
-065xx	3	37	50	30	40	80	125	90	150	80	250	90	250	250	250
-077xx	4	45	60	-	-	100	170	110	200	100	300	110	300	300	300
		-	-	37	50	80	125	90	175	80	250	90	275	250	300
-096xx	5	55	75	-	-	125	200	150	275	125	350	150	500	350	375
		-	-	45	60	100	170	125	200	100	300	125	375	300	375
-125xx	5	55	100	-	-	150	250	200	300	150	500	200	400	375	400
		-	-	45	75	125	200	150	225	125	350	150	300	350	300
-156xx	6	93	125	-	-	200	350	250	375	200	600	250	600	450	500
		-	-	75	100	175	250	200	300	175	500	200	550	375	400
-180xx	6	110	150	-	-	225	400	250	450	225	600	250	600	500	600
		-	-	100	125	200	350	250	375	200	600	250	600	450	500
-248xx	6	132	200	-	-	300	550	350	550	300	700	350	750	700	750
		-	-	110	150	225	400	250	450	225	600	250	600	500	600

Table 4.6 – AC Line Input Fuse Selection Values (600 VAC)

Model Number 6V51	Frame	Nominal Power Ratings				Dual Element Time Delay Fuse		Non-time Delay Fuse		Circuit Breaker
		110% OL Duty		150% OL Duty		600 VAC		600 VAC		600 VAC
		kW	HP	kW	HP	Min	Max	Min	Max	A
-1P7xx	0	.75	1	.33	0.5	2	4	2	6	15
-2P7xx	0	1.5	2	.75	1	3	6	3	10	15
-3P9xx	0	2.2	3	1.5	2	6	9	6	15	15
-6P1xx	0	4	5	2.2	3	9	12	9	20	20
-9P0xx	0	5.5	7.5	4	5	10	20	10	35	30
-011xx	1	7.5	10	5.5	7.5	15	25	15	40	40
-017xx	1	11	15	7.5	10	20	40	20	60	50
-022xx	2	15	20	11	15	30	50	30	80	80
-027xx	2	20	25	15	20	35	60	35	100	100
-032xx	3	25	30	20	25	40	70	40	125	125
-041xx	3	30	40	25	30	50	90	50	150	150
-052xx	3	37	50	30	40	60	110	60	200	200
-062xx	4	45	60	37	50	80	125	80	225	225
-077xx	5	55	75	-	-	90	150	90	300	300
		-	-	45	60	90	125	90	250	250
-099xx	5	75	100	-	-	125	200	125	375	375
		-	-	55	75	100	175	100	300	300
-125xx	6	90	125	-	-	150	250	150	375	375
		-	-	75	100	125	200	125	375	375
-144xx	6	110	150	-	-	175	300	175	400	400
		-	-	90	125	150	275	150	375	375

Table 4.7 – DC Common Bus Input Fuse Selection Values

Model Number 6V41	Frame	Nominal Power Ratings				650 VDC	
		110% OL Duty		150% OL Duty			
		kW	HP	kW	HP	Fuse Rating	Bussmann Style Fuse
-1P1xx	0	.37	0.5	.25	.33	6	Bussmann_JKS-6
-2P1xx	0	.75	1	.55	.75	6	Bussmann_JKS-6
-3P4xx	0	1.5	2	1.1	1.5	6	Bussmann_JKS-6
-5P0xx	0	2.2	3	1.5	2	10	Bussmann_JKS-10
-8P0xx	0	4	5	2.2	3	15	Bussmann_JKS-15
-011xx	0	5.5	7.5	4	5	20	Bussmann_JKS-20
-014xx	1	7.5	10	5.5	7.5	30	Bussmann_JKS-30
-022xx	1	11	15	7.5	10	45	Bussmann_JKS-45
-027xx	2	15	20	11	15	60	Bussmann_JKS-60
-034xx	2	18.5	25	15	20	70	Bussmann_JKS-70
-040xx	3	22	30	18.5	25	80	Bussmann_JKS-80
-052xx	3	30	40	22	30	100	Bussmann_JKS-100
-065xx	3	37	50	30	40	150	Bussmann_JKS-150
-077xx	4	45	60	-	-	150	Bussmann_JKS-150
		-	-	37	50	150	Bussmann_JKS-150
Model Number 6VJ1/6VR1	**Frame**	**Nominal Power Ratings**				**650 VDC**	
		110% OL Duty		**150% OL Duty**			
		kW	**HP**	**kW**	**HP**	**Fuse Rating**	**Bussmann Style Fuse**
-096xx	5	55	75	-	-	150	Bussmann_JKS-150
		-	-	45	60	200	Bussmann_JKS-200
-125xx	5	55	100	-	-	200	Bussmann_JKS-200
		-	-	45	75	250	Bussmann_JKS-250
-156xx	6	93	125	-	-	250	Bussmann_JKS-250
		-	-	75	100	300	Bussmann_JKS-300
-180xx	6	110	150	-	-	300	Bussmann_JKS-300
		-	-	100	125	400	Bussmann_JKS-400
-248xx	6	132	200	-	-	400	Bussmann_JKS-400
		-	-	110	150	400	Bussmann_JKS_400

Note: For 325 VDC input drives, contact the factory.

Chapter 5

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. See figure 2.4 for terminal block locations.

5.1 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.

Follow these steps to open the drive cover:

Frames 0 -4

Step 1. Locate the slot in the upper left hand corner of the drive (see figure 5.1).

Step 2. Slide the locking tab up and swing the door open. The hinges allow the cover to move away from the drive and lay on top of adjacent drive (if present). Refer to section 5.1.2 for information on access panel removal.

Frame 5

Step 1. Locate the slot in the upper left hand corner of the drive (see figure 5.1).

Step 2. Slide the locking tab up, loosen the right-hand cover screw and remove. Refer to section 5.1.2. for information on access panel removal.

Frame 6

Step 1. Loosen two screws at bottom of drive cover.

Step 2. Carefully slide bottom cover down and out.

Step 3. Loosen two screws at top of cover and remove.

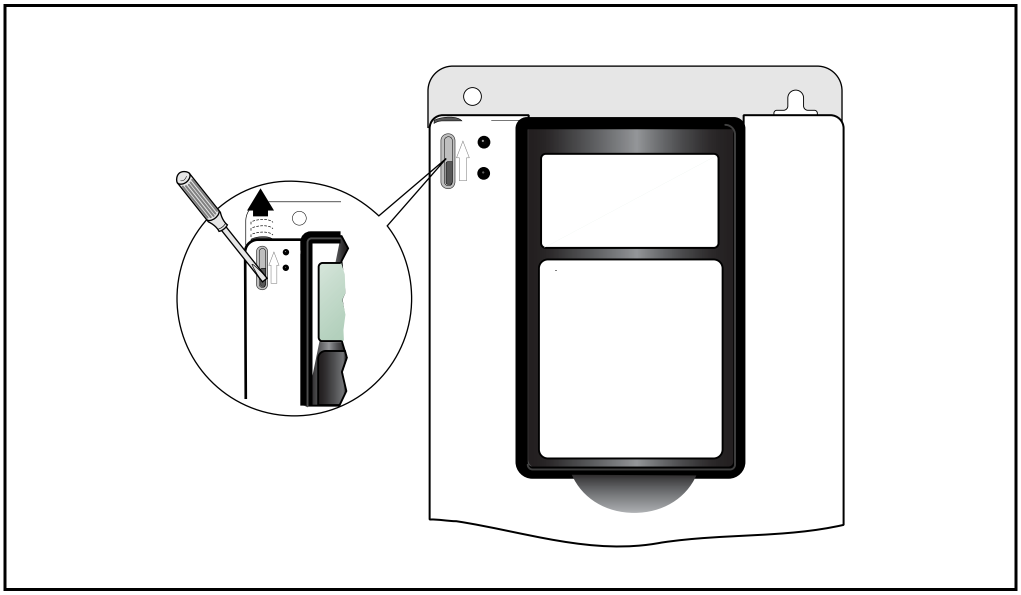


Figure 5.1 – Opening the Drive Cover

5.1.1 Cable Entry Plate Removal

If additional wiring access is needed, the Cable Entry Plate on Frames 0 - 3 drive can be removed. Simply loosen the screws securing the plate to the chassis. The slotted mounting holes allow for easy removal.

Important: Removing the Cable Entry Plate limits the maximum ambient temperature to 40^0 C (104^0 F).

5.1.2 Power Wiring Access Panel Removal

Table 5.1 – Power Wiring Access Panel Removal

Frame	Removal Procedure (Replace when wiring is complete.)
0, 1, 2, & 6	Access Panel is part of front cover.
3	Open front cover and gently slide cover down and out.
4	Loosen the four screws and remove.
5	Remove front cover and gently slide panel up and out.

5.2 Power Terminal Block Specifications

Note: See table 2.7 and figure 2.4 for terminal block descriptions and locations.

Table 5.2 – Power Terminal Block Specifications

No.	Name	Frame	Description	Wire Size Range[1] Maximum	Wire Size Range[1] Minimum	Torque Maximum	Torque Recommended
❶	Power Terminal Block	0 & 1	Input power and motor connections	4.0 mm^2 (10 AWG)	0.5 mm^2 (22 AWG)	1.7 N-m (15 lb.-in.)	0.8 N-m (7 lb.-in.)
		2	Input power and motor connections	10.0 mm^2 (6 AWG)	0.8 mm^2 (18 AWG)	1.7 N-m (15 lb.-in.)	1.4 N-m (12 lb.-in.)
		3	Input power and motor connections	25.0 mm^2 (3 AWG)	2.5 mm^2 (14 AWG)	3.6 N-m (32 lb.-in.)	1.8 N-m (16 lb.-in.)
			BR1, 2 terminals	10.0 mm^2 (6 AWG)	0.8 mm^2 (18 AWG)	1.7 N-m (15 lb.-in.)	1.4 N-m (12 lb.-in.)
		4	Input power and motor connections	35.0 mm^2 (1/0 AWG)	10 mm^2 (8 AWG)	4.0 N-m (35 lb.-in.)	4.0 N-m (35 lb.-in.)
		5 (75 HP)	Input power, BR1, 2, DC+, DC– and motor connections	50.0 mm^2 (1/0 AWG)	2.5 mm^2 (14 AWG)	See Note [2]	
			PE	50.0 mm^2 (1/0 AWG)	4.0 mm^2 (12 AWG)		
		5 (100 HP)	Input power, DC+, DC– and motor	70.0 mm^2 (2/0 AWG)	16.0 mm^2 (6 AWG)		
			BR1, 2, terminals	50.0 mm^2 (1/0 AWG)	2.5 mm^2 (14 AWG)		
			PE	50.0 mm^2 (1/0 AWG)	4.0 mm^2 (12 AWG)		
		6	Input power, DC+, DC–, BR1, 2, PE, motor connections	120.0 mm^2 (4/0 AWG)	2.5 mm^2 (14 AWG)	6 N-m (52 lb.-in.)	6 N-m (52 lb.-in.)
❷	SHLD Terminal	0-6	Terminating point for wiring shields	—	—	1.6 N-m (14 lb.-in.)	1.6 N-m (14 lb.-in.)
❸	AUX Terminal Block	0-4	Auxiliary Control Voltage PS+, PS–[3]	1.5 mm^2 (16 AWG)	0.2 mm^2 (24 AWG)	—	—
		5-6		4.0 mm^2 (12 AWG)	0.5 mm^2 (22 AWG)	0.6 N-m (5.3 lb.-in.)	0.6 N-m (5.3 lb.-in.)
❹	Fan Terminal Block (Common Bus Only)	5-6	User Supplied Fan Voltage (See section 3.1.1.4.)	4.0 mm^2 (12 AWG)	0.5 mm^2 (22 AWG)	0.6 N-m (5.3 lb.-in.)	0.6 N-m (5.3 lb.-in.)

1. Maximum/minimum sizes that the terminal block will accept - these are not recommendations.
2. Refer to the terminal block label inside the drive.
3. External control power: UL Installation-300V DC, ±10%, Non UL Installation-270-600V DC, ±10% 0-3 Frame - 40 W, 165 mA, 5 Frame - 80 W, 90 mA.

5.3 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 figures 3.8 and 3.9 for wire routing locations.

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.

Step 3. Tighten the three-phase AC output power terminals to the proper torque according to drive type as shown in table 5.2.

5.4 Installing Input Wiring

Sections 5.3.1 to 5.3.4 describe incoming line components and how to install them.

5.4.1 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 VAC with less than 5% impedance directly ahead of the drive without additional impedance between the drive and the transformer.

5.4.2 Installing Branch Circuit Protection

Install the required branch circuit protection fuses 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 values are provided in tables 4.4 through 4.7.

> **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.

5.4.3 Installing the Required 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.

5.4.4 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. Connect the AC input power leads to terminals R/L1, S/L2, T/L3 on the power terminal block (see figure 5.2).

Step 2. Tighten the AC input power terminals to the proper torque as shown in table 5.2.

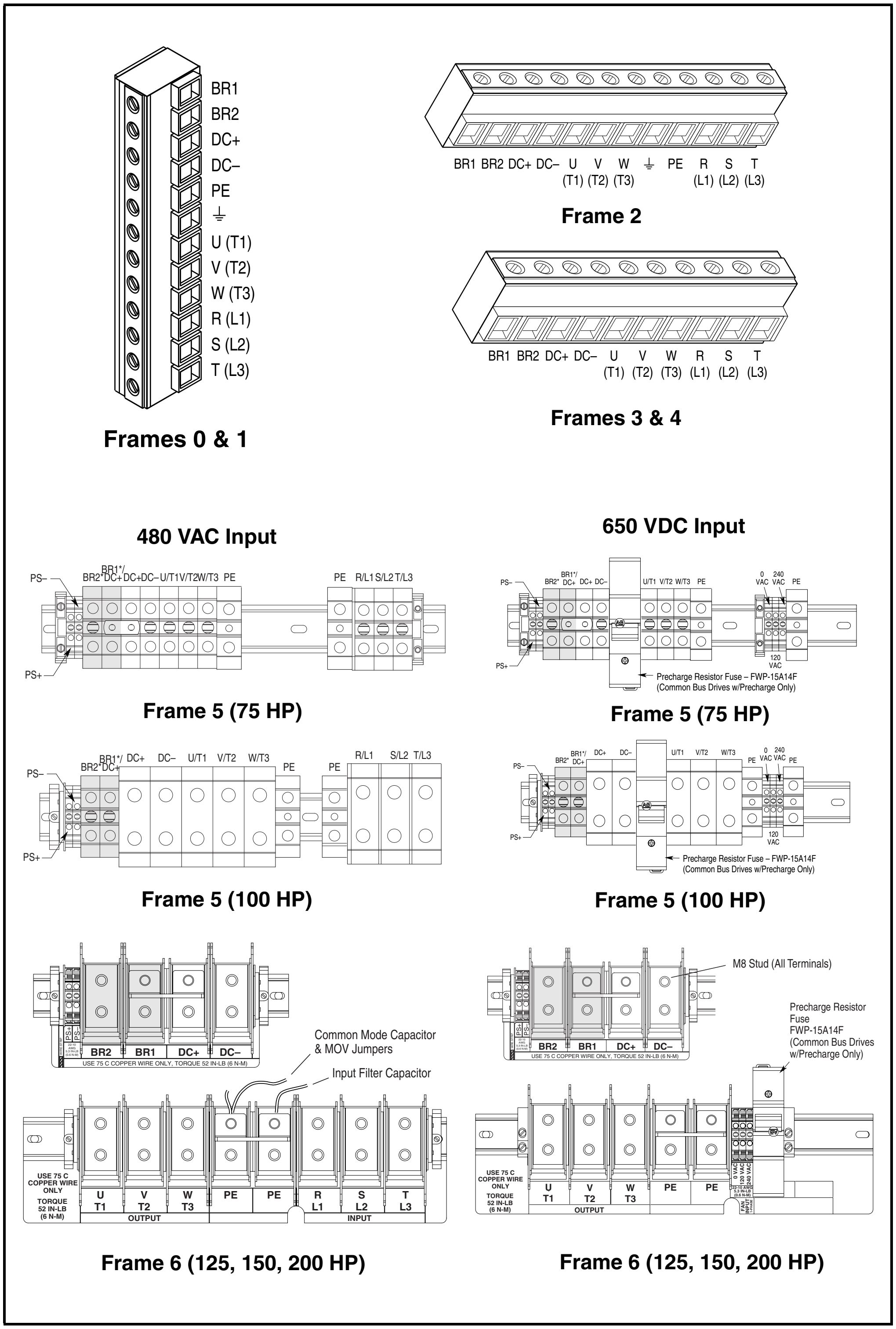


Figure 5.2 – Location of DC Bus Voltage Measuring Points

Table 5.3 – Power Terminal Descriptions

Terminal	Description	Notes
BR1	DC Brake	Dynamic brake resistor connection (+)
BR2	DC Brake	Dynamic brake resistor connection (–)
DC+	DC Bus (+)	DC bus connection (+)
DC–	DC Bus (–)	DC bus connection (–)
U	U (T1)	Output to Motor
V	V (T2)	Output to Motor
W	W (T3)	Output to Motor
⏚ [1]	Ground	
PE[1]	PE Ground	Earth Ground
R	R (L1)	AC line input power
S	S (L2)	AC line input power
T	T (L3)	AC line input power

1. Frame 2 only.

5.5 Dynamic Braking Connections

A dynamic brake consists of the 7th internal braking transistor and an optional dynamic brake resistor.

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

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

Figure 5.3 shows a simplified dynamic braking schematic.

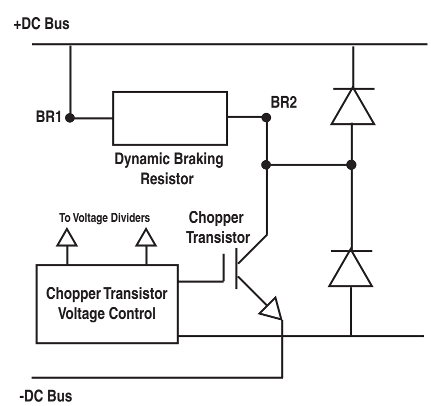


Figure 5.3 – Simplified Dynamic Braking Schematic

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 5.4, or an equivalent, must be supplied.

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

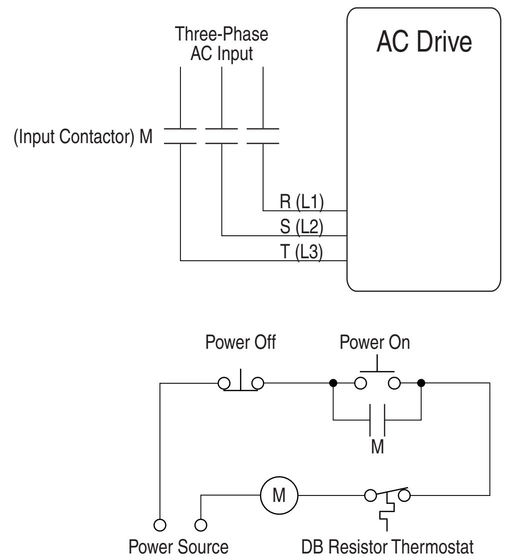


Figure 5.4 – Protective Circuit for External Resistor Packages

When using the braking resistor connections, DB Resistor Type (163) 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.
- **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 GV6000 AC drive.

Table 5.4 – Braking Resistor Capacity

Output Power					Suggested Resistor		
Drive Rating (Normal Duty)	Motor kW	Bus Voltage (VDC)	Absolute Minimum Resistance (Zero Tolerance)	Minimum Resistance with 10% Tolerance	Resistance 10% Tolerance	Peak Power (kW) During On Time	Resulting Braking Torque (expressed in% of rated motor torque)
240 V, 0.5 HP	0.37	395	35.8	40	131	1.08	293%
240 V, 1.0 HP	0.75	395	35.8	40	66	2.15	287%
240 V, 2.0 HP	1.5	395	35.8	40	61	2.33	155%
240 V, 3.0 HP	2.2	395	35.8	40	49	2.89	132%
240 V, 5.0 HP	4	395	29.5	33	33	4.30	107%
240 V, 7.5 HP	5.5	395	22.7	25	24	5.91	107%
240 V, 10 HP	7.5	395	21.0	24	24	5.91	79%
240 V, 15 HP	11	395	11.2	13	13	10.91	99%
240 V, 20 HP	15	395	9.0	10	10	14.18	95%
240 V, 25 HP	18.5	395	9.0	10	10	14.18	77%
240 V, 30 HP	22	395	7.0	8	8	17.73	81%
240 V, 40 HP	30	395	4.6	6	6	23.64	79%
240 V, 50 HP	37	395	4.6	6	6	23.64	64%
240 V, 60 HP 325 VDC, 60 HP	45	395	2.1	3	3	47.28	105%
240 V, 75 HP 325 VDC, 75 HP	55	395	2.1	3	3	47.28	86%
240 V, 100 HP 325 VDC, 100 HP	66	395	TBD	TBD	TBD	TBD	TBD
400 & 480 V, 0.5 HP	0.37	790	63.1	70	502	1.13	305%
400 & 480 V, 1.0 HP	0.75	790	63.1	70	306	1.85	247%
400 & 480 V, 2.0 HP	1.5	790	63.1	70	163	3.48	232%
400 & 480 V, 3.0 HP	2.2	790	63.1	70	131	4.33	197%
400 & 480 V, 5.0 HP	4	790	63.1	70	97	5.85	146%
400 & 480 V, 7.5 HP	5.5	790	63.1	70	70	8.11	147%
400 & 480 V, 10 HP	7.5	790	63.1	70	70	8.11	108%
400 & 480 V, 15 HP	11	790	43.3	48	48	11.82	107%
400 & 480 V, 20 HP	15	790	40.2	45	45	12.61	84%
400 & 480 V, 25 HP	18.5	790	28.2	32	32	17.73	96%
400 & 480 V, 30 HP	22	790	21.7	24	24	23.64	107%
400 & 480 V, 40 HP	30	790	18.7	21	21	27.02	90%
400 & 480 V, 50 HP	37	790	18.7	21	21	27.02	73%
400 & 480 V, 60 HP	45	790	15.4	17	17	33.37	74%
400 & 480 V, 75 HP 650 VDC, 75 HP	55	790	9.2	11	11	51.58	94%
400 & 480 V, 100 HP 650 VDC, 100 HP	75	790	9.2	11	11	51.58	69%

Table 5.4 – Braking Resistor Capacity

Output Power		Bus Voltage (VDC)	Absolute Minimum Resistance (Zero Tolerance)	Minimum Resistance with 10% Tolerance	Suggested Resistor		
Drive Rating (Normal Duty)	**Motor kW**				**Resistance 10% Tolerance**	**Peak Power (kW) During On Time**	**Resulting Braking Torque (expressed in% of rated motor torque)**
400 & 480 V, 125 HP 650 VDC, 125 HP	93	790	4.4	5	5	113.47	122%
400 & 480 V, 150 HP 650 VDC, 150 HP	110	790	4.4	5	5	113.47	103%
400 & 480 V, 200 HP 650 VDC, 200 HP	132	790	3.3	4	4	141.84	107%
600 V, 1.0 HP	0.75	987.5	84	93	471	1.88	251%
600 V, 2.0 HP	1.5	987.5	84	93	255	3.48	232%
600 V, 3.0 HP	2.2	987.5	84	93	209	4.24	193%
600 V, 5.0 HP	4	987.5	84	93	120	7.39	185%
600 V, 7.5 HP	5.5	987.5	75.5	84	84	10.55	192%
600 V, 10 HP	7.5	987.5	75.5	84	84	10.55	141%
600 V, 15 HP	11	987.5	52.0	58	58	15.28	139%
600 V, 20 HP	15	987.5	41.8	46	46	19.27	128%
600 V, 25 HP	20	987.5	36.1	40	40	22.16	111%
600 V, 30 HP	25	987.5	28.9	32	32	27.70	111%
600 V, 40 HP	30	987.5	24.3	27	27	32.83	109%
600 V, 50 HP	37	987.5	24.3	27	27	32.83	89%
600 V, 60 HP	45	987.5	17.7	20	20	44.33	99%
600 V, 75 HP	55	1135	18.1	20	20	58.56	106%
600 V, 100 HP	75	1135	18.1	20	20	58.56	78%
600 V, 125 HP	90	1135	6.3	7	7	167.30	186%
600 V, 150 HP	110	1135	6.3	7	7	167.30	152%

CHAPTER 6

Installing Regulator Board Control Wiring

This chapter describes how to wire the signal and I/O terminal strip for stop, speed feedback, and remote control signals.

6.1 Stop Circuit Requirements

> **ATTENTION:** The user must provide an external, hardwired 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.

Depending upon the requirements of the application, the GV6000 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 stop external to the drive. This stop circuit must contain only hardwired electromechanical components. Operation of the hardwired 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 stop you install can be used at any time to stop the drive.

6.1.1 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 input and the Function Loss input, if configured, are always active. This is independent of the Logic Source Select setting. The terminal block Stop input must be closed only when the terminal block is selected as the logic source. Refer to figure 6.1.

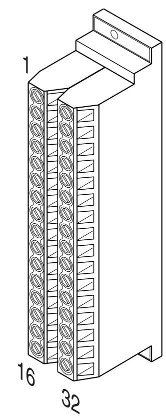
6.2 Wiring the Signal and Control I/O

Important: Two I/O boards are available: 24 VDC logic and 115 VAC logic. Verify which board is installed in the drive before wiring the signal and control I/O terminal block. This can be verified by the drive's model number or by a label on the side of the I/O Cassette.

Note: If the 115 VAC logic board is used, the 115 VAC control power must be supplied separately by the user.

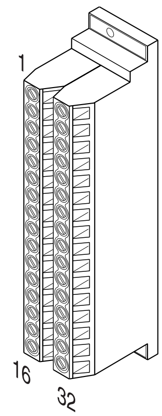
Wire the drive's signal and control I/O to the terminal block as shown in table 6.1.

Table 6.1 – Wiring Signal and Control I/O to the Terminal Block



No.	Signal	Factory Default	Description	Related Param.
1	Analog In 1 (-)[1]	[2]	Isolated[3], bipolar, differential, +/- 10V/4-20mA, 11 bit plus sign, 88k ohm input impedance. For 4-20mA, a jumper must be installed at terminals 17 and 18 (or 19 and 20).	320 - 327
2	Analog In 1 (+) [1]			
3	Analog In 2 (-) [1]			
4	Analog In 2 (+) [1]			
5	Pot Common	-	For (+) and (-) 10V pot references.	
6	Analog Out 1 (-)	[2]	Bipolar (current output is not bipolar), +/- 10V/4-20mA, 11 bit plus sign, voltage mode-limit current to 5 mA. Current mode - max load resistance is 400 ohms.	340 - 347
7	Analog Out 1 (+)			
8	Analog Out 2 (-)			
9	Analog Out 2 (+)			
10	HW PTC Input 1	-	1.8k ohm PTC, internal 3.32k ohm pull-up resistor	18, 211, 238, 259

Table 6.1 – Wiring Signal and Control I/O to the Terminal Block



11	Digital Out 1 - N.C. [4]	Fault	Max. Resistive Load: 240 VAC/30 VDC - 1200VA, 150W Max Current: 5A Min. Load: 10mA Max Inductive Load: 240 VAC/30 VDC - 840VA, 105W Max Current: 3.5 A Min Load: 10mA	380 - 391
12	Digital Out 1 Common			
13	Digital Out 1- N.O.[4]	NOT Fault		
14	Digital Out 2 - N.C. [4]	NOT Run		
15	Digital Out 2/3 Com.			
16	Digital Out 3 - N.O.[4]	Run		
17 18	Current In Jumper[1] - Analog In 1		Placing a jumper across terminals 17 and 18 (or 19 and 20) will configure that analog input for current. (Parameter 320 must be set ON.)	320
19 20	Current In Jumper [1]- Analog In 2			
21	-10V Pot Reference	-	2k ohm minimum load.	
22	+10V Pot Reference	-		
23	HW PTC Input 2	-	1.8k ohm PTC, internal 3.32k ohm pull-up resistor	18, 238, 211, 259
24*	+24 VDC[5]	-	Drive supplied logic input power.[5]	
25*	Digital In Common	-		
26*	24V Common [5]	-	Common for internal power supply.[5]	
27	Digital In 1	Stop-CF	115VAC, 50/60 Hz - Opto isolated Low State: less than 30 VAC High State: less than 100VAC 24VDC - Opto Isolated Low State: less than 50VDC High State: greater than 20VDC 11.2 mA DC	361 - 366
28	Digital In 2	Start		
29*	Digital In 3	Function Loss		
30	Digital In 4	Jog		
31	Digital In 5	Auto/Man.		
32	Digital In 6/Hardware Enable[6]	Speed Sel 1		

1.**Important:** 4-20mA operation requires a jumper at terminals 17 and 18 (or 19 and 20). Drive damage may occur if jumper is not installed.
2.These inputs/outputs are dependent on a number of parameters (see Related Params).

3.Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.
4.Contacts in unpowered state. Consists of 3 relay (dry contact) outputs. Digital Out 1 consists of 1N.O./1 N.C. contact, Digital Out 2 consists of 1 N.C. and Digital Out 3 consists of 1 N.O. contact. Digital Out 2 & 3 share a common terminal (terminal 15). Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.
5.150mA maximum load. Not present on 115V versions.
6.See section 6.4 for more information on hardware enable.

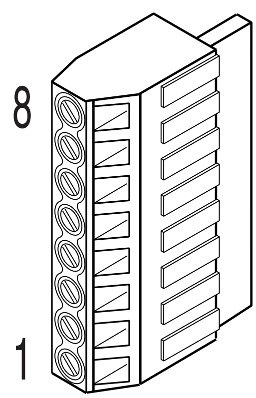
Important: Terminals 24 & 26 are utilized onluy on 24VDC I/O Boards. They are not to be used on 115VAC I/O Boards. 115VAC control power must be provided by user for 115VAC I/O Boards.

Important: *Factory installed jumpers exist between terminals 24 & 29 and between terminals 25 & 26 on the 24 VDC Logic Board only. The jumpers are not present on the 115 VAC Logic Board. The user is responsible for the removal of one or both of these jumpers in order to implement an external function loss circuit.

6.3 Wiring the Encoder Terminal Block

Wire the drive's encoder terminal block as shown in table 6.2.

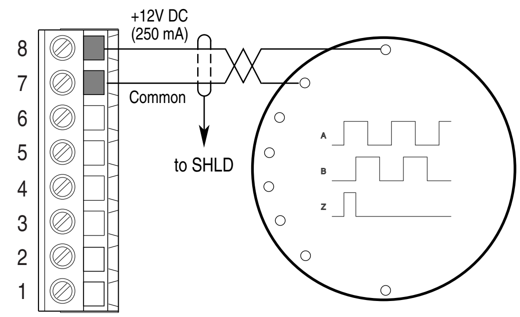
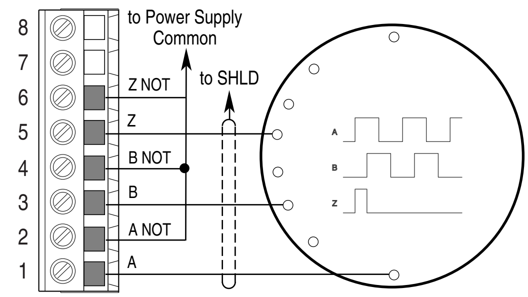
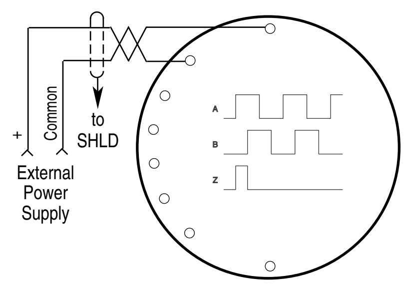
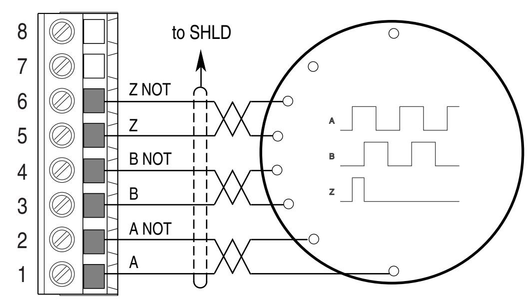
Table 6.2 – Wiring Encoder Terminal Block



No.	**Description** (See Appendix A for Encoder Specifications.)	
8	+12 VDC Power	Internal power source 250mA.
7	+12 VDC Return (Common)	
6	Encoder Z (NOT)	Pulse marker or registration input. [1]
5	Encoder Z	
4	Encoder B (NOT)	Quadrature B input.
3	Encoder B	
2	Encoder A (NOT)	Single channel or quadrature A input.
1	Encoder A	

1.Z channel can be used as a pulse input while A and B are used for encoder.

6.3.1 Encoder Wiring Examples

I/O	Connection Example
Encoder Power - Internal Drive Power Internal (drive) 12 VDC, 250mA	
Encoder Signal - Single-Ended, Dual Channel	
Encoder Power - External Power Source	
Encoder Signal - Differential, Dual Channel	

6.4 Hardware Enable Circuitry

Any of the six (6) digital inputs can be programmed as an Enable input. The status of this input is interpreted by drive software. If the application requires the drive to be disabled without software interpretation, a dedicated hardware enable configuration can be utilized. This is done by removing a jumper and wiring the enable input to Digital In 6. Refer to figure 6.1.

Step 1. Remove the I/O Control Cassette from drive and the cover from the I/O Cassette.

Step 2. Locate and remove Jumper J10 on the Main Control Board.

Step 3. Reassemble cassette.

Step 4. Wire Enable to Digital In 6.

Note: Digital In6 Sel (366) will automatically be set to 1 = Enable.

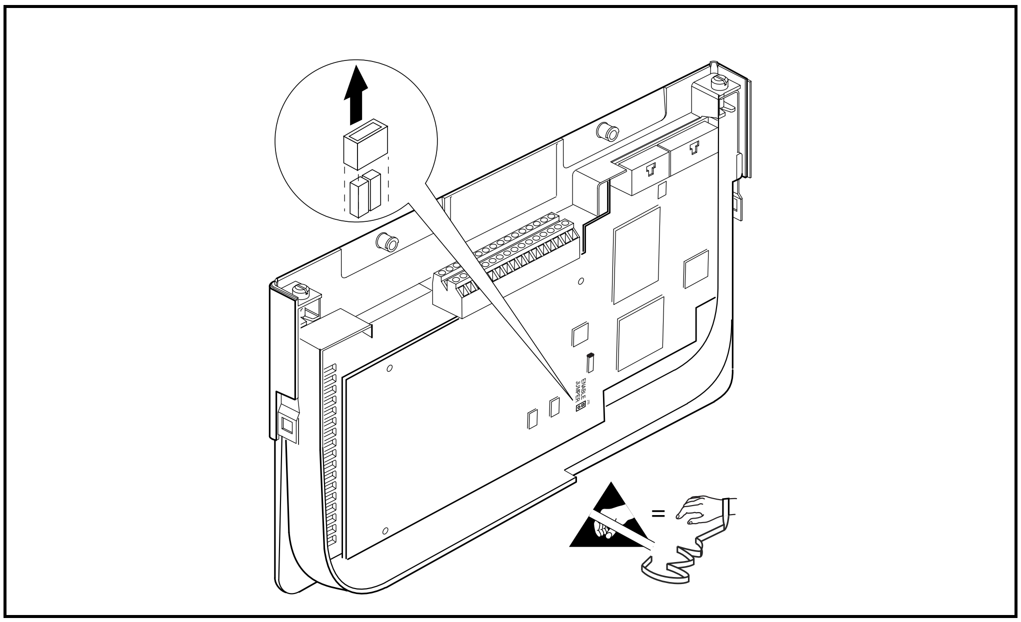
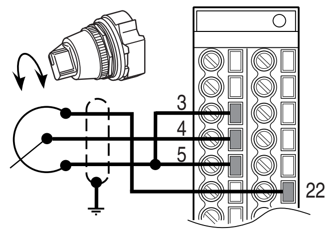
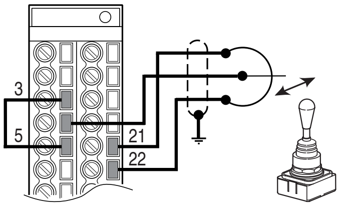
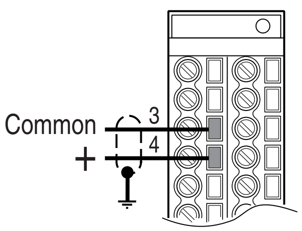
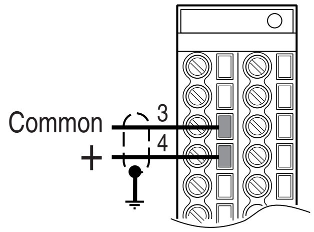
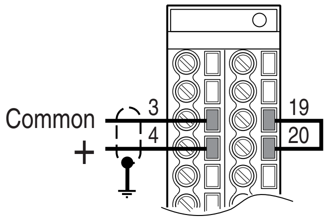
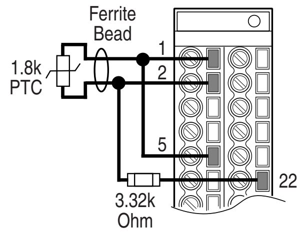
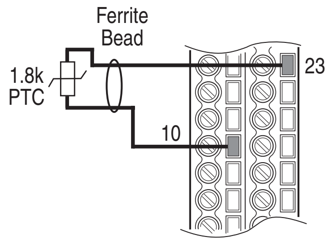
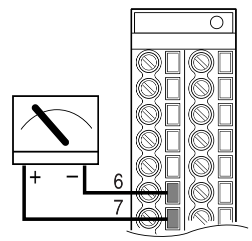
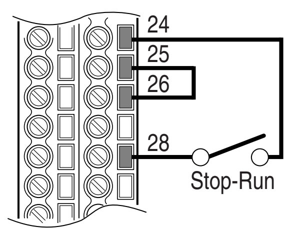
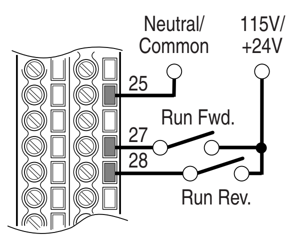


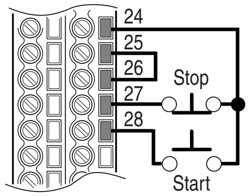
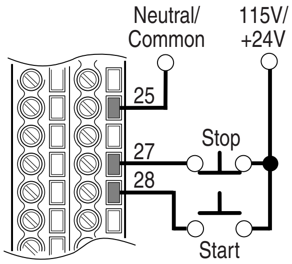
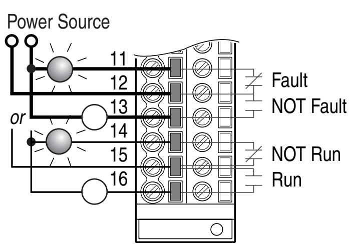
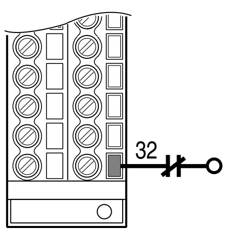
Figure 6.1 – Hardware Enable Circuitry

6.5 I/O Wiring Examples

> **ATTENTION:** When using bipolar analog inputs, unpredictable changes in motor speed and direction can be caused by noise and drift in sensitive circuits. Use speed command parameters to help reduce input source sensitivity. Failure to observe this precaution could result in bodily injury or damage to equipment.

Input/Output	Connection Example	Required Parameter Changes
Potentiometer Unipolar Speed Reference 10k Ohm Pot. Recommended (2k Ohm Minimum)		Adjust Scaling: Parameters 91/92 and 325/326 View Results: Parameter 02
Joystick Bipolar Speed Reference +/- 10V Input		Set Direction Mode: Parameter 190 set to 1 = Bipolar Adjust Scaling: Parameters 91/92 and 325/326 View Results: Parameter 02
Analog Input Bipolar Speed Reference +/- 10V Input		Set Direction Mode: Parameter 190 set to 1 = Bipolar Adjust Scaling: Parameters 91/92 and 325/326 View Results: Parameter 02
Analog Voltage Input Unipolar Speed Reference 0 to +10V Input		Configure input for Current: Parameter 320 and add jumper at appropriate terminals Adjust Scaling: Parameters 91/92 and 325/326 View Results: Parameter 02
Analog Current Input Unipolar Speed Reference 4-20 mA Input		Configure input for Current: Parameter 320 and add jumper at appropriate terminals Adjust Scaling: Parameters 91/92 and 325/326 View Results: Parameter 02

Input/Output	Connection Example	Required Parameter Changes
Analog Input PTC PTC OT set > 5V PTC OT cleared<4V PTC Short < 0.2V		Set Fault Config 1 (238) to bit 7 = Enabled. Set Alarm Config 1 (259) to bit 11 = Enabled.
HW PTC Input PTC OT set > 5V PTC OT cleared<4V PTC Short < 0.2V		Set Fault Config 1 (238) to bit 13 = Enabled. Set Alarm Config 1 (259) to bit 18 = Enabled
Analog Output +/- 10V, 4-20mA Bipolar, +10V Unipolar (shown in example)		Configure with parameter 340. Select Source Value: Digital Out1 Sel (384) Adjust Scaling: parameters 343/344
2-Wire[1] Control Non-Reversing 24V DC internal supply		Set Digital Input 1 (361) to 0 = Unused. Set Digital Input 2 (362) to 7 = Run. Set Direction Mode (190) to 0 = Unipolar.
2-Wire[1] Control Reversing External supply (I/O Board dependent)		Set Digital Input 1(361) to 8 = Run Forward. Set Digital Input 2 (362) to 9 = Run Reverse.

Input/Output	Connection Example	Required Parameter Changes
3-Wire Control Internal Supply		No changes required.
3-Wire Control External supply (I/O Board dependent). Requires 3-wire functions only (Digital In1 Sel). Using 2-wire selections will cause a type 2 alarm		No changes required.
Digital Output Relays (two at terminals 14 and 16) shown in powered state with drive faulted.		Select source to activate: Parameters 380 and 384.
Enable Input		Configure with parameter 366. For dedicated hardware enable, remove jumper J10.

1.**Important:** Programming inputs for 2 wire control deactivates all OIM Start buttons.

6.6 Wiring Diagram - Control and Motor

ATTENTION: Opening the Function Loss input (terminals 24 to 29) will stop the drive. You must ensure that all terminal strip inputs are wired properly for your drive configuration. Failure to observe this precaution could result in severe bodily injury or loss of life.

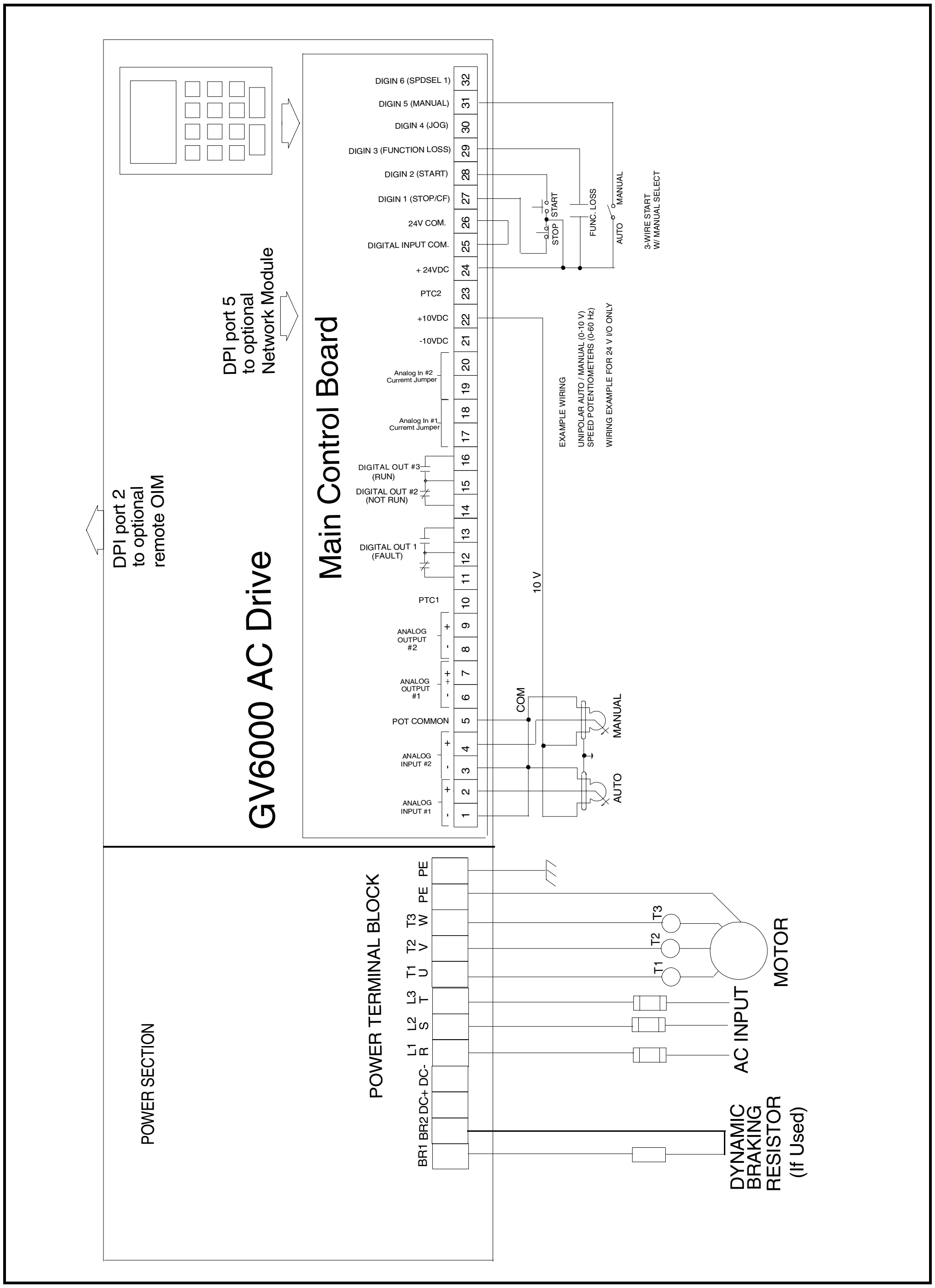


Figure 6.2 – Typical Wiring Diagram (Using Internally Supplied 24 VDC Inputs)

Table 6.3 – Parameter Configuration for Figure 6.2 Wiring Example

Param Number	Description	Value
79	Speed Units	Hz
89	Logic Source Sel	Terminal Blk
90	Speed Ref A Sel	Analog In1
91	Spd Ref A Hi	60 Hz
92	Spd Ref A Lo	0 Hz
96	TB Man Ref	Analog In2
97	TB Man Ref Hi	60 Hz
98	TB Man Ref Lo	0 Hz
320	Analog Conf	xxx.xx00
322	Analog In 1 Hi	10 V
323	Analog In 1 Lo	0 V
325	Analog In 2 Hi	10 V
326	Analog In 2 Lo	0 V
361	Diital In1 Sel	Stop-CF
362	Digital In2 Sel	Start
363	Digital In3 Sel	Function Loss
365	Digital In5 Sel	Auto/Manual

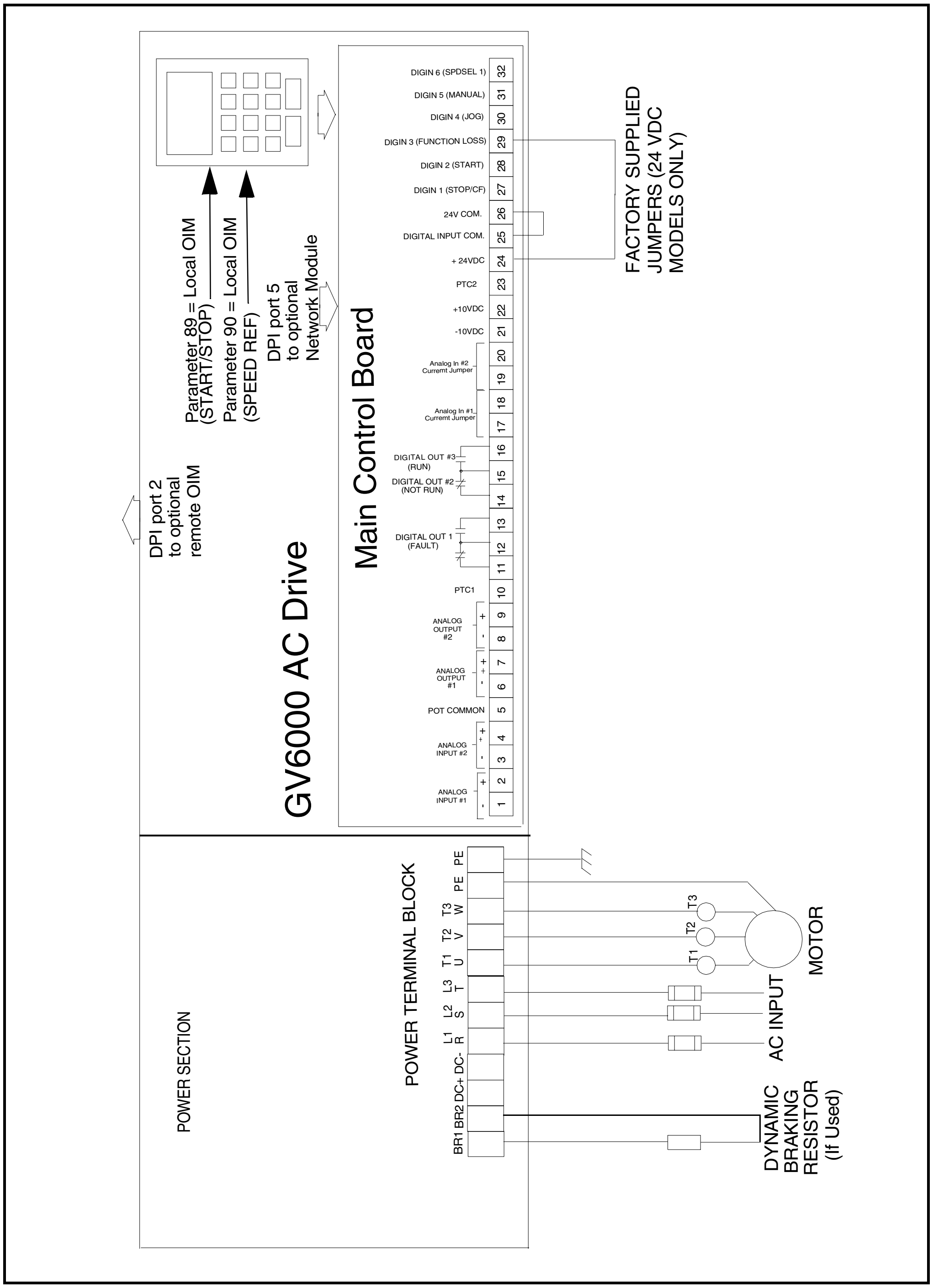


Figure 6.3 – Wiring Diagram - Default Drive Configuration (Using Internally Supplied 24 VDC Inputs)

6.7 Speed Reference Control

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

6.7.1 Auto Reference Source

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, Auto/Manual 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 (90). If Speed Select digital inputs are defined on the terminal block, the drive could use other parameters as the speed reference source.

6.7.2 Manual Reference Source

The manual source for speed command to the drive is either the OIM requesting manual control or the control terminal block (analog input) if a digital input is programmed to Auto/Manual.

6.7.3 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. Refer to figure 6.2.

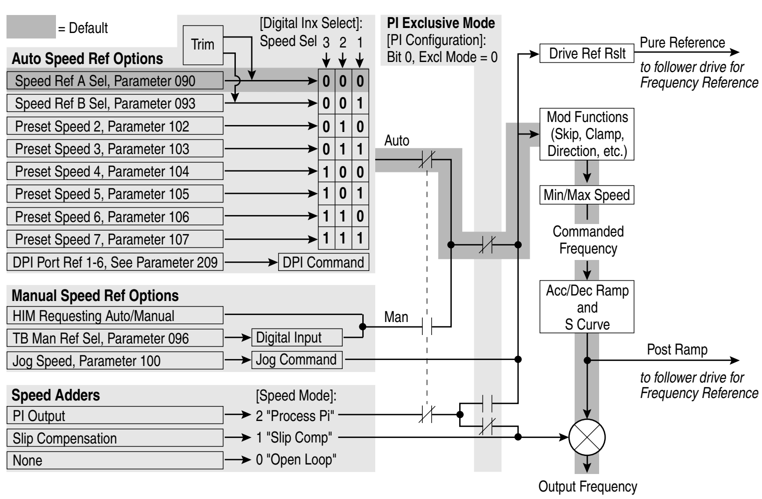


Figure 6.4 – Speed Reference Control Flowchart

6.7.4 Torque Reference Source

The torque reference is normally supplied by an analog input or network reference. Switching between available sources while the drive is running is not available. Digital Inputs programmed as “Speed Sel 1, 2, 3” and the OIM Auto/Manual function do not affect the active torque reference when the drive is in Vector Control Mode.

6.7.5 Auto/Manual Control

Manual control is not exclusive and is granted to the last device requesting it.

If an OIM has manual control and power is removed from the drive, the drive will return to Auto mode when power is reapplied.

6.8 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.

CHAPTER 7

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.

7.1 Checking the Installation

> **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.
>
> **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.

Use the following procedure 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.

Step 3. If a function loss coast-to-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 nothing is 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 the 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.

7.2 Powering Up After Installation Is Complete

Use the following procedure 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 9.

Software

This section of the manual contains information regarding software components, including using the LCD OIM, of the GV6000 AC Drive.

CHAPTER 8

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 8.1 – GV6000 Standard LCD OIM

8.1 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 cable (RECBL-LCD) must be used to convert the OIM for hand-held use.

Remote Mounted: A remote mount OIM is available.

Note: For Hand-Held or Remote Mounted OIM's, the maximum cable length is 32 feet when using extender cables. The connection can be made directly to the external DPI connector using DPI Port 2. If a splitter cable (RECBL-SSP) is used, both DPI Ports 2 and 3 are available.

8.2 Installing and Removing the Local LCD OIM

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.

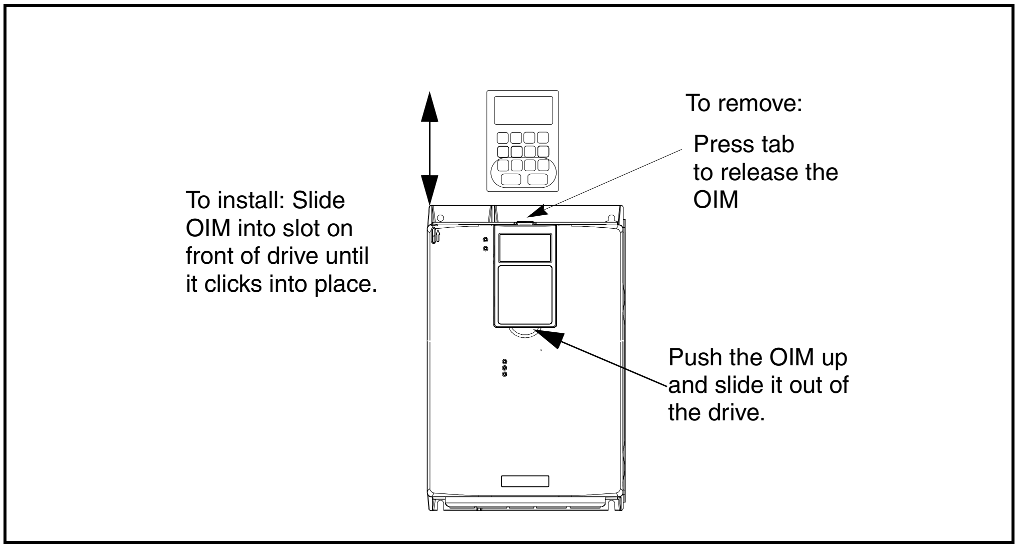


Figure 8.2 – Installing and Removing the Local LCD OIM

8.2.1 Removing the Local LCD OIM While the Drive is Powered

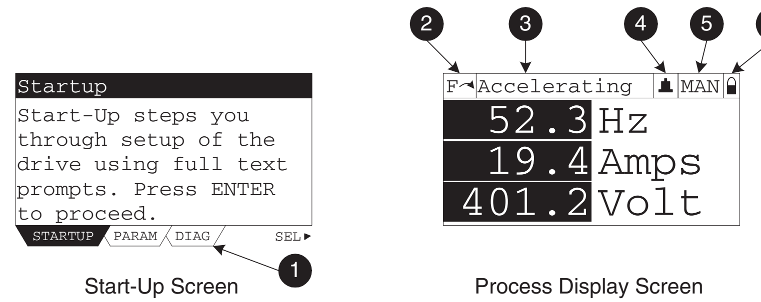
If the local LCD OIM is the selected control source, removing the OIM while the drive is powered will cause a drive fault.

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.

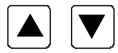
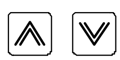
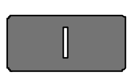
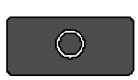
8.3 Display Description



1	Menu Tabs
2	Direction Indicator. Indicates actual motor direction.
3	Operating status (running, stopped, etc.)
4	Alarm annunciation. = Alarm is active.
5	Auto/Manual mode status.
6	Write-protect password status: (unlocked) = Password disabled (locked) = password enabled

Figure 8.3 – Screen Displays

8.3.1 Key Descriptions

Key	Function
	Scroll through list options or decrease/increase parameter values.
SEL	The SEL key selects the next tab and selects digit on numeric data entry.
	The Enter key accepts data changes and activates a selected list item.
DISP	The Display key cycles through the display/status screens.
FAULT ALARM	The FAULT/ALARM key cycles through fault queue and alarm queue displays.
AUTO MAN	The AUTO/MAN key switches between selected Auto reference and Local OIM reference. In AUTO mode, the drive takes its reference from the selected programmed reference. In MANUAL mode, the drive takes its reference from the local OIM.
ESC PROG	The ESC/PROG key goes back to the previous screen and aborts the current menu state.
	The Chevron keys Increases/Decreases local OIM reference.
	Changes motor direction if the OIM is the control source.
JOG	The JOG key jogs the drive only when the drive is not running and the logic control source is set to OIM upon which the Jog is asserted. Hitting the JOG key slowly turns the drive for as long as the key is pressed. JOG will stop when the JOG key is released. If the drive is in Jog mode, hitting the Start key will cause it to switch to run mode.
	Start drive. The Start key only works if the logic control source is set to the OIM upon which the Start is asserted.
	Stop the drive/Reset active fault.

8.4 LCD OIM Menu Structure

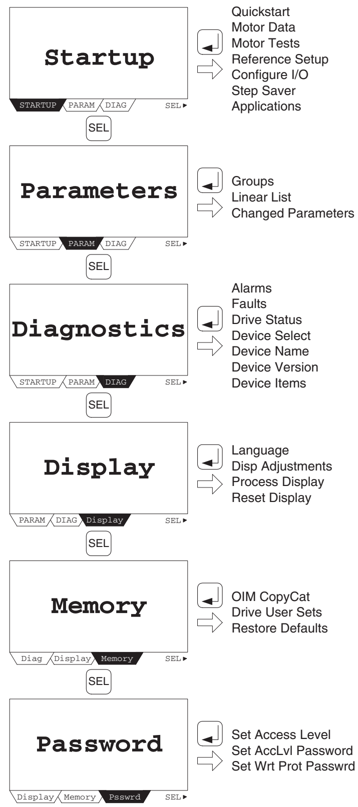


Figure 8.4 – LCD OIM Menu Structure

8.5 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. (English is initially set as the default.) The OIM will display the selected language on subsequent start-ups. The OIM displays the Start-Up menu at each start up.

After initial power-up, the language can be changed by selecting Language from the Display menu.

8.5.1 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 PowerUp Mode from the Display Menu. This feature will remain active for subsequent power-ups of OIM until re-programmed to be inactive.

8.5.2 Adjusting the Screen Contrast

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

8.5.3 Setting the Display Time Out Period

When the OIM is inactive (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 the up, down, sel, enter, or esc/prog key.

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).

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

8.5.4 Selecting Reverse Video for the Process Display Screen

To select normal or reverse video for the process display screen, select Display Adjustments from the Display tab.

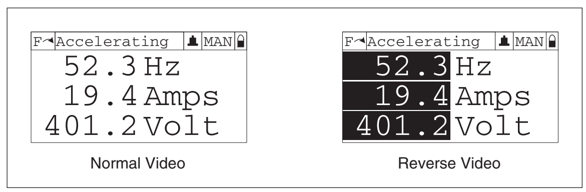


Figure 8.5 – Selecting Reverse Video for the Process Display Screen

8.5.5 Resetting the Display

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

8.6 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 tab. The options listed depend on what is connected to the network.

8.7 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. The selected device (port number) is indicated on the OIM as “pn” where “n” is the part number. If the drive is selected, the port number is not displayed.

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

8.7.1 Viewing and Adjusting Parameters

Refer to chapter 10 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

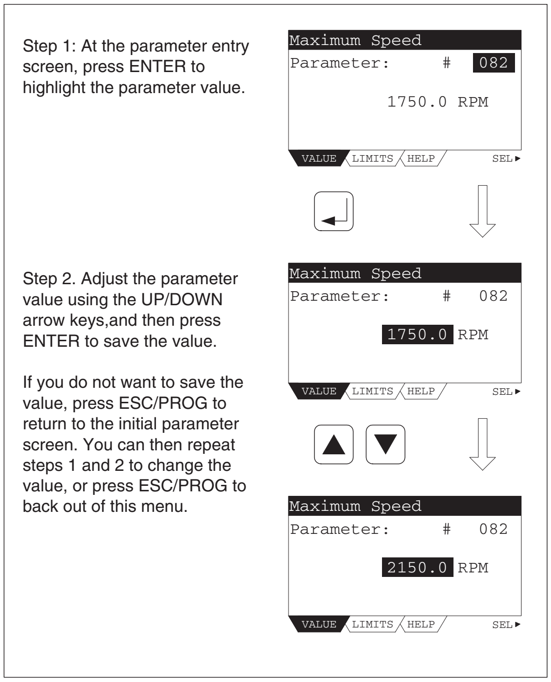


Figure 8.6 – Adjusting Parameters

Table 8.1 – How to Adjust Each Parameter Type

Parameter Type	How to Adjust
Numbered List	Use up/down arrow keys to advance through a list of options.
Bit	Use **SEL** key to move the cursor to the bit location you want to change. Use the up/down arrow keys to change the value of the bit.
Numeric	Use the up/down arrow keys to increase/decrease the value. OR Use **SEL** key to move the cursor to the digit location you want to change. Use the up/down arrow keys to change the value of the digit.

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

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

8.7.2 Loading and Saving User Sets

Drive configurations, called User Sets, can be saved and recalled for use at any time.

To **save** the current drive configuration, select Save to User Set from Drive Memory under the Utilities Group on the Parameter Group menu. User Sets can not be saved if Dynamic User Sets are enabled. See section 2.3.28 for more information on User Sets and Dynamic User Sets.

To recall, or **load**, a user set, select Load Frm Usr Set from Drive Memory under the Utilities Group on the Parameter Group menu. User Sets can not be restored if Dynamic User Sets are enabled or if drive is not disabled.

To **identify** which user set is active, select Active User Set from Drive Memory under the Utilities Group on the Parameter Group 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.

8.8 Monitoring the Drive Using the Process/Status Display Screens on the LCD OIM

Two process display screens are available on the LCD OIM.

One of the process display screens enables you to monitor three process variables. You can select the display, parameter, scale, and text for each process variable being displayed.

The second process display screen enables you to monitor one process variable using a large text display. The parameter, scale, and text is the same as the first line of the three variable display.

Two status screens are also available to provide quick access to the status of drive digital and analog I/O.

The **DISP** key will take you to the most recently viewed process/status display screen from any other screen with a single keystroke. Once one of the process/status screens is active, the **DISP** key cycles between the four screens.

Additionally, the most recently viewed process or status display screen becomes active if no keys have been pressed before the display timeout period expires. See section 8.5.3 for information about setting the display timeout period.

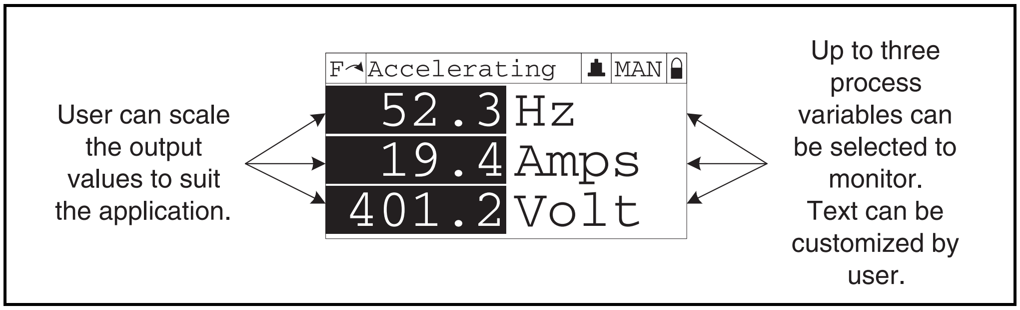


Figure 8.7 – Three Variable Process (User) Display Screen

8.8.1 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 Chevron keys once when one of the process display screens is active. See figure 8.6. The OIM reference can be used for the speed reference, PI reference, or trim reference.

While the display is in Process Display Mode, the speed reference can be changed by pressing and holding down either the up or down Chevron key until desired value is displayed. Release the key to return to the process display screen.

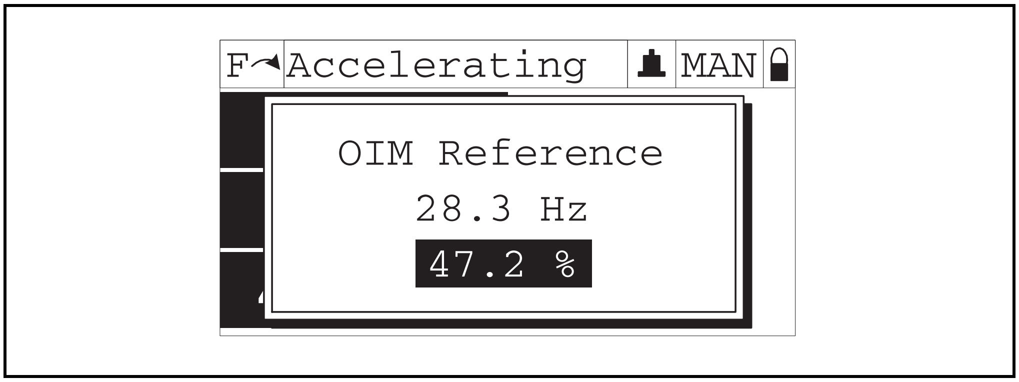
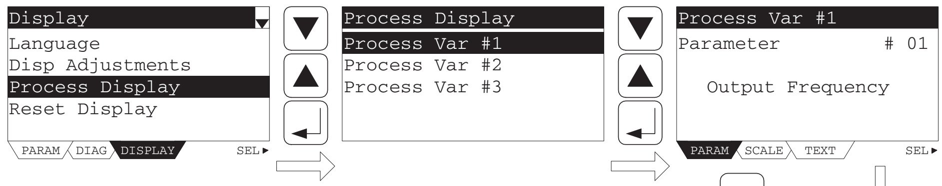


Figure 8.8 – OIM Reference Displayed

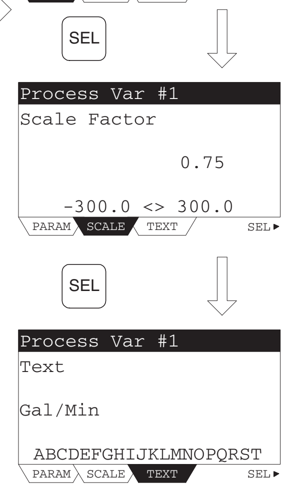
Note that changing the value of the OIM reference does not affect the value of any other port reference.

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

8.8.2 Customizing the Process Display Screen.



Use the SEL key to highlight the DISPLAY tab. Using the UP/DOWN arrows, highlight the "Process Display" line and then press the ENTER key. Use the UP/DOWN arrows to select the process variable you wish to edit and press ENTER. Press ENTER to highlight the parameter number and then use the UP/DOWN arrows to select which parameter you wish to display. Accept your selection with the ENTER key. Use the SEL key to highlight the SCALE tab. Press ENTER to highlight the scale factor and then use the UP/DOWN keys to modify the value. Press ENTER to accept your new value. Use the SEL key to highlight the TEXT key. Use the ENTER, SEL, and UP/DOWN keys to edit the units to be displayed. The ESC key backs you up to the main menu when you are finished.



8.9 Controlling the Drive From the LCD OIM

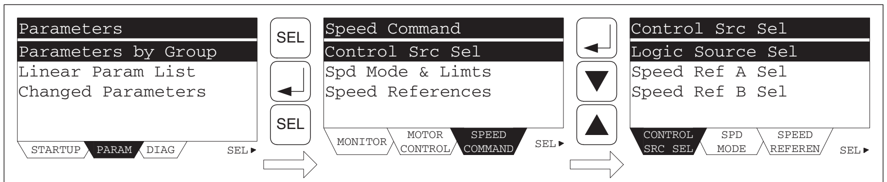
When the OIM is the selected control source, it can be used to control the drive:

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

Note: Pressing two OIM keys at the same time will cause no command to be sent to the drive.

8.9.1 Selecting the Logic and Reference Source

Logic Source Sel (89), Speed Ref A Sel (90) and Speed Ref B Sel (93) are used to select the drive control and speed reference sources. These parameters are grouped in Control Src Sel under Speed Command under on the Parameter Group menu.



Use the SEL key to highlight the PARAM tab. Press the ENTER key and then use the SEL key to highlight the SPEED COMMAND tab. Press the ENTER key and then use the UP/DOWN arrow keys to select the parameter to edit. Press ENTER to edit the parameter.

Figure 8.9 – Selecting the Control 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.

These three parameters can also be accessed individually through the Parameters menu. Refer to chapter 11 for a description of the parameters.

8.9.2 Starting the Drive

When the OIM is the selected control source, pressing I issues a start command to the drive if all run permissives are valid.

8.9.3 Stopping the Drive

Pressing O will issue a stop command to the drive.

Important: Stop commands from any attached OIM will always be enabled, even when not selected as the control source.

8.9.4 Changing Motor Direction

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

If the drive is running, when is pressed, the motor ramps down to 0 Hz and then ramps up to the set speed in the opposite direction. The reference to the motor changes based on Accel/Decel time.

The OIM indicates "F↷ " when the motor is running forward or will run forward when started (if not previously running). "↶R" is indicated when the motor is running in reverse or will run reverse when started (if not previously running). If the "F↷ " or "↶R" indication is flashing, it indicates the actual motor direction, but the drive is in the process of decelerating the motor in order to change directions.

8.9.5 Jogging the Drive

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

CHAPTER 9

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:** When power is first applied to the OIM, it may require approximately 4-5 seconds until any command is recognized, including the "Stop" button. 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 V*S Utilities/ V*S Utilities Pro software.

9.1 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 2 through 7 of this manual.
- properly connect the drive to the motor.

9.2 Running the Start-Up Routines

> **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.

Upon the first power-up of the GV6000, a welcome screen is displayed that prompts you for a language selection and then you are taken to the Quickstart Routine or to the Start-up Menu. See Figure 9.1.

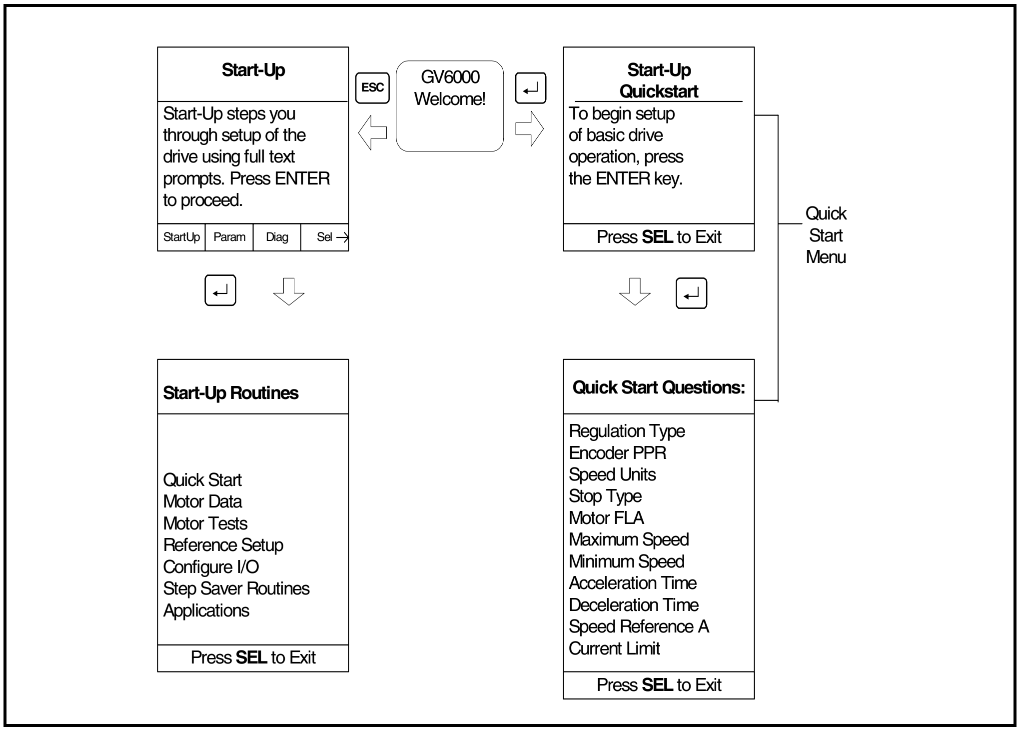


Figure 9.1 – Start-Up Menu

Upon suqsequent power-ups of the GV6000, you can return to the Start-Up Menu by using the **SEL** key.

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 ESC/PROG or exiting the Start-Up routine will not undo the changes.

9.3 Starting Up the Drive for Volts/Hertz Regulation

> **ATTENTION:** Rotation of the motor in an undesired direction can occur during the direction test portion of this procedure. To guard against possible injury and/or equipment damage, ensure that motor rotation in either direction will not cause injury and/or equipment damage.

To start-up in Voltz/Hertz regulation, perform the following steps in the **Start-Up** menus:

Step 1. Enter the **Quickstart** menu. (Enter from either the **Welcome** screen or from the **Start-Up** menu.)

a. Select “Linear V/Hz” at the Drive Control Type prompt.

b. Complete the remaining questions in the **Quickstart** menu.

Step 2. Select “Motor Data” routine from the **Start-Up** menu. (You will be returned to the **Start-Up** menu upon completion of the **Quickstart** menu.) You will be asked to provide information on the following:

a. Motor Nameplate Data

b. Application Stop Mode

c. Dynamic Braking Resistor

d. S-curve Ramp

Step 3. Select “Motor Tests” routine from the **Start-Up** menu. (You will be returned to the **Start-Up** menu upon completion of the “Motor Data” routine.)

a. Disable Slip Compensation.

b. Select the correct direction mode for your application.

c. Perform direction tests to verify proper motor rotation.

d. Select “Done” to leave the “Motor Tests” routine.

Step 4. Select other routines (as needed) from the **Start-Up** menu to complete your configuration of the GV6000 drive. (You will be returned to the **Start-Up** menu upon completion of the “Motor Tests” routine.) Other routines include “Reference Set-up,” “Configure I/O,” etc.

Note: For pump or fan applications, you can further enhance the start-up of the drive by selecting “Pump/Fan” from the “Applications” routine in the **Start-Up** menu.

9.4 Starting Up the Drive for Vector Regulation

> **ATTENTION:** Rotation of the motor in an undesired direction can occur during the direction test portion of this procedure or during the autotone portion of this procedure (Autotune (61) = Rotate Tune (2)). To guard against possible injury and/or equipment damage, ensure that motor rotation in either direction will not cause injury and/or equipment damage.
>
> **ATTENTION:** When this procedure calls for the load to be removed from or reconnected to the motor, ensure that all power to the drive has been removed. Failure to follow this precaution could result in severe bodily injury or loss of life.

To start-up in Vector regulation, perform the following steps in the **Start-Up** menus:

Step 1. Remove power from the drive, and disconnect the load from the motor shaft (including gearing), if you previously connected. Re-apply power to continue the setup.

Step 2. Enter the **Quickstart** menu. (Enter from either the **Welcome** screen or from the **Start-Up** menu.)

a. Select “Flux Vector” at the Drive Control Type prompt.

b. Complete the remaining questions in the **Quickstart** menu.

Step 3. Select “Motor Data” routine from the **Start-Up** menu. (You will be returned to the **Start-Up** menu upon completion of the **Quickstart** menu.) You will be asked to provide information on the following:

a. Motor Nameplate Data

b. Application Stop Mode

c. Dynamic Braking Resistor

d. S-curve Ramp

Step 4. Select “Motor Tests” routine from the **Start-Up** menu. (You will be returned to the **Start-Up** menu upon completion of the “Motor Data” routine.)

a. Disable Slip Compensation if you have encoder feedback. (Enable for “Encoderless” flux vector mode operation.)

b. Select the correct direction mode for your application.

c. Perform direction tests to verify proper motor rotation.

d. Select the “Rotate Tune” routine.

e. Select “Auto Tune” routine.

f. Press the START button on the OIM to initiate the test.

g. After the auto tune routine complete and the drive stops, remove power from the drive.

h. Reconnect the load to the drive.

i. Reapply power to the drive, re-enter the **Start-Up** menu and press the START button on the OIM to initiate the inertia test.

j. Select “Done” to leave the “Motor Tests” routine.

Step 5. Select other routines (as needed) from the **Start-Up** menu to complete your configuration of the GV6000 drive. (You will be returned to the **Start-Up** menu upon completion of the “Motor Tests” routine.) Other routines include “Reference Set-up,” “Configure I/O,” etc.

Note: You can further enhance the start-up of the drive by using the “Applications” or “Step Saver” routines.

9.5 Starting Up the Drive for Sensorless Vector Performance

> **ATTENTION:** Rotation of the motor in an undesired direction can occur during the direction test portion of this procedure or during the autotone portion of this procedure (Autotune (61) = Rotate Tune (2)). To guard against possible injury and/or equipment damage, ensure that motor rotation in either direction will not cause injury and/or equipment damage.
>
> **ATTENTION:** When this procedure calls for the load to be removed from or reconnected to the motor, ensure that all power to the drive has been removed. Failure to follow this precaution could result in severe bodily injury or loss of life.

To start-up in Sensorless Vector regulation, perform the following steps in the **Start-Up** menus:

Step 1. Remove power from the drive, and, if possible, disconnect the load from the motor shaft (including gearing), if you previously connected. Re-apply power to continue the setup.

Step 2. Enter the **Quickstart** menu. (Enter from either the **Welcome** screen or from the **Start-Up** menu.)

a. Select “Sensorless Vector” at the Drive Control Type prompt.

b. Complete the remaining questions in the **Quickstart** menu.

Step 3. Select “Motor Data” routine from the **Start-Up** menu. (You will be returned to the **Start-Up** menu upon completion of the **Quickstart** menu.) You will be asked to provide information on the following:

a. Motor Nameplate Data

b. Application Stop Mode

c. Dynamic Braking Resistor

d. S-curve Ramp

Step 4. Select “Motor Tests” routine from the **Start-Up** menu. (You will be returned to the **Start-Up** menu upon completion of the “Motor Data” routine.)

a. Enable Slip Compensation.

b. Select the correct direction mode for your application.

c. Perform direction tests to verify proper motor rotation.

d. Select “Auto Tune” routine.

e. Select the “Rotate Tune” routine. If the load cannot be disconnected, select the “Static Tune” routine.

f. Press the START button on the OIM to initiate the test.

g. Remove power from the drive.

h. If previously disconnected, reconnect the load to the motor.

i. Reapply power to the drive, re-enter the **Start-Up** menu and select “Done” to leave the “Motor Tests” routine.

Step 5. Select other routines (as needed) from the **Start-Up** menu to complete your configuration of the GV6000 drive. ((You will be returned to the **Start-Up** menu upon completion of the “Motor Tests” routine.) Other routines include “Reference Set-up,” “Configure I/O,” etc.

Note: You can further enhance the start-up of the drive by using the “Applications” or “Step Saver” routines.

9.6 Other Start-Up Considerations

9.6.1 Operation Over Wide Speed Ranges (> 120 Hz)

The GV6000 drive can operate at output frequencies of up to 400 Hz. In this case, autotuning may not be able to accurately tune the drive’s current regulator. Hardware overcurrent faults may occur, and manual tuning using V*S Utilities may be necessary.

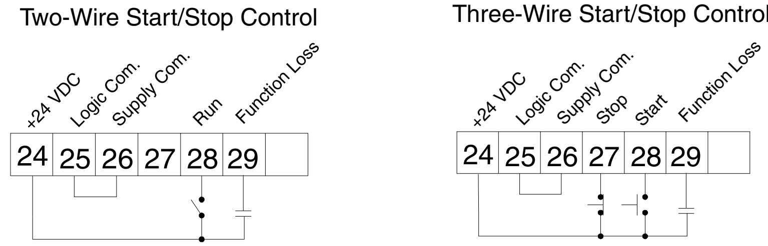
9.6.2 Start/Stop Control

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

> **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 disconnect the AC line from the drive. An auxiliary braking method may be required.

To configure the drive for two-wire or three-wire Start/Stop control, you must set a terminal block input to either the Run function (2-wire) or Start function (3-wire).

Two-Wire Start/Stop Control | Three-Wire Start/Stop Control



Two-Wire Start/Stop Control	Three-Wire Start/Stop Control
(89) Logic Source Sel = Terminal Block	(89) Logic Source Sel = Terminal Block
(361) Digital In1 Sel = Not Used	(361) Digital In1 Sel = Stop
(362) Digital In2 Sel = Run	(362) Digital In2 Sel = Start
(363) Digital In3 Sel = Function Loss	(363) Digital In3 Sel = Function Loss

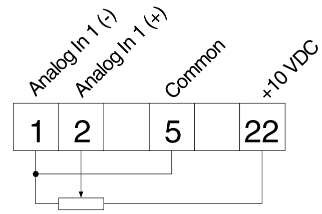
Figure 9.1 – Two-wire and Three-wire Start/Stop Control

See chapter 6 for more information about terminal block control.

9.6.3 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.

Analog Reference Wiring (Voltage)



(90) Speed Ref A Sel = Analog In1
(91) Speed Ref Hi = 60 Hz
(92) Speed Ref Lo = 0 Hz
(P320) Analog In Config = .xx00
(P322) Analog In Hi = 10.0 V
(P323) Analog In Lo = 0.0 V

Note: This example assumes Speed Units (79) is set to “Hz”.

Figure 9.2 – Analog Speed Reference

See chapter 6 for more information about terminal block references.

CHAPTER 10

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 11.

10.1 About Parameters

There are three types of parameters:

- **Numbered List (Enumerated) 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: Dig In Status (216)

- **Numeric Parameters**

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

  Example: Maximum Freq (55)

Parameters are also categorized as configurable, 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.

10.2 How Parameters are Organized

Parameters are organized into nine **files**:

- Monitor
- Motor Control
- Speed Command
- Dynamic Control
- Utility
- Communication
- Inputs & Outputs
- Applications
- Pos/Spd Profile

Each **file** contains parameters that are organized into **groups** by their function. A **file** can contain several **groups** of parameters. See figure 10.1.

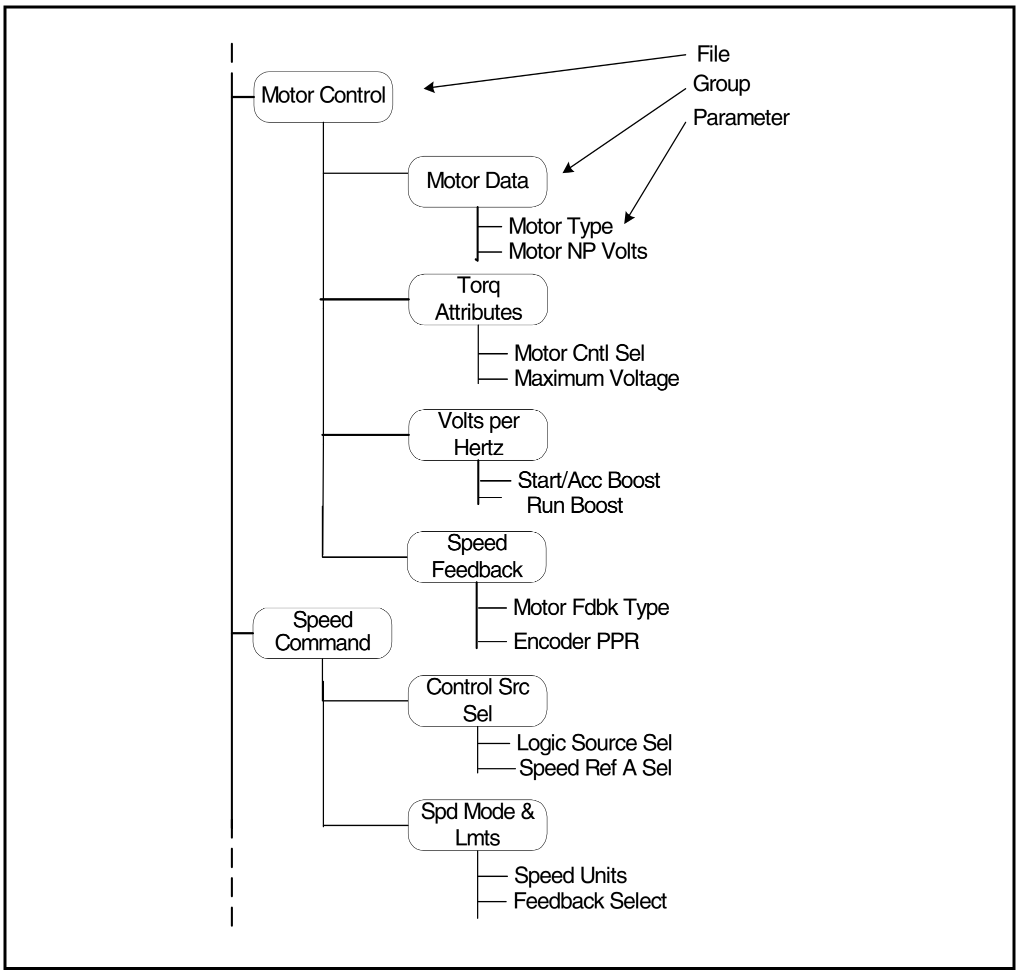


Figure 10.1 – Example of Parameter Organization

10.3 Accessing the Parameters

Parameters are programmed and viewed using the LCD OIM or V*S Utilities/V*S Utilities Pro.

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

To access parameters using the LCD OIM, select the parameters tab from the main screen. See figure 10.2.

See Chapter 8 for information on modifying parameters using the LCD OIM.

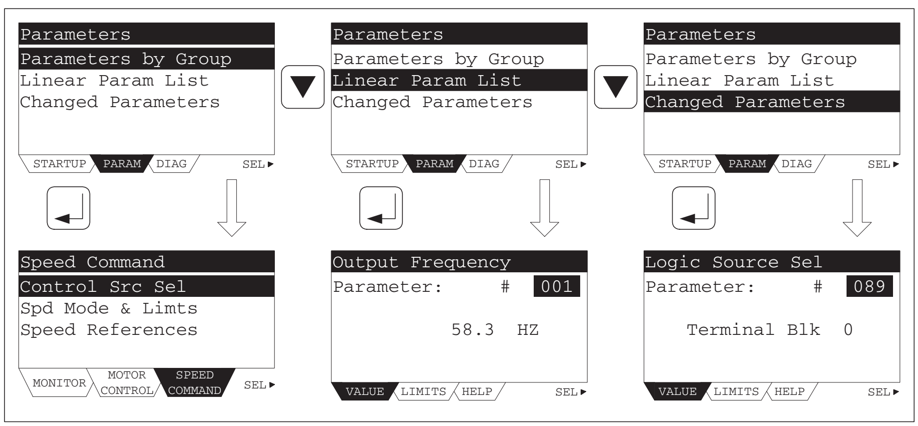


Figure 10.2 – Accessing the Parameters Using the LCD OIM

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

10.3.1 Selecting the Parameter Access Level

The GV6000 AC Drive provides three levels of access to the parameters: Basic (0), Standard (1), and Advanced (2).

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.

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

To select the parameter access level using the LCD OIM, select the Password tab from the main menu. See figure 10.3.

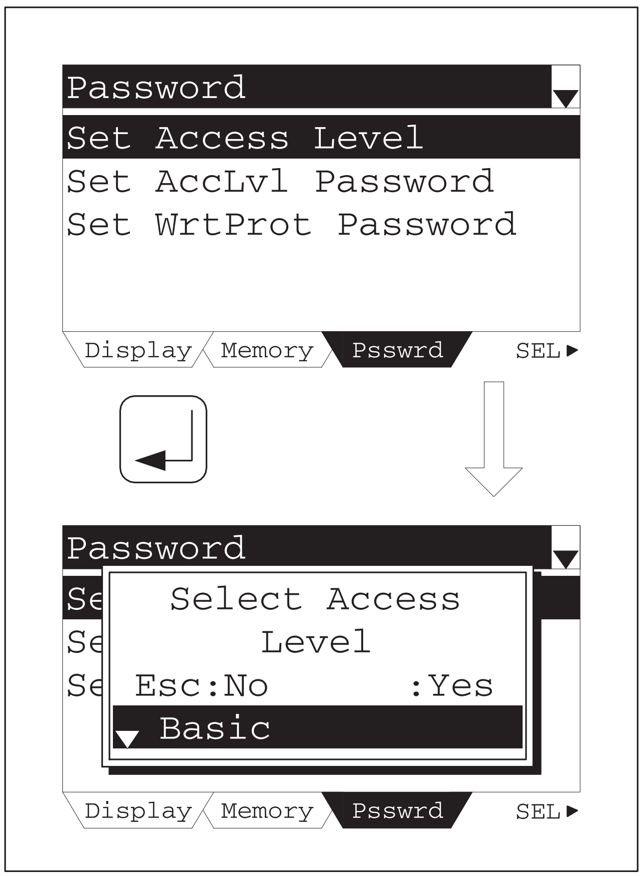


Figure 10.3 – Selecting the Parameter Access Level

10.3.2 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 tab from the main menu. See figure 10.4. The password value can range from 1 to 9999. A value of 0 disables the password (factory default). You must either select Logout or return to the process display screen to activate the password.

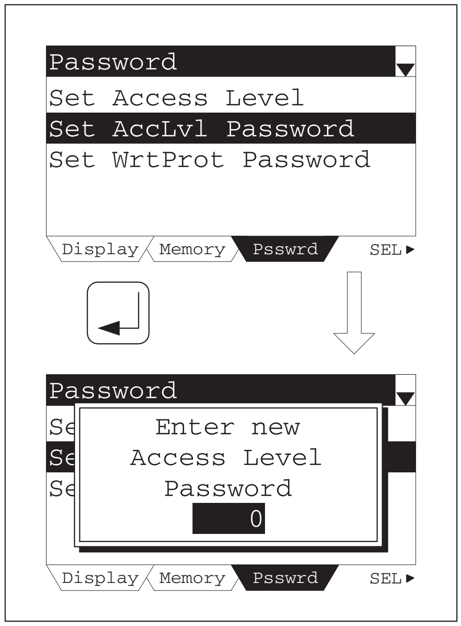


Figure 10.4 – Setting the Access Level Password

When you enter the password, you can change access levels until you return to the process display screen, which re-activates the password.

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 V*S 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.

10.4 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.

All parameter values can be write-protected using the LCD OIM. When the password is enabled, parameter values can still 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 tab from the main menu. See figure 10.5. 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.

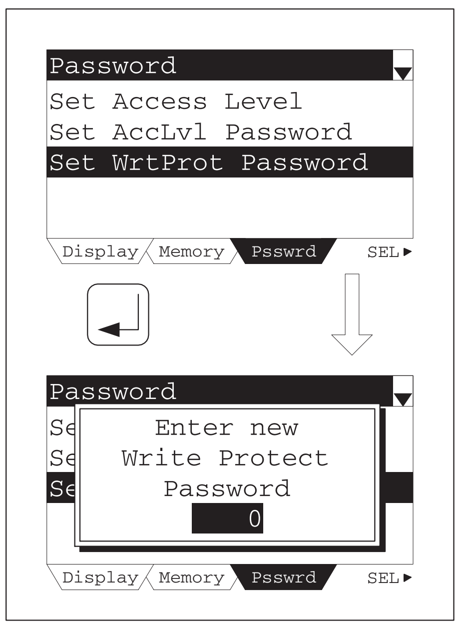


Figure 10.5 – Setting the Write-Protect Password

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.

This option is not supported in the V*S 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 4444 on the remote OIM, you will be required to enter 4444 on the local OIM to program the parameters.

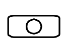
CHAPTER 11

Parameter Descriptions

The following information is provided for each parameter 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 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
	Drive must be stopped before changing parameter value.
FV	Parameter is only displayed when Motor Cntl Sel (53) is set to "4." (FVC Vector)

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

11.1 Parameters

1 Output Freq

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

The output frequency present at T1, T2, and T3 (U, V, and W).

2 Commanded Speed

Range:	+/- [P.082 Maximum Speed] [0.1 Hz or 0.1 RPM]		
Default:	Read Only		
Access:	0	**Path:**	Monitor>Metering
See also:	79		

The value of the active Speed/Frequency Reference. Displayed in Hz or RPM, depending on value of Speed Units (79).

3 Output Current

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

The total output current present at T1, T2, and T3 (U, V, and W).

4 Torque Current

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

The amount of current that is in phase with the fundamental voltage component.

5 Flux Current

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

The amount of current that is out of phase with the fundamental voltage component.

6 Output Voltage

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

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

7 Output Power

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

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:	

The output power factor.

9 Elapsed MWh

Range:	0.0 to 214,748,352.0 MWh [0.1 MWh]
Default:	Read Only
Access:	2 **Path:** Monitor>Metering
See also:	

The accumulated output energy of the drive.

10 Elapsed Run Time

Range:	0.0 to 214,748,352.0 Hr [0.1 Hr]
Default:	Read Only
Access:	1 **Path:** Monitor>Metering
See also:	

The accumulated time the drive has been outputting power.

11 MOP Reference

Range:	+/- [Maximum Speed] [0.1 Hz or 0.1 RPM]
Default:	Read Only
Access:	1 **Path:** Monitor>Metering
See also:	79

The value of the signal at the MOP (Motor-Operated Potentiometer).

12 DC Bus Voltage

Range:	0 to Based on Drive Rating [0.1 VDC]
Default:	Read Only
Access:	1 **Path:** Monitor>Metering
See also:	

The present DC bus voltage level.

13 DC Bus Memory

Range:	0 to Based on Drive Rating [0.1 VDC]
Default:	Read Only
Access:	2 **Path:** Monitor>Metering
See also:	

A six-minute average of the DC bus voltage level.

14 Elapsed kWh

Range:	0 to 429,496,729.5 kWh [0.1 kWh]
Default:	Read Only
Access:	1 **Path:** Monitor>Metering
See also:	

The accumulated output energy of the drive.

16 Analog In1 Value
17 Analog In2 Value

Range:	0.000 to 20.000 mA [0.001 mA] -/+10.000 V [0.001 V]
Default:	Read Only
Access:	1 **Path:** Monitor>Metering
See also:	

The value of the signal of the analog input.

18 PTC HW Value

Range:	0.00 to 5.00 Volts [0.01 Volts]		
Default:	Read Only		
Access:	2	**Path:**	Monitor>Metering
See also:			

This parameter displays the value present at the drive's PTC input terminals. When a motor is provided with a PTC (positive temperature coefficient) thermal sensor, it can be connected to terminals 10 and 23. See page 6-8 for wiring example.

21 Spd Fdbk No Filt

Range:			
Default:	Read Only		
Access:	2	**Path:**	Monitor>Metering
See also:			

Displays the unfiltered value of the actual motor speed based on either the measured encoder feedback or on an estimation when an encoder is not present.

22 Ramped Speed

Range:	+/- 400.0 Hz or +/- 24,000.0 RPM [0.1 Hz or 0.1 RPM]		
Default:	Read Only		
Access:	1	**Path:**	Monitor>Metering
See also:	79		

The value of commanded speed after Accel/Decel and S-Curve are applied.

23 Speed Reference

Range:	+/- 400.0 Hz or +/- 24,000.0 RPM [0.1 Hz or 0.1 RPM]		
Default:	Read Only		
Access:	0	**Path:**	Monitor>Metering
See also:	79		

The summed value of ramped speed, process PI and droop. When FVC Vector mode is selected, droop will not be added

24 Commanded Torque

FV

Range:	+/- 800.0% [0.1%]
Default:	Read Only
Access:	0 **Path:** Monitor>Metering
See also:	53

The final torque reference value after limits and filtering are applied. Percent of motor rated torque.

25 Speed Feedback

Range:	+/- 400.0 Hz or +/- 24,000.0 RPM [0.1 Hz or 0.1 RPM]
Default:	Read Only
Access:	1 **Path:** Monitor>Metering
See also:	

Displays the lightly filtered value of the actual motor speed based on measured encoder feedback or an estimation.

26 Rated kW

Range:	0.00 to 3000.00 kW [0.01 kW]
Default:	Read Only
Access:	0 **Path:** Monitor>Drive Data
See also:	

The drive power rating.

27 Rated Volts

Range:	0.0 to 65535.0 VAC [0.1 VAC]
Default:	Read Only
Access:	0 **Path:** Monitor>Drive Data
See also:	

The drive input voltage class (208, 240, 400, etc.).

28 Rated Amps

Range:	0.0 to 6553.5 Amps [0.1 Amps]
Default:	Read Only
Access:	0 **Path:** Monitor>Drive Data
See also:	

The drive rated output current.

29 Control SW Ver

Range:	0.000 to 65535.000 [0.001]
Default:	Read Only
Access:	0 **Path:** Monitor>Drive Data
See also:	196

The Main Control board software version.

40 Motor Type

Range:	0 = Induction 1 = Synchr Reluc 2 = Synchr PM
Default:	0 = Induction
Access:	2 **Path:** Motor Control>Motor Data
See also:	53, 157, 158, 159

Set to match the type of motor connected: Induction, Synchronous Reluctance, or Synchronous Permanent Magnet.

Important: Selecting option 1 or 2 also requires selection of "Custom V/Hz," option 2 in Motor Cntl Sel (53).

41 Motor NP Volts

Range:	0.0 to Drive Rated Volts [0.1 VAC]
Default:	Based on Drive Rating
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 Rating
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.

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:	60.0 to 25200.0 RPM [0.1 RPM]		
Default:	1780 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 1000.00 [0.01 kW or 0.01 HP]		
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 Mtr NP Pwr Units (46).

46 Mtr NP Pwr Units

Range:	0 = Horsepower (changes power units to HP without rescaling values) 1 = kilowatts (changes power units to kW without rescaling values) 2 = Convert HP (Converts all power units to HP and rescales values) 3 = Convert kW (changes power units to kW and rescales values)		
Default:	Based on Drive Rating		
Access:	2	**Path:**	Motor Control>Motor Data
See also:			

Selects the motor power units to be used. This parameter determines the units for Motor NP Power (45).

Convert HP = Converts all power units to Horsepower.

Convert kW = Converts all power units to kilowatts.

47 Motor OL Hertz

Range:	0.0 to Motor NP Hz [0.1 Hz]
Default:	Motor NP Hz/3
Access:	2 **Path:** Motor Control>Motor Data
See also:	42, 220

Selects the output frequency below which the motor operating current is derated. The motor thermal overload will then generate a fault at lower levels of current.

48 Motor OL Factor

Range:	0.20 to 2.00 [0.1]
Default:	1.00
Access:	2 **Path:** Motor Control>Motor Data
See also:	42, 220

Sets the amps threshold for motor overload fault.

Motor FLA x OL Factor = Operating Level

49 Motor Poles

Range:	2 to 40 [1 Pole]
Default:	4
Access:	0 **Path:** Motor Control>Motor Data
See also:	

Defines the number of poles in the motor.

53 Motor Cntl Sel

Range:	0 = Sensrls Vect 1 = SV Economize 2 = Custom V/Hz 3 = Fan/Pmp-V/Hz 4 = FVC Vector
Default:	0 = Sensrls Vect
Access:	2 **Path:** Motor Control>Torq Attributes
See also:	80

Sets the method of motor control used in the drive.

Important: “FVC Vector” mode with encoder feedback requires autotuning of the motor, both coupled and uncoupled to the load. Being coupled to the load will determine inertia (preferably lightly loaded). Total Inertia (450) will have to be estimated if uncoupled for tuning of the speed loop or separately adjust Ki (445) and Kp (446).

Sensrls Vect = Maintains consistent magnetizing current up to base speed. Voltage increases as a function of load.

SV Economize = Allows the drive to automatically adjust output voltage as the load changes to minimize current supplied to the motor. The voltage is adjusted by means of flux current adaptation.

Custom V/Hz = Allows the user to tailor the volts/hertz curve by adjusting parameters Maximum Voltage (54), Maximum Frequency (55), Run Boost (70), Break Voltage (71) and Break Frequency (72).

Fan/Pmp V/Hz = This mode sets a fan load volts/hertz curve profile exponential to base frequency (and linear from base to maximum frequency). Run Boost (70) can offset the low speed curve point.

FVC Vector = This mode requires autotuning of the motor, both coupled and uncoupled to the load.

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 420.0 Hz [0.1 Hz]		
Default:	110.0 or 130.0 Hz		
Access:	2	**Path:**	Motor Control>Torq Attributes
See also:	83		

Sets the maximum allowable frequency the drive will output. Note that this is not maximum speed, which is set in parameter 82. Refer to figure 11.1.

ATTENTION: The user is responsible for ensuring that the 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. The factory default for overspeed detection is set to 10.0 Hz (or 300.0 RPM) greater than the Maximum Speed (82). Failure to observe this precaution could result in equipment damage, sever injury or loss of life.

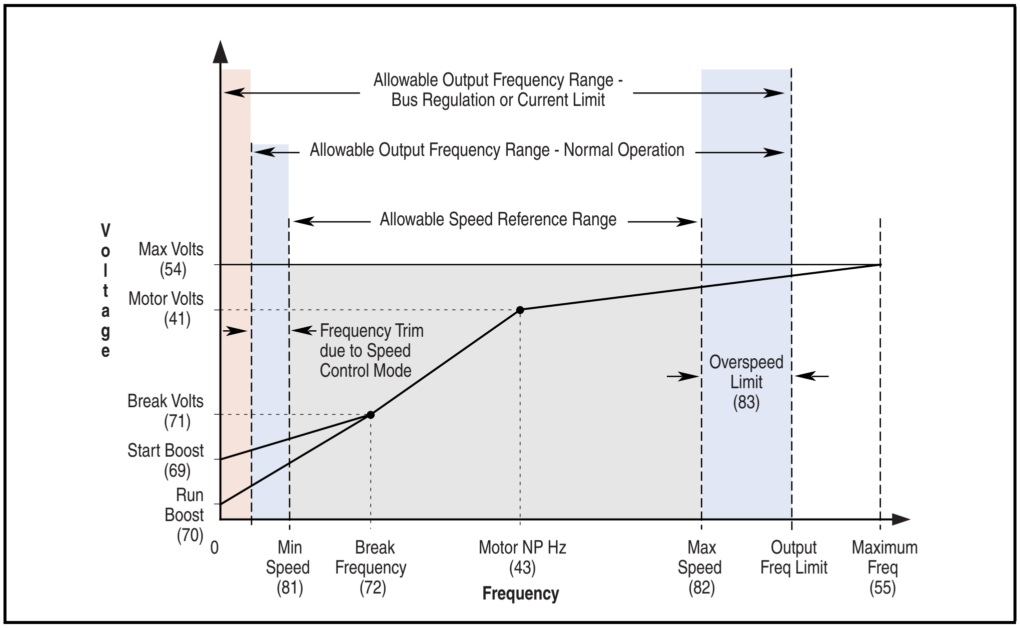


Figure 11.1 – Speed Limits

56 Compensation

Range:	See figure 11.2		
Default:	See figure 11.2		
Access:	2	**Path:**	Motor Control>Torq Attributes
See also:			

Enables/disables the compensation correction options.

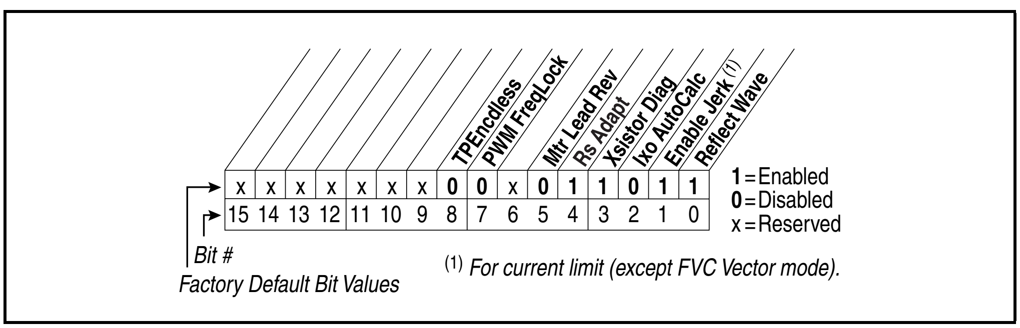


Figure 11.2 – Compensation (56)

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.

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. In non-FVC Vector modes, disabling jerk removes a short S-curve at the start of the accel/decel ramp.

Ixo AutoCalc = Reserved

Xsistor Diag = Enables/disables power transistor power diagnostic tests that execute at each Start command.

Rs Adapt = (FVC w/Encoder only) Disabling may improve torque regulation at lower speeds (although this is typically not needed).

Mtr Lead Rev = Reverses the phase rotation of the applied voltage, effectively reversing the motor leads.

PWM Freq Lock = Keeps the PWM frequency from decreasing to 2 kHz at low operating frequencies in FVC Vector mode without encoder.

57 Flux Up Mode

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

Manual (0): Flux is established for Flux Up Time (58) before acceleration

Auto (1): 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:	0.000 to 5.000 sec [0.001 sec]		
Default:	0.000 sec		
Access:	2	**Path:**	Motor Control>Torq Attributes
See also:	53, 58		

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

59 SV Boost Filter

Range:	0 to 32767 [1]		
Default:	500		
Access:	0	**Path:**	Motor Control>Torq Attributes
See also:			

Sets the amount of filtering used to boost voltage during Sensorless Vector and FVC Vector (encoderless) operation.

61 Autotune

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

Provides a manual or automatic method for setting IR Voltage Drop (62), Flux Current Ref (63) and Ixo Voltage Drop (64). Valid only when Motor Cntl Sel (53) is set to Sensrls Vect, SV Economize or FVC Vector.

Ready (0) = Parameter returns to this setting following a Static Tune or Rotate Tune. It also permits manually setting IR Voltage Drop (62), Ixo Voltage Drop (64) and Flux Current Ref (63).

Static Tune (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of IR Voltage Drop (62) in all valid modes and a non-rotational motor leakage inductance test for the best possible automatic setting of Ixo Voltage Drop (64) in FVC Vector Mode. A start command is required following the initiation of this setting. The parameter returns to Ready (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when the motor cannot be rotated.

Rotate Tune (2) = A temporary command that initiates a Static Tune followed by a rotational test for the best possible automatic setting of Flux Current Ref (63). In FVC Vector mode, with encoder feedback, a test for the best possible automatic setting of Slip RPM @ FLA is also run. A start command is required following initiation of this setting. The parameter returns to Ready (0) following the test, at which time another start transition is required to operate the drive in normal mode.

Important: Rotate Tune (2) is used when the motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure.

ATTENTION: Rotation of the motor in an undesired direction can occur during this procedure (Autotune (61) = Rotate Tune (2)). To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding.

Calculate (3) = This setting uses motor nameplate data to automatically set IR Voltage Drop (62), Ixo Voltage (64) and Flux Current Ref (63).

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, 61		

Value of volts dropped across the resistance of the motor stator. Used only when Motor Cntl Sel (53) is set to Sensrls Vect, SV Economize or FVC Vector.

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, 61		

Value of amps for full motor flux. Used only when Motor Cntl Sel (53) is set to Sensrls Vect, SV Economize or FVC Vector.

64 Ixo Voltage Drop

Range:	0.00 to 230.0, 460.0 or 575.0 VAC [0.1 VAC]		
Default:	Based on Drive Rating		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:			

Sets the value of the voltage drop across the leakage inductance of the motor at rated motor current. Used only when Motor Cntl Sel (53) is set to Sensrls Vect, SV Economize or FVC Vector.

66 Autotune Torque

FV

Range:	0.0 to 150% [0.1%]		
Default:	50%		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:	53		

Specifies motor torque applied to the motor during the flux current and inertia tests performed during an autotune.

67 Inertia Autotune

Range:	0 = Ready 1 = Inertia Tune
Default:	0 = Ready
Access:	1 **Path:** Motor Control>Torq Attributes
See also:	53, 450

Provides an automatic method of setting Total Inertia. This test is automatically run during Start-Up motor tests.

Important: Use when motor is coupled to the load. Results may not be valid if the load is not coupled to the motor during this procedure.

Ready = Parameter returns to this setting following a completed inertia tune.

Inertia Tune = A temporary command that initiates an inertia test of the motor/load combination. The motor will ramp up and down, while the drive measures the amount of inertia.

69 Start/Acc Boost

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

Sets the voltage boost level for starting and acceleration when Custom V/Hz mode is selected.

70 Run Boost

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

Sets the boost level for steady state or deceleration when Fan/Pmp V/Hz or Custom V/Hz modes are selected.

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

Sets the voltage the drive will output at Break Frequency (72).

72 Break Frequency

Range:	0.0 to Maximum Freq [0.1 Hz]
Default:	Motor NP Freq x 0.25
Access:	2 **Path:** Motor Control>Volts per Hertz
See also:	53, 71

Sets the frequency the drive will output at Break Voltage (71).

79 Speed Units

Range:	0 = Hz 1 = RPM 2 = Convert Hz 3 = Convert RPM
Default:	0 = Hz
Access:	0 **Path:** Speed Command>Spd Mode & Limits
See also:	

Selects the units to be used for all speed related parameters. Options 0 and 1 indicate status only. Options 2 and 3 will convert and/or configure the drive for that selection.

Convert Hz (2) = Converts all speed based parameters to Hz and changes the value proportionately (i.e. 1800 RPM = 60 Hz).

Convert RPM (3) = Converts all speed based parameters to RPM and changes the value proportionately.

80 Feedback Select

Range:	0 = Open Loop 1 = Slip Comp 2 = Reserved 3 = Encoder 4 = Reserved 5 = Simulator
Default:	0 = Open Loop
Access:	2 **Path:** Speed Command>Spd Mode & Limits
See also:	53, 152, 412

Selects the source for motor speed feedback. Note that all selections are available when using Process PI.

> **ATTENTION:** When operating the drive with encoder feedback selected (Feedback Select (80) = 3 (Encoder)), a loss of encoder signal may produce an overspeed condition. For differential encoders, Motor Fdbk Type (412) should be selected as option 1 or 3 to detect the loss of an encoder signal. The user is responsible for ensuring that the 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. The factory default for overspeed detection is set to 10.0 Hz (or 300.0 RPM) greater than the Maximum Speed (82). Failure to observe this precaution could result in equipment damage, sever injury or loss of life.

Open Loop (0) = Provides no speed compensation due to load variations. This is strict volts per hertz output as a function of the speed reference. Slip compensation is not needed and encoder is not present.

Slip Comp (1) = Provides for frequency output adjustment as a function of load. The amount of compensation is defined by the value of Slip RPM @ FLA (121). It is used when tight speed control is needed and an encoder is not present.

Encoder (3) = An encoder is present and connected to the drive.

Simulator (5) = Simulates a motor for testing drive operation and interface check.

81 Minimum Speed

Range:	0.0 to Maximum Speed [0.1 Hz or 0.1 RPM]		
Default:	0.0		
Access:	0	**Path:**	Speed Command>Spd Mode & Limits
See also:	79, 83, 92, 95		

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

> **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

Range:	5.0 to 400.0 [0.1 Hz] or 75.0 to 24000.0 RPM [0.1 RPM]		
Default:	50.0 or 60.0 Hz (Volt Class) [Motor NP RPM]		
Access:	0	**Path:**	Speed Command>Spd Mode & Limits
See also:	55, 79, 83, 91, 94, 202		

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

> ⚠ **ATTENTION:** The user is responsible for ensuring that the 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. The factory default for overspeed detection is set to 10.0 Hz (or 300.0 RPM) greater than the Maximum Speed (82). Failure to observe this precaution could result in equipment damage, sever injury or loss of life.

83 Overspeed Limit

Range:	0.0 to 20.0 Hz [0.1 Hz] or 0.0 to 600.0 RPM [0.1 RPM]		
Default:	10.0 Hz or 300.0 RPM		
Access:	2	**Path:**	Speed Command>Spd Mode & Limits
See also:	55, 79, 82		

Sets the incremental amount of the output frequency (above Maximum Speed) allowable for functions such as slip compensation. See figure 11.3

Maximum Speed + Overspeed Limit must be ≤ to Maximum Frequency

> ⚠ **ATTENTION:** The user is responsible for ensuring that the 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. The factory default for overspeed detection is set to 10.0 Hz (or 300.0 RPM) greater than the Maximum Speed (82). Failure to observe this precaution could result in equipment damage, sever injury or loss of life.

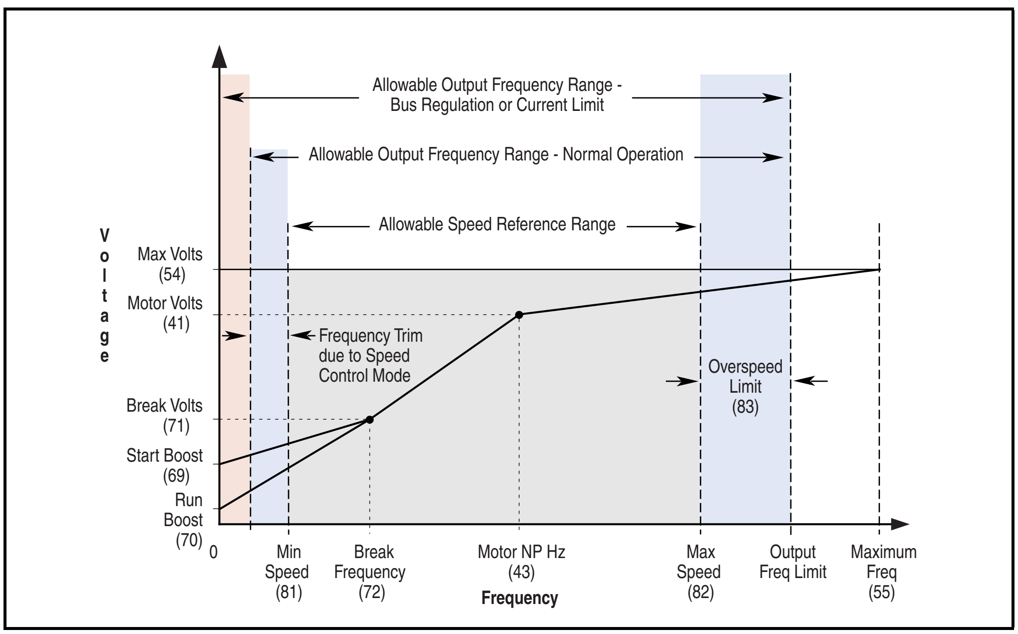


Figure 11.3 – Speed Limits

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

Range: -/+ Maximum Speed [0.1 Hz]

Default: 0.0 Hz

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

See also: 87

Sets a frequency at which the drive will not operate (also called an **avoidance frequency**). Requires that both Skip Frequency 1-3 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). The same bandwidth applies to all skip frequencies.

88 Speed/Torque Mod

FV

Range:
0 = Zero Torque
1 = Speed Reg
2 = Torque Reg
3 = Min Torq/Spd
4 = Max Torq/Spd
5 = Sum Torq/Spd
6 = Absolute Min
7 = Pos/Spd Prof

Default: 1 = Speed Reg

Access: 1 **Path:** Speed Command>Spd Mode & Limits

See also: 53

ATTENTION: When selecting operation in a torque mode configuration, the user is responsible for ensuring that the 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. The factory default for overspeed detection is set to 10.0 Hz (or 300.0 RPM) greater than the Maximum Speed (82). Failure to observe this precaution could result in equipment damage, sever injury or loss of life.

Selects the torque reference source.

Zero Torque (0) = Torque Command = 0.

Speed Reg (1) = Drive operates as a speed regulator.

Torque Reg (2) = An external torque reference is used for the torque command.

Min Torq/Spd (3) = Selects the smallest algebraic value to regulate to when the torque reference and torque generated from the speed regulator are compared.

Max Torq/Spd (4) = Selects the largest algebraic value to regulate to when the torque reference and torque generated from the speed regulator are compared.

Sum Torq /Spd (5) = Selects the sum of the torque reference and the torque generated from the speed regulator.

Absolute Min (6) = Selects the smallest absolute algebraic value to regulate to when the torque reference and torque generated from the speed regulator are compared.

Pos/Spd Prof (7) = Drive operates as a speed or position regulator as determined by the steps configured by the Profile Step parameters (720-877) and Setup parameters (705-719).

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 Sel
See also:			

Selects the only control source for these logic commands:

- Start (Run)
- Jog
- Direction
- Clear Faults
- Stop (Any attached OIM Stop Key is always functional. A Network stop command is effective only for Network or All Ports. A Terminal Block Stop command is effective only for Terminal Blk or All Ports.

Selecting All Ports (7) enables control from any control source (or port).

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

When Start At PowerUp 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.

Important: Asserting an OIM Control digital input or acquiring Manual with Save OIM Ref (192) bit 1 (Manual Mode) True (1) will override this parameter's selection.

90 Speed Ref A Sel

Range:
1 = Analog In 1
2 = Analog In 2
3-6 = Reserved
7 = Pulse In
8 = Encoder
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 = DPI Port 4
22 = Network
23-24 = Reserved
25 = Scale Block 1
26 = Scale Block 2
27 = Scale Block 3
28 = Scale Block 4

Default: 18 = Local OIM

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

See also: 2, 91-93, 101-107, 117-120, 192-194, 213, 272, 273, 320, 361-366

Selects the source of the speed reference to the drive unless Preset Speed 1-7 (101-107) or Speed Ref B (93) is selected.

Note that the manual reference command and input OIM Control can override the reference control 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. 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.

91 Speed Ref A Hi

Range:	-/+Maximum Speed [0.1 Hz or 0.1 RPM]	
Default:	Maximum Speed	
Access:	1	**Path:** Speed Command>Speed References
See also:	79, 82, 190	

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

92 Speed Ref A Lo

Range:	-/+Maximum Speed [0.1 Hz or 0.01 RPM]	
Default:	0.0	
Access:	1	**Path:** Speed Command>Speed References
See also:	79, 81, 190	

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

93 Speed Ref B Sel

Range:	1 = Analog In 1 2 = Analog In 2 3-6 = Reserved 7 = Pulse In 8 = Encoder 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 = DPI Port 4 22 = Network 23-24 = Reserved 25 = Scale Block 1 26 = Scale Block 2 27 = Scale Block 3 28 = Scale Block 4
Default:	11 = Preset Spd 1
Access:	0 **Path:** Speed Command>Speed References Speed Command> Control Src Select
See also:	2, 91-93, 101-107, 117-120, 192-194, 213, 272, 273, 361-366

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

Note that the manual reference command and input OIM Control can override the reference control 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. 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.

94 Speed Ref B Hi

Range: -/+Maximum Speed [0.1 Hz or 0.01 RPM]

Default: Maximum Speed

Access: 1 **Path:** Speed Command>Speed References

See also: 79, 93, 190

Scales the upper value of the Speed Ref B Sel (93) selection when the source is an analog input.

95 Speed Ref B Lo

Range: -/+Maximum Speed [0.1 Hz or 0.01 RPM]

Default: 0.0

Access: 1 **Path:** Speed Command>Speed References

See also: 79, 90, 93, 190

Scales the lower value of the Speed Ref B Sel (93) selection when the source is an analog input.

96 TB Man Ref Sel

Range: 1 = Analog In 1
2 = Analog In 2
3-8 = Reserved
9 = MOP Level

Default: 2 = Analog In 2

Access: 1 **Path:** Speed Command>Speed References

See also: 97, 98

Specifies the manual speed reference source when a digital input is configured for auto/manual.

Important: Analog In 2 is not a valid selection if it was selected for Trim In Select (117), PI Feedback Sel (128), PI Reference Sel (126), Current Lmt Sel (147) or Sleep Wake Ref (179).

97 TB Man Ref Hi

Range: -/+Maximum Speed [0.1 Hz or 0.01 RPM]

Default: Maximum Speed

Access: 1 **Path:** Speed Command>Speed References

See also: 79, 96

Scales the upper value of the TB Man Ref Sel selection when the source is an analog input.

98 TB Man Ref Lo

Range:	-/+Maximum Speed [0.1 Hz or 0.01 RPM]
Default:	0.0
Access:	1 **Path:** Speed Command>Speed References
See also:	79, 96

Scales the lower value of the TB Man Ref Sel selection when the source is an analog input.

99 Pulse Input Ref

Range:	-/+ 400.0 Hz or -/+ 24000.0RPM [0.1 Hz or 0.1 RPM]
Default:	Read Only
Access:	0 **Path:** Speed Command>Speed References
See also:	

Displays the pulse input value as seen at terminals 5 and 6 of the Encoder Terminal Block if Encoder Z Chan (423) is set to "Pulse Input."

100 Jog Speed 1

Range:	+/- Maximum Speed [0.1 Hz or 0.1 RPM]
Default:	10.0 Hz or 300.0 RPM
Access:	0 **Path:** Speed Command>Discrete Speeds
See also:	79

Sets the output frequency/speed when a jog command is issued. Units are selected by Speed Units (79).

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 or 1 RPM]
Default:	See table 11.1
Access:	See table 11.1 **Path:** Speed Command>Discrete Speeds
See also:	79, 90, 93

Provides an internal fixed speed command value. In bipolar mode, direction is commanded by the sign of the reference.

Table 11.1 – Default Values for Preset Speeds 1-7

Parameter No.	Parameter Name	Default	Access
101	Preset Speed 1	5.0 Hz or 150 RPM	0
102	Preset Speed 2	10.0 Hz or 300 RPM	2
103	Preset Speed 3	20.0 Hz or 600 RPM	2
104	Preset Speed 4	30.0 Hz or 900 RPM	2
105	Preset Speed 5	40.0 Hz or 1200 RPM	2
106	Preset Speed 6	50.0 Hz or 1500 RPM	2
107	Preset Speed 7	60.0 Hz or 1800 RPM	2

108 Jog Speed 2

Range: -/+ Maximum Speed [0.1 Hz or 0.1 RPM]

Default: 10.0 Hz or 300.0 RPM

Access: 0 **Path:** Speed Command>Discrete Speeds

See also:

Sets the output frequency of the drive when Jog Speed 2 is selected.

116 Trim % Setpoint

Range: -/+ 200.0% [0.1 %]

Default: 0.0%

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

See also: 118

Adds or subtracts a percentage of the speed reference or maximum speed. Dependent on the setting of Trim Out Select (118).

117 Trim In Select

Range:	0 = Setpoint 1 = Analog In 1 2 = Analog In 2 3-6 = Reserved 7 = Pulse In 8 = Encoder 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 = DPI Port 4 22 = Network 23-24 = Reserved 25 = Scale Block 1 26 = Scale Block 2 27 = Scale Block 3 28 = Scale Block 4
Default:	1 = Analog In 1
Access:	2 **Path:** Speed Command>Speed Trim
See also:	90, 93

Specifies which input signal is being used as a trim input. The trim is an input signal that is added to the selected speed reference. If an analog input is used as the trim signal, two scaling parameters [Trim Hi (119) and Trim Lo (120)] are provided.

118 Trim Out Select

Range:	See figure 11.4
Default:	See figure 11.4
Access:	2 **Path:** Speed Command>Speed Trim
See also:	117, 119, 120

Specifies which speed references are to be trimmed.

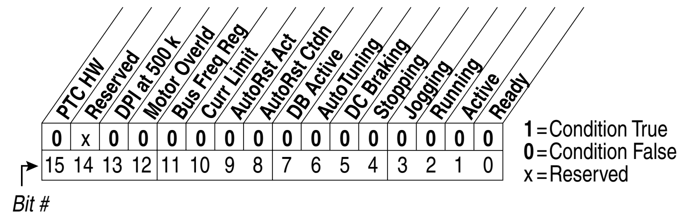


Figure 11.4 – Trim Out Select (118)

119 Trim Hi

Range:	-/+Maximum Speed [0.1 Hz or 1 RPM/%]
Default:	60.0 Hz
Access:	2 **Path:** Speed Command>Speed Trim
See also:	79, 82, 117

Scales the upper value of the Trim In Select (117) selection when the source is an analog input.

120 Trim Lo

Range:	-/+Maximum Speed [0.1 Hz] or 1 RPM/%]
Default:	0.0 Hz
Access:	2 **Path:** Speed Command>Speed Trim
See also:	79, 117

Scales the lower value of the Trim In Select (117) selection when the source is an analog input.

Important: Parameters 121, 122, and 123 are used to enable and tune the Slip Compensation Regulator. In order to allow the regulator to control drive operation, Feedback Select (80) must be set to 1 = Slip Comp.

121 Slip RPM @ FLA

Range:	0.0 to 1200.0 RPM [0.1 RPM]
Default:	Based on Motor NP RPM
Access:	2 **Path:** Speed Command>Slip Comp
See also:	61, 80, 122, 123

Sets the amount of compensation to drive output at motor FLA. If Autotune (61) is set to 3 = Calculate, changes made to this parameter will not be accepted.

Value may be changed by Autotune (61) when “Encoder” is selected in Feedback Select (80).

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.

123 Slip RPM Meter

Range:	-/+300.0 RPM [0.1 RPM]
Default:	Read Only
Access:	2 **Path:** Speed Command>Slip Comp
See also:	80, 121, 122

Displays the present amount of adjustment being applied as slip compensation.

Important: Parameters in the Process PI Group are used to enable and tune the PI Loop. In order to allow the PI Loop to control drive operation, set PI Control (125) to Enabled, bit 0 = 1.

124 PI Configuration

Range:	See figure 11.5
Default:	See figure 11.5
Access:	2 **Path:** Speed Command>Process PI
See also:	124-138

Selects specific features of the PI regulator.

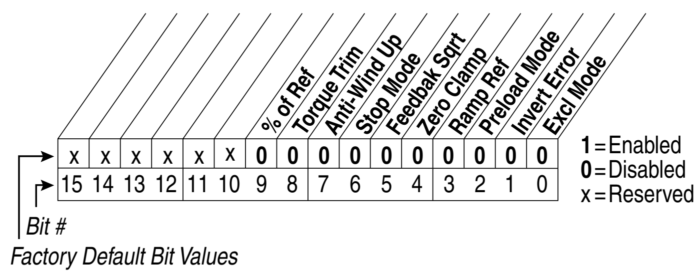


Figure 11.5 – PI Configuration (124)

Bit 0 - Excl Mode (Exclusive Mode)

- Enabled = Selects speed regulation.
- Disabled = Selects trim regulation.

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 Pre-load (133) while the PI is disabled.

Bit 3 - Ramp Ref

- Enables/disables ramping the reference used from PI Feedback to the selected PI Reference after PI is enabled. The active accel time is used for the PI ramp reference slew rate. The ramping is bypassed when the reference equals the setpoint.

Bit 4 - Zero Clamp

- Enables/disables option to limit operation so that the output frequency 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. This is used for pressure control because fans and pumps vary pressure with the square of the speed.

Bit 6 - Stop Mode

- Enabled = A Stop command is issued to the drive and the PI Loop will continue to operate during the decel ramp.

Bit 7 - Anti-Windup

Enabled = The PI Loop will automatically prevent the integrator from creating an excessive error that could cause instability. The integrator will be controlled without the need for PI Reset or PI Hold Inputs.

Bit 8 - Torque Trim

- PI Output summed into the Torque Input.

Bit 9 - % of Ref

- PI scaled to % of Ref instead of Max Frequency.

125 PI Control

Range:	See figure 11.6
Default:	See figure 11.6
Access:	2 **Path:** Speed Command>Process PI
See also:	124-138

Controls the PI regulator. Note that you must use a datalink to write to this parameter interactively from a network.

PI control allows the drive to take a reference signal (setpoint) and an actual signal (feedback) and automatically adjust the speed of the drive to match the actual signal to the reference.

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).

The purpose of the PI regulator is to regulate a process variable such as position, pressure, temperature, or flow rate, by controlling speed.

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 Feedback Select (80) must be set to Process PI (2).

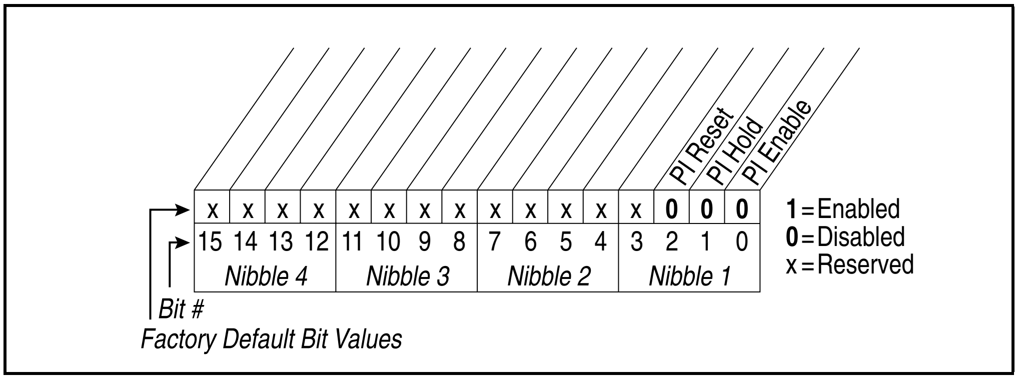


Figure 11.6 – PI Control (125)

Bit 0 - PI Enable

- Enables/disables the operation of the PI loop.

Note: To use the PI loop, Bit 0 must be set to Enable (1), even if a digital input has been programmed to be used as a PI Enable (See parameters 361-366).

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.

126 PI Reference Sel

Range:	0 = Setpoint 1 = Analog In 1 2 = Analog In 2 3-6 = Reserved 7 = Pulse In 8 = Encoder 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 = DPI Port 4 22 = Network 23-24 = Reserved 25 = Scale Block 1 26 = Scale Block 2 27 = Scale Block 3 28 = Scale Block 4
Default:	0 = PI Setpoint
Access:	2 **Path:** Speed Command>Process PI
See also:	124-138

Selects the source of the PI reference signal. Setting this parameter to 0 = PI Setpoint indicates PI Setpoint (127) is used.

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 fixed value for the process setpoint when PI Reference Sel (126) is set to PI Setpoint.

128 PI Feedback Sel

Range:	0 = Setpoint 1 = Analog In 1 2 = Analog In 2 3-6 = Reserved 7 = Pulse In 8 = Encoder 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 = DPI Port 4 22 = Network 23-24 = Reserved 25 = Scale Block 1 26 = Scale Block 2 27 = Scale Block 3 28 = Scale Block 4
Default:	0 = PI Setpoint
Access:	2 **Path:** Speed Command>Process PI
See also:	124-138

Selects the source of the PI feedback signal. Setting this parameter to 0 = PI Setpoint indicates PI Setpoint (127) is used.

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). Not functional when the PI Hold bit of PI Control = 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 PI proportional component when the PI Hold bit of PI Control (125) = Enabled (1).

PI Error x PI Prop Gain = PI Output

131 PI Lower Limit

Range:	-/+400.0 Hz or -/+ 800.0% [0.1 Hz or .01%]
Default:	-Maximum Freq or -100%
Access:	2 **Path:** Speed Command>Process PI
See also:	79, 124-138

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

132 PI Upper Limit

Range:	-/+400.0 Hz or -/+ 800.0% [0.1 Hz or 0.1%]
Default:	+Maximum Freq 0r 100%
Access:	2 **Path:** Speed Command>Process PI
See also:	79, 124-138

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

133 PI Preload

Range:	PI Lower Limit to PI Upper Limit [0.1 Hz or 0.1%]
Default:	0.0 Hz or 100%
Access:	2 **Path:** Speed Command>Process PI
See also:	79, 124-138

Sets the value used to preload the integral component on start or enable.

134 PI Status

Range:	See figure 11.7
Default:	Read Only
Access:	2 **Path:** Speed Command>Process PI
See also:	124-138

The present state of the process PI regulator.

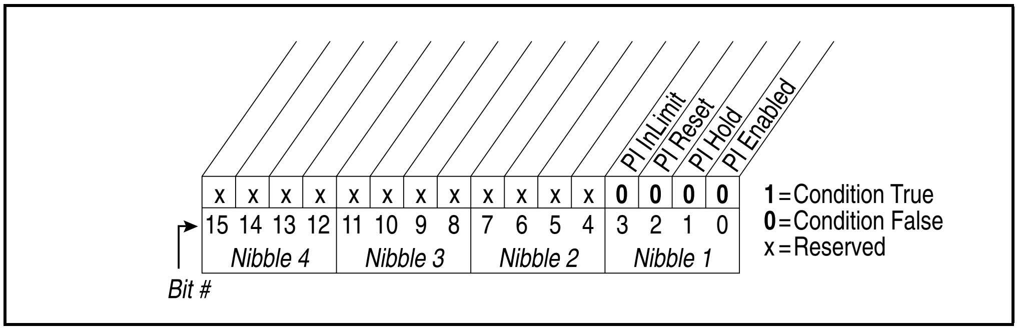


Figure 11.7 – PI Status (134)

Bit 0 - PI Enabled

- Indicates whether or not the 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:	-/+100.0% [0.1%]
Default:	Read Only
Access:	2 **Path:** Speed Command>Process PI
See also:	124 - 138

Present value of the PI reference signal.

136 PI Fdback Meter

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

Present value of the PI feedback signal.

137 PI Error Meter

Range:	-/+200.0% [0.1%]
Default:	Read Only
Access:	2 **Path:** Speed Command>Process PI
See also:	124-138

Present value of the PI error signal.

138 PI Output Meter

Range:	-/+ 100.0 Hz or -/+ 800.0% [0.1 Hz or 0.1%]
Default:	Read Only
Access:	2 **Path:** Speed Command>Process PI
See also:	124-138

Present value of the PI output signal.

139 PI BW Filter

Range:	0.0 to 240.0 Radians [0.1 Radians]
Default:	0.0 Radians
Access:	2 **Path:** Speed Command>Process PI
See also:	137

Provides filter for Process PI error signal. The output of this filter is displayed in PI Error Meter (137). Zero will disable the filter.

.

140 Accel Time 1
141 Accel Time 2

Range:	0.0 to 3600.0 [0.1 sec]
Default:	10.0 secs
Access:	140=0 **Path:** Dynamic Control>Ramp Rates 141=2
See also:	142, 143, 146, 361

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 Speed / Accel Time) = Accel Rate

Two accel times exist to enable acceleration rate changes "on the fly" using a building automation system command or digital input, if configured.

142 Decel Time 1
143 Decel Time 2

Range:	0.0 to 3600.0 sec [0.1 sec]
Default:	10.0 secs
Access:	142=0 **Path:** Dynamic Control>Ramp Rates 143=2
See also:	140, 141, 146, 361

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 building automation system command or digital input, if configured.

145 DB While Stopped

Range:	0 = Disabled 1 = Enabled
Default:	0 = Disabled
Access:	2 **Path:** Dynamic Control>Stop/Brake Modes
See also:	161, 162

Enables/disables dynamic brake operation when drive is stopped. DB may operate when drive is stopped. DB may operate if input voltage becomes too high.

Disabled = DB will only operate when drive is running.

Enabled = DB will only operate when the drive is energized.

146 S Curve %

Range:	0 to 100% [0.1%]
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 S Curve. Time is added; 1/2 at the beginning and 1/2 at the 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:	146, 149

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

148 Current Lmt Val

Range:	Based on Drive Type [0.1 Amps]
Default:	Rated Amps x 1.5 (Yields approximate default value)
Access:	0 **Path:** Dynamic Control>Load Limits
See also:	147, 149

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

When in Adj Voltage mode, the output voltage will not be allowed the exceed this value.

149 Current Lmt Gain

Range:	0 to 5000 [1]
Default:	250
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 and may reduce the current limit value as well as the PWM frequency. If the drive is being used with a sine wave filter, the filter is likely tuned to a specific carrier frequency. To ensure stable operation, it is recommended that Drive OL Mode be set to 1 = Reduce CLim.

151 PWM Frequency

FV

Range:	2 - 10kHz [2/4/8/10 kHz]
Default:	4 kHz 2 kHz (Frames 4-6, 575 VAC)
Access:	0 **Path:** Dynamic Control>Load Limits
See also:	

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

Important: If Motor Cntl Sel (53) is set to FVC Vector, the drive will run at 2kHz carrier frequency when operating below 6 Hz.

152 Droop RPM @ FLA

FV

Range:	0.0 to 200.0 RPM [0.1 RPM]
Default:	0.0 RPM
Access:	1 **Path:** Dynamic Control>Load Limits
See also:	

Selects amount of droop that the speed reference is reduced when at full load torque. Zero disables the droop function.

Important: Selecting "Slip Comp" with Feedback Select (80) in conjunction with Droop RPM @ FLA may produce undesirable results.

153 Regen Power Limit

Range: -800.0 % to 0.0% [0.1%]
Default: -50.0%
Access: 1 **Path:** Dynamic Control>Load Limits
See also: 53

Sets the maximum power limit allowed to transfer from the motor to the DC Bus. When using an external dynamic brake, set Regen Power Limit to its maximum value.

154 Current Rate Lim

Range: 1.0% to 800.0% [0.1%]
Default: 400.0%
Access: 1 **Path:** Dynamic Control>Load Limits
See also:

Sets the largest allowable rate of change for the current reference signal. This number is scaled in percent of maximum motor current every 250 microseconds.

155 Stop Mode A
156 Stop Mode B

Range: 0 = Coast
1 = Ramp
2 = Ramp to Hold
3 = DC Brake
4 = Fast Brake
Default: 155: 1 = Ramp
156: 0 = Coast
Access: 155= 0 **Path:** Dynamic Control>Stop/Brake Modes
156= 2
See also: 157-159

Active stop mode. Stop Mode A is active unless Stop Mode B is selected by a digital input. See section 13.17 for more information.

> **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.

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).

158 DC Brake Level

Range:	0 to (Rated Amps x 1.5) [0.1 Amps]
Default:	Rated Amps x 1.5
Access:	1 **Path:** Dynamic Control>Stop/Brake Modes
See also:	40, 157-159

Defines the maximum DC brake current level injected in the motor when “DC Brake” is selected as a stop mode.

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 Ki

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.

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

Sets the method and sequence of the DC bus regulator voltage. Choices are dynamic brake, frequency adjust, or both.

Sequence is determined by programming or digital input to the terminal block.

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.

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.

163 DB Resistor Type

Range:	0 = Internal Res 1 = External Res 2 = None	
Default:	2 = None	
Access:	1	**Path:** Dynamic Control>Stop/Brake Modes
See also:	161, 162	

Selects whether the internal or an external DB resistor will be used.

Important: In Frame 0-3 drives, only one DB resistor can be connected to the drive. Connecting both an internal and an external resistor could cause damage.

If a dynamic braking resistor is connected to the drive, Bus Reg Mode A and B (161 and 162) must be set to option 2, 3 or 4.

ATTENTION: Equipment damage may result if a drive mounted (internal) resistor is installed and this parameter is set to "External Res" or "None." Thermal protection for the internal resistor will be disabled, resulting in possible device damage. Failure to observe this precaution could result in equipment damage.

164 Bus Reg Kp

Range:	0 to 10000
Default:	1500
Access:	2 **Path:** Dynamic Control>Stop/Brake Modes
See also:	

Proportional gain for the bus regulator. Used to adjust regulator response.

165 Bus Reg Kd

Range:	0 to 10000
Default:	1000
Access:	2 **Path:** Dynamic Control>Stop/Brake Modes
See also:	

Derivative gain for the bus regulator. Used to control regulator overshoot.

166 Flux Braking

Range:	0 = Disabled 1 = Enabled
Default:	0 = Disabled
Access:	2 **Path:** Dynamic Control>Stop/Brake Modes
See also:	

Set to use an increase in the motor flux current to increase the motor losses, and allow a faster deceleration time when a chopper brake or regenerative capability is not available. Flux Braking can be used as a stopping or fast deceleration method.

167 Powerup Delay

Range:	0.0 to 10800.0 Secs [0.1 Sec]
Default:	0.0 Secs
Access:	1 **Path:** Dynamic Control>Restart Modes
See also:	

Defines the programmed delay time, in seconds, before a start command is accepted after a power up.

168 Start At PowerUp

Range:	0 = Disabled 1 = Enabled
Default:	0 = Disabled
Access:	2 **Path:** Dynamic Control>Restart Modes
See also:	

Enables/disables a feature to issue a Start or Run command and automatically resume running at commanded speed after drive input power is restored.

When enabled, Start At PowerUp requires a digital input configured and closed for Run or Start and a valid start contact.

> **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, Start At PowerUp 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.

169 Flying Start En

Range:	0 = Disabled 1 = Enabled	
Default:	0 = Disabled	
Access:	2	**Path:** Dynamic Control>Restart Modes
See also:	170	

Enables/disables the function which reconnects to a spinning motor at actual RPM when a start command is issued.

Flying Start En is not required in FVC Vector mode when using an encoder.

170 Flying StartGain

Range:	20 to 32767 [1]	
Default:	4000	
Access:	2	**Path:** Dynamic Control>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.

Important: Lower gain may be required for permanent magnet motors.

174 Auto Rstrt Tries

Range:	0 to 9 [1]	
Default:	0 (Disabled)	
Access:	1	**Path:** Dynamic Control>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 Start At PowerUp (168) is set to Enabled.

When Start At PowerUp 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 drive 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.

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 Restrt 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 Restrt Tries to zero.
- Occurrence of a fault that is not auto-resettable.
- Removing power from the drive.
- Exhausting an auto-reset/run cycle.

175 Auto Rstrt Delay

Range:	0.5 to 10800.0 sec [0.1 sec]	
Default:	1.0 sec	
Access:	1	**Path:** Dynamic Control>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.

177 Gnd Warn Level

Range:	1.0 to 5.0 Amps [0.1 Amps]	
Default:	3.0 Amps	
Access:	2	**Path:** Dynamic Control>Power Loss
See also:	174	

Sets the level at which a ground warning fault will occur. Configure with Alarm Config 1 (259).

178 Sleep-Wake Mode

Range:	0 = Disabled 1 = Direct (Enabled) 2 = Invert (Enabled)	
Default:	0 = Disabled	
Access:	1	**Path:** Dynamic Control>Restart Modes
See also:		

Enables the Sleep-Wake function.

Important: When enabled, the following conditions must be met:

- A proper value must be programmed for Wake Level (180) and Sleep Level (182).
- A speed reference must be selected in Speed Ref A Sel (90).
- At least one of the following must be programmed (and input closed) in Digital Inx Sel (361-366): Enable, Stop-CF, Run, Run Forward, Run Reverse.

ATTENTION: Enabling the Sleep-Wake function can cause unexpected machine operation during the Wake mode. Failure to observe these precautions can result in damage to the equipment and/or personal injury.

Table 11.2 – Conditions Required to Start Drive when Sleep-Wake is Enabled[1 2 3]

Configured Digital Input(s)	After Power-Up	After Fault		After Stop
		Stop-CF Cmd (OIM or TermBlk)	Clear Faults Cmd (TB or V*S Utilities)	OIM, TB, or Network Stop
Stop	Stop Closed Wake Signal	Stop Closed Wake Signal Start/Run Cmd[4]	Stop Closed	Stop Closed Direct Mode: Analog Sig>Sleep Level[5] Invert Mode: Analog Sig<Sleep Level[5] Start/Run Cmd
Enable	Enable Closed Wake Signal	Enable Closed Wake Signal Start/Run Cmd[4]	Enable Closed Wake Signal	Enable Closed Direct Mode: Analog Sig>Sleep Level[5] Invert Mode: Analog Sig<Sleep Level[5] Start/Run Cmd
Run Run For. Run Rev.	Run Closed Wake Signal	Run Cmd[4] Wake Signal	Run Closed Wake Signal	Run Cmd[4] Wake Signal

1 When power is cycled, restart will occur if all conditions above are met.
2 When Sleep-Wake Mode is enabled, drive start will occur if all conditions above are met.
3 The Sleep-Wake function and Speed Reference may be assigned to the same analog input.
4 Start/Run Cmd must be cycled.
5 Signal does not have to be greater than Wake level.

179 Sleep-Wake Ref

Range: 1 = Analog In 1
2 = Analog In 2

Default: 2 = Analog In 2

Access: 1 **Path:** Dynamic Control>Restart Modes

See also:

Selects the source of the input controlling the Sleep-Wake function.

180 Wake Level

Range: Sleep Level / 20.000 mA, 10.000 volts [0.001 mA, 0.001 V]

Default: 6.000 mA, 6.000 V

Access: 1 **Path:** Dynamic Control>Restart Modes

See also: 181

Defines the analog input level that will start the drive.

181 Wake Time

Range:	0.0 to 1000.0 Secs [0.1 sec]	
Default:	0.0 sec	
Access:	1	**Path:** Dynamic Control>Restart Modes
See also:	180	

Defines the amount of time at or above Wake Level before a start command is issued.

182 Sleep Level

Range:	4.000 mA, 0.000 V / Wake Level [0.001 mA, 0.001 V]	
Default:	5.000 mA, 5.000 V	
Access:	1	**Path:** Dynamic Control>Restart Modes
See also:	183	

Defines the analog input level that will stop the drive.

183 Sleep Time

Range:	0.0 to 1000.0 secs [0.1 sec]	
Default:	0.0 sec	
Access:	1	**Path:** Dynamic Control>Restart Modes
See also:	182	

Defines the amount of time at or below Sleep Level before a stop command is issued.

184 Power Loss Mode

Range:	0 = Coast 1 = Decel 2 = Continue 3 = Coast input 4 = Decel input	
Default:	0 = Coast	
Access:	1	**Path:** Dynamic Control>Power Loss
See also:	13, 184	

Sets the reaction to a loss of input power. Power loss is recognized when:

DC bus voltage is ≤ 73% of DC Bus Memory and Power Loss Mode is set to Coast.
DC bus voltage is ≤ 82% of DC Bus Memory and Power Loss Mode is set to Decel.

185 Power Loss Timer

Range:	0.0 to 60.0 sec [0.1 sec]
Default:	0.5 sec
Access:	1 Path: Dynamic Control>Power Loss
See also:	184

Sets the time that the drive will remain in power loss mode before a fault is issued.

186 Power Loss Level

Range:	0.0 to 999.9 [0.1 VDC]
Default:	Drive Rated Volts
Access:	1 Path: Dynamic Control>Power Loss
See also:	

When set to a non-zero value, selects the change in level at which the Power Loss will occur.

The drive can use the percentages referenced in Power Loss Mode (184) or a trigger point can be set for the line loss detection as follows:

$V_{Trigger}$ = [DC Bus Memory] - [Power Loss Level]

A digital input (programmed to 29 = Pwr Loss Lvl) is used to toggle between fixed percentages and the detection level.

> **ATTENTION:** If the value for Power Loss Level (186) is greater than 18% of DC Bus Memory (13), the user must provide a minimum line impedance to limit inrush current when the power line recovers. The input impedance should be equal to or greater than the equivalent of a 5% transformer with a VA rating 5 times the drive input VA rating. Failure to observe this precaution could result in damage to equipment.

187 Load Loss Level

Range:	0.0 to 800.0% [0.1%]
Default:	200.0%
Access:	2 Path: Dynamic Control>Power Loss
See also:	211, 259

Sets the percentage of motor nameplate torque at which a load loss alarm will occur.

188 Load Loss Time

Range:	0.0 to 30.0 secs [0.1 sec]	
Default:	0.0 secs	
Access:	2	Path: Dynamic Control>Power Loss
See also:	187	

Sets the time that current is below the level set in Load Loss Level (188) before a fault occurs.

189 Shear Pin Time

Range:	0.0 to 30.0 secs [0.1 sec]	
Default:	0.0 secs	
Access:	1	Path: Dynamic Control>Load Limits
See also:	238	

Sets the time that the drive is at or above current limit before a fault occurs. Zero disables this feature.

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 source for control of drive direction.

ATTENTION: When using bipolar analog inputs, unpredictable changes in motor speed and direction can be caused by noise and drift in sensitive circuits. Use speed command parameters to help reduce input source sensitivity. Failure to observe this precaution could result in bodily injury or damage to equipment.

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.

Unipolar = Drive receives unsigned reference (0 to 32767) and direction command separately (from the DPI port). For example, the direction keys on an OIM apply the direction to the reference.

Bipolar = Drive receives signed reference (-32767 to 32767). In this case, the direction keys have no effect.

Reverse Disable = Drive receives signed reference (-32767 to 32767); however, regardless of the reference, the drive is not permitted to reverse.

192 Save OIM Ref

Range:	See figure 11.8
Default:	See figure 11.8
Access:	2 **Path:** Utility>OIM Ref Config
See also:	

Allows configuration of the operation of all attached OIM devices (independent of Logic Source Sel (89)). Upper word (bits 16-31) are reserved.

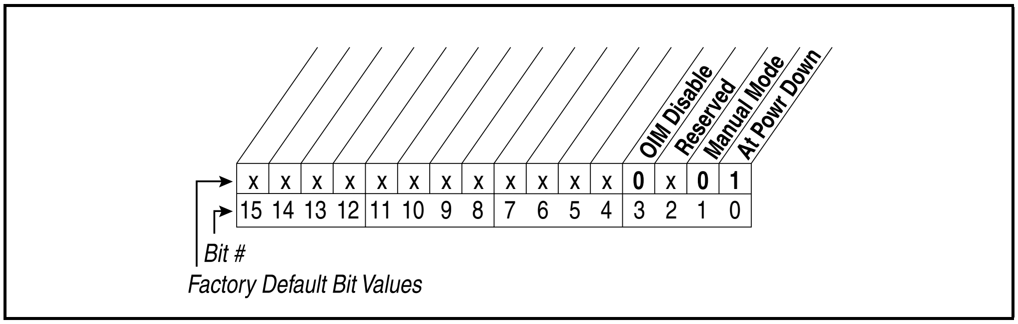


Figure 11.8 – Save OIM Ref (192)

At Power Down:

Inactive = Preload OIM reference with zero at power-up.
Active = Save OIM references at power down and preload them at power-up.

Manual Mode:

Inactive = Transition from Auto to Manual causes only reference to be controlled from the requesting OIM.

Active = Transition from Auto to Manual causes reference and control (Start, Jog, Direction, Clear Faults) to be controlled from the requesting OIM.

OIM Disable:

Inactive: OIM Start, Jog, Direction, and Clear Fault commands are functional.
Active: OIM Start, Jog, Direction, and Clear Fault commands are disabled.

193 Man Ref Preload

Range:	0 = Disabled 1 = Enabled
Default:	1 = Enabled
Access:	2 **Path:** Utility>OIM Ref Config
See also:	

Enables/disables a feature to automatically load the present auto frequency reference value into the OIM when Manual is selected. Allows smooth speed transition from Auto to Manual.

194 Save MOP Ref

Range: See figure 11.9

Default: See figure 11.9

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 or at stop.

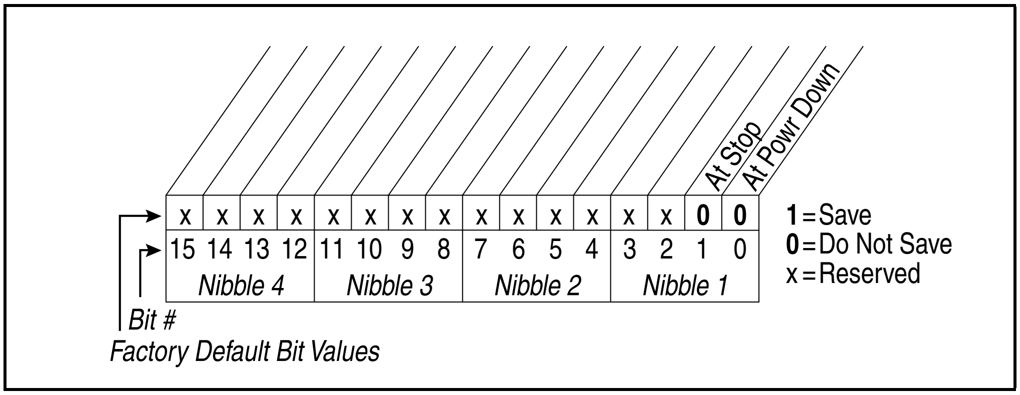


Figure 11.9 – Save MOP Ref (194)

195 MOP Rate

Range: 0.2 to Maximum Frequency [0.1 Hz/sec]
6.0 to Maximum Frequency [0.1 RPM/sec]

Default: 1.0 Hz/sec or 30.0 RPM/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: 0 = Basic

Access: 2 **Path:** Utility>Drive Memory

See also:

Displays the present parameter access level.

The value of this parameter is not affected by a “Reset Defalts” command.

197 Reset to Defalts

Range:	0 = Ready 1 = Factory 2 = Low Voltage 3 = High Voltage
Default:	0 = Ready
Access:	0 **Path:** Utility>Drive Memory
See also:	41-47, 54, 55, 62, 63, 69-72, 82, 148, 158

Resets all parameter values to defaults except Language (201), Param Access Lvl (196), Voltage Class (202) and Torq Prove Cnfg (600).

- Option 1 resets the drive to factory settings based on Voltage Class.
- Options 2 and 3 resets the drive to factory settings and sets alternate voltage and current ratings.

Important: For Frames 5 and 6, the internal fan voltage may have to be changed when using Option 2 or 3.

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 drive non-volatile memory to active drive memory.

> **ATTENTION:** The GV6000 can be configured to use multiple saved parameter (user) sets. Caution must be utilized to ensure that each user set is programmed for proper operation for the application. Recalling an improperly programmed user set may cause rotation of the motor in an undesired direction at unexpected speeds or may cause unpredictable starting of the drive and motor. Failure to observe this precaution could result in damage to equipment, severe bodily injury or loss of life.

This parameter is disabled while Dynamic User Set mode is active. Dyn UserSet Cnfg (204), Dynamic Mode bit (0) = Enabled (1).

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.

200 Reset Meters

Range:	0 = Ready 1 = MWh 2 = Elapsed Time
Default:	0 = Ready
Access:	1 **Path:** Utility>Drive Memory
See also:	

Resets selected meters to zero.

201 Language

Range:	0 = Not Selected 1 = English 2 = Francais 3 = Espanol 4 = Italiano 5 = Deutsch 7 = Portugues 10 = Nederlands
Default:	0 = Not Selected
Access:	2 **Path:** Utility>Drive Memory
See also:	

Selects the display language when using an LCD OIM or V*S Utilities. Options 6, 8 and 9 are reserved.

202 Voltage Class

Range:	2 = Low Voltage 3 = High Voltage 4-5 = Reserved
Default:	Based on Drive Type
Access:	2 **Path:** Utility>Drive Memory
See also:	41-47, 54, 55, 62, 63, 69-72, 82, 148, 158

Resets selected parameters that change the drive voltage rating, current rating, scaling, and motor data. Maximum, Minimum and Default values for parameters 41-47, 54, 55, 62, 63, 69-72, 82, 148 and 158 will be affected by changing this parameter.

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 figure 11.10
Default:	See figure 11.10
Access:	2 **Path:** Utility>Drive Memory
See also:	

Enables/Disables dynamic selection of user parameter sets.

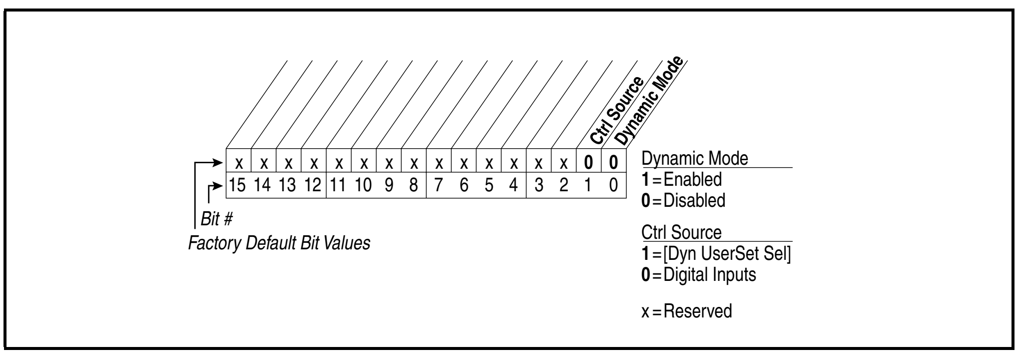


Figure 11.10 – Dyn UsrSet Cnfg

> **ATTENTION:** The GV6000 can be configured to use multiple saved parameter (user) sets. Caution must be utilized to ensure that each user set is programmed for proper operation for the application. Recalling an improperly programmed user set may cause rotation of the motor in an undesired direction at unexpected speeds or may cause unpredictable starting of the drive and motor. Failure to observe this precaution could result in damage to equipment, severe bodily injury or loss of life.

Important: In Dynamic Mode, changes to the parameters are not saved to nonvolatile storage. Switching user sets restores the values last saved before enabling dynamic mode.

205 Dyn UserSet Sel

Range:	See figure 11.11
Default:	See figure 11.11
Access:	2 **Path:** Utility>Drive Memory
See also:	

Selects user set if Dyn UserSet Cnfg = xxxx xx11.

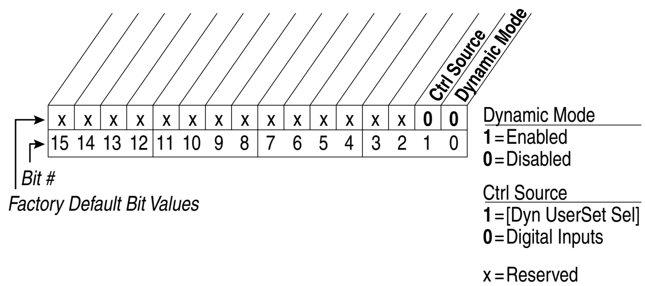


Figure 11.11 – Dyn UsrSet Sel

> **ATTENTION:** The GV6000 can be configured to use multiple saved parameter (user) sets. Caution must be utilized to ensure that each user set is programmed for proper operation for the application. Recalling an improperly programmed user set may cause rotation of the motor in an undesired direction at unexpected speeds or may cause unpredictable starting of the drive and motor. Failure to observe this precaution could result in damage to equipment, severe bodily injury or loss of life.

206 Dyn UserSet Actv

Range: See figure 11.12

Default: Read Only

Access: 2 **Path:** Utility>Drive Memory

See also:

Indicates the active user set and if the operation of the user set is dynamic or normal.

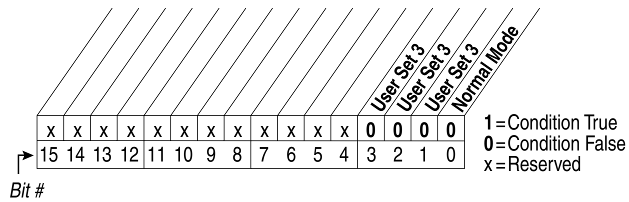


Figure 11.12 – Dyn UserSet Actv

209 Drive Status 1

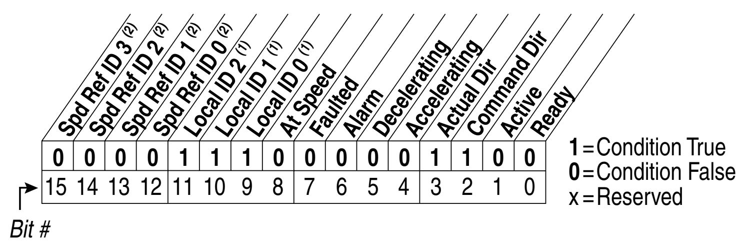
Range: See figure 11.13

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 210

Present operating condition of the drive.



Bits (2)					Bits (1)			
15	14	13	12	Description	11	10	9	Description
0	0	0	0	Ref A Auto	0	0	0	Port 0 (TB)
0	0	0	1	Preset 1 Auto	0	0	1	Port 1
0	0	1	0	Preset 2 Auto	0	1	0	Port 2
0	0	1	1	Preset 3 Auto	0	1	1	Port 3
0	1	0	0	Preset 4 Auto	1	0	0	Port 4
0	1	0	1	Preset 5 Auto	1	0	1	Port 5
0	1	1	0	Preset 6 Auto	1	1	0	Port 6
0	1	1	1	Preset 7 Auto	1	1	1	No Local Control
1	0	0	0	TB Manual				
1	0	0	1	Port 1 Manual				
1	0	1	0	Port 2 Manual				
1	0	1	1	Port 3 Manual				
1	1	0	0	Port 4 Manual				
1	1	0	1	Port 5 Manual				
1	1	1	0	Port 6 Manual				
1	1	1	1	Jog Ref				

Figure 11.13 – Drive Status 1 (209)

210 Drive Status 2

Range:	See figure 11.14
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	209

Present operating condition of the drive.

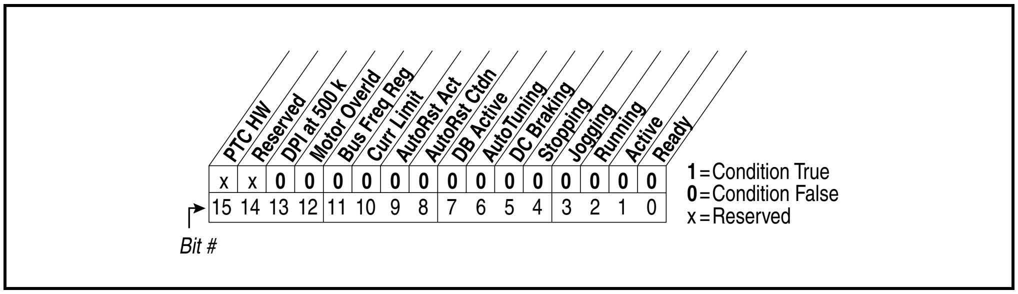


Figure 11.14 – Drive Status 2 (210)

211 Drive Alarm 1

Range:	See figure 11.15
Default:	Read Only
Access:	1 **Path:** Utility>Diagnostics
See also:	212

Indicates Type 1 alarm conditions that currently exist in the drive. Note that for alarm conditions not configured in Alarm Config 1 (259), the status indicated will be a zero.

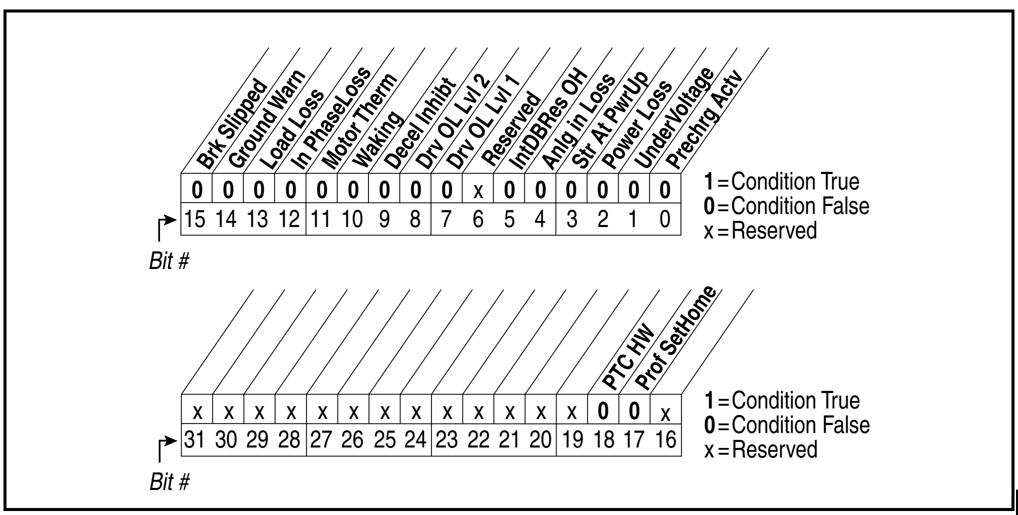


Figure 11.15 – Drive Alarm 1 (211)

212 Drive Alarm 2

Range:	See figure 11.16
Default:	Read Only
Access:	1 **Path:** Utility>Diagnostics
See also:	211

Indicates Type 2 alarm conditions that currently exist in the drive.

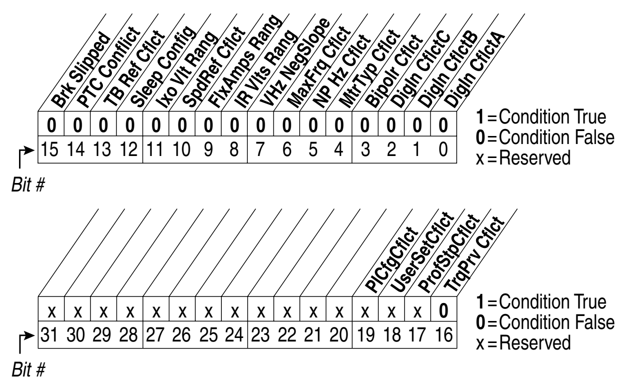


Figure 11.16 – Drive Alarm 2 (212)

213 Speed Ref Source

Range:	0 = PI Output 1 = Analog In 1 2 = Analog In 2 3-6 = Reserved 7 = Pulse In 8 = Encoder 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 = DPI Port 4 22 = Network 23 = Reserved 24 = Auto Tune 25 = Jog Speed 2 26 = Scale Block 1 27 = Scale Block 2 28 = Scale Block 3 29 = Scale Block 4 30 = Pos/Spd Ref 31 = Position Reg 32 = Micro Pos 33 = Homing 34 = Decel Switch 35 = End Switch 36 = Unipolar Lim 37 = Rev Dis Lim 38 = Max Spd Lim 39 = Min Spd Lim 40 = Rev Spd Lim 41 = Load Trq Lim
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	90, 93, 96, 101

Displays the source of the speed reference of the drive.

214 Start Inhibits

Range:	See figure 11.17
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	

Displays the inputs currently preventing the drive from starting.

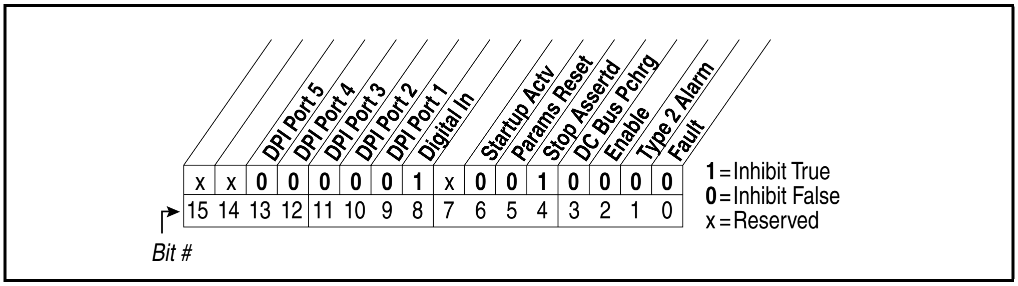


Figure 11.17 – Start Inhibits (214)

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
12 = Autotune
13 = Precharge

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics

See also: 361-366

Displays the source that initiated the most recent stop sequence. It will be cleared (set to 0) during the next start sequence.

216 Dig In Status

Range: See figure 11.18

Default: Read Only

Access: 2 **Path:** Utility>Diagnostics
Inputs & Outputs> Digital Inputs

See also: 361-366

Current state of the digital inputs on the terminal block.

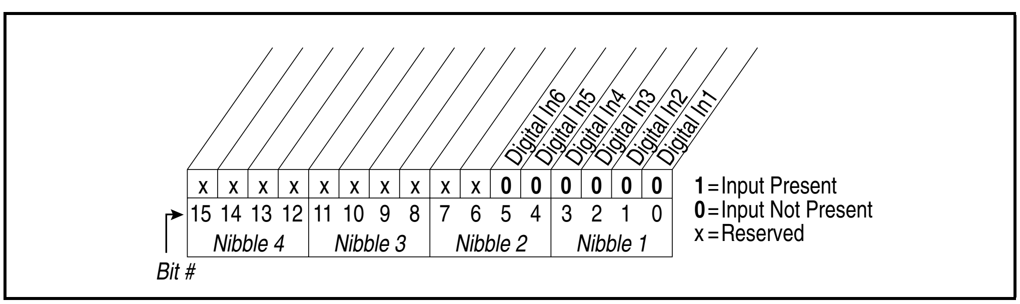


Figure 11.18 – Dig In Status (216)

217 Dig Out Status

Range:	See figure 11.19
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics Inputs & Outputs>Digital Outputs
See also:	380-384

Current state of the digital outputs.

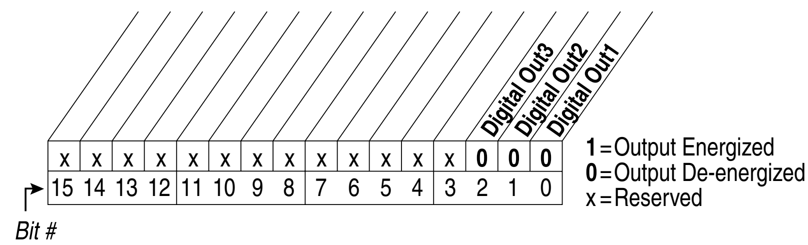


Figure 11.19 – Dig Out Status (276)

218 Drive Temp

Range:	0 to 100.0 degC [0.1 degC]
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	

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

Accumulated percentage of drive overload. Continuously operating the drive over 100% of its rating will increase this value to 100% and cause a drive fault.

220 Motor OL Count

Range:	0.0 to 100.0% [1.0%]		
Default:	Read Only		
Access:	2	**Path:**	Utility>Diagnostics
See also:	47, 48		

Accumulated percentage of motor overload. Continuously operating the motor over 100% of the motor overload setting will increase this value to 100% and cause a drive fault.

221 Mtr OL Trip Time

Range:	0.0 to 99999 [1]		
Default:	Read Only		
Access:	2	**Path:**	Utility>Diagnostics
See also:	220		

Amount of time before a Drive Overload fault occurs if the load condition remains constant. A value of 99999 means that the drive is operating under the overload level.

224 Fault Speed

Range:	0.0 to +Maximum Freq [0.1 Hz] 0.0 to +Maximum Speed [0.1 RPM]		
Default:	Read Only		
Access:	2	**Path:**	Utility>Diagnostics
See also:	79, 225-230		

Captures and displays the output speed 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 figure 11.20
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	209, 224-230

Captures and displays Drive Status 1 bit pattern at the time of the last fault.

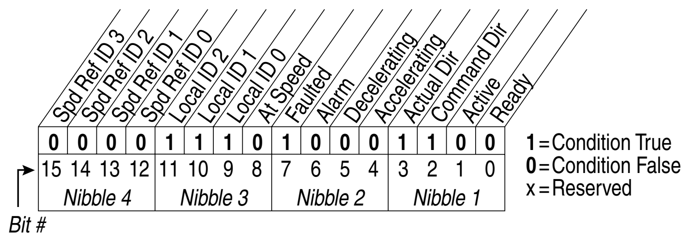


Figure 11.20 – Status 1 @ Fault (227)

228 Status 2 @ Fault

Range:	See figure 11.21
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	210, 224-230

Captures and displays Drive Status 2 bit pattern at the time of last fault.

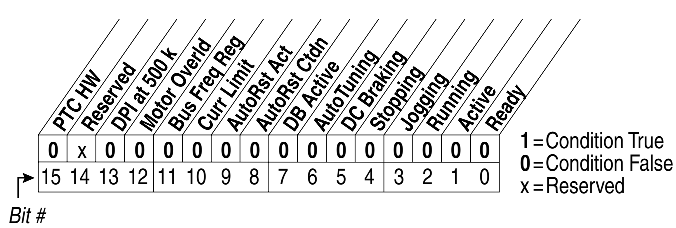


Figure 11.21 – Status 2 @ Fault (228)

229 Alarm 1 @ Fault

Range:	See figure 11.22
Default:	Read Only
Access:	1 **Path:** Utility>Diagnostics
See also:	211, 224-230

Captures and displays Drive Alarm 1 at the time of the last fault.

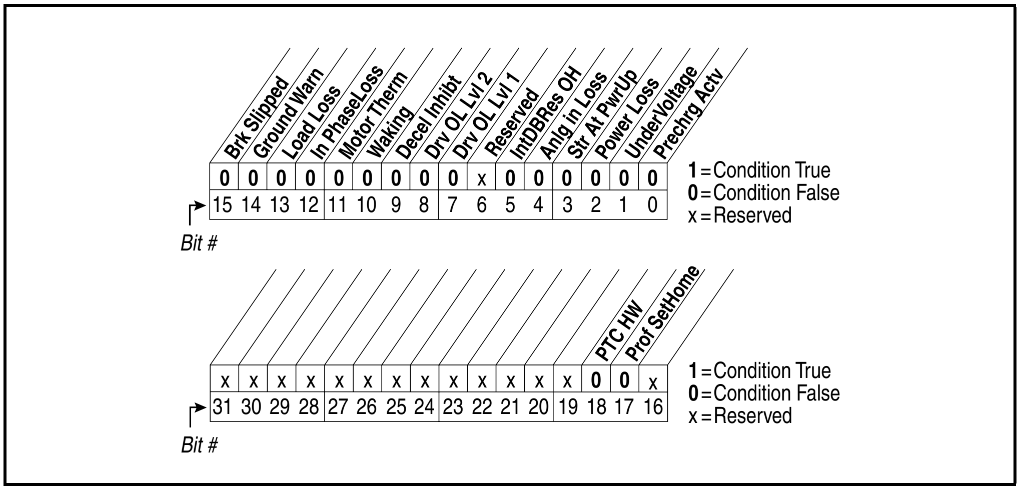


Figure 11.22 – Alarm 1 @ Fault (229)

230 Alarm 2 @ Fault

Range:	See figure 11.23
Default:	Read Only
Access:	1 **Path:** Utility>Diagnostics
See also:	211, 221-230

Captures and displays Drive Alarm 2 bit pattern at the time of last fault.

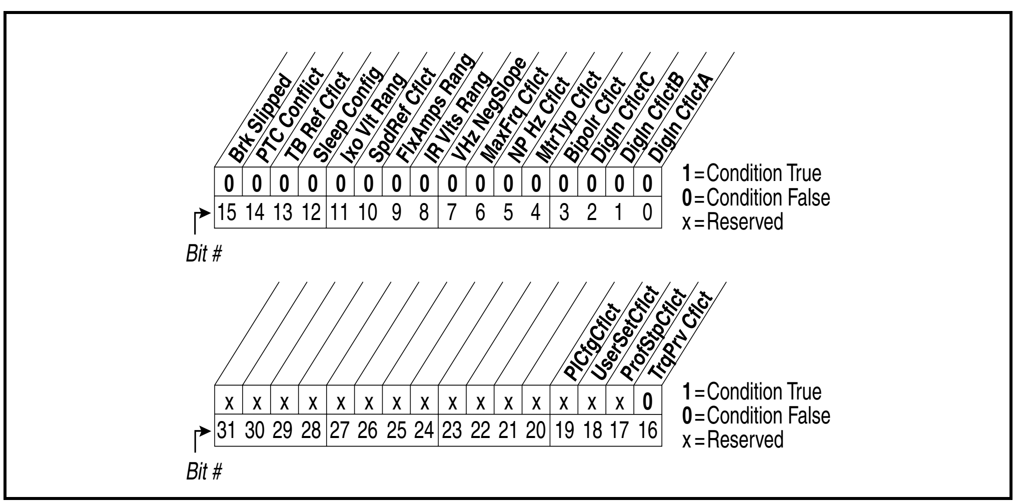


Figure 11.23 – Alarm 2 @ Fault (230)

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.

See Testpoint Codes and Functions in chapter 12 for a list of codes and functions.

235 Testpoint 1 Data

Range:	-/+ 2147483648 [1]
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	234

The present value of the function selected in Testpoint 1 Sel (234).

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.

See the Testpoint Codes and Functions in chapter 12 for a list of codes and functions.

237 Testpoint 2 Data

Range:	-/+ 2147483648 [1]
Default:	Read Only
Access:	2 **Path:** Utility>Diagnostics
See also:	236

The present value of the function selected in Testpoint 2 Sel (236).

238 Fault Config 1

Range:	See figure 11.24
Default:	See figure 11.24
Access:	2 **Path:** Utility>Faults
See also:	

Enables/disables annunciation of the faults shown in figure 11.24.

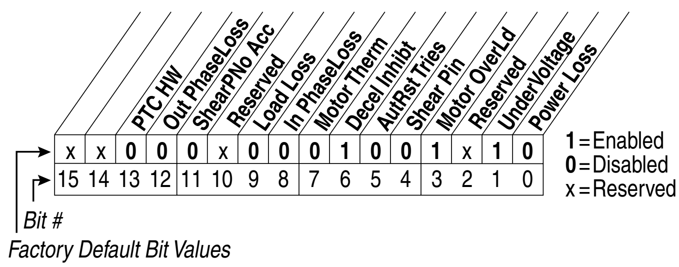


Figure 11.24 – Fault Config 1 (238)

240 Fault Clear

Range:	0 = Ready 1 = Clear Faults 2 = Clr Flt 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, which are cleared indirectly via other actions.

242 Power Up Marker

Range:	0.0000 to 214748.3647 Hr [0.0001 Hr]		
Default:	Read Only		
Access:	2	**Path:**	Utility>Faults
See also:	244, 246, 248, 250, 252, 254, 256, 258		

Elapsed hours since initial drive power up. This value will rollover to 0 after the drive has been powered on for more than the maximum value shown.

243 Fault 1 Code
245 Fault 2 Code
247 Fault 3 Code
249 Fault 4 Code
251 Fault 5 Code
253 Fault 6 Code
255 Fault 7 Code
257 Fault 8 Code

Range:	0000 to 65535		
Default:	Read Only		
Access:	2	**Path:**	Utility>Faults
See also:			

A code that represents a drive fault. The codes will appear in these parameters in the order they occur. Fault 1 Code = the most recent fault.

244 Fault 1 Time
246 Fault 2 Time
248 Fault 3 Time
250 Fault 4 Time
252 Fault 5 Time
254 Fault 6 Time
256 Fault 7 Time
258 Fault 8 Time

Range:	0.0000 to 214748.3647 [0.0001 Hr]		
Default:	Read Only		
Access:	2	**Path:**	Utility>Faults
See also:	242		

The time between initial power up and the occurrence of the associated trip fault. Can be compared to Power Up Marker for the time from the most recent power up.

Fault x Time - Power Up Marker = Time difference to the most recent power up. A negative value indicates a fault occurred before the most recent power up. A positive value indicates a fault occurred after the most recent power up.

259 Alarm Config 1

Range:	See figure 11.25
Default:	See figure 11.25
Access:	2 **Path:** Utility>Alarms
See also:	

Enables/disables alarm conditions that will initiate a drive alarm.

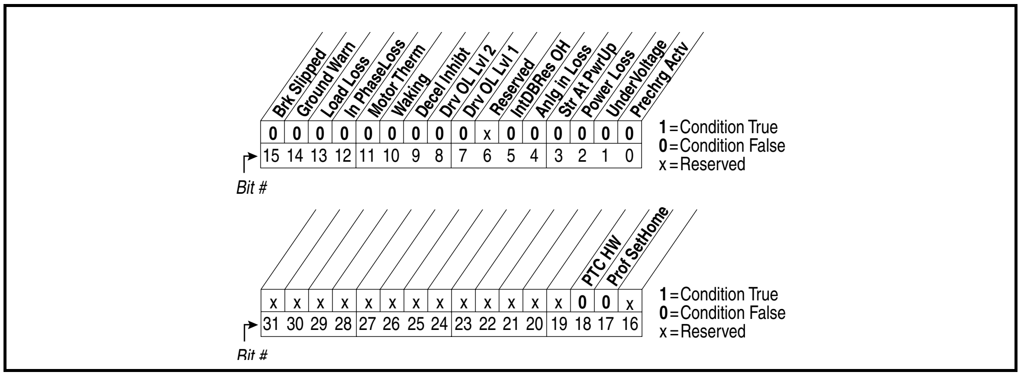


Figure 11.25 – Alarm Config 1 (259)

261 Alarm Clear

Range:	0 = Ready 1 = Clr Alarm Que
Default:	0 = Ready
Access:	1 **Path:** Utility>Alarms
See also:	262 - 269

Resets all Alarm1 - 8 Code parameters (262 - 269) to zero.

262 Alarm 1 Code
263 Alarm 2 Code
264 Alarm 3 Code
265 Alarm 4 Code
266 Alarm 5 Code
267 Alarm 6 Code
268 Alarm 7 Code
269 Alarm 8 Code

Range:	0 to 65535 [1]
Default:	Read Only
Access:	1 **Path:** Utility>Alarms
See also:	261

A code that represents a drive alarm. The codes will appear in the order that the alarms occur. The first code in is the first out. A time stamp is not available with alarms.

270 DPI Data Rate

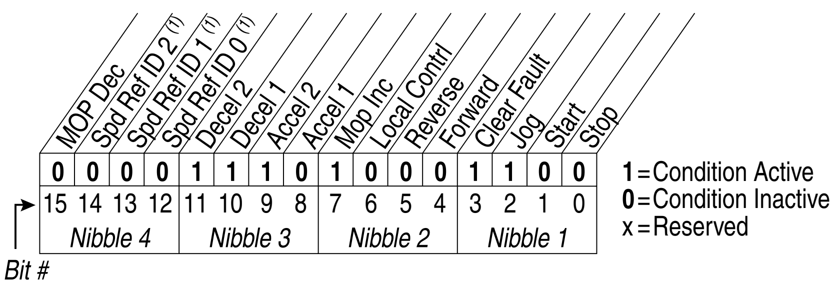
Range:	0 = 125 kbps 1 = 500 kbps
Default:	1 = 500 kbps
Access:	2 **Path:** Communication>Comm Control
See also:	

Sets the drive rate for attached drive peripherals. The drive must be reset for the change in value to be effected.

271 Drive Logic Rslt

Range:	See figure 11.26
Default:	Read Only
Access:	2 **Path:** Communication>Comm Control
See also:	

The final logic command to the drive resulting from the combination of all port requests and masking functions. Each bit or set of bits represent a command to the drive or follower device.



Bits(1)			Description
14	13	12	
0	0	0	No Command - Man. Mode
0	0	1	Ref A Auto
0	1	0	Preset 2 Auto
0	1	1	Preset 3 Auto
1	0	0	Preset 4 Auto
1	0	1	Preset 5 Auto
1	1	0	Preset 6 Auto
1	1	1	Preset 7 Auto

Figure 11.26 – Drive Logic Rslt (271)

272 Drive Ref Rslt

Range:	-/+32767 [1]
Default:	Read Only
Access:	2 **Path:** Communication>Comm Control
See also:	

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:	-/+32767 [1]
Default:	Read Only
Access:	2 **Path:** Communication>Comm Control
See also:	

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.

274 DPI Port Sel

Range:	0 = Not Used 1 = DPI Port 1 2 = DPI Port 2 3 = DPI Port 3 4 = DPI Port 4 5 = DPI Port 5
Default:	0 = Not Used
Access:	2 **Path:** Communication>Comm Control
See also:	

Selects which DPI port reference value will appear in DPI Port Value (275).

275 DPI Port Value

Range:	-/+32767 [1]
Default:	Read Only
Access:	2 **Path:** Communication>Comm Control
See also:	

Value of the DPI reference selected in DPI Port Sel (274).

.

286 Manual Mask

Range:	See figure 11.27		
Default:	See figure 11.27		
Access:	2	**Path:**	Communication>Masks & Owners
See also:			

Disables manual requests at the port corresponding to bit number.

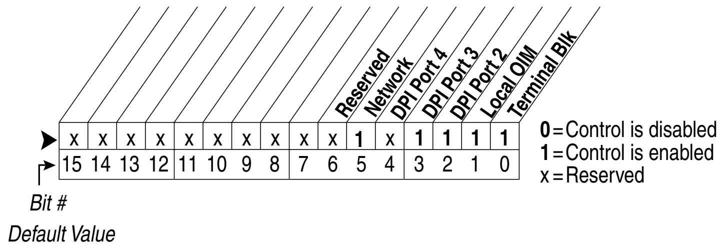


Figure 11.27 – Manual Mask (276)

287 Manual Owner

Range:	See figure 11.28		
Default:	See figure 11.28		
Access:	2	**Path:**	Communication>Masks & Owners
See also:			

Indicates the source providing manual control.

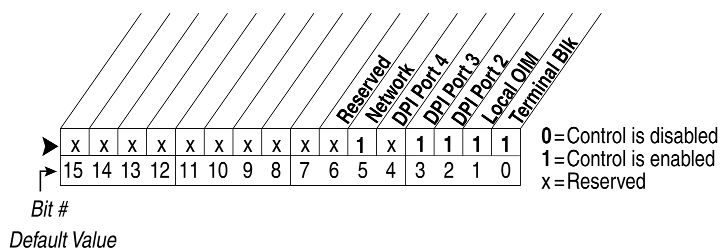


Figure 11.28 – Manual Owner (287)

288 Stop Owner

Range:	See figure 11.29
Default:	Read Only
Access:	2 **Path:** Communication>Masks & Owners
See also:	276 - 285

Modules that are presently issuing a valid stop command.

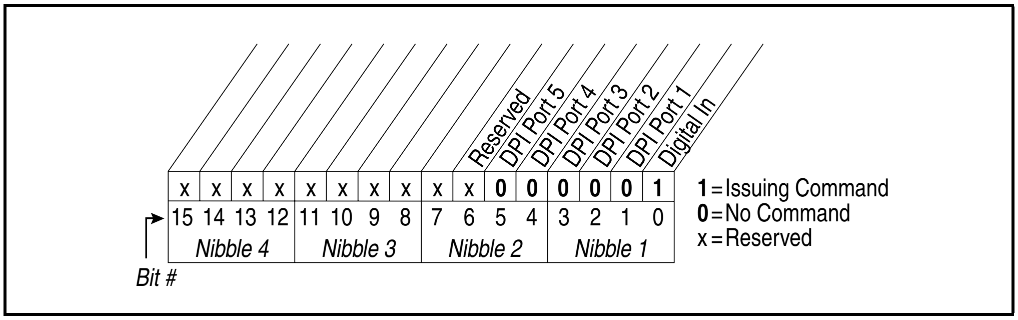


Figure 11.29 – Stop Owner

298 DPI Ref Scale

Range:	0 = Max Freq 1 = Max Speed
Default:	0 = Max Freq
Access:	2 **Path:** Communication>Comm Control
See also:	

Scales DPI on maximum frequency or maximum speed.

299 DPI Fdbk Select

Range:	0 = Output Freq 1 = Command Spd 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 = CommandedTrq 15 = MtrTrqCurRef 16 = Speed Ref 17 = Speed Fdbk 18 = Pulse In Ref 19 = Reserved 20 = Scale Block 1 21 = Scale Block 2 22 = Scale Block 3 23 = Scale Block 4 24 = Param Cntl 25 = SpdFb NoFilt
Default:	17 = Speed Fdbk
Access:	2 **Path:** Communication>Comm Control
See also:	

Selects the data to be copied into the DPI feedback data register.

300 **Data In A1** - Link A Word 1
301 **Data In A2** - Link A Word 2

Range:	0 to 611 [1]
Default:	0 (Disabled)
Access:	2 **Path:** Communication>Datalinks
See also:	

Parameter number whose value will be written from a communications device data table.

Standard Control = 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

Vector Control = Will not be updated until drive is stopped.

Refer to the appropriate communications option board manual for datalink information.

302 **Data In B1** - Link B Word 1
303 **Data In B2** - Link B Word 2

Range:	0 to 611 [1]		
Default:	0 (Disabled)		
Access:	2	**Path:**	Communication>Datalinks
See also:			

Parameter number whose value will be written from a communications device data table.

Standard Control = 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

Vector Control = Will not be updated until drive is stopped.

Refer to the appropriate communications option board manual for datalink information.

304 **Data In C1** - Link C Word 1
305 **Data In C2** - Link C Word 2

Range:	0 to 611 [1]		
Default:	0 (Disabled)		
Access:	2	**Path:**	Communication>Datalinks
See also:			

Parameter number whose value will be written from a communications device data table.

Standard Control = 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

Vector Control = Will not be updated until drive is stopped.

Refer to the appropriate communications option board manual for datalink information.

306 **Data In D1** - Link D Word 1
307 **Data In D2** - Link D Word 2

Range:	0 to 611 [1]		
Default:	0 (Disabled)		
Access:	2	**Path:**	Communication>Datalinks
See also:			

Parameter number whose value will be written from a communications device data table.

Standard Control = 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

Vector Control = Will not be updated until drive is stopped.

Refer to the appropriate communications option board manual for datalink information.

310 **Data Out A1**- Link A Word 1
311 **Data Out A2** - Link A Word 2

Range:	0 to 611 [1]		
Default:	0 (Disabled)		
Access:	2	**Path:**	Communication>Datalinks
See also:			

Parameter number whose value will be written to a communications device data table.

312 **Data Out B1**- Link B Word 1
313 **Data Out B2** - Link B Word 2

Range:	0 to 611 [1]		
Default:	0 (Disabled)		
Access:	2	**Path:**	Communication>Datalinks
See also:			

Parameter number whose value will be written to a communications device data table.

314 **Data Out C1**- Link C Word 1
315 **Data Out C2** - Link C Word 2

Range:	0 to 611 [1]		
Default:	0 (Disabled)		
Access:	2	**Path:**	Communication>Datalinks
See also:			

Parameter number whose value will be written to a communications device data table.

316 **Data Out D1**- Link D Word 1
317 **Data Out D2** - Link D Word 2

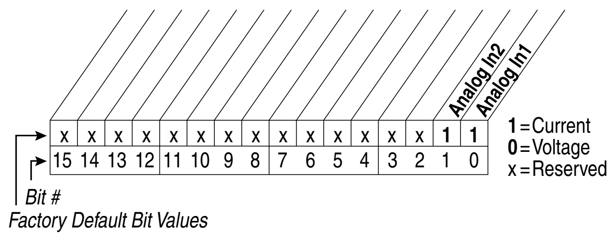
Range:	0 to 611 [1]		
Default:	0 (Disabled)		
Access:	2	**Path:**	Communication>Datalinks
See also:			

Parameter number whose value will be written to a communications device data table.

320 Anlg In Config

Range:	See figure 11.30
Default:	See figure 11.30
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 10VDC (unipolar or bipolar) or as 4-20mA inputs. See scaling parameters Analog In 1 (322 and 323) and Analog In 2 (325 and 326).



Analog In 1	Bit	Term
0 to 10 VDC or -10 to +10 VDC	Bit 0 = 0	1, 2 (17 to 18 not jumpered)
4 to 20 mA	Bit 0 = 1	1, 2 (17 to 18 jumpered)
Analog In 2	**Bit**	**Term**
-0 to 10 VDC or -10 to +10 VDC	Bit 1 = 0	3, 4 (19 to 20 not jumpered)
4 to 20 mA	Bit 1 = 1	3, 4 (19 to 20 jumpered)

Figure 11.30 – Anlg In Config (320)

321 Anlg In Sqr Root

Range:	See figure 11.31
Default:	See figure 11.31
Access:	2 **Path:** Inputs & Outputs>Analog Inputs
See also:	

Enables/disables the square root function for each analog input.

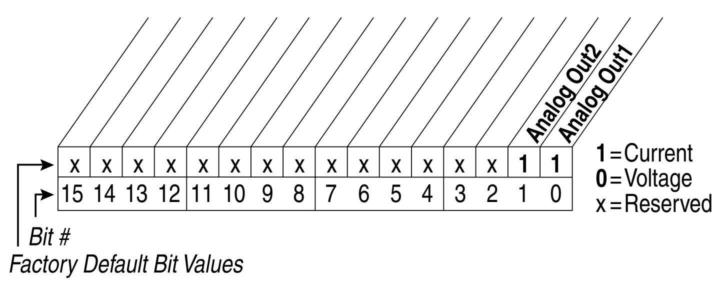


Figure 11.31 – Anlg in Sqr Root (321)

322 Analog In 1 Hi

Range:	0.000 to 20.000 mA [0.001 mA] -/+10.000 V [0.001 V] 0.0 to 10.000 V [0.001 V]	
Default:	20.000 mA	
Access:	0	**Path:** Inputs & Outputs>Analog Inputs
See also:	91, 92	

Analog In 1 Hi sets the highest input value to the analog input 1 scaling block.

Anlg In Config (320) defines if the input value will be -/+10V or 0-20 mA.

Analog Input Scaling Example

Assume:

Speed Ref A Sel = Analog In 1

Minimum Freq = 0 Hz

Maximum Freq = 60 Hz

Analog In 1 Lo = 0.0 V

Analog In 1 Hi = 10.0 V

This is the default setting, where minimum input (0 V) represents Minimum Speed and maximum input (10 V) represents Maximum Speed.

323 Analog In 1 Lo

Range:	0.000 to 20.000 mA [0.001 mA] -/+10.000 V [0.001 V] 0.0 to 10.000 V [0.001 V]	
Default:	4.000 mA	
Access:	0	**Path:** Inputs & Outputs>Analog Inputs
See also:	91, 92	

Sets the lowest input value to the analog input 1 scaling block.

Anlg In Config (320) defines if the input value will be -/+10V or 0-20 mA.

If set below 4 mA, Analog In x Loss (324) should be “Disabled.”

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. Signal loss is defined as an analog signal less than 1 V or 2 mA. The signal loss event ends and normal operation resumes when the input signal level meets or exceeds 1.5 V or 3 mA.

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 greater 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.

325 Analog In 2 Hi

Range:	4.000 to 20.000 mA [0.001 mA] -/+10.000 V [0.001 V]; 0.0 to 10.000 V [0.001 V]	
Default:	10.000 V	
Access:	2	**Path:** Inputs & Outputs>Analog Inputs
See also:	91, 92	

Analog In 2 Hi sets the highest input value to the analog input 2 scaling block.

Anlg In Config (320) defines if the input value will be -/+10V or 0-20 mA.

326 Analog In 2 Lo

Range:	4.000 to 20.000 mA [0.001 mA] -/+10.000 V [0.001 V]; 0.0 to 10.000 V [0.001 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.

Anlg In Config (320) defines if the input value will be -/+10V or 0-20 mA.

If set below 4 mA, Analog In x Loss (324) should be “Disabled.”

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

Selects drive response when an analog signal loss is detected. Signal loss is defined as an analog signal less than 1 V or 2 mA. The signal loss event ends and normal operation resumes when the input signal level meets or exceeds 1.5 V or 3 mA.

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 greater 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.

340 Analog Out Config

Range: See figure 10.32

Default: See figure 10.32

Access: 0 **Path:** Inputs & Outputs>Analog Outputs

See also:

Selects the mode for analog outputs.

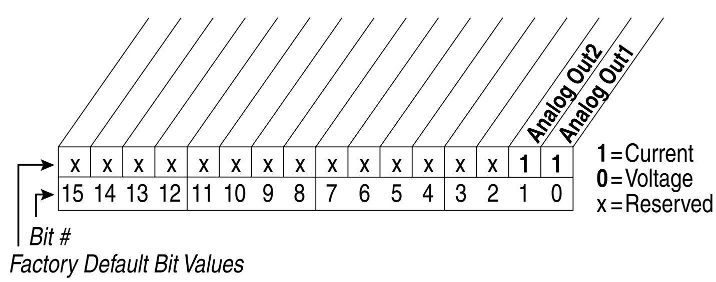


Figure 11.32 – Analog Out Config

341 Anlg Out Absolut

Range: See figure 11.33

Default: See figure 11.33

Access: 2 **Path:** Inputs & Outputs>Analog Outputs

See also:

Selects whether the signed value or absolute value of a parameter is used before being scaled to drive the analog output.

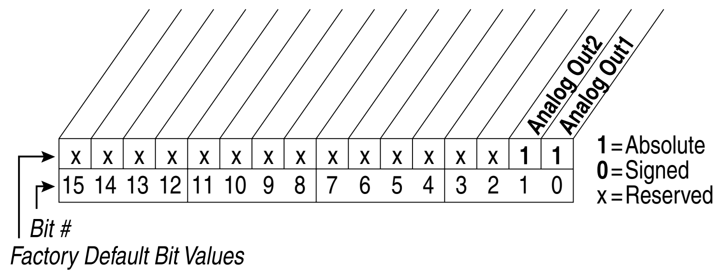


Figure 11.33 – Anlg Out Absolute (341)

342 Analog Out1Sel
345 Analog Out2 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 = CommandedTrq
15 = MtrTqrCurRef
16 = Speed Ref
17 = Speed Fdbk
18 = Pulse In Ref
19 = Torque Est
20 = Scale Block 1
21 = Scale Block 2
22 = Scale Block 3
23 = Scale Block 4
24 = Param Cntl
25 = SpdFb NoFilt

Default: 0 = Output Freq

Access: 1 **Path:** Inputs & Outputs>Analog Outputs

See also: 1 - 7, 12, 135 - 138, 219, 220

Selects the source of the value that drives the analog output.

Table 11.3 – Analog Out1/2 Sel

Options	Analog Out1/2 Lo Value		Analog Out1/2 Hi
	P.341 = Signed	P.341 = Absolute	
0 = Output Freq	-Maximum Speed	0 Hz	+ Maximum Speed
1 = Command Spd	-Maximum Speed	0 Hz/RPM	+ 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 Input Volts
7 = DC Bus Volts	0 Volts	0 Volts	200% Rated Input Volts
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%
14 = CommandedTrq	-800% Rated	0%	800% Rated
15 = MtrTrqCurRef	-200% Rated	0%	200% Rated
16 = Speed Ref	-Maximum Speed	0 Hz/RPM	+ Maximum Speed
17 = Speed Fdbk	-Maximum Speed	0 Hz/RPM	+ Maximum Speed
18 = Pulse In Ref	-25200.0 RPM	0 Hz/RPM	+ Maximum Speed
19 = Torque Est	-800%	0%	800%
20 = Scale Block 1	0%	0%	100%
21 = Scale Block 2	0%	0%	100%
22 = Scale Block 3	0%	0%	100%
23 = Scale Block 4	0%	0%	100%
24 = Param Cntl	0%	0%	100%
25 = SpdFb NoFilt	0%	0%	100%

343 Analog Out1 Hi
346 Analog Out2 Hi

Range:	0.000 to 20.000 mA or -/+10.000 V [0.001 mA or 0.001 V]
Default:	20.000 mA or 10.000 V
Access:	1 **Path:** Inputs & Outputs>Analog Outputs
See also:	340, 342

Sets the analog output value when the source value is at maximum.

344 Analog Out1 Lo
347 Analog Out2 Lo

Range:	0.000 to 20.000 mA or -/+10.000 V [0.001 mA or 0.001 V]
Default:	0.000 mA or 0.000 V
Access:	1 **Path:** Inputs & Outputs>Analog Outputs
See also:	340, 342

Sets the analog output value when the source value is at minimum.

354 Analog Out1 Scale
355 Analog Out2 Scale

Range:	Analog Out1Sel [0.01]
Default:	0.0 (Disable)
Access:	2 **Path:** Inputs & Outputs>Analog Outputs
See also:	340, 342

Sets the high value for the range of analog out scale.

Entering 0.0 will disable this scale and max scale will be used.

Example: If Analog Outx Sel (342,345) = Commanded Trq, then a value of 150 = 150% scale in place of the default 800%.

361 Digital In1 Sel
362 Digital In2 Sel
363 Digital In3 Sel
364 Digital In4 Sel
365 Digital In5 Sel
366 Digital In6 Sel

Range:
0 = Not Used
1 = Enable
2 = Clear Faults[1]
3 = Function Loss
4 = Stop-CF
5 = Start[2]
6 = Fwd/Reverse[2]
7 = Run
8 = Run Forward[3]
9 = Run Reverse[3]
10 = Jog1[2]
11 = Jog Forward[3]
12 = Jog Reverse [3]
13 = Stop Mode B
14 = Bus Reg Md B
15 = Speed Sel 1
16 = Speed Sel 2
17 = Speed Sel 3
18 = Auto/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 = Pwr Loss Lvl
30 = Precharge En
31 = Spd/Trq Sel1
32 = Spd/Trq Sel2
33 = Spd/Trq Sel3
34 = Jog2
35 = PI Invert
36 = Torque Setpt1
37 = Micro Pos
38 = Fast Stop
39 = Decel Limit
40 = End Limit
41 = UserSet Sel1
42 = UserSet Sel2
43 = Run Level
44 = RunFwd Level
45 = RunRev Level
46 = Run w/Comm
47 = Hold Step

361 Digital In1 Sel
362 Digital In2 Sel
363 Digital In3 Sel
364 Digital In4 Sel
365 Digital In5 Sel
366 Digital In6 Sel

48 =Set Home
49 = Find Home
50 = Home Limit

51 = Vel Override
52 = Pos Sel 1
53 = Pos Sel 2
54 = Pos Sel 3
55 = Pos Sel 4
56 = Pos Sel 5
57 = Prof Input

Default: See table 11.6

Access: 361= 0 **Path:** Inputs & Outputs>Digital Inputs
362-366 = 1

See also: 96, 100, 124, 140, 156, 162, 194, 380

[1] When Digital Inx Sel is set to 2 = Clear Faults, the Stop button cannot be used to clear a fault condition.

[2] Typical 3-wire Inputs: Only 3-wire functions are allowed. Including 2-wire selections will cause a type 2 alarm.

[3] Typical 2-wire Inputs: Only 2-wire functions are allowed. Including 3-wire selections will cause a type 2 alarm.

Assigns an input function to the drive's digital inputs.

Table 11.4 – Speed Select Inputs

Speed Select Inputs (17,16,15)			
3	**2**	**1**	**Reference Source**
0	0	0	Reference A
0	0	1	Reference B
0	1	0	Preset Speed 2
0	1	1	Preset Speed 3
1	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Preset Speed 7

To access Preset Speed 1, set Speed Ref x Sel to Preset Speed 1.

Table 11.5 – Spd/Trq Sel # Inputs

Speed/Torque Select Inputs (33, 32, 31)			
3	**2**	**1**	**Reference Source**
0	0	0	Zero Torque
0	0	1	Speed Regulator
0	1	0	Torque Regulator
0	1	1	Min Speed/Torque
1	0	0	Max Speed/Torque
1	0	1	Sum Speed/Torque
1	1	0	Absolute
1	1	1	Zero Torque

Table 11.6 – 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 = Aux Fault: 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 always assert a stop command. 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 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 and **34 = 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.

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.

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. TableTable 11.7 on page 89 describes the actions taken by the drive in response to various states of these input functions.

Table 11.7 – 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.

> **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.

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 11.7 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 7 possible combinations of open/closed states for the three input functions, and thus 7 possible parameters can be selected. The 7 parameters are: Speed Ref A Sel and Preset Speed 2 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 10.6 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 11.8 – 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	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 = Auto/Manual: The Auto/Manual function allows a single control device to assume exclusive control of reference select. The most recent peripheral (OIM or terminal block) that makes a manual reference request will be given control of the reference.

If the Auto/Manual input function is closed, then the drive will use one of the analog inputs (defined by TB Man Ref Sel (96)) 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 current requesting manual control of the reference, then the drive will use the normal reference selection mechanisms.

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 rate contained in MOP Rate. Units for rate are Hz per second.

While the MOP Decrement input is closed, MOP value will decrease at rate contained in MOP Rate. Units for rate 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, either Speed Ref A Sel must be set to MOP.

25 = OIM Control: This input provides a mean 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. See PI Control (125), bit 0.

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.

If this input function is open, the integrator for the Process PI loop will be allowed to increase.

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 = Pwr Loss Lvl: When the DC bus level in the drive falls below a certain level, a "powerloss" condition is created in the drive logic. This input allows the user to select between two different "power loss" detection levels dynamically. If the physical input is closed, then the drive will take its power loss level from a parameter. If the physical input is open (de-energized), then the drive will use a power loss level designated by internal drive memory, typically 82% of nominal. If the input function is not configured, then the drive always uses the internal power loss level.

30 = Precharge En: This input function is used to manage disconnection from a common DC bus.

If the physical input is closed, this indicates that the drive is connected to common DC bus and normal precharge handling can occur, and that the drive can run (start permissive). If the physical input is open, this indicates that the drive is disconnected from the common DC bus, and thus the drive should enter the precharge state (precharge relay open) and initiate a coast stop immediately in order to prepare for reconnection to the bus.

If this input function is not configured, then the drive assumes that it is always connected to the DC bus, and no special precharge handling will be done.

31-33 = Spd/Trq Sel#: See Table 11.5.

35 = PI Invert: Inverts the sign of the PI Error Value.

36 = Torque Setpt1: Selects Torque Setpt1 for Torque Ref A Sel when set. If Torque Setpt1 is not set, the value selected in Torque Ref A Sel is used.

37 = Micro Pos: Microposition Input. When closed, command frequency is set to a percentage speed reference as defined in MicroPosScale% (611).

38 = Fast Stop: When closed, drive will stop with a 0.1 second decel time. If Torque Proving is in use, float will be ignored at end of ramp and the mechanical brake will be set.

39 = Decel Limit: Reference changed to preset speed 1 when activated.

40 = End Limit: Enables a fast stop to zero speed using a zero decel time.

41-42 = UserSet Sel#: 0 = Disabled; 1 = Enabled

43-45 = Run Level, RunFwd Level, RunRev Level: Provides a run level input. They do not require a transition for enable or fault, but a transition is still required for a stop.

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

When Start At PowerUp 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.

46 = Run w/Comm: Allows the comm start bit to operate like a run with the run input on the terminal block. Ownership rules apply.

47 = Hold Step: Inhibits profile from transitioning to next step when active.

48 = Set Home: The input establishes the "home" position in speed profiling.

49 = Find Home: Starts the commissioning procedure when a start command is issued to automatically position the motor to a home position established by a limit switch.

50 = Home Limit: This input is used for the "home" position.

51 = Vel Override: When active, multiplies value of Step X Velocity by % value in Vel Override.

52-56 = Pos Sel 1-5: The binary value of these inputs is used to select the starting step number for the profile.

57 = Prof Input: (Profile Input) Must be chosen if Step X Type is set to Dig Input and the digital input value that is entered in Step X Value is the value of this digital input selector.

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.

377 Anlg1 Out Setpt
378 Anlg2 Out Setpt

Range:	0.000 to 20.000 mA or -/+10.000 V [0.001 mA or 0.001 V]
Default:	20.000 mA or 10.000 V
Access:	2 **Path:** Inputs & Outputs>Analog Outputs
See also:	

Sets the analog output value from a communication device.

Example: Set Data In Ax (300-201) to 377 (value from communication device). Then set Analog Outx Sel (342, 345) to 24 = Param Cntl.

379 Dig Out Setpt

Range: See figure 11.34

Default: See figure 11.34

Access: 2 **Path:** Inputs & Outputs>Digital Outputs

See also: 380

Sets the digital output value from a communication device.

Example: Set Data In B1 (302) to 379. The first three bits of this value will determine the setting of Digital Outx Sel (380, 384, 388), which should be set to 30 = Param Cntl.

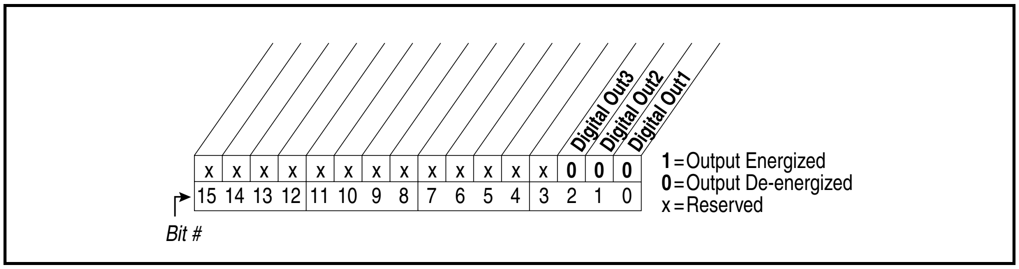


Figure 11.34 – Dig Out Setpt

380 Digital Out1 Sel
384 Digital Out2 Sel
388 Digital Out3 Sel

Range:

1 = Fault
2 = Alarm
3 = Ready
4 = Run
5 = Forward Run
6 = Reverse Run
7 = Auto Restart
8 = Powerup Run
9 = At Speed
10 = At Freq
11 = At Current
12 = At Torque
13 = At Temp
14 = At Bus Volts
15 = At PI Error
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 = PI Enable
28 = PI Hold
29 = Drive Overld
30 = Param Cntl
31 = Mask 1 AND
32 = Mask 1 OR
33 = Prof at Pos
34 = Prof Enabled
35 = Prof Running
36 = Prof Holding
37 = Prof At Home
38 = Prof Complete
39 = Prof Homing
40 = Prof Dwell
41 = Prof Batch
42 = Prof @ Step 1
43 = Prof @ Step 2
44 = Prof @ Step 3
45 = Prof @ Step 4
46 = Prof @ Step 5
47 = Prof @ Step 6
48 = Prof @ Step 7
49 = Prof @ Step 8
50 = Prof @ Step 9
51 = Prof @ Step 10
52 = Prof @ Step 11
53 = Prof @ Step 12

380 Digital Out1 Sel
384 Digital Out2 Sel
388 Digital Out3 Sel

	54 = Prof @ Step 13 55 = Prof @ Step 14 56 = Prof @ Step 15 57 = Prof @ Step 16 58 = TB in Manual
Default:	380: 1 = Fault 384: 4 = Run 388: 4 = Run
Access:	1 **Path:** Inputs & Outputs>Digital Outputs
See also:	1-4, 12, 48, 53, 137, 147, 157, 184, 218, 381-383, 385, 386, 390

Selects the drive status that will energize an output relay.

381 Digital Out1 Level
385 Digital Out2 Level
389 Digital Out3 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 Digital Out"x" Sel. Units are assumed to match the above selection (i.e., At Freq = Hz, At Torque = Amps).

382 Digital Out1 OnTime
386 Digital Out2 OnTime
390 Digital Out3 OnTime

Range:	0.00 to 600.00 sec [0.1 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 Digital Out1 OffTime
387 Digital Out2 OffTime
391 Digital Out3 OffTime

Range:	0.00 to 600.00 sec [0.1 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.

392 Dig Out Invert

Range:	See figure 11.35	
Default:	See figure 11.35	
Access:	2	**Path:** Inputs & Outputs>Digital Outputs
See also:		

Inverts the selected digital output.

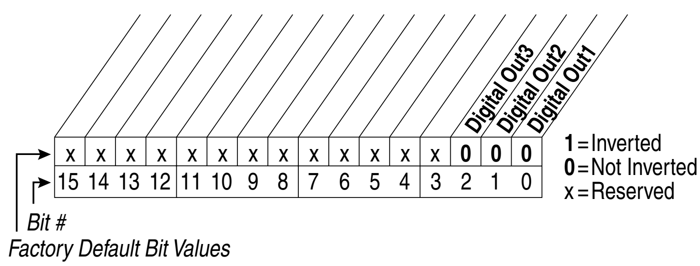


Figure 11.35 – Dig Out Invert

393 Dig Out Param

Range:	0 = PI Config 1 = PI Status 2 = Drive Sts 1 3 = Drive Sts 2 4 = DriveAlarm1 5 = DriveAlarm2 6 = StartInhibit 7 = DigIn Status 8 = DrvSts1Flt 9 = DrvSts2Flt 10 = AlrmSts1Flt 11 = AlrmSts2Flt 12 = LogicCmdRslt 13 = Stop Owner 14 = Start Owner 15 = Jog Owner 16 = Dir Owner 17 = Ref Owner 18 = Accel Owner 19 = Decel Owner 20 = FltRst Owner 21 = MOP Owner 22 = Local Owner 23 = Limit Status 24 = PortMaskAct 25 = WriteMaskAct 26 = LogicMaskAct 27 = TorqProvCnfg 28 = TorqProvSet 29 = TorqProvSts 30 = Profile Sts 31 = Profile Cmd
Default:	0 = PI Config
Access:	2 **Path:** Inputs & Outputs>Digital Outputs
See also:	394

Selects the value that the mask [Dig Out Mask (394)] will be applied to.

394 Dig Out Mask

Range:	See figure 11.36
Default:	See figure 11.36
Access:	2 **Path:** Inputs & Outputs>Digital Outputs
See also:	393

Sets the mask that is applied to the selected value in Dig Out Param (393). A bit (AND/OR) is applied. The bit is selected by the Digital Outx Sel (380, 384,388). All bits with zeros in the mask are ignored.

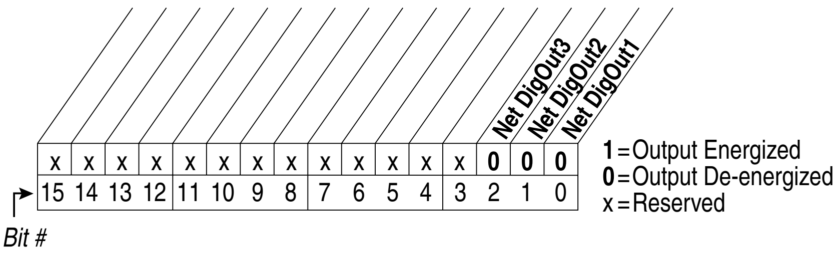


Figure 11.36 – Dig Out Mask

Example:

Mask OR: If any bits in the value are set in the mask, then the output is On.

Selected Value	0	0	0	0	1	1	0	0	1	1	1	1	0	0	0	0
Mask	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Result	Output On															

Mask AND: If all bits in the value are set in the mask, then the output is On.

Selected Value	0	0	0	0	1	1	0	0	1	1	1	1	0	0	0	0
Mask	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Result	Output Off															

412 Motor Fdbk Type

Range: 0 = Quadrature
1 = Quad Check
2 = Single Chan
3 = Single Check

Default: 0 = Quadrature

Access: 0 **Path:** Motor Control>Speed Feedback

See also:

Selects the encoder type - single channel or quadrature. Options 1 and 3 detect a loss of encoder signal (when using differential inputs) regardless of the Feedback Select (80) setting.

For FVC Vector mode, use a quadrature encoder only (option 0 or 1).

If a single channel encoder is used (option 2 or 3) in sensorless vector or V/Hz mode, select 2 = Reverse Dis in Direction Mode (190).

ATTENTION: When operating the drive with encoder feedback selected (Feedback Select (80) = 3 (Encoder)), a loss of encoder signal may produce an overspeed condition. For differential encoders, Motor Fdbk Type (412) should be selected as option 1 or 3 to detect the loss of an encoder signal. The user is responsible for ensuring that the 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. The factory default for overspeed detection is set to 10.0 Hz (or 300.0 RPM) greater than the Maximum Speed (82). Failure to observe this precaution could result in equipment damage, sever injury or loss of life.

413 Encoder PPR

Range:	2 to 20000 PPR [1 PPR]
Default:	1024 PPR
Access:	1 **Path:** Motor Control>Speed Feedback
See also:	

Contains the encoder pulses per revolution. For improved operation in FVC Vector mode, PPR should meet or exceed (64 x motor poles).

414 Enc Position Fdbk

Range:	-/+ 2147483647 [1]
Default:	Read Only
Access:	1 **Path:** Motor Control>Speed Feedback
See also:	

Displays raw encoder pulse count. For single channel encoders, this count will increase (per rev.) by the amount in Encoder PPR (413). For quadrature encoders, this count will increase by 4 times the amount defined in Encoder PPR (413).

415 Encoder Speed

Range:	-/+ 420.0 Hz or -/+ 25200.0 RPM [0.1Hz or 0.1 RPM]
Default:	Read Only
Access:	1 **Path:** Motor Control>Speed Feedback
See also:	79

Provides a monitoring point that reflects speed as seen from the feedback device.

416 Fdbk Filter Sel

Range: 0 = None
1 = Light
2 = Heavy

Default: 0 = None

Access: 1 **Path:** Motor Control>Speed Feedback

See also:

Selects the type of feedback filter desired. “Light” uses a 35/49 radian feedback filter. “Heavy” uses a 20/40 radian feedback filter.

419 Notch Filter Freq

FV

Range: 0.0 to 500.0 Hz [0.1 Hz]

Default: Read Only

Access: 1 **Path:** Motor Control>Speed Feedback

See also: 53

Sets the center frequency for an optional 2-pole notch filter. Filter is applied to the torque command. 0 disables this filter.

420 Notch Filter K

FV

Range: 0.1 to 0.9 Hz [0.1 Hz]

Default: 0.3 Hz

Access: 1 **Path:** Motor Control>Speed Feedback

See also: 53

Sets the gain for the 2-pole notch filter.

421 Marker Pulse

FV

Range: -/+ 2147483647 [1]

Default: Read Only

Access: 1 **Path:** Motor Control>Speed Feedback

See also:

Latches the raw encoder count at each marker pulse.

422 Pulse In Scale

FV

Range:	2 to 20000 [1]	
Default:	64	
Access:	1	**Path:** Motor Control>Speed Feedback
See also:		

Sets the scale factor/gain for the Pulse Input when Encoder Z Chan (423) is set to Pulse Input. Calculate for desired speed command as follows:

For Hz, [Pulse In Scale] = Input Pulse Rate (Hz)/Desired Cmd. (Hz)

For RPM, [Pulse In Scale] = (Input Pulse Rate (Hz)/Desired Cmd. (Hz))/(120/Motor Poles)

423 Encoder Z Chan

FV

Range:	0 = Pulse Input	
Default:	0 = Pulse Input 1 = Pulse Check 2 = Marker Input 3 = Marker Check	
Access:	1	**Path:** Motor Control>Speed Feedback
See also:		

Defines if the input wired to terminals 5 and 6 of the Encoder Terminal Block will be used as a Pulse or Marker Input. Options 1 and 3 detect a loss of signal (when using differential inputs) regardless of the Feedback Select (80) setting. When option 2 or 3 are used with Profile/Indexer Mode, the “homing” routine will position to the nearest marker pulse off of the home limit switch.

427 Torque Ref A Sel
431 Torque Ref B Sel

Range:	0 = Torque Stpt1 1 = Analog In 1 2 = Analog In 2 3-17 = Reserved 18 = DPI Port 1 19 = DPI Port 2 20 = DPI Port 3 21 = DPI Port 4 22 = DPI Port 5 23 = Reserved 24 = Disabled 25 = Scale Block 1 26 = Scale Block 2 27 = Scale Block 3 28 = Scale Block 4 29 = Torque Stpt2		
Default:	427: 0 = Torque Stpt1 431: 24 = Disabled		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:	53		

Selects the source of the external torque reference to the drive. How this reference is used is dependent upon [Speed/Torque Mod].

428 Torque Ref A Hi
432 Torque Ref B Hi

Range:	-/+ 800.0% [0.1%]		
Default:	100.0%		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:	53		

Scales the upper value of the Torque Ref x Sel selection when the source is an analog input.

429 Torque Ref A Lo
433 Torque Ref B Lo

Range:	-/+ 800.0% [0.1%]		
Default:	0.0%		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:	53		

Scales the lower value of the Torque Ref x Sel selection when the source is an analog input.

430 Torq Ref A Div

FV

Range:	0.1 to 3276.7 [0.1]
Default:	1.0
Access:	1 **Path:** Motor Control>Torq Attributes
See also:	53

Defines the value of the divisor for the Torque Ref A Sel (427) selection.

434 Torq Ref B Mult

FV

Range:	-/+ 3276.7 [0.1]
Default:	1.0
Access:	1 **Path:** Motor Control>Torq Attributes
See also:	53

Defines the value of the multiplier for the Torque Ref B Sel (431) selection.

435 Torque Setpoint1

FV

Range:	-/+ 800.0% [0.0%]
Default:	0.0%
Access:	1 **Path:** Motor Control>Torq Attributes
See also:	53

Provides an internal fixed value for Torque Setpoint when Torque Ref Sel is set to Torque Setpt.

436 Pos Torque Limit

FV

Range:	0.0 to 800.0% [0.1%]
Default:	200.0%
Access:	1 **Path:** Motor Control>Torq Attributes
See also:	53

Defines the torque limit for the positive torque reference value. The reference will not be allowed to exceed this value.

437 Neg Torque Limit

Range:	-800.0% to 0.0 [0.1%]		
Default:	-200.0%		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:	53		

Defines the torque limit for the negative torque reference value. The reference will not be allowed to exceed this value.

438 Torque Setpoint2

Range:	-/+ 800.0% [0.1%]		
Default:	0.0%		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:			

Provides an internal fixed value for Torque Setpoint when Torque Ref Sel is set to Torque Setpt2.

440 Control Status

Range:	See figure 11.37		
Default:	Read Only		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:	53		

Displays a summary status of any condition that may be limiting either the current or the torque reference.

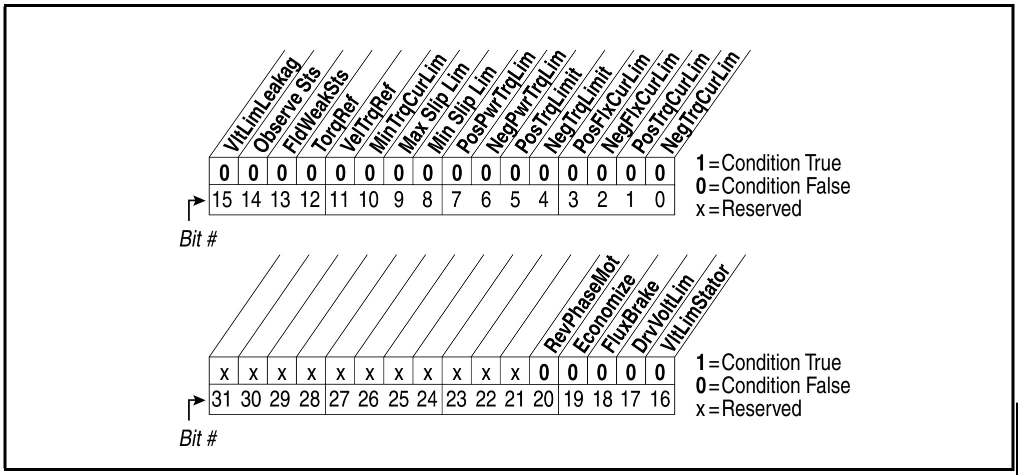


Figure 11.37 – Control Status

441 Mtr Tor Cur Ref

FV

Range:	-/+ 32767.00 Amps [0.01 Amps]		
Default:	Read Only		
Access:	1	**Path:**	Motor Control>Torq Attributes
See also:	53		

Displays the torque current reference value that is present at the output of Current Rate Lim (154).

445 Ki Speed Loop

FV

Range:	0.0 to 4000.0 [0.1]		
Default:	7.8		
Access:	2	**Path:**	Speed Command>Speed Regulator
See also:	53		

Controls the integral error gain of the speed regulator. The drive automatically adjusts Ki Speed Loop when a non-zero value is entered for Speed Desired BW (449) or an autotune is performed. Typically, manual adjustment of this parameter is needed only if system inertia cannot be determined through an autotune. Speed Desired BW (449) is set to 0 when a manual adjustment is made to this parameter.

446 Kp Speed Loop

FV

Range:	0.0 to 200.0 [0.1]		
Default:	6.3		
Access:	2	**Path:**	Speed Command>Speed Regulator
See also:	53		

Controls the proportional error gain of the speed regulator. The drive automatically adjusts Kp Speed Loop (446) when a non-zero value is entered for Speed Desired BW (449) or an auto-tune is performed. Typically, manual adjustment of this parameter is needed only if system inertia cannot be determined through an autotune. Speed Desired BW (449) is set to 0 when a manual adjustment is made to this parameter.

447 Kf Speed Loop

FV

Range:	0.0 to 0.5 [0.1]		
Default:	0.0		
Access:	2	**Path:**	Speed Command>Speed Regulator
See also:	53		

Controls the feed forward gain of the speed regulator. Setting of the Kf gain greater than zero reduces speed feedback overshoot in reponse to a step change in speed reference.

449 Speed Desired BW

FV

Range:	0.0 to 250.0 Radian/sec [0.1 Radian/sec]	
Default:	0.0 Radians/sec	
Access:	2	**Path:** Speed Command>Speed Regulator
See also:	53	

Sets the speed loop bandwidth and determines the dynamic behavior of the speed loop. As bandwidth increases, the speed loop becomes more responsive and can track a faster changing speed reference.

Adjusting this parameter will cause the drive to calculate and change Ki Speed Loop (445) and Kp Speed Loop (447) gains.

450 Total Inertia

FV

Range:	0.01 to 600.0 sec [0.01 sec]	
Default:	0.10 secs	
Access:	2	**Path:** Speed Command>Speed Regulator
See also:	53	

Represents the time in seconds for a motor coupled to a load to accelerate from zero to base speed at rated motor torque. The drive calculates Total Inertia during the autotune inertia procedure.

Adjusting this parameter will cause the drive to calculate and change Ki Speed Loop (445) and Kp Speed Loop (447) gains.

451 Speed Loop Meter

FV

Range:	-/+ 800.0% /Hz/RPM [0.1%/Hz/RPM]	
Default:	Read Only	
Access:	2	**Path:** Speed Command>Speed Regulator
See also:	53, 79, 121	

Value of the speed regulator output.

454 Rev Speed Limit

FV

Range:	-Max Speed to 0.0 Hz or -Max Speed to 0.0 RPM [0.0 Hz or 0.0 RPM]	
Default:	0.0 RPM	
Access:	1	**Path:** Speed Command>Speed Mode & Limits
See also:		

Sets a limit on speed in the negative direction, when in FVC Vector mode. Used in bipolar mode only. A value of zero disables this parameter and uses Maximum Speed for reverse speed limit.

459 PI Deriv Time

FV

Range:	0.00 to 100.00 secs	[0.01 sec]	
Default:	0.0 sec		
Access:	2	**Path:** Speed Command>PI Process	
See also:			

Refer to the formula below:

PI_{Out} = KD (Sec) x ($d_{PI\ Error}$ (%))/(d_t (Sec))

460 PI Reference Hi

Range:	-/+ 100.00%	[0.1%]	
Default:	100.0%		
Access:	2	**Path:** Speed Command>PI Process	
See also:			

Scales the upper value of PI Reference Sel (126) of the source.

461 PI Reference Lo

Range:	-/+ 100.00%	[0.1%]	
Default:	-100.0%		
Access:	2	**Path:** Speed Command>PI Process	
See also:			

Scales the lower value of PI Reference Sel (126) of the source.

462 PI Feedback Hi

Range:	-/+ 100.00%	[0.1%]	
Default:	100.0%		
Access:	2	**Path:** Speed Command>PI Process	
See also:			

Scales the upper value of PI Feedback Sel (128) of the source.

463 PI Feedback Lo

Range:	-/+ 100.00%	[0.1%]	
Default:	0.0%		
Access:	2	**Path:** Speed Command>PI Process	
See also:			

Scales the lower value of PI Feedback Sel (128) of the source.

464 PI Output Gain

Range:	-/+ 8.000 [0.001]		
Default:	1.000		
Access:	2	**Path:**	Speed Command>PI Process
See also:	138		

Sets the gain factor for PI Output Meter (138).

476 Scale1 In Value
482 Scale2 In Value
488 Scale3 In Value
494 Scale4 In Value

Range:	-/+ 32767.000 [0.001]		
Default:	0.00		
Access:	2	**Path:**	Utility>Scaled Blocks
See also:			

Displays the value of the signal being sent to ScaleX In Value using a link.

477 Scale1 In Hi
483 Scale2 In Hi
489 Scale3 In Hi
495 Scale4 In Hi

Range:	-/+ 32767.000 [0.001]		
Default:	0.00		
Access:	2	**Path:**	Utility>Scaled Blocks
See also:			

Scales the upper value of ScaleX In Value.

478 Scale1 In Lo
484 Scale2 In Lo
490 Scale3 In Lo
496 Scale4 In Lo

Range:	-/+ 32767.000 [0.001]		
Default:	0.00		
Access:	2	**Path:** Utility>Scaled Blocks	
See also:			

Scales the lower value of ScaleX In Value.

479 Scale1 Out Hi
485 Scale2 Out Hi
491 Scale3 Out Hi
497 Scale4 Out Hi

Range:	-/+ 32767.000 [0.001]		
Default:	0.00		
Access:	2	**Path:** Utility>Scaled Blocks	
See also:			

Scales the upper value of ScaleX Out Value.

480 Scale1 Out Lo
486 Scale2 Out Lo
492 Scale3 Out Lo
498 Scale4 Out Lo

Range:	-/+ 32767.000 [0.001]		
Default:	0.00		
Access:	2	**Path:** Utility>Scaled Blocks	
See also:			

Scales the lower value of ScaleX Out Value.

481 Scale1 Out Value
487 Scale2 Out Value
493 Scale3 Out Value
499 Scale4 Out Value

Range:	-/+ 32767.000 [0.001]	
Default:	Read Only	
Access:	2	**Path:** Utility>Scaled Blocks
See also:		

Value of the signal being sent out of the Universal Scale Block. Typically this value is used as the source of information and will be linked to another parameter.

Parameters 500 - 598 are found in the Advanced Tuning Parameters Section (Section 11.2).

600 TorqProve Cnfg

Range:	See figure 11.38	
Default:	See figure 11.38	
Access:	2	**Path:** Applications>Torque Proving
See also:		

Enables/disables torque/brake proving feature. When Enabled, Digital Out1 Sel (380) becomes the brake control.

This value is not changed when parameters are reset to factory defaults.

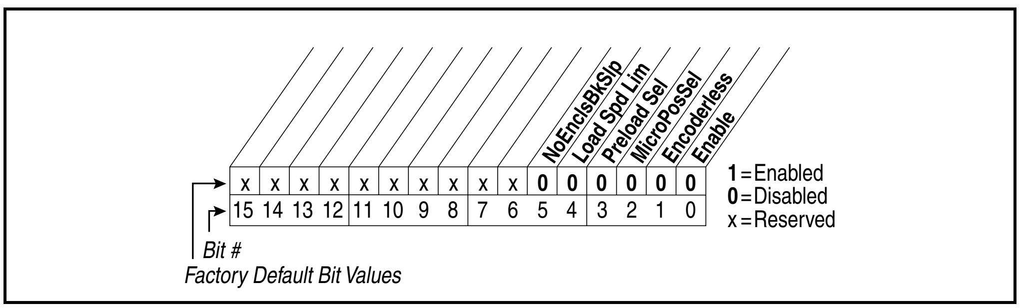


Figure 11.38 – TorqProve Cnfg

Enable = Enables Torque Proving features.

Encoderless = Enables encoderless operation - bit 0 must also be enabled.

MicroPosSel = A “1” allows the Micro Position digital input to change the speed command while the drive is running.

Preload Sel = “0” uses the last torque for preload. “1” uses “TorqRef A” if commanded direction is forward and “TorqRef B” for reverse.

Load Spd Lim = Enables drive to perform load calculation at base speed. Drive will then limit operation above base speed depending on load.

NoEnclsBkSlp = A “1” disables the partial Brake Slip routine from the drive when encoderless is selected.

601 TorqProve Setup

Range:	See figure 11.39
Default:	See figure 11.39
Access:	2 **Path:** Applications>Torque Proving
See also:	

Allows control of specific torque proving functions through a communication device.

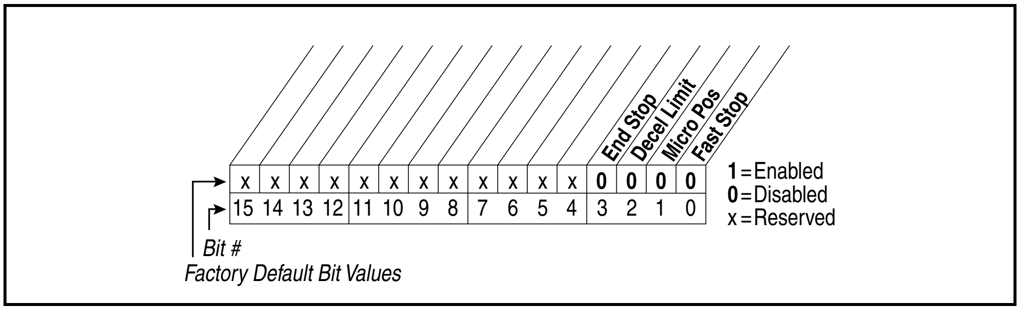


Figure 11.39 – TorqProve Setup

602 Spd Dev Band

Range:	0.1 to 15.0 Hz or 3.0 to 450.0 RPM [0.1 Hz or 0.1 RPM]
Default:	2.0 Hz or 60.0 RPM
Access:	2 **Path:** Applications>Torque Proving
See also:	603

Defines the allowable difference between the commanded frequency and encoder feedback value. A fault will occur when the difference exceeds this value for a period of time.

603 Spd Band Integrat

Range:	1 to 200 mSec [1 mSec]
Default:	60 mSec
Access:	2 **Path:** Applications>Torque Proving
See also:	602

Sets the amount of time before a fault is issued when Spd Dev Band (602) is outside its threshold.

604 Brk Release Time

Range:	0.00 to 10.00 sec [0.01 sec]
Default:	0.10 sec
Access:	2 **Path:** Applications>Torque Proving
See also:	

Sets the amount of time between commanding the brake to release and the start of drive acceleration. In Encoderless mode, this parameter sets the time to release the brake after the drive starts.

605 ZeroSpdFloatTime

Range:	0.1 to 500.0 sec [0.1 sec]
Default:	5.0 sec
Access:	2 **Path:** Applications>Torque Proving
See also:	

Sets the amount of time the drive is below Float Tolerance (606) before the brake is set. Not used in Encoderless Torque Prove mode.

606 Float Tolerance

Range:	0.1 to 5.0 Hz or 3.0 to 150.0 RPM [0.1 Hz or 0.1RPM]
Default:	0.2 Hz or 6.0 RPM
Access:	2 **Path:** Applications>Torque Proving
See also:	

Sets the frequency level where the float timer starts. Also sets the frequency level where the brake will be closed in Encoderless Torque Prove mode.

607 Brk Set Time

Range:	0.00 to 10.00 sec [0.01 sec]
Default:	0.10 sec
Access:	2 **Path:** Applications>Torque Proving
See also:	

Defines the amount of delay time between commanding the brake to be set and the start of brake proving.

608 TorqLim SlewRate

Range:	0.5 to 300.0 sec	[0.1 sec]	
Default:	10.0 sec		
Access:	2	**Path:** Applications>Torque Proving	
See also:			

Sets the rate to ramp the torque limits to zero during brake proving.

609 BrkSlip Count

Range:	0 to 65535	[1]	
Default:	250		
Access:	2	**Path:** Applications>Torque Proving	
See also:			

Sets the number of encoder counts to define a brake slippage condition.

610 Brk Alarm Travel

Range:	0.0 to 1000.0 Revs	[0.1 Revs]	
Default:	1.0 Revs		
Access:	2	**Path:** Applications>Torque Proving	
See also:			

Sets the number of motor shaft revolutions allowed during the brake slippage test. Drive torque is reduced to check for brake slippage. When slippage occurs, the drive allows this number of motor shaft revolutions before regaining control. Not used in Encoderless Torque Prove mode.

611 MicroPos Scale%

Range:	0.1 to 100.0%	[0.1%]	
Default:	10.0%		
Access:	2	**Path:** Applications>Torque Proving	
See also:	361-366		

Sets the percent of speed reference to be used when micropositioning has been selected. Motor must come to a stop before this setting will take effect.

612 Torq Prove Sts

Range: See figure 11.40
Default: Read Only
Access: 2 **Path:** Applications>Torque Proving
See also:

Displays the status bits for Torque Proving.

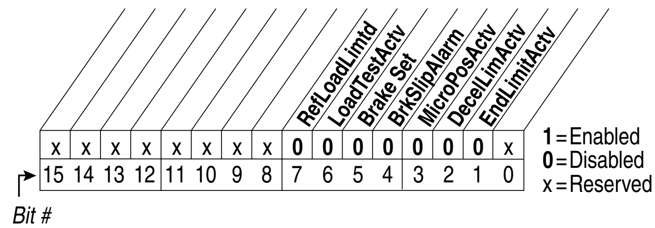


Figure 11.40 – Torq Prove Sts

631 Rod Load Torque

Range: 0.00 to 32000.00 ft-lb [0.01 ft-lb]
Default: Read Only
Access: 2 **Path:** Applications>Oil Well Pump
See also:

Displays the load side torque.

632 TorqAlarm Level

Range: 0.00 to 5000.00 ft-lb [0.01 ft-lb]
Default: 0.00 ft-lb
Access: 2 **Path:** Applications>Oil Well Pump
See also:

Sets the level at which the Torque Alarm becomes active.

633 TorqAlarm Action

Range: 0 = No Action
1 = Goto Preset 1
Default: 0 = No Action
Access: 2 **Path:** Applications>Oil Well Pump
See also:

Sets the drive action when the Torque Alarm is exceeded.

634 TorqAlarm Dwell

Range:	0.0 to 60.0 sec [0.1 sec]		
Default:	0.0 sec		
Access:	2	**Path:**	Applications>Oil Well Pump
See also:			

Sets the time that the torque must exceed [TorqAlarm Level (632)] before TorqAlarm Action (633) occurs.

635 TorqAlrm Timeout

Range:	0.0 to 600.0 sec [0.1 sec]		
Default:	Read Only		
Access:	2	**Path:**	Applications>Oil Well Pump
See also:			

Sets the amount of time a Torque Alarm can be active until timeout action begins.

636 TorqAlrm TO Act

Range:	0 = Resume 1 = Fault Drive		
Default:	0 = Resume		
Access:	2	**Path:**	Applications>Oil Well Pump
See also:			

Sets the drive action when TorqAlrm Timeout (635) is exceeded.

637 PCP Pump Sheave

Range:	0.25 to 200.00 inches [0.01 inches]		
Default:	20.0 Inch		
Access:	2	**Path:**	Applications>Oil Well Pump
See also:			

Displays the diameter of the sheave on the pump.

638 Max Rod Torque

Range:	0.0 to 3000.0 ft/lb [0.1 ft/lb]
Default:	500.0 ft/lb
Access:	2 **Path:** Applications>Oil Well Pump
See also:	

Displays the maximum torque on the polished rod in a PCP oil well application.

639 Min Rod Speed

Range:	0.0 to 199.0 RPM [0.1 RPM]
Default:	0.0 RPM
Access:	2 **Path:** Applications>Oil Well Pump
See also:	

Minimum speed for the polished rod in a PCP oil well application. Parameter related to motor minimum speed through total gear ratio.

640 Max Rod Speed

Range:	200.0 to 600.0 RPM [0.1 RPM]
Default:	300.0 RPM
Access:	2 **Path:** Applications>Oil Well Pump
See also:	

Maximum speed for the polished rod in a PCP oil well application. Parameter related to motor minimum speed through total gear ratio.

641 OilWell Pump Sel

Range:	0 = Disable 1 = Pump Jack 2 = PC Oil Well
Default:	0 = Disable
Access:	2 **Path:** Applications>Oil Well Pump
See also:	

Selects the type of oil well application.

0 = Disable: Disconnects binding of oil well parameters.

1 = Pump Jack: Sets parameters and bindings based on Pump Jack type oil well

2 = PC Oil Well: Sets parameters and bindings based Progressive Cavity type Pumps

642 Gearbox Rating

Range:	16 to 2560 Kin lbs. [0.1 Kin Lb.]	
Default:	640.0 Kin Lb.	
Access:	2	**Path:** Applications>Oil Well Pump
See also:		

Sets the Gearbox ratio rating in K inch-lbs.

Example: A 912 gearbox is rated as 912,000 in-lbs. If the client enters in the value of 912, the calculations for the parameters should use a value of 912,000.

643 Gearbox Sheave

Range:	0.25 to 100.00 inches [0.01 inch]	
Default:	0.25 Inch	
Access:	2	**Path:** Applications>Oil Well Pump
See also:		

Displays the diameter of the Sheave on the Gearbox measured in inches.

644 Gearbox Ratio

Range:	1.00 to 40.00 [0.01]	
Default:	1.00	
Access:	2	**Path:** Applications>Oil Well Pump
See also:		

Gear ratio taken directly off of the name plate information of the gearbox ratio. The ratio is typically specified as X:1.

645 Motor Sheave

Range:	0.25 to 25.00 Inches [0.01]	
Default:	10.00	
Access:	2	**Path:** Applications>Oil Well Pump
See also:		

Sets the sheave diameter on the motor.

646 Total Gear Ratio

Range:	0.00 to 32000.00	[0.01]	
Default:	Read Only		
Access:	2	**Path:** Applications>Oil Well Pump	
See also:			

Displays the calculated total gear ratio as follows:

[(Gearbox Sheave) x (Gearbox Ratio)]/[Motor Sheave]

647 DB Resistor

Range:	0.0 to 100.0 Ohms	[0.1]	
Default:	10.4		
Access:	2	**Path:** Applications>Oil Well Pump	
See also:			

Calculates the negative torque maximum available from the dynamic brake resistor.

648 Gearbox Limit

Range:	0.0 to 200.0%	[0.1%]	
Default:	100.0 %		
Access:	2	**Path:** Applications>Oil Well Pump	
See also:			

Sets the gearbox torque limit. This value is used in determining the Pos Torque Limit (436) and Neg Torque Limit (437).

700 Profile Status

Range:	See figure 11.41
Default:	Read Only
Access:	2 **Path:** Pos/Spd Profile>ProfSetup/Status
See also:	

Provides status of the profile/indexer. Bits 0-4 are a binary value.

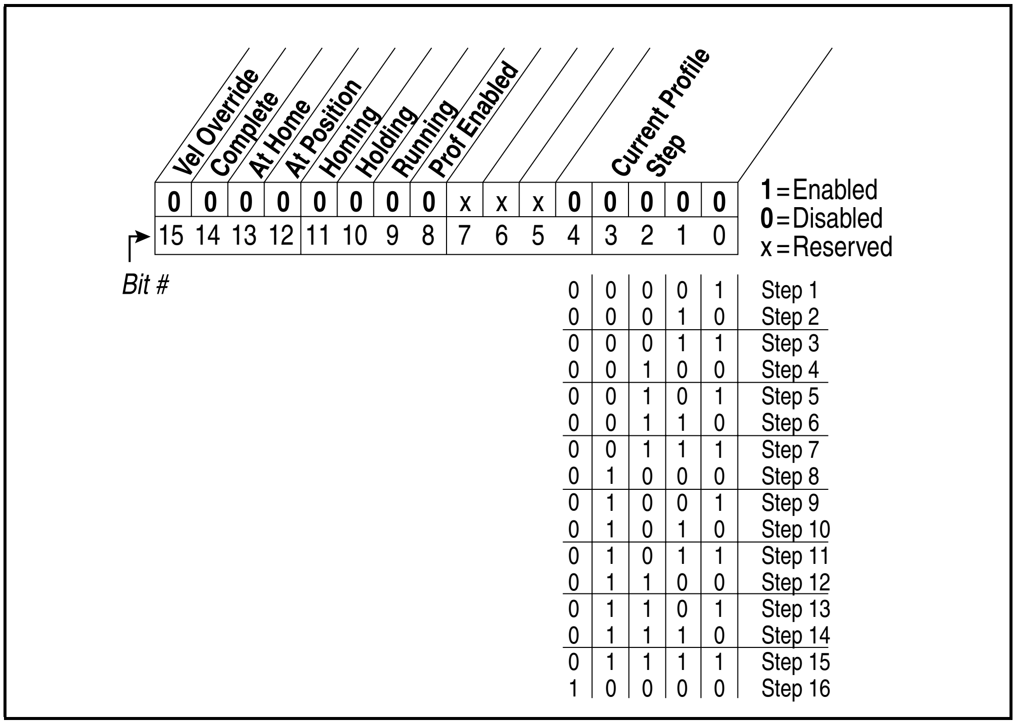


Figure 11.41 – Pos/Spd Prof Sts

701 Units Traveled

Range:	-/+ 214748352.00 [0.01]
Default:	Read Only
Access:	2 **Path:** Pos/Spd Profile>ProfSetup/Status
See also:	

Number of units traveled from the home position.

705 Profile Command

Range:	See figure 11.42		
Default:	See figure 11.42		
Access:	2	**Path:**	Pos/Spd Profile>ProfSetup/Status
See also:			

Control word for the profile/indexer. The control functions are the same as those in the digital input section. If a digital input is configured to provide the starting step (bits 0-4), then its starting step value takes priority over Profile Command. If a digital input is configured for any of bits 8-12, the corresponding functions will respond to the digital input status or the status of Profile Command.

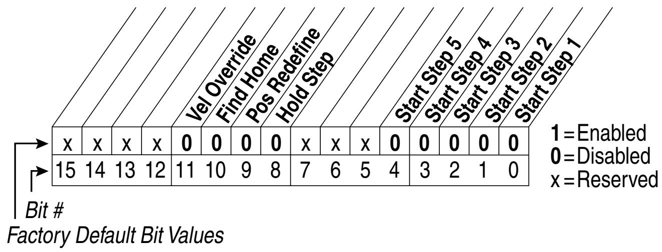


Figure 11.42 – Profile Command

707 Encoder Pos Tol

Range:	1 to 50000 [1]		
Default:	10		
Access:	2	**Path:**	Pos/Spd Profile>ProfSetup/Status
See also:			

Sets the “At Position” tolerance window (See Profile Status (700) bit 12) around the encoder count. The value is subtracted from and added to the encoder unit value. It is applied to all steps using encoder units.

708 Counts per Unit

Range:	1 to 1000000 [1]		
Default:	4096		
Access:	2	**Path:**	Pos/Spd Profile>ProfSetup/Status
See also:			

Sets the number of encoder counts equal to one unit. A 1024 RPM quadrature encoder has 4096 pulses in one revolution.

711 Vel Override

Range:	10.0 to 150.0% [0.1%]
Default:	100.0%
Access:	2 **Path:** Pos/Spd Profile>ProfSetup/Status
See also:	

This value is a multiplier to the Step x Velocity value when “Vel Override” bit of Profile Command (705) is set to 1. This is applicable to all step types.

713 Find Home Speed

Range:	-/+ 50.0% of Maximum Speed [0.1 Hz or 0.1 RPM]
Default:	+10.0% of Maximum Speed
Access:	2 **Path:** Pos/Spd Profile>ProfSetup/Status
See also:	

Sets the speed and direction that are active when “Find Home” of Profile Command (705) is active. The sign of the value defines direction (“+” = Forward, “-” = Reverse).

714 Find Home Ramp

Range:	0.0 to 3600.0 sec [0.1sec]
Default:	10.0 sec
Access:	2 **Path:** Pos/Spd Profile>ProfSetup/Status
See also:	

Sets the rate of acceleration and deceleration of the Find Home moves.

718 Pos Reg Filter

Range:	0.0 to 500.0 [0.1]
Default:	25.0
Access:	2 **Path:** Pos/Spd Profile>ProfSetup/Status
See also:	

Sets the error signal filter in the position regulator.

719 Pos Reg Gain

Range:	0.0 to 200.0 [0.1]	
Default:	4.0	
Access:	2	**Path:** Pos/Spd Profile>ProfSetup/Status
See also:		

Sets the gain adjustment for the position regulator.

720 Step 1 Type
730 Step 2 Type
740 Step 3 Type
750 Step 4 Type
760 Step 5 Type
770 Step 6 Type
780 Step 7 Type
790 Step 8 Type
800 Step 9 Type
810 Step 10 Type
820 Step 11 Type
830 Step 12 Type
840 Step 13 Type
850 Step 14 Type
860 Step 15 Type
870 Step 16 Type

Range:	0 = End 1 = Time 2 = Time Blend 3 = Dig Input 4 = Encoder Incr 5 = EncIncrBlend 6 = Enc Absolute 7 = End Hold Pos 8 = Param Level	
Default:	1 = Time	
Access:	2	**Path:** Pos/Spd Profile>Profile Step 1-16
See also:		

Selects the type of move for a particular step.

The following steps use the **velocity regulator** only:

0 = End: Drive ramps to zero speed and stops the profile after the programmed dwell time.

1 = Time: Drive ramps to step velocity, holds speed and decels to zero in specified step value time.

2 = Time Blend: Drive ramps to step velocity and holds speed until step value time completes and then transitions to step defined in step next.

3 = Dig Input: Drive ramps to step velocity, holds speed until digital input specified in step value transitions in the direction defined by sign of step value.

5 = EncIncrBlend: Drive ramps to step velocity, holds speed, when at encoder position defined by step value within tolerance window transition to step next.

8 = Param Level: Drive ramps to step velocity, holds speed, and compares step value to step dwell. The sign of step value (“+” = >, “-” = <) determines when to transition to next step.

The following step types use the point-to-point **position regulator**:

4 = Encoder Incr: Drive ramps to step velocity, holds speed then ramps to zero at encoder position defined by step value within position tolerance window.

6 = Enc Absolute: Drive ramps to step velocity in direction required, holds speed, then ramps to zero at position within tolerance window.

7 = End Hold Pos: Drive holds last position for step dwell time then stops.

The drive must have Direction Mode (190) set to Bipolar for the position regulator to function properly. Current Limits, Torque Limits and Regen Power Limits must be set so as not to limit the programmed deceleration time. If one of the limits occur, the position regulator may overshoot the position set point.

721 Step 1 Velocity
731 Step 2 Velocity
741 Step 3 Velocity
751 Step 4 Velocity
761 Step 5 Velocity
771 Step 6 Velocity
781 Step 7 Velocity
791 Step 8 Velocity
801 Step 9 Velocity
811 Step 10 Velocity
821 Step 11 Velocity
831 Step 12 Velocity
841 Step 13 Velocity
851 Step 14 Velocity
861 Step 15 Velocity
871 Step 16 Velocity

Range:	-/+ Maximum Speed	[0.1 Hz or 0.1 RPM]	
Default:	0.0		
Access:	2	**Path:** Pos/Spd Profile>Profile Step 1-16	
See also:			

This is the step speed. The sign of this value is used to determine direction for Time, Time Blended, Digital Input and Parameter Level step types. The value is an absolute number for all Encoder step types.

722 Step 1 AccelTime
732 Step 2 AccelTime
742 Step 3 AccelTime
752 Step 4 AccelTime
762 Step 5 AccelTime
772 Step 6 AccelTime
782 Step 7 AccelTime
792 Step 8 AccelTime
802 Step 9 AccelTime
812 Step 10 AccelTime
822 Step 11 AccelTime
832 Step 12 AccelTime
842 Step 13 AccelTime
852 Step 14 AccelTime
862 Step 15 AccelTime
872 Step 16 AccelTime

Range:	0.0 to 3600.0 sec [0.1 sec]	
Default:	10.0 sec	
Access:	2	**Path:** Pos/Spd Profile>Profile Step 1-16
See also:		

This is the acceleration rate for the step. Sets the time to ramp from zero to Maximum Speed.

723 Step 1 DecelTime
733 Step 2 DecelTime
743 Step 3 DecelTime
753 Step 4 DecelTime
763 Step 5 DecelTime
773 Step 6 DecelTime
783 Step 7 DecelTime
793 Step 8 DecelTime
803 Step 9 DecelTime
813 Step 10 DecelTime
823 Step 11 DecelTime
833 Step 12 DecelTime
843 Step 13 DecelTime
853 Step 14 DecelTime
863 Step 15 DecelTime
873 Step 16 DecelTime

Range:	0.0 to 3600.0 sec	[0.1 sec]
Default:	10.0 sec	
Access:	2	**Path:** Pos/Spd Profile>Profile Step 1-16
See also:		

This is the deceleration rate for the step. Sets the time to ramp from Maximum Speed to zero.

724 Step 1 Value
734 Step 2 Value
744 Step 3 Value
754 Step 4 Value
764 Step 5 Value
774 Step 6 Value
784 Step 7 Value
794 Step 8 Value
804 Step 9 Value
814 Step 10 Value
824 Step 11 Value
834 Step 12 Value
844 Step 13 Value
854 Step 14 Value
864 Step 15 Value
874 Step 16 Value

Range:	Based on Step x Type [0.01]	
Default:	6.0	
Access:	2	**Path:** Pos/Spd Profile>Profile Step 1-16
See also:		

Sets the step value used for time, digital input number, parameter level and encoder units. It is used to determine the condition to move to the next step.

Time: 0.00 to 3600.00 seconds

Digital Input: 1 to 6 (decimal ignored). The sign value “+” makes inputs “active high” and a “-” makes them “active low”.

Parameter Level: Parameter Number

Encoder: Units

725 Step 1 Dwell
735 Step 2 Dwell
745 Step 3 Dwell
755 Step 4 Dwell
765 Step 5 Dwell
775 Step 6 Dwell
785 Step 7 Dwell
795 Step 8 Dwell
805 Step 9 Dwell
815 Step 10 Dwell
825 Step 11 Dwell
835 Step 12 Dwell
845 Step 13 Dwell
855 Step 14 Dwell
865 Step 15 Dwell
875 Step 16 Dwell

Range:	Based on Step x Type [0.01]	
Default:	00.0	
Access:	2	**Path:** Pos/Spd Profile>Profile Step 1-16
See also:		

After the condition to move to the next step has been satisfied, the drive continues at its present velocity or position until the dwell time expires, at which point the next step is executed.

726 Step 1 Batch
736 Step 2 Batch
746 Step 3 Batch
756 Step 4 Batch
766 Step 5 Batch
776 Step 6 Batch
786 Step 7 Batch
796 Step 8 Batch
806 Step 9 Batch
816 Step 10 Batch
826 Step 11 Batch
836 Step 12 Batch
846 Step 13 Batch
856 Step 14 Batch
866 Step 15 Batch
876 Step 16 Batch

Range:	0 to 1000000 [1]		
Default:	1		
Access:	2	**Path:**	Pos/Spd Profile>Profile Step 1-16
See also:			

Sets the number of time to run this step.

0 = continuously run this step.

727 Step 1 Next
737 Step 2 Next
747 Step 3 Next
757 Step 4 Next
767 Step 5 Next
777 Step 6 Next
787 Step 7 Next
797 Step 8 Next
807 Step 9 Next
817 Step 10 Next
827 Step 11 Next
837 Step 12 Next
847 Step 13 Next
857 Step 14 Next
867 Step 15 Next
877 Step 16 Next

Range:	1 to 16 [1]	
Default:	Step 1 = 2 Step 2 = 3 Step 3 = 4 Step 4 = 5 Step 5 = 6 Step 6 = 7 Step 7 = 8 Step 8 = 9 Step 9 = 10 Step 10 = 11 Step 11 = 12 Step 12 = 13 Step 13 = 14 Step 14 = 15 Step 15 = 16 Step 16 = 0	
Access:	2	**Path:** Pos/Spd Profile>Profile Step 1-16
See also:		

Sets the step number to execute after this step is complete (including Step X Batch.

11.2 Advanced Tuning Parameters (Vector Control Only)

ATTENTION: To guard against unstable or unpredictable operation, the following parameters must only be changed by qualified service personnel. Failure to observe this precaution could result in damage to equipment or severe bodily injury.

The following parameters can only be viewed when the parameter acces level is set to “2 = Advanced” in Param Access Lvl (196).

500 KI Current Limit

Range:	0 to 10000 [1]		
Default:	1500		
Access:	2	**Path:**	Utility>Diag-Motor Cntl
See also:			

Current Limit Integral gain. This gain is applied to the current limit error signal to eliminate steady state current limit error. A larger value increases overshoot during a step of motor current/load.

501 KD Current Limit

Range:	0 to 10000 [1]		
Default:	500		
Access:	2	**Path:**	Utility>Diag-Motor Cntl
See also:			

Current Limit Derivative gain. This gain is applied to the sensed motor current to anticipate a current limit condition. A larger value reduces overshoot of the current relative to the current limit value.

502 Bus Reg ACR Kp

Range:	0 to 10000 [1]		
Default:	450		
Access:	2	**Path:**	Utility>Diag-Motor Cntl
See also:			

This proportional gain, in conjunction with Bus Reg Ki (160), adjusts the output frequency of the drive during a bus limit or inertia ride through condition. The output frequency is adjusted in response to an error in the active, or torque producing, current to maintain the active bus limit, or inertia ride through bus reference. A larger value of gain reduces the dynamic error of the active current.

503 Jerk

Range:	2 to 30000 [1]	
Default:	900	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

Adjusts the amount of S-Curve or "Jerk" applied to the Acc/Dec rate. To enable the Jerk feature, bit 1 of Compensation (56) must be set high.

504 Kp LL Bus Reg

Range:	0 to 10000 [1]	
Default:	500	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

This proportional gain adjusts the active current command during an inertia-ride through condition, in response to a bus error. A larger value of gain reduces the dynamic error of the bus voltage as compared to the bus voltage reference.

505 Kd LL Bus Reg

Range:	0 to 10000 [1]	
Default:	500	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

Line Loss Bus Reg Kd is a derivative gain, which is applied to the sensed bus voltage to anticipate and minimize dynamic changes. A larger value reduces overshoot of the bus voltage relative to the inertia-ride through bus voltage reference.

506 Angl Stblty Gain

Range:	0 to 32767 [1]	
Default:	51	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

Angle Stability Gain adjusts the electrical angle to maintain stable motor operation. An increase in the value increases the angle adjustment.

507 Volt Stblty Gain

Range:	0 to 32767 [1]	
Default:	93	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

Adjusts the output voltage to maintain stable motor operation. An increase in the value increases the output voltage adjustment.

508 Stability Filter

Range:	0 to 32767 [1]	
Default:	3250	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

The Stability Filter coefficient is used to adjust bandwidth of a low pass filter. The smaller the value of this coefficient, the lower the bandwidth of the filter.

509 Low Freq Reg KpId

Range:	0 to 32767 [1]	
Default:	64	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

This proportional gain adjusts the output voltage at very low frequency in response to the reactive, or d-axis, motor current. A larger value increases the output voltage change.

510 Low Freq Reg KpIq

Range:	0 to 32767 [1]	
Default:	64	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

The proportional gain adjusts the output voltage at very low frequency in response to the active, or q-axis, motor current. A larger value increases the output voltage change.

511 KI Cur Reg

Range:	0 to 32767 [1]	
Default:	44	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

This integral gain adjusts the output voltage in response to the q and d axis motor currents. A larger value increases the output voltage change.

512 Kp Cur Reg

Range:	0 to 32767 [1]	
Default:	1600	
Access:	2	**Path:** Utility>Diag-Motor Cntl
See also:		

This proportional gain adjusts the output voltage in response to the q and d axis motor currents. A larger value increases the output voltage change.

513 PWM DAC Enable

Range:	0 to 1 [1]	
Default:	0	
Access:	2	**Path:** Utility>Diag-DACS
See also:		

Reserved. Do not adjust.

514 DAC47-A
515 DAC47-B
516 DAC47-C
517 DAC47-D

Range:	0 to 7432 [1]	
Default:	0	
Access:	2	**Path:** Utility>Diag-DACS
See also:		

Reserved. Do not adjust.

518 Host DAC Enable

Range:	0 to 1 [1]		
Default:	0		
Access:	2	**Path:**	Utility>Diag-DACS
See also:			

Reserved. Do not adjust.

519 DAC55-A
520 DAC55-B
521 DAC55-C
522 DAC55-D

Range:	0 to 7432 [1]		
Default:	0		
Access:	2	**Path:**	Utility>Diag-DACS
See also:			

Reserved. Do not adjust.

523 Bus Utilization

Range:	85.0 to 100.0% [0.1%]		
Default:	95.0%		
Access:	2	**Path:**	Utility>Diag-Motor Cntl
See also:			

Sets the drive output voltage limit as a percentage of the fundamental output voltage when operating in 6 step mode. Values above 95% increase harmonic content and jeopardize control stability. This output voltage limit is strictly a function of input line and resulting bus voltage.

524 PWM Type Select

Range:	0 to 1 [1]		
Default:	0		
Access:	2	**Path:**	Utility>Diag-Motor Cntl
See also:			

Allows selection of active PWM type. A value of 0 is default and results in a change of PWM method at approximately 2/3 of rated motor frequency. If this is unacceptable for harmonic or audible reasons, a value of 1 disables the change.

525 Torque Adapt Spd

Range:	0.0 to 100.0% [0.1%]		
Default:	10.0%		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Selects the operating frequency/speed at which the adaptive torque control regulators become active as a percent of motor nameplate frequency.

526 Torq Reg Enable

Range:	0 to 1 [1]		
Default:	1		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Enables or disables the torque regulator.

527 Kp Torque Reg

Range:	0 to 32767 [1]		
Default:	32		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Proportional gain for the torque regulator.

528 Ki Torque Reg

Range:	0 to 32767 [1]		
Default:	128		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Integral gain for the torque regulator.

529 Torque Reg Trim

Range:	0.5 to 1.5 [0.1]
Default:	1.00
Access:	2 **Path:** Utility>Diag-Vector Cnt
See also:	

Torque Regulator Trim gain. A larger value increases the developed torque. Typically used to compensate for losses between developed and shaft torque.

530 Slip Reg Enable

Range:	0 to 1 [1]
Default:	1
Access:	2 **Path:** Utility>Diag-Vector Cnt
See also:	

Enables or disables the slip frequency regulator.

531 Kp Slip Reg

Range:	0 to 32767 [1]
Default:	256
Access:	2 **Path:** Utility>Diag-Vector Cnt
See also:	

Proportional gain for the slip frequency regulator.

532 Ki Slip Reg

Range:	0 to 32767 [1]
Default:	64
Access:	2 **Path:** Utility>Diag-Vector Cnt
See also:	

Integral gain for the slip frequency regulator.

533 Flux Reg Enable

Range: 0 to 1 [1]
Default: 1
Access: 2 **Path:** Utility>Diag-Vector Cnt
See also:

Enables or disables the flux regulator.

534 Kp Flux Reg

Range: 0 to 32767 [1]
Default: 64
Access: 2 **Path:** Utility>Diag-Vector Cnt
See also:

Proportional gain for the flux regulator.

535 Ki Flux Reg

Range: 0 to 32767 [1]
Default: 32
Access: 2 **Path:** Utility>Diag-Vector Cnt
See also:

Integral gain for the flux regulator.

536 Kp Flux Brake

Range: 0 to 32767 [1]
Default: 100
Access: 2 **Path:** Utility>Diag-Motor Cntl
See also:

Proportional gain for the Flux Regulator.

537 Ki Flux Brake

Range: 0 to 32767 [1]
Default: 500
Access: 2 **Path:** Utility>Diag-Motor Cntl
See also:

Integral gain for the Flux Regulator.

538 Rec Delay Time

Range:	1 to 30000 [1]		
Default:	1000		
Access:	2	**Path:**	Utility>Diag-Motor Cntl
See also:			

TBD

539 Ki Freq Reg

Range:	0 to 32767 [1]		
Default:	450		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Integral gain for the Frequency Regulator.

540 Kp Freq Reg

Range:	0 to 32767 [1]		
Default:	2000		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Proportional gain for the Frequency Regulator.

541 Encdlss Ang Comp

Range:	-1023 to 1023 [1]		
Default:	0		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Angle used to compensate for long cables attached to inverter and motor. Identified during autotune for Encoderless FVC.

542 Encdlss Vlt Comp

Range:	0 to 115 [1]		
Default:	6.1		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Voltage used to compensate for long cables attached to inverter and motor. Identified during autotune for Encoderless FVC.

543 Excitation Ki

Range:	0 to 32767 [1]		
Default:	44		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Integral gain for current regulator for excitation of Flying start.

544 Excitation Kp

Range:	0 to 32767 [1]		
Default:	1800		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Proportional gain for current regulator for excitation of Flying start.

545 In Phaseloss Lvl

Range:	10 to 1000 [1]		
Default:	325		
Access:	2	**Path:**	Utility>Diag-Vector Cnt
See also:			

Input phase loss detection (level).

546 OutPhase LossLvl

Range:	1 to 400 [1]	
Default:	200	
Access:	2	**Path:** Utility>Diag-Vector Cnt
See also:		

Output phase loss detection (level).

547 Ki Fast Brake

Range:	0 to 32767 [1]	
Default:	1000	
Access:	2	**Path:** Utility>Diag-Vector Cnt
See also:		

Integral tuning term for Fast Brake.

548 Kp Fast Brake

Range:	0 to 32767 [1]	
Default:	2000	
Access:	2	**Path:** Utility>Diag-Vector Cnt
See also:		

Proportional tuning term for Fast Brake.

549 Flux Braking %

Range:	100 to 250 % [1%]	
Default:	175	
Access:	2	**Path:** Utility>Diag-Vector Cnt
See also:		

% of Output voltage applied during Flux braking.

550 Flying Start Ki

Range:	20 to 5000 [1]	
Default:	150	
Access:	2	**Path:** Utility>Diag-Vector Cnt
See also:		

Integral gain for flying start.

551 Ki DC Brake

Range:	0 to 500 [1]
Default:	25
Access:	2 **Path:** Utility>Diag-Vector Cnt
See also:	

Integral tuning term for DC Braking.

595 Port Mask Actv

Range:	See figure11.43
Default:	Read Only
Access:	2 **Path:** Utility>Security
See also:	

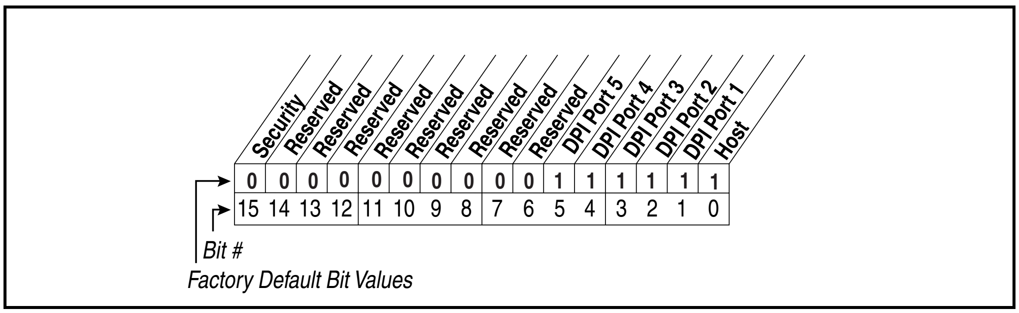


Figure 11.43 – Port Mask Actv

Bits 0-5 indicate status for DPI port communication. Bit 15 indicates when security software is controlling the parameter.

.

596 Write Mask Cfg

Range:	See figure 11.44
Default:	0 x 3E
Access:	2 **Path:** Utility>Security
See also:	

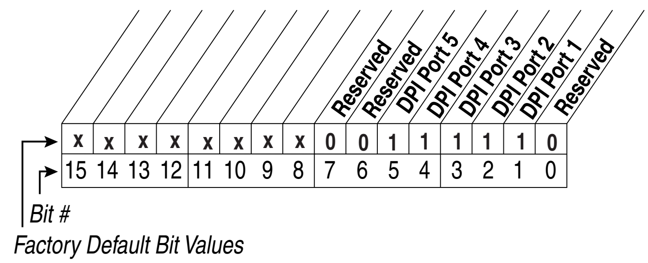


Figure 11.44 – Write Mask Cfg

Enables/disables write access (parameters, links, etc.) for DPI ports. Changes to this parameter only become effective when power is cycled, the drive is reset or bit 15 of Write Mask Actv (597) transitions from 1 to 0.

597 Write Mask Actv

Range:	See figure 11.45
Default:	Read Only
Access:	2 **Path:** Utility>Security
See also:	

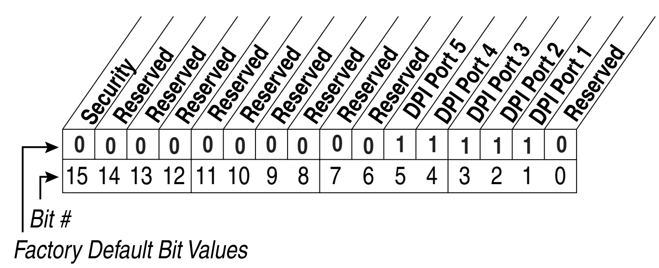


Figure 11.45 – Write Mask Actv

Status of write access for DPI ports. When bit 15 is set, network security is controlling the write mask instead of Write Mask Cfg (596).

598 Logic Mask Actv

Range:	See figure 11.46
Default:	Read Only
Access:	2 **Path:** Utility>Security
See also:	

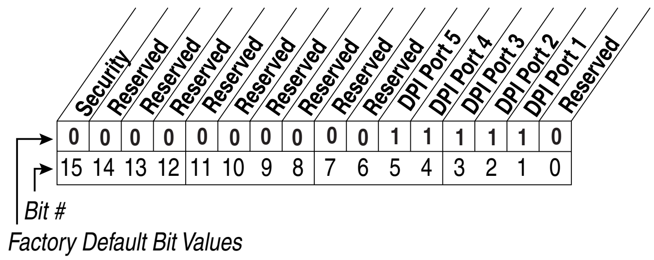


Figure 11.46 – Logic Mask Actv

Indicates status of the logic mask for DPI ports.

CHAPTER 12

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 GV6000 AC drive provides the following ways to determine the status of the drive and to troubleshoot problems that may occur:

- LEDs on the front of the drive
- User-configurable and non-configurable alarms
- User-configurable and non-configurable faults
- Entries in the fault queue
- Drive status parameters

12.1 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 the circuit breaker and lock out input power. Wait 5 minutes.

Step 2. Open 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 12.1.

Step 5. Once the drive has been serviced, reattach the drive's cover.

Step 6. Reapply input power.

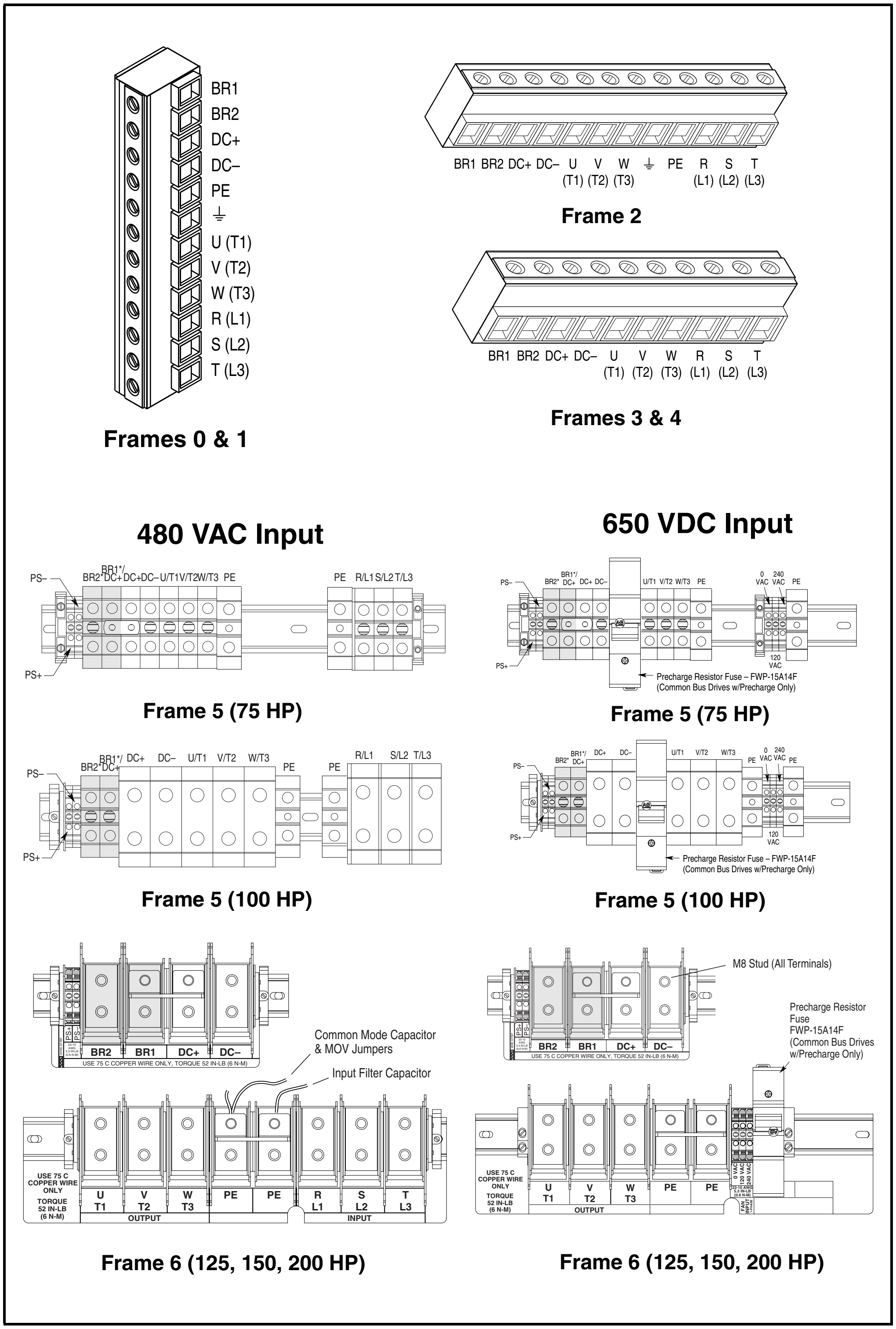


Figure 12.1 – Location of DC Bus Voltage Measuring Points

12.2 Determining Drive Status Using the Status LEDs

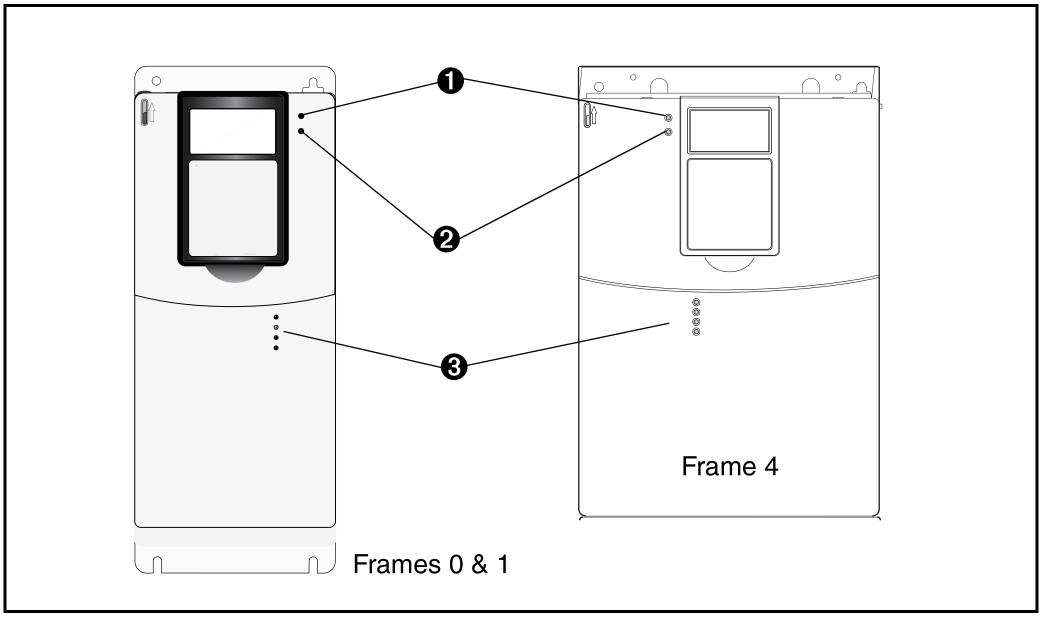


Figure 12.2 – Location of Status LED's

Table 12.1 – Status LED Definitions

Number	Name	Color	State	Description
❶	PWR (Power)	Green	Steady	Power is applied to the drive.
❷	RDY (Ready)	Green	Steady	Drive running, no faults are present.
			Flashing	Drive ready, but not running and no faults are present.
		Yellow	Steady, Drive Running	A continuous type 1 alarm condition exists. Check Drive Alarm 1 (211).
			Flashing, Drive Stopped	A start inhibit condition exists and the drive cannot be started. Check Start Inhibits (214).
			Flashing, Drive Running	An intermittent type 1 alarm condition is occurring. Check Drive Alarm 1 (211).
		Red	Steady	A non-resettable fault has occurred.
			Flashing	Fault has occurred. Check Fault x Code or Fault Queue.
❸	DRIVE	Green	-	Status of DPI Port internal communications (if present).
	MS	Yellow	-	Status of communications module (when installed).
	NET A	Red	-	Status of network (if connected).
	NET B	Red	-	Status of secondary network (if connected).

12.3 Determining Precharge Board Status Using the LED Indicators (Frames 5 & 6 Only)

The precharge board LEDs are located above the Line Type jumper shown in figure 12.3. Precharge board LED indicators are found only on frame 5 and 6 drives.

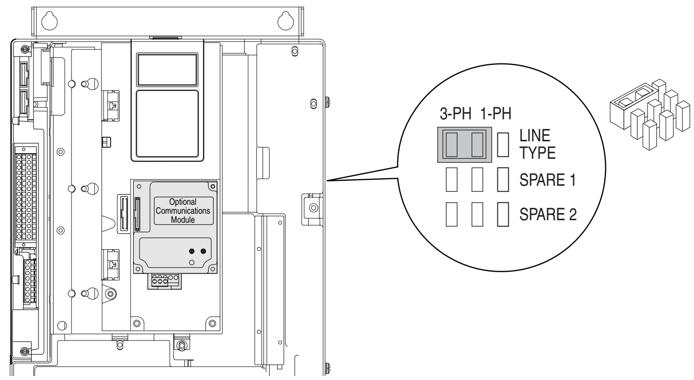


Figure 12.3 – Location of Precharge Status LED (Frame 5 Shown)

Table 12.2 – Precharge Board LED Indicators

Name	Color	State	Description
Power	Green	Steady	Indicates precharge board power supply is operational.
Alarm	Yellow	Flashing	Number in “[ ]” indicates flashes and associated alarm[1].
		[1]	Low line voltage (<90%).
		[2]	Very low line voltage (<50%).
		[3]	Low phase (one phase <80% of line voltage).
		[4]	Frequency out of range or asymmetry (line sync failed).
		[5]	Low DC bus voltage (triggers ride-through operation).
		[6]	Input Frequency momentarily out of range (40-65 Hz).
		[7]	DC bus short circuit detection active.
Fault	Red	Flashing	Number in “[ ]” indicates flashes and associated fault[2].
		[2]	DC bus short (Udc <2% after 20 ms).
		[4]	Line sync failed or low line (Uac<50% Unom).

[1] An alarm condition automatically resets when the condition no longer exists.

[2] An fault indicates a malfunction that must be corrected and can only be reset after cycling power.

12.4 About Alarms

Alarms indicate conditions that may affect drive operation or application performance.

Alarms are automatically cleared when the condition that caused the alarm is no longer present.

There are two alarm types, as described in table 12.3.

Table 12.3 – Types of Alarms

Type	Alarm Description	
①	User-Configurable	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. The alarms are enabled or disabled using Alarm Config 1 (259). The status of these alarms is shown in Drive Alarm 1 (211).
②	Non-Configurable	These alarms alert the operator of conditions caused by improper programming and prevent the drive from starting until the problem is resolved. These alarms are always enabled. The status of these alarms is shown in Drive Alarm 2 (212).

The drive indicates alarm conditions in the following ways:

- Ready LED on the drive cover (see table 12.1).
- Alarm name and bell graphic on the LCD OIM. 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 10 for the parameter descriptions.

12.4.1 Alarm Descriptions

Table 12.4 – Alarm Descriptions

<table>
<tr><th>Alarm</th><th>No.</th><th>Type</th><th>Description</th></tr>
<tr><td>Analog In Loss</td><td>5</td><td>①</td><td>An analog input is configured for alarm on signal loss and signal loss has occurred.</td></tr>
<tr><td>Bipolar Conflict</td><td>20</td><td>②</td><td>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.</td></tr>
<tr><td>Brake Slipped</td><td>32</td><td>②</td><td>Encoder movement has exceeded the level in BrkSlipCount after the brake was set.</td></tr>
<tr><td>Decel Inhibit</td><td>10</td><td>①</td><td>Drive is being inhibited from decelerating.</td></tr>
<tr><td>Dig In ConflictA</td><td>17</td><td>②</td><td>Digital input functions are in conflict. Combinations marked with a 🔔 will cause an alarm.
<table>
<tr><th></th><th>Acc2 / Dec2</th><th>Accel 2</th><th>Decel 2</th><th>Jog</th><th>Jog Fwd</th><th>Jog Rev</th><th>Fwd / Rev</th></tr>
<tr><td>Acc2 / Dec2</td><td></td><td>🔔</td><td>🔔</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Accel 2</td><td>🔔</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Decel 2</td><td>🔔</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog</td><td></td><td></td><td></td><td></td><td>🔔</td><td>■</td><td></td></tr>
<tr><td>Jog Fwd</td><td></td><td></td><td></td><td>🔔</td><td></td><td></td><td>🔔</td></tr>
<tr><td>Jog Rev</td><td></td><td></td><td></td><td>🔔</td><td></td><td></td><td>🔔</td></tr>
<tr><td>Fwd / Rev</td><td></td><td></td><td></td><td></td><td>🔔</td><td>🔔</td><td></td></tr>
</table></td></tr>
<tr><td>Dig In ConflictB</td><td>18</td><td>②</td><td>Digital input functions are in conflict. Combinations marked with a 🔔 will cause an alarm.
<table>
<tr><th></th><th>Start</th><th>Stop–CF</th><th>Run</th><th>Run Fwd</th><th>Run Rev</th><th>Jog</th><th>Jog Fwd</th><th>Jog Rev</th><th>Fwd/ Rev</th></tr>
<tr><td>Start</td><td></td><td></td><td>🔔</td><td>🔔</td><td>🔔</td><td></td><td>🔔</td><td>🔔</td><td></td></tr>
<tr><td>Stop–CF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Run</td><td>🔔</td><td></td><td></td><td>🔔</td><td>🔔</td><td></td><td>🔔</td><td>🔔</td><td></td></tr>
<tr><td>Run Fwd</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td>🔔</td><td></td><td></td><td>🔔</td></tr>
<tr><td>Run Rev</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td>🔔</td><td></td><td></td><td>🔔</td></tr>
<tr><td>Jog</td><td></td><td></td><td></td><td>🔔</td><td>🔔</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog Fwd</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog Rev</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fwd / Rev</td><td></td><td></td><td></td><td>🔔</td><td>🔔</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Dig In ConflictC</td><td>19</td><td>②</td><td>More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions:
<table>
<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>Run</td><td>Decel 2</td></tr>
<tr><td>Run Forward</td><td>Stop Mode B</td><td></td></tr>
</table></td></tr>
</table>

Table 12.4 – Alarm Descriptions (Continued)

Alarm	No.	Type	Description
Drive OL Level 1	8	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	9	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	26	②	The calculated or measured Flux Amps value is not within the expected range. Verify motor data and rerun motor tests.
Ground Warn	15	①	Ground current has exceeded the level set in Gnd Warn Level (177).
Home Not Set	34	①	Configurable alarm set in parameter 259, bit 17. When set to "1", this alarm is displayed when any of the following occur: • parameter 88 is set to "7" (Pos/Spd Prof) • on power up and parameter 88 = "7" • recall user sets and parameter 88 = "7" Alarm is cleared when: • setting parameter 88 to a value other than "7" • reset defaults • parameter 259, bit 17 is cleared • a digital input is configured as "Set Home" and input is True • parameter 705, bit 9 is "Enabled" • parameter 700, bit 13 (At Home) is "Enabled" - position regulator will set this bit if device is "home"
In Phase Loss	13	①	The DC bus ripple has exceeded the level set in Phase Loss Level (545).
IntDBRes OvrHeat	6	①	The drive has temporarily disabled the dynamic braking regulator because the resistor temperature has exceeded a predetermined value.
IR Volts Range	25	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.
Ixo Vlt Rang	28	②	Motor leakage inductance is out of range.
Load Loss	14		Output torque current is below Load Loss Level (187) for a time period greater than Load Loss Time (188).
MaxFreq Conflict	23	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 Thermistor	12		The value at the thermistor terminals have been exceeded.

Table 12.4 – Alarm Descriptions (Continued)

Alarm	No.	Type	Description
Motor Type Cflct	21	②	Motor Type (90) has been set to Sync PM or Sync Reluc, and one or more of the following exist: • Torque Perf Mode = “Sensrls Vect,” “SV Economizer” or “Fan/Pmp V/Hz.” • Flux Up Time is greater than 0.0 secs. • Speed Mode is set to “Slip Comp.” • Autotune = “Static Tune” or “Rotate Tune.”
NP Hz Conflict	22	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	3	①	Drive has sensed a power line loss.
Precharge Actv	1	①	Drive is in the initial DC bus precharge state.
Prof Step Cflct	50	②	An error is detected in trend step(s). • Set if Sleep mode is enabled • Set if: • any profile step uses “Encoder Incr” and/or “Enc Absolute” **and** Motor Cntl Sel (53) is **not** set to “FVC Vector” **and** Feedback Select (80) is **not** set to “Encoder” or “Simulator” **and** Speed/Torque Mod (88) = “7” (Pos/Spd Prof). • a Step Type is configured for “Dig Input” and the Step Value is greater than 6, less than -6, or zero **or** the digital input selected with Digital Inx Sel is **not** set to “57” (Prof Input). • Cleared if none of the above occur.
PTC Conflict	31	②	PTC is enabled for Analog In 1, which is configured as a 0-20 mA current source in Anlg In Config (320).
Sleep Config	29	②	Sleep/Wake configuration error. With Sleep-Wake Mode (178) = Direct, possible causes include: drive is stopped and Wake Level < Sleep Level. “Stop=CF”, “Run,” “Run Forward” and “Run Reverse” is not configured in Digital Inx Sel.
Speed Ref Cflct	27	②	Speed Ref x Sel or PI Reference Sel is set to “Reserved.”
Start At Powerup	4	①	Start At Powerup (168) is enabled. Drive may start at any time within 10 seconds of drive powerup.

Table 12.4 – Alarm Descriptions (Continued)

Alarm	No.	Type	Description
TB Man Ref Cflct	30	②	Occurs when: • "Auto/Manual" is selected (default) for Digital In3 Sel (363) and • TB Man Ref Sel (96) has been reprogrammed. No other use for the selected analog input may be programmed. Example: If TB Man Ref Sel is reprogrammed to "Analog In 2," all of the factory default uses for "Analog In 2" must be reprogrammed. To correct: • Verify/reprogram the parameters that reference an analog input or • Reprogram Digital In3 to another function or "Unused."
TorqProve Cflct	49	②	When TorqProve Cnfg is enabled, Motor CntlSel, Feedback Select, and Motor Fdbk Type must be properly set.
Under-Voltage	2	①	The bus voltage has dropped below a predetermined value.
VHz Neg Slope	24	②	Custom V/Hz mode has been selected in Torq Perf Mode (53) and the V/Hz slope is negative.
Waking	11	①	The Wake timer is counting toward a value that will start the drive.

Table 12.5 – Alarm Names Cross-Referenced by Alarm Numbers

No.[1]	Alarm	No.[1]	Alarm	No.[1]	Alarm
1	Precharge Active	13	In Phase Loss	25	IR Volts Range
2	UnderVoltage	14	Load Loss	26	FluxAmps Ref Rang
3	Power Loss	15	Ground Warn	27	Speed Ref Cflct
4	Start At PowerUp	17	Dig In ConflictA	28	Ixo Vlt Rang
5	Analog In Loss	18	Dig In ConflictB	29	Sleep Config
6	IntDBRes OvrHeat	19	Dig In ConflictC	30	TB Man Ref Cflct
8	Drive OL Level 1	20	Bipolar Conflict	31	PTC Conflict
9	Drive OL Level 2	21	Motor Type Conflict	32	Brake Slipped
10	Decel Inhibit	22	NP Hz Conflict	34	Home Not Set
11	Waking	23	MaxFreq Conflict	49	Torq Prove Cflct
12	Motor Thermistor	24	VHz Neg Slope	50	Prof Step Cflct

[1] Alarm numbers not listed are reserved for future use.

12.5 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 12.6.

Table 12.6 – Fault Types

Type	Fault Description	
①	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.
②	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.
③	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:

- Status LEDs on the drive control panel (see section 12.2).
- Drive status parameters Drive Status 1 (209) and Drive Status 2 (210).
- Entries in the fault queue (see section 12.5.1).
- Pop-up screen on the LCD OIM. The screen displays:
  - Fault number
  - Fault name
  - Time that has elapsed since fault occurred.

12.5.1 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 Pro software.

The fault queue holds the 16 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.

12.5.2 Clearing Faults

A fault condition can be cleared by the following:

Step 1. Press ESC/PROG 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:

- Setting Fault Clear (240) to Clear Faults (1).
- Issuing 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.

12.5.3 Fault Descriptions and Corrective Actions

Table 12.7 describes drive faults and corrective actions. It also indicates if the fault is

① Auto-resettable

② Non-resettable

③ User-configurable

Table 12.7 – 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		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 or a fault occurred.	Restart procedure.
Auxiliary Input	2	①	Input is open.	Check remote wiring.
Cntl Bd Overtemp	55		The temperature sensor on the Main Control Board detected excessive heat.	1. Check Main Control Board fan. 2. Check surrounding air temperature. 3. Verify proper mounting/cooling.
DB Resistance	69		Resistance of the internal DB resistor is out of range.	Replace resistor.
Decel Inhibit	24	③	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.	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.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
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).
Drive Powerup	49		No fault displayed. Used as a Power Up Marker in the Fault Queue indicating that the drive power has been cycled.	
Excessive Load	79		Motor did not come up to speed in the allotted time.	1. Uncouple load from motor. 2. Repeat Autotune (61).
Encoder Loss	91		Required differential encoder. One of the 2 encoder channel signals is missing.	1. Check wiring. 2. Replace encoder.
Encoder Quad Err	90		Both encoder channels changed state within one clock cycle.	1. Check for externally induced noise. 2. Replace encoder.
Faults Cleared	52		No fault displayed. Used as a marker in the Fault Queue indicating that the fault clear function was performed.	
Flt QueueCleared	51		No fault displayed. Used as a marker in the Fault Queue indicating that the clear queue function was performed.	
FluxAmpsRef Rang	78		The value for flux amps determined by the autotune procedure exceeds the programmed Motor NP FLA (42).	1. Reprogram Motor NP FLA (42) with the correct motor nameplate value. 2. Repeat Autotune (61).
Ground Fault	13	①	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.
Hardware Fault	93		Hardware enable is disabled (jumpered high) but logic pin is still low.	1. Check jumper. 2. Replace Main Control Board.
Hardware Fault	130		Gate array load error.	1. Cycle power. 2. Replace Main Control Board.
Hardware Fault	131		Dual port failure.	1. Cycle power. 2. Replace Main Control Board.
Hardware PTC	18		Motor PTC (positive temperature coefficient) sensor overtemp	1. Verify proper PTC connection. 2. Motor is overheated; reduce load.
Heatsink OvrTemp	8	①	Heatsink temperature exceeds 100% of Drive Temp.	1. Verify that maximum ambient temperature has not been exceeded. 2. Check fan. 3. Check for excess load.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
HW OverCurrent	12	①	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.
I/O Comm Loss	121	②	I/O Board lost communication with the Main Control Board.	1. Check connector. 2. Check for induced noise. 3. Replace I/O board of Main Control Board.
I/O Failure	122		I/O was detected, but failed the powerup sequence.	Replace Main Control Board.
I/O Board Mismatch	120		Incorrect I/O board identified.	Restore I/O board to original configuration, or If new configuration is desired, reset fault.
Incompat MCB-PB	106	②	Drive rating information stored on the power board is incompatible with the Main Control board.	Load compatible version files into drive.
Input Phase Loss	17		The DC bus ripple has exceed a preset level.	Checking incoming power for a missing phase/blown fuse.
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.
IXo VoltageRange	87		Voltage calculated for motor inductive impedance exceeds 25% of Motor NP Volts (41).	1. Check for proper motor sizing. 2. Check for correct programming of Motor NP Volts (41). 3. Additional output impedance may be required.
Load Loss	15		Drive output torque current is below Load Loss Level for a time greater than Load Loss Time.	1. Verify connections between motor and load. 2. Verify level and time requirements.
Motor Overload	7	① ③	Internal electronic overload trip. 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).
Motor Thermistor	16		Thermistor output is out of range.	1. Verify that thermistor is connected. 2. Motor is overheated. Reduce load.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
NVS I/O Checksum	109		EEprom checksum error.	1. Cycle power and repeat function. 2. Replace Main Control Board.
NVS I/O Failure	110		EEprom I/O error.	1. Cycle power and repeat function. 2. Replace Main Control Board.
Output Phase Loss	21		Current in one or more phases has been lost or remains below a preset level.	Check the drive and motor wiring. Check for phase-to-phase continuity at the motor terminals. Check for disconnected motor leads.
OverSpeed Limit	25	①	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).
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			

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Port 1-5 DPI Loss	81-85		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.
Port 1-5 Adapter	71-75		The communications card has a fault.	Check the DPI device event queue and corresponding fault information for the device.
Power Loss	3	① ③	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.	1. Check for damaged output transistors. 2. Replace drive.
Pulse In Loss	92		Z channel is selected as a pulse input and no signal is present.	1. Check wiring. 2. Replace pulse generator.
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.	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.	1. Restore defaults. 2. Reprogram parameters.
See Manual	28		Encoderless Torque Proving has been enabled but user has not read and understood application concerns of encoderless operation.	1. Read the attention on page 13-6 relating to the use of Torque Proving with no encoder.
Shear Pin	63	③	Programmed Current Lmt Val (148) has been exceeded. Enabled/disable with Fault Config 1 (238).	Check load requirements and Current Lmt Val (148) setting.
Software Fault	88		Microprocessor handshake error.	Replace Main Control Board.

Table 12.7 – Fault Descriptions and Corrective Actions (Continued)

Fault	No.	Type	Description	Action
Software Fault	89		Microprocessor handshake error.	Replace Main Control Board.
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.
TorqProv Spd Band	20		Difference between Commanded Speed and Encoder Speed has exceeded the level set in Spd Dev Band for a time period greater than Spd Band Integrat.	1. Check wiring between drive and motor. 2. Check release of mechanical brake.
Trnsistr OvrTemp	9	①	Output transistors have exceeded their maximum operating temperature.	Check for proper temperature and flow rate of coolant.
UnderVoltage	4	① ③	DC bus voltage fell below the minimum value of 407V DC at 400/480V input or 204V 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 12.8 – Fault Names Cross-Referenced by Fault Number

No.[1]	Fault	No.[1]	Fault	No[1]	Fault
2	Auxiliary Input	29	Analog In Loss	87	IXo VoltageRange
3	Power Loss	39	Phase V to Grnd	88	Software Fault
4	UnderVoltage	40	Phase W to Grnd	89	Software Fault
5	OverVoltage	41	Phase UV Short	90	Encoder Quad Err
7	Motor Overload	42	Phase VW Short	91	Encoder Loss
8	Heatsink OvrTemp	43	Phase UW Short	92	Pulse In Loss
9	Trnsistr OvrTemp	48	Params Defaulted	93	Hardware Fault
12	HW OverCurrent	49	Drive PowerUp	100	Parameter Chksum
13	Ground Fault	51	Flt QueueCleared	101-103	UserSetX Chksum
15	Load Loss	52	Faults Cleared	104	Pwr Brd Chksum1
16	Motor Thermistor	55	Cntl Bd OverLoad	105	Pwr Brd Chksum2
17	Input Phase Loss	63	Shear Pin	106	Incompat MCB-PB
18	Hardware PTC	64	Drive OverLoad	107	Replaced MCB-PB
20	TorqProv Spd Band	69	DB Resistance	108	Anlg Cal Chksum
21	Output Phase Loss	70	Power Unit	120	I/O Mismatch
24	Decel Inhibit	71- 75	Port 1-5 Net Loss	121	I/O Comm Loss
25	OverSpeed Limit	77	IR Volts Range	122	I/O Failure
28	See Manual	78	FluxAmpsRef Rang	130	Hardware Fault

Table 12.8 – Fault Names Cross-Referenced by Fault Number

No.[1]	Fault	No.[1]	Fault	No[1]	Fault
33	Auto Rstrt Tries	79	Excessive Load	131	Hardware Fault
36	SW OverCurrent	80	AutoTune Aborted		
38	Phase U to Grnd	81- 85	Port 1-5 DPI Loss		

[1] Fault numbers not listed are reserved for future use.

12.6 Testpoint Parameter

Select testpoint with Testpoint X Sel (234, 236). Values can be viewed with Testpoint X Data (235, 237).

Table 12.9 – Test Point Codes and Functions

Number[1]	Description	Default
01	DPI Error Status	0
02	Heatsink Temp	0
03	Active Cur Limit	0
04	Active PWM Freq	4
05	Lifetime MegaWatt Hours[2]	0
06	Life Run Time	0
07	Life Pwr Up Time	0
08	Life Pwr Cycles	0
09	Life MW-HR Fract [2]	0
10	MW-HR Fract Unit [2]	0
11	MCN Life Time	0
12	Raw Analog In 1	0
13	Raw Analog In 2	0
16	CS Msg Rx Cnt	0
17	CS Msg Tx Cnt	0
18	CS Timeout Cnt	0
19	CS Msg Bad Cnt	0
22	PC Msg Rx Cnt	0
23	PC Msg Tx Cnt	0
24-29	PC1-6 Timeout Cnt	0
30	CAN BusOff Cnt	0
31	No. of Analog Inputs	0
32	Raw Temperature	0
33	MTO Norm Mtr Amp	0
34	DTO-Cmd Frequency	0
35	DTP-Cmd Cur Lim	0
36	DTO-Cmd DC Hold	0
37	Control Bd Temp	0.0

[1] Enter in Testpoint x Sel.

[2] Use the equation below to calculate total Lifetime MegaWatt Hours.

$$\left(\frac{\text{Value of Code 9}}{\text{Value of Code 10}} \times 0.1\right) + \text{Value of Code 5} = \text{Total Lifetime Megawatt Hours}$$

12.7 Common Symptoms and Corrective Actions

ATTENTION: Remove power from the drive. 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.

Table 12.10 – 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: • Press stop. • Cycle power. • Set Fault Clear (240) to 1. • "Clear Faults" on the OIM Diagnostic Menu.
Incorrect operation from the terminal block.	Incorrect input wiring. • 2-wire control requires Run, Run Forward, or Run Reverse input(s). • 3-wire control requires Start and Stop inputs • Jumper from terminal 25 to 26 is required.	Wire inputs correctly and/or install jumper.
	Incorrect digital input programming. • 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.	Program Digital In"x" Sel (361-366) for correct inputs. Start or Run programming may be missing.

Table 12.10 – Drive Does Not Start From Start, Run, or Jog Inputs Wired to the Terminal Block (Continued)

Indication(s)	Cause(s)	Corrective Action
Flashing yellow Ready LED and DigIn CflctB indication on LCD OIM. Drive Status 2 (210) shows type 2 alarm(s).	Incorrect digital input programming. • 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.	Program Digital In"x" Sel (361-366) to resolve conflicts. Remove multiple selections for the same function. Install stop button to apply a signal at stop terminal.

Table 12.11 – Drive Does Not Start or Jog From OIM

Indication	Cause(s)	Corrective Action
None	Drive is programmed for 2-wire control. OIM start is disabled for 2-wire control.	If 2-wire control is required, no action is necessary. If 3-wire control is required, program Digital Inx Sel (361-366) for correct inputs.
Flashing or steady red Ready LED.	Active fault.	Reset fault.
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).

Table 12.12 – 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.	1. If the source is an analog input, check wiring and use a meter to check for presence of signal. 2. Check Commanded Speed for correct source.
None	Incorrect reference source has been programmed.	3. Check Speed Ref Source (213) for the source of the speed reference. 4. Reprogram Speed Ref A Sel (90) for correct source.

Table 12.12 – Drive Does Not Respond to Changes in Speed Command (Continued)

Indication	Cause(s)	Corrective Action
None	Incorrect reference source is being selected via remote device or digital inputs.	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 12.13 – 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 12.12.
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 12.14 – 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 12.15 – 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.	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 12.16 – 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.	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.

12.8 Replacement Parts

Table 12.17 – Replacement Parts List

Description	Model Number
DeviceNet Communication Module	RECOMM-DNET
Profibus Communication Module	RECOMM-PBUS
Interbus Communication Module	RECOMM-IBUS
ControlNet Communication Module	RECOMM-CNET
Ethernet/IP Communication Module	RECOMM-ENET
Modbus Communication Module	RECOMM-H485
RS-485 DF1 Communication Module	RECOMM-485
Standard OIM	6VKYPD-STD
Full Numeric OIM	6VKYPD-FN
Remote Mounted Nema 4 OIM	6VKYPD-N4
Blank OIM	REBLNKOIM
24 VDC Input Regulator Board[1]	6VREG-024A
115 VAC Input Regulator Board[1]	6VREG-115B
Encoder Option Board[1]	6VENC-OPT
Removable Control I/O Terminal Block	SK-G9-TB1-S1
Removable Encoder Terminal Block	SK-G9-TB1-ENC1

[1]The drive is shipped with one of the above regulator options and one of the encoder options. The user can purchase one of the above options to field replace a damaged board or to change the digital input voltage from 24 VDC to 115 VAC (or vice versa).

12.9 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
- Selected device version and status information
- OIM version information

12.9.1 Accessing the Fault Queue

As described in section 12.5.1, the drive automatically retains a history of the last 16 faults that have occurred in the fault queue.

To access the fault queue, press FAULT ALARM or select Faults>View Fault Queue from the Diagnostics Menu off of the main screen.

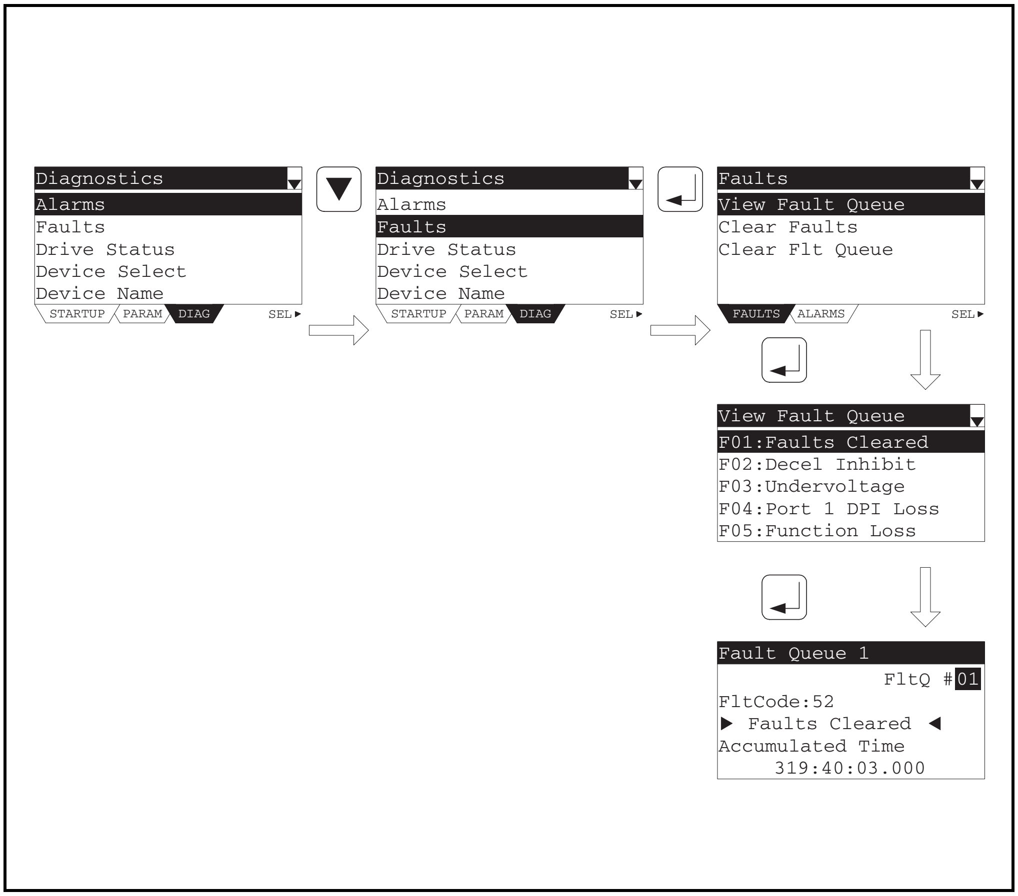


Figure 12.4 – Accessing the Fault Queue

CHAPTER 13

Application Notes

13.1 Dynamic User Sets

See section 2.3.28 for an overview of User Sets.

!	**ATTENTION:** The GV6000 can be configured to use multiple saved parameter (user) sets. Caution must be utilized to ensure that each user set is programmed for proper operation for the application. Recalling an improperly programmed user set may cause rotation of the motor in an undesired direction at unexpected speeds or may cause unpredictable starting of the drive and motor. Failure to observe this precaution could result in damage to equipment, severe bodily injury or loss of life.

13.1.1 Typical Set Up and Operation

Step 1. While in normal mode (Dyn UserSet Cnfg (204) = x0), enter data into drive and save to desired 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 User Set.

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 caused the alarm. Repeat steps two (2) and three (3).

Step 4. Begin normal drive operation. Remember that User Sets can only be loaded while the drive is stopped.

13.1.2 Description of Operation

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.

13.2 Autotune Procedures

13.2.1 Parameters Determined by Autotune

Flux Current Ref (63) is set by the flux current test. Flux current is the reactive portion of the motor current (portion of the current that is out of phase with the motor voltage) and is used to magnetize the motor. The flux current test is used to identify the value of motor flux current required to produce rated motor torque at rated current. When the flux test is performed, the motor will rotate. The drive accelerates the motor to approximately two-thirds of base speed and then coasts for several seconds.

IR Voltage Drop (62) is set by the IR voltage drop test. IR Voltage Drop (62) is used by the IR Compensation procedure 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. The motor should not rotate during this test.

Ixo Voltage Drop (64) is set by the leakage inductance test. This test measures the inductance characteristics of the motor. A measurement of the motor inductance is required to determine references for the regulators that control torque. The motor should not rotate during this test.

Total Inertia (450) is set by the inertia test. Total Inertia (450) represents the time in seconds, for the motor coupled to a load to accelerate from zero to base speed at rated motor torque. During this test, the motor is accelerated to about 2/3 of base motor speed. This test is performed during the Start-up mode, but can be manually performed by setting [Inertia Autotune] to “Inertia Tune”. The Total Inertia (450) and Speed Desired BW (449) automatically determine the Ki Speed Loop (445) and Kp Speed Loop (447) gains for the speed regulator.

13.2.2 Autotune Procedure for Sensorless Vector and Economizer

The purpose of Autotune (61) is to identify the motor flux current and stator resistance for use in Sensorless Vector Control and Economizer modes.

Motor nameplate data must be entered into the following parameters for the Autotune procedure to obtain accurate results:

- Motor NP Volts (41)
- Motor NP FLA (42)

- Motor NP Hertz (43)
- Motor NP Power (45)

Dynamic or Static Autotune tests will be performed during the Autotune Procedures.

- Dynamic - the motor shaft will rotate during this test. The dynamic autotune procedure determines both the stator resistance and motor flux current. The test to identify the motor flux current requires the load, including gearing, to be uncoupled from the motor to find an accurate value. If this is not possible then the static test can be performed.
- Static - the motor shaft will not rotate during this test. The static test determines only IR Voltage Drop (62). This test does not require the load to be uncoupled from the motor.

The static and dynamic tests can be performed during the Start-up routine on the LCD OIM. The tests can also be run manually by setting the value of the Autotune (61) parameter to 1 “Static Tune” or 2 “Rotate Tune”.

13.2.3 Alternate Methods to Determine IR Voltage Drop (62) & Flux Current Ref (63)

If it is not possible or desirable to run the Autotune tests, there are three other methods for the drive to determine the IR Voltage Drop (62) and Flux Current Ref (63) parameters:

The first method is used when the motor nameplate parameters are left at default. When the drive is initially powered up, the Autotune (61) parameter is defaulted to a value of 3 “Calculate”. The values for IR Voltage Drop (62) and Flux Current Ref (63) are calculated based on the default motor nameplate data. This is the least preferred method.

The second method calculates IR Voltage Drop (62) and Flux Current Ref (63) from the user-entered motor nameplate data parameters. When Autotune (61) is set to 3 “Calculate”, any changes made by the user to motor nameplate HP, Voltage, FLA, or Frequency activates a new calculation. This calculation is based on a typical motor with those nameplate values.

Finally, if the stator resistance and flux current of the motor are known, the user can calculate the voltage drop across the stator resistance. Autotune (61) is set to 0 “Ready” and stator resistance and flux current values are directly entered into the Flux Current Ref (63) and IR Voltage Drop (62) parameters.

13.2.4 Autotune Procedure for Flux Vector

For FVC vector control an accurate model of the motor must be used. For this reason, the motor data must be entered and the autotune tests should be performed with the connected motor.

Motor nameplate data must be entered into the following parameters for the Autotune procedure to obtain accurate results:

- Motor NP Volts (41)

- Motor NP FLA (42)
- Motor NP Hertz (43)
- Motor NP RPM (44)
- Motor NP Power (45)
- Motor Poles (49)

Dynamic or Static Autotune tests will be performed during the Autotune Procedures.

- Dynamic - the motor shaft will rotate during this test. The dynamic autotune procedure determines the stator resistance, motor flux current, and leakage inductance. The test to identify the motor flux current requires the load to be uncoupled from the motor to find an accurate value. If this is not possible then the static test can be performed.
- Static - the motor shaft will not rotate during this test. The static test determines only IR Voltage Drop (62) and Ixo Voltage Drop (64). This test does not require the load to be uncoupled from the motor.

The static and dynamic tests can be performed during the Start-up routine on the LCD OIM. The tests can also be run manually by setting the value of Autotune (61) to “1,” (Static Tune) or “2” (Rotate Tune), respectively, and then starting the drive.

After the Static or Dynamic Autotune the Inertia test should be performed. The motor shaft will rotate during the inertia test. During the inertia test the motor should be coupled to the load to find an accurate value. The inertia test can be performed during the Start-up routine on the LCD OIM. The inertia test can also be run manually by setting Inertia Autotune to 1 = “Inertia Tune”, and then starting the drive.

Troubleshooting the Autotune Procedure

If any errors are encountered during the Autotune process drive parameters are not changed, the appropriate fault code will be displayed in the fault queue, and Autotune (61) is reset to 0. If the Autotune procedure is aborted by the user, the drive parameters are not changed and the Autotune (61) parameter is reset to 0.

The following conditions will generate a fault during an Autotune procedure:

- Incorrect stator resistance measurement
- Incorrect motor flux current measurement
- Load too large
- Autotune aborted by user
- Incorrect leakage inductance measurement

13.3 External Brake Resistor

When using an external dynamic braking resistor, the resistor must be equipped with a thermostat that opens under the condition of excessive heat in the resistor. Figure 13 depicts the wiring of the DB resistor thermostat.

Note: An auxiliary contact form from the M contactor should be wired to a digital input on the drive that is programmed to function as a drive enable. See attention note regarding input contactors in section 4.1.2.

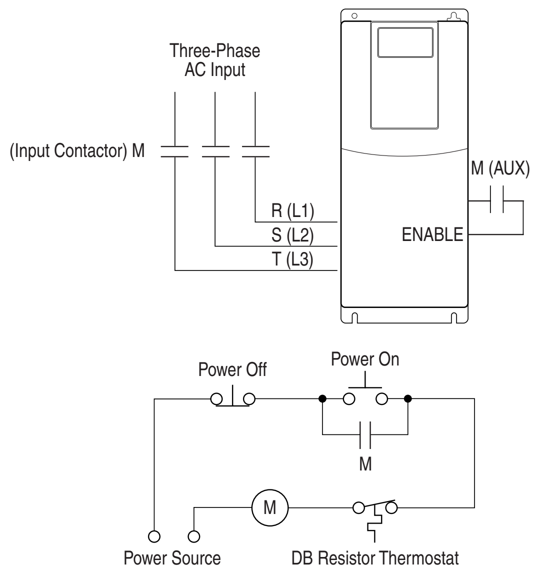


Figure 13.1 – External Brake Resistor Circuitry

13.4 Lifting/Torque Proving

The Torque Proving feature of the GV6000 is intended for applications where proper coordination between motor control and a mechanical brake is required. Prior to releasing a mechanical brake, the drive will check motor output phase continuity and verify proper motor control (torque proving). The drive will also verify that the mechanical brake has control of the load prior to releasing drive control (brake proving). After the drive sets the brake, motor movement is monitored to ensure the brakes ability to hold the load. Torque Proving can be operated with an encoder or encoderless.

Torque Proving functionality with an encoder includes:

- Torque Proving (includes flux up and last torque measurement)
- Brake Proving
- Brake Slip (feature slowly lowers load if brake slips/fails)

- Float Capability (ability to hold full torque at zero speed)
- Micro-Positioning
- Fast Stop
- Speed Deviation Fault, Output Phase Loss Fault, Encoder Loss Fault.

Encoderless Torque Proving functionality includes:

- Torque Proving (includes flux up and last torque measurement)
- Brake Proving
- Micro-Positioning
- Fast Stop
- Speed Deviation Fault, Output Phase Loss Fault.

Important: Brake Slip detection and Float capability (ability to hold load at zero speed) are not available in encoderless Torque Proving.

ATTENTION: Loss of control in suspended load applications can cause personal injury and/or equipment damage. Loads must always be controlled by the drive or a mechanical brake. Parameters 600-612 are designed for lifting/torque proving applications. It is the responsibility of the engineer and/or end user to configure drive parameters, test any lifting functionality and meet safety requirements in accordance with all applicable codes and standards.

ATTENTION: <u>User must read the following</u> prior to the use of Torque Proving with <u>no</u> encoder.

ATTENTION: Encoderless Torque Proving must be limited to lifting applications where personal safety is not a concern. Encoders offer additional protection and must be used where personal safety is a concern. Encoderless Torque Proving can not hold a load at zero speed without a mechanical brake and does not offer additional protection if the brake slips/fails. Loss of control in suspended load applications can cause personal injury and/or equipment damage.

ATTENTION: It is the responsibility of the engineer and/or user to configure drive parameters, test any lifting functionality and meet safety requirements in accordance with all applicable codes and standards. If encoderless Torque Proving is desired, the user must certify the safety of the application. To acknowledge that the end user has read this "Attention" and properly certified their encoderless application, bit 8 ("TPEncdless") of Compensation (56), must be changed to a "1." This will disable Fault 28, "See Manual" and allow bit 1 of Parameter 600 to be changed to a "1" enabling encoderless Torque Proving.

Torque Proving Manual Start Up

It is possible to use the Start Up Routine to tune the motor. However, it is recommended that the motor be disconnected from the hoist/crane equipment during the routine. If this is not possible, refer to steps 1 through 12 on the following pages.

ATTENTION: To guard against personal injury and/or equipment damage caused by unexpected brake release, verify the Digital Out 1 brake connections and/or programming. The **default** drive configuration energizes the Digital Out 1 relay when power is applied to the drive. The GV6000 drive will not control the mechanical brake until Torque Proving is enabled. If the brake is connected to this relay, it could be released. If necessary, disconnect the relay output until wiring/programming can be completed and verified.

Initial Static Auto Tune Test

Step 1. Set the following parameters as shown.

No.	Name	Value	Notes
380	Digital Out1 Sel	"9, At Speed"	keeps brake engaged during test
041-045	Motor NP	per nameplate	enter motor nameplate data
053	Motor Cntl Sel	"4, FVC Vector"	
080	Feedback Select	"3, Encoder"	
061	Autotune	"1, Static Tune"	

Step 2. Press the Start Key on the OIM. Parameters 62-64 will be updated.

Motor Rotation/Encoder Direction Test

Step 3. Set the following parameters as shown.

No.	Name	Value	Notes
053	Motor Cntl Sel	"0, Sensrls Vect"	
080	Feedback Select	"0, Open Loop"	
090	Digital Out1 Sel	"11, Preset Spd1"	
238	Fault Config 1	Bit 8, "In PhaseLoss" = 1 Bit 12, "OutPhaseLoss" = 1	
380	Digital Out1 Sel	"4, Run"	releases brake

ATTENTION: The following procedure causes motor rotation. To guard against possible injury and/or equipment damage, ensure that rotation in either direction will not cause injury and/or equipment damage.

ATTENTION: If the direction of travel is critical at this point, perform short jogs to determine which run direction (RUNFWD or RUNREV) should be used in the next steps.

> **ATTENTION:** This procedure may require the removal of power from the drive in order to modify some of the wiring connections. DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting the 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.

Step 4. Press Start and run the drive in the desired direction. Observe the direction of motor rotation.

- If rotation is not in the desired direction: remove drive power and reverse the two motor leads, **or** set bit 5 of Compensation (56) to "Mtr Lead Rev."

Step 5. With the drive running, observe Encoder Speed (415). If the sign of the encoder is not the same as the displayed frequency, remove drive power and reverse encoder leads A and A NOT.

Step 6. With the drive running, verify correct motor rotation and encoder direction. Set Motor Fdbk Type (412) to "1, Quad Check." Stop the drive.

Rotate AutoTune Test

> **ATTENTION:** In this test the following conditions will occur:
>
> The motor will be run for 12 seconds at 75% of base frequency (60 Hz). Note that equipment travel during this 12 second interval may exceed equipment limits. However, travel distance can be reduced by setting Maximum Speed (82) to a value less than 45 Hz (i.e. 22.5 Hz = 12 seconds at 30 Hz).
>
> The brake will be released without torque provided by the drive for 15 seconds.
>
> To guard against personal injury and/or equipment damage, this test should not be performed if either of the above conditions are considered unacceptable by the user.

Step 7. Set the following parameters as shown.

No.	Name	Value	Notes
053	Motor Cntl Sel	"4, FVC Vector"	
080	Feedback Select	"3, Encoder"	
061	Autotune	"2, Rotate Tune"	

Step 8. Start the drive and run the motor in the desired direction. Parameters 062, 063, 064 & 121 will be updated.

Inertia AutoTune Test

Step 9. Set Inertia Autotune (067) to "1, Inertia Tune."

Step 10. Press Start and run the motor in the direction desired. Parameters 445, 446 and 450 will be updated.

Step 11. Set Speed Desired BW (449) to desired setting.

Step 12. Set up is complete - check for proper operation.

Drive Setup

To Enable Torque Proving with an encoder, bit 0 of TorqProve Cnfg (600) must be set to a “1.” Once this is set, a Type 2 alarm will be active until the following three parameter settings are entered:

No.	Name	Value	Notes
053	Motor Cntl Sel	“4, FVC Vector”	
080	Feedback Select	“3, Encoder”	
412	Motor Fdbk Type	“1, Quad Check”	

To Enable Encoderless Torque Proving, both bits 0 and 1 of TorqProve Cnfg (600) must be set to a “1”. Once this is set, a Type 2 alarm will be active until the following three parameter settings are entered:

No.	Name	Value	Notes
053	Motor Cntl Sel	“4, FVC Vector” or “0, Sensrls Vect”	
080	Feedback Select	“1, Slip Comp”	

Installation/Wiring

When TorqProve Cnfg is set to “Enable,” the Digital Out 1 relay is used to control the external brake contactor. The normally open (N.O.) contact, when closed, is intended to energize the contactor. This provides the mechanical brake with voltage, causing the brake to release. Any interruption of power to the contactor will set the mechanical brake. Programming Digital Out1 Sel (380) will be ignored when [TorqProve Cnfg] is set to “Enable.” See figure 13.2.

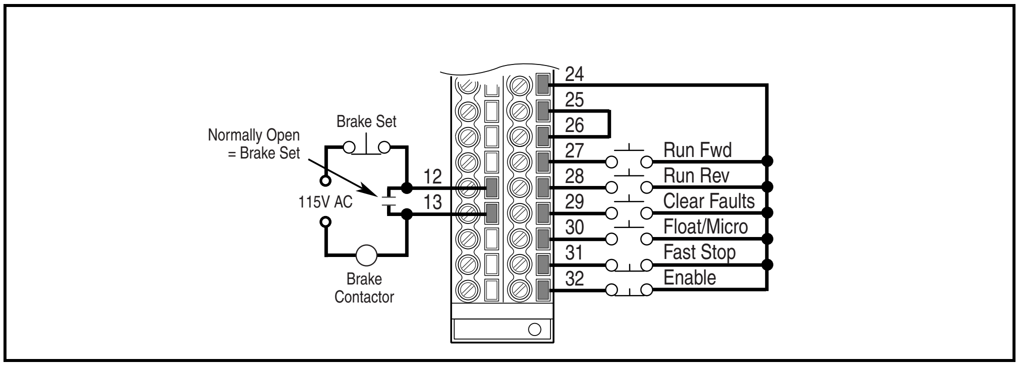


Figure 13.2 – Typical Torque Proving Configuration

Lifting/Torque Proving Application Programming

The GV6000 lifting application is mainly influenced by parameters 600 through 611 in the Torque Proving group of the Application file. Figure 13.3 and the paragraphs that follow describe programming.

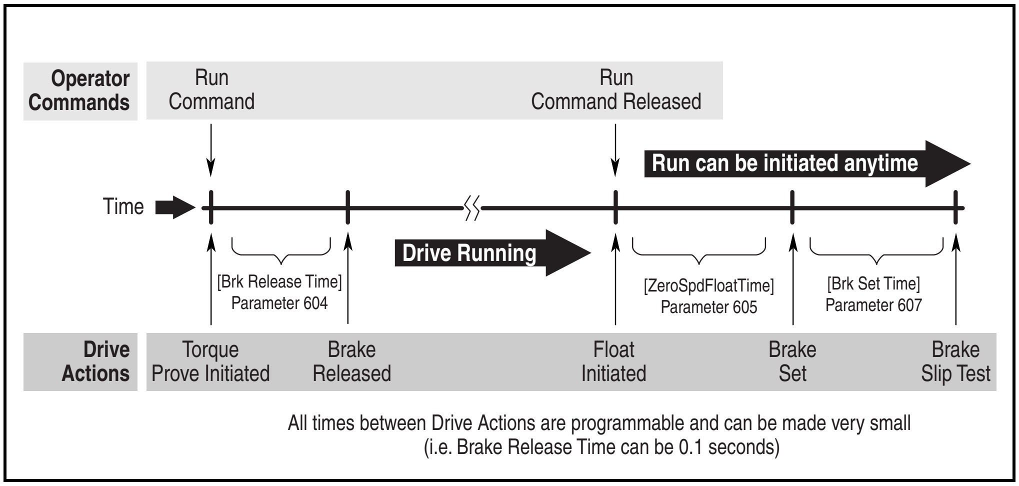


Figure 13.3 – Lifting/Torque Proving Application Programming

Torque Proving

When the drive receives a start command to begin a lifting operation, the following actions occur:

Step 1. The drive first performs a transistor diagnostic test to check for phase-to-phase and phase-to-ground shorts. A failure status from either of these tests will result in a drive fault and the brake relay will NOT be energized (brake remains set).

Step 2. The drive will then provide the motor with flux as well as perform a check for current flow through all three motor phases. This ensures that torque will be delivered to the load when the mechanical brake is released. When torque proving is enabled, open phase loss detection is performed regardless of the setting of Bit 12 of Fault Config 1(238).

Step 3. If the drive passes all tests, the brake will be released and the drive will take control of the load after the programmed time in Brk Release Time (604) which is the typical mechanical release time of the brake.

Brake Proving

When the drive receives a stop command to end a lifting operation, the following actions occur:

Step 1. The brake is commanded closed when the speed of the motor reaches zero.

Step 2. After the time period programmed in Brk Set Time (607) the drive will verify if the brake is capable of holding torque. It will do this by ramping the torque down at a rate set in TorqLim SlewRate (608). Note that the drive can be started again at anytime without waiting for either of the above timers to finish.

Step 3. While the torque is ramping down, the drive will perform a brake slip test. If movement exceeds the limit set in BrkSlip Count (609) then an alarm is set and the drive will start a brake slip procedure. The drive will allow the motor to travel the distance programmed Brk Alarm Travel (610). Another slip test will be performed and will repeat continuously until; A) the load stops slipping, or B) the load reaches the ground. This feature keeps control of the load and returns it to the ground in a controlled manner in the event of a mechanical brake failure.

Speed Monitoring / Speed Band Limit

This routine is intended to fault the drive if the difference between the speed reference and the encoder feedback is larger than the value set in Spd Dev Band (602) and the drive is NOT making any progress toward the reference. SpdBand Integrat (603) sets the time that the speed difference can be greater than the deviation band before causing a fault and setting the brake.

Float

Float is defined as the condition when the drive is holding the load at zero hertz while holding off the mechanical brake. The float condition starts when the frequency drops below the speed set in Float Tolerance (606). Float will stay active for a period of time set by ZeroSpdFloatTime (605). If a digital input (parameters 361-366) is set to “Micro Pos” (also Float) and it is closed, the Float condition will stay active and will disregard the timer. This signal is also available through a communication device, see TorqProve Setup (601).

When encoderless Torque Proving is enabled, the drive can not hold the load at zero speed. Float Tolerance (606) will then define the speed at which the brake is set.

Micro Position

Micro Position refers to rescaling of the commanded frequency by a percentage entered in MicroPos Scale % (611). This allows for slower operation of a lift which provides an operator with better resolution when positioning a load. Micro Position is activated only when the drive is running at or near zero speed. This can be initiated by a digital input configured as Micro Pos or through a communication device (TorqProve Setup) which is the same digital input which signals the float condition. To allow the Micro Position digital input to change the speed command while the drive is running, enter a “1” in Parameter 600, Bit 2 “MicroPosSel.” A “0” will require drive to reach zero speed for micro position speed to become active.

Fast Stop

Fast Stop is intended to stop the load as fast as possible then set the mechanical brake. The Fast Stop can be initiated from a digital input or through a communication device through [TorqProve Setup]. The difference from a normal stop is that the decel time is forced to be 0.1 seconds. When the Torque Proving function is enabled, the Float time is ignored at the end of the ramp. This feature can be used without enabling the Torque Proving function.

13.5 Motor Control Technology

Within the GV6000 there are several motor control technologies:

- Torque Producers
- Torque Controllers
- Speed Regulators

Torque Producers

Volts/Hertz

This technology follows a specific pattern of voltage and frequency output to the motor, regardless of the motor being used. The shape of the V/Hz curve can be controlled a limited amount, but once the shape is determined, the drive output is fixed to those values. Given the fixed values, each motor will react based on its own speed/torque characteristics.

This technology is good for basic centrifugal fan/pump operation and for most multi-motor applications. Torque production is generally good.

Sensorless Vector

This technology combines the basic Volts/Hertz concept with known motor parameters such as Rated FLA, HP, Voltage, stator resistance and flux producing current. Knowledge of the individual motor attached to the drive allows the drive to adjust the output pattern to the motor and load conditions. By identifying motor parameters, the drive can maximize the torque produced in the motor and extend the speed range at which that torque can be produced.

This technology is excellent for applications that require a wider speed range and applications that need maximum possible torque for breakaway, acceleration or overload. Centrifuges, extruders, conveyors and others are candidates.

Torque Controllers

Vector

This technology differs from the two above, because it actually controls or regulates torque. Rather than allowing the motor and load to actually determine the amount of torque produced, Vector technology allows the drive to regulate the torque to a defined value. By independently identifying and controlling both flux and torque currents in the motor, true control of torque is achieved. High bandwidth current regulators remain active with or without encoder feedback to produce outstanding results.

This technology is excellent for those applications where torque control, rather than mere torque production, is key to the success of the process. These include web handling, demanding extruders and lifting applications such as hoists or material handling.

Vector Control can operate in one of two configurations:

1. Encoderless

Not to be confused with Sensorless Vector above, Encoderless Vector is based on a patented field oriented control technology; a feedback device is not required. Torque control can be achieved across a significant speed range without feedback.

2. Closed Loop (with Encoder)

   Vector control with encoder feedback utilizes sophisticated drive control algorithms. This technology allows the drive to control torque over the entire speed range, including zero speed. For those applications that require smooth torque regulation at very low speeds or full torque at zero speed, Closed Loop Vector Control is the answer.

Speed Regulators

The GV6000 (Volts/Hz, Sensorless Vector or Vector) can be set up to regulate speed. Speed regulation and torque regulation must be separated to understand drive operation.

The GV6000 can offer improved speed regulation by adding speed feedback. Using a speed feedback device (encoder) tightens speed regulation to 0.001% of base speed and extends the speed range to zero speed.

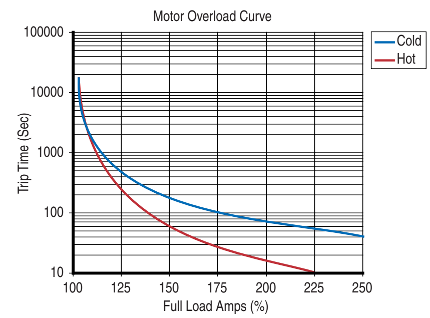
13.6 Motor Overload

For single motor applications the drive can be programmed to protect the motor from overload conditions. An electronic thermal overload I^2T function emulates a thermal overload relay. This operation is based on three parameters; Motor NP FLA (42), Motor OL Factor (48) and Motor OL Hertz (47).

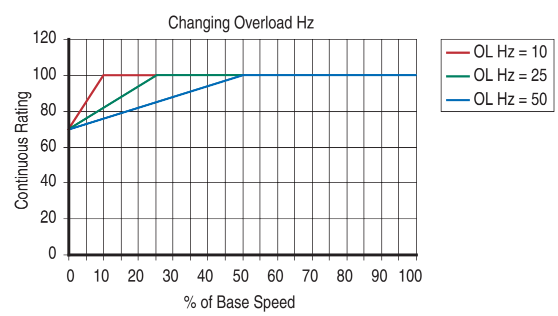
Motor NP FLA (42) is multiplied by Motor OL Factor (48) to allow the user to define the continuous level of current allowed by the motor thermal overload. Motor OL Hertz (47) is used to allow the user to adjust the frequency below which the motor overload is derated.

The motor can operate up to 102% of FLA continuously. If the drive had just been activated, it will run at 150% of FLA for 180 seconds. If the motor had been operating at 100% for over 30 minutes, the drive will run at 150% of FLA for 60 seconds. These values assume the drive is operating above Motor OL Hertz (47), and that Motor OL Factor (48) is set to 1.00.

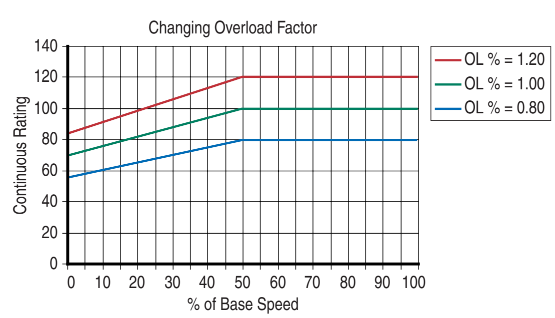
Operation below 100% current causes the temperature calculation to account for motor cooling.



Motor OL Hertz (47) defines the frequency where motor overload capacity derate should begin. The motor overload capacity is reduced when operating below Motor OL Hertz (47). For all settings of Motor OL Hertz (47) other than zero, the overload capacity is reduced to 70% at an output frequency of zero.



Motor NP FLA (42) is multiplied by Motor OL Factor (48) to select the rated current for the motor thermal overload. This can be used to raise or lower the level of current that will cause the motor thermal overload to trip. The effective overload factor is a combination of Motor OL Hertz (47) and Motor OL Factor (48).



13.7 Overspeed

Overspeed Limit is a user programmable value that allows operation at maximum speed, but also provides an “overspeed band” that will allow a speed regulator such as encoder feedback or slip compensation to increase the output frequency above maximum speed in order to maintain maximum motor speed.

The figure below illustrates a typical Custom V/Hz profile. Minimum Speed is entered in Hertz and determines the lower speed reference limit during normal operation. Maximum Speed is entered in Hertz and determines the upper speed reference limit. The two “Speed” parameters only limit the speed reference and not the output frequency.

The actual output frequency at maximum speed reference is the sum of the speed reference plus “speed adder” components from functions such as slip compensation.

The Overspeed Limit is entered in Hertz and added to Maximum Speed and the sum of the two (Speed Limit) limit the output frequency. This sum (Speed Limit) is compared to Maximum Frequency and an alarm is initiated which prevents operation if the Speed Limit exceeds Maximum Frequency.

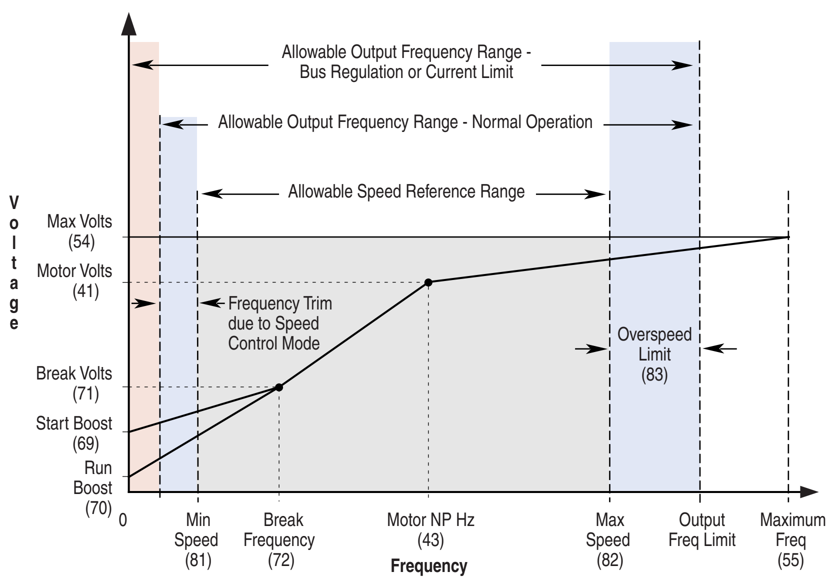


Figure 13.4 – Overspeed

13.8 Power Loss Ride Through

When AC input power is lost, energy is being supplied to the motor from the DC bus capacitors. The energy from the capacitors is not being replaced (via the AC line), thus, the DC bus voltage will fall rapidly. The drive must detect this fall and react according to the way it is programmed. Two parameters display DC bus voltage:

- DC Bus Voltage (12) - displays the instantaneous value

• DC Bus Memory (13) - displays a 6 minute running average of the voltage.

All drive reactions to power loss are based on DC Bus Memory (13). This averages low and high line conditions and sets the drive to react to the average rather than assumed values. For example, a 480V installation would have a 480V AC line and produce a nominal 648V DC bus. If the drive were to react to a fixed voltage for line loss detect, (i.e. 533V DC), then normal operation would occur for nominal line installations. However, if a lower nominal line voltage of 440V AC was used, then nominal DC bus voltage would be only 594V DC. If the drive were to react to the fixed 533V level (only –10%) for line loss detect, any anomaly might trigger a false line loss detection. Line loss, therefore always uses the 6 minute average for DC bus voltage and detects line loss based on a fixed percentage of that memory. In the same example, the average would be 594V DC instead of 650V DC and the fixed percentage, 27% for “Coast to Stop” and 18% for all others, would allow identical operation regardless of line voltage.

The GV6000 can selectively use the same percentages or the user can set a trigger point for line loss detect. The adjustable trigger level is set using Power Loss Level.

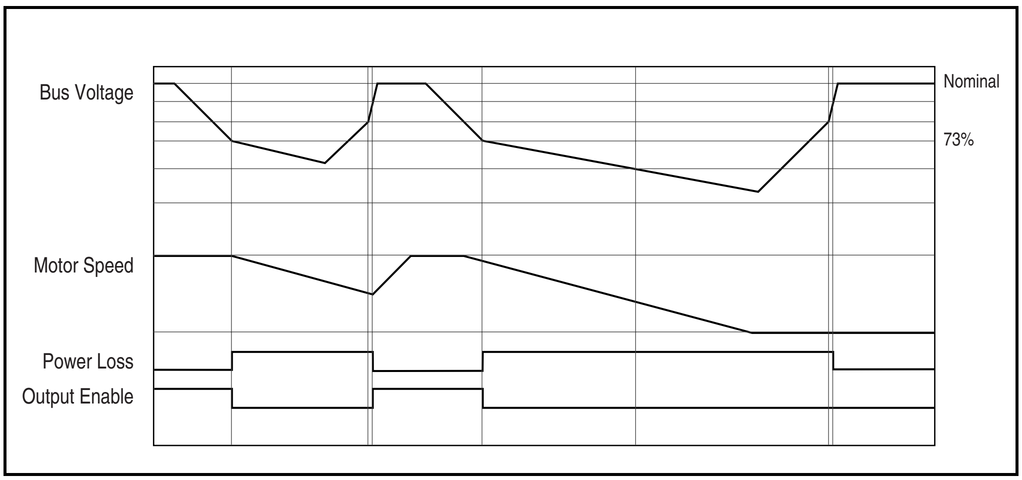


Figure 13.5 – Power Loss Mode = Coast

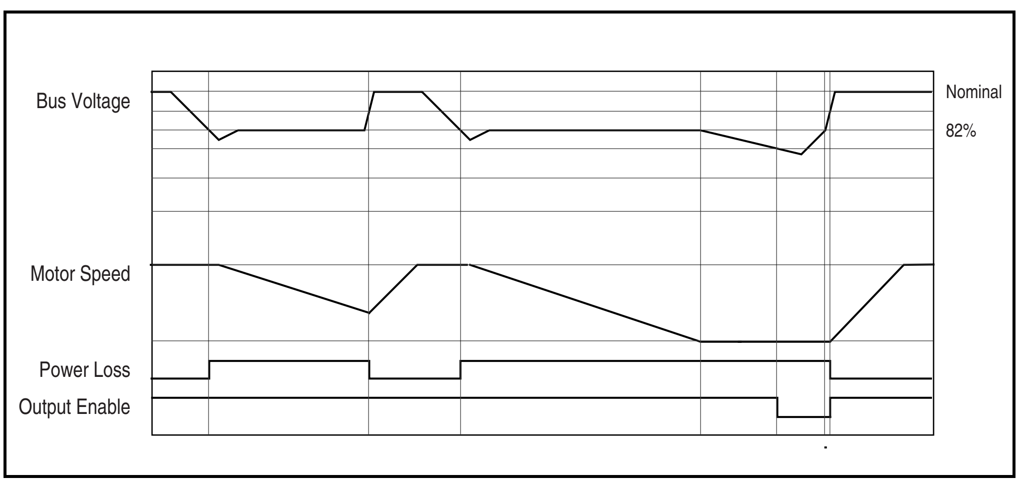


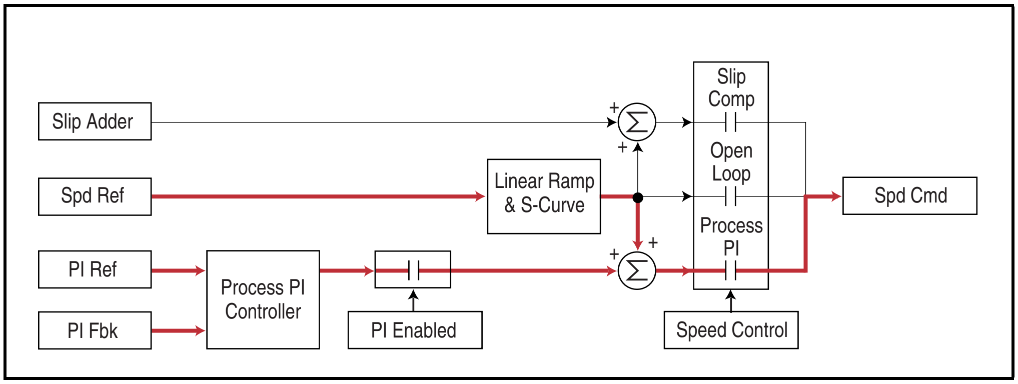
Figure 13.6 – Power Loss Mode = Decel

13.9 Process PID

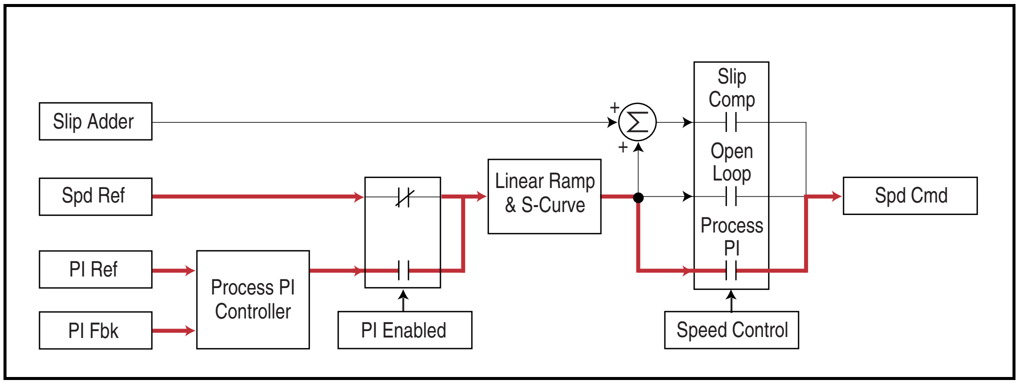
The internal PI function of the GV6000 provides closed loop process control with proportional and integral control action. The function is designed for use in applications that require simple control of a process without external control devices. The PI function allows the microprocessor of the drive to follow a single process control loop.

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 PI regulator, changing drive output frequency to try and make the process variable equal the setpoint.

It can operate as trim mode by summing the PI loop output with a master speed reference.

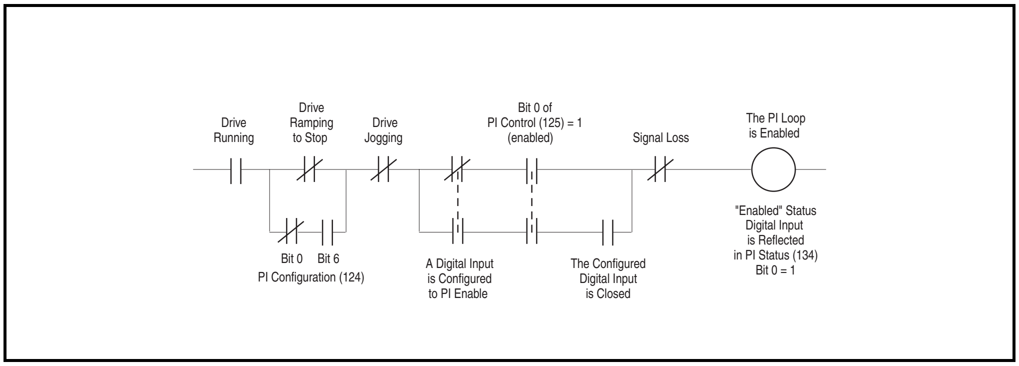


Or, it can operate as control mode by supplying the entire speed reference. This method is identified as “exclusive mode”.



13.10 PI Enable

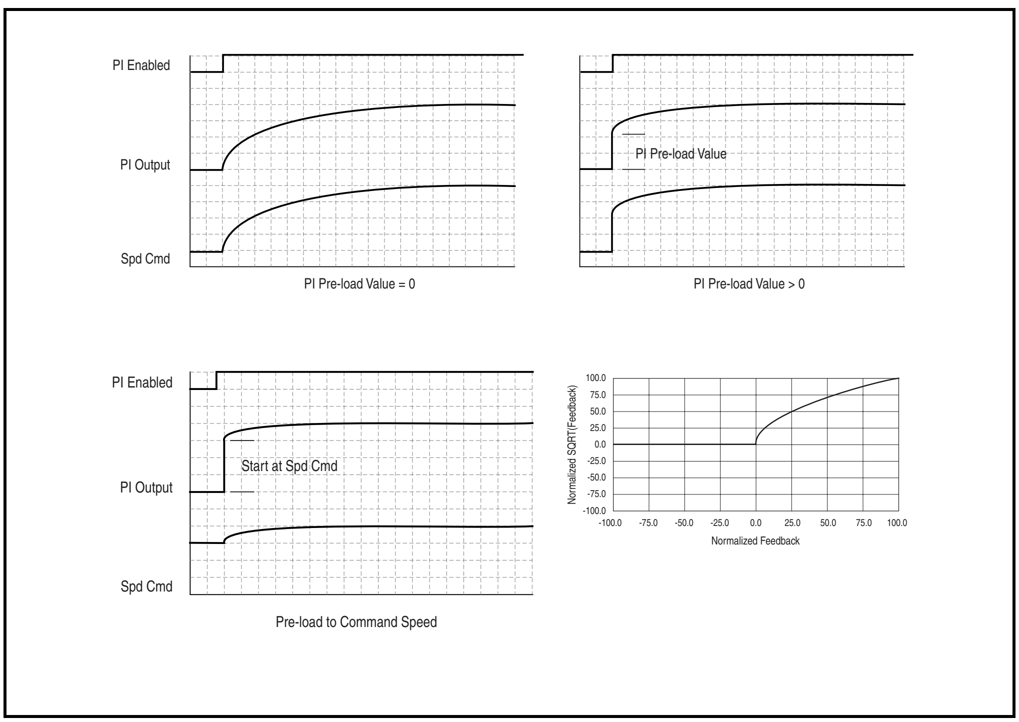
The output of the PI loop can be turned on (enables) or turned off (disabled). This control allows the user to determine when the PI loop is providing part or all of the commanded speed. The logic for enabling the PI loop is shown below.

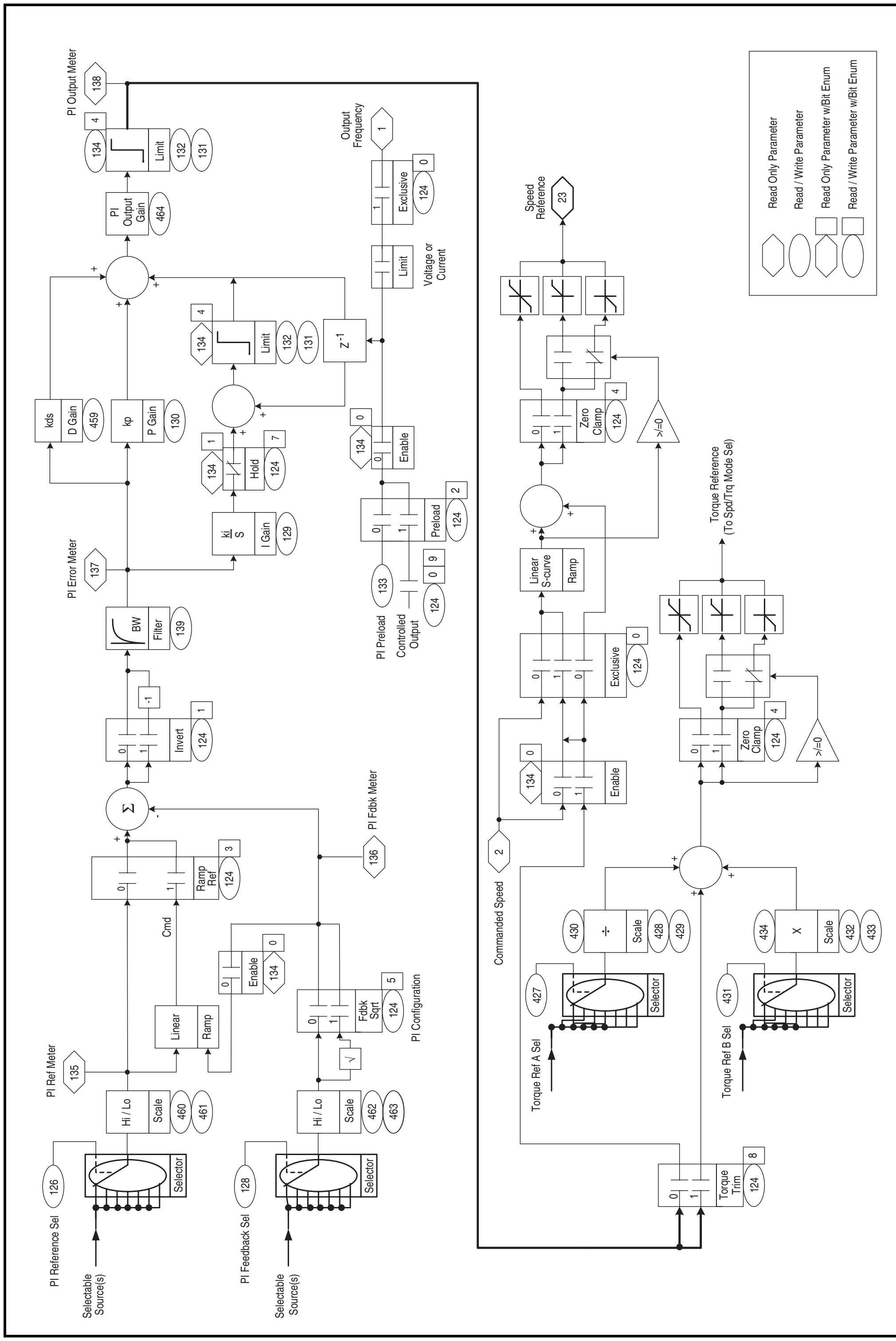


The drive must be running for the PI loop to be enabled. The loop will be disabled when the drive is ramping to a stop (unless “Stop Mode” is configured in PI Configuration (124)), jogging or the signal loss protection for the analog input(s) is sensing a loss of signal.

If a digital input has been configured to “PI Enable,” two events are required to enable the loop: the digital input must be closed AND bit 0 of PI Control (125) must be = 1.

If no digital input is configured to “PI Enable,” then only the Bit 0 = 1 condition must be met. If the bit is permanently set to a “1”, then the loop will become enabled as soon as the drive goes into “run.”





PI Reference Sel
Selectable Source(s)
126
Selector
Hi / Lo
Scale
460
461
PI Ref Meter
135
Linear
Ramp
Cmd
Ramp Ref
124
3
Enable
134
0
PI Feedback Sel
128
462
463
Fdbk Sqrt
5
PI Configuration
136
PI Fdbk Meter
Invert
1
-1
BW
Filter
139
137
PI Error Meter
ki
S
I Gain
129
Hold
7
Limit
132
131
4
kp
P Gain
130
kds
D Gain
459
PI Output Gain
464
138
PI Output Meter
z^{-1}
PI Preload
133
Controlled Output
9
Preload
2
Voltage or Current
Exclusive
Output Frequency
1
Commanded Speed
2
Torque Ref A Sel
427
430
Scale
428
429
Torque Ref B Sel
431
434
X
432
433
Torque Trim
8
Zero Clamp
>/=0
Linear S-curve
Speed Reference
23
Torque Reference (To Spd/Trq Mode Sel)
Read Only Parameter
Read / Write Parameter
Read Only Parameter w/Bit Enum
Read / Write Parameter w/Bit Enum

13.11 Limit Switches for Digital Inputs

The GV6000 includes digital input selections for decel and end limit switches. These can be used for applications that use limit switches for decelerating near the end of travel and then stopping at the end position. The end limit switch can also be used for end limit stops as many hoists require. These inputs can be used with or without Torque Proving enabled.

13.11.1 Decel Limit for Digital Inputs

Decel Limit is enabled by selecting “Decel Limit” as one of the digital inputs in Digital In1-6 Select (361-366). When this input is “low” (opposite logic), the speed reference command will change from the selected reference to the value in Preset Speed 1 (101). The deceleration rate will be based on the active deceleration time. This limit will be enforced only in the direction the drive was running when the switch was actived (momentarily or continuously, see “B” in Figure 13-7. The opposite direction will still be allowed to run at the selected reference speed. No speed limitation will occur between the limit switches (“A” in Figure 13-7).

Two different switches can be connected in series to one digital input to provide a decel limit at both ends of of the application (i.e. lift, conveyer, etc.). With proper set up, the drive will automatically apply the speed reduction based on the direction of the load even though only one digital input is being used. See “B” in Figure 13-7.

13.11.2 End Travel Limit for Digital Inputs

End Travel Limit is enabled by selecting “End Limit” as one of the digital inputs in Digital In1-6 Select (361-366). A “low” at this input (opposite logic) will cause the drive to do a fast decel (0.1 sec) and turn off. This Stop limit will be enforced only in the direction the drive was running when the switch was activated (momentarily or continuously, see “C” in Figure 13-7).

A Start command in the same direction will only allow 0 Hz to be commanded. A Start in the opposite direction will allow motion with a speed command from the selected speed reference If Torque Proving is Enabled, the drive will hold zero speed for a time determined ZeroSpdFloat Time (605).

Two different input switches can be connected in series to one digital input to provide an end limit at both ends of the application (e.g. lift, conveyer, etc.). With proper set up, the drive will automatically apply the proper stopping based on the direction of the load even though only one digital input is being used.

13.11.3 Limit Switch Set up

1. Move the load to a position between two decel switches (“A” in Figure 13-7).
2. Select the switches in Digital In1-6 Select (361-366). If switches are only used on one end of travel, simply keep the load off of both switches when selecting Digital In1-6 Select (361-366).

Important: When properly set up, the drive will remember its location during power cycles (or power loss) unless the load is manually moved during power down conditions. If this occurs, simply reset the feature using the procedure above.

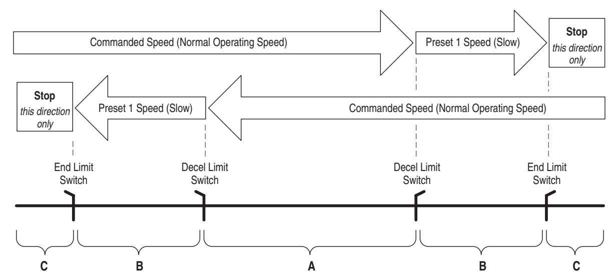


Figure 13.7 – Limit Switch Operation

13.12 Position Indexer/Speed Profiler

The GV6000 includes a position indexer/speed profiler, which provides either point-to-point positioning with a position regulator or speed profiling using a velocity regulator. Point-to-point positioning can be either incremental moves or absolute moves, which are referenced to home. Encoder feedback (incremental encorder) is required for the position regulator. Speed profiling steps can be time-based or triggered by digital inputs, encoder counts or parameter levels. These speed profiling steps can be operated open loop or with an encoder.

The indexer is programmed by entering data into a 16 step array. Each step has several varialbes for optimal customization (see below). The steps cans be run in a continuous cycle or single cyle. The process can also move to or from any step in the array.

Step Type	Value	Velocity	Accel Time	Decel Rate	Next Step Condition	Dwell	Batch	Next

This feature also includes homing capability to a limit switch or a marker pulse using an automatic homing procedure.

Important: The GV6000 uses an incremental encoder only. Since absolute encoders are not used, your process must be able accommodate this homing procedure after a power down or power loss.

13.12.1 Common Guidelines for all Step Types

- Enabling Position Indexer/Speed Profiler

This feature is enabled by selecting “7 - Pos/Spd Prof” in Speed/Torque Mod (088). Paramters 700-877 set up indexer/profiler.

- Motor Control Modes

For Position Indexing with an encoder, only FVC Vector Control should be used for optimum performance.

For Velocity Profiling, any motor control mode can be used. However, Sensorless Vector or FVC Vector Control modes will offer the best performance.

- Direction Control

The drive must be configured to allow the profile to control the direction. This is accomplished by setting Direction Mide (190) to “Bipolar” (default is “Unipolar.”)

- Limits

Many threshold values can affect the performance of the profile/indexer. To help minimize the possibility of overshooting a position, ensure that the following parameters are set for the best performance.

No.	Parameter	Description
153	Regen Power Limit	Default is –50% and will likely require a greater negative value. A brake or other means of dissipating regenerative energy is recommended.
147	Current Lmt Sel	By default these parameters are set to provide 150% of drive rating. If lowered, the performance may be degraded.
148	Current Lmt Sel	
161 162	Bus Reg Mode A Bus Reg Mode B	The default setting will adjust frequency to regulate the DC Bus voltage under regenerative conditions. This will most likely cause a position overshoot. To resolve this, select “Dynamic Brak” and size the load resistor for the application.

NA= Function not applicable to this step type

- Speed Regulator

The bandwidth of the speed regulator will affect the performance. If the connected inertia is relatively high, the bandwidth will be low and therefore a bit sluggish. When programming the acceleration and deceleration rates for each step, do not make them too aggressive or the regulator will be limited and therefore overshoot the desired position.

13.12.2 Position Loop Tuning

Two parameters are available for tuning the position loop.

- Pos Reg Filter (718) is a low pass filter at the input of the position regulator. •
- Pos Reg Gain (719) is a single adjustment for increasing or decreasing the responsiveness of the regulator.

By default these parameters are set at approximately a 6:1 ratio(filter = 25, gain = 4). It is recommended that a minimum ratio of 4:1 be maintained.

13.12.3 Profile Command Control Window

The profile/indexer is controlled with Profile Command (705). The bit definitions are as follows:

Bit	Name	Description
0	Start Step 0	The binary value of these bits determines which step will be the starting step for the profile when a start command is issued. If the value of these bits are not 1-16 the drive will not run since it does not have a valid step to start from. Valid Examples: 00011 = step 3, 01100 = step 12
1	Start Step 1	
2	Start Step 2	
3	Start Step 3	
4	Start Step 4	
5-7	Reserved	Reserved for future use.
8	Hold Step	When set, this command will inhibit the profile from transitioning to the next step when the condition(s) required are satisfied. When the hold command is released, the profile will transition to the next step.
9	Pos Redefine	This bit is used to set the present position as home. When this bit is set, Profile Status (700) bit At Home will be set and the Units Traveled (701) will be set to zero.
10	Find Home	This bit is used to command the find home routine.
11	Vel Override	When this bit is set the velocity of the present step will be multiplied by the value in Vel Override (711).
12-31	Reserved	Reserved for future use.

NA = Function not applicable to this step type

The Profile Command (705) bits can be set via DPI interface (OIM or Comm) or digital inputs. When digital input(s) are programmed for “Pos Sel 1-5,” the starting step of the profile is exclusively controlled by the digital inputs. The DPI interface value for bits 0-4 will be ignored. If a digital input is configured for the bit 8-11 functions (see above), the DPI interface or the digital input can activate the command.

13.12.4 Velocity Regualted Step Types and Parameters

Each of the Velocity Regulated steps has the following associated parameters or functions. Refer to the following page for descriptions.

	Value	Velocity	Accel Time	Decel Time	Next Step Condtion	Dwell	Batch	Next
Time	Total Move Time	Speed and Direction	Accel Rate	Decel Rate	Time greater than Step Value	Dwell Time	Batch Number	Next Step
Time Blend	Total Time	Spreed and Direction	Accel Rate	Decel Rate	Time greater than Step Value	NA	NA	Next Step
Digital Input	Digital Input Number	Speed and Direction	Accel Rate	Decel Rate	Digital Input logic	Dwell Time	Batch Number	Next Step
Encoder Incremental Blend	Position and Direction	Speed	Accel Rate	Decel Rate	At position Step Value	NA	NA	Next Step
Parameter Level	Parameter Number +/-	Speed and Direction	Accel Rate	Decel Rate	Step Value > or < Step Dwell	Compare Value	NA	Next Step
End	NA	N/A	NA	Decel Rate	At Zero transition	Dwell Time	NA	Stop

13.12.4.1 Time

When started, the drive will ramp to the desired velocity, hold the speed, and then ramp to zero in the programmed time for the given step. Dwell time and batch affect when the next step is executed.

13.12.4.2 Time Blend

When started, the drive will ramp to the desired velocity and hold speed for the programmed time. At this point it will transition to the next step and ramp to the programmed velocity without going to zero speed.

13.12.4.3 Digital Input

When started, the drive will ramp to the desired velocity and hold speed until the digital input programmed in the value transitions in the direction defined. When this occurs, the profile will transition to the next step after dwell and batch settings are satisfied. It will then ramp to the programmed velocity without going to zero speed.

13.12.4.4 Encoder Incremental Blend (EncIncrBlend)

When started, the drive will ramp to the desired velocity and hold speed until the units of travel programmed is reached (within tolerance window). The profile will then transition to the next step and the drive will ramp to the speed of the new step without first going to zero speed.

13.12.4.5 Encoder Incremental Blend with Hold

This profile is the same as the previous, but contains the “Hold” function. While “Hold” is applied, the step transition is inhibited. When released, the step can then transition if the conditions to transition are satisfied.

13.12.4.6 Parameter Level (Param Level)

When started, the drive will ramp to the desired velocity, hold speed and compare the parameter value of the parameter number programmed in Step Value to the Step Dwell level. The sign of the Step Value defines “less than or greater than” Step Dwell. When true, the profile will transition to the next step.

13.12.4.7 End

The drive ramps to zero speed and stops the profile. It clears the current step bits and sets the “Complete” bit (14) in Profile Status (700).

13.12.5 Position Regulated Step Types and Parameters

Each of the Position Regulated steps has the following associated parameters or functions:

Step Type	Value	Velocity	Accel Time	Decel Time	Next Step Condtion	Dwell	Batch	Next
Encoder Absolute	Position and Direction	Speed	Accel Rate	Decel Rate	At Position	Dwell Time	NA	Next Step
Encoder Incremental	Position and Direction	Speed	Accel Rate	Decel Rate	At Position	Dwell Time	Batch Number	Next Step
End Hold Position	NA	NA	NA	NA	At Position	Dwell Time	NA	Stop

13.12.5.1Encoder Absolute

This is a move to an absolute position, which is referenced from the home position. When started the drive ramps to the desired velocity in the direction required, holds the speed, then ramps to zero speed landing or ending at the commanded position within the tolerance window.

13.12.5.2 Encoder Incremental (Encoder Incr)

This is a move increment from the current position in the direction, distance and speed programmed. When started the drive ramps to the desired velocity, holds the speed, then ramps to zero speed landing or ending at the commanded position within the tolerance window.

13.12.5.3 End Hold Position

The drive holds the last position and stops the profile after dwell time expires. Must be used with position regulated profile. Do Not use “End.”

13.12.6 Homing Routine

Each time the profile/indexer is enabled, the drive requires a home position to be detected. The following options are available:

- Homing to Marker Pulse with Encoder Feedback

When “Find Home” is commanded the homing routine is run when a start command is issued. The Homing bit (11) in Profile Status (700) will be set while the homing routine is running. The drive will ramp to the speed and direction set in Find Home Speed (713) at the rate set in Find Home Ramp (714) until the digital input defined as “Home Limit” is activated. The drive will then ramp to zero and then back up to first marker pulse prior to the Home Limit switch at 1/10 the Find Home Speed (713). When on the marker pulse, the At Home bit (13) is set in Profile Status (700) and the drive is stopped.

Figure 13-8 shows the sequence of operation for homing to a marker pulse. Encoder Z Chan, (423) must be set to “Marker Input” or “Marker Check” for this type of homing

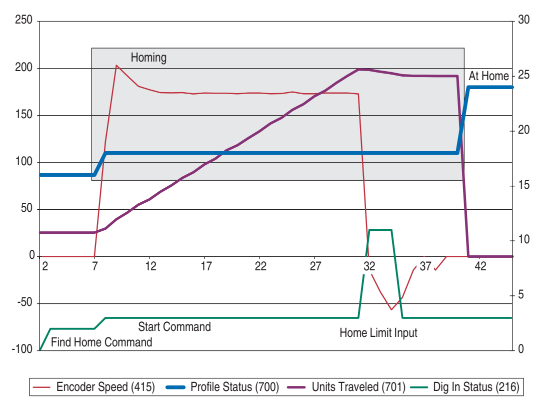


Figure 13.8 – Homing to Marker

- Homing to Limit Switch with Encoder Feedback

When “Find Home” is commanded, the homing routine is run when a start command is issued. The Homing bit (11) in Profile Status (700) will be set while the homing routine is running. The drive will ramp to the speed and direction set in Find Home Speed (713) at the rate set in Find Home Ramp (714) until the digital input defined as Home Limit is activated. The drive will then reverse direction at 1/10 the Find Home Speed (713) to the point where the Home Limit switch activated and stop.

Figure 13-9 shows the sequence of operation for homing to a limit switch with encoder feedback (without a marker pulse). Encoder Z Chan (423) must be set to “Pulse Input” or “Pulse Check.”

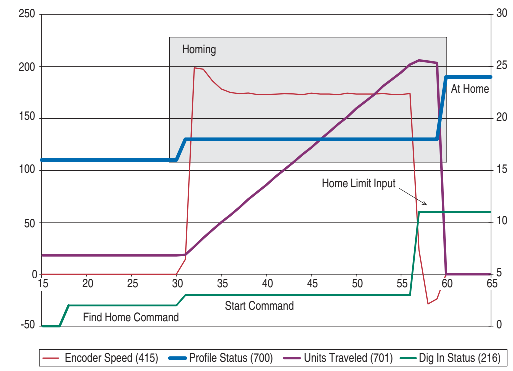


Figure 13.9 – Homing to a Limit Switch

- Homing to Limit Switch w/o Encoder Feedback

When “Find Home” is commanded, the homing routine is run when a Start command is issued. The Homing bit (11) in Profile Status (700) will be set while the homing routine is running. The drive will ramp to the speed and direction set in Find Home Speed (713) at the rate set in Find Home Ramp (714) until the digital input defined as Home Limit is activated. The drive will then decelerate to zero. If the switch is no longer activated, the drive will reverse direction at 1/10 the Find Home Speed (713) to the switch position and then stop. The Home Limit switch will be active when stopped.

Figure 13-10 shows the sequence of operation for homing to a limit switch without encoder feedback.

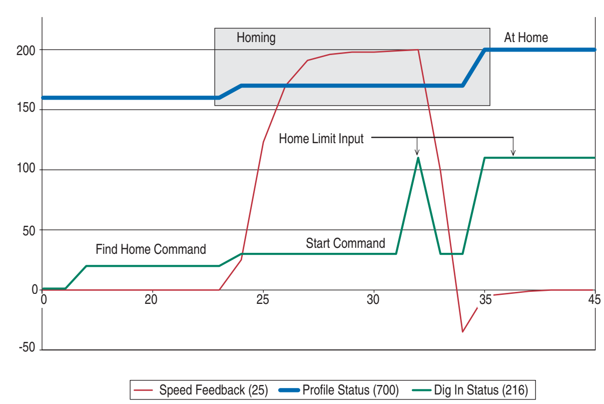


Figure 13.10 – Homing to a Limit Switch (No Feedback)

- Position Redefine

When “Pos Redefine” is set, the present position is established as Home and Units Traveled (701) is set to zero.

- Disable Homing Requirement

If a home position is not required, the routine can be disabled by clearing Alarm Config 1(259), bit 17 (Prof SetHome) to “0”. This will disable the alarm from being set when Pos/Spd Profile mode is configured in Speed/Torque Mod and will set the present position as Home.

Once Homing is complete the Find Home command must be removed to allow the profile to be run. If the Find Home command is not removed, when the drive is started the routine will see that it is At Home and the drive will stop.

13.12.7 Example 1: Five Step Velocity Profile (Time-Based and Encoder-Based)

The first three steps are “Time” steps followed by an “Encoder Abs” step to zero and then an “End” step. For each Time step the drive ramps at Step x AccelTime to Step x Velocity in the direction of the sign of Step x Velocity. The drive then decelerates at Step X DecelTime to zero. The Step X Value is programmed to the desired time for the total time of the accel, run and decel of the step. Each step has a 1 second time programmed in Step X Dwell which is applied to the end of each step. After the dwell time expires, the profile transitions to the next step. The absolute step is used to send the profile back to the home position. This is done by programming Step 4 Value to zero.

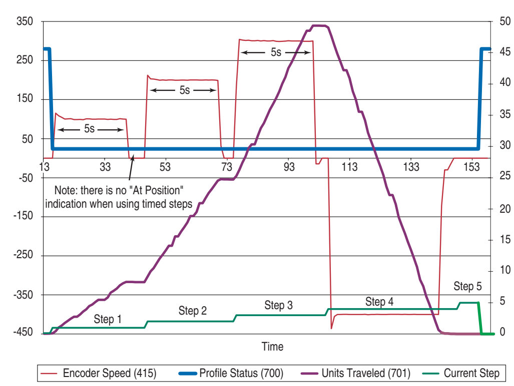


Figure 13.11 – Time Example

Step #	Step x Type	Step x Velocity	Step x Accel Time	Step x Decel Time	Step x Value	Step x Dwell	Step x Batch	Step x Next
1	Time	100	0.5	0.5	5.00	1.00	1	2
2	Time	200	0.5	0.5	5.00	1.00	1	3
3	Time	300	0.5	0.5	5.00	1.00	1	4
4	Encoder Abs	400	0.5	0.5	0.00	1.00	1	5
5	End	NA	NA	0.5	NA	0.00	NA	NA

13.12.8 Example 2: Six Step Velocity Profile (Digital Input-Based)

In each step, the drive ramps at Step x AccelTime to Step x Velocity in the direction of the sign of Step x Velocity until a digital input is detected. When the input is detected it transitions to the next step in the profile. This continues through Digital Input #6 activating step 5. Step 5 is defined as a "Parameter Level" step. Digital Inputs used in the profile must be defined as "Prof Input."

Important: A transition is required to start each step. If the input is already true when transitioning to a digital input step, the indexer will not go to the next step.

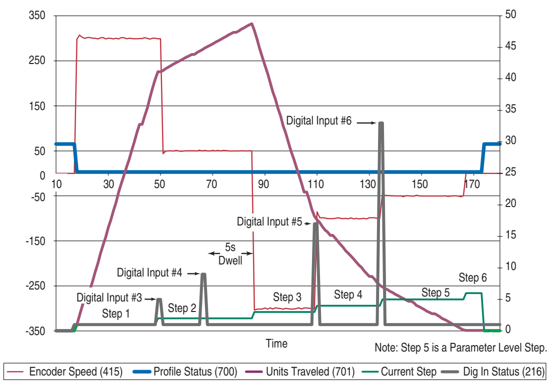


Figure 13.12 – Digital Input Example

Step #	Step x Type	Step x Velocity	Step x Accel Time	Step x Decel Time	Step x Value	Step x Dwell	Step x Batch	Step x Next
1	Digital Input	300	0.5	0.5	3.00	0.00	1	2
2	Digital Input	50	0.5	0.5	4.00	5.00	1	3
3	Digital Input	-300	0.5	0.5	5.00	0.00	1	4
4	Digital Input	-100	0.5	0.5	6.00	0.00	1	5
5	Param Level	-50	0.5	0.5	701	0.00	1	6
6	End	NA	NA	0.5	NA	0.00	NA	NA

13.12.9 Example 3: Five Step Positioner with Incremental Encoder

The first three steps of this indexer are "Encoder Incr" steps followed by an "Encoder Abs" step to zero and then an "End Hold Position" step. For each "Encoder Incr" step the drive ramps at Step x AccelTime to Step x Velocity in the direction of the sign of Step xValue. It then decelerates at the rate of Step x DecelTime to the position programmed in Step x Value which sets the desired units of travel for the step. When the value programmed in Step x Value is reached within the tolerance window programmed in Encoder Pos Tol (707), the “At Position” bit is set in Profile Status (700). In this example a dwell value held each of the first three steps “At Position” for 1 second. After the Step x Dwelltime expires, the profile transitions to the next step. The absolute step is used to send the profile back to the home position. This is accomplished by programming Step 4 Value to zero.

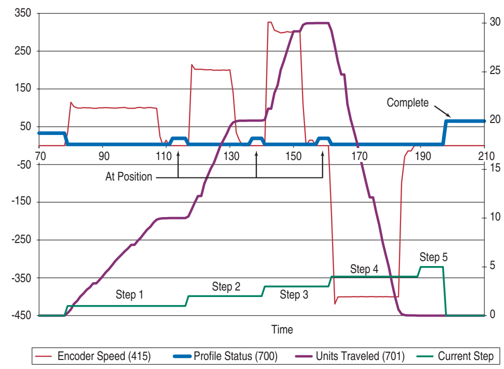


Figure 13.13 – Encoder Incremental with Dwell Example

Step #	Step x Type	Step x Velocity	Step x Accel Time	Step x Decel Time	Step x Value	Step x Dwell	Step x Batch	Step x Next
1	Param Level	100	0.5	0.5	10.00	1.00	1	2
2	Param Level	200	0.5	0.5	10.00	1.00	1	3
3	Param Level	300	0.5	0.5	10.00	1.00	1	4
4	Encoder Abs	400	0.5	0.5	0.00	1.00	1	5
5	End Hold Position	NA	NA	0.5	NA	0.00	NA	NA

13.13 Reverse Speed Limit

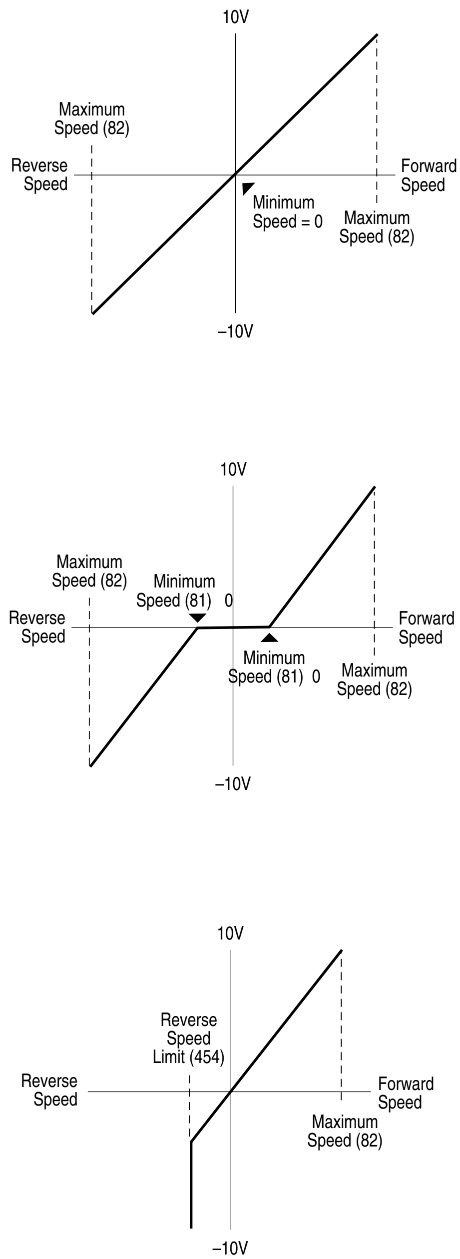


Figure 13.14 – Rev Speed Limit (454) Set to Zero

13.14 Skip Frequency

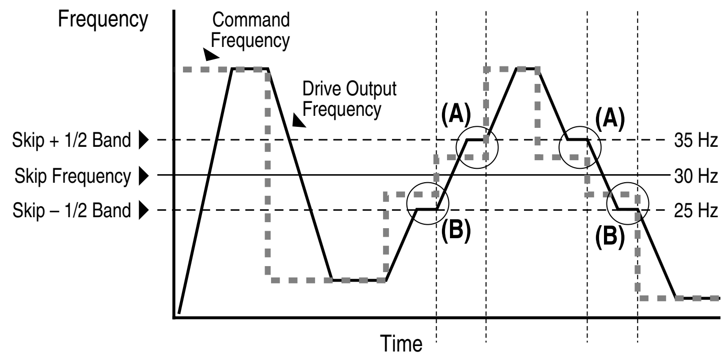


Figure 13.15 – Skip Frequency

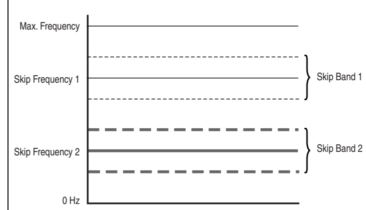
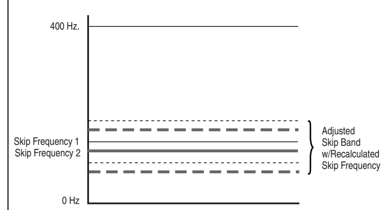
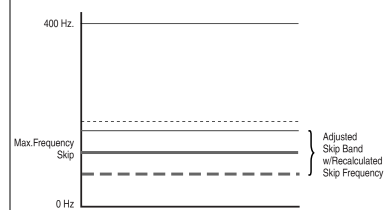
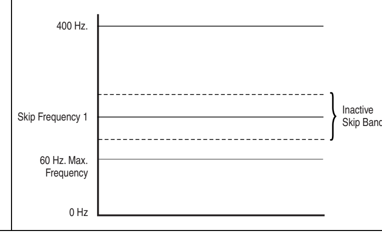
Some machinery may have a resonant operating frequency that must be avoided to minimize the risk of equipment damage. To assure that the motor cannot continuously operate at one or more of the points, skip frequencies are used. Parameters 084-086, (Skip Frequency 1-3) are available to set the frequencies to be avoided.

The value programmed into the skip frequency parameters sets the center point for an entire "skip band" of frequencies. The width of the band (range of frequency around the center point) is determined by parameter Skip Freq Band (87). The range is split, half above and half below the skip frequency parameter.

If the commanded frequency of the drive 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 13-15.

If the commanded 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 13-15.

Acceleration and deceleration are not affected by the skip frequencies. Normal accel/decel will proceed through the band once the commanded frequency is greater than the skip frequency. See (A) & (B) in Figure 13-15. This function affects only continuous operation within the band.

<table>
<tr><th colspan="2">Skip Frequency Examples</th></tr>
<tr><td>The skip frequency will have hysteresis so the output does not toggle between high and low values. Three distinct bands can be programmed. If none of the skip bands touch or overlap, each band has its own high/low limit.</td><td>
</td></tr>
<tr><td>If skip bands overlap or touch, the center frequency is recalculated based on the highest and lowest band values.</td><td>
</td></tr>
<tr><td>If a skip band(s) extend beyond the max frequency limits, the highest band value will be clamped at the max frequency limit. The center frequency is recalculated based on the highest and lowest band values.</td><td>
</td></tr>
<tr><td>If the band is outside the limits, the skip band is inactive.</td><td>
</td></tr>
</table>

13.15 Sleep Wake Mode

This function stops (sleep) and starts (wake) the drive based on separately configurable analog input levels rather than discrete start and stop signals. When enabled in “Direct” mode, the drive will start (wake) when an analog signal is greater than or equal to the user specified Wake Level (180), and stop the drive when an analog signal is less than or equal to the user specified Sleep Level (182). When Sleep Wake is enabled for “Invert” mode(1), the drive will start (wake) when an analog signal is less than or equal to the user specified Wake Level (180), and stop the drive when an analog signal is greater than or equal to the user specified Sleep Level (182).

13.15.1 Definitions

- Wake - A start command generated when the analog input value remains above Wake Level ((180)or below when Invert mode is active)) for a time greater than Wake Time (181).
- Sleep - A Stop command generated when the analog input value remains below Sleep Level (182) (or above when Invert mode is active) for a time greater than
- Sleep Time (183).Speed Reference – The active speed command to the drive as selected by drive logic and Speed Ref x Sel.
- Start Command - A command generated by pressing the Start button on the OIM, closing a digital input programmed for Start, Run, Run Forward or Run Reverse.

Refer to Figure 13-16.

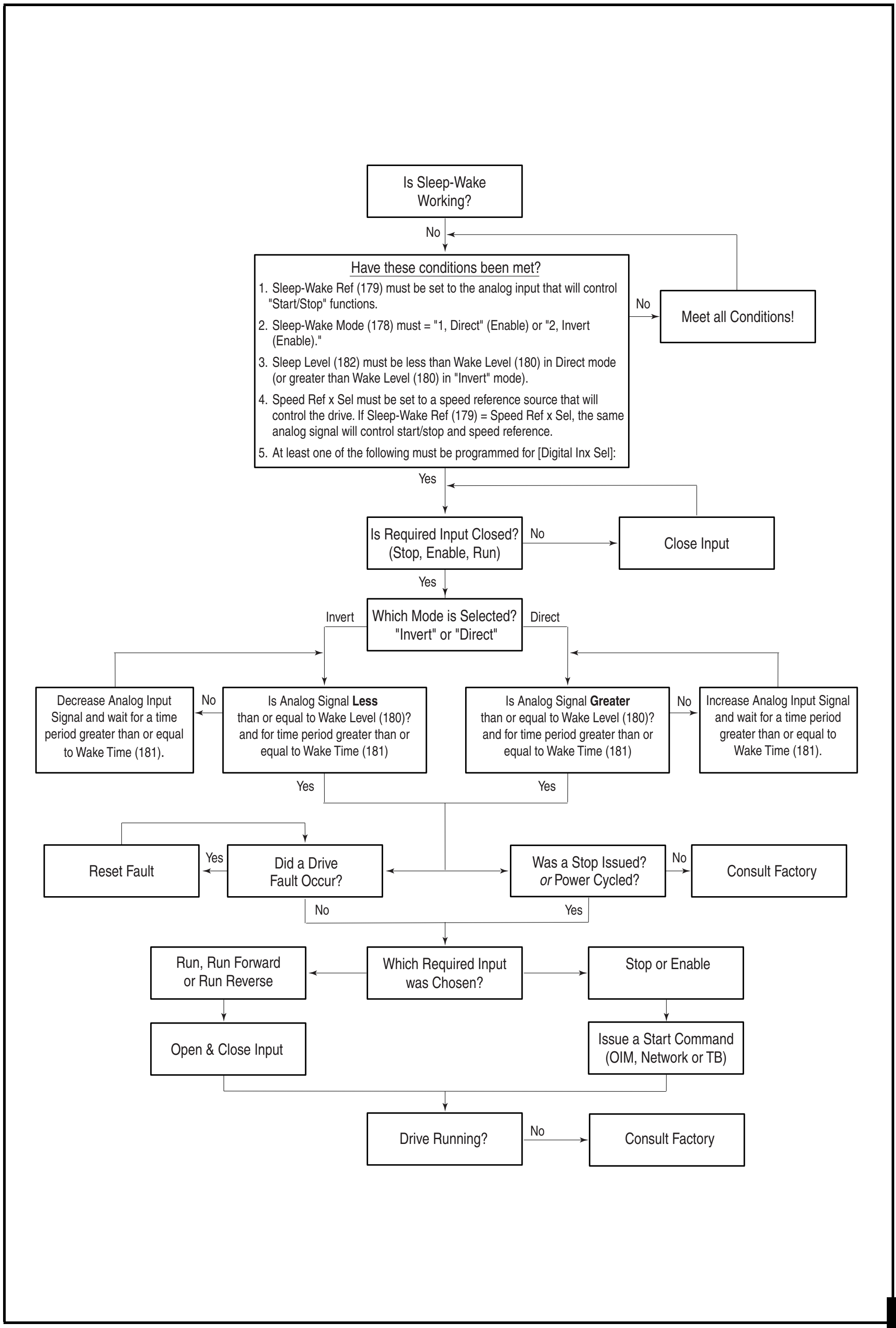
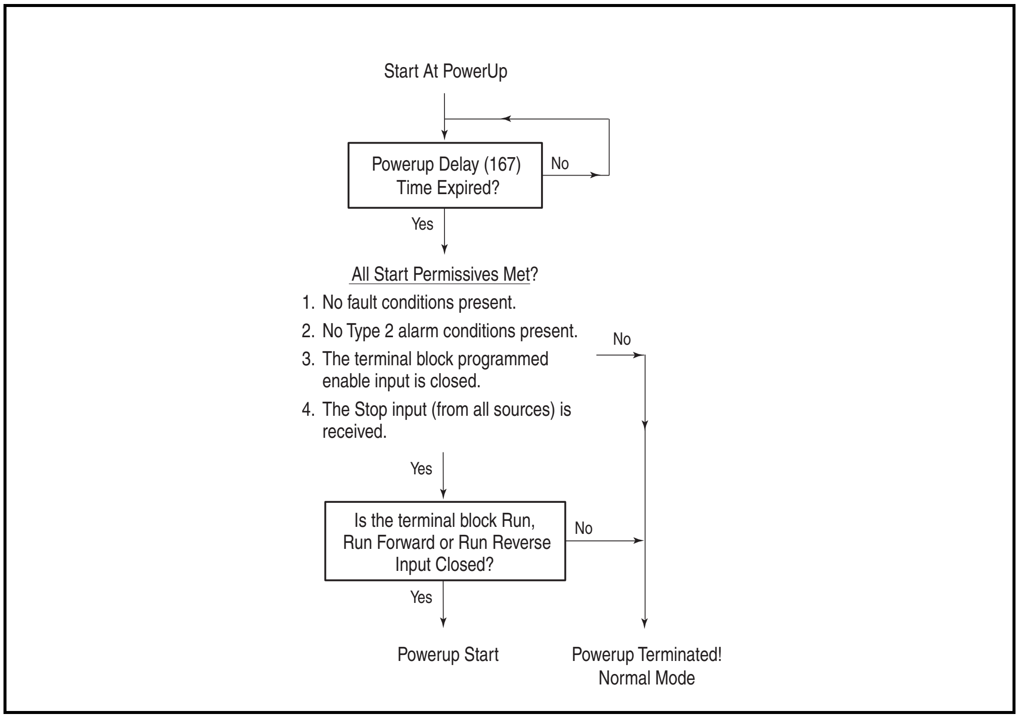


Figure 13.16 – Sleep Wake Mode

13.16 Start At Powerup

A powerup delay time of up to 30 seconds can be programmed through Powerup Delay (167). After the time expires, the drive will start if all of the start permissive conditions are met. Before that time, restart is not possible.



13.17 Stop Mode

The GV6000 offers several methods for stopping a load. The method/mode is defined by Stop/Brk Mode A/B (155 and 156). These modes include:

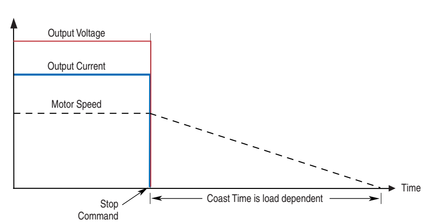
- Coast
- Ramp
- Ramp to Hold
- DC Brake
- Fast Brake

Additionally, Flux Braking (166) can be selected separately to provide additional braking during a “Stop” command or when reducing the speed command. For “Stop” commands, this will provide additional braking power during “Ramp” or “Ramp to Hold” selections only. If “Fast Brake” or “DC Brake” is used, “Flux Braking” will only be active during speed changes (if enabled).

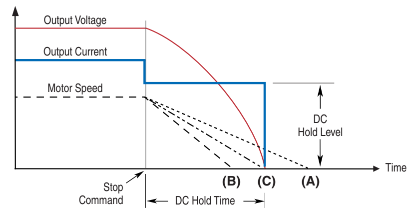
A “Ramp” selection will always provide the fastest stopping time if a method to dissipate the required energy from the DC bus is provided (i.e. resistor brake, regenerative brake, etc.). The alternative braking methods to external brake requirements can be enabled if the stopping time is not as restrictive. Each of these methods will dissipate energy in the motor (use care to avoid motor overheating). Table 13-1 describes several braking capability examples.

Table 13.1 – Braking Method Examples

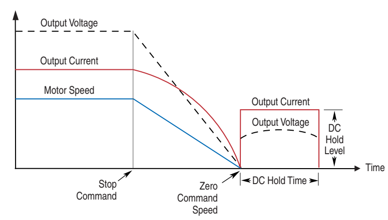
Method	Use When Application Requires . . .	Braking Power
Ramp	The fastest stopping time or fastest ramp time for speed changes (external brake resistor or regenerative capability required for ramp times faster than the methods below). High duty cycles, frequent stops or speed changes. (The other methods may result in excessive motor heating).	Most
Fast Brake	Additional braking capability without use of external brake resistor or regenerative units.	More than Flux Braking or DC Brake
Flux Braking	Fast speed changes and fast stopping time. Typical stop from speeds below 50% of base speed (“Flux Braking” will likely stop the load faster than “Fast Brake” in this case) **Important:** This can be used in conjunction with “Ramp” or “Ramp to Hold” for additional braking power or with “Fast Brake” or “DC Brake” for speed changes.	More than DC Brake
DC Brake	Additional braking capability without use of external brake resistor or regenerative units	Less than above methods

Mode	Description
Coast to Stop	
	This method releases the motor and allows the load to stop by friction. On Stop, the drive output goes immediately to zero (off). No further power is supplied to the motor. The drive has released control. The motor will coast for a time that is dependent on the mechanics of the system (inertia, friction, etc).

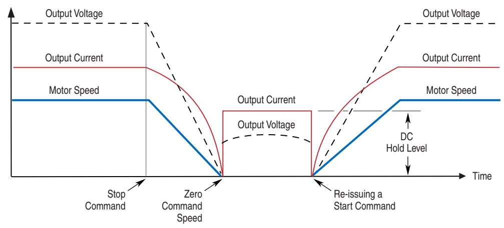
<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td rowspan="2">Brake to Stop</td><td>

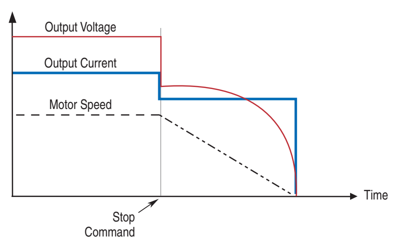


</td></tr>
<tr><td>
This method uses DC injection of the motor to Stop and/or hold the load.
On Stop, 3 phase drive output goes to zero (off)
Drive outputs DC voltage on the last used phase at the level programmed in DC Brake Level (158). This voltage causes a “stopping” brake torque. If the voltage is applied for a time that is longer than the actual possible stopping time, the remaining time will be used to attempt to hold the motor at zero speed.
DC voltage to the motor continues for the amount of time programmed in DC Brake Time (159). Braking ceases after this time expires.
After the DC Braking ceases, no further power is supplied to the motor. The motor may or may not be stopped. The drive has released control.
The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).
</td></tr>
<tr><td rowspan="2">Ramp to Stop</td><td>



</td></tr>
<tr><td>
This method uses drive output reduction to stop the load.
On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed Maximum Freq (82) and the programmed active Decel Time x.
The reduction in output can be limited by other drive factors such as such as bus or current regulation.
When the output reaches zero the output is shut off.
The motor, if rotating, will coast from its present speed for a time that is dependent on the mechanics of the system (inertia, friction, etc).
</td></tr>
</table>

<table>
<tr><th>Mode</th><th>Description</th></tr>
<tr><td rowspan="2">Ramp to Hold</td><td>


</td></tr>
<tr><td>This method combines two of the methods above. It uses drive output reduction to stop the load and DC injection to hold the load at zero speed once it has stopped.
On Stop, drive output will decrease according to the programmed pattern from its present value to zero. The pattern may be linear or squared. The output will decrease to zero at the rate determined by the programmed Maximum Freq (82) and the programmed active Decel Time x.
The reduction in output can be limited by other drive factors such as bus or current regulation.
When the output reaches zero 3 phase drive output goes to zero (off) and the drive outputs DC voltage on the last used phase at the level programmed in DC Brake Level (158). This voltage causes a “holding” brake torque.
DC voltage to the motor continues until a Start command is reissued or the drive is disabled.
If a Start command is reissued, DC Braking ceases and he drive returns to normal AC. If an Enable command is removed, the drive enters a “not ready” state until the enable is restored.</td></tr>
<tr><td rowspan="2">Fast Brake</td><td>


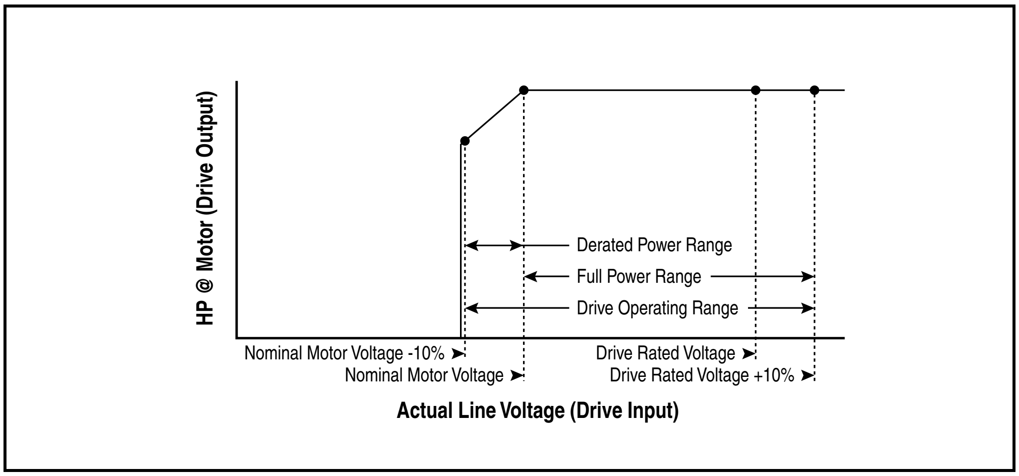
</td></tr>
<tr><td>This method uses drive output reduction to stop the load.
On Stop, the drive output will decrease according to the programmed pattern from its present value to zero at the rate determined by the programmed active Decel Time x. This is accomplished by lowering the output frequency below the motor speed where regeneration will not occur. This causes excess energy to be lost in the motor.
The reduction in output can be limited by other drive factors such as bus or current regulation.
When the output reaches very near zero, DC brake will automatically be used to complete the stop then the output is shut off.</td></tr>
</table>

13.18 Voltage Tolerance

Drive Rating	Nominal Line Voltage	Nominal Motor Voltage	Drive Full Power Range	Drive Operating Range
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 (*Frames 0-4 Only)*	600	575*	575-660	432-660
500-690 (*Frames 5-6 Only)*	600	575*	575-660	475-759

Drive Full Power Range = Nominal Motor Voltage to Drive Rated Voltage + 10%. Rated power is available across the entire Drive Full Power Range.

Drive Operating Range = Lowest(*) Nominal Voltage -10% to Drive Rated Voltage +10%. Drive Output is linearly derated when Actual Line Voltage is less than the Nominal Motor Voltage.

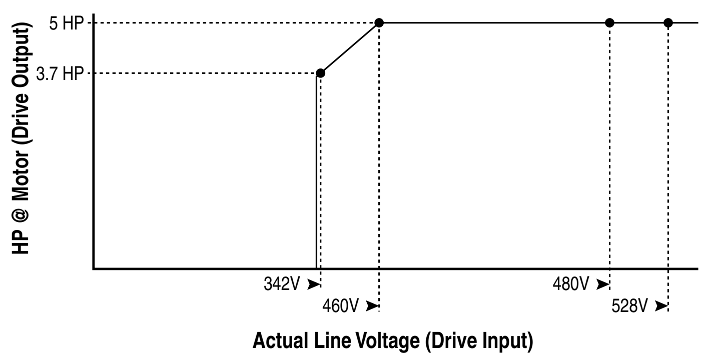


13.18.1 Example

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 = 74.3%
- 74.3% × 5 HP = 3.7 HP
- 74.3% × 60 Hz = 44.6 HzAt 342V

Actual Line Voltage, the maximum power the 5 HP, 460V motor can produce is3.7 HP at 44.6 Hz.



13.19 Analog Inputs

13.19.1 Possible Uses of Analog Inputs

The analog inputs provide data that can be used for the following purposes:

- Provide a value to Speed Ref A or Speed Ref B.
- Provide a trim signal to Speed Ref A or Speed Ref B.
- Provide a reference when the terminal block has assumed manual control of the reference
- Provide the reference and feedback for the PI loop. Refer to Process PI Loop in section 2.3.19.
- Provide an external and adjustable value for the current limit and DC braking level
- Enter and exit sleep mode.
- FV Provide a value to Torque Ref A or Torque Ref B.

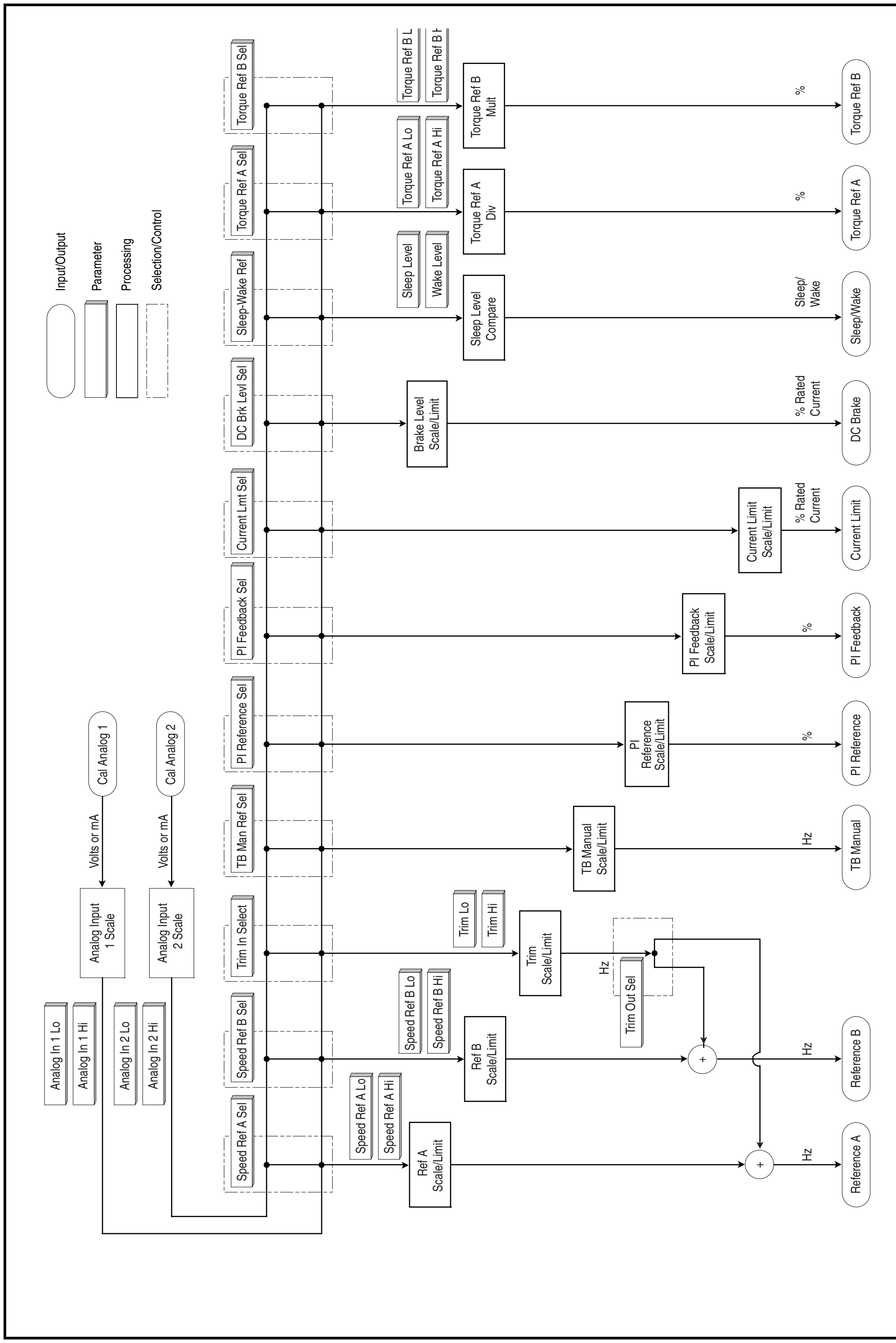
13.19.2 Analog Input Configuration

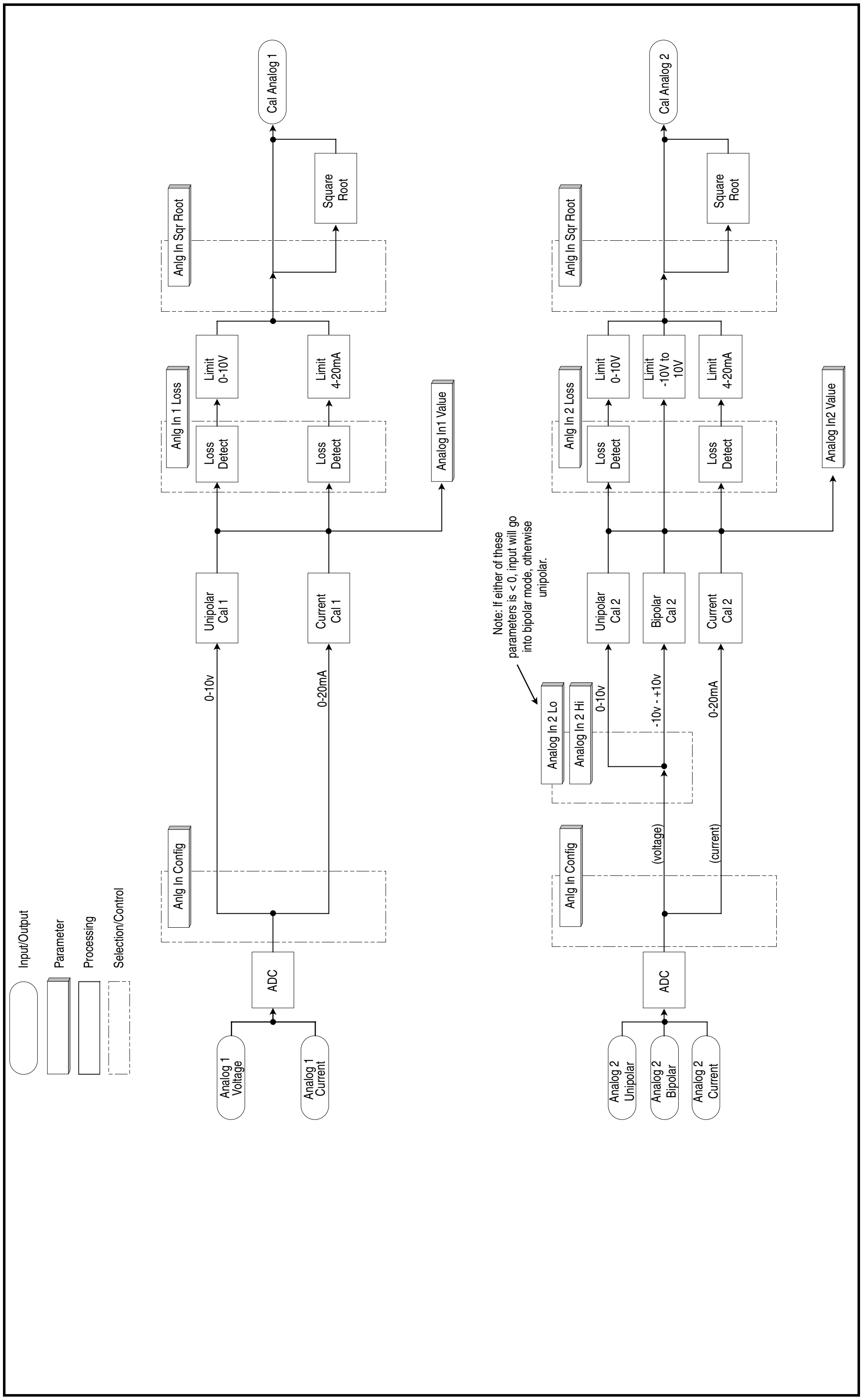
Anlg In Config (320)

Current Lmt Sel (147) allows an analog input to control the set point while DC Brk Levl Sel (157) allows an analog input to define the DC hold level used when Ramp-to-Stop, Ramp-to-Hold, or Brake-to-Stop is active.

To provide local adjustment of a master command signal or to provide improved resolution the input to analog channel 1 or 2 can be defined as a trim input. Setting Trim In Select (117) allows the selected channel to modify the commanded frequency by ±10%. The speed command will be reduced by 10% when the input level is at Anlg In x Lo with it linearly increasing to 10% above command at Anlg In x Hi.

- Feedback can be used to control an operation using the “Process PI” (proportional-integral) feature of the control. In this case one signal, defined using PI Reference Sel (126), provides a reference command and a second, defined using PI Feedback Sel (128), provides a feedback signal for frequency compensation. Refer to Process PI Loop in section 2.3.19.


Input/Output
Parameter
Processing
Selection/Control
Analog In 1 Lo
Analog In 1 Hi
Analog In 2 Lo
Analog In 2 Hi
Analog Input 1 Scale
Analog Input 2 Scale
Volts or mA
Volts or mA
Cal Analog 1
Cal Analog 2
Speed Ref A Sel
Speed Ref B Sel
Trim In Select
TB Man Ref Sel
PI Reference Sel
PI Feedback Sel
Current Lmt Sel
DC Brk Levl Sel
Sleep-Wake Ref
Torque Ref A Sel
Torque Ref B Sel
Speed Ref A Lo
Speed Ref A Hi
Ref A Scale/Limit
Speed Ref B Lo
Speed Ref B Hi
Ref B Scale/Limit
Trim Lo
Trim Hi
Trim Scale/Limit
Hz
Trim Out Sel
TB Manual Scale/Limit
PI Reference Scale/Limit
PI Feedback Scale/Limit
Current Limit Scale/Limit
Brake Level Scale/Limit
Sleep Level
Wake Level
Sleep Level Compare
Torque Ref A Lo
Torque Ref A Hi
Torque Ref A Div
Torque Ref B Lo
Torque Ref B Hi
Torque Ref B Mult
+
+
Hz
Hz
Hz
%
%
%
% Rated Current
% Rated Current
Sleep/ Wake
%
%
Reference A
Reference B
TB Manual
PI Reference
PI Feedback
Current Limit
DC Brake
Sleep/Wake
Torque Ref A
Torque Ref B



Input/Output
Parameter
Processing
Selection/Control
Analog 1 Voltage
Analog 1 Current
ADC
Anlg In Config
0-10v
0-20mA
Unipolar Cal 1
Current Cal 1
Analog In1 Value
Anlg In 1 Loss
Loss Detect
Loss Detect
Limit 0-10V
Limit 4-20mA
Anlg In Sqr Root
Square Root
Cal Analog 1
Analog 2 Unipolar
Analog 2 Bipolar
Analog 2 Current
ADC
Anlg In Config
(voltage)
(current)
Analog In 2 Lo
Analog In 2 Hi
Note: If either of these parameters is < 0, input will go into bipolar mode, otherwise unipolar.
0-10v
-10v - +10v
0-20mA
Unipolar Cal 2
Bipolar Cal 2
Current Cal 2
Analog In2 Value
Anlg In 2 Loss
Loss Detect
Loss Detect
Limit 0-10V
Limit -10V to 10V
Limit 4-20mA
Anlg In Sqr Root
Square Root
Cal Analog 2

13.19.3 Analog Scaling

Analog In x Hi
Analog In x Lo

A scaling operation is performed on the value read from an analog input in order to convert it to units usable for some particular purpose. The user controls the scaling by setting parameters that associate a low and high point in the input range (i.e. in volts or mA) with a low and high point in the target range (e.g. reference frequency).

Two sets of numbers may be used to specify the analog input scaling. One set (called the “input scaling points”) defines low and high points in terms of the units read by the input hardware, i.e. volts or mA.

The second set of numbers (called the “output scaling points”) used in the analog input scaling defines the same low and high points in units appropriate for the desired use of the input. For instance, if the input is to be used as a frequency reference, this second set of numbers would be entered in terms of Hz. For many features the second set of numbers is fixed. The user sets the second set for speed and reference trim.

An analog input or output signal can represent a number of different commands. Typically an analog input is used to control output frequency, but it could control frequency trim, current limit or act as a PI loop input. An analog output typically is a frequency indication, but it could represent output current, voltage, or power. For this reason this document defines an analog signal level as providing a “command” value rather than a “frequency.” However when viewing a command value it is presented as a frequency based on the [Minimum Speed] and [Maximum Freq] settings.

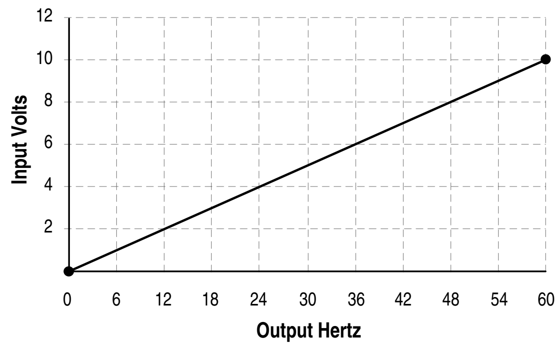
The 0-10 volt input scaling can be adjusted using the following parameters:

- Analog In x Lo
- Analog In x Hi

13.19.3.1 Configuration #1:

- Anlg In Config (320), bit 0 = “0” (Voltage)
- Speed Ref A Sel (90) = “Analog In 1”
- Speed Ref A Hi (91) = 60 Hz
- Speed Ref A Lo (92) = 0 Hz
- Analog In 1 Hi (322) = 10V
- Analog In 1 Lo (323) = 0V

This is a typical setting, where minimum input (0 volts) represents 0 Hz and maximum input (10 volts) represents 60 Hz (it provides 6 Hz change per input volt).



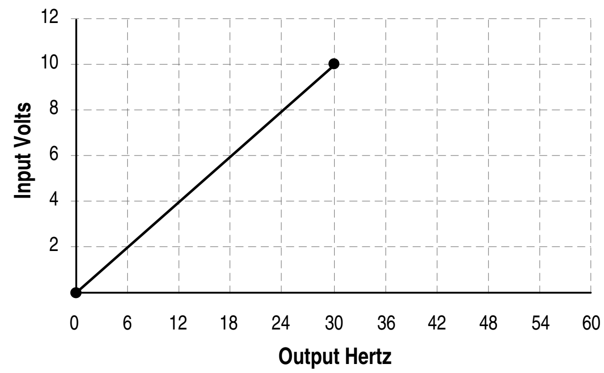
Analog Scaling

Speed Ref A Sel (90) = "Analog In 1"	
Analog In 1Hi (322) 10V	Speed Ref A Hi (91) 60 Hz
Analog In 1Lo (323) 0V	Speed Ref A Lo (92) 0 Hz

13.19.3.2 Configuration #2:

- Anlg In Config (320), bit 0 = "0" (Voltage)
- Speed Ref A Sel (90) = "Analog In 1"
- Speed Ref A Hi (91) = 30 Hz
- Speed Ref A Lo (92) = 0 Hz
- Analog In 1 Hi (322) = 10V
- Analog In 1 Lo (322) = 0V

This is an application that only requires 30 Hz as a maximum output frequency, but is still configured for full 10 volt input. The result is that the resolution of the input has been doubled, providing only 3 Hz change per input volt (Configuration #1 is 6 Hz/Volt).



Analog Scaling

Speed Ref A Sel (90) = "Analog In 1"	
Analog In 1Hi (322) 10V	Speed Ref A Hi (91) 30 Hz
Analog In 1Lo (323) 0V	Speed Ref A Lo (92) 0 Hz

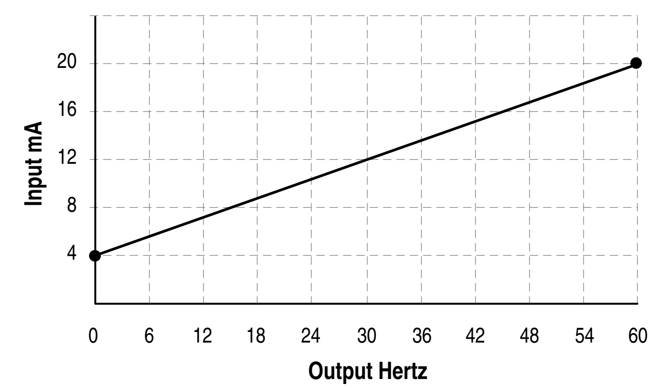
13.19.3.3 Configuration #3:

- Anlg In Config (320), bit 0 = "1" (Current)
- Speed Ref A Sel (90) = "Analog In 1"
- Speed Ref A Hi (91) = 60 Hz
- Speed Ref A Lo (92) = 0 Hz
- Analog In 1 Hi (322) = 20 mA
- Analog In 1 Lo (323) = 4 mA

This configuration is referred to as offset. In this case, a 4-20 mA input signal provides 0-60 Hz output, providing a 4 mA offset in the speed command.

Analog Scaling

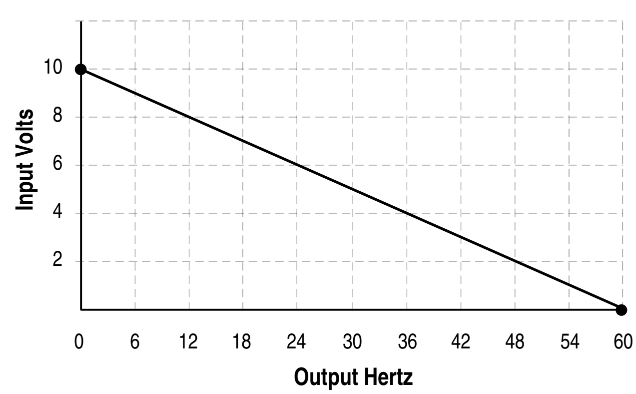
Speed Ref A Sel (90) = "Analog In 1"	
Analog In 1Hi (322) 20 mA	Speed Ref A Hi (91) 60 Hz
Analog In 1Lo (323) 4 mA	Speed Ref A Lo (92) 0 Hz



13.19.3.4 Configuration #4:

- Anlg In Config (320), bit 0 = “0” (Voltage)
- Speed Ref A Sel (90) = “Analog In 1”
- Speed Ref A Hi (91) = 0 Hz
- Speed Ref A Lo (92) = 60 Hz
- Analog In 1 Hi (322) = 10V
- Analog In 1 Lo (323) = 0V

This configuration is used to invert the operation of the input signal. Here, maximum input (10 Volts) represents 0 Hz and minimum input (0 Volts) represents 60 Hz.



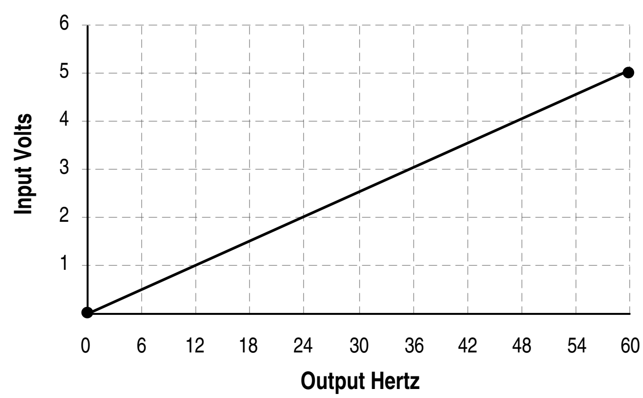
Analog Scaling

Speed Ref A Sel (90) = “Analog In 1”	
Analog In 1Hi (322) 10 V	Speed Ref A Hi (91) 0 Hz
Analog In 1Lo (323) 0 V	Speed Ref A Lo (92) 60 Hz

13.19.3.5 Configuration #5:

- Anlg In Config (320), bit 0 = “0” (Voltage)
- Speed Ref A Sel (90) = “Analog In 1”
- Speed Ref A Hi (91) = 60 Hz
- Speed Ref A Lo (92) = 0 Hz
- Analog In 1 Hi (322) = 5V
- Analog In 1 Lo (323) = 0V

This configuration is used when the input signal is 0-5 volts. Here, minimum input (0 Volts) represents 0 Hz and maximum input (5 Volts) represents 60 Hz. This allows full scale operation from a 0-5 volt source.



Analog Scaling

Speed Ref A Sel (90) = “Analog In 1”	
Analog In 1Hi (322) 5 V	Speed Ref A Hi (91) 60 Hz
Analog In 1Lo (323) 0 V	Speed Ref A Lo (92) 0 Hz

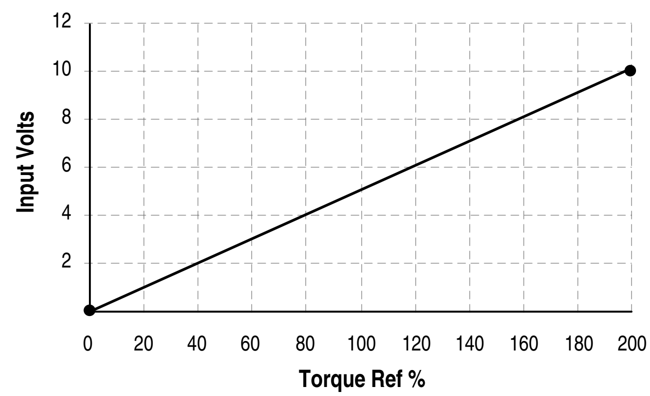
13.19.3.6 Configuration #6: Torque Ref:

- Anlg In Config (320), bit 0 = “0” (Voltage)
- Torque Ref A Sel (427) = “Analog In 1”
- Torque Ref A Hi (428) = 200%
- Torque Ref A Lo (429) = 0%
- Torque Ref A Div (430) = 1

This configuration is used when the input signal is 0-10 volts. The minimum input of 0 volts represents a torque reference of 0% and maximum input of 10 volts represents a torque reference of 200%.

Analog Scaling

Torque Ref A Sel (427) = "Analog In 1"	
Analog In 1Hi (322) 5 V	Torque Ref A Hi (428) 60 Hz
Analog In 1Lo (323) 0 V	Torque Ref A Lo (429) 0 Hz



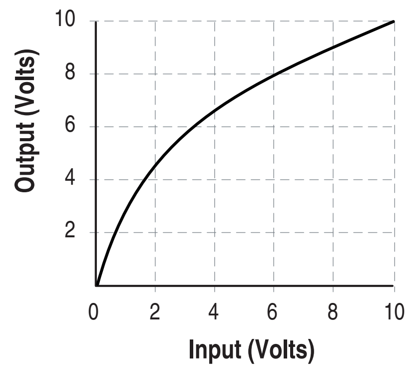
13.19.4 Square Root

Anlg In Sqr Root (321)

For both analog inputs, the user can enable a square root function for an analog input through the use of Analg In Sqr Root (321). The function should be set to enabled if the input signal varies with the square of the quantity (i.e. drive speed) being monitored.

If the mode of the input is bipolar voltage (–10v to 10v), then the square root function will return 0 for all negative voltages.

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, as shown in figure below.



13.19.5 Signal Loss

Analog In 1, 2 Loss (324, 327)

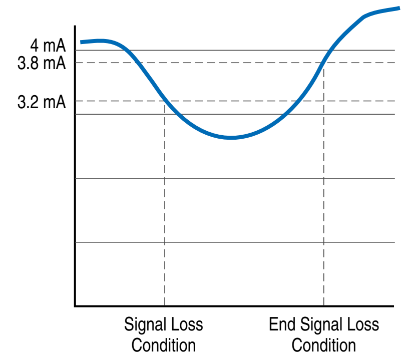
Signal loss detection can be enabled for each analog input. The [Analog In x Loss] parameters control whether signal loss detection is enabled for each input and defines what action the drive will take when loss of any analog input signal occurs.

One of the selections for reaction to signal loss is a drive fault, which will stop the drive. All other choices make it possible for the input signal to return to a usable level while the drive is still running.

- Hold input
- Set input Lo
- Set input Hi
- Goto Preset 1
- Hold Output Frequency

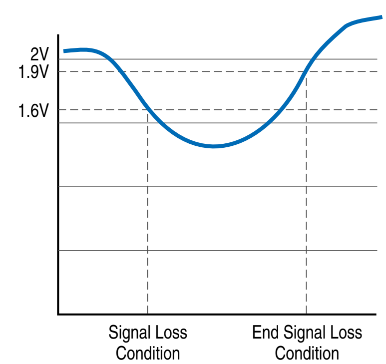
Value	Action on Signal Loss
0	Disabled (default)
1	Fault
2	Hold input (continue to ise last frequency command)
3	Set Input Hi - use Minimum Speed (81) as frequency command
4	Set Input Lo - use Maximum Speed (82) as frequency command
5	Use Preset 1(101) as frequency command
6	Hold Out Freq (maintain last outout frequency)

If the input is in current mode, 4 mA is the normal minimum usable input value. Any value below 3.2 mA will be interpreted by the drive as a signal loss, and a value of 3.8 mA will be required on the input in order for the signal loss condition to end.



If the input is in unipolar voltage mode, 2V is the normal minimum usable input value. Any value below 1.6 volts will be interpreted by the drive as a signal loss, and a value of 1.9 volts will be required on the input in order for the signal loss condition to end.

No signal loss detection is possible while an input is in bipolar voltage mode. The signal loss condition will never occur even if signal loss detection is enabled.



13.19.6 Trim

An analog input can be used to trim the active speed reference (Speed Reference A/B). If analog is chosen as a trim input, two scale parameters are provide to scale the trim reference. The trim is a +/- value which is summed with the current speed reference.

- Trim In Select (117)
- Trim Out Select (118)
- Trim Hi (119)

- Trim Lo (120)

13.19.7 Value Display

Parameters are available in the Monitor Group to view the actual value of an analog input regardless of its use in the application. Whether it is a current limit adjustment, speed reference or trim function, the incoming value can be read via these parameters. The values of the analog inputs can also be viewed by pressing the DISP key until the analog I/O screen is displayed.

The value displayed includes the input value plus any factory hardware calibration value, but does not include scaling information programmed by the user (i.e. Analog In 1 Hi/Lo). The units displayed are determined by the associated configuration bit (Volts or mA)

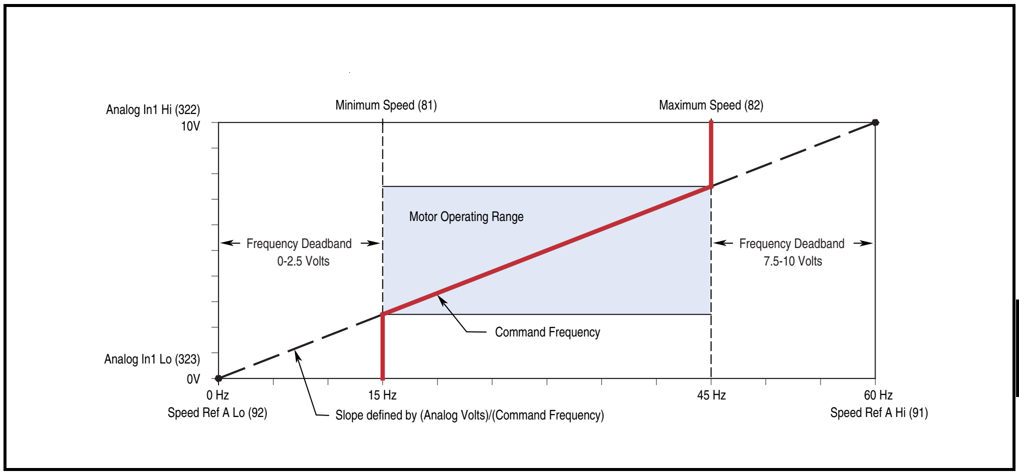
13.19.8 How Analog Inx Hi/Lo & Speed Ref A Hi/Lo Scales the Frequency Command Slope with Minimum/Maximum Speed

Example:

Consider the following setup:

- Anlg In Config (320), bit 0 = "0" (voltage)
- Speed Ref A Sel (90) = "Analog In 1"
- Analog In1 Hi (322) = 10V
- Analog In1 Lo (323) = 0V
- Speed Ref A Hi (91) = 60 Hz
- Speed Ref A Lo (92) = 0 Hz
- Maximum Speed (82) = 45 Hz
- Minimum Speed (81) = 15 Hz

This operation is similar to the 0-10 volts creating a 0-60 Hz signal until the minimum and maximum speeds are added. Minimum Speed (81) and Maximum Speed (82) limits will create a command frequency deadband.



This deadband, as it relates to the analog input, can be calculated as follows:

1. The ratio of analog input volts to frequency (Volts/Hz) needs to be calculated. The voltage span on the analog input is 10 volts. The frequency span is 60 Hz.

   10 Volts/60 Hz = 0.16667 Volts/Hz

2. Determine the frequency span between the Minimum and Maximum Speed limits and Speed Ref A Hi and Lo.

   Speed Ref A Hi (91) – Maximum Speed (82) = 60 – 45 = 15 Hz and . . .
   Minimum Speed (81) – Speed Ref A Lo (92) = 15 – 0 = 15 Hz.

3. Multiply by the Volts/Hertz ratio

   15 Hz x 0.16667 Volts/Hz = 2.5 Volts

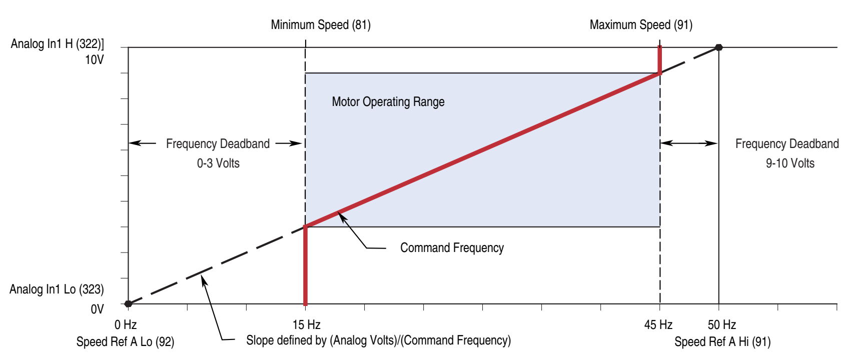
Therefore the command frequency from 0 to 2.5 volts on the analog input will be 15 Hz. After 2.5 volts, the frequency will increase at a rate of 0.16667 volts per hertz to 7.5 volts. After 7.5 volts on the analog input the frequency command will remain at 45 Hertz.

Example 2:

Consider the following setup:

- Anlg In Config (320), bit 0 = “0” (voltage)
- Speed Ref A Sel (90) = “Analog In 1”
- Analog In1 Hi (322) = 10V
- Analog In1 Lo (323) = 0V
- Speed Ref A Hi (91) = 50hz
- Speed Ref A Lo (92) = 0hz
- Maximum Speed (82) = 45hz
- Minimum Speed (81) = 15hz

The only change from Example 1 is the Speed Ref A Hi (91) is changed to 50 Hz.



The deadband, as it relates to the analog input, can be calculated as follows:

1. The ratio of analog input volts to frequency (Volts/Hertz) needs to be calculated. The voltage span on the analog input is 10 volts. The frequency span is 60 Hz.

   10 Volts/50 Hz = 0.2 Volts/Hz

2. Determine the frequency span between the minimum and maximum speed limits and the Speed Ref A Hi and Lo.

   Speed Ref A Hi (91) – Maximum Speed (82) = 50 – 45 = 5 Hz
   and . . .
   Minimum Speed (81) – Speed Ref A Lo (92) = 15 – 0 = 15 Hz

3. Multiply by the volts/hertz ratio

   5 Hz x 0.2 Volts/Hz = 1 Volt
   15 Hz x 0.2 Volts/Hz = 3 Volts

Here, the deadband is “shifted” due to the 50 Hz limitation. The command frequency from 0 to 3 volts on the analog input will be 15 Hz. After 3 volts, the frequency will increase at a rate of 0.2 volts per hertz up to 9 volts. After 9 volts on the analog input the frequency command will remain at 45 Hz.

13.20 Analog Outputs

13.20.1 Explanation

Each GV6000 has two analog outputs that can be used to annunciate a wide variety of drive operating conditions and values.

The user selcts the analog output source by setting Analog Out1 Sel (342) or Analog Out2 Sel (345). See Chapter 11 for a list of potential selections.

13.20.2 Absolute (default)

Certain quantities used to drive the analog output are signed, i.e. the quantity can be both positive and negative. The user has the option of having the absolute value (value without sign) of these quantities taken before the scaling occurs. Absolute value is enabled separately for each analog output via the bitmapped parameter Anlg Out Absolut (341).

Important: Important: If absolute value is enabled but the quantity selected for output is not a signed quantity, then the absolute value operation will have no effect.

13.20.3 Scaling Blocks

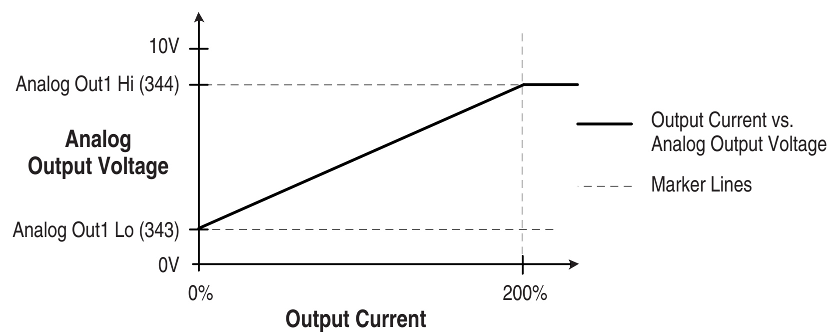
The user defines the scaling for the analog output by entering analog output voltages into two parameters, Analog Outx Lo and Analog Outx Hi. These two output voltages correspond to the bottom and top of the possible range covered by the quantity being output. The output voltage will vary linearly with the quantity being output. The analog output voltage will not go outside the range defined by Analog Outx Lo and Analog Outx Hi.

13.20.4 Analog Output Configuration Examples

This section gives a few examples of valid analog output configurations and describes the behavior of the output in each case.

Example 1 -- Unsigned Output Quantity:

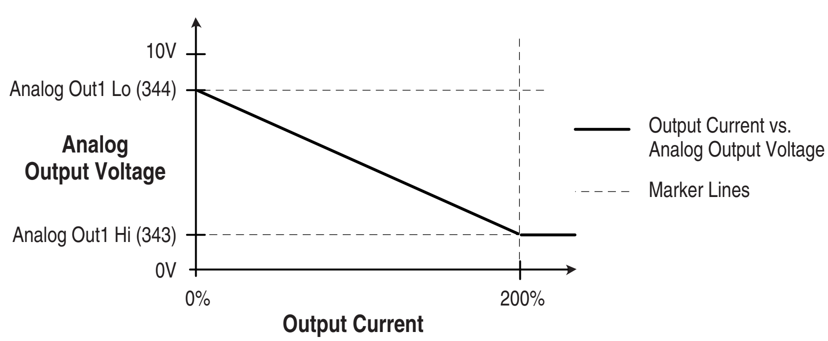
- Analog Out1 Sel (342) = “Output Current”
- Analog Out1 Lo (344) = 1 volt
- Analog Out1 Hi (343) = 9 volts



Note that analog output value never goes outside the range defined by Analog Out1 Lo (344) and Analog Out1 Hi (343). This is true in all cases, including all the following examples.

Example 2 -- Unsigned Output Quantity, Negative Slope:

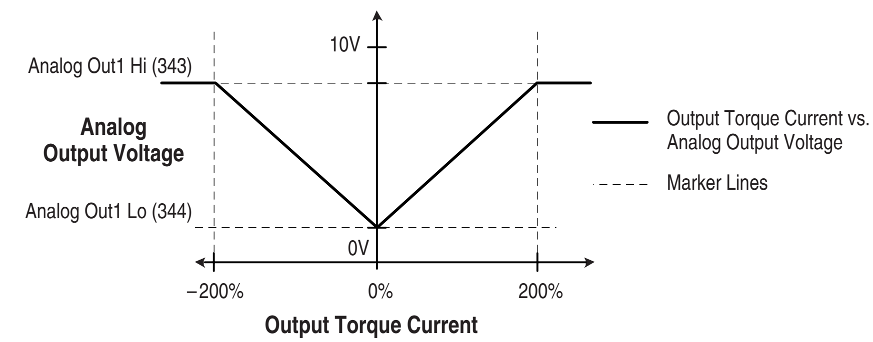
- Analog Out1 Sel (342) = “Output Current”
- Analog Out1 Lo (344) = 9 volts
- Analog Out1 Hi (343) = 1 volts



This example shows that you can have Analog Out1 Lo (344) greater than Analog Out1 Hi (343). The result is a negative slope on the scaling from original quantity to analog output voltage. Negative slope could also be applied to any of the other examples in this section.

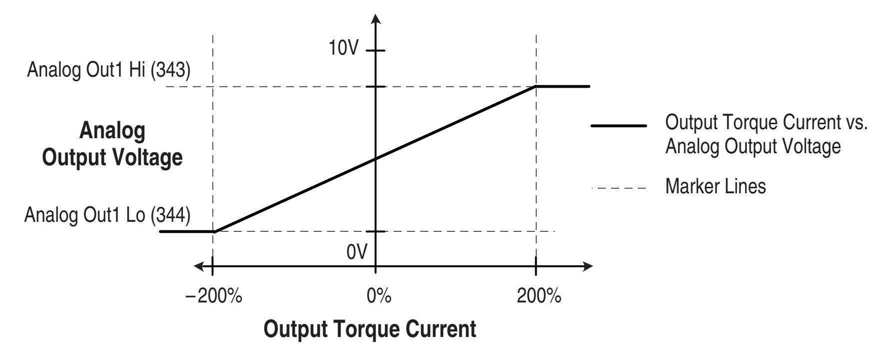
Example 3 – Signed Output Quantity, Absolute Value Enabled:

- Analog Out1 Sel (342) = “Output Torque Current”
- Analog Out1 Lo (342)= 1 volt
- Analog Out1 Hi (344) = 9 volts
- Anlg Out Absolut (343) set so that absolute value is enabled for output 1.



Example 4 – Signed Output Quantity, Absolute Value Disabled:

- Analog Out1 Sel (342) = “Output Torque Current”
- Analog Out1 Lo (344) = 1 volt
- Analog Out1 Hi (343) set to 9 volts
- Anlg Out Absolut (341) set so that absolute value is disabled for output 1.



13.20.5 Filtering

Software filtering will be performed on the analog outputs for certain signal sources, as specified in Table 13-2. “Filter A” is one possible such filter, and it is described later in this section. Any software filtering is in addition to any hardware filtering and sampling delays.

Table 13.2 – Software Filters

Quantity	Filter
Output Frequency	No extra filtering
Commanded Frequency	No extra filtering
Output Current	Filter A
Output Torque Current	Filter A
Output Flux Current	Filter A
Output Power	Filter A
Output Voltage	No extra filtering
DC Bus Voltage	Filter A
PI Reference	No extra filtering
PI Feedback	No extra filtering
PI Error	No extra filtering
PI Output	No extra filtering

Analog output software filters are specified in terms of the time it will take the output of the filter to move from 0% to various higher levels, given an instantaneous step in the filter input from 0% to 100%. The numbers describing filters in this document should be considered approximate; the actual values will depend on implementation.

Filter A is a single pole digital filter with a 162ms time constant. Given a 0% to 100% step input from a steady state, the output of Filter A will take 500ms to get to 95% of maximum, 810 ms to get to 99%, and 910 ms to get to 100%.

13.20.6 Enhancements

Certain analog output enhancements have been included in the GV6000 . These include:

- Ability to scale the analog outputs
- Connect scale blocks to the analog outputs
- Analog Output controlled via Datalink

13.20.6.1 Output Scaling

A new scaling feature has been included to allow scaling. Without this feature, Analog Outx Lo and Analog Outx Hi limited only the voltage. This voltage range was scaled to the selected option range listed in Analog Outx Sel. With this feature, Analog Outx Lo and Analog Outx Hi still set the voltage range, but the scaling parameter now scales the range of the Analog Outx Sel selection. See the following example.

Example

Analog Output 1 set for 0-10V DC at 0-100% Commanded Torque.

Setup

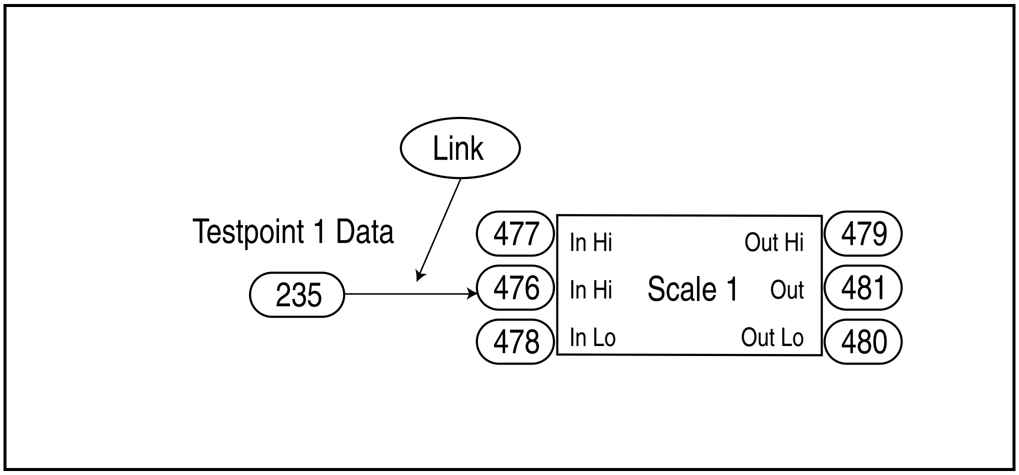
- Analog Out1 Sel (342) = 14 “Commanded Torque”
- Analog Out1 Hi (343) = 10.000 Volts
- Analog Out1 Lo (344) = 0.000 Volts
- Anlg Out1 Scale (354) = 100.0

If Analog Out1 Lo (344) = –10.000 Volts the output will be –10.0 to +10.0V DC for –100% to +100% Commanded Torque.

If Anlg Out1 Scale (354) = 0.0, the default scaling listed in Analog Out1 Sel (342) will be used. This would be 0-1.25V DC for 0-100% Torque or 0-800% for 0-10V DC.

13.20.6.2 Scale Block Analog Output

Selects scaled analog output relative to the Scale Block value. Values not in the Analog OutX Sel parameter list can be used to drive the analog outputs. When using the Scale Block select, the Scale block Out Hi and Out Lo parameters are not used.



Example

Analog Output 2 set for 0-10V DC for Heat Sink Temp 0-100 Degrees C. using Scale Block 1.

Setup

- Link Scale1 In Value (476) to Testpoint 1 Data, (235)
- Testpoint 1 Sel (234) = 2 “Heat Sink Temp”
- Analog Out2 Sel (345) = 20 “Scale Block 1”
- Analog Out2 Hi (346) = 10.000 Volts
- Analog Out2 Lo (347) = 0.000 Volts
- Scale1 In Hi (477) = 100
- Scale1 In Lo (478) = 0

13.20.6.3 Parameter Controlled Analog Output

Enables the analog outputs to be controlled by Datalinks to the drive.

Example

Analog Output 1 controlled by DataLink C1. Output 0-10V DC with DataLink values of 0-10000.

Setup

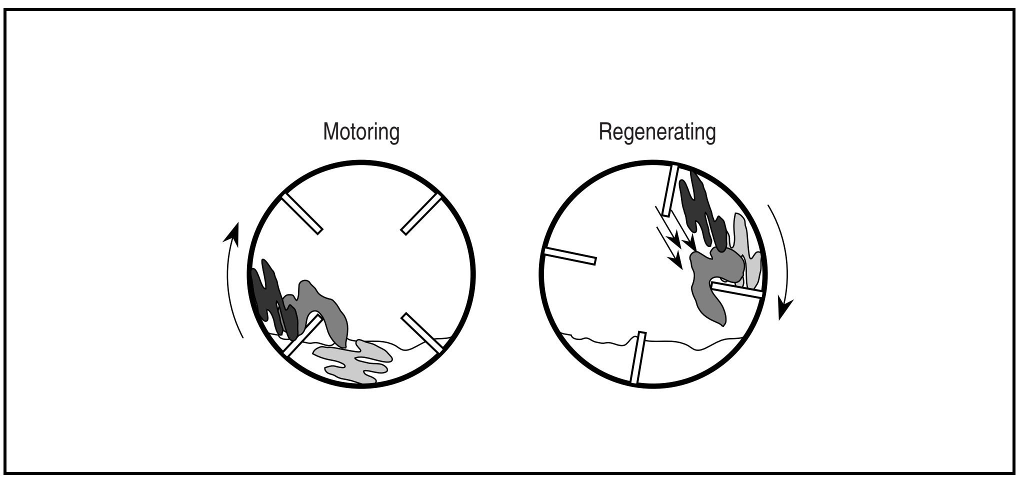
- Data In C1(304) = 377 “Anlg Out1 Setpt”
- Analog Out1 Sel (342) = 24 “Parameter Control”
- Analog Out1 Hi (343) = 10.000 Volts
- Analog Out1 Lo (344) = 0.000 Volts

The device that writes to DataLink C1 now controls the voltage output of Analog Out1. For example: 2500 = 2.5V DC, 5000 = 5.0V DC, 7500 = 7.5V DC.

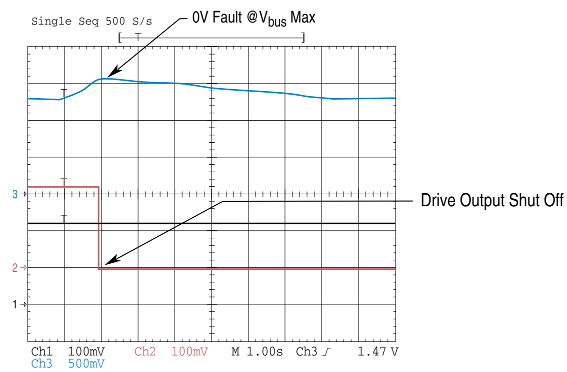
13.21 Bus Regulation

Some applications, such as the hide tanning shown here, create an intermittent regeneration condition. When the hides are being lifted (on the left), motoring current exists. However, when the hides reach the top and fall onto a paddle, the motor regenerates power back to the drive, creating the potential for a nuisance overvoltage trip.

When an AC motor regenerates energy from the load, the drive DC bus voltage increases unless there is another means (dynamic braking chopper/resistor, etc.) of dissipating the energy



Without bus regulation, if the bus voltage exceeds the operating limit established by the power components of the drive, the drive will fault, shutting off the output devices to protect itself from excess voltage.

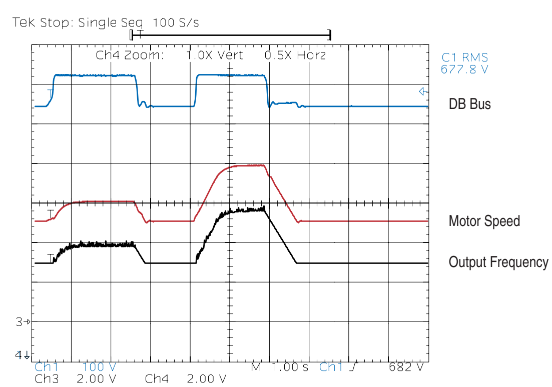


With bus regulation enabled, the drive can respond to the increasing voltage by advancing the output frequency until the regeneration is counteracted. This keeps the bus voltage at a regulated level below the trip point.

Since the same integrator is used for bus regulation as for normal frequency ramp operation, a smooth transition between normal frequency ramp operation and bus regulation is accomplished.

The regulator senses a rapid rise in the bus voltage and activates prior to actually reaching the internal bus voltage regulation set point Vreg. This is important since it minimizes overshoot in the bus voltage when bus regulation begins thereby attempting to avoid an over-voltage fault.

The bus voltage regulation set point (Vreg) in the drive is fixed for each voltage class of drive. The bus voltage regulation set points are identical to the internal dynamic brake regulation set points VDB's.



To avoid over-voltage faults, a bus voltage regulator is incorporated as part of the acceleration/deceleration control. As the bus voltage begins to approach the bus voltage regulation point (Vreg), the bus voltage regulator increases the magnitude of the output frequency and voltage to reduce the bus voltage. The bus voltage regulator function takes precedence over the other two functions. See Figure13-17.

The bus voltage regulator is shown in the lower one-third of Figure 13-17. The inputs to the bus voltage regulator are the bus voltage, the bus voltage regulation set point Vreg, proportional gain, integral gain, and derivative gain. The gains are intended to be internal values and not parameters. These will be test points that are not visible to the user. Bus voltage regulation is selected by the user in the Bus Reg Mode parameter.

13.21.1 Operation

Bus voltage regulation begins when the bus voltage exceeds the bus voltage regulation set point Vreg and the switches shown in Figure 13-17 move to the positions shown in Table 13-2.

Table 13.3 – Switch Positions for Bus Regulator Active

	SW 1	SW 2	SW 3	SW 4	SW 5
Bus Regulation	Limit	Bus Reg	Open	Closed	Don't Care

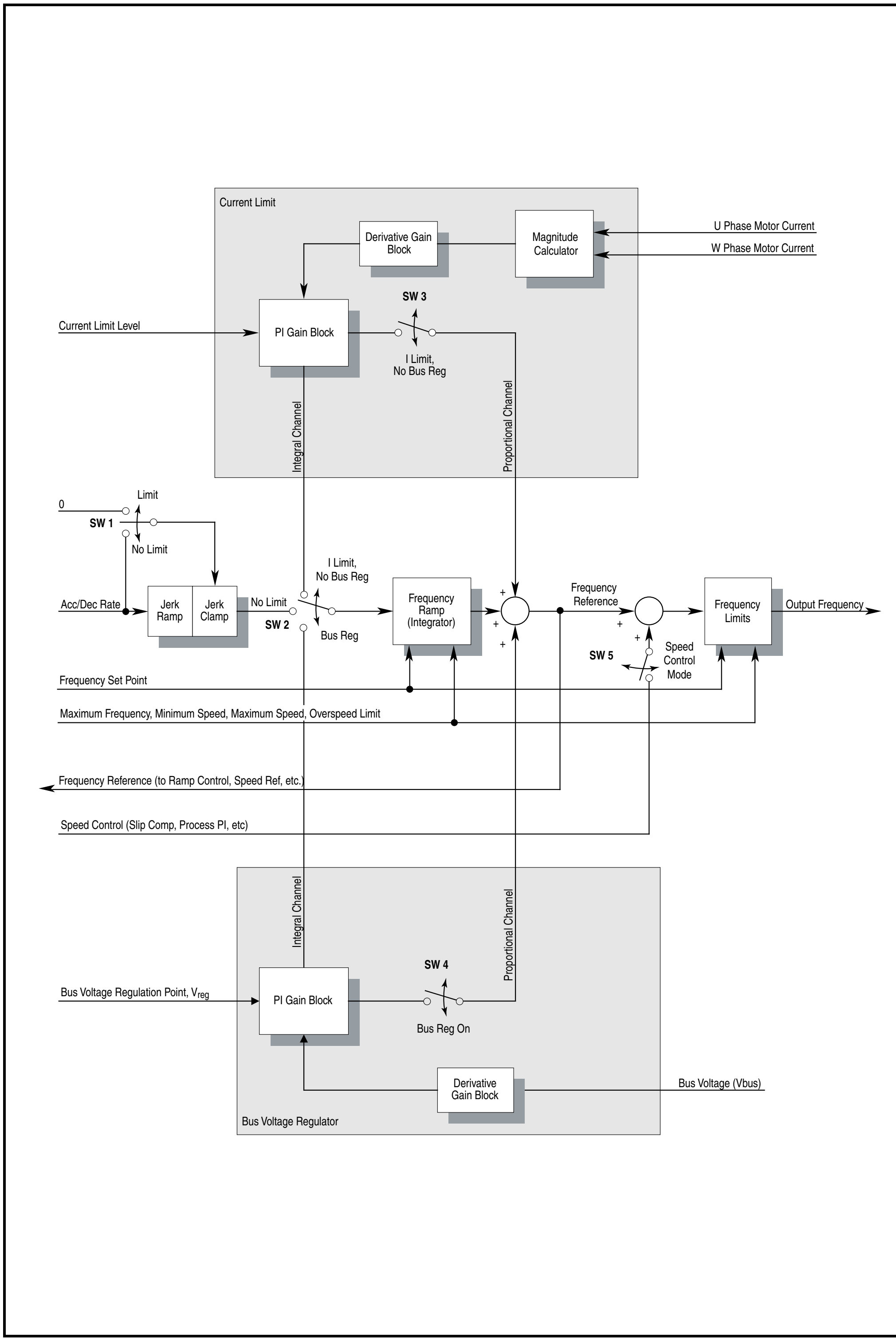


Figure 13.17 – Bus Voltage Regulator, Current Limit and Frequency Ramp

The derivative term senses a rapid rise in the bus voltage and activates the bus regulator prior to actually reaching the bus voltage regulation set point Vreg. The derivative term is important since it minimizes overshoot in the bus voltage when bus regulation begins thereby attempting to avoid an over-voltage fault. The integral channel acts as the acceleration or deceleration rate and is fed to the frequency ramp integrator. The proportional term is added directly to the output of the frequency ramp integrator to form the output frequency. The output frequency is then limited to a maximum output frequency.

Bus voltage regulation is the highest priority of the three components of this controller because minimal drive current will result when limiting the bus voltage and therefore, current limit will not occur.

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.

1. 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).

2. 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: These faults are not instantaneous and have shown test results that take between 2 and 12 seconds to occur.

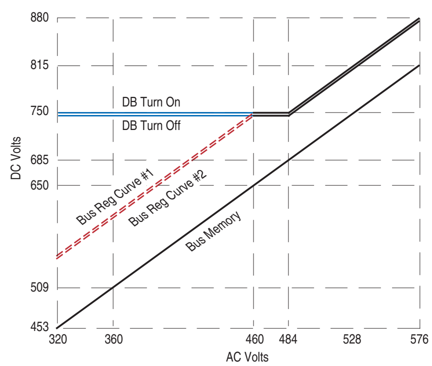
The user selects the bus voltage regulator using the Bus Reg Mode parameters. The available modes include:

- Disabled
- Frequency regulation
- Dynamic braking
- Dynamic braking as the primary regulation means with frequency regulation as a secondary means
- Frequency regulation as the primary regulation means with dynamic braking as a secondary means

The bus voltage regulation setpoint is determined off of bus memory (a means to average DC bus over a period of time). The following graph and tables describe the operation.

Table 13.4 – Bus Voltage Regulation Setpoint Determination 1

Voltage Class	DC Bus Memory	DB on Setpoint	DB Off Setpoint
240	<342 VDC	375 VDC	On -4 VDC
	>342 VDC	Memory +33 VDC	
480	<685 VDC	750 VDC	On -8 VDC
	>685 VDC	Memory +65 VDC	
600	<856 VDC	937 VDC	On -10 VDC
	>856 VDC	Memory +81 VDC	
600/690V Frames 5 and 6 only	<983 VDC	1076 VDC	On -11 VDC



If Bus Reg Mode A (161) is set to “Dynamic Brak”

The Dynamic Brake Regulator is enabled. In “Dynamic Brak” mode the Bus Voltage Regulator is turned off. The “DB Turn On” and turn off curves apply (Table 13-5). For example, with a DC Bus Memory at 684V DC, the Dynamic Brake Regulator will turn on at 750V DC and turn back off at 742V DC.

If Bus Reg Mode A (161) is set to “Both-Frq 1st”

Both regulators are enabled, and the operating point of the Bus Voltage Regulator is lower than that of the Dynamic Brake Regulator. The Bus Voltage Regulator setpoint follows the “Bus Reg Curve 2” below a DC Bus Memory of 650V DC and follows the “DB Turn Off” curve above a DC Bus Memory of 650V DC (Table 13-5). The Dynamic Brake Regulator follows the “DB Turn On” and turn off curves (Table 13-5). For example, with a DC Bus Memory at 684V DC, the Bus Voltage Regulator setpoint is 742V DC and the Dynamic Brake Regulator will turn on at 750V DC and back off at 742V DC.

If Bus Reg Mode A (161) is set to “Adjust Freq”

The Bus Voltage Regulator is enabled. The Bus Voltage Regulator setpoint follows “Bus Reg Curve 1” below a DC Bus Memory of 650V DC and follows the “DB Turn On” above a DC Bus Memory of 650V DC (Table 13-5). For example, with a DC Bus Memory at 684V DC, the adjust frequency setpoint is 750V DC.

If Bus Reg Mode A (161) is set to “Both-DB 1st”

Both regulators are enabled, and the operating point of the Dynamic Brake Regulator is lower than that of the Bus Voltage Regulator. The Bus Voltage Regulator setpoint follows the “DB Turn On” curve (Table 13-5). The Dynamic Brake Regulator follows the “DB Turn On” and turn off curves (Table 13-5). For example, with a DC Bus Memory at 684V DC, the Bus Voltage Regulator setpoint is 750V DC and the Dynamic Brake Regulator will turn on at 750V DC and back off at 742V DC

Table 13.5 – Bus Voltage Regulation Setpoint Determination 2

Voltage Class	DC Bus Memory	Bus Reg Curve #1	Bus Reg Curve #2
240	<325 VDC	Memory +50 VDC	Curve 1-4 VDC
	325V DC ≤ DC Bus Memory ≤ 342V DC	375 VDC	
	>342 VDC	Memory +33 VDC	
480	<650 VDC	Memory +100 VDC	Curve 1-8 VDC
	650V DC ≤ DC Bus Memory ≤ 685V DC	750 VDC	
	>685 VDC	Memory +65 VDC	
600	<813 VDC	Memory +125 VDC	Curve 1-10 VDC
	813V DC ≤ DC Bus Memory ≤ 856V DC	937 VDC	
	>856 VDC	Memory +81 VDC	
600/690V Frames 5 and 6 only	<933 VDC	Memory +143 VDC	Curve 1-11 VDC
	933V DC ≤ DC Bus Memory ≤ 983V DC	1076 VDC	
	>983 VDC	Memory +93 VDC	

13.22 Current Limit

There are 6 ways that the drive can protect itself from overcurrent or overload situations:

- Instantaneous Overcurrent trip
- Software Instantaneous Trip
- Software Current Limit
- Overload Protection IT
- Heatsink temperature protection

- Thermal Manager

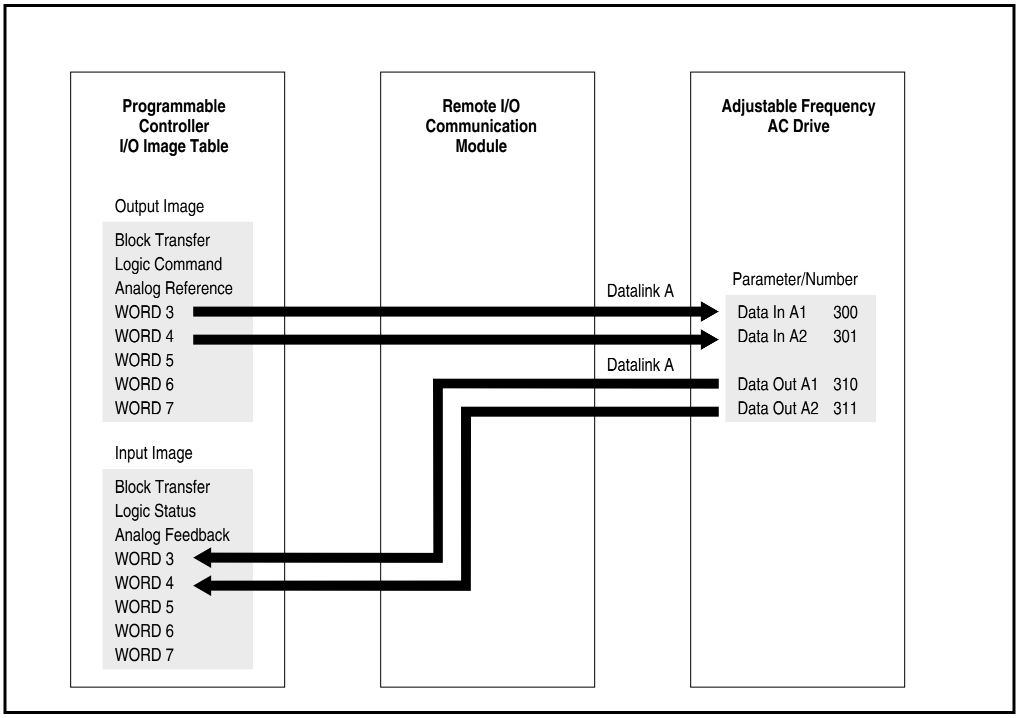
1. Instantaneous Overcurrent - This is a feature that instantaneously trips or faults the drive if the output current exceeds this value. The value is fixed by hardware and is typically 250% of drive rated amps. The Fault code for this feature is F12 “HW Overcurrent.” This feature cannot be defeated or mitigated.
2. Software Instantaneous Trip - There could be situations where peak currents do not reach the F12 “HW Overcurrent” value and are sustained long enough and high enough to damage certain drive components. If this situation occurs, the drives protection scheme will cause an F36 “SW Overcurrent” fault. The point at which this fault occurs is fixed and stored in drive memory.
3. Software Current Limit - This is a software feature that selectively faults the drive or attempts to reduce current by folding back output voltage and frequency if the output current exceeds this value. The Current Lmt Val (148) parameter is programmable between approximately 25% and 150% of drive rating. The reaction to exceeding this value is programmable with [Shear Pin Fault]. Enabling this parameter creates an F63 “Shear Pin Fault.” Disabling this parameter causes the drive to use Volts/Hz fold back to try and reduce load. The frequency adjust or fold back operation consists of two modes. In the primary mode of current limit operation, motor phase current is sampled and compared to the Current Limit setting in the Current Lmt Val (148). If a current “error” exists, error is scaled by an integral gain and fed to the integrator. The output of this integrator is summed with the proportional term and the active speed mode component to adjust the output frequency and the commanded voltage. The second mode of current limit operation is invoked when a frequency limit has been reached and current limit continues to be active. At this point, a current regulator is activated to adjust the output voltage to limit the current. When the current limit condition ceases or the output voltage of the current regulator attempts to exceed the open loop voltage commands, control is transferred to the primary current limit mode or normal ramp operation.
4. Overload Protection I^2T - This is a software feature that monitors the output current over time and integrates per IT. The base protection is 110% for 1 minute or the equivalent I^2T value (i.e. 150% for 3 seconds, etc.). If the IT integrates to maximum, an F64 “Drive Overload” fault will occur. The approximate integrated value can be monitored via the Drive OL Count (219) parameter.
5. Heatsink Temperature Protection - The drive constantly monitors the heatsink temperature. If the temperature exceeds the drive maximum, a “Heatsink OvrTemp” fault will occur. The value is fixed by hardware at a nominal value of 100 degrees C. This fault is generally not used for overcurrent protection due to the thermal time constant of the heatsink. It is an overload protection.
6. Thermal manager (see Drive Overload in Section 13.25).

13.23 Datalinks

A Datalink is one of the mechanisms used by GV6000 drives to transfer data to and from a programmable controller. Datalinks allow a parameter value to be changed without using an Explicit Message or Block Transfer. Datalinks consist of a pair of parameters that can be used independently for 16 bit transfers or in conjunction for 32 bit transfers. Because each Datalink consists of a pair of parameters, when enabled, each Datalink occupies two 16 or 32-bit words in both the input and output image tables, depending on configuration. A user enters a parameter number into the Datalink parameter. The value that is in the corresponding output data table word in the controller is then transferred to the parameter whose number has been placed in the Datalink parameter. The following example demonstrates this concept. The object of the example is to change Accel and Decel times “on the fly” under PLC control.

The user makes the following GV6000 drive parameter settings:
Data In A1(300) = 140 (the parameter number of Accel Time 1(140))

Data In A2 (301) = 142 (the parameter number of Decel Time 1 (142))



In the PLC data Table, the user enters Word 3 as a value of 100 (10.0 Secs) and word 4 as a value of 133 (13.3 seconds). On each I/O scan, the parameters in the GV6000 drive are updated with the value from the data table:

Accel Time1 (140) = 10.0 seconds (value from output image table Word 3)

Decel Time1 (142) = 13.3 seconds (value from output image table Word 4).

Any time these values need to be changed, the new values are entered into the data table, and the parameters are updated on the next PLC I/O scan.

13.23.1 Rules for Using Datalinks

1. 1. A Datalink consists of 4 words, 2 for Datalink x IN and 2 for Datalink x Out. They cannot be separated or turned on individually.
2. Parameter settings in the drive determine the data passed through the Datalink mechanism
3. When you use a Datalink to change a value, the value is not written to the Non-Volatile Storage (EEprom memory). The value is stored in volatile memory

(RAM) and lost when the drive loses power.

13.23.2 32-Bit Parameters using 16-Bit Datalinks

To read (and/or write) a 32-bit parameter using 16-bit Datalinks, typically both Datalinks (A,B,C,D) are set to the 32-bit parameter. For example, to read Elapsed MWh (09), both Datalink A1 and A2 are set to "9." Datalink A1 will contain the least significant word (LSW) and Datalink A2 the most significant word (MSW). In this example, the parameter 9 value of 5.8MWh is read as a "58" in Datalink A1

Datalink	Most/Least Significant Word	Parameter	Data (decimal)
A1	LSW	9	58
A2	MSW	9	0

Regardless of the Datalink combination, x1 will always contain the LSW and x2 will always contain the MSW.

In the following examples Power Up Marker (242) contains a value of 88.4541 hours.

Datalink	Most/Least Significant Word	Parameter	Data (decimal)
A1	LSW	242	32573
A2	-Not Used-	0	0

Datalink	Most/Least Significant Word	Parameter	Data (decimal)
A1	-Not Used-	0	0
A2	MSW	242	13

Even if non-consecutive Datalinks are used (in the next example, Datalinks A1 and B2 would not be used), data is still returned the same way.

Datalink	Most/Least Significant Word	Parameter	Data (decimal)
A1	MSW	242	13
B1	LSW	242	32573

32-bit data is stored as follows

MSW	2^{31} through 2^{16}
LSW	2^{15} through 2^{0}

13.23.3 Example

Parameter 242 - [Power Up Marker] = 88.4541 hours
MSW = $13_{decimal} = 1101_{binary} = 2^{16} + 2^{18} + 2^{19} = 851968$
LSW = 32573
851968 + 32573 = 884541

13.24 DC Bus Voltage/Memory

DC Bus Voltage (12) is a measurement of the instantaneous value. DC Bus Memory (13) is a heavily filtered value or “nominal” bus voltage. Just after the pre-charge relay is closed during initial power-up bus pre-charge, bus memory is set equal to bus voltage. Thereafter it is updated by ramping at a very slow rate toward Vbus. The filtered value ramps at approximately 2.4V DC per minute (for a 480V AC drive).

Bus memory is used as the base line to sense a power loss condition. If the drive enters a power loss state, the bus memory will also be used for recovery (i.e. pre-charge control or inertia ride through upon return of the power source) upon return of the power source. Update of the bus memory is blocked during deceleration to prevent a false high value caused by a regenerative condition.

13.25 Drive Overload

The drive thermal overload has two primary functions. The first requirement is to make sure the drive is not damaged by abuse. The second is to perform the first in a manner that does not degrade the performance, as long the drive temperature and current ratings are not exceeded.

The purpose of the drive overload feature is to protect the power structure from abuse. Any protection for the motor and associated wiring is provided by a Motor Thermal Overload feature.

The drive will monitor 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 will generate 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.

13.25.1 Operation

The drive thermal overload has two separate protection schemes, an overall RMS protection based on current over time, and an IGBT junction thermal manager based on measured power module temperature and operating conditions. The drive may fold back current limit when either of these methods detects a problem.

13.25.2 Overall RMS Protection

The overall RMS protection makes sure the current ratings of the drive are not exceeded. The lower curve in Figure 13-18 shows the boundary of normal-duty operation. In normal duty, the drive is rated to produce 110% of rated current for 60 seconds, 150% of rated current for three seconds, and 165% of rated current for 100 milliseconds. The maximum value for current limit is 150% so the limit of 165% for 100 milliseconds should never be crossed. If the load on the drive exceeds the level of current as shown on the upper curve, current limit may fold back to 100% of the drive rating until the 10/90 or 5/95 duty cycle has been achieved. For example, 60 seconds at 110% will be followed by 9 minutes at 100%, and 3 seconds at 150% will be followed by 57 seconds at 100%. With the threshold for where to take action slightly above the rated level the drive will only fold back when drive ratings are exceeded.

If fold back of current limit is not enabled in Drive OL Mode (150), the drive will generate a fault when operation exceeds the rated levels. This fault can not be disabled. If current limit fold back is enabled then a fault is generated when current limit is reduced.

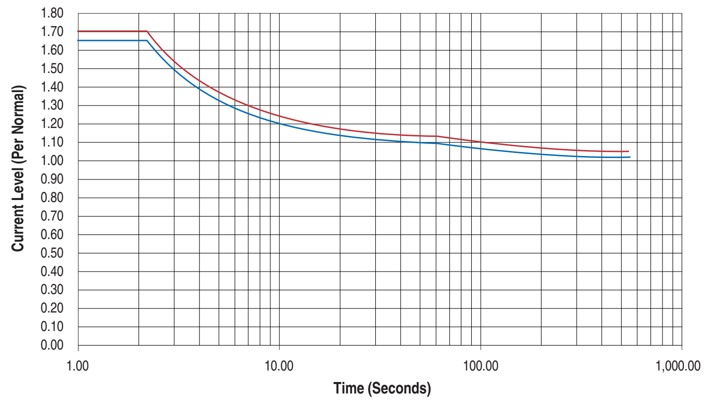


Figure 13.18 – Normal Duty Boundary of Operation

The lower curve in Figure 13-19 shows the boundary of heavy duty operation. In heavy duty, the drive is rated to produce 150% of rated current for 60 seconds, 200% for three seconds, and 220% for 100 milliseconds. The maximum value for current limit is 200% so the limit of 220% for 100 milliseconds should never be crossed. If the load on the drive exceeds the level of current as shown on the upper curve, current limit may fold back to 100% of the drive rating until the 10/90 or 5/95 duty cycle has been achieved. For example, 60 seconds at 150% will be followed by 9 minutes at 100%, and 3 seconds at 200% will be followed by 57 seconds at 100%. With the threshold for where to take action slightly above the rated level the drive will only fold back when drive ratings are exceeded.

Again, if fold back of current limit is not enabled in the Drive OL Mode (150), the drive will generate a fault when operation exceeds the rated levels. This fault can not be disabled. If current limit fold back is enabled then a fault is generated when current limit is reduced.

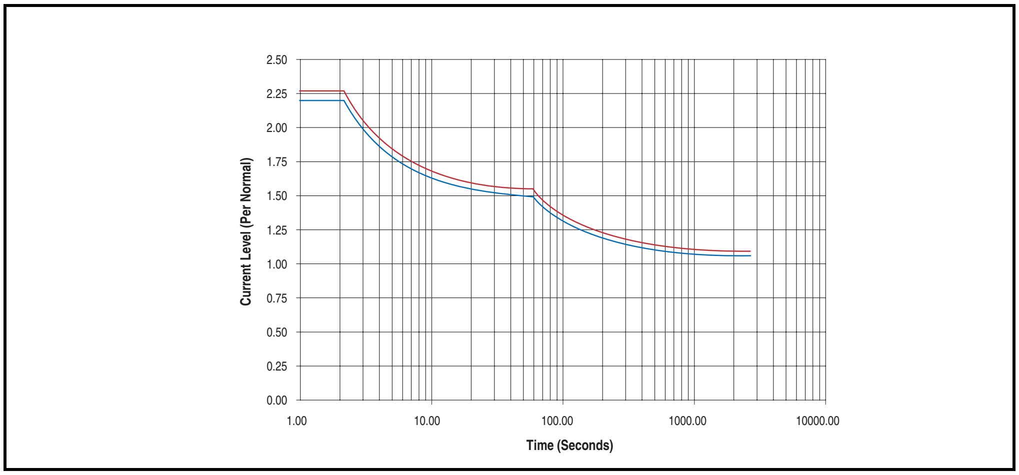


Figure 13.19 – Heavy Duty Boundary of Operation

13.25.3 Thermal Manager Protection

The thermal manager protection assures that the thermal ratings of the power module are not exceeded. The operation of the thermal manager can be thought of as a function block with the inputs and outputs as shown below.

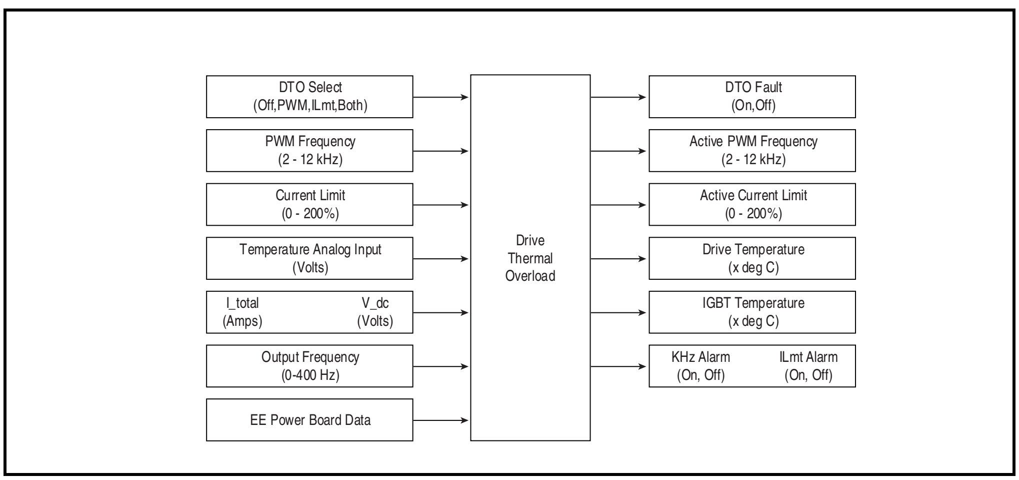


Figure 13.20 – Thermal Manager Inputs/Outputs

The following is a generalization of the calculations done by the thermal manager. The IGBT junction temperature T_J is calculated based on the measured drive temperature T_{Drive}, and a temperature rise that is a function of operating conditions. When the calculated junction temperature reaches a maximum limit the drive will generate a fault. This fault can not be disabled. This maximum junction temperature is stored in EE on the power board along with other information to define the operation of the drive thermal overload function. These values are not user adjustable. In addition to the maximum junction temperature there are thresholds that select the point at which the

PWM frequency begins to fold back, and the point at which current limit begins to fold back. As T_J increases the thermal manager may reduce the PWM frequency. If T_J continues to rise current limit may be reduced, and if T_J continues to rise the drive generates a fault. The calculation of the reduced PWM frequency and current limit is implemented with an integral control.

13.25.4PWM Frequency

PWM Frequency as selected by the user can be reduced by the thermal manager. The resulting Active PWM Frequency may be displayed in a test point parameter.

The active PWM frequency will change in steps of 2 kHz. It will always be less than or equal to the value selected by the user, and will not be less than the drives minimum PWM frequency. When drive temperature reaches the level where PWM frequency would be limited, the *Drv OL Lvl 1* Alarm is turned on. This alarm will be annunciated even if the reduced PWM frequency is not enabled.

13.25.5 Current Limit

Current Limit as selected by the user can be reduced by the thermal manager. The resulting active current limit may be displayed as a test point parameter.

The active current limit will always be less than or equal to the value selected by the user, and will not be less than flux current. When drive temperature reaches the level where current limit would be clamped, the *Drv OL Lvl 2* Alarm is turned on. This alarm will be annunciated even if reduced current limit is not enabled.

The active current limit is used during normal operation and during DC injection braking. Any level of current requested for DC injection braking is limited by the Active Current Limit.

13.25.6 Configuration

The Drive OL Mode (150) allows the user to select the action(s) to perform with increased current or drive temperature. When this parameter is “Disabled,” the drive will not modify the PWM frequency or current limit. When set to “Reduce PWM” the drive will only modify the PWM frequency. “Reduce CLim” will only modify the current limit. Setting this parameter to “Both-PWM 1st” the drive will modify the PWM frequency and the current limit.

13.25.7 DTO Fault

For all possible settings of Drive OL Mode (150), the drive will always monitor the T_j and T_{Drive} and generate a fault when either temperature becomes critical. If T_{Drive} is less than –20° C, a fault is generated. With these provisions, a DTO fault is generated if the NTC ever malfunctions.

13.25.8 Temperature Display

The Drive's temperature is measured (NTC in the IGBT module) and displayed as a percentage of drive thermal capacity in Drive Temp (218). This parameter is normalized to the thermal capacity of the drive (frame dependent) and displays thermal usage in % of maximum (100% = drive Trip). A test point, "Heatsink temperature" is available to read temperature directly in degrees C, but cannot be related to the trip point since "maximums" are only given in %. The IGBT temperature shown in Figure 13-20 is used only for internal development and is not provided to the user.

13.25.9 Low Speed Operation

When operation is below 4 Hz, the duty cycle is such that a given IGBT will carry more of the load for a while and more heat will build up in that device. The thermal manager will increase the calculated IGBT temperature at low output frequencies and will cause corrective action to take place sooner.

When the drive is in current limit the output frequency is reduced to try to reduce the load. This works fine for a variable torque load, but for a constant torque load reducing the output frequency does not lower the current (load). Lowering current limit on a CT load will push the drive down to a region where the thermal issue becomes worse. In this situation the thermal manager will increase the calculated losses in the power module to track the worst case IGBT. For example, if the thermal manager normally provides 150% for 3 seconds at high speeds, it may only provide 150% for one second before generating a fault at low speeds.

If operating at 60Hz 120%, lowering the current limit may cause a fault sooner than allowing the drive to continue to operate. In this case the user may want to disable current limit fold back.

13.26 Droop

FV Droop is used to "shed" load and is usually used when a soft coupling of two motors is present in an application. The master drive speed regulates and the follower uses droop so it does not "fight" the master. The input to the droop block is the commanded motor torque. The output of the droop block reduces the speed reference. Droop RPM @ FLA (152) sets the amount of speed, in RPM, that the speed reference is reduced when at full load torque. For example, when Droop RPM @ FLA (152) is set to 50 RPM and the drive is running at 100% rated motor torque, the droop block would subtract 50 RPM from the speed reference.

13.27 Flux Braking

FV You can use flux braking to stop the drive or to shorten the deceleration time to a lower speed. Other methods of deceleration or stopping may perform better depending on the motor and the load.

To enable flux braking:

1. Bus Reg Mode A, B (161, 162) must be set to "1" Adjust Freq to enable the bus regulator.
2. Flux Braking (166) must be set to 1 "Enabled".

When enabled, flux braking automatically increases the motor flux resulting in an increase of motor losses. The flux current is only increased when the bus voltage regulator is active. When the bus voltage regulator is not active, the flux current is returned to normal. The maximum flux current is equal to rated motor current but may be further reduced depending on the load level, IT protection, or current limits. In general, the flux current is not increased when the motor is at or above rated speed. At higher speeds, field weakening is active and the motor flux current cannot be increased. As the speed decreases below base speed, the flux current increases until there is enough voltage margin to run rated motor current.

Because flux braking increases motor losses, the duty cycle used with this method must be limited. Check with the motor vendor for flux braking or DC braking application guidelines. You may also want to consider using external motor thermal protection.

13.28 Flux Up

AC induction motors require flux to be established before controlled torque can be developed. To build flux in these motors, voltage is applied to them. GV6000 drives have two methods to flux the motor.

The first method is a normal start. During a normal start, flux is established as the output voltage and frequency are applied to the motor. While the flux is being built, the unpredictable nature of the developed torque may cause the rotor to oscillate even though acceleration of the load may occur. In the motor, the acceleration profile may not follow the commanded acceleration profile due to the lack of developed torque.

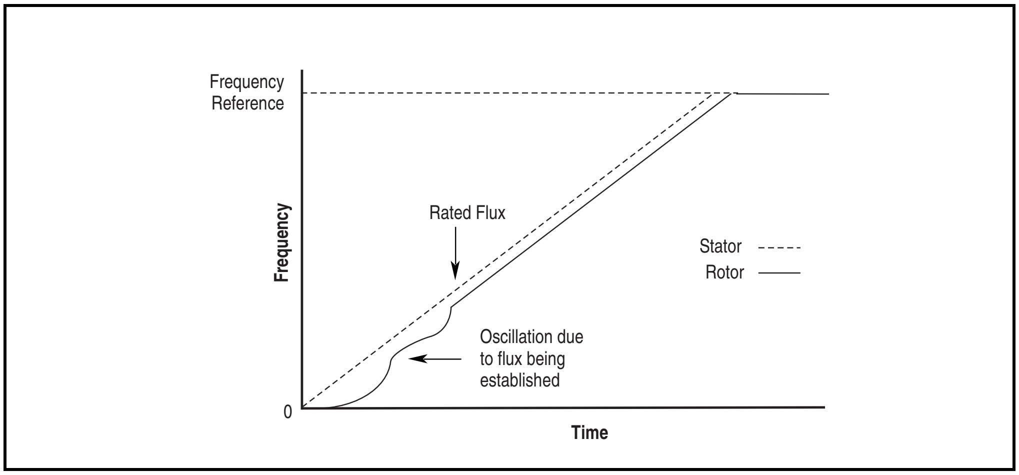


Figure 13.21 – Accel Profile during Normal Start -- No Flux Up

The second method is Flux Up Mode. In this mode, DC current is applied to the motor at a level equal to the lesser of the current limit setting, drive rated current, and drive DC current rating. The flux up time period is based on the level of flux up current and the rotor time constant of the motor.

The flux up current is not user adjustable.

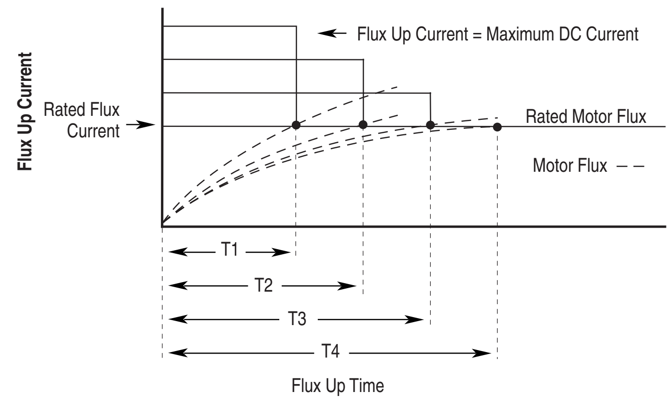


Figure 13.22 – Flux Up versus Flux Up Time

Flux Up Time (58)

Once rated flux is reached in the motor, normal operation begins and the desired acceleration profile is achieved.

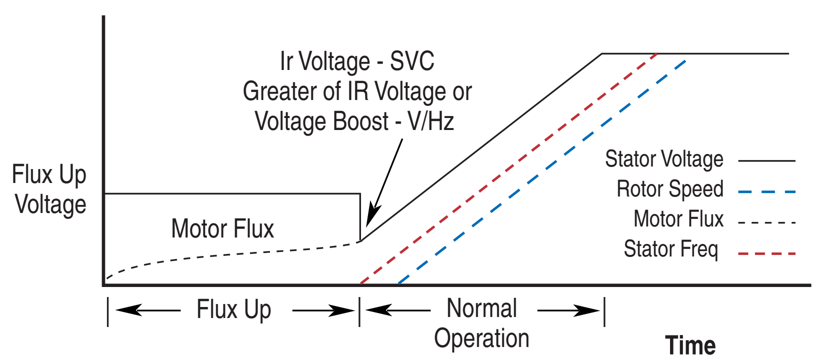


Figure 13.23 – Rated Flux Reached

13.29 Flying Start

The Flying Start feature is used to start into a rotating motor, as quick as possible, and resume normal operation with a minimal impact on load or speed.

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 in this mode with the motor already spinning, large currents will be generated. An overcurrent trip may result if the current limiter cannot react quickly enough. The likelihood of an overcurrent trip is further increased if there is a residual flux (back emf) on the spinning motor when the drive starts. Even if the current limiter is fast enough to prevent an overcurrent trip, it will take an unacceptable amount of time for synchronization to occur and for the motor to reach its desired frequency. In addition, larger mechanical stress is placed on the application, increasing downtime and repair costs while decreasing productivity.

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 back emf of the spinning motor. The motor will then accelerate to the desired frequency. This process 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.

13.29.1 Configuration

Flying Start is activated by setting the Flying Start En (169) parameter to "Enable."

The gain can be adjusted to increase responsiveness. Increasing the value in Flying StartGain (170) increases the responsiveness of the Flying Start Feature.

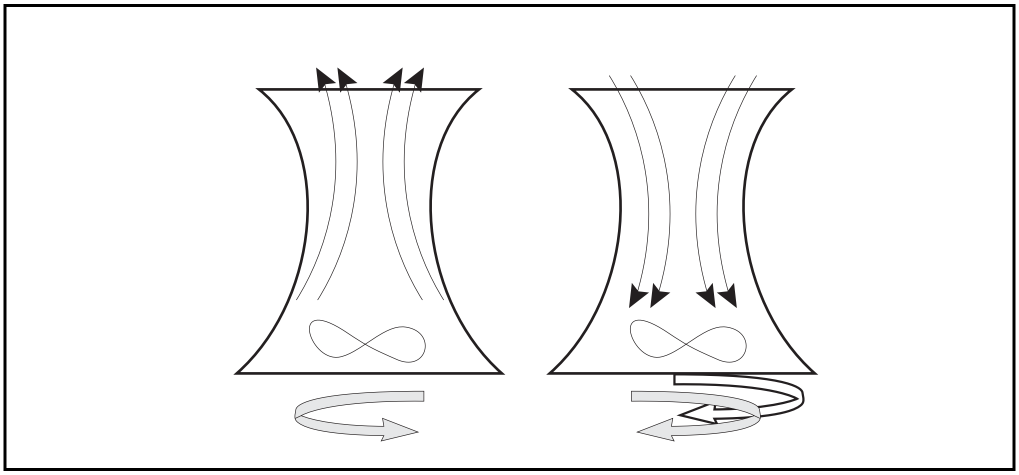
13.29.2 Application Example

In some applications, such as large fans, wind or drafts may rotate the fan in the reverse direction when the drive is stopped. If the drive were started in the normal manner, its output would begin at zero Hz, acting as a brake to bring the reverse rotating fan to a stop and then accelerating it in the correct direction.

This operation can be very hard on the mechanics of the system including fans, belts and other coupling devices.

13.29.2.1 Cooling Tower Fans

Draft/wind blows idle fans in reverse direction. Restart at zero damages fans, breaks belts. Flying start alleviates the problem



13.30 Linking Parameters

Most parameter values are entered directly by the user. However, certain parameters can be “linked,” so the value of one parameter becomes the value of another. For Example: the value of an analog input can be linked to [Accel Time 2]. Rather than entering an acceleration time directly (via HIM), the link allows the value to change by varying the analog signal. This can provide additional flexibility for advanced applications.

Each link has 2 components:

- Source parameter – sender of information.
- Destination parameter – receiver of information.

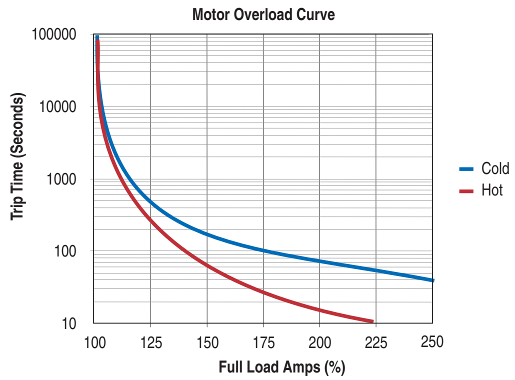
Most parameters can be a source of data for a link, except parameter values that contain an integer representing an ENUM (text choice). These are not allowed, since the integer is not actual data (it represents a value). Table 13-6 lists the parameters that can be destinations. All links must be established between equal data types (parameter value formatted in floating point can only source data to a destination parameter value that is also floating point).

Establishing A Link

1. Select a valid destination parameter (see Table 13-6) to be linked. The parameter value screen will appear.
2. Press SEL to highlight the LIMITS tab.
3. Press ENTER, and the cursor will move to the SOURCE line.
4. Press UP/DOWN arrows to select the source parameter.

13.31 Motor Overload

The motor thermal overload uses an Inverse Time (IT) algorithm to model the temperature of the motor. The curve is modeled after a Class 10 protection thermal overload relay that produces a theoretical trip at 600% motor current in ten (10) seconds and continuously operates at full motor current.



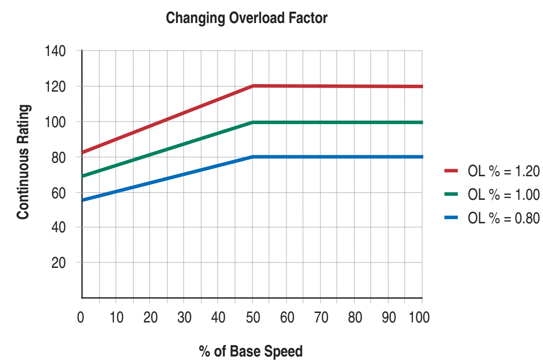
Motor nameplate FLA programming is used to set the overload feature. This parameter, which is set in the start up procedure, is adjustable from 0 - 200% of drive rating and should be set for the actual motor FLA rating.

Setting the correct bit in Fault Config x to zero disables the motor thermal overload. Most multimotor applications (using one drive and more than one motor) will require the MTO to be disabled since the drive would be unable to distinguish each individual motor's current and provide protection.

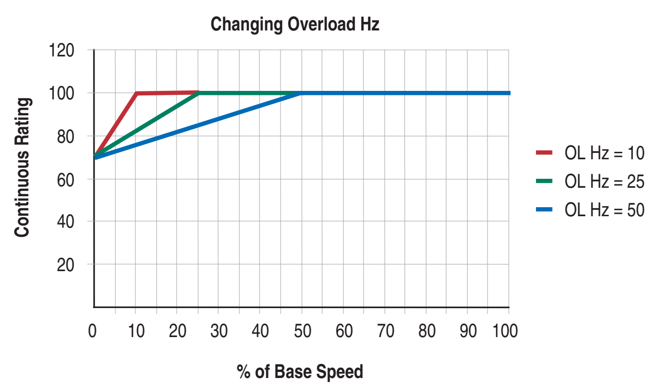
Operation of the overload is based on three parameters; Motor NP FLA (42), Motor OL Factor (48) and Motor OL Hertz (47).

1. Motor NP FLA (42) is the base value for motor protection.
2. Motor OL Factor (48) is used to adjust for the service factor of the motor. Within the drive, motor nameplate FLA is multiplied by motor overload factor to select the rated current for the motor thermal overload. This can be used to raise or lower the level of current that will cause the motor thermal overload to trip without the need to adjust the motor FLA. For example, if motor nameplate FLA is 10 Amps and motor

overload factor is 1.2, then motor thermal overload will use 12 Amps as 100%.

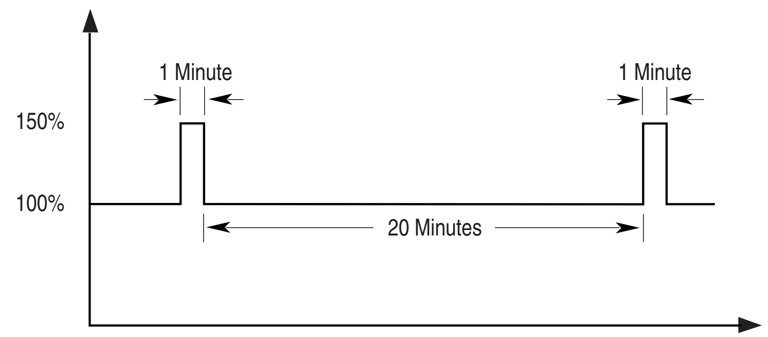


3. Motor OL Hertz (47) is used to further protect motors with limited speed ranges. Since some motors may not have sufficient cooling ability at lower speeds, the Overload feature can be programmed to increase protection in the lower speed areas. This parameter defines the frequency where derating the motor overload capacity should begin. As shown here, the motor overload capacity is reduced when operating below the motor overload Hz. For all settings of overload Hz other than zero, the overload capacity is reduced to 70% when output frequency is zero. During DC injection the motor current may exceed 70% of FLA, but this will cause the Motor Thermal Overload to trip sooner than when operating at base speed. At low frequencies, the limiting factor may be the Drive Thermal Overload.



13.31.1 Duty Cycle for the Motor Thermal Overload

When the motor is cold motor thermal overload will allow 3 minutes at 150%. When the motor is hot motor thermal overload will allow 1 minute at 150%. A continuous load of 102% will not trip. The duty cycle of the motor thermal overload is defined as follows. If operating continuous at 100% FLA, and the load increases to 150% FLA for 59 seconds and then returns to 100%FLA, the load must remain at 100% FLA for 20 minutes to reach steady state.



The ratio of 1:20 is the same for all durations of 150%. When operating continuous at 100%, if the load increases to 150% for 1 second the load must then return to 100% for 20 seconds before another step to 150%

FLA%	Cold Trip Time	Hot Trip Time		FLA%	Cold Trip Time	Hot Trip Time		FLA%	Cold Trip Time	Hot Trip Time
105	6320	5995		155	160	50		205	66	14
110	1794	1500		160	142	42		210	62	12
115	934	667		165	128	36		215	58	11
120	619	375		170	115	31		220	54	10
125	456	240		175	105	27		225	51	10
130	357	167		180	96	23		230	48	9
135	291	122		185	88	21		235	46	8
140	244	94		190	82	19		240	44	8
145	209	74		195	76	17		245	41	7
150	180	60		200	70	15		250	39	7

13.32 Notch Filter

FV The GV6000 has a notch filter in the torque reference loop used to eliminate mechanical resonance created by a gear train. Notch Filter Freq (419) sets the center frequency for the 2 pole notch filter, and Notch Filter K (420) sets the gain.

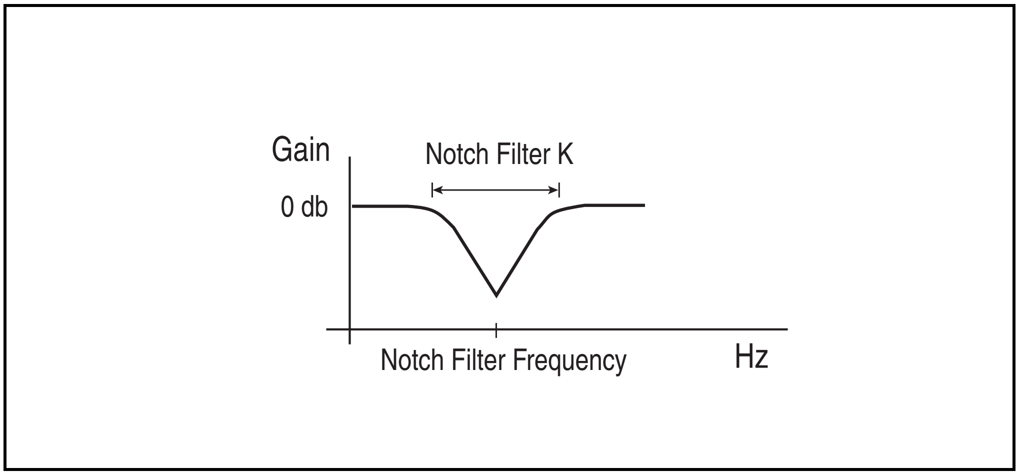


Figure 13.24 – Notch Filter Frequency

Due to the fact that most mechanical frequencies are described in Hertz, Notch Filter Freq (419) and Notch Filter K (420) are in Hertz as well. The following is an example of a notch filter.

A mechanical gear train consists of two masses (the motor and the load) and spring (mechanical coupling between the two loads). See Figure 13-25.

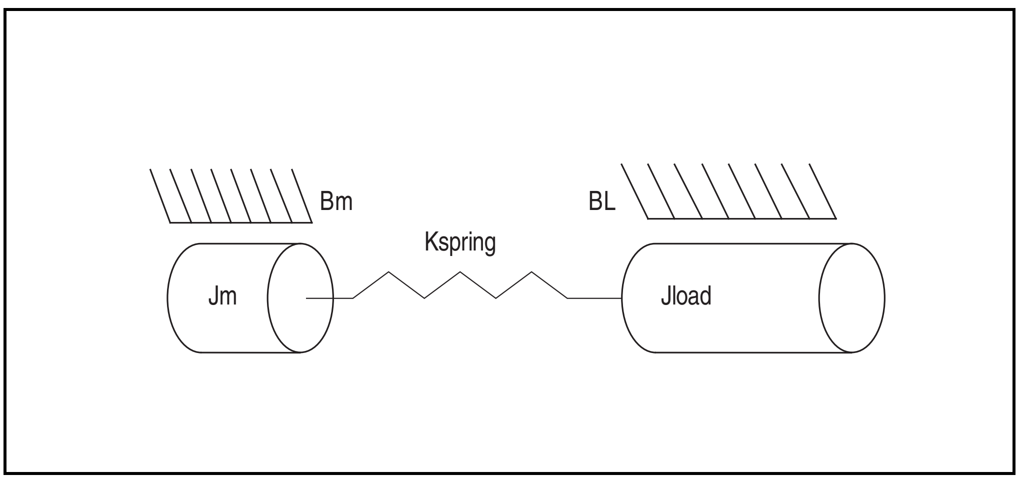


Figure 13.25 – Mechanical Gear Train

The resonant frequency is defined by the following equation:

$$\text{resonance} = \sqrt{\text{Kspring}\frac{(\text{Jm} + \text{Jload})}{\text{Jm} \times \text{Jload}}}$$

Jm is the motor inertia (seconds)
Jload is the load inertia (seconds)
Kspring is the coupling spring constant (rad^2/sec)

Figure 13.26 shows a two mass system with a resonant frequency of 62 radians/second (9.87 Hz). One Hertz is equal to 2π radians/second.

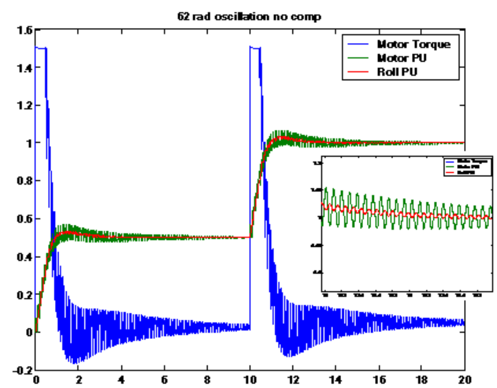


Figure 13.26 – Resonance

The insert shows the resonant frquency in details.

Figure 13-27 shows the same mechanical gear train as Figure 13-26 Notch Filter Freq (419)is set to 10.

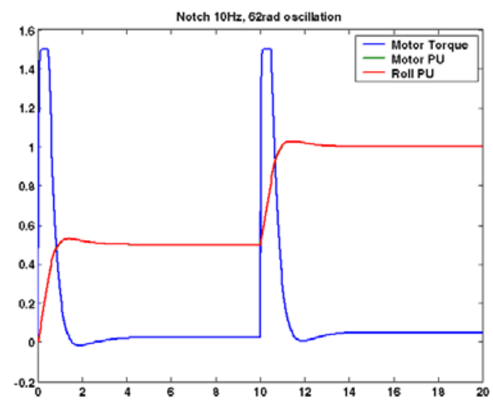


Figure 13.27 – 10 Hz Notch

13.33 Overspeed Limit

The Overspeed Limit is a user programmable value that allows operation at maximum speed but also provides an “overspeed band” that will allow a speed regulator such as encoder feedback or slip compensation to increase the output frequency above maximum Speed in order to maintain maximum Motor Speed.

Figure 13-28 illustrates a typical Custom V/Hz profile. Minimum Speed determines the lower speed reference limit during normal operation. Maximum Speed determines the upper speed reference limit. The two “Speed” parameters only limit the speed reference and not the output frequency.

The actual output at maximum speed reference is the sum of the speed reference plus “speed adder” components from functions such as slip compensation, encoder feedback or process trim.

The Overspeed Limit is added to Maximum Speed and the sum of the two (Speed Limit) limits is output. This sum (Speed Limit) is compared to Maximum Frequency and an alarm is initiated which prevents operation if the Speed Limit exceeds Maximum Frequency.

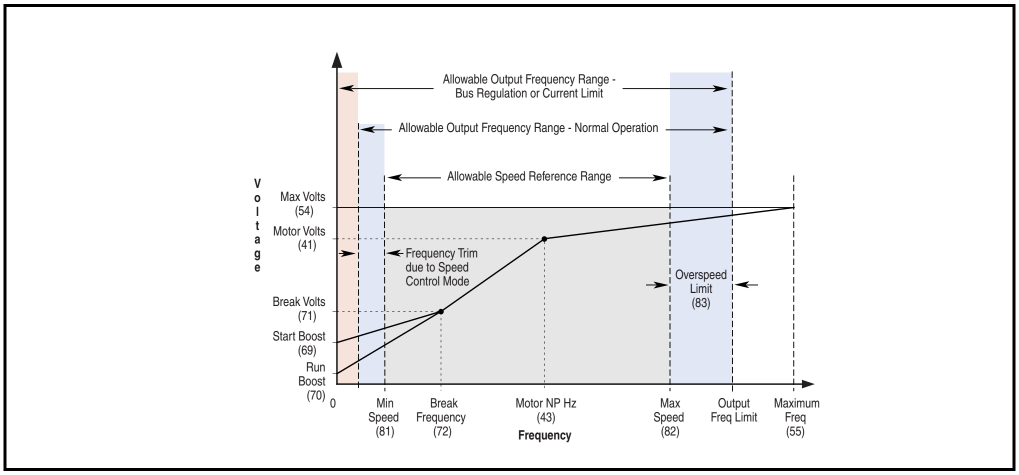


Figure 13.28 – Typical V/Hz Curve for Full Custom (with Speed/Frequency Limits)

13.34 Power Loss

Some processes or applications cannot tolerate drive output interruptions caused by momentary power outages. When AC input line power is interrupted to the drive, user programming can determine the drive's reaction.

13.34.1 Terms

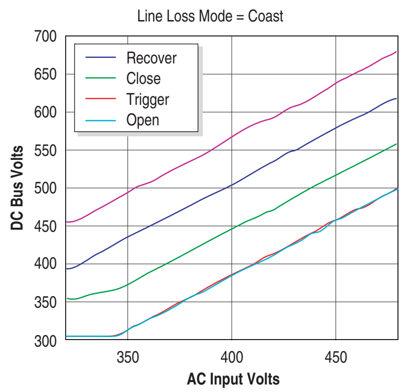
The following is a definition of terms. Some of these values are drive parameters and some are not. The description of how these operate is explained below.

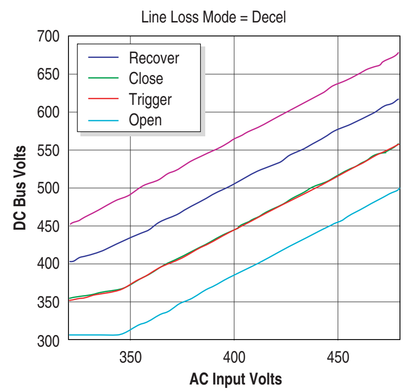
Term	Definition
Vbus	The instantaneous DC bus voltage.
Vmem	The average DC bus voltage. A measure of the "nominal" bus voltage determined by heavily filtering bus voltage. Just after the pre-charge relay is closed during the initial power-up bus pre-charge, bus memory is set equal to bus voltage. Thereafter it is updated by ramping at a very slow rate toward Vbus. The filtered value ramps at 2.4V DC per minute (for a 480VAC drive). An increase in Vmem is blocked during deceleration to prevent a false high value due to the bus being pumped up by regeneration. Any change to Vmem is blocked during inertia ride through.
Vslew	The rate of change of Vmem in volts per minute.
Vrecover	The threshold for recovery from power loss.

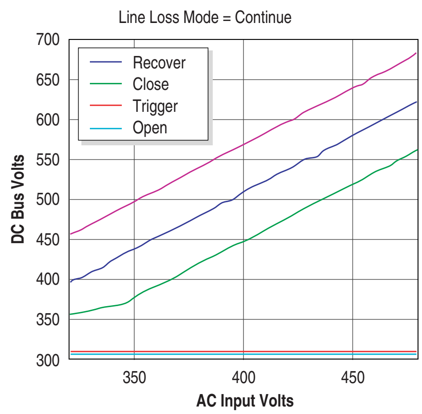
Term	Definition
Vtrigger	The threshold to detect power loss. The level is adjustable. The default is the value in the GV6000 Bus Level table. If “Pwr Loss Lvl” is selected as an input function AND energized, Vtrigger is set to Vmem minus Power Loss Level (186). Vopen is normally 60V DC below Vtrigger (in a 480VAC drive). Both Vopen and Vtrigger are limited to a minimum of Vmin. This is only a factor if Power Loss Level (186) is set to a large value. **WARNING:**When using a value of Power Loss Level (186) larger than default, the customer must provide a minimum line impedance to limit inrush current when the power line recovers. The input impedance should be equal or greater than the equivalent of a 5% transformer with a VA rating 5 times the drive’s input VA rating.
Vinertia	The software regulation reference for Vbus during inertia ride through.
Vclose	The threshold to close the pre-charge contactor.
Vopen	The threshold to open the pre-charge contactor.
Vmin	The minimum value of Vopen.
Voff	The bus voltage below which the switching power supply falls out of regulation.

Table 13.6 – Bus Levels

Class	200/240V AC	400/480V AC	600/690V AC
Vslew	1.2V DC	2.4V DC	3.0V DC
Vrecover	Vmem – 30V	Vmem – 60V	Vmem – 75V
Vclose	Vmem – 60V	Vmem – 120V	Vmem – 150V
Vtrigger1,2	Vmem – 60V	Vmem – 120V	Vmem – 150V
Vtrigger1,3	Vmem – 90V	Vmem – 180V	Vmem – 225V
Vopen	Vmem – 90V	Vmem – 180V	Vmem – 225V
Vopen4	153V DC	305V DC	382V DC
Vmin	153V DC	305V DC	382V DC
Voff 5	–	200V DC	–







13.34.2 Restart Power Restoration

If a power loss causes the drive to coast and power recovers the drive will return to powering the motor if it is in a “run permit” state. The drive is in a “run permit” state if:

3 wire mode – it is not faulted and if all Enable and Not Stop inputs are energized.

2 wire mode – it is not faulted and if all Enable, Not Stop, and Run inputs are energized.

13.34.3 Power Loss Actions

The drive is designed to operate at a nominal bus voltage. When Vbus falls below this nominal value by a significant amount, action can be taken to preserve the bus energy and keep the drive logic alive as long as possible. The drive will have three methods of dealing with low bus voltages:

- “Coast” – Disable the transistors and allow the motor to coast.
- “Decel” – Decelerate the motor at just the correct rate so that the energy absorbed from the mechanical load balances the losses.

- “Continue” – Allow the drive to power the motor down to half bus voltage.

184 Power Loss Mode

Range:	0 = Coast 1 = Decel 2 = Continue 3 = Coast input 4 = Decel input
Default:	0 = Coast
Access:	1 **Path:** Dynamic Control>Power Loss
See also:	13, 184

Sets the reaction to a loss of input power. Power loss is recognized when:

DC bus voltage is ≤ 73% of DC Bus Memory and Power Loss Mode is set to Coast.
DC bus voltage is ≤ 82% of DC Bus Memory and Power Loss Mode is set to Decel.

13.34.4 Coast

This is the default mode of operation.

The drive determines a power loss has occurred if the bus voltage drops below Vtrigger. If the drive is running the inverter output is disabled and the motor coasts.

The power loss alarm in Drive Alarm 1(211) is set and the power loss timer starts.

The Alarm bit in Drive Status 1 (209) is set if the Power Loss bit in Alarm Config 1(211) is set.

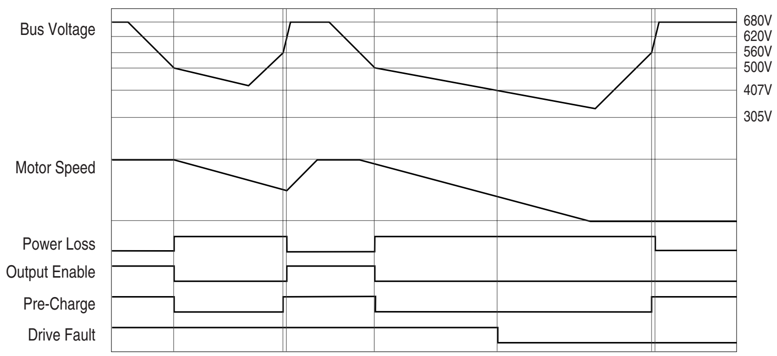
The drive faults with a F003 – Power Loss Fault if the power loss timer exceeds Power Loss Time (185) and the Power Loss bit in Fault Config 1 (238) is set.

The drive faults with a F004 – UnderVoltage fault if the bus voltage falls below Vmin and the UnderVoltage bit in Fault Config 1 (238) is set.

The pre-charge relay opens if the bus voltage drops below Vopen and closes if the bus voltage rises above Vclose

If the bus voltage rises above Vrecover for 20mS, the drive determines the power loss is over. The power loss alarm is cleared.

If the drive is in a “run permit” state, the reconnect algorithm is run to match the speed of the motor. The drive then accelerates at the programmed rate to the set speed.



480 example shown. See Table 13-7 for further information.

13.34.5 Decel

This mode of operation is useful if the mechanical load is high inertia and low friction. 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.

The drive determines a power loss has occurred if the bus voltage drops below Vtrigger.

If the drive is running, the inertia ride through function is activated.

The load is decelerated at just the correct rate so that the energy absorbed from the mechanical load balances the losses and bus voltage is regulated to the value Vinertia.

The Power Loss alarm in Drive Alarm 1 (211) is set and the power loss timer starts.

The Alarm bit in Drive Status 1 (209) is set if the Power Loss bit in Alarm Config 1(259) is set.

The drive faults with a F003 – Power Loss fault if the power loss timer exceeds Power Loss Time (189) and the Power Loss bit in Fault Config 1 (238) is set.

The drive faults with a F004 – UnderVoltage fault if the bus voltage falls below Vmin and the UnderVoltage bit in Fault Config 1 (238) is set.

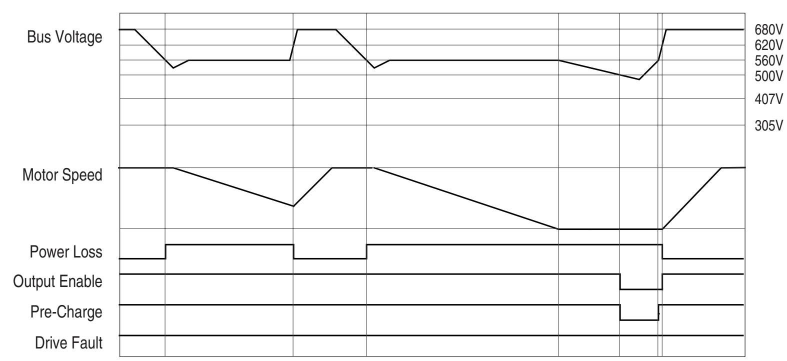
The inverter output is disabled and the motor coasts if the output frequency drops to zero or if the bus voltage drops below Vopen or if any of the “run permit” inputs are de-energized.

The pre-charge relay opens if the bus voltage drops below Vopen.

The pre-charge relay closes if the bus voltage rises above Vclose

If the bus voltage rises above Vrecover for 20mS, the drive determines the power loss is over. The power loss alarm is cleared.

If the drive is still in inertia ride through operation, the drive immediately accelerates at the programmed rate to the set speed. If the drive is coasting and it is in a “run permit” state, the reconnect algorithm is run to match the speed of the motor. The drive then accelerates at the programmed rate to the set speed.



480 V example shown. See Table 13-7 for more information.

13.34.6 Half Voltage

This mode provides the maximum power ride through. In a typical application 230VAC motors are used with a 480VAC drive, the input voltage can then drop to half and the drive is still able to supply full power to the motor.

ATTENTION: To guard against drive damage, a minimum line impedance must be provided to limit inrush current when the power line recovers. The input impedance should be equal or greater than the equivalent of a 5% transformer with a VA rating 6 times the drive’s input VA rating.

The drive determines a power loss has occurred if the bus voltage drops below Vtrigger.

If the drive is running the inverter output is disabled and the motor coasts.

If the bus voltage drops below Vopen/Vmin (In this mode of operation Vopen and Vmin are the same value) or if the Enable input is de-energized, the inverter output is disabled and the motor coasts. If the Not Stop or Run inputs are de-energized, the drive stops in the programmed manner.

The pre-charge relay opens if the bus voltage drops below Vopen/Vmin and closes if the bus voltage rises above Vclose.

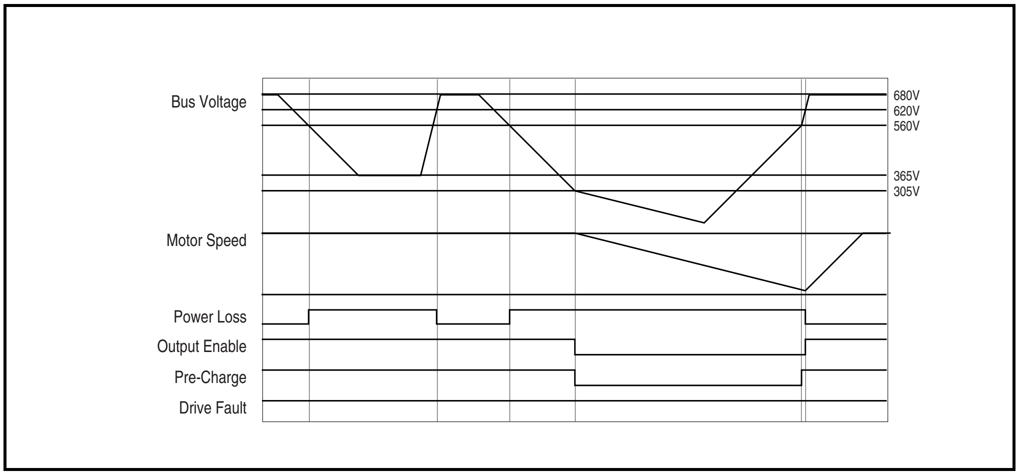
The power loss alarm in Drive Alarm 1 (211) is set and the power loss timer starts. The Alarm bit in Drive Status 1 (209) is set if the Power Loss bit in Alarm Config 1(259) is set.

The drive faults with a F003 – Power Loss fault if the power loss timer exceeds Power Loss Time (185) and the Power Loss bit in Fault Config 1(238) is set.

The drive faults with a F004 – UnderVoltage fault if the bus voltage falls below Vmin and the UnderVoltage bit in Fault Config 1(238) is set.

If the bus voltage rises above Vrecover for 20mS, the drive determines the power loss is over. The power loss alarm is cleared.

If the drive is coasting and if it is in a "run permit" state, the reconnect algorithm is run to match the speed of the motor. The drive then accelerates at the programmed rate to the set speed.



480 V example shown. See Table 13-7 for more information.

13.34.7 Coast Input

This mode can provide additional ride through time by sensing the power loss via an external device that monitors the power line and provides a hardware power loss signal. This signal is then connected to the drive through the "pulse" input (because of its high-speed capability). Normally this hardware power loss input will provide a power loss signal before the bus drops to less than Vopen.

The drive determines a power loss has occurred if the "pulse" input is de-energized OR the bus voltage drops below Vopen. If the drive is running, the inverter output is disabled.

The Power Loss alarm in Drive Alarm 1 (211) is set and the power loss timer starts.

The Alarm bit in Drive Status 1 (209) is set if the Power Loss bit in Alarm Config 1(259) is set.

The drive faults with a F003 – Power Loss fault if the power loss timer exceeds Power Loss Time (185) and the Power Loss bit in Fault Config 1 (238) is set.

The drive faults with a F004 – UnderVoltage fault if the bus voltage falls below Vmin and the UnderVoltage bit in Fault Config 1 (238) is set.

The pre-charge relay opens if the bus voltage drops below Vopen and closes if the bus voltage rises above Vclose.

If the “pulse” input is re energized and the pre-charge relay is closed, the drive determines the power loss is over. The power loss alarm is cleared.

If the drive is in a “run permit” state, the reconnect algorithm is run to match the speed of the motor. The drive then accelerates at the programmed rate to the set speed.

13.34.8 Decel Input

This mode can provide additional ride through time by sensing the power loss via an external device that monitors the power line and provides a hardware power loss signal. This signal is then connected to the drive through the “pulse” input (because of its high-speed capability). Normally this hardware power loss input will provide a power loss signal before the bus drops to less than Vopen.

The drive determine a power loss has occurred if the “pulse” input is de-energized or the bus voltage drops below Vopen.

If the drive is running, the inertia ride through function is activated. The load is decelerated at just the correct rate so that the energy absorbed from the mechanical load balances the losses and bus voltage is regulated to the value Vmem.

If the output frequency drops to zero or if the bus voltage drops below Vopen or if any of the “run permit” inputs are de-energized, the inverter output is disabled and the motor coasts.

The power loss alarm in Drive Alarm 1 (211) is set and the power loss timer starts. The Alarm bit in Drive Status 1 (209) is set if the Power Loss bit in Alarm Config 1 (259) is set.

The drive faults with a F003 – Power Loss fault if the power loss timer exceeds Power Loss Time (185) and the Power Loss bit in Fault Config 1(238) is set.

The drive faults with a F004 – UnderVoltage fault if the bus voltage falls below Vmin and the UnderVoltage bit inFault Config 1 (238) is set.

The pre-charge relay opens if the bus voltage drops below Vopen and closes if the bus voltage rises above Vclose.

If power recovers while the drive is still in inertia ride through the power loss alarm is cleared and it then accelerates at the programmed rate to the set speed. Otherwise, if power recovers before power supply shutdown, the power loss alarm is cleared.

If the drive is in a “run permit” state, the reconnect algorithm is run to match the speed of the motor. The drive then accelerates at the programmed rate to the set speed.

13.35 Scale Blocks

Scale blocks are used to scale a parameter value. Scalex In Value is linked to the parameter that you wish to scale. Scalex In Hi determines the high value for the input to the scale block. Scalex Out Hi determines the corresponding high value for the output of the scale block. Scalex In Lo determines the low value for the input to the scale block. Scalex Out Lo determines the corresponding low value for the output of the scale block. Scalex Out Value is the resulting output of the scale block.

There are (3) ways to use the output of the scale block:

1. A linkable destination parameter can be linked to [Scalex Out Value]. See Example Configuration #1.
2. [Analog Outx Sel] can be set to:

- 20, “Scale Block1”
- 21, “Scale Block2”
- 22, “Scale Block3”
- 23, “Scale Block4”

Note that when the Analog Outputs are set to use the scale blocks, the Scalex Out Hi and Scalex Out Lo parameters are not active. Instead, Analog Outx Hi and Analog Outx Lo determine the scaling for the output of the scale block. See Example Configuration #2.

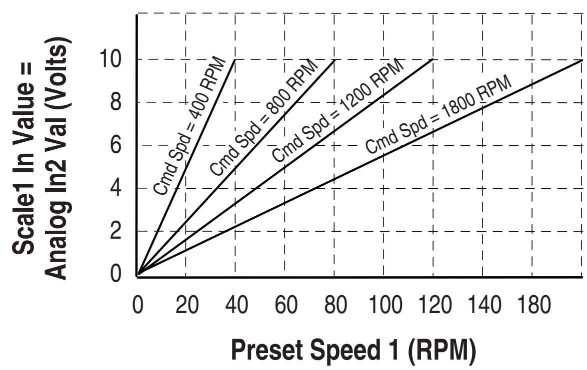
3. PI Reference Sel (126) and PI Feedback Sel (128) can also use the output of the scale block by setting them to:

- 25, “Scale Block1 Out”
- 26, “Scale Block2 Out”

Note that when PI Reference Sel (126) and PI Feedback Sel (128) are set to use the scale blocks, the Scalex Out Hi and Scalex Out Lo parameters are not active. Instead, PI Reference Hi (460) and PI Reference Lo (461), or PI Feedback Hi (462) and PI Feedback Lo (463), determine the scaling for the output of the scale block. See Example Configuration #3.

13.35.1 Example Configuration #1

Use the scale blocks to add a speed trim as a percentage of the speed reference instead of as a percent of full speed. Analog In 2 will be used to provide a 0-10V DC trim signal. For example, when the commanded speed is 800 RPM, the maximum trim with 10V DC at Analog In 2 will be 80 RPM. If the commanded speed is 1800 RPM the maximum trim will be 180 RPM.



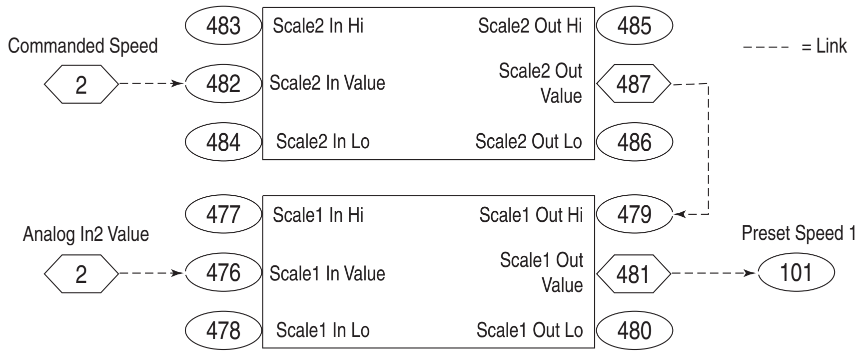
13.35.1.1 Parameter Settings

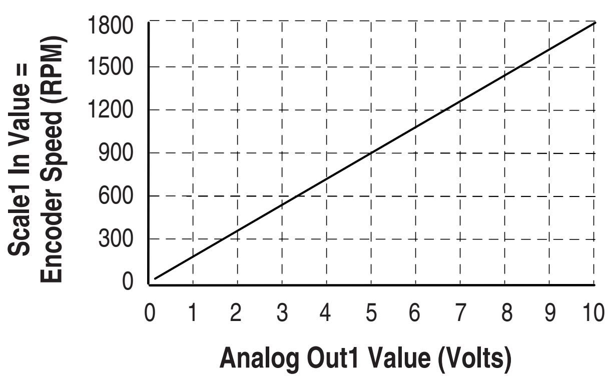
Parameter	Value	Description
Trim In Select (117)	11, Preset 1	Preset 1 becomes the trim speed
Scale1 In Hi (477)	10.0 V	Hi value of Analog In 2
Scale1 In Lo (478)	0 V	Lo value of Analog In 2
Scale1 Out Lo (480)	0 RPM	Lo value of desired Trim
Scale2 In Hi (483)	1800 RPM	Hi value of Commanded Speed (Max Speed)
Scale2 In Lo (484)	0 RPM	Lo value of Commanded Speed
Scale2 Out Hi (485)	180 RPM	10% of Max Speed
Scale2 Out Lo (486)	0 RPM	Corresponds to lo value of Commanded Speed

13.35.1.2 Parameter Links

Destination Parameter	Source Parameter	Description
Scale1 In Value (476)	Analog In2 Value (17)	We are scaling Analog In 2 for our trim

Destination Parameter	Source Parameter	Description
Scale2 In Value (482)	Commanded Speed (2)	Use Commanded Speed as Input to Scale Block 2
Scale1 Out Hi (479)	Scale2 Out Value (487)	Use the output of Scale Block 2 to set the upper limit of Scale Block 1 output
Preset Speed (101)	Scale 1 Out Value (481)	Use the scaled analog input as the trim reference into Preset Speed 1





13.35.2 Example Configuration #2

Set a scale block to send Encoder Speed (415) to Analog Output 1 as a 0-10 V signal.

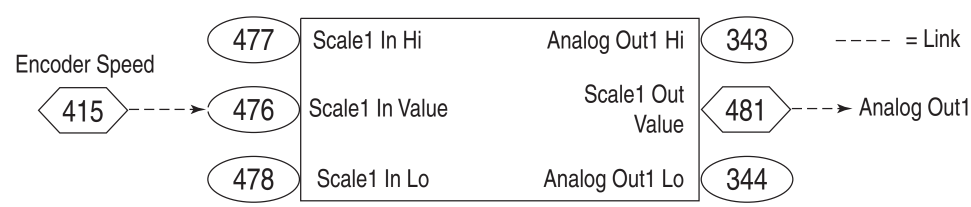
13.35.2.1 Parameter Settings

Parameter	Value	Description
Analog Out1 Sel (342)	Scale Block1 Out	Scale Block1 Output goes to Analog Out1

Parameter	Value	Description
Analog Out1 Hi (343)	10 V	Hi value of Analog Output 1 corresponding to Hi value of encoder speed
Analog Out1 Lo (344)	0 V	Lo value of Analog Output 1 corresponding to Lo value of encoder speed
Scale1 In Hi (477)	1800 RPM	Hi value of the encoder speed
Scale1 In Lo (478)	0 RPM	Lo value of the encoder speed

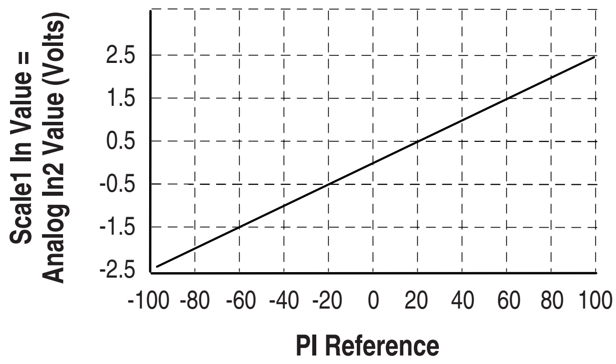
13.35.2.2 Parameter Links

Destination Parameter	Source Parameter	Description
Scale1 In Value (476)	Encoder Speed (415)	We are scaling Encoder Speed



13.35.3 Example Configuration #3

In this configuration Analog In 2 is a –10V to +10V signal which corresponds to –800% to +800% motor torque from another drive. We want to use the –200% to +200% range (–2.5V to +2.5V) of that motor torque and correspond it to –100% to +100% of the PI Reference.

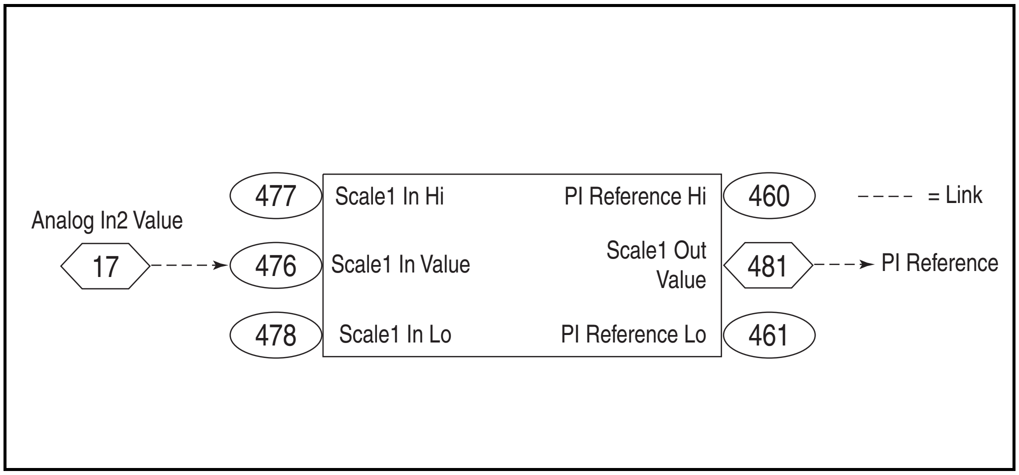


13.35.3.1 Parameter Settings

Parameter	Value	Description
Scale 1 In Hi (477)	2.5 V	2.5 V = 200% torque from other drive
Scale 1 In Lo (478)	–2.5V	–2.5 V = –200% torque from other drive
PI Reference Sel (126)	25, Scale Block1 Out	The PI Reference becomes the output of the scale block
PI Reference Hi (460)	100 %	100% PI Reference corresponds to 200% torque from other drive
PI Reference Lo (461)	–100 %	–100% PI Reference corresponds to –200% torque from other drive

13.35.3.2 Parameter Settings

Destination Parameter	Source Parameter	Description
Scale1 In Value (476)	Analog In2 Value (17)	We are scaling Analog In 2 value



Analog In2 Value
17
477
Scale1 In Hi
476
Scale1 In Value
478
Scale1 In Lo
PI Reference Hi
460
Scale1 Out Value
481
PI Reference Lo
461
= Link
PI Reference

APPENDIX A

Technical Specifications

Table A.1 – Drive Monitoring and Limits

Drive	200-208V	240V	380/400V	480V	600 V Frames 0-4	600 V Frames 5-6
AC Input Overvoltage Trip	285VAC	285VAC	570VAC	570VAC	716VAC	818VAC
AC Input Undervoltage Trip	120VAC	138VAC	233VAC	280VAC	345VAC	345VAC
Bus Overvoltage Trip	405VDC	405VDC	810VDC	810VDC	1031VDC	1162VDC
Bus Undervoltage Trip	153VDC	153VDC	305VDC	305VDC	381VDC	437VDC
Nominal Bus Voltage	281VDC	324VDC	540VDC	648VDC	810VDC	932VDC
All Drives						
Heat Sink Thermistor	Monitored by microprocessor overtemp trip					
Drive Overcurrent Trip Software Current Limit Hardware Current Limit	 200% of rated current (typical) 220-300% of rated current (Depending on drive rating)					
Line Transients	up to 6000 volts peak per IEEE C62.41-1991					
Control Logic Noise Immunity	Showering arc transients up to 1500V 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					
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.					
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.					

Table A.2 – Certifications

The drive is designed to meet 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.	
c UL us	UL and cUL Listed to UL508C and CAN/CSA-C2.2 No. 14-M91
N223	Certified to AS/NZS, 1997 Group 1, Class A **Note:** 600 VAC rated drives are not C-tick Compliant.
CE	Marked for all applicable European Directives[1] EMC Directive (89/336/EEC) Emissions EN 61800-3 Adjustable Speed electrical power drive systems Part 3 Low Voltage Directive (73/23/EEC) EN 50178 Electronic Equipment for use in Power Installations **Note:** 600 VAC rated drives are not CE Compliant.

[1] Applied noise impulses may be counted in addition to the standard pulse train causing erroneously high Pulse Freq readings.

Table A.3 – Environment

Altitude	1000 m (3300 ft) max. without derating
Ambient Operating Temperature without derating: IP20, NEMA 1	0 to 50°C (32 to 122°F)
Storage Temperature (all const.)	–40 to 70°C (–40 to 158°F)
Atmosphere	**Important:** Drive **must not** be installed in an area where the ambient temperature contains a 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

Table A.4 – Voltage Ratings

Voltage Tolerance	–10% of minimum, +10% of maximum.
Frequency Tolerance	47-63 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 lagging over entire speed range
Efficiency	97.5% at rated amps, nominal line volts.
Max. Short Circuit Current Rating	200,000 Amps symmetrical
Actual Short Circuit Rating	Short circuit current rating to match specified fuse/circuit breaker capability

Table A.5 – Control Specifications

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	2-10 kHz. Drive rating based on 4 kHz
Output Voltage Range	0 to rated motor voltage
Output Frequency Range	0 to 420 Hz.
Frequency Accuracy Digital Input Analog Input	 Within ±0.01% of set output frequency. Within ±0.4% of maximum output frequency.
Frequency Control	Speed Regulation - with Slip Compensation (Volts per Hertz Mode) 0.5% of base speed across 40:1 speed range 40:1 operating range 10 rad/sec bandwidth
	Speed Regulation - with Slip Compensation (Sensorless Vector Mode) 0.5% of base speed across 80:1 speed range 80:1 operating range 20 rad/sec bandwidth
	Speed Regulation - with Feedback (Sensorless Vector Mode) 0.1% of base speed across 80:1 speed range 80:1 operating range 20 rad/sec bandwidth
Speed Control	Speed Regulation - without Feedback (Vector Control Mode) 0.1% of base speed across 120:1 speed range 120:1 operating range 50 rad/sec bandwidth
	Speed Regulation - with Feedback (Vector Control Mode) 0.001% of base speed across 120:1 speed range 1000:1 operating range 250 rad/sec bandwidth

Table A.5 – Control Specifications

Torque Regulation	Torque Regulation - without Feedback +/- 5%, 600 rad/sec bandwidth
	Torque Regulation - with Feedback +/- 2%, 2500 rad/sec bandwidth
Selectable Motor Control	Sensorless Vector with full tuning. Standard V/Hz with full custom capability.
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 - 3600 seconds in 0.1 second increments.

Table A.6 – Encoder

Type	Incremental, dual channel
Supply	12V, 250mA. 12V,10mA minimum inputs isolated with differential transmitter, 250 kHz maximum
Quadrature	90°, +/- 27 degrees at 25° C
Duty Cycle	50%, +10%
Requirements	Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), 8-15VDC output, single-ended or differential and capable of supplying a minimum of 10mA per channel. Maximum input frequency is 250 kHz. The Encoder Interface Board accepts 12VDC square-wave with a minimum high state voltage of 7.0VDC (12 volt encoder). Maximum low state voltage is 0.4VDC.

APPENDIX B

Logic Command/Status Words

Appendix B provides information on Logic Command and Logic Status Words.

Important: If block transfers are programmed to continuously write information to the drive, care must be taken to properly format the block transfer. If attribute 10 is selected for the block transfer, values will be written only to RAM and will not be saved by the drive. This is the preferred attribute for continuous tranfers. If attribute 9 is selected, each program scan will complete a write to the drives non-volatile memory (EEprom). Since the EEprom has a fixed number of allowed writes, continuous block transfers will quickly damage the EEprom. Do not assign attribute 9 to continuous block transfers.

B.1 Logic Command Words

Logic Bits																Command	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
															X	Stop[1]	0 = Not Stop 1 = Stop
														X		Start [1,2]	0 = Not Start 1 = Start
													X			Jog	0 = Not Jog 1 = Jog
												X				Clear Faults	0 = Not Clear Faults 1 = Clear Faults
										X	X					Direction	00 = No Command 01 = Forward Command 10 = Reverse Command 11 = Hold Present Direction
									X							Local Control	0 = No Local Control 1 = Local Control
								X								MOP Increment	0 = Not Increment 1 = Increment
						X	X									Accel Rate	00 = No Command 01 = Use Accel Time 1 10 = Use Accel Time 2 11 = Use Present Time
				X	X											Decel Rate	00 = No Command 01 = Use Accel Time 1 10 = Use Accel Time 2 11 = Use Present Time
	X	X	X													Reference Select[3]	000 = No Command 001 = Ref. 1 (Ref A Select) 010 = Ref. 2 (Ref B Select) 011 = Ref. 3 (Preset 3) 100 = Ref. 4 (Preset 4) 101 = Ref. 5 (Preset 5) 110 = Ref. 6 (Preset 6) 111 = Ref. 7 (Preset 7)
X																MOP Decrement	0 = Not Decrement 1 = Decrement

[1]A “0 = Not Stop” condition (logic 0) must first be present before a “1 = Start” condition will start the drive. The start command acts as a momentary Start command. A “1” will start the drive, but returning to “0” will not stop the drive.

[2]This start will not function if a digital input (parameters 361-366) is programmed for a 2-wire control (option 7, 8, or 9).

[3]This Reference Select will not function if a digital input (parameters 361-366) is programmed for “Speed Sel 1, 2, or 3” (option 15, 16, or 17).

B.2 Logic Status Word

Logic Bits																Command	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
															X	Ready	0 = Not Ready 1 = Ready
														X		Active	0 = Not Active 1 = Active
													X			Command Direction	0 = Reverse 1 = Forward
												X				Actual Direction	0 = Reverse 1 = Forward
											X					Accel	0 = Not Accelerating 1 = Accelerating
										X						Decel	0 = Not Decelerating 1 = Decelerating
									X							Alarm	0 = No Alarm 1 = Alarm
								X								Fault	0 = No Fault 1 = Fault
							X									At Speed	0 = Not at Reference 1 = At Reference
				X	X	X										Local Control	000 = Port 0 (TB) 001 = Port 1 010 = Port 2 011 = Port 3 100 = Port 4 101 = Port 5 110 = Reserved 111 = No Local
X	X	X	X													Reference Source	0000 = Ref A Auto 0001 = Ref B Auto 0010 = Preset 2 Auto 0011 = Preset 3 Auto 0100 = Preset 4 Auto 0101 = Preset 5 Auto 0110 = Preset 6 Auto 0111 = Preset 7 Auto 1000 = Term Blk Manual 1001 = DPI 1 Manual 1010 = DPI 2 Manual 1011 = DPI 3 Manual 1100 = DPI 4 Manual 1101 = DPI 5 Manual 1110 = Reserved 1111 = Jog Ref

APPENDIX C

Parameters Cross-Referenced by Name

The following table lists the complete set of GV6000 parameters in alphabetical order.

Parameter Name	No.	Path (File>Group)
Accel Time 1	140	Dynamic Control>Ramp Rates
Accel Time 2	141	Dynamic Control>Ramp Rates
Alarm 1 @ Fault	229	Utility>Diagnostics
Alarm 2 @ Fault	230	Utility>Diagnostics
Alarm Clear 1	261	Utility>Alarms
Alarm Code 1	262	Utility>Alarms
Alarm Code 2	263	Utility>Alarms
Alarm Code 3	264	Utility>Alarms
Alarm Code 4	265	Utility>Alarms
Alarm Code 5	266	Utility>Alarms
Alarm Code 6	267	Utility>Alarms
Alarm Code 7	268	Utility>Alarms
Alarm Code 8	269	Utility>Alarms
Alarm Config 1	259	Utility>Alarms
Analog In 1 Hi	322	Inputs & Outputs>Analog Inputs
Analog In 1 Lo	323	Inputs & Outputs>Analog Inputs
Analog In 1 Loss	324	Inputs & Outputs>Analog Inputs
Analog In 2 Hi	325	Inputs & Outputs>Analog Inputs
Analog In 2 Lo	326	Inputs & Outputs>Analog Inputs
Analog In 2 Loss	327	Inputs & Outputs>Analog Inputs
Analog In1 Value	16	Monitor>Metering
Analog In2 Value	17	Monitor>Metering
Analog Out1 Hi	343	Inputs & Outputs>Analog Outputs
Analog Out1 Lo	344	Inputs & Outputs>Analog Outputs
Analog Out1 Sel	342	Inputs & Outputs>Analog Outputs
Analog Out2 Hi	346	Inputs & Outputs>Analog Outputs
Analog Out2 Lo	347	Inputs & Outputs>Analog Outputs
Analog Out2 Sel	345	Inputs & Outputs>Analog Outputs
Angl Stblty Gain	506	Utility>Diag-Motor Cntl
Anlg In Config	320	Inputs & Outputs>Analog Inputs
Anlg In Sqr Root	321	Inputs & Outputs>Analog Inputs

Parameter Name	No.	Path (File>Group)
Anlg Out1 Scale	354	Inputs & Outputs>Analog Outputs
Anlg Out1 Setpt	377	Inputs & Outputs>Analog Outputs
Anlg Out2 Scale	355	Inputs & Outputs>Analog Outputs
Anlg Out2 Setpt	378	Inputs & Outputs>Analog Outputs
Anlg Out Absolut	341	Inputs & Outputs>Analog Outputs
Anlg Out Config	340	Inputs & Outputs>Analog Outputs
Auto Rstrt Delay	175	Dynamic Control>Stop/Restart Modes
Auto Rstrt Tries	174	Dynamic Control>Stop/Restart Modes
Autotune	61	Motor Control>Torq Attributes
Autotune Torque	66	Motor Control>Torq Attributes
Break Frequency	72	Motor Control>Volts per Hertz
Break Voltage	71	Motor Control>Volts per Hertz
Brk Alarm Travel	610	Applications>Torque Proving
Brk Release Time	604	Applications>Torque Proving
Brk Set Time	607	Applications>Torque Proving
Brk Slip Count	609	Applications>Torque Proving
Bus Reg ACR Kp	502	Utility>Diag-Motor Cntl
Bus Reg Kd	165	Dynamic Control>Stop/Brake Modes
Bus Reg Ki	160	Dynamic Control>Stop/Brake Modes
Bus Reg Kp	164	Dynamic Control>Stop/Brake Modes
Bus Reg Mode A	161	Dynamic Control>Stop/Brake Modes
Bus Reg Mode B	162	Dynamic Control>Stop/Brake Modes
Bus Utilization	523	Utility>Diag-Motor Cntl
Commanded Speed	2	Monitor>Metering
Commanded Torque	24	Monitor>Metering
Compensation	56	Motor Control>Torq Attributes
Control Status	440	Monitor>Metering
Control SW Ver	29	Monitor>Drive Data
Counts per Unit	708	Pos/Spd Profile>ProfSetup/Status
Current Lmt Gain	149	Dynamic Control>Load Limits
Current Lmt Sel	147	Dynamic Control>Ramp Rates
Current Lmt Val	148	Dynamic Control>Load Limits
Current Rate Lim	154	Dynamic Control>Load Limits
DAC47-A	514	Utility>Diag-DACs
DAC47-B	515	Utility>Diag-DACs
DAC47-C	516	Utility>Diag-DACs
DAC47-D	517	Utility>Diag-DACs
DAC55-A	519	Utility>Diag-DACs
DAC55-B	520	Utility>Diag-DACs
DAC55-C	521	Utility>Diag-DACs
DAC55-D	522	Utility>Diag-DACs

Parameter Name	No.	Path (File>Group)
Data In A1 - Link A Word 1	300	Communication>Datalinks
Data In A2 - Link A Word 2	301	Communication>Datalinks
Data In B1 - Link B Word 1	302	Communication>Datalinks
Data In B2 - Link B Word 2	303	Communication>Datalinks
Data In C1 - Link C Word 1	304	Communication>Datalinks
Data In C2 - Link C Word 2	305	Communication>Datalinks
Data In D1 - Link D Word 1	306	Communication>Datalinks
Data In D2 - Link D Word 2	307	Communication>Datalinks
Data Out A1 - Link A Word 1	310	Communication>Datalinks
Data Out A2 - Link A Word 2	311	Communication>Datalinks
Data Out B1 - Link B Word 1	312	Communication>Datalinks
Data Out B2 - Link B Word 2	313	Communication>Datalinks
Data Out C1 - Link C Word 1	314	Communication>Datalinks
Data Out C2 - Link C Word 2	315	Communication>Datalinks
Data Out D1 - Link D Word 1	316	Communication>Datalinks
Data Out D2 - Link D Word 2	317	Communication>Datalinks
DB Resistor	647	Applications>Oil Well Pump
DB Resistor Type	163	Dynamic Control>Stop/Brake Modes
DB While Stopped	145	Dynamic Control>Stop/Brake Modes
DC Brake Level	158	Dynamic Control>Stop/Brake Modes
DC Brake Lvl Sel	157	Dynamic Control>Stop/Brake Modes
DC Brake Time	159	Dynamic Control>Stop/Brake Modes
DC Bus Memory	13	Monitor>Metering
DC Bus Voltage	12	Monitor>Metering
Decel Time 1	142	Dynamic Control>Ramp Rates
Decel Time 2	143	Dynamic Control>Ramp Rates
Dig In Status	216	Utility>Diagnostics Inputs & Outputs>Digital Inputs
Dig Out Status	217	Utility>Diagnostics Inputs & Outputs>Digital Outputs
Dig Out1 Level	381	Inputs & Outputs>Digital Outputs
Dig Out1 OffTime	383	Inputs & Outputs>Digital Outputs
Dig Out1 OnTime	382	Inputs & Outputs>Digital Outputs
Dig Out2 Level	385	Inputs & Outputs>Digital Outputs
Dig Out2 OffTime	387	Inputs & Outputs>Digital Outputs
Dig Out2 OnTime	386	Inputs & Outputs>Digital Outputs
Dig Out3 Level	389	Inputs & Outputs>Digital Outputs
Dig Out3 OffTime	391	Inputs & Outputs>Digital Outputs
Dig Out3 OnTime	390	Inputs & Outputs>Digital Outputs
Dig Out Invert	392	Inputs & Outputs>Digital Outputs
Dig Out Mask	394	Inputs & Outputs>Digital Outputs
Dig Out Param	393	Inputs & Outputs>Digital Outputs

Parameter Name	No.	Path (File>Group)
Dig Out Setpt	379	Inputs & Outputs>Digital Outputs
Dig Out Status	217	Inputs & Outputs>Digital Outputs
Digital In1 Sel	361	Inputs & Outputs>Digital Inputs
Digital In2 Sel	362	Inputs & Outputs>Digital Inputs
Digital In3 Sel	363	Inputs & Outputs>Digital Inputs
Digital In4 Sel	364	Inputs & Outputs>Digital Inputs
Digital In5 Sel	365	Inputs & Outputs>Digital Inputs
Digital In6 Sel	366	Inputs & Outputs>Digital Inputs
Digital Out1 Sel	380	Inputs & Outputs>Digital Outputs
Digital Out2 Sel	384	Inputs & Outputs>Digital Outputs
Digital Out3 Sel	388	Inputs & Outputs>Digital Outputs
Direction Mode	190	Utility>Direction Config
DPI Data Rate	270	Communication>Comm Control
DPI Fdbk Select	299	Communication>Comm Control
DPI Port Select	274	Communication>Comm Control
DPI Port Value	275	Communication>Comm Control
DPI Ref Select	298	Communication>Comm Control
Drive Alarm 1	211	Utility>Diagnostics Utility>Alarms
Drive Alarm 2	212	Utility>Diagnostics Utility>Alarms
Drive Checksum	203	Utility>Drive Memory
Drive Logic Rslt	271	Communication>Comm Control
Drive OL Count	219	Utility>Diagnostics
Drive OL Mode	150	Dynamic Control>Load Limits
Drive Ramp Rslt	273	Communication>Comm Control
Drive Ref Rslt	272	Communication>Comm Control
Drive Status 1	209	Utility>Diagnostics
Drive Status 2	210	Utility>Diagnostics
Drive Temp	218	Utility>Diagnostics
Droop RPM @ FLA	152	Dynamic Control>Load Limits
Dyn UserSet Cnfg	204	Utility>Drive Memory
Dyn UserSet Sel	205	Utility>Drive Memory
Dyn UserSet Actv	206	Utility>Drive Memory
Elapsed kWh	14	Monitor>Metering
Elapsed MWh	9	Monitor>Metering
Elapsed Run Time	10	Monitor>Metering
Enc Pos Feedback	414	Motor Control>Speed Feedback
Encdlss Ang Comp	541	Utility>Diag-Vector Cntl
Encdlss Vlt Comp	542	Utility>Diag-Vector Cntl
Encoder Pos Tol	707	Pos/Spd Profile>ProfSetup/Status
Encoder PPR	413	Motor Control>Speed Feedback

Parameter Name	No.	Path (File>Group)
Encoder Speed	415	Motor Control>Speed Feedback
Encoder Z Chan	423	Motor Control>Speed Feedback
Excitation KI	543	Utility>Diag-Motor Cntl
Excitation KP	544	Utility>Diag-Motor Cntl
Fault 1 Code	243	Utility>Faults
Fault 1 Time	244	Utility>Faults
Fault 2 Code	245	Utility>Faults
Fault 2 Time	246	Utility>Faults
Fault 3 Code	247	Utility>Faults
Fault 3 Time	248	Utility>Faults
Fault 4 Code	249	Utility>Faults
Fault 4 Time	250	Utility>Faults
Fault 5 Code	251	Utility>Faults
Fault 5 Time	252	Utility>Faults
Fault 6 Code	253	Utility>Faults
Fault 6 Time	254	Utility>Faults
Fault 7 Code	255	Utility>Faults
Fault 7 Time	256	Utility>Faults
Fault 8 Code	257	Utility>Faults
Fault 8 Time	258	Utility>Faults
Fault Amps	225	Utility>Diagnostics
Fault Bus Volts	226	Utility>Diagnostics
Fault Clear	240	Utility>Faults
Fault Clear Mode	241	Utility>Faults
Fault Config 1	238	Utility>Faults
Fault Speed	224	Utility>Diagnostics
Fdbk Filter Sel	416	Motor Control>Speed Feedback
Feedback Select	80	Speed Command>Spd Mode & Limits
Find Home Ramp	714	Pos/Spd Profile>ProfSetup/Status
Find Home Speed	713	Pos/Spd Profile>ProfSetup/Status
Float Tolerance	606	Applications>Torque Proving
Flux Braking	166	Dynamic Control>Stop/Brake Modes
Flux Braking %	549	Utility>Diag-Motor Cntl
Flux Current	5	Monitor>Metering
Flux Current Ref	63	Motor Control>Torq Attributes
Flux Reg Enable	530	Utility>Diag-Vector Cntl
Flux Up Mode	57	Motor Control>Torq Attributes
Flux Up Time	58	Motor Control>Torq Attributes
Flying Start En	169	Dynamic Control>Restart Modes
Flying Start Gain	170	Dynamic Control>Restart Modes
Flying Start Ki	550	Utility>Diag-Motor Cntl

Parameter Name	No.	Path (File>Group)
Gearbox Limit	648	Applications>Oil Well Pump
Gearbox Rating	642	Applications>Oil Well Pump
Gearbox Ratio	644	Applications>Oil Well Pump
Gearbox Sheave	643	Applications>Oil Well Pump
Gnd Warn Level	177	Dynamic Control>Power Loss
Host DAC Enable	518	Utility>Diag-DACs
Inertia Autotune	67	Motor Control>Torq Attributes
IR Voltage Drop	62	Motor Control>Torq Attributes
Ixo Voltage Drop	64	Motor Control>Torq Attributes
Jerk	503	Utility>Diag-Motor Cntl
Jog Speed 1	100	Speed Command>Discrete Speeds
Jog Speed 2	108	Speed Command>Discrete Speeds
Kd Current Limit	501	Utility>Diag-Motor Cntl
Kd LL Bus Reg	505	Utility>Diag-Motor Cntl
Kf Speed Loop	447	Speed Command>Speed Regulator
Ki Cur Reg	511	Utility>Diag-Motor Cntl
Ki Fast Brake	547	Utility>Diag-Motor Cntl
Ki Flux Brake	536	Utility>Diag-Motor Cntl
Ki Flux Reg	535	Utility>Diag-Vector Cntl
Ki Freq Reg	540	Utility>Diag-Vector Cntl
Ki Current Limit	500	Utility>Diag-Motor Cntl
Ki Slip Reg	532	Utility>Diag-Vector Cntl
Ki Speed Loop	445	Speed Command>Speed Regulator
Ki Torque Reg	528	Utility>Diag-Vector Cntl
Kp Cur Reg	512	Utility>Diag-Motor Cntl
Kp Fast Brake	548	Utility>Diag-Motor Cntl
Kp Flux Brake	537	Utility>Diag-Motor Cntl
Kp Flux Reg	534	Utility>Diag-Vector Cntl
Kp Freq Reg	539	Utility>Diag-Vector Cntl
Kp LL Bus Reg	504	Utility>Diag-Motor Cntl
Kp Slip Reg	531	Utility>Diag-Vector Cntl
Kp Speed Loop	446	Speed Command>Speed Regulator
Kp Torque Reg	527	Utility>Diag-Vector Cntl
Language	201	Utility>Drive Memory
Last Stop Source	215	Utility>Diagnostics
In PhaseLoss Lvl	545	Utility>Diag-Motor Cntl
Lo Freq Reg Kpld	509	Utility>Diag-Motor Cntl
Lo Freq Reg Kplq	510	Utility>Diag-Motor Cntl
Logic Mask Actv	598	Communications>Security
Load Frm Usr Set	198	Utility>Drive Memory
Load Loss Level	187	Dynamic Control>Restart Modes

Parameter Name	No.	Path (File>Group)
Load Loss Time	188	Dynamic Control>Restart Modes
Logic Source Sel	89	Speed Command>Control Src Select
Man Ref Preload	193	Utility>OIM Ref Config
Manual Mask	286	Communication>Masks & Owners
Manual Owner	287	Communication>Masks & Owners
Marker Pulse	421	Motor Control>Speed Feedback
Max Rod Speed	640	Applications>Oil Well Pump
Maximum Freq	55	Motor Control>Torq Attributes
Maximum Speed	82	Speed Command>Spd Mode & Limits
Maximum Voltage	54	Motor Control>Torq Attributes
MicorPos Scale %	611	Applications>Torque Proving
Min Rod Speed	639	Applications>Oil Well Pump
Minimum Speed	81	Speed Command>Spd Mode & Limits
MOP Reference	11	Monitor>Metering
MOP Rate	195	Utility>MOP Config
Motor Cntl Sel	53	Motor Control>Torq Attributes
Motor Fdbk Type	412	Motor Control>Speed Feedback
Motor NP FLA	42	Motor Control>Motor Data
Motor NP Hertz	43	Motor Control>Motor Data
Motor NP Power	45	Motor Control>Motor Data
Motor NP RPM	44	Motor Control>Motor Data
Motor NP Volts	41	Motor Control>Motor Data
Motor OL Count	220	Utility>Diagnostics
Motor OL Factor	48	Motor Control>Motor Data
Motor OL Hertz	47	Motor Control>Motor Data
Motor Poles	49	Motor Control>Motor Data
Motor Sheave	645	Applications>Oil Well Pump
Motor Type	40	Motor Control>Motor Data
Mtr NP Pwr Units	46	Motor Control>Motor Data
Mtr OL Trip Time	221	Utility>Diagnostics
Neg Torque Limit	437	Monitor>Metering
Notch Filter Freq	419	Motor Control>Speed Feedback
Notch Filter K	420	Motor Control>Speed Feedback
OilWell Pump Sel	641	Applications>Oil Well Pump
OutPhase LossLvl	546	Utility>Diag-Motor Cntl
Output Current	3	Monitor>Metering
Output Freq	1	Monitor>Metering
Output Power	7	Monitor>Metering
Output Powr Fctr	8	Monitor>Metering
Output Voltage	6	Monitor>Metering
Overspeed Limit	83	Speed Command>Spd Mode & Limits

Parameter Name	No.	Path (File>Group)
Param Access Lvl	196	Utility>Drive Memory
PCP Pump Sheave	637	Applications>Oil Well Pump
PCP Rod Torque	638	Applications>Oil Well Pump
PI BW Filter	139	Speed Command>Process PI
PI Configuration	124	Speed Command>Process PI
PI Control	125	Speed Command>Process PI
PI Deriv Time	459	Speed Command>Process PI
PI Error Meter	137	Speed Command>Process PI
PI Fdback Meter	136	Speed Command>Process PI
PI Feedback Hi	462	Speed Command>Process PI
PI Feedback Lo	463	Speed Command>Process PI
PI Feedback Sel	128	Speed Command>Process PI
PI Integral Time	129	Speed Command>Process PI
PI Lower Limit	131	Speed Command>Process PI
PI Output Gain	464	Speed Command>Process PI
PI Output Meter	138	Speed Command>Process PI
PI Preload	133	Speed Command>Process PI
PI Prop Gain	130	Speed Command>Process PI
PI Ref Meter	135	Speed Command>Process PI
PI Reference Hi	460	Speed Command>Process PI
PI Reference Lo	461	Speed Command>Process PI
PI Reference Sel	126	Speed Command>Process PI
PI Setpoint	127	Speed Command>Process PI
PI Status	134	Speed Command>Process PI
PI Upper Limit	132	Speed Command>Process PI
Port Mask Actv	595	Communication>Security
Pos Reg Filter	718	Pos/Spd Profile>ProfSetup/Status
Pos Reg Gain	719	Pos/Spd Profile>ProfSetup/Status
Pos Torque Limit	436	Monitor>Metering
Power Loss Level	186	Dynamic Control>Power Loss
Power Loss Mode	184	Dynamic Control>Stop/Power Loss
Power Loss Time	185	Dynamic Control>Stop/Power Loss
Power Up Delay	167	Dynamic Control>Restart Modes
Power Up Marker	242	Utility>Faults
Preset Speed 1	101	Speed Command>Discrete Speeds
Preset Speed 2	102	Speed Command>Discrete Speeds
Preset Speed 3	103	Speed Command>Discrete Speeds
Preset Speed 4	104	Speed Command>Discrete Speeds
Preset Speed 5	105	Speed Command>Discrete Speeds
Preset Speed 6	106	Speed Command>Discrete Speeds
Preset Speed 7	107	Speed Command>Discrete Speeds

Parameter Name	No.	Path (File>Group)
Profile Command	705	Pos/Spd Profile>ProfSetup/Status
Profile Status	700	Pos/Spd Profile>ProfSetup/Status
PTC HW Value	18	Monitor>Metering
Pulse Input Ref	99	Speed Command>Speed References
Pulse In Scale	422	Motor Control>Speed Feedback
PWM DAC Enable	513	Utility>Diag-DACs
PWM Frequency	151	Dynamic Control>Load Limits
PWM Type Select	524	Utility>Diag-Motor Cntl
Ramped Speed	22	Monitor>Metering
Rated Amps	28	Monitor>Drive Data
Rated kW	26	Monitor>Drive Data
Rated Volts	27	Monitor>Drive Data
Rec Delay Time	538	Utility>Diag-Motor Cntl
Regen Power Lim	153	Dynamic Control>Load Limits
Reset Meters	200	Utility>Drive Memory
Reset To Defalts	197	Utility>Drive Memory
Rev Speed Limit	454	Speed Command>Spd Mode & Limits
Run Boost	70	Motor Control>Volts per Hertz
S Curve %	146	Dynamic Control>Ramp Rates
Save MOP Ref	194	Utility>MOP Config
Save OIM Ref	192	Utility>OIM Ref Config
Save To User Set	199	Utility>Drive Memory
Scale 1 In Hi	477	Utility>Scaled Blocks
Scale 1 In Lo	478	Utility>Scaled Blocks
Scale 1 In Value	476	Utility>Scaled Blocks
Scale 1 Out Hi	479	Utility>Scaled Blocks
Scale 1 Out Lo	480	Utility>Scaled Blocks
Scale 1 Out Value	481	Utility>Scaled Blocks
Scale 2 In Hi	483	Utility>Scaled Blocks
Scale 2 In Lo	484	Utility>Scaled Blocks
Scale 2 In Value	482	Utility>Scaled Blocks
Scale 2 Out Hi	485	Utility>Scaled Blocks
Scale 2 Out Lo	486	Utility>Scaled Blocks
Scale 2 Out Value	487	Utility>Scaled Blocks
Scale 3 In Hi	489	Utility>Scaled Blocks
Scale 3 In Lo	490	Utility>Scaled Blocks
Scale 3 In Value	488	Utility>Scaled Blocks
Scale 3 Out Hi	491	Utility>Scaled Blocks
Scale 3 Out Lo	492	Utility>Scaled Blocks
Scale 3 Out Value	493	Utility>Scaled Blocks
Scale 4 In Hi	495	Utility>Scaled Blocks

Parameter Name	No.	Path (File>Group)
Scale 4 In Lo	496	Utility>Scaled Blocks
Scale 4 In Value	494	Utility>Scaled Blocks
Scale 4 Out Hi	497	Utility>Scaled Blocks
Scale 4 Out Lo	498	Utility>Scaled Blocks
Scale 4 Out Value	499	Utility>Scaled Blocks
Spd Fdbk No Filt	21	Monitor>Metering
Shear Pin Time	189	Dynamic Control>Load Limits
Skip Freq Band	87	Speed Command>Spd Mode & Limits
Skip Frequency 1	84	Speed Command>Spd Mode & Limits
Skip Frequency 2	85	Speed Command>Spd Mode & Limits
Skip Frequency 3	86	Speed Command>Spd Mode & Limits
Sleep Level	182	Dynamic Control>Restart Modes
Sleep Time	183	Dynamic Control>Restart Modes
Sleep-Wake Mode	178	Dynamic Control>Restart Modes
Sleep-Wake Ref	179	Dynamic Control>Restart Modes
Slip Comp Gain	122	Speed Command>Slip Comp
Slip Reg Enable	530	Utility>Diag-Vector Cntl
Slip RPM @ FLA	121	Speed Command>Slip Comp
Slip RPM Meter	123	Speed Command>Slip Comp
Spd Dev Band	602	Applications>Torque Proving
SpdBand Integrat	603	Applications>Torque Proving
Speed Feedback	25	Monitor>Metering
Speed Desired BW	449	Speed Command>Speed Regulator
Speed Loop Meter	451	Speed Command>Speed Regulator
Speed Ref A Hi	91	Speed Command>Speed References
Speed Ref A Lo	92	Speed Command>Speed References
Speed Ref A Sel	90	Speed Command>Control Src Select Speed Command>Speed References
Speed Ref B Hi	94	Speed Command>Speed References
Speed Ref B Lo	95	Speed Command>Speed References
Speed Ref B Sel	93	Speed Command>Control Src Select Speed Command>Speed References
Speed Ref Source	213	Utility>Diagnostics
Speed Reference	23	Monitor>Metering
Speed/Torque Mod	88	Speed Command>Spd Mode & Limits
Speed Units	79	Speed Command>Spd Mode & Limits
Stability Filter	508	Utility>Diag-Motor Cntl
Start At Powerup	168	Dynamic Control>Stop/Restart Modes
Start Inhibits	214	Utility>Diagnostics
Start/Acc Boost	69	Motor Control>Volts per Hertz
Status 1 @ Fault	227	Utility>Diagnostics
Status 2 @ Fault	228	Utility>Diagnostics

Parameter Name	No.	Path (File>Group)
Stop Mode A	155	Dynamic Control>Stop/Brake Modes
Stop Mode B	156	Dynamic Control>Stop/Brake Modes
Stop Owner	288	Communication>Masks & Owners
Step 1 AccelTime	722	Pos/Spd Profile>Profile Step 1-16
Step 1 Batch	726	Pos/Spd Profile>Profile Step 1-16
Step 1 DecelTime	723	Pos/Spd Profile>Profile Step 1-16
Step 1 Dwell	725	Pos/Spd Profile>Profile Step 1-16
Step 1 Next	727	Pos/Spd Profile>Profile Step 1-16
Step 1 Type	720	Pos/Spd Profile>Profile Step 1-16
Step 1 Value	724	Pos/Spd Profile>Profile Step 1-16
Step 1 Velocity	721	Pos/Spd Profile>Profile Step 1-16
Step 2 AccelTime	732	Pos/Spd Profile>Profile Step 1-16
Step 2 Batch	736	Pos/Spd Profile>Profile Step 1-16
Step 2 DecelTime	733	Pos/Spd Profile>Profile Step 1-16
Step 2 Dwell	735	Pos/Spd Profile>Profile Step 1-16
Step 2 Next	737	Pos/Spd Profile>Profile Step 1-16
Step 2 Type	730	Pos/Spd Profile>Profile Step 1-16
Step 2 Value	734	Pos/Spd Profile>Profile Step 1-16
Step 2 Velocity	731	Pos/Spd Profile>Profile Step 1-16
Step 3 AccelTime	742	Pos/Spd Profile>Profile Step 1-16
Step 3 Batch	746	Pos/Spd Profile>Profile Step 1-16
Step 3 DecelTime	743	Pos/Spd Profile>Profile Step 1-16
Step 3 Dwell	745	Pos/Spd Profile>Profile Step 1-16
Step 3 Next	747	Pos/Spd Profile>Profile Step 1-16
Step 3 Type	740	Pos/Spd Profile>Profile Step 1-16
Step 3 Value	744	Pos/Spd Profile>Profile Step 1-16
Step 3 Velocity	741	Pos/Spd Profile>Profile Step 1-16
Step 4 AccelTime	752	Pos/Spd Profile>Profile Step 1-16
Step 4 Batch	756	Pos/Spd Profile>Profile Step 1-16
Step 4 DecelTime	753	Pos/Spd Profile>Profile Step 1-16
Step 4 Dwell	755	Pos/Spd Profile>Profile Step 1-16
Step 4 Next	757	Pos/Spd Profile>Profile Step 1-16
Step 4 Type	750	Pos/Spd Profile>Profile Step 1-16
Step 4 Value	754	Pos/Spd Profile>Profile Step 1-16
Step 4 Velocity	751	Pos/Spd Profile>Profile Step 1-16
Step 5 AccelTime	762	Pos/Spd Profile>Profile Step 1-16
Step 5 Batch	766	Pos/Spd Profile>Profile Step 1-16
Step 5 DecelTime	763	Pos/Spd Profile>Profile Step 1-16
Step 5 Dwell	765	Pos/Spd Profile>Profile Step 1-16
Step 5 Next	767	Pos/Spd Profile>Profile Step 1-16
Step 5 Type	760	Pos/Spd Profile>Profile Step 1-16

Parameter Name	No.	Path (File>Group)
Step 5 Value	764	Pos/Spd Profile>Profile Step 1-16
Step 5 Velocity	761	Pos/Spd Profile>Profile Step 1-16
Step 6 AccelTime	772	Pos/Spd Profile>Profile Step 1-16
Step 6 Batch	776	Pos/Spd Profile>Profile Step 1-16
Step 6 DecelTime	773	Pos/Spd Profile>Profile Step 1-16
Step 6 Dwell	775	Pos/Spd Profile>Profile Step 1-16
Step 6 Next	777	Pos/Spd Profile>Profile Step 1-16
Step 6 Type	770	Pos/Spd Profile>Profile Step 1-16
Step 6 Value	774	Pos/Spd Profile>Profile Step 1-16
Step 6 Velocity	771	Pos/Spd Profile>Profile Step 1-16
Step 7 AccelTime	782	Pos/Spd Profile>Profile Step 1-16
Step 7 Batch	786	Pos/Spd Profile>Profile Step 1-16
Step 7 DecelTime	783	Pos/Spd Profile>Profile Step 1-16
Step 7 Dwell	785	Pos/Spd Profile>Profile Step 1-16
Step 7 Next	787	Pos/Spd Profile>Profile Step 1-16
Step 7 Type	780	Pos/Spd Profile>Profile Step 1-16
Step 7 Value	784	Pos/Spd Profile>Profile Step 1-16
Step 7 Velocity	781	Pos/Spd Profile>Profile Step 1-16
Step 8 AccelTime	792	Pos/Spd Profile>Profile Step 1-16
Step 8 Batch	796	Pos/Spd Profile>Profile Step 1-16
Step 8 DecelTime	793	Pos/Spd Profile>Profile Step 1-16
Step 8 Dwell	795	Pos/Spd Profile>Profile Step 1-16
Step 8 Next	797	Pos/Spd Profile>Profile Step 1-16
Step 8 Type	790	Pos/Spd Profile>Profile Step 1-16
Step 8 Value	794	Pos/Spd Profile>Profile Step 1-16
Step 8 Velocity	791	Pos/Spd Profile>Profile Step 1-16
Step 9 AccelTime	802	Pos/Spd Profile>Profile Step 1-16
Step 9 Batch	806	Pos/Spd Profile>Profile Step 1-16
Step 9 DecelTime	803	Pos/Spd Profile>Profile Step 1-16
Step 9 Dwell	805	Pos/Spd Profile>Profile Step 1-16
Step 9 Next	807	Pos/Spd Profile>Profile Step 1-16
Step 9 Type	800	Pos/Spd Profile>Profile Step 1-16
Step 9 Value	804	Pos/Spd Profile>Profile Step 1-16
Step 9 Velocity	801	Pos/Spd Profile>Profile Step 1-16
Step 10 AccelTime	812	Pos/Spd Profile>Profile Step 1-16
Step 10 Batch	816	Pos/Spd Profile>Profile Step 1-16
Step 10 DecelTime	813	Pos/Spd Profile>Profile Step 1-16
Step 10 Dwell	815	Pos/Spd Profile>Profile Step 1-16
Step 10 Next	817	Pos/Spd Profile>Profile Step 1-16
Step 10 Type	810	Pos/Spd Profile>Profile Step 1-16
Step 10 Value	814	Pos/Spd Profile>Profile Step 1-16

Parameter Name	No.	Path (File>Group)
Step 10 Velocity	811	Pos/Spd Profile>Profile Step 1-16
Step 11 AccelTime	822	Pos/Spd Profile>Profile Step 1-16
Step 11 Batch	826	Pos/Spd Profile>Profile Step 1-16
Step 11 DecelTime	823	Pos/Spd Profile>Profile Step 1-16
Step 11 Dwell	825	Pos/Spd Profile>Profile Step 1-16
Step 11 Next	827	Pos/Spd Profile>Profile Step 1-16
Step 11 Type	820	Pos/Spd Profile>Profile Step 1-16
Step 11 Value	824	Pos/Spd Profile>Profile Step 1-16
Step 11 Velocity	821	Pos/Spd Profile>Profile Step 1-16
Step 12 AccelTime	832	Pos/Spd Profile>Profile Step 1-16
Step 12 Batch	836	Pos/Spd Profile>Profile Step 1-16
Step 12 DecelTime	833	Pos/Spd Profile>Profile Step 1-16
Step 12 Dwell	835	Pos/Spd Profile>Profile Step 1-16
Step 12 Next	837	Pos/Spd Profile>Profile Step 1-16
Step 12 Type	830	Pos/Spd Profile>Profile Step 1-16
Step 12 Value	834	Pos/Spd Profile>Profile Step 1-16
Step 12 Velocity	831	Pos/Spd Profile>Profile Step 1-16
Step 13 AccelTime	842	Pos/Spd Profile>Profile Step 1-16
Step 13 Batch	846	Pos/Spd Profile>Profile Step 1-16
Step 13 DecelTime	843	Pos/Spd Profile>Profile Step 1-16
Step 13 Dwell	845	Pos/Spd Profile>Profile Step 1-16
Step 13 Next	847	Pos/Spd Profile>Profile Step 1-16
Step 13 Type	840	Pos/Spd Profile>Profile Step 1-16
Step 13 Value	844	Pos/Spd Profile>Profile Step 1-16
Step 13 Velocity	841	Pos/Spd Profile>Profile Step 1-16
Step 14 AccelTime	853	Pos/Spd Profile>Profile Step 1-16
Step 14 Batch	856	Pos/Spd Profile>Profile Step 1-16
Step 14 DecelTime	853	Pos/Spd Profile>Profile Step 1-16
Step 14 Dwell	855	Pos/Spd Profile>Profile Step 1-16
Step 14 Next	857	Pos/Spd Profile>Profile Step 1-16
Step 14 Type	850	Pos/Spd Profile>Profile Step 1-16
Step 14 Value	854	Pos/Spd Profile>Profile Step 1-16
Step 14 Velocity	851	Pos/Spd Profile>Profile Step 1-16
Step 15 AccelTime	862	Pos/Spd Profile>Profile Step 1-16
Step 15 Batch	866	Pos/Spd Profile>Profile Step 1-16
Step 15 DecelTime	863	Pos/Spd Profile>Profile Step 1-16
Step 15 Dwell	865	Pos/Spd Profile>Profile Step 1-16
Step 15 Next	867	Pos/Spd Profile>Profile Step 1-16
Step 15 Type	860	Pos/Spd Profile>Profile Step 1-16
Step 15 Value	864	Pos/Spd Profile>Profile Step 1-16
Step 15 Velocity	861	Pos/Spd Profile>Profile Step 1-16

Parameter Name	No.	Path (File>Group)
Step 16 AccelTime	872	Pos/Spd Profile>Profile Step 1-16
Step 16 Batch	876	Pos/Spd Profile>Profile Step 1-16
Step 16 DecelTime	873	Pos/Spd Profile>Profile Step 1-16
Step 16 Dwell	875	Pos/Spd Profile>Profile Step 1-16
Step 16 Next	877	Pos/Spd Profile>Profile Step 1-16
Step 16 Type	870	Pos/Spd Profile>Profile Step 1-16
Step 16 Value	874	Pos/Spd Profile>Profile Step 1-16
Step 16 Velocity	871	Pos/Spd Profile>Profile Step 1-16
SV Boost Filter	59	Motor Control>Torq Attributes
TB Man Ref Hi	97	Speed Command>Speed References
TB Man Ref Lo	98	Speed Command>Speed References
TB Man Ref Sel	96	Speed Command>Speed References
Testpoint 1 Data	235	Utility>Diagnostics
Testpoint 1 Sel	234	Utility>Diagnostics
Testpoint 2 Data	237	Utility>Diagnostics
Testpoint 2 Sel	236	Utility>Diagnostics
Torq Prove Cngf	600	Applications>Torque Proving
Torq Prove Setup	601	Applications>Torque Proving
Torq Sts	612	Applications>Torque Proving
Torq Reg Enable	526	Utility>Diag-Vector Cntl
TorqLim SlewRate	608	Applications>Torque Proving
Torque Adapt Spd	525	Utility>Diag-Vector Cntl
Torque Current	4	Monitor>Metering
Torque Current Ref	441	Monitor>Metering
Torque Ref A Sel	427	Motor Control>Torq Attributes
Torque Ref A Hi	428	Motor Control>Torq Attributes
Torque Ref A Lo	429	Motor Control>Torq Attributes
Torque Ref A Div	430	Motor Control>Torq Attributes
Torque Ref B Sel	431	Motor Control>Torq Attributes
Torque Ref B Hi	432	Motor Control>Torq Attributes
Torque Ref B Lo	433	Motor Control>Torq Attributes
Torque Ref B Mult	434	Motor Control>Torq Attributes
Torque Reg Trim	529	Utility>Diag-Vector Cntl
Torque Setpoint 1	435	Motor Control>Torq Attributes
Torque Setpoint 1	435	Motor Control>Torq Attributes
Total Gear Ratio	646	Applications>Oil Well Pump
Total Inertia	450	Speed Command>Speed Regulator
Trim % Setpoint	116	Speed Command>Speed Trim
Trim Hi	119	Speed Command>Speed Trim
Trim In Select	117	Speed Commands>Speed Trim
Trim Lo	120	Speed Command>Speed Trim

Parameter Name	No.	Path (File>Group)
Trim Out Select	118	Speed Command>Speed Trim
Units Traveled	701	Pos/Spd Profile>ProfSetup/Status
Wake Level	180	Dynamic Control>Restart Modes
Wake Time	181	Dynamic Control>Restart Modes
Write Mask Actv	597	Communication>Security
Write Mask Cfg	596	Communication>Security
Vel Override	711	Pos/Spd Profile>ProfSetup/Status
Volt Stblty Gain	507	Utility>Diag-Motor Cntl
Voltage Class	202	Utility>Drive Memory
ZeroSpdFloatTime	605	Applications>Torque Proving

APPENDIX D

Record of User Sets

The following table lists the complete set of GV6000 parameters in alphabetical order.

No.	Parameter Name	Path (File>Group)	Setting
140	Accel Time 1	Dynamic Control>Ramp Rates	
141	Accel Time 2	Dynamic Control>Ramp Rates	
229	Alarm 1 @ Fault	Utility>Diagnostics	
230	Alarm 2 @ Fault	Utility>Diagnostics	
261	Alarm Clear 1	Utility>Alarms	
262	Alarm Code 1	Utility>Alarms	
263	Alarm Code 2	Utility>Alarms	
264	Alarm Code 3	Utility>Alarms	
265	Alarm Code 4	Utility>Alarms	
266	Alarm Code 5	Utility>Alarms	
267	Alarm Code 6	Utility>Alarms	
268	Alarm Code 7	Utility>Alarms	
269	Alarm Code 8	Utility>Alarms	
259	Alarm Config 1	Utility>Alarms	
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	
16	Analog In1 Value	Monitor>Metering	
17	Analog In2 Value	Monitor>Metering	
343	Analog Out1 Hi	Inputs & Outputs>Analog Outputs	
344	Analog Out1 Lo	Inputs & Outputs>Analog Outputs	
342	Analog Out1 Sel	Inputs & Outputs>Analog Outputs	
346	Analog Out2 Hi	Inputs & Outputs>Analog Outputs	
347	Analog Out2 Lo	Inputs & Outputs>Analog Outputs	
345	Analog Out2 Sel	Inputs & Outputs>Analog Outputs	
506	Angl Stblty Gain	Utility>Diag-Motor Cntl	
320	Anlg In Config	Inputs & Outputs>Analog Inputs	
321	Anlg In Sqr Root	Inputs & Outputs>Analog Inputs	
354	Anlg Out1 Scale	Inputs & Outputs>Analog Outputs	
377	Anlg Out1 Setpt	Inputs & Outputs>Analog Outputs	

No.	Parameter Name	Path (File>Group)	Setting
355	Anlg Out2 Scale	Inputs & Outputs>Analog Outputs	
378	Anlg Out2 Setpt	Inputs & Outputs>Analog Outputs	
341	Anlg Out Absolut	Inputs & Outputs>Analog Outputs	
340	Anlg Out Config	Inputs & Outputs>Analog Outputs	
175	Auto Rstrt Delay	Dynamic Control>Stop/Restart Modes	
174	Auto Rstrt Tries	Dynamic Control>Stop/Restart Modes	
61	Autotune	Motor Control>Torq Attributes	
66	Autotune Torque	Motor Control>Torq Attributes	
72	Break Frequency	Motor Control>Volts per Hertz	
71	Break Voltage	Motor Control>Volts per Hertz	
610	Brk Alarm Travel	Applications>Torque Proving	
604	Brk Release Time	Applications>Torque Proving	
607	Brk Set Time	Applications>Torque Proving	
609	Brk Slip Count	Applications>Torque Proving	
502	Bus Reg ACR Kp	Utility>Diag-Motor Cntl	
165	Bus Reg Kd	Dynamic Control>Stop/Brake Modes	
160	Bus Reg Ki	Dynamic Control>Stop/Brake Modes	
164	Bus Reg Kp	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	
523	Bus Utilization	Utility>Diag-Motor Cntl	
2	Commanded Speed	Monitor>Metering	
24	Commanded Torque	Monitor>Metering	
56	Compensation	Motor Control>Torq Attributes	
440	Control Status	Monitor>Metering	
29	Control SW Ver	Monitor>Drive Data	
708	Counts per Unit	Pos/Spd Profile>ProfSetup/Status	
149	Current Lmt Gain	Dynamic Control>Load Limits	
147	Current Lmt Sel	Dynamic Control>Ramp Rates	
148	Current Lmt Val	Dynamic Control>Load Limits	
154	Current Rate Lim	Dynamic Control>Load Limits	
514	DAC47-A	Utility>Diag-DACs	
515	DAC47-B	Utility>Diag-DACs	
516	DAC47-C	Utility>Diag-DACs	
517	DAC47-D	Utility>Diag-DACs	
519	DAC55-A	Utility>Diag-DACs	
520	DAC55-B	Utility>Diag-DACs	
521	DAC55-C	Utility>Diag-DACs	
522	DAC55-D	Utility>Diag-DACs	
300	Data In A1 - Link A Word 1	Communication>Datalinks	

No.	Parameter Name	Path (File>Group)	Setting
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	
647	DB Resistor	Applications>Oil Well Pump	
163	DB Resistor Type	Dynamic Control>Stop/Brake Modes	
145	DB While Stopped	Dynamic Control>Stop/Brake Modes	
158	DC Brake Level	Dynamic Control>Stop/Brake Modes	
157	DC Brake Lvl Sel	Dynamic Control>Stop/Brake Modes	
159	DC Brake Time	Dynamic Control>Stop/Brake Modes	
13	DC Bus Memory	Monitor>Metering	
12	DC Bus Voltage	Monitor>Metering	
142	Decel Time 1	Dynamic Control>Ramp Rates	
143	Decel Time 2	Dynamic Control>Ramp Rates	
216	Dig In Status	Utility>Diagnostics Inputs & Outputs>Digital Inputs	
217	Dig Out Status	Utility>Diagnostics Inputs & Outputs>Digital Outputs	
381	Dig Out1 Level	Inputs & Outputs>Digital Outputs	
383	Dig Out1 OffTime	Inputs & Outputs>Digital Outputs	
382	Dig Out1 OnTime	Inputs & Outputs>Digital Outputs	
385	Dig Out2 Level	Inputs & Outputs>Digital Outputs	
387	Dig Out2 OffTime	Inputs & Outputs>Digital Outputs	
386	Dig Out2 OnTime	Inputs & Outputs>Digital Outputs	
389	Dig Out3 Level	Inputs & Outputs>Digital Outputs	
391	Dig Out3 OffTime	Inputs & Outputs>Digital Outputs	
390	Dig Out3 OnTime	Inputs & Outputs>Digital Outputs	
392	Dig Out Invert	Inputs & Outputs>Digital Outputs	
394	Dig Out Mask	Inputs & Outputs>Digital Outputs	
393	Dig Out Param	Inputs & Outputs>Digital Outputs	
379	Dig Out Setpt	Inputs & Outputs>Digital Outputs	

No.	Parameter Name	Path (File>Group)	Setting
217	Dig Out Status	Inputs & Outputs>Digital 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	
384	Digital Out2 Sel	Inputs & Outputs>Digital Outputs	
388	Digital Out3 Sel	Inputs & Outputs>Digital Outputs	
190	Direction Mode	Utility>Direction Config	
270	DPI Data Rate	Communication>Comm Control	
299	DPI Fdbk Select	Communication>Comm Control	
274	DPI Port Select	Communication>Comm Control	
275	DPI Port Value	Communication>Comm Control	
298	DPI Ref Select	Communication>Comm Control	
211	Drive Alarm 1	Utility>Diagnostics Utility>Alarms	
212	Drive Alarm 2	Utility>Diagnostics Utility>Alarms	
203	Drive Checksum	Utility>Drive Memory	
271	Drive Logic Rslt	Communication>Comm Control	
219	Drive OL Count	Utility>Diagnostics	
150	Drive OL Mode	Dynamic Control>Load Limits	
273	Drive Ramp Rslt	Communication>Comm Control	
272	Drive Ref Rslt	Communication>Comm Control	
209	Drive Status 1	Utility>Diagnostics	
210	Drive Status 2	Utility>Diagnostics	
218	Drive Temp	Utility>Diagnostics	
152	Droop RPM @ FLA	Dynamic Control>Load Limits	
204	Dyn UserSet Cnfg	Utility>Drive Memory	
205	Dyn UserSet Sel	Utility>Drive Memory	
206	Dyn UserSet Actv	Utility>Drive Memory	
14	Elapsed kWh	Monitor>Metering	
9	Elapsed MWh	Monitor>Metering	
10	Elapsed Run Time	Monitor>Metering	
414	Enc Pos Feedback	Motor Control>Speed Feedback	
541	Encdlss Ang Comp	Utility>Diag-Vector Cntl	
542	Encdlss Vlt Comp	Utility>Diag-Vector Cntl	
707	Encoder Pos Tol	Pos/Spd Profile>ProfSetup/Status	
413	Encoder PPR	Motor Control>Speed Feedback	
415	Encoder Speed	Motor Control>Speed Feedback	

No.	Parameter Name	Path (File>Group)	Setting
423	Encoder Z Chan	Motor Control>Speed Feedback	
543	Excitation KI	Utility>Diag-Motor Cntl	
544	Excitation KP	Utility>Diag-Motor Cntl	
243	Fault 1 Code	Utility>Faults	
244	Fault 1 Time	Utility>Faults	
245	Fault 2 Code	Utility>Faults	
246	Fault 2 Time	Utility>Faults	
247	Fault 3 Code	Utility>Faults	
248	Fault 3 Time	Utility>Faults	
249	Fault 4 Code	Utility>Faults	
250	Fault 4 Time	Utility>Faults	
251	Fault 5 Code	Utility>Faults	
252	Fault 5 Time	Utility>Faults	
253	Fault 6 Code	Utility>Faults	
254	Fault 6 Time	Utility>Faults	
255	Fault 7 Code	Utility>Faults	
256	Fault 7 Time	Utility>Faults	
257	Fault 8 Code	Utility>Faults	
258	Fault 8 Time	Utility>Faults	
225	Fault Amps	Utility>Diagnostics	
226	Fault Bus Volts	Utility>Diagnostics	
240	Fault Clear	Utility>Faults	
241	Fault Clear Mode	Utility>Faults	
238	Fault Config 1	Utility>Faults	
224	Fault Speed	Utility>Diagnostics	
416	Fdbk Filter Sel	Motor Control>Speed Feedback	
80	Feedback Select	Speed Command>Spd Mode & Limits	
714	Find Home Ramp	Pos/Spd Profile>ProfSetup/Status	
713	Find Home Speed	Pos/Spd Profile>ProfSetup/Status	
606	Float Tolerance	Applications>Torque Proving	
166	Flux Braking	Dynamic Control>Stop/Brake Modes	
549	Flux Braking %	Utility>Diag-Motor Cntl	
5	Flux Current	Monitor>Metering	
63	Flux Current Ref	Motor Control>Torq Attributes	
530	Flux Reg Enable	Utility>Diag-Vector Cntl	
57	Flux Up Mode	Motor Control>Torq Attributes	
58	Flux Up Time	Motor Control>Torq Attributes	
169	Flying Start En	Dynamic Control>Restart Modes	
170	Flying Start Gain	Dynamic Control>Restart Modes	
550	Flying Start Ki	Utility>Diag-Motor Cntl	

No.	Parameter Name	Path (File>Group)	Setting
648	Gearbox Limit	Applications>Oil Well Pump	
642	Gearbox Rating	Applications>Oil Well Pump	
644	Gearbox Ratio	Applications>Oil Well Pump	
643	Gearbox Sheave	Applications>Oil Well Pump	
177	Gnd Warn Level	Dynamic Control>Power Loss	
518	Host DAC Enable	Utility>Diag-DACs	
67	Inertia Autotune	Motor Control>Torq Attributes	
62	IR Voltage Drop	Motor Control>Torq Attributes	
64	Ixo Voltage Drop	Motor Control>Torq Attributes	
503	Jerk	Utility>Diag-Motor Cntl	
100	Jog Speed 1	Speed Command>Discrete Speeds	
108 0	Jog Speed 2	Speed Command>Discrete Speeds	
501	Kd Current Limit	Utility>Diag-Motor Cntl	
505	Kd LL Bus Reg	Utility>Diag-Motor Cntl	
447	Kf Speed Loop	Speed Command>Speed Regulator	
511	Ki Cur Reg	Utility>Diag-Motor Cntl	
547	Ki Fast Brake	Utility>Diag-Motor Cntl	
536	Ki Flux Brake	Utility>Diag-Motor Cntl	
535	Ki Flux Reg	Utility>Diag-Vector Cntl	
540	Ki Freq Reg	Utility>Diag-Vector Cntl	
500	Ki Current Limit	Utility>Diag-Motor Cntl	
532	Ki Slip Reg	Utility>Diag-Vector Cntl	
445	Ki Speed Loop	Speed Command>Speed Regulator	
528	Ki Torque Reg	Utility>Diag-Vector Cntl	
512	Kp Cur Reg	Utility>Diag-Motor Cntl	
548	Kp Fast Brake	Utility>Diag-Motor Cntl	
537	Kp Flux Brake	Utility>Diag-Motor Cntl	
534	Kp Flux Reg	Utility>Diag-Vector Cntl	
539	Kp Freq Reg	Utility>Diag-Vector Cntl	
504	Kp LL Bus Reg	Utility>Diag-Motor Cntl	
531	Kp Slip Reg	Utility>Diag-Vector Cntl	
446	Kp Speed Loop	Speed Command>Speed Regulator	
527	Kp Torque Reg	Utility>Diag-Vector Cntl	
201	Language	Utility>Drive Memory	
215	Last Stop Source	Utility>Diagnostics	
545	In PhaseLoss Lvl	Utility>Diag-Motor Cntl	
509	Lo Freq Reg Kpld	Utility>Diag-Motor Cntl	
510	Lo Freq Reg Kplq	Utility>Diag-Motor Cntl	
598	Logic Mask Actv	Communications>Security	
198	Load Frm Usr Set	Utility>Drive Memory	

No.	Parameter Name	Path (File>Group)	Setting
187	Load Loss Level	Dynamic Control>Restart Modes	
188	Load Loss Time	Dynamic Control>Restart Modes	
89	Logic Source Sel	Speed Command>Control Src Select	
193	Man Ref Preload	Utility>OIM Ref Config	
286	Manual Mask	Communication>Masks & Owners	
287	Manual Owner	Communication>Masks & Owners	
421	Marker Pulse	Motor Control>Speed Feedback	
640	Max Rod Speed	Applications>Oil Well Pump	
55	Maximum Freq	Motor Control>Torq Attributes	
82	Maximum Speed	Speed Command>Spd Mode & Limits	
54	Maximum Voltage	Motor Control>Torq Attributes	
611	MicorPos Scale %	Applications>Torque Proving	
639	Min Rod Speed	Applications>Oil Well Pump	
81	Minimum Speed	Speed Command>Spd Mode & Limits	
11	MOP Reference	Monitor>Metering	
195	MOP Rate	Utility>MOP Config	
53	Motor Cntl Sel	Motor Control>Torq Attributes	
412	Motor Fdbk Type	Motor Control>Speed Feedback	
42	Motor NP FLA	Motor Control>Motor Data	
43	Motor NP Hertz	Motor Control>Motor Data	
45	Motor NP Power	Motor Control>Motor Data	
44	Motor NP RPM	Motor Control>Motor Data	
41	Motor NP Volts	Motor Control>Motor Data	
220	Motor OL Count	Utility>Diagnostics	
48	Motor OL Factor	Motor Control>Motor Data	
47	Motor OL Hertz	Motor Control>Motor Data	
49	Motor Poles	Motor Control>Motor Data	
645	Motor Sheave	Applications>Oil Well Pump	
40	Motor Type	Motor Control>Motor Data	
46	Mtr NP Pwr Units	Motor Control>Motor Data	
221	Mtr OL Trip Time	Utility>Diagnostics	
437	Neg Torque Limit	Monitor>Metering	
419	Notch Filter Freq	Motor Control>Speed Feedback	
420	Notch Filter K	Motor Control>Speed Feedback	
641	OilWell Pump Sel	Applications>Oil Well Pump	
546	OutPhase LossLvl	Utility>Diag-Motor Cntl	
3	Output Current	Monitor>Metering	
1	Output Freq	Monitor>Metering	
7	Output Power	Monitor>Metering	
8	Output Powr Fctr	Monitor>Metering	

No.	Parameter Name	Path (File>Group)	Setting
6	Output Voltage	Monitor>Metering	
83	Overspeed Limit	Speed Command>Spd Mode & Limits	
196	Param Access Lvl	Utility>Drive Memory	
637	PCP Pump Sheave	Applications>Oil Well Pump	
638	PCP Rod Torque	Applications>Oil Well Pump	
139	PI BW Filter	Speed Command>Process PI	
124	PI Configuration	Speed Command>Process PI	
125	PI Control	Speed Command>Process PI	
459	PI Deriv Time	Speed Command>Process PI	
137	PI Error Meter	Speed Command>Process PI	
136	PI Fdback Meter	Speed Command>Process PI	
462	PI Feedback Hi	Speed Command>Process PI	
463	PI Feedback Lo	Speed Command>Process PI	
128	PI Feedback Sel	Speed Command>Process PI	
129	PI Integral Time	Speed Command>Process PI	
131	PI Lower Limit	Speed Command>Process PI	
464	PI Output Gain	Speed Command>Process PI	
138	PI Output Meter	Speed Command>Process PI	
133	PI Preload	Speed Command>Process PI	
130	PI Prop Gain	Speed Command>Process PI	
135	PI Ref Meter	Speed Command>Process PI	
460	PI Reference Hi	Speed Command>Process PI	
461	PI Reference Lo	Speed Command>Process PI	
126	PI Reference Sel	Speed Command>Process PI	
127	PI Setpoint	Speed Command>Process PI	
134	PI Status	Speed Command>Process PI	
132	PI Upper Limit	Speed Command>Process PI	
595	Port Mask Actv	Communication>Security	
718	Pos Reg Filter	Pos/Spd Profile>ProfSetup/Status	
719	Pos Reg Gain	Pos/Spd Profile>ProfSetup/Status	
436	Pos Torque Limit	Monitor>Metering	
186	Power Loss Level	Dynamic Control>Power Loss	
184	Power Loss Mode	Dynamic Control>Stop/Power Loss	
185	Power Loss Time	Dynamic Control>Stop/Power Loss	
167	Power Up Delay	Dynamic Control>Restart Modes	
242	Power Up Marker	Utility>Faults	
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	

No.	Parameter Name	Path (File>Group)	Setting
105	Preset Speed 5	Speed Command>Discrete Speeds	
106	Preset Speed 6	Speed Command>Discrete Speeds	
107	Preset Speed 7	Speed Command>Discrete Speeds	
705	Profile Command	Pos/Spd Profile>ProfSetup/Status	
700	Profile Status	Pos/Spd Profile>ProfSetup/Status	
18	PTC HW Value	Monitor>Metering	
99	Pulse Input Ref	Speed Command>Speed References	
422	Pulse In Scale	Motor Control>Speed Feedback	
513	PWM DAC Enable	Utility>Diag-DACs	
151	PWM Frequency	Dynamic Control>Load Limits	
524	PWM Type Select	Utility>Diag-Motor Cntl	
22	Ramped Speed	Monitor>Metering	
28	Rated Amps	Monitor>Drive Data	
26	Rated kW	Monitor>Drive Data	
27	Rated Volts	Monitor>Drive Data	
538	Rec Delay Time	Utility>Diag-Motor Cntl	
153	Regen Power Lim	Dynamic Control>Load Limits	
200	Reset Meters	Utility>Drive Memory	
197	Reset To Defalts	Utility>Drive Memory	
454	Rev Speed Limit	Speed Command>Spd Mode & Limits	
70	Run Boost	Motor Control>Volts per Hertz	
146	S Curve %	Dynamic Control>Ramp Rates	
194	Save MOP Ref	Utility>MOP Config	
192	Save OIM Ref	Utility>OIM Ref Config	
199	Save To User Set	Utility>Drive Memory	
477	Scale 1 In Hi	Utility>Scaled Blocks	
478	Scale 1 In Lo	Utility>Scaled Blocks	
476	Scale 1 In Value	Utility>Scaled Blocks	
479	Scale 1 Out Hi	Utility>Scaled Blocks	
480	Scale 1 Out Lo	Utility>Scaled Blocks	
481	Scale 1 Out Value	Utility>Scaled Blocks	
483	Scale 2 In Hi	Utility>Scaled Blocks	
484	Scale 2 In Lo	Utility>Scaled Blocks	
482	Scale 2 In Value	Utility>Scaled Blocks	
485	Scale 2 Out Hi	Utility>Scaled Blocks	
486	Scale 2 Out Lo	Utility>Scaled Blocks	
487	Scale 2 Out Value	Utility>Scaled Blocks	
489	Scale 3 In Hi	Utility>Scaled Blocks	
490	Scale 3 In Lo	Utility>Scaled Blocks	
488	Scale 3 In Value	Utility>Scaled Blocks	

No.	Parameter Name	Path (File>Group)	Setting
491	Scale 3 Out Hi	Utility>Scaled Blocks	
492	Scale 3 Out Lo	Utility>Scaled Blocks	
493	Scale 3 Out Value	Utility>Scaled Blocks	
495	Scale 4 In Hi	Utility>Scaled Blocks	
496	Scale 4 In Lo	Utility>Scaled Blocks	
494	Scale 4 In Value	Utility>Scaled Blocks	
497	Scale 4 Out Hi	Utility>Scaled Blocks	
498	Scale 4 Out Lo	Utility>Scaled Blocks	
499	Scale 4 Out Value	Utility>Scaled Blocks	
21	Spd Fdbk No Filt	Monitor>Metering	
189	Shear Pin Time	Dynamic Control>Load Limits	
87	Skip Freq Band	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	
182	Sleep Level	Dynamic Control>Restart Modes	
183	Sleep Time	Dynamic Control>Restart Modes	
178	Sleep-Wake Mode	Dynamic Control>Restart Modes	
179	Sleep-Wake Ref	Dynamic Control>Restart Modes	
122	Slip Comp Gain	Speed Command>Slip Comp	
530	Slip Reg Enable	Utility>Diag-Vector Cntl	
121	Slip RPM @ FLA	Speed Command>Slip Comp	
123	Slip RPM Meter	Speed Command>Slip Comp	
602	Spd Dev Band	Applications>Torque Proving	
603	SpdBand Integrat	Applications>Torque Proving	
25	Speed Feedback	Monitor>Metering	
449	Speed Desired BW	Speed Command>Speed Regulator	
451	Speed Loop Meter	Speed Command>Speed Regulator	
91	Speed Ref A Hi	Speed Command>Speed References	
92	Speed Ref A Lo	Speed Command>Speed References	
90	Speed Ref A Sel	Speed Command>Control Src Select Speed Command>Speed References	
94	Speed Ref B Hi	Speed Command>Speed References	
95	Speed Ref B Lo	Speed Command>Speed References	

No.	Parameter Name	Path (File>Group)	Setting
93	Speed Ref B Sel	Speed Command>Control Src Select Speed Command>Speed References	
213	Speed Ref Source	Utility>Diagnostics	
23	Speed Reference	Monitor>Metering	
88	Speed/Torque Mod	Speed Command>Spd Mode & Limits	
79	Speed Units	Speed Command>Spd Mode & Limits	
508	Stability Filter	Utility>Diag-Motor Cntl	
168	Start At Powerup	Dynamic Control>Stop/Restart Modes	
214	Start Inhibits	Utility>Diagnostics	
69	Start/Acc Boost	Motor Control>Volts per Hertz	
227	Status 1 @ Fault	Utility>Diagnostics	
228	Status 2 @ Fault	Utility>Diagnostics	
155	Stop Mode A	Dynamic Control>Stop/Brake Modes	
156	Stop Mode B	Dynamic Control>Stop/Brake Modes	
288	Stop Owner	Communication>Masks & Owners	
722	Step 1 AccelTime	Pos/Spd Profile>Profile Step 1-16	
726	Step 1 Batch	Pos/Spd Profile>Profile Step 1-16	
723	Step 1 DecelTime	Pos/Spd Profile>Profile Step 1-16	
725	Step 1 Dwell	Pos/Spd Profile>Profile Step 1-16	
727	Step 1 Next	Pos/Spd Profile>Profile Step 1-16	
720	Step 1 Type	Pos/Spd Profile>Profile Step 1-16	
724	Step 1 Value	Pos/Spd Profile>Profile Step 1-16	
721	Step 1 Velocity	Pos/Spd Profile>Profile Step 1-16	
732	Step 2 AccelTime	Pos/Spd Profile>Profile Step 1-16	
736	Step 2 Batch	Pos/Spd Profile>Profile Step 1-16	
733	Step 2 DecelTime	Pos/Spd Profile>Profile Step 1-16	
735	Step 2 Dwell	Pos/Spd Profile>Profile Step 1-16	
737	Step 2 Next	Pos/Spd Profile>Profile Step 1-16	
730	Step 2 Type	Pos/Spd Profile>Profile Step 1-16	
734	Step 2 Value	Pos/Spd Profile>Profile Step 1-16	
731	Step 2 Velocity	Pos/Spd Profile>Profile Step 1-16	
742	Step 3 AccelTime	Pos/Spd Profile>Profile Step 1-16	
746	Step 3 Batch	Pos/Spd Profile>Profile Step 1-16	
743	Step 3 DecelTime	Pos/Spd Profile>Profile Step 1-16	
745	Step 3 Dwell	Pos/Spd Profile>Profile Step 1-16	
747	Step 3 Next	Pos/Spd Profile>Profile Step 1-16	
740	Step 3 Type	Pos/Spd Profile>Profile Step 1-16	
744	Step 3 Value	Pos/Spd Profile>Profile Step 1-16	

No.	Parameter Name	Path (File>Group)	Setting
741	Step 3 Velocity	Pos/Spd Profile>Profile Step 1-16	
752	Step 4 AccelTime	Pos/Spd Profile>Profile Step 1-16	
756	Step 4 Batch	Pos/Spd Profile>Profile Step 1-16	
753	Step 4 DecelTime	Pos/Spd Profile>Profile Step 1-16	
755	Step 4 Dwell	Pos/Spd Profile>Profile Step 1-16	
757	Step 4 Next	Pos/Spd Profile>Profile Step 1-16	
750	Step 4 Type	Pos/Spd Profile>Profile Step 1-16	
754	Step 4 Value	Pos/Spd Profile>Profile Step 1-16	
751	Step 4 Velocity	Pos/Spd Profile>Profile Step 1-16	
762	Step 5 AccelTime	Pos/Spd Profile>Profile Step 1-16	
766	Step 5 Batch	Pos/Spd Profile>Profile Step 1-16	
763	Step 5 DecelTime	Pos/Spd Profile>Profile Step 1-16	
765	Step 5 Dwell	Pos/Spd Profile>Profile Step 1-16	
767	Step 5 Next	Pos/Spd Profile>Profile Step 1-16	
760	Step 5 Type	Pos/Spd Profile>Profile Step 1-16	
764	Step 5 Value	Pos/Spd Profile>Profile Step 1-16	
761	Step 5 Velocity	Pos/Spd Profile>Profile Step 1-16	
772	Step 6 AccelTime	Pos/Spd Profile>Profile Step 1-16	
776	Step 6 Batch	Pos/Spd Profile>Profile Step 1-16	
773	Step 6 DecelTime	Pos/Spd Profile>Profile Step 1-16	
775	Step 6 Dwell	Pos/Spd Profile>Profile Step 1-16	
777	Step 6 Next	Pos/Spd Profile>Profile Step 1-16	
770	Step 6 Type	Pos/Spd Profile>Profile Step 1-16	
774	Step 6 Value	Pos/Spd Profile>Profile Step 1-16	
771	Step 6 Velocity	Pos/Spd Profile>Profile Step 1-16	
782	Step 7 AccelTime	Pos/Spd Profile>Profile Step 1-16	
786	Step 7 Batch	Pos/Spd Profile>Profile Step 1-16	
783	Step 7 DecelTime	Pos/Spd Profile>Profile Step 1-16	
785	Step 7 Dwell	Pos/Spd Profile>Profile Step 1-16	
787	Step 7 Next	Pos/Spd Profile>Profile Step 1-16	
780	Step 7 Type	Pos/Spd Profile>Profile Step 1-16	
784	Step 7 Value	Pos/Spd Profile>Profile Step 1-16	
781	Step 7 Velocity	Pos/Spd Profile>Profile Step 1-16	
792	Step 8 AccelTime	Pos/Spd Profile>Profile Step 1-16	
796	Step 8 Batch	Pos/Spd Profile>Profile Step 1-16	
793	Step 8 DecelTime	Pos/Spd Profile>Profile Step 1-16	
795	Step 8 Dwell	Pos/Spd Profile>Profile Step 1-16	
797	Step 8 Next	Pos/Spd Profile>Profile Step 1-16	
790	Step 8 Type	Pos/Spd Profile>Profile Step 1-16	
794	Step 8 Value	Pos/Spd Profile>Profile Step 1-16	
791	Step 8 Velocity	Pos/Spd Profile>Profile Step 1-16	

No.	Parameter Name	Path (File>Group)	Setting
802	Step 9 AccelTime	Pos/Spd Profile>Profile Step 1-16	
806	Step 9 Batch	Pos/Spd Profile>Profile Step 1-16	
803	Step 9 DecelTime	Pos/Spd Profile>Profile Step 1-16	
805	Step 9 Dwell	Pos/Spd Profile>Profile Step 1-16	
807	Step 9 Next	Pos/Spd Profile>Profile Step 1-16	
800	Step 9 Type	Pos/Spd Profile>Profile Step 1-16	
804	Step 9 Value	Pos/Spd Profile>Profile Step 1-16	
801	Step 9 Velocity	Pos/Spd Profile>Profile Step 1-16	
812	Step 10 AccelTime	Pos/Spd Profile>Profile Step 1-16	
816	Step 10 Batch	Pos/Spd Profile>Profile Step 1-16	
813	Step 10 DecelTime	Pos/Spd Profile>Profile Step 1-16	
815	Step 10 Dwell	Pos/Spd Profile>Profile Step 1-16	
817	Step 10 Next	Pos/Spd Profile>Profile Step 1-16	
810	Step 10 Type	Pos/Spd Profile>Profile Step 1-16	
814	Step 10 Value	Pos/Spd Profile>Profile Step 1-16	
811	Step 10 Velocity	Pos/Spd Profile>Profile Step 1-16	
822	Step 11 AccelTime	Pos/Spd Profile>Profile Step 1-16	
826	Step 11 Batch	Pos/Spd Profile>Profile Step 1-16	
823	Step 11 DecelTime	Pos/Spd Profile>Profile Step 1-16	
825	Step 11 Dwell	Pos/Spd Profile>Profile Step 1-16	
827	Step 11 Next	Pos/Spd Profile>Profile Step 1-16	
820	Step 11 Type	Pos/Spd Profile>Profile Step 1-16	
824	Step 11 Value	Pos/Spd Profile>Profile Step 1-16	
821	Step 11 Velocity	Pos/Spd Profile>Profile Step 1-16	
832	Step 12 AccelTime	Pos/Spd Profile>Profile Step 1-16	
836	Step 12 Batch	Pos/Spd Profile>Profile Step 1-16	
833	Step 12 DecelTime	Pos/Spd Profile>Profile Step 1-16	
835	Step 12 Dwell	Pos/Spd Profile>Profile Step 1-16	
837	Step 12 Next	Pos/Spd Profile>Profile Step 1-16	
830	Step 12 Type	Pos/Spd Profile>Profile Step 1-16	
834	Step 12 Value	Pos/Spd Profile>Profile Step 1-16	
831	Step 12 Velocity	Pos/Spd Profile>Profile Step 1-16	
842	Step 13 AccelTime	Pos/Spd Profile>Profile Step 1-16	
846	Step 13 Batch	Pos/Spd Profile>Profile Step 1-16	
843	Step 13 DecelTime	Pos/Spd Profile>Profile Step 1-16	
845	Step 13 Dwell	Pos/Spd Profile>Profile Step 1-16	
847	Step 13 Next	Pos/Spd Profile>Profile Step 1-16	
840	Step 13 Type	Pos/Spd Profile>Profile Step 1-16	
844	Step 13 Value	Pos/Spd Profile>Profile Step 1-16	
841	Step 13 Velocity	Pos/Spd Profile>Profile Step 1-16	
853	Step 14 AccelTime	Pos/Spd Profile>Profile Step 1-16	

No.	Parameter Name	Path (File>Group)	Setting
856	Step 14 Batch	Pos/Spd Profile>Profile Step 1-16	
853	Step 14 DecelTime	Pos/Spd Profile>Profile Step 1-16	
855	Step 14 Dwell	Pos/Spd Profile>Profile Step 1-16	
857	Step 14 Next	Pos/Spd Profile>Profile Step 1-16	
850	Step 14 Type	Pos/Spd Profile>Profile Step 1-16	
854	Step 14 Value	Pos/Spd Profile>Profile Step 1-16	
851	Step 14 Velocity	Pos/Spd Profile>Profile Step 1-16	
862	Step 15 AccelTime	Pos/Spd Profile>Profile Step 1-16	
866	Step 15 Batch	Pos/Spd Profile>Profile Step 1-16	
863	Step 15 DecelTime	Pos/Spd Profile>Profile Step 1-16	
865	Step 15 Dwell	Pos/Spd Profile>Profile Step 1-16	
867	Step 15 Next	Pos/Spd Profile>Profile Step 1-16	
860	Step 15 Type	Pos/Spd Profile>Profile Step 1-16	
864	Step 15 Value	Pos/Spd Profile>Profile Step 1-16	
861	Step 15 Velocity	Pos/Spd Profile>Profile Step 1-16	
872	Step 16 AccelTime	Pos/Spd Profile>Profile Step 1-16	
876	Step 16 Batch	Pos/Spd Profile>Profile Step 1-16	
873	Step 16 DecelTime	Pos/Spd Profile>Profile Step 1-16	
875	Step 16 Dwell	Pos/Spd Profile>Profile Step 1-16	
877	Step 16 Next	Pos/Spd Profile>Profile Step 1-16	
870	Step 16 Type	Pos/Spd Profile>Profile Step 1-16	
874	Step 16 Value	Pos/Spd Profile>Profile Step 1-16	
871	Step 16 Velocity	Pos/Spd Profile>Profile Step 1-16	
59	SV Boost Filter	Motor Control>Torq Attributes	
97	TB Man Ref Hi	Speed Command>Speed References	
98	TB Man Ref Lo	Speed Command>Speed References	
96	TB Man Ref Sel	Speed Command>Speed References	
235	Testpoint 1 Data	Utility>Diagnostics	
234	Testpoint 1 Sel	Utility>Diagnostics	
237	Testpoint 2 Data	Utility>Diagnostics	
236	Testpoint 2 Sel	Utility>Diagnostics	
600	Torq Prove Cngf	Applications>Torque Proving	
601	Torq Prove Setup	Applications>Torque Proving	
612	Torq Sts	Applications>Torque Proving	
526	Torq Reg Enable	Utility>Diag-Vector Cntl	
608	TorqLim SlewRate	Applications>Torque Proving	
525	Torque Adapt Spd	Utility>Diag-Vector Cntl	
4	Torque Current	Monitor>Metering	
441	Torque Current Ref	Monitor>Metering	

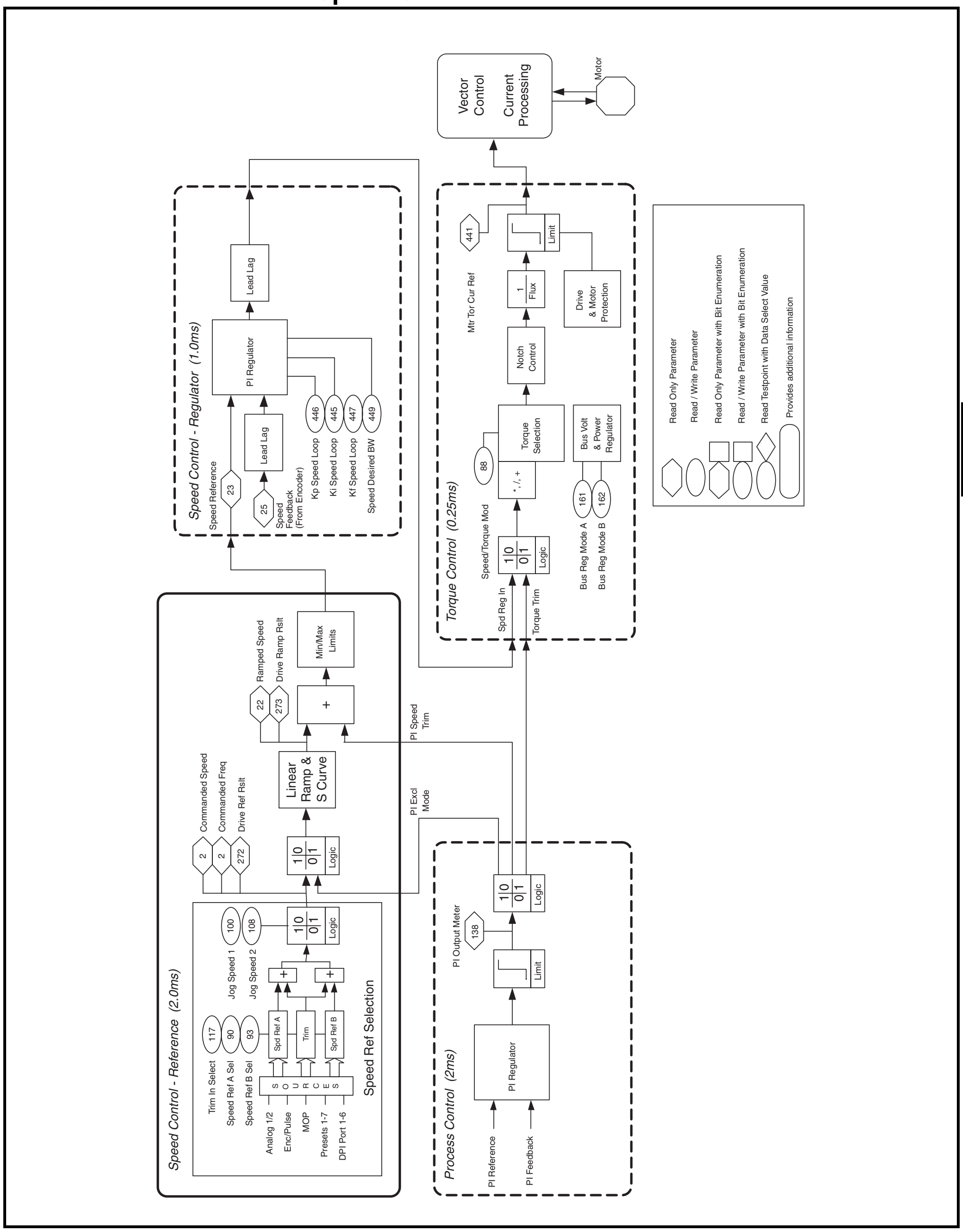
No.	Parameter Name	Path (File>Group)	Setting
427	Torque Ref A Sel	Motor Control>Torq Attributes	
428	Torque Ref A Hi	Motor Control>Torq Attributes	
429	Torque Ref A Lo	Motor Control>Torq Attributes	
430	Torque Ref A Div	Motor Control>Torq Attributes	
431	Torque Ref B Sel	Motor Control>Torq Attributes	
432	Torque Ref B Hi	Motor Control>Torq Attributes	
433	Torque Ref B Lo	Motor Control>Torq Attributes	
434	Torque Ref B Mult	Motor Control>Torq Attributes	
529	Torque Reg Trim	Utility>Diag-Vector Cntl	
435	Torque Setpoint 1	Motor Control>Torq Attributes	
435	Torque Setpoint 1	Motor Control>Torq Attributes	
646	Total Gear Ratio	Applications>Oil Well Pump	
450	Total Inertia	Speed Command>Speed Regulator	
116	Trim % Setpoint	Speed Command>Speed Trim	
119	Trim Hi	Speed Command>Speed Trim	
117	Trim In Select	Speed Commands>Speed Trim	
120	Trim Lo	Speed Command>Speed Trim	
118	Trim Out Select	Speed Command>Speed Trim	
701	Units Traveled	Pos/Spd Profile>ProfSetup/Status	
180	Wake Level	Dynamic Control>Restart Modes	
181	Wake Time	Dynamic Control>Restart Modes	
597	Write Mask Actv	Communication>Security	
596	Write Mask Cfg	Communication>Security	
711	Vel Override	Pos/Spd Profile>ProfSetup/Status	
507	Volt Stblty Gain	Utility>Diag-Motor Cntl	
202	Voltage Class	Utility>Drive Memory	
605	ZeroSpdFloatTime	Applications>Torque Proving	

Appendix E

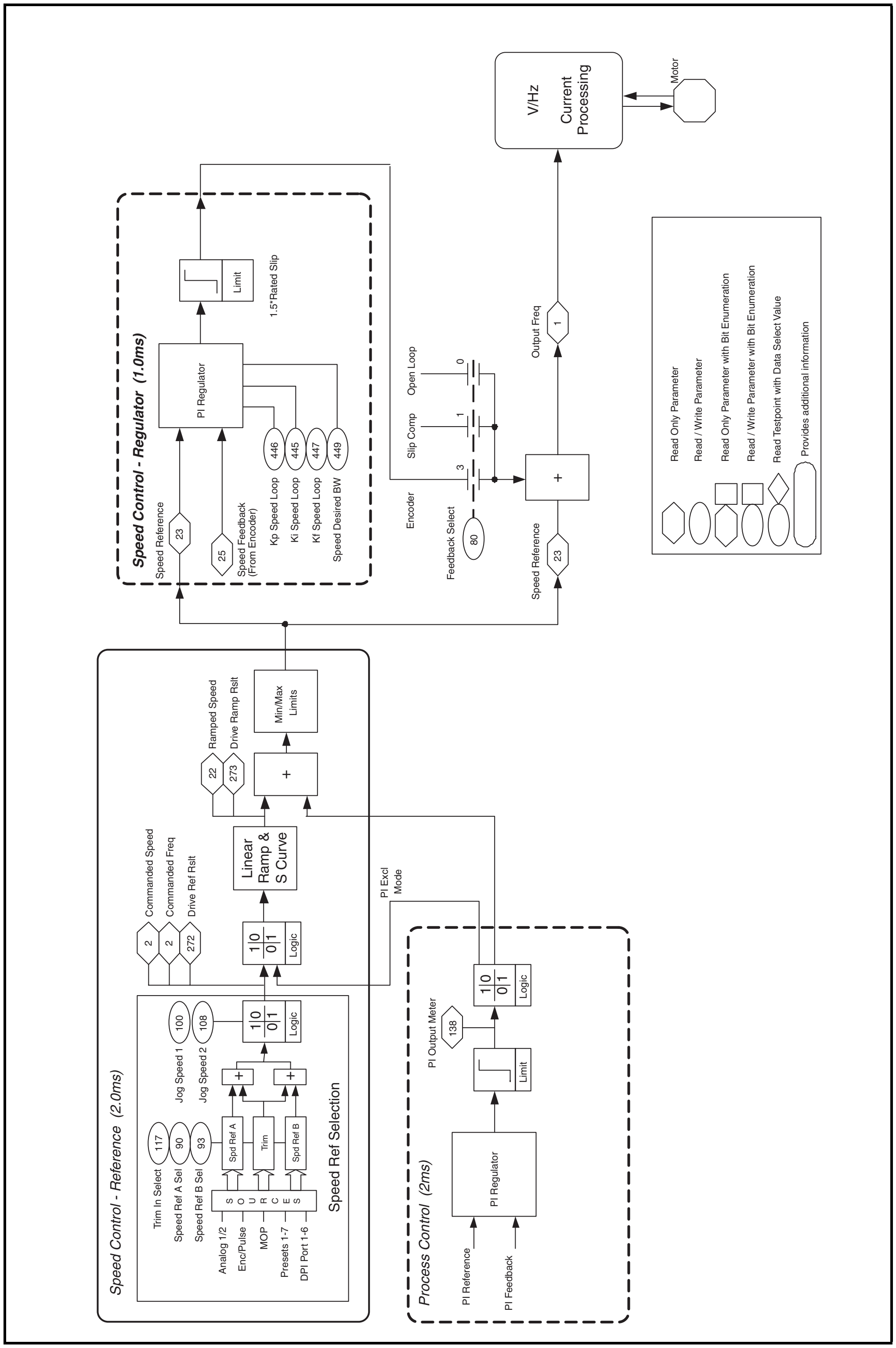
Block Diagrams

Appendix E provides block diagrams for the GV6000 AC Drive.

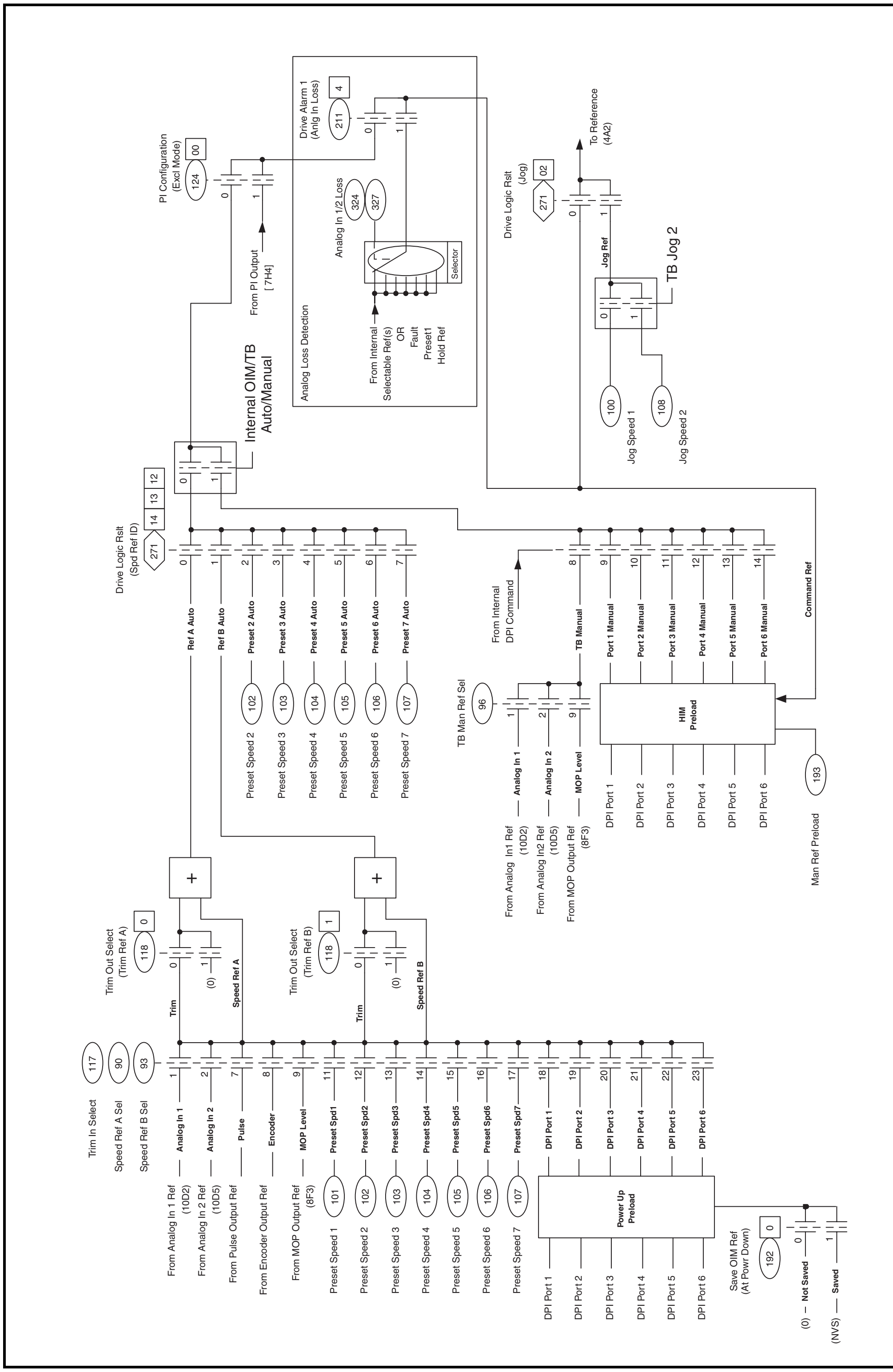
Vector Control Mode with Speed Control



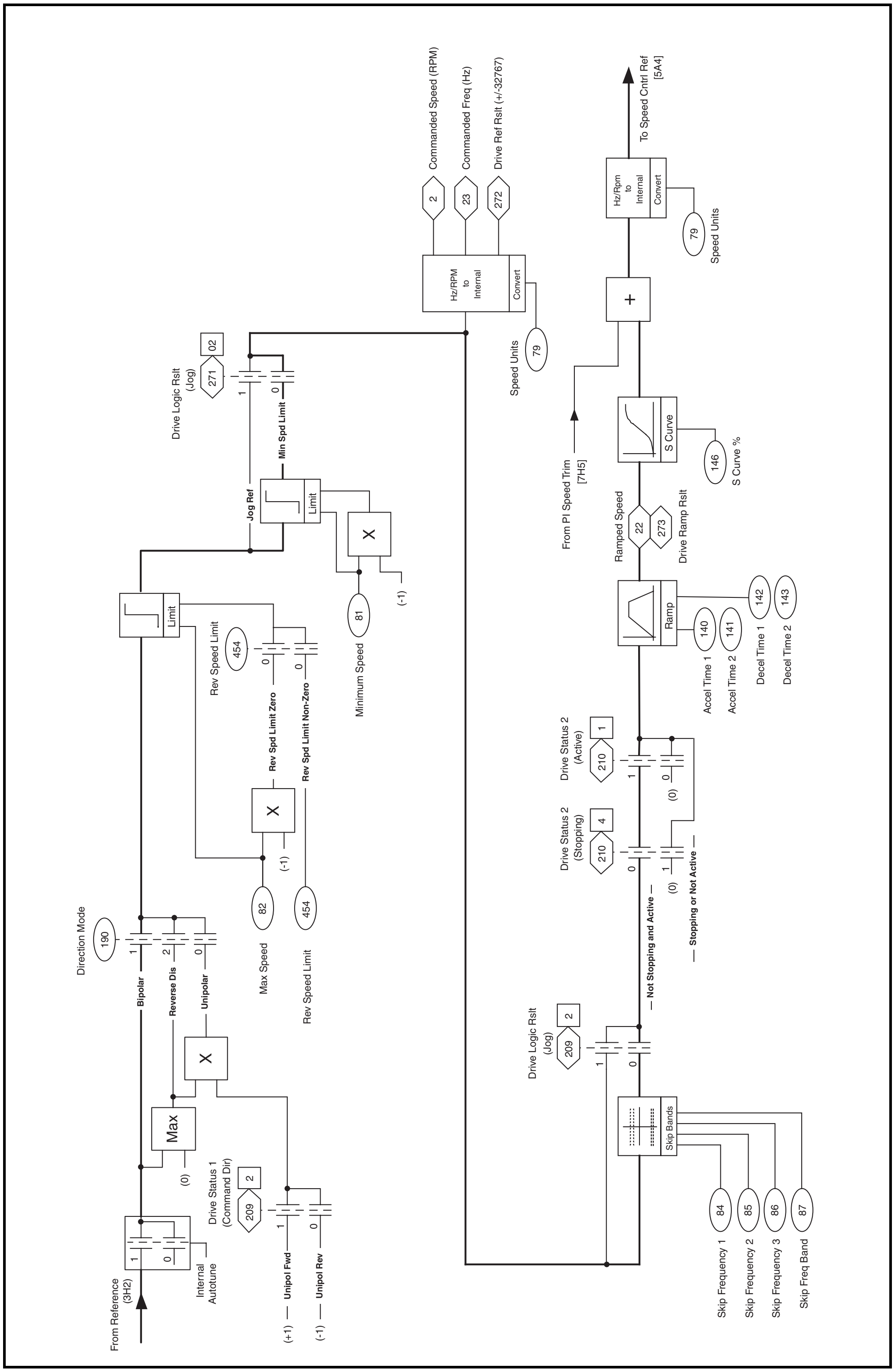
V/Hz Mode with Speed Control



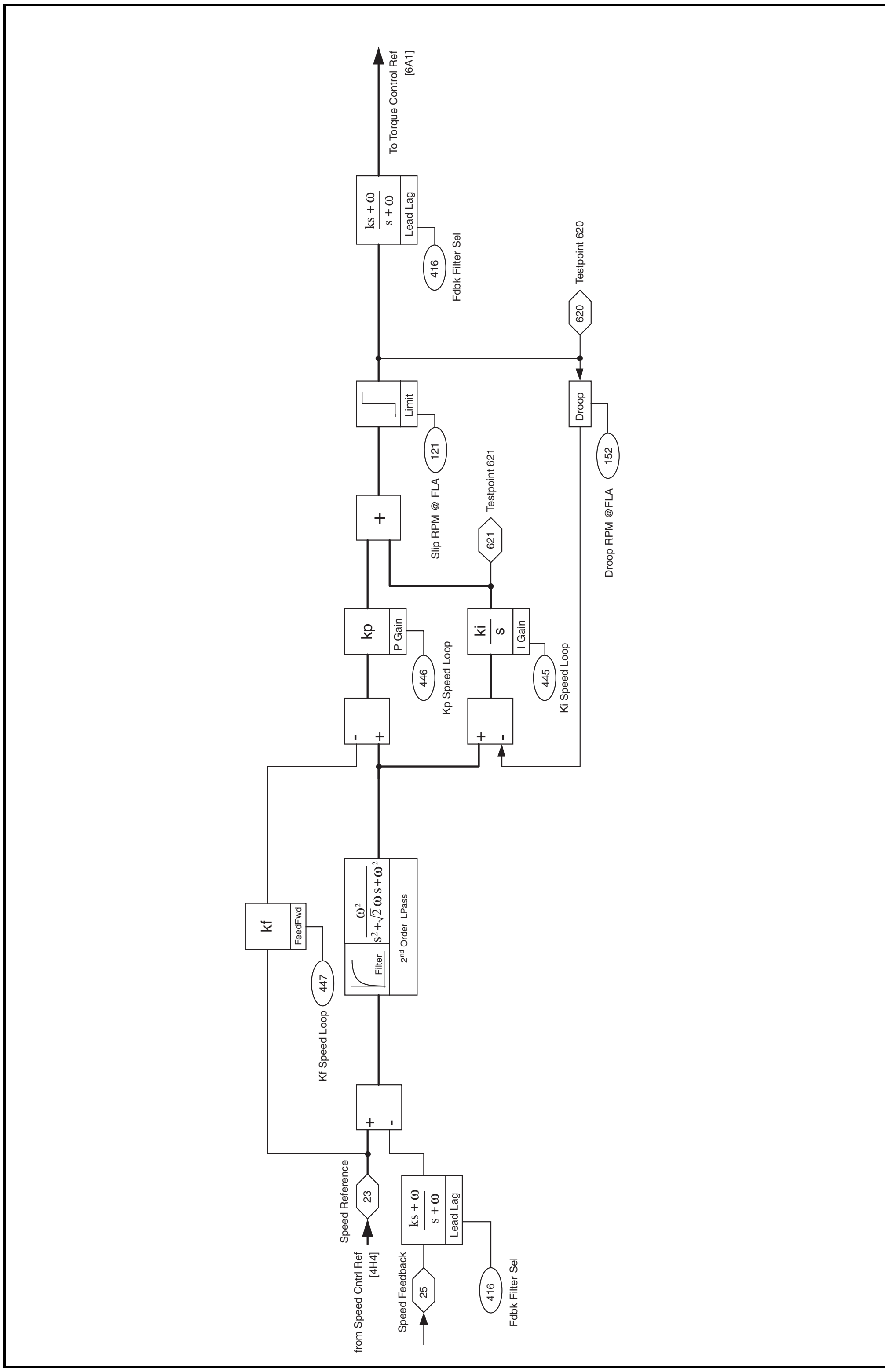
Speed Control - Reference (2.0 ms)



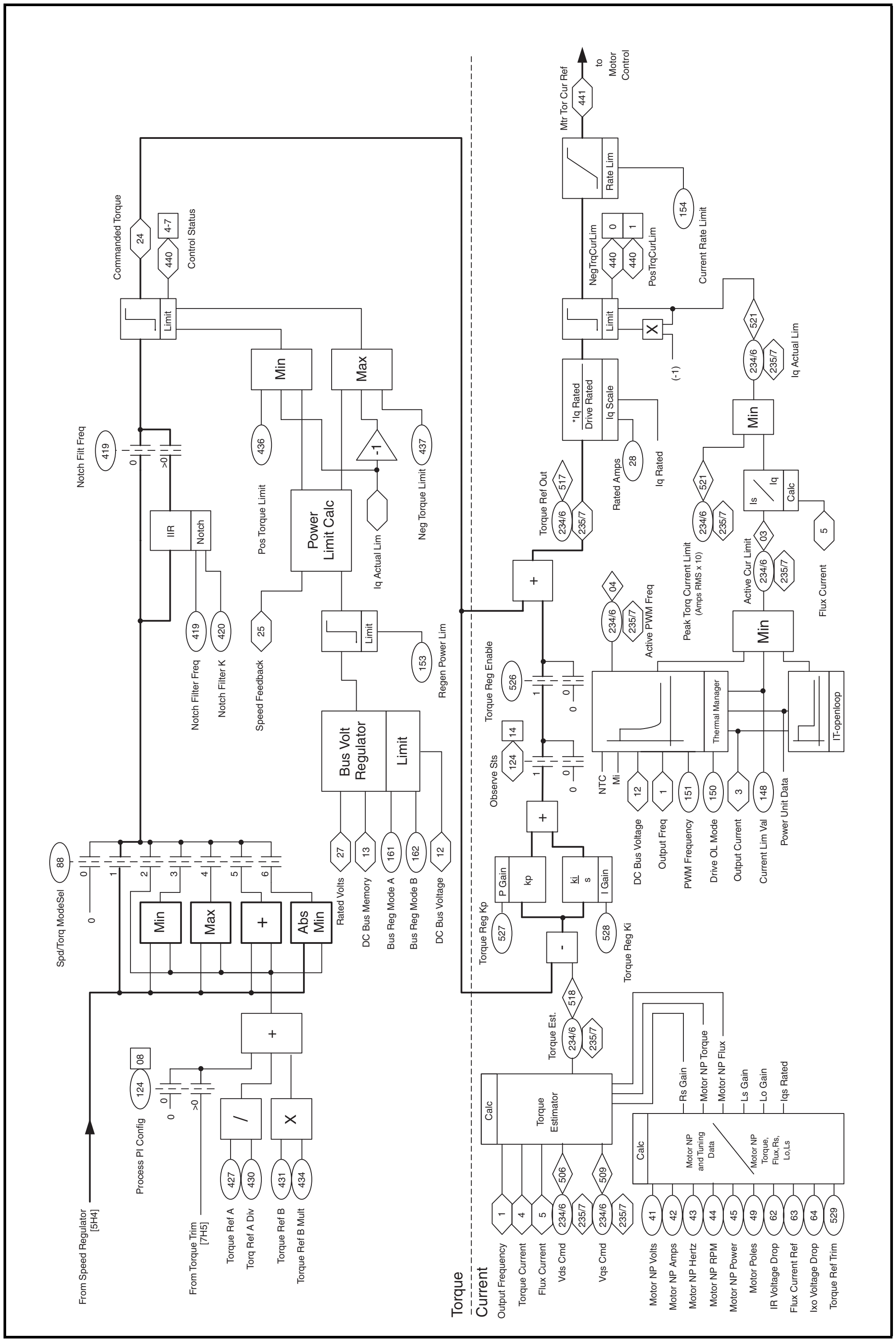
Speed Control - Reference (2.0 ms) - Continued



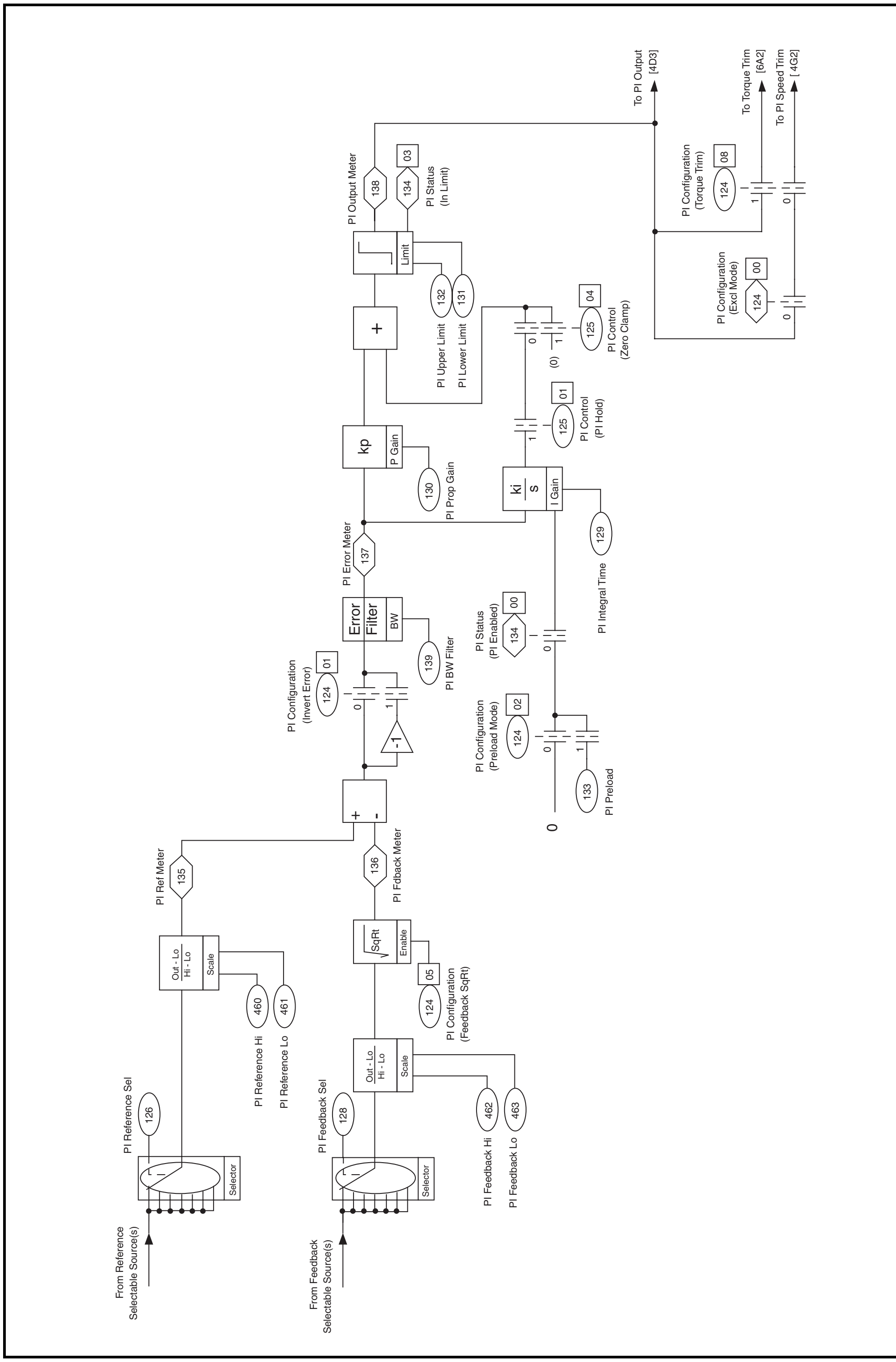
Speed Control - Regulator (1.0 ms)



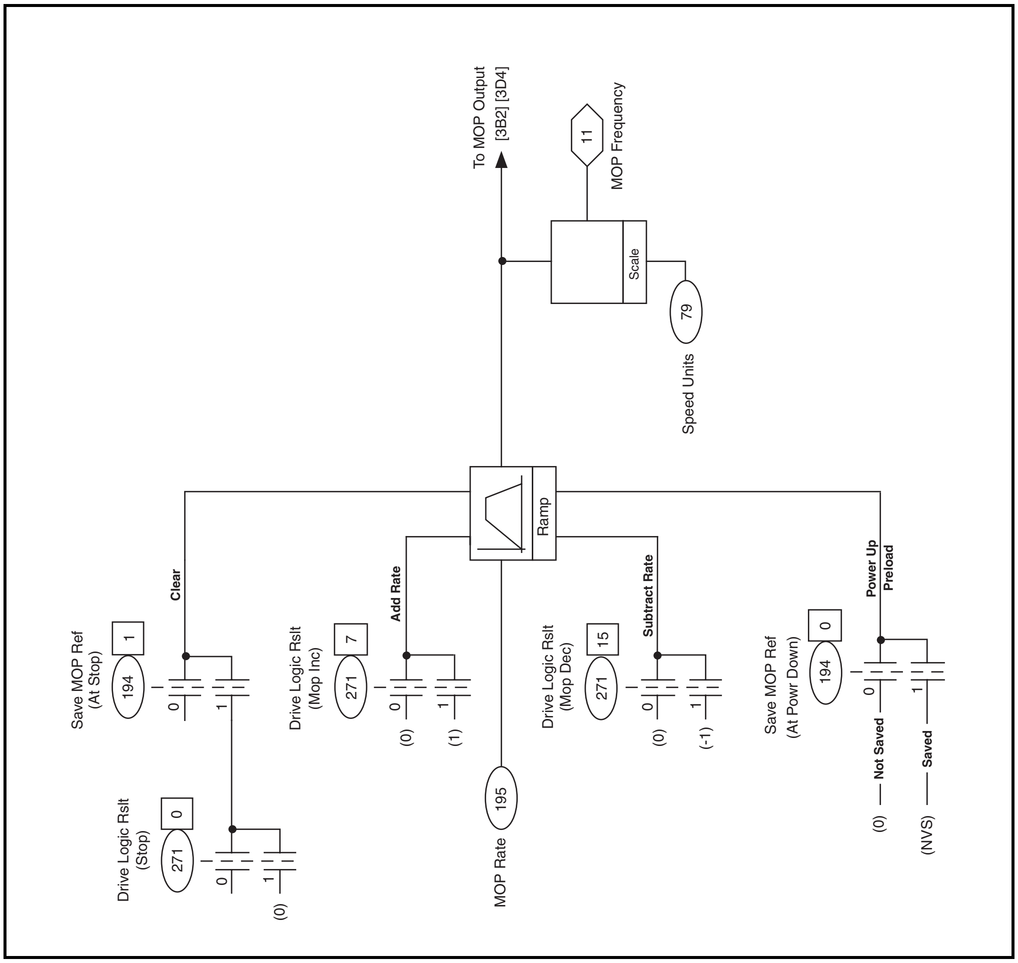
Torque Control (0.25 ms)



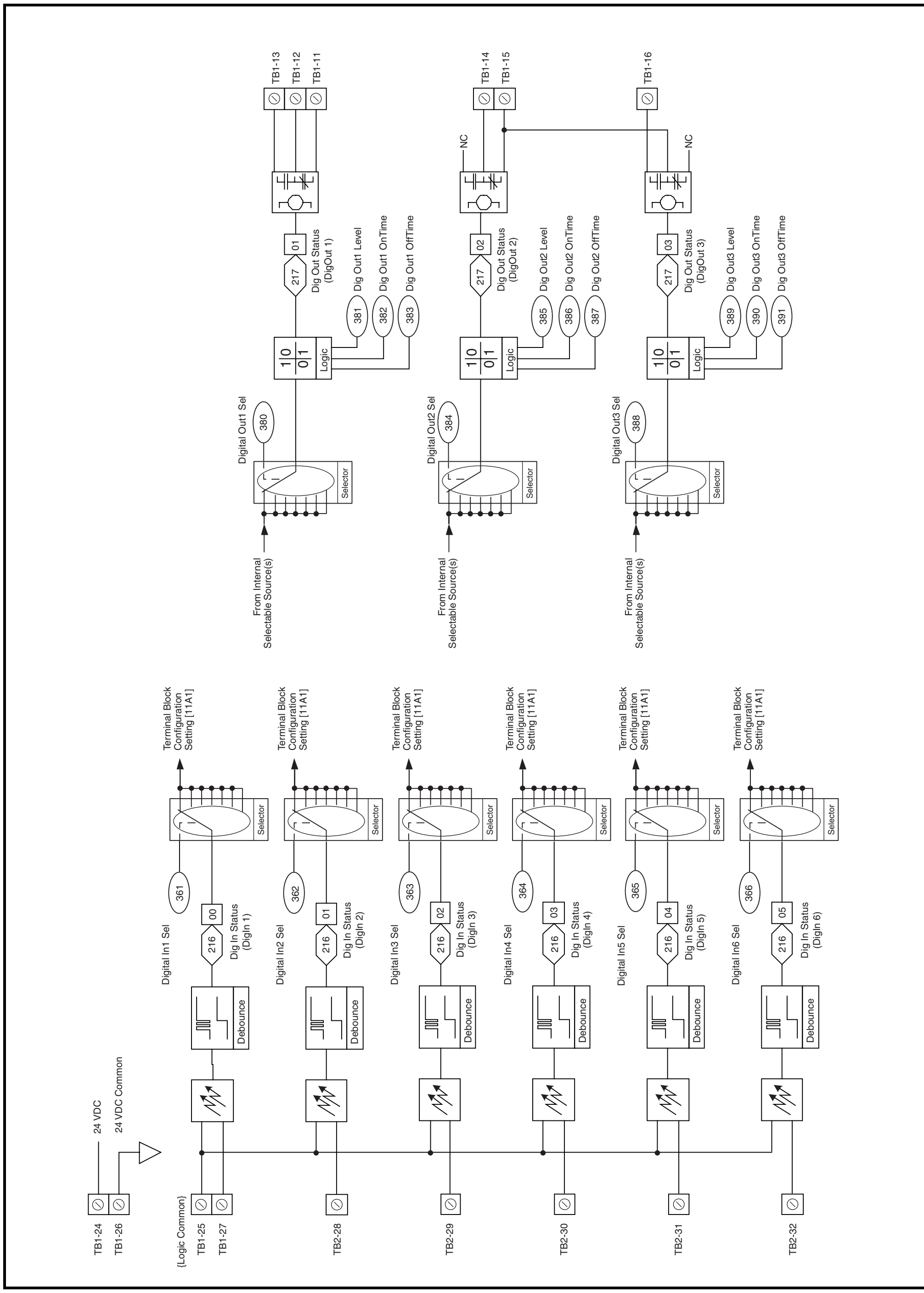
Process Trim (2.0 ms)



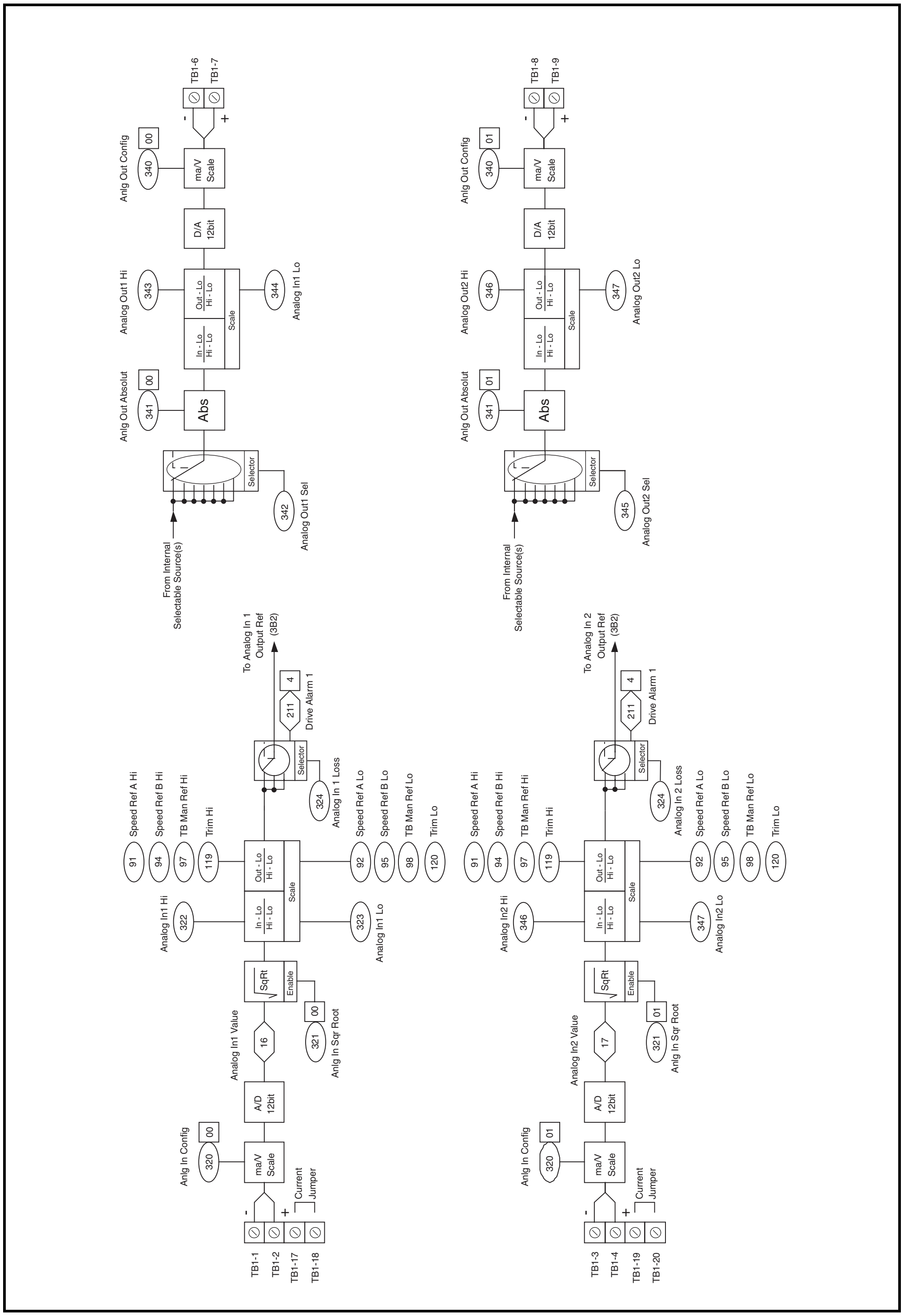
MOP Control (2.0 ms)



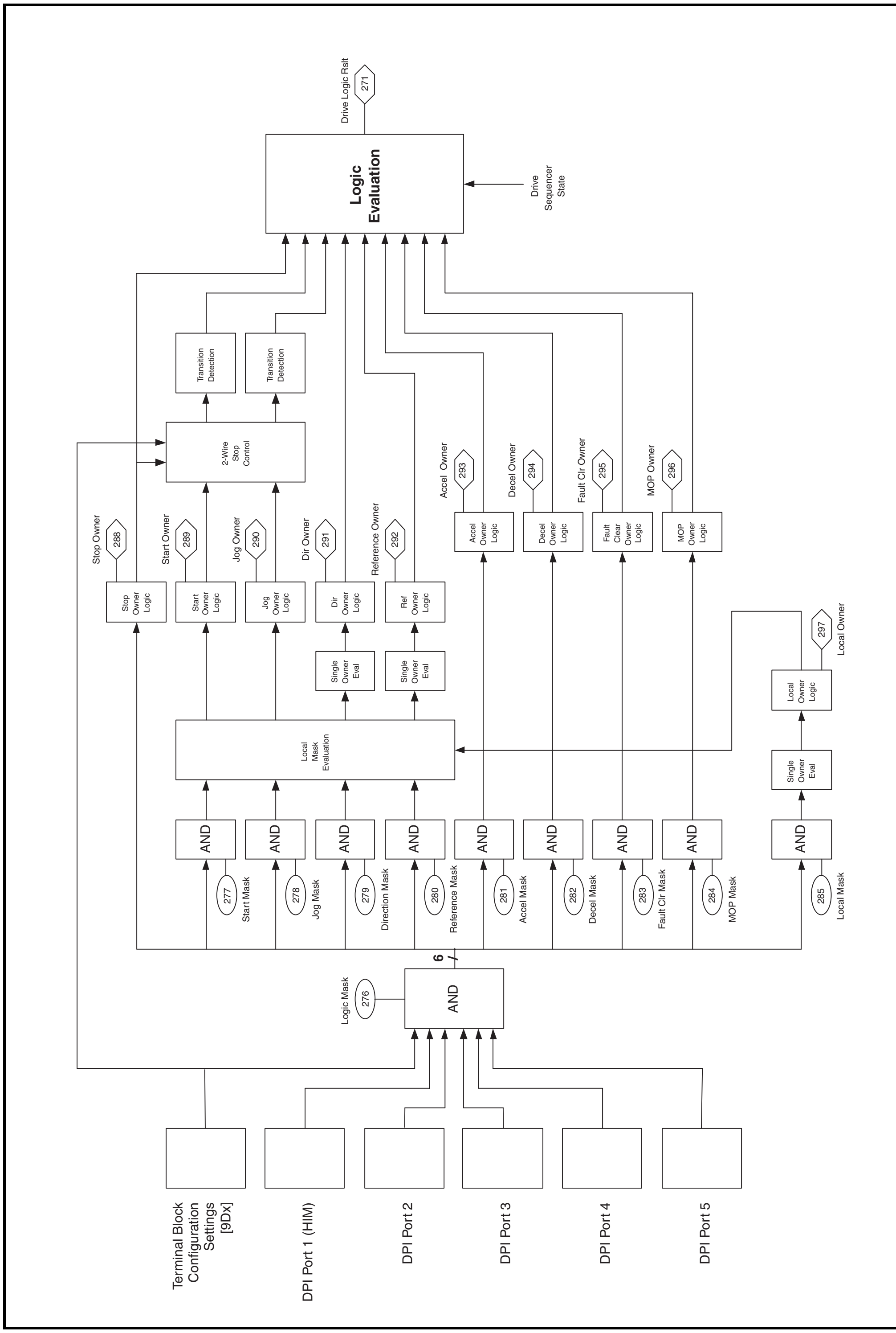
Inputs and Outputs - Digital (0.5 ms)



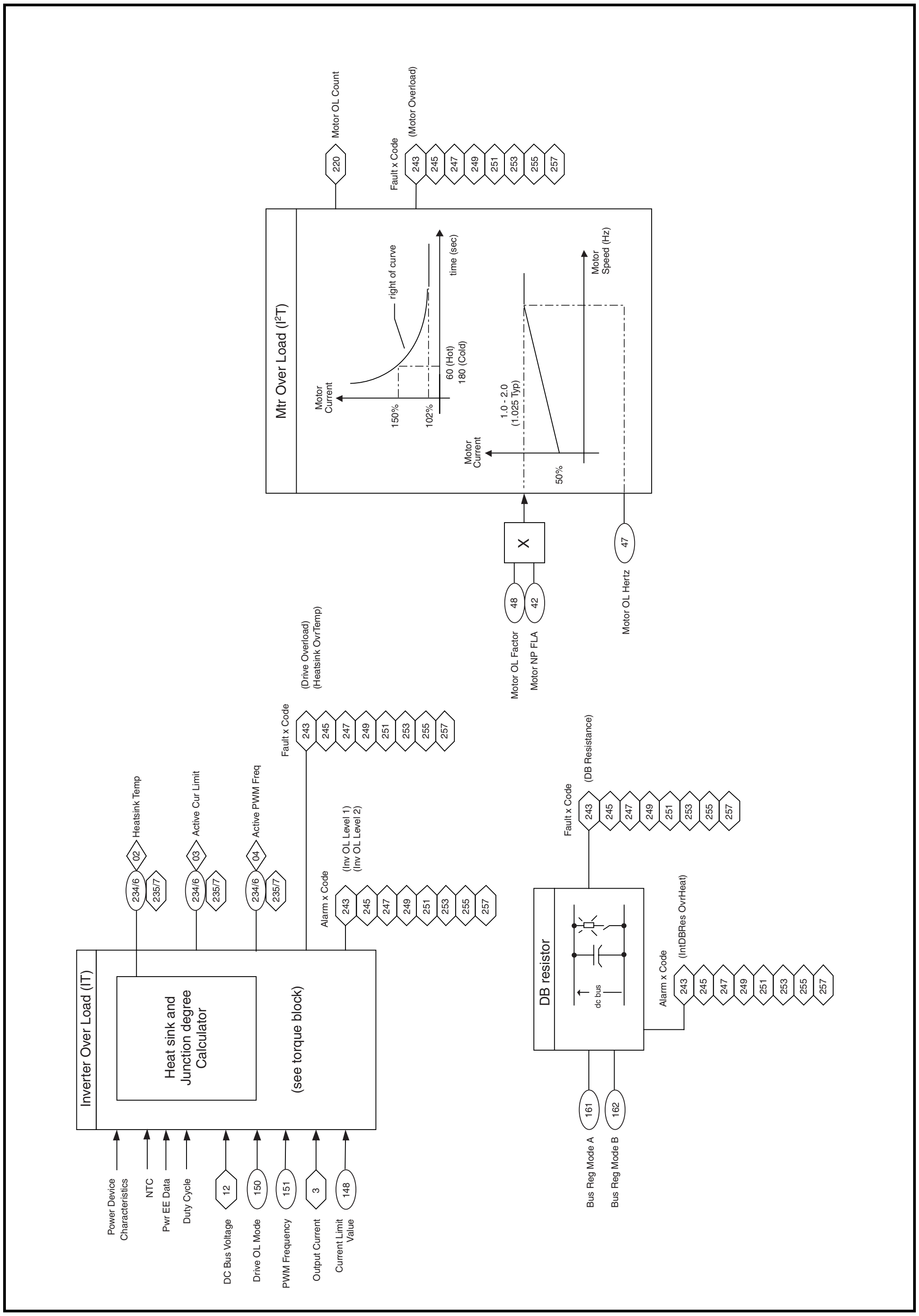
Inputs and Outputs - Analog (2.0 ms)



Control Logic (2.0 ms)



Inverter Overload IT



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