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***DANGER, WARNING, CAUTION, and NOTE* Statements**

DANGER, WARNING, CAUTION, and Note statements are used throughout this manual to emphasize important and critical information. You must read these statements to help ensure safety and to prevent product damage. The statements are defined below.



DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.



WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE: A *NOTE* statement is used to notify people of installation, operation, programming, or maintenance information that is important, but not hazard-related.

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Welcome!

IMPULSE•VG+ Series 2 represents the second generation of our high-performance flux vector crane controls. It goes far beyond the scalar (voltage and frequency control) drive designs by having *true torque-control* capabilities. The IMPULSE•VG+ Series 2, which is designed for a closed-loop system, is ideal for hoists without mechanical load brakes and for very high-performance traverse applications.

Incorporating a pulse-width-modulated (PWM), flux vector design, IMPULSE•VG+ Series 2 generates the optimum current waveform, which gives you impressive torque and speed motor control. The drive offers a 1000:1 speed range — compared to a 3:1 range for two-speed motors and a 10:1 range for wound-rotor motors.

Here's a sample of IMPULSE•VG+ Series 2's special features and how they can help you improve your overhead material handling performance:

- Distinct speed control (up to five speeds) as well as infinitely variable speed control are provided; you can use pendant pushbutton stations, infrared or radio controls, or joysticks.
- An English, plain-language liquid crystal display (2 lines, 16 characters per line) makes programming, troubleshooting, and operating the drive easy.
- Built-in Serial Communication (9600-baud modbus) provides reliable digital linkage among the various crane system peripherals, including our line of PulseStar™ Remote Crane Controls.
- Micro-Positioning Control™ is used to place loads with a high degree of precision, eliminating the need to jog or plug your motors.
- A compact circuit design gives the drive a small footprint.
- Ultra-Lift™ capabilities enhance productivity by allowing the overspeeding of any load less than full load.
- Safe Operating Windows™ prevents you from programming the drive with unsafe parameters.
- Automatic Keypad Lockout™ and a snap-in, removable keypad helps you limit programming access and reduce the possibility of programming errors.
- Load Check™ prevents you from overstressing equipment by attempting to lift a load beyond the capacity of the crane or hoist.
- Weight Measurement enables you to weigh a load with an accuracy of ± 5 percent of full load.
- Phase Loss Detection causes the drive to fault and commands the electric brake to set if an input or output phase loss occurs.
- Quick Stop™ ensures a rapid deceleration to stop once a drive RUN command is removed, reducing the possibility of a crane collision.
- Reverse Plug Simulation™ allows you to change the direction of travel (motor's phase sequence) very rapidly before the electric brake can be set.
- Flash ROM stores the drive system's last four fault occurrences in the drive's memory—even after power-down—for diagnostic purposes.

- Slack Cable Detection identifies slack cable conditions and adjusts outputs to immediately stop lowering.
- Load Float Start & Stop, with the crane fully at rest (without electric brakes set), allows the precise placement of critical loads without rollback or delays because of electric brake operation.
- Motor Changeover Capability allows you to use one inverter for two motors (e.g., main and auxiliary hoists) with different motor characteristics.
- A 120V ControlVoltage Interface Card gives you direct access to a 120V user input device (e.g., pendant) without adding electromechanical components.
- Elapsed Time Counter (with fault history) indicates actual operation time, total power-up time, and the elapsed time between fault occurrences.

Identifying Your Drive

If you ever have to contact Electromotive Systems about your drive, first determine the model and serial numbers of your drive by looking at the nameplate shown below.

<i>IMPULSE</i>		A.C. INPUT		A.C. OUTPUT	
<i>ELECTROMOTIVE SYSTEMS, INC.</i>		VOLTS:	PHASE: 3	VOLTS:	PHASE: 3
<i>MILWAUKEE, WISCONSIN</i>		AMPS:	HZ: 50/60	AMPS:	HZ: 0-400
SERIAL NO.:				H.P.:	
MODEL NO.:					1263

This nameplate is located on the side of the drive nearest to the keypad.

c h a p t e r **1**

Introduction

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WARNING

- Do not touch any circuitry components while the main AC power is on. In addition, you must wait until the red “CHARGE” LED is out before performing any service on that unit. (As you look at the face of the circuitry, the “CHARGE” LED is located in the lower right corner of the board.) It may take as long as 10 minutes for the charge on the main DC bus capacitors to drop to a safe level.
- Do not check signals during operation.
- Do not connect the main output terminals (T1, T2, T3) to the incoming, three-phase AC source.
- Do not connect the control board terminals, which are the 27 two-tiered terminals, directly to the 120VAC user input device.
- Before executing Built-In Auto-Tuning, ensure that the motor is disconnected from the drive train and the electric brake is released. If the electric brake cannot be released, you must ensure that the brake is disengaged for the entire tuning process.

The instructions in the next three chapters apply to most IMPULSE•VG+ Series 2 crane, hoist, and monorail applications. However, you need to carefully evaluate your specific situation and ensure that you follow NEC codes and your local wiring practices.

These chapters tell you how to install IMPULSE•VG+ Series 2 and, to some extent, the components that it interconnects. It explains how to: assess the drive’s environment, mount the drive, and wire the drive circuits. It’s important to develop a “plan of attack” for both the mounting and wiring since each task has an effect on the other one. To assist you, “IMPULSE•VG+ Series 2 Wiring Practices” is included.

NOTE: If your IMPULSE•VG+ Series 2 is part of an Electromotive Systems, pre-engineered TCONTROLS® motor control panel, disregard this chapter and turn to Chapter 4.

Introduction

Assessing the System Requirements

You must know how you're going to use the drive before you start installation and wiring. You will need to know your requirements for the following components:

- Speed control method(s)
- Braking method(s)
- Power source voltage, number of phases, and kVA rating
- Power source location
- Wire size
- Grounding location and method

Assessing the Drive Environment

When you choose a location for IMPULSE•VG+ Series 2, perform the following steps:

1. Ensure that a 220V or 230V (-15% to +10%) three-phase power source is available for a 230V-rated drive, and that a 380V, 400V, 415V, 440V, or 460V (-15% to +10%) three-phase power source is available for a 460V-rated drive, and that a 500V, 575V, 600V (-15% to +10%) power source is available for a 575V Drive.
2. Ensure the encoder is supplied with +12VDC.
3. If the amperage requirement is greater than 200 mA, provide an auxiliary power supply to the encoder
4. Ensure that the drive-to-motor wiring distance is less than 250 ft. unless appropriate reactors and/or filters are used.
5. If required, install reactors.

When connecting a drive (230V/460V/575V, Model 2033-FVG+/4034-FVG+/FVG+5032V and smaller) to a large-capacity power supply transformer (500kVA or greater or more than 10 times the inverter kVA rating), or when switching a phase-advancing capacitor, excessive peak current can flow through the input power supply circuit. To prevent damage to the rectifier section in such cases, install a DC reactor between drive Terminals 1 and 2, or an AC reactor on the input side. Installing reactors also improves the power factor on the power supply side.

6. Ensure that the encoder wiring is less than 300 feet, unless fiber optic cables are used.
7. Ensure that the encoder wiring is isolated from the power wiring.
8. Ensure that the encoder wiring shield is grounded at only one end (PG-X2 TA3).
9. Ensure that the drive circuit wiring is protected or isolated from:
 - Ambient temperatures outside the range of -14° F to +104° F (-10° C to +40° C). (Consult Electromotive Systems if you must exceed this temperature range.)
 - Rain or moisture
 - Corrosive gases or liquids
 - Direct sunlight
 - Severe mechanical vibration
10. Ensure that the drive is housed in an appropriate NEMA-rated enclosure.

11. For severe-duty applications (for example—long lifts) or with 75-Hp-or-greater motors, ensure that the drive control system is adequately cooled, even though the ambient temperature limit is not exceeded. For more information, contact Electromotive Systems.

IMPULSE•VG+ Series 2 General Specifications

230V Class

Specification	Specification Values and Information for Each 230V-Class Model (####-FVG+)												
	2006	2008	2011	2017	2025	2033	2054	2068	2080	2130	2160	2224	2300
Rated current (A)	6	8	11	17.5	25	33	54	68	80	130	160	224	300
Capacity (kVA)	2.3	3.0	4.2	6.7	9.5	13	19	24	30	50	61	85	110

460V Class

Specification	Specification Values and Information for Each 460V-Class Model (####-FVG+)																			
	4001	4003	4005	4008	4011	4014	4021	4028	4034	4041	4052	4065	4080	4096	4128	4165	4224	4302	4450	4605
Rated current (A)	1.9	3.6	5.1	8.5	11.7	14.8	21	28.6	34	41	52	65	80	96	128	165	224	302	450	605
Capacity (kVA)	1.4	2.6	3.7	6.1	8.4	11	16	21	26	31	40	50	61	73	98	130	170	230	340	460

575V Class

Specification	Specification Values and Information for Each 460V-Class Model (####-FVG+)																	
	5003	5004	5006	5009	5012	5017	5022	5027	5032	5041	5052	5062	5077	5099	5130	5172	5200	
Rated current (A)	3.5	4.41	6.3	9.8	12.5	17	22	27	32	41	52	62	77	99	130	172	200	
Capacity (kVA)	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100	125	150	200	

230V, 460V and 575V Classes

Specification	Specification Value and Information for All Models
Certification	UL, CUL, CSA
Rated input power supply volts & freq	3-phase 200/400, 208/415, 220/440, or 230/460 or 500-600VAC; 50 or 60 Hz
Allowable input voltage fluctuation	+10% or -15% of nominal
Allowable input frequency fluctuation	±5% of nominal
Control method	Fully digital, flux vector control; sine-wave, pulse-width-modulated
Maximum output voltage (VA)	Max output voltage 3-phase, 200/308/220/230V; 380/400/415/440/460V; 500/575/600V (proportional to input voltage).
Rated frequency (Hz)	Up to twice motor nameplate RPM (Ultra-Lift) 120 Hz max
Output speed control range	1000:1
Output frequency accuracy	.01%—with digital reference command, -10° to 40° C; .1%—with analog reference command; 10 bits/10V; 25° C ±10° C
Frequency reference resolution	Digital: .01 Hz; analog: .03 Hz (at 60 Hz)
Output frequency resolution	.01 Hz
Overload capacity	150% of rated load for 1 min
Remote frequency reference sources	0–10VDC (20kΩ); 4–20mA (250Ω); ±10VDC (optional); serial (optional)
Accel/decel times	0.1 to 25.5 sec—2 sets; 4 parameters are independently adjustable

Specification	Specification Value and Information for All Models
Braking torque	Approximately 120% if motor and inverter are sized 1:1; 150% or more with dynamic braking (optional)
Motor overload protection	Electronic thermal overload relay; field-programmable
Overcurrent protection level (OC1)	200% of rated current
Circuit protection	Ground fault and blown-fuse protection
Overvoltage protection level	400/800/1000VDC
Undervoltage protection level	190/380/546VDC
Heatsink overtemperature	Thermostat trips at 90° C
Torque limit selection	Separate functions for FORWARD, REVERSE, REGEN.; all selectable from 0–300%)
Stall prevention	Separate functions for accel, decel, at-speed, and constant horsepower region
Other protection features	Speed deviation, overspeed, mechanical brake failure, lost output phase, failed-oscillator, PG-disconnect, mechanical overload, and roll-back detection
DC bus voltage indication	Charge LED is on until DC bus voltage drops below 50VDC
Location	Indoors; requires protection from moisture, corrosive gases, and liquids
Ambient operating temperature	14° to 104° F (-10° to 40° C) for NEMA 1; 14° to 122° F (-10° to 50° C) for open chassis
Storage temperature	-4° to 140° F (-20° to 60° C)
Humidity	90% relative; noncondensing
Vibration	1 G less than 20 Hz; 0.2 G for 20–50 Hz
Elevation	3300 Ft. (1000M) or less

DBU & CDBR Units

The DBU (Dynamic Braking Unit) and CDBR are designed to pass regenerative energy from an inverter's DC bus to a resistor bank. The DBU/CDBR operate when the voltage on the DC bus reaches a specific level which turns on an internal transistor. This transistor stays on until the DC bus voltage drops to an appropriate level. The difference between the turn on and the turn off voltage is the hysteresis voltage.

The DBU/CDBR, and its associated dynamic braking resistor, are used to help the inverter decelerate AC motors (dynamic braking) and to provide a path for motor regenerative energy under over hauling conditions, such as on a hoist.

DBU Specifications

Characteristic	Specification								
Required control circuit power supply	110V; 10VAC, single-phase; 50 to 60 Hz at .2 A; factory-configurable for 220VAC 50to 60 Hz								
Braking start voltage ⁽¹⁾	Jumper-selectable; 330V, 344V, 364V, or 380V for 200V jumper selection; or 629V, 660V, 687V, 727V, or 760V for 400V jumper selection.								
Master/Slave mode	Jumper-configurable								
Master output	Yaskawa CDBR-compatible								
Slave input	Yaskawa CDBR-compatible								
Ampacity selection	Jumper-configurable for IGBTs up to 300 A at 760V								
Fault relay type	1. Normally-open 2. Normally-closed								
Fault relay activation	Relay activates when there is: <ul style="list-style-type: none"> • Input control power failure (TB 1-2) • Internal or external over temperature contact closure • IGBT overcurrent 								
Resistor temperature switch input	Contact closure for over temperature of resistor(s)								
Maximum hysteresis level	Jumper-selectable 1% or 2% of turn on voltage								
Power charge indication	Charge lamp stays on until bus voltage drops below 70VDC								
Overcurrent LED	Activates when overcurrent fault occurs. 5% to 15% above maximum rated current for 5 to 10 minutes; 10 times rated current for 0.1 seconds. Maximum rated currents are: <table style="margin-left: 20px;"> <tr> <td>DBU-24045</td> <td>75A</td> </tr> <tr> <td>DBU-24090</td> <td>150A</td> </tr> <tr> <td>DBU-24160</td> <td>200A</td> </tr> <tr> <td>DBU-24220</td> <td>300A</td> </tr> </table>	DBU-24045	75A	DBU-24090	150A	DBU-24160	200A	DBU-24220	300A
DBU-24045	75A								
DBU-24090	150A								
DBU-24160	200A								
DBU-24220	300A								
Brake LED	Stays on as long as IGBT gate drive is present								
Location	Indoors; requires protection from moisture, corrosive gases and liquids								
Ambient temperature	-4°F to 122°F (-20°C to 50°C)								

Specifications (cont.)

Characteristic	Specification
Storage temperature	-4°F to 140°F (-20°C to 60°C)
Humidity	90% relative (noncondensing)
Vibration	1G less than 20 Hz; up to 0.2 G at 20–50 Hz
Protective configuration	Wall-mounted standard enclosure, including cover, is intended for NEMA 1-rated environments. For NEMA 12, 3R, 4 or other environments, the DBU must be mounted in another enclosure.

(1) Voltage at which dynamic braking is activated; ±% variance.

External DBU Dimensions

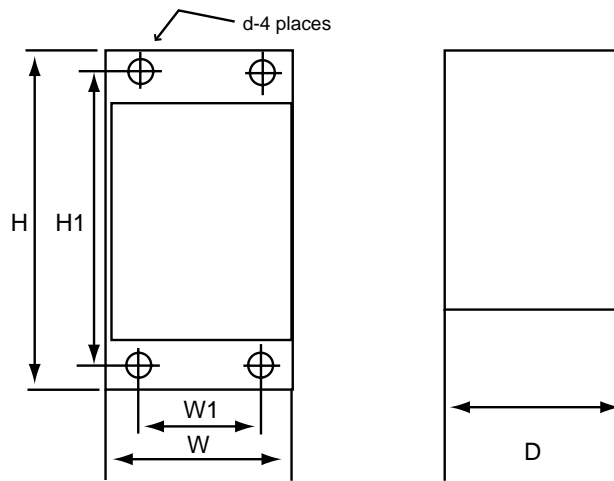


Figure 1.1 IMPULSE•VG+ Series 2 Dynamic Braking Unit

Model No.	Dimensions in inches (mm)		Mounting Dimensions in inches (mm)				Wt Lb (kg)
	W	H	D	W1	H1	d	
DBU-24045	5.69 (144)	11.02 (280)	6.59 (167)	3.94 (100)	10.23 (260)	.236 (M6)	7.7 (3.5)
DBU-24090	9.64 (245)	14.75 (375)	7.56 (192)	8.26 (210)	13.98 (355)	.236 (M6)	27.6 (12.5)
DBU-24160	9.64 (245)	14.75 (375)	7.56 (192)	8.26 (210)	13.98 (355)	.236 (M6)	27.6 (12.5)
DBU-24220	9.64 (245)	14.75 (375)	7.56 (192)	8.26 (210)	13.98 (355)	.236 (M6)	27.6 (12.5)

Minimum Resistor Ohmic Values

The following chart should be used to determine minimum ohmic values for dynamic braking resistors for different supply voltages.

Supply Voltage	Turn On Voltage	Minimum Ohmic Value for Braking Resistor			
		DBU-24045	DBU-24090	DBU-24160	DBU-24220
200V	330V	5.2	2.6	1.9	1.3
208V	344V	5.4	2.7	2.0	1.4
220V	364V	5.7	2.9	2.1	1.4
230V	380V	6.0	3.0	2.2	1.5
380V	629V	9.9	4.9	3.7	2.5
400V	660V	10.4	5.2	3.9	2.6
415V	687V	10.8	5.4	4.1	2.7
440V	727V	11.4	5.7	4.3	2.9
460V	760V	12.0	6.0	4.5	3.0

IMPULSE•VG+ Series 2 External Dynamic Braking Unit—Specifications & Dimensions

External Dynamic Braking Unit Specifications

	Specification Information by Model (DBU-XXXX)			
	24045	24090	24160	24220
Required control circuit power supply	110V; 10VAC			
Braking start voltage ⁽¹⁾	Jumper-selectable; 330V, 344V, 364V, or 380V for 200V jumper selection; or 629V, 660V, 687V, 727V, or 760V for 400V jumper selection.			
Maximum hysteresis error	Jumper-selectable 1% or 2%			
Power charge indication	Charge lamp stays on until bus voltage drops below 70VDC			
Location	Indoors; requires protection from moisture, corrosive gases and liquids			
Ambient temperature	-4° F to 122° F (-20° C to 50° C)			
Storage temperature	-4° F to 140° F (-20° C to 60° C)			
Humidity	90% relative (noncondensing)			
Vibration	1G less than 20 Hz; up to 0.2 G at 20–50 Hz			
Protective configuration	Wall-mounted, enclosed			

⁽¹⁾ Voltage at which dynamic braking is activated; $\pm 2\%$ variance.

NOTE: *If a Series 2 drive is used to replace an older version IMPULSE drive, it is permissible to use the older version dynamic braking units (CDBRs).*

CDBR Braking Unit Specification

Braking Unit Model CDBR		200V to 300V				380V to 460V				500V to 575V
		2015B	2022B	2045	2110	4030B	4045B	4090	4220	5037
Applicable Motor Output HP (kW)		20 (15)	30 (22)	60 (45)	150 (110)	40 (30)	60 (45)	120 (90)	300 (220)	57 (37)
Output Charac- teristics	Max. Discharge Current (A (peak value))*	40	60	100	250	40	60	100	250	40
	Rated Discharge Current (A)	15	20	30	80	15	18	30	80	15
	Braking Start Voltage	330/345/365/380V ±3V				630/660/690/730/760V ±6V				825V/950V ± 8V
	Max. Hysteresis Error	Approx. 8V				Approx. 16V				Approx. 20V
Power Supply	VDC	243 (1.35 x 200 x 0.9) to 400V peak				460 (1.35 x 380 x 0.9) to 800V peak				607 (1.35 x 500 x 0.9) to 100V
	VAC†	—			Single phase 200 to 220V 50Hz 200 to 230V 60Hz	—			Single phase 380 to 460V 50Hz/ 60Hz	—
Protective Functions	Fin Overheat	Thermostat								
	Power Charge Indication	Charge lamp stays ON until bus voltage drops below 50V.								
Environ- mental Conditions	Location	Indoor (protected from corrosive gases and dust)								
	Ambient Temperature	+14° to 104°F (-10° to +40°C) (not frozen)								
	Storage Temperature	-4° to +140°F (-20° to +60°C)								
	Humidity	90%RH (non-condensing)								
	Vibration	1G at less than 20Hz, up to 0.2G at 20 to 50 Hz								
Protective Configuration		Wall-mounted enclosed type								
Heat Loss (W)		32	38	62	129	54	59	94	135	70

* Loading time rate can be used below 10% ED (max. 10 min.)

† AC power supply for cooling fan is used only for models CDBR-2110 and CDBR-4220.

CDBR Braking Unit Dimensions

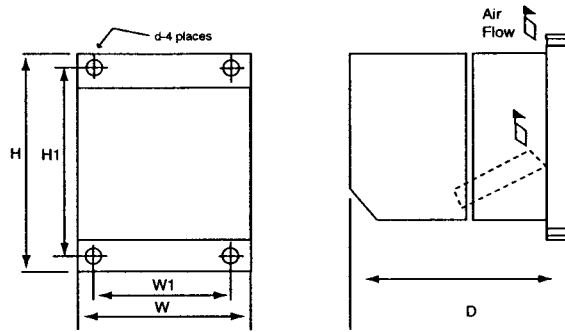


Figure 1.2 CDBR 2110 - 4220

Model Number	Dimensions in inches (mm)						Wt. in lbs. (kg)
	Overall			Mounting			
	W	H	D	W1	H1	d	
CDBR-2110	7.09 (180)	14.57 (370)	7.87 (200)	5.51 (140)	13.78 (350)		
CDBR-2022							7.13 (3.24)
CDBR-4045	5.51 (140)	11.02 (280)	6.29 (160)	3.94 (100)	10.23 (260)	.24 (6)	7.79 (3.54)
CDBR-4090	8.66 (220)	14.76 (375)	7.87 (200)	7.09 (180)	13.98 (355)		
CDBR-4220	9.84 (250)	14.76 (375)	7.87 (200)	8.27 (210)	13.98 (355)		27.19 (12.34)

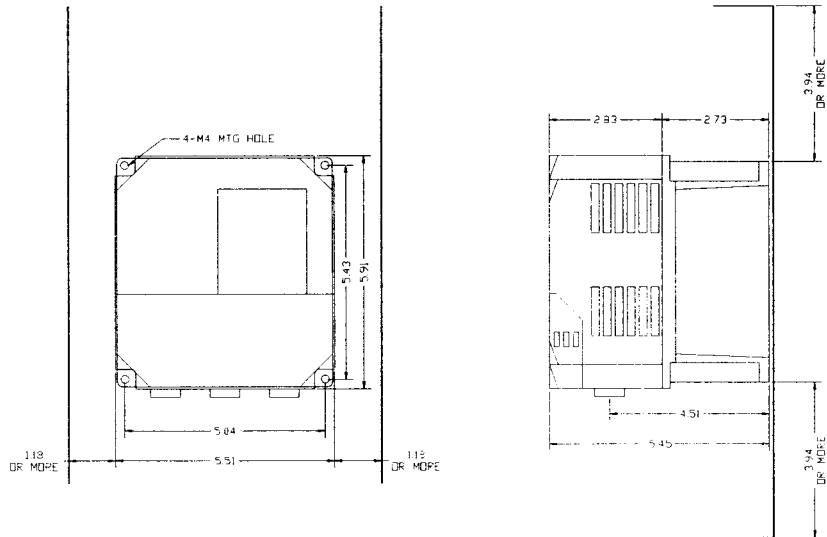


Figure 1.3 CDBR 4045B

AC Reactor Specifications

Reactors, both as input (line) and output (load) devices, protect adjustable frequency drives, motors, and other load devices against excessive voltage and current.

The following guidelines may help determine input and output reactor requirements:

- Install an input reactor if the power source is greater than 500kVA.
- Install an input reactor if the distance between the drive and the motor exceeds 150 feet.
- Install an output reactor if the distance between the drive and the motor exceeds 150 feet.
- Install an output reactor if a device, such as a power limit switch, is used to disconnect the motor from the drive.
- Install one output reactor per drive for a multiple-drive arrangement requiring reactor protection.
- For a multiple drive arrangement, an input for each drive is recommended for optional protection. However, if the drives are within two drive sizes of each other, a single input reactor can be used. The reactor must be rated at an amperage equal to or greater than the sum of the amperage for all the drives.

230V Class

Model Number	230V Part Number	Maximum Amps of Reactor
2006-FVG+	REA230-2	8
2008-FVG+	REA230-2	8
2011-FVG+	REA230-3	12
2017-FVG+	REA230-5	18
2025-FVG-	REA230-7.5	25
2033-FVG+	REA230-10	35
2054-FVG+	REA230-20	55
2068-FVG+	REA230-25	80
2080-FVG+	REA230-30	80
2130-FVG+	REA230-50	130
2160-FVG+	REA230-60	160
2224-FVG+	REA230-75	250
2300-FVG+	REA230-100	300

460V Class

Model Number	460V Part Number	Maximum Amps of Reactor
4001-FVG+	REA460-1	2
4003-FVG+	REA460-2	3
4005-FVG+	REA460-5	6
4008-FVG+	REA460-5	8
4011-FVG+	REA460-7.5	12
4014-FVG+	REA460-10	16
4021-FVG+	REA460-15	25
4028-FVG+	REA460-20	35
4034-FVG+	REA460-25	35
4041-FVG+	REA460-30	45
4052-FVG+	REA460-40	55
4065-FVG+	REA460-50	80
4080-FVG+	REA460-60	80
4096-FVG+	REA460-100	110
4128-FVG+	REA460-100	130
4165-FVG+	REA460-150	200
4224-FVG+	REA460-200	250
4302-FVG+	REA460-250	360
4450-FVG+	REA460-300	480
4605-FVG+	REA460-400	600
4605-FVG+	REA460-500	600

575V Class

5003-FVG+	REA575-2 & 3	4
5004-FVG+	REA575-2 & 3	4
5006-FVG+	REA575-5	8
5009-FVG+	REA575-10	12
5012-FVG+	REA575-10	12
5017-FVG+	REA575-15	18
5022-FVG+	REA575-20 & 25	25
5032-FVG+	REA575-30	35
5041-FVG+	REA575-40	45
5052-FVG+	REA575-50	55
5062-FVG+	REA575-60 & 75	80
5077-FVG+	REA575-60 & 75	80
5099-FVG+	REA575-100	100
5130-FVG+	REA575-150	160
5172-FVG+	REA575-200	200
5200-FVG+	REA575-200	200

Interface Cards Specifications

IMPULSE•VG+ Series 2 is designed to interface directly with 120VAC user input and output devices via G5IF, G5IN4, and G5OUT. This eliminates the need for an additional interface relay or isolation circuitry

G5IF has eight optically isolated drive terminals which can be used to connect with the user input device. The Terminal 1 and 2 are always used for the directional run commands (Forward and Reverse, Up and Down). The rest of six terminals are multi-function terminals, and are used for speed control and other characteristics. With multi-function terminals you can assign various functions and performance characteristics without having to rewire the drive.

G5OUT has two 240VAC, 1.5 Amp solid state relays for output indication devices. It includes two programmable multi-function output terminals.

G5IN4 card has four additional input terminals, which can have a total of 14 sets of input selections. The individual terminals can be enabled/disabled within a set. For program information refer to Chapter 5, Programming Advanced Features.

Interface Card Specification

Model Number	Rated Input Voltage (AC)	Rated Maximum Current
G5IF	120V	1.5 Amp
G5OUT	240V	1.5 Amp
G5IN4	120V	1.5 Amp

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c h a p t e r **2**

Installation

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WARNING

- When preparing to mount the IMPULSE•VG+ Series 2 drive, lift it by its base. Never lift it by the front cover
- Mount the drive on nonflammable material.
- The IMPULSE•VG+ Series 2 drive generates heat. For the most effective cooling possible, mount it vertically. For more details, refer to the “IMPULSE•VG+ Series 2 Dimensions/Heat Loss—Open Chassis” pages 2-9 through 2-12.
- When mounting units in an enclosure, install a fan or other cooling device to keep the intake air temperature below 104°F (40°C).

Failure to observe these Warnings may result in equipment damage.

This chapter explains the following:

1. Choosing a location
2. IMPULSE•VG+ Series 2 components and external devices
3. Drive environment
4. Drive installation

In addition, this section will cover information on the components that interconnect with IMPULSE•VG+ Series 2.

Choosing a Location

Be sure that the drive is mounted in a location protected against the following conditions:

- Extreme cold and heat. Use only within the ambient temperature range:
NEMA1: +14 to 104°F (-10 to 40°C).
Open Chassis: +14 to 113°F (-10 to 45°C)
- Direct sunlight (not for use outdoors)
- Rain, moisture
- High humidity
- Oil sprays, splashes
- Salt spray
- Dust or metallic particles in the air
- Corrosive gases (e.g. sulfurized gas) or liquids
- Radioactive substances
- Combustibles (e.g. thinner, solvents, etc.)
- Physical shock, vibration
- Magnetic noise (e.g. welding machines, power devices, etc.)

IMPULSE•VG+ Series 2 System Components And External Devices

Standard IMPULSE•VG+ Series 2 Drive Components

- G5IF 120V Control Voltage Interface Card
- G5OUT Control Output Card

Optional Drive Components

- G5IN4 Control Input Card
- D0-08 Control Output Board
- D0-02 Control Output Relay Board
- AI-14B Analog Input Card

As-Required Drive Components

- AC reactor—line or load
- DC bus reactor
- External dynamic braking resistor(s) (See “External Dynamic Braking Unit (DBU)” in Chapter 3, page 3-18.)
- External dynamic braking unit

Required External Devices

- Motor
- User input device (pendant, joystick, PC, PLC, radio, or infrared control)
- External circuit protection devices (fuses or circuit breakers) (See “Suggested Circuit Protection Specifications and Wire Size in Chapter 3, page 3-6.)
- R-C surge suppressors on contactor coils

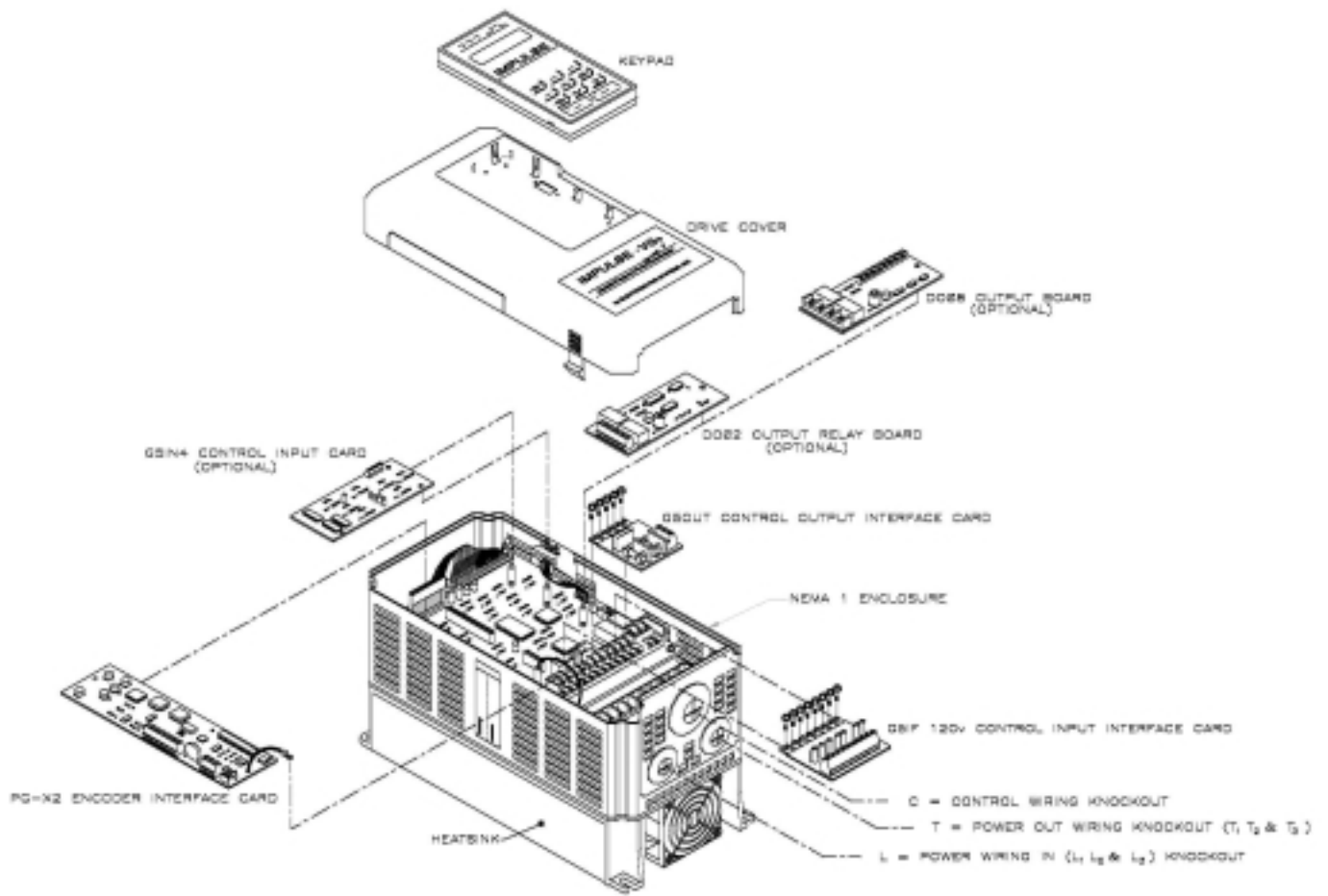


Figure 2-1: IMPULSE•VG+ Series 2 Components Diagram Installing the Drive

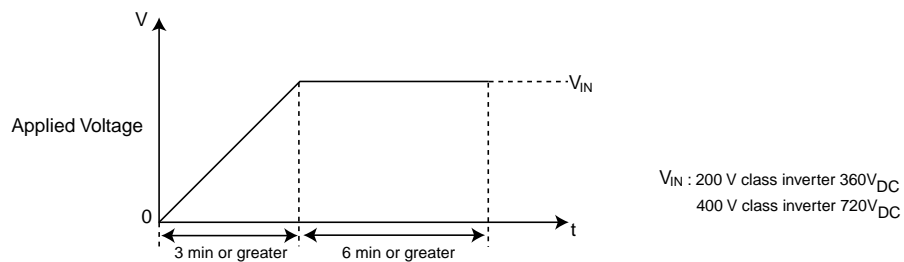
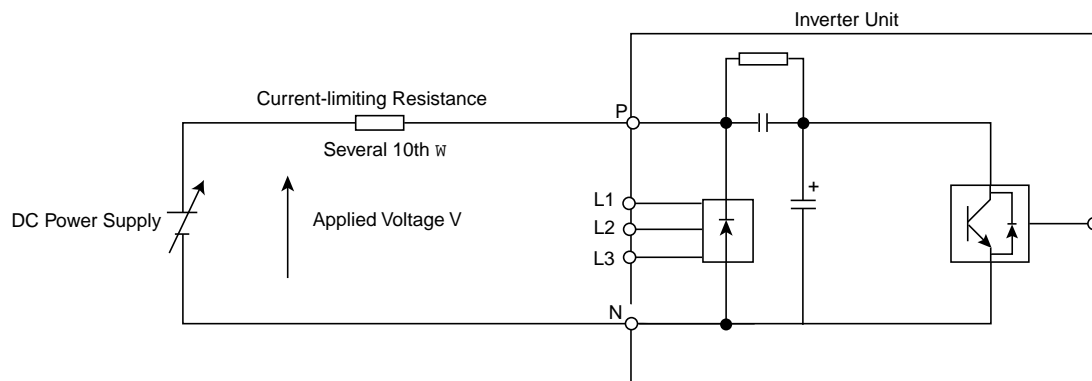
Long Time Storage

When an inverter stored for a long time (six months or more) is applied, aging of the main circuit electrolytic capacitor is required.

Execute the aging as follows:

- Main Circuit Electrolytic Capacitor Aging

Voltage applied to the main circuit electrolytic capacitor is slowly added, and it is applied for 60 seconds.



Caution: For aging, voltage input must NOT be executed from the main circuit terminal L1, L2 and L3.

Figure 2-2: Long Time Storage

Installing the Drive

To install IMPULSE•VG+ Series 2:

1. Ensure the drive will be used in a proper environment. Refer to page 1-4.
2. Review “IMPULSE•VG+ Series 2 Components Diagram” on page 2-5 and “IMPULSE•VG+ Series 2 Terminal Diagram” on page 3-5.
3. Determine the sizes and connection locations for the drive components and external devices that need to be wired. Locate the ground. For exact dimensions, see pages 2-9 through 2-12.
4. Determine the position of the subpanel.
5. Ensure that the drive is positioned vertically so that the heat can dissipate properly.
6. Ensure that the air can flow freely around the heat sink as shown below in Figure 2-3.

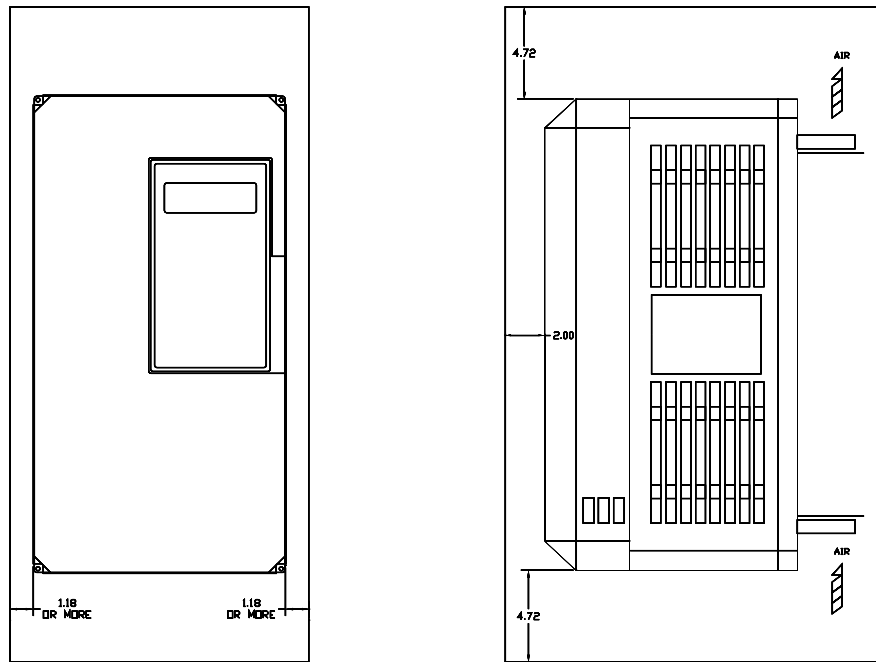


Figure 2-3

NOTE:

- *The required clearances at the top, bottom, and both sides of the inverter are the same for both open chassis and NEMA 1 enclosures.*
- *Allowable intake air temperature: 14°F to 104°F (-10°C to +40°C)*
- *If necessary, a heater or air conditioner must be used to maintain the temperature range listed above.*

7. Lay out the wire runs. Size the wire according to NEC Table 610-14(a). At a minimum, use #16 AWG for control wiring and #12AWG for power wiring. When performing this step:
 - Ensure that the drive control circuit and power circuit wires are perpendicular to each other at any point they cross.
 - Keep power and control festoon wiring in separate cables.
 - Separate control drive circuit and power circuit wiring on the terminal block strip.
8. Obtain the appropriate hardware for mounting.
9. Mount the subpanel or surface to which you are mounting the drive. (Contact Electromotive Systems if you need advice on mounting, especially for larger drives.)
10. Fasten the drive and components to the subpanel.
11. Remove the keypad from the front cover by pushing the depression area and lifting the keypad as shown below in Figure 2-4.

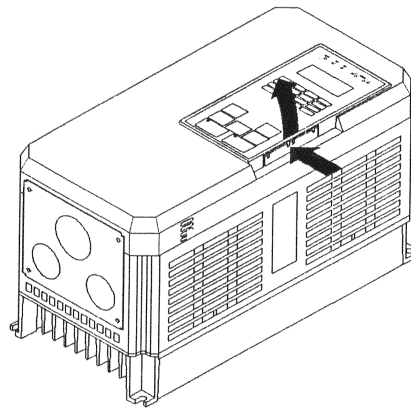


Figure 2-4

12. Remove the drive cover. For Models 2003-FVG+ through 2033-FVG+ and 4001-FVG+ through 4014-FVG+. See Figure 2-5. On larger size drives, the cover is attached with screws.

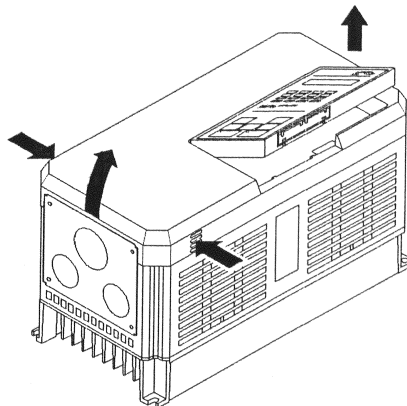


Figure 2-5

13. Remove the G5OUT Card (if used).
14. Remove the G5IF Card.
15. Follow the wiring practices outlined in Chapter 3.

IMPULSE•VG+ Series 2 Dimensions/Heat Loss—Open Chassis

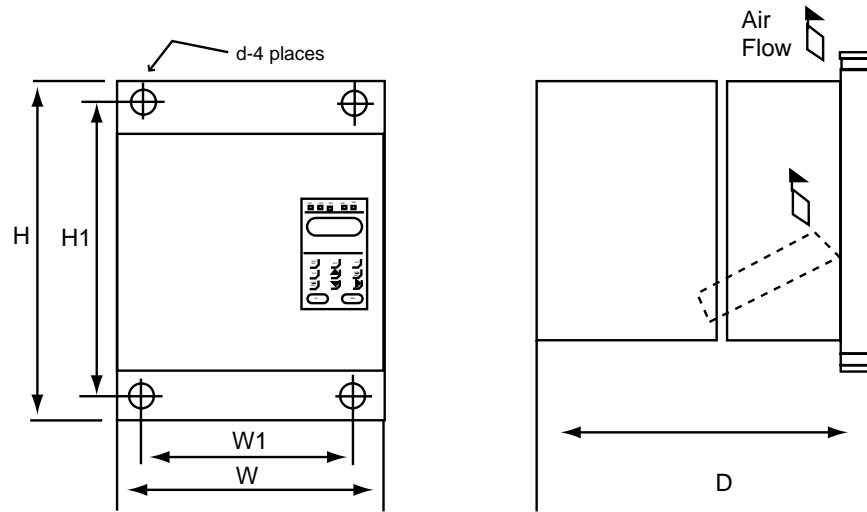


Figure 2-6: 230V—Open Chassis

NOTE: Some models are shipped with metal enclosures that can be removed and discarded.

Model	Overall Dimensions in inches and (mm)			Mounting Dimensions in inches and (mm)			Heat Loss (W)	
	W	H	D	W1	H1	H2	Wt Lbs/(kg)	Total
2006-FVG+	5.51 (140)	11.02 (280)	6.30 (160)	4.95 (126)	10.47 (266)	0.28 (7)	6.5 (3)	90
2008-FVG+	5.51 (140)	11.02 (280)	6.30 (160)	4.95 (126)	10.47 (266)	0.28 (7)	6.5 (3)	120
2011-FVG+	5.51 (140)	11.02 (280)	7.09 (180)	4.95 (126)	10.47 (266)	0.28 (7)	10 (4.5)	140
2017-FVG+	5.51 (140)	11.02 (280)	7.09 (180)	4.95 (126)	10.47 (266)	0.28 (7)	10 (4.5)	215
2025-FVG+	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	12 (5.5)	300
2033-FVG+	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	13 (6)	345
2054-FVG+	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.62)	24 (10.8)	585
2068-FVG+	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.62)	24 (10.8)	725
2080-FVG+	12.80 (325)	17.72 (450)	11.22 (285)	10.83 (275)	17.13 (435)	0.30 (7.62)	62 (28)	885
2130-FVG+	16.73 (425)	26.57 (675)	13.78 (350)	12.60 (320)	25.59 (650)	0.49 (12.5)	134 (61)	1370
2160-FVG+	16.73 (425)	26.57 (675)	13.78 (350)	12.60 (320)	25.59 (650)	0.49 (12.5)	137 (62)	1730
2224-FVG+	18.70 (475)	31.50 (800)	13.78 (350)	14.57 (370)	30.51 (775)	0.49 (12.5)	176 (80)	2630
2300-FVG+	22.64 (575)	36.42 (925)	15.75 (400)	17.52 (445)	35.24 (895)	0.59 (15)	298 (135)	3210

IMPULSE•VG+ Series 2 Dimensions/Heat Loss—Open Chassis

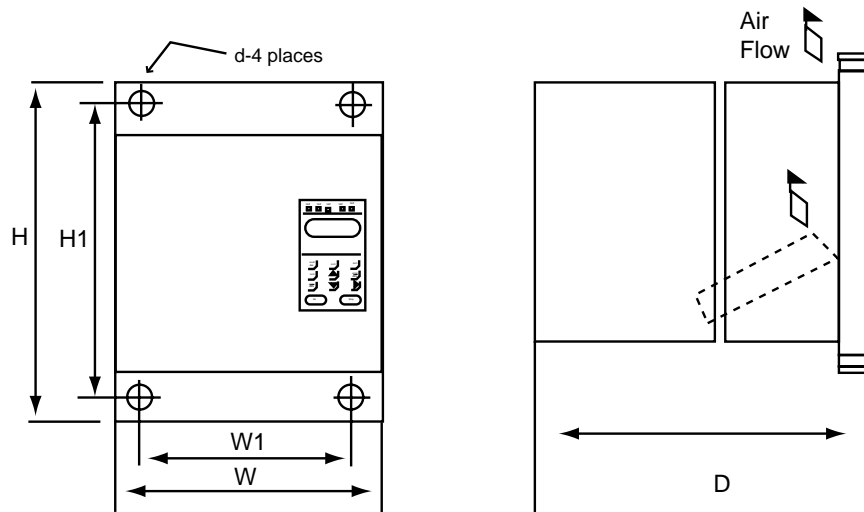


Figure 2-7: 460V Class—Open Chassis

NOTE: Some models are shipped with metal enclosures that can be removed and discarded.

Model	Overall Dimensions—in. & (mm)			Mounting Dimensions—in. & (mm)			Wt Lbs/(kg)	Heat Loss (W)
	W	H	D	W1	H1	H2		Total
4001-FVG+	5.51 (140)	11.02 (280)	6.30 (160)	4.95 (126)	10.47 (266)	0.28 (7)	6.5 (3)	60
4003-FVG+	5.51 (140)	11.02 (280)	6.30 (160)	4.95 (126)	10.47 (266)	0.28 (7)	6.5 (3)	85
4005-FVG+	5.51 (140)	11.02 (280)	7.09 (180)	4.95 (126)	10.47 (266)	0.28 (7)	8.8 (4)	110
4008-FVG+	5.51 (140)	11.02 (280)	7.09 (180)	4.95 (126)	10.47 (266)	0.28 (7)	10 (4.5)	145
4011-FVG+	5.51 (140)	11.02 (280)	7.09 (180)	4.95 (126)	10.47 (266)	0.28 (7)	10 (4.5)	200
4014-FVG+	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	13 (6)	220
4021-FVG+	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	13 (6)	360
4028-FVG+	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.5)	24 (11)	455
4034-FVG+	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.30 (7.5)	24 (11)	570
4041-FVG+	12.80 (325)	17.72 (450)	11.22 (285)	10.83 (275)	17.13 (435)	0.30 (7.5)	60 (27)	660
4052-FVG+	12.80 (325)	17.72 (450)	11.22 (285)	10.83 (275)	17.13 (435)	0.30 (7.5)	60 (27)	880
4065-FVG+	12.80 (325)	24.61 (625)	11.22 (285)	10.83 (275)	24.02 (610)	0.30 (7.5)	97 (44)	1020
4080-FVG+	12.80 (325)	24.61 (625)	11.22 (285)	10.83 (275)	24.02 (610)	0.30 (7.5)	97 (44)	1245
4096-FVG+	12.80 (325)	24.61 (625)	11.22 (285)	10.83 (275)	24.02 (610)	0.30 (7.5)	97 (44)	1385
4128-FVG+	17.91 (455)	32.28 (820)	13.78 (350)	13.78 (350)	31.30 (795)	0.49 (12.5)	174 (79)	1820
4165-FVG+	17.91 (455)	32.28 (820)	13.78 (350)	13.78 (350)	31.30 (795)	0.49 (12.5)	176 (80)	2320
4224-FVG+	22.64 (575)	36.42 (925)	14.76 (375)	17.52 (445)	35.24 (895)	0.59 (15)	298 (135)	3030

Model	Overall Dimensions—in. & (mm)			Mounting Dimensions—in. & (mm)			Wt Lbs/(kg)	Heat Loss
	W	H	D	W1	H1	H2		(W)
4302-FVG+	22.64 (575)	36.42 (925)	15.75 (400)	17.52 (445)	35.24 (895)	0.59 (15)	320 (145)	4190
4450-FVG+	37.40 (950)	57.09 (1450)	17.13 (435)	29.53 (750)	55.12 (1400)	0.98 (25)	794 (360)	6850
4605-FVG+	37.80 (960)	62.99 (1600)	17.91 (455)	29.53 (750)	61.02 (1550)	0.98 (25)	926 (420)	9730

IMPULSE•VG+ Series 2 Dimensions/Heat Loss—Open Chassis

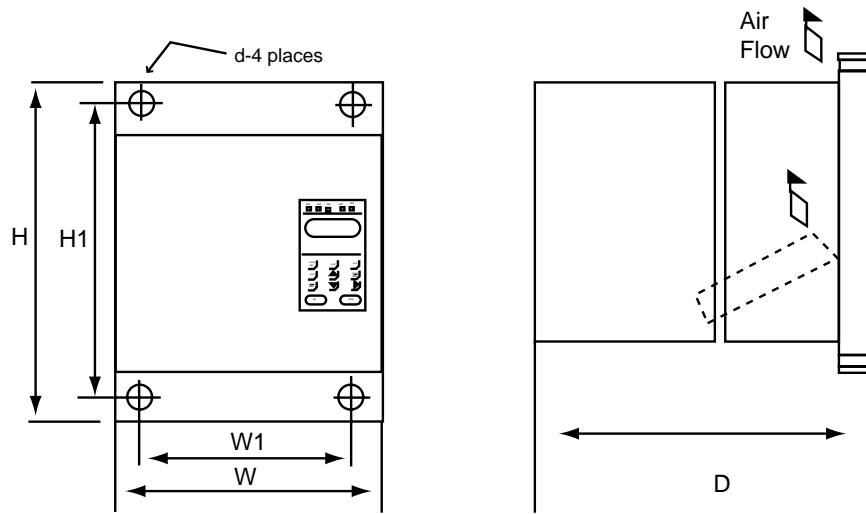


Figure 2-8: 575V Class—Open Chassis

NOTE: Some models are shipped with metal enclosures that can be removed and discarded.

Model	Overall Dimensions—in. & (mm)			Mounting Dimensions—in. & (mm)			Wt Lbs/(kg)	Heat Loss (W)
	W	H	D	W1	H1	H2		Total
5003-FVG+	5.51 (140)	11.02 (280)	7.09 (180)	4.96 (126)	10.47 (266)	0.28 (7)	8.8 (4)	90
5004-FVG+	5.51 (140)	11.02 (280)	7.09 (180)	4.96 (126)	10.47 (266)	0.28 (7)	8.8 (4)	105
5006-FVG+	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	13 (6)	140
5009-FVG+	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	14 (6.5)	205
5012-FVG+	7.87 (200)	11.81 (300)	8.07 (205)	7.32 (186)	11.22 (285)	0.31 (8)	14 (6.5)	220
5017-FVG+	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.29 (7.5)	28 (13)	330
5022-FVG+	9.84 (250)	14.96 (380)	8.86 (225)	9.29 (236)	14.37 (365)	0.29 (7.5)	28 (13)	460
5027-FVG+	15.75 (400)	29.53 (750)	11.22 (285)	11.81 (300)	28.74 (730)	0.39 (10)	97 (44)	540
5032-FVG+	15.75 (400)	29.53 (750)	11.22 (285)	11.81 (300)	28.74 (730)	0.39 (10)	97 (44)	730
5041-FVG+	22.64 (575)	33.46 (850)	11.81 (300)	18.71 (475)	32.48 (825)	0.49 (12.5)	156 (72)	820
5052-FVG+	22.64 (575)	33.46 (850)	11.81 (300)	18.71 (475)	32.48 (825)	0.49 (12.5)	156 (72)	1220
5062-FVG+	22.64 (575)	33.46 (850)	11.81 (300)	18.71 (475)	32.48 (825)	0.49 (12.5)	156 (72)	1650
5077-FVG+	22.64 (575)	41.34 (1050)	12.80 (325)	18.70 (475)	40.35 (1025)	0.49 (12.5)	195 (90)	1750
5099-FVG+	22.64 (575)	41.97 (1066)	12.80 (325)	18.70 (475)	40.35 (1025)	0.49 (12.5)	195 (90)	2250
5130-FVG+	22.80 (579)	57.68 (1465)	12.99 (330)	18.70 (475)	48.23 (1225)	0.49 (12.5)	271 (125)	2350
5172-FVG+	22.80 (579)	77.43 (1966.5)	13.98 (355)	18.70 (475)	61.81 (1570)	0.59 (15)	331 (153)	3200
5200-FVG+	22.80 (579)	77.43 (1966.5)	13.98 (355)	18.70 (475)	61.81 (1570)	0.59 (15)	342 (158)	4700

c h a p t e r **3**

Wiring

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IMPULSE•VG+ Series 2 Wiring Practices



WARNING

Before you wire the drive, review the following practices to help ensure that your system is wired properly.

- **Do not** connect the main output terminals (T1, T2, and T3) to the incoming, three-phase AC source. This will damage the unit!
- Except for Terminals 18, 19, and 20, do not connect the control board terminals directly to the 120VAC user input device. This will damage the unit!
- Ensure that the drive-to-motor wiring distance is less than 250 ft unless appropriate reactors and/or filters are used.
- If a device that can interrupt power is installed between the drive and the motor, install a reactor on the output side of the drive.
- On external user input devices, use hard contact inputs rather than solid-state inputs.
- If the power source is 500 kVA or greater, or more than 10 times the inverter kVA rating, ensure that there is at least 3 percent impedance between the power source and the drive input. To accomplish this, you can install a DC reactor between inverter terminals ⊕1 and ⊕2, or use an AC line reactor on the input of the drive. If you don't provide enough impedance, excessive peak currents could damage the input power supply circuit.
- If the user input device is a PLC TRIAC output, use a 5-K Ω , 10-W resistor between the signal and L2 (X2).
- Comply with "Suggested Circuit Protection Specifications" on page 3-6.
- Use time delay fuses, which are sized at 150% of drive's continuous-rated current, for drive input protection.
- Use R-C-type surge absorbers across the coil of all contactors and relays in the system. Failure to do so could result in noise-related, nuisance fault incidents. For selection information, see "R-C Surge Absorber Selection" on page 3-33.
- Use external dynamic braking resistors for all applications.
- Do not ground the drive with any large-current machines.
- Before you use any welding or high-current machines near the crane, disconnect all line and ground wiring.
- Do not use output contactors between the drive and the motor.
- Do not let the wiring leads come in contact with the drive enclosure.
- Do not connect power factor correction capacitors to the drive input or output.
- Hard-wire the drive and motor (e.g., festoon cable). Do not use sliding collector bars.
- If you have a user input device or interface board that is remote, use shielded cable between the drive input terminals and the interface output terminals or user input device(s).
- Before turning on the drive, check the output circuit (T1, T2 and T3) for possible short circuits and ground faults.

- Increase the wire size by one size for every 25 ft between the drive and motor; suggested for center driven cranes, trolleys and bridges. (Voltage drop is especially significant at low frequencies.)
- When using more than one transformer for the drive's power, properly phase each transformer.
- To reverse the direction of rotation, interchange any two motor leads (T1, T2 or T3). (Changing L1, L2 or L3 will not affect the shaft rotation direction.)
- Use shielded cable for all low-level DC speed reference signals (0 to 10VDC, 4 to 20 mA). Ground the shield only at the drive side.
- Please observe National Electrical Code (NEC) guidelines when wiring electrical devices.

Failure to observe these warnings may result in equipment damage.

IMPULSE•VG+ Series 2 Standard Connection Diagram

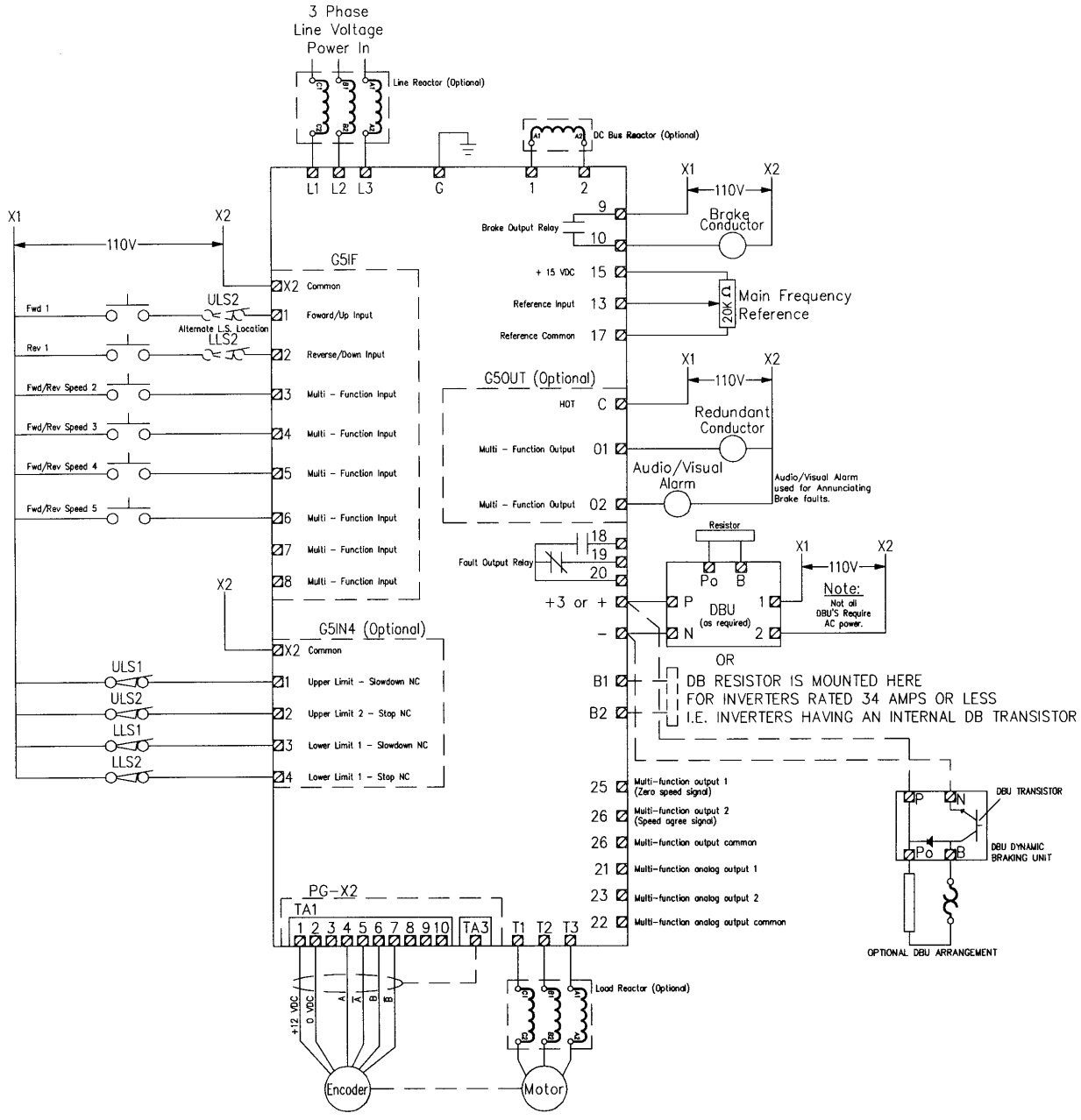


Figure 3-1: IMPULSE•VG+ Series 2 Terminal Diagram

NOTE: Wiring may vary between DBU and CDBR.

Suggested Circuit Protection Specifications and Wire Size

In order to comply with most safety standards, some circuit protective devices should be used between the incoming three-phase power supply and the IMPULSE•VG+ Series 2. These devices can be thermal, magnetic, or molded-case breakers (MCCB); or “slow-blow” type fuses such as “CCMR” or “J.”



CAUTION:

The following guidelines are only suggested values. Always conform to local electrical codes and wiring practices.

Model #	Rated Current(A)		Time Delay	Inverse Time	Wiring Size (AWG/MCM)		
	Drive	InputFuse	Input Fuse Class	Molded/Case Circuit Breaker	Power Circuit Wiring	Control Wiring	Ground
230VClass							
2006 -FVG+	6	9	CC	15	12	16/14	14/10
2008 -FVG+	8	12	CC	20	12	16/14	12/10
2011 -FVG+	11	20	CC	25	12	16/14	12/10
2017 -FVG+	17.5	25	J	40	12	16/14	10
2025 -FVG+	25	35	J	60	10	16/14	10/8
2033 -FVG+	33	45	J	70	10	16/14	10/8
2054 -FVG+	54	70	J	100	6	16/14	8
2068 -FVG+	68	90	J	100	4	16/14	6
2080 -FVG+	80	100	J	175	4	16/14	6
2130 -FVG+	130	175	J	250	1/0	16/14	4
2160 -FVG+	160	200	J	300	1/0	16/14	4
2224 -FVG+	224	300	J	450	4/0	16/14	2
2300 -FVG+	300	400	J	600	2/0 x 2P	16/14	1
460VClass							
4001 -FVG+	1.9	3	CC	10	12	16/14	12/10
4003 -FVG+	3.6	6	CC	10	12	16/14	12/10
4005 -FVG+	5.1	8	CC	15	12	16/14	12/10
4008 -FVG+	8.5	15	CC	20	12	16/14	12/10
4011 -FVG+	11.7	20	CC	25	12	16/14	12/10
4014 -FVG+	14.8	25	CC	30	12	16/14	8/6
4021 -FVG+	21	30	J	50	10	16/14	8
4028 -FVG+	28.6	40	J	60	10	16/14	8
4034 -FVG+	34	45	J	80	8	16/14	8
4041 -FVG+	41	60	J	80	8	16/14	8
4052 -FVG+	52	70	J	125	6	16/14	8
4065 -FVG+	65	90	J	125	6	16/14	8
4080 -FVG+	80	100	J	150	4	16/14	6
4096 -FVG+	96	125	J	200	2	16/14	6

Model #	Rated Current(A)		Time Delay	Inverse Time	Wiring Size (AWG/MCM)		
	Drive	InputFuse	Input Fuse Class	Molded/Case Circuit Breaker	Power Circuit Wiring	Control Wiring	Ground
4128 -FVG+	128	175	J	250	1/0	16/14	4
4165 -FVG+	165	225	J	350	2/0	16/14	4
4224 -FVG+	224	300	J	450	4/0	16/14	2
4302 -FVG+	302	400	J	600	2/0 x 2P	16/14	1
4450 -FVG+	450	600	J	900	2/0 x 2P	16/14	1/0
4605 -FVG+	605	800	L	1450	250 MCM x 2P	16/14	1/0
575V Class							
5003-FVG+	3.5	5	CC	10	12	16/14	12/10
5004-FVG+	4.1	7	CC	10	12	16/14	12/10
5006-FVG+	6.3	10	CC	15	12	16/14	12/10
5009-FVG+	9.8	15	CC	20	12	16/14	12/10
5012-FVG+	12.5	20	CC	30	12	16/14	12/10
5017-FVG+	17	25	CC	40	12	16/14	8/6
5022-FVG+	22	35	J	50	10	16/14	8
5027-FVG+	27	40	J	60	10	16/14	8
5032-FVG+	32	45	J	80	10	16/14	8
5041-FVG+	41	60	J	80	8	16/14	8
5052-FVG+	52	70	J	125	6	16/14	8
5062-FVG+	62	90	J	125	4	16/14	8
5077-FVG+	77	100	J	150	4	16/14	6
5099-FVG+	99	125	J	200	2	16/14	6
5130-FVG+	130	175	J	250	1/0	16/14	4
5172-FVG+	172	225	J	350	2/0	16/14	4
5200-FVG+	200	300	J	450	4/0	16/14	2

Power Circuit Wiring Procedures

To wire the power circuit for IMPULSE•VG+ Series 2:

1. Run the three-phase power supply wires through an appropriate enclosure hole.
2. Referring to “Suggested Circuit Protection Specifications—IMPULSE•VG+ Series 2” and the following two tables, connect the three-phase power supply wires to a circuit protection system.
3. Connect the three-phase power supply wires from the circuit protection Terminals L1, L2 and L3.
4. From Terminals T1, T2 and T3, connect the power output wires to the motor. If a load reactor is used, connect these output wires to the reactor input instead; then connect the reactor output to the motor.

NOTE: If a device that can interrupt power is installed between the drive and the motor, install a reactor on the output side of the drive.

5. For Models 4041-FVG+ and greater, ensure the jumper plug is inserted in the printed-circuit board (3PCB), which is underneath the control board, as follows:

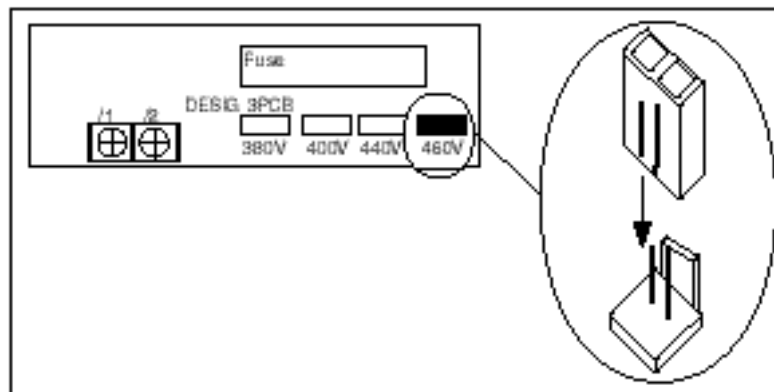


Figure 3-2: Models 4041-FVG+ to 4096-FVG+

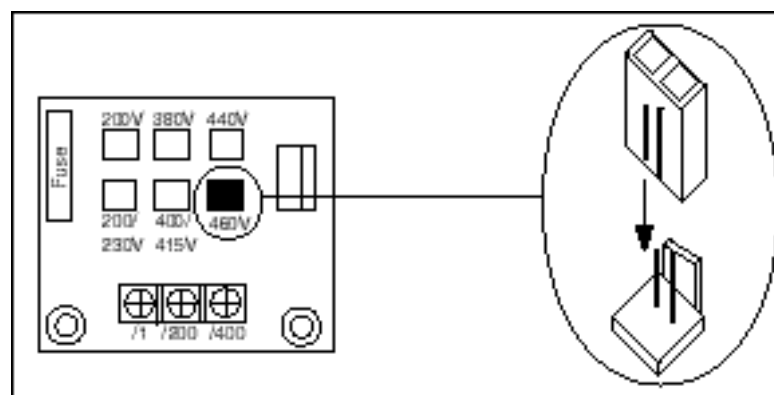


Figure 3-3: Models 4128-FVG+ to 4605-FVG+

Installation/Wiring of CDBR Braking Unit

The following wiring instructions apply to Figures 3-4 (page 3-10) through 3-8 (page 3-14).



WARNING

120 VAC is not needed for the control circuit to operate. If 120 VAC is applied to terminals 1, 2, 5 or 6, DAMAGE TO THE UNIT WILL RESULT.

NOTE:

- Some Braking units have only a symbol labeling the terminal.
- Most resistors do not have P_0 (Γ_0) and B (S_0) designators.
- Polarity does not matter on the resistor.

1. Wire N (**S**) on the CDBR to N (**S**) on the drive.
2. Wire P (Γ) on the CDBR to P(Γ) on the drive.
3. Wire the P_0 (Γ_0) on the CDBR to the dynamic braking resistor.
4. Wire B (S_0) on the CDBR to the dynamic braking resistor.
5. For CDBR Model #4220, wire **r** on the CDBR to **r (I1)** on the drive. For Drive Model numbers 4096-AFG+ and 4096-FVG+ and below, wire **s** on the CDBR to **s (I2)** on the drive. For Model numbers 4128-AFG+ and 4128-FVG+ and above, wire **S** on the CDBR to **S400 (I2 400)** on the drive.
6. Terminals 3 and 4 are the Cooling Fin Overheat Contact.
Thermoswitch contact rating: 250VAC, 1A max
30VDC, 1A max
7. Terminals 1, 2, 5 and 6 are used for **MASTER/SLAVE** Operation. Use twisted-pair wires of 14 AWG or smaller for connection between 5, 6, and 1, 2 on the braking units. Parallel connection is possible up to a maximum of 10 units. Refer to Figure 3-5 on page 3-11 for parallel connection of braking units.
8. Set the Voltage Selection Jumper to match the voltage of the incoming power source.
9. Set the Master/Slave Jumper to Master for single unit operation.

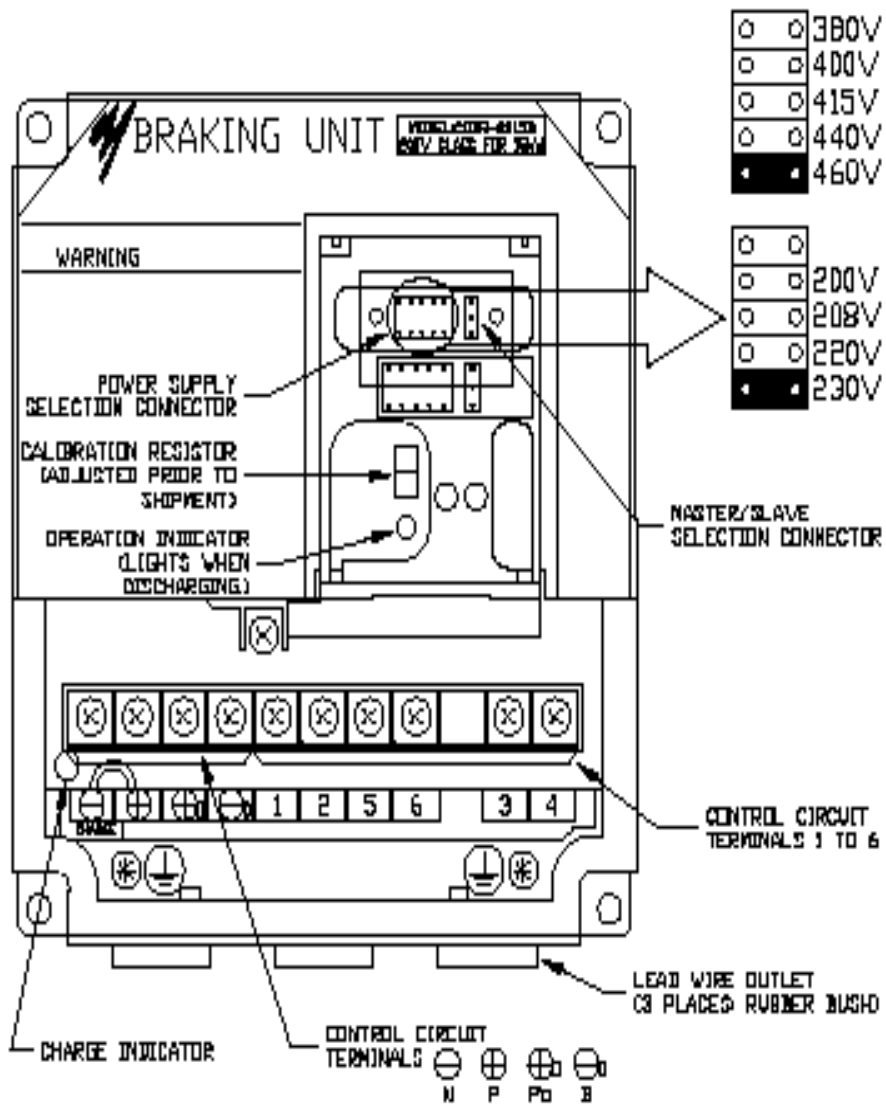


Figure 3-4: CDBR 4045B

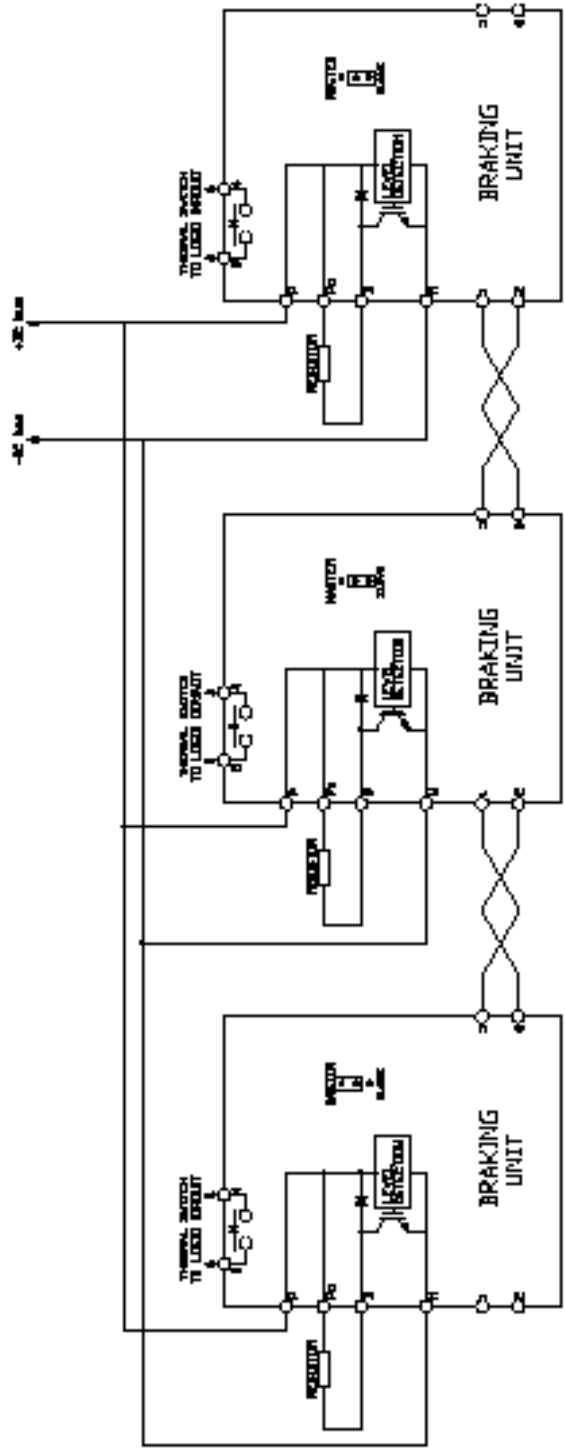


Figure 3-5: CDBR Parallel connection of Braking Unit

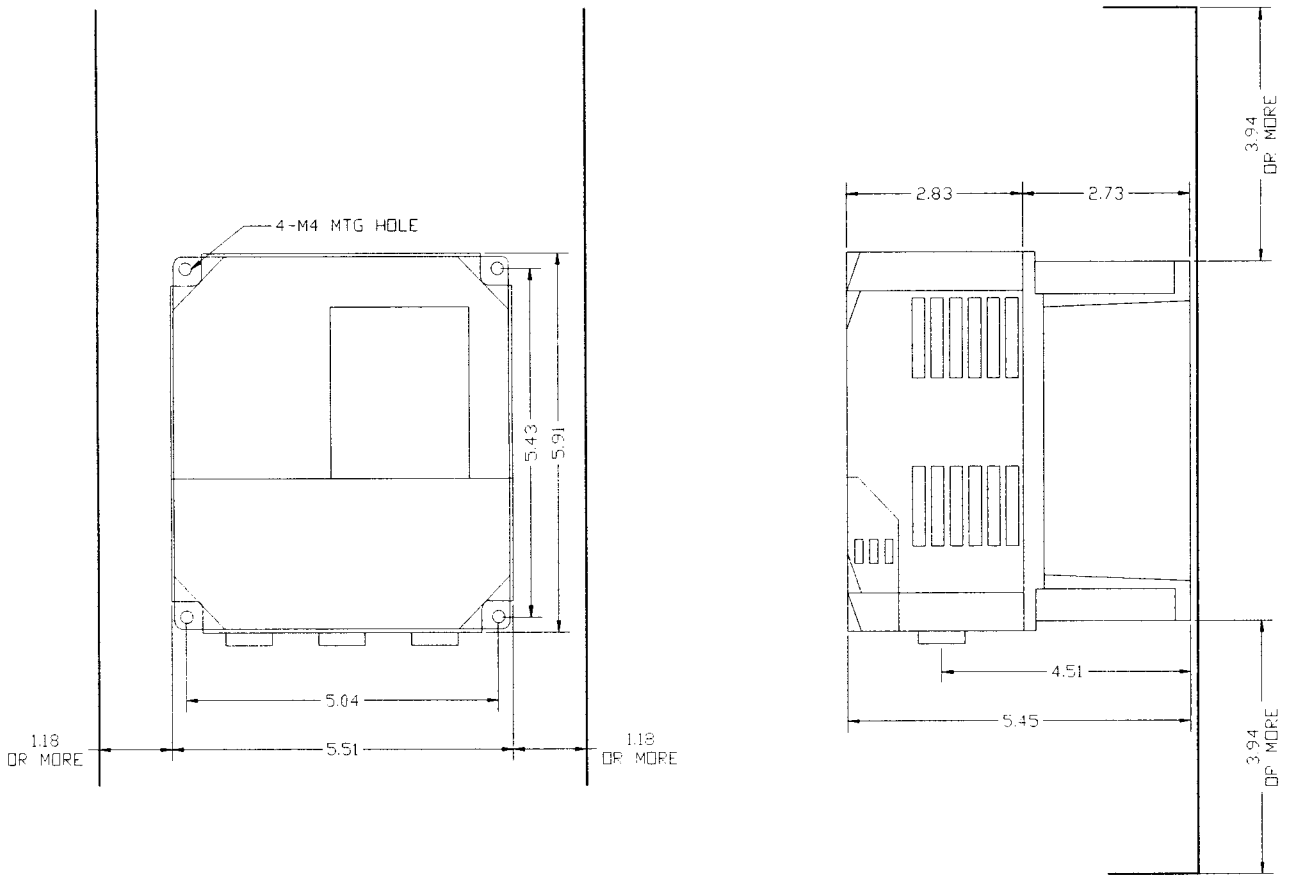


Figure 3-6: CDBR 4045B

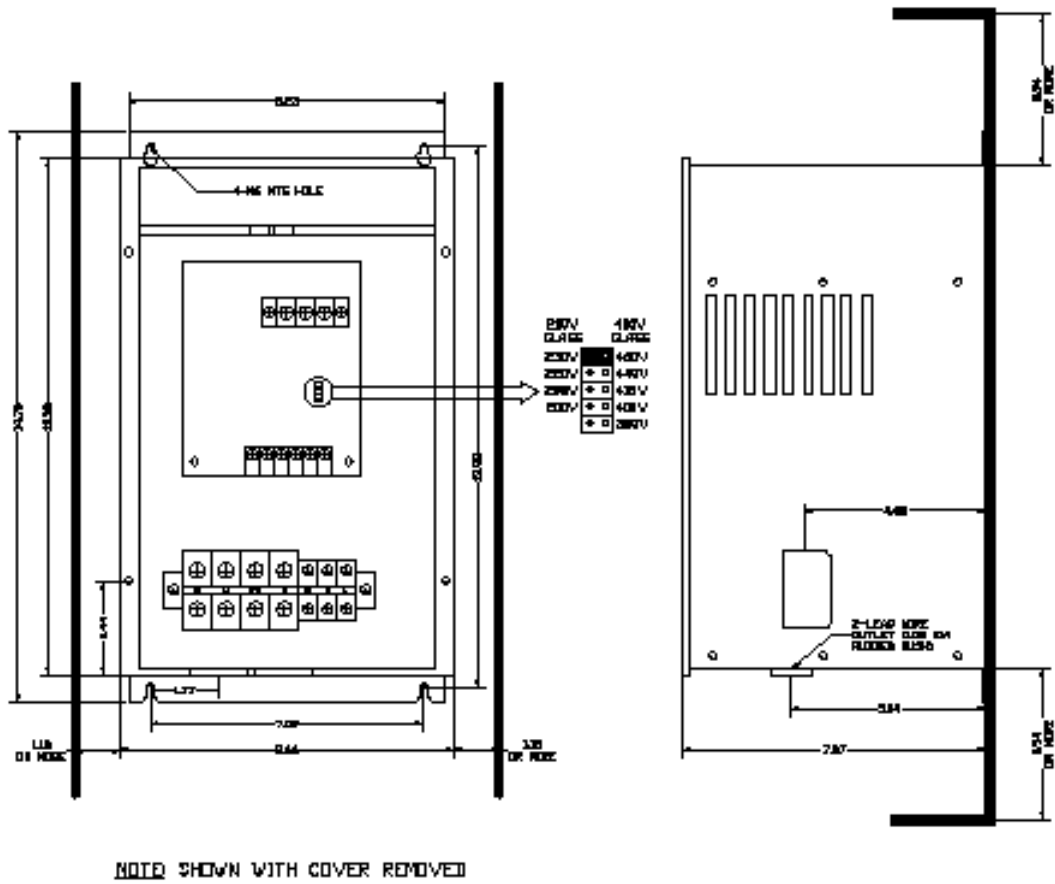


Figure 3-7: CDBR 4090

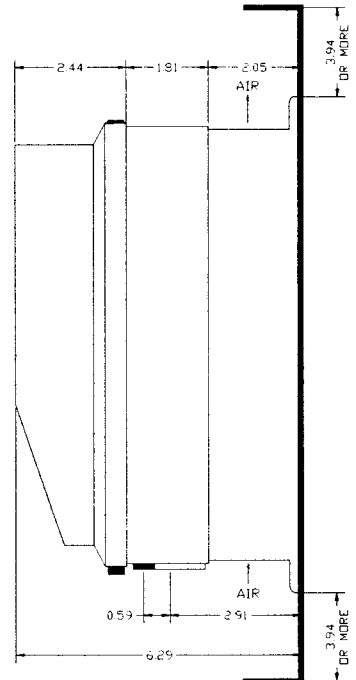
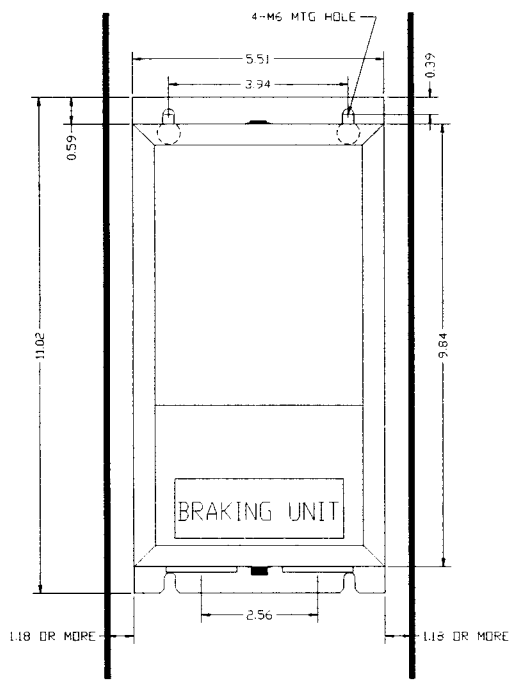




Figure 3-9: CDBR-5037


230 V Class Terminal Functions

	<i>Model</i>	2006-FVG+ to 2033-FVG+	2054-FVG+ to 2068-FVG+	2080-FVG+	2130-FVG+ to 2300-FVG+
	<i>Rated Current</i>	6 to 33 Amps	54 to 68 Amps	80 Amps	130 to 300 Amps
T e r m i n a l	L1	Main circuit input power supply			
	L2				
	L3				
	T1	Inverter output			
	T2				
	T3				
	B1	Braking resistor	n/a		
	B2				
	S	DC reactor (⊕1-⊕2) DC Power supply (⊕1-S)	DC reactor (⊕1-⊕2) DC power supply (⊕1-⊕) Braking unit (⊕3-S)	DC power supply (⊕1-S) Braking unit (⊕3-S) (⊕1 and ⊕2 terminals not provided)	
	⊕1				
	⊕2				
	⊕3				
	r	n/a		Cooling fan power supply	
	s				
	Ground terminal (Ground resistance: 100 Ω or less)				

460 V Class Terminal Functions

	<i>Model</i>	4003-FVG+ to 4034-FVG+	4041-FVG+ to 4096-FVG+	4128-FVG+ to 4302-FVG+	4450-FVG+ to 4605-FVG+
	<i>Rated Current</i>	3.6 to 34 Amps	41 to 96 Amps	128 to 302 Amps	450 to 605 Amps
T e r m i n a l	L1	Main circuit input power supply			
	L2				
	L3				
	T1	Inverter output			
	T2				
	T3				
	B1	Braking resistor	n/a		
	B2				
	S	DC reactor (⊕1-⊕2) DC power supply (⊕-S)	DC power supply (⊕1-S) Braking unit (⊕3-S)	Braking unit (⊕3-S) (⊕1 and ⊕2 terminals not provided)	
	⊕1				
	⊕2				
	⊕3				
	s	n/a	Cooling fan power supply	n/a	
	r		Cooling fan power supply (Control power supply) r-s200: 200 to 230VAC input r-s400: 380 to 460VAC input		
s200	n/a				
s400	n/a				
	Ground terminal (Ground resistance: 10 Ω or less)				

575 V Class

	<i>Model</i>	5003-FVG+ to 5032-FVG+	5003-FVG+ to 5017-FVG+	5041-FVG+ to 5200-FVG+	
	<i>Rated Current</i>	3 to 32 Amps	3 to 17 Amps	41 to 200 Amps	
Terminal	L1 (R)	Main circuit input power supply			
	L2 (S)				
	L3 (T)				
	T1 (u)	Inverter output			
	T2 (V)				
	T3 (W)				
	B1	Braking resistor		n/a	
	B2				
	S	DC reactor (⊕1-⊕2) DC power supply (⊕-S) Braking Unit(⊕-S)		DC power supply (⊕1-S) Braking unit (⊕1-S) (⊕2 terminal not provided)	
	⊕1				
	⊕2				
	l1(r)	n/a		Cooling fan power supply	
	l2(s)				
		Ground terminal (Ground resistance: 10 Ω or less)			

External Dynamic Braking Unit (DBU)

For applications that require more than one External DBU, wire the DBUs in parallel as shown in Figures 3-4 (page 3-10) through 3-8 (page 3-14), 2130-FVG+ to 2300-FVG+, and 4128-FVG+ to 4302-FVG+, and 4450-FVG+ to 4605-FVG+.

You can connect up to 10 of these units in a “master/slave” configuration. An application can have multiple slaves, but only one master. With this configuration, ensure that you connect all of the thermal switches (Terminals 3 and 4) in parallel and connect them to your RUN circuitry. Use twisted-pair, shielded cable (Belden 8760) for this control circuitry. For more information on the DBU, see “IMPULSE•VG+ Series 2 External Dynamic Braking Unit—Specifications & Dimensions.”

NOTE: The wiring distance between the DBU and IMPULSE•VG+ Series 2 must be less than 16.4 feet (5 m). The wiring distance between the DB resistor and the DBU must be less than 32.8 feet (10 m).

10. Run the wires into the DBU through the holes in the bottom of its enclosure.

NOTE: The maximum wire size for a single DBU is #6.

11. Make a cross cut in the rubber bushings supplied with the unit.

12. Run the wires through a hole in both the drive and the DBU. (This will provide the DBU components with an extra degree of protection from the environment.)

13. Connect DBU terminals to the drive as indicated in “Detailed Power Circuits—By Model,” found on pages 3-22 through 3-27.

14. “Jumper” JP5, and then JP4, on the DBU logic card, as indicated in the following two drawings, to correspond with the incoming line voltage.

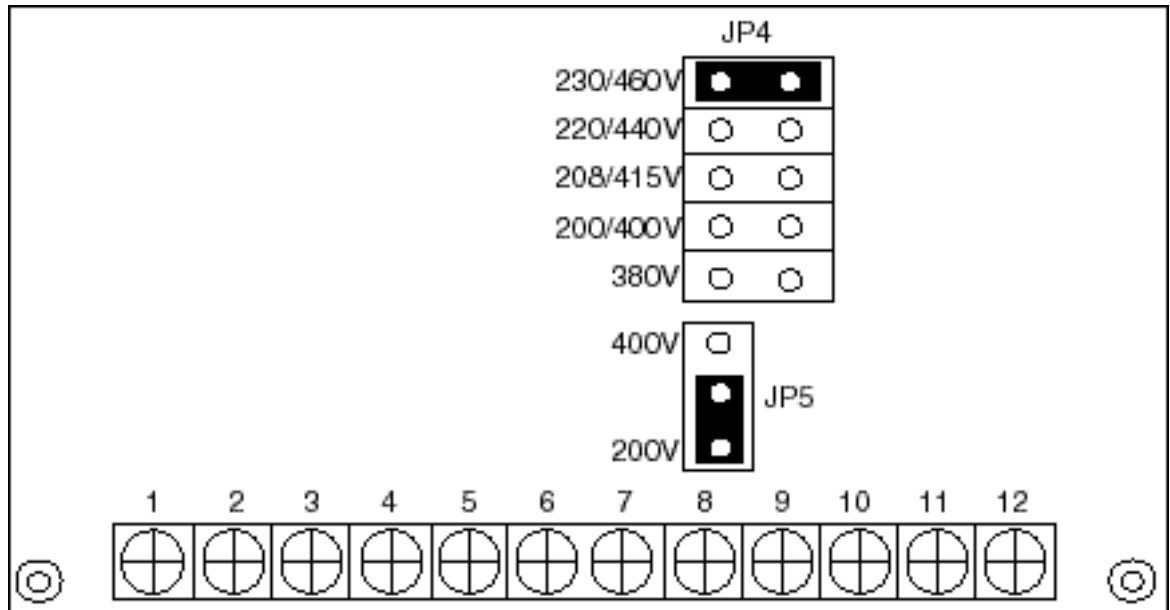


Figure 3-10: 200V

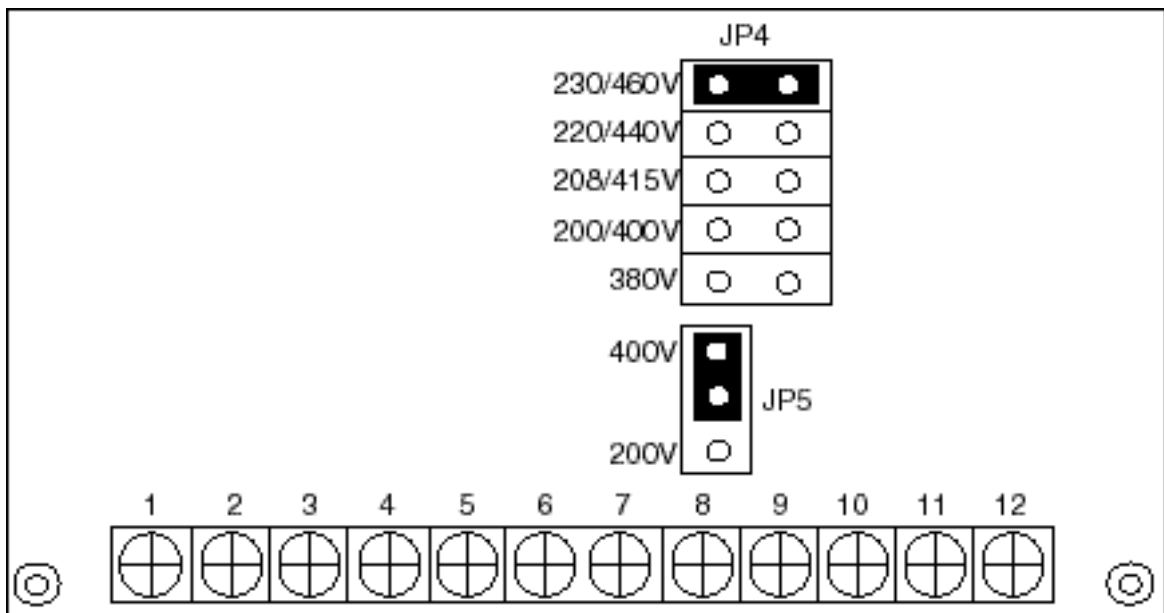


Figure 3-11: 400V

External Dynamic Braking Resistor

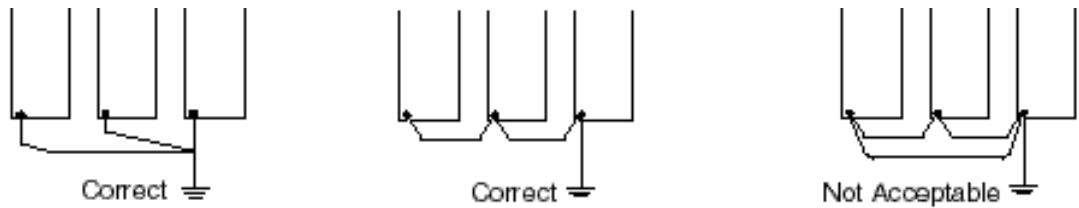
15. Referring to the drawings in “Detailed Power Circuits—By Model” found on pages 3-22 through 3-27, connect the dynamic braking resistor(s) as follows:

- For Models 2003-FVG+ through 2033-FVG+ through 4034-FVG+, connect the resistor(s) to terminals B1 and B2.
- For all other models, connect the resistor(s) to terminals PO and B on the External DBU.

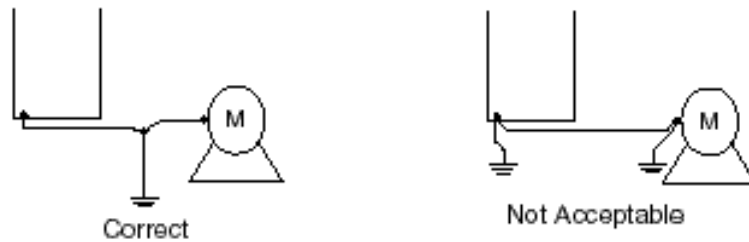
Grounding

16. Connect terminal G to the common panel ground. Use ground wiring as specified in “Suggested Circuit Protection and Wire Size” on page 3-38, and keep the length as short as possible.

- Ground Resistance: 230V class; 100 Ω or less, 460V or greater class; 10 Ω or less.
- Never ground the IMPULSE•VG+ Series 2 drives in common welding machines, motors, or other high-current electrical equipment. Run all ground wiring in separate conduit.
- When more than one drive is used for the same system, ground each directly or daisy-chain to the ground pole. Do not loop the ground wires.



Grounding of three IMPULSE • VG+ Series 2 Drives



Grounding of IMPULSE • VG+ Series 2 Drive and Vector Control Motor

Figure 3-12: Grounding

Power Circuit Wiring Diagrams

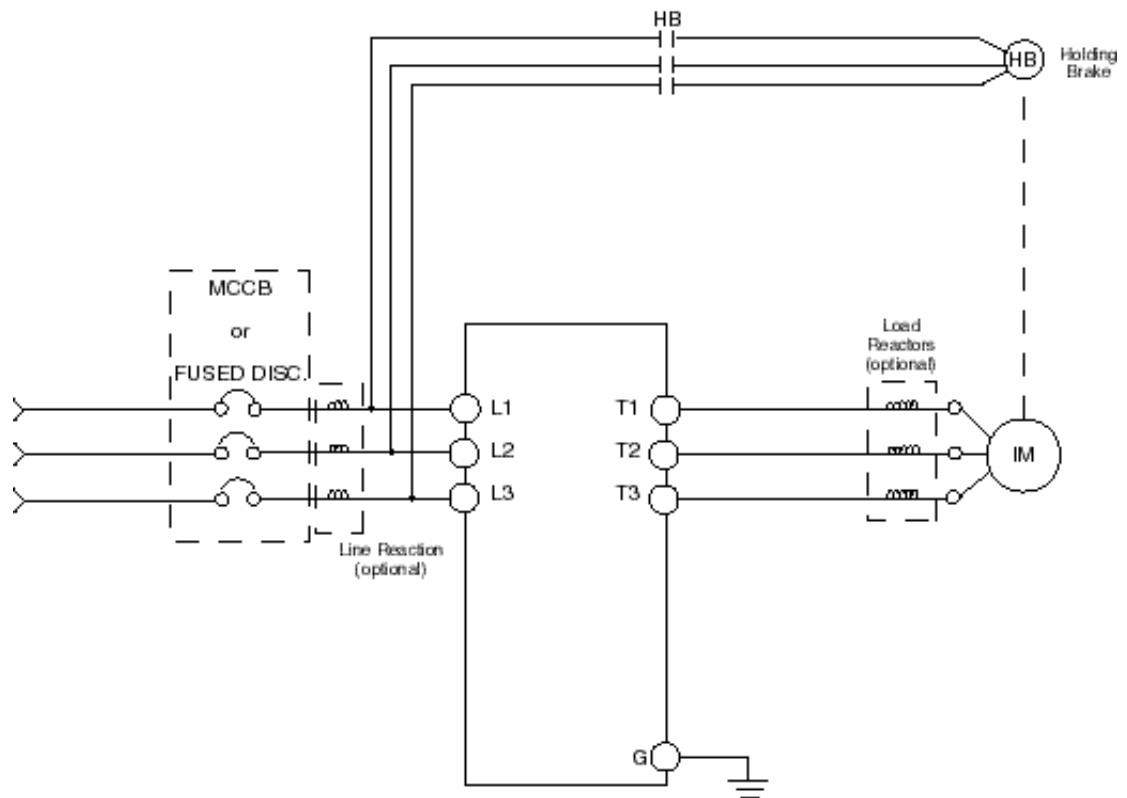


Figure 3-13: Power Circuit Wiring Diagram

Detailed Power Circuits—By Model

The following ten drawings show detailed power wiring circuits by model.

NOTE: If a Series 2 drive is used to replace an older version IMPULSE drive, it is permissible to use the older version dynamic braking units (CDBRs).

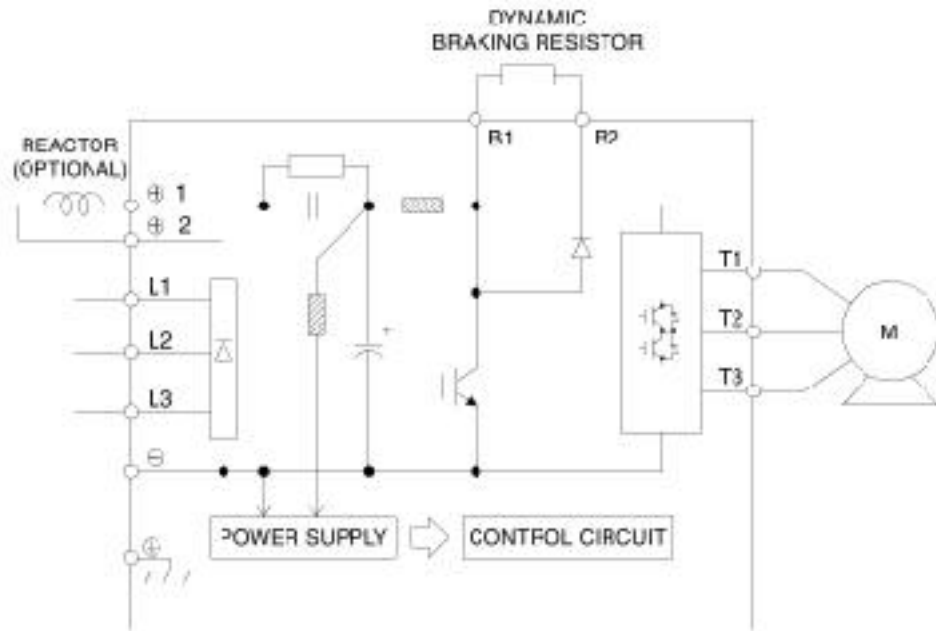


Figure 3-14: 2006-FVG+ to 2008-FVG+

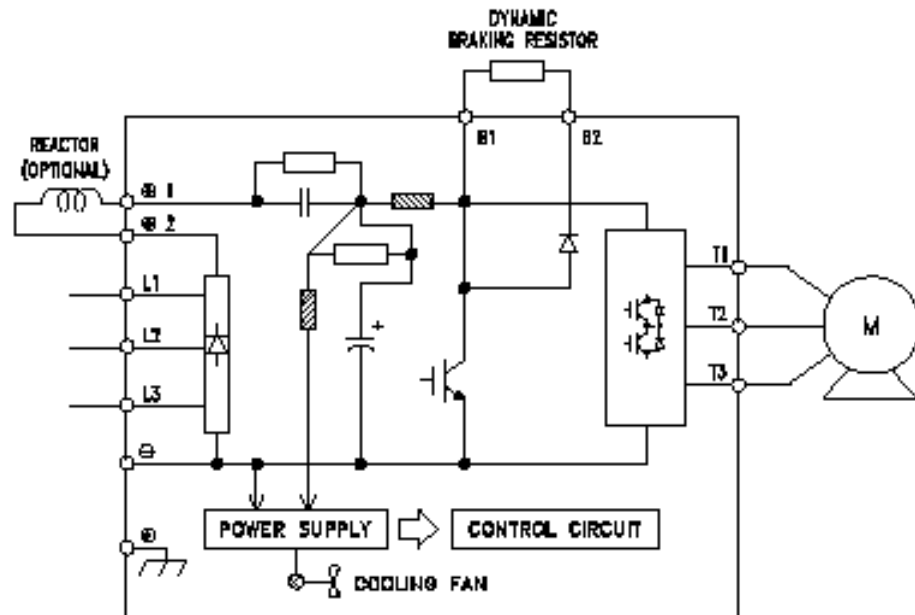


Figure 3-15: 2011-FVG+ to 2033-FVG+

NOTE: Wiring will vary between DBU and CDBR.

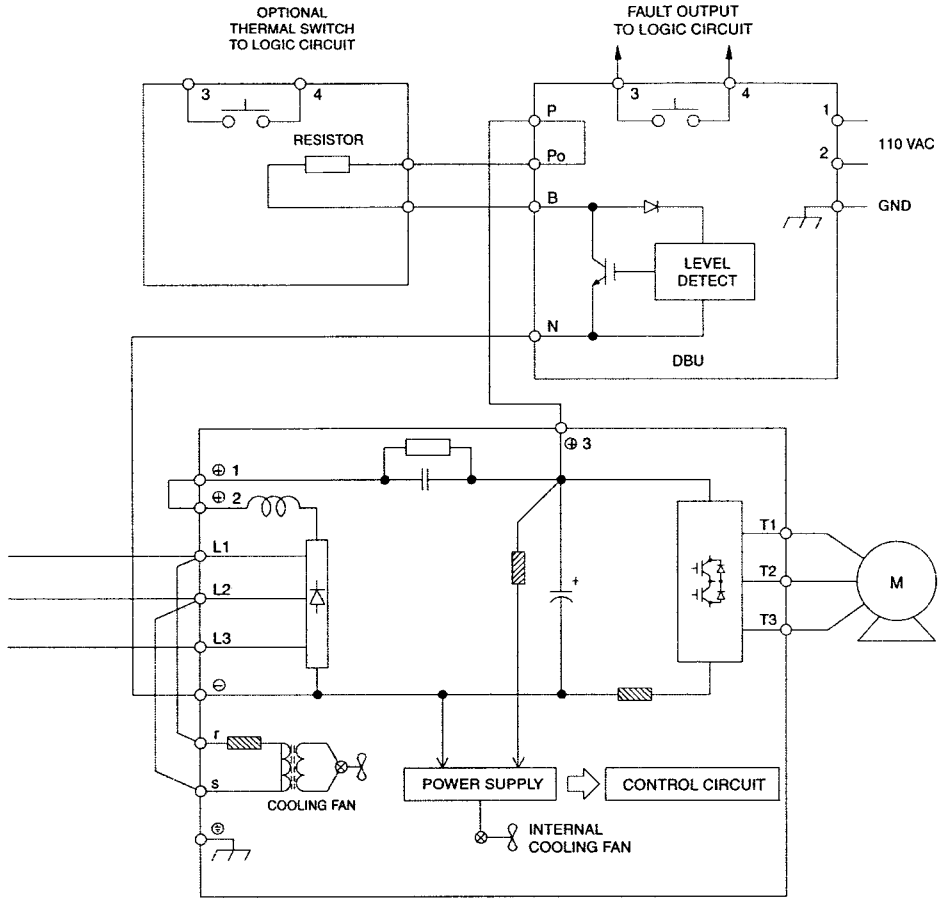


Figure 3-16: 2054-FVG+ to 2068-FVG+

NOTE: Wiring will vary between DBU and CDBR.

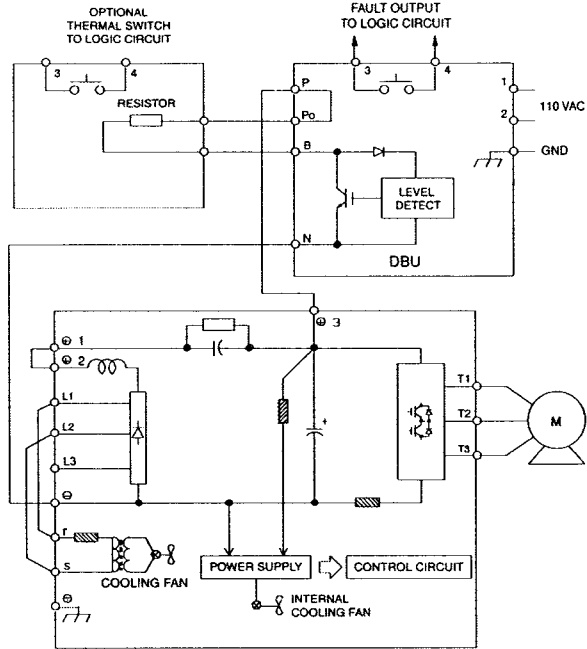


Figure 3-17: 2080-FVG+

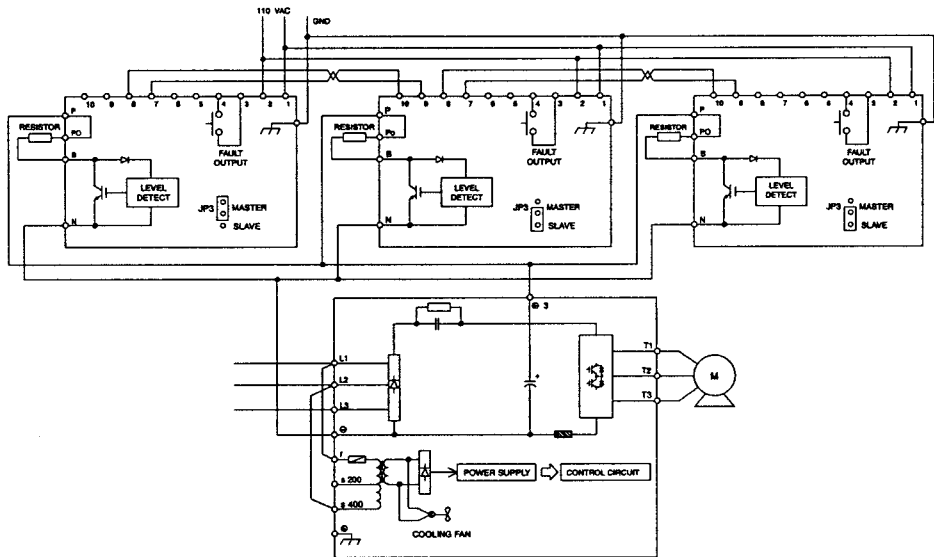


Figure 3-18: 2130-FVG+ to 2300-FVG+

NOTE: Wiring will vary between DBU and CDBR.

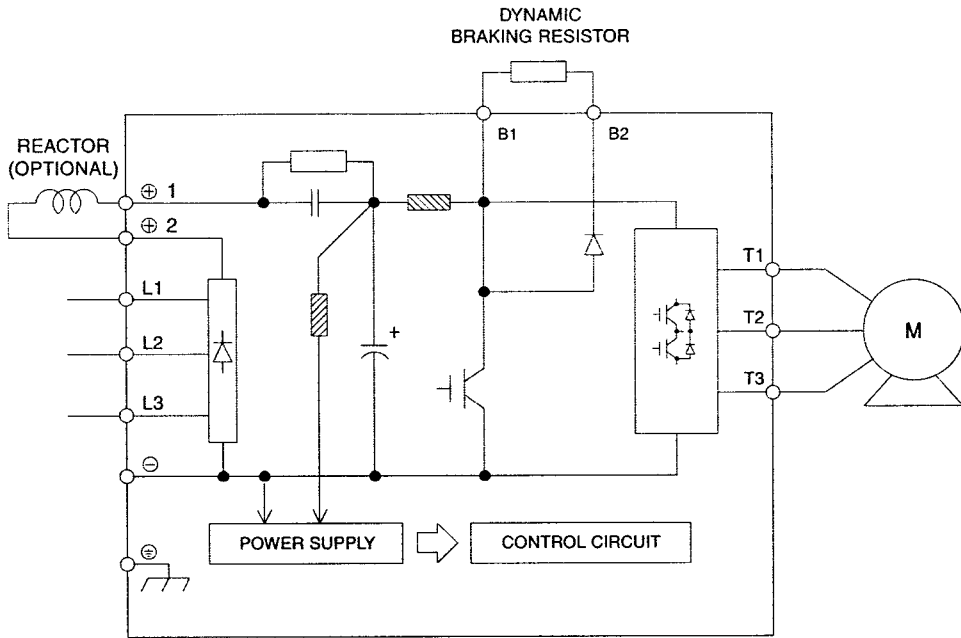


Figure 3-19: 4003-FVG+ to 4005-FVG+

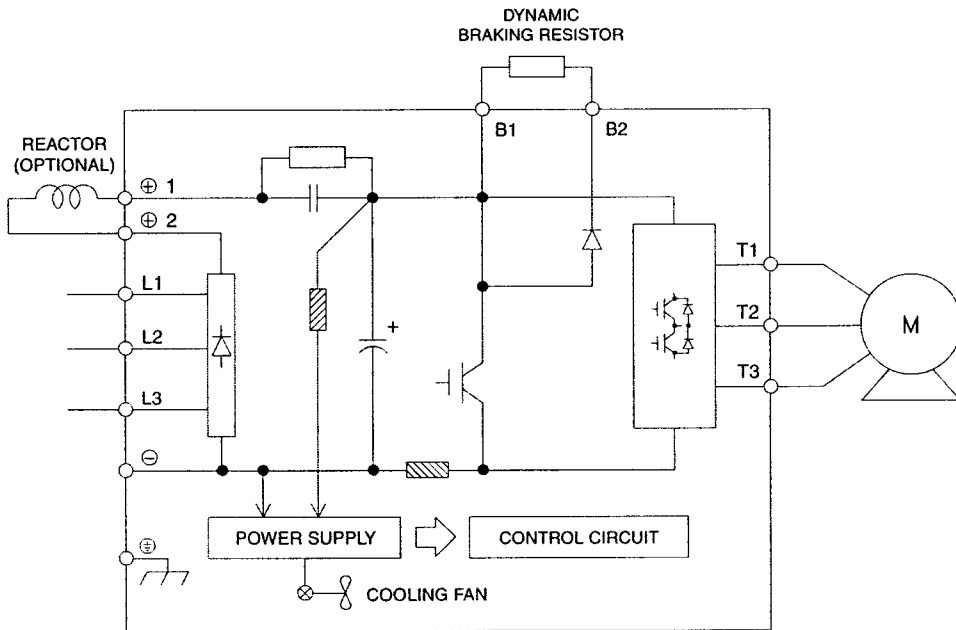


Figure 3-20: 4008-FVG+ to 4034-FVG+

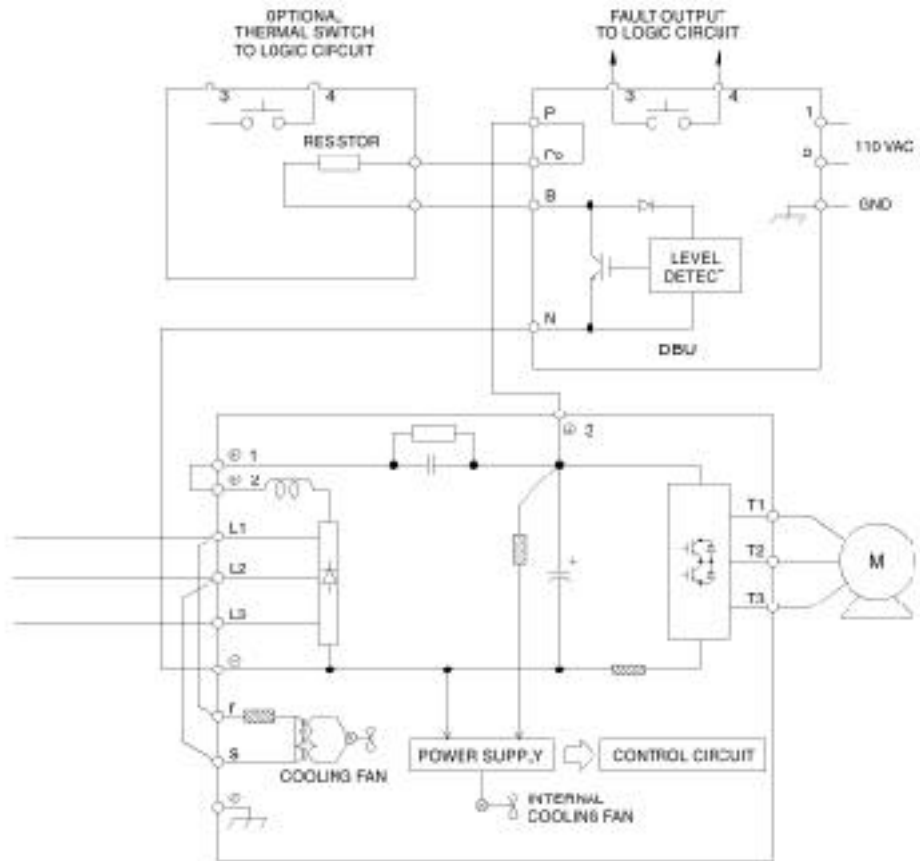


Figure 3-21: 4041-FVG+ to 4096-FVG+

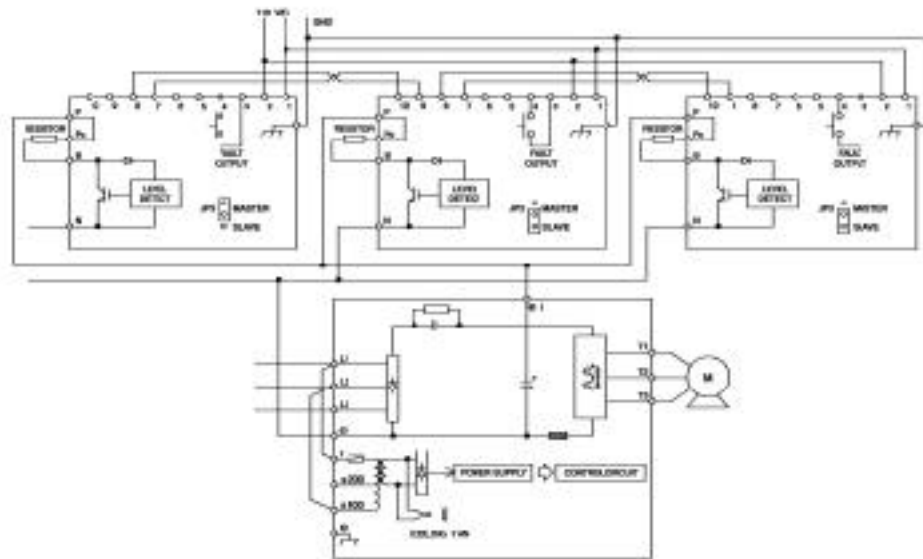


Figure 3-22: 4128-FVG+ to 4302-FVG+

NOTE: Wiring will vary between DBU and CDBR.

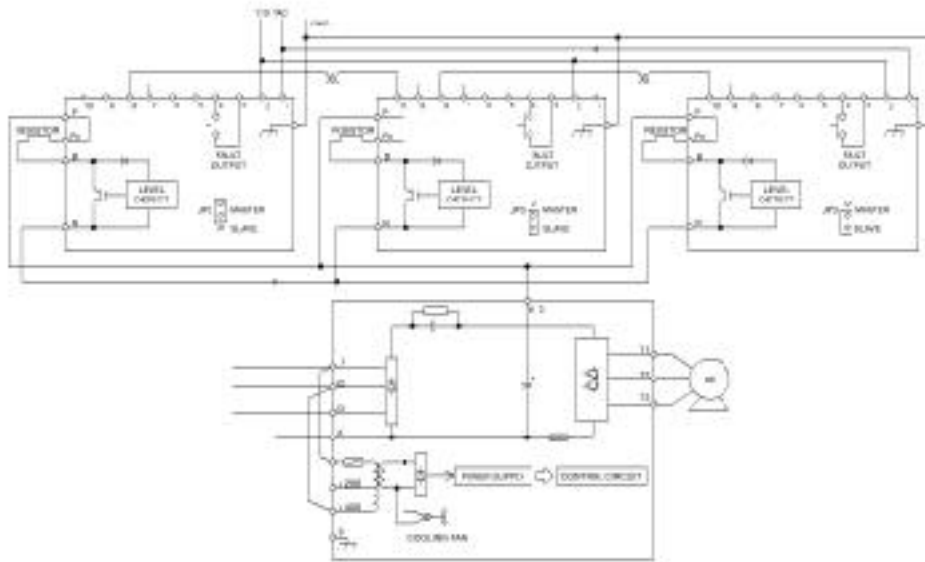


Figure 3-23: 4450-FVG+ to 4605-FVG+

NOTE: Wiring will vary between DBU and CDBR.

Wiring the Control Circuit

Control Input

IMPULSE•VG+ Series 2 is designed to interface directly with a 120VAC user input device. User input devices include: pendant controls (pushbutton station), remote control transmitters (infrared and radio), master switches, programmable logic controls (PLC), and personal computers. This design feature eliminates the need for interface relays or isolation circuitry. The user interface device is connected to the G5IF 120V Control Interface Card, which includes Terminals 1, 2, 3, 4, 5, 6, 7, and 8. Four more terminals can be added with the optional G5IN4 120V Control Input Card.

NOTE: Terminal X2 is also on both control input cards, and should always be connected to X2 of the user input device.

For the G5IF, Terminals 1 and 2 are always used for the directional run commands (FORWARD, REVERSE, UP, DOWN, LEFT, RIGHT). The other terminals are multi-function terminals, and are used for speed control and other characteristics. With multi-function terminals you can assign entirely different functions and performance characteristics without having to rewire the drive.

Additional Input Terminals

Four additional digital input terminals can be added with the optional G5IN4 120V input card. To program the G5IN4 input card, please refer to Chapter 5; “Special Function Group, G5IN4 Digital Multi-Function Inputs” Sections (C9-XX) on page 5-40.

Control Output

The table below summarizes the control output terminal functions:

Circuit Board	Terminal	Function
G5OUT	C	Connection to X1 of 120VAC power supply
G5OUT	01	Multi-function Output (See H2 constants)
G5OUT	02	Multi-function Output (See H2 constants)
Drive Control Board	9	Electric brake output; electric brake release signal
Drive Control Board	10	Electric brake output; electric brake release signal
Drive Control Board	18	Fault output—normally open; closed to COM at fault
Drive Control Board	19	Fault output—normally closed; open to COM at fault
Drive Control Board	20	Fault output—common

Control Circuit Terminals

The table below outlines the functions of the control circuit terminals.

Classification	Terminal	Signal Function	Description		Signal Level
Sequence Input Signal	1	Forward run/stop	Forward run when closed, stop when open		Photo-coupler isolation Input: +24VDC 8mA
	2	Reverse run/stop	Reverse run when closed, stop when open		
	3	Speed 2	Multi-function contact inputs (H1-01 to H1-06)		
	4	Speed 3			
	5	Speed 4			
	6	Speed 5			
	7	External Fault			
	8	M-Speed Gain 1			
11	Sequence control input common terminal	-			
Analog Input Signal	15	+15V Power supply output	For analog command +15V power supply		+15V (Allowable current 20 mA max.)
	33	-15V Power supply output	For analog command -15V power supply		-15V (Allowable current 20 mA max.)
	13	Master frequency reference	-10 to +10V/-100% to 100% 0 to +10V/0 to 100%		-10 to +10V (20k Ω), 0 to +10V/(20k Ω)
	14	Multi-function analog reference	4 to 20 mA/0 to 100% -10 to +10V/-100% to 100% 0 to 10 V/0 to 100%	Multi-function analog reference (H3-05)	4 to 20mA (250 Ω) -10 to +10V (20k Ω), 0 to +10V/(20k Ω)
	16	Multi-function analog input	-10 to +10V/-100% to +100% 0 to +10 V/0 to 100%	Auxiliary analog input (H3-05)	-10 to +10V (20k Ω), 0 to +10V/(20k Ω)
	17	Common terminal for control circuit	0V		-
	12	Connection to shield sheath of signal lead	-		-
Sequence Output Signal	9	Brake output	Multi-function output (H2-01 to H2-03)		Dry contact Contact capacity: 250VAC, 1A or less 30VDC, 1A or less
	10				
	25				
	26	Fault annunciate			Open collector output 48V, 50mA or less
	27	Open collector output common			-
	18	Fault contact output (NO/NC contact)	Fault when closed between terminals 18 and 20 Fault when open between terminals 19 and 20		Dry contact Contact capacity: 250VAC 1A or less 30VDC 1A or less
	19				
20					
Analog Output Signal	21	Frequency meter output	0 to \pm 10V/0 to 100% frequency	Multi-function analog monitor (H4-01 to H4-03)	0 to \pm 11V Max. \pm 5% 2mA or less
	22	Common			
	23	Current monitor	5V/inverter rated current	Multi-function analog monitor 2 (H4-04 to H4-06)	

Control Circuit Wiring Procedures

To wire the drive control circuit for IMPULSE•VG+ Series 2:

1. While the G5IF 120V Control Voltage Interface and G5OUT Control Output Cards are already attached to the drive control terminals when the drive is shipped, the figure below is provided in case you have to reattach these boards.

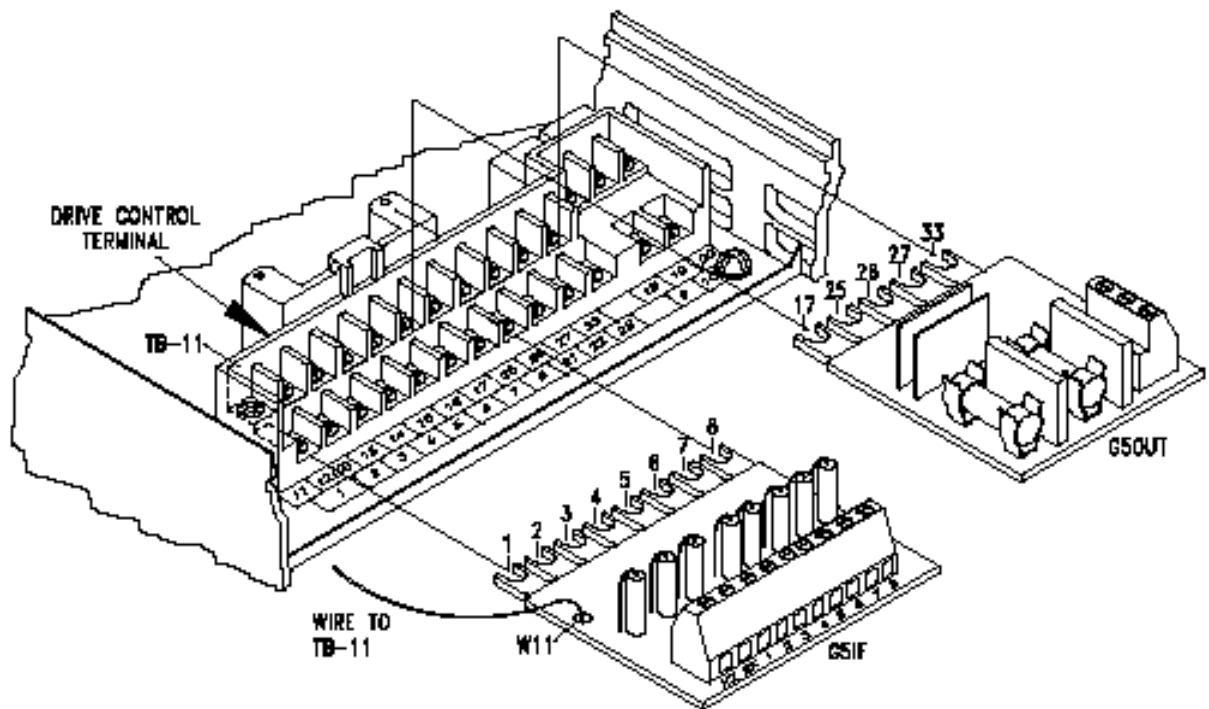


Figure 3-24: Interface Cards

- Connect input terminals—X2, 1, 2, 3, 4, 5, 6 and 7 for G5IF and X2, 1, 2, 3 and 4 for G5IN4—to the user input device. The following drawing shows a typical five-speed interconnection and should help you understand how to wire any control circuit application. For more information on multi-function inputs, see **Terminal 3 Sel (H1-01)** through **Terminal 8 Sel (H1-06)** in Chapter 5 on page 5-72, Terminal Parameters Group, Digital Inputs Section.

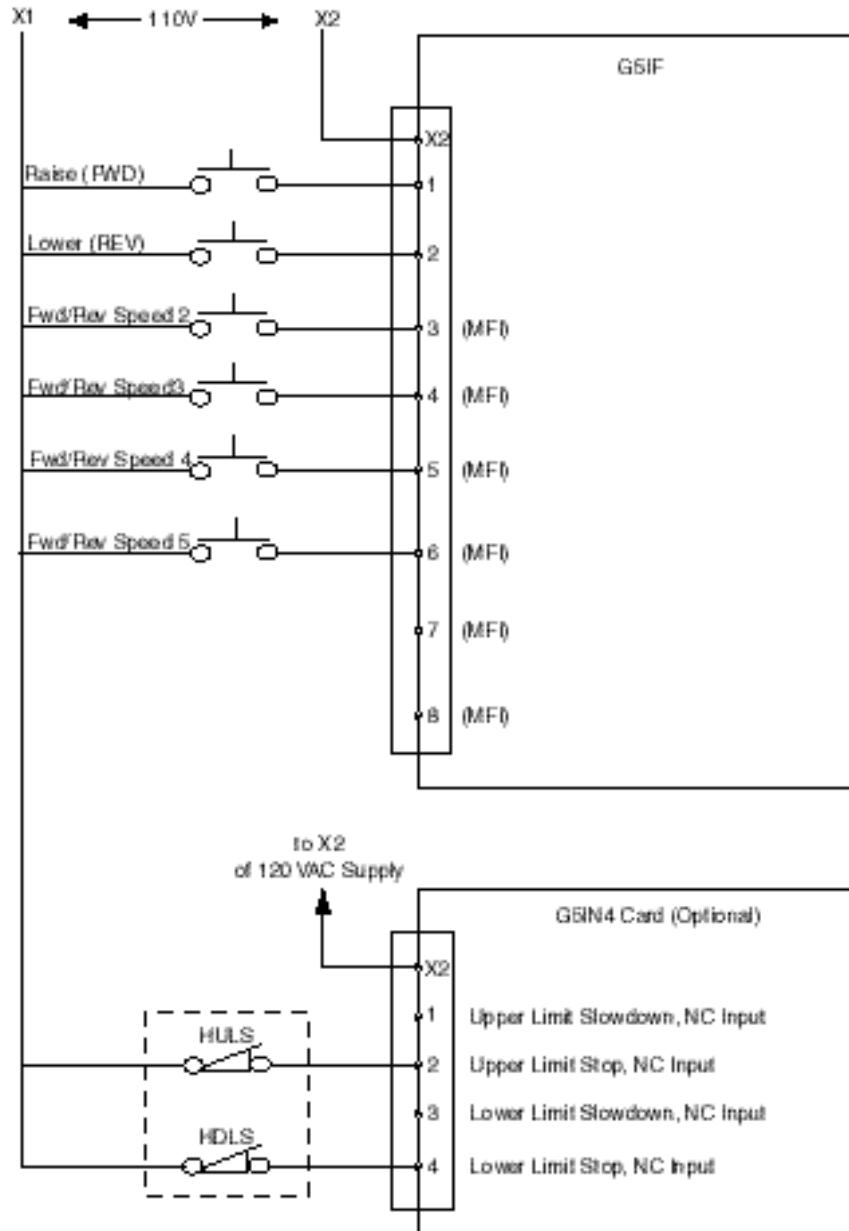


Figure 3-25: Five-Step Multi-Speed Terminal Diagram (Example)

- Install G5OUT card to the drive as indicated in Figure 3-24 “Interface Cards” on page 3-30.
- Connect the output terminals, as indicated in the following drawing, to the intended output device(s).

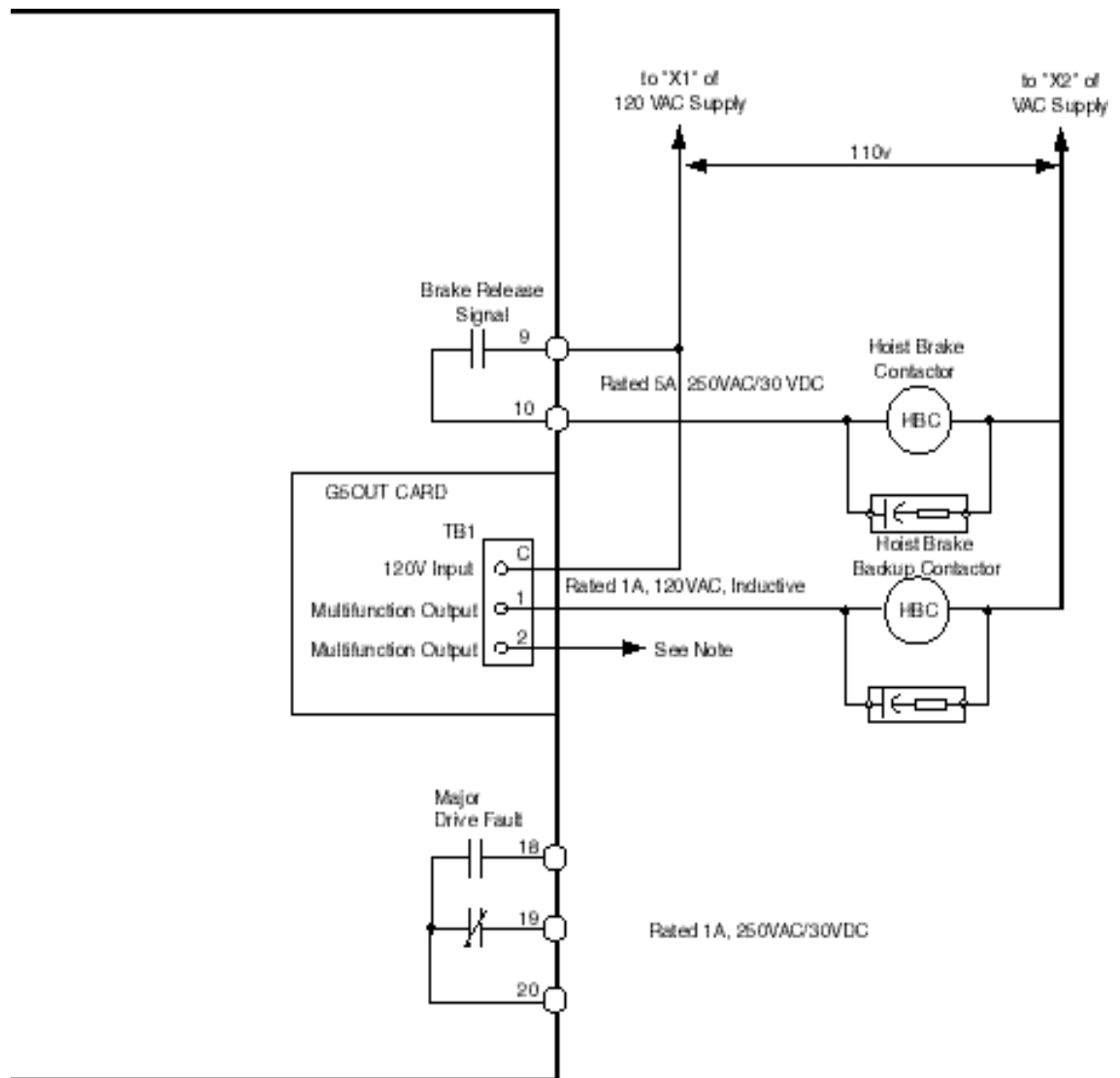


Figure 3-25: Output Terminals

5. Connect the G5IF common lead (blue wire W11) to Terminal 11 on the drive control terminal. Refer to Figure 3-24 “Interface Cards” on page 3-30.

NOTE: *If the drive is being applied in a no-load brake hoist application, Electromotive Systems recommends the use of an external warning device wired to terminal 2 of the G5OUT card. Reference No-Load Brake Start/Stop and Digital Outputs – Fault Annunciate in Chapter 5 on page 5-31 for more details.*

R-C Surge Absorber Selection

- Install R-C-type surge absorbers across the coils of any contactors installed in the drive's control panel enclosure. Refer to the following table when selecting surge absorbers.

Applied VAC	Application	Resistance	R-C Surge Absorber Part Number ^{(1), (2)}
120 VAC (1Ø)	Contactor or magnetic brake coils	100 Ω	RCS1C6 ^{(3), (4)}
		150 Ω	RCS1H6
		220 Ω	RCS1A6
240VAC (1Ø)	Contactor or magnetic brake coils	100 Ω	RCS2G6
		150 Ω	RCS2H6
		220 Ω	RSC2A6
480VAC (3Ø)	Brake coils	100 Ω	RCY6G-30
		220 Ω	RCY6A-30

⁽¹⁾ Part numbers are those of R-K Electronics, and are available from Electromotive Systems.

⁽²⁾ All surge absorbers .47 microfarads.

⁽³⁾ The surge absorber most often used by Electromotive Systems.

⁽⁴⁾ If an A-B-type contactor (IEC-type) is used, then part number used is A-B 199-FSMA1.

Electric Brake Coil and Reattachment

- Connect 110VAC supply (X1) to Terminal 9, the electric brake contactor coil to Terminal 10, and the other side of the contactor coil to the 110V return (X2).
- Reattach the G5IF card to the lower-level control board Terminals 1 through 8. (Refer to Figure 3-24 "Interface Cards" on page 3-30.)
- Reattach the G5OUT card to top-level control board Terminals 17, 25, 26, 27, and 33. (Refer to Figure 3-24 "Interface Cards" on page 3-30.)

Cover and Keypad

NOTE: Before you perform the following step, wire the encoder circuit, which is explained in "Wiring the Encoder Circuit" in the following section.

- Refasten the cover, inserting the top of the cover first.

11. Referring to the following drawing, reinsert the keypad in the keypad well of the cover by aligning the keypad with the claws and locking the keypad into place.

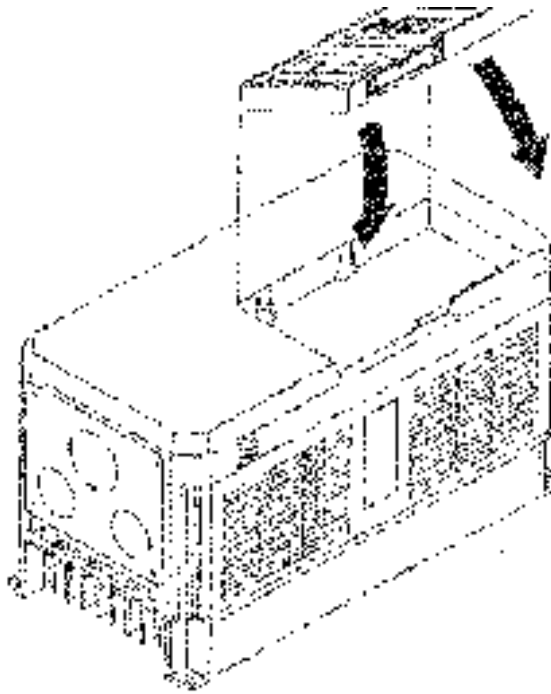


Figure 3-27: Cover and Keypad

Wiring the Encoder Circuit

A shaft-mounted encoder is required to provide speed and shaft position feedback to IMPULSE•VG+ Series 2. Without an encoder, a flux vector control cannot operate properly.

Before you wire the encoder circuit, refer to the specification tables in this section and to “Wiring Specifications.”

Encoder Circuit Wiring Procedures

Encoder Specifications

Power supply	+12VDC; if current demand is greater than 200 mA, an auxiliary power supply must provided
Output Type	Quadrature (A and B channels; Z is not necessary)
Type of output circuit	High-speed, differential line drive
Resolution	1024 PPR
Mounting method	Encoder must be direct-coupled to motor shaft, using a zero-backlash-type coupling.

To wire the encoder circuit for IMPULSE•VG+ Series 2 (assuming the cover and keypad are detached):

1. Direct-couple the encoder to the motor shaft, using a zero-backlash-type coupling.

NOTE: Do not connect the encoder to the motor with roller chain or gear drive. If unable to direct-couple the encoder, use a timing belt to drive the encoder. (Contact Electromotive Systems for encoder kits.) Also, do not connect the encoder to the low-speed shaft of a speed reducer.

2. Connect the encoder to the PG-X2 Encoder Interface Card. Refer to Figure 3-29: “Generic Encoder” and Figure 29: “PG-X2 Interface Card Terminal Functions” on page 3-36.

NOTE: Use twisted-pair, shielded cable (Electromotive R-20/6, Belden 9730, or Brand Rex T-11651). Strip the encoder wires .25 in. (5.5 mm). Keep the wiring length less than 300 feet. (For cable lengths greater than 300 feet, contact Electromotive Systems for information on available fiber optic cable systems.)

3. Ground the shielded cable to Terminal TA-3 of the PG-X2 Encoder Interface Card. (Ground only one end of the shielded cable.)

NOTE: For LakeShore encoders, the shield connection is not considered “Ground.” The shield should be grounded at TA-3 and connected to the shield at the encoder.

Encoder Wiring Diagrams and Information

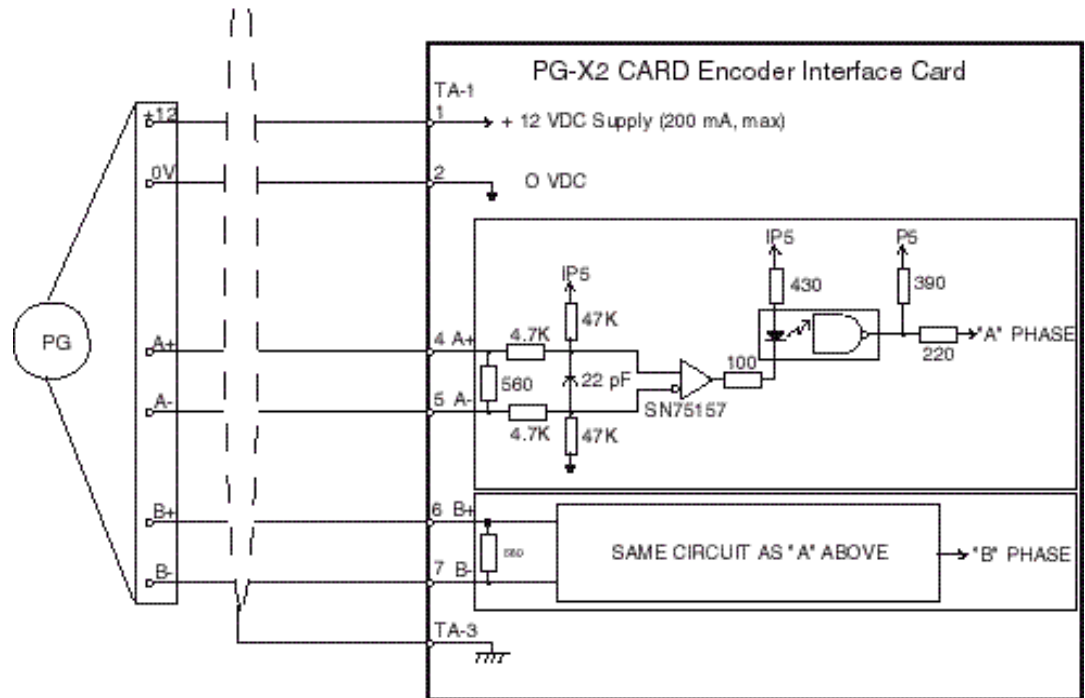


Figure 3-28: Generic Encoder

The following drawing and table shows you how to connect a LakeShore Model 8500 encoder to the PG-X2 Encoder Interface Card.

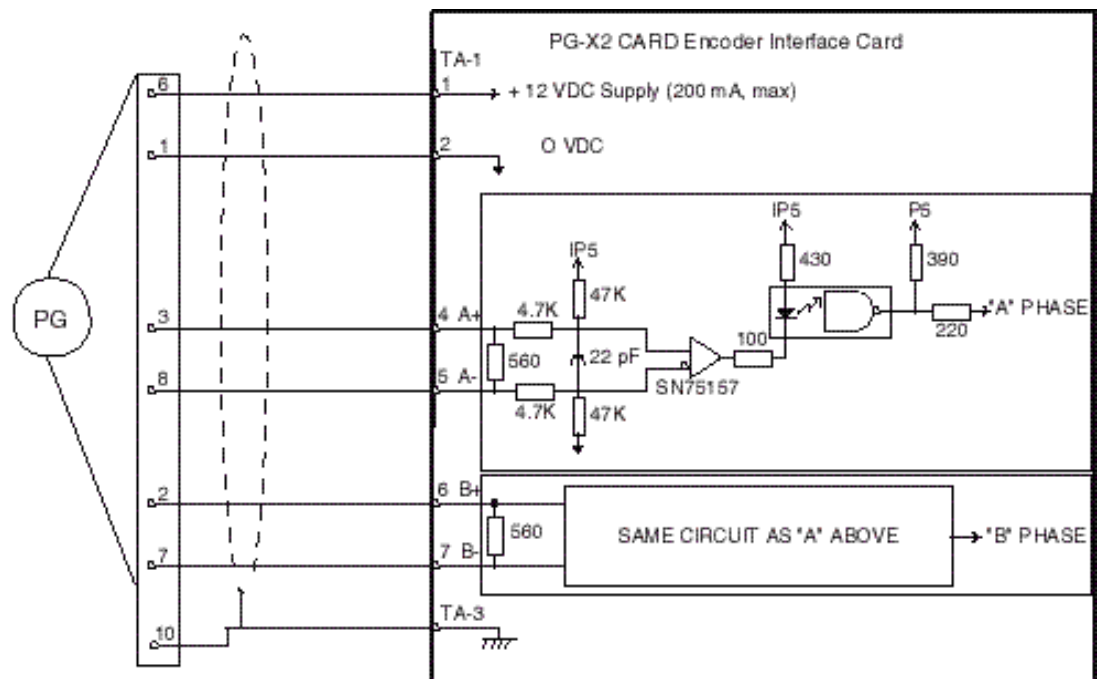


Figure 3-29: LakeShore Model 8500 Encoder

Lakeshore Model SL56 Encoder Wiring Scheme

Encoder Signal	Wire Color	PG-X2 Terminal (TA-1)
+5 to 15VDC	Red	1
OV	Black	2
A+	Blue	4
A-	Gray	5
B+	Green	6
B-	Yellow	7
Shield	N/A	TA3

PG-X2 Encoder Interface Card Specifications

Power supply to encoder:	Dual; +12VDC; 200 mA maximum
Encoder input signal:	RS-422–level, line-driver-type
Pulse monitor output signal (repeater):	RS-422–level, line-driver-type
Pulse phases accepted:	Phases A and B (both + and -)
Maximum input frequency:	300 kHz
Connector type:	Phoenix MKDS1 series

PG-X2 Encoder Interface Card Terminal Functions

Terminal Block	Pin #	Function
TA1	1	+12VDC power supply; do not use Pins 1 and 3 together
TA1	2	Power supply common
TA1	3	Alternate 5VDC power supply for encoder; do not use Pins 1 and 3 together
TA1	4	A+ pulse input
TA1	5	A- pulse input
TA1	6	B+ pulse input
TA1	7	B- pulse input
TA1	10	Ground
TA2	1	A-pulse output
TA2	2	A-pulse output
TA2	3	B-pulse output
TA2	4	B-pulse output
TA2	7	Common signal ground terminal
TA3	–	Shielded-sheath connection terminal

Suggested Circuit Protection Specifications and Wire Size

In order to comply with most safety standards, some circuit protective devices should be used between the incoming three-phase power supply and the IMPULSE•VG+ Series 2. These devices can be thermal, magnetic, or molded-case breakers (MCCB); or “slow-blow” type fuses such as “CCMR” or “J.”



CAUTION:

The following guidelines are only suggested values. Always conform to local electrical codes and wiring practices.

Model #	Rated Current(A)		Input Fuse Class	Molded/Case Circuit Breaker	Wiring Size (AWG/MCM)		
	Drive	Input Fuse			Power Circuit Wiring	Control Wiring	Ground
230V Class							
2006 -FVG+	6	9	CC	15	12	16/14	14/10
2008 -FVG+	8	12	CC	20	12	16/14	12/10
2011 -FVG+	11	20	CC	25	12	16/14	12/10
2017 -FVG+	17.5	25	LPJ	40	12	16/14	10
2025 -FVG+	25	35	LPJ	60	10	16/14	10/8
2033 -FVG+	33	45	LPJ	70	10	16/14	10/8
2054 -FVG+	54	70	LPJ	100	6	16/14	8
2068 -FVG+	68	90	LPJ	100	4	16/14	6
2080 -FVG+	80	100	LPJ	175	4	16/14	6
2130 -FVG+	130	175	LPJ	250	1/0	16/14	4
2160 -FVG+	160	200	LPJ	300	1/0	16/14	4
2224 -FVG+	224	300	LPJ	450	4/0	16/14	3
2300 -FVG+	300	400	LPJ	600	2/0 x 2P	16/14	1
460V Class							
4001 -FVG+	1.9	3	CC	10	12	16/14	12/10
4003 -FVG+	3.6	6	CC	10	12	16/14	12/10
4005 -FVG+	5.1	8	CC	15	12	16/14	12/10
4008 -FVG+	8.5	15	CC	20	12	16/14	12/10
4011 -FVG+	11.7	20	CC	25	12	16/14	12/10
4014 -FVG+	14.8	25	CC	30	12	16/14	8/6
4021 -FVG+	21	30	LPJ	50	10	16/14	8
4028 -FVG+	28.6	40	LPJ	60	10	16/14	8
4034 -FVG+	34	45	LPJ	80	8	16/14	8
4041 -FVG+	41	60	LPJ	80	8	16/14	8
4052 -FVG+	52	70	LPJ	125	6	16/14	8
4065 -FVG+	65	90	LPJ	125	6	16/14	8
4080 -FVG+	80	100	LPJ	150	4	16/14	6
4096 -FVG+	96	125	LPJ	200	2	16/14	6

Model #	Rated Current(A)			Wiring Size (AWG/MCM)			
	Drive	InputFuse	Input Fuse Class	Molded/Case Circuit Breaker	Power Circuit Wiring	Control Wiring	Ground
4128 -FVG+	128	175	LPJ	250	1/0	16/14	4
4165 -FVG+	165	225	LPJ	350	2/0	16/14	4
4224 -FVG+	224	300	LPJ	450	4/0	16/14	3
4302 -FVG+	302	400	LPJ	600	2/0 x 2P	16/14	1
4450 -FVG+	450	600	J	900	2/0 x 2P	16/14	1/0
4605 -FVG+	605	800	KRP-C	1450	250 MCM x 2P	16/14	1/0

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c h a p t e r **4**

Programming Basic Features

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Overview

With its easy-to-use keypad and X-Press Programming, IMPULSE•VG+ Series 2 makes it easy to get up and running right away. In addition to explaining the keypad and X-Press Programming, this chapter explains how to view the scroll settings, get into the programming mode, and program speeds.

Checks Before Powering

After mounting and interconnections are completed, verify:

- Correct connections.
- Correct input power supply. (No voltage drop or imbalance, source kVA \leq 200, unless a line is used.)



WARNING

DO not power 230V-rated drives with 460V power.

- No short circuit conditions.
- No loose screw terminals. (Check especially for loose wire clippings.)
- Proper load conditions.

Precautions

- Only start the motor if motor shaft rotation is stopped.
- Even with small loading, never use a motor whose nameplate amperage exceeds the inverter rated current.



DANGER

Braking method selection as shipped from Electromotive Systems is set for Decelerate to Stop command. Extreme caution should be used. If deceleration time is too long, equipment could run into endstop device, causing damage to equipment or injury to personnel.

Using the Keypad

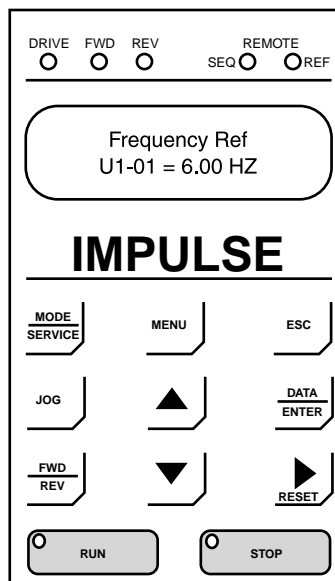
With two 16-character lines available, the English keypad display makes it possible to view fault codes and change parameter settings. Parameter settings, with their parameter codes, are displayed in most cases. In addition, the parameter description is included on the top line of the display. The keypad enables you to:

- Program the various drive parameters.
- Monitor the functions of the drive.
- Read alpha-numeric fault-diagnostic indications.
- Operate the drive using the keypad (local operation).



WARNING

Because of the additional potential hazards that are introduced when any drive is operated locally, we advise you to avoid operating it this way. If you do operate the drive locally, be aware that the crane or hoist will move when you press the RUN button. If you have questions, contact Electromotive Systems, Inc.



Keypad LED and Button Functions

Some of the keypad buttons, whose functions are described below, are dual-purpose. The dual-purpose keys have one function when used in a view-only mode, and another function when used in a programming mode.



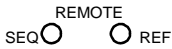
This LED lights only when the drive is in the **Operation** mode, which includes when the drive is first powered up.



This LED lights when the FORWARD command is given.



This LED lights when the REVERSE command is given.



- The SEQ LED lights when selecting the RUN command from the control circuit terminals or serial communication.
- The REF LED lights when the **Speed Reference** is input through control circuit terminals or serial communication.



- Pressing this key toggles between the mode set-up display and the phone number for Electromotive Systems Service Department.
- Also toggles between REMOTE and LOCAL (Digital operator from keypad) operation when 02-1 is set to 1.



Displays to the Main Menu for mode selection.



Backs up to the previous display (before the DATA/ENTER key is depressed).



Jog run is enabled when local operation is selected.



Selects the next mode, parameter group, parameter function, parameter or parameter setting. It also increases the blinking digit of a parameter setting.



Selects the previous mode, parameter group, parameter function, parameter or parameter setting. It also decreases the blinking digit of a parameter setting.



Selects the digit—from left to right—to be changed (indicated by blinking). It also resets the operation at faults.



Selects mode, group, function or parameter. Displays each parameter's set value. By pressing this key again, the set value is entered.



Selects forward or reverse run when LOCAL operation is selected.



- Pressing this key initiates run command when LOCAL operation is selected.
- The red LED lights steadily.



- Pressing this key initiates Base Block stop command.
- The red LED lights steadily when drive is at stop; blinks when Run command is active but output frequency reference is zero, off when drive output is controlling motor speed.

Parameters

There are hundreds of parameters that determine how the drive functions. These parameters are programmed in the drive's software as measurable values or options—both of which will be referred to in this manual as *settings*. While some of these parameters are associated with one setting, others are tied to a number of possible settings.

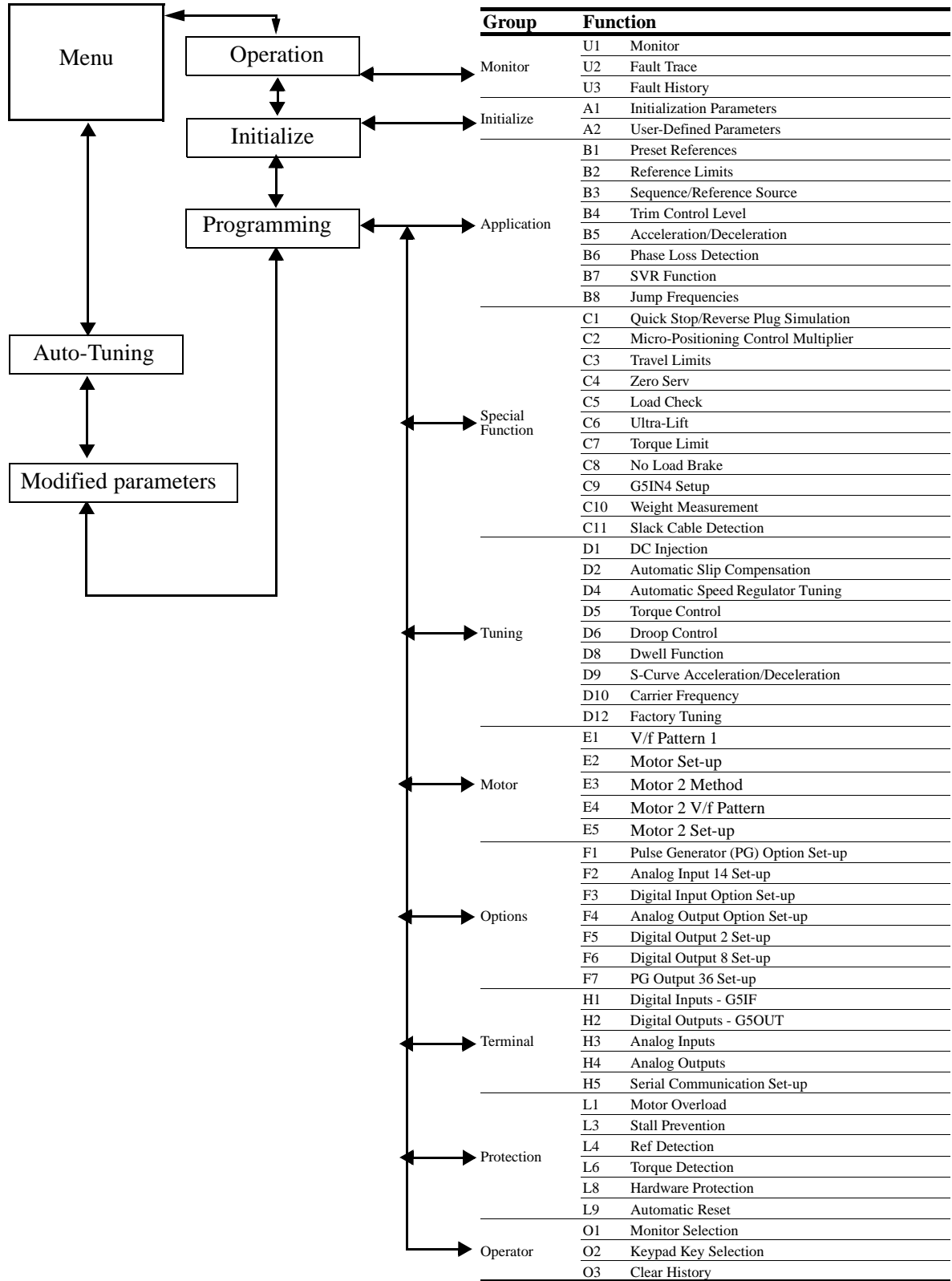
NOTE: The terms “constant” and “parameter” have the same meaning.

Before shipping the drive to you, we programmed initial settings in the drive's software so that most, if not all, of your crane system requirements are supported. However, if you do find it necessary to change the initial settings, we recommend that you only allow qualified crane system technicians to program the drive. This can be accomplished by using the **Password Barrier** and **Access Level** features. For more information on these security features, see Initialization Set-up on page 4-9.

You also have the option of allowing personnel with limited crane system knowledge to program only certain parameters—**User Parameters**—that you select. To select these parameters, see “User Parameters (A2-XX)” on page 4-11.

Two other features to be aware of are **Initialize Parameters** (A1-05) and **User Defaults** (O2-03). Both these features are related and allow you to revert back to parameter settings that you save. This is especially helpful when you have made a number of programming changes, but want to get back to the settings you had before you made any changes. To program these features, see “Initilize Parameters (A1-05)” and “User Defaults (02-03)” on page 4-11.

IMPULSE•VG+ Series 2 Structure of Parameters



Parameter Modes

All parameters are organized under five modes:

Operation Mode

Drive operation is enabled. Drive status LED lights.

Initialize Mode

Parameter access levels, control method, motion, speed control mode, and passwords are selected.

Programming Mode

Parameters are set/read. Items to be set/read vary depending on the access level setting.

Auto-Tuning Mode

Motor parameters are automatically set by entering tuning data (motor nameplate values) when using open loop vector control method.

Modified Constants Mode

Only parameters that have been changed from the factory settings are set/read.

Initialization Set-up

Parameter Access Level (A1-01)

This parameter allows the “masking” of parameters according to user level. See the following table:

Setting	Description
0	Operation Only
1	User Program - Accesses parameters selected by OEM (A2-01 to A2-32).
2	Advanced Level - For advanced programming in special applications.

Refer to the parameter code table in Chapter 5 for available parameters at each level.

Control Method Selection (A1-02)

Select the control method best suited for your application.

Setting	Description
3	Flux Vector

NOTE: An auto-tune must be performed for all flux vector applications. Refer to the Auto-Tuning section on page 4-12.

Select Motion (A1-03)

Set this parameter to match the motion of application.

Setting	Description
0	Traverse - Decelerate to stop upon removal of RUN command.
2	No-Load Brake Hoist

Speed Reference (A1-04)

This parameter will automatically define the input terminals for the selections listed below.

Setting	Description
0	5-SPD Multi-step (default) — Defines Terminals 3-6 as speeds 2-5.
1	2-Step infinitely variable — Terminals 1 and 2 = b1-01 (Reference 1) and speed hold. Terminal 3 = Accelerate.
2	3-Step infinitely variable — Terminals 1 and 2 = b1-01 (Reference 1). Terminal 3 = Speed Hold. Terminal 4 = Accelerate.
3	Uni-polar analog — Terminals 1 and 2 = A directional input. Terminal 13 = 0-10V. Terminal 14 = 4-20mA.
4	Bi-polar analog — Terminal 13 = -10 to +10V. An input on Terminal 1 is required, but direction is determined by the reference given on Terminal 13.
5	2-SPD Multi-step — Defines Terminal 3 = 2nd speed.
6	3-SPD multi-step — Defines Terminals 3 and 4 as speeds 2 and 3 respectively.

Parameters Changed by X-Press Programming

Const#	Abbreviation	5-Speed M-Step	2-Step Infinitely Variable	5-Step Infinitely Variable	Uni-Polar Analog	Bi-Polar Analog	2-Speed M-Step	3-Speed M-Step
A1-04	Speed Ref	0	1	2	3	4	5	6
B1-01	Speed 1	6.00	6.00	6.00	6.00	6.00	20.00	15.00
B1-02	Speed 2	15.00	15.00	15.00	15.00	15.00	60.00	30.00
B1-03	Speed 3	30.00	30.00	30.00	30.00	30.00	30.00	60.00
B1-04	Speed 4	45.00	45.00	45.00	45.00	45.00	45.00	45.00
B1-05	Speed 5	60.00	60.00	60.00	60.00	60.00	60.00	60.00
B1-09	JOG Speed	6.00	6.00	6.00	6.00	6.00	6.00	6.00
B1-10	Ref Priority	0	0	0	1	1	0	0
H1-01	Terminal 3 Sel	00	05	04	07	07	00	00
H1-02	Terminal 4 Sel	01	07	05	09	09	07	01
H1-03	Terminal 5 Sel	02	09	07	13	13	09	07
H1-04	Terminal 6 Sel	03	13	09	16	16	13	09
H1-05	Terminal 7 Sel	24	24	24	24	24	24	24
H1-06	Terminal 8 Sel	0E	0E	0E	0E	0E	0E	0E

Initial Parameters (A1-05)

Use this parameter to reset the inverter to its factory default settings.

Setting	Description
0	No Initialization (factory default)
1110	User Initialization - resets the inverter to user-specified initial values. To set user-specified initial values, make all required changes to parameter settings, then set 02-03 to "1". The inverter will memorize all current settings as the user-specified initial values. Up to 50 changed parameters can be stored.

Password Entry (A1-06)

This parameter will enable the user to set a password that will inhibit the programming of the *A1-01* to *A1-03* parameters. This function is useful when used in conjunction with the access level parameter *A1-01*. To set the password, press the MENU and RESET buttons at the same time and the display will change from *A1-06* to *A1-07*. Program in a password number, then when *A1-06* is not the same as *A1-07* parameter *A1-01* to *A1-03* cannot be changed. When *A1-06* is the same as *A1-07*, then *A1-01* to *A1-03* can be changed.

User Parameters (A2-01 through 30)

The user can select up to 30 parameters for quick-access programming. By setting the user access level (*A1-01*) to "User Program," only the parameters selected in function A2 can be accessed by the user. To assign a parameter as a user parameter go to the A2 level in the initialize menu. Once the A2 parameters are set and *A1-01* is programmed to "User Program," only the parameters visible in the program menu will be assigned to an A2 parameter.

Auto-Tuning



CAUTION

The brake output is not energized during auto-tune. The brake must be manually released and unreleased when Auto-Tuning is complete.



WARNING

Auto-tuning should only be performed on a motor that is not coupled to a gearbox.

The IMPULSE•VG+ can adapt to all motors manufactured worldwide with its automatic tuning function. The inverter asks the user for minimal motor information, then guides the user through a quick simple tuning process. Refer to the Structure of Parameters on page 4-7 and the table below for the motor data required for automatic tuning.

NOTE: Contact Electromotive Systems service department if an auto-tune can not be performed.

Display	Description	Default Setting
Rated Voltage	Sets motor rated voltage inVAC	KVA dependent
Rated Current	Sets motor rated current in Amps	KVA dependent
Rated Frequenc	Sets motor rated frequency in Hertz	60.0 Hz
Rated Speed	Sets motor rated speed in RPM	1750 RPM
Number of Poles	Sets the number of motor poles	4
Select Motor	Selects between motor 1 or 2	1
PG Pulses/Rev	Sets encoder PPR	1024 PPR

After scrolling through the tuning parameters using the Up Arrowkey, depress the RUN key to begin auto-tuning. During tuning, “Tuning Proceeding” flashes on the digital operator display. When complete, “Tune Successful”, is displayed. Depress the Menu key to exit auto-tuning mode. Please refer to the “Fault Display and Corrective Actions at Auto-Tuning” section on page 6-11 if “Tune Successful” is not displayed.

NOTE: If the STOP key is depressed during tuning, auto-tuning is interrupted and the motor coasts to a stop. The data changed during tuning returns to its original values.

NOTE: If an auto-tune is unsuccessful, temporarily change D12-30=1 and D10-01 to at least 5.0KHz.

c h a p t e r **5**

**Programming Advanced
Features**

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Application

- B1 Preset References
- B2 Reference Limits
- B3 Sequence/Reference Source
- B4 Trim Control Level
- B5 Acceleration/Deceleration
- B6 Phase Loss Detection
- B8 Jump Frequencies

Preset Reference

Parmtr Code	Display	Function	Range	Initial Value	V/F Access	Open Loop Vector Access
B1-01	Reference 1	Sets the frequency of Minimum Speed/Speed 1.	0.00–150.00 Hz	15	Adv	Adv
B1-02	Reference 2	Sets the Speed 2 frequency.	0.00–150.00 Hz	30	Adv	Adv
B1-03	Reference 3	Sets the Speed 3 frequency.	0.00–150.00 Hz	60	Adv	Adv
B1-04	Reference 4	Sets the Speed 4 frequency.	0.00–150.00 Hz	45	Adv	Adv
B1-05	Reference 5	Sets the Speed 5 frequency.	0.00–150.00 Hz	60	Adv	Adv
B1-09	Jog Reference	Jog Control and Inching Control frequency reference.	0.00–150.00 Hz	6	Adv	Adv
B1-10	Ref Priority	Determines whether the digital or analog frequency reference is used.		0	Adv	Adv

0 Digital Ref Only*
1 Analog Ref Only*
2 Higher Ref Sel

* Changes automatically with A1-04 (Speed Reference).

Reference Limits

When a run command is input and the frequency reference is less than the lower limit, operation discontinues. However, when the lower limit is set to less than the minimum output frequency (E1-09), operation discontinues.

An alternate upper limit frequency can be used during operation when a Multi-Function Input (MFI) is set to 43 (Alt S-Ref UpLimit) and the MFI is on. Alternate Upper Limit Frequency = (B2-03)% x (E1-04).

Parmtr Code	Display	Function	Range	Initial Value	V/F Access	Open Loop Vector Access
B2-01	Ref Upper Limit	Sets as a percentage of the maximum output frequency (E1-04), which determines the maximum frequency at which the drive is able to run.	0.0–110%	100	Adv	Adv
B2-02	Ref Lower Limit	Sets as a percentage of the maximum output frequency (E1-04), which determines the minimum frequency at which the drive is able to run.	0.0–109%	2	Adv	Adv
B2-03	Upper Lim Gain	A multiplier, sets an alternate upper limit frequency by a multi-function input = 43	0–255%	100	Adv	Adv

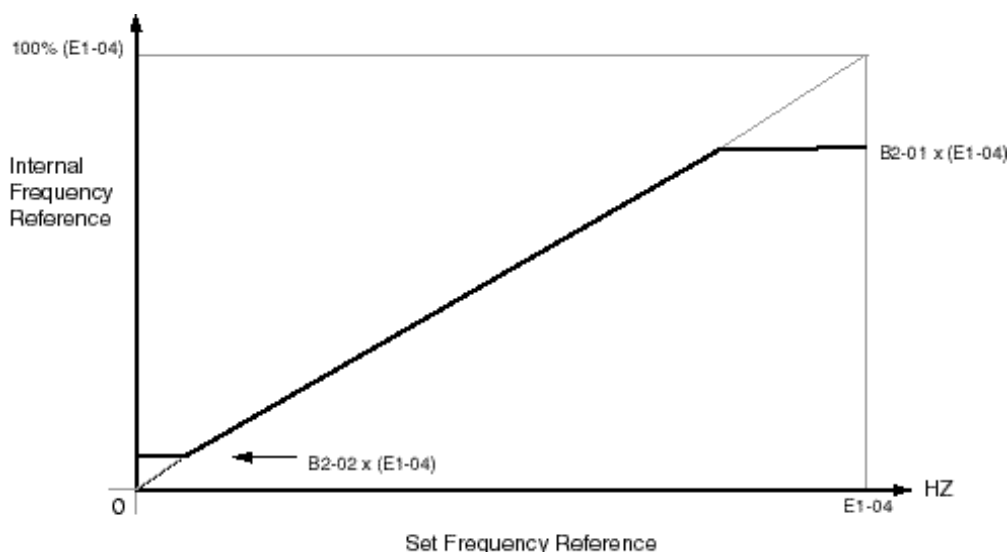


Figure 5-1: Setting Frequency Upper and Lower Limits

Sequence/Reference Source

B3-01 and B3-02 determine the source from where the frequency reference and RUN command are generated.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B3-01	Reference Source	Source from where the frequency reference is generated.		1	Adv
	0 Operator	Digital operator (Keypad).			
	1 Terminals	Control circuit terminal (G5IF card).			
	2 Serial Com	Serial communication (Port 6CN).			
	3 Option PCB	Optional card (Port 2CN).			
B3-02	Run Source	Source from where the RUN command is generated.		1	Adv
	0 Operator	Digital operator (Keypad).			
	1 Terminals	Control circuit terminal (G5IF card).			
	2 Serial Com	Serial communication (Port 6CN).			
	3 Option PCB	Optional card (Port 2CN).			

* Changes automatically with A1-03 (Motion).

Ramp to Stop (B3-03=0)

Upon removal of the FWD or REV run command, the motor decelerates at a rate determined by the time set in deceleration time 1 (B5-02) and DC injection braking is applied after the minimum output frequency (E1-09) has been reached. If the deceleration time is set too short or the load inertia is large, an overvoltage fault (OV) may occur during deceleration. In this case, increase the deceleration time or install an optional braking transistor and/or braking resistor.

Braking torque: without braking resistor, approximately 20% of motor rated torque; with braking option, approximately 150% of motor rated torque.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B3-03	Stop Method	Determines stop method.		*	Adv
	0 Ramp to Stop (A1-03=0)				
	1 Coast to Stop (A1-03=1)				
	5 Hoist 2-Stop				
	6 No Load Brake (A1-03=2)				

* Changes automatically with A1-03 (Motion)

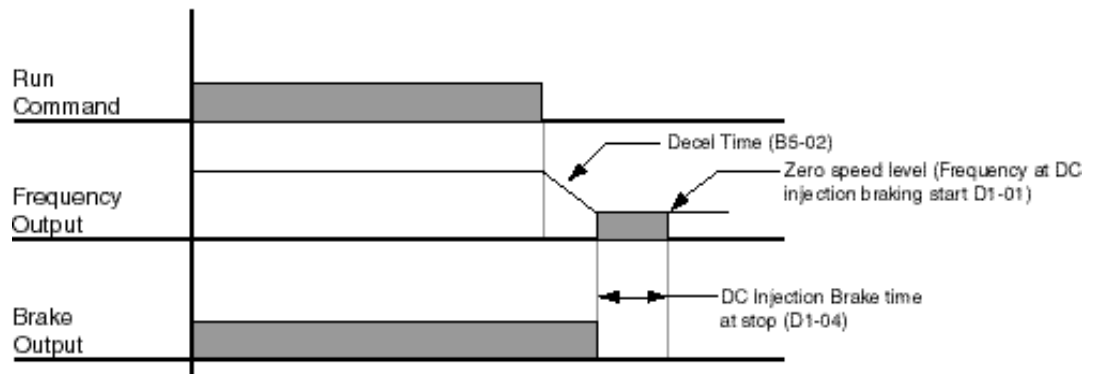


Figure 5-2: Ramp to Stop

Coast to Stop (B3-03=1)

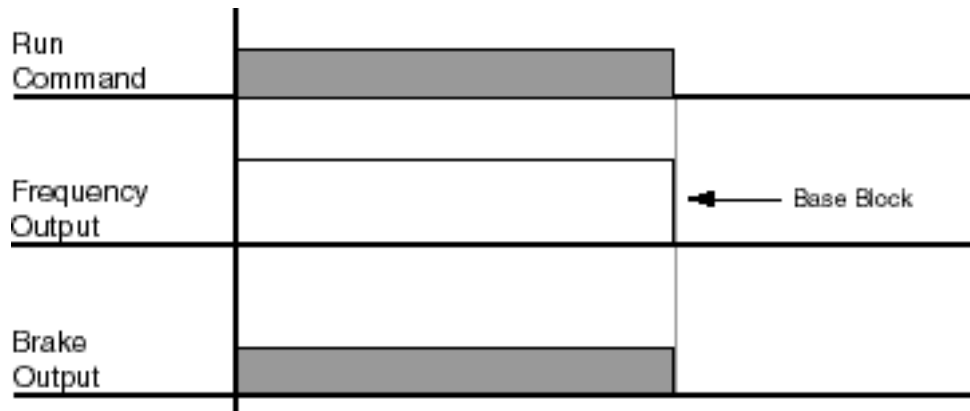


Figure 5-3: Coast to Stop

Hoist 2-Stop (B3-03=5)

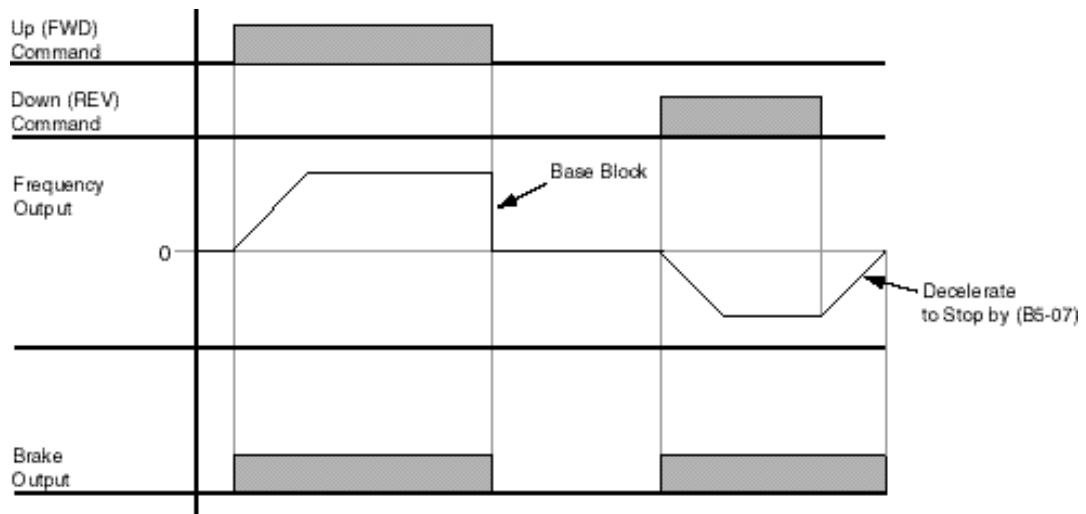


Figure 5-4: Hoist 2-Stop

Zero-Speed Operation

This parameter sets the speed reference level at which Zero Speed mode operation will activate, in accordance with the selection programmed B3-05 (see the figures below).

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B3-05	Zero-Speed Oper	Operation Selection at Zero Speed.		0	Adv
	0 RUN at Freq Ref	Operate according to the Frequency Reference			
	1 Stop	Coast when the Frequency Reference is below E1-09			
	2 RUN at Min. Freq (E1-09)	Output the Frequency set in E1-09			
	3 RUN at Zero RPM	Zero reference value when the frequency reference is below E1-09			

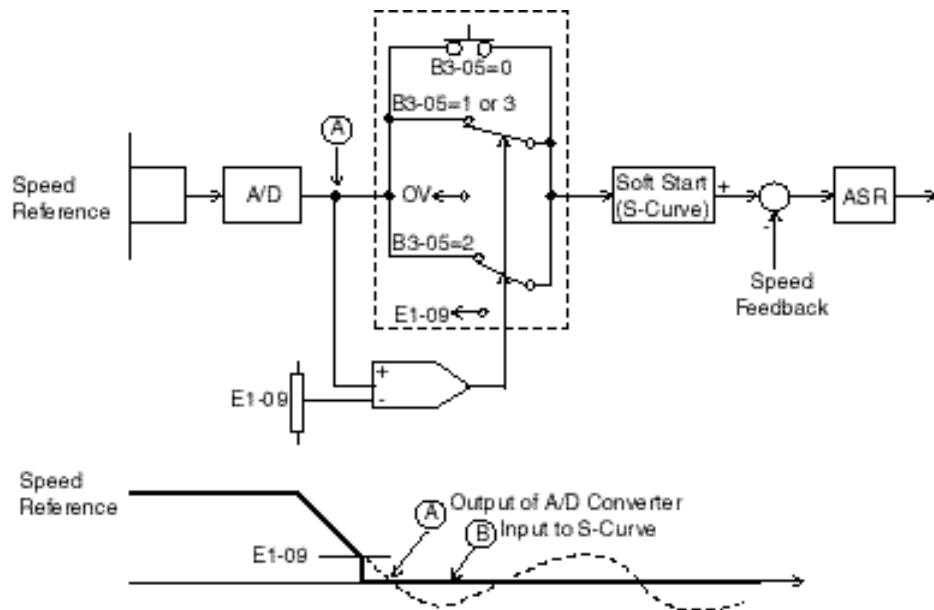


Figure 5-5: ASR Output with Analog Input

When the Speed Reference input is an analog signal, Zero Speed mode operation over long.

B3-05: 0 Run at Frequency Reference

E1-09: (Minimum Output Frequency) ineffective

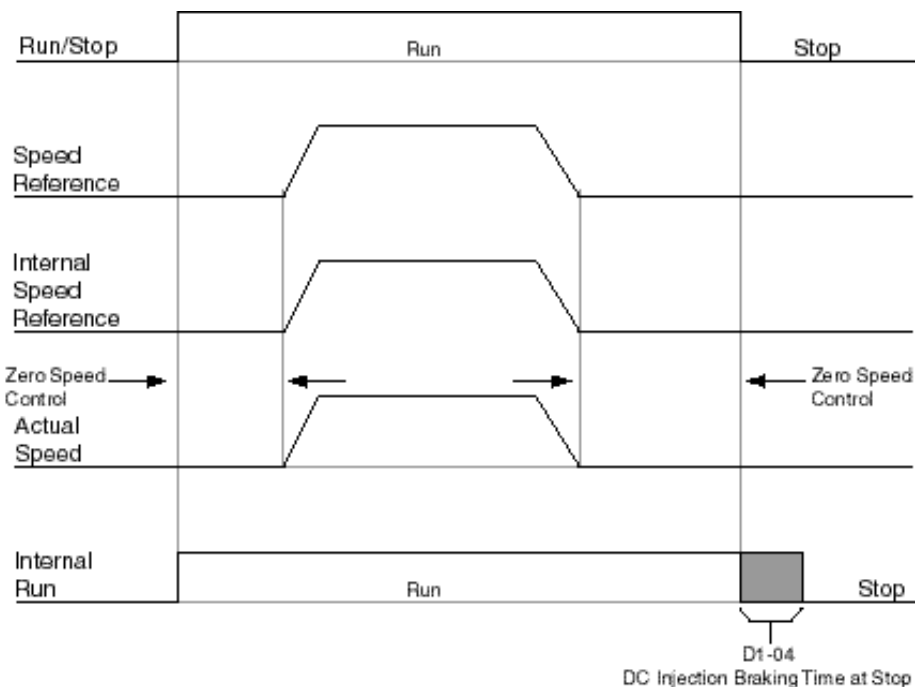


Figure 5-6: B3-05: 0 Run at Frequency Reference

B3-05: 1 STOP

E1-09: (Minimum Output Frequency) effective

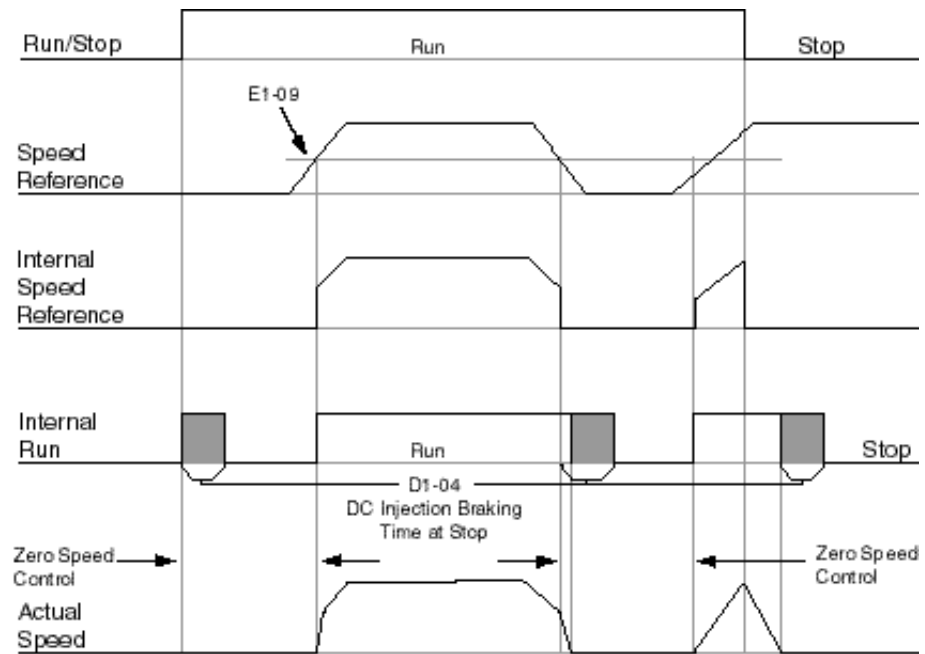


Figure 5-7: B3-05: 1 STOP

B3-05: 2 Run at Minimum Frequency

E1-09: (Minimum Output Frequency) effective

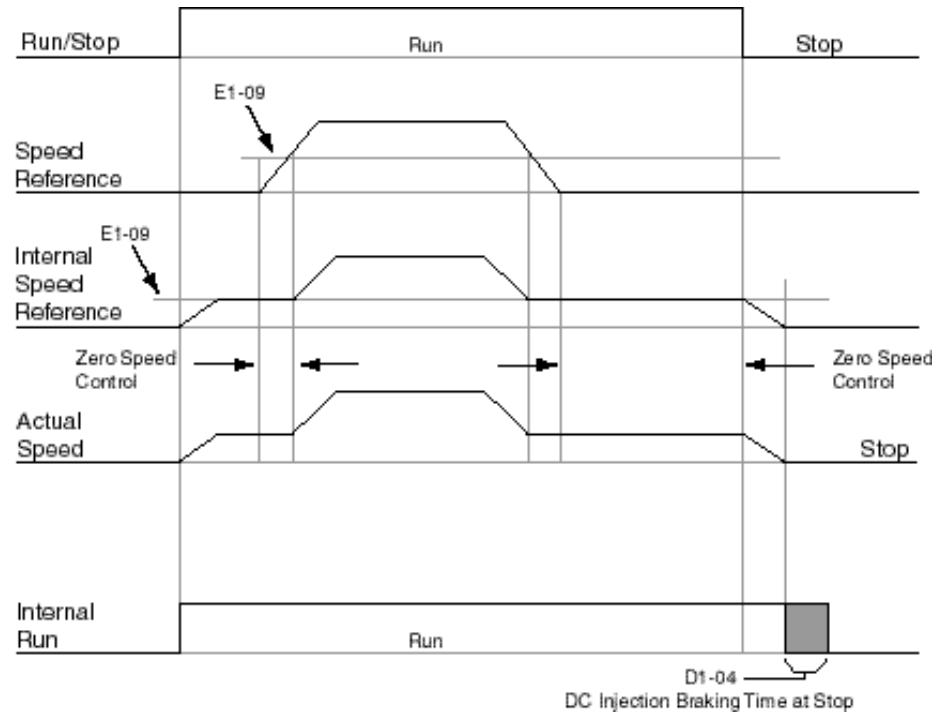


Figure 5-8: B3-05: 2 Run at Minimum Frequency

B3-05: 3 Run at Zero RPM

E1-09: (Minimum Output Frequency) effective

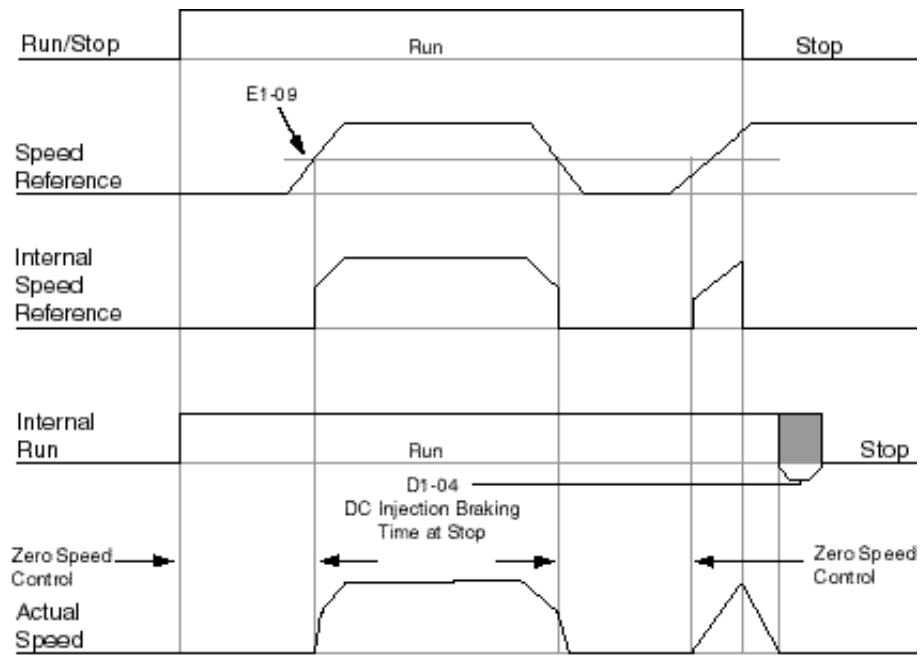


Figure 5-9: B3-05: 3 Run at Zero RPM

Input Scan Time

B3-06 selects the microprocessor scan time for reading sequence input data from the control circuit terminals. Set B3-06 to “0” when a quicker response is needed from the control circuit terminal.

Parmtr Code	Display	Function	Range	Initial Value	V/F Access	Open Loop Vector Access
B3-06	# of Input Scans	Selects the microprocessor scan time		1	Adv	Adv
	0 <i>2ms–2 scans</i>					
	1 <i>5ms–2 scans</i>					

LOC/REM Run Select

If the run reference/speed reference are switched between serial mode and drive terminal mode, B3-07 determines action after the switch.

Parmtr Code	Display	Function	Range	Initial Value	V/F Access	Open Loop Vector Access
B3-07	LOC/REM Run Sel	Determines action after switching Run/Speed reference source.		0	Adv	Adv
	0 <i>Cycle Extrn Run</i>	If the run command is present at the time when the Run/Speed reference source is switched, it requires the run command to be removed and then reapply the run command from the new source to resume the normal operation.				
	1 <i>Accep Extrn Run</i>	If the run command is present at the time when the Run/Speed reference source is switched, it does not require the run command from the new source to be removed. The normal operation will continue.				

Trim Control Level

The trim control level is valid when the trim control increase command (setting: 1C) or trim control decrease command (setting: 1D) is set for a multi-function input (H1-01 to H1-06).

If the trim control increase command is ON when a frequency reference is input on the analog input, the trim control level will be added to the analog frequency reference and then output as the output frequency. If the trim control decrease command is ON, the frequency reference will be decreased by the trim control level.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B4-02	Trim Control LVL	Sets Trim Control speed level	0–100%	10	Adv

Set the trim control level as a percentage of the maximum output frequency.

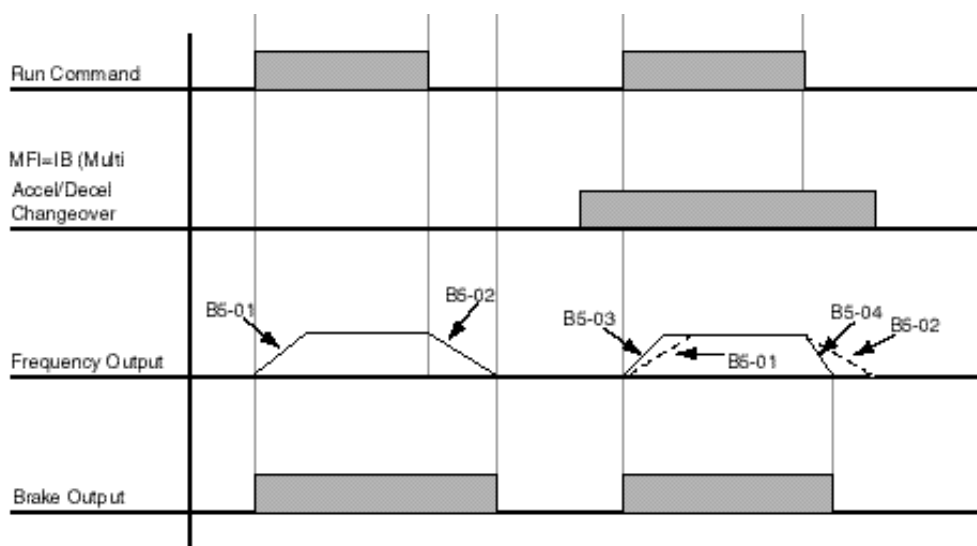
If the frequency reference minus the trim control level is less than zero, the output frequency will be zero.

Refer to the description of *Multi-function Inputs (H1)* for details on the trim control increase and trim control decrease commands.

Acceleration/Deceleration

Acceleration time sets the time necessary for the output frequency to accelerate from 0Hz to maximum output frequency (E1-04). Deceleration time sets the time necessary for the output frequency to decelerate from the maximum output frequency (E1-04) to 0Hz.

Parmr Code	Display	Function	Range	Initial Value	Access Level
B5-01	Accel Time 1	Sets acceleration time.	0.0–25.5 sec	3.5	Adv
B5-02	Decel Time 1	Sets deceleration time.	0.0–25.5 sec	2.5	Adv
B5-03	Accel Time 2	Sets alternate accel. time. Enabled by multifunction input=1B.	0.0–25.5 sec	1.0	Adv
B5-04	Decel Time 2	Sets alternate decel. time. Enabled by multi-function input=1B.	0.0–25.5 sec	1.0	Adv



NOTE: Assume the constant B3-03 is set to "0" (Ramp to Stop).

Figure 5-10: Normal Accel/Decel Time and Multiple Accel/Decel Changeover

Accel/Decel Time Switching Frequency

Accel/Decel times can be changed automatically without using multi-function inputs. When multi-function contact inputs are set for Accel/Decel selection, this command has priority over automatic change of Accel/Decel.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B5-05	Accel Time N Chg	Sets acceleration time at Speed Switch frequency.	0.0–25.5 sec	1.0	Adv
B5-06	Dec Time N Chg	Sets deceleration time at Speed Switch frequency.	0.0–25.5 sec	1.0	Adv
B5-07	Hoist 2 Stop	Sets deceleration time for DOWN/REVERSE direction, when B3-03=5 (Hoist 2-Stop).	0.0–25.5 sec	0.3	Adv
B5-08	Fault Stop Time	Sets decel time to complete rest at STOP.	0.0–25.5 sec	0.3	Adv
B5-09	Acc/Dec Units	Determines acceleration and deceleration time interval and range.		1	Adv
	<i>0 0.01sec for 0.00–2.55 sec</i>				
	<i>1 0.1sec for 0.0–25.5</i>				
B5-10	Acc/Dec SW Freq	Determines acceleration/ deceleration switching level	0.0–150.0Hz	120.0	Adv
B5-11	SW Freq Compare	Determines when Acceleration Time and Deceleration Time at Speed Switch Hz is enabled;		1	Adv
	<i>0 lower SW Freq</i>	0: B5-05/06 is enabled, N-out≤B5-10			
	<i>1 upper SW Freq</i>	1: B5-05/06 is enabled, N-out≥B5-10			

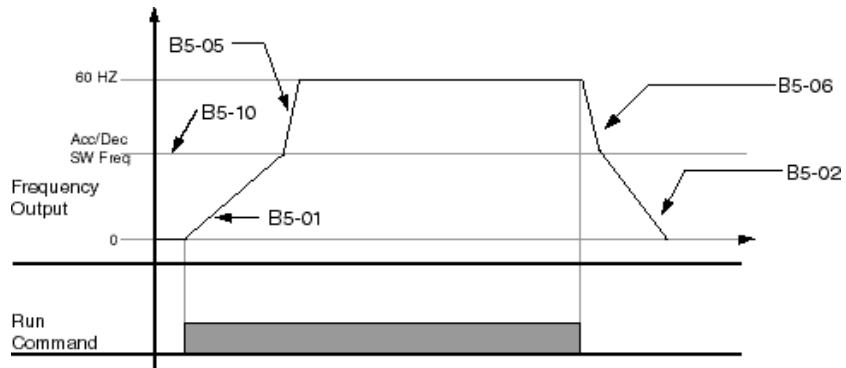


Figure 5-11: When B5-11=1 (Upper Switch Frequency)

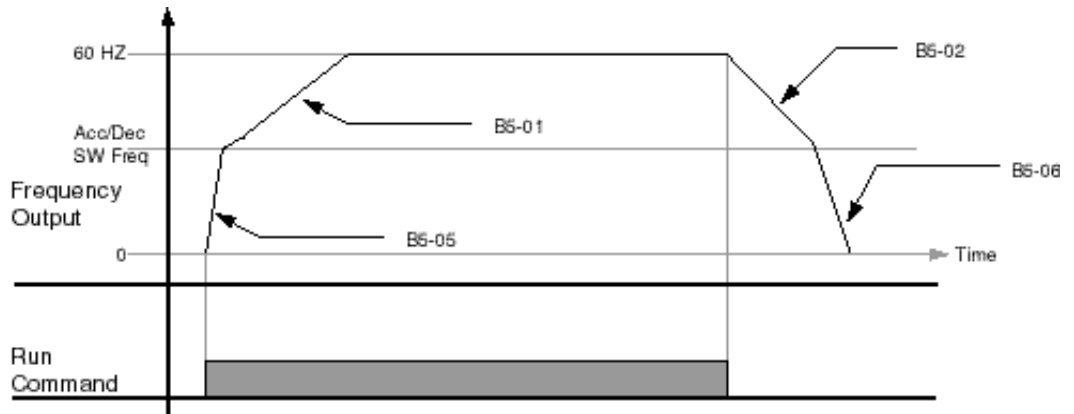


Figure 5-12: B5-11=0 (Lower Switch Frequency)

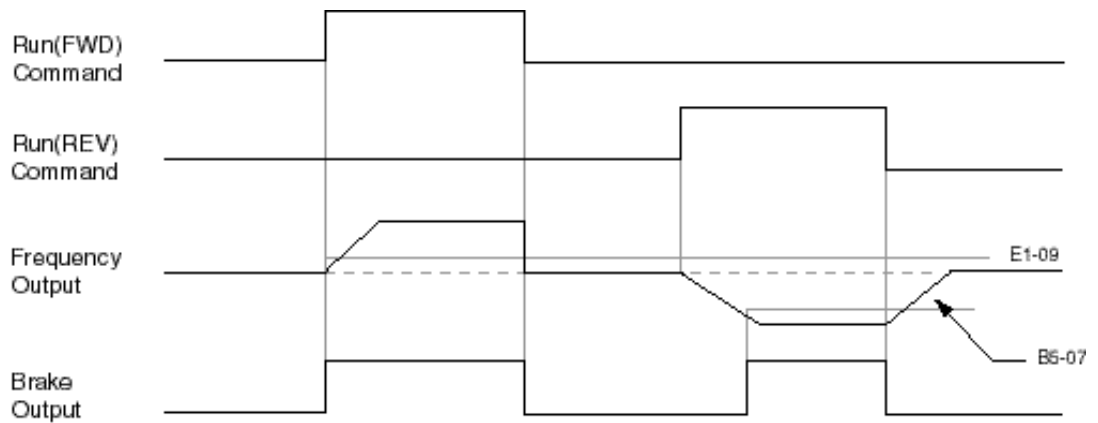


Figure 5-13: B5-07 = 3 (Hoist 2-Stop)

Torque Limit Accel/Decel

Determines Accel/Decel times when the multi-function input H1-01~H1-06 = 14 (Torque Limit Accel/Decel) is on.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B5-12	For T Lim Accel	Determines acceleration time at FORWARD when Torque Limit Acc/Dec is multi-function input = 14.	0.0–25.5 sec	0	Adv
B5-13	For T Lim Decel	Determines deceleration time at FORWARD when Torque Limit Acc/Dec is multi-function input = 14.	0.0–25.5 sec	0	Adv
B5-14	Rev T Lim Accel	Determines acceleration time at REVERSE when Torque Limit Acc/Dec is multi-function input = 14.	0.0–25.5 sec	0.5	Adv
B5-15	Rev T Lim Decel	Determines deceleration time at REVERSE when Torque Limit Acc/Dec is multi-function input = 14.	0.0–25.5 sec	0	Adv

Phase Loss Detection

Input Phase Loss Detection is provided to protect the main power rectifiers and capacitors in the IMPULSE•VG+ Series 2. If any of the three-phase input lines are lost, the DC Bus capacitors and rectifiers suffer approximately a 40% increase in current. This increase will cause a ripple on the DC Bus voltage. If this ripple becomes too great, the drive automatically shuts down and displays a fault code “PF”.

Phase Loss Detection compares the output current of each of the three phases to a preset level. If the output current of any of the phase falls below the preset level, a “LF” fault will appear on the display. The drive will immediately set the brake, thus retaining control of the load.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B6-01	Ph Loss In Sel <i>0 Disabled</i> <i>1 Enabled</i>	Determines whether Phase Loss Detection Input is enabled.		0	Adv
B6-02	Ph Loss In Lvl	Determines Phase Loss Detection Input Level.	0.0–25.5%	7.5	Adv
B6-03	Ph Loss Out Sel <i>0 Disabled</i> <i>1 Enabled</i>	Determines whether Phase Loss Detection Output is enabled.		1	Adv
B6-04	Ph Loss Out Lvl	Determines Phase Loss Detection Output level.	0.0–20.0%	5.0	Adv
B7-01	SVR Delay Timer	“Noisy” Encoder Signal Detection	0–2000ms	70	Adv

Jump Frequencies

This function allows the “jumping” of critical frequencies so that the motor can operate without resonant vibrations caused by some machine systems. This function is also used for deadband control. Setting the value to 0.0 Hz disables this function.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
B8-01	Jump Freq 1	First of three jump frequencies; part of Jump Bandwidth.	0.0–150.0 Hz	0	Adv
B8-02	Jump Freq 2	Second of three jump frequencies; part of Jump Bandwidth.	0.0–150.0 Hz	0	Adv
B8-03	Jump Freq 3	Third of three jump frequencies; part of Jump Bandwidth.	0.0–150.0 Hz	0	Adv
B8-04	Jump Bandwidth	Jump frequency reference bandwidth; combines Jump Frequencies 1, 2, and 3.	0.0–20.0 Hz	1.0	Adv

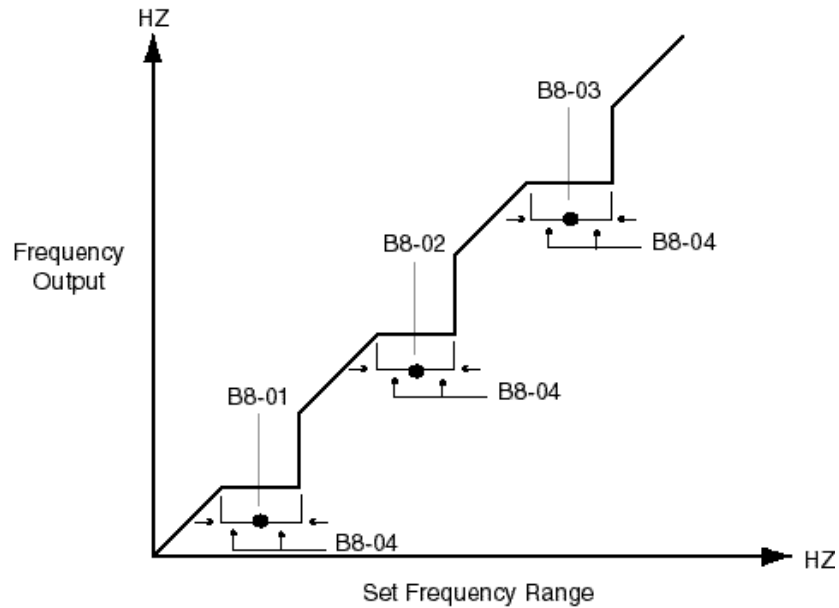


Figure 5-14: Jump Frequencies

Special Functions

- C1 Quick Stop/Reverse Plug Simulation
- C2 Micro-Positioning Control Multiplier
- C3 End of Travel Limit
- C4 Zero Servo
- C5 Load Check
- C6 Ultra-Lift
- C7 Torque Limit
- C8 No Load Brake
- C9 G5IN4 Setup
- C10 Weight Measurement
- C11 Slack Cable Detection

Special Function	Motion (A1-03)	
	Traverse (A1-03=0)	No-Load Brake (A1-03=2)
C1: Quick Stop/Reverse Plug Simulation	Yes	Yes
C2: Micro Positioning	Yes	Yes
C3: End of Travel Limits	Yes	Yes
C4: Zero Servo	Yes	Yes
C5: Load Check	No	Yes
C6: Ultra Lift	No	Yes
C7: Torque Limit	Yes	Yes
C8: No-Load Brake Hoist	No	Yes
C9: G5IN4 Setup	Yes	Yes
C10: Weight Measurement	No	Yes
C11: Slack Cable Detection	No	Yes

Quick Stop™/Reverse Plug Simulation™

The **Quick Stop Function** provides an automatic Alternate Deceleration at Stop Command.

NOTE: The Quick Stop Deceleration time differs from the normal deceleration time and is applied only when the RUN command is removed.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C1-01	Quick Stop 0/1 0 Disabled 1 Enabled	Determines whether Quick Stop is enabled		0	Adv
C1-02	Quick Stop Time	Deceleration time during Quick Stop function.	0.0–25.5 sec	0.5	Adv

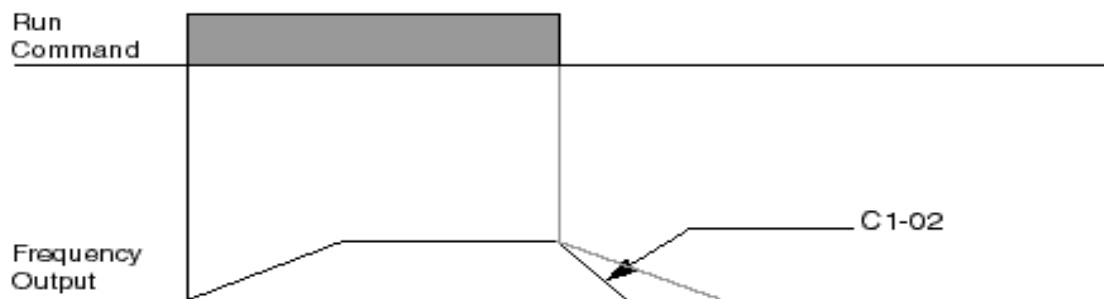


Figure 5-15: Quick Stop

The **Reverse Plug Simulation** provides an automatic alternate deceleration time/acceleration time at a change direction command. The deceleration time and the acceleration time are set independently of the normal acceleration and deceleration times.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C1-03	Reverse Plug 0/1	Determines whether Reverse Plug Simulation is enabled.		0	Adv
	0 Disabled				
	1 Enabled				
C1-04	RevPlg	Deceleration time during Reverse Plug Simulation.	0.0–25.5 sec	1.0	Adv
C1-05	RevPlg	Acceleration time during Reverse Plug Simulation	0.0–25.5 sec	1.0	Adv

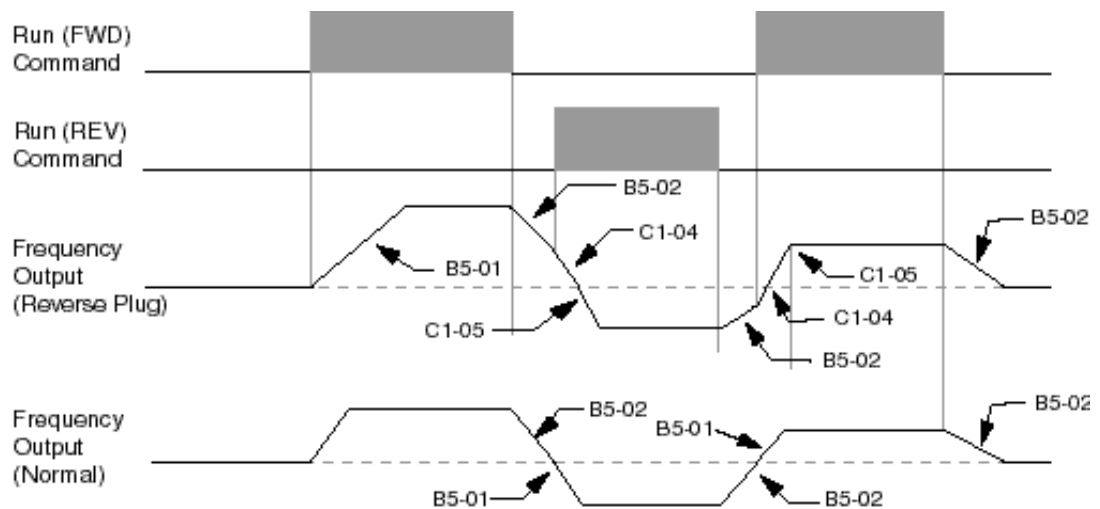


Figure 5-16: Reverse Plug Simulation

Micro-Positioning Control™

Micro-Positioning Control function can provide a reduced speed range operation for precise positioning. Enabled by a Multi-Function Input, it multiplies the normal speed reference by the Micro-Speed Gain. Two Micro-Speed Gains are available. MS Gain 1 (C2-01) and MS Gain 2 (C2-02). They can be adjusted and enabled independently.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C2-01	MS Gain 1	For Micro-Positioning Control—the number multiplied by the Analog or Digital Speed Reference to achieve slow-speed operation.	0.00–2.55	1.00	Adv
C2-02	MS Gain 2	For Micro-Positioning Control—an alternate number multiplied by the Analog or Digital Speed Reference to achieve slow-speed operation.	0.00–2.55	1.00	Adv

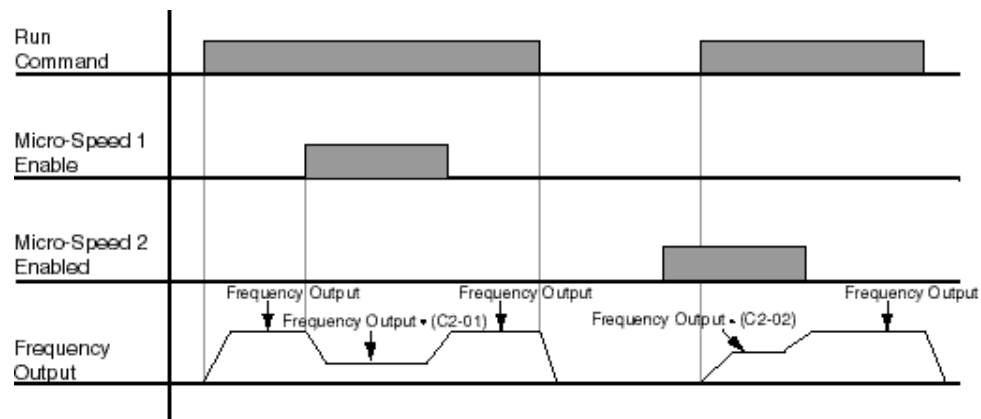


Figure 5-17: Micro-Positioning Control

NOTE: If both Micro-Speed 1 and Micro-Speed 2 are enabled. Micro-Speed 1 always takes higher priority over Micro-Speed 2.

Travel Limits

This function can automatically slow and stop a crane or hoist when it reaches the MS travel limits. Two types of limit inputs (slowdown and stop) are available in both travel directions. Inputs can be programmed through either G5IF and G5IN4 cards.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C3-01	Up Limit 1 Speed	Speed at Upper Limit input..	0–150 Hz	6	Adv
C3-02	UL 1 Decel Time	Decel time to Upper Limit Speed.	0.0–25.5 sec	1.0	Adv
C3-03	UL 2 Stop Time	Decel time to STOP when Upper Limit is Input..	0.0–25.5 sec	0.5	Adv
C3-04	Low Limit 1 Speed	Speed at Lower Limit input..	0–150 Hz	6	Adv
C3-05	LL 1 Decel Time	Decel time to Lower Limit Speed	0.0–25.5 sec	1.0	Adv
C3-06	LL 2 Stop Time	Decel time to STOP when Lower Limit is input.	0.0–25.5 sec	0.5	Adv
C3-07	Upper Action	Determine the stop method at Upper Limit 2 Input.		0	Adv
	0	Decel to Stop			
	1	BB to Stop			

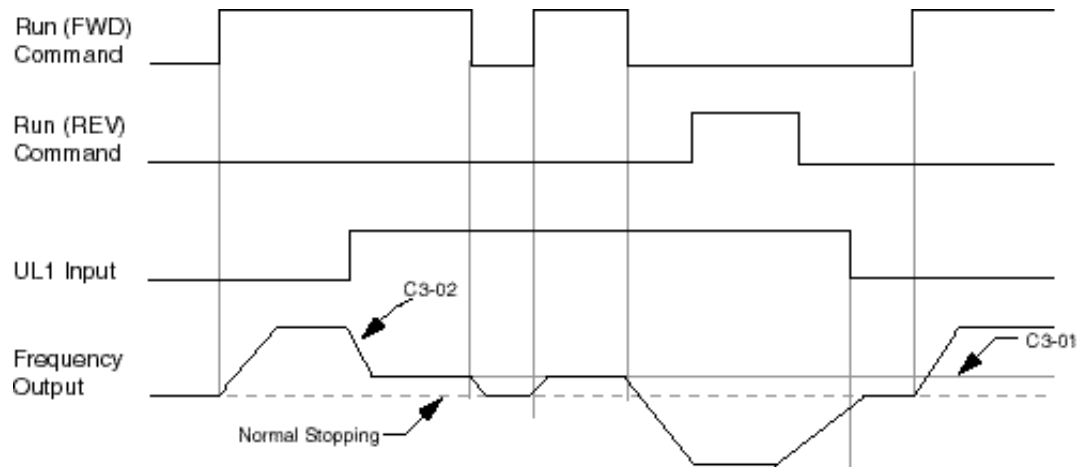


Figure 5-18: Upper Limit (UL1)

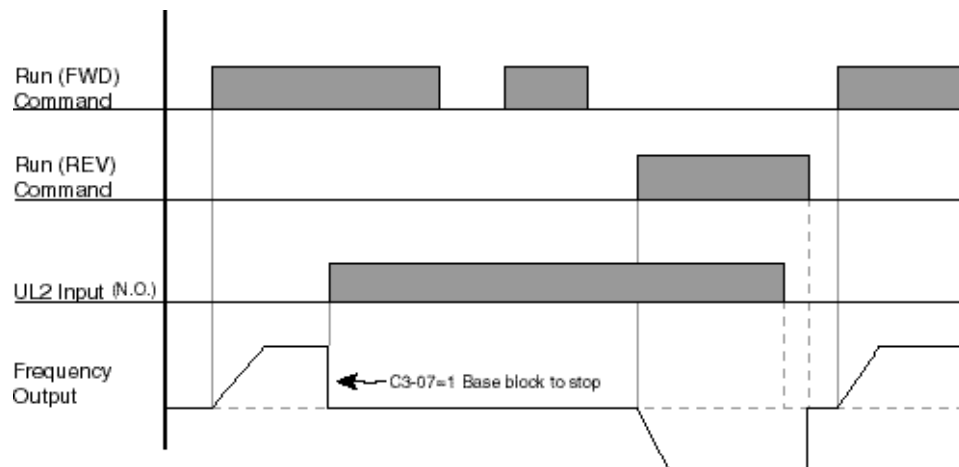


Figure 5-19: Upper Limit 2 (UL2)

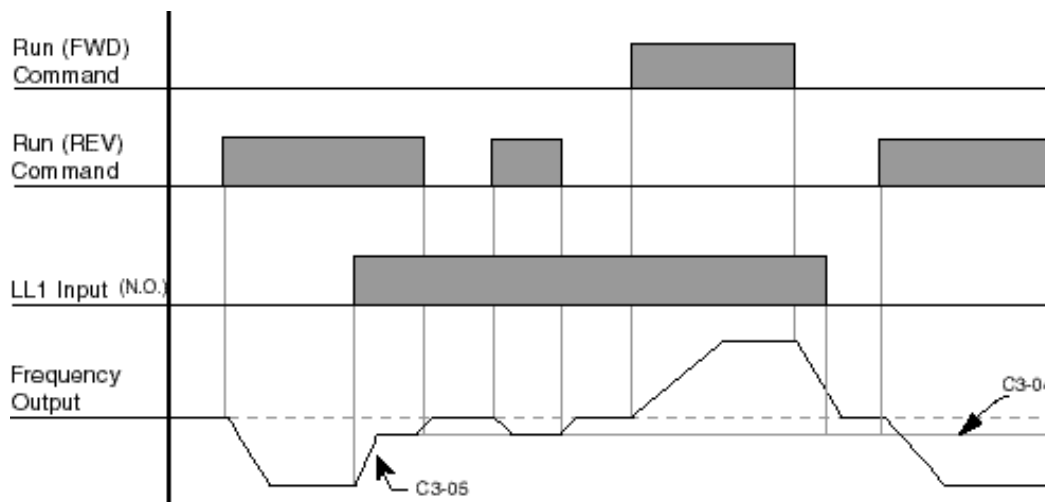


Figure 5-20: Lower Limit 1 (LL1)

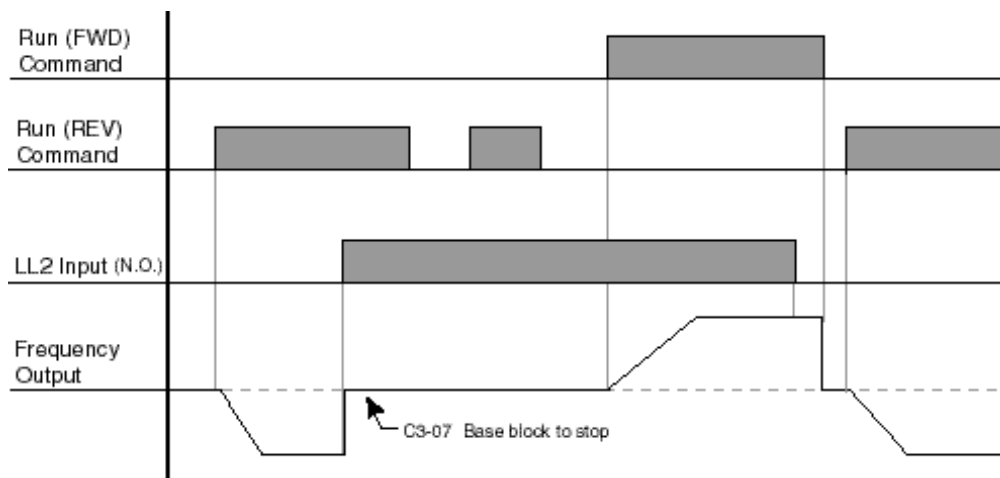


Figure 5-21: Lower Limit 2 (LL2)

Zero Servo

When Zero Servo is enabled, it maintains the motor shaft at a stationary position. This function is enabled by a MFI (Multi-Function Input) that is programmed as the digital input code #3A H1-01~06=3A.

Parmr Code	Display	Function	Range	Initial Value	Access Level
C4-01	Zero Servo Timer	Maximum duration of Zero Servo action at multi-function input.	0-255 sec	10	Adv
C4-02	Zero Servo Gain	Zero Servo multiplier.	0-100	*	Adv
C4-03	Zero Servo Count	Zero Servo completion width.	0-16383	5	Adv

* For drive model #s 2006-2054 and 4003-4021 the Initial Value is 25. For drive model #s 2068-2300 and 4028-4605 the Initial Value is 50.

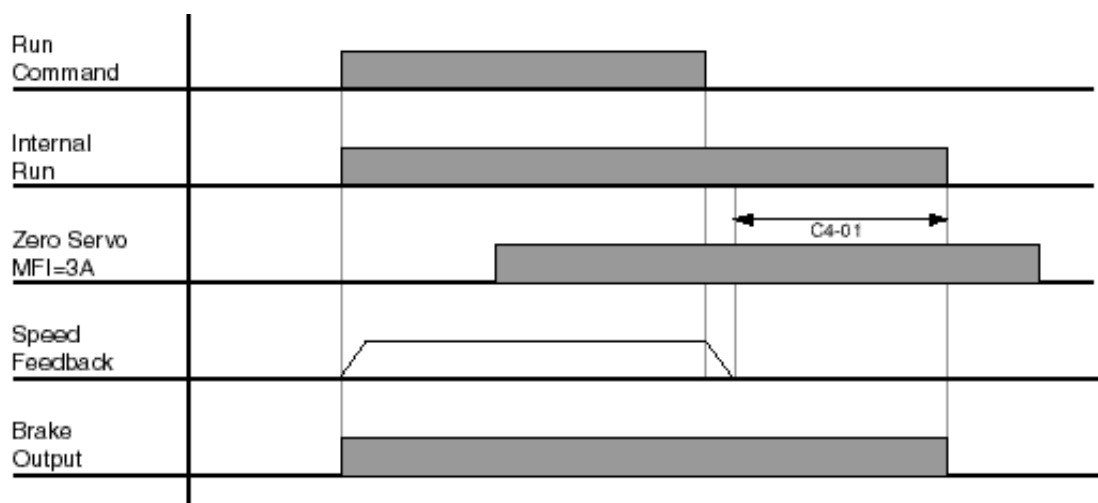


Figure 5-22: Zero Servo

Load Check

Load Check function is a load-limiting feature that ensures the programmed load limit of the hoist is not exceeded. It prevents the lifting (and potential loss) of a load that is overweight. When IMPULSE•VG+ Series 2 detects an overload condition, it prevents any further raising. However, the load can be lowered at the speed that is specified by constant C5-14 (Load Check Fault speeds).

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C5-01	Load Check 0/1 <i>0 Disabled</i> <i>1 Enabled</i>	Determines whether Load Check is enabled.		0	Adv
C5-02	LC Alarm Action <i>0 Alarm Only</i> <i>1 Decel to Stop</i> <i>2 Coast to Stop</i> <i>3 Fault Stop</i>	Action at Load Check alarm or fault. "BB to Stop" is Immediate Stop at STOP.		2	Adv
C5-03	Min Torque Ref	Minimum current/torque reference during acceleration that triggers Load Check.	0–100%	60	Adv
C5-04	Look Speed 1	First Load Check frequency reference.	0–150 Hz	6	Adv
C5-06	Vec Torque Ref	Torque reference at LS1, 2 and 3.	0–300%	125	Adv
C5-07	Look Speed 2	Second Load Check frequency reference.	0–150 Hz	20	Adv
C5-09	Look Speed 3	Third Load Check frequency reference.	0–150 Hz	60	Adv
C5-11	1 Ref for > LS 3	Load Check Current when Output Frequency > Look Speed 3.	30–200%	160	Adv
C5-12	LC Setting Time	Time for holding Output Frequency to stabilize Output Current.	0–2.55 sec	0.20	Adv
C5-13	LC Test Time	Time (after the LC Setting Time) for comparing Output Current with Reference Current	0–2.55 sec	0.10	Adv
C5-14	LC Fault Speed	Maximum lowering speed after Load Check fault	0–255 Hz	6	Adv

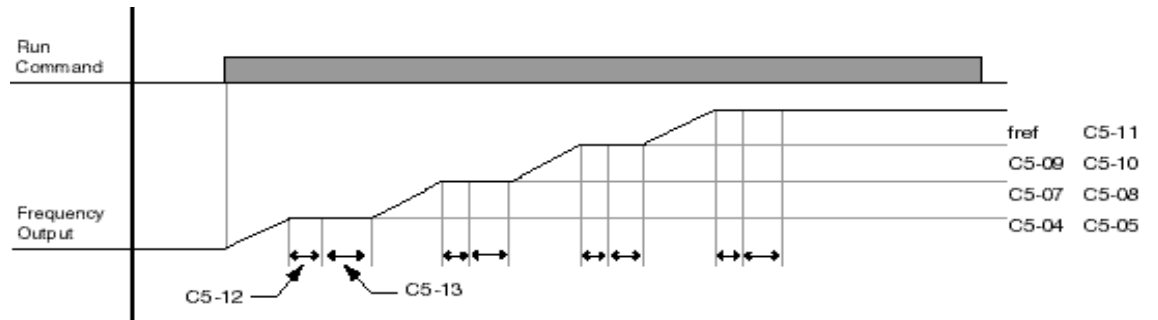


Figure 5-23: Load Check

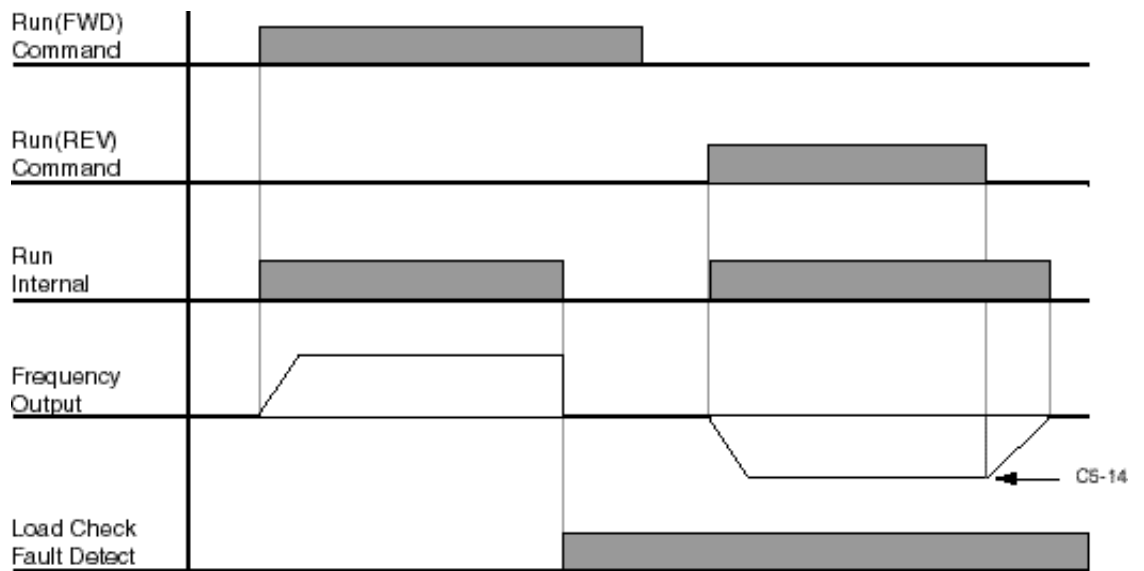


Figure 5-24: Example of Operation C5-02=2

Ultra-Lift

Ultra-Lift provides additional productivity by allowing a crane or hoist to quickly move into position. The feature enables the motor to over speed when the load is less than 100 percent of the rated capacity. Ultra-Lift determines the torque required for the load, calculates the maximum safe speed, and automatically accelerates to this speed. However, the maximum speed cannot exceed the lesser value of the Ultra-Lift Maximum Output Frequency-RAISE (C6-02), Ultra-Lift Maximum Output Frequency-LOWER (C6-03), and Maximum Frequency (E1-04).

NOTE: Note: Ultra-Lift is disabled when in traverse applications or in the reverse direction. Maximum Frequency (E1-04) must be \geq the higher value between C6-02 and C6-03.

Parmtr Code	Display	Function	Range	Initial Value	V/F Access	Open Loop Vector Access
C6-01	Ultra Lift 0/1 0 Disabled 1 Enabled Automatic 2 Enabled by MFI	Determines whether Ultra Lift is enabled.		0	Adv	Adv
C6-02	Ultra Lift ForSpd	Maximum Output Frequency during Ultra Lift—FORWARD.	0–150 Hz	60	Adv	Adv
C6-03	Ultra Lift RevSpd	Maximum Output Frequency during Ultra Lift—REVERSE.	0–150 Hz	60	Adv	Adv
C6-04	Ultra Lift For T	Maximum output torque below which Ultra Lift—FORWARD is enabled.	0–100%	50	Adv	Adv
C6-05	Ultra Lift Rev T	Maximum output torque below which enabled Ultra Lift REVERSE.	0–255%	30	Adv	Adv
C6-06	UL Enabling Spd	Threshold frequency at which Ultra Lift is enabled.	0–150 Hz	60	Adv	Adv
C6-07	UL Delay Time	Delay time at enabling speed prior to torque-compare function.	0.0–30.0 sec	2.0	Adv	Adv
C6-08	SFS Acc Gain	Speed feedback acceleration multiplier.	0.1–9.9	1.0	Adv	Adv

Enable Ultra-Lift Function:

2,3,5-Speed Multi-Step (A1-04=0, 5, or 6):

1. Set C6-01=1 or 2 to enable the **Ultra-Lift Function**, 1= Enable Automatic, 2= Enable by Multi-Function Input (MFI).
2. Set C6-02 and C6-03 to determine **Ultra-Lift** maximum FOR/REV output frequency.
3. Set C6-04 and C6-05 to determine **Ultra-Lift** maximum enable output current.
4. Set the **Ultra-Lift Enabling Speed (C6-06)** one or two hertz below the maximum normal running speed reference.

For example: If the maximum normal running speed is at 60 Hz, set C6-06 to 59 Hz or 58 Hz as the **Ultra-Lift Enabling Speed**.

5. Ensure that the **Maximum Frequency (E1-04)** is increased from 60 Hz.

2, 3 Step Infinitely Variable (A1-04=1 or 2)

6. If the system is using **2-Step** or **3-Step Infinitely Variable** as the **Speed Control Method**, the following formula is used to adjust the constant **B2-01 (Reference Upper Limit)**.

$$B2-01=60 \text{ Hz} \times 100 / E1-04$$

Bi-Polar/Uni-Polar Analog (A1-04=3 or 4)

7. If the system is using **Bi-Polar Analog** or **Uni-Polar Analog** as the **Speed Control Method**, the following formula is used to adjust the constant **H3-02 (Gain Multiplier for Terminal 13 analog input signal)**.

$$H3-02=60 \text{ Hz} \times 100 / E1-04$$



WARNING

Motors and drive machinery must be capable of operating above motor base speed. Consult the motor/gearbox/hoist manufacturer before enabling Swift Lift function. Failure to observe this warning may result in damage to equipment and possible injury or death to personnel.

Torque Limit

IMPULSE•VG+ Series 2 dynamically controls the torque output of the motor at all times. The Torque Limit Function limits the amount of motor torque on all four quadrants of vector control operation:

- Forward Motoring
- Reverse Motoring
- Forward Regenerating
- Reverse Regenerating

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C7-01	Torque Limit Fwd	FORWARD torque limit	0–300%	150	Adv
C7-02	Torque Limit Rev	REVERSE torque limit	0–300%	150	Adv
C7-03	Torq Lmt Rgn	Regenerative torque limit at FORWARD	0–300%	180	Adv
C7-04	Torq Limit Rev Rgn	Regenerative torque limit at REVERSE	0–300%	180	Adv
C7-07	T-Lim Gain MFI	Used when H1-01~H1-06 = 15 and MFI is on	0–2.55	1.25	Adv

No-Load Brake Start/Stop

The No-Load Brake Hoist mode provides a special start/stop sequence designed specifically for No-Load Brake Hoists. This mode is enabled automatically when the Motion is set to NLB Hoist (A1-03=2). This will also automatically set the Stopping Method to No-Load Brake (B3-03 = 6).

The NLB Sequence is comprised of a series of Timers and Counters that monitor certain feedback devices. The sequence is divided into two parts, NLB Start and NLB Stop.

The NLB Start Sequence begins by building up torque in the motor to a predefined level within the C8-01 (Torque Compensation Time) timer. This level is determined by several factors which are defined below. During the C8-01 time, the drive is monitoring current to motor. The internal current feedback equation must be satisfied within the time set in C8-02 (IFB OK Time). If it is not, a BE2 (No-Current) alarm will be displayed on the Keypad.

Factor 1: On the first run command after power up, or after any major fault which causes the NLB Stop sequence to be skipped, the NLB Start sequence by default looks at the value programmed in C8-16, the Initial Brake Release torque.

Factor 2: Once the system has completed a successful NLB Start and NLB Stop, a new value is used. This value is one that has been memorized and stored into memory during the NLB Stop Sequence. It is equivalent to the amount of torque required for the motor to hold the load that is on the hook in Zero Servo (otherwise known as Load Float) with the brake released. Some benefits of memorized Load Float torque for the next brake release are:

- Faster response to run commands when drive is in Base Block Status.
- Upon brake release, shaft rotation begins in the direction of the run command.

If the memorized value is less than the programmed value in C8-03 (Minimum Brake Release torque), then C8-03 is used as the next brake release value. If the feature must be disabled, C8-03 and C8-16 should be set to equal values of approximately 100 %.

Once the brake has been commanded to release, the drive frequency output remains at zero for the amount of time programmed into C8-04. During C8-04, the drive waits for the brake to completely open and watches encoder feedback. If the amount of feedback is less than the setting in C8-05 (Roll Back Count), then the drive proceeds to the BE3 check. If it is not, a BE1 alarm is displayed on the keypad. For the BE3 check, if the brake opened mechanically, then the encoder feedback must be greater than or equal to the value programmed in C8-07 (BE3 Detect Count) within the time set in C8-06 (BE3/Alternate Torque Time). If it is not, then BE3 is displayed. By the time the drive has completed the BE3 check, there should be a significant amount of motor shaft movement and the NLB start sequence is complete.

The NLB Stop Sequence begins when the run command has been removed and the output frequency has decelerated to zero. Once at zero speed, the motor maintains a Zero Servo position or more commonly referred to as Load Float for the duration of C8-10 (Load Float Time). During the Load Float time, run commands in either direction are accepted and will begin accelerating immediately in the commanded direction thereby skipping the NLB Start Sequence entirely. The Load Float Timer is reset after each new run command. Once the Load Float Timer expires, the brake output command is removed (thereby closing the brake) and Zero Servo is maintained for the time set in C8-11 (Brake Delay Time) to allow the brake to fully close. Once the Brake Delay Time has expired, the BE6 check is executed. The BE6 check simply monitors encoder feedback and compares it to C8-13 (BE6 Max count). The encoder feedback must not exceed the number of counts in C8-13 within the C8-12 (BE6 Detect Timer) time. If it does (meaning the load slipped through the brake), a BE6 alarm is displayed on the keypad and the drive will reset its zero servo position and maintain its new position. Run commands will still be accepted with the exception of a reduced speed in the up direction set by C8-17 (BE6 Up speed) and the NLB stop sequence will begin again once the run command had been removed.

NOTE: All of the above faults are annunciated by a digital output which is preprogrammed by Electromotive Systems to output to terminal 2 on the G5OUT card. A customer supplied warning device may be connected to this output to notify operators of potentially hazardous brake conditions. BE6 detection is disabled (C8-12=0) when the inverter leaves the factory. Electromotive Systems does not recommend enabling BE6 detection without the use of an audible or visual alarm to signal an operator of a hazardous condition. If BE6 detection is desired, a warning device should be installed and wired to terminal 2 of the G5OUT card (see Fig. 3-35 for wiring details). If the alarm activates upon removing the run command and the stopping sequence is initiated, DO NOT turn off power. This fault means the brake has failed and the motor/drive combination is holding the load. In this situation, move the crane to a safe location and remove the load from the hook. Corrective action should then be taken. See page 6-5.



WARNING

DO NOT turn off power to the drive during a BE6 fault. This may result in loss of control of the load if the brake has failed in the open position or is unable to hold the load.

To enable BE6 detection, C8-12 must be greater than 0. C8-12=2.0 seconds is the recommended BE6 detect time. For more information on BE6 detection, reference Fig. 5-29, No Load Brake BE6 timing diagram.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C8-01	Torq Comp Time	Time for torque to build to 300% at start.	0.00–2.55 sec	*	Adv
C8-02	IFB OK Timer	Time period during which Output Current must be OK.	0.00–2.55 sec	*	Adv
C8-03	Brake Rel Torq	Minimum brake release torque.	0–300%	10	Adv
C8-04	Roll Back Timer	Time period during which the roll back is checked.	0.00–2.55 sec	0.50	Adv
C8-05	Roll Back Count	Detection counts for excessive roll back.	0–16536	400	Adv
C8-06	RE3/Alt Torq T	Time period during which C8-07 is measured.	0.00–2.55 sec	0.50	Adv
C8-07	BE3 Det Count	Detection count for Encoder/ Seized-Brake Fault (BE3). It is the encoder pulse count, during the time period of C8-06, below which the BE3 fault triggered.	0–16536	50	Adv
C8-08	Alt Rev T Limit	For a LOWER command in the NLB Hoist Motion Mode only—Torque limit for time of C8-06 to prevent driving through a brake that has failed closed.	0–100%	10	Adv
C8-09	Zero Speed Level	Determines speed reference at which Zero-Speed Level activates.	0–150 Hz	2	Adv
C8-10	Load Float Time	After stop command time period during which the load is held at the zero-position and the electric brake is not set.	255 sec	10	Adv
C8-11	Brake Delay Time	The delay time between Immediate Stop at STOP and Brake Set.*	0.00–25.5 sec	0.7	Adv
C8-12	BE6 Detect Timer	Time period during which the electric brake is set and tested for sustaining the load.	0.00–25.5 sec	0	Adv
C8-13	BE6 Max Count	Total pulse counts must be <C8-13, during C8-12, otherwise BE6 Fault.	0–16536 pulses	50	Adv
C8-15	Load Float Ext. T	Load Float extension time enabled MFI=46.	0–255sec	10	Adv
C8-16	Init Brk Release	Brake release torque at power up and after UL2, LL2, EF faults or MFI's which cause the output to base block.	0-300%	100	Adv
C8-17	BE6 Up Speed	Maximum up speed after BE6 is detected.	0-30 Hz	6.00	Adv

* For drive model #s 2006-2054 and 4003-4021 the Initial Value is 1.5. For drive model #s 2068-2300 and 4028-4605 the Initial Value is 2.5.

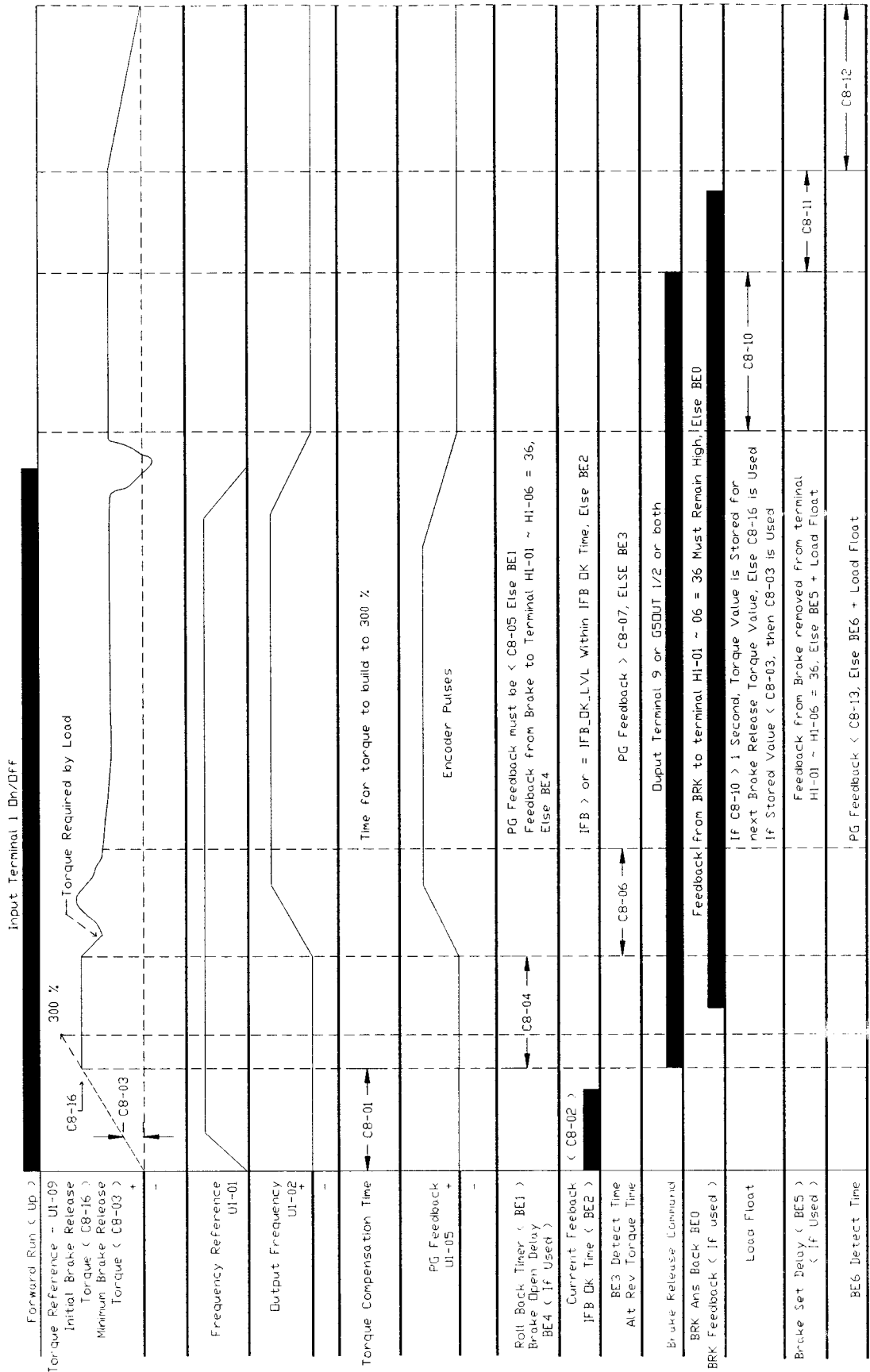


Figure 5-25: No Load Brake Up Timing Diagram

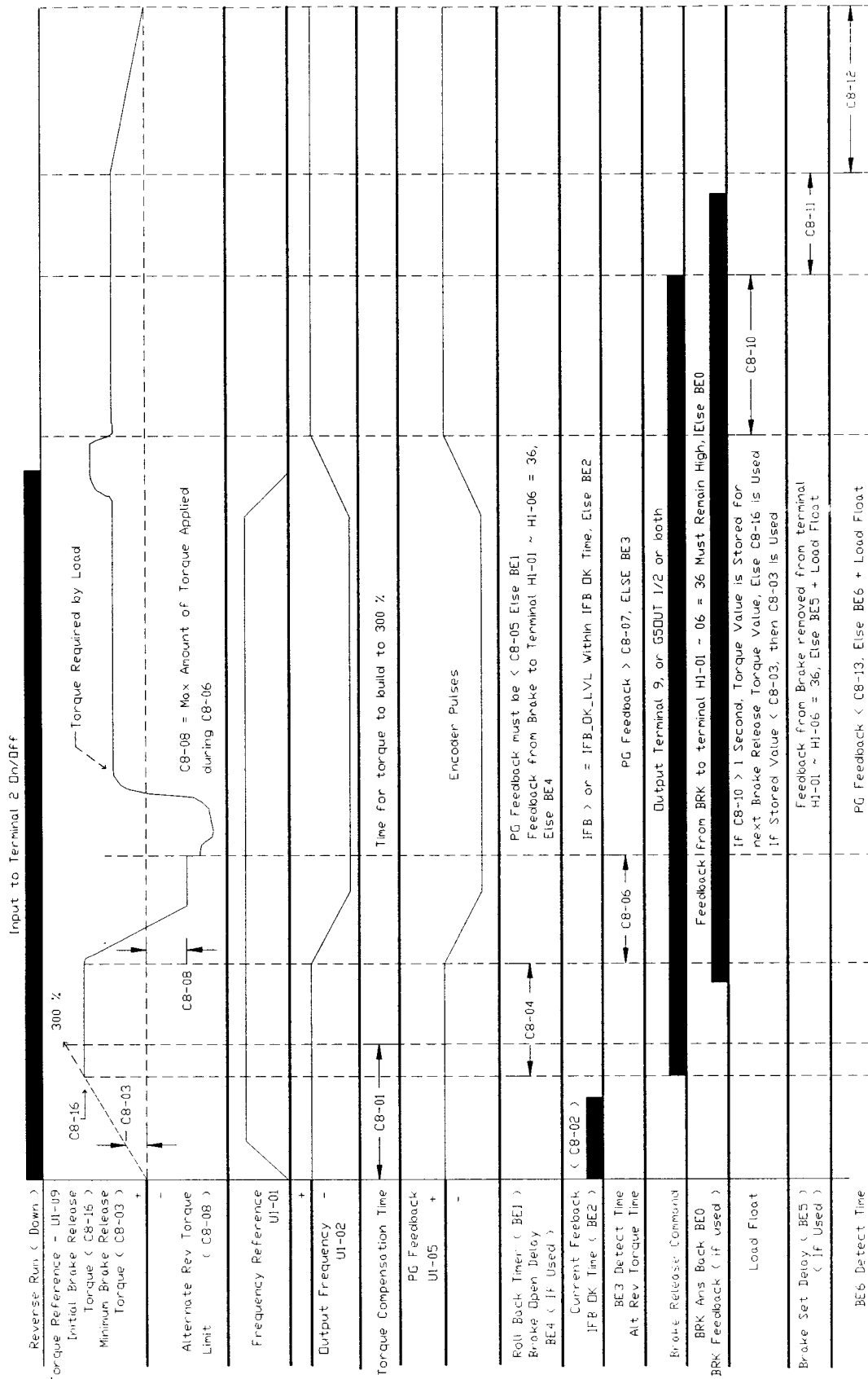
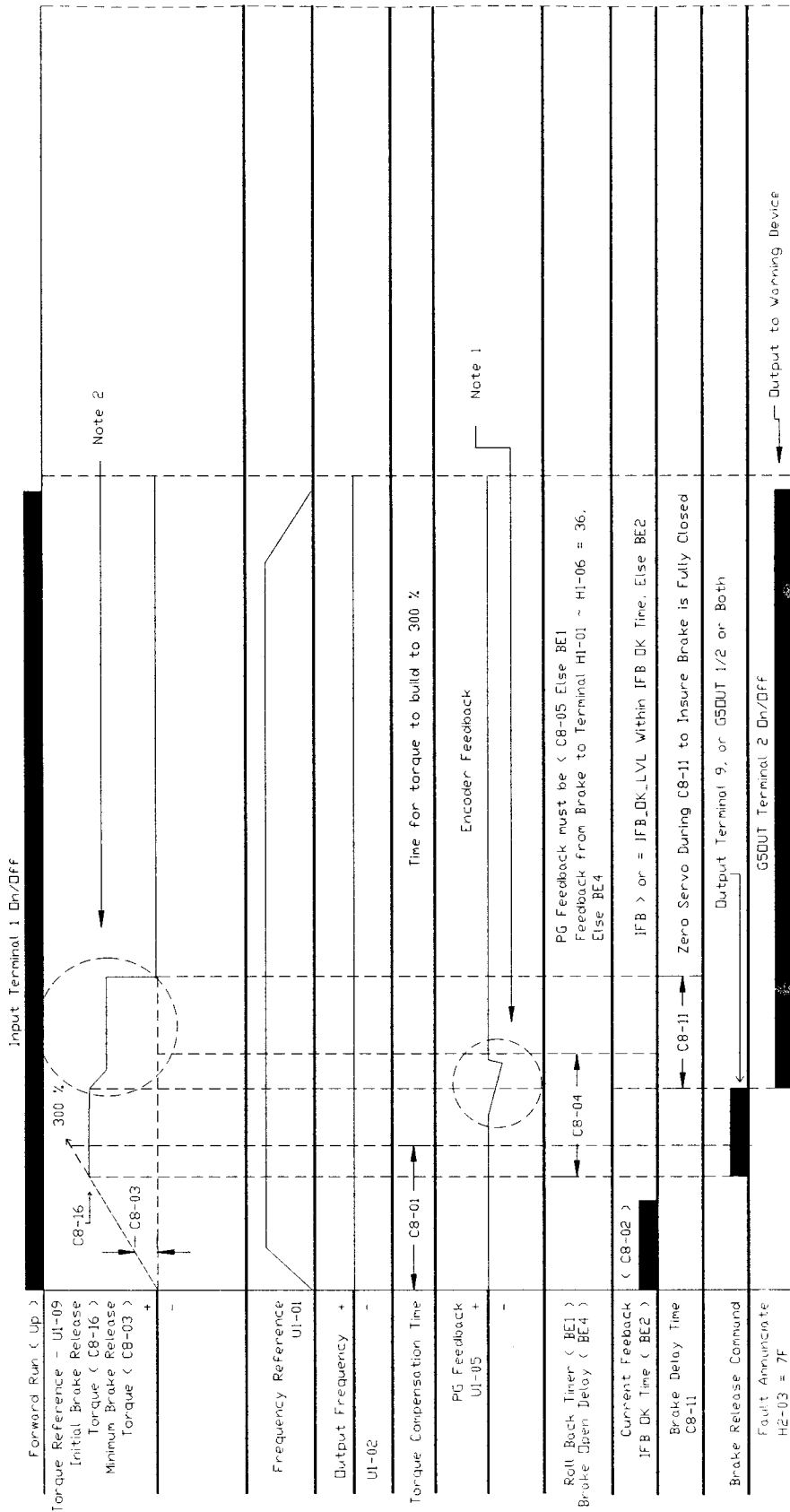


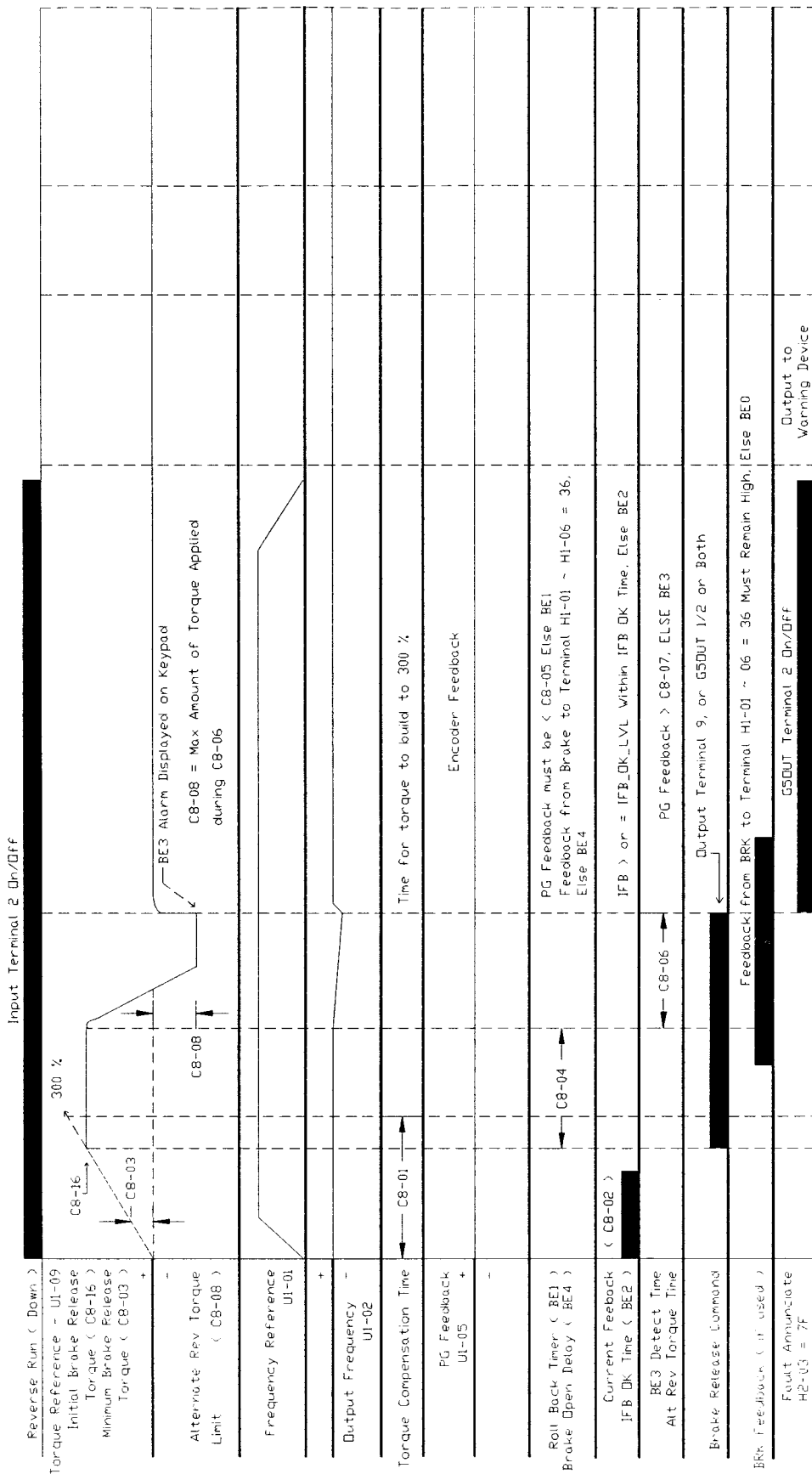
Figure 5-26: No Load Brake Down Timing Diagram



Notes:

1. Rollback is detected, PG Feedback is > C8-05 BE1 Alarm is displayed on Keypad until Run Command is removed, Then Reset.
2. When BE1 is detected, Zero Servo is Maintained During C8-11 Time to Insure Brake is Fully Closed.

Figure 5-27: No Load Brake BE1 Timing Diagram



- Notes:
1. If Brake Feedback is used it should appear as drawn. If it does not, then BE4 is Display on Keypad
 2. If Brake Feedback is used it should appear as drawn. If it does not, the PG Feedback is < C8-07 within C8-06 time, then BE3 is Displayed on Keypad.
 3. If No Brake Feedback is used, and PG Feedback is < C8-07 within C8-06 time, then BE3 is Displayed on Keypad.

Figure 5-28: No Load Brake BE3 Timing Diagram

No-Load Brake Sequence Faults

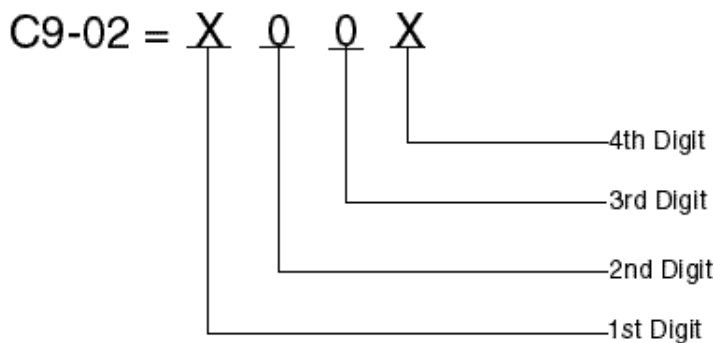
Fault Code	Fault or Indicator Name/Description
BE0	Brake Answer-Back Fault. During RUN, Brake Answer-Back is lost. Input from brake contactor or brake limit switch has been disconnected for more than 500 msec.
BE1	Torque-Proving Fault. At START, pulse feedback, after brake release, is greater than C8-05 count. There is excessive roll-back at start.
BE2	Current-Proving Fault. At START for Torque Proving Sequence only-Current (IFB has not reached predetermined setting within C8-02 time at START.
BE3	Brake Release Fault. For Brake Release-Check Sequence only-Pulse feedback is less than C8-07 counts. After electric brake release command is output-Electric brake is not released.
BE4	Brake Answer-Back Fault. At Start, Brake Answer-back is not input within C8-04 time.
BE5	Brake Answer-Back Fault. At Stop, Brake Answer-back signal is not removed within C8-11 time.
BE6	Brake Set Fault. At Stop, Brake Proving Sequence only-Pulse feedback after brake command removed, is greater than C8-13 count-Excessive movement through brake at stop.
BE7	Brake Answer-Back Fault. At Power Up, Brake Answer-back is on-Electric brake not closed.

Optional Digital Input Set-up (G5IN4 Digital Multi-Function Inputs)

Parltr Code	Display	Function	Range	Initial Value	Access Level
C9-01	G5IN4 0/1 <i>0 Disabled</i> <i>1 Enabled</i>	Determines whether the G5IN4 Digital Multi-Function Inputs are enabled.		0	Adv
C9-02	G5IN4 Setup	Determines the four settings for G5IN4 Digital Multi-Function Inputs.	0000-FFFF	0000	Adv

The optional G5IN4 board accepts four additional multi-function inputs. The G5IN4 board has four terminals, each of which can be programmed to one of the fourteen sets of inputs. Each input in the set can be enabled or disabled.

1. Set C9-01 to 1.
2. Determine the parameter C9-02 setting by specifying the first digit (from left) and the fourth digit (from left) using table 5.1 and 5.2. The second and third digit should always be "0".
3. Set parameter C9-02.



1 = 120V is present on terminal

0 = No voltage is present on terminal

MONITOR	TERMINAL			
U1-25	1	2	3	4
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0

MONITOR		TERMINAL		
8	0	0	0	1
9	1	0	0	1
A	0	1	0	1
B	1	1	0	1
C	0	0	1	1
D	1	0	1	1
E	0	1	1	1
F	1	1	1	1

Table 5.1: G5IN4 Digital Multi-Function Input Sets (1 through E)

Multi-Function Input Assigned to Each Terminal				First Digit (From Left) You Enter
Terminal 1	Terminal 2	Terminal 3	Terminal 4	
<i>Upper Limit—SLOW DOWN; Normally Closed</i>	<i>Upper Limit STOP; Normally Closed</i>	<i>Lower Limit SLOW; Normally Closed</i>	<i>Lower Limit STOP; Normally Closed</i>	1
<i>Upper Limit—SLOW DOWN; Normally Open</i>	<i>Upper Limit STOP; Normally Open</i>	<i>Lower Limit SLOW; Normally Open</i>	<i>Lower Limit STOP; Normally Open</i>	2
<i>Upper Limit STOP; Normally Closed</i>	<i>Lower Limit STOP; Normally Closed</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Micro-Positioning Control Multiplier 2</i>	3
<i>Upper Limit STOP; Normally Open</i>	<i>Lower Limit STOP; Normally Open</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Micro-Positioning Control Multiplier 2</i>	4
<i>Upper Limit STOP; Normally Closed</i>	<i>Lower Limit STOP; Normally Closed</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Swift-Lift Enable</i>	5
<i>Upper Limit STOP; Normally Open</i>	<i>Lower Limit STOP; Normally Open</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Swift-Lift Enable</i>	6
<i>Upper Limit STOP; Normally Closed</i>	<i>Lower Limit STOP; Normally Closed</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Torque Limit Acceleration/Deceleration</i>	7
<i>Upper Limit STOP; Normally Closed</i>	<i>Lower Limit STOP; Normally Closed</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Torque Limit Acceleration/Deceleration</i>	8
<i>Upper Limit STOP; Normally Closed</i>	<i>Lower Limit STOP; Normally Closed</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Zero Servo Command</i>	9
<i>Upper Limit STOP; Normally Closed</i>	<i>Lower Limit STOP; Normally Closed</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Weight Measurement Command</i>	A
<i>Swift-Lift Enable</i>	<i>Torque Limit Acceleration/Deceleration</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Micro-Positioning Control Multiplier 2</i>	B
<i>Alternate Torque Limit</i>	<i>Torque Limit Acceleration/Deceleration</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Upper Limit SLOW; Normally Closed</i>	C
<i>Zero Servo Command</i>	<i>Load Float Time Extension</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Micro-Positioning Control Multiplier 2</i>	D
<i>Alternate Speed Reference Upper Limit</i>	<i>Serial/Inverter Command Changeover</i>	<i>Micro-Positioning Control Multiplier 1</i>	<i>Alternate Torque Limit</i>	E

Table 5.2: Enabling/Disabling Decision Table for C9-02

Input for Terminal 1	Input for Terminal 2	Input for Terminal 3	Input for Terminal 4	Fourth Digit (From Left) You Enter
<i>E</i>	D	D	D	1
D	<i>E</i>	D	D	2
<i>E</i>	<i>E</i>	D	D	3
D	D	<i>E</i>	D	4
<i>E</i>	D	<i>E</i>	D	5
D	<i>E</i>	<i>E</i>	D	6
<i>E</i>	<i>E</i>	<i>E</i>	D	7
D	D	D	<i>E</i>	8
<i>E</i>	D	D	<i>E</i>	9
D	<i>E</i>	D	<i>E</i>	A
<i>E</i>	<i>E</i>	D	<i>E</i>	B
D	D	<i>E</i>	<i>E</i>	C
<i>E</i>	D	<i>E</i>	<i>E</i>	D
D	<i>E</i>	<i>E</i>	<i>E</i>	E
<i>E</i>	<i>E</i>	<i>E</i>	<i>E</i>	F

Key Enable = *E*
 Disable = D

Weight Measurement

The IMPULSE•VG+ Series 2 offers Weight Measurement Function for the hoist applications. The Weight Measurement function can be enabled automatically or manually. The load weights can be displayed by the constant U1-29 on the keypad or by an external device through the analog output terminals.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C10-01	Load Weight 0/1 0 <i>Disabled</i> 1 <i>Enabled at C5-04</i> 2 <i>Enabled at MFI</i> 3 <i>Both Auto & MFI</i>	Determines whether Load Weight is enabled.		0	Adv
C10-02	TRO Pri Delay	Torque Output Calculation primary delay time.	0–1000 msec	200	Adv
C10-03	LW Display Hold 0 <i>Hold Display</i> 1 <i>Hold Disp 3 sec</i>	Until next run command is on		0	Adv
C10-04	LW Conversion	Multiplier of torque output calculation for display. Data is n0000, so multiplier is 10000; “n” is decimal point.	00000–39999	0	Adv
C10-05	Full Load TRO	Percentage of Torque Output that is defined as Full-Load Torque Output.	0.0–200.0%	100	Adv
C10-06	No Load TRO	Percentage of Torque Output that is defined as No-Load Torque Output.	0.0–200.0%	0	Adv
C10-07	Line 2 Display 0 <i>tons</i> 1 <i>pounds</i> 2 <i>kilograms</i> 3 <i>metric tons</i> 4 <i>percent Rload</i>	Determines “weight” measurement units in which the parameter settings will be expressed. The unit abbreviations appear on line 2 of the display		0	Adv
H1-01~06	Terminal 3~8 = 44	Weight Measurement enable by Multi-Function Input.			Adv

NOTE: The Weight Measurement Function only works during the forward motion (lifting).

Setup Procedures

System Tare:

Attach all of the under hook attachments that are required during normal lifting, i.e. chains. Run the hoist motor at 30 Hz. Record the Torque reference value by monitoring U1-09 during at constant speed. For better accuracy, repeat the above operation several times and calculate the average torque reference value. Enter the average value at C10-06 (no load torque reference).

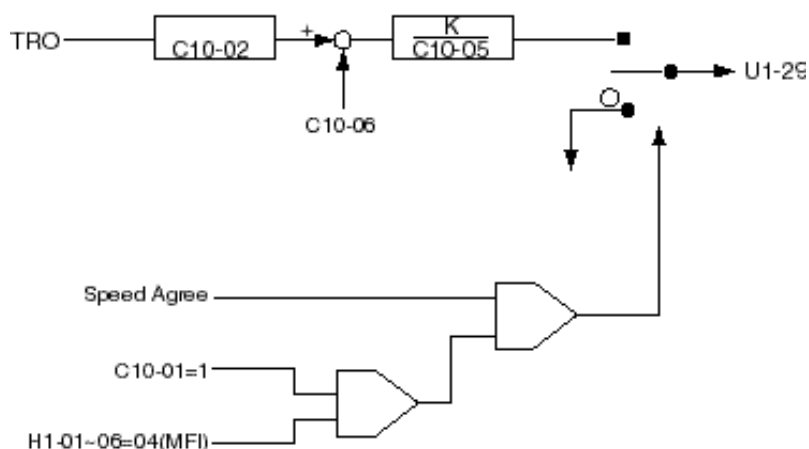


Figure 5-30: System Tare

K: C10-04 multiplier of torque output calculation for display. The display data is N_{xxxx} .
 “N” is the decimal points. $xxxx$ four digits are multiplier.

Example: $C10-04=10050 \rightarrow K_{IW}=50$

System Calibration

The following is a example of system calibration.

Set

C10-01=2	Enabled at MFI
C10-02=700ms	TRO Calculation primary Delay Time
C10-03=1	Hold Display for 3 seconds
C10-04= K_1	Multiplier of TRO Calculation for Display
C10-05=100%	Full Load Torque Output
C10-06=U1-09	No Load Torque Output obtained for system tare
C10-07=0	Display Units; tons
H1-06=44	Weight measurement enabled by MFI

1. Calculate K_1 as indicated below

$$K_1 = \frac{WRL}{100 - (C10-06)} \times 100$$

2. Enter the K_1 value for the parameter C10-04.
3. Place a known weight that is equal or less than the rated load, to the hoist.
4. Run the hoist at 6Hz and take a reading value of W_1 (U1-29). Repeat above step several times to obtain an average of W_1 (U1-29).
5. Compare W_1 to WRL. If the difference between W and WRL is greater than 5%, calculate K_2 as indicated below.

$$K_2 = \frac{WRL}{W_1 (U1-29)} \times K_1$$

6. Replace K_1 and K_2 by setting C10-04= K_2 .
7. Repeat steps 4 and 5 until the difference between W_1 (U1-29) and WRL is less than 5%.

WRL = Weights at 100% rated load.

W = Weights that are displayed by U1-29.

K = Multiplier (C10-04).

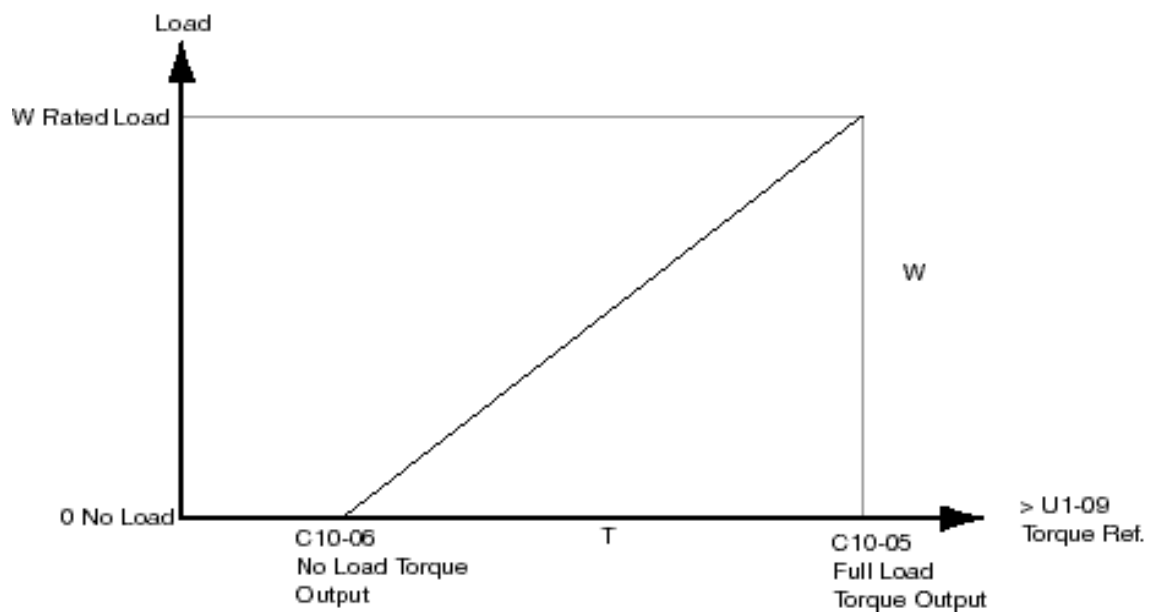


Figure 5-31: Load vs. Torque

Slack Cable Detection

IMPULSE•VG+ Series 2 offers Slack Cable Detection in the hoist application. The Slack Cable condition is detected when the torque output is drastically reduced and has dipped below a set-point (C11-03) level. When Slack Cable condition occurs, the output action is defined by the C11-02 which has 6 selections.

The Slack Cable Detection is not executed, unless both of the following conditions are true:

- The output frequency is between C11-04 and C11-06.
- The Slack Cable Detection delay time is between C11-05 and C11-07.

Setup Procedure:

- To set the Slack Cable Detection torque level (C11-03), by lowering the hoist without load at a constant speed that the hoist would normally run during the operation. Monitor and record the torque reference (U1-09). Repeat above operation several times to ensure an accurate reading.
- Then Set C11-03 = [(U1-09)-2].
- Enable Slack Cable Detection by setting the C11-01 to 1.
- Select output action when Slack Cable is detected by defining C11-02.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C11-01	Slack Cable 0/1	(For Hoist Application) Determines whether Slack Cable Detection is enabled.		0	Adv
	0 Disabled				
	1 Enabled				
C11-02	Action at SLC	Multi-function output that occurs at Slack Cable Detection. For all Selections, RAISE command is permitted.		2	Adv
	0 No Action	Alarm Only			
	1 No Act/C3-04	Next LOWER command is at Lower Limit 1 speed (C3-04).			
	2 Decel/C3-04	Decelerate to Lower Limit 1 Speed C3-04. Continued LOWER commands allowed, but at C3-04.			
	3 Decel/No Opr	Decelerate to Lower Limit 1 Speed C3-04. Continued LOWER commands are <i>not</i> allowed.			
	4 Dec Stop/C3-04	Decel (by C3-05) to Lower Limit 1 Speed C3-04. Continued LOWER commands allowed, but at C3-04.			
	5 Dec Stop/No Opr	Decel (by C3-06) to stop. Continued LOWER commands are <i>not</i> allowed.			

Parmtr Code	Display	Function	Range	Initial Value	Access Level
C11-03	SLC Detect Torq	Percentage of Output Torque below which the enabled Slack Cable Detection is activated—as long as the Frequency output is between C11-04 and C11-06, and the delay time is between C11-05 and C11-07.	0–100%	30	Adv
C11-04	SLC Detect Spd 1	The minimum Frequency Output that is required for the enabled Slack Cable Detection to be activated. It corresponds to Slack Cable Detection Delay Time 1 (C11-05).	0–150Hz	2	Adv
C11-05	SLC Delay Time 1	The minimum delay time before the enabled Slack Cable Detection can be activated. It corresponds to Slack Cable Detection Speed 1. Prevents false outputs.	0.00–2.55sec.	0.50	Adv
C11-06	SLC Detect Spd 2	The maximum Frequency Output below which the enabled Slack Cable Detection can be activated. It corresponds to Slack Cable Detection Delay Time 2 (C11-07).	0–150Hz	60	Adv
C11-07	SLC Delay Time 2	The maximum delay time before the enabled Slack Cable Detection can be activated. It corresponds to Slack Cable Detection Speed 2. Prevents false outputs.	0.00–2.55sec.	0.10	Adv

Tuning

- D1 Injection
- D2 Automatic Slip Compensation
- D4 ASR Tuning
- D5 Torque Control
- D6 Droop Control
- D8 Dwell Function
- D9 S-Curve Acceleration/Deceleration
- D10 Carrier Frequency
- D12 Factory Tuning

DC Injection

DC Injection can be used to stop a motor whose rotational direction is uncertain at start-up.

With ramp to stop enabled (B3-03=0), upon removal of the run command the IMPULSE•VG+ Series 2 drive controls motor deceleration according to the Decel Time setting, until output frequency reaches the DC Injection Braking Start Frequency (D1-01 setting). Then the IMPULSE•VG+ Series 2 drive output is turned off and DC injection current is applied to the motor. The effective DC injection time and current should be set to provide adequate stopping without excessive motor heating. The DC injection voltage is determined by the DC injection braking current and motor impedance.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D1-01	DCInj Start Freq	DC Injection braking frequency start.	0.0–10 Hz	1.5	Adv
D1-03	DCInj@Start	DC Injection braking time.	0.00–10.00 sec	0.00	Adv
D1-04	DCInj Time@Stop	DC Injection braking time at stop.	0.00–10.00 sec	0.05	Adv
D1-05	DC Injection P Gain		0.00–1.00	0.05	Factory
D1-06	DC Injection Integral Time		0–1000 msec	100	Factory
D1-07	DC Injection Limit		0.0–30%	15.0	Factory

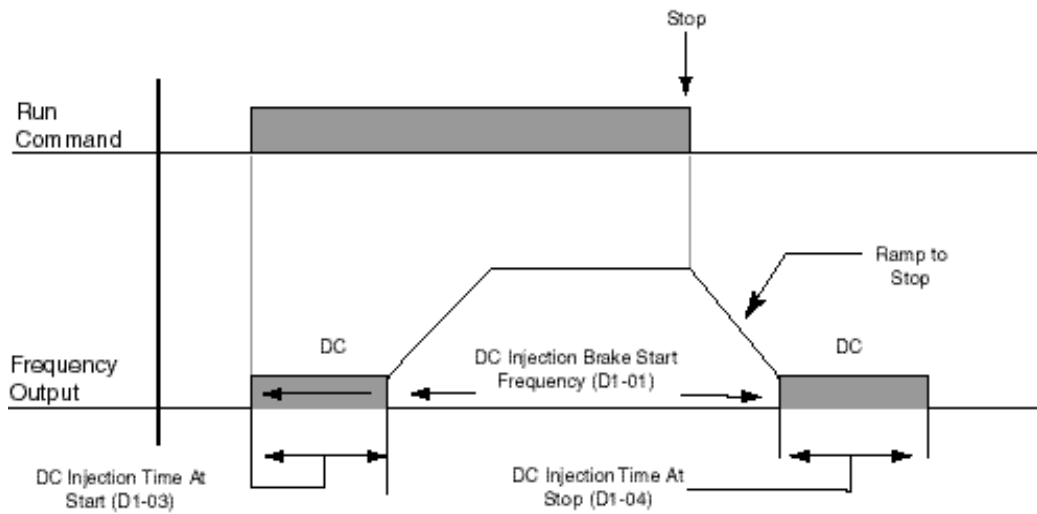


Figure 5-32: DC Braking Sequence

Automatic Slip Compensation

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D2-01	Slip Comp Gain	Slip compensation multiplier.	0.0–2.5	1	Adv

Automatic Speed Regulator (ASR) Tuning

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D4-01	ASR P Gain 1	ASR Proportional Gain 1.	1.00–300.00	30	Adv
D4-02	ASR I Time 1	ASR Integral Time 1.	0.00–10.000 sec.	0.500	Adv

Parameters D4-01 and D4-02 provide adjustments to enable the optimum performance during load disturbances. The proportional gain (D4-01) adjusts the amount of instantaneous droop as a function of loss, and provides dampening from load disturbances such as speed reference change, or a change in load. The integral time (D4-02) adjusts the response time of the IMPULSE•VG+ Series 2 to the load disturbances.

NOTE: Speed control response is increased by increasing the proportional gain setting and decreasing the integral time. However, instability or hunting may occur between the IMPULSE•VG+ Series 2 and the load if D4-01 (ASR Proportional Gain) is set too high, or D4-02 (ASR Integral Time) is set too low.

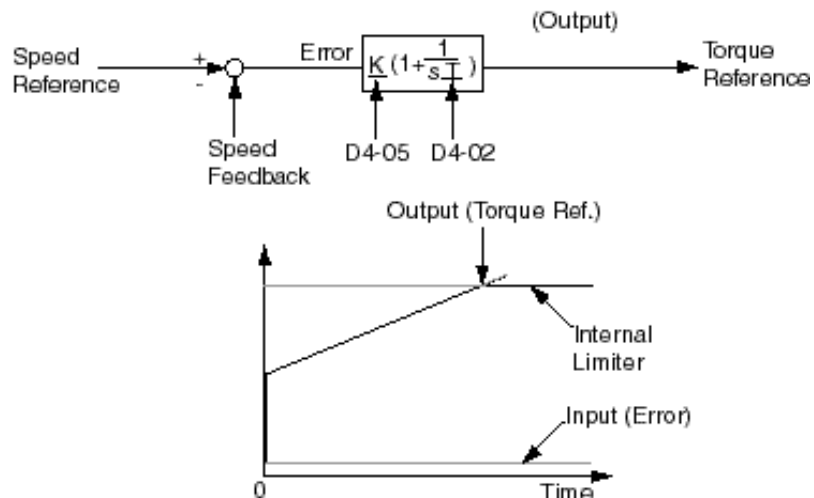


Figure 5-33: Automatic Speed Regulator (ASR) Tuning

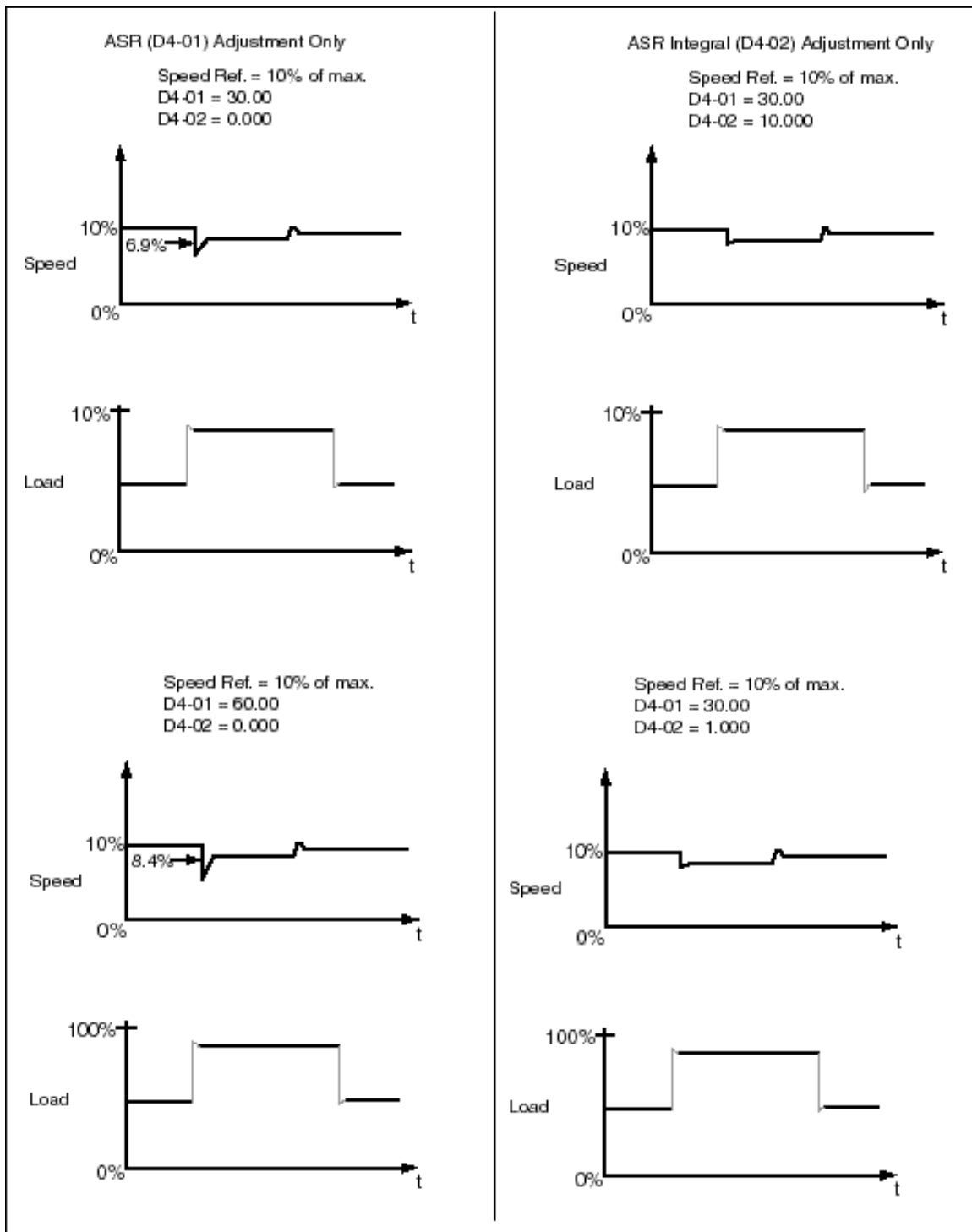


Figure 5-34: Examples of D4-01 and D4-02 Adjustments

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D4-03	ASR P Gain 2	ASR Proportional Gain 2.	1.00–300.0	20	Adv
D4-04	ASR I Time 2	ASR Integral Time 2.	0.000–10.000 sec	0.5	Adv
D4-06	ASR Delay Time	ASR Output Primary Delay Time.	0.000–0.500 sec	0.004	Adv
Mechanical backlash in an application can cause secondary current (I_2) reference variations in the motor's rotor. This condition can prevent the desired adjustment of ASR parameters. The output delay time constant is used to increase the stability of the system allowing a wider setting range of ASR parameters.					
D4-07	ASR Gain SW Freq	ASR Gain Switching Frequency.	0.0–150.0 Hz	0.0	Adv
D4-08	ASR I Limit	ASR Integral Limit.	0–400%	400	Adv

Parameter D4-03 is used as an additional proportional gain adjustment, and parameter D4-04 determines the response time for Proportional Gain 2 (D4-03).

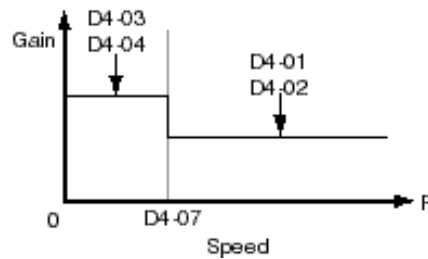


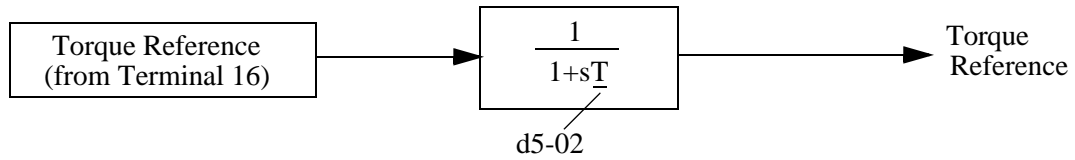
Figure 5-35: Proportional Gain

NOTE: When C5-07= “0,” proportional gain 1 (C5-01) and integral time 1 (C5-02) are selected.

Torque Control

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D5-01	Torque Control	Determines whether Speed or Torque Control is selected.		0	Adv
	0 Speed Control	Speed Control enabled with torque limit			
	1 Torque Control	Torque control enabled with speed limit.			
Speed/torque control selection can also be made by using a multi-function input select (H1-XX=39 speed-torque control changeover).					
D5-02	Torque Ref Filter	Primary delay time for Torque Reference Input.	0–1000msec	0	Adv

This function is used to avoid excessive changes in torque, which may be caused by abnormal resonance when the torque reference changes rapidly.



Parmtr Code	Display	Function	Range	Initial Value	Access Level
D5-03	Speed Limit Sel	Speed Limit Selection (See figure below)		1	Adv
	1 Analog Input				
	2 Program Setting				
D5-04	Speed Lmt Value	Speed Limit Value (% of E1-04)	-120–120%	0	Adv
D5-05	Speed Lmt Bias	Speed Limit Bias (% of E1-04)	0–120%	10	Adv
D5-06	Ref Hold Time	Speed/Torque Switching Timer	0–120%	0	Adv

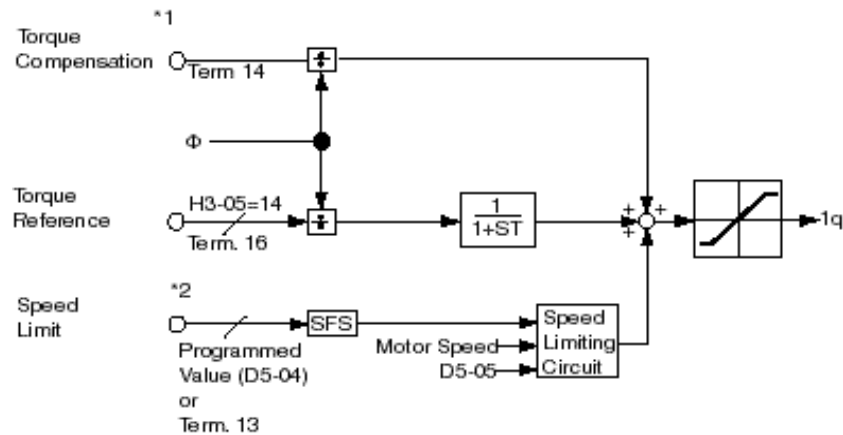


Figure 5-36: Torque Control Block Diagram

*1: When speed limit selection (D5-03) is set to “1”, the master frequency reference input from terminal 13, 14 or 16 becomes the speed limit selection (D5-03) is set to “2”, the set value of D5-04 becomes the speed limit.

*2: When terminal 14 or 16 function selection is set to torque compensation (H3-09= “14”), terminal 14 or 16 set value can be used as the torque compensation value.

Speed/Torque Control Switching

Speed control or torque control can be selected “on the fly” by using the multi-function input speed/torque control selection command (H1-XX = “39”).

Terminal Number	Parameter Number	Setting	Description
8	H1-06	39	Speed/torque control selection
13	B3-01	1	Frequency reference selection (terminals 13, 14, or 16)
	D5-03	1	Speed limit selection (terminals 13, 14, or 16)
16/14	H3-05/H3-09	13	Torque reference/torque limit

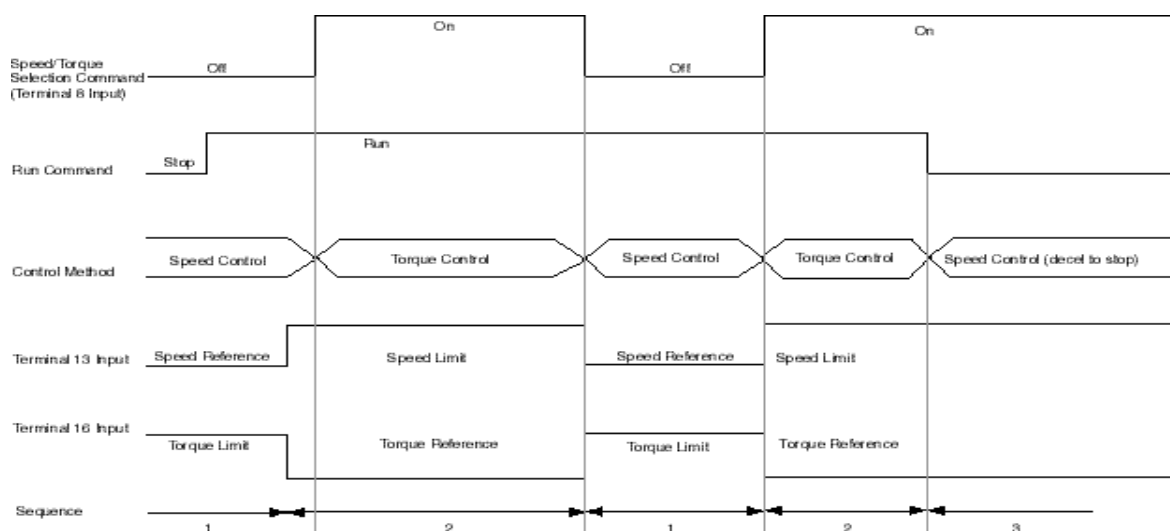


Figure 5-37: Speed/Torque Control Selection Timing Diagram

- When the speed/torque control selection contact is OFF, speed control is activated.
 - Speed reference during speed control depends on the frequency reference selection (B3-01) setting. To use terminal 13, 14 or 16 as the master frequency reference, set B3-01 to “1.”
 - Torque limit during speed control is the smaller of the absolute value of terminal 14 or 16 torque limit, or the values set in the torque limit parameters (C7-01 to C7-04) is used as the torque limit.
 - When a stop command is given during speed control, speed control is maintained as the motor decelerates to stop and the smaller of the absolute value of the terminal 16 torque limit, or the values set in the torque limit parameters (C7-01 to C7-04) is used as the torque limit.
- When the speed/torque control selection is ON, torque control is activated.
 - Speed limit during torque control is the master frequency reference at terminal 13, 14 or 16 when speed limit selection (D5-03) is set to “1”, and is the speed limit value (D5-04) when

D5-03 = “2”, regardless of the frequency reference selection (B3-01) setting.

- During torque control, the terminal 14 or 16 analog input value becomes the torque reference.
3. By giving a stop command during torque control, operation changes to speed control automatically, and the motor decelerates to stop. The torque limit during deceleration to stop becomes the values set in the torque limit parameters (C7-01 to C7-04).

NOTE: The control mode actually changes after the speed/torque control selection command changes and the reference delay timer (D5-06) elapses. The speed reference/speed limit and the torque limit/torque reference are stored in the inverter until the time set to D5-06 elapses.

Droop Control

The Drooping function reduces the motor speed based on the load torque of the motor. The actual amount of motor speed reduction is based on the ratio of the amount of motor torque and maximum output frequency (E1-04).

The Droop Delay Time 06-02 sets the response time for the dropping function. Decreasing the Droop Delay Time will cause the response to become quicker, however, instability may occur.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D6-01	Droop Quantity	Sets the motor speed reduction when torque output equals 100%	0.0 - 100.0	0	Adv
D6-02	Droop Delay Time	Sets the response time for the dropping function	0.03 - 2.0 sec	0.05	Adv

Dwell Function

The Dwell Function is used to temporarily hold the output frequency at a set reference for a set time. This function can be used when driving a motor with a heavy starting load. This pause in acceleration reduces traditionally high starting current.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D8-01	Dwell Ref @ Start	Sets Dwell frequency reference at start.	0.0–150.0 Hz	0	Adv
08-02	Dwell Time @ Start	Sets the time duration for the Dwell function at start.	0.0–10.0 sec	0	Adv
08-03	Dwell Ref @ Stop	Sets dwell frequency Reference at stop.	0.0–150.0 Hz	0	Adv
08-04	Dwell Time @ Stop	Sets the time duration for the Dwell function at stop.	0.0–10.0 sec	0	Adv

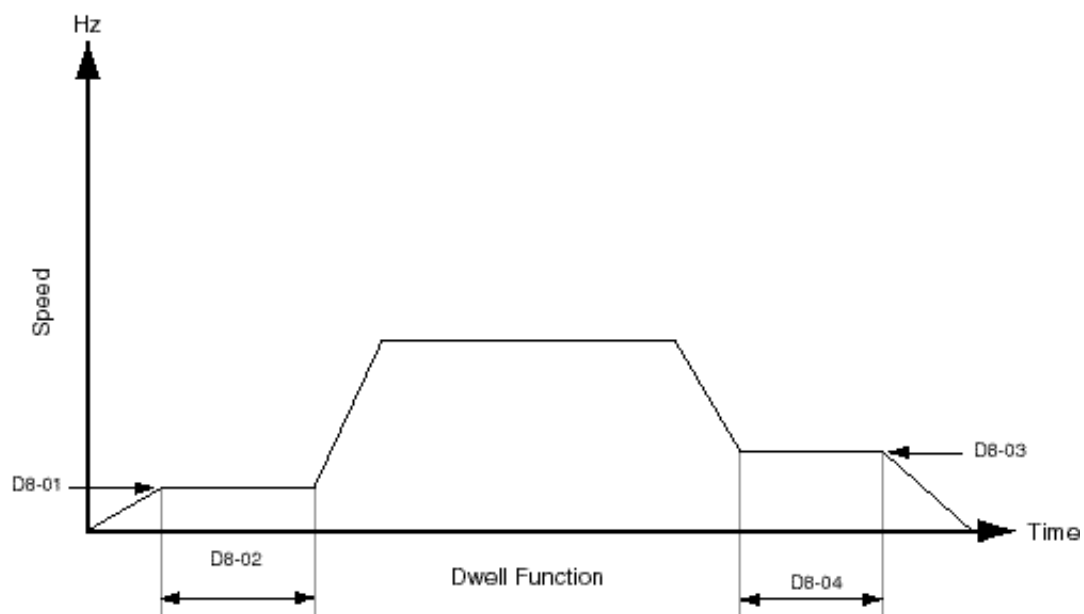


Figure 5-38: Dwell Function

S-Curve Acceleration/Deceleration

A S-Curve pattern is used to reduce shock and provide smooth transitions during machine acceleration and deceleration. S-Curve characteristic time is the time from the output frequency to the set accel/decel time. See S-Curve Characteristic timing diagrams below and on the following page.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D9-01	S-Crv Acc @ Start	Sets S-Curve time at Accel start	0.00–2.50 sec	1.50	Adv
D9-02	S-Crv Acc @ End	Sets S-Curve time at Accel end	0.00–2.50 sec	1.50	Adv
D9-03	S-Crv Dec @ Start	Sets S-Curve time Decel start	0.00–2.50 sec	1.50	Adv
D9-04	S-Crv Dec @ End	Sets S-Curve time at Decel end	0.00–2.50 sec	0	Adv

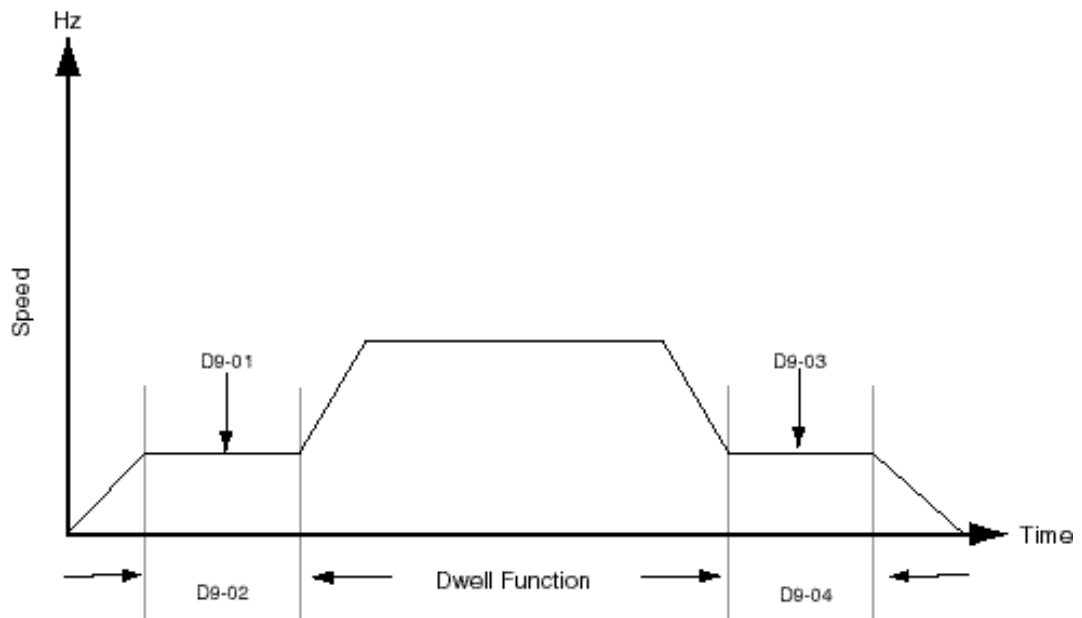



Figure 5-39: S-Curve Characteristic Timing Diagram

The figure below shows FWD/REV run switching during deceleration to stop. The S-curve function will add time to the acceleration and deceleration. Time to accelerate from the minimum frequency to the maximum frequency (total acceleration) = $B5-01 + (D9-01 + D9-02)/2$.



CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

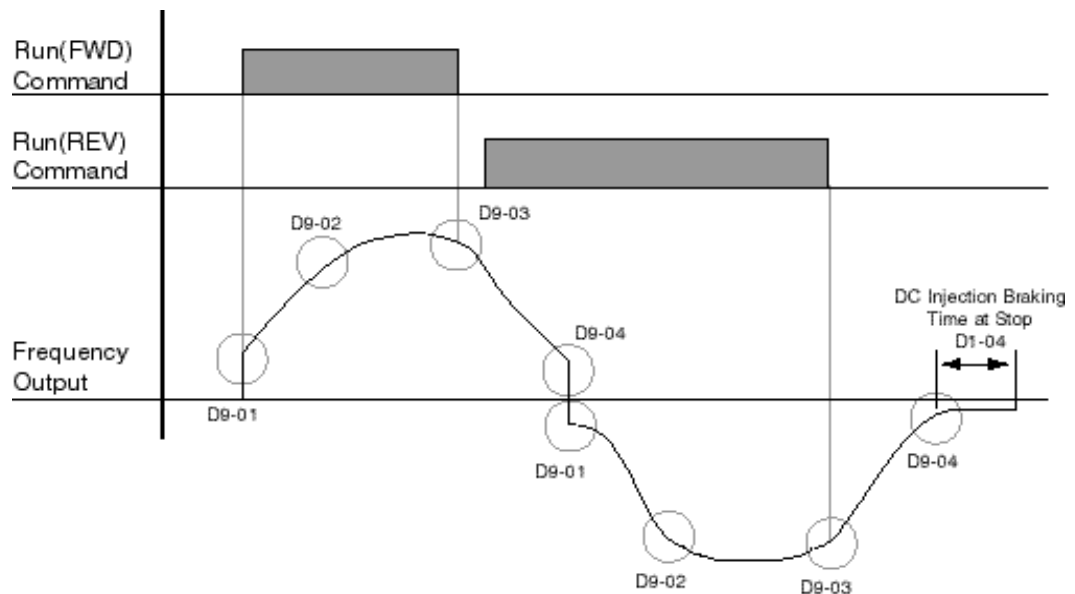


Figure 5-40: S-Curve Characteristics–FWD/REV Operation

Carrier Frequency

This function sets the inverter output transistor switching frequency (Carrier Frequency). Increasing the carrier frequency reduces motor noise. See Figure 5-41 below.

Parltr Code	Display	Function	Range	Initial Value	Access Level
D10-01	Carrier Frequency Max	Carrier frequency upper limit.		4	Adv
	0	0.4 kHz			
	1	1.0 kHz			
	2	1.5 kHz			
	3	2.0 kHz			
	4	2.5 kHz			
	5	5.0 kHz			
	6	10.0 kHz			

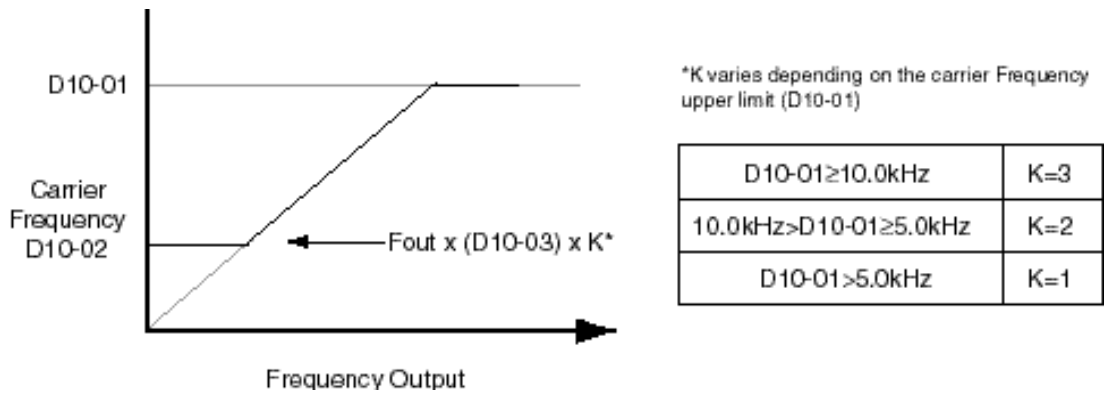


Figure 5-41: Carrier Frequency Setting

NOTE: An OPE11 fault occurs if either of the following conditions is present:

1. D10-03 > 6 and D10-02 > D10-01.
2. D10-01 > 5 kHz and D10-02 ≤ 5 kHz.

Factory Tuning

During normal auto-tuning, the inverter is tuned while running at a carrier frequency of 2kHz. This parameter allows the user to specify the inverter's carrier frequency during auto-tuning. Adjustment may be necessary if "OC" fault is displayed after completion of auto-tuning.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
D12-30	Carrier in tune	Sets the carrier frequency during auto-tuning		0	–
	<i>0 2kHz</i>				
	<i>1 Adjustable by D10-01 (Fc Upper Limit)</i>				

Motor Parameters

- E1 V/f Pattern 1
- E2 Motor Set-up
- E3 Motor 2 Method
- E4 Motor 2 V/f Pattern
- E5 Motor 2 Set-up

Voltage/Frequency Pattern

Parmtr Code	Display	Function	Range	Initial ⁽¹⁾ Value	Access Level
E1-01	Input Voltage	Sets input voltage	155-255/ 310-510	230/460	User

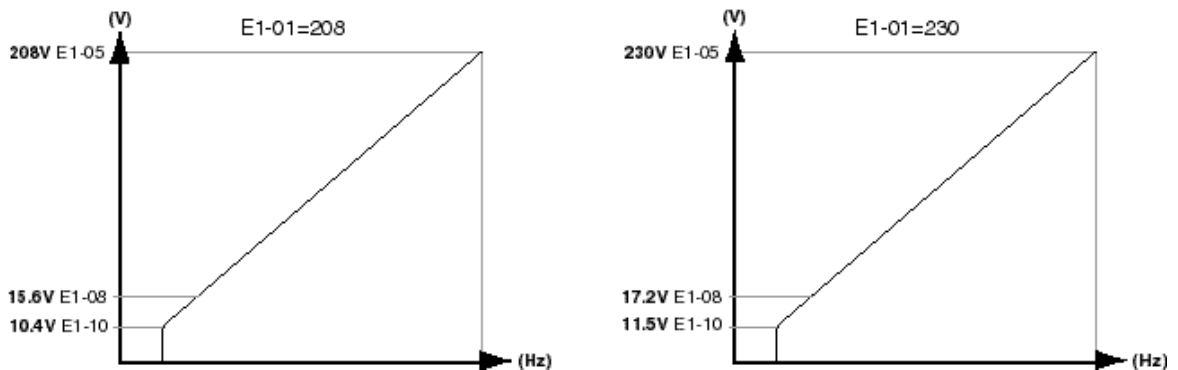


Figure 5-42: E1-01 Input Voltage

- When using flux vector control mode, the V/f pattern voltage values will be adjusted by the Auto-Tuning function.
- Factory setting is 230 (230V units), 460 (460V units) and 575 (575V units).

The setting E1-01 adjusts the overvoltage level, braking transistor turn on level and the stall prevention level during deceleration.

Inverter Voltage	E1-01 Setting	Overvoltage Trip		Braking Transistor		Stall Level
		Trip	Reset	On	Off	
230	150-255	400V	380V	380V	375V	380V
460	≥400	800V	760V	760V	750V	760V
460	<400	720V	680V	660V	650V	670V
575	>500V	1040V	990V	990V	970V	960V
575	<500V	990V	940V	860V	840V	830V

Parameter E1-01 performs the above mentioned function in all three control modes.

Parmtr Code	Display	Function	Range	Initial ⁽¹⁾ Value	Access Level
E1-02	Motor Selection	Identifies motor as fan-cooled or blower-cooled		1	User
	<i>0 Stf Fan Cooled</i>				
	<i>1 Std Blower Cooled</i>				
E1-03	<i>V/f Selection</i>	Select V/f Pattern		F	-
E1-04	Max Frequency	Maximum Frequency “F”	40.0–400.0 Hz	60.0	User
E1-05 ⁽²⁾	Max Voltage	Maximum Voltage “F”	0.0–510.0 V	460	User
E1-06	Base Frequency	Motor Base Frequency	0.0–400.0 Hz	60	-
E1-09	Min Frequency	Minimum Frequency	0.0–400.0 Hz	0.5	User
E1-11	Mid Frequency B	Midpoint Output Frequency B	0.0–400.0 Hz	0.0	Adv
E1-12	Mid Voltage B	Midpoint Output Voltage B	0.0–510.0 V	0.0	Adv
E1-13 ⁽²⁾	Base Voltage	Motor Base Voltage	0.0–510.0 V	0.0	User

⁽¹⁾ The initial value displayed here is for 400V class drives..

⁽²⁾ For 230V class units, the value is half that of 400V class units.

Motor Set-up

E2 constants define motor parameters. Normally, the default settings for E2 constants are determined by KVA selection (O2-04). In flux vector control the E2 constants will be set automatically during auto-tuning. If the control method is V/F (A1-02=0), the motor rated current should be entered into E2-01.

If auto-tuning cannot be performed, some E2 constants can be calculated using the motor's nameplate information.

Motor rated slip frequency (E2-02) can be calculated by using the following equation:

$$f_s = f - \frac{(N \cdot P)}{120}$$

Where...
 f_s : slip frequency (Hz)
 f : rated frequency (Hz)
 N : rated motor speed (rpm)
 P : number of motor poles

Motor terminal resistance E2-05 can be calculated by using the following equation:

$$r_t = r_p \cdot \frac{273 + (25^\circ\text{C} + T_i)/2}{273 + T_i}$$

Where...
 r_t : motor terminal resistance
 r_p : Phase-to-Phase resistance at insulation class temperature
 T_i : insulation class temperature ($^\circ\text{C}$)

Parmtr Code	Display	Function	Range	Initial Value	Access Level
E2-01	Motor Rated FLA	Motor-rated current	0.01–1500.0 A	*	User
E2-02	Motor Rated Slip	Motor-rated slip frequency	0.00–20.00 Hz	*	User
E2-03	No-Load Current	Motor no-load current	0.0–1500.0 A	*	User
E2-04	Number of Poles	Number of poles in motor	2–48	4	Adv
E2-05	Term Resistance	Motor terminal resistance	0.000–65.000 Ω	*	Adv
E2-06	Leak Inductance	Leakage Inductance	0.0–30.0%	*	Adv
E2-07	Saturation Comp 1	Core-Saturation Compensation Coefficient 1	0.00–0.50	*	Adv
E2-08	Saturation Comp 2	Core-Saturation Compensation Coefficient 2	0.00–0.75	*	Adv
E2-09	Mechanical Loss	Motor mechanical loss in percentage	0.0–10.0%	*	Adv

* Initial value is determined by O2-04 (kVA Selection)

Motor 2 Method

The Motor 2 method function allows one drive to control two separate motors which are coupled to separate motions. The output of the drive is switched from one motor to the other and a multi-function input (H1-XX=3b Motor 2 Select) informs the drive of which motor is being used.



WARNING

Do not switch between motors when the drive's output is on as it will damage the unit!

Parmtr Code	Display	Function	Range	Initial Value	Access Level
E3-01	Control Method <i>0 V/f control</i> <i>2 Open loop vector</i>	Motor 2 control method	0–2	2	Adv
E3-02	Motion 2 <i>0 Traverse</i> <i>1 Standard Hoist</i>	Motor 2 motion	0–2	1	Adv

Motor 2 Voltage/Frequency Pattern

Parmtr Code	Display	Function	Range	Initial Value	Access Level
E4-01	V/f 2 Max freq	Maximum frequency for Motor 2	40.0–400.0 Hz	60.0	Adv
E4-02	V/f 2 Max voltage	Maximum voltage for Motor 2	0.0–255.0 V	230.0	Adv
E4-03	V/f 2 Base Freq	Base frequency for Motor 2	50.0–400.0 Hz	60.0	Adv
E4-04	V/f 2 Mid Freq	Midpoint output frequency for Motor 2	50.0–400.0 Hz	3.0	Factory
E4-05	V/f 2 Mid Voltage	Midpoint output voltage for Motor 2	0.0–255.0 V	12.6	Factory
E4-06	V/f 2 Min Freq	Minimum output frequency for Motor 2	0.0–400.0 Hz	0.5	Factory
E4-07	V/f 2 Min Voltage	Minimum output voltage for Motor 2	0.0–255.0 V	2.3	Factory

Motor 2 Set-up

Parmtr Code	Display	Function	Range	Initial Value	Access Level
E5-01	Motor2 Rated FLA	Motor-rated current for Motor 2	0.0–150.0 A	*	Adv
E5-02	Motor2 Slip Freq	Motor-rated slip frequency for Motor 2	0.00–20.0 Hz	*	Adv
E5-03	Motor2 No Load 1	Motor no-load current for Motor 2	0.0–150.0 A	*	Adv
E5-05	Motor2 Term Ohms	Motor terminal resistance for Motor 2	0.000–65.000Ω	*	Adv
E5-06	Motor2 Leak	Leakage inductance for Motor 2	0.0–30.0%	*	Adv

* Based upon inverter models

Option Parameters

- F1 Pulse Generator Option Set-up
- F2 Analog Input 14 Set-up
- F3 Digital Input Option Set-up
- F4 Analog Output Option Set-up
- F5 Digital Output 2 Set-up
- F6 Digital Output 8 Set-up
- F7 PG Output 36 Set-up

Encoder (PG) Option Set-up

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F1-01	PG Pulses/Rev	Sets encode Pulses/Rev	0–60000 pulses/rev	1024	Adv
F1-02	PG Fdbk Loss Sel	Selects stopping method or alarm output when PG line break is detected.		1	Adv
	0 Ramp to Stop	Decels to stop			
	1 Coast to Stop	Immediate stop			
	2 Fast-Stop*	Decel by B5-08			
	3 Alarm Only	Displayed on keypad only			
F1-03	PG Overspeed Sel	Selects stopping method or alarm output when motor overspeed is detected.		1	Adv
	0 Ramp to Stop	Decels to stop			
	1 Coast to Stop	Immediate stop			
	2 Fast-Stop*	Decel by B5-08			
	3 Alarm Only	Displayed on keypad only			
F1-04	PG Deviation Sel	Selects stopping method when PG deviation is detected.		1	Adv
	0 Ramp to Stop	Decels to stop5			
	1 Coast to Stop	Immediate stop			
	2 Fast-Stop*	Decel by B5-08			
	3 Alarm Only	Displayed on keypad only			
F1-05	PG Rotation Sel	Selects PG rotation		0	Adv
	0 Fwd = C.C.W.				
	1 Fwd = C.W.				
F1-06	PG Output Ratio	PG division rate (pulse output)	1-132	1	Adv

NOTE: *Fast-stop is selected, the stopping time is set by B5-08 (Fault stop time)

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F1-07	PG Ramp PI/I Sel	Enable/Disable speed control (ASR) integral operation during acceleration/deceleration (see D4 sections)		0	Adv
	<i>0 Disabled</i>				
	<i>1 Enabled</i>				
F1-08	PG Overspd Level	Motor overspeed detection level.	0–120%	115	Adv
F1-09	PG Overspd Time	Motor overspeed detection level.	0–2.0 sec	0.0	Adv
F1-10	PG Deviate Level	Excessive speed deviation level.	0–50%	10	Adv
F1-11	PG Deviate Time	Excessive speed deviation time.	0–10.0 sec	0.5	Adv
F1-12	SFS Deviate	Soft starter deviation level	0-400 Hz	120.0	Adv
F1-13	PG # Gear Teeth1	Number of gear teeth—Option 1.	0–1000	0	Adv
F1-14	PG# Gear Teeth2	Number of gear teeth—Option 2.	0–1000	0	Adv
F1-15	PGO Detect Time	Open encoder circuit	0-10.0	2.0	Adv

AI-14 Set-up

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F2-01	AI-14 Input Sel	Determines whether the 3-channel input selection is individual or additional.		0	Adv
	<i>0 3ch Individual</i>				
	<i>1 3ch Additional</i>				

Sets CH1 to CH3 input functions when AI-14B option is connected

Setting	Function	CH1 (TC1 to TC4)	CH2 (TC2 to TC4)	CH3 (TC3 to TC4)
0	3-channel individual input (factory default)	Substitute for terminals 13 & 17	Substitute for terminals 14 & 17	Substitute for terminals 16 & 17
1	3-channel additional input	Sum of CH1 to CH3 input values is used as the frequency reference value		

When the 3CH individual input is used, parameter B3-01 is automatically set to “1” (frequency reference from control circuit terminal). The option/inverter reference selection, which is selected by a multi-function contact input (H1-XX= “IE”), is disabled when using the AI-14B option.

Digital Input Option Set-up

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F3-01	DI Option Setup	Selects the setting mode of the reference input from the DI-08 and DI-164 options	0-7	0	Adv
	0 BCD 1%	BCD 1% unit			
	1 BCD 0.1%	BCD 0.1% unit			
	2 BCD 0.01%	BCD 0.01% unit			
	3 BCD 1Hz	BCD 1Hz unit			
	4 BCD 0.1Hz	BCD 0.1Hz unit			
	5 BCD 0.01Hz	BCD 0.01Hz unit			
	6 BCD (5DG) 0.01Hz	Binary			
		DI-00:	255/100%		
		DI-16H, 12 bit selection:	4096/100%		
		DI-16H, 16 bit selection:	3000/100%		
	7 Binary	Set value is displayed in decimal notation			

Analog Output Option Set-up

When the 3CH individual input is used, parameter B3-01 is automatically set to “1” (frequency reference from control circuit terminal). The option/inverter reference selection, which is selected by a multi-function contact input (H1-XX=“IF”), is disabled when using the AI-14B option.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F4-01	AO Ch1 Select	Analog output option Channel 1 selection	1–35	2	Adv
	1	<i>Frequency Ref</i>			
	2	<i>Output Freq</i>			
	3	<i>Output Current</i>			
	5	<i>Motor Speed</i>			
	6	<i>Output Voltage</i>			
	7	<i>DC Bus Voltage</i>			
	8	<i>Output kWatts</i>			
	9	<i>Torque Reference</i>			
	15	<i>Term 13 Level</i>			
	16	<i>Term 14 Level</i>			
	17	<i>Term 16 Level</i>			
	18	<i>Mot SEC Current</i>			
	19	<i>Mot EXC Current</i>			
	20	<i>SFS Output</i>			
	21	<i>ASR Input</i>			
	22	<i>ASR Output</i>			
	23	<i>Speed Deviation</i>			
	24	<i>PID Feedback</i>			
	26	<i>Voltage Ref (Vq)</i>			
	27	<i>Voltage Ref (Vd)</i>			
	29	<i>Load Weight</i>			
	31	<i>Not used</i>			
	32	<i>ACR (q) Output</i>			
	33	<i>ACR (d) Output</i>			
	35	<i>Friction Torq</i>			
F4-02	AO Ch1 Gain	Analog output Channel 1 multiplier	0–2.50	1.00	Adv
F4-03	AO Ch2 Select	Analog output option Channel 2 selection (Same as F4-01)	1–35	3	Adv
F4-04	AO Ch2 Gain	Analog output Channel 2 multiplier	0–2.50	0.50	Adv

DO-02 Digital Output Set-up

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F5-01	DO-02 Ch1 Select	Determines the DO-02 digital output Channel 1 selection (Same as H2-01)	0–FF	0	Adv
F5-02	DO-02 Ch2 Select	Determines the DO-02 digital output Channel 2 selection (Same as H2-01)	0–FF	1	Adv

DO-08 Digital Output Set-up

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F6-01	DO-08 Selection	Selects Multi-Function Output Selections for the DO-08 option.		0	Adv
	0 <i>Sch Individual</i>				
	1 <i>Binary Output</i>				
	2 <i>Srl Com Output</i>				

Selects the multi-function output selections for the DO-08 option.

Setting	Terminal No.	Description
0 8-Channel individual (factory Default)	TD5/TD11	Overcurrent (SC, OC, GF)
	TD6/TD11	Overvoltage (OV)
	TD7/TD11	Inverter overload (OL2)
	TD8/TD11	Fuse blown (FU)
	TD9/TD11	Not used
	TD10/TD11	Inverter overheat (OH)
	TD1/TD2	During zero-speed detection
	TD3/TD4	During speed agree
1 binary output	TD5/TD11	
	TD6/TD11	Binary output*
	TD7/TD11	
	TD8/TD11	
	TD9/TD11	During zero-speed detection
	TD10/TD11	During speed agree
	TD1/TD2	During run
TD3/TD4	Minor fault	

* When F6-01 is set to binary output (setting = "1"), use the table on the following page to read the DO-08 output.

TD8/TD11 (bit 3)	TD7/TD11 (bit 2)	TD6/TD11 (bit 1)	TD5/TD11 (bit 0)	Description
0	0	0	0	No Fault
0	0	0	1	Overcurrent (SC, OC, GF)
0	0	1	0	Overvoltage (OV)
0	0	1	1	Inverter overload (OL2)
0	1	0	0	Inverter overheat (OH)
0	1	0	1	Overspeed (OS)
0	1	1	0	Fuse blown (FU)
0	1	1	1	Not used
1	0	0	0	External fault (EF3~EF8)
1	0	0	1	Controller fault
1	0	1	0	Motor overload (OL1)
1	0	1	1	Not used
1	1	0	0	Power loss (UV1, UV2, UV3)
1	1	0	1	Excessive speed deviation (DEV)
1	1	1	0	PG disconnection (PGO)
1	1	1	1	Not used

PO-36F Set-up

Parmtr Code	Display	Function	Range	Initial Value	Access Level
F7-01	PO-36F Selection	Sets the number of pulse signals to be output from the PO-36F option		1	Adv
	0	1 X Output Freq			
	1	6 X Output Freq			
	2	10 X Output Freq			
	3	12 X Output Freq			
	4	36 X Output Freq			

Terminal Parameters

- H1 Digital Inputs
- H2 Digital Outputs
- H3 Analog Inputs
- H4 Analog Outputs
- H5 Serial Communication Set-up

Digital Inputs

The IMPULSE•VG+ Series 2 has six multi-function contact inputs for the set-up of numerous functions. The following table lists the function selections for the multi-function contact inputs (terminals 3 to 8) and indicates the control modes during which each function can be enabled. An OPEO3 error will occur if a function is programmed in more than one terminal at the same time.

Parmtr Code	Display	Function	Ref Page Number	Range	Initial Value	Access Level
H1-01	Terminal 3 Sel <i>(parameter)</i>	Selects the multi-function inputs.			0	Adv
H1-02	Terminal 4 Sel <i>(parameter)</i>	Same as H1-01		0-45	1	Adv
H1-03	Terminal 5 Sel <i>(parameter)</i>	Same as H1-01		0-45	7	Adv
H1-04	Terminal 6 Sel <i>(parameter)</i>	Same as H1-01		0-45	9	Adv
H1-05	Terminal 7 Sel <i>(parameter)</i>	Same as H1-01		0-45	24	Adv
H1-06	Terminal 8 Sel <i>(parameter)</i>	Same as H1-01		0-45	E	Adv
	<i>0 Multi-Step Ref 2</i>	<i>Multi-Step Speed 2.</i>	<i>5-3</i>			
	<i>1 Multi-Step Ref 3</i>	<i>Multi-Step Speed 3.</i>	<i>5-3</i>			
	<i>2 Multi-Step Ref 4</i>	<i>Multi-Step Speed 4.</i>	<i>5-3</i>			
	<i>3 Multi-Step Ref 5</i>	<i>Multi-Step Speed 5.</i>	<i>5-3</i>			
	<i>4 Speed Hold 2</i>	<i>Hold function (2nd step of Three-Step Infinitely Variable).</i>	<i>4-10</i>			
	<i>5 Accel Command</i>	<i>Acceleration function (2nd step of Two-Step Infinitely Variable or 3rd step of Three-Step Infinitely Variable).</i>	<i>4-10</i>			

6	Upper Lmt 1 N/O	Upper Limit–SLOW DOWN; Normally Open	5-24
7	Upper Lmt 2 N/O	Upper Limit–STOP; Normally Open	5-24
8	Lower Lmt 1 N/O	Lower Limit–SLOW DOWN; Normally Open	5-24
9	Lower Lmt 2 N/O	Lower Limit–STOP; Normally Open	5-24
A	Upper Lmt 2 N/C	Upper Limit–SLOW DOWN; Normally Closed	5-24
B	Upper Lmt 2 N/C	Upper Limit–STOP; Normally Closed	5-24
C	Lower Lmt 1 N/C	Lower Limit–SLOW DOWN; Normally Closed	5-24
D	Lower Limit 2 N/C	Lower Limit–STOP; Normally Closed	5-24
E	M-Speed Gain 1	Micro-Positioning Control Multiplier 1	5-23
F	Not used	No function	n/a
10	M-Speed Gain 2	Micro-Positioning Control Multiplier 2	5-23
13	Ultra/Swift Lift	Ultra-Lift enable	5-29
14	Torque Lmt Acc/Dec	Torque Limit Acceleration/ Deceleration	5-17
15	Alt T-Lim Gain	Alternate Torque Limit Multiplier	5-31
16	Forward Jog	Jog Control FORWARD command	5-3
17	Reverse Jog	Jog Control REVERSE command	5-3
18	Forward Inch	Inch Control	n/a
19	Reverse Inch	Inch Control	n/a
1A	Inch Repeat	Inch Control	n/a
1B	Multi-Acc/Dec 1	Acceleration and Deceleration Changeover Time	5-15
1C	Reference SW	Analog/Digital Reference Changeover. B1-10=1. Open=Analog Closed=Digital	5-13
1D	Term 13/16 Switch	Terminal 13/16 Switch	5-81
1E	Option/Inv Sel	Option/Inverter Speed Reference Changeover (Option Speed Reference at closed)	n/a
1F	Program Lockout	Program Lockout	n/a
24	External Fault	See “External Fault response selection”	5-80
30	Term 13/14 Switch	Terminal 13/14 Switch	5-81
31	Fault Reset N/O	Fault Reset; Normally Open	n/a
32	Fault Reset N/C	Fault Reset; Normally Closed	n/a
34	Trim Ctl Increase	Trim Control Increase	5-13
35	Trim Ctl Decrease	Trim Control Decrease	5-13

36	<i>Brake Ans Back</i>	<i>Brake Answer-Back</i>	5-33
37	<i>Ext BaseBlk N/O</i>	<i>Immediate Stop at STOP Command; Normally Open</i>	n/a
38	<i>Ext BaseBlk N/C</i>	<i>Immediate Stop at STOP Command; Normally Closed</i>	n/a
3D	<i>Motor Select</i>	<i>Motor 2 enabled</i>	5-64
41	<i>DCInj Activate</i>	<i>DC Injection Brake</i>	n/a
43	<i>Alt S-Ref UpLmt</i>	<i>Alternate Upper Limit Frequency Reference</i>	5-4
45	<i>Serial/Inv Swtch</i>	<i>Serial/Inverter Run and Speed Reference Changeover</i>	n/a

Digital Outputs

The IMPULSE•VG+ Series 2 has three multi-function control outputs for indicating various conditions. The following table lists the function selections for the multi-function contact output (terminals 9, 25, and 26), and indicates the control modes during which each function can be enabled. Note that Terminals 25 and 26 are Terminals 1 and 2 respectively on G5OUT option card.

3

Parmtr Code	Display	Function	Reference		Initial Value	Access Level
			Page Number	Range		
H2-01	Terminal 9 Sel	Assigns one of the following 48 multi-function digital output parameters to Terminal 9, 25, or 26.	---	0-40	0	Adv
H2-02	Terminal 25 Sel	Terminal 1 on the G5OUT Option Card	---	0-40	0	Adv
H2-03	Terminal 26 Sel	Terminal 2 on the G5OUT Option Card	---	0-40	7F	Adv
	0 Brake Output	Closed when voltage or frequency is output	n/a			
	1 Zero Speed	Closed when below B2-02 or D1-01	5-48			
	2 Fref/Fout Agree 1	Output when Frequency Reference and Frequency Output agree	5-87			
	3 Fref/Set Agree 1	Output when Ouptut Frequency Reference equals L4-01.	5-87			
	4 Freq Detect 1	Closed when output frequency is < L4-01.	5-87			
	5 Freq Detect 2	Closed when output frequency is > L4-01.	5-87			
	6 Inverter Ready	Closed when an inverter is not in a fault state	n/a			
	7 DC Bus Undervolt	Closed when DC Bus voltage drops below UV trip point.	n/a			
	8 BaseBlk 1	Closed when the inverter is not outputting voltage.	n/a			
	9 Option Reference	Closed when the frequency reference is input from the digital operator.	5-97			
	A Remote Operation	Closed when the RUN command is input from the digital operator.	5-97			
	B Trq Det 1 N.O.	Output when torque > L6-02	5-89			
	C Loss of Ref	Closed when inverter has detected a loss of frequency reference	5-88			
	D DB Overheat	Closed when inverter displays "RH" or "RR" fault.	n/a			
	E Fault	Closed during a major fault.	6-3			
	F Not Used	No function				
	10 Minor Fault	Closed during minor fault or alarm.	6-3			

Parmtr Code	Display	Function	Reference		Initial Value	Access Level
			Page Number	Range		
11	Reset Cmd Active	Closed when a reset command is present on the terminals	n/a			
13	Fref/Fout Agree 2	Closed when output frequency = frequency reference	5-87			
14	Fref/Set Agree 2	Closed when output frequency = L4-03	5-87			
15	Freq Detect 3	Closed when output frequency is \leq L4-03	5-88			
16	Freq Detect 4	Closed when output frequency \geq L4-03	5-88			
17	Trq Det 1 N.C.	Open when torque > L6-02	5-89			
18	Trq Det 2 N.O.	Closed when torque > L6-05	5-89			
19	Trq Det 2 N.C.	Open when torque > L6-05	5-89			
1A	Forward Dir	Closed at FWD/UP command	n/a			
1B	Reverse Dir	Closed at REV/DOWN command	n/a			
1C	Speed Increasing	Closed when speed is increasing	n/a			
1D	BaseBlk 2 (N.C.)	Open when inverter is not outputting voltage.	n/a			
1E	Motor A/B Change	Closed when motor changeover is input to terminals	n/a			
20	Auto-Rst Enabled	Auto-Reset Enabled	5-93			
21	Overload (OLI)	OLI Overload fault code	n/a			
22	OH Prealarm	Closed when "OH" is displayed on keypad	n/a			
30	Current Trq LIM	Current Torque Limit	n/a			
34	During RUN 2	During Run 2 - ON: Frequency output, OFF: Base block, DC injection braking, initial excitation	n/a			
35	Load Check Fault	Load Check fault output	5-27			
36	Slack Cable Det	Slack Cable Detection output	5-46			
37	Upper Lmt input	Closed when Upper Limit-SLOW DOWN or Upper Limit STOP is input	5-24			
38	Lower Lmt input	Closed when Lower Limit-SLOW DOWN or Lower Limit STOP is input	5-24			
39	Up/Low Lmt input	Closed when Upper Limit-SLOW DOWN or Upper Limit STOP or Lower Limit-SLOW DOWN or Lower Limit STOP is input	5-24			
3B	During RUN 1	Output for RUN 1	n/a			
40	Fault Annunciate	Closed on specified faults.	5-78			

Digital Outputs—Fault Annunciate (H2-01~03=40)

Digital Outputs—Fault Annunciate enables you to assign a set of six fault outputs to Terminals 1 and/or Terminal 2 on the G5out cord. In addition, you can select whether each fault output is enabled.

NOTE: Terminal 9 can also be used for Digital Outputs—Fault Annunciate; however, it is normally assigned to a brake output.

Before you start to program this feature, you may find it convenient to first photocopy the “Binary-to-Hexadecimal Conversion Worksheet” in this section. By being able to write in the worksheet’s boxes, you will find it easier to program the feature.

Programming **Digital Outputs—Fault Annunciate** requires that you determine two 4-digit binary numbers and then convert these numbers to two 1-digit hexadecimal numbers. You enter the hexadecimal numbers when you program the drive.

To program **Digital Outputs—Fault Annunciate** (assuming you are in **Programming Mode**):

1. Press the **UP** button until

Group H
Terminal

 appears.
2. Press the **DATA/ENTER** button.

Function H1
Digital Inputs

 appears.
3. Press the **UP** button.

Function H2
Digital Outputs

 appears.
4. Determine the output terminal to which you want **Fault Annunciate** assigned; Terminal 9, 25, or 26.
5. Press the **DATA/ENTER** button.

Terminal 9 Sel
XXXXXXXXXX

 appears. If you want Terminal 25 or 26, press the **UP** button until it appears. Assume you are using Terminal 9.
6. Press the **DATA/ENTER** button.

H2-01=X***
XXXXXXXXXX

 appears.
7. Press the **UP** or **DOWN** button until

H2-01=40
Fault Annunciate

 appears.
8. Press the **DATA/ENTER** button.

Fault Data Input
00

 appears.

9. From the following worksheet, select one of three fault output sets. (Each row is a set.)

Enter the one-zero combination that corresponds to the set (row) that you selected.

For example, if you selected Set 2, you would enter “1 0” in the first two columns from the left, which would represent the first two digits of the first binary number that you would convert later.

Table 5.1: Binary-to-Hexadecimal Conversion Worksheet

	First digit from the left				Second digit from the left			
	<input type="checkbox"/> 1 or 0	<input type="checkbox"/> 1 or 0	<input type="checkbox"/> 1 or 0	<input type="checkbox"/> 1 or 0	<input type="checkbox"/> 1 or 0	<input type="checkbox"/> 1 or 0	<input type="checkbox"/> 1 or 0	<input type="checkbox"/> 1 or 0
Set 1	1	1	BE7	BE5	BE4	BE0	OL2	OL1
Set 2	1	0	OS	DEV	LL1	LL2	UL1	UL2
Set 3	0	1	BE6	BE5	BE4	BE3	BE2	BE1

10. Determine which fault outputs should be enabled. To enable a fault output, enter 1 in the box above the fault output; otherwise, enter 0. Do this for each fault output in the set.

For example, if Set 2 is selected and LL1 and UL1=1, “1 0 0 0” and “1 0 1 0 “ would be the two 4-digit binary numbers.

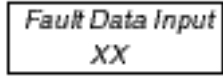
11. Using the conversion table below, determine the 1-digit hexadecimal number for both 4-digit binary numbers.

Table 5.2

Binary Number	Hexadecimal Number
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Continuing with the example, “1 0 0 0” and “1 0 1 0 “ converts to “8A.”

12. Press the **UP** or **DOWN** button until the appropriate hexadecimal number appears for XX on



External Fault Response Selection

It is sometimes desirable to have at least one external fault input to the drive. To properly program a multi-function input (H1-01 to H1-06) for this purpose an external fault response must be selected. The table below shows the possible selections for an external fault response.

Table 5.3

External Fault Selection								MFI Setting Result
Input Level Selection		Detection Method		External Fault Action				
N.O.	N.C.	Always	During Run	Ramp to Stop	Coast to Stop	Fast-stop*	Alarm Only	
√		√		√				20
√		√			√			24
√		√				√		28
√		√					√	2C
√			√	√				22
√			√		√			26
√			√			√		2A
√			√				√	2E
	√	√		√				21
	√	√			√			25
	√	√				√		29
	√	√					√	2D
	√		√	√				23
	√		√		√			27
	√		√			√		2B
	√		√				√	2F

* Uses B5-08 timer

NOTE: (1) *N.O.* = normally open contact; *N.C.* = normally closed contact
 (2) Setting 24 is the factory default

Analog Inputs

The IMPULSE•VG+ Series 2 has three analog inputs (two multi-function and one reference) for the external input of numerous references and limits.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
H3-01	Term 13 Signal <i>0 OVDC to 10VDC</i> <i>1 -10VDC to +10VDC</i>	Voltage for Terminal 13 analog input signal	0-1	0	Adv
H3-02	Terminal 13 Gain	Gain multiplier for Terminal 13 analog input signal	0.0-1000.0%	100	
H3-03	Terminal 13 Bias	Bias multiplier for Terminal 13 analog input signal	-100.0–100.0%	0	
H3-04	Term 16 Signal <i>0 OVDC to 10VDC</i> <i>1 -10VDC to +10VDC</i>	Voltage for Terminal 13 analog input signal	6-1	0	
H3-05	Terminal 16 Sel <i>0 Aux Reference</i> <i>1 Frequency Gain</i> <i>2 Frequency Bias</i> <i>4 Voltage Bias</i> <i>5 Acc/Dec Change</i> <i>6 DC Brake Current</i> <i>7 Overtorque Level</i> <i>8 Stall Prev Level</i> <i>9 Ref Lower Limit</i> <i>A Jump Frequency</i> <i>B PID Feedback</i> <i>16 Term 16 SW Ref</i> <i>1F Not Used</i>	Assigns one of the following function analog input parameters to Terminal 16 <i>Auxiliary Reference</i> <i>Frequency Gain</i> <i>Frequency Reference Bias</i> <i>Voltage Bias</i> <i>Acceleration/Deceleration Changeover</i> <i>DC injection braking current</i> <i>Overtorque Detection Level</i> <i>Speed Reference Lower Limit</i> <i>Jump Frequency</i> <i>Proportional, Integral, and Derivative (PID) Control Feedback</i> <i>Switching Level Reference for Terminal 16</i> <i>Do not use</i>		0	Adv
H3-06	Terminal 16 Gain	Gain multiplier for Terminal 16 analog input signal	0000.0–1000.0%	100.0	Adv
H3-07	Terminal 16 Bias	Bias multiplier for Terminal 16 analog input signal	-100.0–100.0%	0.0	Adv
H3-08	Term 14 Signal <i>0 0 to +10VDC</i> <i>1 -10 to +10VDC</i> <i>2 4 to 20mA</i>	Terminal 14 Signal Level Selection		2	Adv

Parmtr Code	Display	Function	Range	Initial Value	Access Level
H3-09	Terminal 14 Sel	Assigns one of the following function analog input parameters to Terminal 14.		1F	Adv
	1 <i>Frequency Gain</i>				
	2 <i>Frequency Bias</i>				
	4 <i>Voltage Bias</i>				
	5 <i>Acc/Dec Change</i>				
	6 <i>DC Brake Current</i>				
	7 <i>Overtorque Level</i>				
	8 <i>Stall Prev Level</i>				
	9 <i>Ref Lower Limit</i>				
	A <i>Jump Frequency</i>				
	B <i>PID Feedback</i>				
	1F <i>Not Used</i>				
H3-10	Terminal 14 Gain		0000.0–1000.0%	100.0	Adv
H3-11	Terminal 14 Bias		-100.0–100.0%	0.0	Adv
H3-12	Filter Avg Time	Filter average time	0.00–2.00sec	0.00	Adv

Analog Outputs

The IMPULSE•VG+ Series 2 has two analog outputs for the external monitoring of drive conditions.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
H4-01	Terminal 21 Sel	Assigns one of the following function analog output parameters to Terminal 21		2	Adv
	1 <i>Frequency Ref</i>				
	2 <i>Output Freq</i>				
	3 <i>Output Current</i>				
	6 <i>Output Voltage</i>				
	7 <i>DC Bus Voltage</i>				
	8 <i>Output kWatts</i>				
	15 <i>Term 13 Level</i>				
	16 <i>Term 14 Level</i>				
	17 <i>Term 16 Level</i>				
	18 <i>Mot SEC Current</i>				
	20 <i>SFS Output</i>				
	24 <i>PID Feedback</i>				
	31 <i>Not Used</i>				
H4-02	Terminal 21 Gain		0.00–2.50	1.00	Adv
H4-03	Terminal 21 Bias		-10.0–10.0	0.0	Adv

Parmtr Code	Display	Function	Range	Initial Value	Access Level
H4-04	Terminal 23 Sel	Sames as H4-01 except assigned to Terminal 23		3	Adv
H4-05	Terminal 23 Gain		0.00–2.50	1.00	Adv
H4-06	Terminal 23 Bias		-10.0–10.0%	0.0	Adv
H4-07	AO Level Select			0	Adv
	0 0 to +10VDC				
	1 -10 to +10VDC				

Serial Communication Set-up

The IMPULSE•VG+ Series 2 uses communication port 6CN to communicate via MODBUS protocol.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
H5-01	Serial Com Adr	Serial communication address	0–20	1F	Adv
H5-02	Serial Baud Rate			3	Adv
	0 1200 Baud				
	1 2400 Baud				
	2 4800 Baud				
	3 9600 Baud				
H5-03	Serial Com Sel	Determines stopping method or fault at a serial fault occurrence	0–2	0	Adv
	0 No parity				
	1 Even parity				
	2 Odd parity				
H5-04	Serial Fault Set	Determines stopping method or fault at a serial fault occurrence		1	Adv
	0 Ramp to Stop				
	1 Coast to Stop				
	2 Fast-Stop				
	3 Alarm Only				
H5-05	Serial Flt Dtct	Determines whether Serial Fault Detection is enabled		1	Adv
	0 Disabled				
	1 Enabled				

NOTE: After changing any H5 parameter, power to the inverter must be cycled.

NOTE: After initial communication, if the inverter is not communicated with for 2 seconds, a communication fault will occur (CE Memobus ERR).

Protection Parameters

- L1 Motor Overload
- L3 Stall Prevention
- L4 Ref Detection
- L6 Torque Detection
- L8 Hardware Protection
- L9 Automatic Reset

Motor Overload

The IMPULSE•VG+ Series 2 protects against motor overload with a UL-recognized, built-in electronic thermal overload function.

The electronic thermal overload function estimates motor temperature, based on inverter output current, frequency and time to protect the motor from overheating. When the thermal overload fault is activated, an “OL1” trip occurs, shutting OFF the inverter output and preventing excessive overheating in the motor. As long as the inverter is powered up, it continues to calculate the motor temperature.

When operating with one inverter connected to one motor, an external thermal relay is not needed. When operating several motors with one inverter, install a thermal relay on each motor. In this case, set parameter *L1-01* to “0.”

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L1-01	MOL Fault Select	Enable/disable motor overload detection.		1	Adv
	<i>0 Disabled</i>				
	<i>1 Coast to Stop</i>	(Immediate stop)			
L1-02	MOL Time Const	Time for OL1 fault when motor current is $\geq 150\%$ of the motor rated current.	0.1–5.0 min	1.0	Adv

Stall Prevention

This function automatically adjusts the output frequency, acceleration and/or deceleration rates in order to continue operation without tripping or “stalling” the inverter.



CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L3-04	StallP Decel Sel	Enable/Disable stall prevention during deceleration		0	Adv
	0 <i>Disabled</i>	See table below			
	1 <i>General Purpose</i>	See table below			

If deceleration times are set too short for load conditions, the inverter automatically extends the deceleration time according to the main circuit DC bus voltage level. When using an optional braking resistor for the IMPULSE•VG+ Series 2, set parameter *L3-04* to “0.” See the figure on next page.

Setting	Description
0 (Disabled)	Stall prevention during deceleration is disabled (factory default). An excessively short deceleration time will generate an overvoltage fault (OV), and the inverter will stop.
1 (General Purpose)	Stall prevention during deceleration is enabled. The DC bus voltage level is monitored, and the deceleration rate is automatically extended to prevent an overvoltage condition. This deceleration rate may be longer than the set value (B5-02).

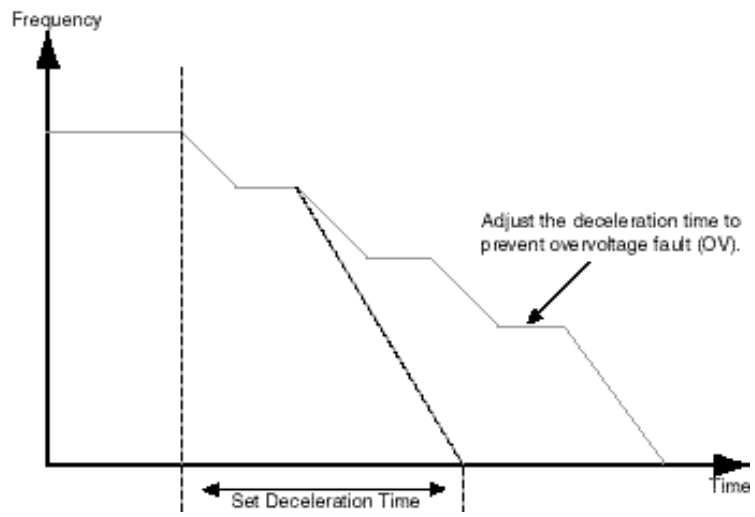


Figure 5-43: Stall Prevention During Deceleration

Reference Detection

The IMPULSE•VG+ Series 2 utilizes three different functions for detecting output frequency:

- When frequency agree is enabled using the multi-function contact outputs (H2-XX="2" or "13"), the contact closes whenever the output frequency "agrees" with the frequency reference, plus or minus the speed agree detection width.
- When desired frequency agree is enabled using the multi-function contact outputs (H2-XX="3" or "14"), the contact closes whenever the output frequency "agrees" with the speed agree detection level, plus or minus the speed agree detection width.
- When frequency detection is enabled using the multi-function contact outputs (H2-XX="4", "5", "15" or "16"), the contact closes whenever the output frequency is less than or more than the speed agree detection level, depending on which detection is selected.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L4-01	Spd Agree Level	Speed Agree Level	0.0–400.0 Hz	0.0	Adv

Sets the detection level for the desired frequency agree 1 and frequency detection 1 and 2 functions. The set detection level is effective during both FWD and REV operation.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L4-02	Spd Agree Width	Speed Agree Width	0.0–20.0 Hz	2.0	Adv

Sets the detection width for frequency and desired frequency agree 1 and frequency detection 1 and 2 functions.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L4-03	Speed Agree Lvl ±	Speed Agree Level ±	-400.0–400.0 Hz	0.0	Adv

Sets the detection level for the desired frequency agree 2 and frequency detection 3 and 4 functions. The set detection level is effective during either FWD or REV operation, depending on the set detection level (positive value for FWD operation, negative value for REV operation).

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L4-04	Speed Agree Width ±	Speed Agree Width ±	0.0–20.0 Hz	2.0	Adv

Sets the detection width for frequency and desired frequency agree 2 and frequency detection 3 and 4 functions.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L4-05	Ref Loss Sel	Selects operation when the frequency reference when the control terminal is reduced by 90% within 400ms		0	Adv
	<i>0 Stop</i>				
	<i>1 Run @ 80% Prev Ref</i>				

Torque Detection

The overtorque detection circuit activates when the motor load causes the motor current to exceed the overtorque detection level (L6-02). When an overtorque condition is detected, alarm signals can be sent to the multi-function output terminals 9, 25 and 26. To output an overtorque detection signal, select torque detection 1 at either of the multi-function contact outputs (H2-XX="B" or "17"). Refer to the H2 section Digital Output on page 5-76 for more details.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L6-01	Torque Det 1 Sel	Activates overtorque detection and selects whether detection generates an alarm or a fault		0	Adv
	0	Disable	(See Table 5.4 for details)		
	1	At Speed Agree-Alarm			
	2	At Run-Alarm			
	3	At Speed Agree-Fault			
	4	At Run-Fault			

Table 5.4

Setting	Description
0	Overtorque detection is disabled (<i>factory default</i>).
1	Overtorque detection is enabled whenever at the speed agree level (when inverter is not accelerating or decelerating). Continue running after detection (OL3 alarm).
2	Overtorque detection is enabled always. Continue running after detection (OL3 alarm).
3	Overtorque detection is enabled whenever at the speed at the speed agree level. Coast to a stop after detection (OL3 fault).
4	Overtorque detection is enabled always. Coast to a stop after detection (OL3 fault).

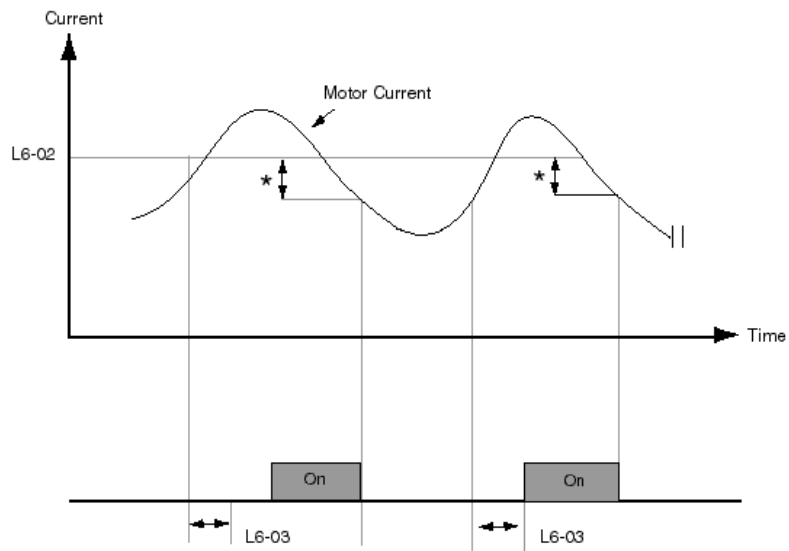
NOTE: To detect torque during acceleration or deceleration, set to "2" or "4."

NOTE: To continue operation after overtorque detection, set to "1" or "2." During detection, the digital operator displays an "OL3" alarm (blinking).

NOTE: To stop the inverter after an overtorque detection fault, set to "3" or "4". During detection, the digital operator displays an "OL3" fault.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L6-02	Torq Det 1 Lvl	Sets the overtorque detection as a percentage of inverter rated current, during V/f control, and motor rated torque during vector control.	0–300%	150%	Adv
L6-03	Torq Det 1 Time	The overtorque detection delay time inserts a delay, between the time motor current (or torque) exceeds the overtorque level (L6-02) and when the overtorque detection function is enabled. The digital operator then displays “OL3”.	0.0–10.0 sec	0.1 sec	Adv

Overtorque detection 2 functions the same as overtorque detection 1 (L6-01), except that “OL4” is displayed on the digital operator instead. This function is used when two types of detection are output to the multi-function output terminals.



Multi-function Contact Output Signal (Overtorque Detection Signal) Terminal 9, 25, 26

* Release width (hysteresis) during overtorque detection is 5% of the inverter rated current level.

Figure 5-44: Overtorque Characteristics Timing Diagram

Parmtr code	Display	Function	Range	Initial Value	Access Level
L6-04	Torq Det 2 Sel	Activates overtorque detection, and selects whether detection generates an alarm or a fault.		0	Adv
	0 <i>Disable</i>	(See Table 5.4 for details)			
	1 <i>At Speed Agree-Alarm</i>				
	2 <i>At Run-Alarm</i>				
	3 <i>At Speed Agree-Fault</i>				
	4 <i>At Run-Fault</i>				

Setting	Description
0	Overtorque detection is disabled (<i>factory default</i>).
1	Overtorque detection is enabled whenever at the speed agree level (when inverter is not accelerating or decelerating). Continue running after detection (OL4 alarm).
2	Overtorque detection is enabled always. Continue running after detection (OL4 alarm).
3	Overtorque detection is enabled whenever at the speed agree level. Coast to a stop after detection (OL4 fault).
4	Overtorque detection is enabled always. Coast to a stop after detection (OL4 fault).

Overtorque detection 2 functions the same as overtorque detection 1 (*L6-01*), except that “OL4” is displayed on the digital operator instead. This function is used when two types of detection are output to the multi-function output terminals.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L6-05	Torq Det 2 Lvl	Torque Detection 2 Level	0–300%	150%	Adv
L6-06	Torq Det 2 Time	Torque Detection 2 Time	0.0–10.0 sec	0.1 sec	Adv

Hardware Protection

The IMPULSE•VG+ Series 2 comes equipped with a number of built-in functions designed to protect the inverter and its components from damage.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
L8-02	OH Pre-Alarm Lvl	Sets the heatsink temperature level for protection against overheating (OH). Note: The inverter measures heatsink temperature by a negative temperature coefficient thermister.	50–110°C	95°C	Adv
L8-03	OH Pre-Alarm Sel	Selects the stopping method when heatsink overheat is detected.		3	Adv
	0 Ramp to Stop	(Decel to stop using B5-02)			
	1 Coast to Stop	(Immediate stop)			
	2 Fast-Stop	(Decel to stop using B5-08)			
	3 Alarm Only	(Operation continues and "OH Heatsink Overtemp" is displayed on keypad)			
L8-10	Ground Fault Detect	Enables/disables ground fault detection		1	Adv
	0 Disabled				
	1 Enabled				
L8-14	UV3 Detect	Enables/disables UV3 detection (MC-Answer Back)		0	Adv
	0 Disabled				
	1 Enabled				

Automatic Reset

When a fault occurs (listed in Table 1.1) during operation, the IMPULSE•VG+ Series 2 can be programmed for an auto restart operation to automatically reset the fault.

Parmtr Code	Display	Function	Range	Initial Value	Level Access
L9-01	Reset Select	Activates the fault auto-reset function.		1	Adv
	0 Disabled				
	1 Enabled				
L9-02	Reset Attempts	Sets the number of reset attempts. Reset attempt counter is returned to zero if no faults occur within a ten minute period.	0–10	3	Adv
L9-03	Reset Time	Sets the reset starting time	0.0–10.0 sec	0.5	Adv
L9-04*	Reset Flt Sel 1	Reset Fault Select 1.	0000–FFFF	0001	Adv
L9-05*	Reset Flt Sel 2	Reset Fault Select 2.	0000–FFFF	0080	Adv

* To program constant L9-04 and L9-05, refer to the example on the following page and follow steps 1 through 4:

1. Sign 1 to each fault code that you wish to enable the auto reset.
2. Sign 0 to each fault code that you wish to disable the auto reset.
3. Convert all Digits (1 to 4) from binary to hex.
4. Program L9-04 and L9-05 by entering the hex number obtained from step 3.

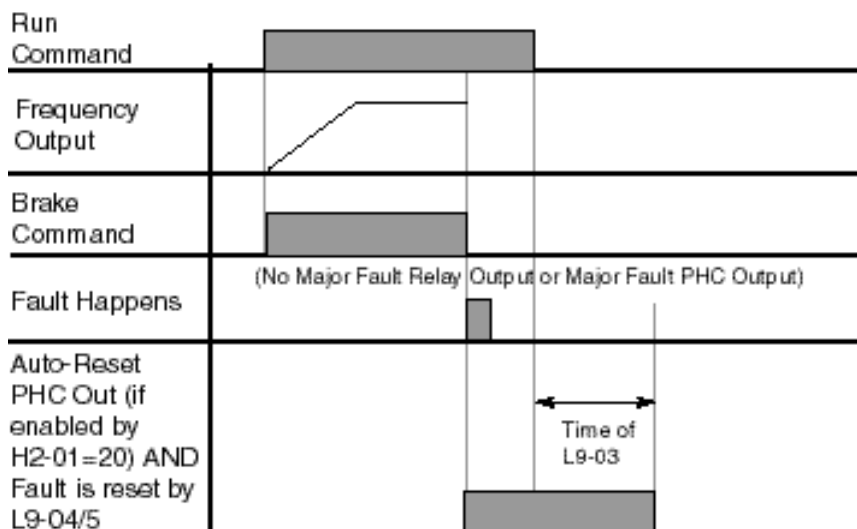


Figure 5-45

Example:

Enable auto-reset for UV1, OS and CE faults.

Table 5.5

	Digit 4	Digit 3	Digit 2	Digit 1
HEX	2	0	0	1
Binary	0 0 1 0	0 0 0 0	0 0 0 0	0 0 0 1
L9-04	D P O R E G S H V O	L P O O F F L L 2 1	O S O G H C V F	O U U U C V V V 3 2 1
HEX	0	0	8	0
Binary	0 0 0 0	0 0 0 0	1 0 0 0	0 0 0 0
L9-05	- - - -	- - - S V E	C C E E E A F F L 8 7 L	E E E E F F F F 6 5 4 3

Table 5.6

L9-04	Binary	HEX
Digit 4	0010	2
Digit 3	0000	0
Digit 2	0000	0
Digit 1	0001	1

Table 5.7

Binary Number	Hexadecimal Number
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Operator Parameters

- O1 Monitor Selection
- O2 Keypad Key Selection
- O3 Clear History

Monitor Selection

The top level in the operation mode allows the viewing of four monitor variables. They are Fref, Fout, Iout, and User-Selected monitor. This user-selected monitor can be selected from the following table. See Monitor Parameters table on page 5-101 for available monitors by control method.

Parmtr Code	Display	Function	Range	Initial Value	Access Level
O1-01	User Monitor Sel	Assigns one of the following monitor parameter as user-selected monitor.	4N35	6	Adv
	4 <i>Control Method</i>				
	5 <i>Motor Speed</i>				
	6 <i>Output Voltage</i>				
	7 <i>DC Bus Voltage</i>				
	8 <i>Output kWatts</i>				
	9 <i>Torque Reference</i>				
	10 <i>Input Term Sts</i>				
	11 <i>Output Term Sts</i>				
	12 <i>Int Ctl Sts 1</i>				
	13 <i>Elapsed Time</i>				
	14 <i>FLASH ID</i>				
	15 <i>Term 13 Level</i>				
	16 <i>Term 14 Level</i>				
	17 <i>Term 16 Level</i>				
	18 <i>Mot SEC Current</i>				
	19 <i>Mot EXC Current</i>				
	20 <i>SFS Output</i>				
	21 <i>ASR Input</i>				
	22 <i>ASR Output</i>				
	23 <i>Speed Deviation</i>				
	24 <i>PID Feedback</i>				
	25 <i>DI-16 Reference</i>				
	26 <i>Voltage Ref (Vq)</i>				
	27 <i>Voltage Ref (Vd)</i>				
	28 <i>CPU ID</i>				
	29 <i>Load Weight</i>				
	32 <i>ACR(q) Output</i>				

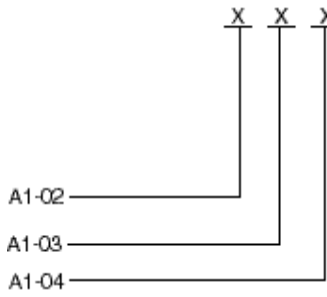
Parmtr Code	Display	Function	Range	Initial Value	Access Level
	33	ACR(d) Output			
	34	OPE Detected			
	35	Friction Torque			
01-02	Power-On Monitor	Selects the monitor to be displayed on the digital operator immediately after the power supply is turned on.		2	Adv
	1	Frequency Ref	(U1-01)		
	2	Output Freq	(U1-02)		
	3	Output Current	(U1-03)		
	4	User Monitor	(01-01)		
01-03	Display Scaling	Units for parameters and monitor related to frequency reference and output frequency can be scaled as shown below.	0-39999	0	Adv

Table 5.8

Setting (O1-03)	Description
00000	Unit: 0.01Hz (factory default)
00001	Unit: 0.01%
00002 to 00039	Unit rpm (0 to 3999) setting = number of motor poles
00040 to 39999 (user-selected units)	<p>Digits: $\frac{5th}{0}$ $\frac{4th}{0}$ $\frac{3rd}{0}$ $\frac{2nd}{0}$ $\frac{1st}{0}$</p> <p>The first thru fourth digits determine the set value at 100% output frequency. Decimal point position is set by the fifth digit as follows:</p> <p>5th digit = 0: displayed as 0000 5th digit = 1: displayed as 000.0 5th digit = 2: displayed as 00.00 5th digit = 3: displayed as 0.000</p> <p>Example 1 If 100% output frequency is equal to 200.0 units: Set O1-03="12000"; 100% of this reference is displayed as 200.0 and 60% of this reference is displayed as 120.0.</p> <p>Example 2 If 100% output frequency is equal to 65.00: Set O1-03="26500"; 60% of this reference is displayed as 39.00.</p>

Parmtr Code	Display	Function	Range	Initial Value	Access Level
01-04	Display Units <i>0) Hertz</i> <i>1) RPM</i>	Display units for motor speed		0	Adv
01-05	Address Display <i>0 Parameter Number</i> <i>1 MEMOBUS Address</i>	Selects how the parameter addresses are displayed on the digital operator.		0	Adv

Keypad Key Selection

Parmtr Code	Display	Function	Range	Initial Value	Access Level
02-01	Mode/Service <i>0 Mode/Service</i>	1. Pressing the mode key once will Enable/disable the digital operator MODE/SERVICE key (see diagram below)		0	Adv
					
	<i>1 Remote Local</i>	2. Pressing the key again Displays the "Call ESI Service" 800-288-8178. Local/remote key is enabled depressing the local/removed key switches operation command between the digital operator and the settings of B3-01 and B3-02.			
02-02	Oper Stop Key <i>0 BB, Brake Set</i> <i>1 Decel tim1 Stop</i> <i>2 Decel tim2 Stop</i> <i>3 Decel Fault Stop</i>	Selects the action when the digital stop key is pressed. (Immediate stop) (B5-02) (B5-04) (B5-08)		0	Adv

O2-03	User Defaults		0	Adv
	0	No Change		
	1	Set Defaults		Memorizes up to 50 modified parameters. User defaults can be restored by setting A1 - 05= "1110".
	2	Clear all		Clear user defaults
O2-04	KVA Selection	Determines the model number of the drive, which is based on the kVA rating. The following in this column are Electromotive Systems model numbers.	00-FF	Adv
	0	20P4		Not used.
	1	20P7		2006-FVG+
	2	21P5		2008-FVG+
	3	22P2		2011-FVG+
	4	23P7		2017-FVG+
	5	25P5		2025-FVG+
	6	27P5		2033-FVG+
	7	2011		2054-FVG+
	8	2015		2068-FVG+
	9	2018		2080-FVG+
	A	2022		Not used
	B	2030		2130-FVG+
	C	2037		2160-FVG+
	D	2045		Not used
	E	2055		2224-FVG+
	F)	2075		2300-FVG+
	20	40P4		4001-FVG+
	21	40P7		4003-FVG+
	22	41P5		4005-FVG+
	23	42P2		Not used
	24	43P7		4008-FVG+
	25	44P0		4011-FVG+
	26	45P5		4014-FVG+
	27	47P5		4021-FVG+
	28	4011		4028-FVG+
	29	4015		4034-FVG+
	2A	4018		4041-FVG+
	2B	4022		4052-FVG+
	2C	4030		4065-FVG+
	2D	4037		4080-FVG+
	2E	4045		4096-FVG+
	2F	4055		4128-FVG+
	30	4075		4165-FVG+
	31)	4090		Not Used
	32	4110		4224-FVG+

33)	4132	Not Used		
34	4160	4302-FVG+		
35	4185	Not used		
36	4220	4450-FVG+		
37	4300	4605-FVG+		
42	51P5	5003-FVG+		
43	52P2	5004-FVG+		
44	53P7	5006-FVG+		
45	55P5	5009-FVG+		
46	57P5	5012-FVG+		
47	5011	5017-FVG+		
48	5015	5022-FVG+		
49	5018	5027-FVG+		
4A	5022	5032-FVG+		
4B	5030	5041-FVG+		
4C	5037	5052-FVG+		
4D	5045	5062-FVG+		
4E	5055	5077-FVG+		
4F	5075	5099-FVG+		
50	5090	5130-FVG+		
51	5110	5172-FVG+		
52	5160	5200-FVG+		
<hr/>				
O2-05	Up/Down Freq Ref	Selects whether the ENTER key is used when the frequency reference is set by the digital operator. The digital operator can simulate a motor operated potentiometer (M.O.P.) by setting this parameter.	0	Adv
	0 Disabled	ENTER Key Required		
	1 Enabled	ENTER Key Not Required		
<i>Note: This feature cannot be used in conjunction with infinitely variable speed control.</i>				
<hr/>				
O2-06	Oper Detection	If the digital operator is disconnected from the inverter. This parameter selects whether the inverter detects this condition. The operator is only detected when the inverter is being commanded locally.	1	Adv
	0 Disabled			
	1 Enabled			
<hr/>				
O2-07	Elapsed Time Set	Viewable by U1-13	0-65535	0 Adv
<hr/>				
O2-08	Elapsed Time Run	Defines the operation time that accumulates in the timer.	0	Adv
	0 Power-On Time			
	1 Running Time			
<hr/>				

Clear History

Parmtr Code	Display	Function	Range	Initial Value	Access Level
03-01	Clear History 1 <i>0 Not Clear</i> <i>1 Clear</i>	Clears fault history		0	Adv
03-02	Clear History 2 <i>0 Not Clear</i> <i>1 AC Count Clr</i> <i>2 OL/LC Count Clr</i> <i>3 Both Count Clr</i>	Clears count history Number of run command is received (U3-09) Number of OL or LC fault is detected (U3-10) Both (U3-09 and U3-10)		0	Adv

Monitor Parameters

Parmtr Code	Display	Function	Units	Access Level
Monitor				
U1-01	Frequency Ref	Frequency Reference	Hz	Operation
U1-02	Output Frequency	Inverter Output Frequency	Hz	User Program
U1-03	Output Current	Inverter Output Current	A	User Program
U1-04	Control Method	Displays the value of A1-02	n/a	User Program
U1-05	Motor Speed	Motor Speed	Hz	User Program
U1-06	Output Voltage	Inverter Output Voltage (Reference)	V	User Program
U1-07	DC Bus Voltage	DC Bus Voltage (Measured)	V	User Program
U1-08	Output kWatts	Inverter Output Power (Calculated)	kW	User Program
U1-09	Torque Reference	Torque Reference (Internal)	%	User Program
U1-10	Input Term Sts	Input Terminal Status (See page 5-103 for a detailed description.)	n/a	User Program
U1-11	Output Term Sts	Output Terminal Status (See page 5-104 for a detailed description.)	n/a	User Program
U1-12	Int Ctl Sts 1	Operation Status (See page 5-105 for a detailed description.)	n/a	User Program
U1-13	Elapsed Time	Elapsed Time. See O2-07 and O2-08.	hours	User Program
U1-14	Flash ID	Flash ROM software ID number	n/a	User Program
U1-15	Terminal 13 Level	External Terminal 13 input level	V	Advance
U1-16	Terminal 14 Level	External Terminal 14 input level	V/mA	Advance
U1-17	Terminal 16 Level	External Terminal 16 input level	V	Advance
U1-18	Mot SEC Current	Motor secondary current (Iq).	A	Advance
U1-19	Mot EXC Current	Motor excitation current (Id).	A	Advance
U1-20	SFS Output	Primary freq. after the SFS	Hz	Advance
U1-21	ASR Input	Monitors the input to the speed regulator. 100%=FMAX	%	Advance
U1-22	ASR Output	Monitors the output from the speed regulator. The motor's secondary current corresponds to 100%.	%	Advance
U1-23	Speed Deviation	Monitors the speed deviation within the speed regulator. FMAX=100%	%	Advance
U1-24	PID Feedback	PID feedback signal level	%	Advance
U1-25	G5IN4 Monitor	See page 5-29.	Hex	Advance
U1-26	Voltage Reference (Vq)	Motor secondary voltage reference	V	Advance
U1-27	Voltage Reference (Vd)	Motor excitation voltage reference	V	Advance
U1-28	CPU ID	CPU software ID number	n/a	Advance

Parmtr Code	Display	Function	Units	Access Level
U1-29	Load Weight	Monitors load weight when C10-01 is enabled	tons	Advance
U1-32	ACR (q) Output		%	Advance
U1-33	ACR (d) Output		%	Advance
U1-34	OPE Detected		const #	Advance
U1-35	Friction Torq		%	Advance

Fault Trace

U2-01	Current Fault	Displays current fault		User Program
U2-02	Last Fault	Displays last fault detected		User Program
U2-03	Frequency Reference	Freq ref when fault was detected	Hz	User Program
U2-04	Output Frequency	Output freq when fault was detected	Hz	User Program
U2-05	Output Current	Output current when fault was detected	A	User Program
U2-07	Output Voltage	Output voltage when fault was detected	V	User Program
U2-08	DC Bus Voltage	DC Bus voltage when fault was detected	V	User Program
U2-09	Output kWatts	Output power when fault was detected	kW	User Program
U2-11	Input Terminal Sts	Input terminal status when fault was detected	n/a	User Program
U2-12	Output Terminal Sts	Output terminal status when fault was detected	n/a	User Program
U2-13	Inverter Status	Inverter status before fault was detected	n/a	User Program
U2-14	Elapsed Time	Elapsed time when fault was detected	hours	User Program

Fault History

U3-01	Last Fault	Most recent fault		User Program
U3-02	Fault Message 2	2nd most recent fault		User Program
U3-03	Fault Message 3	3rd most recent fault		User Program
U3-04	Fault Message 4	4th most recent fault		User Program
U3-05	Elapsed Time 1	Elapsed time of most recent fault		User Program
U3-06	Elapsed Time 2	Elapsed time of 2nd most recent fault		User Program
U3-07	Elapsed Time 3	Elapsed time of 3rd most recent fault		User Program
U3-08	Elapsed Time 4	Elapsed time of 4th most recent fault		User Program
U3-09	AC Operations	Total number of RUN commands received since the AC counter was last cleared (03-02)		User Program
U3-10	OL/LC Count	Total number of OL and LC faults detected since the OL/LC counter was last cleared (03-02)		User Program

U1-10 Input Terminal Status

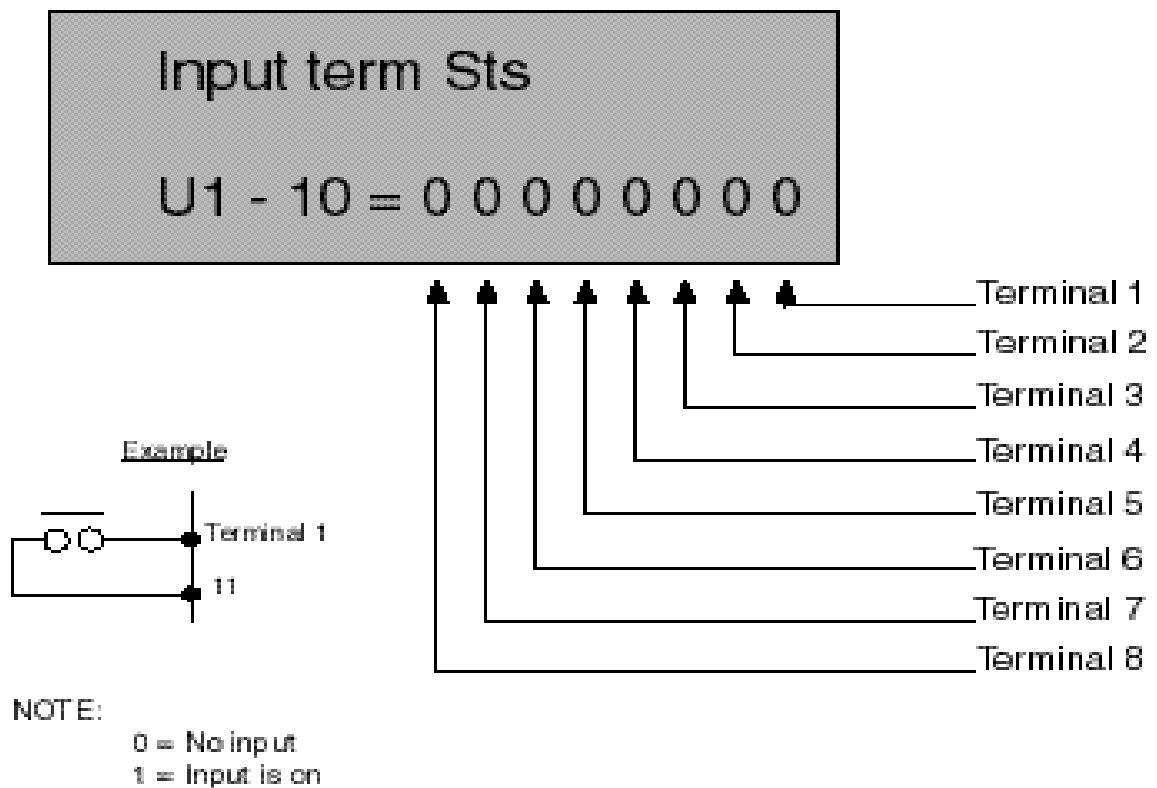


Figure 5-46: Input Terminal Status

U1-11 Output Terminal Status

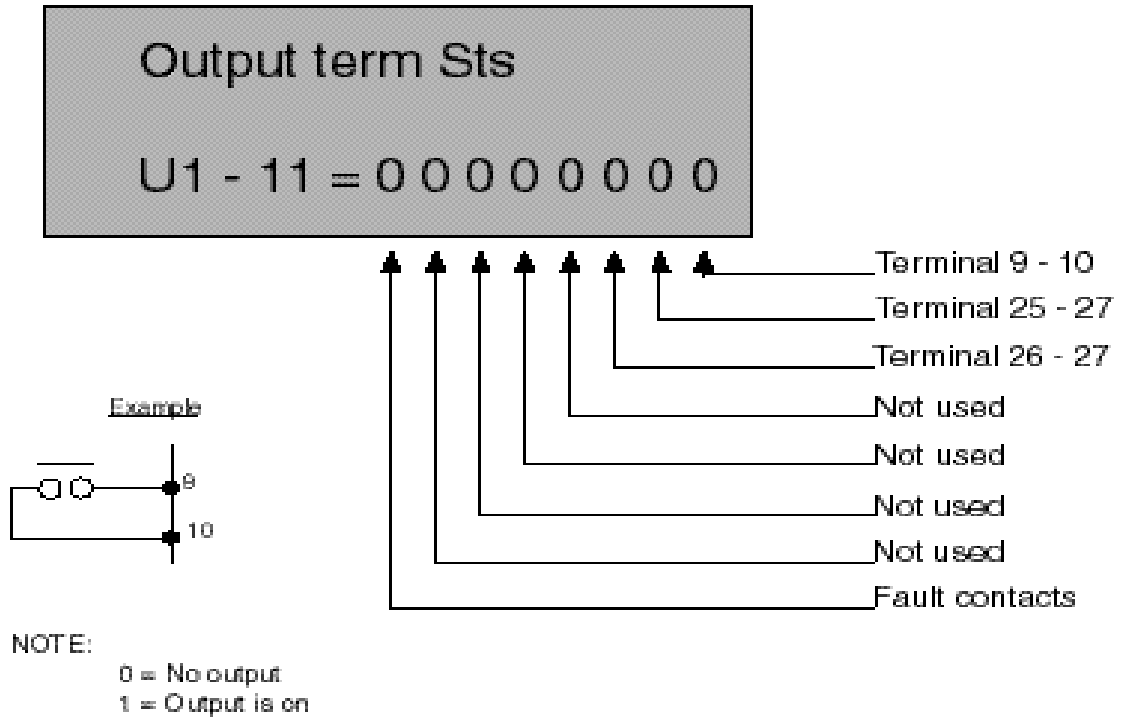


Figure 5-47: Output Terminal Status

U1-12 Inverter Status

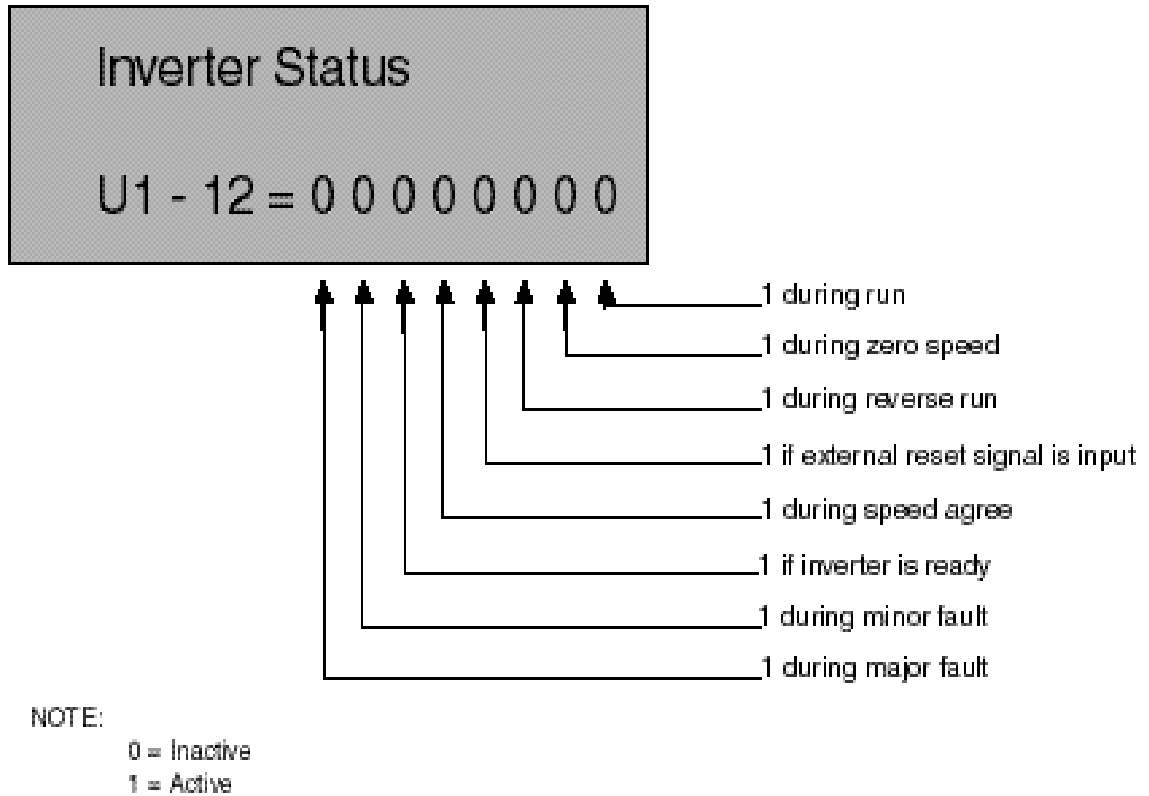


Figure 5-48: Inverter Status

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**Troubleshooting
IMPULSE•VG+ Series 2**

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Troubleshooting the Drive

In this troubleshooting section, “*check*,” means *investigating whether an item is functioning and in an acceptable physical condition, and then taking corrective action (adjusting, fixing, replacing, etc.) as necessary*. In the Corrective Action column, you may not have to perform all of the steps to correct the problem.

Maintenance and Inspection

This section describes basic maintenance and inspection procedures for the IMPULSE•VG+ Series 2.

Component	Check	Corrective Action
External terminals, connectors, mounting screws, etc.	Loose screws or connectors	Securely tighten.
Heatsink	Build-up of dust and dirt	Blow with dry, compress air (57-86 psi).
Printed Circuit Board (PCB)	Accumulation of conductive dust or oil	Blow with dry, compress air (57-86 psi). If dust and oil cannot be removed, replace the board.
Cooling Fan	Abnormal noise and vibration	Clean or replace the fan.
Power Components	Accumulation of dust or dirt	Blow with dry, compress air (57-86 psi).

Alarm and Fault classes are described as follows:

- Major Fault: Brake is set, operation indicator lights flash, fault is displayed on keypad and fault contact output (terminals 18, 19 & 20) are activated. The reset key must be pressed, a multi-function input set for fault reset or power must be cycled in order to continue operation.
- Fault (minor): Brake is set, RUN Led flashes until run command is removed, fault is displayed on keypad, fault contact output (terminals 18, 19 & 20) are not activated. The reset key does not need to be pressed. The drive will attempt to run again at the next run command.
- Alarm (Warning): Operation continues, fault is displayed on the keypad, fault contact output (terminals 18, 19 & 20) are not activated.

Motor Faults and Corrective Actions

Symptom	Corrective Action
Analog frequency reference is not stable. (drifting)	<ol style="list-style-type: none"> 1. Stabilize the analog source. 2. Increase B2-02. 3. Increase B5-01, -02.
No motor rotation.	<ol style="list-style-type: none"> 1. Verify that power is on (Charge LED). 2. Verify that the keypad display is not showing a fault. 3. Verify that the run command is input to the drive (U1-10). 4. Motor stalled due to excessive load.
Motor rotation is in the wrong direction.	<ol style="list-style-type: none"> 1. Verify FWD/REV or UP/DN is correct at the interface card. 2. Match wiring to the phase to the phase order of the motor leads T1, T2, T3.
Motor rotates, but at minimum speed only.	<ol style="list-style-type: none"> 1. Check wiring of speed inputs. 2. Verify speed reference setting (A1-04). 3. Verify reference and run source settings are correct (B3-01, -02). 4. Verify reference priority setting (B1-10).
Motor RPM too high or too low	<ol style="list-style-type: none"> 1. Compare motor nameplate specifications with E1 parameter. 2. Check maximum frequency setting (E1-04). 3. Check minimum frequency setting (E1-09).

Drive Faults and Indicators

Fault Code	Fault or Indicator Name/Description	Corrective Action
BB Base Block	External Base Block Indicator The flashing base block signal is the result of a multi-function input in the terminal strip. The base block indicates that the drive's IGBTs have been disabled. The motor will begin coasting when the base block input is received. If a RUN command is still present when the BB signal is removed, the output voltage will be restored to the previous operating level and operation will continue at the previously commanded frequency.	<ol style="list-style-type: none"> 1. Check constants H1-01 through H1-06 for proper programming. 2. Check terminal status.
BE0 Brake Ans Lost	Brake answer back signal is lost during run. While running, the multi-function input brake answer back is lost.	<ol style="list-style-type: none"> 1. Check brake answer back circuit. 2. Check terminal status. (U1-10)
BE1 Rollback detect	Torque Proving Minor Fault. At START, pulse feedback, after brake release, is greater than C8-05 count. There is no excessive roll-back at start.	<ol style="list-style-type: none"> 1. See BE1 timing diagram on page 5-36. Increase value of C8-03. 2. Check for motor shaft movement after brake release. 3. Increase the value of C8-05. 4. Check the encoder signal for noise. 5. Check encoder grounding. 6. Check encoder shielded cable. 7. Replace encoder.

Fault Code	Fault or Indicator Name/Description	Corrective Action
BE2 No Current	Current-Proving Minor Fault. At START for Torque Proving Sequence only - Current (IFB) has not reached predetermined setting within predetermined time at START.	<ol style="list-style-type: none"> 1. See Timing diagram NLB.UP on page 5-34. 2. If powerlimit switch is used, switch is closed. 3. Make sure motor has been auto-tuned properly 4. Increase the value of C8-01 and C8-02. 5. Increase the value of C4-02.
BE3 Brake Release NG	Brake Release Minor Fault. For Brake Release-Check Sequence only-Speed feedback is less than C8-07 counts. After electric brake release command is output - Electric brake not released.	<ol style="list-style-type: none"> 1. See NLB_BE3 on page 5-37. 2. Check programming of H2-01 & H2-02. 3. Check electric brake. 4. Check brake contactor(s). 5. Check encoder and wiring. 6. Increase the value of C8-06 timer. 7. Decrease the value of C8-07 counts.
BE4 Brake Answer 1	Brake Answer-Back Minor Fault Released. At Start, Brake Answer-back is not input within predetermined time (C8-04) after electric brake release command is output—Electric brake not released.	<ol style="list-style-type: none"> 1. See NLB_UP on page 5-34. 2. Check brake answer back circuit. 3. Increase the value of C8-04. 4. Check terminal status (U1-10).
BE5 Brake Answer 2	Brake Answer-Back At Stop. At Stop, Brake Answer-back signal is not removed within predetermined time (C8-11) after electric brake release command is removed—Electric brake not closed.	<ol style="list-style-type: none"> 1. See NLB_UP on page 5-34. 2. Check brake answer back circuitries 3. Increase the value of C8-11 time. Note: A1-02 must = 2 OLV
BE6 Brake Stop Fault	Brake Set Alarm. At stop, Brake proving Sequence only - Pulse feedback after brake command removed, is greater than C8-13 count - Excessive movement through brake, not closed, or worn brake.	<ol style="list-style-type: none"> 1. See NLB_BE6 on page 5-38. 2. Check if brake is failed in the open position, is improperly adjusted, or has worn pads. 3. Increase the value of C8-11 timer. 4. Increase the vaule of C8-13 counts. 5. Check encoder signal for noise. Ensure encoder shielded cable is in good condition. 6. Replace encoder.
BE7 Brake Welded	Brake Answer-Back Major Fault. At Power Up, Brake Answer-Back is on - Electric brake not closed.	<ol style="list-style-type: none"> 1. Check if brake is closed. 2. Check brake answer back circuitry.
CALL Serial Com Call	Serial Communication SI-B Transmission Fault. Control data is not received correctly after power supply is turned ON for 2 sec.	<ol style="list-style-type: none"> 1. Check serial device connections. 2. Ensure drive is properly programmed for serial communication.
CE Memobus Com Err	Communication Error. Serial communications disruption.	<ol style="list-style-type: none"> 1. Check serial connections (6 CN). 2. Check H5-01 through H5-05 for proper programming.
CPF00 Com-Err (OP&INV)	Control Circuit Fault 1— Keypad Transmission. Because of external noise, excessive vibration or shock, or component failure (including RAM and PROM), one or both of the following occurs: <ul style="list-style-type: none"> • Transmission between the inverter and keypad cannot be established 5 sec after power-up. • MPU peripheral element check fault (on-line). 	<ol style="list-style-type: none"> 1. Check the keypad connection. 2. Check the control circuit wiring. 3. Replace keyboard. 4. Replace Control board.

Fault Code	Fault or Indicator Name/Description	Corrective Action
CPF01 Com-Err (OP&INV)	Control Circuit Fault 2—Keypad Transmission. After initial power-up, communication between the inverter and keypad was interrupted for more than 2 seconds.	<ol style="list-style-type: none"> 1. Check keypad connection. 2. Cycle Power 3. Replace keypad 4. Replace Control board.
CPF02 BB Circuit Err	Base Block Circuit Fault. Base block circuit fault at power-up.	<ol style="list-style-type: none"> 1. Cycle power 2. Ensure that the control board terminals are shielded from electrical noise. 3. Replace Control board.
CPF03 EEPROM Err	EEPROM Fault. Invalid data found in the EEPROM.	<ol style="list-style-type: none"> 1. Cycle power 2. Ensure that the control board terminals are shielded from electrical noise. 3. Replace Control board.
CPF04 Internal A/D Err	Internal A/D Converter Fault. CPU internal analog-digital converter fault.	<ol style="list-style-type: none"> 1. Cycle power 2. Ensure that the control board terminals are shielded from electrical noise. 3. Replace Control board.
CPF05 External A/D Err	External A/D Converter Fault. CPU external analog-digital converter fault.	<ol style="list-style-type: none"> 1. Cycle power 2. Ensure that the control board terminals are shielded from electrical noise. 3. Replace Control board.
CPF06 Option Error	Option Card Fault. Optional card has disconnected or failed.	<ol style="list-style-type: none"> 1. Power down. 2. Verify proper installation of all option cards.
CPF10	Control Circuit Fault 10 — G5IN4. G5IN4 option card failure.	<ol style="list-style-type: none"> 1. Power down. 2. Verify proper installation of G5IN4. 3. Replace G5IN4 card.
CPF20 Option A/D Error	Control Circuit Fault 20 — AI-14. Analog-to-digital converter fails or analog speed reference error.	<ol style="list-style-type: none"> 1. Power down. 2. Verify proper installation of AI-14B. 3. Replace AI-14B card.
CPF21 Option CPU Down	Control Circuit Fault 21 — CPU on Optional Card. CPU on an installed optional card fails.	<ol style="list-style-type: none"> 1. Power down. 2. Verify proper installation of Option card. 3. Replace card.
CPF22 Option Type Err	Control Circuit Fault 22 — Optional Card Code. Optional card code is not compatible with the inverter	<ol style="list-style-type: none"> 1. Power down. 2. Verify proper card. 3. Verify proper installation of Option card. 4. Replace card.
CPF23 Option DPRAM Err	Control Circuit Fault 23 — DP-RAM. DP-RAM on an installed optional card failed.	<ol style="list-style-type: none"> 1. Power down. 2. Remove any inputs to card. 3. Verify proper installation of Option card. 4. Replace card.

Fault Code	Fault or Indicator Name/Description	Corrective Action
Dev Speed Deviation	Speed Deviation Fault. Occurs when the deviation of the speed reference and speed feedback exceeds the regulation level, F1-10 for the time F1-11.	<ol style="list-style-type: none"> 1. Check the load. 2. Reduce Accel/Decel times. 3. Check the encoder wiring. 4. Check the encoder grounding. 5. Increase Encoder Excessive Speed Deviation Level (F1-10).
EF (Blinks) External Fault	Both FORWARD/UP and REVERSE/DOWN commands are input at same time for 500 msec or longer	<ol style="list-style-type: none"> 1. Check control input circuitries. 2. Check the sequence of operation.
EF3 External Fault 3	External fault occurs in the Terminal 3 external control circuit.	<ol style="list-style-type: none"> 1. Check constant H1-01 for proper programming. 2. Check the condition of the input terminal #3 on G5IF card.
EF4 External Fault 4	External fault occurs in the Terminal 4 external control circuit.	<ol style="list-style-type: none"> 1. Check constant H1-02 for proper programming. 2. Check the condition of the input terminal #4 on G5IF card.
EF5 External Fault 5	External fault occurs in the Terminal 5 external control circuit.	<ol style="list-style-type: none"> 1. Check constant H1-03 for proper programming. 2. Check the condition of the input terminal #5 on G5IF card.
EF6 External Fault 6	External fault occurs in the Terminal 6 external control circuit.	<ol style="list-style-type: none"> 1. Check constant H1-04 for proper programming. 2. Check the condition of the input terminal #6 on G5IF card.
EF7 External Fault 7	External fault occurs in the Terminal 7 external control circuit.	<ol style="list-style-type: none"> 1. Check constant H1-05 for proper programming. 2. Check the condition of the input terminal #7 on G5IF card.
EF8 External Fault 8	External fault occurs in the Terminal 8 external control circuit.	<ol style="list-style-type: none"> 1. Check constant H1-06 for proper programming. 2. Check the condition of the input terminal #8 on G5IF card.
ERR EEPROM R/W Err	EEPROM Read/Write Fault. EEPROM internal data did not match when initializing the parameter.	<ol style="list-style-type: none"> 1. Cycle Power. 2. User initialize (A1-05=1110). 3. Replace Control board.
FAN Fan Fault	Cooling fan fails while power is on.	<ol style="list-style-type: none"> 1. Remove any debris from fan. 2. Check fan wiring. 3. Replace fan (contact Electromotive Systems).
GF Ground Fault	During operation, the inverter sums the currents of all three motor phases. Ideally, the sum should always equal zero. If the sum is greater than 50% of the inverter rated output current, a GF occurs.	<ol style="list-style-type: none"> 1. Disconnect motor from drive and check it for shorts using a megger 2. Ensure that R/C Surge Suppressors are used across all brake contactor coils to prevent disturbance by electrical transients. 3. With Output Phase Loss disabled (B6-03), verify drive operation with motor disconnected.
LCI Load Check Err	Load Check Fault. Load is greater than specified amount.	<ol style="list-style-type: none"> 1. Reduce Load. 2. Check Load Check sequence set-up. (C5-XX).

Fault Code	Fault or Indicator Name/Description	Corrective Action
LF Output Pha Loss	An open phase occurred at the inverter output.	<ol style="list-style-type: none"> 1. Check for broken wires in output cable. 2. Check for open winding in the motor. 3. Check for loose terminals 4. With Output Phase Loss disabled, verify drive operation with motor disconnected.
LL1 Lower Limit 1 Err	Lower Limit 1—SLOW DOWN Indicator. Lower Limit 1—SLOW DOWN is input (switch status is changed).	<ol style="list-style-type: none"> 1. May not require corrective action. 2. Check the Limit Switches position. 3. Check the Limit Switches condition.
LL2 Lower Limit 2 Err	Lower Limit 2—STOP Indicator. Lower Limit 2—STOP is input (switch status is changed).	<ol style="list-style-type: none"> 1. May not require corrective action. 2. Check the Limit Switches position. 3. Check the Limit Switches condition.
OC Over Current	Output current exceeds 200% of inverter rated output current.	<ol style="list-style-type: none"> 1. Check for a phase-to-phase short in the motor or wiring using a megger. 2. Extend the acceleration/deceleration time.
OH (blinking) Heatsnk Over temp	Overheat Pre-Alarm. Cooling fan is overheating. The temperature of the inverters cooling fans exceeded the setting in L8-02.	<ol style="list-style-type: none"> 1. The inverter cooling fan has stopped. 2. Reduce the ambient temperature.
OHI Heatsnk Max Temp	Cooling fan overheated. The temperature of the cooling fan has exceeded the factory setting.	<ol style="list-style-type: none"> 1. The inverter cooling fan has stopped. 2. Reduce the ambient temperature.
OH2 Heatsink MaxTemp	Overheat Fault. There are two situations that result in an overheat fault. The first occurs when the measured heat sink exceeded 105°C. The second is a result of a fault in the internal 24VDC cooling fan.	<ol style="list-style-type: none"> 1. Ensure that the heat sink cooling fans are functioning. 2. Ensure that the heat sink is free from dirt and debris. 3. Ensure that the inverter's ambient temperature is within specification. 4. Replace the 24VDC fan 5. Replace the heat sink thermistor(s)
OLI Motor Overloaded	Motor Overload Fault. Inverter output exceeded the motor overload level.	<ol style="list-style-type: none"> 1. Ensure drive is programmed with proper motor full load Amp (E2-01). 2. Reduce the load.
OL2 INV Overloaded	Inverter Overload Fault. Inverter output exceeded the inverter overload level.	<ol style="list-style-type: none"> 1. Reduce the load. 2. Extend the acceleration time.
OL3 Overtorque Det 1	Overtorque Detection Level 1 Fault. Defined by L6-02. Alarm defined by L6-01.	<ol style="list-style-type: none"> 1. Check for proper programming for L6-XX constant.
OL4 Overtorque Det 2	Overtorque Detection Level 2 Fault. Defined by L6-05. Alarm defined by L6-04.	<ol style="list-style-type: none"> 1. .Check for proper programming for L6-XX constant.
OP	Keypad Digital Monitor Fault. Digital monitor unit in keypad fails, or the keypad is mounted when in the program mode or during operation by the operator	<ol style="list-style-type: none"> 1. Remove power and remount keypad.
OP3	Optional Card Fault. Optional card is incompatible or has failed.	<ol style="list-style-type: none"> 1. Replace optional card.
OPE01 kVA Selection	kVA Setting Fault. Inverter kVA setting range is incorrect.	<ol style="list-style-type: none"> 1. Check 02-04 constant for proper kVA.

Fault Code	Fault or Indicator Name/Description	Corrective Action
OPE02 Limit	Setting Out of Range . Parameter setting is out of range.	<ol style="list-style-type: none"> 1. With the fault displayed on the keypad, press the DATA/ENTER key to reveal the “Out of Range” parameter via the U1-34 monitor. 2. Verify that E2-03 is < E2-01. 3. Verify E1-05 is within range. 4. Compare Modified constants with defaults. 5. Cycle Power.
OPE03 Terminal	Multi-Function Input Setting Fault. Set values other than “F” and “FF” are duplicated.	<ol style="list-style-type: none"> 1. Check the settings for H1-01 to H1-06, verify that the same input is not used twice.
OPE05 Sequence Select	Sequence Select Setting Fault. B3-01 and B3-02 and no option is plugged in.	<ol style="list-style-type: none"> 1. Check the function selection or plug in optional card.
OPE06 PG Opt Missing	Missing PG Card. A closed loop control method was selected, and the required PG feedback card is not installed.	<ol style="list-style-type: none"> 1. Install the required option card. 2. Remove power and reseat the option card. 3. Check the A1-02, control method, program setting
OPE07 Analog Selection	Multi-Function Analog Output Setting Fault. H3-05 and H3-09 multi-Function analog output settings are set to the same value.	<ol style="list-style-type: none"> 1. Check the function selections.
OPR Oper Disconnect	Keypad Disconnected. The keypad is removed while the inverter is running, and the run command was initiated via the keypad RUN key.	<ol style="list-style-type: none"> 1. Secure the keypad. 2. Verify O2-06 setting.
OS Over Speed	Overspeed Fault. The motor has exceeded the programmed detection level and time. This is typically caused by a overshoot condition due to an over-responsive ASR loop. If the drive is programmed to flux vector “torque control” mode, and no load is present, an overspeed fault will typically occur.	<ol style="list-style-type: none"> 1. Check the Automatic Speed Regulator settings, C5 sub group. 2. Check for rapid load changes 3. Verify proper encoder PPR setting, F1-01.
OV DC Bus Overvolt	Overvoltage Fault. The main circuit direct current voltage exceeded the overvoltage level. Detection level: 230V class—approx. 400V 460V class—approx. 800V	<ol style="list-style-type: none"> 1. Extend the deceleration time. 2. Check for proper DBU operation. 3. Check the resistor. 4. Check the line voltage.
OV (blinks) DC Bus Overvolt	Overvoltage Fault. Overvoltage occurs during stop. Main circuit DC voltage rises above the detection level while the drive output is off. Detection level: 410V or more for 230V and 820V or more for 460V	<ol style="list-style-type: none"> 1. Check the line voltage.
PF Input Pha Loss	Input Phase Loss Fault. Inverter input power supply has open phase.	<ol style="list-style-type: none"> 1. Check the line voltage. 2. Remove power. 3. Retighten the input terminal screws.
PGO PG Open	Pulse Generator Signal Missing Fault. The inverter detected a loss of encoder feedback.	<ol style="list-style-type: none"> 1. Check for missing or broken encoder wiring. 2. Check for proper direction of encoder feedback. 3. Check for a physical obstruction to rotor rotation (brake).

Fault Code	Fault or Indicator Name/Description	Corrective Action
PUF DC Bus Fuse Open	DC Bus Fuse Open Fault. The DC fuse is open.	<ol style="list-style-type: none"> 1. Check for damaged transistor. 2. Check load-side short circuit. 3. Check grounding. <p><i>Do not replace an open DC bus fuse until the cause of failure has been corrected; non-warranty, damage to the drive may result.</i></p>
RH DynBrk Resistor	Braking Resistor Overheat Fault. The factory installed, 3% dynamic braking resistor has exceeded an allowable temperature. This does not apply to ESI external braking resistors.	<ol style="list-style-type: none"> 1. Check the L8-01 setting. Only select “provided” when using the factory installed 3% resistor. 2. Ensure that the braking duty cycle is not greater than 3% of the operation time.
RR DynBrk Transistr	Braking Transistor Fault. Internal Braking transistor failed.	<ol style="list-style-type: none"> 1. Verify that the external braking resistor is connected to the proper terminals. 2. Confirm that the proper resistor is installed. 3. Check for a short circuit across the braking resistor
SC Short Circuit	Short Circuit Fault. The inverter has detected an output short circuit condition.	<ol style="list-style-type: none"> 1. Disconnect the motor from the inverter 2. Check for a short circuit in the motor or wiring using a megger.
SLC Slack Cable Detection	Slack Cable Fault. A hoist slack cable condition occurred.	<ol style="list-style-type: none"> 1. May not require corrective action. 2. Check proper programming of Slack Cable Detection (C11-XX).
SVE Zero Servo Fault	Zero-Servo Fault.	<ol style="list-style-type: none"> 1. Check Zero-Servo sequence set-up.
SVR PG Quality	Noisy Encoder Fault.	<ol style="list-style-type: none"> 1. Check encoder and encoder wiring. 2. Increase B7-01.
THM	Thermistor Fault. Thermistor is not connected, or thermistor connection is faulty	Reconnect or replace thermistor.
UL1 Upper Limit 1 Err	Upper Limit 1—SLOW DOWN Indicator. Upper Limit 1—SLOW DOWN switch status is changed.	<ol style="list-style-type: none"> 1. May not require corrective action. 2. Check the limit switches location. 3. Check the limit switches condition.
UL2 Upper Limit 2 Err	Upper Limit 2—STOP Indicator Upper Limit 2—STOP switch status is changed.	<ol style="list-style-type: none"> 1. May not require corrective action. 2. Check the limit switches location. 3. Check the limit switches condition.
UV DC Bus Undervolt	Undervoltage Fault. Undervoltage status occurs for more than 2 sec during STOP. Input voltage drops below 210V DC or less for 230V AC class and 420V DC or less for 460V AC class.	<ol style="list-style-type: none"> 1. Check the power source wiring. 2. Replace any bad branch fuses. 3. Check collector system.
UVI DC Bus Undervolt	Undervoltage 1 Fault. Undervoltage status occurs for more than 2 sec during RUN command. Input voltage drops below 190V or less for 230V AC class and 380V DC or less for 460V AC class.	<ol style="list-style-type: none"> 1. Check power supply wiring. 2. Correct the line voltage. 3. Check collector system.
UV2 CTL PS Undervolt	Undervoltage 2 Fault. The inverter detected a loss of the 24V logic power supply voltage. This fault is only detected in inverters rated 4128-AFG+ through 4605-AFG+ and 2130-AFG+ through 2300-AFG+.	<ol style="list-style-type: none"> 1. Check power supply wiring. 2. Correct the line voltage. 3. Check collector system.

Fault Code	Fault or Indicator Name/Description	Corrective Action
<i>UV3</i> MC Answerback	MC Fault. The pre-charge contactor opened during operation.	<ol style="list-style-type: none">1. Check power supply wiring.2. Correct the line voltage.3. Check collector system.4. Wait 30-45 seconds before restarting drive after auto shut down.

Fault Display and Corrective Actions at Auto-tuning

The following are fault displays and corrective actions at auto-tuning. If any of the following faults are found, the digital operator displays that fault contents; the motor coasts to stop if it is under operation. Fault contact output or minor fault contact output does not operate.

Fault Display	Fault or Indicator Name/Description	Corrective Action
Data Invalid (Motor data fault)	Motor data fault. Invalid motor data.	<ol style="list-style-type: none"> 1. Verify input data. 2. Verify motor/drive capacities. 3. Change the settings to conform to the following equation: Rated speed < 120 x Motor frequency/ number of poles
Resistance (Line-to-line resistance fault)	Terminal resistance fault. Tuning was not completed within the specified time.	
No-Load Current	No-Load Current fault. Tuning was not completed within the specified time.	
Saturation-1	Iron core saturation coefficient 1 fault. The core saturation coefficient was not completed within the specified time.	<ol style="list-style-type: none"> 1. Incorrect rated current setting 2. Check for loose/broken or disconnected motor wire
Saturation-2	Iron core saturation coefficient 2 fault. the core saturation coefficient was not completed within the specified time.	
Rated Slip	Rated Slip Fault. Rated slip setting was not completed within the specified time.	<ol style="list-style-type: none"> 1. Verify that the motor is de-coupled from load.
Accelerate	Acceleration fault. Motor does not accelerate in specified time.	<ol style="list-style-type: none"> 1. Verify the brake is released (manually). 2. Increase acceleration time (B5-01). 3. Verify that the motor is de-coupled from load. 4. Verify that C7-01, -02 = 150%.
PG Direction	Motor rotating direction fault.	<ol style="list-style-type: none"> 1. Change F1-05 2. Swap T1 and T2 motor leads. 3. Check the PG wiring. 4. Check the motor wiring.
Motor Speed	Motor Speed Fault. Torque reference becomes excessive (100%) during tuning.	<ol style="list-style-type: none"> 1. Verify that the brake is released (manually). 2. Increase acceleration time B5-01. 3. Verify that the motor is de-coupled from load.
Alarm: Overload (Displayed after completion of turning)	Excessive tuning load. Torque reference exceeded 20% at tuning	<ol style="list-style-type: none"> 1. Verify that the motor is de-coupled from load. 2. Turn the power off and rotate the motor shaft by hand. Replace motor if it does not turn smoothly

Troubleshooting CDBR Faults

Fault Status	Possible Cause	Corrective Action
Drive trips at overvoltage (OV)	<ul style="list-style-type: none"> • Insufficient braking unit capacity • Insufficient resistor capacity • Improper wiring • Deceleration time too short • Braking unit fault 	<ol style="list-style-type: none"> 1. Verify CDBR capacity 2. Verify resistor capacity 3. Verify wiring is correct 4. Lengthen deceleration time 5. Replace the braking unit
Braking Unit Thermal Overload trips when not decelerating	<ul style="list-style-type: none"> • Improper braking unit power supply voltage selection setting • Incoming (line) voltage too high • Discharge transistor shorted 	<ol style="list-style-type: none"> 1. Verify Jumper setting 2. Correct LineVoltage 3. Replace the braking unit
Braking Unit trips by heatsink overheat	<ul style="list-style-type: none"> • Excessive load inertia • Improper combination of braking unit and resistor • Ambient temperature > 104°F 	<ol style="list-style-type: none"> 1. Reduce load 2. Verify proper braking unit/resistor 3. Install air conditioner

Power Section Check



WARNING

Do NOT touch any circuit components while AC main power is on or immediately after the main AC power is disconnected from the unit. You must wait until the red “CHARGE” lamp is extinguished. It may take as long as 10 minutes for the charge on the main DC bus capacitors to drop to a safe level. Failure to adhere to this warning could result in serious injury.

Power Off Checks

To perform a power section check, remove the drives main and control wiring from the terminal strips. Obtain reading as specified in the table on the next page, and ensure that the reading falls within the normal reading range.

Test equipment - Analog Ohmmeter set R x 1 scale or digital multimeter set to the diode check.

Device	VOM (on RX1 Scale)		Normal Reading (Analog Meter)	Normal Reading (Digital Meter)
	Positive Lead	Negative Lead		
Input Rectifier Bridge *1	L1	+	7-100Ω	Approximately 0.5 V
	L2	+		
	L3	+		
	-	L1		
	-	L2		
	-	L3		
	L1	-	Infinite Ω	OL Displayed
	L2	-		
	L3	-		
	+	L1		
	+	L2		
	+	L3		
Bus Capacitors	+	-	Observe gradually increasing resistance	Observe gradually increasing voltage to OL
Pre-charge Resistor	-	Across the Resistors	100 Ω or less	-
Output Transistors *2 *3	T1	+	7-100 Ω	Approximately 0.5V
	T2	+		
	T3	+		
	-	T1		
	-	T2		
	-	T3		
	T1	-	Infinite Ω	OL Displayed
	T2	-		
	T3	-		
	+	T1		
	+	T2		
	+	T3		
Braking Diode (2006-2033) (4001-4034)	B2	B1	10 Ω	0.5 V
	B1	B2	Infinite Ω	OL Displayed
	B2	-	Infinite Ω	OL Displayed
	-	B2	Infinite Ω	OL Displayed

*1. "+" could be any one of three (+) terminals which are labeled as ⊕1, ⊕2, and ⊕3.

*2. If the bus fuse is blown you must install a jumper across the fuse terminals to get accurate resistance measurements.

*3. If the pre-charge resistor is open, you will need infinite Ω between + and any output terminal unless you install a temporary jumper across the resistor.

Braking Circuit

Test Equipment - Analog Ohmmeter set to R X 1 scale or digital multimeter set to the diode check.

Step No.	Ohmmeter Positive Lead	Ohmmeter Negative Lead	Expected Reading (Analog Meter)	Expected Reading (Digital Meter)
1	Connect to B2	Connect to B1	10 Ohms	0.5 Volts
2	Connect to B1	Connect to B2	Infinite Ohms	0L displayed
3	Connect to B2	-	Infinite Ohms	0L displayed
4	-	Connect to B2	Infinite Ohms	0L displayed

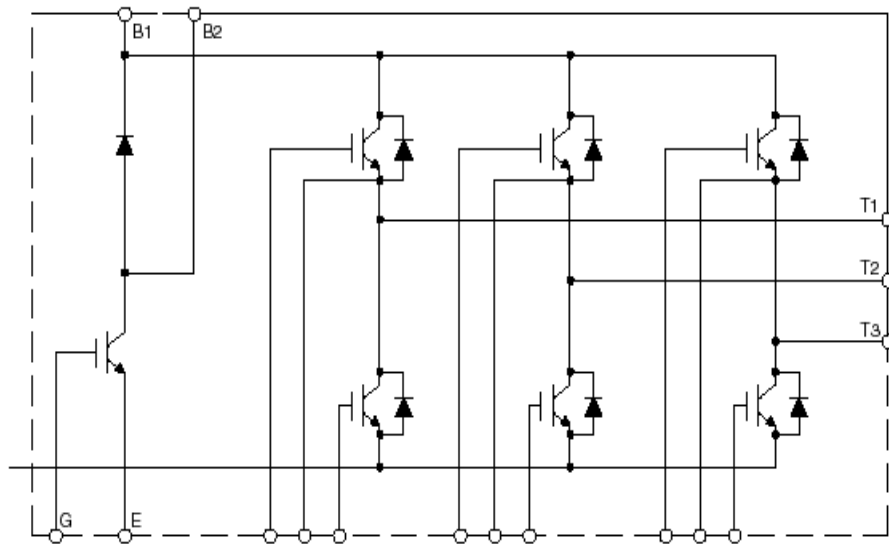


Figure 6-1

A p p e n d i x **A**

Servicing
IMPULSE•VG+ Series 2

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Service

This chapter includes information pertaining to on-call service, drive identification, troubleshooting, and warranty. Before you install, troubleshoot, or service the drive, we highly recommend that you read this entire chapter. Doing this will help assure quick service response, minimize your on-site repair costs, and reduce crane downtime.

Your *IMPULSE*•VG+ Series 2 drive includes a two-year warranty from date of shipment. The warranty is described in detail later in this chapter.

On-Call Service

If you ever require our assistance, contact us at (800) 288-8178; our fax number is (800) 298-3508. Technical support is available 24 hours a day, seven days a week, and 365 days a year. If necessary, we can arrange to have a Service Technician visit your site to evaluate the situation.

Identifying Your Drive

If you ever have to contact Electromotive Systems about your drive, first determine the model and serial numbers of your drive by looking at the nameplate shown below.

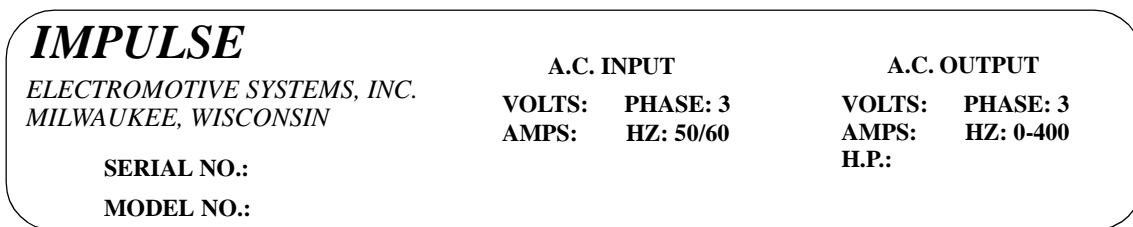


Figure 6.1

This nameplate is normally located on the side of the drive nearest to the keypad.

Service Policy For Small Drives, DBUs, and Other Electrical Components

This section explains Electromotive Systems' service policy for the small drives (2006-FVG+ through 2224-FVG+ and 4001-FVG+ through 4165-FVG+), dynamic braking units (DBUs), and other electrical components.

Should your *IMPULSE* product fail during the warranty period, Electromotive Systems will repair or replace your unit within 72 hours (3 working days). In most cases, we can supply a replacement unit within 24 hours (1 working day). If the problem is not covered under warranty, you are responsible for the cost of the repairs and the shipping charges.

To return a failed unit (or part):

1. Request a Return Authorization (RA) from Electromotive Systems' Service Department, as a condition for us to repair or replace the unit. Return the failed unit to Electromotive Systems **via pre-paid freight**. When you call, please have the serial number of the drive available and be prepared to provide the information requested on the Return Authorization Information Sheet found on page A-5.
2. A purchase order or credit card is required to cover the cost of the replacement unit or repairs to a returned unit.

Electromotive Systems will inspect the failed unit and determine if the unit is covered under warranty.

- If the unit is covered under warranty, Electromotive Systems will credit the cost of the replacement unit and/or repairs and reimburse for all reasonable freight charges.

NOTE: Freight charges incurred from sources other than common ground carriers WILL NOT be reimbursed unless pre-approved by Electromotive Systems.

- If the unit is not covered under warranty, Electromotive Systems will bill you for the cost of the replacement unit or the cost of repairs. Electromotive Systems will also bill you for a \$125.00 inspection fee (this fee will be waived if repairs are made to the unit) and any freight charges incurred by Electromotive Systems.

Service Policy for Large Drives

This section explains Electromotive Systems' service policy for the large drive (2300-FVG+ and 4224-FVG+ and larger).

Because of the size and weight of large units, it may not be practical to return the entire drive to Electromotive Systems for repair. If a drive has failed, you must first contact us by telephone for assistance in diagnosis. If necessary, we may authorize the on-site replacement of specific components and the return of these failed parts for credit, replacement, or repair.

These components include; but not limited to:

- Control/logic card
- Main base drive card
- Subbase drive card
- Drive unit transistor cassette
- Fan unit
- Main input diode circuit
- Capacitors
- DC Bus Fuses
- Electromotive Systems interface and special option cards.

On-site troubleshooting and the replacement of failed components is to be performed only by technicians approved by Electromotive Systems.

Follow procedures outlined above for returning components.

ELECTOMOTIVE SYSTEMS, INC.
RETURN AUTHORIZATION INFORMATION SHEET

To Expedite Processing Complete This Form

Please complete lines 5 through 15. If you have any questions regarding the completion of this form contact Electomotive Systems Service Department at 800-288-8178 ext. 375.

1. Return Authorization Number: RA _____ Issue Date / /
2. Customer _____
3. Customer P.O. Number _____
4. Contact Name _____ Phone _____ Fax _____
5. End User (name/location) _____
6. Component Model _____
7. Component Serial Number _____

ABOVE MATERIAL TO BE RETURNED VIA PRE-PAID FRIGHT TO:

*Electomotive Systems, Inc.
N49 W13650 Cambell Drive
Menomonie Falls, WI 53051*

*Please enclose a copy of this form with material to be returned and
mark RA number clearly on shipping container*

APPLICATION INFORMATION

8. Type of application (i.e. Mill, Log Handling, Standard Industrial): _____
9. Crane Duty Cycle: CMAA A B C D E F (circle)
10. Motion: _____ Main Hoist _____ Aux Hoist _____ Bridge _____ Trolley
Other (please specify) _____
11. Describe conditions under which problem occurred _____
12. Make/Model Dynamic Braking Resistor: _____
13. Line Voltage _____ 230 _____ 460 _____ 575 _____ Other (specify) _____
14. Motor Information: Qty _____ 1 _____ 2 _____ Other (please specify) _____
_____ Motor RPM _____ Nameplate Full Load Amps
15. Reactors used _____ Line _____ Load _____ None

FOR WARRANTY INFORMATION SEE BACK OF THIS FORM

Control number 1584

Original Date: 04/08/97

Rev 00 Page 1 of 1

Electromotive Systems Limited Warranty

Electromotive Systems, Inc., hereafter referred to as Company, guarantees all items manufactured by it against any defects of material and/or workmanship for a period of two years from the date of shipment. Company makes NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AS TO THE MERCHANTABILITY OR FITNESS OF THE ITEMS FOR THEIR INTENDED USE OR AS TO THEIR PERFORMANCE. Any statement, description or specification in Company's literature is for the sole purpose of identification of items sold by the Company and imparts no guarantee, warranty or undertaking by company of any kind. Components and accessories not manufactured by Electromotive Systems are not included in this warranty and are warranted separately by their respective manufacturers.

Company's sole liability shall be to repair at its factory, or replace any item returned to it within two years from date of shipment, which Company finds to contain defective material or workmanship. All items to be repaired or replaced shall be shipped to Company (Note: return authorization by Company is required) within said two year period, freight prepaid, as a condition to repair or replace defective material or workmanship. Company's herein assumed responsibility does not cover defects resulting from improper installation, maintenance, or improper use. Any corrective maintenance performed by anyone other than the Company during the warranty period shall void the warranty. Company shall not be liable for damages of any kind from any cause whatsoever beyond the price of the defective Company supplied items involved. Company shall not be liable for economic loss, property damage, or other consequential damages or physical injury sustained by the purchaser or by any third party as a result of the use of any Company supplied items or material.

Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of items sold by Company.

Materials or items may not be returned for credit, without the prior written consent of the Company. Any authorized return of materials or items shall be subject to a restocking charge equal to 25% of the net invoiced amount (\$100 minimum charge for all control products) after Company determines that the material or item is in resalable condition. If upon receipt of the material or items returned, the Company determines that said material or items cannot be resold without alteration or service, the Company reserves the right to reject the returned materials or items and to send the same back to said purchaser at purchaser's expense.

Any claim for errors in shipment or for material or time shortages must be received by Company within 30 days of shipment and must be accompanied by copies of the bill of lading and packing slip.

IMPULSE•VG+ Series 2 Parameter Listing

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