IMPULSE®•G+/VG+ Series 5
Variable Frequency/Vector Crane Controls
Technical Manual

MAGNETEK
By Columbus McKinnon

VFD Firmware: 14300
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Magnetek, hereafter referred to as Company, assumes no responsibility for improper programming of a VFD by untrained personnel. A VFD should only be programmed by a trained technician who has read and understands the contents of this manual. Improper programming of a VFD can lead to unexpected, undesirable, or unsafe operation or performance of the VFD. This may result in damage to equipment or personal injury. 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 such programming. Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of this product.

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WARNING

Improper programming of a VFD can lead to unexpected, undesirable, or unsafe operation or performance of the VFD.

DANGER, WARNING, CAUTION and NOTE Statements

Read and understand this manual before installing, operating or servicing this product. Install the product according to this manual and local codes.

The following conventions indicate safety messages in this manual. Failure to heed these messages could cause fatal injury or damage products and related equipment and systems.

DANGERS, WARNINGS and CAUTIONS

Throughout this document DANGERS, WARNING and CAUTION statements have been deliberately placed to highlight items critical to the protection of personnel and equipment.

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.*

DANGERS, WARNINGS and CAUTIONS SHOULD NEVER BE DISREGARDED.

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Table of Contents

1 Introduction

WARNING

Do not touch any circuitry components while the main AC power is on. In addition, wait until the red “CHARGE” LED is out before performing any service on that unit. It may take as long as 5 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 (U/T1, V/T2, W/T3) to the incoming, three-phase AC source.

Before executing a rotational 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.

Read and understand this manual before installing, operating, or servicing this VFD. All warnings, cautions, and instructions must be followed. All activity must be performed by qualified personnel. The VFD must be installed according to this manual and local codes.

Do not connect or disconnect wiring while the power is on. Do not remove covers or touch circuit boards while the power is on. Do not remove or insert the keypad while power is on.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 VDC. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure DC bus voltage to confirm safe level.

Do not perform a withstand voltage test on any part of the unit. This equipment uses sensitive devices and may be damaged by high voltage.

The VFD is suitable for circuits capable of delivering not more than 100,000 RMS symmetrical Amperes. Install adequate branch circuit short circuit protection per applicable codes. Failure to do so may result in equipment damage and/or personal injury.

Do not connect unapproved LC or RC interference suppression filters, capacitors, or overvoltage protection devices to the output of the VFD. These devices may generate peak currents that exceed VFD specifications.

1.1 How to Use This Manual

This manual provides technical information on IMPULSE®•G+/VG+ Series 5 VFD (variable frequency drive) parameter settings, functions, troubleshooting, and installation details. Use this manual to expand the functionality and to take advantage of higher performance features. This manual is available for download at www.cmco.com/magnetek.

The VFDs share a common power section and similar parameters. The parameters and performance differ because the VG+ includes a PG-X3 encoder feedback card allowing the VFD to perform Closed Loop Vector control of the motor. The G+ VFDs operate in V/f or Open Loop Vector control methods, appropriate for traverse or standard (mechanical load brake) hoist motions. The VG+ VFDs are typically applied to hoists without mechanical load brakes, and can be applied to traverse motions where torque control or a wide speed control range is required.

Many parameter functions are common between the two VFD classes. The functions that differ by model or control method are noted in the parameter descriptions. ***Table 1-1*** below lists the available configurations by model.

Table 1-1: Configurations by Model

VFD Model	Control Method (A01-02)	Speed Control Range	Motion (A01-03)
G+	V/f (0)	40:1	Traverse (0) Standard Hoist (1)
G+	Open Loop Vector (2)	200:1	Traverse (0) Standard Hoist (1)
VG+	Closed Loop Vector (3)	1500:1	Traverse (0) NLB Hoist (2)

The instructions in the following chapters apply to most crane, hoist, and monorail applications. However, carefully evaluate each specific situation and ensure that the National Electric Code (NEC) codes or local wiring practices are followed.

These chapters explain how to install the VFD and, to some extent, the components that it interconnects. It explains how to: assess the environment, mount, and wire the VFD. It is important to develop a plan for mounting and wiring since each task has an effect on the other one. Wiring Practices is included to provide assistance and reference.

NOTE: *If the IMPULSE•G+/VG+ Series 5 is part of a Magnetek motor control panel, reference the control drawings and this technical manual, as needed.*

1.2 General Information

1.2.1 Assessing the System Requirements

It is important to know how the VFD will be utilized before installation. Please know the requirements for the following components:

- Speed control method(s) - i.e. stepped, stepless, infinitely variable
- Braking method(s) - coast to stop, decel to stop, NLB Hoist
- Power source voltage, number of phases, and kVA rating
- Power source location
- Wire size
- Grounding location and method
- Control wiring sources - i.e., cab, pendant, radio

1.2.2 Assessing the VFD Environment

When choosing a location for the IMPULSE•G+/VG+ Series 5, perform the following steps:

1. Ensure that a three-phase 200 to 240 VAC 50/60 Hz power supply is available for a 230 VAC-rated VFD, a three-phase 380 to 480 VAC 50/60 Hz power supply is available for a 460 VAC-rated VFD, and a 500 to 600 VAC 50/60 Hz power supply is available for a 575 VAC-rated VFD.
2. Ensure the encoder (if required) is compatible with +5 VDC or 12 VDC.
3. If the RMS encoder current requirement is greater than 200 mA, provide an auxiliary power supply.
4. Ensure that the VFD-to-motor wiring distance is less than 150 ft. unless appropriate reactors, filters, and/or inverter duty motor is used.
5. Ensure that the VFD is protected or isolated from:
   - Ambient temperatures outside the range of +14°F to +140°F (-10°C to +60°C).
   - Rain or moisture
   - Corrosive gases or liquids
   - Direct sunlight
   - Severe mechanical vibration
6. Ensure that the VFD is housed in an appropriate NEMA-rated enclosure.
7. For severe-duty applications (long lifts, for example), ensure that the VFD control system (including dynamic braking resistors) is adequately cooled, even though the ambient temperature limit is not exceeded. For more information, contact Magnetek.

1.3 Specifications

1.3.1 VFD Specifications

Table 1-2: VFD Capacity - Heavy Duty

230 VAC			460 VAC			575 VAC		
Model (G+/VG+ S5)	Output Current (A)	Input Power (kVA)	Model (G+/VG+ S5)	Output Current (A)	Input Power (kVA)	Model (G+/VG+ S5)	Output Current (A)	Input Power (kVA)
2003	3.5	1.2	4001	1.8	1.3	TBD	1.7	1.7
2005	5.0	1.9	4003	3.4	1.7	TBD	3.5	3.5
2007	6.9	2.6	4004	4.8	2.7	TBD	4.1	4.1
2008	8.0	3.0	4005	5.5	3.8	TBD	6.3	6.3
2011	11	4.2	4007	7.2	5.5	TBD	9.8	9.8
2014	14	5.3	4009	9.2	6.1	TBD	12.5	12.5
2017	17.5	6.7	4014	14.8	8.8	TBD	17.0	17.0
2025	25	9.5	4018	18	11	TBD	22.0	22.0
2033	33	12.6	4024	24	17	TBD	27.0	27.0
2047	47	17.9	4031	31	22	TBD	32.0	32.0
2060	60	23	4039	39	27	TBD	41.0	41.0
2075	75	29	4045	45	32	TBD	52.0	52.0
2088	88	32	4060	60	41	TBD	62.0	62.0
2115	115	44	4075	75	52	TBD	77.0	77.0
2145	145	55	4091	91	61	TBD	99.0	99.0
2180	180	69	4112	112	76	TBD	130	129
2215	215	82	4150	150	99	TBD	172	171
2283	283	108	4180	180	124	TBD	200	199
2346	346	132	4216	216	143	TBD	242	229
2415	415	158	4260	260	191	TBD	336	319
			4304	304	241	TBD	382	364
			4371	371	288	TBD	412	408
			4414	414	330			
			4477	477	380			
			4515	515	410			
			4605	605	461			

Table 1-3: VFD Specifications

Specification	Specification Value and Information for All Models
Global Certifications	UL, CSA, CE (with filters), RCM, RoHs
Crane Duty Classification	CMAA Crane Duty Class A - F (or equivalent)
Rated input power supply	230 VAC Class: • AC: 200 to 240 VAC, 3-phase, 50/60 Hz • DC: 270 to 340 VDC 460 VAC Class: • AC: 380 to 480 VAC, 3-phase, 50/60 Hz • DC: 513 to 679 VDC 575 VAC Class: • AC: 500 to 600 VAC, 3-phase, 50/60 Hz • DC: 675 to 848 VDC
Short-Circuit Current Rating (SCCR)	The VFD is suitable for circuits capable of delivering a maximum of 100,000 RMS symmetrical Amps.
Control voltage	120 VAC (50/60 Hz) - optional interface card 24 VDC
Allowable voltage fluctuation	+10% or -15% of nominal
Allowable input frequency fluctuation	±5% of nominal
Allowable control frequency fluctuation	±3 Hz of nominal
Control methods	V/f, open loop vector, or closed loop vector; sine-wave, pulse-width modulated (PWM)
Maximum output voltage (VAC)	230 VAC Class: 3-phase 200 to 240 VAC (proportional to input voltage) 460 VAC Class: 3-phase 380 to 480 VAC (proportional to input voltage) 575 VAC Class: 3-phase 500 to 600 VAC (proportional to input voltage)
Output frequency (Hz)	0.00 to 300.00 Hz
Output speed control range	Closed Loop Vector: 1500:1; Open Loop Vector: 200:1; V/f: 40:1
Output frequency accuracy	Digital inputs: ± 0.01% of max frequency Analog inputs: ± 0.1% of max frequency, 10 bits/10 V
Frequency reference resolution	Digital: 0.01 Hz; Analog: 1/2048 of max frequency (11 bits and sign bit)
Output frequency resolution	0.001 Hz
Overload capacity	150% of VFD rated current for 1 minute, 175% for 5 seconds
Frequency reference sources	0–10 VDC; 0–20 mA; 4–20 mA; ±10 VDC; Serial (RS-485); Digital (Stepped)
Acceleration/deceleration times	0.00 to 60.00 seconds (standard); 0.0 to 600.0 seconds (optional)
Braking torque	150% or more with dynamic braking
DC Link Choke	Models 2088 to 2415, 4045 to 4605 have a built-in DC link choke.
Internal Braking Transistor	Models 2003 to 2115, 4001 to 4150 have an internal braking transistor (B1 and B2 terminals).
Motor overload protection	UL recognized electronic thermal overload relay; field-programmable
Overcurrent protection level (OC)	200% of VFD rated current
Circuit protection	Ground Fault and Short Circuit detection
Overvoltage protection level	230 VAC Class: Stops when DC bus voltage exceeds approx. 410 VDC 460 VAC Class: Stops when DC bus voltage exceeds approx. 820 VDC 575 VAC Class: Stops when DC bus voltage exceeds approx. 1040 VDC

Specification	Specification Value and Information for All Models
Undervoltage protection level	230 VAC Class: Stops when DC bus voltage falls below approx. 190 VDC 460 VAC Class: Stops when DC bus voltage falls below approx. 380 VDC 575 VAC Class: Stops when DC bus voltage falls below approx. 475 VDC
Heatsink overtemperature	Thermostat trips at approximately 100°C (212°F)
Torque limit selection	Limiting of Forward, Reverse, and Regen torques; selectable from 0–300%
Stall prevention	Functions for accel, decel, at-speed, and constant horsepower region
Other protection features	**VG+:** Speed deviation, overspeed, mechanical brake failure, output phase loss, failed-oscillator, encoder disconnect, roll-back detection, micro controller watchdog, internal braking transistor failure, torque output limit, motor overcurrent, VFD overcurrent, input phase loss. **G+:** Output phase loss, micro-controller watchdog, internal braking resistor failure, motor overcurrent, VFD overcurrent, input phase loss.
Chassis Design	Open Chassis (standard) UL Type 1 (optional kits)
DC bus voltage indication	Charge LED is on until DC bus voltage drops below 50 VDC
Installation Location	VFD must be installed inside an enclosure, and requires protection from moisture, corrosive gases, and liquids
Ambient operating temperature	-10° to 60°C (14° to 140°F)*
Storage temperature	-20°C to +70°C (-4°F to 158°F)
Humidity	95% relative; non-condensing
Vibration	10 to 20 Hz at 9.8 m/s^2 20 to 55 Hz at 5.9 m/s^2 (Models 2003 to 2180, 4001 to 4150) or 20 to 55 Hz at 2.0 m/s^2 (Models 2215 to 2415, 4180 to 4605)
Seismic Standards	Capable of structurally and operationally withstanding the seismic response criteria as defined in the IBC, ASCE7, HCAI, and tested to AC-156. Contact Magnetek for information on the IBC/HCAI seismic mounting requirements.
Elevation	Up to 1,000 m without derate, and up to 4,000 m with derate. Derate 1% of the VFD output current for every 100 m above 1,000 m.
Atmospheric Pressure	0.7 atmosphere (10.3 psi/70.9 kPa) to 1.05 atmosphere (15.4 psi/106.4 kPa)
Orientation	Install the VFD vertically to maintain maximum cooling effects.

* *Maximum ambient temperature of 60°C at the VFD chassis with output current derate*

1.3.2 AC Reactor Specifications

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

The following guidelines are recommendations to help determine input and output reactor requirements:

- The following tables are only a guideline. The size of the reactor is based on motor HP.
- Install an input reactor if the power source is greater than 500 kVA.
- Install an output reactor if the distance between the VFD and the motor exceeds 150 feet (45.7 meters).
- Install an output reactor if a device, such as a power limit switch, is used to disconnect the motor from the VFD. Use a power limit switch early break circuit to fault the VFD.
- Install one output reactor per VFD for a multiple-VFD arrangement requiring reactor protection.
- For a multiple VFD arrangement, an input reactor for each VFD is recommended for optimal protection. However, if the VFDs are within two VFD sizes of each other, a single input reactor can be used. The reactor must be rated at amperage equal to or greater than the sum of the amperage for all the VFDs.
- Reactors are most effective when the reactor current rating approaches the VFD current rating.

Table 1-4: 230 V Class

VFD Model Number	Reactor Part Number	Reactor Fundamental Amps	Reactor HP (kW)
2003-G+/VG+S5	REA230-1	4	1 (0.75)
2005-G+/VG+S5	REA230-1	4	1 (0.75)
2007-G+/VG+S5	REA230-2	8	2 (1.5)
2008-G+/VG+S5	REA230-2	8	2 (1.5)
2011-G+/VG+S5	REA230-3	12	3 (2.2)
2014-G+/VG+S5	REA230-3	12	3 (2.2)
2017-G+/VG+S5	REA230-5	18	5 (3.7)
2025-G+/VG+S5	REA230-7.5	25	7.5 (5.6)
2033-G+/VG+S5	REA230-10	35	10 (7.5)
2047-G+/VG+S5	REA230-15	45	15 (11)
2060-G+/VG+S5	REA230-20	55	20 (15)
2075-G+/VG+S5	REA230-25	80	25 (18.5)
2088-G+/VG+S5	REA230-30	80	30 (22)
2115-G+/VG+S5	REA230-40	100	40 (30)
2145-G+/VG+S5	REA230-50	130	50 (37)
2180-G+/VG+S5	REA230-60	160	60 (45)
2215-G+/VG+S5	REA230-75	200	75 (56)
2283-G+/VG+S5	REA230-100	250	100 (75)
2346-G+/VG+S5	REA230-125	320	125 (93)
2415-G+/VG+S5	REA230-150	400	150 (112)

Table 1-5: 460 V Class

VFD Model Number	Reactor Part Number	Reactor Fundamental Amps	Reactor HP (kW)
4001-G+/VG+S5	REA460-1	2	1 (0.75)
4003-G+/VG+S5	REA460-2	4	2 (1.5)
4004-G+/VG+S5	REA460-3	4	3 (2.2)
4005-G+/VG+S5	REA460-5	8	5 (3.7)
4007-G+/VG+S5	REA460-5	8	5 (3.7)
4009-G+/VG+S5	REA460-5	8	5 (3.7)
4014-G+/VG+S5	REA460-7.5	12	7.5 (5.6)
4018-G+/VG+S5	REA460-10	18	10 (7.5)
4024-G+/VG+S5	REA460-15	25	15 (11)
4031-G+/VG+S5	REA460-20	35	20 (15)
4039-G+/VG+S5	REA460-25	35	25 (18.5)
4045-G+/VG+S5	REA460-30	45	30 (22)
4060-G+/VG+S5	REA460-40	55	40 (30)
4075-G+/VG+S5	REA460-50	80	50 (37)
4091-G+/VG+S5	REA460-60	80	60 (45)
4112-G+/VG+S5	REA460-75	100	75 (56)
4150-G+/VG+S5	REA460-100	130	100 (75)
4180-G+/VG+S5	REA460-125	160	125 (93)
4216-G+/VG+S5	REA460-150	200	150 (112)
4260-G+/VG+S5	REA460-200	250	200 (150)
4304-G+/VG+S5	REA460-250	320	250 (187)
4371-G+/VG+S5	REA460-300	400	300 (224)
4414 G+/VG+S5	REA460-400	500	400 (298)
4477 G+/VG+S5	REA460-400	500	400 (298)
4515 G+/VG+S5	REA460-500	600	500 (373)
4605-G+/VG+S5	REA460-500	600	500 (373)

1.3.3 Terminal Board Specifications

IMPULSE•G+/VG+ Series 5 is designed to interface with user input and output devices through the integrated terminal board. This eliminates the need for an additional interface relay or isolation circuitry. The terminal board supports 24VDC digital inputs.

The terminal board has eight optically isolated input terminals which can be used to connect the user input device to the VFD. The eight terminals are multi-function and programmable.

The terminal board has four 250 VAC, 1.0 Amp relays for output devices. Three of them are programmable multi-function output terminals, and one is a fault output terminal.

A **120 VAC interface card** is available for support of 120 VAC 50/60 Hz digital inputs. The interface card plugs into the S1-S8 terminals of the 24 VDC terminal board.

Table 1-6: Terminal Board Ratings

Part Number	S1-S8	
	Voltage	Frequency
S5-120VAC-CARD	120 VAC	50/60 Hz
S5-24VDC-TERM	24 VDC	-

NOTE: *The 120 VAC interface card (S5-120VAC-CARD) cannot be used without the 24 VDC terminal board (S5-24VDC-TERM).*

1.3.4 S4IO Option Card Specifications

The S4IO is an option card that plugs into the VFD to provide additional I/O capability in addition to the I/O included on the terminal board.

The S4IO has four optically isolated input terminals and four dry contact form A relays.

NOTE: *The S4IO does not comply with UL, CSA, or CE standards.*

Table 1-7: S4IO Ratings

Part Number	I1-I4		O1-O6	
	Voltage	Frequency	Voltage (max)	Current (max)
S4IO-120A60	120 VAC	50/60 Hz	250 VAC/30 VDC	1.0 A

2 Installation

WARNING

- When preparing to mount the IMPULSE•G+/VG+ Series 5 VFD, lift it by its base. Never lift the VFD by the front cover, as doing so may cause damage or personal injury.
- Mount the VFD on nonflammable material.
- The VFD generates heat. For the most effective cooling, mount it vertically. For more details, refer to the “Dimensions (Open-Chassis)” section in this chapter.
- Install a fan or other cooling device to keep the ambient temperature below 60°C (140°F).

Failure to observe these warnings may result in equipment damage.

This chapter explains the following:

- Environmental requirements
- System components
- VFD dimensions
- VFD installation
- VFD derating

2.1 Environmental Requirements

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

- -10°C to +60°C (+14°F to 140°F):
- Excessive cold and heat. Use only within the ambient temperature range.
- Direct sunlight (The VFD must be installed inside an enclosure)
- 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 environments
- Combustibles (e.g. thinner, solvents, etc.)
- Physical shock, vibration
- Magnetic noise (e.g. welding machines, power devices, etc.)

2.2 System Components

2.2.1 Standard Components

- Terminal Board (24VDC with Optional 120VAC Interface Card)
- PG-X3 Line Driver Encoder Option Card (VG+ only)

2.2.2 Optional Components

- DI-A3 Digital DC Input Option Card
- DO-A3 Digital Output Option Card
- AO-A3 Analog Output Option Card
- S4IO Digital AC Input/Output Option Card
- PG-B3 Open Collector Encoder Option Card
- SI-EN3 EtherNet/IP Option Card
- SI-EN3D EtherNet/IP (Dual-Port) Option Card
- SI-EM3 Modbus TCP/IP Option Card
- SI-EM3D Modbus TCP/IP (Dual-Port) Option Card
- SI-EP3 PROFINET Option Card
- SI-P3 PROFIBUS-DP Option Card

2.2.3 As-Required Components

- AC reactor - line or load
- DC link choke
- External dynamic braking unit

2.2.4 Required Control Components

- External dynamic braking resistor(s)
- Motor
- User input device (pendant, joystick, PC, PLC, radio, or infrared control)
- External circuit protection devices (fuses or circuit breakers). ***See Section 3.2 on page 35.***
- R-C surge suppressors on contactor coils

2.3 Long-Term Storage and Capacitor Reforming

Powering up the VFD every six months is recommended. Over longer periods of time without power, the VFD's electrolytic DC bus capacitors require reformation, especially if stored in an area of high temperatures. Capacitor reforming is required if VFDs are stored without power for more than 2 to 3 years. This process can be avoided by powering up the VFD bi-annually for 30 to 60 minutes.

NOTE: *Bus cap reforming may not restore full VFD functionality after 2 to 3 years of storage without power.*

Variable frequency drives (VFD) contain large bus capacitors that have the potential to be reformed. However, printed circuit boards also contain electrolytic capacitors that may not function after several years without power. Magnetek recommends replacing the PCBs should the VFD's functionality not be restored after bus cap reforming. Contact Magnetek Field Service for assistance.

The electrical characteristics of aluminum electrolytic capacitors are dependent on temperature; the higher the ambient temperature, the faster the deterioration of the electrical characteristics (i.e., leakage current increase, capacitance drop, etc.). If an aluminum electrolytic capacitor is exposed to high temperatures such as direct sunlight, heating elements, etc., the life of the capacitor may be adversely affected. When capacitors are stored under humid conditions for long periods of time, the humidity will cause the lead wires and terminals to oxidize, which impairs their solderability. Therefore, aluminum electrolytic capacitors should be stored at room temperature, in a dry location and out of direct sunlight.

In the event that a capacitor has been stored in a high ambient environment for more than 2 or 3 years, a voltage treatment reformation process to electrolytic capacitors should be performed. When stored above room temperatures for long periods of time, the anode foil may react with the electrolyte, increasing the leakage current. After storage, the application of even normal voltages to these capacitors may result in higher than normal leakage currents. In most cases the leakage current levels will decrease in a short period of time as the normal chemical reaction within the capacitor occurs. However, in extreme cases, the amount of gas generated may cause the safety vent to open.

Capacitors, when used in VFDs that are stored for long periods of time, should be subjected to a voltage treatment/ reforming process as noted below, which will reform the dielectric and return the leakage current to the initial level.

2.3.1 Capacitor Reforming Procedure

1. Connect the VFD inputs L1 and L2 to a variac. It is also acceptable to use a three-phase variac or a variable DC power supply rated for the VFD's nominal DC bus voltage.
2. Make sure the variac voltage setting is turned down so that when input power is applied to the variac, the output of the variac will be at or near 0 volts.
3. Apply power to the variac, listening for abnormal sounds and watching for abnormal visual indications in the VFD. If the variac has an output current indication, make sure the current is near zero.
4. Slowly turn the variac up, increasing the output voltage to nominal rated input voltage over a time period of 2 to 3 minutes. In other words, ramp the voltage up at a rate of approximately 75 to 100 volts/minute for 230 VAC units, 150 to 200 volts/minute for 460 VAC units, and 225 to 300 volts/minute for 575 VAC.
5. Let the output voltage remain at rated voltage for 30 to 60 minutes while keeping close watch for abnormal signs within the VFD. While increasing the variac's output voltage, the current will momentarily increase as current is necessary to charge the capacitors.
6. Once 30 to 60 minutes elapse, remove power.

If any abnormal indications occur during this process, it is recommended that the process be repeated. If problems persist, the VFD should be replaced.

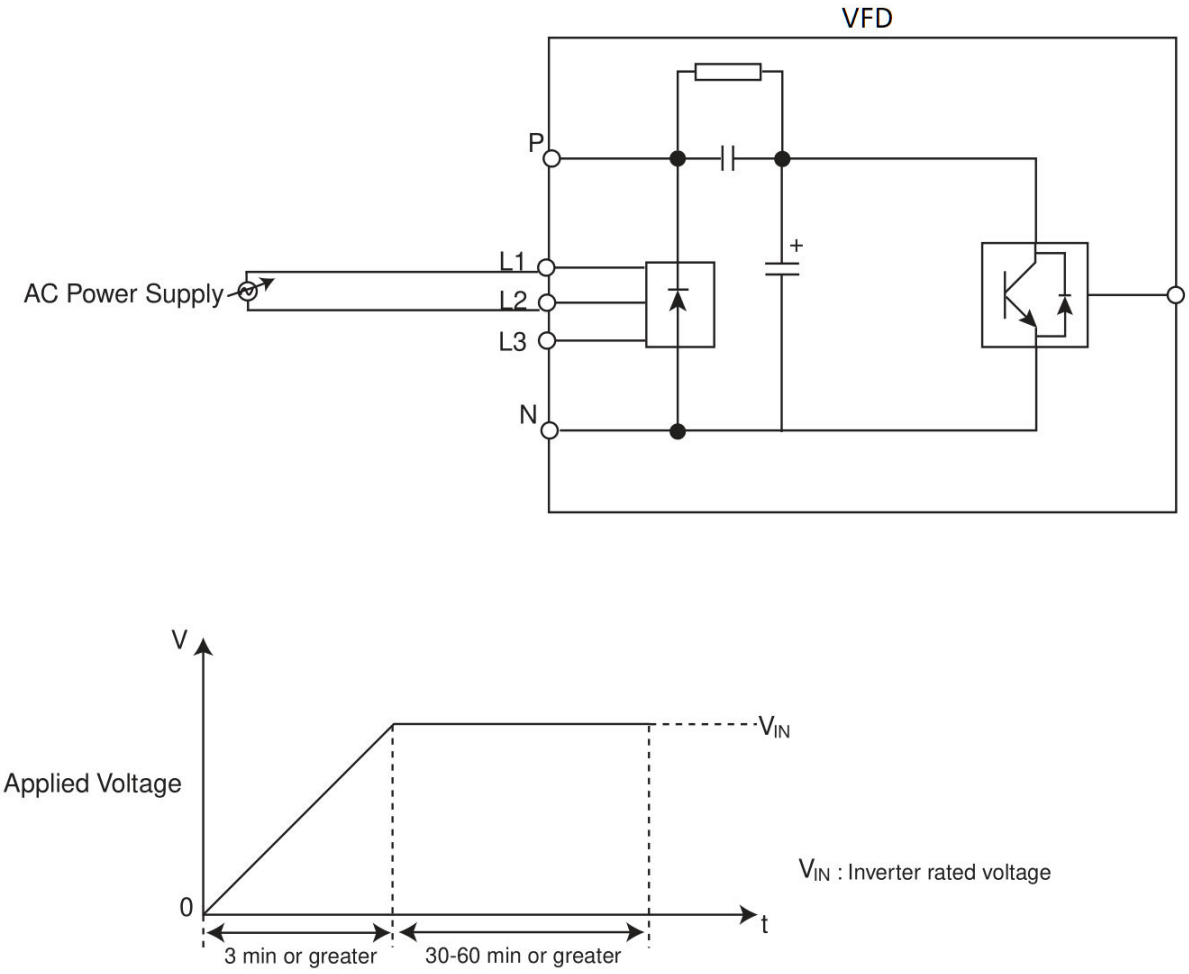


Figure 2-1: Capacitor Reform Diagrams

2.4 Installation Orientation

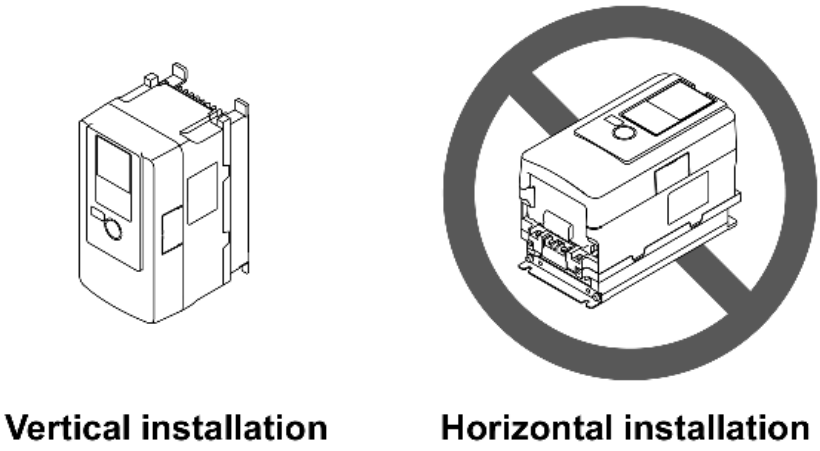


Figure 2-2: Standard Installation Orientation

2.5 Recommended Installation Clearances

The following two figures show the recommended minimum clearances when mounting the VFD in standard or side-by-side installations. If the recommended clearances can't be met, decreased airflow may reduce the life of the VFD.

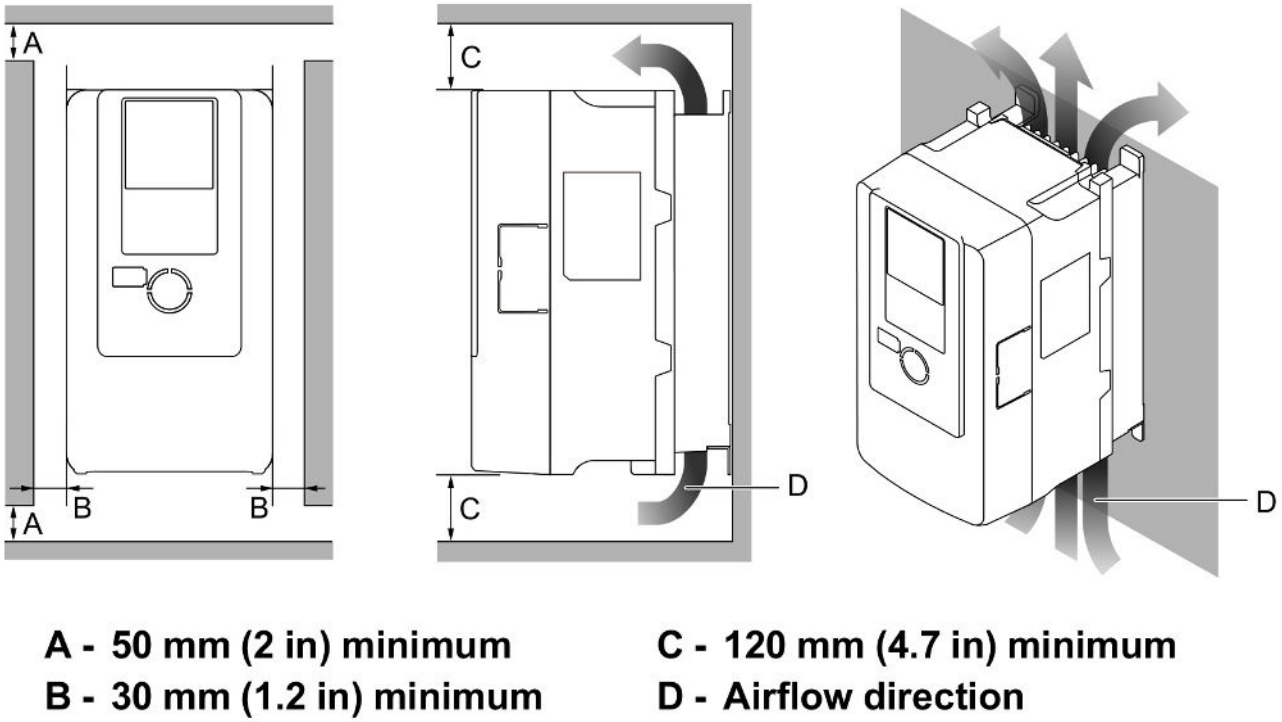
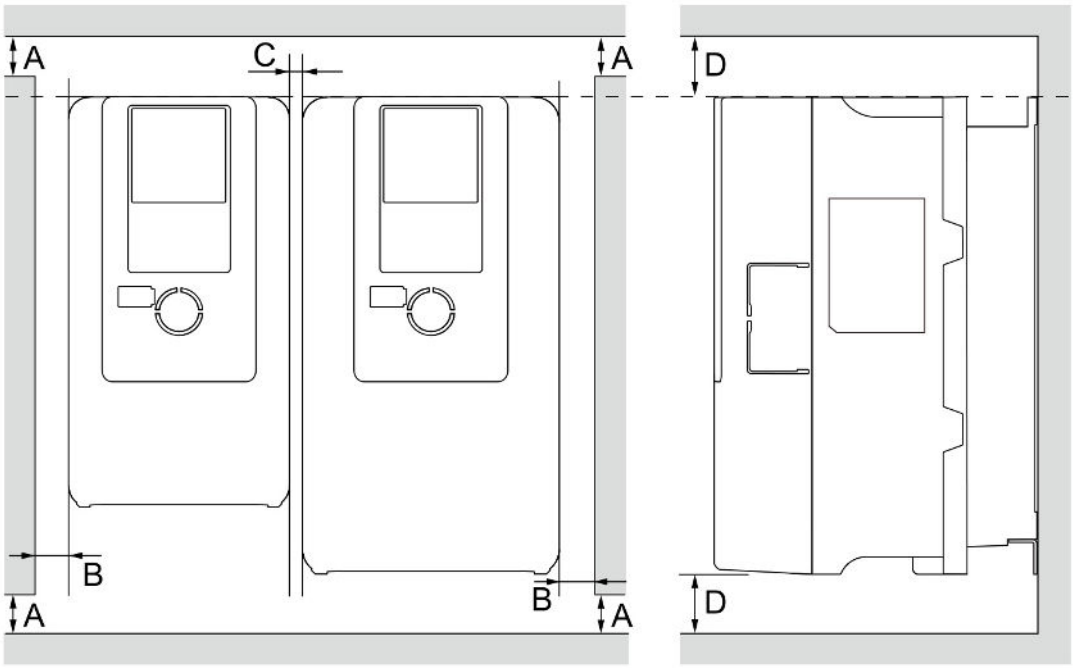


Figure 2-3: Standard Installation

2.6 Optional Side-by-Side Installation

Models 2003 to 2075 and 4001 to 4039 can take advantage of Side-by-Side installation.

It is recommended to set parameter L08-35 = 1 when mounting VFDs in a side-by-side configuration. This provides a more conservative OL2 overload protection.



A - 50 mm (2 in) minimum **C - 2 mm (0.08 in) minimum**
B - 30 mm (1.2 in) minimum **D - 120 mm (4.7 in) minimum**

Figure 2-4: Side-by-Side Installation

2.7 VFD Derating

2.7.1 Temperature Derating

To ensure the maximum performance life, the VFD output current must be derated when it is installed in areas with high ambient temperature or if VFDs are mounted side-by-side in a cabinet. In order to ensure reliable VFD overload protection, set parameters L08-12 and L08-35 according to the installation conditions.

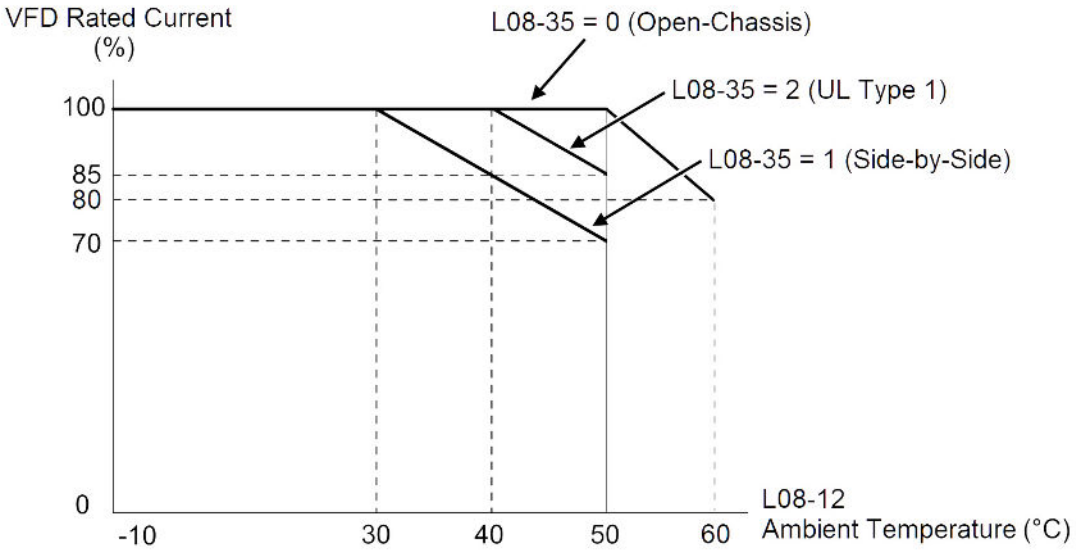


Figure 2-5: Ambient Temperature and Installation Method Derating

2.7.1.1 Open-Chassis Enclosure

An ambient temperature between -10°C to +50°C (14°F to 122°F) allows continuous and fully loaded operation without derating. For ambient temperatures up to 60°C (140°F), derate the output current to 80% of rated output current.

2.7.1.2 Side-by-Side Mounting

An ambient temperature between -10°C and 40°C (14°F to 104°F) allows continuous and fully loaded operation without derating. Operation between 40°C and 50°C (104°F to 122°F) requires output current derating.

2.7.2 Altitude Derating

The VFD output current must be derated when it is installed in altitudes above 1000 meters and up to a maximum of 4000 meters. Derate 1% for every 100 m above 1000 m.

2.8 Dimensions (Open-Chassis)

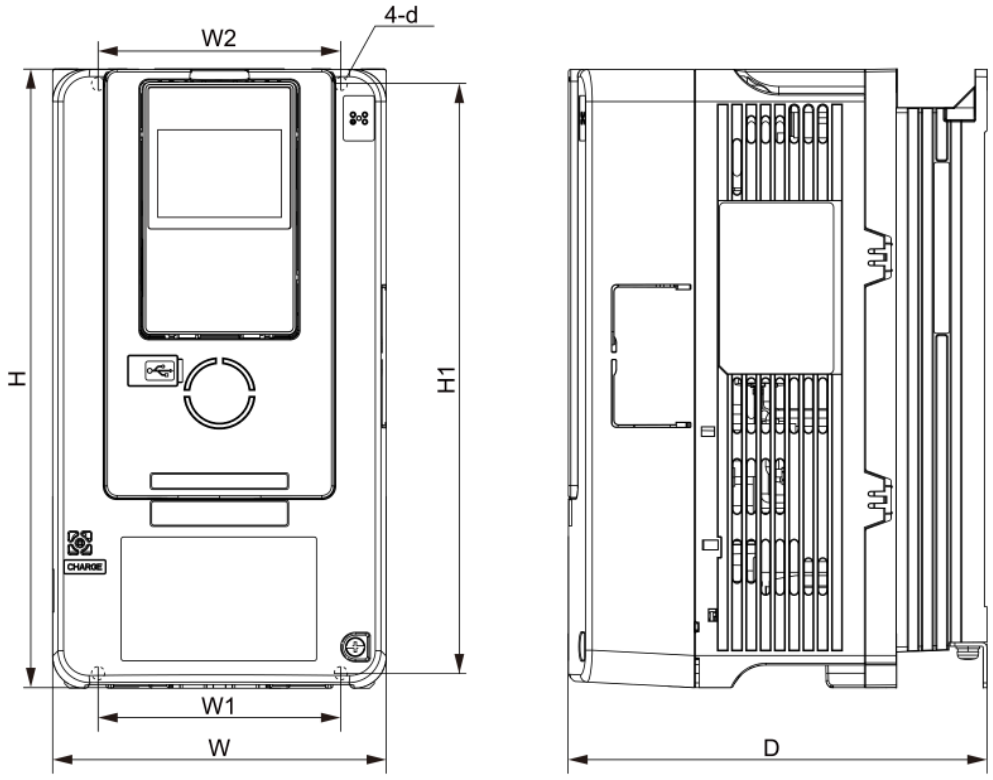


Figure 2-6

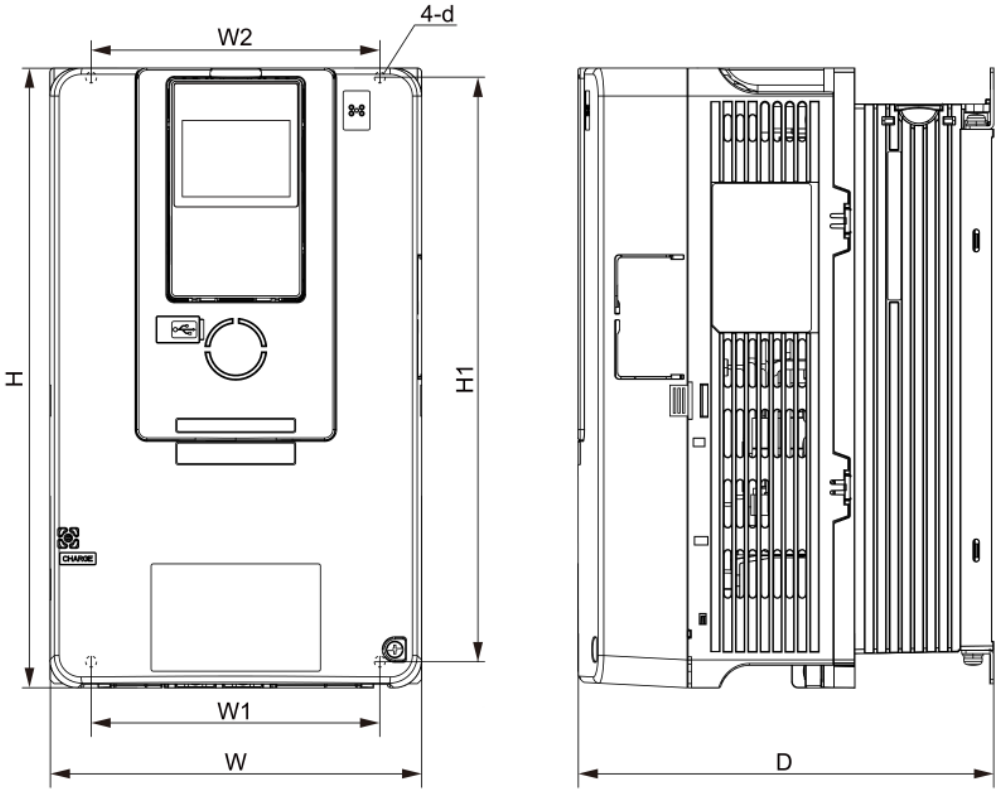


Figure 2-7

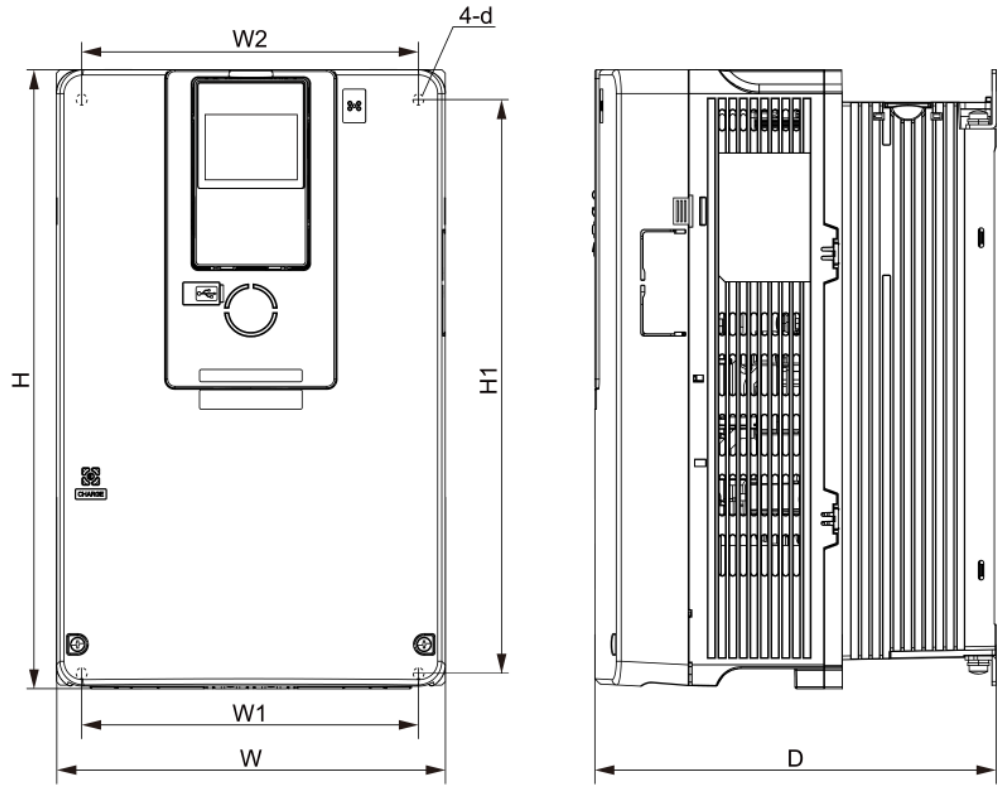


Figure 2-8

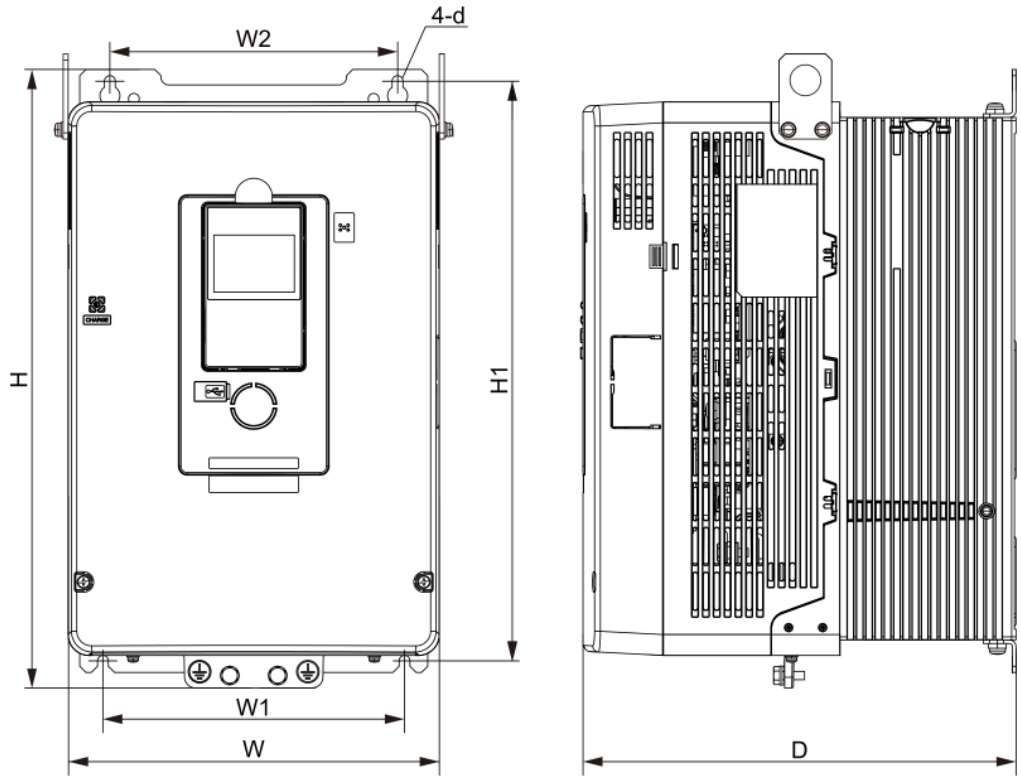


Figure 2-9

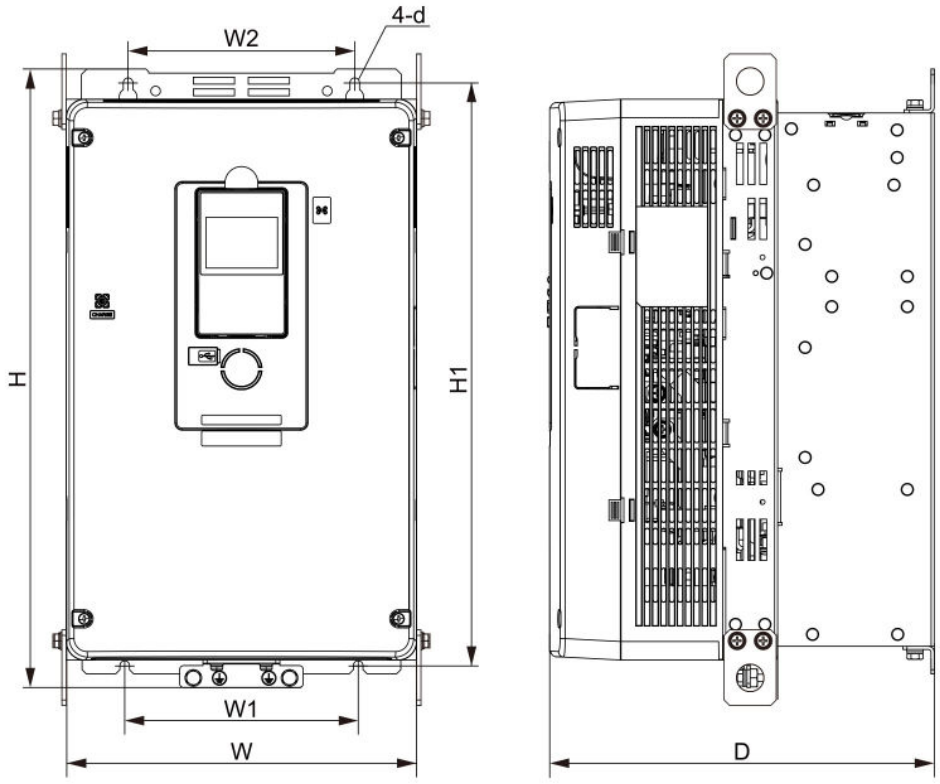


Figure 2-10

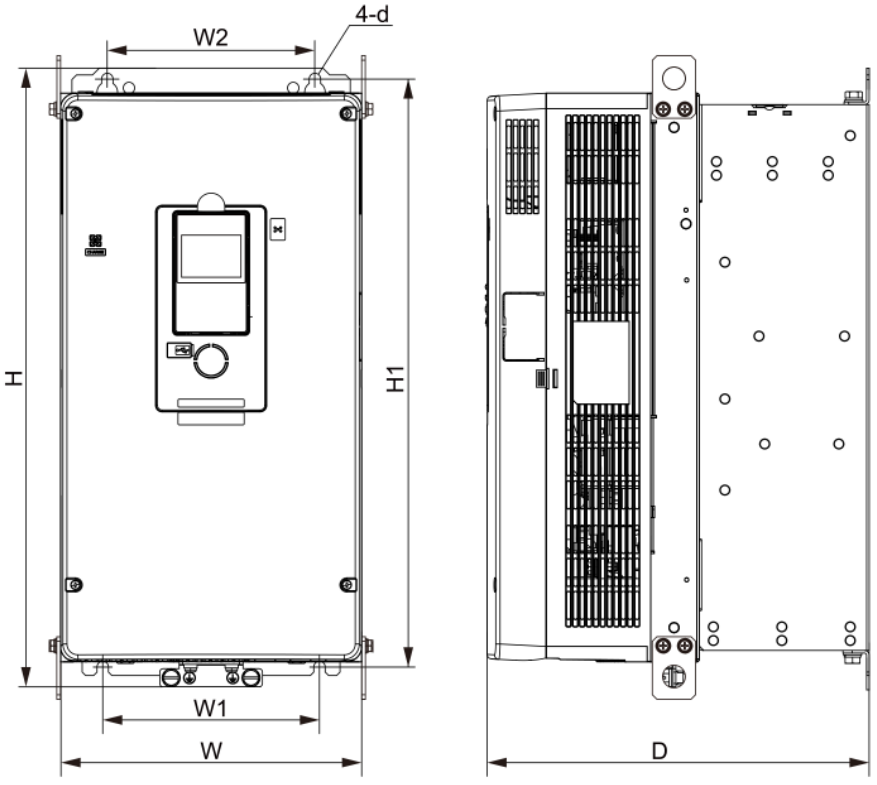


Figure 2-11

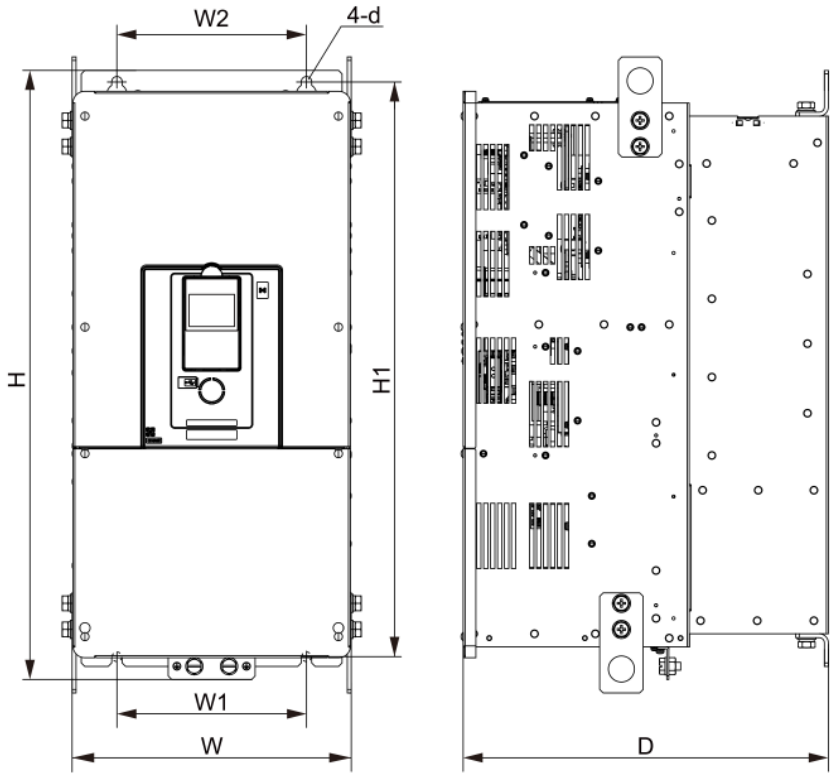


Figure 2-12

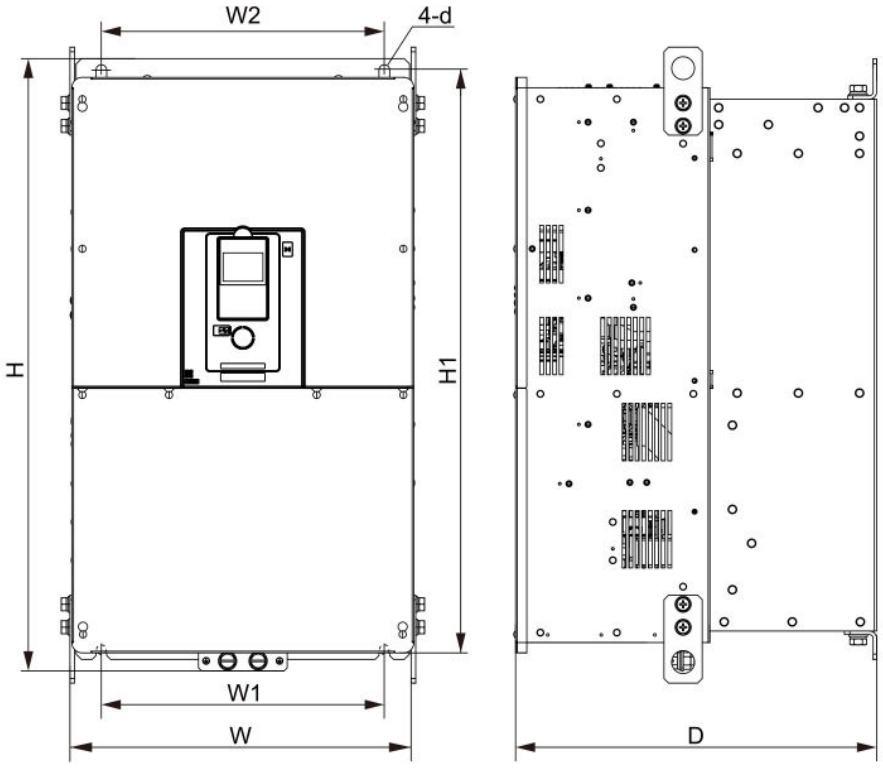


Figure 2-13

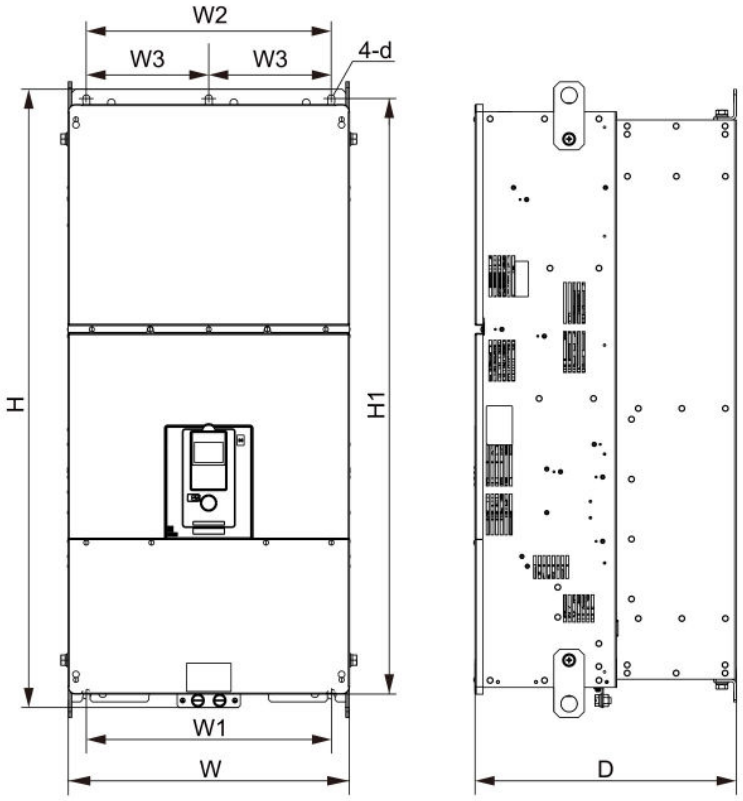


Figure 2-14

Table 2-1: Open-Chassis Dimensions – 230 V Class

Model	Figure	Dimensions - inches (mm)							Weight lbs (kg)	Heat Loss (W)*
		W	H	D	W1	W2	H1	d		
2003	2-6	5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	9.76 (248)	M5	7.7 (3.5)	54
2005		5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	9.76 (248)	M5	7.7 (3.5)	63
2007		5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	9.76 (248)	M5	7.7 (3.5)	76
2008		5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	9.76 (248)	M5	7.7 (3.5)	87
2011		5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	9.76 (248)	M5	7.7 (3.5)	111
2014		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	9.76 (248)	M5	8.4 (3.8)	129
2017		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	9.76 (248)	M5	8.4 (3.8)	161
2025		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	9.76 (248)	M5	9.3 (4.2)	248
2033		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	9.76 (248)	M5	9.3 (4.2)	271
2047	2-7	7.09 (180)	11.81 (300)	7.95 (202)	5.51 (140)	5.51 (140)	11.18 (284)	M5	13.2 (6.0)	379
2060	2-8	8.66 (220)	13.78 (350)	8.94 (227)	7.56 (192)	7.56 (192)	13.19 (335)	M6	18.7 (8.5)	518
2075		8.66 (220)	13.78 (350)	8.94 (227)	7.56 (192)	7.56 (192)	13.19 (335)	M6	21.0 (9.5)	657
2088	2-9	9.45 (240)	15.75 (400)	11.02 (280)	7.68 (195)	7.32 (186)	14.76 (375)	M6	39.7 (18.0)	718
2115	2-10	10.04 (255)	17.72 (450)	11.02 (280)	6.69 (170)	6.50 (165)	16.69 (424)	M6	46.3 (21.0)	892
2145	2-11	10.39 (264)	21.38 (543)	13.19 (335)	7.48 (190)	7.17 (182)	20.31 (516)	M8	75.0 (34.0)	1095
2180		10.39 (264)	21.38 (543)	13.19 (335)	7.48 (190)	7.17 (182)	20.31 (516)	M8	77.2 (35.0)	1305
2215	2-12	12.28 (312)	27.56 (700)	16.54 (420)	8.58 (218)	8.58 (218)	25.94 (659)	M10	127.9 (58.0)	1650
2283		12.28 (312)	27.56 (700)	16.54 (420)	8.58 (218)	8.58 (218)	25.94 (659)	M10	134.5 (61.0)	2145
2346	2-13	17.32 (440)	31.50 (800)	18.58 (472)	14.57 (370)	14.57 (370)	29.80 (757)	M12	220.5 (100.0)	2560
2415		17.32 (440)	31.50 (800)	18.58 (472)	14.57 (370)	14.57 (370)	29.80 (757)	M12	233.7 (106.0)	3003

* *Heat Loss is specified for fully loaded, continuous operation.*

Table 2-2: Open-Chassis Dimensions – 460 V Class

Model	Figure	Dimensions - inches (mm)								Weight lbs (kg)	Heat Loss (W)*
		W	H	D	W1	W2	W3	H1	d		
4001	2-6	5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	7.5 (3.4)	53
4003		5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	7.5 (3.4)	70
4004		5.51 (140)	10.24 (260)	6.93 (176)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	7.5 (3.4)	83
4005		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	8.2 (3.6)	93
4007		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	8.2 (3.7)	98
4009		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	8.2 (3.7)	128
4014		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	8.8 (4.0)	205
4018		5.51 (140)	10.24 (260)	8.31 (211)	4.02 (102)	4.02 (102)	-	9.76 (248)	M5	8.8 (4.0)	223
4024	2-7	7.09 (180)	11.81 (300)	7.95 (202)	5.51 (140)	5.51 (140)	-	11.18 (284)	M5	12.1 (5.5)	312
4031		7.09 (180)	11.81 (300)	7.95 (202)	5.51 (140)	5.51 (140)	-	11.18 (284)	M5	12.1 (5.5)	391
4039	2-8	8.66 (220)	13.78 (350)	8.94 (227)	7.56 (192)	7.56 (192)	-	13.19 (335)	M6	17.6 (8.0)	502
4045		8.66 (220)	13.78 (350)	9.69 (246)	7.56 (192)	7.56 (192)	-	13.19 (335)	M6	28.7 (13.0)	515
4060	2-9	9.45 (240)	15.75 (400)	11.02 (280)	7.68 (195)	7.32 (186)	-	14.76 (375)	M6	33.1 (15.0)	692
4075	2-10	10.04 (255)	17.72 (450)	11.02 (280)	6.69 (170)	6.50 (165)	-	16.69 (424)	M6	44.1 (20.0)	801
4091		10.04 (255)	17.72 (450)	11.02 (280)	6.69 (170)	6.50 (165)	-	16.69 (424)	M6	52.9 (24.0)	1016
4112	2-11	10.39 (264)	21.38 (543)	13.19 (335)	7.48 (190)	7.17 (182)	-	20.31 (516)	M8	79.4 (36.0)	1256
4150		10.39 (264)	21.38 (543)	13.19 (335)	7.48 (190)	7.17 (182)	-	20.31 (516)	M8	81.6 (37.0)	1760
4180	2-12	12.28 (312)	27.56 (700)	16.54 (420)	8.58 (218)	8.58 (218)	-	25.94 (659)	M10	132.3 (60.0)	1878
4216		12.28 (312)	27.56 (700)	16.54 (420)	8.58 (218)	8.58 (218)	-	25.94 (659)	M10	136.7 (62.0)	2022
4260		12.28 (312)	27.56 (700)	16.54 (420)	8.58 (218)	8.58 (218)	-	25.94 (659)	M10	143.3 (65.0)	2753
4304	2-13	17.32 (440)	31.50 (800)	18.58 (472)	14.57 (370)	14.57 (370)	-	29.80 (757)	M12	233.7 (106.0)	3342
4371		17.32 (440)	31.50 (800)	18.58 (472)	14.57 (370)	14.57 (370)	-	29.80 (757)	M12	247.0 (112.0)	2989
4414	2-14	20.08 (510)	44.72 (1136)	18.90 (480)	17.72 (450)	17.72 (450)	8.86 (225)	43.03 (1093)	M12	436.5 (198.0)	3659
4477		20.08 (510)	44.72 (1136)	18.90 (480)	17.72 (450)	17.72 (450)	8.86 (225)	43.03 (1093)	M12	436.5 (198.0)	4512
4515		20.08 (510)	44.72 (1136)	18.90 (480)	17.72 (450)	17.72 (450)	8.86 (225)	43.03 (1093)	M12	456.3 (207.0)	5485
4605		20.08 (510)	44.72 (1136)	18.90 (480)	17.72 (450)	17.72 (450)	8.86 (225)	43.03 (1093)	M12	451.9 (205.0)	5593

* *Heat Loss is specified for fully loaded, continuous operation.*

3 Wiring

3.1 Wiring Practices

WARNING

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

- Recommended wire is to be rated for minimum 75°C, 600 VAC, vinyl sheathed.
- Ensure that the encoder wiring is less than 300 feet unless fiber optic cables are used.
- Ensure that the encoder wiring is isolated from the power wiring.
- Ensure that the encoder wiring shield is grounded only at the VFD end.
- Connect the incoming three-phase AC source to terminals R/L1, S/L2, T/L3.
- Connect the Motor leads to terminals U/T1, V/T2, W/T3.
- Install a line reactor between the output of the VFD in applications that require a disconnecting means between the VFD's output and motor. Use a "make before break" auxiliary contact with the disconnect means and the hardware baseblock of the VFD.
- Use hard contacts between the PLC output and the VFD interface board. If using a solid state output from a PLC (TRIAC) to a 120 VAC input card, use a 5KΩ, 5W resistor between the signal and X2.
- If the power source is 500 kVA or greater, or more than 10 times the VFD kVA rating, ensure there is at least 3% impedance between the power source and the VFD input. To accomplish this, a DC reactor can be installed between VFD terminals +1 and +2, or an AC line reactor can be used on the input of the VFD. Excessive peak currents could damage the input power supply circuit if there is not enough impedance.
- Comply with the Suggested Circuit Protection and Wire Size specifications in ***Section 3.2 on page 35***.
- Use time delay fuses, which are sized at 150% of VFD's continuous rated input current, for wiring protection.
- Use appropriate R-C or MOV 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.
- Use external dynamic braking resistors for all applications.
- Do not ground the VFD with any large-current machines.
- Before using any welding or high-current machines near the crane, disconnect all line and ground wiring.
- Do not let the wiring leads come in contact with the VFD enclosure.
- Do not connect power factor correction capacitors to the VFD input or output; use a sine wave filter.
- The VFD and motor must be hardwired together. Do not use sliding collector bars.
- If there is a user input device or interface board that is remote, use shielded cable between the VFD input terminals and the interface output terminals or user input device(s).
- Before turning on the VFD, check the output circuit (U/T1, V/T2 and W/T3) for possible short circuits and ground faults.
- Increase the wire size by one gauge for every 250 feet (76.2 meters) between the VFD and motor; suggested for center driven cranes, trolleys, and bridges (voltage drop is significant at low frequencies).

- When using more than one transformer for the VFD's power, properly phase each transformer.
- To reverse the direction of rotation, program b03-04 = 1 (exchange phases), or interchange any two motor leads (changing R/L1, S/L2, or T/L3 will not affect the shaft rotation direction) as well as encoder phasing (F01-02 = 1 or swap the A+ and A- wires).
- Use shielded cable for all low-level DC speed reference signals (0 to 10 VDC, 4 to 20 mA). Ground the shield only at the VFD side.
- Please observe National Electrical Code (NEC) guidelines when wiring electrical devices.
- IMPORTANT: All wire connections must have strain relief, and must not apply downward pressure to the terminals on the VFD.

NOTE: *Failure to observe these warnings may result in equipment damage.*

CAUTION

Do NOT connect external dynamic braking units to VFD braking resistor terminal “B2”. Connect positive external dynamic braking unit terminal(s) to terminal “+3” and negative external dynamic braking unit terminal(s) to terminal “-”. When terminal “+3” is unavailable, use terminal “B1”.

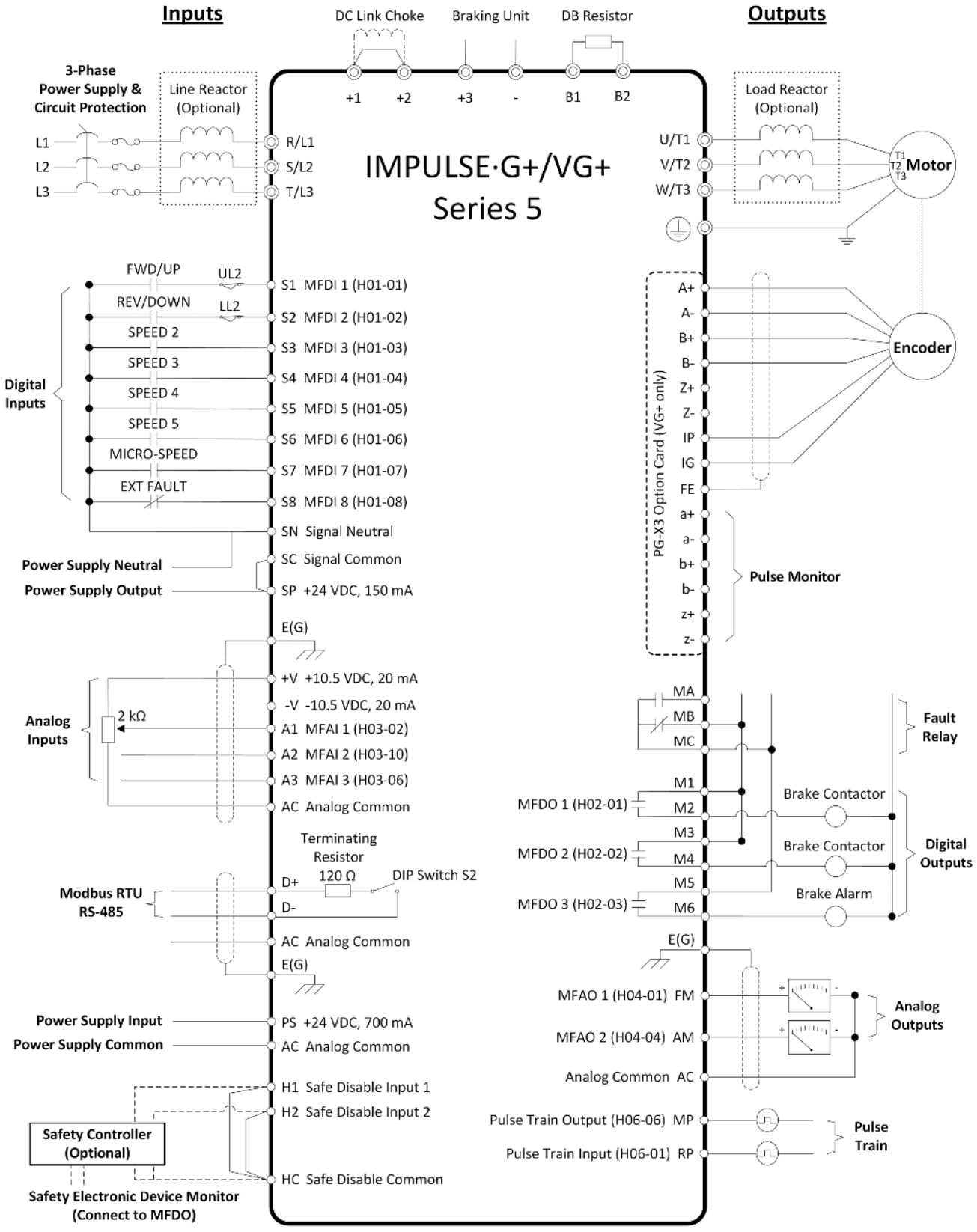


Figure 3-1: Typical Connection Diagram

3.2 Suggested Circuit Protection and Wire Size

In order to comply with most safety standards, circuit protective devices should be used between the incoming three-phase power supply and the VFD. These devices can be thermal, magnetic, or molded-case circuit breakers (MCCB); or “slow-blow” type time-delay fuses.

NOTE: *The following are recommendations based on the rated capacity of the VFD. Per NEC guidelines, circuit protection and wiring can be selected based on the capacity of the motor.*

CAUTION

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

Table 3-1: Wire Size and Circuit Protection for 230 V Class

Model Number (G+/VG+ S5)	Recommended Maximum Circuit Protection				Recommended Wire Size (AWG)[1]			
	Continuous HD Input Amps	Time Delay Input Fuse (A)[3]	Time Delay Input Fuse Class	Inverse Time Circuit Breaker (A)[3]	Power Circuit Wiring	Control Wiring[4]	Ground Copper[2] (Fuse)	Ground Copper[2] (Breaker)
2003	3.6	7	CC	15	14	24 to 16	14	14
2005	4.8	9	CC	15	14	24 to 16	14	14
2007	6.7	12	CC	20	14	24 to 16	14	12
2008	8.9	18	CC	25	14	24 to 16	12	10
2011	12.7	25	CC	35	14	24 to 16	10	10
2014	17	30	CC	45	14	24 to 16	10	10
2017	20.7	40	J	60	14 to 12	24 to 16	10	10
2025	30	60	J	80	12 to 10	24 to 16	10	8
2033	40.3	80	J	110	10 to 8	24 to 16	8	6
2047	58.2	110	J	150	8 to 4	24 to 16	6	6
2060	78.4	150	J	200	6 to 2	24 to 16	6	6
2075	96	175	J	250	4 to 2	24 to 16	6	4
2088	82	150	J	225	4 to 2	24 to 16	6	4
2115	111	200	J	300	2 to 1/0	24 to 16	6	4
2145	136	250	J	350	1/0 to 2/0	24 to 16	4	3
2180	164	300	J	450	1/0 to 3/0	24 to 16	4	2
2215	200	350	J	500	3/0 to 250	24 to 16	3	2
2283	271	500	J	700	250 to (2)2/0	24 to 16	2	1/0
2346	324	600	J	1000	(2)1/0 to 500	24 to 16	1	2/0
2415	394	700	J	1000	(3)1/0 to 450	24 to 16	1/0	2/0

1) NFPA 70 National Electric Code 2017. Tables 430.122(a), 310.15(b)(16), and 610.14(a), 75°C conductor, 60-minute, copper with 40°C ambient correction factor, for up to CMAA Class F duty cycle cranes and hoists.

2) NFPA 70 National Electric Code 2017. Table 250.122.

3) NFPA 70 National Electric Code 2017. Table 430.52 (selected based on VFD input Amps).

*4) **See Section 3.5** for stranded, solid, and dual wire specifications.*

Table 3-2: Wire Size and Circuit Protection for 460 V Class

Model Number (G+/VG+ S5)	Recommended Maximum Circuit Protection				Recommended Wire Size (AWG)[1]			
	Continuous HD Input Amps	Time Delay Input Fuse (A)[3]	Time Delay Input Fuse Class	Inverse Time Circuit Breaker (A)[3]	Power Circuit Wiring	Control Wiring[4]	Ground Copper[2] (Fuse)	Ground Copper[2] (Breaker)
4001	1.6	2.8	CC	15	14	24 to 16	14	14
4003	2.1	4	CC	15	14	24 to 16	14	14
4004	3.9	7	CC	15	14	24 to 16	14	14
4005	5.5	10	CC	15	14	24 to 16	14	14
4007	7.4	15	CC	20	14	24 to 16	14	12
4009	9	18	CC	25	14	24 to 16	12	10
4014	13.1	25	CC	35	14	24 to 16	10	10
4018	17.5	35	J	45	14 to 12	24 to 16	10	10
4024	25.3	45	J	70	12 to 10	24 to 16	10	8
4031	34.1	60	J	90	10 to 8	24 to 16	10	8
4039	41.7	80	J	110	8 to 6	24 to 16	8	6
4045	35.6	70	J	90	8 to 6	24 to 16	8	8
4060	48.1	90	J	125	8 to 4	24 to 16	8	6
4075	59	110	J	150	4 to 2	24 to 16	6	6
4091	71.4	125	J	200	4 to 2	24 to 16	6	6
4112	86.9	175	J	225	4 to 1/0	24 to 16	6	6
4150	118	225	J	300	2 to 2/0	24 to 16	4	4
4180	141	250	J	400	1/0 to 3/0	24 to 16	4	3
4216	171	300	J	450	2/0 to 250	24 to 16	4	2
4260	232	450	J	600	(2)1/0 3/0 to 300	24 to 16	2	1
4304	289	600	J	800	(2)2/0 250 to 400	24 to 16	1	1/0
4371	346	650	J	1000	(2)2/0 to 400	24 to 16	1/0	2/0
4414	403	750	L	1200	(2)250 to (2)300 350 to 400	24 to 16	1/0	3/0
4450	410	750	L	1200	(2)4/0 to 450	24 to 16	1/0	3/0
4477	460	900	L	1200	(3)2/0 to (2)250	24 to 18	2/0	3/0
4515	516	1000	L	1600	(3)3/0 to 450	24 to 18	2/0	4/0
4605	573	1100	L	1600	(2)250 to 500	24 to 16	3/0	4/0

1) NFPA 70 National Electric Code 2017. Tables 430.122(a), 310.15(b)(16), and 610.14(a), 75°C conductor, 60-minute, copper with 40°C ambient correction factor, for up to CMAA Class F duty cycle cranes and hoists.

2) NFPA 70 National Electric Code 2017. Table 250.122.

3) NFPA 70 National Electric Code 2017. Table 430.52 (selected based on VFD input Amps).

*4) **See Section 3.5** for stranded, solid, and dual wire specifications.*

Table 3-3: Wire Size Range and Tightening Torque for 230 V Class

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
2003	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
2005	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
2007	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
2008	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
2011	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
2014	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
2017	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	12 - 8 (4.0 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
2025	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	10 - 8 (6.0 - 10)	M5	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
2033	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	10 - 8 (6.0 - 10)	M5	2.0 - 2.5 (17.7 - 22.1)
2047	R/L1, S/L2, T/L3	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	U/T1, V/T2, W/T3	14 - 4 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	-, +1, +2	14 - 1 (2.5 - 50)	M6	5 - 5.5 (45 - 49)
	B1, B2	14 - 8 (2.5 - 10)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	8 - 6 (10 - 16)	M6	5.4 - 6.0 (47.8 - 53.1)
2060	R/L1, S/L2, T/L3	14 - 1 (2.5 - 50)	M6	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	14 - 3 (2.5 - 25)	M6	5 - 5.5 (45 - 49)
	-, +1, +2	14 - 1/0 (2.5 - 50)	M6	5 - 5.5 (45 - 49)
	B1, B2	14 - 8 (2.5 - 10)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	6 - 4 (16 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)
2075	R/L1, S/L2, T/L3	14 - 1/0 (2.5 - 50)	M6	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	14 - 2 (2.5 - 35)	M6	5 - 5.5 (45 - 49)
	-, +1, +2	14 - 2/0 (2.5 - 70)	M6	5 - 5.5 (45 - 49)
	B1, B2	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	6 - 4 (16 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
2088	R/L1, S/L2, T/L3	6 - 1/0 (16 - 50)	M6	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	6 - 1/0 (16 - 50)	M6	8 - 9 (71 - 80)
	-, +1	2 - 2/0 (35 - 70)	M8	10 - 12 (89 - 107)
	B1, B2	14 - 4 (2.5 - 25)	M6	3 - 3.5 (27 - 31)
	Ground	6 - 4 (16 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)
2115	R/L1, S/L2, T/L3	6 - 2/0 (16 - 70)	M6	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	6 - 2/0 (16 - 70)	M6	8 - 9 (71 - 80)
	-, +1	2 - 4/0 (35 - 95)	M8	10 - 12 (89 - 107)
	B1, B2	14 - 3 (2.5 - 25)	M6	3 - 3.5 (27 - 31)
	Ground	4 (25)	M6	5.4 - 6.0 (47.8 - 53.1)
2145	R/L1, S/L2, T/L3	2 - 250 (35 - 120)	M10	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	2 - 300 (35 - 150)	M10	12 - 14 (107 - 124)
	-, -, +1, +1*2,*3	6 - 2/0 (16 - 70)	M6	8 - 9 (71 - 80)
	+3*3	4 - 2/0 (25 - 70)	M8	8 - 9 (71 - 80)
	Ground	4 - 1/0 (25 - 50)	M8	9.0 - 11 (79.7 - 97.4)
2180	R/L1, S/L2, T/L3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	U/T1, V/T2, W/T3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	-, -, +1, +1*2,*3	2 - 250 x 2P (35 - 120 x 2P)	M10	20 (177)
	+3*3	4 - 1/0 x 2P (25 - 50 x 2P)	M10	20 (177)
	Ground	3 - 350 (25 - 185)	M10	18 - 23 (159 - 204)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
2215	R/L1, S/L2, T/L3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	U/T1, V/T2, W/T3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	-, +1	2 - 250 x 2P (35 - 120 x 2P)	M10	20 (177)
	+3	4 - 1/0 x 2P (25 - 50 x 2P)	M10	20 (177)
	Ground	3 - 350 (25 - 150)	M10	18 - 23 (159 - 204)
2283	R/L1, S/L2, T/L3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	U/T1, V/T2, W/T3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	-, +1	2 - 250 x 2P (35 - 120 x 2P)	M10	20 (177)
	+3	4 - 1/0 x 2P (25 - 50 x 2P)	M10	20 (177)
	Ground	2 - 350 (35 - 150)	M10	18 - 23 (159 - 204)
2346	R/L1, S/L2, T/L3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	-, +1	4/0 - 400 x 2P (95 - 185 x 2P)	M12	35 (310)
	+3	1/0 - 4/0 x 2P (50 - 95 x 2P)	M12	35 (310)
	Ground	1 - 350 (50 - 150)	M12	32 - 40 (283 - 354)
2415	R/L1, S/L2, T/L3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	-, +1	4/0 - 400 x 2P (95 - 185 x 2P)	M12	35 (310)
	+3	1/0 - 4/0 x 2P (50 - 95 x 2P)	M12	35 (310)
	Ground	1 - 350 (50 - 150)	M12	32 - 40 (283 - 354)

**1 For wire gauges more than AWG 8, tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf-in to 40 lbf-in).*

**2 Terminals - and +1 have two screws. The Wire Range is the wire gauge for one terminal.*

**3 A junction terminal is necessary to connect a braking unit (CDBR) to terminals - and +3.*

Table 3-4: Wire Size Range and Tightening Torque for 460 V Class

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
4001	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
4003	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
4004	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
4005	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
4007	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
4009	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (2.5 - 10)	M4	1.2 - 1.5 (10.6 - 13.3)
4014	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	14 - 8 (4.0 - 10)	M5	2.0 - 2.5 (17.7 - 22.1)
4018	R/L1, S/L2, T/L3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 10 (2.5 - 6.0)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	12 - 8 (4.0 - 10)	M5	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
4024	R/L1, S/L2, T/L3	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	U/T1, V/T2, W/T3	14 - 4 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	-, +1, +2	14 - 1 (2.5 - 50)	M6	5 - 5.5 (45 - 49)
	B1, B2	14 - 8 (2.5 - 10)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	10 - 6 (6.0 - 16)	M6	5.4 - 6.0 (47.8 - 53.1)
4031	R/L1, S/L2, T/L3	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	U/T1, V/T2, W/T3	14 - 4 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	-, +1, +2	14 - 1 (2.5 - 50)	M6	5 - 5.5 (45 - 49)
	B1, B2	14 - 8 (2.5 - 10)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	10 - 6 (6.0 - 16)	M6	5.4 - 6.0 (47.8 - 53.1)
4039	R/L1, S/L2, T/L3	14 - 4 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	U/T1, V/T2, W/T3	14 - 6 (2.5 - 16)	M5	2.3 - 2.5 (19.8 - 22)*1
	-, +1, +2	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 8 (2.5 - 10)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	8 - 4 (10 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)
4045	R/L1, S/L2, T/L3	14 - 4 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	U/T1, V/T2, W/T3	14 - 4 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	-, +1	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 8 (2.5 - 10)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	8 - 4 (10 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
4060	R/L1, S/L2, T/L3	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	U/T1, V/T2, W/T3	14 - 3 (2.5 - 25)	M5	2.3 - 2.5 (19.8 - 22)*1
	-, +1	14 - 2 (2.5 - 35)	M5	2.3 - 2.5 (19.8 - 22)*1
	B1, B2	14 - 6 (2.5 - 16)	M4	1.5 - 1.7 (13.5 - 15)
	Ground	6 - 4 (16 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)
4075	R/L1, S/L2, T/L3	14 - 2 (2.5 - 35)	M5	2.3 - 2.5 (19.8 - 22)*1
	U/T1, V/T2, W/T3	14 - 2 (2.5 - 35)	M5	2.3 - 2.5 (19.8 - 22)*1
	-, +1, +2	14 - 1/0 (2.5 - 50)	M6	5 - 5.5 (45 - 49)
	B1, B2	14 - 6 (2.5 - 16)	M5	2.3 - 2.5 (19.8 - 22)*1
	Ground	6 - 4 (16 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)
4091	R/L1, S/L2, T/L3	6 - 2/0 (16 - 70)	M6	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	6 - 2/0 (16 - 70)	M6	8 - 9 (71 - 80)
	-, +1	2 - 4/0 (35 - 95)	M8	10 - 12 (89 - 107)
	B1, B2	14 - 3 (2.5 - 25)	M6	3 - 3.5 (27 - 31)
	Ground	6 - 4 (16 - 25)	M6	5.4 - 6.0 (47.8 - 53.1)
4112	R/L1, S/L2, T/L3	2 - 250 (35 - 120)	M10	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	2 - 300 (35 - 150)	M10	12 - 14 (107 - 124)
	-, -, +1, +1*2	6 - 2/0 (16 - 70)	M6	8 - 9 (71 - 80)
	B1, B2*3	4 - 2/0 (25 - 70)	M8	8 - 9 (71 - 80)
	Ground	4 - 1/0 (25 - 50)	M8	9.0 - 11 (79.7 - 97.4)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
4150	R/L1, S/L2, T/L3	2 - 250 (35 - 120)	M10	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	2 - 300 (35 - 150)	M10	12 - 14 (107 - 124)
	-, -, +1, +1*2	6 - 2/0 (16 - 70)	M6	8 - 9 (71 - 80)
	B1, B2*3	4 - 2/0 (25 - 70)	M8	8 - 9 (71 - 80)
	Ground	4 - 1/0 (25 - 50)	M8	9.0 - 11 (79.7 - 97.4)
4180	R/L1, S/L2, T/L3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	U/T1, V/T2, W/T3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	-, +1	2 - 250 x 2P (35 - 120 x 2P)	M10	20 (177)
	+3	4 - 1/0 x 2P (25 - 50 x 2P)	M10	20 (177)
	Ground	4 - 350 (25 - 185)	M10	18 - 23 (159 - 204)
4216	R/L1, S/L2, T/L3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	U/T1, V/T2, W/T3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	-, +1	2 - 250 x 2P (35 - 120 - 2P)	M10	20 (177)
	+3	4 - 1/0 x 2P (25 - 50 x 2P)	M10	20 (177)
	Ground	2 - 350 (35 - 185)	M10	18 - 23 (159 - 204)
4260	R/L1, S/L2, T/L3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	U/T1, V/T2, W/T3	3 - 4/0 x 2P (25 - 95 x 2P)	M10	20 (177)
	-, +1	2 - 250 x 2P (35 - 120 x 2P)	M10	20 (177)
	+3	4 - 1/0 x 2P (25 - 50 x 2P)	M10	20 (177)
	Ground	2 - 350 (35 - 185)	M10	18 - 23 (159 - 204)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
4304	R/L1, S/L2, T/L3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	-, +1	4/0 - 400 x 2P (95 - 185 x 2P)	M12	35 (310)
	+3	1 - 4/0 x 2P (50 - 95 x 2P)	M12	35 (310)
	Ground	1 - 350 (50 - 185)	M12	32 - 40 (283 - 354)
4371	R/L1, S/L2, T/L3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 2P (70 - 150 x 2P)	M12	35 (310)
	-, +1	4/0 - 400 x 2P (95 - 185 x 2P)	M12	35 (310)
	+3	1 - 4/0 x 2P (50 - 95 x 2P)	M12	35 (310)
	Ground	1 - 350 (50 - 185)	M12	32 - 40 (283 - 354)
4414	R/L1, S/L2, T/L3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	-, +1	3/0 - 400 x 4P (95 - 185 x 4P)	M12	35 (310)
	+3	2 - 4/0 x 4P (35 - 95 x 4P)	M12	35 (310)
	Ground	1/0 - 300 (50 - 150)	M12	32 - 40 (283 - 354)
4477	R/L1, S/L2, T/L3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	-, +1	3/0 - 400 x 4P (95 - 185 x 4P)	M12	35 (310)
	+3	2 - 4/0 x 4P (35 - 95 x 4P)	M12	35 (310)
	Ground	2/0 - 300 (70 - 150)	M12	32 - 40 (283 - 354)

Model	Terminal	Wire Range AWG (mm^2)	Screw Size	Tightening Torque N·m (lbf-in)
4515	R/L1, S/L2, T/L3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	-, +1	3/0 - 400 x 4P (95 - 185 x 4P)	M12	35 (310)
	+3	2 - 4/0 x 4P (35 - 95 x 4P)	M12	35 (310)
	Ground	2/0 - 300 (70 - 150)	M12	32 - 40 (283 - 354)
4605	R/L1, S/L2, T/L3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	U/T1, V/T2, W/T3	2/0 - 300 x 4P (70 - 150 x 4P)	M12	35 (310)
	-, +1	3/0 - 400 x 4P (95 - 185 x 4P)	M12	35 (310)
	+3	2 - 4/0 x 4P (35 - 95 x 4P)	M12	35 (310)
	Ground	2/0 - 300 (70 - 150)	M12	32 - 40 (283 - 354)

**1 For wire gauges more than AWG 8, tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf-in to 40 lbf-in).*

**2 Terminals - and +1 have two screws. The Wire Range is the wire gauge for one terminal.*

**3 A junction terminal is necessary to connect a braking unit (CDBR) to terminals - and +3.*

3.3 Power Circuit Wiring

To wire the power circuit for IMPULSE•G+/VG+ Series 5:

1. Run the power supply wires through an appropriate enclosure hole.
2. Connect the power supply wires to a circuit protection system. ***See Section 3.2 on page 35.***
3. Connect the power supply wires from the circuit protection to Terminals R/L1, S/L2, and T/L3.
4. From Terminals U/T1, V/T2, and W/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 VFD and the motor, install a reactor on the output side of the VFD.*

Table 3-5: Power Circuit Terminals

<table>
<tr><th>Terminal</th><th colspan="3">VFD Model</th><th rowspan="4">Function</th></tr>
<tr><th>230 V Class</th><th>2003 to 2075</th><th>2085 to 2115</th><th>2145 to 2415</th></tr>
<tr><th>460 V Class</th><th>4001 to 4039</th><th>4045 to 4150</th><th>4180 to 4605</th></tr>
<tr><th>575 V Class</th><th colspan="2"></th><th>TBD</th></tr>
<tr><td>R/L1</td><td colspan="3" rowspan="3">Main circuit power supply input
NOTE: *6-pulse operation only*</td><td rowspan="3">Connects line power to the VFD</td></tr>
<tr><td>S/L2</td></tr>
<tr><td>T/L3</td></tr>
<tr><td>U/T1</td><td colspan="3" rowspan="3">VFD Output</td><td rowspan="3">Connects to the motor</td></tr>
<tr><td>V/T2</td></tr>
<tr><td>W/T3</td></tr>
<tr><td>B1</td><td colspan="2" rowspan="2">Braking Resistor</td><td rowspan="2">Not Available
(braking unit required)</td><td rowspan="2">Connects to a braking resistor</td></tr>
<tr><td>B2</td></tr>
<tr><td>+2</td><td rowspan="3">DC link choke (+1, +2)
DC power supply
(+1, -)
Braking unit (B1, -)</td><td colspan="2">Not Available</td><td rowspan="3">For connecting:
• DC power supply
• Braking Unit (CDBR)
• DC link choke
NOTE: *Note: Remove the jumper between +1 and +2 to connect a DC link choke.*</td></tr>
<tr><td>+1</td><td>DC power supply
(+1, -)
Braking unit (B1, -)</td><td rowspan="2">DC power supply
(+1, -)
Braking unit (+3, -)</td></tr>
<tr><td>-</td></tr>
<tr><td>+3</td><td colspan="3">Not available. Use B1 instead.</td></tr>
<tr><td>⏚</td><td colspan="3">For 230 V class: 100Ω or less
For 460 V class: 10Ω or less
For 575 V class: 10Ω or less</td><td>Grounding terminal</td></tr>
</table>

3.3.1 Power Circuit Connection Diagrams

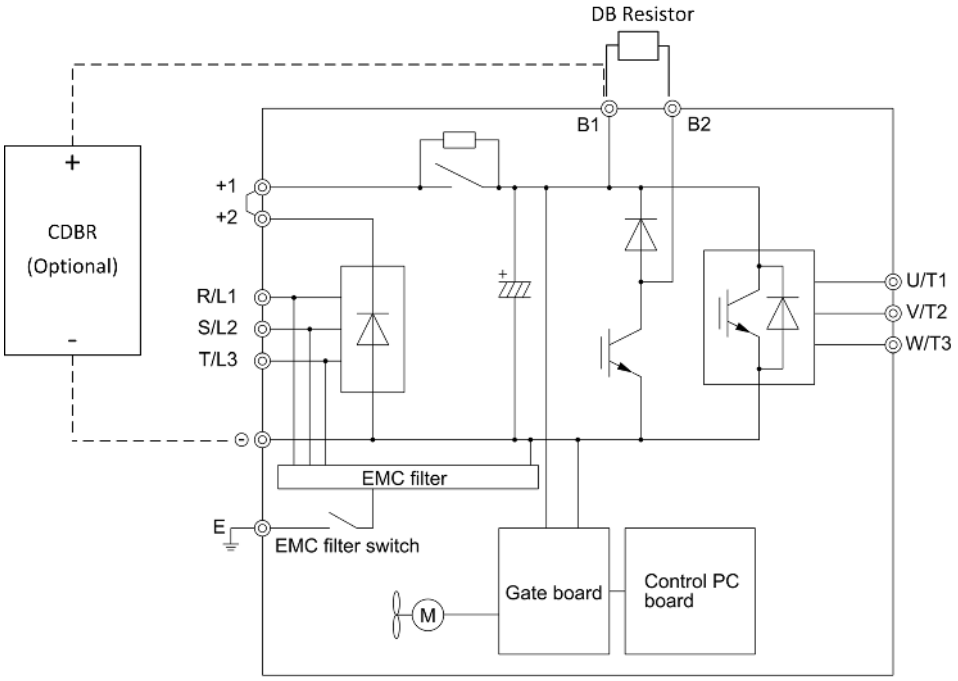


Figure 3-2: Power Circuit Connections (2003 to 2075, 4001 to 4039)

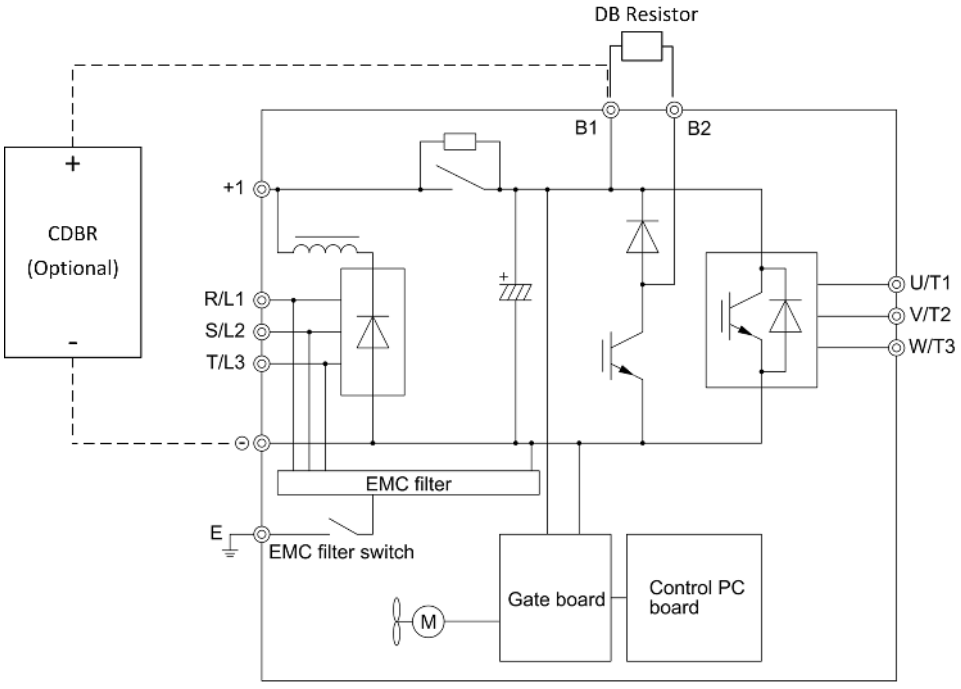


Figure 3-3: Power Circuit Connections (2088 and 2115, 4045 and 4150)

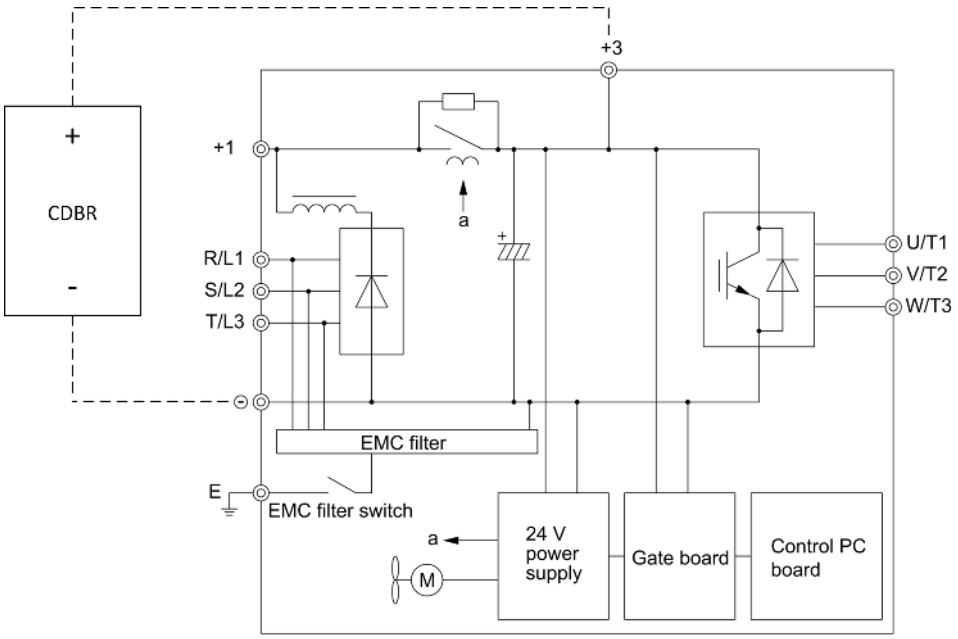


Figure 3-4: Power Circuit Connections (2145 to 2415, 4180 to 4371)

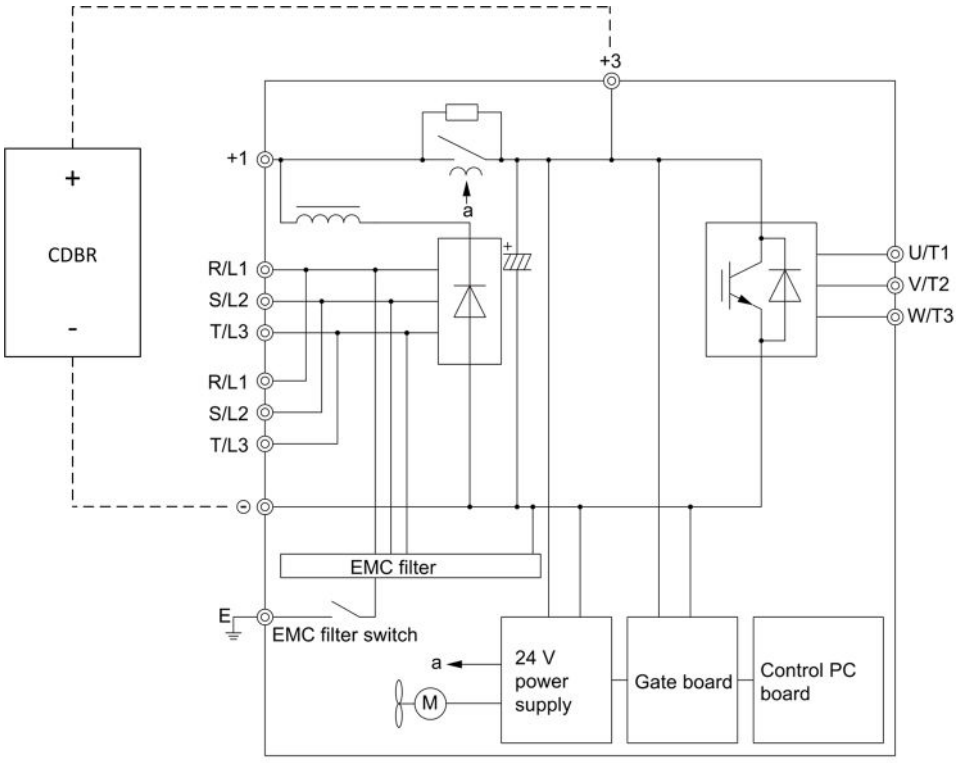


Figure 3-5: Power Circuit Connections (4414 to 4605)

3.3.2 Power Circuit Terminal Block Diagrams

Figure 3-6 through ***Figure 3-19*** show the main circuit terminal arrangements for the various VFD models.

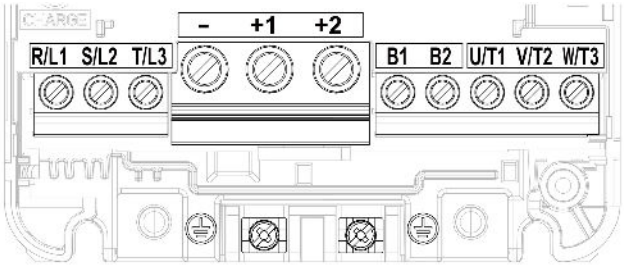


Figure 3-6: Main Circuit Terminal Block (2003 - 2033, 4001 - 4018)

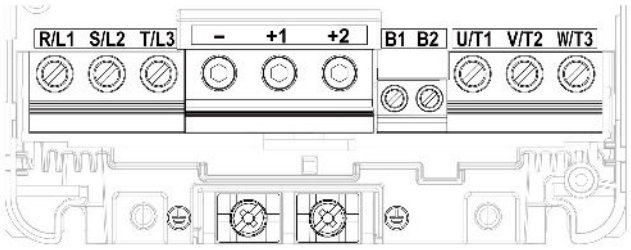


Figure 3-7: Main Circuit Terminal Block (2047, 4024, 4031)

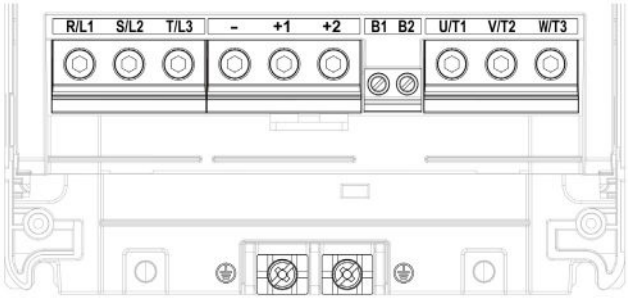


Figure 3-8: Main Circuit Terminal Block (2060, 2075)

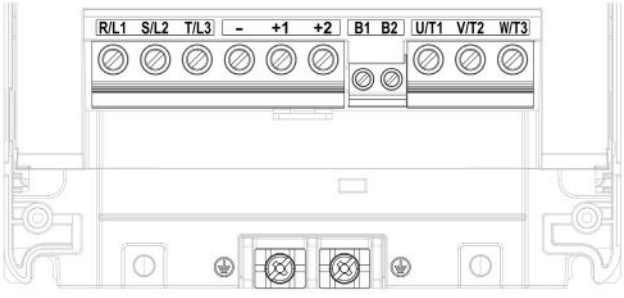


Figure 3-9: Main Circuit Terminal Block (4039)

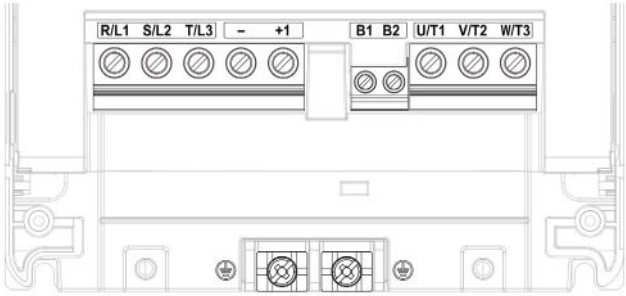


Figure 3-10: Main Circuit Terminal Block (4045)

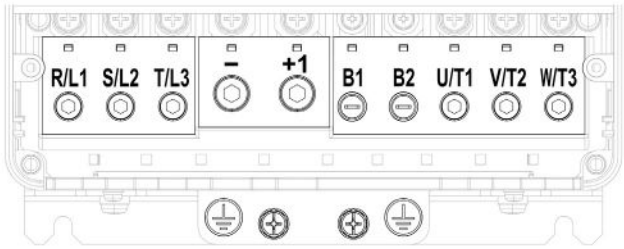


Figure 3-11: Main Circuit Terminal Block (2088)

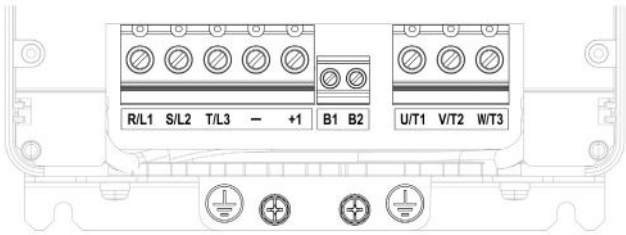


Figure 3-12: Main Circuit Terminal Block (4060)

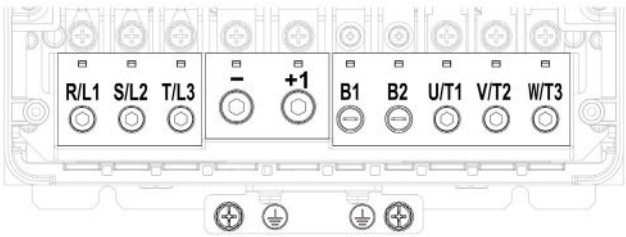


Figure 3-13: Main Circuit Terminal Block (2115, 4091)

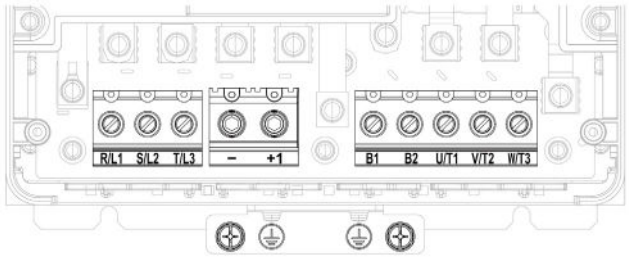


Figure 3-14: Main Circuit Terminal Block (4075)

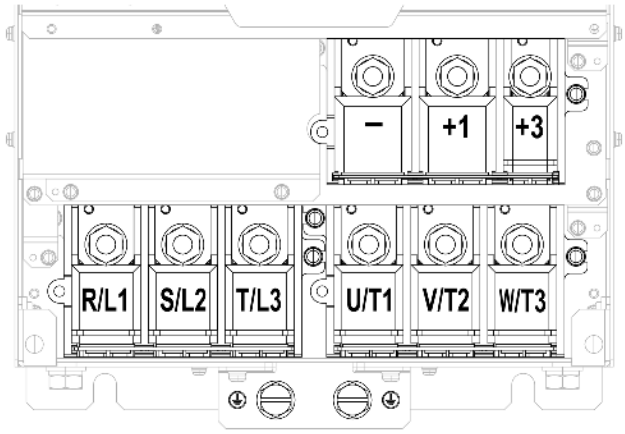


Figure 3-17: Main Circuit Terminal Block (2215, 2283, 4180 - 4260)

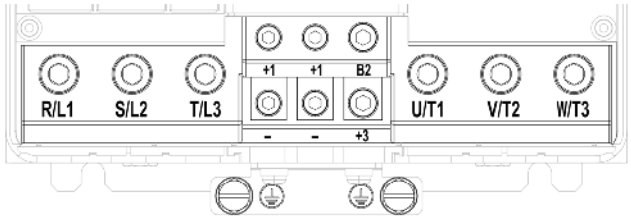


Figure 3-15: Main Circuit Terminal Block (2145, 2180)

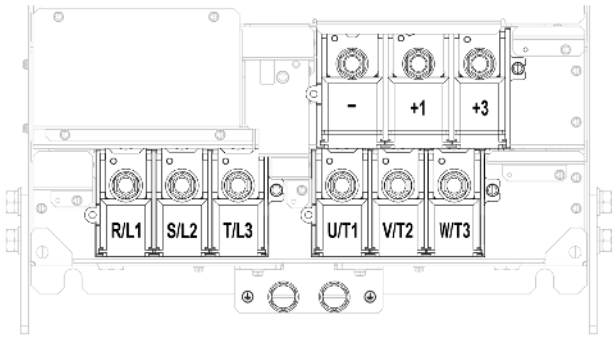


Figure 3-18: Main Circuit Terminal Block (2346, 2415, 4304, 4371)

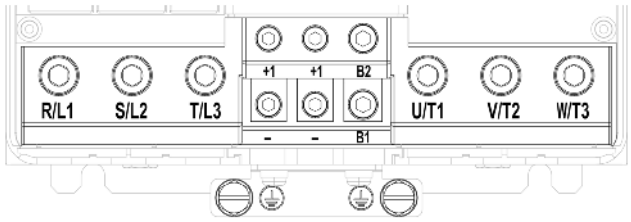


Figure 3-16: Main Circuit Terminal Block (4112, 4150)

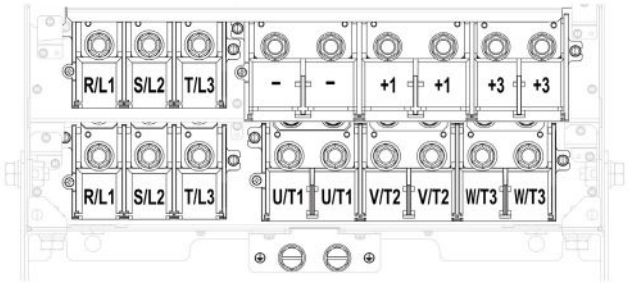


Figure 3-19: Main Circuit Terminal Block (4414 - 4605)

3.4 Grounding

Connect the VFD's ground terminal to a common grounding point on the control panel. Use ground wiring as specified in ***Section 3.2 on page 35***, and keep the length as short as possible.

- Ground Resistance:
  - For 230V class: 100Ω or less
  - For 460V class: 10Ω or less
  - For 575V class: 10Ω or less
- Never run the VFD ground wires in common with welding machines, or other high-current electrical equipment.
- When more than one VFD is used for the same system, ground each directly or daisy-chain to the ground pole. Do not loop the ground wires.

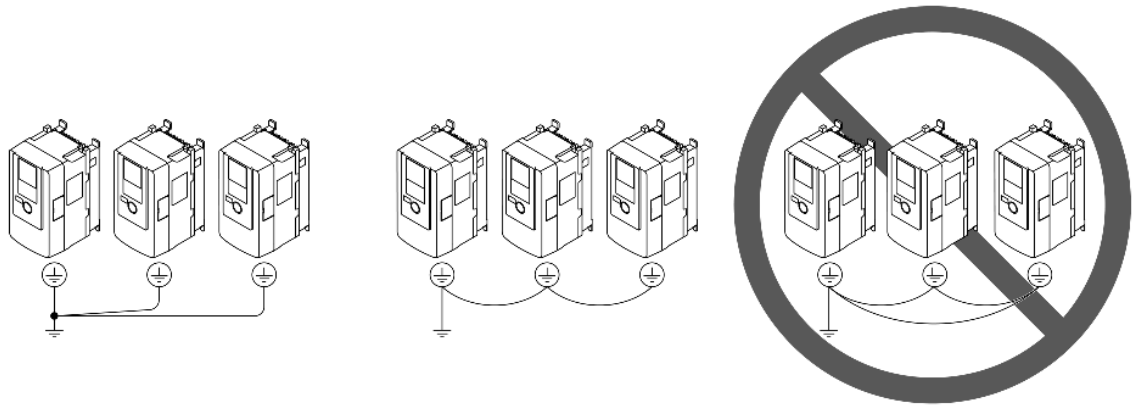


Figure 3-20: VFD Grounding

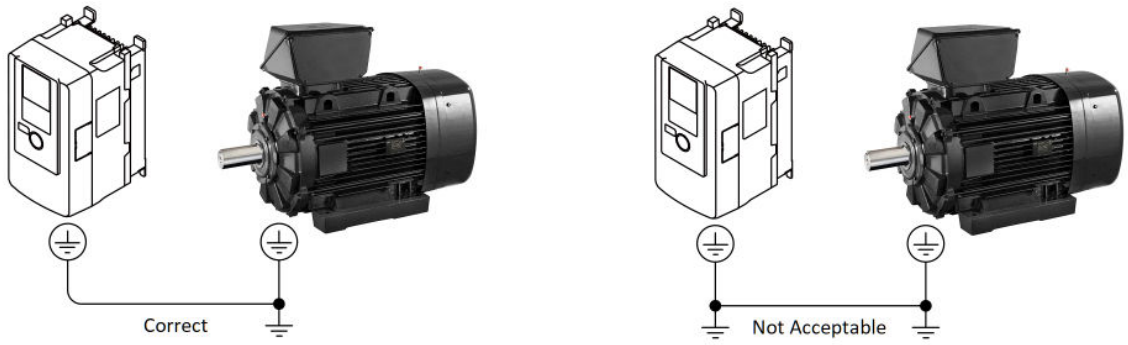


Figure 3-21: Motor Grounding

3.5 Terminal Board (24 VDC) & Interface Card (120 VAC)

Table 3-6: Terminal and Wire Specifications

Circuit Board	Screw Size	Tightening Torque lbf·in (N·m)	Wire Size AWG (mm^2)
24 VDC Terminal Board 120 VAC Interface Card	M3	4.4 to 5.3 (0.5 to 0.6)	Single Stranded: 24 to 17 (0.25 to 1.0) Single Solid: 24 to 16 (0.25 to 1.5) Dual Stranded: 24 to 20 (0.25 to 0.50) Dual Solid: 24 to 18 (0.25 to 0.75)

3.5.1 Terminal Block, DIP Switch, and Jumper Diagrams

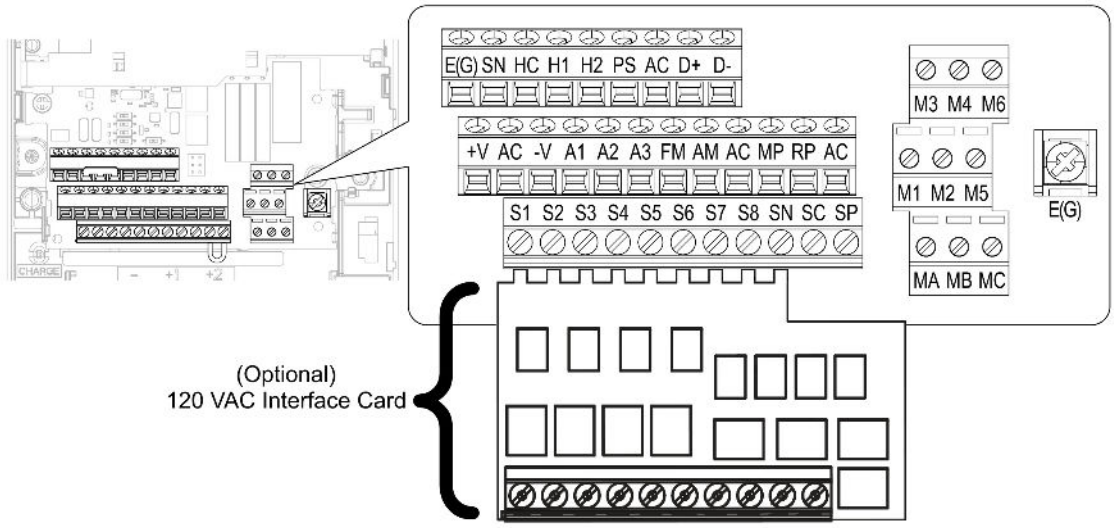


Figure 3-22: 24 VDC Terminal Board and Optional 120 VAC Interface Card

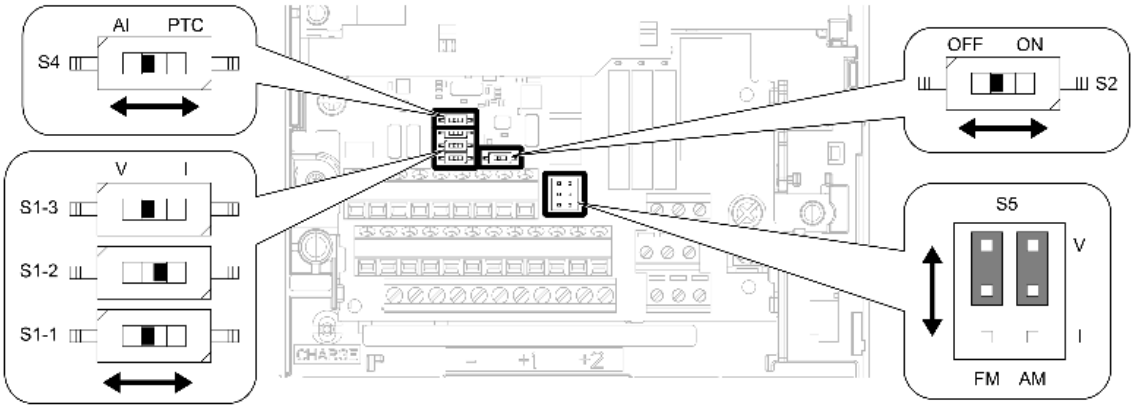


Figure 3-23: 24 VDC Terminal Board DIP Switches and Jumpers

3.5.2 DIP Switch and Jumper Functions

DIP Switches and Jumpers are described in this section, and the functions are shown in ***Table 3-7***.

Table 3-7: DIP Switches

Name	Function	Setting
S1-1	Analog Input A1 Signal Level	V: 0–10VDC or -10–10VDC (internal impedance: 20 kΩ) **(default)** I: 0–20mA or 4–20mA (internal impedance: 250 Ω)
S1-2	Analog Input A2 Signal Level	V: 0–10VDC or -10–10VDC (internal impedance: 20 kΩ) I: 0–20mA or 4–20mA (internal impedance: 250 Ω) **(default)**
S1-3	Analog Input A3 Signal Level	V: 0–10VDC or -10–10VDC (internal impedance: 20 kΩ) **(default)** I: 0–20mA or 4–20mA (internal impedance: 250 Ω)
S2	RS-485 Termination Resistor	OFF: No terminating resistance **(default)** ON: Terminating resistance of 120 Ω
S4	Analog Input A3 Select	AI: A3 is used as Analog Input 3 **(default)** PTC: A3 is used with a Positive Temperature Coefficient (PTC) thermistor
S5	Analog Output FM and AM Signal Level	V: 0–10VDC or -10–10VDC **(default)** I: 4–20mA

3.6 Control Circuit Wiring

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

Terms:

- Multi-Function Digital Input (MFDI)
- Multi-Function Digital Output (MFDO)
- Multi-Function Analog Input (MFAI)
- Multi-Function Analog Output (MFAO)

Table 3-8: Control Circuit Terminals

Type	Terminal	Function	Description	Signal Level
Digital Inputs	S1	MFDI 1	Multi-function digital inputs (H01-01 to H01-08)	Photo-coupler isolation 24 VDC; 6 mA per input 120 VAC interface card (optional)
	S2	MFDI 2		
	S3	MFDI 3		
	S4	MFDI 4		
	S5	MFDI 5		
	S6	MFDI 6		
	S7	MFDI 7		
	S8	MFDI 8		
	X2	Common	120 VAC interface card only	0 V
	SC	Common	Digital input common	0 V
	SN	Neutral	Digital input neutral	0 V
	SP	MFDI Power Supply	Digital input power supply	24 VDC, 150 mA

Type	Terminal	Function	Description	Signal Level
Analog Inputs	+V	MFAI Power Supply	Analog input positive supply	+10.5 VDC, 20 mA
	-V	MFAI Power Supply	Analog input negative supply	-10.5 VDC, 20 mA
	A1	MFAI 1	Multi-function analog input 1 (H03-02)	-10 to 10 VDC (impedance: 20kΩ) 0 to 10 VDC (impedance: 20kΩ) 0 to 20 mA (impedance: 250kΩ) 4 to 20 mA (impedance: 250kΩ)
	A2	MFAI 2	Multi-function analog input 2 (H03-10)	
	A3	MFAI 3	Multi-function analog input 3 (H03-06)	
	AC	Common	Analog signal common	0 V
	E(G)	Shield	Analog input shield	-
Digital Outputs	M1	MFDO 1	Multi-function digital output 1 (H02-01)	Form A Relay: 250 VAC, 1 A; 30 VDC, 1 A
	M2			
	M3	MFDO 2	Multi-function digital output 2 (H02-02)	Form A Relay: 250 VAC, 1 A; 30 VDC, 1 A
	M4			
	M5	MFDO 3	Multi-function digital output 3 (H02-03)	Form A Relay: 250 VAC, 1 A; 30 VDC, 1 A
	M6			
	MA	Fault Relays	MA-MC N/O; closed during fault MB-MC N/C; open during fault	Form C Relay: 250 VAC, 1 A; 30 VDC, 1 A
	MB			
	MC			
Analog Outputs	FM	MFAO 1	Multi-function analog output 1 (H04-01 to H04-03)	-10 to +10 VDC 0 to +10 VDC 4 to 20 mA
	AM	MFAO 2	Multi-function analog output 2 (H04-04 to H04-06)	
	AC	Common	Analog signal common	0 V
External Power Supply	SC	Power Supply Input	Supplies backup power to the control circuit and keypad	21.6 to 26.4 VDC, 700 mA
	AC	Common	Power supply common	0 V
Pulse I/O Signal	RP	Pulse Train Input	Pulse input frequency (H06-01)	Frequency: 0 to 32 kHz Duty Cycle: 30 to 70% High level: 3.5 to 13.2 VDC Low Level: 0 to 0.8 VDC Input Impedance: 3kΩ
	MP	Pulse Train Output	Pulse output frequency (H06-06)	32 kHz (max)
Modbus	D+	Communication (+)	RS-485 Modbus (H05 parameters)	115.2 kbps (max)
	D-	Communication (-)		
	AC	Common	Shield ground	0 V
Safe Disable	H1	Safe Disable Input 1	• One or both open: Motor Output Disabled • Both closed: normal operation • Off time of at least 2ms	24 VDC, 6 mA Internal Impedance: 4.7kΩ
	H2	Safe Disable Input 2		
	HC	Safe Disable Common		-

3.6.1 Control Circuit Terminal Block Diagrams

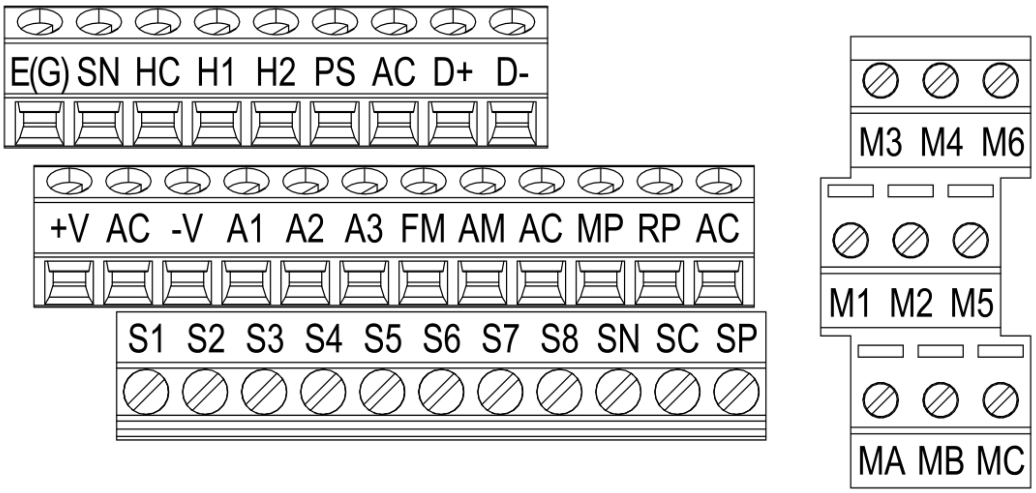
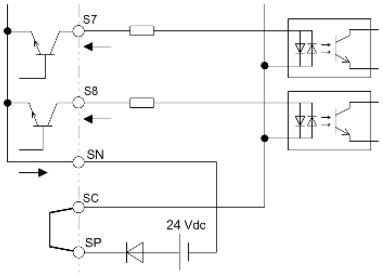
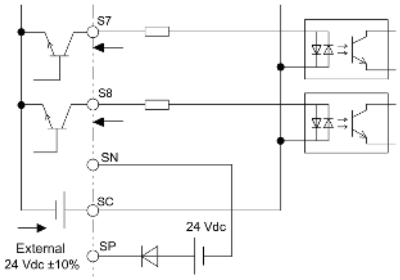
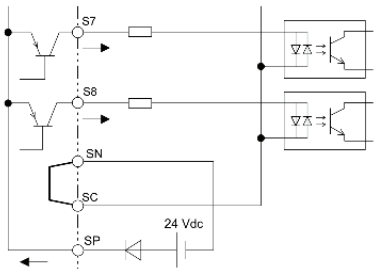
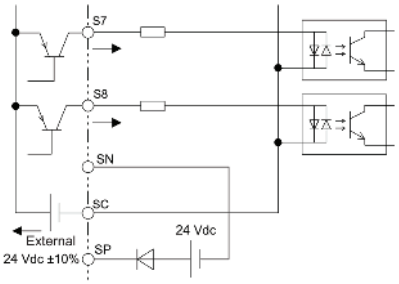


Figure 3-24: Terminal Board Diagram

3.6.2 Sinking/Sourcing for Digital Inputs (24 VDC Only)

Use the wire jumper between terminals SC and SP or SC and SN to select Sink mode, Source mode, or to externally power the digital inputs. This function does not apply when using the 120 VAC interface card.

Table 3-9: Safe Disable Input Sink/Source/External Power Supply Selection

Mode	VFD Internal Power Supply	External 24 VDC Power Supply
Sinking Mode		
(Default)		
Sourcing Mode		

3.6.3 Safe Disable and Safe Torque Off

The Safe Disable inputs provide a stop function in compliance with “Safe Torque Off” as defined in IEC/EN 61800-5-2. Safe Disable inputs have been designed to meet the requirements of the ISO/EN 13849-1, Category 3 PL e, IEC/EN 61508 (SIL3), and IEC/EN 62061 (SIL CL3).

Inputs/Outputs		Inputs: 2 (H1 and H2) Signal ON level: 18 to 28 VDC Signal OFF level: -4 to +4 VDC Output: 1 MFDO safety monitor output for external device monitor (EDM)
Operation Time		Time from input open to VFD output stop is less than 3 ms.
Failure Probability	**Demand Rate Low**	PFD = $4.65E^{-6}$
	Demand Rate High/ Continuous	PFH = $1.11E^{-9}$
Performance Level		The Safe Disable inputs satisfy all requirements of Performance Level (PL) e according to ISO/EN 13849-1.
HFT (Hardware Fault Tolerance)		N = 1
Type of Subsystem		Type B

Safe Torque Off disables the VFD power section for mechanical maintenance, E-stops, or redundancy safety monitor controller intervention. The feature provides safe removal of motor torque without removal of power to the VFD. This is a standard feature on the IMPULSE•G+/VG+ Series 5. A Safe Disable Status Monitor for error detection in the safety circuit is also provided.

The Safe Disable circuit (***Figure 3-25***) consists of two independent input channels (H1 and H2) that can block the output transistors and provide external device monitoring (EDM), using a digital output relay (H02-xx = 24 or 124), to monitor the status of the Safe Disable function.

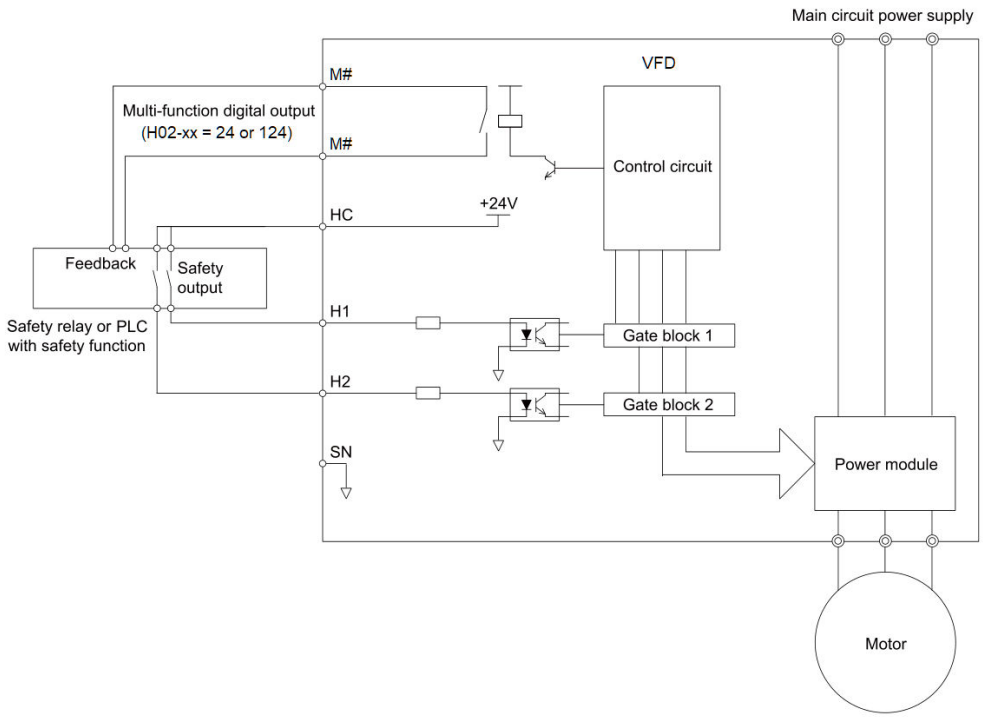


Figure 3-25: Safe Torque Off Block Diagram

3.7 Encoder Circuit

A shaft-mounted encoder is required to provide speed and shaft position feedback to the IMPULSE•VG+ Series 5. Without an encoder, closed loop vector control cannot operate properly.

Before you wire the encoder circuit, refer to ***Table 3-10 on page 60*** and ***Table 3-11 on page 61***.

3.7.1 Encoder Circuit Specification and Wiring Procedure

Table 3-10: Encoder and PG-X3 Option Card Specifications

Power supply	+12 VDC (+5 VDC by CN3 jumper); max. 200 mA (consult factory if inrush currents exceed 200 mA), an auxiliary power supply is required
Output Type	Differential Quadrature (A+, A-, B+, and B- channels; Z is not used)
Compatible Types	Line Driver (TTL/RS422) Push-Pull (HTL) Open Collector (PNP or NPN)
Non-Compatible Types	Resolver Absolute (sine/cosine)
Maximum Input Frequency	300 kHz
Mounting method	Encoder must be direct-coupled to motor shaft, using a zero-backlash-type coupling.

To wire the encoder circuit (assuming the VFD 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. Also, do not connect the encoder to the low-speed shaft of a speed reducer.*

2. Connect the encoder to the PG-X3 Encoder Option Card. ***See Figure 3-26 on page 61***.

NOTE: *Use twisted-pair, shielded cable 100 Ω impedance (Magnetek R-20/6, R-22/6, Belden 9730, or equivalent. Strip the encoder wires 0.25 in. (5.5 mm). Keep the wiring length less than 300 feet (for cable lengths greater than 300 feet, use fiber optic cable).*

3. Connect the shield to Terminal FE of the PG-X3 Option Card (on only one end of the shielded cable).
4. Whenever possible, the encoder cable should be a continuous run between the motor and VFD. If it cannot be a direct run, the splice should be in its own junction box and isolated from the power wires.

3.7.2 Encoder Wiring Diagram

Encoder 1: Install in option port CN5-C

Encoder 2: Install in option port CN5-B

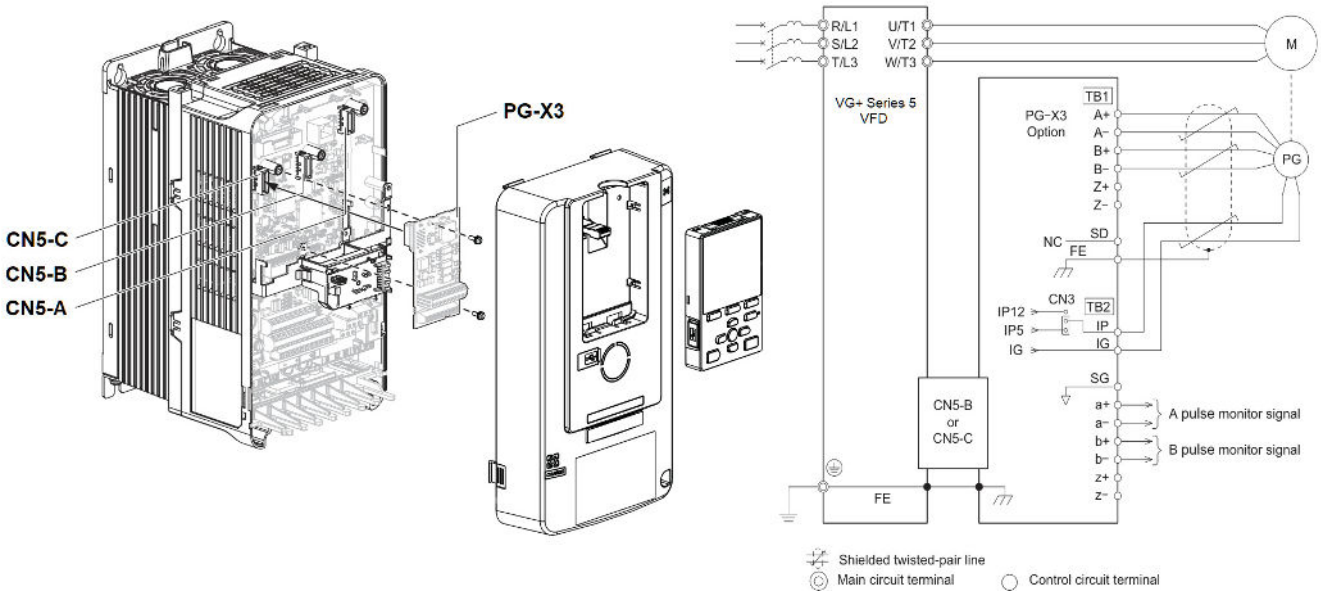


Figure 3-26: PG-X3 Encoder Card Wiring

Table 3-11: Encoder Wiring

Encoder Signal	Wire Color Example	PG-X3 Terminal
+5 or 12 VDC (select via CN3 jumper)	Red	IP
0V	Black	IG
A+	Blue	A+
A-	Gray	A-
B+	Green	B+
B-	Yellow	B-
Shield	-	FE

4 Getting Started

4.1 Overview

With its easy-to-use keypad and X-Press Programming, the IMPULSE•G+/VG+ Series 5 makes it easy to get up and running quickly. In addition to explaining the keypad and X-Press Programming, this chapter explains how to navigate the menus and configure the VFD.

4.1.1 Checks Before Powering

After VFD installation and wiring are completed, verify:

- Correct connections.
- Correct input power supply (no voltage drop or imbalance, source kVA ≤ 500, unless a line reactor is used).
- No short circuit conditions.
- No loose screw terminals (check especially for loose wire clippings).
- Proper load conditions.

4.1.2 Precautions

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

DANGER

Extreme caution should be used if braking method is set for Decelerate to stop. If deceleration time is too long, equipment could run into the end stop device, causing damage to equipment or injury to personnel.

4.2 Using the Keypad

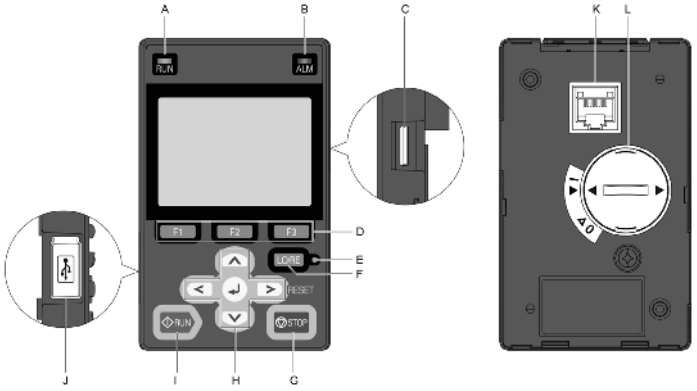
With five 16-character lines available, the keypad display makes it possible to monitor VFD operation, change parameter settings, and view fault codes. In addition, the parameter description is included on the top line of the display. The keypad enables you to:

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

WARNING

Because of additional potential hazards when the VFD is operated locally, we advise you to avoid operating it this way. If the VFD is operated locally, be aware that the crane or hoist will move when the RUN button is pressed. Contact Magnetek with any questions.

4.2.1 Keypad LED and Button Functions



A	RUN	Lit while VFD is operating the motor; Flashing during a phantom fault.
B	ALM	Off during normal operation (no fault or alarm). Lit during a fault; Flashing during an alarm, oPE, or error.
C	Memory Card Slot	No function.
D	F1 F2 F3	Function keys with configurable functions.
E	LO/RE	Lit while the keypad is selected to run the VFD (LOCAL mode).
F	LO/RE	• Displays the phone number for the Magnetek Service department. • Switches VFD control between LOCAL and REMOTE mode.*2
G	STOP	Stops VFD operation. *1
H	ENTER	• ENTER key for parameter values and settings. • Selects menu items to move between screens.
	<	• Moves the cursor to the left, or the previous screen.
	>	• Moves the cursor to the right, or the next screen. • Resets an active fault.
	^ v	• Scrolls up or down to show the next or previous item. • Increments or decrements parameter values.
I	RUN	Starts the VFD when in LOCAL mode.
J	USB Port	No function
K	RJ-45 Connector	The keypad connects to the VFD through this port.
L	Battery Cover	Access to the CR2016 battery which maintains the real time clock.

**1 The STOP key has highest priority and pressing it will stop the motor, even if a Run command is active from an external Run command source.*

**2 The LO/RE key can only switch between LOCAL and REMOTE when the VFD is stopped. See parameter O02-01 = 1.*

4.3 Parameters

There are a variety of parameters that determine how the VFD functions. These parameters are programmed into the VFD'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.

Before shipping the VFD, Magnetek programmed initial settings so that most, if not all, of the crane system requirements are supported. However, if it is necessary to change the initial settings, Magnetek recommends that only qualified crane system technicians program the VFD. Security can be enabled by using the **Password** and **Access Level** features. For more information on these security features, ***see Section 4.3.3 on page 67***.

The VFD can be restricted to allow access to only certain parameters, called **User Parameters**. To select these parameters, ***see Section 4.3.3.10 on page 74***.

Two additional features are **Initialize Parameters** (A01-05) and **User Defaults** (o02-03). Both of these features are related and revert back to previously saved parameter settings. This is especially helpful when a number of programming changes were made, but the previous settings may still be needed. To program these features, ***see Section 4.3.3.7 on page 73*** and ***User Defaults (o02-03) on page 211***.

4.3.1 Parameter Menus

All parameters are organized under four modes:

4.3.1.1 Monitor Menu

VFD operation is enabled, and various live monitors can be viewed.

4.3.1.2 Programming and Quick Setting Menu

Parameter access levels, control method, motion, speed reference, and passwords are selected. Parameters are set/read. Items to be set/read vary depending on the access level setting.

4.3.1.3 Auto-Tuning Menu

Automatically calculates and sets motor parameters to optimize VFD performance.

4.3.1.4 Modified Parameters Menu

Only parameters that have been changed from the default settings are shown.

4.3.2 Menu Structure

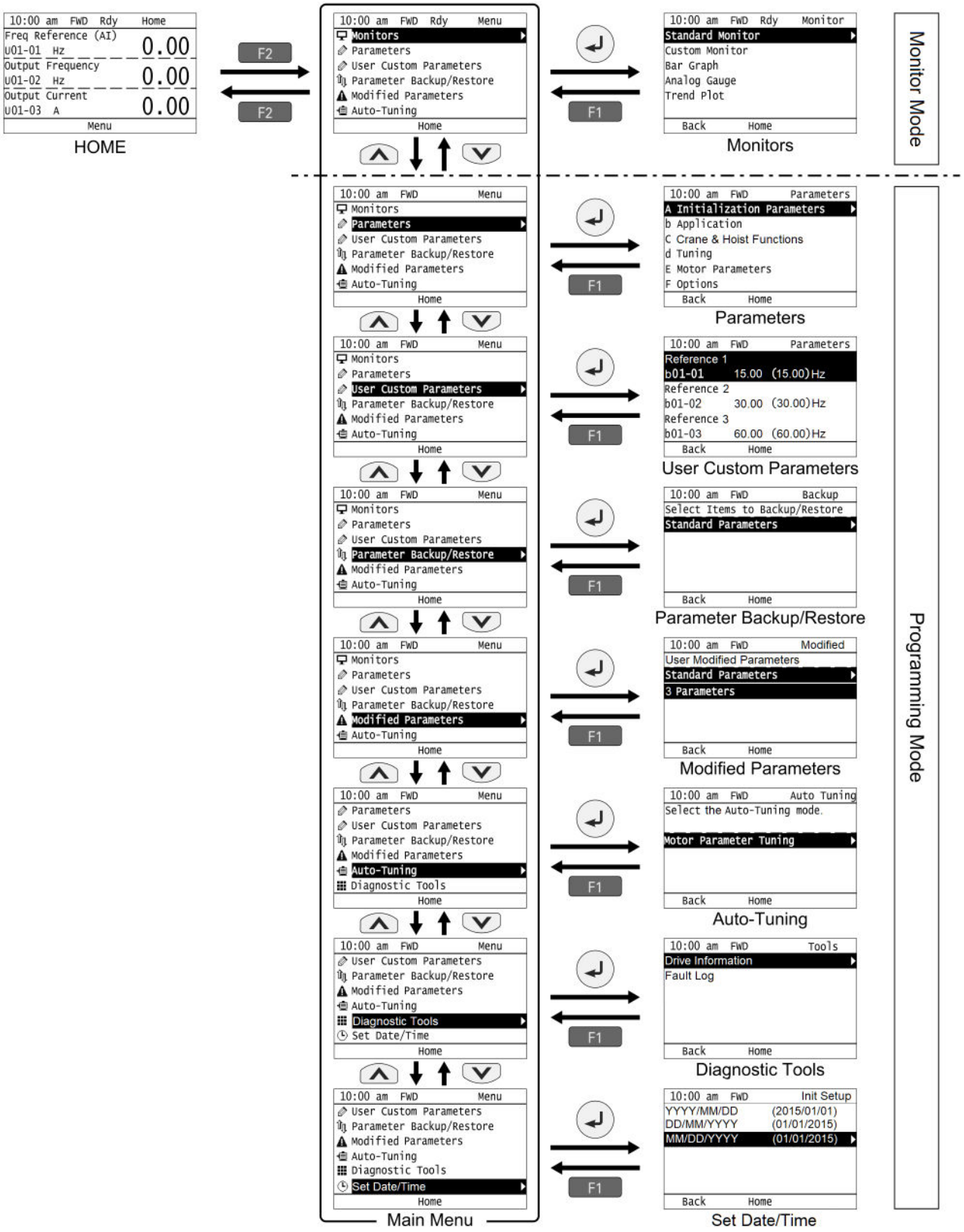
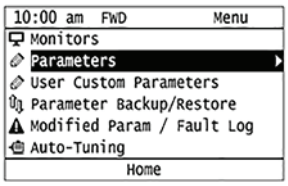


Figure 4-1: Menu Structure



Group	Function	
Monitor	U01	Operation Status
	U02	Fault Trace
	U03	Fault History
	U04	Maintenance
	U06	Additional Operation Status
Initialize	A01	Initial Setup
	A02	User Parameters
Application	b01	Frequency References
	b02	Reference Limits
	b03	Operation Mode
	b05	Acceleration/Deceleration Times
	b08	Jump Frequencies
	b09	Field Forcing
Crane & Hoist Functions	C01	Quick Stop
	C01	Reverse Plug Simulation
	C02	Micro-Speed
	C03	End of Travel Limits
	C03	Phantom Stop
	C03	Hook Height Measurement
	C03	Electronic Programmable Limit Switches (EPLS)
	C04	Load Float 2
	C04	Load Share (Torque Following)
	C05	Load Check
	C06	Ultra-Lift
	C07	Torque Limit
	C07	Anti-Shock
	C08	No Load Brake (NLB) Hoist
	C08	Brake Answerback
	C08	Emergency Lift / Dual Brake
	C11	Slack Cable Detection
	C11	Snap Shaft Detection
	C12	Delay and Maintenance Timers and Counters
	C13	Inch Control
	C13	Index Control
	C14	Sway Control
Tuning	d01	DC Injection / Short Circuit Braking
	d02	Slip Compensation
	d03	Torque Compensation
	d04	Automatic Speed Regulator (ASR) Tuning
	d05	Torque Control
	d08	Dwell
	d09	S-Curve Acceleration/Deceleration
	d10	Duty / Carrier Frequency
Motor	E01	V/f Pattern for Motor 1
	E02	Motor 1 Parameters
	E03	V/f Pattern for Motor 2
	E04	Motor 2 Parameters
	E07	Test Mode
Options	F01	Encoder Feedback (PG-X3) Option Card Setup
	F04	Analog Output (AO-A3) Option Card Setup
	F05	Digital Output (DO-A3 or S4IO) Option Card Setup
	F06	Profibus-DP (SI-P3) Option Card Setup
	F07	Ethernet, Profinet, & Modbus Option Card Setup
Terminal	H01	Digital Inputs
	H02	Digital Outputs
	H03	Analog Inputs
	H04	Analog Outputs
	H05	Modbus Communication
	H06	Pulse Train Input/Output
	H07	Virtual Inputs/Outputs
Protection	L01	Motor Protection
	L02	Power Loss Ride Through
	L03	Stall Prevention
	L04	Speed Detection
	L06	Torque Detection
	L08	Hardware Protection
	L09	Automatic Fault Reset
Special Adjustment	n01	Hunting Prevention
	n02	Automatic Frequency Regulator (AFR)
Keypad	o01	Keypad Display
	o02	Keypad Operation
	o03	Maintenance Monitors
	o06	User Stored Data

4.3.3 Initial Setup

4.3.3.1 Parameter Access Level (A01-01)

This parameter allows the “masking” of parameters according to user level.

Table 4-1: Parameter Access Level Settings

Setting	Description
0	**Operation Only** Access to only parameters A01-01, A01-06, and all U monitors.
1	**User Parameters** Allows access to only the parameters programmed to A02-01 through A02-32.
2	**Advanced Level** Commonly used parameters can be viewed and edited.
3	**Expert Level** All parameters can be viewed and edited.

4.3.3.2 Control Method (A01-02)

A VG+ VFD comes pre-configured to Closed Loop Vector and locked into that setting. A G+ VFD comes pre-configured to V/f and may be changed to Open Loop Vector, but not Closed Loop Vector.

Table 4-2: Control Method Settings

Setting	Description	Model
0	**Volts-per-Hertz (V/f)** Use this mode for simple speed control and for multiple motor applications with low demands to dynamic response or speed accuracy. This control method is also used when the motor parameters are unknown and Auto-Tuning cannot be performed. The speed control range is 40:1.	G+
2	**Open Loop Vector (OLV)** Use this mode for applications that require precise speed control, quick torque response, and high torque at low speed without using a speed feedback signal from the motor. The speed control range is 200:1.	G+
3	**Closed Loop Vector (CLV)** Use this mode for applications that require precise speed control down to zero speed, quick torque response or precise torque control, and a speed feedback signal from the motor. The speed control range is up to 1500:1.	VG+

NOTE: *An auto-tune should be performed for all Closed Loop Vector and Open Loop Vector applications.* ***See Section 4.4 on page 75***.

4.3.3.3 X-Press Programming™

X-Press Programming™ automatically configures several commonly used parameters and features when Control Method (A01-02), Motion (A01-03), or Speed Reference (A01-04) are programmed. These parameters are also added to the Quick-Set menu for fast parameter modification. ***See Table 4-6 on page 70***, ***Table 4-7 on page 71***, and ***Table 4-8 on page 72*** for X-Press Programming™ defaults.

4.3.3.4 Motion (A01-03)

Set this parameter to match the motion of application. See X-Press Programming (***Table 4-6 on page 70***, ***Table 4-7 on page 71***, or ***Table 4-8 on page 72***) for details.

Table 4-3: Motion Settings

Setting		Notes	Model
0	Traverse		G+/VG+
1	Standard Hoist	G+ Default	G+
2	NLB Hoist	VG+ Default	VG+

4.3.3.5 Speed Reference (A01-04)

This parameter will automatically define the input terminals for the selections listed below. See X-Press Programming (***Table 4-6 on page 70***, ***Table 4-7 on page 71***, or ***Table 4-8 on page 72***) for details.

Table 4-4: Speed Reference Settings

Setting	Description
0	**2-Speed Multi-Step** – Terminal S3 = 2nd speed.
1	**3-Speed Multi-Step** – Terminals S3 and S4 = speeds 2 and 3 respectively (default).
2	**5-Speed Multi-Step** – Terminals S3-S6 = speeds 2–5.
3	**2-Step Infinitely Variable** – Terminals S1 (Forward) and S2 (Reverse) use B01-01 and speed hold. Terminal S3 = Accelerate.
4	**3-Step Infinitely Variable** – Terminals S1 (Forward) and S2 (Reverse) use B01-01. Terminal S3 = Speed Hold. Terminal S4 = Accelerate.
5	**Uni-Polar Analog** – Terminals S1 and S2 = Directional input. Terminal A1 = 0-10V. Terminal A2 = 4-20mA (when using Terminal A2, set H03-02 to 1F and H03-10 to 0).
6	**Bi-Polar Analog** – Terminal S1 = Run Command. Terminal A1 = direction and frequency -10 to +10VDC.

WARNING

When changing A01-03 or A01-04, the MFDI, MFDO, and speed reference parameters will be overwritten by X-Press Programming™ (***Table 4-6 on page 70***, ***Table 4-7 on page 71***, or ***Table 4-8 on page 72***). All parameter settings must be verified for proper operation.

Table 4-5: X-Press Programming I/O Quick Reference

A01-04 =	0	1	2	3	4	5	6
Terminal S1	FWD	FWD	FWD	FWD	FWD	FWD	FWD
Terminal S2	REV	REV	REV	REV	REV	REV	REV
Terminal S3	Step 2	Step 2	Step 2	Accel	Hold	-	-
Terminal S4	-	Step 3	Step 3	-	Accel	-	-
Terminal S5	-	-	Step 4	-	-	-	-
Terminal S6	-	-	Step 5	-	-	-	-
Terminal S7	-	-	-	-	-	-	-
Terminal S8	-	-	-	-	-	-	-
Terminal A1	-	-	-	-	-	FREF	FREF
Terminal M1-M2	Brake	Brake	Brake	Brake	Brake	Brake	Brake
Terminal M3-M4	Brake (NLB Hoist only), otherwise not used						
Terminal M5-M6	Fault Annunciate (NLB Hoist only), otherwise not used						

4.3.3.6 Parameters Changed by X-Press Programming

Table 4-6: Traverse (A01-03 = 0)

Parameter	Description	A01-04 =						
		0	1	2	3	4	5	6
		2-Speed Multi-Step	3-Speed Multi-Step	5-Speed Multi-Step	2-Step Infinitely Variable	3-Step Infinitely Variable	Uni-Polar Analog	Bi-Polar Analog
b01-01	Speed 1	20.00	15.00	6.00	15.00	15.00	15.00	15.00
b01-02	Speed 2	60.00	30.00	15.00	30.00	30.00	30.00	30.00
b01-03	Speed 3	0.00	60.00	30.00	60.00	60.00	60.00	60.00
b01-04	Speed 4	0.00	0.00	45.00	0.00	0.00	0.00	0.00
b01-05	Speed 5	0.00	0.00	60.00	0.00	0.00	0.00	0.00
b01-17	Jog Reference	6.00	6.00	6.00	6.00	6.00	6.00	6.00
b02-01	Freq Ref Upper Limit	100.0	100.0	100.0	100.0	100.0	100.0	100.0
b03-01	Frequency Reference 1	0	0	0	0	0	1	1
b03-02	Run Command 1	1	1	1	1	1	1	1
b03-03	Stopping Method	0	0	0	0	0	0	0
b05-01	Acceleration Time 1	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b05-02	Deceleration Time 1	5.0	5.0	5.0	5.0	5.0	5.0	5.0
C01-01	Quick Stop	0	0	0	0	0	0	0
C01-03	Reverse Plug	0	0	0	0	0	0	0
C08-10	Load Float Time	0	0	0	0	0	0	0
C13-12	Index Brake Control	0	0	0	0	0	0	0
D09-01	S-Curve Time @ Start of Accel	1.50	1.50	1.50	1.50	1.50	1.50	1.50
D09-02	S-Curve Time @ End of Accel	1.50	1.50	1.50	1.50	1.50	1.50	1.50
D09-03	S-Curve Time @ Start of Decel	1.50	1.50	1.50	1.50	1.50	1.50	1.50
D09-04	S-Curve Time @ End of Decel	1.50	1.50	1.50	1.50	1.50	1.50	1.50
E01-03	V/f Pattern	0	0	0	0	0	0	0
H01-01	Terminal S1	80	80	80	80	80	80	80
H01-02	Terminal S2	81	81	81	81	81	81	81
H01-03	Terminal S3	0	0	0	5	4	F	F
H01-04	Terminal S4	F	1	1	F	5	F	F
H01-05	Terminal S5	F	F	2	F	F	F	F
H01-06	Terminal S6	F	F	3	F	F	F	F
H01-07	Terminal S7	F	F	F	F	F	F	F
H01-08	Terminal S8	F	F	F	F	F	F	F
H02-01	Terminal M1-M2	0	0	0	0	0	0	0
H02-02	Terminal M3-M4	F	F	F	F	F	F	F
H02-03	Terminal M5-M6	F	F	F	F	F	F	F
H03-01	Terminal A1 Signal Level	0	0	0	0	0	0	1
H03-02	Terminal A1	0	0	0	0	0	0	0
H03-06	Terminal A3	1F	1F	1F	1F	1F	1F	1F
H03-10	Terminal A2	1F	1F	1F	1F	1F	1F	1F

Table 4-7: Standard Hoist (A01-03 = 1)

Parameter	Description	A01-04 =						
		0	1	2	3	4	5	6
		2-Speed Multi-Step	3-Speed Multi-Step	5-Speed Multi-Step	2-Step Infinitely Variable	3-Step Infinitely Variable	Uni-Polar Analog	Bi-Polar Analog
b01-01	Speed 1	20.00	15.00	6.00	15.00	15.00	15.00	15.00
b01-02	Speed 2	60.00	30.00	15.00	30.00	30.00	30.00	30.00
b01-03	Speed 3	0.00	60.00	30.00	60.00	60.00	60.00	60.00
b01-04	Speed 4	0.00	0.00	45.00	0.00	0.00	0.00	0.00
b01-05	Speed 5	0.00	0.00	60.00	0.00	0.00	0.00	0.00
b01-17	Jog Reference	6.00	6.00	6.00	6.00	6.00	6.00	6.00
b02-01	Freq Ref Upper Limit	100.0	100.0	100.0	100.0	100.0	100.0	100.0
b03-01	Frequency Reference 1	0	0	0	0	0	1	1
b03-02	Run Command 1	1	1	1	1	1	1	1
b03-03	Stopping Method	1	1	1	1	1	1	1
b05-01	Acceleration Time 1	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b05-02	Deceleration Time 1	3.0	3.0	3.0	3.0	3.0	3.0	3.0
C01-01	Quick Stop	0	0	0	0	0	0	0
C01-03	Reverse Plug	0	0	0	0	0	0	0
C08-10	Load Float Time	0	0	0	0	0	0	0
C13-12	Index Brake Control	0	0	0	0	0	0	0
D09-01	S-Curve Time @ Start of Accel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
D09-02	S-Curve Time @ End of Accel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
D09-03	S-Curve Time @ Start of Decel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
D09-04	S-Curve Time @ End of Decel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
E01-03	V/f Pattern	4	4	4	4	4	4	4
H01-01	Terminal S1	80	80	80	80	80	80	80
H01-02	Terminal S2	81	81	81	81	81	81	81
H01-03	Terminal S3	0	0	0	5	4	F	F
H01-04	Terminal S4	F	1	1	F	5	F	F
H01-05	Terminal S5	F	F	2	F	F	F	F
H01-06	Terminal S6	F	F	3	F	F	F	F
H01-07	Terminal S7	F	F	F	F	F	F	F
H01-08	Terminal S8	F	F	F	F	F	F	F
H02-01	Terminal M1-M2	0	0	0	0	0	0	0
H02-02	Terminal M3-M4	F	F	F	F	F	F	F
H02-03	Terminal M5-M6	F	F	F	F	F	F	F
H03-01	Terminal A1 Signal Level	0	0	0	0	0	0	1
H03-02	Terminal A1	0	0	0	0	0	0	0
H03-06	Terminal A3	1F	1F	1F	1F	1F	1F	1F
H03-10	Terminal A2	1F	1F	1F	1F	1F	1F	1F

Table 4-8: NLB Hoist (A01-03 = 2)

Parameter	Description	A01-04 =						
		0	1	2	3	4	5	6
		2-Speed Multi-Step	3-Speed Multi-Step	5-Speed Multi-Step	2-Step Infinitely Variable	3-Step Infinitely Variable	Uni-Polar Analog	Bi-Polar Analog
b01-01	Speed 1	20.00	15.00	6.00	15.00	15.00	15.00	15.00
b01-02	Speed 2	60.00	30.00	15.00	30.00	30.00	30.00	30.00
b01-03	Speed 3	0.00	60.00	30.00	60.00	60.00	60.00	60.00
b01-04	Speed 4	0.00	0.00	45.00	0.00	0.00	0.00	0.00
b01-05	Speed 5	0.00	0.00	60.00	0.00	0.00	0.00	0.00
b01-17	Jog Reference	6.00	6.00	6.00	6.00	6.00	6.00	6.00
b02-01	Freq Ref Upper Limit	100.0	100.0	100.0	100.0	100.0	100.0	100.0
b03-01	Frequency Reference 1	0	0	0	0	0	1	1
b03-02	Run Command 1	1	1	1	1	1	1	1
b03-03	Stopping Method	6	6	6	6	6	6	6
b05-01	Acceleration Time 1	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b05-02	Deceleration Time 1	3.0	3.0	3.0	3.0	3.0	3.0	3.0
C01-01	Quick Stop	1	1	1	1	1	1	1
C01-03	Reverse Plug	1	1	1	1	1	1	1
C08-10	Load Float Time	10	10	10	10	10	10	10
C13-12	Index Brake Control	2	2	2	2	2	2	2
D09-01	S-Curve Time @ Start of Accel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
D09-02	S-Curve Time @ End of Accel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
D09-03	S-Curve Time @ Start of Decel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
D09-04	S-Curve Time @ End of Decel	0.50	0.50	0.50	0.50	0.50	0.50	0.50
E01-03	V/f Pattern	F	F	F	F	F	F	F
H01-01	Terminal S1	80	80	80	80	80	80	80
H01-02	Terminal S2	81	81	81	81	81	81	81
H01-03	Terminal S3	0	0	0	5	4	F	F
H01-04	Terminal S4	F	1	1	F	5	F	F
H01-05	Terminal S5	F	F	2	F	F	F	F
H01-06	Terminal S6	F	F	3	F	F	F	F
H01-07	Terminal S7	F	F	F	F	F	F	F
H01-08	Terminal S8	F	F	F	F	F	F	F
H02-01	Terminal M1-M2	0	0	0	0	0	0	0
H02-02	Terminal M3-M4	0	0	0	0	0	0	0
H02-03	Terminal M5-M6	78	78	78	78	78	78	78
H03-01	Terminal A1 Signal Level	0	0	0	0	0	0	1
H03-02	Terminal A1	0	0	0	0	0	0	0
H03-06	Terminal A3	1F	1F	1F	1F	1F	1F	1F
H03-10	Terminal A2	1F	1F	1F	1F	1F	1F	1F

4.3.3.7 Initialize Parameters (A01-05)

Use this parameter to reset the VFD to its factory default settings or transfer parameters.

Table 4-9: Initialize Settings

Setting	Description
0	**No Initialization** (factory default)
1110	**User Default** Resets parameters to the values saved by the user as User Settings. User Settings are stored when parameter O02-03 is set to "1: Set defaults". ***NOTE:*** *User Initialization resets all parameters to a user-defined set of default values previously saved to the VFD. Set parameter O02-03 to 2 to clear the user-defined default values.*
2220	**Parameter Setting Reset** Resets all parameters back to default values.

4.3.3.8 Password (A01-06)

This parameter enables the user to set a password that inhibits the programming of the parameters. This function is used in conjunction with the access level parameter A01-01. To set the password, enter a password number in parameter A01-07 and press the ENTER key. If A01-06 is not the same as A01-07, A01-01 cannot be changed once A01-01 is set to 0 or 1. When A01-06 is the same as A01-07, A01-01 can be changed.

To create a password, when A01-06 is displayed, press the ∧ and STOP key simultaneously to reveal A01-07.

4.3.3.9 X-Press Programming Legacy Method (A01-13)

The IMPULSE Series 5 VFD method for X-Press Programming is different than that of the IMPULSE Series 4 VFD. This parameter allows the option to select the new or legacy method.

Table 4-10: X-Press Programming Legacy Method Settings

Setting	Description
0	**Disabled** (factory default) Triggering X-Press Programming with an A01-04 change will only update parameters if the default setting of the current motion (A01-04) is different than that of the new motion being set. Example: The default of B01-01 = 20.00 Hz when A01-04 = 0 (2-Speed). When A01-04 is changed to 1 (3-Speed), the B01-01 setting will change since the new default of B01-01 = 15.00 Hz. Adversely, since the default setting of H01-05 is F (Not Used) in both 2-Speed and 3-Speed, so that parameter will not be updated and will retain the existing value.
1	**Enabled** Use the legacy X-Press Programming method from the IMPULSE Series 4. In this method, triggering X-Press Programming with an A01-04 change, will cause all X-Press parameters to be overwritten to the settings in the X-Press Programming tables.

4.3.3.10 User Parameters (A02-01 through 32)

The user can select up to 32 parameters for quick-access programming. By setting the user access level (A01-01) to “User Program”, only the parameters selected in the A02 parameters can be accessed by the user. To assign a parameter as a user parameter, go to the A02 level in the initialize menu. Once the A02 parameters are set and A01-01 is programmed to “User Program”, only the parameters visible in the program menu will be assigned to an A02 parameter.

The A02 group is pre-loaded with the settings listed in ***Table 4-11***, based on A01-03.

Table 4-11: Application Quick Set

A01-03	0	1	2
Parameter	**Traverse**	**Standard Hoist**	**NLB Hoist**
A02-01	b01-01: Speed 1	b01-01: Speed 1	b01-01: Speed 1
A02-02	b01-02: Speed 2	b01-02: Speed 2	b01-02: Speed 2
A02-03	b01-03: Speed 3	b01-03: Speed 3	b01-03: Speed 3
A02-04	b01-04: Speed 4	b01-04: Speed 4	b01-04: Speed 4
A02-05	b01-05: Speed 5	b01-05: Speed 5	b01-05: Speed 5
A02-06	b01-20: Inf-Var Min Speed	b01-20: Inf-Var Min Speed	b01-20: Inf-Var Min Speed
A02-07	b01-21: Inf-Var Speed 1	b01-21: Inf-Var Speed 1	b01-21: Inf-Var Speed 1
A02-08	b03-04: Phase Order	b03-04: Phase Order	b03-04: Phase Order
A02-09	b05-01: Acceleration Time 1	b05-01: Acceleration Time 1	b05-01: Acceleration Time 1
A02-10	b05-02: Deceleration Time 1	b05-02: Deceleration Time 1	b05-02: Deceleration Time 1
A02-11	C01-03: Reverse Plug	C02-01: Micro-Speed Gain 1	C01-01: Quick Stop
A02-12	C01-04: Reverse Plug Decel	E01-03: V/f Pattern	C01-02: Quick Stop Time
A02-13	C02-01: Micro-Speed Gain 1	E02-01: Motor FLA	C02-01: Micro-Speed Gain 1
A02-14	C03-01: UL1 Speed	H01-05: Terminal S5	C03-01: UL1 Speed
A02-15	C03-04: LL1 Speed	H01-06: Terminal S6	C03-04: LL1 Speed
A02-16	D09-01: S-Curve Time 1	H01-07: Terminal S7	C08-03: Min Brake Release Trq
A02-17	D09-02: S-Curve Time 2	H01-08: Terminal S8	C08-10: Load Float Time
A02-18	D09-03: S-Curve Time 3	H02-03: Terminal M5-M6	C08-11: BE5 Brake Set Time
A02-19	D09-04: S-Curve Time 4	H03-02: Terminal A1	H01-05: Terminal S5
A02-20	E01-03: V/f Pattern	H03-03: Terminal A1 Gain	H01-06: Terminal S6
A02-21	E02-01: Motor FLA	-	H01-07: Terminal S7
A02-22	H01-05: Terminal S5	-	H01-08: Terminal S8
A02-23	H01-06: Terminal S6	-	H02-03: Terminal M5-M6
A02-24	H01-07: Terminal S7	-	H03-02: Terminal A1
A02-25	H01-08: Terminal S8	-	H03-03: Terminal A1 Gain
A02-26	H02-03: Terminal M5-M6	-	-
A02-27	H03-02: Terminal A1	-	-
A02-28	H03-03: Terminal A1 Gain	-	-
A02-29	-	-	-
A02-30	-	-	-
A02-31	-	-	-
A02-32	-	-	-

4.4 Auto-Tuning

CAUTION

The brake output is not energized during Auto-Tune. The brake must be manually released before a rotational Auto-Tune and reengaged when Auto-Tuning is complete. Ensure no load is on the hook, and that the hook is near the floor.

The IMPULSE•G+/VG+ Series 5 can perform a calibration process with its automatic tuning function. The VFD prompts for motor information, and then runs a quick tuning process. Ideally, perform a rotational Auto-Tune with the motor uncoupled from the load. When the motor cannot be decoupled, perform a stationary Auto-Tune.

NOTE: *Contact Magnetek's service department if an auto-tune cannot be performed.*

Table 4-12: Auto-Tuning Parameter Settings

Display	Description	Default
Auto-Tuning Mode	Auto-Tuning Method	0
0 Rotational Auto-Tuning	*Rotational Auto-Tune*	
1 Stationary Auto-Tuning 1	*Non-Rotational Auto-Tune 1*	
2 Stationary Line-Line Resistance	*Non-Rotational Auto-Tune for Terminal Resistance*	
Motor Rated Power	Rated power shown on the motor nameplate (note: HP = kW/0.746)	Model dependent
Motor Rated Voltage	Rated voltage shown on the motor nameplate	Model dependent
Motor Rated Current	Rated full-load current (FLA) shown on the motor nameplate	Model dependent
Motor Base Frequency	Rated frequency shown on the motor nameplate	60.0 Hz
Number of Motor Poles	Number of motor poles shown on the motor nameplate	4
Motor Base Speed	Rated base speed, shown on the motor nameplate. This is the rotor speed, not the synchronous speed.	1750 RPM
Encoder Pulse Count (PPR)	Number of pulses per revolution for the encoder (VG+ only)	1024 PPR
Motor No-Load Current	No-load current shown on the motor test report or motor nameplate (G+ only).	-
Motor Rated Slip Frequency	Rated slip shown on the motor test report or motor nameplate (G+ only).	-
Motor Iron Loss	Iron loss to calculate the energy-saving coefficient.	-
Motor No-Load Voltage*	No-load voltage of the motor at rated speed. If shown on the motor test report, set the voltage in this parameter.	Model dependent

** If the value is not known, leave at default.*

4.4.1 Rotational Auto-Tune (T01-01 = 0)

This is a rotational Auto-Tuning method for Open Loop Vector and Closed Loop Vector only, which allows for Auto-Tuning a motor that is unloaded and ideally decoupled from the gearbox. The brake must also be disengaged.

The instructions below will provide a step-by-step procedure to complete this Auto-Tune function:

1. In preparation for the Auto-Tune, the crane should be with minimal attachments. This Auto-Tuning method requires free rotation of the motor, so decoupling the motor from the load or gearbox is ideal.
2. Ensure the brake is disengaged.
3. Using the keypad, browse to the “Auto-Tuning” menu.
4. Choose “Standard Tuning” (T01-01 = 0) for the Tuning Mode.
5. Enter the nameplate motor characteristics (T01-02 – T01-08) until the “Tuning Ready?” screen is reached.
6. Press the green “RUN” key to start the Auto-Tune. It will take up to a few minutes to complete. During this time, the current will ramp up and down and a high pitched frequency may be audible coming from the motor; this is normal. The motor will then begin a rotational cycle, which will complete in one minute or less.
7. When the Auto-Tune has completed, the keypad display will display an “End Tune Successful” message. Press the “ESC” key twice to exit.

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.*

4.4.2 Non-Rotational Auto-Tune 1 (T01-01 = 1)

This is a non-rotational Auto-Tuning method for Open Loop Vector and Closed Loop Vector only, which allows for Auto-Tuning without decoupling the motor.

This method will require a short movement of the crane subsequent to the non-rotational Auto-Tune process which allows the VFD to calibrate the Motor Rated Slip and No-Load Current.

The instructions below will provide a step-by-step procedure to complete this Auto-Tune function:

1. In preparation for the Auto-Tune, the crane should be unloaded with minimal hook attachments. For Traverse motion, ensure freedom of travel for Step #6.
2. Using the keypad, browse to the “Auto-Tuning” menu.
3. Choose “Tune-No Rotate1” (T01-01 = 1) for the Tuning Mode.
4. Enter the nameplate motor characteristics (T01-02 – T01-09) until the “Tuning Ready?” screen is reached.
5. Press the green “RUN” key to start the Auto-Tune. It will take up to a few minutes to complete. During this time, the current will ramp up and down and a high pitched frequency may be audible coming from the motor; this is normal. When the Auto-Tune has completed, the keypad display will display an “End Tune Successful” message. Press the “ESC” key twice to exit.
6. Run the motor to at least 30% of the Rated Frequency (T01-05). For example, if the Rated Frequency is 60 Hz, the motor must run to at least 18 Hz. In a hoisting motion, the motor must be run in the Up/Raising direction.
7. When the short run and adjustments have been completed, the motor will stop, and the keypad will display “TMDN Tune Complete”. The Auto-Tune is now complete and the VFD is ready for normal operation.

4.4.3 Non-Rotational Terminal Resistance Auto-Tune (T01-01 = 2)

This is a non-rotational Auto-Tuning method, which allows for Auto-Tuning without decoupling the motor.

This method is recommended for motors configured with the V/f control method when the motor horsepower and motor rated current are known.

The instructions below will provide a step-by-step procedure to complete this Auto-Tune function:

1. In preparation for the Auto-Tune, the crane should be unloaded with minimal hook attachments.
2. Using the keypad, browse to the “Auto-Tuning” menu.
3. Choose “Term Resistance” (T01-01 = 2) for the Tuning Mode.
4. Enter the nameplate motor characteristics for Motor Horsepower and Motor Rated Current (T01-02 and T01-04) until the “Tuning Ready?” screen is reached.
5. Press the green “RUN” key to start the Auto-Tune. It will take up to a few minutes to complete. During this time, the current will ramp up and down and a high pitched frequency may be audible coming from the motor; this is normal. When the Auto-Tune has completed, the keypad display will display an “End Tune Successful” message. Press the “ESC” key twice to exit.

5 Programming Advanced Features

5.1 Application Parameters

The application parameters control the speed references, acceleration and deceleration characteristics, and reference sources. Application parameters included in this section are listed below:

- b01 Frequency References
- b02 Reference Limits
- b03 Operation Mode
- b05 Acceleration/Deceleration Times
- b08 Jump Frequencies
- b09 Field Forcing

5.1.1 Frequency References

Table 5-1: Frequency References Parameter Settings

Parameter	Display	Function	Range	Default
b01-01	Reference 1	Speed 1 frequency	0.00–E01-04 Hz	15.00*
b01-02	Reference 2	Speed 2 frequency	0.00–E01-04 Hz	30.00*
b01-03	Reference 3	Speed 3 frequency	0.00–E01-04 Hz	60.00*
b01-04	Reference 4	Speed 4 frequency	0.00–E01-04 Hz	0.00*
b01-05	Reference 5	Speed 5 frequency	0.00–E01-04 Hz	0.00*
b01-06	Reference 6	Speed 6 frequency	0.00–E01-04 Hz	0.00
b01-07	Reference 7	Speed 7 frequency	0.00–E01-04 Hz	0.00
b01-08	Reference 8	Speed 8 frequency	0.00–E01-04 Hz	0.00
b01-09	Reference 9	Speed 9 frequency	0.00–E01-04 Hz	0.00
b01-10	Reference 10	Speed 10 frequency	0.00–E01-04 Hz	0.00
b01-11	Reference 11	Speed 11 frequency	0.00–E01-04 Hz	0.00
b01-12	Reference 12	Speed 12 frequency	0.00–E01-04 Hz	0.00
b01-13	Reference 13	Speed 13 frequency	0.00–E01-04 Hz	0.00
b01-14	Reference 14	Speed 14 frequency	0.00–E01-04 Hz	0.00
b01-15	Reference 15	Speed 15 frequency	0.00–E01-04 Hz	0.00
b01-16	Reference 16	Speed 16 frequency	0.00–E01-04 Hz	0.00
b01-17	Jog Reference	Jog Control and Inching Control frequency	0.00–E01-04 Hz	6.00*
b01-20	Inf-Var Start Speed	Infinitely Variable starting speed	0.00–E01-04 Hz	6.00
b01-21	Inf-Var Max Reference 1	Infinitely Variable max speed reference 1	0.00–E01-04 Hz	60.00
b01-22	Inf-Var Max Reference 2	Infinitely Variable max speed reference 2	0.00–E01-04 Hz	60.00

* *Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

Table 5-2: Multi-Step Speed Processing by Multi-Function Digital Input (b01-01–b01-16)

Speed Reference	Forward/ Reverse Terminal S1 or S2	Multi-Step Speed 2 H01-XX = 0	Multi-Step Speed 3 H01-XX = 1	Multi-Step Speed 4 H01-XX = 2	Multi-Step Speed 5 H01-XX = 3	Jog/Inch H01-XX = 15, 16, 17, 18
STOP	Off	-	-	-	-	Off
b01-01 Reference 1	On	Off	Off	Off	Off	Off
b01-02 Reference 2	On	On	Off	Off	Off	Off
b01-03 Reference 3	On	On	On	Off	Off	Off
b01-04 Reference 4	On	On	On	On	Off	Off
b01-05 Reference 5	On	On	On	On	On	Off
b01-06 Reference 6	On	Off	On	Off	Off	Off
b01-07 Reference 7	On	Off	On	On	Off	Off
b01-08 Reference 8	On	Off	Off	On	Off	Off
b01-09 Reference 9	On	Off	On	On	On	Off
b01-10 Reference 10	On	Off	Off	On	On	Off
b01-11 Reference 11	On	Off	Off	Off	On	Off
b01-12 Reference 12	On	On	Off	Off	On	Off
b01-13 Reference 13	On	On	On	Off	On	Off
b01-14 Reference 14	On	Off	On	Off	On	Off
b01-15 Reference 15	On	On	Off	On	Off	Off
b01-16 Reference 16	On	On	Off	On	On	Off

5.1.2 Reference Limits

These parameters limit the frequency range as a percentage of maximum output frequency (E01-04). If the lower limit is below the DC Inj Start Freq (D01-01), then operation will continue according to b03-05.

An alternate upper limit frequency can be used during operation when a Multi-Function Digital Input (MFDI) is set to 59 (Alt F-Ref Up Lmt) and the MFDI is on.

Table 5-3: Reference Limits Parameter Settings

Parameter	Display	Function	Range	Default
b02-01	Frequency Reference Upper Limit	Percentage of the maximum output frequency (E01-04), which determines the maximum frequency at which the VFD is able to run.	0.0–110.0%	100.0*
b02-02	Frequency Reference Lower Limit	Frequency reference lower limit as a percentage of maximum output frequency (E01-04).	0.0–110.0%	CLV: 0.0 else: 2.0
b02-04	Alternate Frequency Upper Limit	Alternate of b02-01 set by MFDI=59.	0.0–110.0%	0.0

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

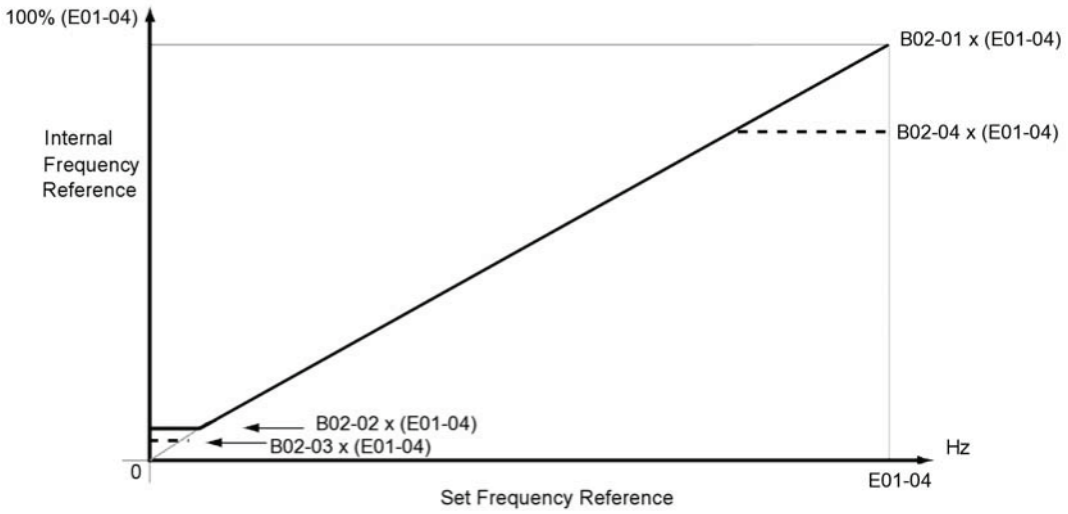


Figure 5-1: Frequency Upper and Lower Limits

5.1.3 Operation Mode

Determines the source from where the frequency reference and RUN command are generated.

Table 5-4: Run/Reference Source Parameter Settings

Parameter	Display	Function	Range	Default
b03-01	Frequency Reference Selection 1	Source from where the frequency reference is generated.	0–5	0*
	0 Multi-Step Terminals	Multi-Step Terminals • Terminal Board / Interface Card • S4IO Digital Input/Output Option Card • DI-A3 Digital Input Option Card		
	1 Analog Input	Analog Input		
	2 Serial Communication	Serial communication • RS-485 Serial Communications (D+, D-)		
	3 Option PCB - (Port CN5-A)	Communication option card (Port CN5-A) • EtherNet/IP • Modbus TCP/IP • PROFINET • PROFIBUS-DP		
	4 Pulse Input - (H06-01)	Pulse input via Terminal RP (H06-01)		
	5 Inf-Var Control	Infinitely Variable control		
b03-02	Run Command Selection 1	Source from where the RUN command is generated.	0–3	1*
	0 Operator - Keypad	Keypad (Expert)		
	1 Terminals	Terminals • Terminal Board / Interface Card		
	2 Serial Communication	Serial communication • RS-485 Serial Communications (D+, D-)		
	3 Option PCB - (Port CN5-A)	Communication Option card (Port CN5-A) • EtherNet/IP • Modbus TCP/IP • PROFINET • PROFIBUS-DP		

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

5.1.4 Stopping Method

Selects the stopping method suitable for the application.

Table 5-5: Stopping Method Parameter Settings

Parameter	Display	Function	Range	Default
b03-03	Stopping Method Selection	Determines the stopping method.	0, 1, 4, 6	G+: 0* VG+: 6*
	0 Decel to Stop	(***Figure 5-2***)		
	1 Coast to Stop	(***Figure 5-3***)		
	4 Decel with timer	(***Figure 5-4***) Traverse only		
	6 No Load Brake	See C08 parameter group (VG+ only).		

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

5.1.4.1 Decel to Stop (b03-03 = 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 (b05-02) and DC injection braking is applied after the DC injection start frequency D01-01 has been reached. If the deceleration time is set too short or the load inertia is too large, an overvoltage fault (OV) or deviation (DEV) may occur during deceleration. In this case, increase the deceleration time or verify the braking resistor is sized correctly.

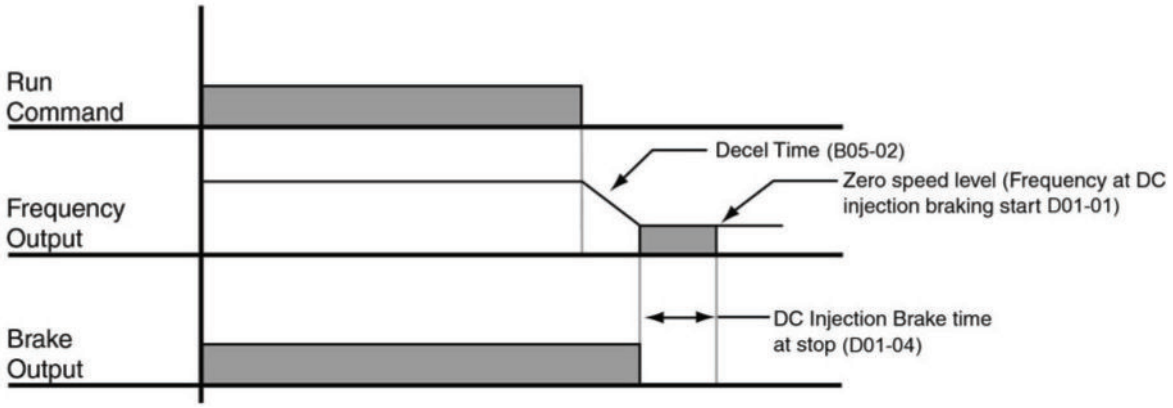


Figure 5-2: Decel to Stop

5.1.4.2 Coast to Stop (b03-03 = 1)

Upon removal of the FWD or REV run command, the motor starts to coast and the electric brake sets.

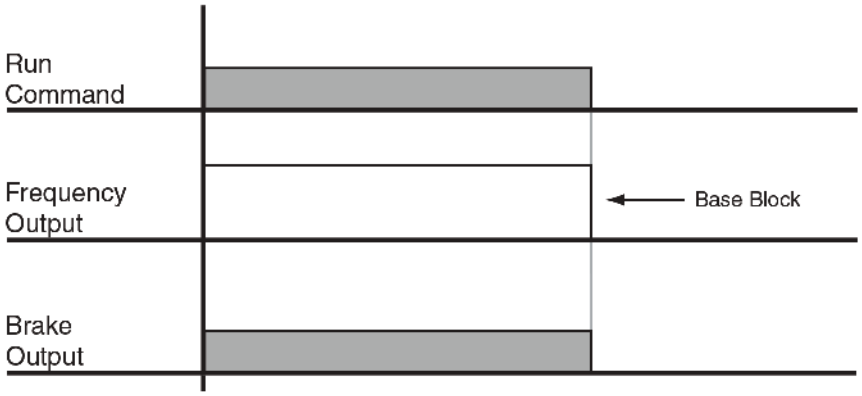


Figure 5-3: Coast to Stop

5.1.4.3 Decel with Timer (b03-03 = 4)

NOTE: *This option is only available in traverse motion.*

Upon run command removal, the motor decelerates to stop. The brake delays for a time interval (C12-02) before it is set. This option reduces brake wear for applications that involve frequent stopping and starting.

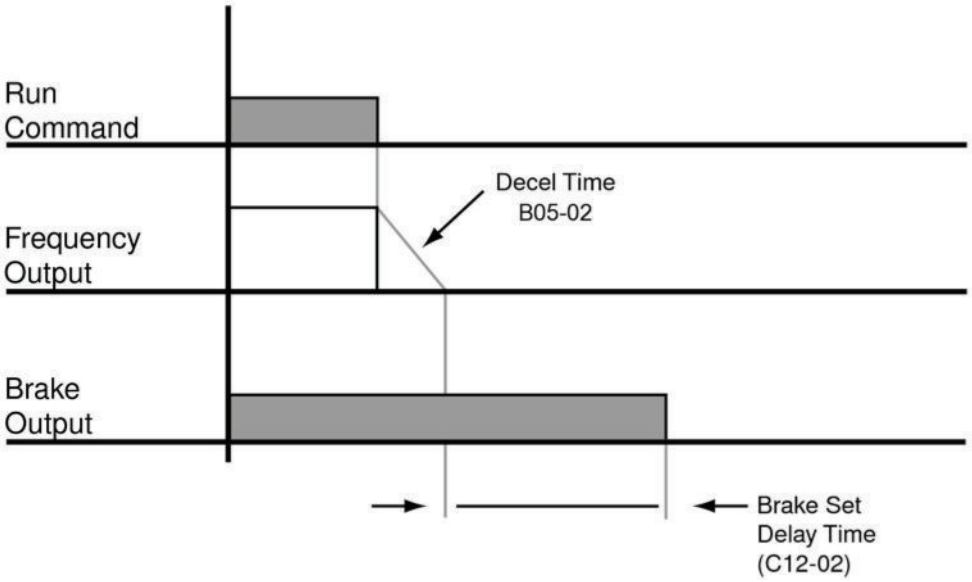


Figure 5-4: Decel w/Timer

5.1.5 Motor Rotation Change

This parameter allows you to change the motor direction without changing the motor leads.

Table 5-6: Motor Rotation Change Parameter Settings

Parameter	Display	Function	Range	Default
b03-04	Phase Order Selection	Motor phase order	0, 1	0
	0 Standard			
	1 Switch Phase Order	Reverses the motor direction		

NOTE: *To reverse the direction of rotation, set b03-04 = 1, or swap any two motor leads (changing R/L1, S/L2, or T/L3 will not affect motor rotation direction) as well as encoder phasing (F01-02 = 1 or swap A+ and A- wires).*

5.1.6 Input Scan Time

Selects the microprocessor scan time for reading the status of the input control terminals. Set b03-06 = 0 when a quicker response is needed from the control circuit terminal.

Table 5-7: Input Scan Time Parameter Settings

Parameter	Display	Function	Range	Default
b03-06	Digital Input Reading	Selects the terminal scan time	0, 1	1
	0 Single Scan	0.5 ms		
	1 Double Scan	2 ms (better for noise immunity)		

5.1.7 Run Select

Determines additional RUN command options and the secondary source from where the frequency reference and RUN command are generated.

Table 5-8: Run Select Parameter Settings

Parameter	Display	Function	Range	Default
b03-08	Run Command Select in PRG Mode	Determines whether the VFD is allowed to run while inside the Programming menu.	0–2	0
	0 Disregard RUN while Programming	Run command not accepted while in Programming menu.		
	1 Accept RUN while Programming	Run command is accepted while in Programming menu.		
	2 Allow Programming Only at Stop	Prohibit entering Programming menu while running.		
b03-15	Frequency Reference Selection 2	Determines what source the VFD will use for Frequency Reference. Enabled by H01-0x = 1F.	0–5	0
	0 Multi-Step Terminals	Terminals • Terminal Board / Interface Card • S4IO Digital Input/Output Option Card • DI-A3 Digital Input Option Card		
	1 Analog Input	Analog Input		
	2 Serial Communication	Serial communication • RS-485 Serial Communications (D+, D-)		
	3 Option PCB - (Port CN5-A)	Communication Option card (Port CN5-A) • EtherNet/IP • Modbus TCP/IP • PROFINET • PROFIBUS-DP		
	4 Pulse Input (H06-01)	Pulse input via Terminal RP (H06-01)		
	5 Inf-Var Control	Infinitely Variable control		
b03-16	Run Source 2	Determines what the VFD will use for Run Reference. Enabled by H01-0x = 1F.	0–3	0
	0 Operator - Keypad	Keypad (Expert)		
	1 Terminals	Terminals • Terminal Board / Interface Card		
	2 Serial Communication	Serial communication • RS-485 Serial Communications (D+, D-)		
	3 Option PCB - (Port CN5-A)	Communication Option card (Port CN5-A) • EtherNet/IP • Modbus TCP/IP • PROFINET • PROFIBUS-DP		
b03-35	Digital Input Deadband Time	Deadband time for the digital inputs. This can help prevent malfunctions caused by relay chattering.	0.0–100.0 ms	0.0

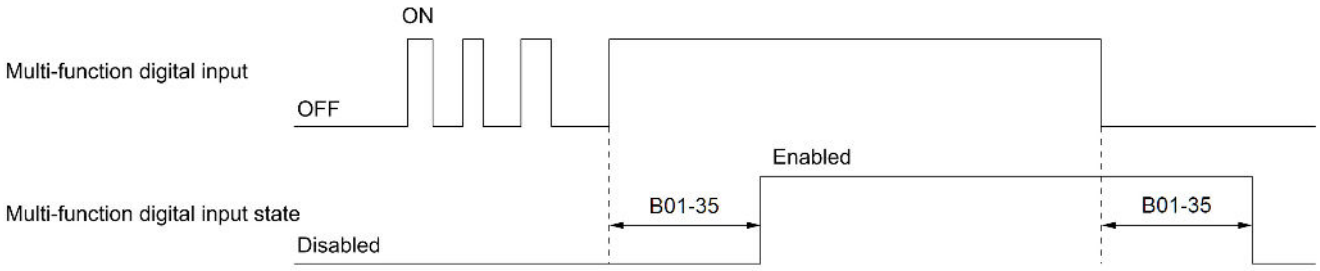


Figure 5-5: Digital Input Deadband Time (b03-35)

5.1.8 Acceleration/Deceleration Time

Acceleration time sets the time necessary for the output frequency to accelerate from 0 Hz to maximum output frequency (E01-04). Deceleration time sets the time necessary for the output frequency to decelerate from the maximum output frequency (E01-04) to 0 Hz.

Table 5-9: Acceleration/Deceleration Time Parameter Settings

Parameter	Display	Function	Range	Default
b05-01	Acceleration Time 1	Acceleration time for normal operation.	0.00–60.00 sec	5.00*
b05-02	Deceleration Time 1	Deceleration time for normal operation.	0.00–60.00 sec	3.00*
b05-03	Acceleration Time 2	Acceleration time 2 enabled when H01-xx = 1A.	0.00–60.00 sec	10.00
b05-04	Deceleration Time 2	Deceleration time 2 enabled when H01-xx = 1A.	0.00–60.00 sec	10.00

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

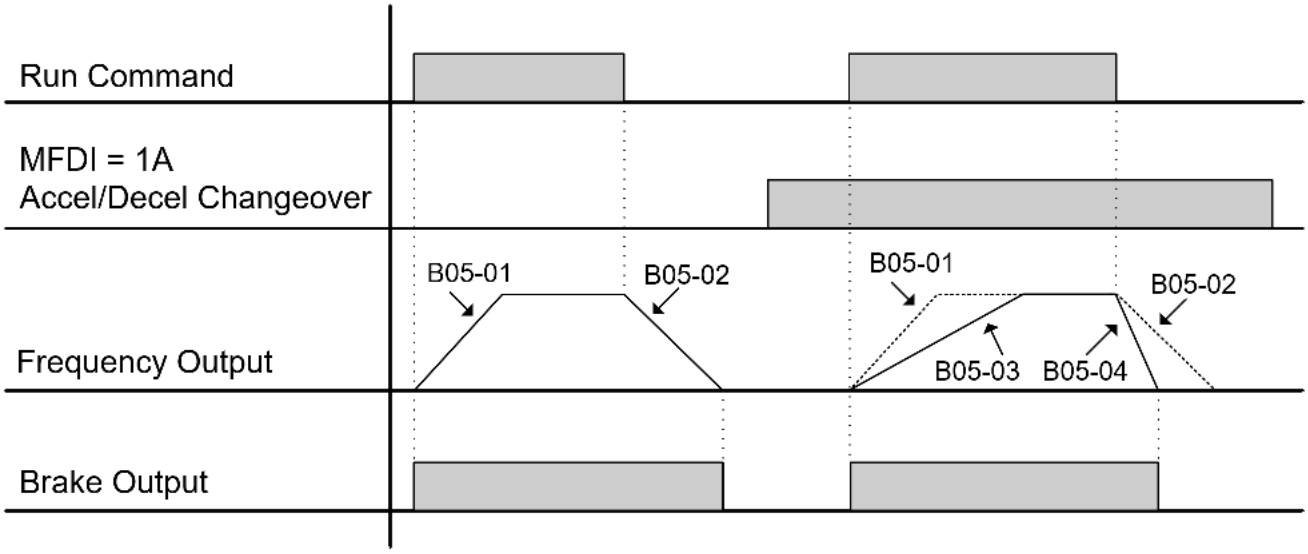


Figure 5-6: Acceleration and Deceleration Time and Changeover

***NOTE:** Assume b03-03 = 0 (Decel to Stop).*

5.1.9 Accel/Decel Time Switching Frequency

Accel/Decel times can be changed automatically without using digital inputs. Alternatively, digital inputs can be used to enable additional accel and decel times. This has priority over automatic change of Accel/Decel.

Table 5-10: Accel/Decel Time Switching Frequency Parameter Settings

Parameter	Display	Function	Range	Default
b05-05	Switch Frequency Accel Time	Acceleration time at Switch Frequency (b05-10)	0.00–60.00 sec	2.00
b05-06	Switch Frequency Decel Time	Deceleration time at Switch Frequency (b05-10)	0.00–60.00 sec	2.00
b05-08	Fast Stop Time	Deceleration time for Fast Stop at external fault. ***See Section 5.6.1.1 on page 173.***	0.00–60.00 sec	0.50
b05-09	Accel/Decel Time Setting Units	Enables extended range of Acc/Dec Params: b05-01–b05-08, b05-12–b05-15	0, 1	0
	0 0.01s (0.00 to 60.00s)	Range = 0.00–60.00 seconds		
	1 0.1s (0.0 to 600.0s)	Range = 0.0–600.0 seconds		
b05-10	Accel/Decel Time Switchover Freq	Frequency to switch between acceleration/ deceleration time settings	0.0–300.0 Hz	0.0
b05-11	Switch Frequency Compare	Determines when Acceleration and Deceleration Time at b05-10 is enabled	0, 1	1
	0 Lower SW Freq	b05-05/b05-06 enabled if U01-02 < b05-10		
	1 Upper SW Freq	b05-05/b05-06 enabled if U01-02 > b05-10		
b05-12	Acceleration Time 3	Acceleration time 3 enabled by H01-xx = 1B.	0.00–60.00 sec	3.00
b05-13	Deceleration Time 3	Deceleration time 3 enabled by H01-xx = 1B.	0.00–60.00 sec	3.00
b05-14	Acceleration Time 4	Acceleration time 4 enabled by H01-xx = 1C.	0.00–60.00 sec	3.00
b05-15	Deceleration Time 4	Deceleration time 4 enabled by H01-xx = 1C.	0.00–60.00 sec	3.00
b05-16	Accel/Decel Rate Frequency	Starting frequency used to calculate acceleration and deceleration rates.	0.0–300.0 Hz	0.0

5.1.10 Jump Frequencies

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

Table 5-11: Jump Frequencies Parameter Settings

Parameter	Display	Function	Range	Default
b08-01	Jump Frequency 1	First of three jump frequencies	0.0–300.0 Hz	0.0
b08-02	Jump Frequency 2	Second of three jump frequencies	0.0–300.0 Hz	0.0
b08-03	Jump Frequency 3	Third of three jump frequencies	0.0–300.0 Hz	0.0
b08-04	Jump Frequency Width	Jump frequency reference bandwidth	0.0–20.0 Hz	1.0

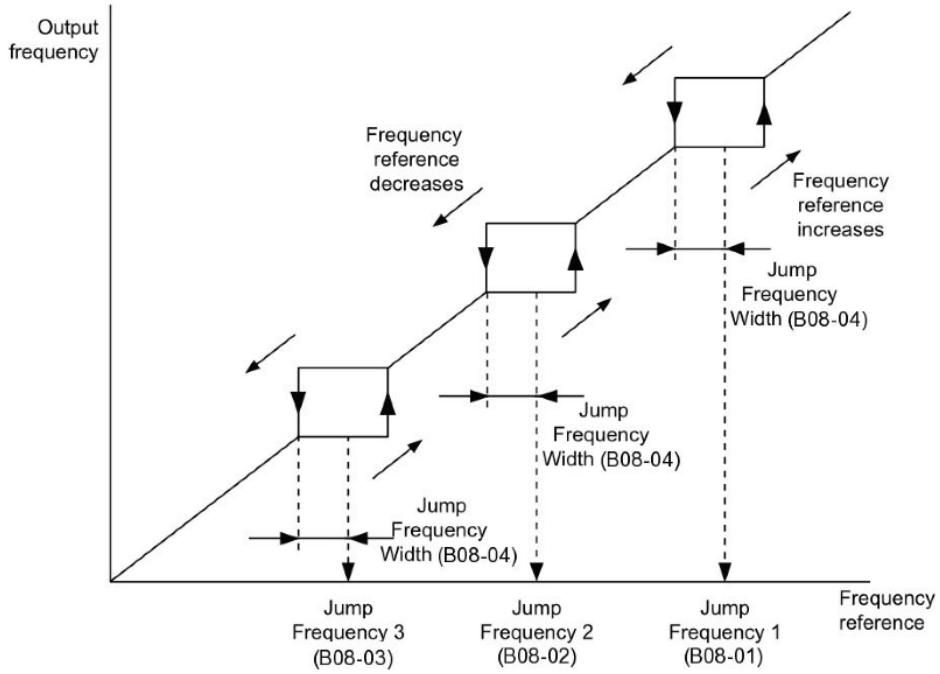


Figure 5-7: Jump Frequencies

5.1.11 Offset Frequencies

This function consists of three digital inputs to add or subtract an offset to/from the frequency reference and correct the speed. Each offset input is applied as a percentage of the Maximum Output Frequency (E01-04). When more than one offset is enabled at the same time, the offsets are added together.

Table 5-12: Offset Frequencies Parameter Settings

Parameter	Display	Function	Range	Default
b08-05	Offset Frequency 1	Enabled by MFDI H01-XX = 6C	-100.0–100.0%	0.0
b08-06	Offset Frequency 2	Enabled by MFDI H01-XX = 6D	-100.0–100.0%	0.0
b08-07	Offset Frequency 3	Enabled by MFDI H01-XX = 6E	-100.0–100.0%	0.0

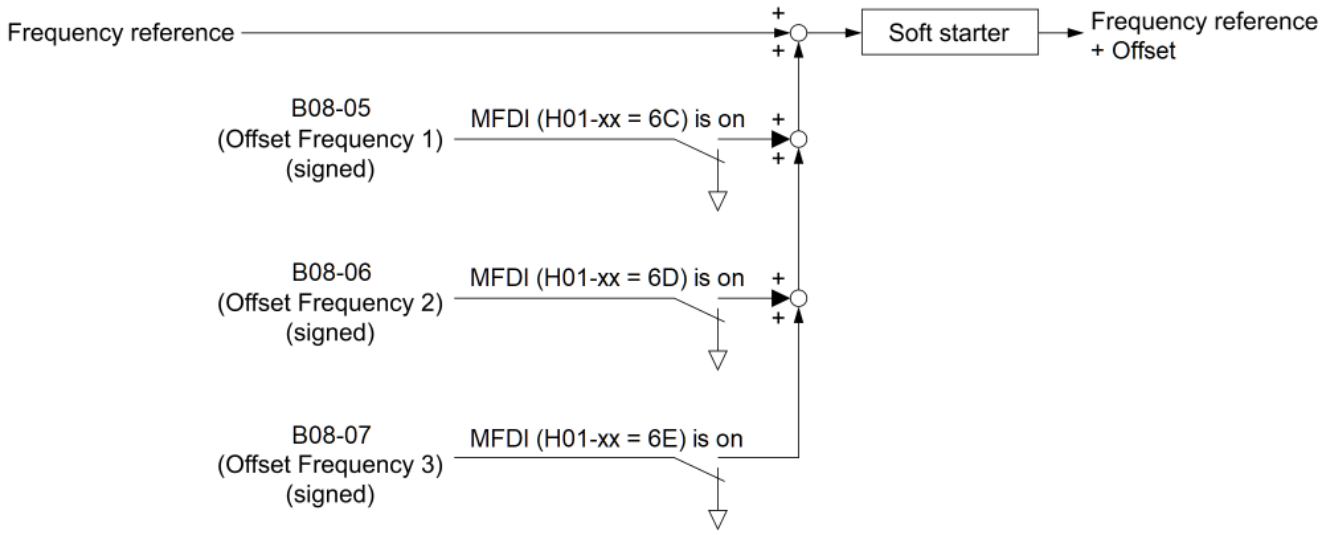


Figure 5-8: Offset Frequency Operation

5.1.12 Field Forcing

This function compensates the delaying influence of the motor time constant when changing the excitation current reference and improves motor responsiveness. Field Forcing has no effect during DC Injection Braking.

Table 5-13: Field Forcing Parameter Settings

Parameter	Display	Function	Range	Default
b09-03	Field Forcing Selection *0 Disabled* *1 Enabled*	Enables or disables the Field Forcing Function	0, 1	0
b09-06	Field Forcing Limit	Maximum level at which the Field Forcing function can boost the excitation current reference. The value is set as a percentage of the motor no load current. This does not normally need to be changed.	100–400%	200

5.2 Crane & Hoist Functions

Table 5-14: Crane & Hoist Function Availability

Access Level (A01-01)	Advanced (2) or Expert (3)					
Motion (A01-02)	Traverse (0)			Standard Hoist (1)		NLB Hoist (2)
Function/Control Method (A01-03)	V/f (0)	OLV (2)	CLV (3)	V/f (0)	OLV (2)	CLV (3)
C01: Quick Stop	○	○	○	○	○	○
C01: Reverse Plug Simulation	○	○	○	×	×	○
C02: Micro-Speed	○	○	○	○	○	○
C03: End of Travel Limits	○	○	○	○	○	○
C03: Phantom Stop	○	○	○	○	○	○
C03: Hook Height Measurement	×	×	×	×	×	○
C03: EPLS	×	×	×	×	×	○
C04: Load Float	×	×	○	×	×	○
C04: Load Share (Torque Following)	×	×	○	×	×	○
C05: Load Check	×	×	×	×	○	○
C06: Ultra-Lift	×	×	×	○	○	○
C07: Torque Limit	×	○	○	×	○	○
C07: Anti-Shock	×	×	×	×	×	○
C08: Dual Brake	×	×	×	×	×	○
C08: No Load Brake (NLB) Hoist	×	×	×	×	×	○
C08: Brake Answerback	○	○	○	○	○	○
C08: Emergency Lift	×	×	×	×	×	○
C11: Slack Cable Detection	×	×	×	×	×	○
C11: Snap Shaft Detection	×	×	○	×	×	○
C12: Brake Delay Timers	○	○	○	×	×	×
C12: On/Off Delay Timers	○	○	○	○	○	○
C12: Maintenance Timers and Counters	○	○	○	○	○	○
C13: Inch Control	○	○	○	○	○	○
C13: Index Control	×	×	○	×	×	○
C14: Sway Control	○	○	○	×	×	×

○: Available

×: Not available

5.2.1 Quick Stop

Quick Stop provides an automatic Alternate Deceleration at Stop.

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

Table 5-15: Quick Stop Parameter Settings

Parameter	Display	Function	Range	Default
C01-01	Quick Stop *0 Disabled* *1 Enabled*	Determines whether Quick Stop is enabled	0, 1	0*
C01-02	Quick Stop Time	Deceleration time during Quick Stop	0.0–25.5 sec	1.0

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

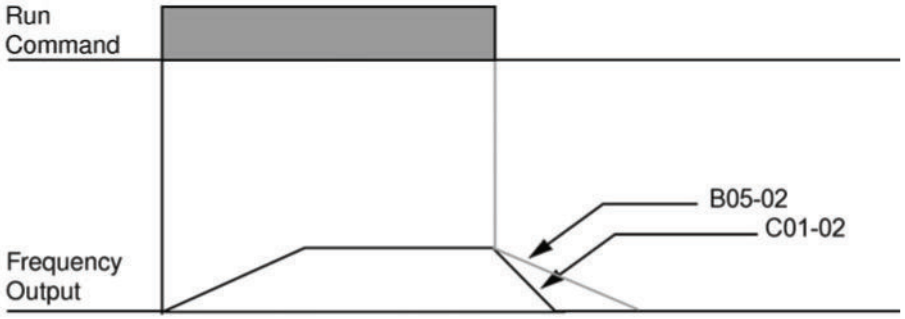


Figure 5-9: Quick Stop

5.2.2 Reverse Plug Simulation

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.

NOTE: *Reverse Plug Simulation is not available in Standard Hoist mode (A01-03 = 1).*

Table 5-16: Reverse Plug Simulation Parameter Settings

Parameter	Display	Function	Range	Default
C01-03	Reverse Plug *0 Disabled* *1 Enabled*	Determines whether Reverse Plug Simulation is enabled.	0, 1	0*
C01-04	Reverse Plug Deceleration Time	Deceleration time during Reverse Plug Simulation.	0.0–25.5 sec	2.0
C01-05	Reverse Plug Acceleration Time	Acceleration time during Reverse Plug Simulation. If set to 0.0, b05-01 is used. ***NOTE:*** Not available in NLB Hoist mode.	0.0–25.5 sec	0.0

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

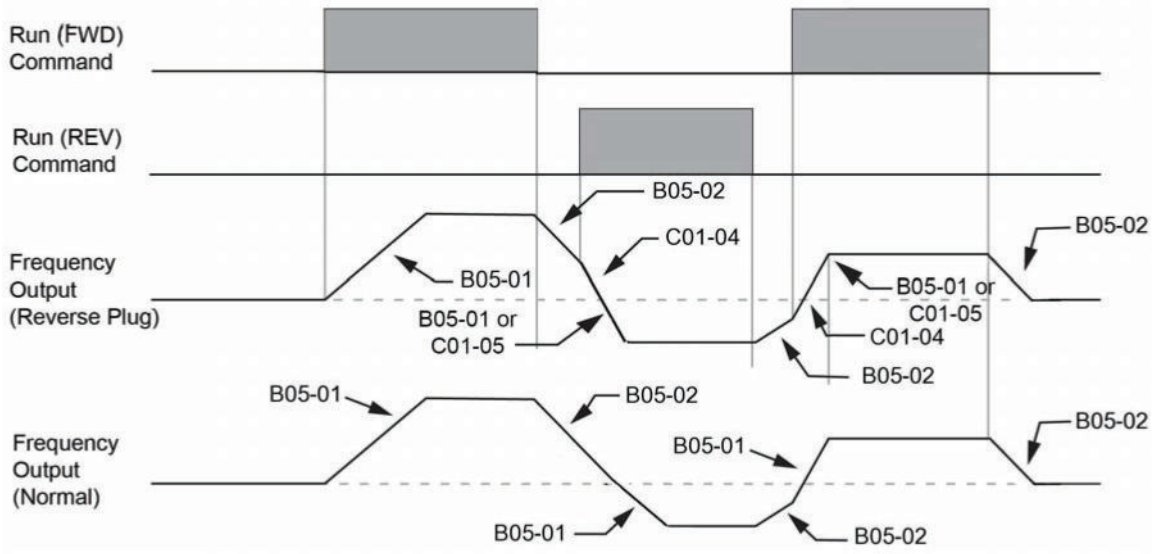


Figure 5-10: Reverse Plug Simulation

5.2.3 Micro-Speed

Micro-Speed provides 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 and can be adjusted and enabled independently.

Table 5-17: Micro-Speed Parameter Settings

Parameter	Display	Function	Range	Default
C02-01	Micro-Speed Gain 1	The multiplier of the Analog or Digital Speed Reference to achieve slow-speed operation. Enabled by digital input H01-xx = E.	Hoist: 0.001–1.000 Traverse: 0.001–2.000	1.000
C02-02	Micro-Speed Gain 2	An alternate multiplier of the Analog or Digital Speed Reference to achieve slow-speed operation. Enabled by digital input H01-xx = 10.	Hoist: 0.001–1.000 Traverse: 0.001–2.000	1.000

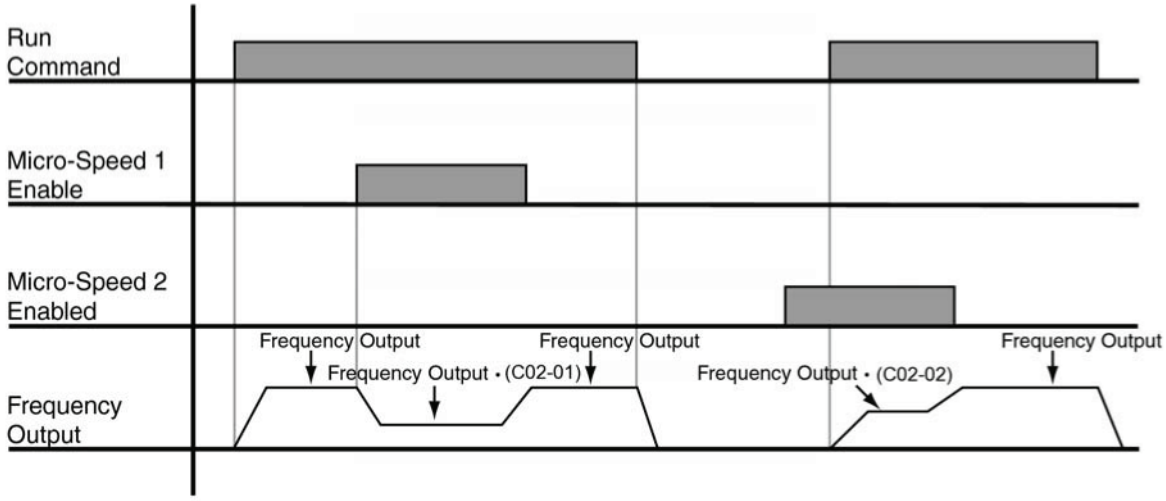


Figure 5-11: Micro-Speed Control

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

5.2.4 End of Travel Limits

This function can automatically slow and stop a crane or hoist when it reaches the end of travel limits. Two types of limit inputs (slowdown and stop) are available in both travel directions. Travel limit inputs can be programmed through the H01 and F03 digital input parameters.

Table 5-18: End of Travel Limits Parameter Settings

Parameter	Display	Function	Range	Default
C03-01	UL1 Speed	Speed when UL1 is detected	0.00–E01-04 Hz	6.00
C03-02	UL0/UL1 Deceleration Time	Decel time when UL1 is detected	0.0–25.5 sec	1.0
C03-03	UL2 Deceleration Time	Decel time to STOP when UL2 is detected	0.0–25.5 sec	1.0
C03-04	LL1 Speed	Speed when LL1 is detected	0.00–E01-04 Hz	6.00
C03-05	LL0/LL1 Deceleration Time	Decel time when LL1 is detected	0.0–25.5 sec	1.0
C03-06	LL2 Deceleration Time	Decel time to STOP when LL2 is detected	0.0–25.5 sec	1.0
C03-07	UL0 Speed	Speed when UL0 is detected. Deceleration time is by C03-02.	0.00–E01-04 Hz	30.00
C03-08	LL0 Speed	Speed when LL0 is detected. Deceleration time is by C03-06.	0.00–E01-04 Hz	30.00
C03-09	LL2/UL2 Action *0 Decel to Stop* *1 Coast to Stop* *2 Use b03-03 Method*	Stopping method when UL2 or LL2 is detected. The faster stopping method between b03-03 and C03-09 will be used.	NLB: 1–2 else: 0–2	2*
C03-10	LL3/UL3 Action	Weighted Limit (UL3) or Ultimate Lower Limit (LL3) stopping method for H01-xx = 11, 12, 111, or 112. Alarm only when VFD is not running. Deceleration time is by Fast Stop Time (b05-08).	NLB: 1–2, 4–5 else: 0–5	1
	0 Decel to Stop	Decel to Stop with Fault		
	1 Coast to Stop	Coast to Stop with Fault		
	2 Use b03-03 Method	b03-03 to Stop with Fault		
	3 Decel to Stop, Alarm	Decel to Stop with Alarm. If UL3, Forward commands not allowed. If LL3, Reverse commands not allowed.		
	4 Coast to Stop, Alarm	Coast to Stop with Alarm. If UL3, Forward commands not allowed. If LL3, Reverse commands not allowed.		
	5 b03-03 to Stop, Alarm	b03-03 to Stop with Alarm. If UL3, Forward commands not allowed. If LL3, Reverse commands not allowed.		
C03-11	LL3/UL3 Deceleration Time	Decel time when UL3 or LL3 is detected.	0.0–25.5 sec	1.0

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

5.2.5 Phantom Stop

Phantom Stop allows quick identification of a faulted VFD while stopping other VFDs with Phantom Stop enabled. This feature is designed to stop the VFD operation using the stopping method selected in C03-10 when a Phantom Fault input (H01-xx = 5F or 15F) is active. The VFD will indicate a Phantom Fault by blinking the keypad RUN key LED, in sequence of two short bursts. The VFD will resume normal operation when a Phantom Fault is removed.

Table 5-19: Phantom Stop Parameter Settings

Parameter	Display	Function	Range	Default
C03-12	Phantom Stop Method	Stopping Method when H01-xx = 5F or 15F	NLB: 1–2 else: 0–2	1
	0 Decel to Stop	Deceleration by Fast Stop (b05-08)		
	1 Coast to Stop			
	2 Use b03-03 Method	Deceleration by Fast Stop (b05-08)		

5.2.6 Hook Height Measurement

Hook Height Measurement is an IMPULSE•VG+ Series 5 feature that provides a monitor parameter (U01-50) and analog output proportional to the hook's current position between a home position and a limit position. Hook height programming is used in conjunction with the Electronic Programmable Limit Switch parameters. ***See Figure 5-12 on page 98*** for Hook Height configuration. The physical limit switch must be normally open (N.O.) to prevent homing during a power-down or power loss.

NOTE: *Setting C03-20 = 10 will home the hook height. This can be useful for zeroing out the hook height without the need of a digital input.*

Table 5-20: Hook Height Parameter Settings

Parameter	Display	Function	Range	Default
C03-14	Hook Height Revolutions Total	Number of motor revolutions from the top of travel (FWD direction) to the bottom of travel (REV direction).	0–65535 Rev	250
C03-15	Hook Height Home Position	MFDI to be used for setting the Hook Height Home position. Corresponding MFDI must be programmed or oPE40 will be shown.	0–4	2
	0 Home = UL2	Motor Revolutions is set to 0 when UL2 N.O. is closed (H01-xx = 07).		
	1 Home = LL2	Motor Revolutions is set to C03-13 when LL2 N.O. is closed (H01-xx = 09).		
	2 Home MFDI Upper	Motor Revolutions is set to C03-29 when Hook Height Home is closed (H01-xx = 67).		
	3 Home MFDI Lower	Motor Revolutions is set to C03-14 when Hook Height Home is closed (H01-xx = 67).		
	4 Home = UL3	Motor Revolutions is set to 0 when UL3 N.O. is closed (H01-xx = 62).		
C03-16	Hook Height Analog Output	Output voltage for the analog Hook Height monitor.	0, 1	0
	0 0 Revs = 0% Analog Output	U01-50 = 0%, MFAO = 0V		
	1 0 Revs = 100% Analog Output	U01-50 = 100%, MFAO = 10V		

NOTE: *Motor revolutions (U01-51) will not go negative. If 0 motor revolutions has been reached and the hoist continues in the Up (FWD) direction, the motor revolutions will remain at 0.*

Table 5-21: Monitor Values at Hook Height Home Position

		C03-16 = 0	C03-16 = 1
C03-15	**U01-51**	**U01-50**	**U01-50**
0	0	0%	100%
1	C03-13	100%	0%
2	0	0%	100%
3	C03-13	100%	0%
4	0	0%	100%

5.2.7 Electronic Programmable Limit Switches (EPLS)

Using the motor revolutions (U01-51) from the Hook Height Measurement function, it is possible to program UL0, UL1, UL2, UL3, LL0, LL1, LL2, and LL3 positions without the use of rotary limit switches. Hook Height Measurement must be correctly set up before using EPLS.

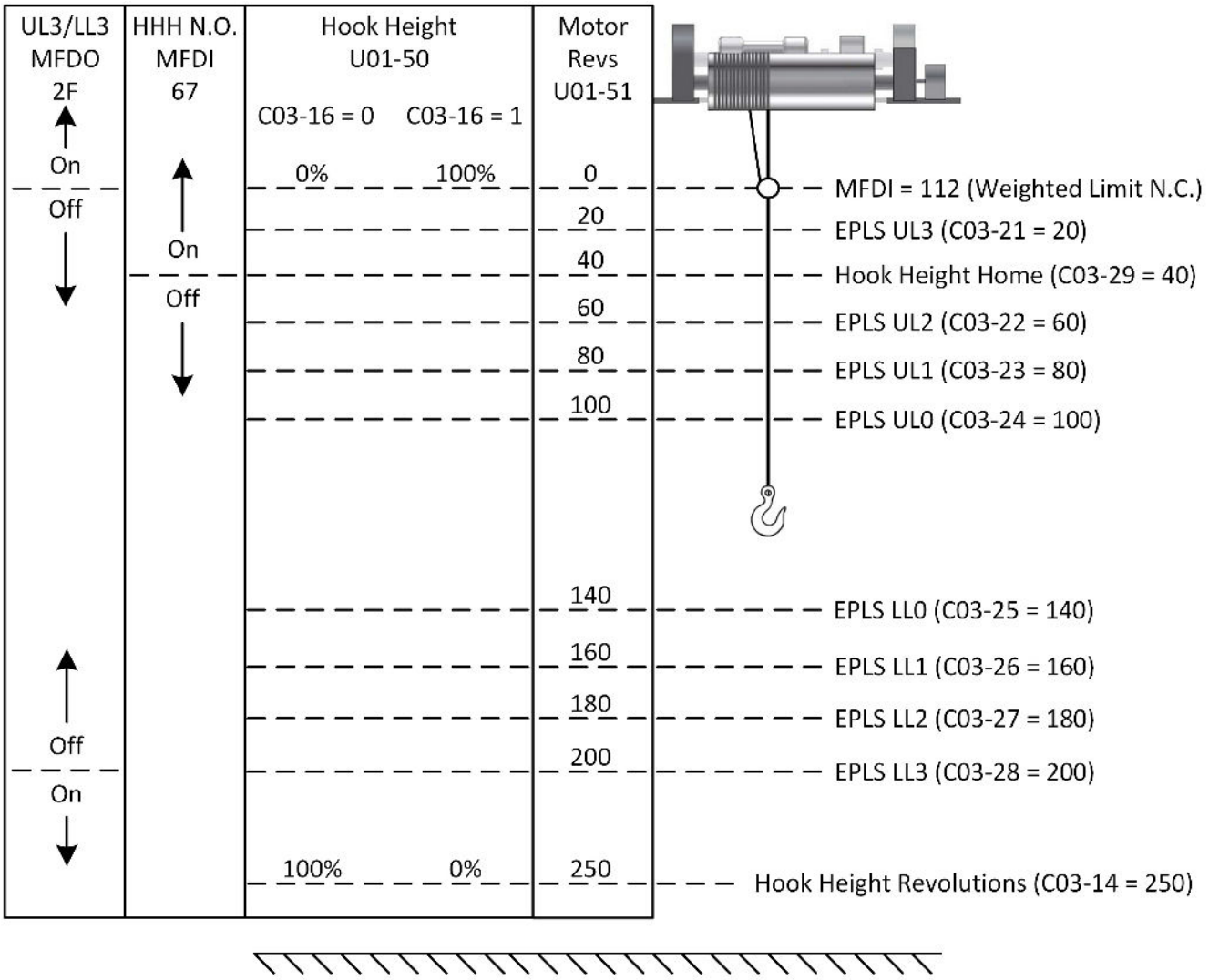
Table 5-22: Electronic Programmable Limit Switches Parameter Settings

Parameter	Display	Function	Range	Default
C03-20	Electronic Programmable Limits *0 Disabled* *1 Enabled* *2 Set UL3* *3 Set Upper Limits (UL2/UL1)* *4 Set Lower Limits (LL2/LL1)* *5 Set LL3* *10 Trigger Hook Height Home* *11 Set EPLS Rev Params to 0*	Enables or configures the EPLS function.	0–5, 10, 11	0
C03-21	UL3 Revolutions	Weighted Limit position	0–65535 Rev	0
C03-22	UL2 Revolutions	Upper Limit 2 position	0–65535 Rev	0
C03-23	UL1 Revolutions	Upper Limit 1 position	0–65535 Rev	0
C03-24	UL0 Revolutions	Upper Limit 0 position	0–65535 Rev	0
C03-25	LL0 Revolutions	Lower Limit 0 position	0–65535 Rev	0
C03-26	LL1 Revolutions	Lower Limit 1 position	0–65535 Rev	0
C03-27	LL2 Revolutions	Lower Limit 2 position	0–65535 Rev	0
C03-28	LL3 Revolutions	Ultimate Lower Limit position	0–65535 Rev	0
C03-29	Motor Revolutions at Home Pos	Home position	0–65535 Rev	0

NOTE: *A setting of 0 disables that specific limit.*

Table 5-23: Limit Switch Outputs

H02-0x or F05-0x =	Function
2B - Upper Limit 1	Output ON when keypad displays UL1
2C - Upper Limit 2	Output ON when keypad displays UL2
2D - Lower Limit 1	Output ON when keypad displays LL1
2E - Lower Limit 2	Output ON when keypad displays LL2
2F - Upper/Lower Limit 3	Output ON when keypad displays UL3 or LL3



Note 1: Hook Height Home input is triggered on the edge only.
Note 2: There is a 1 sec. delay at startup for N.C. inputs to engage. A Run command ends the delay.
Note 3: Motor revolutions do not go negative.

Figure 5-12: EPLS Parameter Layout

5.2.8 Upper/Lower Limit Bypass

The Limit Bypass allows for the following without the use of jumpers or re-programming parameters:

1. Ease of testing the Weighted Upper Limit Switch (UL3) or re-homing the Hook Height.
2. To allow changing of the wire ropes, i.e. spooling all the rope off of the hoist drum.

NOTE: *A momentary key-switch is recommended to operate this function and should only be accessible to maintenance personnel, not the crane operator. A functional description and usage procedure should be included in an administrative control program to avoid confusion and potentially have the End of Travel Limit switches left in a bypassed state during normal operation of the crane.*

Table 5-24: Limit Bypass MFDI

Functions Bypassed	F03-0x or H01-0x =	
	62	63
Upper Limit 1 N.C. (MFDI = 106)		
Upper Limit 2 N.C. (MFDI = 107)	×	
Lower Limit 1 N.C. (MFDI = 108)		
Lower Limit 2 N.C. (MFDI = 109)	×	
Lower Limit 3 N.C. (MFDI = 111)		
Upper Limit 3 N.C. (MFDI = 112)		
UL3 detected by EPLS (C03-21)		×
UL2 detected by EPLS (C03-22)	×	×
UL1 detected by EPLS (C03-23)		×
UL0 detected by EPLS (C03-24)		×
LL0 detected by EPLS (C03-25)		×
LL1 detected by EPLS (C03-26)		×
LL2 detected by EPLS (C03-27)	×	×
LL3 detected by EPLS (C03-28)		×

× = *Limit Bypass*

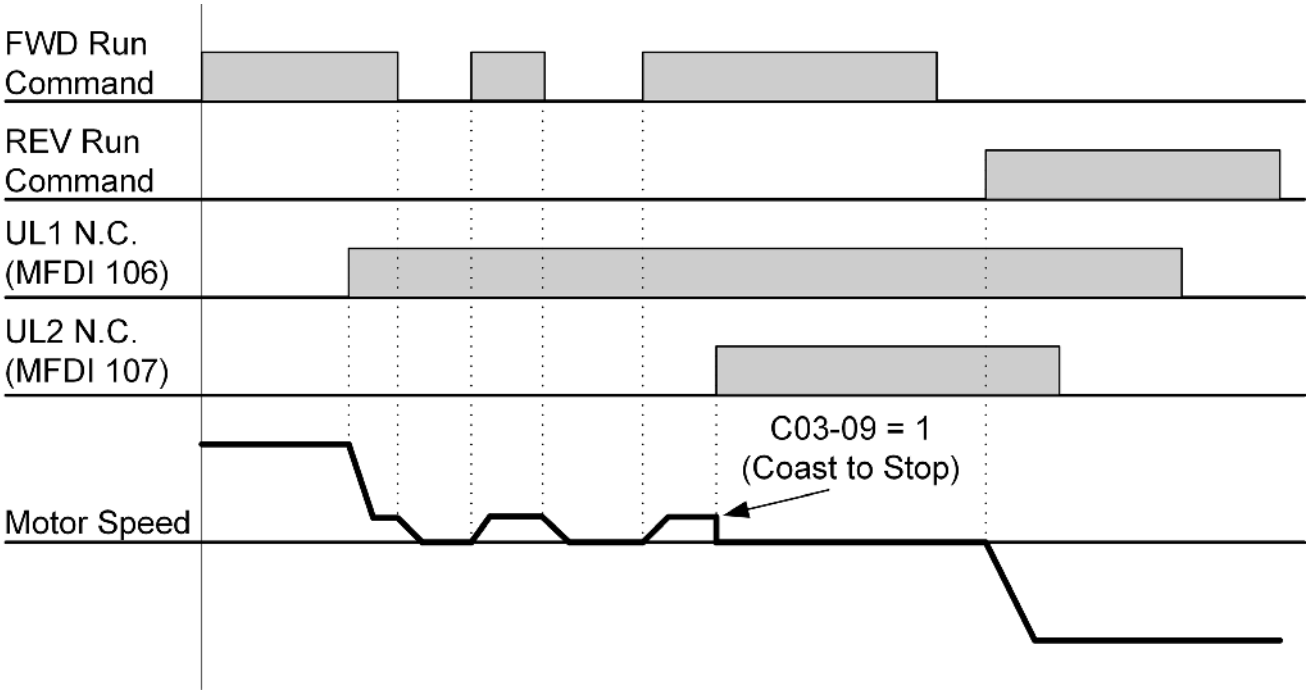


Figure 5-13: Upper Limits (UL1 / UL2)

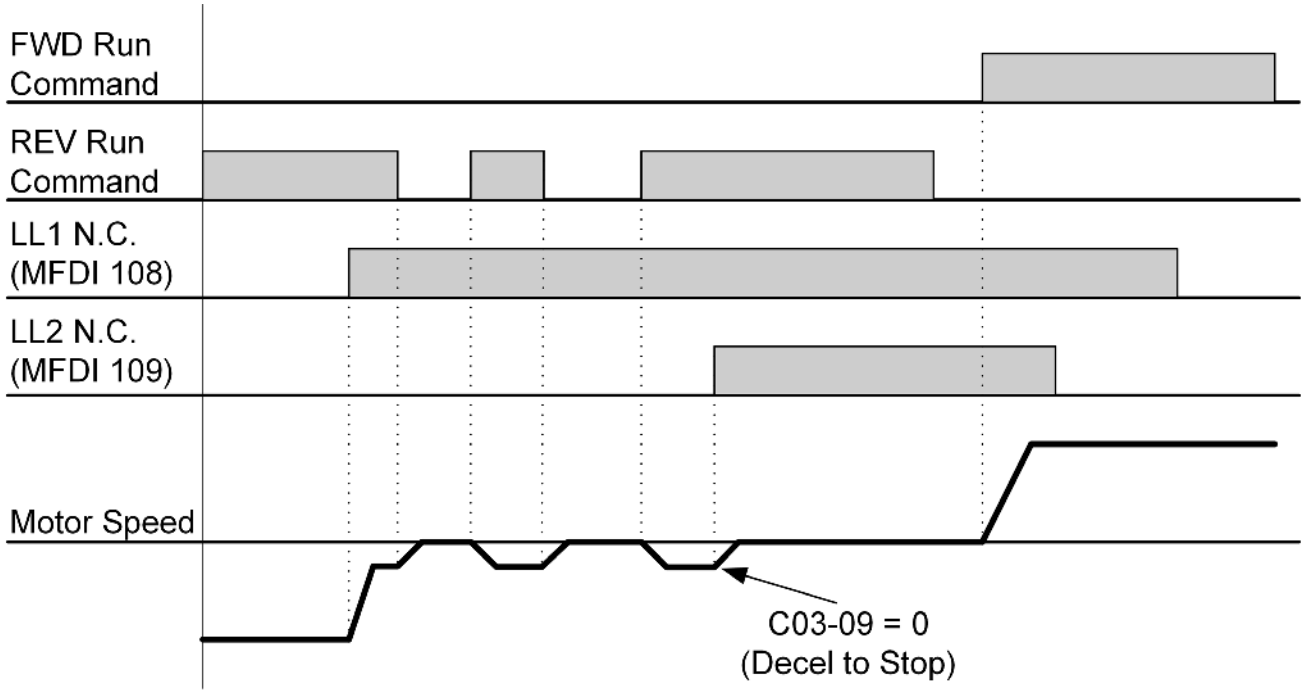


Figure 5-14: Lower Limits (LL1 / LL2)

5.2.9 Analog Input Programmable Limits

The Analog Input Programmable Limits function allows for a LaserGuard 2 laser to be connected to an analog input of the VFD. This function will assign travel limits based on the analog input signal.

Table 5-25: Analog Input Programmable Limits Parameters

Parameter	Display	Function	Range	Default
C03-40	Analog Input Programmable Limits *0 Disabled* *1 Enabled* *2 Set UL3* *3 Set Upper Limits (UL2/UL1)* *4 Set Lower Limits (LL2/LL1)* *5 Set LL3* *11 Set MFAI Parameters to 0*	Function of the analog input programmable limits.	0–5, 11	0
C03-41	UL3 Analog Level	Upper Limit 3 analog input level.	0.0–100.0%	0.0
C03-42	UL2 Analog Level	Upper Limit 2 analog input level. Equivalent to a LaserGuard stop level.	0.0–100.0%	0.0
C03-43	UL1 Analog Level	Upper Limit 1 analog input level. Equivalent to a LaserGuard slowdown level.	0.0–100.0%	0.0
C03-44	UL0 Analog Level	Upper Limit 0 analog input level. Equivalent to a LaserGuard warning level.	0.0–100.0%	0.0
C03-45	LL0 Analog Level	Lower Limit 0 analog input level. Equivalent to a LaserGuard warning level.	0.0–100.0%	0.0
C03-46	LL1 Analog Level	Lower Limit 1 analog input level. Equivalent to a LaserGuard slowdown level.	0.0–100.0%	0.0
C03-47	LL2 Analog Level	Lower Limit 2 analog input level. Equivalent to a LaserGuard stop level.	0.0–100.0%	0.0
C03-48	LL3 Analog Level	Lower Limit 3 analog input level.	0.0–100.0%	0.0
C03-49	MFAI Hysteresis	Hysteresis around the analog input set points to prevent relay chattering.	0.0–10.0%	1.0
C03-50	MFAI Range Check *0 Disabled* *1 Enabled*	When enabled, a fault will occur if the analog inputs signal is 0% or 100%, indicating a damaged laser or signal is out of range.	0, 1	0
C03-51	Rate of Change Fault	An ROC (Analog Rate of Change) fault will occur if the analog input signal changes more than C03-51 percent over a 100ms period.	0–20%	0

5.2.10 Hook Height Set Points

The Hook Height Set Points function provides an indication of the hook height position using a configurable action of an analog output.

Table 5-26: Hook Height Set Points Parameters

Parameter	Display	Function	Range	Default
C03-60	Hook Height Point 1 Function *0 Above Set Point* *1 Below Set Point* *2 Between SP1 & SP2*	Determines when the digital output (MFDO = 26) will close when Set Point 1 is reached. Selecting C03-60 = 9 serves as a setup function and will automatically program the current motor revolutions (U01-51) to C03-61.	0–2	0
C03-61	Hook Height Point 1 Revolutions	Motor revolutions for Set Point 1 MFDO.	0–65535 Rev	0
C03-62	Hook Height Point 2 Function *0 Above Set Point* *1 Below Set Point* *2 Between SP1 & SP2*	Determines when the digital output (MFDO = 27) will close when Set Point 2 is reached. Selecting C03-62 = 9 serves as a setup function and will automatically program the current motor revolutions (U01-51) to C03-63.	0–2	1
C03-63	Hook Height Point 2 Revolutions	Motor revolutions for Set Point 2 MFDO.	0–65535 Rev	0

5.2.11 Load Float

When Load Float (C08-10) is enabled, it maintains the motor shaft at a stationary position with brake open. The Load Float Hold digital input (MFDI = 35) triggers the VFD to go into Load Float for the time set in C04-01. During this time, the VFD will open the brake and hold the motor at a zero position. A FWD or REV run command takes priority over this function.

Table 5-27: Load Float Parameter Settings

Parameter	Display	Function	Range	Default
C04-01	Load Float MFDI Run Time	Maximum duration of Load Float time when MFDI = 35 is enabled.	0–65535 sec	10
C04-02	Load Float Gain	Gain for the control loop to hold the load from moving during load float	0–100	10*

** Dependent on kVA (≤ 30 HP: 10; > 30 HP: 20)*

5.2.12 Load Share (Torque Following)

Load Share allows one or more mechanically coupled motors to be connected in a Leader/Follower fashion where the Follower VFD will follow the torque reference of the Leader VFD. It can be configured in two ways, either as a dedicated Follower or as a Leader/Follower that can be switched with a digital input. When in Load Share, the follower motor is a torque helper to the lead motor. The Leader outputs the commanded torque from a ± 10 VDC analog signal into the Follower, which correlates directly to the direction and quantity of torque the Follower should apply to its own motor. This can be particularly useful when two or more motors are driving a common load (i.e. single drum, gear box, etc.) and need to share the load. This will allow one VFD/motor to handle the speed reference and speed regulation while the others simply help. This overcomes inherent problems with having more than one VFD/motor trying to regulate speed on a common load. The Load Sharing function can be used for Hoist or Traverse motions.

Table 5-28: Load Share Parameter Settings

Parameter	Display	Function	Range	Default
C04-05	Load Share *0 Enabled by MFDI = 68* *1 Enabled Always*	Selects how Load Share is enabled. If using Load Share as a standalone application, F01-24 needs to be increased to 110% to prevent OS faults.	0, 1	0
C04-06	Load Share Fault Time	The amount of time to wait for Follower VFD to give a Ready Signal, when in Load Share, before triggering a fault.	0.0–25.5 sec	1.5

1. The leader can be any IMPULSE•VG+ VFD.
2. The Limit Switch stopping method is not selectable in Load Sharing mode. If a Stop Limit is input, the output is turned off and the brake output will set immediately.
3. Weighted Upper Limit (UL3) Input (H01-xx = 112) is functional regardless of the C04-05 setting.

5.2.12.1 Load Share Setup Example

At least one wire interconnection is required between the Leader and Follower VFDs, in addition to the parameter settings below. Connect a wire between an analog output on the Leader to an analog input on the Follower. If using the Optional step below, connect a wire between a digital output on the Follower and a digital input on the Leader.

NOTE: *Consult factory for applications with more than two Follower VFDs.*

1. **Leader** and **Follower** VFDs must be set to Closed Loop Vector, A01-02 = 3.
2. **Leader** VFD ±10 VDC analog output H04-01 or H04-04 = 109 — “Torque Reference”.
3. **Leader** VFD analog output gain H04-02 or H04-05 = 50%.
4. **Leader** VFD digital output H02-0x = 2A — “During Frequency Output”.
5. **Follower** VFD digital input H01-xx = 68 — “Load Share Enable”.
6. **Follower** VFD ±10 VDC analog input H03-06 or H03-10 = 13 — “Torque Reference”.
7. **Follower** VFD analog input gain H03-07 or H03-11 = 200%.
8. OPTIONAL: The **Leader** VFD can be set to H01-xx = 69 (Load Share Follower Ready), and then the **Follower** VFD set to H02-0x = 0 — “Brake Release.”

5.2.13 Load Check

The Load Check function is a load-limiting feature which ensures the programmed load limit of the hoist is not exceeded. It prevents the lifting (and potential stall) of a load that is overweight. When an overload condition is detected, further lifting is restricted. The load may then be lowered at the speed that is specified by the Load Check Alarm Speed (C05-08).

DANGER

Load Check is designed to limit loads less than or equal to the crane's rated capacity. Consult the factory and crane manufacturer before calibrating Load Check with a load heavier than the crane capacity.

5.2.13.1 V/f Operation (A01-02 = 0)

When using Load Check in V/f, motor current (U01-03) is compared to values stored during the Load Check set up process. If they exceed the values for the active Load Check Zone, the motor will stop based on the LC Alarm Action (C05-02) and display a Load Check alarm (LC).

NOTE: *If an application requires Load Check to be bypassed, program an MFDI to 6A (N.O.) or 16A (N.C.).*

NOTE: *It is highly recommended to use Open or Closed Loop Vector control methods for Load Check.*

5.2.13.2 Open and Closed Loop Vector Operation (A01-02 = 2 and 3)

When using Load Check in Open Loop Vector or Closed Loop Vector, motor torque (U01-09) is compared to values stored during the Load Check set up process. If they exceed the values for the active Load Check Zone, the motor will stop based on the LC Alarm Action (C05-02) and displays a Load Check alarm (LC).

NOTE: *If an application requires Load Check to be bypassed, program an MFDI to 6A (N.O.) or 16A (N.C.).*

NOTE: *The Load Check function will alter the acceleration time, depending on loading. It must be disabled when using two or more hoists to lift a single load.*

5.2.13.3 Load Check Set Up (C05-01 = 9)

The Load Check set up procedure will quickly measure and calculate the current or torque required at each of the Load Check Zones starting with the rated load suspended. These values will automatically be stored in parameters C05-09 through C05-24 during the Load Check set up process.

The following steps are required to perform the Load Check setup process.

1. Verify that when the Master Switch is at full deflection (the highest speed point if stepped, or 10V if Analog), the Frequency Reference shown in U01-01 is equal to Motor Base Frequency shown in E01-06 (typically 60Hz). For example, with a 3-Step speed reference, if b01-03 is set at 60Hz, then the frequency reference should be 60Hz when the Master Switch is pushed to full deflection. If the frequency reference doesn't reach Motor Base Frequency, set the following (depending on Speed Ref):
   - Multi-Step: b01-0x is 60Hz
   - Infinitely Variable: b01-21 = 100%
   - Analog: H03-03 = 100% and b02-01 = 100%
2. The motor should be properly Auto-tuned.
   - Open and Closed Loop Vector operation – Rotational Auto-tune.
   - V/f operation – Stationary Auto-tune.
3. Ensure b02-03 and E01-09 are at the desired values. If you change these, re-run Load Check setup.

4. Motor should be at normal operating temperature for the application (operate at or near rated capacity for at least 10 minutes) before performing the Load Check set up process.
5. Suspend the rated load just off of the ground (this allows for accurate measurements during calibration).
6. Set C05-01 = 9.
7. Press and hold the Hoist (Up) command on the pendant or radio for full speed operation (60 Hz).

NOTE: *The Load Check set up process can be temporarily paused by lowering the load back to the ground, keeping the load suspended, then pressing and holding the Hoist (Up) command button at full speed until the Load Check set up process is complete.*

8. When the Load Check set up process finishes its calculations, the VFD will decelerate the load to indicate the set up calibration is complete.

NOTE: *If an application requires Load Check to be bypassed, program an MFDI to 6A (N.O.) or 16A (N.C.).*

NOTE: *Upon completion of the Load Check setup process, the VFD will automatically set C05-01 = 1.*

NOTE: *If an error occurs during the Load Check set up, the load being lifted may have caused the current or torque to exceed 250%. Increase Holding Time and Testing Time, or decrease the load weight.*

5.2.13.4 Clearing a Load Check Alarm (LC)

A Load Check alarm/fault can be reset by pressing the RESET key on the keypad.

Table 5-29: Load Check Parameter Settings

Parameter	Display	Function	Range	Default
C05-01	Load Check	Determines whether Load Check is enabled.	0, 1, 7–9	0
	0 Disabled	Disables Load Check		
	1 Hold & Measure	Checks per Holding and Testing Time		
	7 Clear LC Values	Reverts C05-09 through C05-24 to default		
	8 Setup	Setup Load Check		
	9 Setup - Optimize	Setup Load Check and average the new readings with the existing values. This method dials in the accuracy of the setup.		
C05-02	Load Check Detected Action	Action at Load Check alarm or fault	0, 2–5	5
	0 Alarm Only	L.C. blinking, can continue raising		
	2 Coast to Stop, Alarm	Allows lower only		
	3 Fault Stop	Fault contacts change state - requires reset		
	4 b03-03 to Stop, Alarm	Allows Lower only		
	5 b03-03 with LC Reset	Stopping method is b03-03. Allows Lower Only. Alarm will be reset when load is lowered.		
C05-03	Load Check Holding Time	Time to hold the output frequency allowing the output current/torque to stabilize.	0.00–2.55 sec	0.20
C05-04	Load Check Testing Time	Time (after the Holding Time) for comparing output current/torque to values for a particular LC Zone being tested.	0.00–2.55 sec	0.20
C05-05	Detection Margin at Acceleration	Margin for Load Check detection during acceleration. A setting of 0 is the most sensitive.	0–50%	5

Parameter	Display	Function	Range	Default
C05-07	Detection Margin at Speed Agree	Margin for Load Check detection at speed agree. A setting of 0 is the most sensitive.	0–50%	10
C05-08	Alarm Speed	Maximum lowering speed after an LC alarm.	0.0–30.0 Hz	6.0
C05-09	Load Check Level 01	Current/Torque for Zone 01	0–250%	0
C05-10	Load Check Level 02	Current/Torque for Zone 02	0–250%	0
C05-11	Load Check Level 03	Current/Torque for Zone 03	0–250%	0
C05-12	Load Check Level 04	Current/Torque for Zone 04	0–250%	0
C05-13	Load Check Level 05	Current/Torque for Zone 05	0–250%	0
C05-14	Load Check Level 06	Current/Torque for Zone 06	0–250%	0
C05-15	Load Check Level 07	Current/Torque for Zone 07	0–250%	0
C05-16	Load Check Level 08	Current/Torque for Zone 08	0–250%	0
C05-17	Load Check Level 09	Current/Torque for Zone 09	0–250%	0
C05-18	Load Check Level 10	Current/Torque for Zone 10	0–250%	0
C05-19	Load Check Level 11	Current/Torque for Zone 11	0–250%	0
C05-20	Load Check Level 12	Current/Torque for Zone 12	0–250%	0
C05-21	Load Check Level 13	Current/Torque for Zone 13	0–250%	0
C05-22	Load Check Level 14	Current/Torque for Zone 14	0–250%	0
C05-23	Load Check Level 15	Current/Torque for Zone 15	0–250%	0
C05-24	Load Check Level 16	Current/Torque for Zone 16	0–250%	0
C05-26	Load Check Delay Time	Load Check delay time for transitions	0.00–2.55 sec	0.25
C05-27	Load Check REV to FWD Delay	Minimum delay when switching from REV to FWD in LC. Used when the VFD cannot stop the load fast enough. Disabled when set to 0.	0.0–25.5 sec	0.0
C05-28	Load Check REV to FWD Frequency	Minimum frequency that will trigger C05-27	0.0–60.0 Hz	30.0

5.2.14 Ultra-Lift

Ultra-Lift provides additional productivity by allowing a hoist to run above base speed when the load is less than 100% of the rated capacity. Ultra-Lift determines the torque required for the load, calculates the maximum safe speed, and automatically accelerates to this speed. The maximum speed cannot exceed the lesser value of the Maximum Forward Speed (C06-02), Maximum Reverse Speed (C06-03), and Maximum Frequency (E01-04).

NOTE: *Ultra-Lift is disabled for traverse motions. Maximum Frequency (E01-04) must be ≥ C06-02 & C06-03.*

WARNING

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

5.2.14.1 Ultra-Lift in V/f and Open Loop Vector

Ultra-Lift can be enabled in Standard Hoist mode (A01-03 = 1). In the V/f control method, the Ultra-Lift function uses motor current to determine the maximum safe speed. When the OLV control method is selected, the Ultra-Lift function uses motor torque for its safe speed calculations. Ultra-Lift will not be enabled if the current or torque levels do not exceed C06-04 or C06-05 settings. Both C06-04 and C06-05 are a percentage of E02-01.

5.2.14.2 Ultra-Lift in Closed Loop Vector

Ultra-Lift can be enabled in NLB Hoist mode (A01-03 = 2). The Ultra-Lift function measures motor torque at base speed and accelerates to the maximum safe speed if the torque levels do not exceed C06-04 or C06-05 levels.

5.2.14.3 Adaptive Ultra-Lift

Adaptive Ultra-Lift can be enabled in NLB Hoist mode (A01-03 = 2). It continuously monitors motor torque when running above base speed to increase or decrease motor speed based on varying load conditions.

Table 5-30: Ultra-Lift Parameter Settings

Parameter	Display	Function	Range	Default
C06-01	Ultra-Lift	Determines if Ultra-Lift is enabled.	0–4	0
	0 Disabled			
	1 Enabled Auto			
	2 Enabled by MFDI			
	3 Enabled Adaptive Auto	Closed Loop Vector NLB only		
	4 Enabled Adaptive by MFDI	Closed Loop Vector NLB only		
C06-02	Ultra-Lift Max Forward Speed	Maximum Ultra-Lift Forward Speed	0.1–300.0 Hz	60.0
C06-03	Ultra-Lift Max Reverse Speed	Maximum Ultra-Lift Reverse Speed	0.1–300.0 Hz	60.0
C06-04	Ultra-Lift Forward Torque	Output Current/Torque < C06-04 to enable Ultra-Lift Forward. Not used with Adaptive UL.	0–100%	50
C06-05	Ultra-Lift Reverse Torque	Output Current/Torque < C06-05 to enable Ultra-Lift Reverse. Not used with Adaptive UL.	0–100%	30

Parameter	Display	Function	Range	Default
C06-06	Ultra-Lift Enabling Speed	Frequency at which to trigger Ultra-Lift.	0.1–300.0 Hz	59.0
C06-07	Ultra-Lift Delay Time	Delay time at Enabling Speed to check Output Current/Torque	0.0–25.5 sec	2.0
C06-08	Ultra-Lift Accel Multiplier	Acceleration multiplier for V/f Modes. Greater than 1 increases accel time; less than 1 decreases accel time.	0.1–9.9	1.0
C06-10	Motor Torque QuickSet *0 Very Low Torque* *1 Low Torque* *2 Standard* *3 High Torque* *4 Very High Torque*	Available motor torque over base speed.	0–4	2
C06-15	Adaptive UL Torque FWD Offset	Adaptive UL torque measurement offset in the up direction to allow for deceleration.	0–100%	10
C06-16	Adaptive UL Torque REV Offset	Adaptive UL torque measurement offset in the down direction to allow for deceleration	0–100%	20

5.2.14.4 Ultra-Lift Setup

For Multi-Step or Infinitely Variable (A01-04 = 0 to 4):

1. Set C06-01= 1–4 to enable the Ultra-Lift function, 1 = Enable Automatic, 2 = Enable by MFDI, 3 = Enable Adaptive Automatic, 4 = Enable Adaptive by MFDI.
2. Set C06-02 and C06-03 to the desired Ultra-Lift maximum FWD/REV output frequency.
3. Set C06-04 and C06-05 to the current/torque that the motor must be under in order to enable Ultra-Lift.
4. Set C06-06 (Enabling Speed) to one or two hertz below the maximum normal running speed reference.
   For example: If the maximum normal running speed is at 60 Hz, set C06-06 = 58 or 59 Hz.
5. Ensure that the Maximum Frequency (E01-04) is increased above 60 Hz.

For Uni-Polar/Bi-Polar Analog (A01-04 = 5 or 6)

1. If the system is using Bi-Polar Analog or Uni-Polar Analog as the Control Method, use the following formula to calculate the gain for the respective analog input.

$$\text{H03-03} = \frac{60\ \text{Hz} \times 100}{\text{E01-04}} \quad \text{or H03-11} = \frac{60\ \text{Hz} \times 100}{\text{E01-04}}$$

5.2.15 Torque Limit

IMPULSE•G+/VG+ Series 5 VFDs dynamically control the torque output of the motor while running. The Torque Limit function limits the amount of torque the motor is capable of producing in Open and Closed Loop Vector control.

- *Forward Motoring (I)*
- *Forward Regenerating (II)*
- *Reverse Motoring (III)*
- *Reverse Regenerating (IV)*

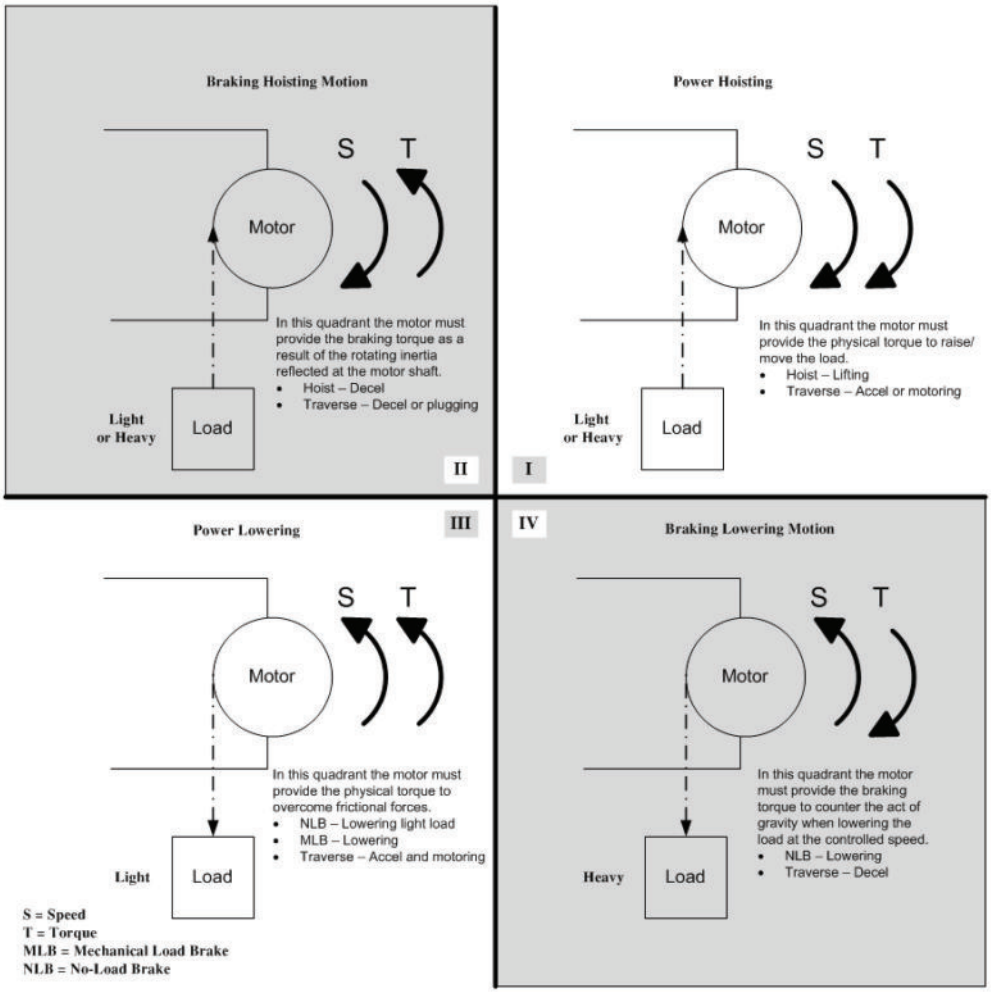


Table 5-31: Torque Limit Parameter Settings

Parameter	Display	Function	Range	Default
C07-01	Forward Torque Limit	Forward Motoring torque limit	0–300%	150
C07-02	Reverse Torque Limit	Reverse Motoring torque limit	0–300%	150
C07-03	Forward Regenerative Torque Limit	Forward Regenerative torque limit	0–300%	180
C07-04	Reverse Regenerative Torque Limit	Reverse Regenerative torque limit	0–300%	180
C07-05	Torque Limit Forward Gain	Torque Limit gain in FWD direction when MFDI = 14 is ON. Gain is applied to C07-01. If T-Lim by Analog Input is used, gain is applied to post-scaled/biased input.	0.50–1.50	1.25
C07-06	Torque Limit Reverse Gain	Torque Limit gain in REV direction when MFDI = 14 is ON. Gain is applied to C07-02. If T-Lim by Analog Input is used, gain is applied to post-scaled/biased input.	0.50–1.50	1.25
C07-07	Torque Limit Regenerative Gain	Torque Limit gain in RGN mode when MFDI = 14 is ON. Gain is applied to C07-03 and C07-04. If T-Lim by Analog Input is used, gain is applied to post-scaled/biased input.	0.50–1.50	1.25
C07-08	Torque Limit Integral Time	Integral time constant for the torque limit. (OLV only)	5–10000 ms	200
C07-09	Torque Limit during Accel/Decel	Torque Limit Method during Accel/Decel (OLV only)	0, 1	0
	0 Proportional Only	The torque limit uses proportional control during accel and decel, and switches to I control at constant speed. Use this setting when getting to the desired speed has priority over the torque limit.		
	1 Proportional & Integral Control	The torque limit will always use integral control. Use this when a highly accurate torque limit is required during speed changes. This setting may increase the acceleration time, or prevent the motor from reaching the frequency reference if the torque limit is reached first.		

5.2.16 Anti-Shock

Anti-Shock is a hoist feature on the IMPULSE•VG+ Series 5 VFD. The torque output of the hoist is continuously monitored, and when it increases above a threshold (C07-15 and C07-16), the hoist automatically decelerates and waits for the torque to stabilize before smoothly re-accelerating (C07-17 and C07-18). Anti-Shock is designed to reduce crane structure fatigue.

Initial Setup and Adjustment

1. Choose an option to enable/disable Anti-Shock:
   a. C07-12 = 0 (Disabled) ensures Anti-Shock does not function.
   b. C07-12 = 1 (Enabled) allows Anti-Shock to run always.
   c. C07-12 = 2 (Enabled, Not in Micro-Speed) will block Anti-Shock when Micro-Speed is enabled.
   d. H01-xx = 4B (Anti-Shock OFF), when enabled, will block Anti-Shock. This allows Anti-Shock to be enabled or disabled by a digital input.
2. Run the hoist, unloaded, in the UP direction. Note the value of U01-09 and enter that value into C07-23.

To make Anti-Shock less sensitive to light loads and more sensitive to heavy loads:

1. Increasing C07-15 (Torque Delta) to a higher percentage increases the torque spike magnitude that is required to trigger Anti-Shock.
2. Increasing C07-16 (Detection Time) to a higher time widens the window that a torque spike is looked for.

To make Anti-Shock more sensitive to light loads:

1. Decreasing C07-15 (Torque Delta) to a lower percentage lowers the torque increase magnitude that is required to trigger Anti-Shock.
2. Increasing C07-16 (Detection Time) to a higher time widens the window that a torque spike is looked for.

Troubleshooting

Anti-Shock is triggered when the load is already in the air:

Cause: This is caused by a torque increase due to acceleration, which falls within the parameter settings for triggering Anti-Shock.

Corrective Action:

1. Increasing C07-14 (Reaccelerate Delay) to a higher time delay.
2. Increasing C07-15 (Torque Delta) and decreasing C07-16 (Detection Time) will require a higher torque spike to occur in a shorter amount of time.

When Anti-Shock is triggered, the VFD faults with an OV (Overvoltage) or OC (Overcurrent):

Cause: By default, Anti-Shock is configured to decelerate very quickly when a torque spike is detected. The deceleration rate may cause a rapid increase in voltage or current, which may fault the VFD.

Corrective Action:

Increasing C07-18 (Smoothing Decel Time) will increase the time it takes for the motor to decelerate directly after the torque spike is detected. Resulting spikes in voltage and/or current will be reduced.

Table 5-32: Anti-Shock Parameter Settings

Parameter	Display	Function	Range	Default
C07-12	Anti-Shock	Enables or disables the Anti-Shock function.	0–2	0
	0 Disabled	Anti-Shock is disabled.		
	1 Enabled	Anti-Shock is enabled always.		
	2 Enabled, Not in Micro-Speed	Disables Anti-Shock if Micro-Speed is enabled.		
C07-13	Anti-Shock Enabling Frequency	Anti-Shock is disabled until the output frequency is above this setting.	0.0–60.0 Hz	6.0
C07-14	Anti-Shock Reaccelerate Delay	If the operator decelerates the hoist then re-accelerates, Anti-Shock Detection is disabled for this period of time.	0.00–2.55 sec	0.20
C07-15	Anti-Shock Torque Delta	Torque increase required to initiate the Anti-Shock sequence.	0–180%	10
C07-16	Anti-Shock Detection Time	Time window to detect torque delta (C07-15).	0.01–0.50 sec	0.30
C07-17	Anti-Shock Smoothing Frequency	When the torque increase is detected, the motor will decelerate to this frequency.	0.0–15.0 Hz	3.0
C07-18	Anti-Shock Smoothing Decel Time	Deceleration time once an Anti-Shock event has been detected. Increase this value in 0.1 sec increments if DEV faults are occurring.	0.00–1.00 sec	0.30
C07-20	Anti-Shock Smoothing Time	Time window to smooth out the torque.	0.00–0.50 sec	0.20
C07-22	Anti-Shock Alarm Display Time	When Anti-Shock is triggered, an alarm will display on the keypad screen for the selected duration of time.	0–30 sec	4
C07-23	Anti-Shock No Load Torque	Any torque values below this level are ignored. Best described as the torque level while hoisting with an empty hook (no load).	0–100%	20
C07-24	Anti-Shock Activation Torque	In order for Anti-Shock to be triggered, the torque increase is required to peak above this percentage.	0–180%	75
C07-25	Anti-Shock Detection Method	Anti-Shock detection method.	0–2	1
	0 Always Detect	Anti-Shock can be continuously detected.		
	1 Detect Once Per Lift	After Anti-Shock is detected once during a lift, it is disabled until the hoist is lowered.		
	2 Fault on Detect	Fault when Anti-Shock is detected.		

5.2.17 Torque Time Filter

The Torque Time Filter function assigns a time filter to allow the torque to build at start.

Table 5-33: Torque Time Filter Parameter Settings

Parameter	Display	Function	Range	Default
C07-30	Torque Limit Process at Start *0 Disabled* *1 Enabled*	Adds a 64ms ramp-up time to the torque limits at the start of a run.	0, 1	1

5.2.18 Traverse Torque Limiter

The Traverse Torque Limiter function (C07-40 and C07-41) is used in multi-VFD, closed-loop traverse applications to reduce skewing due to speed differences in the motors on each side of a bridge. This prevents one side of a bridge being at full forward torque, while the other side is at full regen torque, which can lead to skewing, DEV faults, or the motors simply not sharing the load sufficiently. When accelerating past the Limiter Freq (C07-41), this feature is enabled, and the ASR I time is reduced to zero to limit torque imbalance. Once the motor has reached its target speed, the regen torque limit is also reduced to zero. It will remain in this state until the speed reference is changed. When the speed reference is raised or lowered, regen torque limit is re-enabled to accel or decel the bridge as required.

Table 5-34: Traverse Torque Limiter Parameter Settings

Parameter	Display	Function	Range	Default
C07-40	Traverse Torque Limiter *0 Disabled* *1 Enabled*	ASR I time is forced to 0 when the output frequency is greater than the C07-41 speed window. When using this feature, it is suggested that the Overspeed Detect Level (F01-24) be increased to 110% to avoid overspeed faults.	0, 1	0
C07-41	Traverse Torque Limiter Window	Frequency window (+/-) size for Traverse Torque Limiter (C07-40) when at speed.	0.5–10.0 Hz	2.0

5.2.19 No Load Brake (NLB) Hoist

The No Load Brake (NLB) Hoist mode is a VG+ feature that provides a start and stop sequence designed specifically for hoists without a mechanical load brake. This mode is enabled automatically when the Motion is set to NLB Hoist (A01-03 = 2). This will also automatically set the Stopping Method to No Load Brake (B03-03 = 6).

Start

The start sequence begins by building up torque in the motor to a predefined level within the C08-01 (BE2 Torque Build Up Time) timer. This level is determined by several factors which are defined below. During the C08-02 time, the VFD is monitoring current to motor. The current feedback equation must be satisfied within the time set in C08-02 (BE2 Torque Detection Time). If it is not, a BE2 (No Current) fault will be displayed on the keypad and the VFD will stop outputting voltage to the motor. The brake will remain closed.

Once the brake has been commanded to release, the VFD output remains in Load Float for the amount of time programmed into C08-04. During C08-04, the VFD waits for the brake to completely open and watches encoder feedback. If the amount of feedback is less than the setting in C08-05 (BE1 Rollback Pulse Count), then the VFD proceeds to the BE3 check. If it is not, a BE1 fault is displayed on the keypad and the sequence stops. For the BE3 check, if the brake opened mechanically, then the encoder feedback must be greater than or equal to the value programmed in C08-07 (BE3 Brake Release Pulse Count) within the time set in C08-06 (BE3 Brake Release Time). If it is not, then a BE3 fault is displayed. Once the VFD has completed the BE3 check, the No Load Brake start sequence is complete.

Stop

The 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 Load Float position for the duration of C08-10 (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 start sequence. 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 Load Float is maintained for the time set in C08-11 (BE5 Brake Set Time) to allow the brake to fully close. Once the Brake Delay Time has expired, the BE6 check is executed. The BE6 check monitors encoder feedback while the load is being transferred from the motor to the brake and compares it to C08-13 (BE6 Maximum Pulse Count). The encoder feedback must not exceed the number of counts in C08-13 within the C08-12 (BE6 Detection Time) time. If it does (meaning the load slipped through the brake), a BE6 alarm is displayed on the keypad and the VFD will keep Load Float active, with the brake closed, to maintain control of the load. Run commands will still be accepted with the exception of a reduced speed in the up direction set by C08-18 (BE6/BE8 Maximum Forward Speed). The VFD will remain in the BE6 alarm state after each run, allowing the operator to set down the load before turning off the crane for servicing.

Torque Proving

Factor 1: On the first run command after power up, or after any fault which causes the stop sequence to be skipped, the start sequence uses the value programmed to C08-16 (Initial Forward Brake Torque).

Factor 2: Once the system has completed a successful start and stop, a new Brake Release Torque value is used. This value is one that has been memorized and stored into memory during the stop sequence. It is equivalent to the amount of torque required for the motor to hold the load on the hook in Load Float with the brake released. Some benefits of stored Load Float torque for the next brake release are:

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

If the stored value is less than the programmed value in C08-03 (BE2 Minimum Brake Release Torque), C08-03 is used as the next brake release value. If the feature must be disabled, C08-03 will override C08-16 if it is a greater value.

Dual Brake Feature

The Dual Brake feature is designed for hoist systems with redundant holding brakes. One brake is controlled by an MFDO = 0, and the second brake is controlled by an MFDO = A. After a Load Float, during the BE6 (Brake Test) time, one brake is left Open, while the VFD tests that the Closed brake is capable of holding the load. After the BE6 time expires, the second brake is closed.

This feature is only intended as a method to test each brake individually. A mechanical delay system may be required to prevent both brakes from closing simultaneously if power is lost.

NOTE: *All brake faults are annunciated by both the keypad and via a programmed digital output. Since the keypad is not visible by the operator, an external warning device must be used to ensure proper safety of personnel and equipment. Annunciating a brake fault can be accomplished by using one, or both, of the following methods: 1) An indicator or strobe light that is continuously “ON”, indicating proper operation. If the light should turn “OFF”, this indicates that the light bulb has either burned out, or there is a VFD or brake problem. Either scenario requires immediate corrective action. 2) The use of an indicating light wired to relay output terminals MC-MA, N.O. contact, or an audible warning device that will sound during a brake fault condition. An audible warning device can be wired directly to terminals MC-MA, provided that its ratings do not exceed the 1 Amp specification.*

If a brake fault is annunciated during a “Start” sequence, it is recommended that the crane be moved to a safe location with the load on the hook. The hoist should only be operated if absolutely necessary. In this type of alarm sequence, either the brake is seized or the VFD cannot develop enough torque in the motor in the time allotted. To troubleshoot the hoist, it will be necessary to monitor the keypad on the VFD and operate the hoist at the same time. Two people are recommended for this procedure. With one person operating the hoist and the other person monitoring the keypad, run the hoist. The keypad should display one of the following faults: BE1, BE2, BE3, or BE4. For corrective action, ***see Section 6.1 on page 222****.*

If a brake fault is annunciated after the hoist has come to a complete stop, and Load Float (C08-10) has timed out, it would indicate that the VFD has checked the brake and determined that the brake has insufficient torque available to hold the load. DO NOT TURN OFF POWER. This condition indicates that the brake has failed and the VFD / motor combination is suspending the load. If, during this condition, the hoist is operated in the "Raise" direction, it will only be allowed to run at a speed equal to or less than the "BE6/BE8 Maximum Forward Speed" setting in parameter C08-18 (6 Hz by default.) This is an additional indication that the brake has failed to open, or the load is slipping through the brake. It is recommended that the crane be moved to a safe location and the load lowered to the ground. Corrective action should be taken to repair the brake. The keypad will be displaying one of two alarms during this condition: BE5 or BE6. ***See Section 6.1 on page 222.***

WARNING

During a BE5, BE6, or BE8 alarm, DO NOT turn off power to the VFD until the load has been lowered to the ground and removed from the hoist. Otherwise 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.

Table 5-35: No Load Brake Parameter Settings

Parameter	Display	Function	Range	Default
C08-01	BE2 Torque Build Up Time	Time (slope) for the Torque Compensation value to reach 300%.	0.00–2.55 sec	1.00
C08-02	BE2 Torque Detection Time	Time to look for current feedback before posting a BE2 alarm. Setting this to 0.00 will disable torque proving and BE2 detection (consult factory before disabling torque proving).	0.00–2.55 sec	1.00
C08-03	BE2 Minimum Brake Release Torque	Minimum brake release torque.	0–200%	10
C08-04	BE1 Rollback Time	Time for the brake to release and for brake feedback to be received into the Brake Answerback MFDI at start before posting BE1 or BE4 alarm. It is also the time when the amount of rollback is checked.	0.00–2.55 sec	0.30
C08-05	BE1 Rollback Pulse Count	Detection counts for excessive rollback.	0–15000 pulses	200
C08-06	BE3 Brake Release Time	Time period when C08-07 is measured. See C08-08.	0.00–2.55 sec	0.30
C08-07	BE3 Brake Release Pulse Count	Detection count for Encoder/Seized-Brake Alarm (BE3). It is the minimum encoder pulse count, during C08-06, below which triggers a BE3 alarm.	0–2000 pulses	10
C08-08	BE3 Reverse Torque Limit	For a LOWER command in the NLB Hoist mode only (A01-03 = 2). Torque limit for time of C08-06 to prevent driving through a brake that has failed closed with a load on the hook.	0–250%	25
C08-09	Zero Speed Level	Speed feedback at which Load Float activates.	0.0–5.0 Hz	0.5
C08-10	Load Float Time	Time period during which the motor is held stationary and the motor brake remains open. This time begins when the motor speed is below the Zero Speed Level (C08-09).	0–65535 sec	10*
C08-11	BE5 Brake Set Time	Time for the brake to set and for brake feedback to be removed from the Brake Answerback digital input at stop before posting a BE5 Alarm.	0.0–25.5 sec	0.7
C08-12	BE6 Detection Time	Time period during which the electric brake is set and tested for sustaining the load. ***NOTE:*** *To disable BE6 detection, set C08-12 = 0.0.*	0.0–25.5 sec	5.0

Parameter	Display	Function	Range	Default
C08-13	BE6 Maximum Pulse Count	Total pulse counts must be less than C08-13, during C08-12, otherwise BE6 alarm.	0–2000 pulses	50
C08-14	Brake Set Hold Speed	Frequency the VFD outputs to push against the brake for BE2 torque proving at start and the frequency the VFD outputs until BE5 Brake Set Time (C08-11) time expires or the Brake Answerback MFDI is removed.	0.0–25.5%	CLV: 0.0 else: 2.0
C08-15	Load Float Extension Time	Load Float extension time enabled by MFDI=5D.	0–65535 sec	10
C08-16	Initial Forward Brake Torque	Initial Forward Brake Release Torque for BE2 Detection. The percent of forward/up motor torque that must be reached within C08-02 time to release the brake at the start of a forward/up run.	10–300%	100
C08-17	Initial Reverse Brake Torque	Initial Reverse Brake Release Torque for BE2 Detection. The percent of reverse/down motor torque that must be reached within C08-02 time to release the brake at the start of a reverse/down run. (OLV only)	10–300%	30
C08-18	BE6/BE8 Maximum Forward Speed	Maximum up speed limit during a BE6 or BE8 alarm.	0.00–300.00 Hz	6.00
C08-19	BE6/BE8 Brake Slip Reset *0 Disabled* *1 Enabled*	Determines if BE6 alarm is automatically reset. If enabled, VFD will always perform BE6 test after Load Float to determine if brake is operational and the fault can be cleared. If disabled the VFD will remain in BE6 alarm state until power is cycled.	0, 1	0
C08-20	BE6 Torque Reference	Torque output during a BE6 check.	0–20%	0
C08-21	Minimum Magnetizing Current	Minimum magnetizing current before starting the BE2 check.	0–100%	30
C08-22	BE8 Brake Slip Detection *0 Disabled* *1 Enabled*	Continuous monitoring for a slipping brake. (BE8 Detection)	0, 1	0
C08-23	BE8 Detection Sensitivity	Adjusts the sensitivity of BE8 Slip Detection.	0.0–10.0 Hz	0.5
C08-24	Brake Test Torque	Motor runs in Forward direction at C08-25 speed when MFDI = 61 is active. Brake output relay is not energized, PGO and DEV detection are disabled. Monitor Brake Test Torque at U01-86.	50-200% Rated Torque FtLb	**
C08-25	Brake Test Complete Indication *0 Alarm* *1 Fault*	Determines whether an alarm of fault occurs if the Brake Test fails.	0, 1	1
C08-28	BE2 Brake Torque Check Time	Time during which the torque must be above C08-03 or C08-16 before releasing the brake. Increasing this time allows the load to stabilize and minimize erroneous BE2 faults. Disabled if set to 0.00.	0.00–2.55 sec	0.05
C08-33	Dual Brake Test *0 Disabled* *1 Enabled*	Enabling this alternates the brake outputs after every run. MFDOs must be set to 00 and 0A or OPE28 will be displayed	0, 1	0
C08-34	DIR Fault Torque Level	Regen torque level required to trigger a DIR fault. This is used to detect an NLB hoist set up backwards (FWD is down). Disabled if set to 0.	0–100%	50

* *Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

** $1.25x \frac{E02\text{-}11x5252}{\text{Motor RPM}}$

5.2.20 Emergency Lift

Emergency Lift (E-Lift) is a VG+ feature that allows operation of the VFD in the event of an encoder related fault (PGO-1-S/PGO-1-H) that resulted from a defective encoder, encoder cable, or PG-X3 option card. E-Lift can be enabled with C08-35 when the VFD is idle and not running.

When E-Lift is active, the VFD will switch to parameters for Motor 2, set in the E03 and E04 groups. Furthermore, functions that depend on encoder feedback will be disabled. By default, E-Lift will remain operational for 10 minutes (user-adjustable by C08-37), after which a fault will be generated.

DANGER

E-Lift allows temporary hoisting operations of motors equipped with an encoder in Closed Loop Vector control. Always follow the setup instructions, and use extreme caution when operating a hoist in E-Lift mode. Stop the hoist if undesired motion occurs and contact Magnetek for additional assistance.

DANGER

Do NOT set E03-01 = 0 (V/f Control) when using E-Lift in hoist applications. E-Lift is designed to operate using the Open Loop Vector (OLV) control method. The use of the V/f control method may cause undesired motion of the load and is only intended for troubleshooting Closed Loop Vector control method related problems.

5.2.20.1 Emergency Lift Setup

1. **Auto-Tune the motor:**
   Complete an Auto-Tune for the motor described in ***Section 4.4 on page 75***.
2. **Configure the E03 and E04 Parameter Groups for Motor 2:**
   When E-Lift is active, the Mode 2 parameters are used for voltage and frequency limits instead of the E01 group. The E03 and E04 paramater group should be configured as described in ***Table 5-68 on page 156***.
3. **Configure the E-Lift Parameters:**
   The parameters listed in ***Table 5-36*** are used to configure the E-Lift function.

Table 5-36: Emergency Lift Parameter Settings

Parameter	Display	Function	Range	Default
C08-35	Emergency Lift *0 Disabled* *1 Enabled by MFDI*	Determines if the E-Lift function is enabled.	0, 1	0
C08-36	Emergency Lift Maximum Speed	Maximum frequency when E-Lift is active.	0–150 Hz	30
C08-37	Emergency Lift Maximum Time	Maximum time that E-Lift can be active.	0–20 min	10

4. **Conduct a Preliminary E-Lift Test:**

   After all parameters have been configured in steps 2 and 3, the E-Lift function must be tested to ensure it can raise and lower a load properly. Conduct the following steps to verify the E-Lift function:

DANGER

If any undesired motions occur while E-Lift is active, immediately remove any RUN commands, turn off the E-Lift MFDI, and contact Magnetek.

   a. Attach a test load to the hoist (rated capacity is recommended).

   b. Raise the load approximately one foot above the floor.

   c. Turn on the MFDI associated with E-Lift enable (H01-xx = 4A).

   d. The keypad display will show E-LIFT to indicate that the feature is active.

   e. Perform a series of raise and lower commands and observe the test load.

   f. If steps 4.a through 4.e were successful, turn off the E-Lift MFDI and return the hoist to normal operations.

5.2.21 Slack Cable Detection

Slack Cable Detection is a VG+ hoist function that monitors motor torque, while running at a steady speed, and detects when the torque suddenly dips below a set level (C11-03).

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

- *The output frequency is at a steady speed between C11-04 and C11-06.*
- *The Slack Cable Detection delay time is between C11-05 and C11-07.*

Setup Procedure:

- *Lower the hoist without load at a constant speed that the hoist would normally run at during operation. Record the torque reference (U01-09). Repeat this several times to ensure an accurate reading.*
- *Set C11-03 = U01-09 - 2%.*
- *Enable Slack Cable Detection by setting C11-01 = 1 or 2.*
- *Select output action when Slack Cable is detected by defining C11-02.*

Table 5-37: Slack Cable Detection Parameter Settings

Parameter	Display	Function	Range	Default
C11-01	Slack Cable	Determines whether Slack Cable Detection is enabled.	0–2	0
	0 Disabled			
	1 Enabled			
	2 Enabled by MFDI			
C11-02	Slack Cable Action	Action and allowable motion when Slack Cable is detected. RAISE command is permitted (MFDO = 28).	0–5	2
	0 No Action	Alarm Only		
	1 No Action, Lower at C03-04	Next LOWER command is at LL1 speed C03-04.		
	2 Limit Lower to C03-04	Decel (by C03-05) to LL1 Speed C03-04. LOWER limited to C03-04.		
	3 Decel to C03-05, Lower Blocked	Decel (by C03-05) to LL1 Speed C03-04. LOWER not allowed.		
	4 Decel to Stop, Lower at C03-04	Decel (by C03-06) to stop. LOWER limited to C03-04.		
	5 Decel to Stop, Lower Blocked	Decel (by C03-06) to stop. LOWER not allowed.		
C11-03	Slack Cable Detection Torque	Percentage of Output Torque below which Slack Cable Detection is activated-as long as the motor speed is between C11-04 and C11-06, and the delay time is between C11-05 and C11-07.	-50–100%	30
C11-04	Slack Cable Detection Speed 1	Frequency Output that is required for Slack Cable Detection to be activated. It corresponds to Slack Cable Detection Delay Time 1 (C11-05).	0–E01-04 Hz	2
C11-05	Slack Cable Delay Time 1	Delay time before Slack Cable Detection can be activated. Corresponds to Slack Cable Detect Speed 1 (C11-04).	0.00–2.55 sec	0.50
C11-06	Slack Cable Detection Speed 2	Frequency Output below which Slack Cable Detection can be activated. It corresponds to Slack Cable Detection Delay Time 2 (C11-07).	0–E01-04 Hz	60
C11-07	Slack Cable Delay Time 2	Delay time before Slack Cable Detection can be activated. It corresponds to Slack Cable Detection Speed 2 (C11-06).	0.00–2.55 sec	0.10

5.2.22 Snap Shaft Detection

Snap Shaft Detection is designed to detect a broken or loose coupling by monitoring for a speed deviation between rotating shafts on a drive train. Ideally, mount one encoder on the motor, which drives the gearbox and one encoder on the last rotating part of the drive train, usually near the drum if used for a hoist motion. It is required that a second brake be mounted on the drum shaft. The encoders are wired into two separate PG-X3 encoder option cards, with channel 1 (CN5-C) being the high speed shaft input and channel 2 (CN5-B) being the low speed shaft input. The VFD will use channel 1 for closed loop vector feedback. The software monitors and compares the speed of both encoders. A gear ratio is entered into parameters C11-12 and C11-13. In an example, if the gearbox ratio is 46.34 : 1, then you would program C11-12 to 4634 and C11-13 to 100. If the difference in speed is greater than the value in C11-10 for a period longer than the setting of C11-11, a “Snap Shaft” is displayed on the keypad display and the VFD will perform the action at snap (C11-09).

Parameter U01-30 should be monitored during operation to obtain the exact speed difference in RPM between the two shafts. The low speed shaft speed is normalized internally by multiplying the speed of the gear ratio. The value of C11-12 should be adjusted at start up such that U01-30 approaches zero.

Table 5-38: Snap Shaft Detection Parameter Settings

Parameter	Display	Function	Range	Default
C11-08	Snap Shaft *0 Disabled* *1 Enabled* *2 Auto-Detect Gear Ratio*	Determines if snap shaft detection is enabled. Auto detect and set the values for Numerator (C11-12) and Denominator (C11-13). To use this feature: 1. Set C11-08 = 2. 2. Run VFD at minimum of half speed. 3. Wait for “PASS” to be displayed. 4. Validate C11-12 and C11-13.	0–2	0
C11-09	Snap Shaft Action *0 Fault* *1 Alarm Only*	Action taken at detection. A setting of 0 will set the brake and display a fault. With a setting of 1, the VFD will continue to run.	0, 1	0
C11-10	Snap Shaft Delta Speed	Difference in speeds of the two shafts normalized by the gear ratio.	0–900 RPM	30
C11-11	Snap Shaft Delay Time	Gear backlash time in milliseconds	0–2000 ms	250
C11-12	Snap Shaft Gear Ratio Numerator	Gear ratio numerator	1–65535	10000
C11-13	Snap Shaft Gear Ratio Denominator	Gear ratio denominator	1–65535	10000

5.2.23 Brake Delay Timers

The Brake Delay Timers are used in trolley and bridge applications to reduce the mechanical brake wear when positioning a load. This is a Traverse only function and B03-03 must be set to 4 (Decel With Timer).

Table 5-39: Brake Delay Timers Parameter Settings

Parameter	Display	Function	Range	Default
C12-01	Brake Set Delay @ Jog	Brake set delay time at Jog Control input.	0.0–100.0 sec	0.0
C12-02	Brake Set Delay @ Run	Brake set delay time at RUN input.	0.0–100.0 sec	0.0

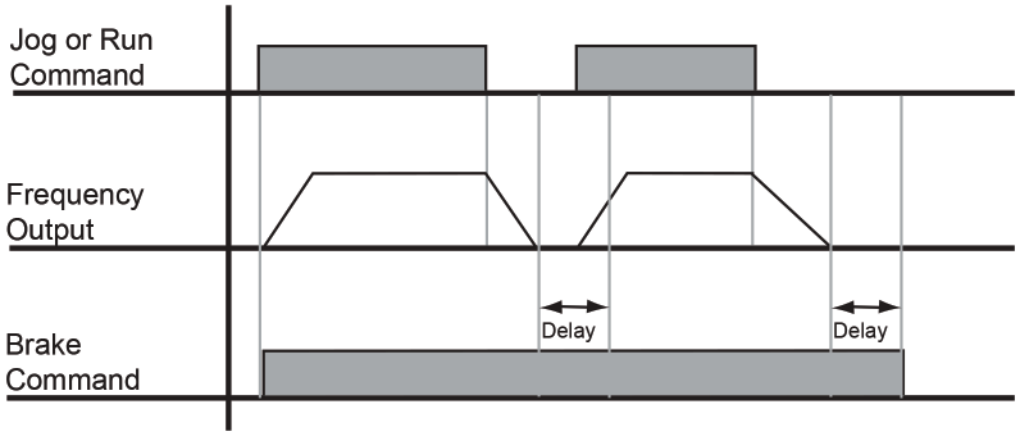


Figure 5-15: Brake Delay Timers

5.2.24 On/Off Delay Timers

- The timer function is enabled when the timer function MFDI (H01-0x = 43) and MFDO (H02-0x = 12) are both set.
- These serve as general purpose I/O. Chattering of sensors, switches, contactors, etc., can be prevented with a delay time.
- When the timer function input **ON** time is longer than the value set for **C12-03** (Timer ON-Delay Time), the timer function output turns **ON**.
- When the timer function input **OFF** time is longer than the value set for **C12-04** (Timer OFF-Delay Time), the timer function output turns **OFF**.

Table 5-40: On/Off Delay Timers Parameter Settings

Parameter	Display	Function	Range	Default
C12-03	Timer Function ON-Delay Time	Timer function On-Delay time.	0.0–3000.0 sec	0.0
C12-04	Timer Function OFF-Delay Time	Timer function Off-Delay time.	0.0–3000.0 sec	0.0

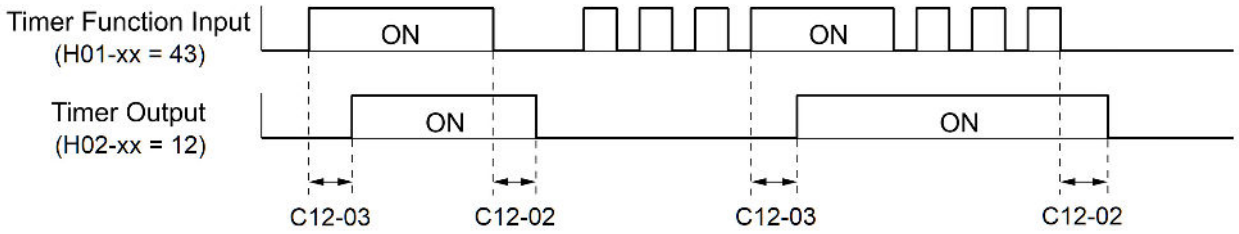


Figure 5-16: Timer Function Operation

5.2.25 Maintenance Timers and Counters

The Maintenance Timers and Counters functions are based on various VFD run conditions and will alert an operator, for example, when the bearings need to be greased. It consists of a digital output (H02-0x = 37) that becomes active when the total running time has exceeded the amount of time (in hours) programmed in parameter C12-05 and the frequency reference will be multiplied by a gain (C12-06) to slow the motion down until the bearings have been greased. An alarm will be posted on the Keypad stating “Maintenance Required”. Once the bearings have been greased, the output and alarm message can be reset two ways. One method is through a digital input programmed for any of the timer and counter resets (H01-xx = 7C, 7D, or 7E) and the second method is by pressing the Mode/Service (Local/Remote) button three consecutive times with no more than 2 seconds between presses. Press enter to reset the timer. A message will then appear on the keypad stating that the timer has been reset. The digital output will turn off at this time. When C12-05 = 0, the function is disabled.

Table 5-41: Maintenance Timers and Counters Parameter Settings

Parameter	Display	Function	Range	Default
C12-05	Maintenance Run Timer	Timer increments while VFD is outputting current. Maintenance Gain (C12-06) is enabled when the timer exceeds the C12-05 hours. Reset the timer by keypad or MFDI = 7C. View monitor U04-28 for remaining hours.	0–32000 Hrs	0
C12-06	Maintenance Alarm Speed Gain	Speed Reference Gain	0–100%	50
C12-07	Maintenance On Timer	Timer increments while VFD is powered up. Maintenance Gain (C12-06) is enabled when the timer exceeds C12-07 hours. Reset the timer by keypad or MFDI = 7D. View monitor U04-30 for remaining hours.	0–32000 Hrs	0
C12-08	Maintenance Brake Cycles	Counter increments each time the brake is commanded to open. Maintenance Gain (C12-06) is enabled when the brake cycle count exceeds 1,000x the C12-08 value. Reset the count by keypad or MFDI = 7E. View monitor U04-33 for remaining count. Example: To set counter to expire after 1,000,000 cycles, (1,000 x 1,000 = 1,000,000), so set C12-08 = 1,000	0–65000 kCycles	0

5.2.26 MFDO Delay Timer Function

The MFDO Delay Timer function provides a delay for activating and deactivating the multi-function digital output terminals.

Table 5-42: MFDO Delay Timer Function Parameter Settings

Parameter	Display	Function	Range	Default
C12-10	Terminal M1-M2 ON-Delay Time	Delay time to activate the M1-M2 output after the H02-01 function activates.	0–65000 ms	0
C12-11	Terminal M1-M2 OFF-Delay Time	Delay time to deactivate the M1-M2 output after the H02-01 function deactivates.	0–65000 ms	0
C12-12	Terminal M3-M4 ON-Delay Time	Delay time to activate the M3-M4 output after the H02-02 function activates.	0–65000 ms	0
C12-13	Terminal M3-M4 OFF-Delay Time	Delay time to deactivate the M3-M4 output after the H02-02 function deactivates.	0–65000 ms	0
C12-14	Terminal M5-M6 ON-Delay Time	Delay time to activate the M5-M6 output after the H02-03 function activates.	0–65000 ms	0
C12-15	Terminal M5-M6 OFF-Delay Time	Delay time to deactivate the M5-M6 output after the H02-03 function deactivates.	0–65000 ms	0

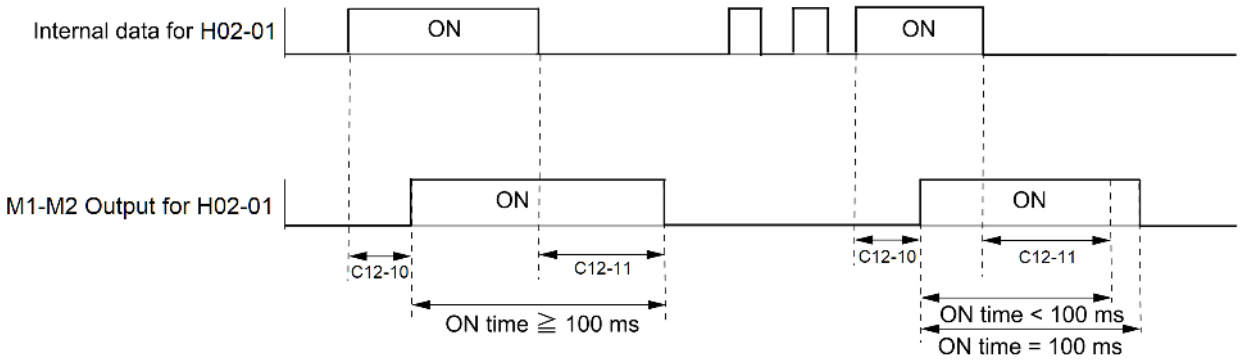


Figure 5-17: M1-M2 Delay Timer Example

5.2.27 Inch Control

The Inch Control function can be enabled by programming H01-xx = 17, 18, or 19. The frequency reference used during inching is determined by B01-17 (Jog Reference).

CAUTION

A directional input is not needed to enable motion of the motor.

Table 5-43: Inch Control Parameter Settings

Parameter	Display	Function	Range	Default
C13-01	Inch Run Time	Inching Control run time	0.00–2.55 sec	1.00
C13-02	Inch Repeat Delay Time	Inching Control repeat delay time. The Inch Repeat function is enabled with a digital input (H01-xx or F03-xx=19).	0.00–2.55 sec	1.00

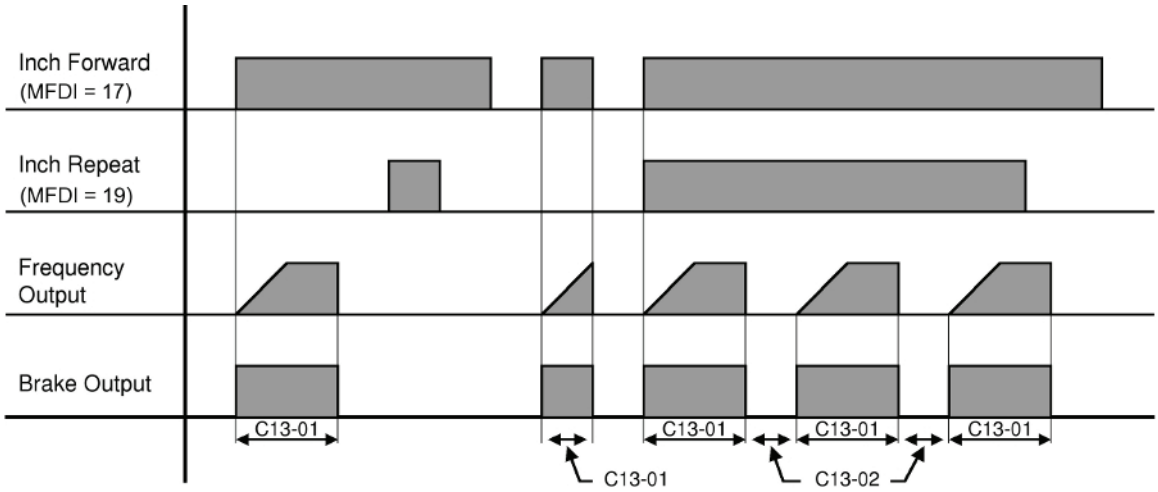


Figure 5-18: Inch Run and Inch Repeat

5.2.28 Index Control

Index Control is an IMPULSE•VG+ Series 5 feature that allows for precise movement of the motor each time a run command is applied and the Index function is enabled by a digital input (H01-xx = 60).

The total distance (Pulses) the motor will index is determined by the following equation:

$$\textbf{Total distance}\ (\text{Pulses}) = [\textbf{F01-01}(^{\text{Pulse}}/_{\text{Rev}}) * \textbf{C13-04}(\text{Revs})] + \textbf{C13-05}(\text{Pulses})$$

When Index is turned ON, it can be programmed to repeat as long as the Run command is enabled and by setting the Index Repeat Delay (C13-06) greater than 0.00 seconds. The Index will repeat after the Index Repeat Delay (C13-06) time has expired. Once the motor completes the Index, the brake will either set or remain in Load Float depending on the braking sequence described below.

When an Index is complete, a digital output (H02-xx = 34) will turn ON until one of the following is true:

- another directional run input is received,
- the repeat delay time has expired and the movement is repeating, or
- the Index Function is disabled.

When Applied in Traverse (A01-03 = 0)

When Index is turned ON, Index Brake Control (C13-12) controls the action of the brake. The following describes the brake control for each setting:

Open on Index Command (C13-12 = 0)

When Index is turned ON, the brake will release and hold the position in Load Float until a run command is applied. The brake will set and resume normal operation when the Index input is turned OFF.

Open on Run Command (C13-12 = 1)

When Index is turned ON, the brake will release after each run command is applied, then Index the motor. The brake will set after the Index or Index Repeat is complete, or the run command is removed.

Latch Open on Run Command (C13-12 = 2)

When Index is turned ON, the brake will release when a run command is applied, and the VFD will Index the motor and will hold position in Load Float after Index is complete. It will remain in Load Float until the next run command or the Index input is turned OFF. The brake will set and resume normal operation when the Index input is turned OFF.

NOTE: *For best performance, enable Index after brake release. Not recommended for double A4 applications.*

When Applied in NLB Hoist (A01-03 = 2)

When Index Brake Control C13-12 = 2, the action of the brake is controlled by the NLB sequence. The Index function can be enabled at any time during operation.

At Stop

If Index is turned ON while the crane is stopped, the brake will release when a run command is applied. The VFD will Index the motor and will hold position in Load Float after Index is complete. It will remain in Load Float until the next run command or the Index input is turned OFF. When Index is turned OFF, the brake will set according to the NLB stop sequence.

During Run

If the motor is in motion when Index is turned ON, the VFD will decelerate to zero and hold the position in Load Float. After a Run command is applied, the VFD will Index the load and hold the position in Load Float after the Index is complete. The brake is set according to the NLB stop sequence when Index is turned OFF.

NOTE: *For best performance, enable Index after brake release. Not recommended for double A4 applications.*

Table 5-44: Index Control Parameter Settings

Parameter	Display	Function	Range	Default
C13-03	Index Frequency Reference	Index frequency reference (MFDI = 60)	0.01–60.00 Hz	1.00
C13-04	Index Motor Revolutions	Index motor revolutions (F01-01 ppr = 1 motor revolution)	0–65535 Revs	0
C13-05	Index Motor Pulses	Index fractional motor revolution. 4 pulses = 1 ppr of F01-01	0–65535 Pulses	100
C13-06	Index Repeat Delay	Index Repeat Delay Time (Setting of 0.00 disables Index Repeat).	0.00–60.00 sec	0.00
C13-07	Index Complete Width	Index Complete Width (Quadrupled) for MFDO = 34. Upper Limit range is dependent on the following conditions: 32767 or (C13-04 *4 * encoder PPR + C13-05 -1), whichever is smaller. 1 pulse = 1 ppr of F01-01	1–1000	10
C13-08	Index Load Float Gain	Index Zero Servo Gain.	0–100	10
C13-09	Index ASR Proportional Gain	Index ASR P Gain.	0.00–300.00	30.00
C13-10	Index ASR Integral Time	Index ASR Integral Time.	0.000–10.000 sec	0.200
C13-11	Index Accel/Decel Gain	Index Accel/Decel Rate Gain.	0.0–5.0	1.0
C13-12	Index Brake Control	Configures brake behavior when indexing.	Traverse: 0–2	NLB: 2
	0 Open on Index Command	Brake will open on Index Command and remain open until Index Command is OFF. VFD is in Load Float between runs.	NLB: 0, 2	else: 0
	1 Open on Run Command	Brake will open on Run command and close when the run is finished.		
	2 Latch Open on Run Command	Brake will open on Run command and remain open with VFD in Load Float until Index is turned off.		

5.2.29 Sway Control

Sway Control is a method to greatly reduce the amount of unwanted swing when moving suspended loads. It works by point-mass theory such that a suspended load behaves as a pendulum. The algorithm predicts how the system will react to movement and reshapes the motor speed commands to prevent unwanted swing. A 90%-95% swing reduction is typical, but better results can be achieved. Less swing translates into increased productivity and a safer work environment. Tact times can be shorter, and personnel are not required on the ground to stop a hazardous swinging load.

Two elements are required for Sway Control to function properly:

1. The (swing length) distance from the drum center to the center of gravity (C.G.) of the load.
2. Desired speed of the traverse motion (crane bridge or trolley).

Hoist hook height feedback (from an encoder) boosts the sway control performance across any hook height, but it is not required. Programming a static hook height into the VFD at the common hoisting height will still provide improved performance. A dial is commonly to the operator for fine tuning the swing length.

Table 5-45: Sway Control Parameters

Parameter	Display	Function	Range	Default
C14-01	Sway Control 0 Disabled 1 Enabled Always 2 Enabled by MFDI	Selects how Sway Control is enabled.	0–2	0
C14-02	Hook Height	**Hoist has hook height (encoder) feedback:** The Hoist VFD is configured to output a 0-10V signal that represents the percent hook height. The Sway Control function takes this percentage and multiplies it by C14-02 to determine the current Hook Height in feet. **Hoist does <u>not</u> have hook height feedback:** If hoist hook height feedback is not possible, sway control will work best at the height programed to this parameter. More sway will occur as the hook deviates further from this height. Measure the distance from the drum to where the hook will be lifted during moves and enter that value into this parameter. A good starting point is 75% of the height from drum to floor.	0–300 ft	25
C14-03	Drum to Weighted Limit Offset	Distance from the Drum to the Hook when the hook is lifted to its maximum height (usually UL2). This value does not change and is always added to the total Swing Length.	1–100 ft	5
C14-04	Center of Gravity Offset by MFDI	Size of each hook height increment for the additional center of gravity offset, enabled by MFDI (H01-xx or F03-xx = 77-7A).	0–10 ft	1
C14-05	Center of Gravity Offset by MFAI	Additional hook height enabled by MFAI (H03-xx = 22). The input voltage (not percent) is multiplied by this value to calculate the additional hook height.	0–10 ft	1

Parameter	Display	Function	Range	Default
C14-06	Acceleration Aggression	Aggression scale of Acceleration. 0.0 is the least aggressive (slower). 10.0 is the most aggressive (faster).	0.0–10.0	6.0
C14-07	Deceleration Aggression	Aggression scale of Deceleration. 0.0 is the least aggressive (slower). 10.0 is the most aggressive (faster).	0.0–10.0	6.0
C14-08	Sway Control in Micro-Speed 0 Disabled 1 Enabled	Disable Sway Control when Micro-Speed 1 or Micro-Speed 2 is enabled.	0, 1	0
C14-09	Alternate Hook Height	Use alternate hook height, enabled by MFDI (H01-xx or F03-xx = 7B). Will override all other hook height settings. Motor must be stopped before switching.	0–300 ft	20
C14-10	Sway Control Algorithm Gain	Gain on the Hook height feedback to increase the responsiveness of the motion, resulting in increased swing. Lowering this gain will allow a faster deceleration, at the expense of more swing.	0–100	100
C14-11	*End at Zero Speed* *0 Disabled* *1 Enabled*	When enabled, motion will stop, and the brake will close when the motor speed has reached zero. Minor sway may occur at low speeds. When disabled, brief and low speed movements may result in the brake actuating and the motor moving slightly. This is due to the algorithm attempting to perfectly counteract sway.	0, 1	1
C14-12	*Travel Limit Decel Method* *0 Disable Sway Control* *1 Decel with Sway Control* *2 Quick Decel with Sway Control*	Sway Control response when a slowdown (LL1/UL1) travel limit is reached. A setting of 0 will use normal deceleration rates when a travel limit is reached, at the expense of sway occurring, but decelerating quickly. A setting of 1 will maintain sway control during the travel limit, at the expense of an elongated deceleration distance, though without sway. A setting of 2 is a combination of settings 0 and 1. The hook height is scaled to 50%, which allows some sway control to remain effective, while decelerating quicker.	0–2	0

5.2.29.1 Setting Up Sway Control

The optimal Sway Control configuration includes an IMPULSE®•VG+ VFD on the Hoist. With this configuration, the hook height can be dynamically relayed from the Hoist to the Traverse (sway control) VFDs. With an IMPULSE®•G+ Hoist VFD, the hook height is not known since there is no encoder feedback from the motor. In this configuration, a static hook height is programmed into the sway control VFDs, and sway control will function best when the hook is at that height. More swing will occur as the hook height deviates from the statically programmed setting.

Parameter Setup

1. Determine how Sway Control will be enabled. If the operator will always be using Sway Control, set C14-01 = 1 (Enabled Always). Alternatively, C14-01 can be set to 2 (Enabled by MFDI). This will allow the operator to enable Sway Control with a switch. The switch is wired to a digital input and that input programmed to H01-xx or F03-xx = 75 (Sway Control Main Hoist) or 76 (Sway Control Aux Hoist).
2. Determine the desired Acceleration and Deceleration Aggressiveness. The Sway Control algorithm will typically extend the accel/decel times depending on the Swing Length. Enter the aggressiveness number into C14-06 and C14-07 (higher numbers cause quicker acceleration and deceleration).
3. If needed, determine how the Center of Gravity Offset will be applied. This is the distance from the Hook to the Center of Gravity of the load.
   a. Offset by MFDI - Enter the distance multiplier (in feet) into C14-04. Wire and program four digital inputs to “CG Offset bit 1” to “CG Offset bit 4” (e.g., H01-03 = 77, H01-04 = 78, H01-05 = 79, and H01-06 = 7A). The four inputs will be used to generate a 4 bit number, 0 to 15 (see Table x-x). This value is then multiplied by the value in C14-04, usually 1 ft. For example, an input value of 5 will add 5 * 1 ft, or 5 feet to the swing length.
   b. Offset by MFAI - Enter the distance multiplier into C14-05. Set an analog input (H03-0x) to 22 (Center of Gravity Offset). The Analog Input voltage will be multiplied by C14-05 to determine the distance from the Hook to the Center of Gravity of the load. For example, if C14-05 is 2 ft, and the input voltage is 2 volts, the additional length will be 2 * 2 ft, or 4 feet.

Table 5-46: Center of Gravity Offset Input Logic

Value	CG Offset bit 4 (MFDI = 7A)	CG Offset bit 3 (MFDI = 79)	CG Offset bit 2 (MFDI = 78)	CG Offset bit 1 (MFDI = 77)
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Open Loop Hoist VFD Setup (Such as IMPULSE®•G+ Series 5)

The height of the hook is not known by the Hoist VFD due to lack of an encoder. In this configuration, a static hook height is programmed into the sway control VFDs, and sway control will function best when the hook is at that height.

1. Lift the hook to the height that will be commonly used when moving the load.
2. Measure the distance from the weighted upper limit block to the hook. Enter this value into C14-02 (Hook Height).
3. Measure the distance from the center of the drum to the weighted upper limit block. Enter this value into C14-03 (Drum to Weighted Limit Offset).

Closed Loop Hoist VFD Setup (Such as IMPULSE®•VG+ Series 5)

Setting up Sway Control with a closed loop VFD allows for Sway Control to function at any height and allows lifting or lowering the load while moving without resulting swing. The following steps explain how to configure the Hook Height output of an IMPULSE®•VG+ Series 5 VFD.

1. Set C03-15 (Hook Height Home Position) to 2 (Home MFDI Upper). A Normally Open (N.O.) contact on the Weighted Limit Switch (UL3) or Upper Limit 2 (UL2) is used to act as a homing location to zero out the hook height.
2. Set C03-16 (Hook Height Analog Output) to 0 (0 Revs = 0% Analog Output). This configures a 0 volt output when the hook is at the home point and 10V when the hook is at 100% hook height.
3. Set an MFDI (H01-xx or F03-xx) to 67 (Hook Height Home). This terminal will close when the Limit switch opens. UL3 may require a relay, as most weighted limit switches only provide normally closed contacts.
4. Set parameter C03-14 (Hook Height Revolutions Total) to the total number of motor revolutions required for the entire lift.
   a. Start by raising the hoist up to the home point. Ensure that this action results in the system being homed (U01-50 will display 0%).
   b. Lower the hook all the way to the lowest point of travel (usually the floor).
   c. Transfer the number of motor revolutions from U01-51 to parameter C03-14.
5. Use monitors U01-50 (Hook Height) and U01-51 (Motor Revolutions) to verify the setup.
6. Set H04-04 (Terminal AM Function) to 150 (Hook Height).
7. Set H04-05 (Terminal AM Gain) to 100%.
8. Run a shielded wire from the Analog Output (Terminal AM) on the Hoist VFD to an Analog Input on The Trolley and Bridge VFDs.

Swing Length Measurement

The Hoist VFD is now setup to output the height of the hook as an analog signal. An analog input on each of the Traverse VFDs is programmed to read this value into the Sway Control function. This value will be scaled to determine the exact height of the hook. The actual hook height needs to be measured and entered into C14-02. There are two methods to do this, outlined below.

Finding C14-02 and C14-03 by Manual Measurement

1. Raise the hook to the Home position. U01-50 on the hoist VFD will read 0%.
2. Measure the distance from the center of the drum to the hook (it may be helpful to use a long rope and mark the position with a knot or marker to be measured later). This value is the Constant Offset (C14-03).
3. Lower the hook to the ground or lowest point. U01-50 on the hoist VFD will read 100%.
4. Measure the distance from the center of the drum to the hook.
5. Subtract the distance from Step 2 from the distance from Step 4. This is the difference in Hook Height between 0% and 100%. Enter this value into C14-02.
6. Confirm that U01-49 displays the value found in Step 2 when at Home, and the value found in Step 5 when at the ground. Ensure that a Center of Gravity Offset is not being applied.

Finding C14-02 and C14-03 by Swing Period

1. Remove all loads from the end of the hook (including slings). Lower the hook to its lowest point. U01-50 on the hoist VFD should show 100%.
2. With Sway Control disabled, move the bridge so that the hook is swinging back and forth a few feet. The amount of swing does not matter, so long as it is easy to count the number of complete swings.
3. With a stopwatch, time how long 10 complete swings take. Take this number and divide by 10. This is the swing period for the Low point. Record this number.
4. Raise the hook to its highest point (U01-50 on the hoist VFD should show 0%).
5. Move the bridge so that the hook is swinging back and forth a few feet.
6. Time how long 10 complete swings take. Take this number and divide by 10. This is the swing period for the Home point. Record this number.
7. Use Table 9 to find the Swing Length for the time determined in Step 6. If the recorded swing time is not shown, use the closest value. Enter this length into C14-03.
8. Use Table 9 to find the Swing Length for the time determined in Step 3. Subtract the value in C14-03 from this value. Enter this value into C14-02.
9. Confirm that U01-49 displays the value found in Step 7 when at the Home position, and the value found in Step 8 when at the ground. Ensure that the Offset by MFDI or Offset by Analog Input is zero before checking.

Table 5-47: Swing Time to Swing Length Conversion Table

Swing Time (sec)	Swing Length (feet)	Swing Time (sec)	Swing Length (feet)	Swing Time (sec)	Swing Length (feet)	Swing Time (sec)	Swing Length (feet)
2	3	6.5	34	11	98	15.5	195
2.25	4	6.75	37	11.25	103	15.75	202
2.5	5	7	39	11.5	107	16	208
2.75	6	7.25	42	11.75	112	16.25	215
3	7	7.5	45	12	117	16.5	222
3.25	8	7.75	48	12.25	122	16.75	228
3.5	9	8	52	12.5	127	17	235
3.75	11	8.25	55	12.75	132	17.25	242
4	13	8.5	58	13	137	17.5	249
4.25	14	8.75	62	13.25	143	17.75	256
4.5	16	9	66	13.5	148	18	264
4.75	18	9.25	69	13.75	154	18.25	271
5	20	9.5	73	14	159	18.5	279
5.25	22	9.75	77	14.25	165	18.75	286
5.5	24	10	81	14.5	171	19	294
5.75	26	10.25	85	14.75	177	19.25	302
6	29	10.5	89	15	183		
6.25	31	10.75	94	15.25	189		

5.2.29.2 Sway Control Limitations

The control algorithm is built into the IMPULSE®•G+/VG+ Series 5 VFD and considered an open loop system which will not add additional swing but will also not remove any existing swing. Any external forces, such as wind, will not be accounted for and may cause a small amount of swing.

Sway Control is limited to 300 foot swing lengths, meaning the combination of all swing length adders, such as Drum to UL3 Offset, Offset by MFDI and so on, cannot add up to more than that. If 300 feet is exceeded, a fault will be displayed on the keypad and movement will be halted until the calculated swing length is less than 300 feet and the fault is cleared.

Sway Control can only be enabled or disabled by digital input (MFDI) when the motor is not spinning. If the operator attempts to enable or disable Sway Control during a move, an error will be displayed on the keypad.

5.2.29.3 Sway Control Expected Acceleration/Deceleration Times

Table 5-48: Expected Acceleration/Deceleration Times (0-60 Hz)

Swing Length (ft)	C14-06 (Accel) or C14-07 (Decel) Aggressiveness [Unitless]					
	0.0	2.0	4.0	6.0	8.0	10.0
20	13.4 sec	11.4 sec	9.4 sec	7.4 sec	5.4 sec	3.4 sec
40	14.5 sec	12.5 sec	10.5 sec	8.5 sec	6.5 sec	4.5 sec
60	15.2 sec	13.2 sec	11.2 sec	9.2 sec	7.2 sec	5.2 sec
80	15.9 sec	13.9 sec	11.9 sec	9.9 sec	7.9 sec	5.9 sec
100	16.5 sec	14.5 sec	12.5 sec	10.5 sec	8.5 sec	6.5 sec
120	17.0 sec	15.0 sec	13.0 sec	11.0 sec	9.0 sec	7.0 sec
140	17.5 sec	15.5 sec	13.5 sec	11.5 sec	9.5 sec	7.5 sec
160	18.0 sec	16.0 sec	14.0 sec	12.0 sec	10.0 sec	8.0 sec
180	18.4 sec	16.4 sec	14.4 sec	12.4 sec	10.4 sec	8.4 sec
200	18.8 sec	16.8 sec	14.8 sec	12.8 sec	10.8 sec	8.8 sec
220	19.2 sec	17.2 sec	15.2 sec	13.2 sec	11.2 sec	9.2 sec
240	19.6 sec	17.6 sec	15.6 sec	13.6 sec	11.6 sec	9.6 sec
260	19.9 sec	17.9 sec	15.9 sec	13.9 sec	11.9 sec	9.9 sec
280	20.3 sec	18.3 sec	16.3 sec	14.3 sec	12.3 sec	10.3 sec
300	20.6 sec	18.6 sec	16.6 sec	14.6 sec	12.6 sec	10.6 sec

5.2.29.4 Hoist Swing Length Diagram

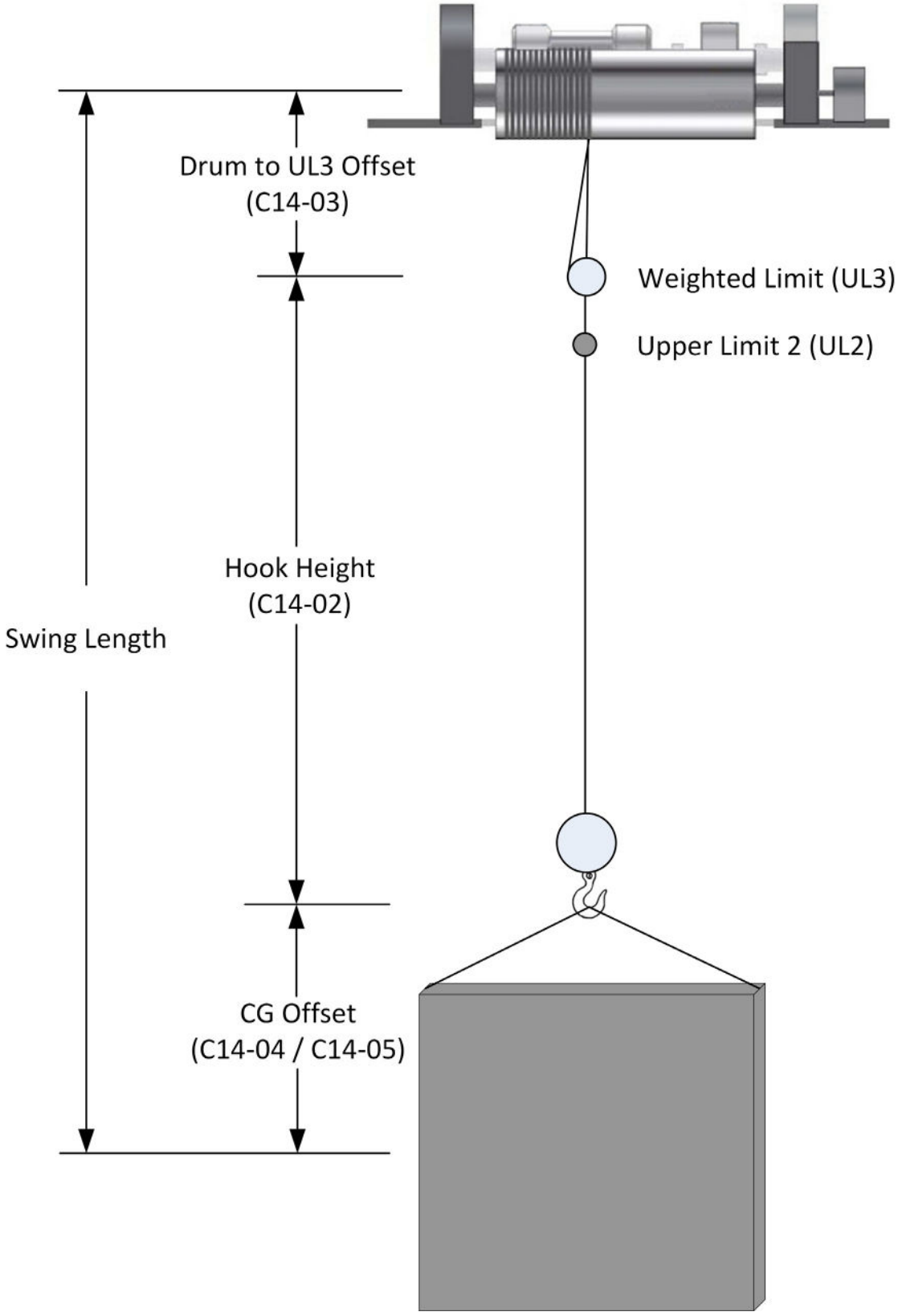


Figure 5-19: Hoist Swing Length Diagram

5.3 Tuning

- d01 DC Injection / Short Circuit Braking
- d02 Slip Compensation
- d03 Torque Compensation
- d04 Automatic Speed Regulator (ASR) Tuning
- d05 Torque Control
- d08 Dwell
- d09 S-Curve Acceleration/Deceleration
- d10 Duty & Carrier Frequency

5.3.1 DC Injection / Short Circuit Braking

With decel to stop enabled (b03-03 = 0), upon removal of the run command, the motor will decelerate according to the Decel Time (b05-02), until output frequency reaches the DC Injection Braking Start Frequency (d01-01). Then the frequency 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.

Table 5-49: DC Injection / Short Circuit Braking Parameter Settings

Parameter	Display	Function	Range	Default
d01-01	DC Injection/Zero Speed Threshold	DC Injection Braking Frequency Start	0.0–10.0 Hz	0.5
d01-02*	DC Injection Braking Current	DC Injection Braking current as a percentage of the VFD rated current.	0–100%	50
d01-03	DC Inject Braking Time at Start	DC Injection Braking Time	0.00–10.00 sec	0.00
d01-04	DC Inject Braking Time at Stop	DC Injection Braking Time at Stop	0.00–10.00 sec	0.05
d01-08*	Magnetic Flux Compensation Value	Current injected at the start of DC Injection Braking as a percentage of motor no-load current (E02-03).	0–1000%	0

** Not available in the Closed Loop Vector control method (A01-02 = 3).*

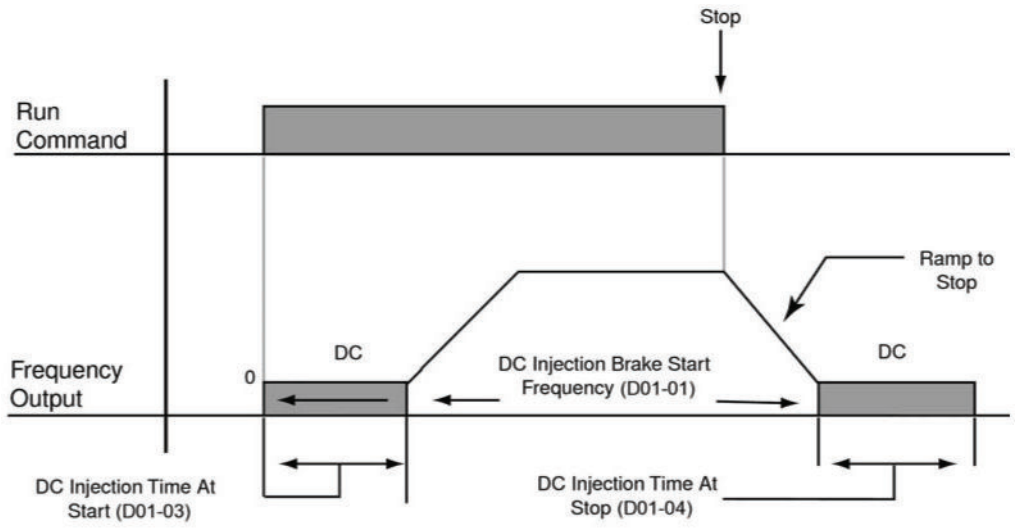


Figure 5-20: DC Injection Braking Sequence

5.3.2 Slip Compensation

As the load becomes larger, the motor speed is reduced and the motor slip increases. The Slip Compensation function keeps the motor speed constant under varying load conditions. Parameter d02-01 sets the slip compensation gain. When d02-01 = 1.0, the output frequency is increased by 1% of the E01-06 setting at rated current. A setting of d02-01 = 0.0 results in no slip compensation.

Table 5-50: Slip Compensation Parameter Settings

Parameter	Display	Function	Range	Default
d02-01	Slip Compensation Gain	Slip compensation multiplier.	0.0–2.5	V/f: 0.0 OLV: 1.0 CLV: 1.0
d02-02	Slip Compensation Delay Time	Adjusts the slip compensation function delay time (G+ only).	0–10000 ms	V/f: 2000 OLV: 200
d02-03	Slip Compensation Limit	Upper limit for the slip compensation as a percentage of motor rated slip E02-02 (G+ only).	0–250%	200
d02-04	Slip Compensation at Regen *0 Disabled* *1 Enabled Above 6Hz* *2 Enabled Above D02-07*	Disabled slip compensation during regeneration (G+ only).	0–2	0
d02-05	Output Voltage Limit Selection *0 Disabled* *1 Enabled*	Automatically reduces motor flux when the output voltage saturates.	0, 1	0
d02-16	Vout Modulation Limit Start Lvl	Modulation factor that starts the output voltage limit operation when d02-05 = 1 (Enabled).	70.0–D02–17%	90.0
d02-17	Vout Modulation Limit Max Level	Modulation factor used with d02-18 for output voltage limit operation when d02-05 = 1 (Enabled).	85.0–100.0%	100.0
d02-18	Output Voltage Limit Level	Maximum voltage level drop width when d02-05 = 1 (Enabled).	50.0–100.0%	90.0
d02-21	Motor 2 Slip Compensation Gain	Slip Compensation gain for Motor 2.	0.0–2.5	Depends on E03-01
d02-22	Motor 2 Slip Comp Delay Time	Slip Compensation delay time for Motor 2 when speed is unstable or response is too slow.	0–10000 ms	Depends on E03-01
d02-23	Motor 2 Slip Compensation Limit	Slip Compensation upper limit for Motor 2 as a percentage of rated slip.	0–250%	200
d02-24	Motor 2 Slip Comp during Regen *0 Disabled* *1 Enabled Above 6Hz* *2 Enabled Above Defined Range*	Slip Compensation during regenerative operation for Motor 2.	0–2	0
d02-28	Adaptive Slip Control Mode *0 Normal* *1 Advance*	Slip Compensation function mode.	0,1	0

5.3.3 Torque Compensation

The motor torque requirement changes according to load conditions. Full-range automatic torque boost adjusts the voltage of the V/f pattern according to the required torque. The VFD automatically adjusts the voltage during constant-speed operation as well as during acceleration.

The required torque is calculated by the VFD. This ensures smooth operation and power savings.

Output voltage α Torque compensation gain x Required torque

When more torque is needed, increase the torque compensation gain in one-tenth (0.1) increments. Increase the setting when the wiring distance between the VFD and the motor is 100 feet (30.5 meters) or longer. If the motor generates excessive vibration or oscillates, decrease the torque compensation.

Increasing torque compensation gain increases motor torque, but an excessive increase may cause the following:

- VFD faults due to motor overexcitation, and/or
- Motor overheat or excessive vibration.

Increase the torque compensation time constant in 10 ms increments when the motor's output current is unstable. Decrease this value when speed response is slow.

Table 5-51: Torque Compensation Parameter Settings

Parameter	Display	Function	Range	Default
d03-01	Torque Compensation Gain	Gain for the automatic torque (voltage) boost function and helps to produce better starting torque.	0.00–2.50	1.00*
d03-02	Torque Compensation Delay Time	Torque compensation delay time.	0–60000 ms	V/f: 200 OLV: 20
d03-03	Torque Compensation @ FWD Start	Torque compensation at forward start as a percentage of motor torque.	0.0–200.0%	0.0**
d03-04	Torque Compensation @ REV Start	Torque compensation at reverse start as a percentage of motor torque.	-200.0–0.0%	0.0**
d03-05	Torque Compensation Time	Time constant for torque compensation at forward start and reverse start (d03-03 and d03-04).	0–200 ms	10**
d03-06	Motor 2 Torque Comp Delay Time	Torque compensation delay time 2.	0–10000 ms	150**
d03-07	Motor 2 Torque Compensation Gain	Torque Compensation gain for Motor 2.	0.00–2.50	1.00
d03-19	Torque Ripple Suppress Min Freq	Adjust this setting if there is slow oscillation at low speed.	0.0–10.0 Hz	0.1
d03-20	Voltage Compensation Adjust 1	Voltage Compensation 1 precision.	0–200 Hz	120
d03-21	Voltage Compensation Adjust 2	Voltage Compensation 2 precision.	0–10	5
d03-23	Current Control Gain	Current control gain.	0.50–2.50	1.00

** Default setting is determined by parameter A01-02, Control Method Setting.*

*** Only available in Open Loop Vector (A01-02 = 2).*

5.3.4 Automatic Speed Regulator (ASR) Tuning

The ASR controls the motor speed in the Closed Loop Vector control method and adjusts the output torque reference to minimize the difference between frequency reference and actual motor speed.

The figure below illustrates ASR functionality:

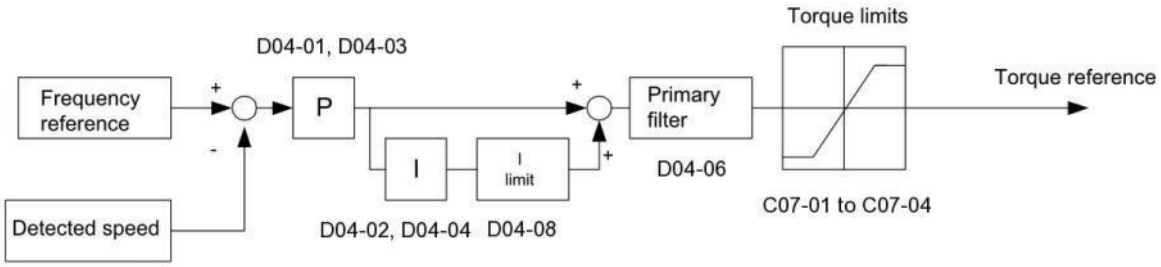


Figure 5-21: Speed Control Block Diagram for Closed Loop Vector

Perform Auto-Tuning and set up all motor data correctly prior to adjusting ASR parameters.

Generally when tuning the ASR, optimize the ASR gain before adjusting the integral time settings. Always make adjustments with the load connected to the motor.

Parameters d04-03 and d04-04 define the ASR proportional gain an integral time at zero speed. The settings in d04-01 and d04-02 are used at speeds above the setting in d04-07. Parameter d04-07 is set by default to 0.0 so d04-01 and d04-02 are used by default over the entire speed range. However, changing d04-07 creates two levels of ASR control settings, as shown in ***Figure 5-22*** below.

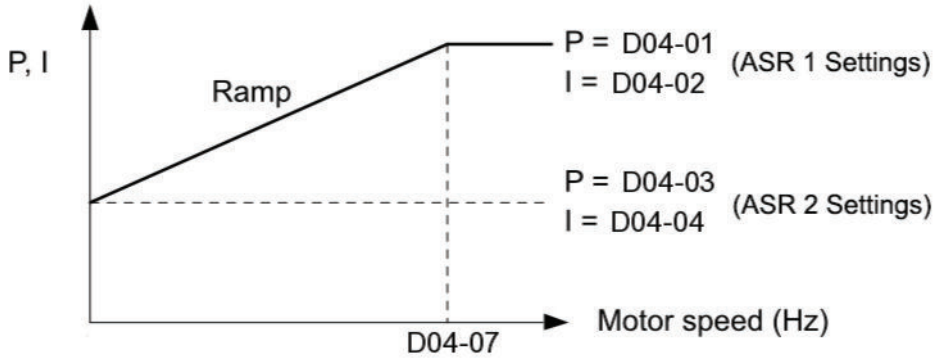


Figure 5-22: Low-speed and High-speed Gain Settings

The switching frequency (d04-07) can also be controlled with a digital input programmed to H01-xx = 37 (ASR Gain Select). When the digital input is OFF, the VFD uses the ASR gain level set by the pattern in ***Figure 5-22***. When the digital input is ON, d04-03 is used. The integral time set to d04-02 is used to change linearly between these settings, as shown in ***Figure 5-23***. The ASR gain enabled by a digital input overrides d04-07.

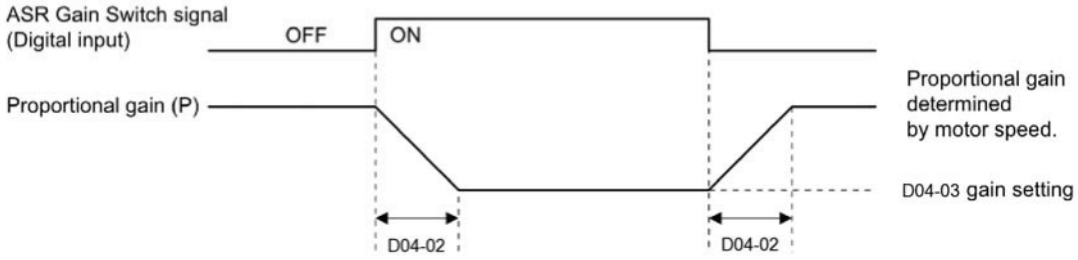


Figure 5-23: ASR Proportional Gain Switch

5.3.4.1 Adjusting the ASR Parameters in Closed Loop Vector

The VFD is preset to use ASR settings d04-01/d04-02 over the entire speed range in Closed Loop Vector. If required by the application, a second set of ASR parameters (d04-03/d04-04) can be automatically activated depending on the motor speed or by using a digital input.

Perform the following steps for adjusting ASR parameters:

1. Run the motor at zero speed and increase the ASR gain (d04-01) as much as possible without oscillation.
2. Run the motor at zero speed and decrease the ASR integral time (d04-02) as much as possible without oscillation.
3. Run at the normal operating speed. Check for over/undershoot when changing speed and for any oscillation.
4. If problems occur in step 3, increase the integral time and reduce the gain.

Alternatively, use different ASR settings for high and low speed. Set the values from step 1 and 2 to parameters d04-03 and d04-04, then set an ASR switching frequency in parameter d04-07. Run the motor at a speed higher than d04-07 and repeat step 3 while adjusting d04-01 and d04-02.

5.3.4.2 Solving Problems During ASR Setup

Use ***Table 5-52*** when making adjustments to ASR.

Table 5-52: ASR Setup Problems and Corrective Actions

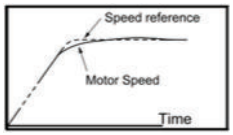
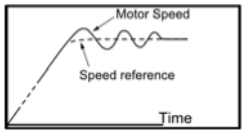
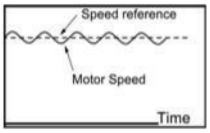
Problem		Possible Solutions
Slow response to speed changes or speed deviation lasts for too long		• Increase the ASR gain. • Decrease the integral time.
Overshoot or undershoot at the end of acceleration or deceleration		• Decrease the ASR gain. • Increase the integral time.
Vibration and oscillation occur at constant speed		• Decrease the ASR gain. • Increase the integral time. • Increase the ASR delay time (d04-06).
Oscillation at low speed and response is too slow at high speed (or vice versa)	-	• Use d04-01, d04-02, d04-03, and d04-04 to define optimal ASR settings for high and low speed. Use d04-07 to define a switching frequency.

Table 5-53: ASR Tuning Parameter Settings

Parameter	Display	Function	Range	Default
d04-01	ASR Proportional Gain 1	Proportional gain of the speed control loop.	0.00–300.00	20.00
d04-02	ASR Integral Time 1	Integral time of the speed control loop.	0.000–10.000 sec	0.500
d04-03	ASR Proportional Gain 2	Proportional gain 2 of the speed control loop.	0.00–300.00	20.00
d04-04	ASR Integral Time 2	Integral time 2 of the speed control loop.	0.000–10.000 sec	0.500
d04-06	ASR Delay Time	ASR Output Primary Delay Time.	0.000–0.500 sec	0.004
d04-07	ASR Gain Switchover Frequency	ASR Gain Switching Frequency.	0.0–150.0 Hz	0.0
d04-08	ASR Integral Limit	ASR Integral Limit.	0–400%	400
d04-09	Up/Down 2 Bias Lower Limit	Up/Down frequency reference bias lower limit.	-99.9–0.0%	0.0
d04-10	Up/Down Freq Lower Limit Select *0 Greater of B02-02 or Analog* *1 B02-02*	Up/Down frequency reference limit.	0, 1	0
d04-17	Motor Inertia	Motor inertia.	0.0001–600.0000 kgm^2	Depends on O02-04
d04-18	Load Inertia Ratio	Load inertia ratio for the motor inertia.	0.0–6000.0	1.0
d04-29	Speed Control Response *0 Standard* *1 High Performance 1*	Speed control responsiveness.	0, 1	0
d04-37	Motor 2 Inertia	Motor inertia for Motor 2.	0.0001–600.0000 kgm^2	Depends on O02-04
d04-38	Motor 2 Load Inertia Ratio	Load inertia ratio for the Motor 2 inertia.	0.0–6000.0	1.0
d04-50	Notch Filter Frequency	Machine resonance frequency.	0–100 Hz	0
d04-51	Notch Filter Bandwidth	Notch width of the notch filter.	0.5–5.0	1.0

NOTE: *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.*

5.3.5 Torque Control

Please consult factory for application assistance regarding torque control. Typically, torque control should not be applied on a hoist.

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

Table 5-54: Torque Control Parameter Settings

Parameter	Display	Function	Range	Default
d05-01	Torque Control Selection	Selects between Speed or Torque Control.	0, 1	0
	0 Speed Control	Speed Control enabled with torque limit.		
	*1 Torque Control**	Torque control enabled with speed limit.		
d05-02	Torque Reference Delay Time	Primary delay time for Torque Reference Input.	0–1000 ms	0
d05-03	Speed Limit Selection	Speed Limit Selection (***Figure 5-24 on page 142***)	1, 2	2
	1 Active Frequency Reference	Limit set by the frequency reference in b01-01.		
	2 D05-04 Setting	Limit set by D05-04.		
d05-04	Speed Limit	Speed Limit Value (% of E01-04)	-120–120%	105
d05-05	Speed Limit Bias	Speed Limit Bias (% of E01-04)	0–120%	10
d05-06	Speed/Torque Changeover Time	Speed/Torque Switching Timer	0–1000 ms	0
d05-08	Uni-directional Speed Limit Bias	Determines if the speed limit bias is applied.	0, 1	1
	0 Disabled			
	1 Enabled			

** Cannot set d05-01 = 1 for NLB Hoist; use Load Share MFDI (H01-xx = 68) instead.*

5.3.5.1 Speed/Torque Control Switching

Speed control or torque control is used in traverse applications and can be selected “on the fly” with the VG+ VFD by using the digital input speed/torque control selection (H01-xx = 68).

Table 5-55: Speed/Torque Control Switch Parameters

Terminal	Parameter	Setting	Description
S1 - S8	H01-01–H01-08	68	Speed/torque control selection
A1	b03-01	1	Frequency reference selection (terminals A1, A2, or A3)
	d05-03	1	Speed limit selection (terminals A1, A2, or A3)
A3/A2	H03-06/H03-10	13	Torque reference/torque limit

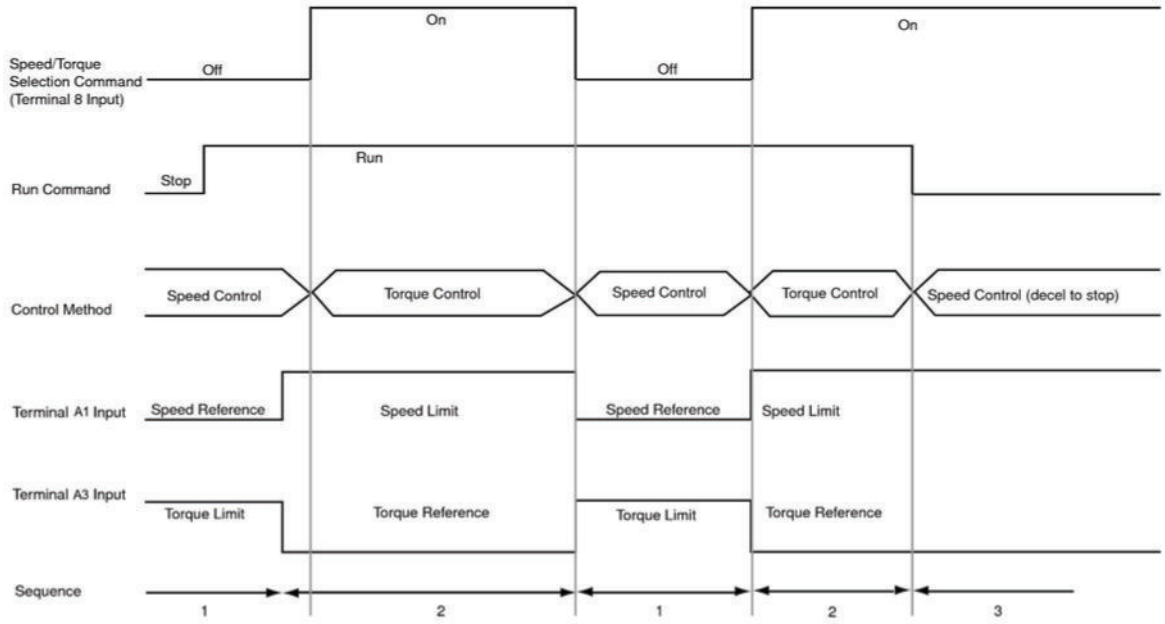


Figure 5-24: Speed/Torque Control Selection Timing Diagram

1. When the speed/torque control selection is OFF, speed control is activated.
   - Speed reference during speed control depends on the frequency reference selection (b03-01) setting. To use terminal A1, A2, or A3 as the frequency reference, set b03-01 = 1.
   - Torque limit during speed control is the smaller of the absolute value of terminal A2 or A3 torque limit, or the values set in the torque limit parameters (C07-01 to C07-04) 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 A2 or A3 torque limit, or the values set in the torque limit parameters (C07-01 to C07-04) is used as the torque limit.
2. When the speed/torque control selection is ON, torque control is activated.
   - Speed limit during torque control is the frequency reference at terminal A1, A2, or A3 when speed limit selection (d05-03 = 1), and is the speed limit value (d05-04) when d05-03 = 2, regardless of the frequency reference selection (b03-01) setting.
   - During torque control, the terminal A2 or A3 analog input value becomes the torque reference.
3. When the run command is removed during torque control, operation changes to speed control automatically, and the motor decelerates to stop. The torque limit during deceleration becomes the values set in the torque limit parameters (C07-01 to C07-04).

5.3.6 Dwell

The Dwell function is used to temporarily hold the output frequency at a set reference for a set time. Enable by setting H01-xx = 65.

Table 5-56: Dwell Function Parameter Settings

Parameter	Display	Function	Range	Default
d08-01	Dwell Reference at Start	Dwell frequency reference at start.	0.0–150.0 Hz	0.0
d08-02	Dwell Time at Start	Time duration for the Dwell function at start.	0.0–10.0 sec	0.0
d08-03	Dwell Reference at Stop	Dwell frequency reference at stop.	0.0–150.0 Hz	0.0
d08-04	Dwell Time at Stop	Time duration for the Dwell function at stop.	0.0–10.0 sec	0.0

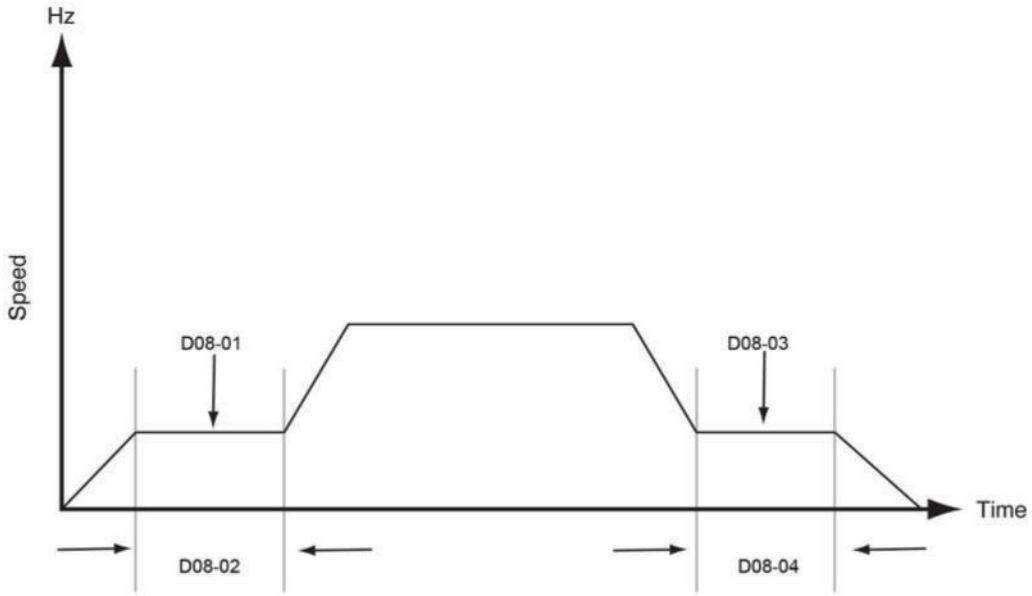


Figure 5-25: Dwell Function

5.3.7 S-Curve Acceleration/Deceleration

An 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.

Table 5-57: S-Curve Acceleration/Deceleration Parameter Settings

Parameter	Display	Function	Range	Default
d09-01	S-Curve Time @ Start of Accel	S-Curve at the beginning of the Accel time.	0.00–10.00 sec	0.50*
d09-02	S-Curve Time @ End of Accel	S-Curve at the end of the Accel time.	0.00–10.00 sec	0.50*
d09-03	S-Curve Time @ Start of Decel	S-Curve at the beginning of the Decel time.	0.00–10.00 sec	0.50*
d09-04	S-Curve Time @ End of Decel	S-Curve at the end of the Decel time.	0.00–10.00 sec	0.50*

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

Time to accelerate from the minimum frequency to the maximum frequency (total acceleration) is:

$$\text{Total Acceleration} = \text{b05-01} + \frac{\text{d09-01} + \text{d09-02}}{2}$$

Time to decelerate from the maximum frequency to the minimum frequency (total deceleration) is:

$$\text{Total Deceleration} = \text{b05-02} + \frac{\text{d09-03} + \text{d09-04}}{2}$$

CAUTION

Acceleration and deceleration times will be extended.

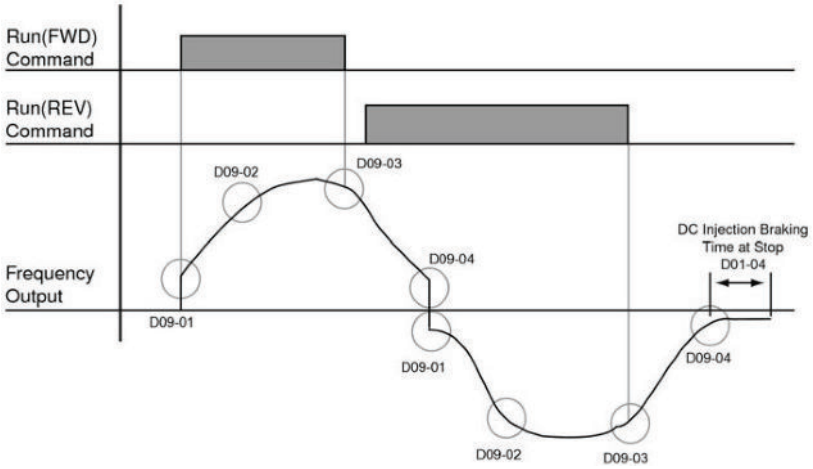


Figure 5-26: S-Curve Characteristic-FWD/REV Operation

5.3.8 Duty & Carrier Frequency

The Duty & Carrier Frequency group configures the VFD's output carrier frequency and overload level.

CAUTION

Consult Magnetek for VFD derating before modifying the d10 group parameters. Failure to do so may result in equipment damage.

Table 5-58: Duty & Carrier Frequency Parameter Settings

Parameter	Display	Function	Range	Default
d10-01	Normal / Heavy Duty Selection	Duty rating, which determines the output and overload rating	0, 1	0
	0 Heavy Duty Rating	150% of rated current for 1 minute		
	1 Normal Duty Rating	120% of rated current for 1 minute		
d10-02	Carrier Frequency Selection	Carrier Frequency Selection	1–9, A, F	1
	1 2.0 kHz			
	2 5.0 kHz			
	3 8.0 kHz			
	4 10.0 kHz			
	5 12.5 kHz			
	6 15 kHz			
	7 Swing PWM1 (Audible Sound 1)			
	8 Swing PWM2 (Audible Sound 2)			
	9 Swing PWM3 (Audible Sound 3)			
	A Swing PWM4 (Audible Sound 4)			
	F User Defined	Determined by d10-03 through d10-05		
d10-03	Carrier Frequency Upper Limit	Carrier frequency upper limit.	1.0–15.0 kHz	2.0
d10-04	Carrier Frequency Lower Limit	Carrier frequency lower limit (V/f only).	1.0–15.0 kHz	2.0
d10-05	Carrier Freq Proportional Gain	Carrier Frequency Gain (V/f only).	0–99	0
d10-09	Carrier Freq at Rotational Tune	Carrier frequency while performing a rotational Auto-Tune.	0, 1	0
	0 5 kHz			
	1 Use d10-02			

5.4 Motor Parameters

- E01 V/f Pattern for Motor 1
- E02 Motor 1 Parameters
- E03 V/f Pattern for Motor 2
- E04 Motor 2 Parameters
- E07 Test Mode

5.4.1 Voltage/Frequency (V/f) Pattern for Motor 1

WARNING

VFD input voltage (not motor voltage) must be set in E01-01 for the protective features of the VFD to function properly. Failure to do so may result in equipment damage and/or death or personal injury.

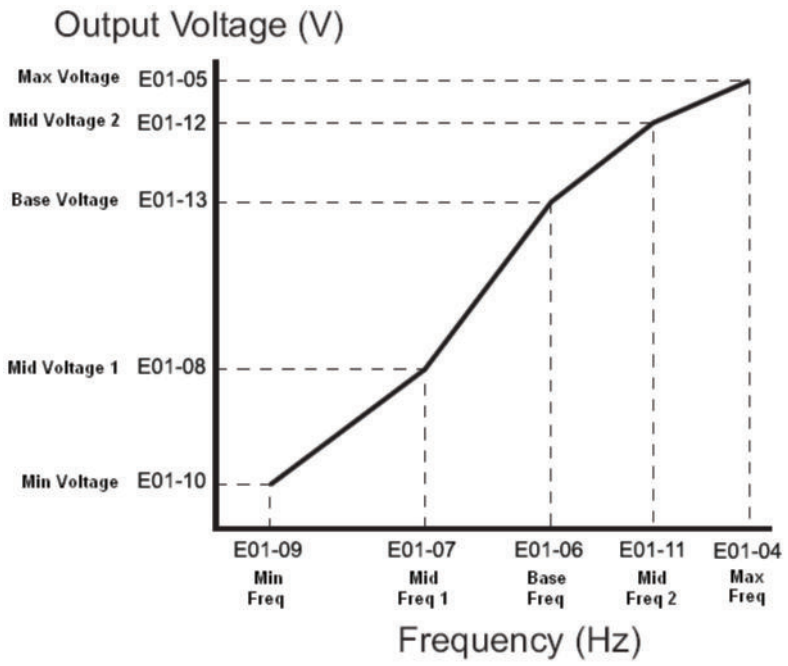


Figure 5-27: Output Voltage

An OPE10 error will occur if the following conditions are not met:

E01-05 ≥ E01-12 ≥ E01-13 ≥ E01-08 ≥ E01-10

E01-04 ≥ E01-11 ≥ E01-06 ≥ E01-07 ≥ E01-09

Table 5-59: DC Bus Regulation

VFD Voltage	Overvoltage Level		Braking Transistor	Stall Level
	Fault	Reset	Turn-On	
230	410 VDC	400 VDC	394 VDC	380 VDC
460	820 VDC	800 VDC	788 VDC	760 VDC
575	1178 VDC	990 VDC	1132 VDC	960 VDC

Table 5-60: V/f Pattern for Motor 1 Parameter Settings

Parameter	Display	Function	Range	Default
E01-01	Input AC Supply Voltage	VFD input voltage used as the max and base voltage by preset V/f patterns (E01-03 = 0 to E). It also adjusts the levels of protective features (e.g., Overvoltage, braking transistor turn-on, stall prevention, etc).	230V: 155–255 VAC 460V: 310–510 VAC 575V: 446–733 VAC	240 480 575
E01-03	V/f Pattern Selection	V/f Pattern Selection	V/f: 0–9, A–F, FF OLV: F, FF	0*
	0 60 Hz, Level 0	Default for A01-03 = 0 (Traverse)		
	1 60 Hz, Level 1			
	2 60 Hz, Level 2			
	3 60 Hz, Level 3			
	4 60 Hz, Level 4	Default for A01-03 = 1 (Std Hoist)		
	5 60 Hz, Level 5			
	6 60 Hz, Level 6			
	7 50 Hz, Level 0			
	8 50 Hz, Level 1			
	9 50 Hz, Level 2			
	A 50 Hz, Level 3			
	B 50 Hz, Level 4			
	C 50 Hz, Level 6			
	D 75 Hz, Level 4			
	E 90 Hz, Level 4			
	F Custom V/f	Default for A01-03 = 2 (NLB Hoist), E01-04 through E01-13 define the V/f pattern.		
	FF Custom w/o Limit	Custom with no lower limits on E01-xx.		
E01-04	Maximum Output Frequency	Maximum Output Frequency	20.0–300.0 Hz	60.0
E01-05	Maximum Output Voltage	Maximum Output Voltage	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on O02-04
E01-06	Base Frequency	Motor Base Frequency	0.0–300.0 Hz	60.0
E01-07	Mid Point A Frequency	Midpoint Output Frequency A	0.0–300.0 Hz	Depends on E01-03
E01-08	Mid Point A Voltage	Midpoint Output Voltage A	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on E01-03
E01-09	Minimum Output Frequency	Minimum Output Frequency	0.0–300.0 Hz	Depends on E01-03
E01-10	Minimum Output Voltage	Minimum Output Voltage	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on E01-03
E01-11	Mid Point B Frequency	Midpoint Output Frequency B Disabled when 0.0.	0.0–300.0 Hz	0.0

Parameter	Display	Function	Range	Default
E01-12	Mid Point B Voltage	Midpoint Output Voltage B Disabled when 0.0.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	0.0
E01-13	Base Voltage	Motor Base Voltage Disabled when 0.0.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	0.0

** Initial value determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

***NOTE:** In Closed Loop Vector, E01-03 is hidden, and the V/f pattern values are adjusted during an Auto-Tune.*

Table 5-61: Voltage/Frequency (V/f) Pattern Options (230 V Models: 2003 to 2017)

	E01-04	E01-05*4	E01-06	E01-07	E01-08	E01-09	E01-10	E01-11	E01-12	E01-13
E01-03	Hz	VAC	Hz	Hz	VAC	Hz	VAC	Hz	VAC	VAC
0*	60.0	230.0	60.0	3.0	15.6	1.3	8.4	0.0	0.0	0.0
1	60.0	230.0	60.0	3.0	16.8	1.3	9.6	0.0	0.0	0.0
2	60.0	230.0	60.0	3.0	18.0	1.3	10.8	0.0	0.0	0.0
3	60.0	230.0	60.0	3.0	19.2	1.3	12.0	0.0	0.0	0.0
4*1	60.0	230.0	60.0	3.0	20.4	1.3	13.2	0.0	0.0	0.0
5	60.0	230.0	60.0	3.0	21.6	1.3	14.4	0.0	0.0	0.0
6	60.0	230.0	60.0	3.0	22.8	1.3	15.6	0.0	0.0	0.0
7	50.0	230.0	50.0	2.5	15.6	1.1	8.4	0.0	0.0	0.0
8	50.0	230.0	50.0	2.5	16.8	1.1	9.6	0.0	0.0	0.0
9*2	50.0	230.0	50.0	2.5	18.0	1.1	10.8	0.0	0.0	0.0
A	50.0	230.0	50.0	2.5	19.2	1.1	12.0	0.0	0.0	0.0
B*3	50.0	230.0	50.0	2.5	20.4	1.1	13.2	0.0	0.0	0.0
C	50.0	230.0	50.0	2.5	22.8	1.1	15.6	0.0	0.0	0.0
D	75.0	230.0	50.0	2.5	20.4	1.1	13.2	0.0	0.0	0.0
E	90.0	230.0	60.0	3.0	20.4	1.3	13.2	0.0	0.0	0.0
US (V/f) F & FF	60.0	230.0	60.0	3.0	20.4	1.3	13.2	0.0	0.0	0.0
Euro (V/f) F & FF	50.0	200.0	50.0	2.5	15.0	1.3	9.0	0.0	0.0	0.0
US (OLV) F & FF	60.0	230.0	60.0	3.0	14.4	0.5	2.9	0.0	0.0	0.0
Euro (OLV) F & FF	50.0	200.0	50.0	3.0	14.4	0.5	3.0	0.0	0.0	0.0

** Default for O02-09 = 1 (US) and Traverse*

**1 Default for O02-09 = 1 (US) and Std Hoist*

**2 Default for O02-09 = 2 (Euro) and Traverse*

**3 Default for O02-09 = 2 (Euro) and Std Hoist*

**4 Default for E01-05 is 200.0 when O02-09 = 2 (Euro)*

Table 5-62: Voltage/Frequency (V/f) Pattern Options (230 V Models: 2025 to 2180)

	E01-04	E01-05*4	E01-06	E01-07	E01-08	E01-09	E01-10	E01-11	E01-12	E01-13
E01-03	Hz	VAC	Hz	Hz	VAC	Hz	VAC	Hz	VAC	VAC
0*	60.0	230.0	60.0	3.0	14.4	1.3	6.1	0.0	0.0	0.0
1	60.0	230.0	60.0	3.0	15.7	1.3	7.3	0.0	0.0	0.0
2	60.0	230.0	60.0	3.0	16.8	1.3	8.4	0.0	0.0	0.0
3	60.0	230.0	60.0	3.0	18.0	1.3	9.7	0.0	0.0	0.0
4*1	60.0	230.0	60.0	3.0	19.3	1.3	10.9	0.0	0.0	0.0
5	60.0	230.0	60.0	3.0	20.4	1.3	12.1	0.0	0.0	0.0
6	60.0	230.0	60.0	3.0	21.7	1.3	13.3	0.0	0.0	0.0
7	50.0	230.0	50.0	2.5	14.4	1.1	6.1	0.0	0.0	0.0
8	50.0	230.0	50.0	2.5	15.7	1.1	7.3	0.0	0.0	0.0
9*2	50.0	230.0	50.0	2.5	16.8	1.1	8.4	0.0	0.0	0.0
A	50.0	230.0	50.0	2.5	18.0	1.1	9.7	0.0	0.0	0.0
B*3	50.0	230.0	50.0	2.5	19.3	1.1	10.9	0.0	0.0	0.0
C	50.0	230.0	50.0	2.5	21.7	1.1	13.3	0.0	0.0	0.0
D	75.0	230.0	50.0	2.5	19.3	1.1	10.9	0.0	0.0	0.0
E	90.0	230.0	60.0	3.0	19.3	1.3	10.9	0.0	0.0	0.0
US (V/f) F & FF	60.0	230.0	60.0	3.0	16.1	1.3	8.1	0.0	0.0	0.0
Euro (V/f) F & FF	50.0	200.0	50.0	2.5	14.0	1.3	7.0	0.0	0.0	0.0
US (OLV) F & FF	60.0	230.0	60.0	3.0	12.7	0.5	2.3	0.0	0.0	0.0
Euro (OLV) F & FF	50.0	200.0	50.0	3.0	13.2	0.5	2.4	0.0	0.0	0.0

** Default for O02-09 = 1 (US) and Traverse*

**1 Default for O02-09 = 1 (US) and Std Hoist*

**2 Default for O02-09 = 2 (Euro) and Traverse*

**3 Default for O02-09 = 2 (Euro) and Std Hoist*

**4 Default for E01-05 is 200.0 when O02-09 = 2 (Euro)*

Table 5-63: Voltage/Frequency (V/f) Pattern Options (230 V Models: 2215 to 2415)

	E01-04	E01-05*4	E01-06	E01-07	E01-08	E01-09	E01-10	E01-11	E01-12	E01-13
E01-03	Hz	VAC	Hz	Hz	VAC	Hz	VAC	Hz	VAC	VAC
0*	60.0	230.0	60.0	3.0	12.1	1.3	5.0	0.0	0.0	0.0
1	60.0	230.0	60.0	3.0	13.4	1.3	6.1	0.0	0.0	0.0
2	60.0	230.0	60.0	3.0	14.5	1.3	7.3	0.0	0.0	0.0
3	60.0	230.0	60.0	3.0	15.7	1.3	8.6	0.0	0.0	0.0
4*1	60.0	230.0	60.0	3.0	17.0	1.3	9.7	0.0	0.0	0.0
5	60.0	230.0	60.0	3.0	18.1	1.3	11.0	0.0	0.0	0.0
6	60.0	230.0	60.0	3.0	19.4	1.3	12.1	0.0	0.0	0.0
7	50.0	230.0	50.0	2.5	12.1	1.1	5.0	0.0	0.0	0.0
8	50.0	230.0	50.0	2.5	13.4	1.1	6.1	0.0	0.0	0.0
9*2	50.0	230.0	50.0	2.5	14.5	1.1	7.3	0.0	0.0	0.0
A	50.0	230.0	50.0	2.5	15.7	1.1	8.6	0.0	0.0	0.0
B*3	50.0	230.0	50.0	2.5	17.0	1.1	9.7	0.0	0.0	0.0
C	50.0	230.0	50.0	2.5	19.4	1.1	12.1	0.0	0.0	0.0
D	75.0	230.0	50.0	2.5	17.0	1.1	9.7	0.0	0.0	0.0
E	90.0	230.0	60.0	3.0	17.0	1.3	9.7	0.0	0.0	0.0
US (V/f) F & FF	60.0	230.0	60.0	3.0	13.8	1.3	6.9	0.0	0.0	0.0
Euro (V/f) F & FF	50.0	200.0	50.0	2.5	12.0	1.3	6.0	0.0	0.0	0.0
US (OLV) F & FF	60.0	230.0	60.0	3.0	12.7	0.5	2.3	0.0	0.0	0.0
Euro (OLV) F & FF	50.0	200.0	50.0	3.0	13.2	0.5	2.4	0.0	0.0	0.0

** Default for O02-09 = 1 (US) and Traverse*

**1 Default for O02-09 = 1 (US) and Std Hoist*

**2 Default for O02-09 = 2 (Euro) and Traverse*

**3 Default for O02-09 = 2 (Euro) and Std Hoist*

**4 Default for E01-05 is 200.0 when O02-09 = 2 (Euro)*

Table 5-64: Voltage/Frequency (V/f) Pattern Options (460 V Models: 4001 to 4009)

	E01-04	E01-05*4	E01-06	E01-07	E01-08	E01-09	E01-10	E01-11	E01-12	E01-13
E01-03	Hz	VAC	Hz	Hz	VAC	Hz	VAC	Hz	VAC	VAC
0*	60.0	460.0	60.0	3.0	31.1	1.3	16.8	0.0	0.0	0.0
1	60.0	460.0	60.0	3.0	33.6	1.3	19.1	0.0	0.0	0.0
2	60.0	460.0	60.0	3.0	35.9	1.3	21.4	0.0	0.0	0.0
3	60.0	460.0	60.0	3.0	38.2	1.3	24.0	0.0	0.0	0.0
4*1	60.0	460.0	60.0	3.0	40.8	1.3	26.3	0.0	0.0	0.0
5	60.0	460.0	60.0	3.0	43.1	1.3	28.8	0.0	0.0	0.0
6	60.0	460.0	60.0	3.0	45.6	1.3	31.1	0.0	0.0	0.0
7	50.0	460.0	50.0	2.5	31.1	1.1	16.8	0.0	0.0	0.0
8	50.0	460.0	50.0	2.5	33.6	1.1	19.1	0.0	0.0	0.0
9*2	50.0	460.0	50.0	2.5	35.9	1.1	21.4	0.0	0.0	0.0
A	50.0	460.0	50.0	2.5	38.2	1.1	24.0	0.0	0.0	0.0
B*3	50.0	460.0	50.0	2.5	40.8	1.1	26.3	0.0	0.0	0.0
C	50.0	460.0	50.0	2.5	45.6	1.1	31.1	0.0	0.0	0.0
D	75.0	460.0	50.0	2.5	40.8	1.1	26.3	0.0	0.0	0.0
E	90.0	460.0	60.0	3.0	40.8	1.3	26.3	0.0	0.0	0.0
US (V/f) F & FF	60.0	460.0	60.0	3.0	40.8	1.3	26.4	0.0	0.0	0.0
Euro (V/f) F & FF	50.0	400.0	50.0	2.5	30.0	1.3	18.0	0.0	0.0	0.0
US (OLV) F & FF	60.0	460.0	60.0	3.0	28.8	0.5	5.8	0.0	0.0	0.0
Euro (OLV) F & FF	50.0	400.0	50.0	2.5	28.8	0.5	6.0	0.0	0.0	0.0

** Default for O02-09 = 1 (US) and Traverse*

**1 Default for O02-09 = 1 (US) and Std Hoist*

**2 Default for O02-09 = 2 (Euro) and Traverse*

**3 Default for O02-09 = 2 (Euro) and Std Hoist*

**4 Default for E01-05 is 400.0 when O02-09 = 2 (Euro)*

Table 5-65: Voltage/Frequency (V/f) Pattern Options (460 V Models: 4014 to 4091)

	E01-04	E01-05*4	E01-06	E01-07	E01-08	E01-09	E01-10	E01-11	E01-12	E01-13
E01-03	Hz	VAC	Hz	Hz	VAC	Hz	VAC	Hz	VAC	VAC
0*	60.0	460.0	60.0	3.0	28.8	1.3	12.2	0.0	0.0	0.0
1	60.0	460.0	60.0	3.0	31.3	1.3	14.5	0.0	0.0	0.0
2	60.0	460.0	60.0	3.0	33.6	1.3	16.8	0.0	0.0	0.0
3	60.0	460.0	60.0	3.0	35.9	1.3	19.4	0.0	0.0	0.0
4*1	60.0	460.0	60.0	3.0	38.5	1.3	21.7	0.0	0.0	0.0
5	60.0	460.0	60.0	3.0	40.8	1.3	24.2	0.0	0.0	0.0
6	60.0	460.0	60.0	3.0	43.3	1.3	26.5	0.0	0.0	0.0
7	50.0	460.0	50.0	2.5	28.8	1.1	12.2	0.0	0.0	0.0
8	50.0	460.0	50.0	2.5	31.3	1.1	14.5	0.0	0.0	0.0
9*2	50.0	460.0	50.0	2.5	33.6	1.1	16.8	0.0	0.0	0.0
A	50.0	460.0	50.0	2.5	35.9	1.1	19.4	0.0	0.0	0.0
B*3	50.0	460.0	50.0	2.5	38.5	1.1	21.7	0.0	0.0	0.0
C	50.0	460.0	50.0	2.5	43.3	1.1	26.5	0.0	0.0	0.0
D	75.0	460.0	50.0	2.5	38.5	1.1	21.7	0.0	0.0	0.0
E	90.0	460.0	60.0	3.0	38.5	1.3	21.7	0.0	0.0	0.0
US (V/f) F & FF	60.0	460.0	60.0	3.0	32.2	1.3	16.2	0.0	0.0	0.0
Euro (V/f) F & FF	50.0	400.0	50.0	2.5	28.0	1.3	14.0	0.0	0.0	0.0
US (OLV) F & FF	60.0	460.0	60.0	3.0	25.4	0.5	4.6	0.0	0.0	0.0
Euro (OLV) F & FF	50.0	400.0	50.0	2.5	26.4	0.5	4.8	0.0	0.0	0.0

** Default for O02-09 = 1 (US) and Traverse*

**1 Default for O02-09 = 1 (US) and Std Hoist*

**2 Default for O02-09 = 2 (Euro) and Traverse*

**3 Default for O02-09 = 2 (Euro) and Std Hoist*

**4 Default for E01-05 is 400.0 when O02-09 = 2 (Euro)*

Table 5-66: Voltage/Frequency (V/f) Pattern Options (460 V Models: 4112 to 4605)

	E01-04	E01-05*4	E01-06	E01-07	E01-08	E01-09	E01-10	E01-11	E01-12	E01-13
E01-03	Hz	VAC	Hz	Hz	VAC	Hz	VAC	Hz	VAC	VAC
0*	60.0	460.0	60.0	3.0	24.2	1.3	9.9	0.0	0.0	0.0
1	60.0	460.0	60.0	3.0	26.7	1.3	12.2	0.0	0.0	0.0
2	60.0	460.0	60.0	3.0	29.0	1.3	14.5	0.0	0.0	0.0
3	60.0	460.0	60.0	3.0	31.3	1.3	17.1	0.0	0.0	0.0
4*1	60.0	460.0	60.0	3.0	33.9	1.3	19.4	0.0	0.0	0.0
5	60.0	460.0	60.0	3.0	36.2	1.3	21.9	0.0	0.0	0.0
6	60.0	460.0	60.0	3.0	38.7	1.3	24.2	0.0	0.0	0.0
7	50.0	460.0	50.0	2.5	24.2	1.1	9.9	0.0	0.0	0.0
8	50.0	460.0	50.0	2.5	26.7	1.1	12.2	0.0	0.0	0.0
9*2	50.0	460.0	50.0	2.5	29.0	1.1	14.5	0.0	0.0	0.0
A	50.0	460.0	50.0	2.5	31.3	1.1	17.1	0.0	0.0	0.0
B*3	50.0	460.0	50.0	2.5	33.9	1.1	19.4	0.0	0.0	0.0
C	50.0	460.0	50.0	2.5	38.7	1.1	24.2	0.0	0.0	0.0
D	75.0	460.0	50.0	2.5	33.9	1.1	19.4	0.0	0.0	0.0
E	90.0	460.0	60.0	3.0	33.9	1.3	19.4	0.0	0.0	0.0
US (V/f) F & FF	60.0	460.0	60.0	3.0	27.6	1.3	13.8	0.0	0.0	0.0
Euro (V/f) F & FF	50.0	400.0	50.0	2.5	24.0	1.3	12.0	0.0	0.0	0.0
US (OLV) F & FF	60.0	460.0	60.0	3.0	25.4	0.5	4.6	0.0	0.0	0.0
Euro (OLV) F & FF	50.0	400.0	50.0	2.5	26.4	0.5	4.8	0.0	0.0	0.0

** Default for O02-09 = 1 (US) and Traverse*

**1 Default for O02-09 = 1 (US) and Std Hoist*

**2 Default for O02-09 = 2 (Euro) and Traverse*

**3 Default for O02-09 = 2 (Euro) and Std Hoist*

**4 Default for E01-05 is 400.0 when O02-09 = 2 (Euro)*

5.4.2 Motor 1 Parameters

The Motor Setup parameters define the motor characteristics. Normally, the default settings for E02 parameters are determined by kVA selection (O02-04). In closed loop vector and open loop vector, the E02 parameters will be set automatically during auto-tuning. At minimum, the motor rated current should be entered into E02-01.

If rotational auto-tuning cannot be performed, E02-02 and E02-05 can be calculated using the motor's nameplate information or by performing non-rotational auto-tuning.

Motor rated slip frequency (E02-02) can be calculated by using the following equation:

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

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

Motor terminal resistance E02-05 can be calculated by using the following equation:

$$r_t = r_p * \frac{273 + \left[\frac{(25°C + T_i)}{2}\right]}{273 + T_i}$$

Where... r_t: motor terminal resistance
r_p: Phase-to-Phase resistance at insulation class temperature
T_i: insulation class temperature (°C)

Table 5-67: Motor 1 Parameter Settings

Parameter	Display	Function	Range	Default
E02-01	Motor Rated Current (FLA)	Motor-rated current	*	*
E02-02**	Motor Rated Slip	Motor-rated slip frequency	0.000–20.000 Hz	*
E02-03**	Motor No-Load Current	Motor no-load current	0.00–(E02-01–0.01) A	*
E02-04	Motor Pole Count	Number of motor poles	2–48	4
E02-05**	Motor Line-to-Line Resistance	Line-to-line resistance of motor stator windings	0.000–65.000 Ω	*
E02-06**	Motor Leakage Inductance	Leakage inductance as a percentage of motor rated voltage.	0.0–60.0%	*
E02-07**	Motor Saturation Coefficient 1	Motor iron-core saturation coefficient at 50% magnetic flux.	0.00–0.50	0.50
E02-08**	Motor Saturation Coefficient 2	Motor iron-core saturation coefficient at 75% magnetic flux.	E02-07–0.75	0.75
E02-09**	Motor Mechanical Loss	Motor mechanical loss as a percentage of motor rated power (E02-11).	0.0–10.0%	0.0
E02-10**	Motor Iron Loss	Motor iron loss.	0–65535 W	*
E02-11	Motor Rated Power	Motor-rated power output	0.00–650.00 HP/kW	*

* *Initial value is determined by O02-04 (kVA Selection) and D10-01.*

** *This value is automatically set during auto tuning.*

5.4.3 Voltage/Frequency (V/f) Pattern for Motor 2

The Motor 2 function allows for a secondary motor to be enabled and controlled by the VFD. This motor may serve as a backup to the primary motor, for redundancy.

To enable Motor 2, configure an MFDI to H01-xx = 16 (Motor 2 Selection).

Table 5-68: Motor 2 Parameter Settings

Parameter	Display	Function	Range	Default
E03-01	Motor 2 Control Mode Selection *0 V/f Control* *2 Open Loop Vector*	Control method for Motor 2.	0, 2	2
E03-02	Motor 2 Stopping Method *0 Decel to Stop* *1 Coast to Stop*	Stopping method for Motor 2.	0, 1	1
E03-04	Motor 2 Maximum Output Frequency	Maximum output frequency for Motor 2. This setting is recommended to be the same as E01-04 (Motor 1 Maximum Output Frequency).	20.0–300.0 Hz	60.0
E03-05	Motor 2 Maximum Output Voltage	Maximum output voltage for Motor 2.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on O02-04
E03-06	Motor 2 Base Frequency	Base frequency for Motor 2.	0.0–300.0 Hz	60.0
E03-07	Motor 2 Mid Point A Frequency	Middle output frequency for Motor 2.	0.0–300.0 Hz	Depends on E01-03
E03-08	Motor 2 Mid Point A Voltage	Middle output voltage for Motor 2.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on E01-03
E03-09	Motor 2 Minimum Output Frequency	Minimum output frequency for Motor 2.	0.0–300.0 Hz	Depends on E01-03
E03-10	Motor 2 Minimum Output Voltage	Minimum output voltage for Motor 2.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on E01-03
E03-11	Motor 2 Mid Point B Frequency	Middle output frequency for constant output range of Motor 2. Disabled with a setting of 0.0.	0.0–300.0 Hz	0.0
E03-12	Motor 2 Mid Point B Voltage	Middle output voltage for constant output range of Motor 2. Disabled with a setting of 0.0.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	0.0
E03-13	Motor 2 Base Voltage	Base voltage for constant output range of Motor 2.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	0.0

5.4.4 Motor 2 Parameters

These parameters define the Motor 2 characteristics.

Table 5-69: Motor 2 Parameter Settings

Parameter	Display	Function	Range	Default
E04-01	Motor 2 Rated Current	Motor-rated current	*	*
E04-02	Motor 2 Rated Slip	Motor-rated slip frequency	0.000–20.000 Hz	*
E04-03	Motor 2 No-Load Current	Motor no-load current	0.00–(E04-01–0.01) A	*
E04-04	Motor 2 Motor Poles	Number of motor poles	2–48	4
E04-05	Motor 2 Line-to-Line Resistance	Line-to-line resistance of motor stator windings	0.000–65.000 Ω	*
E04-06	Motor 2 Leakage Inductance	Leakage inductance as a percentage of motor rated voltage.	0.0–60.0%	*
E04-07	Motor 2 Saturation Coefficient 1	Motor iron-core saturation coefficient at 50% magnetic flux.	0.00–0.50	0.50
E04-08	Motor 2 Saturation Coefficient 2	Motor iron-core saturation coefficient at 75% magnetic flux.	E04-07–0.75	0.75
E04-09	Motor 2 Mechanical Loss	Motor mechanical loss as a percentage of motor rated power (E02-11).	0.0–10.0%	0.0
E04-10	Motor 2 Iron Loss	Motor iron loss.	0–65535 W	*
E04-11	Motor 2 Rated Power	Motor-rated power output	0.00–650.00 HP/kW	*

** Initial value is determined by O02-04 (kVA Selection) and D10-01.*

5.4.5 Test Mode

DANGER

Test Mode is designed to allow for temporary hoisting operations of motors normally equipped with an encoder in Closed Loop Vector control. Always follow the instructions listed below, and use extreme caution when operating a hoist in Test Mode. Stop the hoist if any undesired motion occurs and contact Magnetek for additional assistance.

Test Mode is a troubleshooting aid intended for troubleshooting Closed Loop Vector problems. The feature cannot be left on indefinitely and will generate a fault after being on for 10 minutes. At this time, the fault must be reset or power must be cycled.

When enabled, the Control Method in A01-02 is temporarily overridden to the setting of E03-01. All other functions for the new control method are not restricted. Certain programming may need to be done to clear any OPE conditions that occur as a result of the new Control Method. It is up to the user to determine if a special function may cause an unsafe condition during testing. Since this feature is typically used for No Load Brake type hoists, many of the inherent safety checks will become disabled. It may be desirable to disable functions such as Ultra-Lift, but leave Limit Switch functions enabled. The user will determine what functions are being used. If unsure, it is best to disable the function (either by programming or MFDI in OFF state).

Table 5-70: Test Mode Parameter Settings

Parameter	Display	Function	Range	Default
E07-00	Test Mode *0 Disabled* *1 Enabled*	Test Mode Enable. Starts a 10 minute timer after which the VFD will not function until Test Mode is disabled. If power is cycled, Test Mode will become disabled.	0, 1	0
E07-01	Test Mode Control Mode Selection *0 V/f Control* *2 Open Loop Vector Control*	Control method for Test Mode.	0, 2	2
E07-02	Test Mode Stopping Method *0 Decel to Stop* *1 Coast to Stop*	Stopping method for Test Mode.	0, 1	1
E07-04	Test Mode Max Output Frequency	Maximum output frequency for Test Mode.	20.0–300.0 Hz	60.0
E07-05	Test Mode Max Output Voltage	Maximum output voltage for Test Mode.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on O02-04
E07-06	Test Mode Base Frequency	Base frequency for Test Mode.	0.0–300.0 Hz	60.0
E07-07	Test Mode Mid Point A Frequency	Middle output frequency for Test Mode.	0.0–300.0 Hz	Depends on E01-03
E07-08	Test Mode Mid Point A Voltage	Middle output voltage for Test Mode.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on E01-03
E07-09	Test Mode Min Output Frequency	Minimum output frequency for Test Mode.	0.0–300.0 Hz	Depends on E01-03
E07-10	Test Mode Min Output Voltage	Minimum output voltage for Test Mode.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	Depends on E01-03
E07-11	Test Mode Mid Point B Frequency	Middle output frequency for constant output range of Test Mode. Disabled with a setting of 0.0.	0.0–300.0 Hz	0.0
E07-12	Test Mode Mid Point B Voltage	Middle output voltage for constant output range of Test Mode. Disabled with a setting of 0.0.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	0.0
E07-13	Test Mode Base Voltage	Base voltage for constant output range of Test Mode.	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	0.0

5.5 Option Card Parameters

- F01 Encoder Feedback (PG-X3) Option Card Setup
- F04 Analog Output (AO-A3) Option Card Setup
- F05 Digital Output (DO-A3 or S4IO) Option Card Setup
- F06 Communication Option Card Settings and Profibus-DP (SI-P3) Option Card Setup
- F07 Ethernet/IP (SI-EN3), ProfiNET (SI-EP3), and Modbus TCP/IP (SI-EM3) Option Card Setup

5.5.1 Encoder Feedback (PG-X3) Option Card Setup

Table 5-71: PG-X3 Parameter Settings (VG+ Only)

Parameter	Display	Function	Range	Default
F01-01	Encoder 1 Pulse Count (PPR)	PPR for the encoder connected to the PG-X3 card seated in port CN5-C.	1–60000 ppr	1024
F01-02	Encoder 1 Rotation Selection *0 Pulse A Leads in FWD Direction* *1 Pulse B Leads in FWD Direction*	Changing this parameter has the same effect as swapping A+ and A- encoder wires.	0, 1	0
F01-03	Encoder 1 Pulse Monitor Scaling	Division ratio for the pulse monitor. $f_{Pulse\ Input} = f_{Pulse\ Output} * \frac{(1+n)}{m}$ Example: For a ratio of 1/32 between the PG card pulse input and output, set F01-03 = 032 (where n = 0 and m = 32).	1–132	1
F01-06	Encoder 1 PCB Disconnect Detect	Delay time for PGO-1-H detection. A setting of 0 disables PGO-1-H detection.	0–200 ms	15
F01-11	Encoder 2 Pulse Count (PPR)	PPR for the encoder connected to the PG-X3 card seated in port CN5-B.	1–60000 ppr	1024
F01-12	Encoder 2 Rotation Selection *0 Pulse A Leads in FWD Direction* *1 Pulse B Leads in FWD Direction*	Changing this parameter has the same effect as swapping A+ and A- encoder wires.	0, 1	0
F01-15	Encoder 2 Pulse Monitor Scaling	Division ratio for the pulse monitor.	1–132	1
F01-16	Encoder 2 PCB Disconnect Detect	Delay time for PGO-2-H detection. A setting of 0 disables PGO-2-H detection.	0–200 ms	15
F01-21	Encoder Signal Loss Detect Sel *0 Decel to Stop* *1 Coast to Stop* *2 Fast Stop* *3 Alarm Only* *3 No Alarm Display*	PGO-1-S or PGO-2-S fault stopping method. Decelerate to stop using the decel time in b05-02. Decelerate to stop using the decel time in b05-08.	Traverse: 0–4 NLB: 1	1

Parameter	Display	Function	Range	Default
F01-22	Encoder Open-Circuit Detect Time	PGO-1-S disconnection detection time. A setting of zero disables PGO-1-S detection.	0.0–10.0 sec	2.0
F01-23	Overspeed Detection Selection	Overspeed (OS) fault stopping method.	Traverse: 0–3 NLB: 1	1
	0 Decel to Stop	Decelerate to stop using the decel time in b05-02.		
	1 Coast to Stop			
	2 Fast Stop	Decelerate to stop using the decel time in b05-08.		
	3 Alarm Only			
F01-24	Overspeed Detection Level	Overspeed detection level as a percentage of the maximum output frequency.	0–120%	105
F01-25	Overspeed Detection Delay Time	Time for an overspeed event to trigger a fault (oS).	0.0–2.0 sec	0.0
F01-26	Speed Deviation Detection Select	Stopping method at excessive speed deviation.	Traverse: 0–7 NLB: 5	5
	0 @SpdAgree-Decel	Stops by deceleration time 1 - b05-02.		
	1 @SpdAgree-Coast	Coast to stop.		
	2 @SpdAgree-F-Stop	Decelerates by Fast-Stop b05-08.		
	3 @Spd Agree-Alm	DEV displayed, operation continues.		
	4 @Run-Decel	Stops by deceleration time 1 - b05-02.		
	5 @Run-Coast	Coast to stop.		
	6 @Run-Fast Stop	Decelerates by Fast-Stop b05-08.		
	7 @Run-Alarm Only	DEV displayed, operation continues		
F01-27	Speed Deviation Detection Level	Speed deviation detection level as a percentage of the maximum output frequency.	0–50%	10
F01-28	Speed Deviation Detect Delay Time	Time for a speed deviation event to trigger a DEV fault.	0.0–10.0 sec	0.3

5.5.2 Digital Input (DI-A3 or S4IO) Option Card Setup

Selects the digital input functions for the DI-A3 or S4IO option cards.

Table 5-72: DI-A3/S4IO Parameter Settings

Parameter	Display	Function	Range	Default
F03-01	Digital Input Option	Provides additional programmable MFDI	0–2, 5	0
	0 Disabled	No additional MFDI are enabled.		
	1 S4IO Allowed	S4IO card is installed		
	2 All Inputs Allowed	DI-A3 card is installed		

Parameter	Display	Terminal Designation		Range	Default
		DI-A3	S4IO		
F03-02*	Digital Input 1 Function	D0	I1	0–19F	F
F03-03*	Digital Input 2 Function	D1	I2	0–19F	F
F03-04*	Digital Input 3 Function	D2	I3	0–19F	F
F03-05*	Digital Input 4 Function	D3	I4	0–19F	F
F03-06*	Digital Input 5 Function	D4	-	0–19F	F
F03-07*	Digital Input 6 Function	D5	-	0–19F	F
F03-08*	Digital Input 7 Function	D6	-	0–19F	F
F03-09*	Digital Input 8 Function	D7	-	0–19F	F
F03-10*	Digital Input 9 Function	D8	-	0–19F	F
F03-11*	Digital Input 10 Function	D9	-	0–19F	F
F03-12*	Digital Input 11 Function	DA	-	0–19F	F
F03-13*	Digital Input 12 Function	DB	-	0–19F	F
F03-14*	Digital Input 13 Function	DC	-	0–19F	F
F03-15*	Digital Input 14 Function	DD	-	0–19F	F
F03-16*	Digital Input 15 Function	DE	-	0–19F	F
F03-17*	Digital Input 16 Function	DF	-	0–19F	F

* ***See Table 5-79 on page 169*** *for MFDI selections. Run commands, FWD (80) or REV (81), are not allowed.*

5.5.3 Analog Output (AO-A3) Option Card Setup

Selects the analog output functions for the AO-A3 option card.

Table 5-73: AO-A3 Parameter Settings

Parameter	Display	Function	Range	Default
F04-01	Terminal V1 Function Selection	Terminal V1 function	1–631	102
F04-02	Terminal V1 Gain	Terminal V1 gain	-999.9–999.9%	100.0
F04-03	Terminal V2 Function Selection	Terminal V2 function	1–631	103
F04-04	Terminal V2 Gain	Terminal V1 gain	-999.9–999.9%	50.0
F04-05	Terminal V1 Bias	Terminal V1 bias	-999.9–999.9%	0.0
F04-06	Terminal V2 Bias	Terminal V2 bias	-999.9–999.9%	0.0
F04-07	Terminal V1 Signal Level *0 0 to 10 V* *1 -10 to 10 V*	Terminal V1 output signal	0, 1	0
F04-08	Terminal V2 Signal Level *0 0 to 10 V* *1 -10 to 10 V*	Terminal V2 output signal	0, 1	0

* ***See Table 5-85 on page 177*** *for MFAO selections.*

5.5.4 Digital Output (DO-A3 or S4IO) Option Card Setup

Selects the digital output functions for the DO-A3 and S4IO option cards.

Table 5-74: DO-A3/S4IO Parameter Settings

Parameter	Display	Terminal Designation		Range	Default
		DO-A3	S4IO		
F05-01*	Digital Output 1 Function	P1-PC	O1-O2	0–169	F
F05-02*	Digital Output 2 Function	P2-PC	O3-O2	0–169	F
F05-03*	Digital Output 3 Function	P3-PC	O4-O5	0–169	F
F05-04*	Digital Output 4 Function	P4-PC	O6-O5	0–169	F
F05-05*	Digital Output 5 Function	P5-PC	-	0–169	F
F05-06*	Digital Output 6 Function	P6-PC	-	0–169	F
F05-07*	Digital Output 7 Function	M1-M2	-	0–169	F
F05-08*	Digital Output 8 Function	M3-M4	-	0–169	F

* ***See Table 5-85 on page 177*** *for MFDO selections.*

5.5.5 Communication Option Card Settings

These parameters are used to set the basic communication settings and method of fault detection for the communication option cards.

Table 5-75: Communication Option Card Settings Parameter Settings

Parameter	Display	Function	Range	Default
F06-01	Communication Error Selection *0 Decel to Stop* *1 Coast to Stop* *2 Fast Stop (Use b05-08)* *3 Alarm Only* *4 Alarm (Run at b01-17)* *5 Decel to Stop, Alarm*	Action or stopping method when an Open Card Communication Error (bUS) is detected.	0–5	1
F06-02	Comm External Fault (EF0) Detect *0 Always Detected* *1 Detected During Run Only*	Condition at which an Option Card External Fault (EF0) is detected.	0, 1	0
F06-03	Comm External Fault (EF0) Select *0 Decel to Stop* *1 Coast to Stop* *2 Fast Stop (Use b05-08)* *3 Alarm Only*	Action or stopping method when an Option Card External Fault (EF0) is detected.	0–3	1
F06-04	bUS Error Detection Time	Time required to detect an Option Card Communications Error (bUS) when communications stop. A setting of 0.0 will disable bUS detection, which is highly discouraged. Consult factory for assistance.	0.0–5.0 sec	2.0
F06-06	Torque Reference/Limit by Comm *0 Disabled* *1 Enabled*	Torque Reference Limit Selection (CLV only)	0, 1	0
F06-07	Multi-Step Ref @ NetRef/ ComRef *0 Disable Multi-Step References* *1 Enable Multi-Step References*	Selects how multi-step speed inputs are treated when the NetRef command is set. Multi-step reference disabled Multi-step reference enabled	0, 1	0
F06-08	Comm Parameter Reset @Initialize *0 No Reset - Parameters Retained* *1 Reset Back to Factory Default*	Determines whether communication-related parameters (F06-xx and F07-xx) are reset when the VFD is initialized using A01-05. Communication-related parameters (F06-xx and F07-xx) are not reset when the VFD is initialized using A01-05. Reset all communication-related parameters (F06-xx and F07-xx) when the VFD is initialized using A01-05.	0, 1	0

Parameter	Display	Function	Range	Default
F06-14	BUS Error Auto Reset *0 Disabled* *1 Enabled*	Automatic reset function for bUS error.	0, 1	0
F06-15	Comm. Option Parameters Reload *0 Reload at Next Power Cycle* *1 Reload Now* *2 Cancel Reload Request*	Update method when an F06-xx or F07-xx parameter is changed.	0–2	0

5.5.6 Profibus-DP (SI-P3) Option Card Setup

Settings for the Profibus-DP communication option card SI-P3.

Table 5-76: SI-P3 Parameter Settings

Parameter	Display	Function	Range	Default
F06-30	PROFIBUS-DP Node Address	Node address	0–125	0
F06-31	PROFIBUS-DP Clear Mode Selection	Determines the operation when a “Clear Mode” command is received.	0, 1	0
	0 Reset	Resets VFD operation with a Clear mode command.		
	1 Hold Previous State	Maintains the previous operation state when Clear mode command is given.		
F06-32	PROFIBUS-DP Data Format Select	Data format used for Profibus-DP comms	0–5	0
	0 PPO Type			
	1 Conventional			
	2 PPO (bit0)			
	3 PPO (Enter)			
	4 Conventional (Enter)			
	5 PPO (bit0, Enter)			

5.5.7 Ethernet/IP (SI-EN3), ProfiNET (SI-EP3), and Modbus TCP/IP (SI-EM3) Option Card Setup

Settings for Ethernet/IP (SI-EN3), ProfiNET (SI-EP3), and Modbus TCP/IP (SI-EM3) option cards.

Table 5-77: SI-EN3/SI-EP3/SI-EM3 Parameter Settings

Parameter	Display	Function	Range	Default
F07-01	IP Address 1	IP Address 1	0–255	192
F07-02	IP Address 2	IP Address 2	0–255	168
F07-03	IP Address 3	IP Address 3	0–255	1
F07-04	IP Address 4	IP Address 4	0–255	20
F07-05	Subnet Mask 1	Subnet Mask 1	0–255	255
F07-06	Subnet Mask 2	Subnet Mask 2	0–255	255
F07-07	Subnet Mask 3	Subnet Mask 3	0–255	255
F07-08	Subnet Mask 4	Subnet Mask 4	0–255	0
F07-09	Gateway Address 1	Gateway Address 1	0–255	192
F07-10	Gateway Address 2	Gateway Address 2	0–255	168
F07-11	Gateway Address 3	Gateway Address 3	0–255	1
F07-12	Gateway Address 4	Gateway Address 4	0–255	1
F07-13	Address Mode at Startup *0 Static* *1 BOOTP* *2 DHCP*	How the IP Address is set at start up	0–2	2
F07-14	Duplex Mode Selection *0 Half/Half* *1 Auto/Auto* *2 Full/Full* *3 Half/Auto* *4 Half/Full* *5 Auto/Half* *6 Auto/Full* *7 Full/Half* *8 Full/Auto*	How the communication between host/client will be determined	0–8	1
F07-15	Communication Speed Selection *10 10/10 Mbps* *100 100/100 Mbps* *101 10/100 Mbps* *102 100/10 Mbps*	Communication speed	10, 100–102	10
F07-16	Timeout Value	Time-out value for comm loss detection	0.0–30.0 sec	0
F07-17	EtherNet/IP Speed Scaling Factor	Scaling factor for EtherNet/IP speed monitor	-15–15	0
F07-18	EtherNet/IP Current Scale Factor	Scaling factor for EtherNet/IP output current monitor	-15–15	0

Parameter	Display	Function	Range	Default
F07-19	EtherNet/IP Torque Scale Factor	Scaling factor for EtherNet/IP torque monitor	-15–15	0
F07-20	EtherNet/IP Power Scaling Factor	Scaling factor for EtherNet/IP power monitor	-15–15	0
F07-21	EtherNet/IP Voltage Scale Factor	Scaling factor for EtherNet/IP voltage monitor	-15–15	0
F07-22	EtherNet/IP Time Scaling	Scaling factor for EtherNet/IP time monitor	-15–15	0
F07-23 to F07-32*	DOA116 (1 to 10)	Dynamic parameters that contain the Modbus addresses used for programmable registers in the output assembly 116. Data residing in bites 20 to 39 of assembly 116 will be written to the respective Modbus registers identified by the addresses contained in these parameters. No data is written to the Modbus registers if the parameter setting is 0.	Modbus Address 0x- - - -	0
F07-33 to F07-42*	DIA166 (1 to 10)	Dynamic parameters that contain the Modbus addresses used for programmable registers in the input assembly 166. Data residing in the Modbus registers will be written to the respective assembly 166 bytes 20 to 39. The Modbus registers are identified by the addresses contained in these parameters. No data is written to the programmable registers if the parameter setting is 0.	Modbus Address 0x- - - -	0
F07-60	PZD1 Write (Control Word)	For Profibus, this sets the Modbus address for PZD1 (PPO output). PZD1 (PPO output) functions as the STW when F07-60 = 0 to 2.	Modbus Address 0x- - - -	0
F07-61	PZD2 Write (Frequency Reference)	For Profibus, this sets the Modbus address for PZD2 (PPO output). PZD2 (PPO output) functions as the HSW when F07-61 = 0 to 2.	Modbus Address 0x- - - -	0
F07-62 to F07-69	PZD3 to 10 Write	For Profibus, this sets the Modbus address for PZD3 to 10 (PPO output). A setting of 0, 1, or 2 will disable the PZD3 to 10 (PPO output) write operation to the Modbus register.	Modbus Address 0x- - - -	0
F07-70	PZD1 Read (Control Word)	For Profibus, this sets the Modbus address for PZD1 (PPO input). PZD1 (PPO input) functions as the ZSW when F07-70 = 0.	Modbus Address 0x- - - -	0
F07-71	PZD2 Read (Output Frequency)	For Profibus, this sets the Modbus address for PZD2 (PPO input). PZD2 (PPO input) functions as the HIW when F07-71 = 0.	Modbus Address 0x- - - -	0
F07-71 to F07-79	PZD3 to 10 Read	For Profibus, this sets the Modbus address for PZD3 to 10 (PPO input). A setting of 0 will disable the PZD3 to 10 (PPO input) read operation from the Modbus register.	Modbus Address 0x- - - -	0

** The SI-EP3 ProfiNET option card is limited to F07-23 to F07-27 (DOA116 1 to 5) and F07-33 to F07-37 (DIA166 1 to 5).*

5.6 Control I/O Parameters

- H01 Digital Inputs
- H02 Digital Outputs
- H03 Analog Inputs
- H04 Analog Outputs
- H05 Modbus Communication
- H06 Pulse Train Input/Output
- H07 Virtual Inputs/Outputs

5.6.1 Digital Inputs

The VFD has eight multi-function digital inputs for numerous functions. The following table lists the function selections for Terminals S1 to S8. An OPE03 error will occur if a function is programmed to more than one terminal at the same time.

Table 5-78: Digital Inputs Parameter Settings

Parameter	Display	Function	Range	Default
H01-01	Terminal S1 Function Selection	***See Table 5-79 on page 169***.	0–81	80 (FWD)
H01-02	Terminal S2 Function Selection	***See Table 5-79 on page 169***.	0–81	81 (REV)
H01-03	Terminal S3 Function Selection	***See Table 5-79 on page 169***.	0–81	*
H01-04	Terminal S4 Function Selection	***See Table 5-79 on page 169***.	0–81	*
H01-05	Terminal S5 Function Selection	***See Table 5-79 on page 169***.	0–81	*
H01-06	Terminal S6 Function Selection	***See Table 5-79 on page 169***.	0–81	*
H01-07	Terminal S7 Function Selection	***See Table 5-79 on page 169***.	0–81	*
H01-08	Terminal S8 Function Selection	***See Table 5-79 on page 169***.	0–81	*

** Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

Table 5-79: Multi-Function Digital Input (MFDI) Selections for H01-0x and F03-0x

NOTE: *Some settings have a normally open (N.O.) and normally closed (N.C.) option. The normally open option will be a setting below 100. The normally closed option is 100 above that.*

Setting	Display	Function
0	Multi-Step Speed Reference 2	**ON:** Multi-Step Speed Reference 2 enabled
1	Multi-Step Speed Reference 3	**ON:** Multi-Step Speed Reference 3 enabled
2	Multi-Step Speed Reference 4	**ON:** Multi-Step Speed Reference 4 enabled
3	Multi-Step Speed Reference 5	**ON:** Multi-Step Speed Reference 5 enabled
4	Infinitely Variable Hold	**ON:** Hold current speed 2nd Step of 3-Step Infinitely Variable
5	Infinitely Variable Accelerate	**ON:** Accelerate 2nd Step of 2-Step Infinitely Variable or 3rd Step of 3-Step Infinitely Variable
6	Upper Limit 1 (N.O.)*	**ON:** Upper Limit 1 slow down limit reached. Keypad blinks UL1 alarm.
7	Upper Limit 2 (N.O.)*	**ON:** Upper Limit 2 stop limit reached. Keypad blinks UL2 alarm.
8	Lower Limit 1 (N.O.)*	**ON:** Lower Limit 1 slow down limit reached. Keypad blinks LL1 alarm.
9	Lower Limit 2 (N.O.)*	**ON:** Lower Limit 2 stop limit reached. Keypad blinks LL2 alarm.
E	Micro-Speed Gain 1	**ON:** Micro-Speed Gain 1 (C02-01) enabled. Takes priority over Micro-Speed Gain 2.
F	Not Used	Digital input is disabled.
10	Micro-Speed Gain 2	**ON:** Micro-Speed Gain 2 (C02-02) enabled
11	Lower Limit Fault LL3 (N.O.)*	**ON:** Lower Limit 3 stop limit reached. Keypad displays LL3 fault. Uses C03-10 stopping method and requires fault reset.
12	Weighted Limit Fault UL3 (N.O.)*	**ON:** Weighted Upper Limit 3 stop limit reached. Keypad displays UL3 fault. Uses C03-10 stopping method and requires fault reset.
13	Ultra-Lift Enable	**ON:** Ultra-Lift enabled This input is used when C06-01 = 2 or 4. Not available for Traverse motions.
14	Alternate Torque Limit Gain	**ON:** Torque Limit Gains (C07-05 to C07-07) added to C07-01 to C07-04. Typically used when load testing a hoist to lift an overload.
15	Forward Jog	**ON:** Forward Jog at b01-17 speed reference
16	Reverse Jog	**ON:** Reverse Jog at b01-17 speed reference
17	Forward Inch	**ON:** Forward Inch at b01-17 speed reference for duration C13-01 (Inch Run Time)
18	Reverse Inch	**ON:** Reverse Inch at b01-17 speed reference for duration C13-01 (Inch Run Time)
19	Inch Repeat	**ON:** Repeat the Forward/Reverse Inch after C13-02 (Inch Repeat Delay Time)
1A	Accel/Decel Time Selection 2	**ON:** Use Acceleration/Deceleration Time 2 (b05-03 and b05-04)
1B	Accel/Decel Time Selection 3	**ON:** Use Acceleration/Deceleration Time 3 (b05-12 and b05-13)
1C	Accel/Decel Time Selection 4	**ON:** Use Acceleration/Deceleration Time 4 (b05-14 and b05-15)
1F	Run/Reference Selection 2	**ON:** Frequency Reference 2 (b03-15) and Run Reference 2 (b03-16) enabled **OFF:** Frequency Reference 1 (b03-01) and Run Reference 1 (b03-02) enabled
20 – 2F	External Fault	External Fault selection (***See Table 5-80 on page 173***)
30	Programming Lockout	**OFF:** Parameter changes are prohibited
32	Baseblock Command (N.O.)	**ON:** External Baseblock signal. Keypad blinks BB alarm.
34	Load Float Extend for C08-15	**ON:** Load Float extended by C08-15 (Load Float Extension Time)
35	Load Float Hold	**ON:** Load Float initiated Requires a run command or that the VFD is already running.

Setting	Display	Function
36	Load Float Run for C04-01	**ON:** Load Float initiated for time duration C04-01 (Load Float Run Time) Requires a run command or that the VFD is already running.
37	ASR Gain Select	**ON:** Uses ASR Proportional Gain 2 (d04-03) **OFF:** Uses ASR Proportional Gain 1 (d04-01)
38	Accel/Decel Ramp Hold	**ON:** Acceleration/deceleration is stopped, and frequency is held.
3A	Jog Reference Selection	**ON:** Frequency reference is changed to b01-17 (Jog Reference)
3C	ASR Integral Reset	**ON:** Resets the ASR Integral value and use Proportional control.
3F	Fault Reset	**ON:** Resets all active faults
40	Fast Stop (N.O.)	**ON:** Deceleration time is set to b05-08 (Fast Stop Time)
42	Snap Shaft Disable	**ON:** Snap Shaft Detection is disabled
43	Timer Function	**ON:** Timer Function started Used with C12-03 and C12-04 delay times and H02-xx = 12 (Timer Output).
44	Motor 2 Selection	**ON:** Motor 2 selected **OFF:** Motor 1 selected
48	Fault Latch Reset	**ON:** Clears a latched fault when this input is toggled ON and then OFF.
4A	Emergency Lift Enable	**ON:** Emergency Lift enabled to allow hoist to operate during an encoder failure.
4B	Anti-Shock OFF	**ON:** Anti-Shock is disabled
4C	DC Injection Braking Command	**ON:** DC Injection Braking output (d01-01) enabled A run command will override DC Injection Braking.
53	Communications Test Mode	**ON:** Begin a loopback self-test of Modbus RS-485 communications A jumper wire between this input and terminal SN is required.
55	Drive Enable	**ON:** VFD is ready to run. **OFF:** VFD is disabled and run commands ignored. Keypad displays dnE alarm.
56	Klixon (N.O.)	**ON:** Klixon input indicating an overheated motor. Stopping method selected with L01-06 (Klixon Action). Keypad displays KLX alarm.
58	Brake 1 Answerback	**ON:** Brake answerback feedback received. Used with BE0, BE4, BE5, and BE7 conditions (C08-04 and C08-11).
59	Alternate Freq Ref Upper Limit	**ON:** Frequency reference upper limit set to b02-04 (Alternate Frequency Upper Limit)
5B	Brake Error Up Speed Limit	**ON:** Frequency reference upper limit set to C08-18 (BE6/BE8 Max Forward Speed)
5F	Phantom Stop (N.O.)	**ON:** Phantom Stop input stops motion via C03-10. RUN LED on keypad blinks.
60	Index Enable	**ON:** Index function enabled and uses C13-03 (Index Frequency Reference) A run command is required to initiate the Index.
61	Brake Test	**ON:** Brake Test initiated. PG faults disabled and brake stays closed during the test. Motor pushes against the brake up to C08-24 (Brake Test Torque).
62	Bypass Stop Travel Limits	**ON:** Bypass Upper/Lower Limit 2 (UL2 and LL2) MFDI and EPLS travel limits.
63	Bypass EPLS	**ON:** Bypass all EPLS travel limits (including LL3/UL3).
64	Slack Cable Enable	**ON:** Slack Cable Detection is enabled.
65	Dwell Enable	**ON:** Dwell function enabled.
67	Hook Height Home (N.O.)	**ON:** Hook Height (U01-50) set to C03-29 (Motor Revolutions at Home Position). Used with C03-15 (Hook Height Home Position).
68	Load Share Enable	**ON:** Torque Control / Load Share enabled

Setting	Display	Function
69	Load Share Follower Ready	**ON:** Load Share follower ready signal received. Loss of this signal while running will result in an FNR fault.
6A	Load Check Bypass	**ON:** Disables Load Check and clears any LC faults
6B	Brake 2 Answerback	**ON:** Brake answerback feedback received from Brake 2. Used with C08-33 (Dual Brake Test) and MFDO = A (Brake 2 Output)
6C	Add Offset Frequency 1	**ON:** Add B08-05 (Offset Frequency 1) to the frequency reference.
6D	Add Offset Frequency 2	**ON:** Add B08-06 (Offset Frequency 2) to the frequency reference.
6E	Add Offset Frequency 3	**ON:** Add B08-07 (Offset Frequency 3) to the frequency reference.
72	External Anti-Shock	**ON:** Anti-Shock Fault from another VFD.
75	Sway Control Main Hoist	**ON:** Sway Control enabled with Main Hook Height Used when C14-01 = 2 (Enabled by MFDI) and the motor is stopped. Enabling or disabling this input is not recommended while the motor is running. Hook height determined by H03-xx = 20 (Main Hook Height) analog input.
76	Sway Control Aux Hoist	**ON:** Sway Control enabled with Aux Hook Height Used when C14-01 = 2 (Enabled by MFDI) and the motor is stopped. Enabling or disabling this input is not recommended while the motor is running. Hook height determined by H03-xx = 21 (Aux Hook Height) analog input.
77	Center of Gravity Offset (Bit 1)	**ON:** Sway Control Center of Gravity Offset binary Bit 1 (least significant bit) enabled
78	Center of Gravity Offset (Bit 2)	**ON:** Sway Control Center of Gravity Offset binary Bit 2 enabled
79	Center of Gravity Offset (Bit 3)	**ON:** Sway Control Center of Gravity Offset binary Bit 3 enabled
7A	Center of Gravity Offset (Bit 4)	**ON:** Sway Control Center of Gravity Offset binary Bit 4 (most significant bit) enabled
7B	Alternate Hook Height Offset	**ON:** Sway Control swing length forced to C14-09 setting. This MFDI is typically used for tandem-lift bridge applications.
7C	Reset Maintenance Run Timer	**ON:** Reset the maintenance run timer (U04-24 and U04-25)
7D	Reset Maintenance On Timer	**ON:** Reset the maintenance on-time timer (U04-27)
7E	Reset Maintenance Brake Counter	**ON:** Reset the maintenance brake cycles counter (U04-31 and U04-32)
80	Run Forward	**ON:** Forward/Up run command
81	Run Reverse	**ON:** Reverse/Down run command
100	Multi-Step Speed Reference 2	**OFF:** Multi-Step Speed Reference 2 enabled
101	Multi-Step Speed Reference 3	**OFF:** Multi-Step Speed Reference 3 enabled
102	Multi-Step Speed Reference 4	**OFF:** Multi-Step Speed Reference 4 enabled
103	Multi-Step Speed Reference 5	**OFF:** Multi-Step Speed Reference 5 enabled
104	Infinitely Variable Hold	**OFF:** Hold current speed 2nd Step of 3-Step Infinitely Variable
105	Infinitely Variable Accelerate	**OFF:** Accelerate 2nd Step of 2-Step Infinitely Variable or 3rd Step of 3-Step Infinitely Variable
106	Upper Limit 1 (N.C.)	**OFF:** Upper Limit 1 slow down limit reached. Keypad blinks UL1 alarm.
107	Upper Limit 2 (N.C.)	**OFF:** Upper Limit 2 stop limit reached. Keypad blinks UL2 alarm.
108	Lower Limit 1 (N.C.)	**OFF:** Lower Limit 1 slow down limit reached. Keypad blinks LL1 alarm.
109	Lower Limit 2 (N.C.)	**OFF:** Lower Limit 2 stop limit reached. Keypad blinks LL2 alarm.
10E	Micro-Speed Gain 1	**OFF:** Micro-Speed Gain 1 (C02-01) enabled. Takes priority over Micro-Speed Gain 2.
110	Micro-Speed Gain 2	**OFF:** Micro-Speed Gain 2 (C02-02) enabled
111	Lower Limit Fault LL3 (N.C.)	**OFF:** Lower Limit 3 stop limit reached. Keypad displays LL3 fault. Uses C03-10 stopping method and requires fault reset.

Setting	Display	Function
112	Weighted Limit Fault UL3 (N.C.)	**OFF:** Weighted Upper Limit 3 stop limit reached. Keypad displays UL3 fault. Uses C03-10 stopping method and requires fault reset.
113	Ultra-Lift Enable	**OFF:** Ultra-Lift enabled This input is used when C06-01 = 2 or 4. Not available for Traverse motions.
114	Alternate Torque Limit Gain	**OFF:** Torque Limit Gains (C07-05 to C07-07) added to C07-01 to C07-04. Typically used when load testing a hoist to lift an overload.
11A	Accel/Decel Time Selection 2	**OFF:** Use Acceleration/Deceleration Time 2 (b05-03 and b05-04)
11B	Accel/Decel Time Selection 3	**OFF:** Use Acceleration/Deceleration Time 3 (b05-12 and b05-13)
11C	Accel/Decel Time Selection 4	**OFF:** Use Acceleration/Deceleration Time 4 (b05-14 and b05-15)
11F	Run/Reference Selection 2	**OFF:** Frequency Reference 2 (b03-15) & Run Reference 2 (b03-16) enabled **ON:** Frequency Reference 1 (b03-01) & Run Reference 1 (b03-02) enabled
130	Programming Lockout	**ON:** Parameter changes are prohibited
132	Baseblock Command (N.C.)	**OFF:** External Baseblock signal. Keypad blinks BB alarm.
134	Load Float Extend for C08-15	**OFF:** Load Float extended by C08-15 (Load Float Extension Time)
137	ASR Gain Select	**OFF:** Uses ASR Proportional Gain 2 (d04-03) **ON:** Uses ASR Proportional Gain 1 (d04-01)
13A	Jog Reference Selection	**OFF:** Frequency reference is changed to b01-17 (Jog Reference)
13C	ASR Integral Reset	**OFF:** Resets the ASR Integral value and use Proportional control.
140	Fast Stop (N.C.)	**OFF:** Deceleration time is set to b05-08 (Fast Stop Time)
143	Timer Function	**OFF:** Timer Function started Used with C12-03 and C12-04 delay times and H02-01 to H02-03 = 12 (Timer Output).
144	Motor 2 Selection	**OFF:** Motor 2 selected **ON:** Motor 1 selected
148	Fault Latch Reset	**OFF:** Clears a latched fault when this input is toggled ON and then OFF.
14B	Anti-Shock OFF	**OFF:** Anti-Shock is disabled
155	Drive Enable	**OFF:** VFD is ready to run. **ON:** VFD is disabled and run commands ignored. Keypad displays dnE alarm.
156	Klixon (N.C.)	**OFF:** Klixon input indicating an overheated motor. Stopping method selected with L01-06 (Klixon Action). Keypad displays KLX alarm.
159	Alternate Freq Ref Upper Limit	**OFF:** Frequency reference upper limit set to b02-04 (Alternate Frequency Upper Limit)
15B	Brake Error Up Speed Limit	**OFF:** Frequency reference upper limit set to C08-18 (BE6/BE8 Max Forward Speed)
15F	Phantom Stop (N.C.)	**OFF:** Phantom Stop stops motion via C03-10. RUN LED on keypad blinks.
164	Slack Cable Enable	**OFF:** Slack Cable Detection is enabled.
167	Hook Height Home (N.C.)	**OFF:** Hook Height (U01-50) set to C03-29 (Motor Revolutions at Home Position). Used with C03-15 (Hook Height Home Position).
16C	Add Offset Frequency 1	**OFF:** Add b08-05 (Offset Frequency 1) to the frequency reference.
16D	Add Offset Frequency 2	**OFF:** Add b08-06 (Offset Frequency 2) to the frequency reference.
16E	Add Offset Frequency 3	**OFF:** Add b08-07 (Offset Frequency 3) to the frequency reference.
175	Sway Control Main Hoist	**OFF:** Sway Control enabled with Main Hook Height Used when C14-01 = 2 (Enabled by MFDI) and the motor is stopped. Enabling or disabling this input is not recommended while the motor is running. Hook height determined by H03-xx = 20 (Main Hook Height) analog input.

Setting	Display	Function
176	Sway Control Aux Hoist	**OFF:** Sway Control enabled with Aux Hook Height Used when C14-01 = 2 (Enabled by MFDI) and the motor is stopped. Enabling or disabling this input is not recommended while the motor is running. Hook height determined by H03-xx = 21 (Aux Hook Height) analog input.
177	Center of Gravity Offset (Bit 1)	**OFF:** Sway Control Center of Gravity Offset binary Bit 1 (least significant bit) enabled
178	Center of Gravity Offset (Bit 2)	**OFF:** Sway Control Center of Gravity Offset binary Bit 2 enabled
179	Center of Gravity Offset (Bit 3)	**OFF:** Sway Control Center of Gravity Offset binary Bit 3 enabled
17A	Center of Gravity Offset (Bit 4)	**OFF:** Sway Control Center of Gravity Offset binary Bit 4 (most significant bit) enabled
17B	Alternate Hook Height Offset	**OFF:** Sway Control swing length forced to C14-09 setting. This MFDI is typically used for tandem-lift bridge applications.

** These inputs are only available for serial Modbus communications.*

5.6.1.1 Digital Inputs—External Fault

It is sometimes desirable to have at least one external fault input to the VFD. The table below shows the possible selections for external faults that can be assigned to a digital input (H01-xx or F03-xx).

Table 5-80: External Fault Selection

Input Type		Detection Method		External Fault Action				MFDI Setting
N.O.(1)	N.C.(1)	Always	During Run	Decel to Stop	Coast to Stop	Fast Stop (b05-08)	Alarm Only	
√		√		√				20
√		√			√			24
√		√				√		28
√		√					√	2C
√			√	√				22
√			√		√			26
√			√			√		2A
√			√				√	2E
	√	√		√				21
	√	√			√			25
	√	√				√		29
	√	√					√	2D
	√		√	√				23
	√		√		√			27
	√		√			√		2B
	√		√				√	2F

(1) N.O. = normally open contact; N.C. = normally closed contact

Table 5-81: F1, F2, and F3 Key Functions

Display	Function	Instruction	Alert/Confirm Message
F Not Used	Function key is disabled	-	-
53 Communications Test Mode	Communication Test Mode - loopback test of Modbus RS-485 interface	Hold down the F key for 2-3 seconds to initiate the Comm Test.	*Running: Comm Test Mode*
61 Brake Test	Motor pushes against brake up to torque setting C08-24 at frequency C08-25. PG faults disabled during the test.	Hold down the F key to initiate the Brake Test.	*Running: Brake Test*
62 Bypass Stop Travel Limits	Bypass LL1/LL2 limits	Hold down the F key to initiate LL2/UL2 Bypass.	*Running: LL2/UL2 Bypass*
63 Bypass EPLS	Bypass LL/UL 1 and 2 limits	Hold down the F key to initiate LL/UL Bypass.	*Running: LL/UL Bypass*
67 Hook Height Home (N.O.)	Used with C03-14 - Height Measurement function.	Press F once to start Hook Height Home. A confirm message will appear, and the same key press is required once more to home the Hook Height.	*Confirm? Hook Height Home*
6A Load Check Bypass	Disables Load Check and clears any LC faults.	Hold down the F key to initiate the LC Bypass.	*Running: LC Bypass N.O.*
7C Reset Maintenance Run Timer	Resets U04-24 and U04-25 maintenance timer.	Press the F Key once to start the timer reset. A confirm message will appear, and the same key press is required once more to reset the timer.	*Confirm? Reset Maintenance Run Timer*
7D Reset Maintenance On Timer	Resets U04-27 maintenance timer.	Press the F Key once to start the timer reset. A confirm message will appear, and the same key press is required once more to reset the timer.	*Confirm? Reset Maintenance On Timer*
7E Reset Maintenance Brake Counter	Resets U04-31 and U04-32 maintenance counter.	Press the F Key once to start the counter reset. A confirm message will appear, and the same key press is required once more to reset the counter.	*Confirm? Reset Maintenance Brake Counter*

5.6.1.2 Digital Inputs—Secondary Functions

The parameters in this section allow the selection of a secondary function for the S1 to S8 digital input terminals. An OPE03 error will occur if a function is programmed to more than one terminal at the same time.

Table 5-82: Digital Inputs Secondary Functions Parameter Settings

Parameter	Display	Function	Range	Default
H01-211	Terminal S1 Function Select 2	Secondary function for Terminal S1.	0–81	F
H01-22*	Terminal S2 Function Select 2	Secondary function for Terminal S2.	0–81	F
H01-23*	Terminal S3 Function Select 2	Secondary function for Terminal S3.	0–81	F
H01-24*	Terminal S4 Function Select 2	Secondary function for Terminal S4.	0–81	F
H01-25*	Terminal S5 Function Select 2	Secondary function for Terminal S5.	0–81	F
H01-26*	Terminal S6 Function Select 2	Secondary function for Terminal S6.	0–81	F
H01-27*	Terminal S7 Function Select 2	Secondary function for Terminal S7.	0–81	F
H01-28*	Terminal S8 Function Select 2	Secondary function for Terminal S8.	0–81	F

1 ***See Table 5-79 on page 169*** *for MFDI selections.*

5.6.1.3 Digital Inputs—Modbus

The parameters in this section configure digital inputs using the serial Modbus protocol. Run commands cannot be programmed to these inputs, and they cannot be used at the same time as the DI-A3 option card.

Table 5-83: Modbus Digital Inputs Parameter Settings

Parameter	Display	Function	Range	Default
H01-40 to H01-55	Mbus Reg 15C0h bit0 to 15 Input Func	Input function for bit 0 to 15 of Modbus register 15C0 (Hex.).	0–7F	F

5.6.2 Digital Outputs

The VFD has three built-in multi-function digital outputs for indicating various conditions. Digital output capabilities can be increased with the installation of an S4IO or DO-A3 option card.

Table 5-84: Digital Outputs Parameter Settings

Parameter	Display	Function	Range	Default
H02-01	Term M1-M2 Function Selection	Digital Output 1 Function (***See Table 5-85 on page 177***.)	0–169	*
H02-02	Term M3-M4 Function Selection	Digital Output 2 Function (***See Table 5-85 on page 177***.)	0–169	*
H02-03	Term M5-M6 Function Selection	Digital Output 3 Function (***See Table 5-85 on page 177***.)	0–169	*
H02-06	Watt Hour Output Unit Selection *0 0.1 kWh units* *1 1 kWh units* *2 10 kWh units* *3 100 kWh units* *4 1000 kWh units*	Watt Hour Output Unit Selection	0–4	0
H02-16	Fault Annunciate 1	Selects the faults to annunciate when an MFDO is set to H02-xx = 40.	0–3FF	1E0
H02-17	Fault Annunciate 2	Selects the faults to annunciate when an MFDO is set to H02-xx = 41.	0–3FF	0
H02-18	Fault Annunciate 3	Selects the faults to annunciate when an MFDO is set to H02-xx = 42.	0–3FF	0
H02-19	Fault Annunciate 4	Selects the faults to annunciate when an MFDO is set to H02-xx = 43.	0–3FF	0

* *Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

Table 5-85: Multi-Function Digital Output (MFDO) Selections for H02-0x and F05-0x

Display	Function
*0 Brake Release**	ON: VFD is commanding the brake to be Open
	OFF: VFD is commanding the brake to be Closed
1 Zero Speed	ON: Motor Speed < d01-01 or E01-09
	OFF: Motor Speed > d01-01 or E01-09
2 Speed Agree 1	ON: Output frequency (U01-02) is within frequency reference (U01-01) ± L04-02
	OFF: Output frequency (U01-02) is not within frequency reference (U01-01) ± L04-02
3 User-Set Speed Agree 1	ON: Output frequency (U01-02) is within L04-01 ± L04-02
	OFF: Output frequency (U01-02) is not within L04-01 ± L04-02
4 Frequency Detection 1	***See Frequency Detection on page 198***.
5 Frequency Detection 2	***See Frequency Detection on page 198***.
6 Drive Ready	ON: VFD is in a run-ready state
	OFF: VFD is not in a run-ready state
7 DC Bus Undervoltage	ON: DC Bus voltage falls below the L02-05 level
	OFF: DC Bus voltage is above L02-05
8 During Baseblock (N.O.)	ON: During Baseblock - No Voltage output
	OFF: VFD is not in a Baseblock state - Voltage Output
*A Brake 2 Release**	ON: VFD is commanding the secondary brake to be Open
	OFF: VFD is commanding the secondary brake to be Closed
B Torque Detection 1 (N.O.)	ON: Output current/torque exceeds L06-02 for longer than the time set in L06-03.
	OFF: Output current/torque does not exceed L06-02 for longer than the time set in L06-03.
*C Anti-Shock**	ON: Anti-Shock is enabled and a torque spike is detected.
	OFF: Normal operation
E Fault	ON: VFD is in a fault condition (excluding CPF00 and CPF01)
	OFF: Normal operation
*F Not Used**	No Function
10 Alarm	ON: VFD is in an alarm condition
	OFF: VFD is not in an alarm condition
11 Fault Reset Command Active	ON: Reset command is present
	OFF: Normal operation
12 Timer Output	ON: H01-xx or F03-xx = 43 is ON for longer than C12-03 time
	OFF: H01-xx or F03-xx = 43 is OFF
13 Speed Agree 2	ON: Output frequency (U01-02) is within the frequency reference (U01-01) ± L04-04
	OFF: Output frequency (U01-02) is not within the frequency reference (U01-01) ± L04-04
14 User-Set Speed Agree 2	ON: Output frequency (U01-02) is within L04-03 ± L04-04
	OFF: Output frequency (U01-02) is not within L04-03 ± L04-04
17 Torque Detection 2 (N.O.)	ON: Output current/torque exceeds L06-05 for longer than time L06-06
	OFF: Output current/torque does not exceed L06-05 for longer than time L06-06
19 During Fast Stop	ON: Fast stop is in process.
	OFF: Normal operation

Display	Function
1A Forward Direction	ON: During Forward/Up operation
	OFF: Running in Reverse/Down direction or baseblock
1B During Reverse	ON: During Reverse/Down operation
	OFF: Running in Forward/Up direction or baseblock
1C Ultra-Lift Active	ON: VFD is operating in Ultra-Lift
	OFF: VFD is not operating in Ultra-Lift
1D Braking Transistor Fault	ON: VFD detects a braking resistor or transistor failure. Available if L08-55 = 1.
	OFF: Normal operation
1F During Regeneration	ON: VFD is in a regenerative mode
	OFF: Normal operation
21 Motor Overload Alarm (oL1)	ON: VFD exceeds 90% of the motor overload detection level (oL1)
	OFF: Normal operation
22 Drive Overheat Pre-Alarm (oH)	ON: VFD heatsink temperature ≥ L08-02
	OFF: Normal operation
23 During Torque Limit	ON: Torque (U01-09) is ≥ C07-01–C07-04.
	OFF: Normal operation
*24 Safe Torque OFF**	ON: Terminals H1 and H2 are OFF (safety stop state)
	OFF: Terminal H1 or H2 is OFF (safety circuit fault), or both are ON.
25 During Load Float	ON: VFD is in Load Float
	OFF: VFD is not in Load Float
26 Hook Height SetPoint 1	ON: Conditions of C03-60 and C03-61 met.
	OFF: Normal operation
27 Hook Height SetPoint 2	ON: Conditions of C03-62 and C03-63 met.
	OFF: Normal operation
28 Sway Control Enabled	ON: Sway Control function is enabled
	OFF: Sway Control function is disabled
29 Run Command Input ON	ON: Forward or Reverse command is ON via H01-xx
	OFF: Forward or Reverse command is OFF via on H01-xx
2A During Frequency Output	ON: Run command is active or the VFD is outputting voltage.
	OFF: Run command is off and the VFD is not outputting voltage.
2B EPLS Upper Limit 1	ON: UL1 is detected when using the EPLS function
	OFF: Normal operation
2C EPLS Upper Limit 2	ON: UL2 is detected when using the EPLS function
	OFF: Normal operation
2D EPLS Lower Limit 1	ON: LL1 is detected when using the EPLS function
	OFF: Normal operation
2E EPLS Lower Limit 2	ON: LL2 is detected when using the EPLS function
	OFF: Normal operation
2F EPLS Fault Stop	ON: UL3 or LL3 is detected when using the EPLS function
	OFF: Normal operation

Display	Function
30 Load Check Detected	ON: VFD has detected a Load Check fault OFF: Normal operation
31 Slack Cable Detected	ON: VFD has detected a Slack Cable OFF: Normal operation
32 Snap Shaft Detected	ON: VFD has detected a Snap Shaft OFF: Normal operation
34 Index Complete	ON: Index move is complete OFF: Normal operation or Index move is not complete
*35 Ready for F-Ref**	ON: C08-04 timer has expired or Brake Answerback is detected H01-xx or F03-xx = 58 OFF: Normal operation or VFD detected a BE1, BE2, BE4 alarm or is stopped.
*37 Maintenance Notification**	ON: Maintenance Timer U01-52 ≥ C12-05 OFF: Normal operation or the Maintenance Timer U01-52 < C12-05
*38 In Speed Limit During Trq Ctrl**	ON: Speed Limit has been reached while using Torque Control OFF: Speed Limit has not been reached when using Torque Control
39 Drive Enabled	ON: VFD Enable (H01-xx or F03-xx = 55) input is ON OFF: VFD Enable (H01-xx or F03-xx = 55) input is OFF
*3A Ultra-Lift Ready**	ON: All conditions for Ultra-Lift have been met. OFF: Ultra-Lift not ready.
3F Klixon	ON: Klixon alarm is detected (H01-xx or F03-xx = 56 or 156 input is ON) OFF: Normal operation
40 Fault Annunciate 1	ON: The faults selected via H02-16 are active. OFF: Normal operation
41 Fault Annunciate 2	ON: The faults selected via H02-17 are active. OFF: Normal operation
42 Fault Annunciate 3	ON: The faults selected via H02-18 are active. OFF: Normal operation
43 Fault Annunciate 4	ON: The faults selected via H02-19 are active. OFF: Normal operation
4D OH Pre-Alarm Time Limit	ON: OH pre-alarm time limit has passed. OFF: Normal operation
4E Braking Transistor Fault (rr)	ON: Braking transistor fault (rr) active OFF: Normal operation
4F Braking Resistor Overheat (rH)	ON: Braking resistor overheat (rH) active OFF: Normal operation
60 Internal Cooling Fan Failure	ON: Cooling fan failure is detected OFF: Normal operation
69 External Power 24V Supply	ON: External 24V power active at the PS-AC terminal. OFF: VFD not being supplied with external 24V power.
*102 through 169***	Inverse of settings 2 through 69

** This output does not have an inverse output*

*** Relay will open (turn off) when power is disconnected*

5.6.2.1 Digital Outputs—Alarm/Fault Annunciate (H02-01–03 = 40 through 43)

Fault Annunciate enables you to assign a set of eight fault/alarm outputs to Relay Outputs M1-M2, M3-M4, and M5-M6. M1-M2 is typically assigned to a brake output, but it could instead be used for fault annunciate. This function will also trigger the MA-MB-MC fault relay.

You may find it convenient to print the Fault Annunciate Worksheet in this section. By being able to write in the worksheet's boxes, you will find it easier to program the feature.

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

To program **Fault Annunciate** (from the **Programming Menu**):

1. Navigate to H02-01 (M1-M2), H02-02 (M3-M4), or H02-03 (M5-M6) and press ENTER until the value blinks.
2. Press the UP or DOWN key until H02-xx = 40, 41, 42, or 43 appears. These settings correlate with H02-16 through H02-19 respectively.
3. Press the ENTER key to accept the selection.
4. From the worksheet in ***Table 5-87 on page 181***, select one of three fault output sets (each row is a set).
5. Determine which faults/alarms will trigger the fault output. To enable a fault/alarm, enter 1 in the box; otherwise, enter 0. Do this for each column in the set.
6. Using the Binary to Hexadecimal Conversion chart (***Table 5-88 on page 182***), determine the 1-digit hexadecimal value for each 4-digit binary number.
7. Navigate to H02-16 through H02-19, which correlates with the value that was set in Step 2. Program the hexadecimal value to this parameter.

Example:

Select a Set containing the alarm/fault(s) you want to trigger an output. You can only select from one set. If you want a relay output based on only LL1 and LL2, you would choose Set 1.

1. Set relay M5-M6 to H02-03 = 43 (Fault Annunciate 4).
2. Place a "1" below LL1 and LL2 for Set 1.
3. *Use table 5-93 to convert the left binary value "0 0 1 0" to Hex 2.*
4. *Use table 5-93 to convert the right binary value "1 0 0 0" to Hex 8.*
5. *Enter 128 into H02-19 (Fault Annunciate 4).*

Table 5-86: Fault Annunciate Example

	First digit				Second digit			
	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0
Set 1	LL3	UL3	LL2	UL2	LL1	UL1	LL0	UL0
Binary Number	0	0	1	0	**1**	0	**0**	0

First digit = 1 (corresponds with the fault annunciate set)
Second digit = 2 (hex value for 0 0 1 0)
Second digit = 8 (hex value for 1 0 0 0), so **H02-16 through H02-19 = 128**

Table 5-87: Fault Annunciate Worksheet

	First digit				Second digit			
	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0
Set 1	LL3	UL3	LL2	UL2	LL1	UL1	LL0	UL0
Binary Number	0	1						

	First digit				Second digit			
	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0
Set 2	BE8	BE6	BE5	BE4	BE3	BE2	BE1	ELFT
Binary Number								

	First digit				Second digit			
	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0	1 or 0
Set 3	SLC	SNAP	OS	LF	KLX	LC	DEV	AS1
Binary Number								

Table 5-88: Binary to Hexadecimal Conversion

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

5.6.2.2 Digital Outputs—Modbus

The parameters in this section configure digital outputs using the serial Modbus protocol.

Table 5-89: Modbus Digital Outputs Parameter Settings

Parameter	Display	Function	Range	Default
H02-40 to H02-47	Mbus Reg 15E0h bit0 to 7 Output Func	Output function for bit 0 to 7 of Modbus register 15E0 (Hex.).	0–1A7	F

5.6.2.3 Digital Outputs—Secondary Functions

The parameters in this section allow the selection of a secondary function for the M1-M2, M3-M4, and M5-M6 digital output relays. Additional parameters are available for delay times and logical operation options for the secondary functions.

Table 5-90: Digital Outputs Secondary Functions Parameter Settings

Parameter	Display	Function	Range	Default
H02-601	Term M1-M2 Secondary Function	Secondary function for the M1-M2 relay.	0–1A7	F
H02-61	Terminal M1-M2 Logical Operation *0 A=B=1* *1 A=1 or B=1* *2 A=0 or B=0* *3 A=B=0* *4 A=B* *5 A != B* *6 A=1 and B=0* *7 A=1 or B=0* *8 ON Always*	Secondary function logical operation for the M1-M2 relay in relation to H02-01.	0–8	0
H02-62	Terminal M1-M2 Delay Time	Delay time after applying the H02-61 logical operation results.	0.0–25.0 sec	0.1
H02-63*	Term M3-M4 Secondary Function	Secondary function for the M3-M4 relay.	0–1A7	F
H02-64	Terminal M3-M4 Logical Operation *0 A=B=1* *1 A=1 or B=1* *2 A=0 or B=0* *3 A=B=0* *4 A=B* *5 A != B* *6 A=1 and B=0* *7 A=1 or B=0* *8 ON Always*	Secondary function logical operation for the M3-M4 relay in relation to H02-02.	0–8	0
H02-65	Terminal M3-M4 Delay Time	Delay time after applying the H02-64 logical operation results.	0.0–25.0 sec	0.1
H02-66*	Term M5-M6 Secondary Function	Secondary function for the M5-M6 relay.	0–1A7	F
H02-67	Terminal M5-M6 Logical Operation *0 A=B=1* *1 A=1 or B=1* *2 A=0 or B=0* *3 A=B=0* *4 A=B* *5 A != B* *6 A=1 and B=0* *7 A=1 or B=0* *8 ON Always*	Secondary function logical operation for the M5-M6 relay in relation to H02-03.	0–8	0
H02-68	Terminal M5-M6 Delay Time	Delay time after applying the H02-67 logical operation results.	0.0–25.0 sec	0.1

1 ***See Table 5-85 on page 177*** *for MFDO selections.*

5.6.3 Analog Inputs

The VFD has three built-in analog inputs for the external input of references and limits.

Table 5-91: Analog Inputs Parameter Settings

Parameter	Display	Function	Range	Default
H03-01	Terminal A1 Signal Level Select *0 0 to 10 V* *1 -10 to 10 V* *2 4 to 20 mA* *3 0 to 20 mA* ***NOTE:*** *DIP switch S1-1 selects a current or voltage input signal.*	Terminal A1 analog input signal	0–3	0*
H03-02	Terminal A1 Function Selection	Function of terminal A1 (***see Table 5-93 on page 186***)	0–35	0*
H03-03	Terminal A1 Gain Setting	Gain multiplier for Terminal A1 analog input	-999.9–999.9%	100.0
H03-04	Terminal A1 Bias Setting	Bias multiplier for Terminal A1 analog input	-999.9–999.9%	0.0
H03-05	Terminal A3 Signal Level Select *0 0 to 10 V* *1 -10 to 10 V* *2 4 to 20 mA* *3 0 to 20 mA* ***NOTE:*** *DIP switch S1-3 selects a current or voltage input signal.*	Terminal A3 analog input signal	0–3	0
H03-06	Terminal A3 Function Selection	Function of terminal A3 (***see Table 5-93 on page 186***)	0–35	1F*
H03-07	Terminal A3 Gain Setting	Gain multiplier for Terminal A3 analog input	-999.9–999.9%	100.0
H03-08	Terminal A3 Bias Setting	Bias multiplier for Terminal A3 analog input	-999.9–999.9%	0.0
H03-09	Terminal A2 Signal Level Select *0 0 to 10 V* *1 -10 to 10 V* *2 4 to 20 mA* *3 0 to 20 mA* ***NOTE:*** *DIP switch S1-2 selects a current or voltage input signal.*	Terminal A2 analog input signal	0–3	2
H03-10	Terminal A2 Selection	Function of terminal A2 (***see Table 5-93 on page 186***)	0–35	1F*
H03-11	Terminal A2 Gain Setting	Gain multiplier for terminal A2 analog input	-999.9–999.9%	100.0
H03-12	Terminal A2 Bias Setting	Bias multiplier for terminal A2 analog input	-999.9–999.9%	0.0
H03-13	Analog Input Filter Time Constant	Analog input filter average time	0.00–2.00 sec	0.03

Parameter	Display	Function	Range	Default
H03-19	4-20mA Feedback Loss Time	If a 4-20 mA analog input is less than 2 mA for this set time, an AFbL fault will occur. A setting of 0.0 disables this function.	0.0–2.0 sec	0.0

* *Initial value is determined by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** or **Table 4-8 on page 72**).*

5.6.3.1 Analog Inputs—Modbus

The parameters in this section configure analog inputs using the serial Modbus protocol.

Table 5-92: Modbus Analog Inputs Parameter Settings

Parameter	Display	Function	Range	Default
H03-40	Mbus Reg 15C1h Input Function	Analog input function for Modbus register 15C1 (Hex.).	4–35	1F
H03-41	Mbus Reg 15C2h Input Function	Analog input function for Modbus register 15C2 (Hex.).	4–35	1F
H03-42	Mbus Reg 15C3h Input Function	Analog input function for Modbus register 15C3 (Hex.).	4–35	1F
H03-43	Mbus Reg Inputs Filter Time Constant	Delay filter time constant applied to the Modbus analog input register values.	0.00–2.00 sec	0.00

Table 5-93: Multi-Function Analog Input (MFAI) Selections for H03-02, -06, and -10

Setting	Display	Function
0	Analog Frequency Reference 1	Analog Frequency Reference 1 10V = E01-04 (maximum output frequency)
1	Frequency Gain	Analog frequency reference is multiplied with the Frequency Gain.
2	Analog Frequency Reference 2	Analog Frequency Reference 2 10V = E01-04 (maximum output frequency)
3	Analog Frequency Reference 3	Analog Frequency Reference 3 10V = E01-04 (maximum output frequency)
4	Output Voltage Bias*	The Output Voltage Bias boosts the output voltage of the V/f curve as a percentage of the maximum output voltage. Only available in V/f mode. 10V = E01-05 (motor rated voltage)
5	Accel/Decel Time Gain	10V = 100% acceleration and deceleration time
6	DC Injection Braking Current	DC Injection Braking Current 10V = 100% VFD rated current 4 to 20 mA = 0 to 100% VFD rated current
7	Torque Detection Level	Overtorque/undertorque level as a percentage of VFD rated current.
8	Stall Prevent Level During Run*	Stall prevention level, during run.
9	Output Frequency Lower Limit	Output frequency lower limit as a percentage of the maximum output frequency. 10V = E01-04 (maximum output frequency)
D	Frequency Bias	Bias added to the frequency reference as a percentage of the maximum output frequency.
E	Motor Temperature (PTC Input)	Positive Temperature Coefficient (PTC) thermistor input. Set Terminal Board DIP switch S4 to “PTC.”
10	Forward Torque Limit**	Torque limit when motoring in the forward direction.
11	Reverse Torque Limit**	Torque limit when motoring in the reverse direction.
12	Regenerative Torque Limit**	Torque limit during regen.
13	Torque Reference / Torque Limit**	Torque reference when in Torque Control mode. Torque limit when in Speed Control mode.
14	Torque Compensation**	Torque compensation when using torque control.
15	General Torque Limit**	Reverse, Forward, or Regen torque limit.
16	Load Cell	Analog signal from a load cell used for Load Check.
1B	Main Hook Height	0 V = 0% of C14-02 added to swing length 10 V = 100% of C14-02 added to swing length
1C	Aux Hook Height	0 V = 0% of C14-02 added to swing length 10 V = 100% of C14-02 added to swing length
1D	Center of Gravity Offset	0 V = 0 * C14-05 added to swing length 1 V = C14-05 added to swing length 10 V = 10 * C14-05 added to swing length
1F	Not Used	Input is disabled
35	Travel Limits	Travel Limit feedback.

* Only available for the V/f control method (A01-02 = 0).

** Not available for the V/f control method (A01-02 = 0).

5.6.4 Analog Outputs

The VFD has two built-in analog outputs for condition monitoring. Analog output capabilities can be increased with the installation of an AO-A3 option.

Table 5-94: Analog Outputs Parameter Settings

Parameter	Display	Function	Range	Default
H04-01	Terminal FM Analog Output Select	Function for Terminal FM. Reference the U monitor group for output function descriptions.	0–631	102
	0 Not Used			
	101 Frequency Reference			
	102 Output Frequency			
	103 Output Current			
	105 Motor Speed			
	106 Output Voltage Ref			
	107 DC Bus Voltage			
	108 Output Power			
	109 Torque Reference			
	115 Terminal A1 Level			
	116 Terminal A2 Level			
	117 Terminal A3 Level			
	120 SFS Output Frequency			
	143 Virtual Analog Input			
	149 Swing Length			
	150 Hook Height			
	151 Motor Revolution			
	154 Input Pulse Monitor			
	163 Encoder 1 Pulse Counter			
	164 Encoder 2 Pulse Counter			
	191 Output Voltage			
	401 Cumulative Operation Time			
	403 Cooling Fan Operation Time			
	404 Cooling Fan Maintenance			
	405 Capacitor Maintenace			
	406 Precharge Relay Maintenance			
	407 IGBT Maintenance			
	408 Heatsink Temperature			
	416 Motor oL1 Level			
	417 Drive oL2 Level			
	419 Modbus Frequency Ref (dec)			
	419 Option Frequency Ref (dec)			
	424 Number of Runs (Low)			
	425 Number of Runs (High)			

Parameter	Display	Function	Range	Default
H04-01	*428 Run Time Remaining* *430 On Time Remaining* *433 Brake Cycles Remaining* *452 Torque Reference from Comm* *601 Iq Secondary Current* *602 Id Excitation Current* *603 ASR Input* *604 ASR Output* *605 Output Voltage Reference (Vq)* *606 Output Voltage Reference (Vd)* *607 q-Axis ACR Output* *608 d-Axis ACR Output* *621 Offset Frequency* *631 Torque Detect Monitor*		000–631	102
H04-02	Terminal FM Analog Output Gain	Gain multiplier for Terminal FM	-999.9–999.9%	100.0
H04-03	Terminal FM Analog Output Bias	Bias multiplier for Terminal FM	-999.9–999.9%	0.0
H04-04	Terminal AM Analog Output Select	Function for Terminal AM	0–631	103
H04-05	Terminal AM Analog Output Gain	Gain multiplier for Terminal AM	-999.9–999.9%	50.0
H04-06	Terminal AM Analog Output Bias	Bias multiplier for Terminal AM	-999.9–999.9%	0.0
H04-07	Terminal FM Signal Level Select *0 0 to 10 VDC* *1 -10 to +10 VDC* *2 4 to 20 mA*	Voltage output level of Terminal FM	0–2	0
H04-08	Terminal AM Signal Level Select *0 0 to 10 VDC* *1 -10 to +10 VDC* *2 4 to 20 mA*	Voltage output level of Terminal AM	0–2	0
H04-20	Analog Power Monitor 100% Level	Level at 10 V when an analog output is set for U01-08 (Output Power).	0.00–650.00 HP/kW	0.00

5.6.5 Modbus Communication

The VFD uses terminals D+ and D- to communicate the Modbus (RS-485) protocol. Cycle power after changing any of these parameters.

NOTE: *The Modbus RS-422 protocol is not compatible.*

Table 5-95: Modbus Communication Parameter Settings

Parameter	Display	Function	Range	Default
H05-01	Drive Node Address	Serial communication address	0–FF	1F
H05-02	Communication Speed Selection *0 1200 bps* *1 2400 bps* *2 4800 bps* *3 9600 bps* *4 19.2 kbps* *5 38.4 kbps* *6 57.6 kbps* *7 76.8 kbps* *8 115.2 kbps*	Baud rate	0–8	4
H05-03	Communication Parity Selection *0 No Parity* *1 Even Parity* *2 Odd Parity*	Parity type	0–2	0
H05-04	Communication Error Stop Method *0 Decel to Stop* *1 Coast to Stop* *2 Fast Stop (Use b05-08)* *3 Alarm Only*	Serial fault stopping method	0–3	0
H05-05	Comm Fault Detection Selection *0 Disabled* *1 Enabled*	Serial Fault Detection	0, 1	1
H05-06	Drive Transmit Wait Time	Send waiting time	0–65 ms	5
H05-09	CE Detection Time	Time required to detect a Modbus Communications Error (CE) when communication stops. Adjustment may be needed when networking several VFDs. A setting of 0.0 will disable CE detection, which is highly discouraged. Consult factory for assistance.	0.0–10.0 sec	1.0
H05-10	Modbus Register 0025H Unit Sel *0 0.1 V Units* *1 1 V Units*	Units for the output voltage monitor value in Modbus Register 0025H.	0, 1	0

Parameter	Display	Function	Range	Default
H05-11	Comm ENTER Command Mode	Enter command function via serial.	0, 1	1
	0 ENTER Command Required	VFD requires an Enter command before accepting any parameter changes.		
	1 ENTER Command Not Required	Parameter changes are activated immediately without the Enter command.		
H05-13	RDSI Legacy Mode	Legacy support for Hetronic RDSI.	0, 1	0
	0 Disabled			
	1 Enabled			
H05-17	ENTER Command Response @CPU BUSY	Allows VFD to substitute a RAM enter with a ROM enter when under heavy CPU load.	0, 1	0
	0 Ignore Command (No ROM/RAM Write)			
	1 Write to RAM Only			
H05-18	Motor Speed Filter Over Comms	Motor Speed Monitor Filter Time. Adds a filter to Motor Speed monitor (U01-05).	0–100 ms	0
H05-20	Communication Parameters Reload	Determines how Modbus parameter settings are updated.	0, 1	0
	0 Reload at Next Power Cycle			
	1 Reload Now			
H05-25	Function 5A Register 1 Selection	Returns the contents of the specified Modbus register.	0000-FFFF	44 (U01-05)
H05-26	Function 5A Register 2 Selection	Returns the contents of the specified Modbus register.	0000-FFFF	45 (U01-06)
H05-27	Function 5A Register 3 Selection	Returns the contents of the specified Modbus register.	0000-FFFF	42 (U01-03)
H05-28	Function 5A Register 4 Selection	Returns the contents of the specified Modbus register.	0000-FFFF	49 (U01-10)

NOTE: *After initial communication, if the VFD is not communicated with for the time duration set at parameter H05-09, a communication fault will occur (CE alarm/fault).*

5.6.6 Pulse Train Input/Output

Pulse Input and Output provides speed control capabilities via the RP and MP terminals.

Table 5-96: Pulse Train Input/Output Parameter Settings

Parameter	Display	Function	Range	Default
H06-01	Terminal RP Pulse Train Function	Terminal RP pulse input	0, 3, 5	0
	0 Frequency Reference	Set B03-01 = 4 (Pulse Input) to enable RP.		
	3 Speed Feedback (V/f Control)	Simple PG feedback for better speed control in V/f.		
	5 Follower Speed Feedback	Pulse feedback into the RP terminal coming from a Follower VFD.		
H06-02	Terminal RP Frequency Scaling	Frequency of the terminal RP pulse train input when the H06-01 input is 100%.	100–32000 Hz	1440
H06-03	Terminal RP Function Gain	Gain applied to the RP function.	0.0–1000.0%	100.0
H06-04	Terminal RP Function Bias	Bias applied to the RP function.	-100.0–100.0%	0.0
H06-05	Terminal RP Filter Time	Input filter time constant	0.00–2.00 sec	0.10
H06-06	Terminal MP Monitor Selection	Terminal MP pulse output monitor	0–120	102
	0 Not Used			
	101 Frequency Reference			
	102 Output Frequency			
	105 Motor Speed			
	120 SFS Output Frequency			
H06-07	Terminal MP Frequency Scaling	Frequency of the terminal MP pulse train output when the H06-06 monitor is 100%.	0–32000 Hz	1440
H06-08	Terminal RP Minimum Frequency	Minimum frequency for the pulse train input to be detected. Enabled when H06-01 = 0.	0.1–1000.0 Hz	0.5
H06-09	Voltage Phase Sync MP Selection	Output the pulse synchronized with output voltage phase at terminal MP. Enabled when H06-06 = 102 (Output Frequency) and H06-07 = 0 Hz.	0, 1	0
	0 Disabled			
	1 Enabled			
H06-10	Pulse Difference Detect	When H06-01 = 5 (Follower Speed Feedback), the terminal RP pulse input is compared to the terminal MP pulse output. If the difference is greater than the percentage of H06-10, a Pulse Deviation fault will occur.	0.0–25.5%	5.0

5.6.7 Virtual Inputs/Outputs

Virtual inputs and outputs allow for the passing of information without the need for external wiring. This function performs the following:

- Inputs the result of the output from the MFDO terminal to the MFDI terminal without external wiring.
- Inputs the result of the output from the MFAO terminal to the MFAI terminal without external wiring.

Table 5-97: Virtual Inputs/Outputs Parameter Settings

Parameter	Display	Function	Range	Default
H07-00	Virtual MFIO Selection *0 Disabled* *1 Enabled*	Enable or disable the virtual I/O function.	0, 1	0
H07-01	Virtual Multi-Function Input 1	The function that enters the virtual input set in H07-10.	1–19F	F
H07-02	Virtual Multi-Function Input 2	The function that enters the virtual input set in H07-12.	1–19F	F
H07-03	Virtual Multi-Function Input 3	The function that enters the virtual input set in H07-14.	1–19F	F
H07-04	Virtual Multi-Function Input 4	The function that enters the virtual input set in H07-16.	1–19F	F
H07-10	Virtual Multi-Function Output 1	Function for virtual digital output 1.	0–1A7	F
H07-11	Virtual Output 1 Delay Time	Minimum ON time for virtual digital output 1.	0.0–25.0 sec	0.1
H07-12	Virtual Multi-Function Output 2	Function for virtual digital output 2.	0–1A7	F
H07-13	Virtual Output 2 Delay Time	Minimum ON time for virtual digital output 2.	0.0–25.0 sec	0.1
H07-14	Virtual Multi-Function Output 3	Function for virtual digital output 3.	0–1A7	F
H07-15	Virtual Output 3 Delay Time	Minimum ON time for virtual digital output 3.	0.0–25.0 sec	0.1
H07-16	Virtual Multi-Function Output 4	Function for virtual digital output 4.	0–1A7	F
H07-17	Virtual Output 4 Delay Time	Minimum ON time for virtual digital output 4.	0.0–25.0 sec	0.1
H07-30	Virtual Analog Input Selection	Function for virtual analog input.	0–4F	1F
H07-31	Virtual Analog Input Gain	Gain for virtual analog input.	-999.9–999.9%	100.0
H07-32	Virtual Analog Input Bias	Bias for virtual analog input.	-999.9–999.9%	0.0
H07-40	Virtual Analog Out Signal Select *0 0 to 100% (Absolute Value)* *1 100 to 100%* *2 0 to 100% (Lower Limit at 0)*	Signal level of the virtual analog output.	0–2	0
H07-41	Virtual Analog Output Function	Monitor to be output from the virtual analog output. Set the x-xx part of the U0x-xx monitor. For example, set H07-41 = 102 to monitor U01-02 (Output Frequency).	0–999	102
H07-42	Virtual Analog Output Filter Time	Time constant filter of the virtual analog output.	0.00–2.00 sec	0.00

5.7 Protection Parameters

- L01 Motor Protection
- L02 Power Loss Ride Through
- L03 Stall Prevention
- L04 Speed Detection
- L06 Torque Detection
- L08 Hardware Protection
- L09 Automatic Fault Reset
- L09 Fault Latch

5.7.1 Motor Protection

The VFD has an electronic overload protection function (OL1) for protecting the motor from overheating. It bases the protection on time, output current, and output frequency. The electronic thermal overload function is UL-recognized, so an external thermal overload relay is not required for single motor operation.

This parameter selects the motor overload curve used according to the type of motor applied.

L01-01 = 1 selects a motor with limited cooling capability below rated 60 Hz base speed when running at 100% load. The OL1 function derates the motor any time it is running below 60 Hz.

L01-01 = 2 selects a motor capable of cooling itself at any speed when running at 100% load. The OL1 function derates the motor when it is running at 10% of its rated speed or less.

L01-01 = 3 selects a motor capable of cooling itself at any speed when running at 100% load. The OL1 function derates the motor when it is running at 1% of its rated speed or less.

L01-01 = 6 selects a motor with limited cooling capability below rated 50 Hz base speed when running at 100% load. The OL1 function derates the motor any time it is running below 50 Hz.

If the VFD is connected to a single motor, the motor overload protection should be enabled.

Do not disable OL1 unless another means of preventing motor thermal overload is provided. When an overload is detected, an OL1 fault occurs, and shuts off the VFD output, thus preventing additional overheating of the motor. The motor temperature is continuously calculated while the VFD is powered up.

When operating several motors with one VFD, install a thermal relay on each motor and disable the motor overload protection (L01-01 = 0).

Table 5-98: Motor Protection Parameter Settings

Parameter	Display	Function	Range	Default
L01-01	Motor Overload (oL1) Protection	Motor type for OL1 overload protection.	0–3, 6	CLV: 3 else: 2
	0 Disabled			
	1 Variable Torque	General purpose motor (60 Hz base frequency)		
	2 Constant Torque 10:1 Speed Range	Speed range for constant torque of 1:10		
	3 Constant Torque 100:1 Speed Range	Speed range for constant torque of 1:100		
	6 Variable Torque (50Hz)	General purpose motor (50 Hz base frequency)		
L01-02	Motor Overload Protection Time	Time for OL1 fault when motor current is ≥ 150% of the motor rated current.	0.1–5.0 min	1.0

Parameter	Display	Function	Range	Default
L01-03	Motor Thermistor oH Alarm Select *0 Decel to Stop* *1 Coast to Stop* *2 Fast Stop (Use b05-08)* *3 Alarm Only*	Operation when the motor temperature analog input (H03-02, H03-06, or H03-10 = E) exceeds the oH3 alarm level. (1.17V) Decel by b05-08 oH3 Flashes	0–3	3
L01-04	Motor Thermistor oH Fault Select *0 Decel to Stop* *1 Coast to Stop* *2 Fast Stop (Use b05-08)*	Operation when the motor temperature analog input (H03-02, H03-06, or H03-10 = E) exceeds the oH4 fault level. (2.34V) Decel by b05-08	0–2	1
L01-05	Motor Thermistor Filter Time	Motor temperature analog input filter time constant (H03-02, H03-06, or H03-10 = E)	0.00–10.00 sec	0.20
L01-06	Klixon Action *0 Decel to Stop* *1 Coast to Stop* *2 Use b03-03 Method* *3 Decel to Stop, Alarm* *4 Coast to Stop, Alarm* *5 b03-03 to Stop, Alarm*	The Klixon function is used with motors that have a Thermal Overload Switch. Klixons are usually embedded in the motor windings and change state when the motor reaches a certain temperature. When a digital input H01-0x = 56 (N.O.) or 156 (N.C.) is active, the VFD will use this stopping method and display the Klixon (KLX) alarm. The VFD will resume operation when the motor cools down and a new RUN command is issued.	0–5	2
L01-08	oL1 Current Level	Reference current for the Motor 1 oL1 detection. When L01-08 > 0.00 A, you cannot set this value < 10% of VFD rated current.	0.00–(150% VFD Rated Current) A	0.00
L01-09	oL1 Current Level for Motor 2	Reference current for the Motor 2 oL1 detection. When L01-09 > 0.00 A, you cannot set this value < 10% of VFD rated current.	0.00–(150% VFD Rated Current) A	0.00
L01-13	Motor Overload Memory Selection *0 Disabled* *1 Enabled*	Determines whether or not to hold the current value of the electrothermal motor protection (L01-01) when the power supply is interrupted.	0, 1	1

5.7.2 Power Loss Ride Through

Table 5-99: Power Loss Ride Through Parameter Settings

Parameter	Display	Function	Range	Default
L02-01	Power Loss Ride Through Select	Enables/disables the Power Loss Ride thru function	0–2	0
	0 Disabled	UV1 fault when power is lost for more than 15 milliseconds.		
	1 Enabled for L02-02 Time	Recover within the time set in L02-02. Uv1 will be detected if power loss is longer than L02-02.		
	2 Enabled while CPU Power Active	Recover as long as CPU has power. Uv1 is not detected.		
L02-02	Power Loss Ride Through Time	Power Loss Ride thru time	0.0–25.5 sec	Depends on O02-04
L02-03	Minimum Baseblock Time	Output turn on delay after power resumes	0.1–5.0 sec	Depends on O02-04
L02-04	Powerloss V/f Recovery Ramp Time	Voltage recovery time after speed search is complete	0.0–5.0 sec	Depends on O02-04
L02-05	Undervoltage Detection Lvl (Uv1)	Under voltage fault detection level	230V: 150–210 VDC 460V: 300–420 VDC 575V: 431–603 VDC	Depends on E01-01
L02-06	Kinetic Energy Backup Decel Time	Deceleration time during KEB operation down to a frequency of 0.	0.0–6000.0 sec	0.0
L02-07	Kinetic Energy Backup Accel Time	Acceleration time to return to the frequency reference before a power loss after canceling KEB operation.	0.0–6000.0 sec	0.0
L02-08	Frequency Gain at KEB Start	Output frequency reduction used when KEB operation starts as a percentage of motor rated slip before starting KEB operation.	0–300%	100
L02-09	KEB Minimum Frequency Level	Output frequency reduction used as a percentage of E02-02 (Motor Rated Slip) when KEB operation starts.	0–100%	20
L02-10	Minimum KEB Time	Minimum time to operate the KEB after a momentary power loss is detected.	0–25500 ms	50
L02-11	KEB DC Bus Voltage Setpoint	Target value that controls the DC bus voltage to a constant level when L02-29 = 2. For the other L02-29 settings, this is the DC bus voltage level that completes the KEB operation.	230V: 150–400 VDC 460V: 300–800 VDC 575V: 431–1015 VDC	E01-01 x 1.22
L02-29	Kinetic Energy Backup Method	KEB function operation mode.	0–3	0
	0 Single Drive KEB Ride-Thru 1			
	1 Single Drive KEB Ride-Thru 2			
	2 System KEB Ride-Thru 1			
	3 System KEB Ride-Thru 2			
L02-30	KEB Zero Speed Operation	Operation when the output frequency decreases below D01-01 (DC Injection Threshold) during KEB deceleration when L02-01 = 3 to 5.	0,1	0
	0 Baseblock			
	1 DC/SC Braking			

Parameter	Display	Function	Range	Default
L02-31	KEB Start Voltage Offset Level	KEB start voltage offset.	230V: 0–100 VDC 460V: 0–200 VDC 575V: 0–287 VDC	Depends on A01-02

5.7.3 Stall Prevention

Table 5-100: Stall Prevention Parameter Settings

Parameter	Display	Function	Range	Default
L03-01	Stall Prevention during Accel	Stall Prevention will function during acceleration. (G+ only)	0–2	1
	0 Disabled			
	1 Enabled	Acceleration is paused as long as the current is above the L03-02 setting.		
	2 Intelligent (Ignore Accel Ramp)	Accelerate in the shortest possible time without exceeding the L03-02 level.		
	3 Current Limit Acceleration	Acceleration rate is automatically adjusted when the output current exceeds L03-02.		
L03-02	Stall Prevent Level during Accel	Output current level at which the Stall Prevention during acceleration is activated. (G+ only)	0–150%	Depends on D10-01
L03-03	Stall Prevent Limit during Accel	Stall Prevention lower limit during acceleration when operating in the constant power range. Set as a percentage of VFD rated current. (G+ only)	0–100%	50
L03-05	Stall Prevention during RUN	Control for the stall prevention during run. (G+ only)	0–2	1
	0 Disabled	Runs at a set frequency. A heavy load may stall.		
	1 Deceleration Time 1	Use Decel Time 1 (B05-02)		
	2 Deceleration Time 2	Use Decel Time 2 (B05-04)		
L03-06	Stall Prevent Level during Run	Current level to trigger Stall Prevention during run. Depending on L03-23, the level is automatically reduced in the constant power range (speed beyond base speed). (G+ only) Enabled when L03-05 = 1 or 2.	30–150%	Depends on D10-01
L03-11	Overvoltage Suppression Select *0 Disabled* *1 Enabled*	Enables or disables the OV suppression function, which allows the VFD to change the output frequency as the load changes to prevent an OV fault.	0, 1	0
L03-17	DC Bus Regulation Level	DC bus voltage during overvoltage suppression and Stall Prevention during deceleration	230V: 150–400 VDC 460V: 300–800 VDC 575V: 431–1150 VDC	375 750 930
L03-20	DC Bus Voltage Adjustment Gain	Proportional gain for Stall Prevention and overvoltage suppression	0.00–5.00	Depends on A01-02
L03-21	OVSuppression Accel/ Decel P Gain	Proportional gain used to calculate the deceleration rate during OV suppression function and Stall Prevention during deceleration	0.10–10.00	Depends on A01-02

Parameter	Display	Function	Range	Default
L03-23	Stall P Reduction at Constant HP	Reduces the Stall Prevention during run level in the constant power range. (G+ only)	0, 1	0
	0 Use L3-06 for Entire Speed Range	Sets the Stall Prevention level that is used throughout the entire frequency range.		
	1 Automatic Reduction @ CHP Region	Automatic Stall Prevention level reduction in the constant output range. Lower limit is 40% of L03-06.		
L03-24	Motor Accel Time @ Rated Torque	Time needed to accelerate the uncoupled motor at rated torque from stop to the maximum frequency.	0.001–10.000 sec	Depends on O02-04
L03-25	Load Inertia Ratio	Ratio between motor inertia and machine inertia.	0.1–1000.0	1.0
L03-26	Additional DC Bus Capacitors	Capacity for external main circuit capacitors. This parameter may be used with the KEB Ride Through.	0 to 65000 μF	0
L03-27	Stall Prevention Detection Time	Delay between reaching the Stall Prevention level and starting the Stall Prevention function.	0–5000 ms	50
L03-35	Speed Agree Width for Auto Decel	Speed agreement width when L03-04 = 2.	0.00–1.00 Hz	0.00
L03-36	Current Suppression Gain @ Accel	Gain to suppress current and motor speed hunting during operation when L03-01 = 3.	0.0–100.0	Depends on A01-02
L03-37	Current Limit P Gain @ Accel	P Gain to suppress current hunting during acceleration when L03-01 = 3.	0–100 ms	5
L03-38	Current Limit I Time @ Accel	I Time to suppress current hunting and overshooting if a stall occurs during acceleration when L03-01 = 3.	0.0–100.0	10.0
L03-39	Current Limit Filter Time @ Accel	Time constant to adjust the acceleration rate when L03-01 = 3.	1.0–1000.0 ms	100.0
L03-40	Current Limit S-Curve @ Acc/Dec	Use the best S-curve characteristic for current-limited acceleration when L03-01 = 3.	0, 1	0
	0 Disabled			
	1 Enabled			

5.7.4 Speed Detection

The IMPULSE•G+/VG+ Series 5 has three functions for detecting output frequency:

Speed Agree 1

- When enabled using MFDO "H02-xx = 2", the contact closes when the output frequency (U01-02) is equal to the frequency reference (U01-01) plus or minus the speed agree detection width (L04-02).
  - *U01-02 = (U01-01 ± L04-02)*
- When enabled using MFDO “H02-xx = 3”, the contact closes when the output frequency (U01-02) is equal to the speed agree detection level (L04-01) plus or minus the speed agree detection width (L04-02).
  - *U01-02 = (L04-01 ± L04-02)*

Speed Agree 2

- When enabled using MFDO “H02-xx = 13”, the contact closes when the output frequency (U01-02) is equal to the frequency reference (U01-01) plus or minus the speed agree detection width (L04-04).
  - *U01-02 = (U01-01 ± L04-04)*
- When enabled using MFDO “H02-xx = 14”, the contact closes when output frequency (U01-02) is equal to the speed agree detection level (L04-03) plus or minus the speed agree detection width (L04-04).
  - *U01-02 = (L04-03 ± L04-04)*

Frequency Detection

When enabled using MFDO “H02-xx = 4”:

- Contact closes at start.
- Contact opens when accelerating: U01-02 ≥ (L04-01 + L04-02).
- Contact closes again when decelerating: U01-02 < L04-01.

When enabled using MFDO “H02-xx = 5”:

- Contact opens at start.
- Contact closes when accelerating: U01-02 ≥ L04-01.
- Contact opens again when decelerating: U01-02 < (L04-01 - L04-02).

NOTE: *If L04-01 or L04-03 is set below 5 Hz, the DC Injection Start Frequency (D01-01) and Speed Agree Widths (L04-02/L04-04) may need to be adjusted lower in order for the VFD to recognize runs properly.*

Table 5-101: Speed Agree Parameter Settings

Parameter	Display	Function	Range	Default
L04-01	Speed Agree Detection Level	Detection level for the desired speed agree 1 and frequency detection functions. The detection level is effective during both FWD and REV operation.	0.0–150.0 Hz	0.0
L04-02	Speed Agree Detection Width	Detection width for speed agree 1 and frequency detection functions.	0.0–20.0 Hz	2.0
L04-03	Speed Agree Detection Level (+/-)	Detection level for the desired speed agree 2 function. The 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).	-150.0–150.0 Hz	0.0
L04-04	Speed Agree Detection Width (+/-)	Detection width for the speed agree 2 function.	0.0–20.0 Hz	2.0

Table 5-102: Frequency Detection Parameter Settings

Parameter	Display	Function	Range	Default
L04-05	Fref Loss Detection Selection	The VFD can detect a loss of an analog frequency reference from input A1, A2, or A3. Frequency reference loss is detected when the reference is less than 10% in 400 ms.	0, 1	0
	0 Stop	VFD stops when frequency reference is lost.		
	1 Run at (L04-06 x Last Reference)	VFD runs at a reduced speed when the frequency reference is lost.		
L04-06	Frequency Reference @Loss of Ref	Percentage of the frequency reference that the VFD should run at when the frequency reference is lost.	0.0–100.0%	80.0
L04-07	Speed Agree Detection Selection	Determines when frequency detection is active using parameters L04-01 to L04-04.	0, 1	0
	0 No Detection During Baseblock	No detection during baseblock.		
	1 Detection Always Enabled	Detection always enabled.		

5.7.5 Torque Detection

The torque detection function will trigger an alarm or fault when the motor load is above or below a set threshold. When an undertorque/overtorque condition is detected, a signal can be sent to a multi-function output (H02-0x = “B” or “18”).

Table 5-103: Torque Detection Parameter Settings

Parameter	Display	Function	Range	Default
L06-01	Torque Detection Selection 1	Activates overtorque/undertorque detection and selects whether detection generates an alarm or a fault	0–8	0
	0 Disabled			
	1 OT @ Speed Agree - Alarm			
	2 OT @ RUN - Alarm			
	3 OT @ Speed Agree - Fault			
	4 OT @ RUN - Fault			
	5 UT @ Speed Agree - Alarm			
	6 UT @ RUN - Alarm			
	7 UT @ Speed Agree - Fault			
	8 UT @ RUN - Fault			

Table 5-104: Torque Detection 1 (L06-01) Setting Descriptions

Settings	Description
0	Torque detection is disabled *(factory default)*.
1	Overtorque detection is enabled whenever at speed agree (when VFD is not accelerating or decelerating). Continue running after detection (OT1 alarm).
2	Overtorque detection is enabled always. Continue running after detection (OT1 alarm).
3	Overtorque detection is enabled whenever at speed agree. Coast to a stop after detection (OT1 fault).
4	Overtorque detection is enabled always. Coast to a stop after detection (OT1 fault).
5	Undertorque detection is enabled whenever at speed agree (when VFD is not accelerating or decelerating). Continue running after detection (UT1 alarm).
6	Undertorque detection is enabled always. Continuing running after detection (UT1 alarm).
7	Undertorque detection is enabled whenever at speed agree. Coast to a stop after detection (UT1 fault).
8	Undertorque detection is enabled always. Coast to stop after detection (UT1 fault)

NOTE:

- *To detect overtorque/undertorque during acceleration or deceleration, set to “2” or “4” / “6” or “8”.*
- *To continue operation after overtorque/undertorque detection, set to “1” or “2” / “5” or “6” During detection, the keypad displays an “OT1/UT1” alarm (blinking).*
- *To stop the VFD after an overtorque/undertorque detection fault, set to “3” or “4” / “7” or “8”. During detection, the keypad displays an “OT1/UT1” fault.*

Table 5-105: Torque Detection Parameter Settings - continued

Parameter	Display	Function	Range	Default
L06-02	Torque Detection Level 1	Overtorque detection as a percentage of VFD rated current, during V/f control, and motor rated torque during vector control.	0–300%	150
L06-03	Torque Detection Time 1	The overtorque detection delay time inserts a delay, between the time motor current (or torque) exceeds the overtorque level (L06-02) and when the overtorque detection function is enabled. Keypad displays “OT1”.	0.0–10.0 sec	0.1
L06-04	Torque Detection Selection 2 *0 Disabled* *1 OT @ Speed Agree - Alarm* *2 OT @ RUN - Alarm* *3 OT @ Speed Agree - Fault* *4 OT @ RUN - Fault* *5 UT @ Speed Agree - Alarm* *6 UT @ RUN - Alarm* *7 UT @ Speed Agree - Fault* *8 UT @ RUN - Fault*	Activates overtorque/undertorque detection, and selects whether detection generates an alarm or a fault.	0–8	0

Table 5-106: Torque Detection 2 (L06-04) Setting Descriptions

Settings	Description
0	Overtorque/undertorque detection is disabled *(factory default)*.
1	Overtorque detection is enabled whenever at speed agree (when VFD is not accelerating or decelerating). Continue running after detection (OT2 alarm).
2	Overtorque detection is enabled always. Continue running after detection (OT2 alarm).
3	Overtorque detection is enabled whenever at speed agree. Coast to a stop after detection (OT2 fault).
4	Overtorque detection is enabled always. Coast to a stop after detection (OT2 fault).
5	Undertorque detection is enabled whenever at speed agree (when VFD is not accelerating or decelerating). Continue running after detection (UT2 alarm).
6	Undertorque detection is enabled always. Continuing running after detection (UT2 alarm).
7	Undertorque detection is enabled whenever at speed agree. Coast to a stop after detection (UT2 fault).
8	Undertorque detection is enabled always. Coast to stop after detection (UT2 fault).

Overtorque detection 2 functions the same as overtorque/undertorque detection 1 (L06-01), except that “OT2/UT2” is displayed on the keypad instead.

Table 5-107: Torque Detection Parameter Settings - continued

Parameter	Display	Function	Range	Default
L06-05	Torque Detection Level 2	Torque Detection 2 Level	0–300%	150
L06-06	Torque Detection Time 2	Torque Detection 2 Time	0.0–10.0 sec	0.1
L06-07	Torque Detection Filter Time	Time constant filter for the torque reference or output current used to detect overtorque/ undertorque.	0–1000 ms	0
L06-08	Mechanical Fatigue Detect Select *0 Disabled* *1 oL5 @ Speed > L06-09 - Alarm* *2 oL5 @ |Speed| > L06-09 - Alarm* *3 oL5 @ Speed > L06-09 - Fault* *4 oL5 @ |Speed| > L06-09 - Fault* *5 UL5 @ Speed < L06-09 - Alarm* *6 UL5 @ |Speed| < L06-09 - Alarm* *7 UL5 @ Speed < L06-09 - Fault* *8 UL5 @ |Speed| < L06-09 - Fault*	This function can detect an overtorque or undertorque in a certain speed range as a result of machine fatigue. It is triggered by a specified operation time and uses the oL1 detection settings (L06-01 and L06-03).	0–8	0

Table 5-108: Mechanical Fatigue (L06-08) Setting Descriptions

Settings	Description
0	Mechanical Weakening Detection disabled (factory default).
1	Continue running (alarm only). Detected when the speed (signed) is greater than L06-09.
2	Continue running (alarm only). Detected when the speed (not signed) is greater than L06-09.
3	Interrupt VFD output (fault). Detected when the speed (signed) is greater than L06-09.
4	Interrupt VFD output (fault). Detected when the speed (not signed) is greater than L06-09.
5	Continue running (alarm only). Detected when the speed (signed) is less than L06-09.
6	Continue running (alarm only). Detected when the speed (not signed) is less than L06-09.
7	Interrupt VFD output (fault). Detected when the speed (signed) is less than L06-09.
8	Interrupt VFD output (fault). Detected when the speed (not signed) is less than L06-09.

Table 5-109: Mechanical Fatigue Parameter Settings

Parameter	Display	Function	Range	Default
L06-09	Mech Fatigue Detect Speed Level	Speed that triggers Mechanical Weakening Detection. When L06-08 is set for an unsigned value, the absolute value is used if the setting is negative.	-110.0–110.0%	110.0
L06-10	Mech Fatigue Detect Delay Time	Time mechanical weakening has to be detected before an alarm or fault is triggered.	0.0–10.0 sec	0.1
L06-11	Mech Fatigue Hold Off Time	Operation time (U04-01) required before Mechanical Weakening Detection is active.	0–65535 Hrs	0

5.7.6 Hardware Protection

The IMPULSE•G+/VG+ Series 5 has several built-in functions designed to protect the VFD and its components from damage.

Table 5-110: Hardware Protection Parameter Settings

Parameter	Display	Function	Range	Default
L08-02	Overheat Alarm Level	Heatsink temperature level for protection against overheat (OH). ***NOTE:*** *The VFD measures heatsink temperature by a negative temperature coefficient thermistor.*	50–150°C	105*
L08-03	Overheat Pre-Alarm Selection	Stopping method when heatsink overheat is detected	0–4	3
	0 Decel to Stop	Decel to stop using b05-02		
	1 Coast to Stop	Immediate stop		
	2 Fast Stop (Use b05-08)	Decel to stop using b05-08		
	3 Alarm Only	Operation continues and “OH Heatsink Overtemp” is displayed on keypad		
	4 Operate at Reduced Speed (L08-19)	Continue operation at reduced speed L08-19.		
L08-05	Input Phase Loss Protection Sel	Input phase loss detection	0, 1	1
	0 Disabled			
	1 Enabled			
L08-06	Input Phase Loss Detection Level	Input Phase Loss Detection Level	0.0–50.0%	*
L08-07	Output Phase Loss Protection Sel	Output phase loss detection	0–2	2
	0 Disabled			
	1 Fault When One Phase is Lost			
	2 Fault When Two Phases are Lost			
L08-08	Output Phase Loss Detection Lvl	Output current level above which is considered an output phase.	0.0–20.0%	5.0
L08-09	Output Ground Fault Detection	Ground fault detection	0, 1	1
	0 Disabled			
	1 Enabled			
L08-10	Heatsink Fan Operation Selection	Cooling fan operation	0, 1	0
	0 During Run w/ L08-11 Off-Delay			
	1 Always On			
L08-11	Heatsink Fan Off-Delay Time	When L08-10 = 0, fan will operate L08-11 seconds after Run Command is removed	0–300 sec	60
L08-12	Ambient Temperature Setting	Ambient temperature of the VFD installation area	-10–50°C	40

Parameter	Display	Function	Range	Default
L08-15	Drive oL2 @ Low Speed Protection	OL2 detection when output frequency ≤ 6 Hz	0, 1	0**
	0 Disabled			
	1 Enabled			
L08-18	Software Current Limit Selection	Software current limit	0, 1	0
	0 Disabled			
	1 Enabled			
L08-19	Freq Reduction @ oH Pre-Alarm	Frequency reference reduction gain at overheat pre-alarm when L08-03 = 4.	0.1–0.9 Hz	0.8
L08-35	Installation Method Selection	VFD Installation Method	0–3	2*
	0 Open Chassis			
	1 Side-by-Side Mounting			
	2 UL Type 1			
	3 Finless			
L08-38	Carrier Frequency Reduction	Temporarily reduces the carrier frequency when the VFD exceeds a certain level. This temporarily increases the overload capability (OL2 detection) allowing the VFD to run through transient load peaks without faulting.	0–2	2
	0 Disabled			
	1 Enabled Below 6 Hz	Enabled below 6 Hz Carrier Frequency is reduced when: < 6Hz and current > 100% of VFD Rated Current, returns to normal carrier frequency when output current falls below 88% of VFD rated current or frequency > 7Hz		
	2 Enabled for All Speeds	Enabled for the entire speed range Carrier Frequency is reduced when: < 6Hz when current > 100% of VFD Rated Current 7Hz when current > 112% of VFD Rated Current		
L08-40	Carrier Freq Reduction Off-Delay	Time that the VFD continues running with reduced carrier frequency after the carrier reduction condition is gone. Setting L08-40 to 0.00 disables the carrier frequency reduction time.	0.00–2.00 sec	Depends on A01-02
L08-41	High Current Alarm Selection	Triggers a high current alarm (HCA) when the output current rises exceeds 150% of the VFD rated current.	0, 1	0
	0 Disabled			
	1 Enabled			
L08-55	Internal DB Transistor Protection	Internal Braking Transistor Protection	0, 1	0*
	0 Disabled	Disable when not using the internal braking transistor.		
	1 Enabled	Enable when connecting a braking resistor to built-in braking transistor.		

** Initial value is dependent on VFD size, which is determined by O02-04 (kVA selection)*

*** Initial value is dependent on d10-02 (carrier frequency). 2kHz = 0, else 1*

5.7.7 Automatic Fault Reset

When a fault occurs during operation, it can be automatically reset.

Table 5-111: Automatic Fault Reset Parameter Settings

Parameter	Display	Function	Range	Default
L09-01	Auto Fault Reset Attempts	Number of auto fault reset attempts. Reset attempt counter is returned to zero if no faults occur within a ten minute period.	0–10	3
L09-02	Fault Contact at Restart Select *0 Active Only when Not Restarting* *1 Always Active*	Fault contact status for faults set in L09-08 and L09-08 while the fault is active.	0, 1	0
L09-08*	Fault Reset Group 1	Automatic fault reset Group.	0000–FFFF	4201
L09-09*	Fault Reset Group 2	Automatic fault reset Group.	0000–FFFF	E000

* To program L09-08 or L09-09, refer to the example on the following page and follow steps 1 through 4:

1. Assign 1 to each fault code to enable the auto reset.
2. Assign 0 to each fault code to disable the auto reset.
3. Convert all Digits (1 to 4) from binary to hex.
4. Program L09-08 or L09-09 by entering the hex number obtained from step 3.

Example:

Enable auto-reset for AS1, COF, UV1, BE1, BE2, and BE3 faults.

Table 5-112: Auto-Reset Programming

	Digit 4				Digit 3				Digit 2				Digit 1			
HEX	4				2				0				1			
Binary	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1
L09-08	E	A			L	P	C		O	S	O	G	O	U	U	U
	F	S			F	F	O		H	C	V	F	C	V	V	V
	O	1					F		1					3	2	1
HEX	E				0				0				0			
Binary	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
L09-09	B	B	B	B	O	O	O	L	C		E	E	E	E	E	E
	E	E	E	E	L	L	W	C	E		F	F	F	F	F	F
	1	2	3	4	1	2					8	7	6	5	4	3

Table 5-113: Auto-Reset Programming Example

L09-08	Binary	HEX	L09-09	Binary	HEX
Digit 4	0100	4	Digit 4	1110	E
Digit 3	0010	2	Digit 3	0000	0
Digit 2	0000	0	Digit 2	0000	0
Digit 1	0001	1	Digit 1	0000	0

Table 5-114: Binary to Hexadecimal Conversion

Binary Number	Hexadecimal Value
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

5.8 Special Adjustment

- n01 Hunting Prevention
- n02 Auto Frequency Regulator (AFR)

5.8.1 Hunting Prevention

Hunting Prevention is a feature available for the V/f control method only. Occasionally, resonance between the internal control system and the mechanical system causes instability. This is called hunting, and may cause a crane to vibrate at a lower speed (up to 30 Hz) and/or with a light load. The hunting prevention function monitors the motor flux and uses a special control circuit to “smooth out” any peaks in the output current wave form.

Increase the value of N01-02 when hunting is present while driving a light load. Decrease the value of N01-02 when the motor vibrates or stalls while driving a heavy load.

Table 5-115: Hunting Prevention Parameter Settings

Parameter	Display	Function	Range	Default
n01-01	Hunting Prevention Selection *0 Disabled* *1 Enabled (Normal)* *2 Enabled (High Carrier Frequency)*	Hunting Prevention	0–2	1
n01-02	Hunting Prevention Gain Setting	Hunting Prevention Gain	0.00–2.50	1.00
n01-03	Hunting Prevention Time Constant	Hunting Prevention Time Constant	0–500ms	10
n01-05	Hunting Prevent Gain in Reverse	Reverse Hunting Prevention Gain	0.00–2.50	0.00
n01-08	Current Detection Method *0 2-Phases* *1 3-Phases*	Determines how to suppress motor vibration that is caused by leakage current. A setting of 1 may be beneficial when motor wiring distance is long.	0, 1	0
n01-13	DC Bus Stabilization Control *0 Disabled* *1 Enabled*	Oscillation suppression of the DC bus voltage. A setting of 1 may be beneficial if the DC bus voltage is not stable with light loads and OV faults occur.	0, 1	0
n01-14	DC Bus Stabilization Time	Responsiveness of the DC bus voltage oscillation suppression function. Enable by setting N01-13 = 1.	50.0–500.0 ms	100.0
n01-15	PWM Voltage Offset Calibration *0 No Calibration* *1 One Time Calibrate at Next Start* *2 Calibrate Every Time at Start*	Calibration method used to decrease torque/current ripple.	0–2	0
n01-16	Hunting Prevention High Fc Gain	Hunting prevention gain. This parameter functions best with a high carrier frequency. Enable by setting N01-01 = 2.	0.00–2.50	0.5

Parameter	Display	Function	Range	Default
n01-17	Hunting Prevent High Fc Filter	Hunting prevention responsiveness. Enable by setting N01-01 = 2.	0–1000 ms	500
n01-20	Voltage Calibration Duration	Voltage calibration time at start.	10–500 ms	50

5.8.2 Auto Frequency Regulator (AFR)

The Automatic Frequency Regulator (AFR) is a speed feedback detection reduction function for Open Loop Vector that helps with speed stability during sudden load changes.

Table 5-116: Auto Frequency Regulator (AFR) Parameter Settings

Parameter	Display	Function	Range	Default
n02-01	Current Detection Method	Gain of the AFR function as a magnification value.	0.00–10.00	1.00
n02-02	Automatic Freq Regulator Time 1	Time constant that sets the rate of change for the AFR function.	0–2000 ms	50
n02-03	Automatic Freq Regulator Time 2	Time constant that sets the speed difference of the AFR function	0–2000 ms	750
n02-06	OLV Stabilize Level 0 D03-02 = 10, N02-02 = 25 1 D03-02 = 20, N02-02 = 50 2 D03-02 = 30, N02-02 = 75 3 D03-02 = 50, N02-02 = 125 4 D03-02 = 60, N02-02 = 150 5 D03-02 = 80, N02-02 = 200 6 D03-02 = 100, N02-02 = 250 7 D03-02 = 120, N02-02 = 300 8 D03-02 = 140, N02-02 = 350 9 D03-02 = 160, N02-02 = 400 10 D03-02 = 200, N02-02 = 500 11 D03-02 = 240, N02-02 = 600 12 D03-02 = 200, N02-02 = 700 13 D03-02 = 320, N02-02 = 800 14 D03-02 = 360, N02-02 = 900 15 Custom D03-02 and N02-02	Used to stabilize torque in OLV applications.	0–15	1
n02-07	OLV NLB AFR Integral Time	ARF integral time during torque proving for NLB OLV applications.	0–2000 ms	5

5.9 Keypad and VFD Configuration

- o01 Keypad Display
- o02 Keypad Operation
- o03 Maintenance Monitors
- o06 User Stored Data

5.9.1 Keypad Display

The home screen of the keypad can be configured to display various monitors. A maximum of three selected monitors will fit on each screen, and arrow keys can be used to navigate between screens.

Table 5-117: Keypad Display Parameter Settings

Parameter	Display	Function	Range	Default
o01-05	LCD Contrast Adjustment	Adjusts contrast of the keypad display	0–10	5
o01-24 to o01-35	Custom Monitor 1 to 12	Selects a maximum of 12 monitors to be displayed across the home screens.	0, 101–855	O01-24: 101 O01-25: 102 O01-26: 103 O01-27: 106 O01-28: 107 O01-29: 110 O01-30: 111 O01-31: 113 O01-32: 114 O01-33: 115 O01-34: 120 O01-35: 202
o01-36	LCD Backlight Brightness	Intensity of the LCD keypad backlight.	1–5	5
o01-40	Home Screen Display Selection *0 Custom Monitor* *1 Bar Graph* *2 Analog Gauge* *3 Trend Plot*	Monitor display mode for the Home screen.	0–3	0
o01-41	1st Monitor Area Selection *0 +/- Area (-o01-42 ~ o01-42)* *1 + Area (0 ~ o01-42)*	Horizontal range used to display the monitor set in o01-24 (Custom Monitor 1) as a bar graph.	0, 1	0
o01-42	1st Monitor Area Setting	Horizontal axis value used to display the monitor set in o01-24 (Custom Monitor 1) as a bar graph.	0.0–100.0%	100.0
o01-43	2nd Monitor Area Selection *0 +/- Area (-o01-44 ~ o01-44)* *1 + Area (0 ~ o01-44)*	Horizontal range used to display the monitor set in o01-25 (Custom Monitor 2) as a bar graph.	0, 1	0

Parameter	Display	Function	Range	Default
o01-44	2nd Monitor Area Setting	Horizontal axis value used to display the monitor set in o01-25 (Custom Monitor 2) as a bar graph.	0.0–100.0%	100.0
o01-45	3rd Monitor Area Selection *0 +/- Area (-o01-46 ~ o01-46)* *1 + Area (0 ~ o01-46)*	Horizontal range used to display the monitor set in o01-26 (Custom Monitor 3) as a bar graph.	0, 1	0
o01-46	3rd Monitor Area Setting	Horizontal axis value used to display the monitor set in O01-26 (Custom Monitor 3) as a bar graph.	0.0–100.0%	100.0
o01-47	Trend Plot 1 Scale Minimum Value	Minimum value for the horizontal axis used to display the monitor set in O01-24 (Custom Monitor 1) as a trend plot.	-300.0–299.9%	-100.0
o01-48	Trend Plot 1 Scale Maximum Value	Maximum value for the vertical axis used to display the monitor set in O01-24 (Custom Monitor 1) as a trend plot.	-299.9–300.0%	100.0
o01-49	Trend Plot 2 Scale Minimum Value	Minimum value for the horizontal axis used to display the monitor set in O01-25 (Custom Monitor 2) as a trend plot.	-300.0–299.9%	-100.0
o01-50	Trend Plot 2 Scale Maximum Value	Maximum value for the vertical axis used to display the monitor set in O01-25 (Custom Monitor 2) as a trend plot.	-299.9–300.0%	100.0
o01-51	Trend Plot Time Scale Setting	Time scale (horizontal axis) to display the trend plot. When this setting is changed, the VFD automatically adjusts the data sampling time.	1–3600 sec	300
o01-55	Analog Gauge Area Selection *0 +/- Area (-o01-56 ~ o01-56)* *1 + Area (0 ~ o01-56)*	Range used to display the monitor set in O01-24 (Custom Monitor 1) as an analog gauge.	0, 1	1
o01-56	Analog Gauge Area Setting	Value used to display the monitor set in O01-24 (Custom Monitor 1) as an analog gauge.	0.0–100.0%	100.0

5.9.2 Keypad Operation

Table 5-118: Keypad Operation Parameter Settings

Parameter	Display	Function	Range	Default
o02-01	LO/RE Key Function Selection	Pressing the LO/RE Key once displays: “Call Magnetek at 1-866-624-7378”.	0, 1	0
	0 Mode/Service	Firmware Version (U01-14)		
		VFD Specifications		
		Pressing the LO/RE Key a second time:		
		Control Method (A01-02)		
		Motion (A01-03)		
		Speed Reference (A01-04)		
	1 Local/Remote	Pressing the LO/RE key switches operation command between the keypad and the settings of b03-01 and b03-02. Local/Remote mode is not compatible with Run Reference 2 (H01-0x = 1F).		
o02-03	User Parameter Default Value	Store or clear a copy of the parameter settings.	0–2	0
	0 No Change			
	1 Set Defaults	Memorizes up to 150 modified parameters. User defaults can be restored by setting A01-05 = 1110.		
	2 Clear All	Clear user defaults.		
o02-04	Drive Model (KVA) Selection	VFD model.	62–AE	*
		*Default determined by VFD capacity. Use VFD nameplate.		
	62 2003	2003-G+/VG+S5		
	63 2005	2005-G+/VG+S5		
	64 2007	2007-G+/VG+S5		
	65 2008	2008-G+/VG+S5		
	66 2011	2011-G+/VG+S5		
	67 2014	2014-G+/VG+S5		
	68 2017	2017-G+/VG+S5		
	6A 2025	2025-G+/VG+S5		
	6B 2033	2033-G+/VG+S5		
	6D 2047	2047-G+/VG+S5		
	6E 2060	2060-G+/VG+S5		
	6F 2075	2075-G+/VG+S5		
	70 2088	2088-G+/VG+S5		
	72 2115	2115-G+/VG+S5		
	73 2145	2145-G+/VG+S5		
	74 2180	2180-G+/VG+S5		
	75 2215	2215-G+/VG+S5		
	76 2283	2283-G+/VG+S5		
	77 2346	2346-G+/VG+S5		
	78 2415	2415-G+/VG+S5		

Parameter	Display	Function	Range	Default
o02-04	*92 4001*	4001-G+/VG+S5	00–FF	*
	93 4003	4003-G+/VG+S5		
	94 4004	4004-G+/VG+S5		
	95 4005	4005-G+/VG+S5		
	96 4007	4007-G+/VG+S5		
	97 4009	4009-G+/VG+S5		
	99 4014	4014-G+/VG+S5		
	9A 4018	4018-G+/VG+S5		
	9C 4024	4024-G+/VG+S5		
	9D 4031	4031-G+/VG+S5		
	9E 4039	4039-G+/VG+S5		
	9F 4045	4045-G+/VG+S5		
	A1 4060	4060-G+/VG+S5		
	A2 4075	4075-G+/VG+S5		
	A3 4091	4091-G+/VG+S5		
	A4 4112	4112-G+/VG+S5		
	A5 4150	4150-G+/VG+S5		
	A6 4180	4180-G+/VG+S5		
	A7 4216	4216-G+/VG+S5		
	A8 4260	4260-G+/VG+S5		
	A9 4304	4304-G+/VG+S5		
	AA 4371	4371-G+/VG+S5		
	AC 4450	4450-G+/VG+S5		
	AE 4605	4605-G+/VG+S5		
o02-05	Home Mode Freq Ref Entry Mode	ENTER key is used when the frequency reference is set by the keypad. The keypad can simulate a motor operated potentiometer (M.O.P.).	0, 1	0
	0 ENTER Key Required	ENTER Key Required		
	1 Immediate / MOP-style	ENTER Key Not Required		
		NOTE: *This feature cannot be used with infinitely variable speed control.*		
o02-09	Region Code	VFD region. This presets the voltage and frequencies along with the motor power units that are common to the region.	1, 2	1
	1 American Spec			
	2 European Spec			
o02-10	Motor Power Units	Units for motor power.	0, 1	0
	0 HP			
	1 kW			
o02-23	External 24V Powerloss Detection	Display a (L24v) warning if the backup external 24 V power supply is lost when the main circuit power supply is on.	0, 1	0
	0 Disabled			
	1 Enabled			

Parameter	Display	Function	Range	Default
o02-24	LED Light Function Selection *0 Enable Status Ring & Keypad LED* *1 LED Status Ring Disable* *2 Keypad LED Light Disable*	Function of the LED status rings and keypad LED lights.	0–2	0
o02-26	Alarm Display at Ext. 24V Power *0 Disabled* *1 Enabled*	Display an (EP24v) alarm if the main supply power decreases below the UV level. This indicates that the control circuit is still live, but VFD operation is not possible.	0, 1	0

5.9.3 Maintenance Monitors

Table 5-119: Maintenance Monitors Parameter Settings

Parameter	Display	Function	Range	Default
o03-01	Elapsed Operating Time Setting	Cumulative operation time of the VFD in units of 10 hours. Cumulative time can be viewed using monitor Cumulative Operation Time (U04-01). A setting of 30 = 300 hours	0–9999 x 10 Hrs	0
o03-02	Elapsed Operating Time Selection	How the cumulative timer will keep track of the total operation time.	0, 1	1
	0 U04-01 Shows Total Power-up Time	Logs power-on time		
	1 U04-01 Shows Total RUN Time	Logs operation time when the VFD output is active.		
o03-03	Fan Operation Time Setting	Fan Operation Time monitor (U04-03) in units of 10 hours. A setting of 30 = 300 hours	0–9999 x 10 Hrs	0
o03-05	Capacitor Maintenance Setting	Maintenance Monitor for the capacitors. See U04-05 to check when the capacitors may need to be replaced.	0–150%	0
o03-07	Softcharge Relay Maintenance Set	Maintenance Monitor for the precharge relay. See U04-06 to check when the precharge relay may need to be replaced.	0–150%	0
o03-09	IGBT Maintenance Setting	Maintenance Monitor for the IGBTs. See U04-07 for IGBT replacement times.	0–150%	0
o03-11	Fault Trace/History Init (U02/U03)	Fault Trace (U02-xx) and Fault History (U03-xx) reset.	0, 1	0
	0 No Reset	Not cleared.		
	1 Reset	Resets the U02-xx and U03-xx fault history		
o03-12	kWh Monitor Initialization	Reset the monitor data (U04-10 and U04-11).	0, 1	0
	0 No Reset	Not cleared.		
	1 Reset	Resets the U04-10 and U04-11 power meter.		
o03-13	RUN Command Counter @ Initialize	Reset the run command counter monitors (U04-02, U04-24, and U04-25).	0, 1	0
	0 No Reset			
	1 Reset			

Parameter	Display	Function	Range	Default
o03-14	Clear OL/LC/OW Counter	Reset the Overload (OL), Load Check (LC), and Overweight (OW) fault counter (U01-73).	0, 1	0
	0 No Reset	Not cleared.		
	1 Reset	Resets the U01-73 counter.		
o03-22	Time Format	Time display format.	0–2	1
	0 24 Hour Clock			
	1 12 Hour Clock			
	2 12 Hour JP Clock			
o03-23	Date Format	Date display format.	0–2	2
	0 YYYY/MM/DD			
	1 DD/MM/YYYY			
	2 MM/DD/YYYY			
o03-24	bAT Detection Selection	Operation when a low keypad battery alarm (bAT) or keypad time not set alarm (TiM) occurs.	0–2	0
	0 Disable			
	1 Enable (Alarm Detected)			
	2 Enable (Fault Detected)			

5.9.4 User Stored Data

The parameters in the section can be used for data storage. The parameters and their settings have no effect on the performance of the VFD.

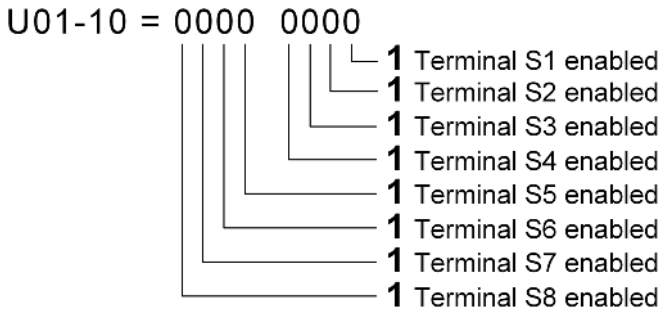
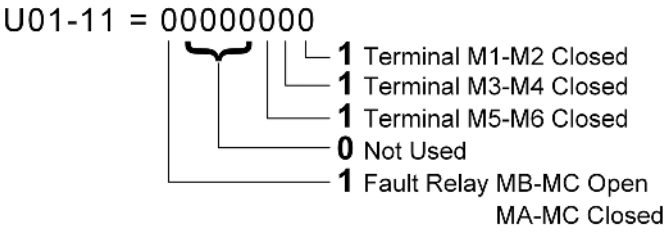
Table 5-120: User Stored Data Parameter Settings

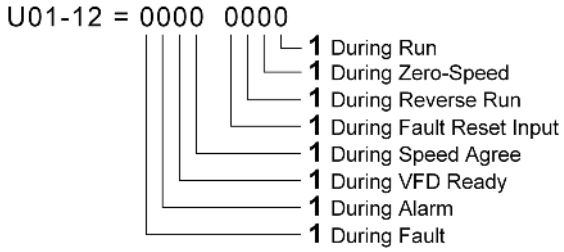
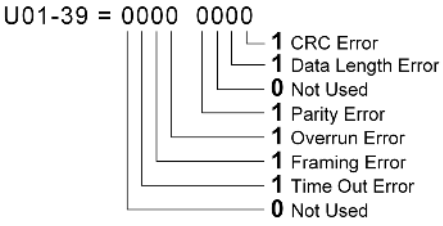
Parameter	Display	Function	Range	Default
o06-01 to o06-16	User Stored Data 0 to 15	User stored data Slot 0 to Slot 15.	0–65535	0

5.10 Monitors

- U01 Operation Status
- U02 Fault Trace
- U03 Fault History
- U04 Maintenance
- U06 Control Status

Table 5-121: Operation Status Monitors

Monitor	Display	Function	Units
U01-01	Frequency Reference	Frequency Reference	Hz
U01-02	Output Frequency	Output Frequency	Hz
U01-03	Output Current	Output Current	A
U01-04	Control Method	Value of A01-02	-
U01-05	Motor Speed	Motor Speed	Hz
U01-06	Output Voltage Reference	Output Voltage (Reference)	VAC
U01-07	DC Bus Voltage	DC Bus Voltage (Measured)	VDC
U01-08	Output Power	Output Power (Calculated)	HP/kW
U01-09	Torque Reference	Torque Reference (Internal)	%
U01-10	Input Terminal Status	Input Terminal Status	-
			
U01-11	Output Terminal Status	Output Terminal Status	-
			

Monitor	Display	Function	Units
U01-12	Drive Status	Operation Status 	-
U01-14	Software Number Flash	Firmware version	-
U01-15	Terminal A1 Level	External Terminal A1 Input level	%
U01-16	Terminal A2 Level	External Terminal A2 Input level	%
U01-17	Terminal A2 Level	External Terminal A3 Input level	%
U01-20	SFS Output Frequency	Output frequency after the soft starter	Hz
U01-24	Option Card MFDO 8 Bits	Output from the option card S4IO - 8 bits.	-
U01-25	Option Card MFDI Lower 8 Bits	Reference value input from the option card (DI-A3 or S4IO) lower 8 bits.	-
U01-26	Option Card MFDI Upper 8 Bits	Reference value input from the option card (DI-A3 or S4IO) upper 8 bits.	-
U01-28	Software Number ROM	ROM ID	-
U01-30	SS Delta Speed	Snap Shaft Delta Speed between Ch1 and Ch2 after gear ratio	RPM
U01-31	Load Weight	Load weight when C10-01 is enabled	C10-06
U01-32	Load Sum Weight	Displays the Load Sum Chain percentage for this hoist and all other hoists.	C10-38
U01-34	oPE Fault Parameter	Parameter number that caused the OPExx or Err (EEPROM write error) error.	-
U01-39	MEMOBUS/Modbus Error Code	Contents of a Modbus error 	-
U01-49	Swing Length	Calculated pendulum swing length. Distance from the hoist drum to the load's center of gravity.	Ft
U01-50	Hook Height	Percentage of Hook height. This will display 0% until the system is homed.	%
U01-51	Motor Revolution	Number of revolutions after Home with respect to Home.	Revs
U01-53	Index Count	Number of motor revolutions the shaft has moved since the beginning of a new Index command.	Revs
U01-54	Input Pulse Monitor	Frequency of pulse train input terminal RP.	Hz
U01-60	Encoder 1 Pulse Counter	Raw PG Channel 1 pulse count 4 pulses = 1 ppr of F01-01	Pulses

Monitor	Display	Function	Units
U01-61	Encoder 2 Pulse Counter	Raw PG Channel 2 pulse count 4 pulses = 1 ppr of F01-01	Pulses
U01-68	Load Check Zone	Load Check zone the VFD is currently running in when an LC fault occurs.	-
U01-69	Load Check Margin	How close the current/torque levels are to the target value for each of the Load Check zones. Values less than zero will cause an LC detection or an LC fault to occur. If the LC fault occurs, the value displayed is the amount the level was below the Load Check zone setting.	%
U01-73	OL/LC Count	Increments a counter after an OL1, OL2, or LC fault occurs. Counter cleared by O03-14.	-
U01-86	Brake Test Torque	Brake breakaway torque; CLV only; MFDI needs to be programmed to “Brake Test”	Ftlb
U01-91	Output Voltage	Displays the internal output voltage reference (pre AVR).	VAC

Table 5-122: Fault Trace Monitors

Monitor	Display	Function	Units
U02-01	Current Fault	Most current fault detected before being reset	-
U02-02	Previous Fault	Most recent fault after being reset	-
U02-03	Frequency Reference @ Fault	Freq ref when the fault was detected	Hz
U02-04	Output Frequency @ Fault	Output freq when the fault was detected	Hz
U02-05	Output Current @ Fault	Output current when the fault was detected	A
U02-06	Motor Speed @ Fault	Motor Speed when the fault was detected	Hz
U02-07	Output Voltage @ Fault	Output voltage when the fault was detected	VAC
U02-08	DC Bus Voltage @ Fault	DC Bus voltage when the fault was detected	VDC
U02-09	Output Power @ Fault	Output power when the fault was detected	HP/kW
U02-10	Torque Reference @ Fault	Torque reference when the fault was detected	%
U02-11	Input Terminal Status @ Fault	Input terminal status when the fault was detected	-
U02-12	Output Terminal Status @ Fault	Output terminal status when the fault was detected	-
U02-13	Operation Status @ Fault	VFD status when the fault was detected	-
U02-14	Elapsed Time @ Fault	Elapsed time when the fault was detected	Hrs
U02-15	SFS Output @ Fault	Speed reference for the soft starter when the fault was detected	Hz
U02-16	q-Axis Current @ Fault	Q-axis current for the motor when the fault was detected	%
U02-17	d-Axis Current @ Fault	D-axis current for the motor when the fault was detected	%
U02-20	Heatsink Temperature @ Fault	Temperature of the heatsink when the fault was detected	°C

Table 5-123: Fault History Monitors

Monitor	Display	Function	Units
U03-01	1st Most Recent Fault	First most recent fault	-
U03-02	2nd Most Recent Fault	Second most recent fault	-
U03-03	3rd Most Recent Fault	Third most recent faults	-
U03-04	4th Most Recent Fault	Fourth most recent fault	-
U03-05	5th Most Recent Fault	Fifth most recent fault	-
U03-06	6th Most Recent Fault	Sixth most recent fault	-
U03-07	7th Most Recent Fault	Seventh most recent fault	-
U03-08	8th Most Recent Fault	Eighth most recent fault	-
U03-09	9th Most Recent Fault	Ninth most recent fault	-
U03-10	10th Most Recent Fault	Tenth most recent fault	-
U03-11	Elapsed Time @ 1st Fault	Elapsed time of the first most recent fault	Hrs
U03-12	Elapsed Time @ 2nd Fault	Elapsed time of the second most recent fault	Hrs
U03-13	Elapsed Time @ 3rd Fault	Elapsed time of the third most recent fault	Hrs
U03-14	Elapsed Time @ 4th Fault	Elapsed time of the fourth most recent fault	Hrs
U03-15	Elapsed Time @ 5th Fault	Elapsed time of the fifth most recent fault	Hrs
U03-16	Elapsed Time @ 6th Fault	Elapsed time of the sixth most recent fault	Hrs
U03-17	Elapsed Time @ 7th Fault	Elapsed time of the seventh most recent fault	Hrs
U03-18	Elapsed Time @ 8th Fault	Elapsed time of the eighth most recent fault	Hrs
U03-19	Elapsed Time @ 9th Fault	Elapsed time of the ninth most recent fault	Hrs
U03-20	Elapsed Time @ 10th Fault	Elapsed time of the tenth most recent fault	Hrs

Table 5-124: Maintenance Monitors

Monitor	Display	Function	Units
U04-01	Cumulative Operation Time	Cumulative operation time of the VFD. The value for the cumulative operation time counter can be reset in parameter O03-01. Use parameter O03-02 to determine if the operation time should start as soon as the power is switched on or only while the Run command is present. The maximum number displayed is 99999, after which the value is reset to 0.	Hrs
U04-03	Cooling Fan Operation Time	Cumulative operation time of the cooling fan. The default value for the fan operation time is reset in parameter O03-03. After the count reaches 99999, the value will reset to 0 and start counting again.	Hrs
U04-04	Cooling Fan Maintenance	Main cooling fan usage time as a percentage of its expected performance life. Parameter O03-03 can reset this monitor.	%
U04-05	Capacitor Maintenance	Main circuit capacitor usage time as a percentage of their expected performance life. Parameter O03-05 can reset this monitor.	%
U04-06	Precharge Relay Maintenance	Soft charge bypass relay maintenance time as a percentage of its estimated performance life. Parameter O04-07 can reset this monitor.	%
U04-07	IGBT Maintenance	IGBT usage time as a percentage of the expected performance life. Parameter O03-09 can reset this monitor.	%
U04-08	Heatsink Temperature	Heatsink temperature.	°C
U04-09	LED Check	Lights all LED segments to verify the display is working properly.	-

Monitor	Display	Function	Units
U04-10	kWh, Lower 4 Digits	VFD output power. The value is a 9 digit number displayed across two monitors, U04-10 and U04-11.	kWH
U04-11	kWh, Upper 5 Digits	-	MWH
U04-13	Peak Hold Current	Highest current value that occurred during run.	A
U04-14	Peak Hold Output Frequency	Output frequency when the value shown in U04-13 occurred.	Hz
U04-16	Motor oL1 Level	Motor overload detection accumulator. 100% is equal to the OL1 detection level. Accumulator is reset when power is cycled.	%
U04-17	Drive oL2 Level	100% = OL2 detection level	%
U04-18	Reference Source	Source for the frequency reference as XY-nn. X: External Reference 1/2 Selection (H01-xx = 1F) • 1: b03-01 (Frequency Reference Selection 1) • 2: b03-15 (Frequency Reference Selection 2) Y-nn: Frequency reference source • 0-01: Keypad • 1-00: Analog (unassigned) • 1-01: Analog terminal A1 • 1-02: Analog terminal A2 • 1-03: Analog terminal A3 • 2-02 to 2-17: Multi-Step Reference 2 to 16, Jog Reference • 3-01: Modbus communications • 4-01: Communication option card • 5-01: Pulse train input • 9-01: Up/Down command	-
U04-19	Modbus Frequency Reference	Frequency reference provided by Modbus (decimal).	%
U04-20	Option Frequency Reference	Frequency reference input by an option card (decimal).	%
U04-21	Run Command Source	Source for the Run command as XY-nn.	-
U04-22	Modbus Command Data	VFD control data set by Modbus communications register no. 0001H as a four-digit hexadecimal number.	-
U04-23	Option Command Data	VFD control data set by an option card as a four-digit hexadecimal number.	-
U04-24	Number of Runs (Low)	Lower 4 digits of the VFD run counter. The run counter appears as an 8-digit number.	-
U04-25	Number of Runs (High)	Upper 4 digits of the VFD run counter. The run counter appears as an 8-digit number.	-
U04-26	OL/LC Count	Counter of OL1, OL2, and LC faults. Counter cleared by O03-14.	-
U04-27	Run Time Elapsed	Run time hours since last timer reset. Set using C12-06. Reset using MFDI or keypad function button.	Hrs
U04-28	Run Time Remaining	C12-06 - U04-27	Hrs
U04-29	On Time Elapsed	On time hours since last timer reset. Set using C12-07. Reset using MFDI or keypad function button.	Hrs
U04-30	On Time Remaining	C12-07 - U04-29	Hrs
U04-31	Brake Cycle Counts	Keypad displays the LONG integer of U04-31. Modbus register stores the LOWER word of Brake Cycles Elapsed. Reset using MFDI or keypad function button.	-

Monitor	Display	Function	Units
U04-33	Brake Cycles Remaining	Keypad displays the LONG integer of U04-31. Modbus register stores the LOWER word of Brake Cycles Remaining. Reset using MFDI or keypad function button.	-
U04-49	Password Challenge	Challenge code for temporary Factory password.	-
U04-52	Torque Reference from Comm	Torque reference received from a communication option card or from Modbus communications as a decimal number.	%

Table 5-125: Control Status Monitors

Monitor	Display	Function	Units
U06-01	Iq Secondary Current	Motor secondary current (Iq) as a percentage of motor rated secondary current.	%
U06-02	Id Excitation Current	Motor excitation current (Id) as a percentage of motor rated secondary current.	%
U06-03	ASR Input	Input value when using ASR control.	%
U06-04	ASR Output	Output value when using ASR control.	%
U06-05	Output Voltage Reference (Vq)	Output voltage reference (Vq) for the q-axis.	VAC
U06-06	Output Voltage Reference (Vd)	Output voltage reference (Vd) for the d-axis.	VAC
U06-07	q-Axis ACR Output	Output value for current control relative to motor secondary current (q-axis).	%
U06-08	d-Axis ACR Output	Output value for current control relative to motor secondary current (d-axis).	%
U06-17	Energy Save Coefficient	Total time of direction of motor rotation detections for Speed Estimation Speed Searches. This value adjusts B06-26.	-
U06-21	Offset Frequency	Total value of b08-05 to b08-07 (Offset Frequency 1 to 3) with Add Offset Frequency 1 to 3 (H01-xx = 44 to 46).	%
U06-31	Torque Detect Monitor	Monitors the torque reference or the output current after applying the filter set to L06-07 (Torque Detection Filter Time).	%
U06-36	Comm Errors-Host	Number of inter-CPU communication errors. When the VFD is powered off, this value resets to 0.	-
U06-37	Comm Errors-Sensor	Number of inter-CPU communication errors. When the VFD is powered off, this value resets to 0.	-
U06-48	ASIC Comm Errors	Number of inter-ASIC communication errors. When the VFD is powered off, this value resets to 0.	-

6 Troubleshooting

6.1 Troubleshooting the VFD

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.

6.1.1 Maintenance and Inspection

This section describes basic maintenance and inspection procedures for the VFD.

Table 6-1: Maintenance and Inspection

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, compressed air (57-86 psi).
Printed Circuit Board (PCB)	Accumulation of conductive dust or oil	Blow with dry, compressed 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, compressed air (57-86 psi).

Alarms and Faults are described as follows:

- Fault: Brake is set, operation indicator lights flash, fault is displayed on keypad, and fault relay MB-MC is activated. The reset key must be pressed, a digital input set for fault reset must be enabled, or power must be cycled in order to continue operation.
- Alarm: Brake does not set, operation continues, alarm is displayed on the keypad and ALM LED flashes, fault relay is not activated.

Table 6-2: Motor Related Issues

Symptom	Corrective Action
Analog frequency reference is not stable. (drifting)	1. Stabilize the analog source. 2. Increase H03-13. 3. Increase b05-01 or b05-02.
No motor rotation.	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 VFD (U01-10). 4. Check if motor is stalled due to excessive load.
Motor rotation is in the wrong direction.	1. Verify FWD/REV or UP/DN is correct at the interface card. 2. Match wiring to the phase order of motor leads T1, T2, T3. 3. Change motor rotation (b03-04).
Motor rotates, but at minimum speed only.	1. Check wiring of speed inputs. 2. Verify speed reference setting (A01-04). 3. Verify reference and run source settings (b03-01, -02). 4. Verify reference priority setting (b01-18). 5. Verify encoder direction (VG+).
Motor RPM too high or too low.	1. Compare motor nameplate with E02 parameters. 2. Check maximum frequency setting (E01-04). 3. Check minimum frequency setting (E01-09).

Table 6-3: VFD Faults and Alarms

Display	Description	Corrective Action	Fault	Alarm
AFbL Analog Feedback Lost	**Analog Feedback Lost Fault.** The 4-20mA analog input signal is less than 0.2% or higher than 99.8% per the settings of C03-50 and H03-19.	1. Check the wiring of the device connected to the analog input. 2. Verify proper setting of C03-50 and H03-19.	X	
AS1 Anti-Shock 1	**Anti-Shock Indicator.** When Anti-Shock is triggered, the fault or alarm will be displayed on the keypad for the duration of time set via C07-22.	1. No action is required.	X	X
bb Base Block	**External Baseblock Indicator.** The baseblock signal is the result of a digital input. The baseblock indicates that the VFD's output has been disabled. The motor will begin coasting when the baseblock input is received while running. If a RUN command is still present when the bb alarm is cleared, the VFD will continue operation at the currently commanded frequency.	1. Check H01-01 through H01-08 for proper programming. 2. Check input status (U01-10).		X
BE0 Brake Answerback Lost	**Brake Answerback Lost During Run Alarm.** While running, the multi-function input brake answerback (H01-0x = 58) is lost.	1. Check brake answerback circuit. 2. Check input status. (U01-10)	X	X
BE0-2 Brake 2 Answerback Lost	**Brake 2 Answerback Lost During Run Alarm.** Brake Answerback 2 closes during operation.	1. Check brake answerback circuit. 2. Check input status. (U01-10)	X	X

Display	Description	Corrective Action	Fault	Alarm
BE1 Rollback Detect	**Torque Proving Fault.** The BE1 fault indicates that the VFD has released the brake, but not started to accelerate the motor when it detects excessive encoder feedback. A BE1 fault will occur if the pulses received during the BE1 detection time (C08-04) are greater then the expected number of pulses (C08-05).	1. Increase the value of C08-21. 2. ***See Section 6.2 on page 236***.	X	
BE2 No Current	**Torque Proving Fault.** Before the brake is released, the VFD's current/torque did not reach Initial Brake Release Torque level (C08-16) within the IFB OK timer (C08-02).	1. Ensure the motor has been Auto-tuned successfully. 2. Confirm that the holding brake is closed. 3. If a power limit switch is used, ensure the switch is closed. 4. Decrease the value of C08-02 to no less than 0.5 seconds. 5. Decrease the value of C04-02 to no less than 5. 6. Decrease the value of C08-16 to no less than 50.	X	
BE3 Brake Release NG	**Brake Release Fault.** The BE3 fault indicates that the VFD has released the brake and commanded the VFD to run, but it has not detected the expected encoder feedback. A BE3 fault will occur if the pulses received during the BE3 detection time (C08-06) are less than the expected number of pulses (C08-07).	1. ***See Section 6.2 on page 236***.	X	
BE4 Brake Answer 1	**Brake Answerback, Brake not Released Alarm.** At Start, Brake Answerback is not input within predetermined time (C08-04) after brake release command is output brake not released.	1. Check brake answerback circuit. 2. Increase the value of C08-04. 3. Check input status (U01-10).	X	X
BE4-2 Brake 2 Answer 1	**Brake 2 Answerback, Brake not Released Alarm.** Brake 2 Answerback does not release during Brake Release state.	1. Check brake answerback circuit. 2. Increase the value of C08-04. 3. Check input status (U01-10).	X	X
BE5 Brake Answer 2	**Brake Answerback At Stop Alarm.** At Stop, Brake Answerback signal is not removed within predetermined time (C08-11) after brake release command is removed—brake not closed.	1. Check brake answerback circuitries. 2. Increase the C08-11 time.	X*	X
BE5-2 Brake 2 Answer 2	**Brake 2 Answerback at Stop Alarm.** Brake 2 Answerback does not close during Brake Set time.	1. Check brake answerback circuitries. 2. Increase the C08-11 time.	X*	X
BE6 Brake Slipping	**Brake Proving Alarm.** The BE6 alarm indicates that the VFD has commanded the brake to set but detected excessive encoder feedback. This occurs if the number of pulses received during the BE6 detection time (C08-12) is greater than the expected number of pulses (C08-13).	1. Check the brake. 2. ***See Section 6.2 on page 236***.	X*	X
BE6-2 Brake 2 Slipping	**Brake 2 Slipping Alarm.** Load slipping while Brake 2 is closed.	1. Check the brake. 2. ***See Section 6.2 on page 236***.	X*	X
BE7 Brake Welded	**Brake Answerback Fault.** At Power Up, Brake Answerback is on—brake not closed.	1. Check if brake is closed. 2. Check brake answerback circuitry.	X	

Display	Description	Corrective Action	Fault	Alarm
BE7-2 Brake 2 Welded	**Brake 2 Answerback Fault.** Brake Answerback is on at power-up.	1. Check if brake is closed. 2. Check brake answerback circuitry.	X	
BE8 Brake Slipping	**Brake Slipping Alarm.** The BE8 alarm indicates that the VFD has detected excessive encoder feedback while not running. This occurs if the encoder frequency exceeds C08-23; Load Float will be enabled, and the brake will remain closed.	1. Check the brake. 2. Check C08-23 for proper programming.	X*	X
boL Tr BOLerr	**Braking Transistor Overload Fault.** The braking transistor reached its overload level.	1. The wrong braking resistor is installed. 2. Select the correct braking resistor. 3. Install an external braking module.	X	X
BUS Option Com Err	**Option Card Communication Error.** Communication to the option card was lost.	1. Check all connections.	X	X
CALL Option ComCall	**Serial Communication Transmission Error.** Control data is not received correctly after power supply is turned ON for 2 sec.	1. Check serial device connections. 2. Ensure VFD is properly programmed for serial communication.		X
Cant Run Drive Not Ready	User is trying to give a run command while a FWD or REV is present at Power Up.	1. Toggle the run command input. 2. Check H01-01 to H01-08 programming.		X
Can't SW Motor Running	**Can't Switch - Motor Running.** The user is trying to enable or disable the Digital Changeover MFDI (H01-XX = 1D), while the motor is still running.	1. Allow the motor to come to a stop before enabling or disabling the Digital Changeover MFDI.		X
CE Serial Com Err	**Communication Error.** Serial communications disruption. Fault or alarm defined by H05-04.	1. Check serial connections. 2. Check H05-01 through H05-05 for proper programming.	X	X
COF Current Offset	**Current Offset Fault.** The VFD automatically adjusts the current offset, the calculated value exceeded the allowable setting range.	1. Press reset. 2. Check brake. 3. Check brake contact.	X	
CPF00 CPF01	**Control Circuit Error.** There is a self-diagnostic error in the control circuit, or the connector on the keypad is damaged.	1. Cycle power to the VFD. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board. 3. Replace the keypad if it is damaged.	X	
CPF02 Internal A/D Err	**A/D Conversion Error.** An A/D conversion error or control circuit error occurred. The control circuit is damaged.	1. Cycle power to the VFD. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.	X	

Display	Description	Corrective Action	Fault	Alarm
CPF03 CPU Serial Err	**Control Board Connection Error.** Connection error between the control board and the VFD. Can be caused by a connection error, or the VFD failing to operate properly due to noise interference.	**Connection Error:** 1. Turn off the power and check the connection between the control board and the VFD. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board. **Noise Interference:** 1. Check the various options available to minimize the effects of noise. 2. Counteract noise in the control circuit, main circuit, and ground wiring. 3. Use only recommended cables or other shielded line. Ground the shield on the controller side or the VFD input power side. 4. Ensure that other equipment such as switches or relays do not cause noise. Use surge suppressors if required. 5. Separate all communication wiring from VFD power lines. Install an EMC noise filter to the VFD power supply input.	X	
CPF06 EEPROM Error	**EEPROM Memory Data Error.** An Error in the data saved to EEPROM. Can be caused by an error in the EEPROM control circuit, or the power supply being switched off while parameters are being saved to the VFD.	**Error in the EEPROM Circuit** 1. Turn off the power and check the connection between the control board and the VFD. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board. **Parameter Save Interruption** Reinitialize (A01-05 = 5432).	X	
CPF07 CPF08 Terminal Board Err	**Terminal Board Connection Error.** There is a fault connection between the terminal board and the control board.	1. Turn off the power and reconnect the terminal board. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.	X	
CPF20 CPF21 CPU Err	**Control Circuit Error.** Hardware is damaged.	1. Cycle power to the VFD. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.	X	

Display	Description	Corrective Action	Fault	Alarm
CPF22 Internal A/D Err	**Hybrid IC Failure.** Hybrid IC failure on the power board.	1. Cycle power to the VFD. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.	X	
CPF23 CPU COM Err	**Control Board Connection Error.** Connection error between the control board and the VFD. The hardware is damaged.	1. Turn off the power and check the connection between the control board and the VFD. 2. If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.	X	
CPF24 Signal Err	**VFD Unit Signal Fault.** The VFD capacity cannot be detected correctly (VFD capacity is checked when powered up). The hardware is damaged.	If the problem continues, replace the control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.	X	
CPF25 No Terminal Board	**Terminal Board Not Connected.** Terminal board is not connected correctly.	Reconnect the terminal board to the connector on the VFD, then cycle power.	X	
CPF26– CPF34 CPF40– CPF45	**Control Circuit Error.**	1. Cycle power. 2. Ensure that the terminal board is seated properly. 3. Set A01-05 = 5550. 4. Replace control board and/or terminal board.	X	
DEV Speed Deviation	**Speed Deviation Fault.** Occurs when the deviation of the speed reference and speed feedback exceeds the regulation level, F01-27 for the time F01-28. Alarm or fault defined by F01-26.	***See Section 6.2 on page 236***.	X	X
DIR Direction Fault	**Direction Fault.** Occurs when the VFD detects that a hoist is configured so FWD direction is DOWN motion.	1. Verify FWD is shown on the keypad when moving in the UP direction. Change B03-04 if REV is shown when going UP. 2. If correct travel direction has been verified, set C08-34 = 0 to disable DIR detection.	X	
EF External Fault	Both FORWARD/UP and REVERSE/DOWN commands are input at same time for 500 msec or longer.	1. Check control input wiring. 2. Check the sequence of operation.		X
EF0 Option External Fault	External fault input from communication option card. Alarm or fault defined by F06-03.	Check communication option card connection and signals.	X	X
EF1 External Fault 1	External fault occurs on Terminal S1. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-01 for proper programming. 2. Check the conditions for input terminal S1.	X	X

Display	Description	Corrective Action	Fault	Alarm
EF2 External Fault 2	External fault occurs on Terminal S2. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-02 for proper programming. 2. Check the conditions for input terminal S2.	X	X
EF3 External Fault 3	External fault occurs on Terminal S3. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-03 for proper programming. 2. Check the conditions for input terminal S3.	X	X
EF4 External Fault 4	External fault occurs on Terminal S4. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-04 for proper programming. 2. Check the conditions for input terminal S4.	X	X
EF5 External Fault 5	External fault occurs on Terminal S5. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-05 for proper programming. 2. Check the conditions for input terminal S5.	X	X
EF6 External Fault 6	External fault occurs on Terminal S6. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-06 for proper programming. 2. Check the conditions for input terminal S6.	X	X
EF7 External Fault 7	External fault occurs on Terminal S7. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-07 for proper programming. 2. Check the conditions for input terminal S7.	X	X
EF8 External Fault 8	External fault occurs on Terminal S8. Alarm or fault defined by the External Fault Selection table (***Table 5-88 on page 182***).	1. Check H01-08 for proper programming. 2. Check the conditions for input terminal S8.	X	X
ERR EEPROM R/W Err	**EEPROM Read/Write Fault.** EEPROM internal data did not match when initializing the parameter.	1. Cycle Power. 2. User initialize (A01-05=1110). 3. Replace Control board.	X	
FAn Cooling FAN Err	**Internal Fan Fault.** Internal cooling fan has malfunctioned. Alarm or fault defined by L08-32.	1. Cycle power to the VFD. 2. Check for fan operation. 3. Verify the fan elapsed time with U04-03 and verify the fan maintenance timer with U04-04. 4. Replace fan.	X	X
GF Ground Fault	During operation, the VFD sums the currents of all three motor phases. Ideally, the sum should always equal zero. If the sum is greater than 50% of the VFD rated output current, a GF occurs.	1. Disconnect motor from VFD 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.	X	

Display	Description	Corrective Action	Fault	Alarm
HBB or HBBf Hardware Baseblock	**Hardware Baseblock.** The flashing Hardware Baseblock signal is a result of either of the Safe Disable inputs being open. The motor will begin coasting when the Hardware Baseblock signal is open, and the brake relay digital output will open.	1. Check signal status at the input terminals H1 and H2. 2. Check the Sink/Source Selection for the digital inputs. 3. If the Safe Disable function is not utilized, verify that H1 and H2 jumpers are installed correctly. 4. Replace either the control board or the entire VFD.		X
HCA High Current	**High Current Alarm.** VFD current exceeded overcurrent warning level (150% of the rated current).	1. Reduce the load. 2. Check the motor capacity.		X
KLX Klixon	**Klixon Circuit Alarm.** Input by MFDI H01-0x = 56 or 57.	1. Check Motor for Overtemp. 2. Check Klixon Circuit.		X
LC Load Check Err	**Load Check Fault.** Load is greater than specified amount. Alarm or fault defined by C05-02.	1. Reduce Load. 2. Check Load Check sequence setup (C05-xx).	X	X
LC Done Load Check Done	**Load Check Done Alarm.** This alarm is displayed after the LC set up process is done. The alarm will clear when the Down command is pressed and complete the LC set up process.	None.		X
LF Output Phase Loss	An open phase occurred at the VFD output.	1. Check for broken wires in output cable. 2. Check for open winding in the motor. 3. Check for loose terminals	X	
LF2 Output Current Imbalance	**Output Current Imbalance.** One or more of the phases in the output current are lost.	1. Check for faulty wiring or poor/loose connections on the output side of the VFD. 2. Correct the wiring. 3. Measure the line-to-line resistance for each motor phase. Ensure all values match. 4. Replace the motor.	X	
LL1 Lower Limit 1 Err	**Lower Limit 1—SLOW DOWN Indicator.** Lower Limit 1—SLOW DOWN is input (switch status is changed).	1. May not require corrective action. 2. Check the Limit Switches position. 3. Check the Limit Switches condition.		X
LL2 Lower Limit 2 Err	**Lower Limit 2—STOP Indicator.** Lower Limit 2—STOP is input (switch status is changed).	1. May not require corrective action. 2. Check the Limit Switches position. 3. Check the Limit Switches condition.		X
MNT Maintenance Reqd	**Maintenance Required Alert.** Running time has exceeded C12-05	Reset timer by H01-0x = 5A or depress Mode/Service key three times and enter within 2 seconds.		X

Display	Description	Corrective Action	Fault	Alarm
oC Over Current	**Over Current Detected.** Output current exceeds 200% of VFD rated output current.	1. Check for a phase-to-phase short in the motor or wiring using a megger. 2. Extend the acceleration/ deceleration time. 3. Check torque limit setting. 4. ***See Section 6.2 on page 236***.	X	
oH Heatsnk Over temp	**Overheat Pre-Alarm.** Heatsink is overheating. The temperature of the VFD heatsink exceeded the setting in L08-02.	1. The VFD cooling fan has stopped. 2. Reduce the ambient temperature.	X	X
oH1 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 24 VDC cooling fan.	1. Ensure the heat sink cooling fans are functioning. 2. Ensure the heat sink is free from dirt and debris. 3. Ensure the VFD's ambient temperature is within specification. 4. Replace the 24 VDC fan. 5. Replace the heat sink thermistor(s).	X	
oH2 Overheat 2	**Overheat Alarm.** Signal is input by external terminal. H01-0x=39			X
oH3 Motor Overheat 1	**Motor Overheating 1.** Thermistor analog input detected motor overheating. See L01-03. Alarm defined by L01-03.	1. Check the motor rated current value, E02-01. 2. Increase cycle time or reduce the load.		X
oH4 Motor Overheat 2	**Motor Overheating 2.** Thermistor analog input detected motor overheating. See L01-04.		X	
oL1 Motor Overloaded	**Motor Overload Fault.** VFD output exceeded the motor overload level. Alarm or fault defined by L06-08.	1. Check setting of motor full load Amps (E02-01). 2. Reduce the load.	X	X
oL2 VFD Overloaded	**VFD Overload Fault.** VFD output exceeded the overload level.	1. Reduce the load. 2. Extend the acceleration time.	X	X
oPR Oper Disconnect	**Keypad Disconnected.** The keypad is removed while the VFD is running, and the run command was initiated via the keypad RUN key.	1. Secure the keypad. 2. Verify O02-06 setting.	X	X
oS Over Speed	**Overspeed Fault.** The motor has exceeded the programmed detection level and time. This is typically caused by an overshoot condition due to an over-responsive ASR loop. If the VFD is programmed to closed loop vector "torque control" mode, and no load is present, an overspeed fault will typically occur. Alarm or fault defined by F01-23.	1. Check the Automatic Speed Regulator settings, D04 sub group. 2. Check setting of F01-24, F01-25. 3. Verify proper encoder PPR setting, F01-01.	X	X
oT1 Overtorque Det 1	**Overtorque Detection Level 1.** Defined by L06-02. Alarm or fault defined by L06-01.	Check for proper programming for L06-02 and L06-03.	X	X
oT2 Overtorque Det 2	**Overtorque Detection Level 2.** Defined by L06-05. Alarm or fault defined by L06-04.	Check for proper programming for L06-05 and L06-06.	X	X

Display	Description	Corrective Action	Fault	Alarm
oV DC Bus Overvolt	**Overvoltage Fault.** The main circuit direct current voltage exceeded the overvoltage level.	1. Extend the deceleration time. 2. Check DBU operation. 3. Check the resistor. 4. Check the line voltage.	X	
oV DC Bus Overvolt	**Overvoltage Fault.** Overvoltage occurs during stop. Main circuit DC voltage rises above the detection level while the VFD output is off.	Check the line voltage.		X
PF Input Phase Loss	**Input Phase Loss Fault.** VFD input power supply has open phase.	1. Check the line voltage and fuses. 2. Remove power. 3. Tighten input terminals.	X	
PGO-1-S PGO-1-H PG Open Ch1	**Pulse Generator Channel 1 Fault or Alarm.** PGO-1-S, software detected signal loss. PGO-1-H, hardware detected signal loss. Alarm or fault defined by F01-21.	1. Check for proper direction of encoder feedback. 2. ***See Section 6.2 on page 236***.	X	X
PGO-2-S PGO-2-H PG Open Ch2	**Pulse Generator Channel 2 Fault or Alarm.** PGO-2-S, software detected signal loss. PGO-2-H, hardware detected signal loss. Alarm or fault defined by F01-21.	1. Check for proper direction of encoder feedback. 2. ***See Section 6.2 on page 236***.	X	X
PULSDEV Pulse Deviation	**Pulse Deviation Fault.** The pulse input into terminal RP compared to the pulse output from terminal MP is greater than the percentage programmed into H06-09.	1. During operation, verify that there is an incoming pulse signal on the RP terminal, viewable at U01-54. 2. Increase the deviation margin percentage in H06-09.	X	
RF Tr RFerr	**Braking Resistor Fault.** The resistance of the braking resistor is too low, or the proper braking resistor has not been installed.	Verify correct braking resistor.	X	
RH DynBrk Resistor	**Braking Resistor Overheat Fault.** Deceleration time is too short and excessive regenerative energy is flowing back into the VFD.	Verify correct braking resistor.	X	
ROC Analog Rate of Change Fault	**Analog Rate of Change Fault.** The analog input signal changed more than C03-51 percent over a 100ms period.	1. Check the wiring of the device connected to the analog input. 2. Verify proper setting of C03-51.	X	
RR DynBrk Transistr	**Braking Transistor Fault.** Internal Braking transistor failed.	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.	X	
SC Short Circuit	**Short Circuit Fault.** The VFD has detected an output short circuit condition.	1. Disconnect the motor. 2. Check for a short circuit in the motor or wiring using a megger.	X	

Display	Description	Corrective Action	Fault	Alarm
SLC Slack Cable Detection	**Slack Cable Fault.** A hoist slack cable condition occurred.	1. May not require corrective action. 2. Check setting of Slack Cable Detection (C11-xx).		X
SNAP Snapped Shaft	**Snapped Shaft Fault.** A drive train discontinuity has been detected. Alarm or fault defined by C11-09.	1. Check for loose/broken coupling. 2. Check for loose encoder(s). 3. Check for broken shaft.	X	X
SNR Follower Not Ready	**Load Share follower not ready alarm.** The Load Share follower VFD ready signal has been lost.	1. Check for loose/broken wires. 2. Check digital input settings.		X
TST END Test Mode Timer Expired	Exceeded the 10 minute time limit.	1. Ensure the test mode MFDI is OFF. 2. Reset the fault (Fault Reset MFDI, Keypad, or cycle power). 3. Ensure that test mode is not used for normal operation.		X
UL1 Upper Limit 1 Err	**Upper Limit 1—SLOW DOWN Indicator.** Upper Limit 1—SLOW DOWN switch status is changed.	1. May not require corrective action. 2. Check the limit switches location and condition.		X
UL2 Upper Limit 2 Err	**Upper Limit 2—STOP Indicator.** Upper Limit 2—STOP switch status is changed.	1. May not require corrective action. 2. Check the limit switches location and condition.		X
UL3 Upper Limit 3 Err	**Upper Limit 3—Weighted Stop.** Upper Limit weighted limit switch tripped.	1. May not require corrective action. 2. Check the position and condition of the limit switch. 3. Check the conditions of/for terminal H01-xx (U01-10).	X	X
UT1 Undertorque Det 1	**Undertorque Detection 1.** The current is less than L06-02 for more than L06-03. Alarm or fault defined by L06-01.	1. Check settings. 2. Check motor coupling.	X	X
UT2 Undertorque Det 2	**Undertorque Detection 2.** The current is less than L06-05 for more than L06-06. Alarm or fault defined by L06-04.	1. Check settings. 2. Check motor coupling.	X	X
UV DC Bus Undervolt	**Undervoltage Fault.** Undervoltage status occurs for more than 2 sec during STOP.	1. Check the power wiring. 2. Replace any bad branch fuses. 3. Check collector system.		X
UV1 DC Bus Undervolt	**Undervoltage 1 Fault.** Undervoltage status occurs for more than 2 sec during RUN command.	1. Check power wiring. 2. Correct the line voltage. 3. Check collector system.	X	
UV2 CTL PS Undervolt	**Undervoltage 2 Fault.** The VFD detected a loss of the 24V logic power supply voltage.	1. Check power wiring. 2. Correct the line voltage. 3. Check collector system.	X	

Display	Description	Corrective Action	Fault	Alarm
UV3 MC Answerback	**MC Fault.** The pre-charge contactor opened during operation.	1. Check power wiring. 2. Correct the line voltage. 3. Check collector system. 4. Wait 30-45 seconds before restarting VFD.	X	
voF Vout Det Error	**Output Voltage Detection Fault.** Problem detected with the voltage on the output side of the VFD.	Replace the VFD.	X	X

* These faults only occur when latched.

Table 6-4: Operation Error Table

Display	Description	Corrective Action
oPE01	**VFD Capacity Setting Error.** VFD kVA setting range is incorrect.	Check that o02-04 matches the VFD model.
oPE02	**Setting Out of Range Error.** Parameter setting is out of range.	1. With the fault displayed on the keypad, press the ENTER key to reveal the “Out of Range” parameter via the U01-34 monitor. 2. Verify that E02-03 is < E02-01. 3. Verify E01-05 is within range. 4. Compare modified parameters with defaults. 5. Cycle Power.
oPE03	**Digital Input Setting Error.** Multiple digital inputs are set to the same value, besides for F (Not Used).	Check the settings for H01-xx and F03-xx and, verify that the same setting is not used twice.
oPE05	**Frequency Reference Source Selection Error.** A frequency reference is assigned to an option card that is not connected.	1. Cycle power. 2. Ensure that the option card is seated properly into the option card slot. 3. Replace option card.
oPE06	**Missing PG Card Error.** A closed loop control method was selected, and the required encoder feedback option card (PG-X3 or PG-B3) is not installed.	1. Install the required encoder option card. 2. Remove power and reset the option card.
oPE07	**Analog Input Setting Error.** H03-02, H03-06, and/or H03-10 multi-function analog input settings are set to the same value.	Check the function selections.
oPE08	**Parameter Selection Error.** A parameter has been changed that is not available in the present control method.	1. Undo the last parameter change (if known). 2. Scroll through modified parameters for obvious setting errors. 3. Perform a user initialize (A01-05=1110). **CAUTION: All settings will be restored to the factory defaults.**
oPE10	**V/f Parameter Setting Error.** The V/f pattern parameters do not satisfy these conditions: • For Motor 1: E01-09 ≤ E01-07 < E01-06 ≤ E01-11 ≤ E01-04 • For Motor 2: E03-09 ≤ E03-07 < E03-06 ≤ E03-11 ≤ E03-04	Check parameters E01-04 to E01-11.
oPE11	**Carrier Frequency Parameter Error.** These parameters are set at the same time: • D10-05 > 6 • D10-04 > D10-03 ***NOTE:*** *D10-04 is disabled when D10-05 > 7, during which the carrier frequency becomes D10-03.*	Check parameters d10-02 to d10-05.

Display	Description	Corrective Action
oPE13	**Pulse Monitor Selection Error.** H06-06 = 101, 102, 105, or 116 (Terminal MP Monitor Selection = Frequency Reference, Output Frequency, Motor Speed, or SFS Output Frequency) has not been set when H06-07 = 0 (Terminal MP Frequency Scaling = 0 Hz).	Check parameters H06-06 and H06-07.
oPE15	**Torque Control Setting Error.** More than one parameter is selecting torque control at the same time. • d05-01 = 1 (Torque Control Selection = Torque Control) • H01-xx = 68 (MFDI = Torque Control)	Check parameter d05-01 and the MFDI settings.
oPE19	**Incompatible Setting of Stopping Method and Control Method.**	Satisfy b03-03 ≥ 6 and A01-02 ≤ 1.
oPE20	**Electronic Programmable Limit Switch Setting Error.**	1. Check if C03-14 = 0, 2 or 4: C03-19 > C03-18 > C03-17 > C03-16 2. Check if C03-14 = 1 or 3: C03-19 < C03-18 < C03-17 < C03-16
oPE33	**Digital Output Selection Error.** The H02-60, H02-63, and H02-66 (MFDO secondary functions) can't be used if their primary counterparts (H02-01, H02-02, or H02-03) are set to an inverse function.	Check the H02-xx MFDO settings.
oPE40	**Hook Height Home MFDI Setting Error.** Hook Height Home is set to UL2 N.O., LL2 N.O., or UL3 N.O., but no MFDI is programmed for the corresponding function.	1. Check C03-14 settings. 2. Check H01-xx settings.
oPE41	**Dual Brake MFDO.** MFDO programmed to A, but another not programmed to 0. Must have 0 and A programmed.	1. Check MFDO settings (H02-xx = 0 and H02-xx = A). 2. Set C08-33 to Disabled.
oPE42	**E-Lift and Motor 2 MFDI Error.** The E-Lift and Motor 2 MFDIs are both set concurrently.	Check that multiple MFDIs are not set to 44 or 144 (Motor 2 Selection) and 4A (Emergency Lift Enable) at the same time.
oPE43	**Bi-Polar Speed Incompatibility Error.** A selected feature is incompatible with the Bi-Polar Analog speed reference.	1. Select a different A01-04 (Speed Reference). 2. Check Modified Parameter list to determine which feature triggered the error.

6.2 Troubleshooting Encoder and Brake Faults and Alarms

The faults and alarms in this section may involve the encoder feedback or motor brake system. During system startup, these faults and alarms are often caused by parameters that need to be adjusted. However, if the system has been running for some time, this usually indicates a problem with the physical system and adjusting the parameters should only be done after the physical system has been inspected.

6.2.1 DEV–Speed Deviation Fault

Definition

A Speed Deviation fault means that the VFD output is not able to follow the commanded speed reference. This is possible if there is not enough torque available to follow the internal speed reference. Therefore, speed deviations may occur when the VFD is at its programmed torque limit. In addition, if the VFD receives erratic, or missing, encoder pulses, speed deviations are also possible. If the initial VFD tuning and start-up of the system was successfully completed and the crane has been in operation without any faults, then the occurrence of this fault most likely indicates that something mechanical with the system has changed or VFD parameters were changed (i.e., failed encoder, load snag, crane overload, change in acceleration or deceleration times, etc.).

Corrective Action

1. Do **NOT** continue to operate the hoist.

NOTE: *Continued attempts to operate the hoist with speed deviation faults can result in loss of control of the load.*

2. As a precaution, the Load Float Time (C08-10) should be set to zero until the source of the speed deviation fault has been determined and corrected.
3. Verify if the load has snagged or if there is a load on the hook that exceeds capacity.
4. Check the alignment of the encoder pulse wheel and sensor head, or the encoder shaft coupling. If the pulse wheel is misaligned or the shaft coupling is loose, the VFD may get erratic pulse signals or no signals at all causing a Speed Deviation or PGO fault. Make repairs before attempting to operate the hoist.
5. The encoder cable should be checked for damage.
   - Each of the encoder wires should be checked for continuity, and visually checked for damage.
   - The wires should be checked for shorts between any two wires, including the shield or ground.
6. If the encoder feedback system checks out mechanically and electrically, then check for something in the mechanical system that might be resisting normal operation. One example may be the brake is not opening fully and drag is preventing the system from operating at commanded speed.
7. If the encoder feedback system checks out and no other mechanical problems can be found, then something must have changed in the control system.
   - Check if the accel or decel times have been changed (B05-01, B05-02, C01-02, C01-04, or C01-05).
   - Check if a function that provides an alternate acceleration or deceleration rate has been enabled or changed (Quick Stop, Reverse Plug Simulation, Accel/Decel Time 2).

   If one of these times is too short, causing a torque limit, then the times should be extended.
8. If none of the above steps has identified a valid problem(s), only then should the speed deviation detection levels be adjusted.

NOTE: *The reaction time necessary to stop a load is limited to the lift of the hoist and the response time of the hoist brakes. It is desirable to have as fast a fault reaction time as possible without causing nuisance faults.*

9. Increase Encoder Speed Deviation Level to no more than 30% (F01-27).
10. After the corrective action has been taken and the fault no longer occurs, set the Load Float Time (C08-10) back to its initial value.

6.2.2 PGO-X-S/PGO-X-H–Pulse Generator Signal Fault

Definition

A Pulse Generator Signal fault indicates that the VFD has detected a problem with encoder feedback. This fault will typically occur if the VFD doesn't receive any encoder feedback pulses while it is commanded to run or encoder wiring has a discontinuity.

NOTE: *The "X" in PGO-X-S and PGO-X-H depicts either a "1" if the PG-X3 is seated in connector CN5-C, or a "2" if the PG-X3 is seated in connector CN5-B.*

Corrective Action

1. Do **NOT** continue to operate the hoist in the event of a PGO-X-H fault or repeated PGO-X-S faults.

NOTE: *Continued attempts to operate the hoist with PGO faults can result in loss of control of the load.*

2. As a precaution, the Load Float Time (C08-10), should be set to zero until the source of the PGO Fault has been determined and corrected. Disable PGO hardware detection with F01-06 or F01-16.
3. Check the alignment of the encoder pulse wheel and sensor head, the encoder shaft coupling, or check for a failed encoder sensor head. If one of these conditions exists the VFD may get erratic pulse signals or no signal at all causing a Speed Deviation or PGO fault. Make repairs before attempting to operate the hoist.
4. If the encoder appears to have no mechanical problems, the encoder cable should be checked for damage.
   - Each of the encoder wires should be checked for continuity.
   - The wires should be checked for shorts between any two wires.
   - The wires should be checked for shorts to the shield or ground.
   - Visually inspect the cable for damage that may be causing intermittent problems.
5. If the encoder feedback system checks out, then check for physical obstruction to motor rotation such as the brake failing to open.
6. After corrective action has been taken and the fault no longer occurs, set the Load Float Time (C08-10) back to its initial value.

6.2.3 BE1–Rollback Fault

Definition

A BE1 fault indicates that the VFD has released the brake, but has not started to accelerate the motor when it detects more than the expected encoder feedback. A BE1 fault will occur if the pulses received during the BE1 detection time (C08-04) are greater than the expected number of pulses (C08-05). This is typically caused by the VFD/motor having insufficient torque to accelerate the load.

Correction Action

1. Check the encoder cable for damage and proper grounding. Replace it if a problem is found.
   - Each of the encoder signals should be checked for excessive noise.
   - The shielded encoder cable should be properly grounded.
   - Visually inspect the cable for damage that may be causing intermittent problems.
2. Check the alignment of the encoder pulse wheel and sensor head, or the encoder shaft coupling. If the pulse wheel is misaligned or the shaft coupling is loose the VFD may get erratic pulse signals and cause a BE1 fault. Make repairs before attempting to operate the hoist.
3. If none of the steps identified a problem(s), only then should the BE1 detection parameters be adjusted.

NOTE: *It is desirable to have as fast a fault reaction time as possible without causing nuisance faults.*

4. The Rollback Pulse Count (C08-05) setting should remain as close to 800 pulses as possible.

6.2.4 BE2–Torque Proving Fault

Definition

A BE2 fault indicates that the VFD was unable to develop sufficient torque before releasing the brake. A BE2 fault occurs when the torque (U01-09) is less than the Initial Forward Brake Release Torque (C08-16) during the current feedback timer (C08-02) at start. This typically indicates that the brake is slipping while torque is building up in the motor before releasing the brake.

NOTE: *This fault typically indicates a failed brake. Power should NOT be removed while this alarm is active and the load should be moved to a safe location and lowered before proceeding with any corrective action.*

Corrective Action

1. Check the brake for proper operation and adjustment. If the brake does not set, is improperly adjusted or is excessively worn, it may not be able to hold the load. This can cause encoder pulses to be received while torque is building up in the motor.
2. Check the encoder cable for damage and proper grounding. Replace it if a problem is found.
   - Each of the encoder signals should be checked for excessive noise.
   - The shielded encoder cable should be properly grounded.
   - Visually inspect the cable for damage that may be causing intermittent problems.
3. Check the alignment of the encoder pulse wheel and sensor head, or the encoder shaft coupling. If the pulse wheel is misaligned or the shaft coupling is loose the VFD may get erratic pulse signals and cause a BE2 fault. Make repairs before attempting to operate the hoist.
4. Perform a Brake Torque test to verify the torque matches brake specifications.
5. If none of the above steps has identified a valid problem(s), the brake may need to be replaced.

NOTE: *The Current Feedback Timer (C08-02) should be set as low as possible without causing nuisance faults.*

6.2.5 BE3–Brake Release Fault

Definition

The BE3 fault indicates that the VFD has released the brake and commanded the VFD to run, but has not detected the expected encoder feedback. A BE3 fault will occur if the pulses received during the BE3 detection time (C08-06) are less than the expected number of pulses (C08-07).

NOTE: *Depending on the condition of the crane and control system, the load may drift during the BE3 detection time until the brake is again set. If giving a run command, the BE3 fault should be detected before a PGO fault would be detected.*

Corrective Action

1. Check the brake for proper operation. If the brake does not open the VFD will not see the proper number of encoder pulses returned and will post this fault.
2. Check the alignment of the encoder pulse wheel with the sensor head, or the encoder shaft coupling. If the pulse wheel is misaligned or the shaft coupling is loose the VFD will get erratic pulse signals or no signals at all possibly causing a BE3 fault. Make repairs before attempting to operate the hoist.
3. If the encoder appears to have no mechanical problems, the encoder cable should be checked for damage and replaced if a problem is found.
   - Each of the encoder wires should be checked for continuity.
   - The wires should be checked for shorts between any two wires.
   - The wires should be checked for shorts to the shield or ground.
   - Visually inspect the cable for damage that may be causing intermittent problems.
4. If none of the above steps has identified a valid problem(s), only then should the BE3 detection parameters be adjusted.

NOTE: *It is desirable to have as fast a fault reaction time as possible without causing nuisance faults.*

5. Ensure that C08-04 is equal to the brake's mechanical delay time.
6. Increase the value of C08-06 to no more than 1 second.
7. Decrease the value of C08-07 to no less than 10 pulses.

6.2.6 BE6–Brake Proving Alarm

Definition

The BE6 alarm indicates that the VFD has commanded the brake to set but it has detected more encoder pulse feedback than expected. A BE6 alarm will occur if the number of pulses received during the BE6 detection time (C08-12) is greater than the expected number of pulses (C08-13). The VFD will initiate Load Float for the duration of the BE6 alarm.

NOTE: *This alarm typically indicates a failed brake. Power should NOT be removed while this alarm is active and the load should be moved to a safe location and lowered before proceeding with any corrective action.*

NOTE: *The BE6-Brake Proving Alarm is re-verified during every brake set, including brake sets that occur after the BE6 alarm is posted.* ***The BE6 alarm will turn off if a successful brake check occurs after an initial BE6 alarm condition is posted*** *based on the setting of C08-19.*

Corrective Action

1. Check the brake for proper operation and adjustment. If the brake does not set, is improperly adjusted or is excessively worn, it may not be able to hold the load. This will allow the encoder pulses received during the detection time to exceed the set point.
2. Check the encoder cable for damage and proper grounding. Replace it if a problem is found.
   - Each of the encoder signals should be checked for excessive noise.
   - The shielded encoder cable should be properly grounded.
   - Visually inspect the cable for damage that may be causing intermittent problems.
3. Check the alignment of the encoder pulse wheel with the sensor head, or the encoder shaft coupling. If the pulse wheel is misaligned or the shaft coupling is loose the VFD may get erratic pulse signals possibly causing a BE6 alarm. Repairs to the encoder wheel or shaft coupling should be made immediately before again attempting to operate the hoist.
4. If none of the above steps has identified a valid problem(s), only then should the BE6 detection parameters be adjusted.

NOTE: *It is desirable to have as fast an alarm reaction time as possible without causing nuisance alarms.*

5. Ensure that C08-11 is equal to the brake's mechanical delay time.
6. Increase the value of C08-13.

6.2.7 BE8–Brake Slipping Alarm

Definition

A BE8 alarm indicates that the VFD has detected that the brake is slipping after the brake is set. A BE8 alarm will occur if the load is moving greater than the Brake Slip Detection Speed (C08-23) when the brake is set. When this occurs, the VFD will go into load float while the brake is set.

NOTE: *This alarm typically indicates a failed brake. Power should NOT be removed while this alarm is active and the load should be moved to a safe location and lowered before proceeding with any corrective action.*

Corrective Action

1. Check the brake for proper operation and adjustment. If the brake does not set, is improperly adjusted or is excessively worn, it may not be able to hold the load and encoder pulses will be received.
2. Check the encoder cable for damage and proper grounding. Replace it if a problem is found.
   - Each of the encoder signals should be checked for excessive noise.
   - The shielded encoder cable should be properly grounded.
   - Visually inspect the cable for damage.
3. Check the alignment of the encoder pulse wheel and sensor head, or the encoder shaft coupling. If the pulse wheel is misaligned or the shaft coupling is loose the VFD may get erratic pulse signals and cause a BE8 alarm. Make repairs before attempting to operate the hoist.
4. If none of the above steps has identified a valid problem(s), the brake may need to be replaced.

NOTE: *It is desirable to have as fast an alarm reaction time as possible without causing nuisance alarms.*

6.2.8 OC–Over Current Fault

Definition

An over current fault is caused if the output current exceeds 200% of the VFD rated output current. This fault can be caused by short circuits in the wiring or in the motor, or caused by parameters that are not adjusted properly. Another cause of this fault could be erratic or no encoder feedback. In the last instance, the VFD is trying to command the motor to hold a position, but due to the encoder problem, is unable to find the correct position. This would cause the VFD to increase current output to the motor in an attempt to correct the position.

Corrective Action

1. Check the motor wiring and the motor itself for a short between phases.
2. Check the alignment of the encoder pulse wheel and sensor head, or the encoder shaft coupling. If the pulse wheel is misaligned or the shaft coupling is loose the VFD may get erratic pulse signals or no signals at all. Make repairs before attempting to operate the hoist.
3. If the encoder has no mechanical problems, the encoder cable should be checked for damage.
   - Each of the encoder wires should be checked for continuity.
   - The wires should be checked for shorts between any two wires.
   - The shield should be checked for proper grounding.
   - The wires should be checked for shorts to the shield or ground.
   - Visually inspect the cable for damage.
4. If none of the above steps has identified a valid problem(s), check the torque limit parameters (C07-01 to C07-04). If these parameters have been changed to allow a higher torque value, it could cause OC faults.

NOTE: *Changing these parameters may cause DEV or OL faults. Only a trained technician should make modifications. It is desirable to have a fast fault reaction time without causing nuisance faults.*

6.3 Auto-Tuning Errors

The following are errors during auto-tuning and corrective actions. If any of the following errors are detected, the keypad will display the error text and the motor will coast to stop, if running. No fault or alarm output is triggered.

Table 6-5: Error Display and Corrective Actions

Display	Description	Corrective Action
ATL	**Auto-Tune Travel Limit Error.** A travel limit was encountered during an Auto-Tune.	• Decouple the motor and rerun the Auto-Tune. • Move the crane to a safer location and retry.
Er-01	**Motor Data Error.** Motor data input fault for auto-tuning. Relationship between motor output and motor rated current fault. Relationship between input motor rated current and set no-load current fault (at vector control method and line-to-line resistance tuning.)	• Check input data. • Check VFD and motor capacity. • Check motor rated current and no-load current.
Er-02	**Alarm.** An alarm is detected during auto-tuning.	• Check input data. • Check wirings. • Check load.
Er-03	**STOP Key Input.** The stop key is pressed during auto-tuning.	
Er-04	**Line-to-Line Resistance Error.** Auto-tuning is not completed within the expected time. The auto-tuning is outside the parameter setting.	• Check input data. • Check motor wiring. • If a motor and a load are connected, disconnect the motor from machinery system.
Er-05	**No-load Current Error.** Auto-tuning is not completed within the expected time. The auto-tuning is outside the parameter setting.	
Er-08	**Rated Slip Error.** Auto-tuning is not completed within the expected time. The auto-tuning is outside the parameter setting.	
Er-09	**Acceleration Error.** The motor did not accelerate at the expected time.	• Increase b05-01 (acceleration time). • If C07-01 and C07-02 (torque limit value) are decreased, increase values. • If a motor and a load are connected, separate the motor from the load.
Er-10	**Motor Direction Error.** The encoder signal lines are not properly connected to the VFD; the motor direction and PG direction are opposite; or the load pulled the motor in the opposite direction of the speed reference and the torque exceeded 100%.	• Check and correct wiring to the PG encoder. • Check the motor speed monitor U01-05 while manually turning the motor forward. If the sign displayed is negative, change the setting of parameter F01-02. • Uncouple the motor from the load and restart Auto-Tuning.
Er-11	**Motor Speed Error (Rotational tuning only).** The motor speed was over 100% during the auto-tune.	• Increase b05-01 (acceleration time). • If a motor and a load are connected, separate the motor from the load.
Er-12	**Current Detection Error.** Current exceeded the motor rated current.	• Release brake. • Check for open motor lead.
Er-13	**Leakage Inductance Error.** Auto-tuning did not finish within the set time.	• Check the Auto-Tune parameters. • Check motor wiring.
End 1	**Excess Rated Voltage Setting (Rotational tuning only).** The torque reference was more than 20% during Auto-Tune or the no-load current after Auto-Tune is more than 80%.	• Check the Auto-Tune parameters. • Disconnect the motor from the load.

Display	Description	Corrective Action
End 2	**Motor Iron Core Saturation Coefficient Error (Rotational tuning only).** Since the motor iron core saturation coefficient could not be auto-tuned within the set time, tentative value is set in the iron core saturation coefficient.	• Check the Auto-Tune parameters. • Check motor wiring. • Disconnect the motor from the load.
End 3	**Rated Current Setting Error.** Motor current during tuning was greater than the set value.	• Check E02-01.
End 4	**Adjusted Slip Calculation Error.** The slip that was calculated is outside the allowable range.	• Make sure the Auto-Tuning data is correct. • Execute Rotational Auto-Tuning instead. If not possible, try Non-Rotational Auto-Tuning 2.
End 5	**Resistance Tuning Error.** The resistance value that was calculated is outside the allowable range.	• Double check the data that was entered for the Auto-Tuning process. • Check the motor and wire connection for damage.
End 6	**Leakage Inductance Error.** The leakage inductance value that was calculated is outside the allowable range.	• Double check the data that was entered for the Auto-Tuning process.
End 7	**No-Load Current Error.** The entered no-load current value was outside the allowable range, or Auto-Tuning results were less than 5% of the motor current.	• Check and correct faulty motor wiring. • Double check the data that was entered for the Auto-Tuning process.

6.4 Option Card Faults

Check the following items first when an option card fault occurs on the VFD:

- Communication cable connections.
- Make sure the option card is properly installed to the VFD.
- Did a momentary power loss interrupt communications?

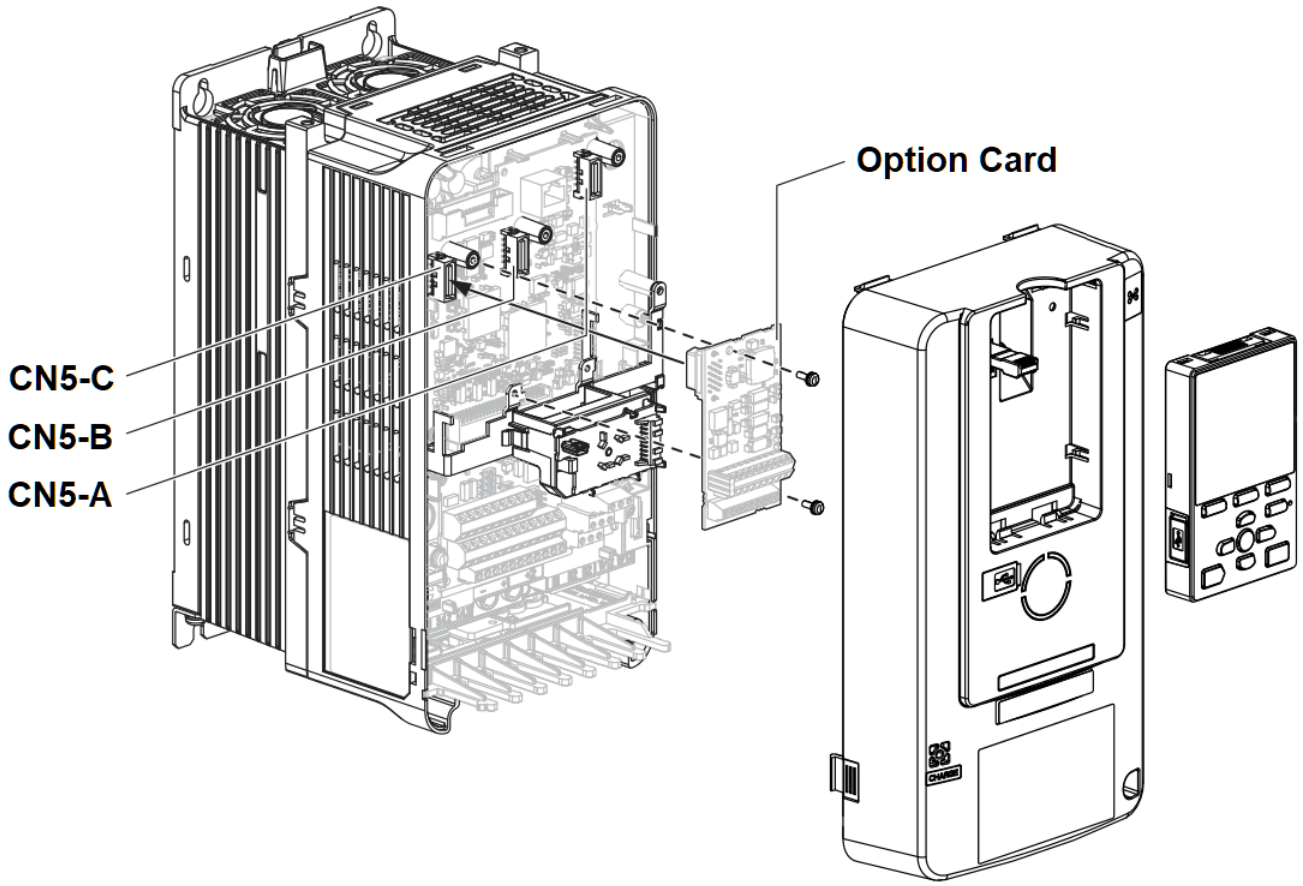


Figure 6-1: Option Card Ports

Table 6-6: Fault Codes for Option Cards

Display	Card	Description	Cause	Possible Solution
oFA00	SI- AO-A3 DI-A3 DO-A3 S4IO	**Option Error (CN5-A).** Option Card Connection Error at Port CN5-A.	• The option card installed into port CN5-A is incompatible. • A PG- or SI- option card is connected to port CN5-A.	• Confirm that the VFD supports the option card. • PG option cards are supported in ports CN5-B and CN5-C only. Connect the PG option card to the correct port. • SI- option cards are supported in port CN5-A only. Connect the SI- option card to the correct port.
oFA01	SI- AO-A3 DI-A3 DO-A3 S4IO	**Option Fault (CN5-A).** Option Card at Port CN5-A is not properly connected or is faulty.	• Option at port CN5-A was changed during run.	• Turn the power off and check the connectors between the VFD and the option.
oFB00	AO-A3 DO-A3 S4IO	**Option Error (CN5-B).** Option Card connection error at VFD port CN5-B.	• The option card installed into port CN5-B is incompatible. • A communication option card has been installed in option port CN5-B.	• Confirm that the VFD supports the option card. • Communication option cards are only supported in port CN5-A. It is not possible to install more than one communication option.
oFB01	AO-A3 DO-A3 S4IO	**Option Fault (CN5-B).** Option Card at Port CN5-B is not properly connected or is faulty.	• Option at port CN5-B was changed during run.	• Turn the power off and check the connectors between the VFD and the option.
oFB02	AO-A3 DO-A3 S4IO	**Option Fault (CN5-B).** Two of the same option cards are connected simultaneously.	• Duplicate type of option card is connected to ports CN5-A, CN5-B, and CN5-C.	• AI-A3/DI-A3/SI-: These option cards may only be connected to port CN5-A. • AO-A3/DO-A3: Both of these options can't be connected at the same time.
oFC00	AO-A3 DO-A3 S4IO	**Option Error (CN5-C).** Option Card Connection Error at Port CN5-C.	• The option card installed into port CN5-C is incompatible. • A communication option card has been installed in option port CN5-C.	• Confirm that the VFD supports the option card. • Communication option cards are only supported in port CN5-A. It is not possible to install more than one communication option.
oFC01	AO-A3 DO-A3 S4IO	**Option Fault (CN5-C).** Option Card at Port CN5-C is not properly connected or is faulty.	• Option at VFD port CN5-C was changed during run.	• Turn off the power and check the connectors between the VFD and the option.
oFC02	AO-A3 DO-A3 S4IO	**Option Fault (CN5-C).** Two of the same option cards are connected simultaneously.	• Duplicate type of option card is connected to ports CN5-A, CN5-B, and CN5-C.	• AI-A3/DI-A3/SI-: These option cards may only be connected to port CN5-A. • AO-A3/DO-A3: Both of these options can't be connected at the same time.

Display	Card	Description	Cause	Possible Solution
oFA03 to oFA17	SI- AO-A3 DI-A3 DO-A3 S4IO	Option Card Fault at Option Port CN5-A.	• Option card or hardware is damaged.	• Cycle power to the VFD. • If the problem continues, replace the option card, control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.
oFA30 to oFA43	SI-	Communication Card Fault at Option Port CN5-A.	• Option card or hardware is damaged.	• Cycle power to the VFD. • If the problem continues, replace the option card, control board, or the entire VFD. Contact Magnetek for instructions on replacing the control board.
oFB03 to oFB17	AO-A3 DO-A3 S4IO	Option Card Fault at Option Port CN5-B.	• Option card or hardware is damaged.	• Cycle power to the VFD. • If the problem continues, replace the option card, control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.
oFC03 to oFC17	AO-A3 DO-A3 S4IO	Option Card Fault at Option Port CN5-C.	• Option card or hardware is damaged.	• Cycle power to the VFD. • If the problem continues, replace the option card, control board or the entire VFD. Contact Magnetek for instructions on replacing the control board.

6.5 Copy Function Errors

The table below lists the messages and errors that may appear when using the Copy function.

When executing the tasks offered by the Copy function, the keypad will indicate the task being performed. When an error occurs, a code appears on the keypad to indicate the error. Note that errors related to the Copy function do not trigger the fault relay. To clear an error, simply press any key on the keypad and the error display will disappear.

NOTE:

1. *Whenever using the copy function, the VFD should be fully stopped.*
2. *The VFD will not accept a Run command while the Copy function is being executed.*
3. *Parameters can only be saved to a VFD when the model, control method, and firmware version match.*

Table 6-7: Copy Function Error Displays

Display	Description	Corrective Action
CPyE	**Error Writing Data.** Failed writing parameters.	Attempt to write parameters again.
CSEr	**Control Mode Mismatch.** The keypad is broken.	Replace the keypad.
dFPS	**VFD Model Mismatch.** The parameters being restored to the VFD are different than those in the backup.	Examine the VFD model being backed up along with the destination VFD model.
iFEr	**Keypad Communication Error.** • A communication error occurred between the VFD and the keypad. • A non-compatible cable is being used to connect the keypad and the VFD.	• Check the cable connection.
ndAT	**Model, Voltage Class, Capacity Mismatch.** • The VFD from which the parameters were copied and the VFD to which the parameters will be written have different electrical specifications, capacities, are set to different control methods, or are different models. • The device being used to write the parameters is blank and does not have any parameters saved on it.	• Make sure model numbers and specifications are the same for both VFDs. • Make sure all connections are correct, and copy the parameter settings onto the keypad.
vAEr	**Voltage Class, Capacity Mismatch.** The VFD from which the parameters were copied and the VFD on which the Verify mode is being performed have different electrical specifications or are a different capacity.	Make sure electrical specifications and capacities are the same for both VFDs.
vFyE	**Parameter Settings Mismatch.** Indicates that parameter settings that have been Read and loaded onto the keypad are different.	Restore or backup the parameters again.

6.6 Power Section Check

WARNING

Do NOT touch any circuit components while main power is on or immediately after main power is turned off. You must wait until the red “CHARGE” lamp is extinguished, which may take up to 10 minutes for the DC bus voltage to drop to a safe level. Failure to adhere to this warning could result in serious injury.

To perform a power section check, remove the VFD’s main and control wiring from the terminal strips. Obtain reading as specified in the table below, and ensure that the reading falls within the normal reading range.

Table 6-8: Analog Ohmmeter (R x 1 Scale) or Digital Multimeter (Diode Test)

Device	VFD Terminal		Normal Reading (Analog Meter)	Normal Reading (Digital Meter)
	Positive Lead	Negative Lead		
Input Rectifier Bridge	L1	+	7–100 Ω	0.299 ~ 0.675 VDC
	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
Output Transistors	T1	+	7–100 Ω	0.299 ~ 0.675 VDC
	T2	+		
	T3	+		
	-	T1		
	-	T2		
	-	T3		
	T1	-	Infinite Ω	OL Displayed
	T2	-		
	T3	-		
	+	T1		
	+	T2		
	+	T3		
Braking Diode	B2	B1	10 Ω	0.299 ~ 0.675 VDC
	B1	B2	Infinite Ω	OL Displayed
	B2	-	Infinite Ω	OL Displayed
	-	B2	Infinite Ω	0.299 ~ 0.675 VDC

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

6.7 Terminal Board (24 VDC) Replacement Procedure

WARNING

Do NOT touch any circuit components while AC main power is on or immediately after the main AC power is disconnected from the VFD. 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.

NOTE: *When handling circuit boards always use electrostatic discharge protection. Keep the boards in the ESD bag as long as you can. Do not lay the board on any surfaces without ESD protection. When handling, always hold the board from the edges and do not touch the components. Installation should be performed only by qualified personnel who are familiar with this type of equipment and the hazards involved.*

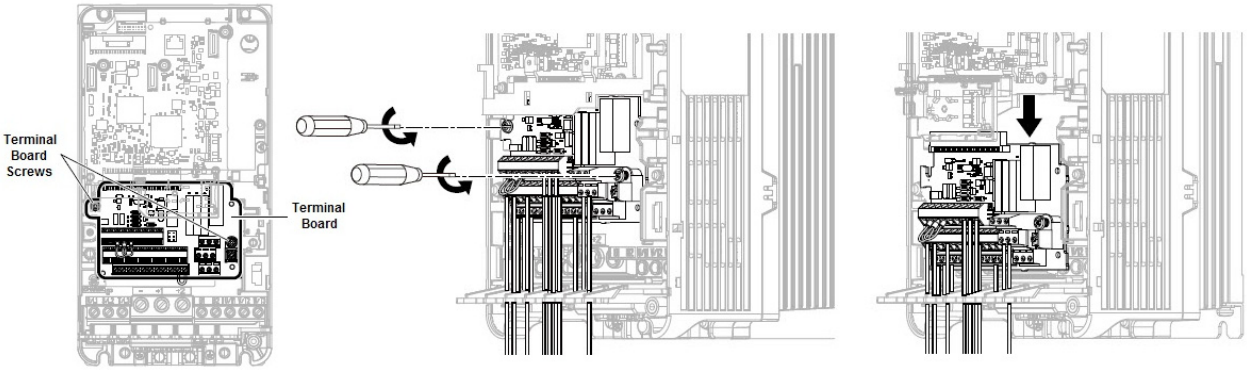


Figure 6-2: Terminal Board Removal

Removal Process

The following process explains how to remove the 24 VDC terminal board from the VFD. Installing the new terminal board consists of the same steps, but in reverse. No additional programming is required before or after the new terminal board is installed.

1. Remove the keypad and front cover(s) to access the terminal board.
2. Loosen the two screws securing the terminal board.
3. Slide the terminal board in a downward direction to detach itself from the control board.

Appendix A: Parameter Listing

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
A01-01	Access Level Selection	2	0–3	-	0101	***Page 67***
A01-02	Control Method Selection	G+: 0 VG+: 3	0, 2, 3	-	0102	***Page 67***
A01-03	Motion	G+: 1 VG+: 2	0–2	-	1600	***Page 68***
A01-04	Speed Reference	1*	0–6	-	1601	***Page 68***
A01-05	Initialize Parameters	0	0, 1110, 2220	-	0103	***Page 73***
A01-06	Password	-	-	-	0104	***Page 73***
A01-13	X-Press Legacy Method	0	0-1	-	1603	***Page 74***
A02-01	User Parameter 1	-	-	-	0106	***Page 74***
A02-02	User Parameter 2	-	-	-	0107	***Page 74***
A02-03	User Parameter 3	-	-	-	0108	***Page 74***
A02-04	User Parameter 4	-	-	-	0109	***Page 74***
A02-05	User Parameter 5	-	-	-	010A	***Page 74***
A02-06	User Parameter 6	-	-	-	010B	***Page 74***
A02-07	User Parameter 7	-	-	-	010C	***Page 74***
A02-08	User Parameter 8	-	-	-	010D	***Page 74***
A02-09	User Parameter 9	-	-	-	010E	***Page 74***
A02-10	User Parameter 10	-	-	-	010F	***Page 74***
A02-11	User Parameter 11	-	-	-	0110	***Page 74***
A02-12	User Parameter 12	-	-	-	0111	***Page 74***
A02-13	User Parameter 13	-	-	-	0112	***Page 74***
A02-14	User Parameter 14	-	-	-	0113	***Page 74***
A02-15	User Parameter 15	-	-	-	0114	***Page 74***
A02-16	User Parameter 16	-	-	-	0115	***Page 74***
A02-17	User Parameter 17	-	-	-	0116	***Page 74***
A02-18	User Parameter 18	-	-	-	0117	***Page 74***
A02-19	User Parameter 19	-	-	-	0118	***Page 74***
A02-20	User Parameter 20	-	-	-	0119	***Page 74***
A02-21	User Parameter 21	-	-	-	011A	***Page 74***
A02-22	User Parameter 22	-	-	-	011B	***Page 74***
A02-23	User Parameter 23	-	-	-	011C	***Page 74***
A02-24	User Parameter 24	-	-	-	011D	***Page 74***
A02-25	User Parameter 25	-	-	-	011E	***Page 74***
A02-26	User Parameter 26	-	-	-	011F	***Page 74***
A02-27	User Parameter 27	-	-	-	0120	***Page 74***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
A02-28	User Parameter 28	-	-	-	0121	***Page 74***
A02-29	User Parameter 29	-	-	-	0122	***Page 74***
A02-30	User Parameter 30	-	-	-	0123	***Page 74***
A02-31	User Parameter 31	-	-	-	0124	***Page 74***
A02-32	User Parameter 32	-	-	-	0125	***Page 74***
b01-01	Reference 1	15.00*	0.00–E01-04	Hz	0280	***Page 78***
b01-02	Reference 2	30.00*	0.00–E01-04	Hz	0281	***Page 78***
b01-03	Reference 3	60.00*	0.00–E01-04	Hz	0282	***Page 78***
b01-04	Reference 4	0.00*	0.00–E01-04	Hz	0283	***Page 78***
b01-05	Reference 5	0.00*	0.00–E01-04	Hz	0284	***Page 78***
b01-06	Reference 6	0.00	0.00–E01-04	Hz	0285	***Page 78***
b01-07	Reference 7	0.00	0.00–E01-04	Hz	0286	***Page 78***
b01-08	Reference 8	0.00	0.00–E01-04	Hz	0287	***Page 78***
b01-09	Reference 9	0.00	0.00–E01-04	Hz	0288	***Page 78***
b01-10	Reference 10	0.00	0.00–E01-04	Hz	028B	***Page 78***
b01-11	Reference 11	0.00	0.00–E01-04	Hz	028C	***Page 78***
b01-12	Reference 12	0.00	0.00–E01-04	Hz	028D	***Page 78***
b01-13	Reference 13	0.00	0.00–E01-04	Hz	028E	***Page 78***
b01-14	Reference 14	0.00	0.00–E01-04	Hz	028F	***Page 78***
b01-15	Reference 15	0.00	0.00–E01-04	Hz	0290	***Page 78***
b01-16	Reference 16	0.00	0.00–E01-04	Hz	0291	***Page 78***
b01-17	Jog Reference	6.00*	0.00–E01-04	Hz	0292	***Page 78***
b01-20	Inf-Var Start Speed	6.00	0.00–E01-04	Hz	02A6	***Page 78***
b01-21	Inf-Var Max Reference 1	60.00	0.00–E01-04	Hz	02A7	***Page 78***
b01-22	Inf-Var Max Reference 2	60.00	0.00–E01-04	Hz	02A8	***Page 78***
b02-01	Frequency Reference Upper Limit	100.0*	0.0–110.0	%	0289	***Page 80***
b02-02	Frequency Reference Lower Limit	CLV: 0.0 else: 2.0	0.0–110.0	%	028A	***Page 80***
b02-04	Alternate Frequency Upper Limit	0.0	0.0–110.0	%	0298	***Page 80***
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b03-02	Run Command Selection 1	1*	0–3	-	0181	***Page 81***
b03-03	Stopping Method Selection	G+: 0* VG+: 6*	0, 1, 4, 6	-	0182	***Page 82***
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b03-06	Digital Input Reading	1	0–1	-	0185	***Page 84***
b03-08	Run Command Select in PRG Mode	0	0–2	-	0187	***Page 85***
b03-15	Frequency Reference Selection 2	0	0–5	-	01C4	***Page 85***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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b05-01	Acceleration Time 1	5.00*	0.00–60.00	sec	0200	***Page 87***
b05-02	Deceleration Time 1	3.00*	0.00–60.00	sec	0201	***Page 87***
b05-03	Acceleration Time 2	10.00	0.00–60.00	sec	0202	***Page 87***
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b05-10	Accel/Decel Time Switchover Freq	0.0	0.0–300.0	Hz	022F	***Page 88***
b05-11	Switch Frequency Compare	0	0–1	-	0206	***Page 88***
b05-12	Acceleration Time 3	3.00	0.00–60.00	sec	0207	***Page 88***
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C03-05	LL0/LL1 Deceleration Time	1.0	0.0–25.5	sec	1627	***Page 95***
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C03-10	LL3/UL3 Action	1	0–5	-	162C	***Page 95***
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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C04-06	Load Share Fault Time	1.5	0.0–25.5	sec	1715	***Page 103***
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C05-03	Load Check Holding Time	0.20	0.00–2.55	sec	1725	***Page 105***
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C05-07	Detection Margin at Speed Agree	10	0–50	%	1728	***Page 106***
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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C07-20	Anti-Shock Smoothing Time	0.20	0.00–0.50	sec	05ED	***Page 112***
C07-22	Anti-Shock Alarm Display Time	4	0–30	sec	017B	***Page 112***
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C07-41	Traverse Torque Limiter Window	2.0	0.5–10.0	Hz	047B	***Page 113***
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C08-02	BE2 Torque Detection Time	1.00	0.00–2.55	sec	16B0	***Page 115***
C08-03	BE2 Minimum Brake Release Torque	10	0–200	%	16B1	***Page 115***
C08-04	BE1 Rollback Time	0.30	0.00–2.55	sec	16B2	***Page 115***
C08-05	BE1 Rollback Pulse Count	200	0–15000	Pulses	16B3	***Page 115***
C08-06	BE3 Brake Release Time	0.30	0.00–2.55	sec	16B4	***Page 115***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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C08-09	Zero Speed Level	0.5	0.0–5.0	Hz	16B7	***Page 115***
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C08-11	BE5 Brake Set Time	0.7	0.0–25.5	sec	16B9	***Page 115***
C08-12	BE6 Detection Time	5.0	0.0–25.5	sec	16BA	***Page 115***
C08-13	BE6 Maximum Pulse Count	50	0–2000	Pulses	16BB	***Page 116***
C08-14	Brake Set Hold Speed	CLV: 0.0 else: 2.0	0.0–25.5	%	16BC	***Page 116***
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C11-10	Snap Shaft Delta Speed	30	0–900	RPM	169B	***Page 120***
C11-11	Snap Shaft Delay Time	250	0–2000	ms	169C	***Page 120***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
C11-12	Snap Shaft Gear Ratio Numerator	10000	1–65535	-	169D	***Page 120***
C11-13	Snap Shaft Gear Ratio Denominatr	10000	1–65535	-	169E	***Page 120***
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C12-07	Maintenance On Timer	0	0–32000	Hrs	16EB	***Page 123***
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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d01-03	DC Inject Braking Time at Start	0.00	0.00–10.00	sec	018B	***Page 135***
d01-04	DC Inject Braking Time at Stop	0.05	0.00–10.00	sec	018C	***Page 135***
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d02-16	Vout Modulation Limit Start Lvl	90.0	70.0–D02-17	%	0261	***Page 136***
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d02-21	Motor 2 Slip Compensation Gain	Depends on E03-01	0.0–2.50	-	033E	***Page 136***
d02-22	Motor 2 Slip Comp Delay Time	Depends on E03-01	0–10000	ms	0241	***Page 136***
d02-23	Motor 2 Slip Compensation Limit	200	0–250	%	0242	***Page 136***
d02-24	Motor 2 Slip Comp during Regen	0	0–2	-	0243	***Page 136***
d02-28	Adaptive Slip Control Mode	0	0–1	-	1B5B	***Page 136***
d03-01	Torque Compensation Gain	1.00	0.00–2.50	-	0215	
d03-02	Torque Compensation Delay Time	V/f: 200 OLV: 20	0–60000	ms	0216	***Page 137***
d03-03	Torque Compensation @ FWD Start	0	0.0–200.0	%	0217	***Page 137***
d03-04	Torque Compensation @ REV Start	0	-200.0–0.0	%	0218	***Page 137***
d03-05	Torque Compensation Time	10	0–200	ms	0219	***Page 137***
d03-06	Motor 2 Torque Comp Delay Time	150	0–10000	ms	021A	***Page 137***
d03-07	Motor 2 Torque Compensation Gain	1.00	0.00–2.50	-	0341	***Page 137***
d03-19	Torque Ripple Suppress Min Freq	0.1	0.0–10.0	Hz	0B8D	***Page 137***
d03-20	Voltage Compensation Adjust 1	120	0–200	Hz	0BCB	***Page 137***
d03-21	Voltage Compensation Adjust 2	5	0–10	-	0BCC	***Page 137***
d03-23	Current Control Gain	1.00	0.50–2.50	-	1583	***Page 137***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
d04-01	ASR Proportional Gain 1	20.00	0.00–300.00	-	021B	***Page 140***
d04-02	ASR Integral Time 1	0.500	0.000–10.000	sec	021C	***Page 140***
d04-03	ASR Proportional Gain 2	20.00	0.00–300.00	-	021D	***Page 140***
d04-04	ASR Integral Time 2	0.500	0.000–10.000	sec	021E	***Page 140***
d04-06	ASR Delay Time	0.004	0.000–0.500	sec	0220	***Page 140***
d04-07	ASR Gain Switchover Frequency	0.0	0.0–150.0	Hz	0221	***Page 140***
d04-08	ASR Integral Limit	400	0–400	%	0222	***Page 140***
d04-09	Up/Down 2 Bias Lower Limit	0.0	-99.9–0.0	%	02B0	***Page 140***
d04-10	Up/Down Freq Lower Limit Select	0	0–1	-	02B6	***Page 140***
d04-17	Motor Inertia	**	0.0001–600.0000	kgm^2	0276	***Page 140***
d04-18	Load Inertia Ratio	1.0	0.0–6000.0	-	0277	***Page 140***
d04-29	Speed Control Response	0	0–1	-	0B18	***Page 140***
d04-37	Motor 2 Inertia	**	0.0001–600.0000	kgm^2	0278	***Page 140***
d04-38	Motor 2 Load Inertia Ratio	1.0	0.0–6000.0	-	0279	***Page 140***
d04-50	Notch Filter Frequency	0	0–100	Hz	0B14	***Page 140***
d04-51	Notch Filter Bandwidth	1.0	0.5–5.0	-	0B15	***Page 140***
d05-01	Torque Control Selection	0	0–1	-	029A	***Page 141***
d05-02	Torque Reference Delay Time	0	0–1000	ms	029B	***Page 141***
d05-03	Speed Limit Selection	2	1–2	-	029C	***Page 141***
d05-04	Speed Limit	105	-120–120	%	029D	***Page 141***
d05-05	Speed Limit Bias	10	0–120	%	029E	***Page 141***
d05-06	Speed/Torque Changeover Time	0	0–1000	ms	029F	***Page 141***
d05-08	Uni-directional Speed Limit Bias	1	0–1	-	02B5	***Page 141***
d08-01	Dwell Reference at Start	0.0	0.0–150.0	Hz	01B6	***Page 143***
d08-02	Dwell Time at Start	0.0	0.0–10.0	sec	01B7	***Page 143***
d08-03	Dwell Reference at Stop	0.0	0.0–150.0	Hz	01B8	***Page 143***
d08-04	Dwell Time at Stop	0.0	0.0–10.0	sec	01B9	***Page 143***
d09-01	S-Curve Time @ Start of Accel	0.50*	0.00–10.00	sec	020B	***Page 144***
d09-02	S-Curve Time @ End of Accel	0.50*	0.00–10.00	sec	020C	***Page 144***
d09-03	S-Curve Time @ Start of Decel	0.50*	0.00–10.00	sec	020D	***Page 144***
d09-04	S-Curve Time @ End of Decel	0.50*	0.00–10.00	sec	020E	***Page 144***
d10-01	Normal / Heavy Duty Selection	0	0–1	-	0223	***Page 146***
d10-02	Carrier Frequency Selection	1	1–9, A, F	-	0224	***Page 146***
d10-03	Carrier Frequency Upper Limit	2.0	1.0–15.0	kHz	0225	***Page 146***
d10-04	Carrier Frequency Lower Limit	2.0	1.0–15.0	kHz	0226	***Page 146***
d10-05	Carrier Freq Proportional Gain	0	0–99	-	0227	***Page 146***
d10-09	Carrier Freq at Rotational Tune	0	0–1	-	022B	***Page 146***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
E01-01	Input AC Supply Voltage	230V: 240 460V: 480 575V: 575	230V: 155–255 460V: 310–510 575V: 446–733	VAC	0300	***Page 148***
E01-03	V/f Pattern Selection	0*	V/f: 0–9, A–F, FF OLV: F, FF	-	0302	***Page 148***
E01-04	Maximum Output Frequency	60.0	20.0–300.0	Hz	0303	***Page 148***
E01-05	Maximum Output Voltage	**	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	0304	***Page 148***
E01-06	Base Frequency	60.0	0.0–300.0	Hz	0305	***Page 148***
E01-07	Mid Point A Frequency	Depends on E03-01	0.0–300.0	Hz	0306	***Page 148***
E01-08	Mid Point A Voltage	Depends on E03-01	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	0307	***Page 148***
E01-09	Minimum Output Frequency	Depends on E03-01	0.0–300.0	Hz	0308	***Page 148***
E01-10	Minimum Output Voltage	Depends on E03-01	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	0309	***Page 148***
E01-11	Mid Point B Frequency	0.0	0.0–300.0	Hz	030A	***Page 148***
E01-12	Mid Point B Voltage	0.0	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	030B	***Page 149***
E01-13	Base Voltage	0.0	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	030C	***Page 149***
E02-01	Motor Rated Current (FLA)	**	**	A	030E	***Page 155***
E02-02	Motor Rated Slip	**	0.000–20.000	Hz	030F	***Page 155***
E02-03	Motor No-Load Current	**	0.00–(E02-01–0.01)	A	0310	***Page 155***
E02-04	Motor Pole Count	4	2–48	-	0311	***Page 155***
E02-05	Motor Line-to-Line Resistance	**	0.000–65.000	Ω	0312	***Page 155***
E02-06	Motor Leakage Inductance	**	0.0–60.0	%	0313	***Page 155***
E02-07	Motor Saturation Coefficient 1	0.50	0.00–0.50	-	0314	***Page 155***
E02-08	Motor Saturation Coefficient 2	0.75	E02-07–0.75	-	0315	***Page 155***
E02-09	Motor Mechanical Loss	0.0	0.0–10.0	%	0316	***Page 155***
E02-10	Motor Iron Loss	**	0–65535	W	0317	***Page 155***
E02-11	Motor Rated Power	**	0.00–650.00	HP/kW	0318	***Page 155***
E03-01	Motor 2 Control Mode Selection	2	0, 2	-	0319	***Page 156***
E03-02	Motor 2 Stopping Method	1	0–1	-	0348	***Page 156***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
E03-04	Motor 2 Maximum Output Frequency	60.0	20.0–300.0	Hz	031A	***Page 156***
E03-05	Motor 2 Maximum Output Voltage	**	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	031B	***Page 156***
E03-06	Motor 2 Base Frequency	60.0	0.0–300.0	Hz	031C	***Page 156***
E03-07	Motor 2 Mid Point A Frequency	Depends on E01-03	0.0–300.0	Hz	031D	***Page 156***
E03-08	Motor 2 Mid Point A Voltage	Depends on E01-03	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	031E	***Page 156***
E03-09	Motor 2 Minimum Output Frequency	Depends on E01-03	0.0–300.0	Hz	031F	***Page 156***
E03-10	Motor 2 Minimum Output Voltage	Depends on E01-03	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	0320	***Page 156***
E03-11	Motor 2 Mid Point B Frequency	0.0	0.0–300.0	Hz	0345	***Page 156***
E03-12	Motor 2 Mid Point B Voltage	0.0	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	0346	***Page 156***
E03-13	Motor 2 Base Voltage	0.0	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	0347	***Page 156***
E04-01	Motor 2 Rated Current	**	**	A	0321	***Page 157***
E04-02	Motor 2 Rated Slip	**	0.000–20.000	Hz	0322	***Page 157***
E04-03	Motor 2 Rated No-Load Current	**	0.00–(E04-01–0.01)	A	0323	***Page 157***
E04-04	Motor 2 Motor Poles	4	2–48	-	0324	***Page 157***
E04-05	Motor 2 Line-to-Line Resistance	**	0.000–65.000	Ω	0325	***Page 157***
E04-06	Motor 2 Leakage Inductance	**	0.0–60.0	%	0326	***Page 157***
E04-07	Motor 2 Saturation Coefficient 1	0.50	0.00–0.50	-	0343	***Page 157***
E04-08	Motor 2 Saturation Coefficient 2	0.75	E04-07–0.75	-	0344	***Page 157***
E04-09	Motor 2 Mechanical Loss	0.0	0.0–10.0	%	033F	***Page 157***
E04-10	Motor 2 Iron Loss	**	0–65535	W	0340	***Page 157***
E04-11	Motor 2 Rated Power	**	0.00–650.00	HP/kW	0327	***Page 157***
E07-00	Test Mode	0	0–1	-	16E5	***Page 158***
E07-01	Test Mode Control Mode Selection	2	0, 2	-	06F0	***Page 158***
E07-02	Test Mode Stopping Method	1	0–1	-	06F1	***Page 158***
E07-04	Test Mode Max Output Frequency	60.0	20.0–300.0	Hz	06F4	***Page 158***
E07-05	Test Mode Max Output Voltage	**	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	06F5	***Page 158***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
E07-06	Test Mode Base Frequency	60.0	0.0–300.0	Hz	06F6	***Page 158***
E07-07	Test Mode Mid Point A Frequency	Depends on E01-03	0.0–300.0	Hz	06F7	***Page 158***
E07-08	Test Mode Mid Point A Voltage	Depends on E01-03	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	06F8	***Page 158***
E07-09	Test Mode Minimum Output Freq	Depends on E01-03	0.0–300.0	Hz	06F9	***Page 158***
E07-10	Test Mode Minimum Output Voltage	Depends on E01-03	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	06FA	***Page 158***
E07-11	Test Mode Mid Point B Frequency	0.0	0.0–300.0	Hz	06FB	***Page 158***
E07-12	Test Mode Mid Point B Voltage	0.0	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	06FC	***Page 158***
E07-13	Test Mode Base Voltage	0.0	230V: 0.0–255.0 460V: 0.0–510.0 575V: 0.0–733.1	VAC	06FD	***Page 158***
F01-01	Encoder 1 Pulse Count (PPR)	1024	1–60000	ppr	0380	***Page 159***
F01-02	Encoder 1 Rotation Selection	0	0–1	-	0384	***Page 159***
F01-03	Encoder 1 Pulse Monitor Scaling	1	1–132	-	0385	***Page 159***
F01-06	Encoder 1 PCB Disconnect Detect	15	0–200	ms	03B4	***Page 159***
F01-11	Encoder 2 Pulse Count (PPR)	1024	1–60000	ppr	03B0	***Page 159***
F01-12	Encoder 2 Rotation Selection	0	0–1	-	03B1	***Page 159***
F01-15	Encoder 2 Pulse Monitor Scaling	1	1–132	-	03BE	***Page 159***
F01-16	Encoder 2 PCB Disconnect Detect	15	0–200	ms	03B5	***Page 159***
F01-21	Encoder Signal Loss Detect Sel	1	Traverse: 0–4 NLB: 1	-	0381	***Page 159***
F01-22	Encoder Open-Circuit Detect Time	2.0	0.0–10.0	sec	038D	***Page 160***
F01-23	Overspeed Detection Selection	1	Traverse: 0–3 NLB: 1	-	0382	***Page 160***
F01-24	Overspeed Detection Level	105	0–120	%	0387	***Page 160***
F01-25	Overspeed Detection Delay Time	0.0	0.0–2.0	sec	0388	***Page 160***
F01-26	Speed Deviation Detection Select	5	Traverse: 0–7 NLB: 5	-	0383	***Page 160***
F01-27	Speed Deviation Detection Level	10	0–50	%	0389	***Page 160***
F01-28	Speed Deviation Detect Delay Time	0.3	0.0–10.0	sec	038A	***Page 160***
F03-01	Digital Input Option	0	0–2	-	1677	***Page 161***
F03-02	Digital Input 1 Function	F	0–19F	-	1678	***Page 161***
F03-03	Digital Input 2 Function	F	0–19F	-	1679	***Page 161***
F03-04	Digital Input 3 Function	F	0–19F	-	167A	***Page 161***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
F03-05	Digital Input 4 Function	F	0–19F	-	167B	***Page 161***
F03-06	Digital Input 5 Function	F	0–19F	-	167C	***Page 161***
F03-07	Digital Input 6 Function	F	0–19F	-	167D	***Page 161***
F03-08	Digital Input 7 Function	F	0–19F	-	167E	***Page 161***
F03-09	Digital Input 8 Function	F	0–19F	-	167F	***Page 161***
F03-10	Digital Input 9 Function	F	0–19F	-	1680	***Page 161***
F03-11	Digital Input 10 Function	F	0–19F	-	1681	***Page 161***
F03-12	Digital Input 11 Function	F	0–19F	-	1682	***Page 161***
F03-13	Digital Input 12 Function	F	0–19F	-	1683	***Page 161***
F03-14	Digital Input 13 Function	F	0–19F	-	1684	***Page 161***
F03-15	Digital Input 14 Function	F	0–19F	-	1685	***Page 161***
F03-16	Digital Input 15 Function	F	0–19F	-	1686	***Page 161***
F03-17	Digital Input 16 Function	F	0–19F	-	1687	***Page 161***
F04-01	Terminal V1 Function Selection	102	1–631	-	0391	***Page 162***
F04-02	Terminal V1 Gain	100.0	-999.9–999.9	%	0392	***Page 162***
F04-03	Terminal V2 Function Selection	103	1–631	-	0393	***Page 162***
F04-04	Terminal V2 Gain	50.0	-999.9–999.9	%	0394	***Page 162***
F04-05	Terminal V1 Bias	0.0	-999.9–999.9	%	0395	***Page 162***
F04-06	Terminal V2 Bias	0.0	-999.9–999.9	%	0396	***Page 162***
F04-07	Terminal V1 Signal Level	0	0–1	-	0397	***Page 162***
F04-08	Terminal V2 Signal Level	0	0–1	-	0398	***Page 162***
F05-01	Digital Output 1 Function	F	0–169	-	0399	***Page 162***
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F05-04	Digital Output 4 Function	F	0–169	-	039C	***Page 162***
F05-05	Digital Output 5 Function	F	0–169	-	039D	***Page 162***
F05-06	Digital Output 6 Function	F	0–169	-	039E	***Page 162***
F05-07	Digital Output 7 Function	F	0–169	-	039F	***Page 162***
F05-08	Digital Output 8 Function	F	0–169	-	03A0	***Page 162***
F06-01	Communication Error Selection	1	0–5	-	03A2	***Page 163***
F06-02	Comm External Fault (EF0) Detect	0	0–1	-	03A3	***Page 163***
F06-03	Comm External Fault (EF0) Select	1	0–3	-	03A4	***Page 163***
F06-04	bUS Error Detection Time	2.0	0.0–5.0	sec	03A5	***Page 163***
F06-06	Torque Reference/Limit by Comm	0	0–1	-	03A7	***Page 163***
F06-07	Multi-Step Ref @ NetRef/ComRef	0	0–1	-	03A8	***Page 163***
F06-08	Comm Parameter Reset @Initialize	0	0–1	-	036A	***Page 163***
F06-15	Comm. Option Parameters Reload	0	0–2	-	0B5B	***Page 164***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
F06-16	Gateway Mode	0	0–4	-	0B52	
F06-30	PROFIBUS-DP Node Address	0	0–125	-	03CB	***Page 165***
F06-31	PROFIBUS-DP Clear Mode Selection	0	0–1	-	03CC	***Page 165***
F06-32	PROFIBUS-DP Data Format Select	0	0–5	-	03CD	***Page 164***
F07-01	IP Address 1	192	0–255	-	03E5	***Page 166***
F07-02	IP Address 2	168	0–255	-	03E6	***Page 166***
F07-03	IP Address 3	1	0–255	-	03E7	***Page 166***
F07-04	IP Address 4	20	0–255	-	03E8	***Page 166***
F07-05	Subnet Mask 1	255	0–255	-	03E9	***Page 166***
F07-06	Subnet Mask 2	255	0–255	-	03EA	***Page 166***
F07-07	Subnet Mask 3	255	0–255	-	03EB	***Page 166***
F07-08	Subnet Mask 4	0	0–255	-	03EC	***Page 166***
F07-09	Gateway Address 1	192	0–255	-	03ED	***Page 166***
F07-10	Gateway Address 2	168	0–255	-	03EE	***Page 166***
F07-11	Gateway Address 3	1	0–255	-	03EF	***Page 166***
F07-12	Gateway Address 4	1	0–255	-	03F0	***Page 166***
F07-13	Address Mode at Startup	2	0–2	-	03F1	***Page 166***
F07-14	Duplex Mode Selection	1	0–8	-	03F2	***Page 166***
F07-15	Communication Speed Selection	10	10, 100–102	-	03F3	***Page 166***
F07-16	Timeout Value	0.0	0.0–30.0	sec	03F4	***Page 166***
F07-17	EtherNet/IP Speed Scaling Factor	0	-15–15	-	03F5	***Page 166***
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F07-21	EtherNet/IP Voltage Scale Factor	0	-15–15	-	03F9	***Page 167***
F07-22	EtherNet/IP Time Scaling	0	-15–15	-	03FA	***Page 167***
F07-23	DOA116 1	0	Modbus Address 0x----	-	03FB	***Page 167***
F07-24	DOA116 2	0	Modbus Address 0x----	-	03FC	***Page 167***
F07-25	DOA116 3	0	Modbus Address 0x----	-	03FD	***Page 167***
F07-26	DOA116 4	0	Modbus Address 0x----	-	03FE	***Page 167***
F07-27	DOA116 5	0	Modbus Address 0x----	-	03FF	***Page 167***
F07-28	DOA116 6	0	Modbus Address 0x----	-	0370	***Page 167***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
F07-29	DOA116 7	0	Modbus Address 0x----	-	0371	***Page 167***
F07-30	DOA116 8	0	Modbus Address 0x----	-	0372	***Page 167***
F07-31	DOA116 9	0	Modbus Address 0x----	-	0373	***Page 167***
F07-32	DOA116 10	0	Modbus Address 0x----	-	0374	***Page 167***
F07-33	DIA166 1	0	Modbus Address 0x----	-	0375	***Page 167***
F07-34	DIA166 2	0	Modbus Address 0x----	-	0376	***Page 167***
F07-35	DIA166 3	0	Modbus Address 0x----	-	0377	***Page 167***
F07-36	DIA166 4	0	Modbus Address 0x----	-	0378	***Page 167***
F07-37	DIA166 5	0	Modbus Address 0x----	-	0379	***Page 167***
F07-38	DIA166 6	0	Modbus Address 0x----	-	037A	***Page 167***
F07-39	DIA166 7	0	Modbus Address 0x----	-	037B	***Page 167***
F07-40	DIA166 8	0	Modbus Address 0x----	-	037C	***Page 167***
F07-41	DIA166 9	0	Modbus Address 0x----	-	037D	***Page 167***
F07-42	DIA166 10	0	Modbus Address 0x----	-	037E	***Page 167***
F07-60	PZD1 Write (Control Word)	0	Modbus Address 0x----	-	0780	***Page 167***
F07-61	PZD2 Write (Frequency Reference)	0	Modbus Address 0x----	-	0781	***Page 167***
F07-62	PZD3 Write	0	Modbus Address 0x----	-	0782	***Page 167***
F07-63	PZD4 Write	0	Modbus Address 0x----	-	0783	***Page 167***
F07-64	PZD5 Write	0	Modbus Address 0x----	-	0784	***Page 167***
F07-65	PZD6 Write	0	Modbus Address 0x----	-	0785	***Page 167***
F07-66	PZD7 Write	0	Modbus Address 0x----	-	0786	***Page 167***
F07-67	PZD8 Write	0	Modbus Address 0x----	-	0787	***Page 167***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
F07-68	PZD9 Write	0	Modbus Address 0x----	-	0788	***Page 167***
F07-69	PZD10 Write	0	Modbus Address 0x----	-	0789	***Page 167***
F07-70	PZD1 Read (Status Word)	0	Modbus Address 0x----	-	078A	***Page 167***
F07-71	PZD2 Read (Output Frequency)	0	Modbus Address 0x----	-	078B	***Page 167***
F07-72	PZD3 Read	0	Modbus Address 0x----	-	078C	***Page 167***
F07-73	PZD4 Read	0	Modbus Address 0x----	-	078D	***Page 167***
F07-74	PZD5 Read	0	Modbus Address 0x----	-	078E	***Page 167***
F07-75	PZD6 Read	0	Modbus Address 0x----	-	078F	***Page 167***
F07-76	PZD7 Read	0	Modbus Address 0x----	-	0790	***Page 167***
F07-77	PZD8 Read	0	Modbus Address 0x----	-	0791	***Page 167***
F07-78	PZD9 Read	0	Modbus Address 0x----	-	0792	***Page 167***
F07-79	PZD10 Read	0	Modbus Address 0x----	-	0793	***Page 167***
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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H04-04	Terminal AM Analog Output Select	103	0–631	-	0420	***Page 188***
H04-05	Terminal AM Analog Output Gain	50.0	-999.9–999.9	%	0421	***Page 188***
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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H05-09	CE Detection Time	1.0	0.0–10.0	sec	0435	***Page 189***
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H05-27	Function 5A Register 3 Selection	42 (U01-03)	0000–FFFF	-	158B	***Page 190***
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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H07-32	Virtual Analog Input Bias	0.0	-999.9–999.9	%	1179	***Page 192***
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L01-05	Motor Thermistor Filter Time	0.20	0.00–10.00	sec	0484	***Page 194***
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L02-09	KEB Minimum Frequency Level	20	0–100	%	048D	***Page 195***
L02-10	Minimum KEB Time	50	0–25500	ms	048E	***Page 195***
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L02-29	Kinetic Energy Backup Method	0	0–3	-	0475	***Page 195***
L02-30	KEB Zero Speed Operation	0	0–1	-	045E	***Page 195***
L02-31	KEB Start Voltage Offset Level	Depends on A01-02	230V: 0–100 460V: 0–200 575V: 0–287	VDC	045D	***Page 196***
L03-01	Stall Prevention during Accel	1	0–2	-	048F	***Page 196***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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L03-05	Stall Prevention during RUN	1	0–2	-	0493	***Page 196***
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L03-25	Load Inertia Ratio	1.0	0.1–1000.0	-	046F	***Page 197***
L03-26	Additional DC Bus Capacitors	0	0–65000	uF	0455	***Page 197***
L03-27	Stall Prevention Detection Time	50	0–5000	ms	0456	***Page 197***
L03-35	Speed Agree Width for Auto Decel	0.00	0.00–1.00	Hz	0747	***Page 197***
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L04-07	Speed Agree Detection Selection	0	0–1	-	0470	***Page 199***
L06-01	Torque Detection Selection 1	0	0–8	-	04A1	***Page 199***
L06-02	Torque Detection Level 1	150	0–300	%	04A2	***Page 200***
L06-03	Torque Detection Time 1	0.1	0.0–10.0	sec	04A3	***Page 200***
L06-04	Torque Detection Selection 2	0	0–8	-	04A4	***Page 200***
L06-05	Torque Detection Level 2	150	0–300	%	04A5	***Page 201***
L06-06	Torque Detection Time 2	0.1	0.0–10.0	sec	04A6	***Page 201***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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L06-09	Mech Fatigue Detect Speed Level	110.00	-110.0–110.0	%	0469	***Page 202***
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L08-05	Input Phase Loss Protection Sel	1	0–1	-	04B1	***Page 203***
L08-06	Input Phase Loss Detection Level	**	0.0–50.0	%	04B2	***Page 203***
L08-07	Output Phase Loss Protection Sel	2	0–2	-	04B3	***Page 203***
L08-08	Output Phase Loss Detection Lvl	5.0	0.0–20.0	%	04B4	***Page 203***
L08-09	Output Ground Fault Detection	1	0–1	-	04B5	***Page 203***
L08-10	Heatsink Fan Operation Selection	0	0–1	-	04B6	***Page 203***
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L08-35	Installation Method Selection	2*	0–3	-	04EC	***Page 204***
L08-38	Carrier Frequency Reduction	2	0–2	-	04EF	***Page 204***
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n01-03	Hunting Prevention Time Constant	10	0–500	ms	0582	***Page 207***
n01-05	Hunting Prevent Gain in Reverse	0.00	0.00–2.50	-	0530	***Page 207***
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n01-13	DC Bus Stabilization Control	0	0–1	-	1B59	***Page 207***
n01-14	DC Bus Stabilization Time	100.0	50.0–500.0	ms	1B5A	***Page 207***
n01-15	PWM Voltage Offset Calibration	0	0–2	-	0BF8	***Page 207***
n01-16	Hunting Prevention High Fc Gain	0.5	0.00–2.50	-	0BFB	***Page 207***
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Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
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n02-01	Automatic Freq Regulator Gain	1.00	0.00–10.00	-	0584	***Page 208***
n02-02	Automatic Freq Regulator Time 1	50	0–2000	ms	0585	***Page 208***
n02-03	Automatic Freq Regulator Time 2	750	0–2000	ms	0586	***Page 208***
n02-06	OLV Stabilize Level	1	0–15	-	05C2	***Page 208***
n02-07	OLV NLB AFR Integral Time	5	0–2000	ms	0578	***Page 208***
o01-05	LCD Contrast Adjustment	5	0–10	-	0504	***Page 209***
o01-24	Custom Monitor 1	101	0, 101–855	-	11AD	***Page 209***
o01-25	Custom Monitor 2	102	0, 101–855	-	11AE	***Page 209***
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o01-30	Custom Monitor 7	111	0, 101–855	-	11B3	***Page 209***
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o01-32	Custom Monitor 9	114	0, 101–855	-	11B5	***Page 209***
o01-33	Custom Monitor 10	115	0, 101–855	-	11B6	***Page 209***
o01-34	Custom Monitor 11	120	0, 101–855	-	11B7	***Page 209***
o01-35	Custom Monitor 12	202	0, 101–855	-	11B8	***Page 209***
o01-36	LCD Backlight Brightness	5	1–5	-	11B9	***Page 209***
o01-40	Home Screen Display Selection	0	0–3	-	11BD	***Page 209***
o01-41	1st Monitor Area Selection	0	0–1	-	11C1	***Page 209***
o01-42	1st Monitor Area Setting	100.0	0.0–100.0	%	11C2	***Page 209***
o01-43	2nd Monitor Area Selection	0	0–1	-	11C3	***Page 209***
o01-44	2nd Monitor Area Setting	100.0	0.0–100.0	%	11C4	***Page 209***
o01-45	3rd Monitor Area Selection	0	0–1	-	11C5	***Page 210***
o01-46	3rd Monitor Area Setting	100.0	0.0–100.0	%	11C6	***Page 210***
o01-47	Trend Plot 1 Scale Minimum Value	-100.0	-300.0–299.9	%	11C7	***Page 210***
o01-48	Trend Plot 1 Scale Maximum Value	100.0	-299.9–300.0	%	11C8	***Page 210***
o01-49	Trend Plot 2 Scale Minimum Value	-100.0	-300.0–299.9	%	11C9	***Page 210***
o01-50	Trend Plot 2 Scale Maximum Value	100.0	-299.9–300.0	%	11CA	***Page 210***
o01-51	Trend Plot Time Scale Setting	300	1–3600	sec	11CB	***Page 210***
o01-55	Analog Gauge Area Selection	1	0–1	-	11EE	***Page 210***
o01-56	Analog Gauge Area Setting	100.0	0.0–100.0	%	11EF	***Page 210***
o02-01	LO/RE Key Function Selection	0	0–1	-	0505	***Page 211***
o02-03	User Parameter Default Value	0	0–2	-	0507	***Page 211***
o02-04	Drive Model (KVA) Selection	62**	62–AE	-	0508	***Page 211***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
o02-05	Home Mode Freq Ref Entry Mode	0	0–1	-	0509	***Page 212***
o02-09	Region Code	1	1–2	-	050D	***Page 212***
o02-10	Motor Power Units	0	0–1	-	3125	***Page 212***
o02-23	External 24V Powerloss Detection	0	0–1	-	11F8	***Page 212***
o02-24	LED Light Function Selection	0	0–2	-	11FE	***Page 213***
o02-26	Alarm Display at Ext. 24V Power	0	0–1	-	1563	***Page 213***
o03-01	Elapsed Operating Time Setting	0	0–9999 x 10	Hrs	050B	***Page 213***
o03-02	Elapsed Operating Time Selection	1	0–1	-	050C	***Page 213***
o03-03	Fan Operation Time Setting	0	0–9999 x 10	Hrs	050E	***Page 213***
o03-05	Capacitor Maintenance Setting	0	0–150	%	051D	***Page 213***
o03-07	Softcharge Relay Maintenance Set	0	0–150	%	0523	***Page 213***
o03-09	IGBT Maintenance Setting	0	0–150	%	0525	***Page 213***
o03-11	Fault Trace/History Init (U2/U3)	0	0–1	-	0510	***Page 213***
o03-12	kWh Monitor Initialization	0	0–1	-	0511	***Page 213***
o03-13	RUN Command Counter @ Initialize	0	0–1	-	0528	***Page 214***
o03-14	OL/LC/OW Counter Reset	0	0–1	-	0529	***Page 214***
o03-22	Time Format	1	0–2	-	154F	***Page 214***
o03-23	Date Format	2	0–2	-	1550	***Page 214***
o03-24	bAT Detection Selection	0	0–2	-	310F	***Page 214***
o06-01	User Stored Data 0	0	0–65535	-	1520	***Page 214***
o06-02	User Stored Data 1	0	0–65535	-	1521	***Page 214***
o06-03	User Stored Data 2	0	0–65535	-	1522	***Page 214***
o06-04	User Stored Data 3	0	0–65535	-	1523	***Page 214***
o06-05	User Stored Data 4	0	0–65535	-	1524	***Page 214***
o06-06	User Stored Data 5	0	0–65535	-	1525	***Page 214***
o06-07	User Stored Data 6	0	0–65535	-	1526	***Page 214***
o06-08	User Stored Data 7	0	0–65535	-	1527	***Page 214***
o06-09	User Stored Data 8	0	0–65535	-	1528	***Page 214***
o06-10	User Stored Data 9	0	0–65535	-	1529	***Page 214***
o06-11	User Stored Data 10	0	0–65535	-	152A	***Page 214***
o06-12	User Stored Data 11	0	0–65535	-	152B	***Page 214***
o06-13	User Stored Data 12	0	0–65535	-	152C	***Page 214***
o06-14	User Stored Data 13	0	0–65535	-	152D	***Page 214***
o06-15	User Stored Data 14	0	0–65535	-	152E	***Page 214***
o06-16	User Stored Data 15	0	0–65535	-	152F	***Page 214***
U01-01	Frequency Reference	-	-	Hz	0040	***Page 215***
U01-02	Output Frequency	-	-	Hz	0041	***Page 215***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
U01-03	Output Current	-	-	A	0042	***Page 215***
U01-04	Control Method	-	-	-	0043	***Page 215***
U01-05	Motor Speed	-	-	Hz	0044	***Page 215***
U01-06	Output Voltage Reference	-	-	VAC	0045	***Page 215***
U01-07	DC Bus Voltage	-	-	VDC	0046	***Page 215***
U01-08	Output Power	-	-	HP/kW	0047	***Page 215***
U01-09	Torque Reference	-	-	%	0048	***Page 215***
U01-10	Input Terminal Status	-	-	-	0049	***Page 215***
U01-11	Output Terminal Status	-	-	-	004A	***Page 215***
U01-12	Drive Status	-	-	-	004B	***Page 215***
U01-14	Software Number Flash	-	-	-	004D	***Page 216***
U01-15	Terminal A1 Level	-	-	%	004E	***Page 216***
U01-16	Terminal A2 Level	-	-	%	004F	***Page 216***
U01-17	Terminal A3 Level	-	-	%	0050	***Page 216***
U01-20	SFS Output Frequency	-	-	Hz	0053	***Page 216***
U01-24	Option Card MFDO 8 bits	-	-	-	00A0	***Page 216***
U01-25	Option Card MFDI Lower 8 bits	-	-	-	009D	***Page 216***
U01-26	Option Card MFDI Upper 8 bits	-	-	-	009E	***Page 216***
U01-28	Software Number ROM	-	-	-	005B	***Page 216***
U01-30	SS Delta Speed	-	-	RPM	17C8	***Page 216***
U01-34	oPE Fault Parameter	-	-	-	0061	***Page 216***
U01-39	MEMOBUS/Modbus Error Code	-	-	-	0066	***Page 216***
U01-49	Swing Length	-	-	Ft	17A2	***Page 216***
U01-50	Hook Height	-	-	%	17A3	***Page 216***
U01-51	Motor Revolution	-	-	Revs	17A4	***Page 216***
U01-53	Index Count	-	-	Revs	17A6	***Page 216***
U01-54	Input Pulse Monitor	-	-	Hz	007D	***Page 216***
U01-60	Encoder 1 Pulse Counter	-	-	Pulses	07CD	***Page 216***
U01-61	Encoder 2 Pulse Counter	-	-	Pulses	07E5	***Page 217***
U01-68	Load Check Zone	-	-	-	17AF	***Page 217***
U01-69	Load Check Margin	-	-	%	17B0	***Page 217***
U01-73	OL/LC Count	-	-	-	17B1	***Page 217***
U01-86	Brake Test Torque	-	-	Ftlb	17C7	***Page 217***
U01-91	Output Voltage	-	-	VAC	154E	***Page 217***
U02-01	Current Fault	-	-	-	0080	***Page 217***
U02-02	Previous Fault	-	-	-	0081	***Page 217***
U02-03	Frequency Reference @ Fault	-	-	Hz	0082	***Page 217***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
U02-04	Output Frequency @ Fault	-	-	Hz	0083	***Page 217***
U02-05	Output Current @ Fault	-	-	A	0084	***Page 217***
U02-06	Motor Speed @ Fault	-	-	Hz	0085	***Page 217***
U02-07	Output Voltage @ Fault	-	-	VAC	0086	***Page 217***
U02-08	DC Bus Voltage @ Fault	-	-	VDC	0087	***Page 217***
U02-09	Output Power @ Fault	-	-	HP/kW	0088	***Page 217***
U02-10	Torque Reference @ Fault	-	-	%	0089	***Page 217***
U02-11	Input Terminal Status @ Fault	-	-	-	008A	***Page 217***
U02-12	Output Terminal Status @ Fault	-	-	-	008B	***Page 217***
U02-13	Operation Status @ Fault	-	-	-	008C	***Page 217***
U02-14	Elapsed Time @ Fault	-	-	Hrs	008D	***Page 217***
U02-15	SFS Output @ Fault	-	-	Hz	07E0	***Page 217***
U02-16	q-Axis Current @ Fault	-	-	%	07E1	***Page 217***
U02-17	d-Axis Current @ Fault	-	-	%	07E2	***Page 217***
U02-20	Heatsink Temperature @ Fault	-	-	°C	008E	***Page 217***
U03-01	1st Most Recent Fault	-	-	-	0800	***Page 217***
U03-02	2nd Most Recent Fault	-	-	-	0801	***Page 218***
U03-03	3rd Most Recent Fault	-	-	-	0802	***Page 218***
U03-04	4th Most Recent Fault	-	-	-	0803	***Page 218***
U03-05	5th Most Recent Fault	-	-	-	0804	***Page 218***
U03-06	6th Most Recent Fault	-	-	-	0805	***Page 218***
U03-07	7th Most Recent Fault	-	-	-	0806	***Page 218***
U03-08	8th Most Recent Fault	-	-	-	0807	***Page 218***
U03-09	9th Most Recent Fault	-	-	-	0808	***Page 218***
U03-10	10th Most Recent Fault	-	-	-	0809	***Page 218***
U03-11	Elapsed Time @ 1st Fault	-	-	Hrs	080A	***Page 218***
U03-12	Elapsed Time @ 2nd Fault	-	-	Hrs	080B	***Page 218***
U03-13	Elapsed Time @ 3rd Fault	-	-	Hrs	080C	***Page 218***
U03-14	Elapsed Time @ 4th Fault	-	-	Hrs	080D	***Page 218***
U03-15	Elapsed Time @ 5th Fault	-	-	Hrs	080E	***Page 218***
U03-16	Elapsed Time @ 6th Fault	-	-	Hrs	080F	***Page 218***
U03-17	Elapsed Time @ 7th Fault	-	-	Hrs	0810	***Page 218***
U03-18	Elapsed Time @ 8th Fault	-	-	Hrs	0811	***Page 218***
U03-19	Elapsed Time @ 9th Fault	-	-	Hrs	0812	***Page 218***
U03-20	Elapsed Time @ 10th Fault	-	-	Hrs	0813	***Page 218***
U04-01	Cumulative Operation Time	-	-	Hrs	004C	***Page 218***
U04-03	Cooling Fan Operation Time	-	-	Hrs	0067	***Page 218***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
U04-04	Cooling Fan Maintenance	-	-	%	007E	***Page 218***
U04-05	Capacitor Maintenance	-	-	%	007C	***Page 218***
U04-06	Precharge Relay Maintenance	-	-	%	07D6	***Page 218***
U04-07	IGBT Maintenance	-	-	%	07D7	***Page 218***
U04-08	Heatsink Temperature	-	-	°C	0068	***Page 218***
U04-09	LED Check	-	-	-	005E	***Page 218***
U04-10	kWh, Lower 4 Digits	-	-	kWH	005C	***Page 219***
U04-11	kWh, Upper 5 Digits	-	-	MWH	005D	***Page 219***
U04-13	Peak Hold Current	-	-	A	07CF	***Page 219***
U04-14	Peak Hold Output Frequency	-	-	Hz	07D0	***Page 219***
U04-16	Motor oL1 Level	-	-	%	07D8	***Page 219***
U04-17	Drive oL2 Level	-	-	%	07D9	***Page 219***
U04-18	Reference Source	-	-	-	07DA	***Page 219***
U04-19	Modbus Frequency Reference	-	-	%	07DB	***Page 219***
U04-20	Option Frequency Reference	-	-	%	07DC	***Page 219***
U04-21	Run Command Source	-	-	-	07DD	***Page 219***
U04-22	Modbus Command Data	-	-	-	07DE	***Page 219***
U04-23	Option Command Data	-	-	-	07DF	***Page 219***
U04-24	Number of Runs (Low)	-	-	-	07E6	***Page 219***
U04-25	Number of Runs (High)	-	-	-	07E7	***Page 219***
U04-26	OL/LC Count	-	-	-	07E8	***Page 219***
U04-27	Run Time Elapsed	-	-	Hrs	1210	***Page 219***
U04-28	Run Time Remaining	-	-	Hrs	1211	***Page 219***
U04-29	On Time Elapsed	-	-	Hrs	1212	***Page 219***
U04-30	On Time Remaining	-	-	Hrs	1213	***Page 219***
U04-31	Brake Cycle Counts	-	-	-	1214	***Page 219***
U04-33	Brake Cycles Remaining	-	-	-	1216	***Page 219***
U04-49	Password Challenge	-	-	-	158F	***Page 219***
U04-52	Torque Reference from Comm	-	-	%	1592	***Page 220***
U06-01	Iq Secondary Current	-	-	%	0051	***Page 220***
U06-02	Id Excitation Current	-	-	%	0052	***Page 220***
U06-03	ASR Input	-	-	%	0054	***Page 220***
U06-04	ASR Output	-	-	%	0055	***Page 220***
U06-05	Output Voltage Reference (Vq)	-	-	VAC	0059	***Page 220***
U06-06	Output Voltage Reference (Vd)	-	-	VAC	005A	***Page 220***
U06-07	q-Axis ACR Output	-	-	%	005F	***Page 220***
U06-08	d-Axis ACR Output	-	-	%	0060	***Page 220***

Parameter	Parameter Name	Default	Range	Units	Modbus (Hex.)	Reference
U06-17	Energy Save Coefficient	-	-	-	07D1	***Page 220***
U06-21	Offset Frequency	-	-	%	07D5	***Page 220***
U06-26	Feed Forward Contol Output	-	-	%	006C	***Page 220***
U06-31	Torque Detect Monitor	-	-	%	007B	***Page 220***
U06-36	Comm Errors-Host	-	-	-	0720	***Page 220***
U06-37	Comm Errors-Sensor	-	-	-	0721	***Page 220***
U06-48	ASIC Comm Errors	-	-	-	072E	***Page 220***

** Initial value set by X-Press Programming (**Table 4-6 on page 70**, **Table 4-7 on page 71** and **Table 4-8 on page 72**).*

*** Initial value dependent on VFD size, which is determined by O02-04 (kVA Selection).*

Appendix B: Standards Compliance

Electromagnetic Compatibility (EMC) Guidelines Compliance

Figure B-1: CE Mark

The CE mark indicates compliance with European safety and environmental regulations. It is required for engaging in business and commerce in Europe.

European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers, and the EMC guidelines for controlling noise.

This VFD displays the CE mark based on the EMC guidelines and the Low Voltage Directive.

- Low Voltage Directive: 2014/35/EU (Harmonized Standard: EN 61800-5-1)

Devices used in combination with this VFD must also be CE certified and display the CE mark. When using VFDs displaying the CE mark in combination with other devices, it is ultimately the responsibility of the user to ensure compliance with CE standards. After setting up the device, verify that conditions meet European standards.

EMC Guidelines Compliance

This VFD is tested according to EMC Directive 2014/30/EU (Harmonized Standard: EN 61800-3).

Since the device is intended exclusively for commercial applications, it is not subject to the requirements of the EN 61000-3-2 standard for the emission of harmonic current emissions.

In a residential environment, this device may cause high-frequency interference, which requires interference suppression. If the device is used in this environment, make sure that an EMC expert carries out the installation and commissioning.

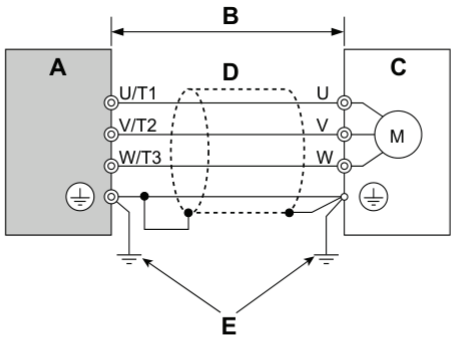
EMC Filter Installation

The following conditions must be met to ensure continued compliance with guidelines. ***See EMC Filters on page 282*** for EMC filter selection.

Installation Method

Verify the following installation conditions to ensure that other devices and machinery used in combination with this VFD also comply with EMC guidelines.

1. Install an EMC noise filter to the input side specified by Magnetek for compliance with European standards.
2. Place the VFD and EMC noise filter in the same enclosure.
3. Use braided shield cable for the VFD and motor wiring, or run the wiring through a metal conduit.
4. Keep wiring as short as possible. Ground the shield on both the VFD side and the motor side.



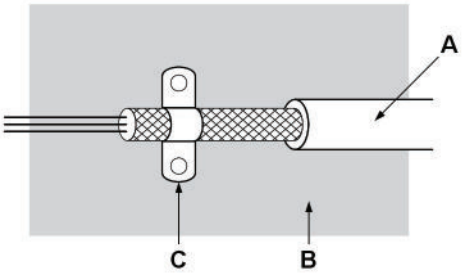
A – Drive
B – 10 m max cable length between drive and motor
C – Motor
D – Metal conduit
E – Ground wire should be as short as possible.

Figure B-2: Installation Method

5. Make sure the protective earthing conductor complies with technical standards and local safety regulations.

WARNING

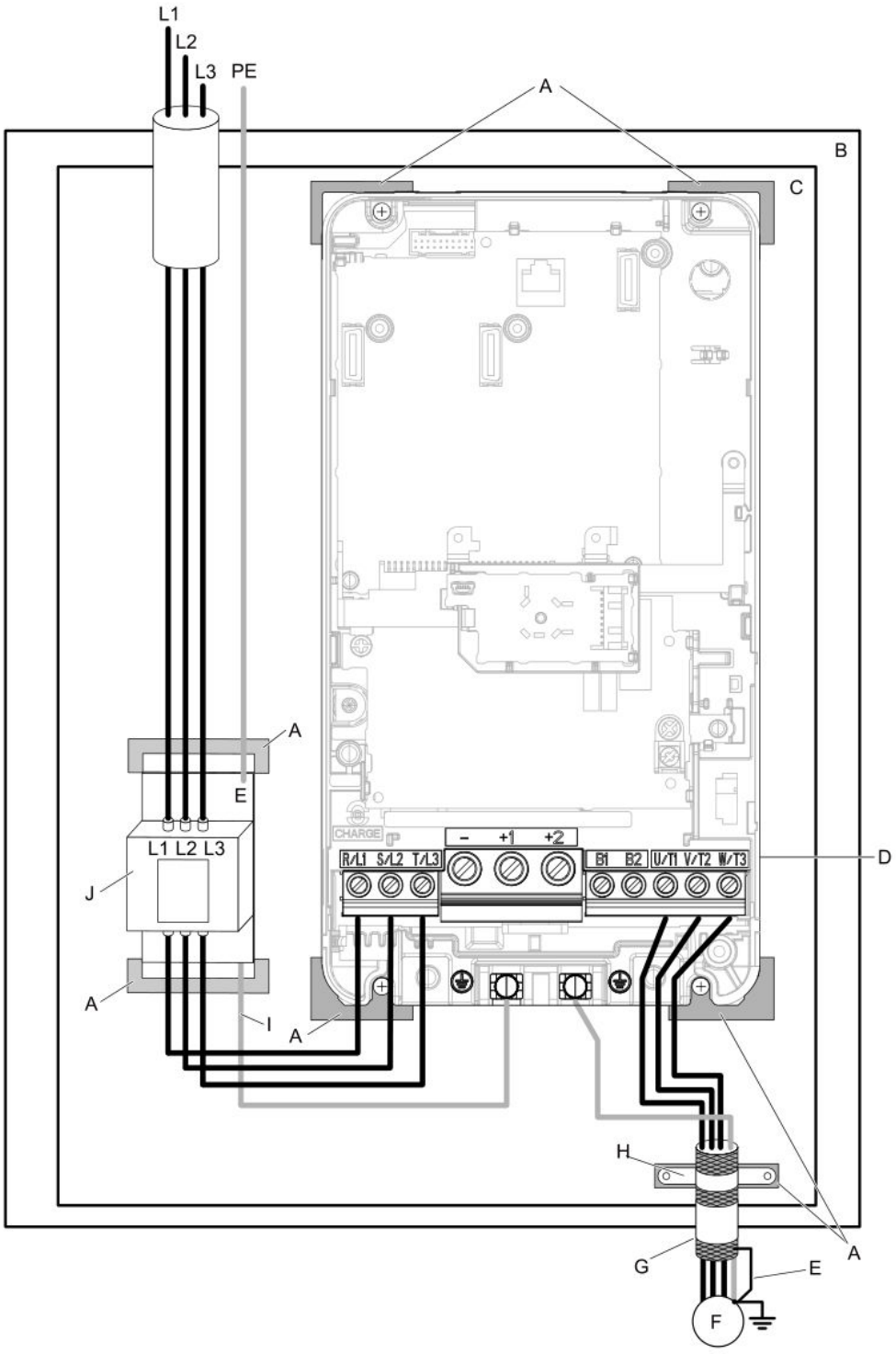
Electrical Shock Hazard. Because the leakage current exceeds 3.5 mA in models 4370 to 4605-G+/VG+S5, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor, or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.



A – Braided shield cable
B – Metal panel
C – Cable clamp (conductive)

Figure B-3: Ground Area

6. Connect a DC link choke to minimize harmonic distortion. ***See DC Link Chokes for EN 61000-3-2 Compliance on page 284***.



A - Grounding surface (Remove any paint)
B - Enclosure panel
C - Metal plate
D - VFD
E - Ground the shield.
F - Motor
G - Motor cable (Braided shield cable: 10 m (32.8 ft) maximum)
H - Cable clamp
I - Grounding wire
J - EMC noise filter

Figure B-4: EMC Filter and VFD Installation for CE Compliance

EMC Filters

Install the VFD with the EMC filters listed in ***Table B-1*** and ***Table B-2*** to comply with the EN 61800-3 requirements.

Table B-1: EMC Filters – 230 V Class

VFD Model	Filter Specifications				
	Filter Model	Rated Current (A)	Weight lb (kg)	Dimensions W x H x D (in) [W x H x D (mm)]	Mounting Dimensions W1 x H1 (in) [W1 x H1 (mm)]
2003	RTEN-5006	6	0.9 (0.4)	2.5 x 4.7 x 1.7 (63 x 120 x 42)	2.1 x 4.3 (53 x 110)
2005	RTEN-5010	10			
2007					
2008	RTEN-5020	20	1.3 (0.6)	2.8 x 5.5 x 1.7 (70 x 140 x 42)	2.4 x 5.1 (60 x 130)
2011					
2014	RTEN-5030	30			
2017					
2025	RTEN-5060	60	2.4 (1.1)	3.5 x 6.7 x 2.1 (90 x 170 x 54	3.1 x 6.3 (80 x 160)
2033					
2047	RTEN-5080	80	8.6 (3.9)	6.3 x 10.5 x 3.3 (161 x 267 x 85)	5.3 x 9.7 (135 x 247)
2060	FS5972-100-35	100	7.5 (3.4)	3.5 x 5.9 x 13.0 (90 x 330 x 150)	2.6 x 10.0 (65 x 255)
2075					
2088	FS5972-170-40	170	13.2 (6.0)	4.7 x 6.7 x 17.8 (120 x 451 x 170)	4.0 x 14.4 (102 x 365)
2115					
2145					
2180	FS5972-250-37	250	25.8 (11.7)	5.1 x 9.5 x 24.0 (130 x 610 x 240)	3.5 x 19.6 (90 x 498)
2215	FS5972-410-99	410	23.1 (10.5)	10.2 x 4.5 x 15.2 (260 x 386 x 115)	9.3 x 4.7 (235 x 120)
2283					
2346					
2415	FS5972-600-99	600	24.3 (11)	10.2 x 5.3 x 15.2 (260 x 386 x 135)	9.3 x 4.7 (235 x 120)

Table B-2: EMC Filters - 460V Class

VFD Model	Filter Specifications				
	Filter Model	Rated Current (A)	Weight lb (kg)	Dimensions W x H x D (in) [W x H x D (mm)]	Mounting Dimensions W1 x H1 (in) [W1 x H1 (mm)]
4001	B84143A0010R106	10	0.9 (0.4)	2.2 x 5.9 x 2.3 (55 x 150 x 58)	1.1 x 5.2 (28 x 132)
4003					
4004					
4005					
4007	B84143A0020R106	20	1.3 (0.6)		
4009					
4014	B84143A0035R106	35	2.0 (0.9)	2.8 x 6.3 x 2.8 (70 x 160 x 71)	2.0 x 5.6 (50 x 143)
4018					
4024	B84143A0050R106	50	3.1 (1.4)	3.2 x 6.7 x 3.1 (82 x 170 x 80)	2.6 x 6.0 (65 x 153)
4031	B84143A0065R106	65	4.2 (1.9)		
4039					
4045					
4060	B84143A0080R106	80	5.3 (2.4)	3.6 x 7.9 x 3.5 (92 x 200 x 90)	3.0 x 7.2 (75 x 183)
4075	FS5972-100-35	100	7.5 (3.4)	3.5 x 5.9 x 13.0 (90 x 330 x 150)	2.6 x 10.0 (65 x 255)
4091	FS5972-170-40	170	13.2 (6.0)	4.7 x 6.7 x 17.8 (120 x 451 x 170)	4.0 x 14.4 (102 x 365)
4112					
4150					
4180	FS5972-250-37	250	25.8 (11.7)	5.1 x 9.5 x 24.0 (130 x 610 x 240)	3.5 x 19.6 (90 x 498)
4216					
4260	FS5972-410-99	410	23.1 (10.5)	10.2 x 4.5 x 15.2 (260 x 386 x 115)	9.3 x 4.7 (235 x 120)
4304					
4371					
4414	FS5972-600-99	600	24.3 (11)	10.2 x 5.3 x 15.2 (260 x 386 x 135)	9.3 x 4.7 (235 x 120)
4477					
4515	FS5972-800-99	800	69.4 (31.5)	11.8 x 6.3 x 28.2 (300 x 160 x 716)	10.8 x 8.3 (275 x 210)
4605					

DC Link Chokes for EN 61000-3-2 Compliance

Table B-3: DC Link Chokes for Harmonic Reduction

VFD Model	DC Link Chokes Rating
2003	5.4 A, 8 mH
2005	
4001	3.2 A, 28 mH
4003	

NOTE: *DC link chokes are not required for other models to comply with EMC.*

IMPULSE•G+/VG+ Series 5
Adjustable Frequency/Vector Crane Controls Technical Manual
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COLUMBUS McKINNON FAMILY OF BRANDS