

# **IMPULSE<sup>®</sup> VG+** *Series 4*

Adjustable Frequency/Vector Crane Controls

## **Motor PG Feedback Line Driver Interface Installation Manual**



**MAGNETEK**  
MATERIAL HANDLING

September 2014  
Part Number: 144-23921 R1  
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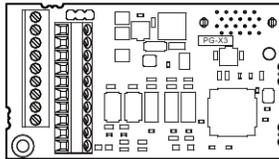
# 1. Preface and Safety

Magnetek manufactures products used as components in a wide variety of industrial systems and equipment. The selection and application of Magnetek products remain the responsibility of the equipment manufacturer or end user. Magnetek accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any Magnetek product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All systems or equipment designed to incorporate a product manufactured by Magnetek must be supplied to the end user with appropriate warnings and instructions as to the safe use and operation of that part. Any warnings provided by Magnetek must be promptly provided to the end user. Magnetek offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the Magnetek manual. **NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED.** Magnetek assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

## Applicable Documentation

The following manuals are available for the option:

### Option

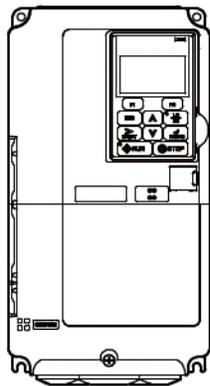


**IMPULSE®•VG+ Series 4  
PG-X3 Installation Manual  
Manual No: 144-23921**

Read this manual first.  
The installation manual is packaged with the option and contains information required to install the option and set up related drive parameters.

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## IMPULSE®•VG+ Series 4 Drive



**IMPULSE®•VG+ Series 4  
Quick Start Guide**

**IMPULSE®•VG+ Series 4  
Instruction Manual**

The drive manuals cover basic installation, wiring, operation procedures, functions, troubleshooting, and maintenance information. The manuals also include important information about parameter settings and drive tuning.  
Access <http://www.magnetek.com> to obtain Magnetek instruction manuals.

## Terms

**Drive:** IMPULSE®•VG+ Series 4

**Option:** IMPULSE®•VG+ Series 4 Option Motor PG Feedback Line Driver Interface: PG-X3

**PG:** Pulse Generator or Encoder Mounted on the Motor

## Registered Trademarks

Trademarks are the property of their respective owners.

## Supplemental Safety Instructions

Read and understand this manual before installing, operating, or servicing this option. Install the option 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.



### **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.

### **NOTICE**

*NOTICE* indicates an equipment damage message.

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

## General Safety

### General Precautions

- The diagrams in this book may include options and drives without covers or safety shields to illustrate details. Be sure to reinstall covers or shields before operating any devices. Use the option according to the instructions described in this manual.
- Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.
- The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual.
- When ordering new copies of the manual, contact a Magnetek representative and provide the manual number shown on the front cover.



### **DANGER**

*Heed the safety messages in this manual.*

Failure to comply will result in death or serious injury.

The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

### **NOTICE**

*Do not modify the drive or option circuitry.*

Failure to comply could result in damage to the drive or option and will void warranty.

Magnetek is not responsible for any modification of the product made by the user. This product must not be modified.

*Do not expose the drive or option to halogen group disinfectants.*

Failure to comply may cause damage to the electrical components in the option.

Do not pack the drive in wooden materials that have been fumigated or sterilized.

Do not sterilize the entire package after the product is packed.

## 2. Product Overview

### About This Product

The PG-X3 Option allows the user to connect an incremental line driver encoder (PG) for motor speed feedback to the drive and take advantage of the Closed Loop (Flux) Vector control mode. The option helps increase the control accuracy and performance.

This PG signal allows the drive to compensate for subtle variations in the load, while providing the drive with the necessary data to control the output frequency and maintain an accurate constant speed.

The PG-X3 Option reads a maximum input frequency from the PG of 300 kHz. Be sure to select a PG with an output of maximum 300 kHz when operating at maximum speed.

*NOTE: This option cannot be used with an open collector encoder. Use option PG-B3 with open collector encoders.*

## 3. Specifications

**Table 1: Option Specifications**

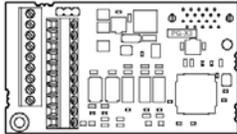
Items	Specifications
Model	PG-X3
Compatible Pulse Generators	Line driver Two-channel (A, B pulse) or three-channel (A, B, Z (R) pulse)
PG Wiring Length	100 m (328 ft.) maximum
PG Power Supply	Output voltage: 12 V $\pm$ 5% or 5.5 V $\pm$ 5% Max. Output Current: 200 mA
Compatible Control Modes	Closed Loop (Flux) Vector
Maximum Input Frequency	300 kHz
Pulse Monitor Output	Monitor for A channel, B channel, and Z pulse output Matches RS-422 level
PG Disconnect Detection	Software and hardware detection
Ambient Temperature	-10 °C to +60 °C (14 °F to 140 °F)
Humidity	95% RH or lower with no condensation
Storage Temperature	-20 °C to +70 °C (-4 °F to 158 °F) allowed for short-term transport of the product
Area of Use	Indoor (free of corrosive gas, airborne particles, etc.)
Altitude	1000 m (3280 ft.) or lower

## 4. Receiving

Please perform the following tasks upon receiving the option:

- Inspect the option for damage. Contact the shipper immediately if the option appears damaged upon receipt.
- Verify receipt of the correct model by checking the model number printed on the option nameplate (refer to Figure 1 for more information).
- Contact your supplier if you have received the wrong model or the option does not function properly.

### Option Package Contents

Description:	Option	Ground Wires	Screws (M3)	Installation Manual
--				
Quantity	1	2	3	1

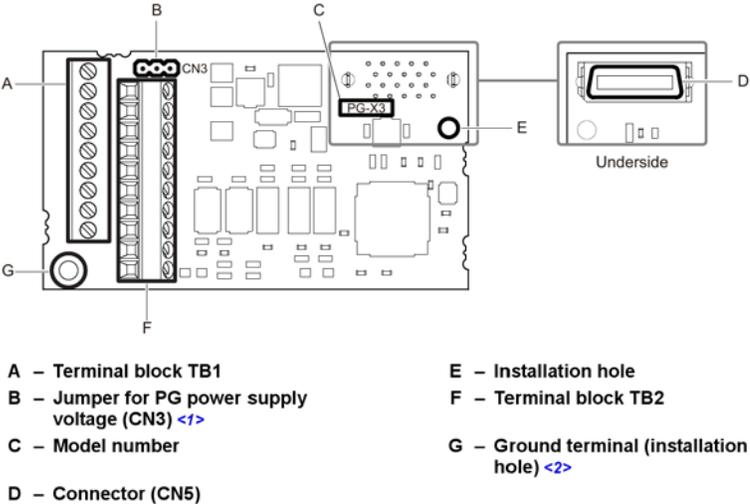
### Tools Required for Installation

- A Phillips screwdriver (M3 metric / #1, #2 U.S. standard size) is required to install the option.
- A straight-edge screwdriver (blade depth: 1/32" [0.6 mm], width: 1/8" [3.5 mm]) is required to wire the option terminal block.
- A pair of diagonal cutting pliers.
- A small file or medium-grit sandpaper.

**NOTE:** *Tools required to prepare option cables for wiring are not listed in this manual.*

# 5. Option Components

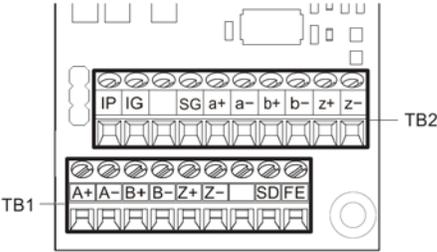
## PG-X3 Option



**Figure 1: PG-X3 Option Components**

<1> Refer to Table 2 on page 15 for detail.  
 <2> Terminal for ground wire packaged with the option card.

## Terminal Blocks TB1 and TB2



**Figure 2: Terminal Blocks**

Refer to Table 5 on page 18 for details on TB1 and TB2 terminal functions and signal levels.

## 6. Installation Procedure

### Section Safety



#### **DANGER**

##### **Electric Shock Hazard**

*Do not connect or disconnect wiring while the power is on.*

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait at least the amount of time specified on the drive before touching any components.



#### **WARNING**

##### **Electrical Shock Hazard**

*Do not remove the front cover of the drive while the power is on.*

Failure to comply could result in death or serious injury.

The diagrams in this section may include options and drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating any devices.

Use the option according to the instructions described in this manual.

*Do not allow unqualified personnel to use equipment.*

Failure to comply could result in death or serious injury.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of this product.

*Do not touch circuit boards while the power to the drive is on.*

Failure to comply could result in death or serious injury.

*Do not use damaged wires, stress the wiring, or damage the wire insulation.*

Failure to comply could result in death or serious injury.

##### **Fire Hazard**

*Tighten all terminal screws to the specified tightening torque.*

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

## NOTICE

### Damage to Equipment

*Observe proper electrostatic discharge (ESD) procedures when handling the option, drive, and circuit boards.*

Failure to comply may result in ESD damage to circuitry.

*Never shut the power off while the drive is running or outputting voltage.*

Failure to comply may cause the application to operate incorrectly or damage the drive.

*Do not operate damaged equipment.*

Failure to comply may cause further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

*Do not use unshielded cable for control wiring.*

Failure to comply may cause electrical interference resulting in poor system performance.

Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

*Properly connect all pins and connectors.*

Failure to comply may prevent proper operation and possibly damage equipment.

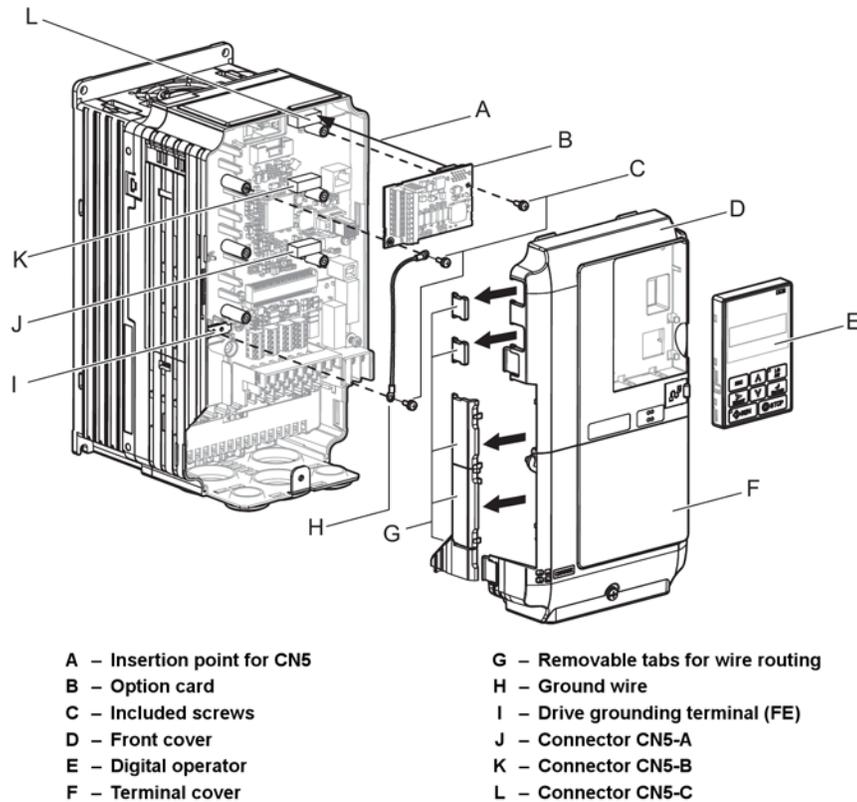
*Check wiring to ensure that all connections are correct after installing the option and connecting any other devices.*

Failure to comply may result in damage to the option.

## Prior to Installing the Option

Prior to installing the option, wire the drive, make the necessary connections to the drive terminals, and verify that the drive functions normally. Refer to the Quick Start Guide packaged with the drive for information on wiring and connecting the drive.

Figure 3 shows an exploded view of the drive with the option and related components for reference.



**Figure 3: Drive Components with Options**

## Installing the Option

Remove the front covers of the drive before installing the option. Refer to the drive manual for directions on removing the front covers. Cover removal varies depending on drive size (see Figure 4).

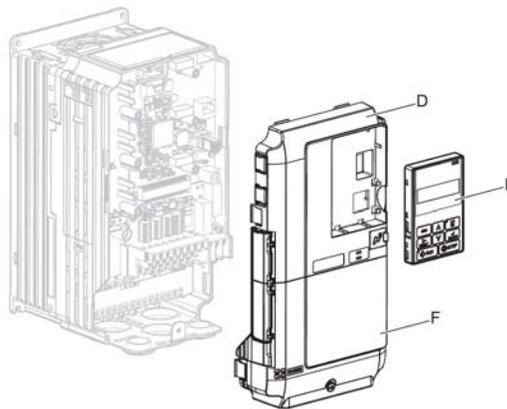
1. Shut off power to the drive, wait the appropriate amount of time specified on the drive for voltage to dissipate, then remove the digital operator (E) and front covers (D, F).



**DANGER**

### **Electrical Shock Hazard.**

Do not connect or disconnect wiring while the power is on. Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait at least the amount of time specified on the drive before touching any components.

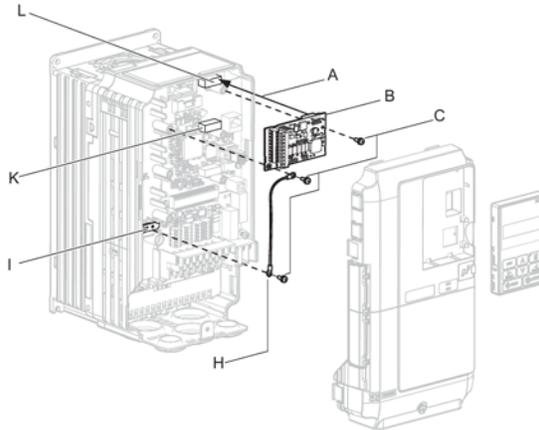


**Figure 4: Remove the Front Covers and Digital Operator**

2. Insert the option (B) into the CN5-B (K) or CN5-C (L) connectors located on the drive and fasten it into place using one of the included screws (C).

Use the CN5-C connector (L) when connecting only one option to the drive; use both CN5-B and CN5-C when connecting two options.

Connect one of the ground wires (H) to the ground terminal (I) using one of the remaining screws (C). Connect the other end of the ground wire (H) to the remaining ground terminal and installation hole on the option using the last remaining provided screw (C).



**Figure 5: Insert the Option and Connect the Ground Wire**

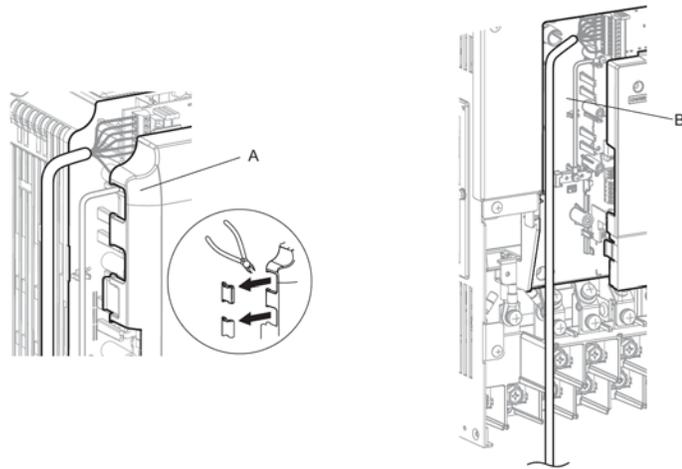
- NOTE:**
1. The option package includes two ground wires. Use the longer wire when plugging the option into connector CN5-C (L) on the drive side. Use the shorter wire when plugging the option into connector CN5-B (K). Refer to Option Package Contents on page 6 for more information.
  2. There are two screw holes on the drive for use as ground terminals. When connecting three options, two ground wires will need to share the same drive ground terminal.

### 3. Route the option wiring.

Depending on the drive model, some drives may require routing the wiring through the side of the front cover to the outside. In these cases, cut out the perforated openings on the left side of the drive front cover as shown in Figure 6 (A) and leave no sharp edges to damage wiring.

Route the wiring inside the enclosure as shown in Figure 6 (B) for drives that do not require routing through the front cover.

For more information, refer to the IMPULSE®•G+/VG+ Series 4 Instruction Manual in your application.



**A – Route wires through the openings provided on the left side of the front cover. <1>**

**B – Use the open space provided inside the drive to route option wiring.**

<1> The drive will not meet NEMA Type 1 requirements if wiring is exposed outside the enclosure.

**Figure 6: Wire Routing Examples**

4. Prepare wire ends as shown in Figure 7. Refer to Table 4 on page 17 to confirm that the proper tightening torque is applied to each terminal. Take particular precaution to ensure that each wire is properly connected and wire insulation is not accidentally pinched into electrical terminals.

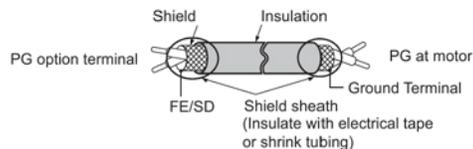


## WARNING

### Fire Hazard.

Tighten terminal screws to the specified tightening torque. Loose electrical connections could result in death or serious injury by fire due to overheating. Tightening screws beyond the specified tightening torque may cause erroneous operation, damage the terminal block, or cause a fire.

**NOTE:** Heat shrink tubing or electrical tape may be required to ensure that cable shielding does not contact other wiring. Insufficient insulation may cause a short circuit and damage the option or drive.



**Figure 7: Preparing Ends of Shielded Cable**

5. Wire the motor PG encoder to the terminal block on the option. Refer to Figure 8 for the wiring diagram.

A shaft-mounted encoder is required to provide speed and shaft position feedback to IMPULSE®•VG+ Series 4. Without an encoder, a flux vector control cannot operate properly.

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

To wire the encoder circuit for IMPULSE®•VG+ Series 4 (assuming the cover and keypad are detached):

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

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

2. Connect the encoder to the PG-X3 Encoder Interface Card. Refer to Figure 8 on page 15.

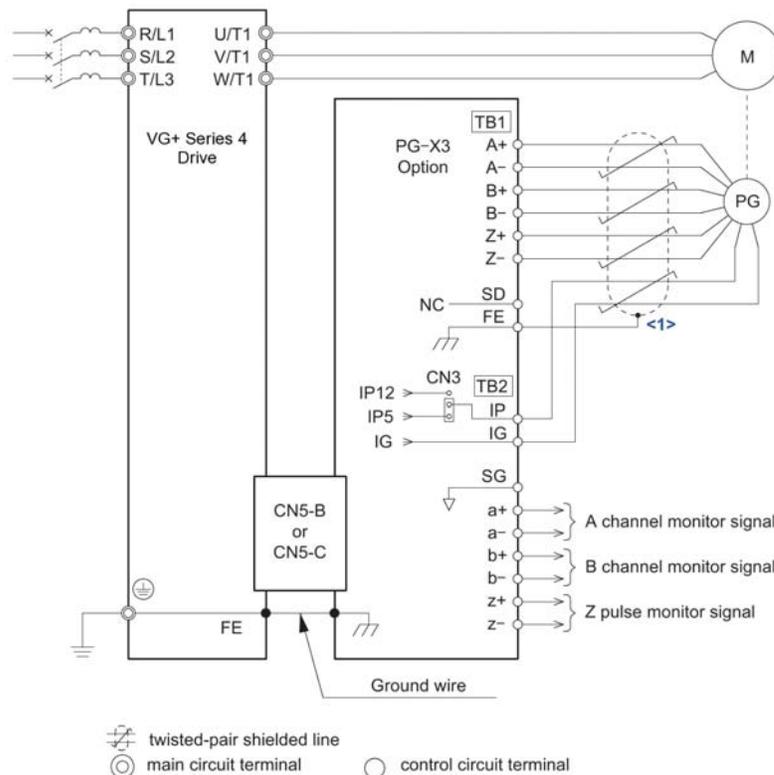
**NOTE:** Use twisted-pair, shielded cable W100W impedance (Magnetek R-20/6, R-22/6, Belden 9730, or Brand Rex T-11651). Use 08/6 encoder wire on runs less than 100 feet. Strip the encoder wires .25 in. (5.5 mm). Keep the wiring length less than 300 feet; for cable lengths greater than 300 feet, contact Magnetek for information on available fiber optic cable systems.

- Ground the shielded cable to Terminal TA4 of the PG-X3 Encoder Interface Card (ground only one end of the shielded cable).

**NOTE:** For LakeShore encoders, the shield connection is not considered "Ground." The shield should be grounded at TA4 and connected to the shield at the encoder.

- Whenever possible, the encoder cable should be wired in a continuous run between the motor and drive. If it cannot be a direct run, the splice should be in its own junction box and isolated from the power wires.

Refer to Table 6, "Option Terminal Functions," on page 18 for a detailed description of the option board terminal functions.



<1> Ground the shield on the PG side and the drive side. If noise problems arise in the PG signal, remove the shield ground from one end of the signal line or remove the shield ground connection on both ends.

**Figure 8: PG-X3 Option and PG Connection Diagram**

**Table 2: Encoder Wiring**

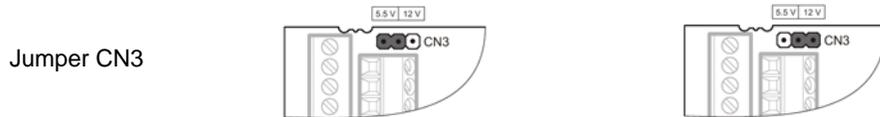
Encoder Signal	Wire Color	PG-X3 Terminal
+5 to 15 VDC	Red	IP
0V	Black	IG
A+	Blue	A+
A-	Gray	A-
B+	Green	B+
B-	Yellow	B-
Shield	--	FE

6. Set the voltage for the PG power supply using jumper CN3 located on the option. Position the jumper as shown in Table 3 to select the voltage level.

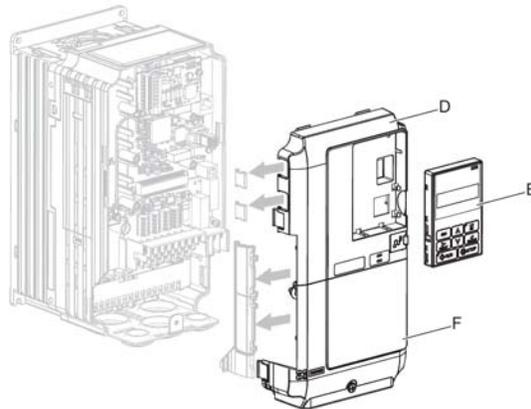
**NOTE:** The positioning of jumper CN3 selects the PG power supply voltage (5.5 V or 12 V). Select the voltage level for the PG connected to the option and motor. If the wrong voltage is selected, the PG may not operate properly or may become damaged as a result.

**Table 3: Setting PG Power Supply Voltage (IP) with Jumper CN3**

Voltage Level	5.5 V $\pm$ 5%	12.0 V $\pm$ 5% (default)
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7. Replace and secure the front covers of the drive (D, F) and replace the digital operator (E).

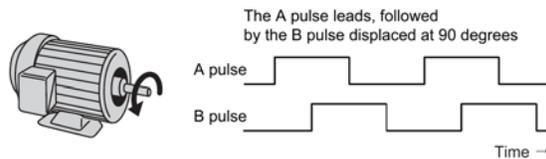


**Figure 9: Replace the Front Covers and Digital Operator**

**NOTE:** Take proper precautions when wiring the option so that the front covers will easily fit back onto the drive. Make sure cables are not pinched between the front covers and the drive when replacing the covers.

8. Set drive parameters for proper motor rotation.

With a two-channel or three-channel encoder, the leading pulse determines the motor rotation direction. A PG signal with leading A pulse is considered to be rotating forward (counter-clockwise when viewing rotation from motor load side).



**Figure 10: Displacement of A and B Pulses**

After connecting the PG outputs to the option, apply power to the drive and manually rotate the motor and check the rotation direction by viewing monitor U01-05 on the digital operator.

Reverse motor rotation is indicated by a negative value for U01-05; forward motor rotation is indicated by a positive value.

If monitor U01-05 indicates that the forward direction is opposite of what is intended, reverse the two A channel wires with the two B channel wires on option terminal TB1 as shown in Figure 11.



**Figure 11: A Channel and B Channel Wire Switching**

If switching the wires is inconvenient, set drive parameter F01-02 to 1 to switch the direction of how the option reads pulses from the PG output.

Please note that when the drive is initialized using A01-05 = 5550, the value for F01-02 will reset to factory default and the parameter will need to be adjusted again to switch the direction.

## Wire Gauges, Tightening Torques, and Crimp Terminals

Wire gauge and torque specifications are listed in Table 4. Magnetek recommends using crimp terminals with the specifications listed in Table 5 to facilitate wiring and ensure proper connection.

**Table 4: Wire Gauges and Tightening Torques**

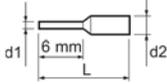
Terminal Size	Screw Size	Tightening Torque N-m (in-lb)	Bare Cable		Crimp Terminals		Wire Type
			Applicable Gauges mm <sup>2</sup> (AWG)	Recomm. Gauge mm <sup>2</sup> (AWG)	Applicable Gauges mm <sup>2</sup> (AWG)	Recomm. Gauge mm <sup>2</sup> (AWG)	
D0 to DF SI, SE, SP, SC, SN, SD, FE	M2	0.22 to 0.25 (1.95 to 2.21)	Stranded wire: 0.25 to 1.0 (24 to 17)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	Shielded twisted pair, etc.
a+, a-, b+, b-, z+, z-, SG			Solid wire: 0.25 to 1.5 (24 to 16)				Shielded cable, etc.

### Crimp Terminals

Magnetek recommends using CRIMPFOX 6 by Phoenix Contact or equivalent to crimp the terminal ends.

**NOTE:** Properly trim wire ends so loose wire ends do not extend from the crimp terminals.

**Table 5: Crimp Terminal Sizes**

	Wire Gauge mm <sup>2</sup> (AWG)	Phoenix Contact Model	L mm (in)	d1 mm (in)	d2 mm (in)
	0.25 (24)	AI 0.25 - 6YE	10.5 (13/32)	0.8 (1/32)	2 (5/64)
	0.34 (22)	AI 0.34 - 6TQ	10.5 (13/32)	0.8 (1/32)	2 (5/64)
	0.5 (20)	AI 0.5 - 6WH	14 (9/16)	1.1 (3/64)	2.5 (3/32)

**Terminal Functions**

**Table 6: Option Terminal Functions**

Terminal Block	Terminal	Function	Description
TB1	A+	A pulse signal input	<ul style="list-style-type: none"> <li>Inputs to the A channel, B channel, and Z pulses from the PG</li> <li>Signal level matches RS-422</li> <li>Z pulses are not used</li> </ul>
	A-	A inverse pulse signal input	
	B+	B pulse signal input	
	B-	B inverse pulse signal input	
	Z+	Z pulse signal input	
	Z-	Z inverse pulse signal input	
	SD	NC pin (open)	Open connection port for use when cable shields should not be grounded
	FE	Ground	Used as the shield ground termination point
TB2	IP	PG power supply	<ul style="list-style-type: none"> <li>Output voltage: 12.0 V ± 5% or 5.5 V ± 5%</li> <li>Max. output current: 200 mA*</li> </ul>
	IG	PG power supply common	
	SG	Monitor signal common	<ul style="list-style-type: none"> <li>Output signal for monitoring A channel, B channel, and Z pulses from the PG</li> <li>Signal level matches RS-422</li> </ul>
	a+	A pulse monitor signal	
	a-	A pulse inverse monitor signal	
	b+	B pulse monitor signal	
	b-	B pulse inverse monitor signal	
	z+	Z pulse monitor signal	
z-	Z pulse inverse monitor signal		

\* A separate power supply is needed if the PG requires more than 200 mA to operate. Select a UL-listed class 2 power supply.

## 7. Related Parameters

The following parameters are used to set up the drive for operation with the option. Set parameters as needed. Parameter setting methods can be found in the drive's IMPULSE®•G+/VG+ Series 4 Instruction Manual.

**Table 7: Encoder (PG) Option Set-Up Parameter Settings**

Parameter Code	Display	Function	Range	Initial Value	Model
F01-01	PG1 Pulses/Rev	Sets encoder Pulses/Rev for Channel 1	0–60000 ppr	1024	VG+
F01-02	PG1 Rotation Sel 0 Fwd = C.C.W. 1 Fwd = C.W.	(B-phase at motor REV. run) (A-phase at motor REV. run)	0, 1	0	VG+
F01-03	PG1 Output Ratio	Sets the division ratio for the pulse monitor used of the PG option card installed to CH1 (port CN5-C).	1–132	1	VG+
$f_{\text{Pulse Input}} = f_{\text{Pulse Output}} * \frac{(1 + n)}{m}$ <p>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).</p> <p>If only using the A pulse for one-track input, the input ratio will be 1:1 regardless of F01-03 setting.</p>					
F01-04	PG1 #Gear Teeth1	Sets the gear ratio between the motor shaft and the encoder (PG).  A gear ratio of 1 will be used if F01-04 or F01-05 are set to 0. A gear ratio of 1 will be used if either of these parameters is set to 0.	0–1000	0	VG+
F01-05	PG1 #Gear Teeth2	Sets the gear ratio between the motor shaft and the encoder (PG).  A gear ratio of 1 will be used if F01-04 or F01-05 are set to 0. A gear ratio of 1 will be used if either of these parameters is set to 0. This function is not available in Flux Loop Vector Control.	0–1000	0	VG+
F01-06	PGO-1-H	Delay time for PGO-1-H detection. A setting of zero disables PGO-1-H detection. Channel 1 is associated with slot CN5-C, used for motor encoder feedback.	0–100 ms	15	VG+
F01-11	PG2 Pulses/Rev	Sets the number of pulses for a PG option card connected to port CN5-B.	0–60000 ppr	1024	VG+

Parameter Code	Display	Function	Range	Initial Value	Model
F01-12	PG2 Rotation Sel 0 Fwd= C.C.W. 1 Fwd = C.W.	(B-phase at motor REV. run) (A-phase at motor REV. run)	0, 1	0	VG+
F01-13	PG2 #Gear Teeth1	Sets the gear ratio between the motor shaft and the encoder (PG). A gear ratio of 1 will be used if F01-13or F01-14 are set to 0.	0–1000	0	VG+
F01-14	PG2 #Gear Teeth2	Sets the gear ratio between the motor shaft and the encoder (PG). A gear ratio of 1 will be used if F01-13 or F01-14 are set to 0.	0–1000	0	VG+
F01-15	PG2 Output Ratio	Sets the division ratio for the pulse monitor used of the PG option card installed to port CN5-B.	1–132	1	VG+
F01-16	PGO-2-H	Delay time for PGO-2-H detection. A setting of zero disables PGO-2-H detection. Channel 2 is associated with slot CN5-B.	0–100 ms	15	VG+
F01-21	PG Fdbk Loss Sel 0 Decel to Stop 1 Coast to Stop 2 Fast Stop 3 Alarm Only	Stopping method when PGO-1-H, PGO-2-H, PGO-1-S, or PGO-2-S faults are detected. Decelerate to stop using the deceleration time in B05-02. Decelerate to stop using the deceleration time in B05-08.	Traverse: 0–3 NLB: 1	1	VG+
F01-22	PGO-1-S Det Time	PGO-1-S (CH1) disconnection detection time	0.0–10.0 sec	2.0	VG+
F01-23	PG Overspeed Sel 0 Decel to Stop 1 Coast to Stop 2 Fast Stop 3 Alarm Only	Sets the stopping method when an overspeed (OS) fault occurs. Decelerate to stop using the deceleration time in B05-02. Decelerate to stop using the deceleration time in B05-08.	Traverse: 0–3 NLB: 1	1	VG+
F01-24	PG Overspd Level	Sets the overspeed detection level as a percentage of the maximum output frequency.	0–120%	105	VG+
F01-25	PG Overspd Time	Sets the time in seconds for an overspeed situation to trigger a fault (oS).	0.0–2.0 sec	0.0	VG+

Parameter Code	Display	Function	Range	Initial Value	Model
F01-26	PG Deviation Sel	Stopping method at excessive speed deviation.	Traverse: 0–7 NLB: 5	5	VG+
	0 @Spd Agree-Decel	Stops by deceleration time 1 - B05-02.			
	1 @Spd Agree-Coast	Coast to stop.			
	2 @Spd Agree-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	PG Deviate Level	Sets the speed deviation detection level as a percentage of the maximum output frequency.	0–50%	10	VG+
F01-28	PG Deviate Time	Sets the time in seconds for a speed deviation situation to trigger a fault DEV.	0.0–10.0 sec	0.3	VG+

# 8. Troubleshooting

## Preventing Noise Interference

Take the following steps to prevent erroneous operation caused by noise interference:

- Use shielded wire for the PG signal lines.
- Limit the length of all motor output power cables to less than 100 m.
- Separate the control wiring to the option, main circuit input power wiring, and motor output power cables.
- Ground the shield on the PG side and the drive side. If noise problems arise in the PG signal, verify that the shield is properly grounded and ground one end of the signal line or remove the ground connection on both ends.

## Interface Circuit

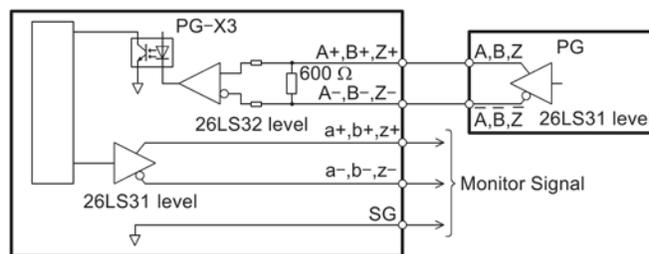


Figure 12: Interface Circuit

## Test Points

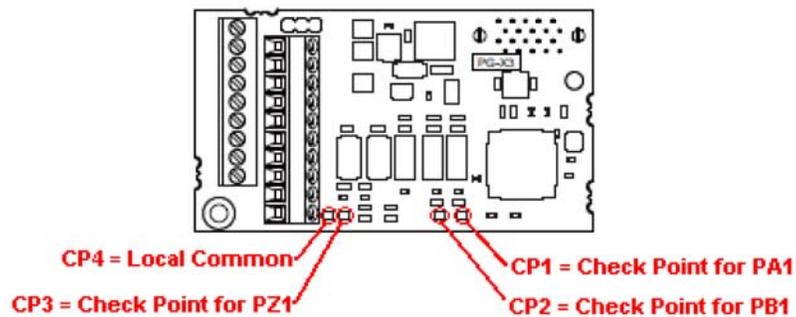


Figure 13: Test Points

## Encoder Related Faults

The faults in this section may involve the encoder feedback system. During system startup, these faults are often caused by parameters that need to be adjusted. However, after the system has been running for some time without a fault, this usually indicates a problem with the physical system and adjusting the parameters should only be done after the physical system has been inspected.

### Fault Code: DEV– Speed Deviation Fault

#### Definition

A speed deviation fault means that the drive 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 will typically occur when the drive is at its programmed torque limit. In addition, if the drive receives erratic, or missing, encoder pulses, speed deviations are also possible. If the initial drive 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 drive 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 occurring can result in loss of control of the load under certain circumstances.*

2. As a precaution the load float time, parameter 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 with the sensor head, or the encoder shaft coupling (depending on the type of encoder used). If the pulse wheel is misaligned or the shaft coupling is loose the drive will get erratic pulse signals or no signals at all causing a speed deviation fault or PGO (Pulse Generator Open) fault. Repairs to the encoder wheel or shaft coupling should be made immediately before again attempting to operate the hoist.
5. If the encoder appears to have no mechanical problems, the encoder cable should be checked for damage and replaced if a problem is found.
  - 5.1 Each of the encoder wires should be checked for continuity.
  - 5.2 The wires should be checked for shorts between any two wires.
  - 5.3 The wires should be checked for shorts to the shield or ground.
  - 5.4 Visually inspect the cable for damage that may be causing intermittent problems.
6. If the encoder feedback system checks out mechanically and electrically, then the last physical check to make is for something in the mechanical system that might be resisting normal operation. One example may be the brake is not opening fully and is causing enough drag to prevent 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.
  - 7.1 Check if the acceleration or deceleration times have been changed (B05-01, B05-02, C01-02, C01-04, or C01-05).
  - 7.2 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 torque limited acceleration or deceleration, 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 trips.)*
9. Increase Encoder Excessive Speed Deviation Level to no more than 30 (F01-27).
10. After the corrective action has been taken and the fault no longer occurs then the load float time, C08-10, can be set back to its initial value.

## Fault Code: PGO-X-S/PGO-X-H–Pulse Generator Signal Fault

### Definition

The pulse generator signal missing fault indicates that the drive has detected a problem with encoder feedback. This fault will typically occur if the drive 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 occurring can result in loss of control of the load under certain circumstances.*
2. As a precaution, the load float time, parameter 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 F01-08.
3. Check the alignment of the encoder pulse wheel with the sensor head, the encoder shaft coupling (depending on the type of encoder used), or check for a failed encoder sensor head. If one of these conditions exists the drive will get erratic pulse signals or no signal at all causing a speed deviation fault or PGO fault. Repairs to the encoder wheel or shaft coupling should be made immediately before attempting to operate the hoist again.
4. If the encoder appears to have no mechanical problems, the encoder cable should be checked for damage and replaced if a problem is found.
  - 4.1 Each of the encoder wires should be check for continuity.
  - 4.2 The wires should be checked for shorts between any two wires.
  - 4.3 The wires should be checked for shorts to the shield or ground.
  - 4.4 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 brake failing to open.

6. After corrective action has been taken and the fault no longer occurs then the load float time, C08-10, can be set back to initial value.

## Fault Code: BE1–Rollback Fault

### Definition

The BE1 fault indicates that the drive 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 drive/motor having insufficient torque to suspend the load.

### Corrective Action

1. Check the encoder cable for damage and proper grounding. Replace it if a problem is found.
  - 1.1 Each of the encoder signals should be checked for excessive noise.
  - 1.2 The shielded encoder cable should be properly grounded.
  - 1.3 Visually inspect the cable for damage that may be causing intermittent problems.
2. Check the alignment of the encoder pulse wheel with the sensor head, or the encoder shaft coupling (Depending on the type of encoder used). If the pulse wheel is misaligned or the shaft coupling is loose the drive may get erratic pulse signals possibly causing a BE1 fault. Repairs to the encoder wheel or shaft coupling should be made immediately before again attempting to operate the hoist.
3. If none of the above steps has identified a valid 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 trips.*
4. Increase C08-05 to no more than 800 pulses.

## Fault Code: BE2–Torque Proving Fault

### Definition

The BE2 fault indicates that the drive 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 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 will allow the encoder pulses 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.
  - 2.1 Each of the encoder signals should be checked for excessive noise.
  - 2.2 The shielded encoder cable should be properly grounded.
  - 2.3 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 (depending on the type of encoder used). If the pulse wheel is misaligned or the shaft

coupling is loose the drive may get erratic pulse signals possibly causing a BE2 fault. Repairs to the encoder wheel or shaft coupling should be made immediately before again attempting to operate the hoist.

4. Perform a Brake Torque test to verify the braking torque compared to the brake specifications before proceeding.
5. 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 the Current Feedback Timer set as low as possible without causing nuisance trips.*

## Fault Code: BE3–Brake Release Fault

### Definition

The BE3 fault indicates that the drive has released the brake and commanded the drive 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 drive 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 (depending on the type of encoder used). If the pulse wheel is misaligned or the shaft coupling is loose the drive will get erratic pulse signals or no signals at all possibly causing a BE3 fault. Repairs to the encoder wheel or shaft coupling should be made immediately before again 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.
  - 3.1 Each of the encoder wires should be checked for continuity.
  - 3.2 The wires should be checked for shorts between any two wires.
  - 3.3 The wires should be checked for shorts to the shield or ground.
  - 3.4 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 trips.*
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.

## Alarm Code: BE6–Brake Proving Alarm

### Definition

The BE6 alarm indicates that the drive 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 drive will initiate Load Float for the duration of the BE6 alarm.

*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.*

*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.
  - 2.1 Each of the encoder signals should be checked for excessive noise.
  - 2.2 The shielded encoder cable should be properly grounded.
  - 2.3 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 (depending on the type of encoder used). If the pulse wheel is misaligned or the shaft coupling is loose the drive 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 a fault reaction time as possible without causing nuisance trips.*
5. Ensure that C08-11 is equal to the brake's mechanical delay time.
6. Increase the value of C08-13.

## Alarm Code: BE8–Brake Slipping Alarm

### Definition

The BE8 alarm indicates that the drive has detected that the brake slipping after the brake is set. A BE8 alarm will occur if the drive detects that the load is moving greater than the brake Slip Detection Speed (C08-23) when the brake is set. When this occurs, the drive 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. This will allow the encoder pulses received while the brake is set.

2. Check the encoder cable for damage and proper grounding. Replace it if a problem is found.
  - 2.1 Each of the encoder signals should be checked for excessive noise.
  - 2.2 The shielded encoder cable should be properly grounded.
  - 2.3 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 (depending on the type of encoder used). If the pulse wheel is misaligned or the shaft coupling is loose the drive may get erratic pulse signals possibly causing a BE8 fault. 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), the brake may need to be replaced.

*NOTE: It is desirable to have as fast a fault reaction time as possible without causing nuisance trips.*

## **Fault Code: OC—Over Current Fault**

### **Definition**

An over current fault is caused if the output current exceeds 200% of the inverter rated output current. This fault can be caused by short circuits in the wiring or in the motor, and it can also be caused by parameters that are not adjusted properly. One other cause of this fault could be erratic or no encoder feedback. In the last instance, the drive 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 drive to increase current output to the motor in an attempt to correct the position until an over current fault occurs.

### **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 with the sensor head, or the encoder shaft coupling (depending on the type of encoder used). If the pulse wheel is misaligned or the shaft coupling is loose the drive will get erratic pulse signals or no signals at all possibly causing an OC fault. Repairs to the encoder wheel or shaft coupling should be made immediately before again 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.
  - 3.1 Each of the encoder wires should be check for continuity.
  - 3.2 The wires should be checked for shorts between any two wires.
  - 3.3 The shield should be check for proper grounding.
  - 3.4 The wires should be checked for shorts to the shield or ground.
  - 3.5 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), check if any of the torque limit parameters (C07-01 to C07-04) have been changed. If these parameters have been changed to allow a higher torque value, it could cause overcurrent trips.

*NOTE: Changing these parameters could also induce speed deviation or overload faults. Only a trained technician should modify these parameters. It is desirable to have as fast a fault reaction time as possible without causing nuisance trips.*