

# **IMPULSE·VG+** *Series 4*

Adjustable Frequency/Vector Crane Controls

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



**MAGNETEK**  
MATERIAL HANDLING

August 2011  
Part Number: 144-23921  
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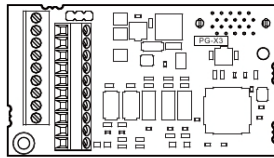
# 1. Preface and Safety

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

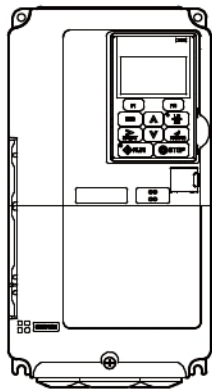


**IMPULSE®•VG+ Series 4  
PG-X3 Installation Manual  
Manual No: 144-23921**

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**

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.magnetekmh.com> to obtain Magnetek instruction manuals.

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

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## Terms

**Drive:** IMPULSE®•VG+ Series 4

**Option:** IMPULSE®•VG+ Series 4 Option Motor PG Feedback Line Driver Interface: Type 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 V/f with PG and Closed Loop Vector control modes. 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.

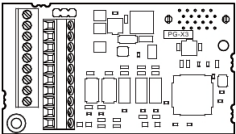


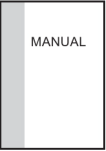
*NOTE: This option cannot be used with an open collector encoder. Use option PG-B3 with open collector encoders.*

### 3. 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 on page 7 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

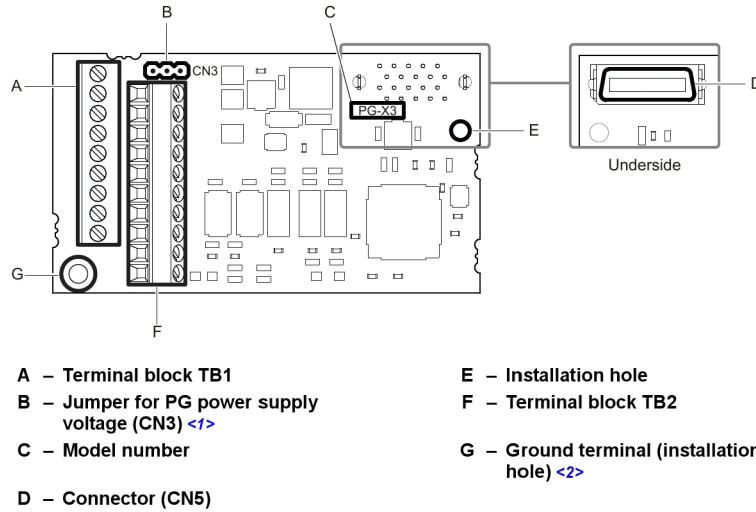
#### Tools Required for Installation

- 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.*

# 4. Option Components

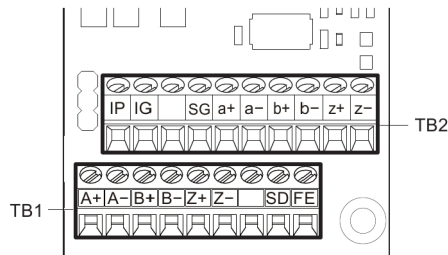
## PG-X3 Option



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

<1> Refer to Table 2 on page 16 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.

## 5. 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.

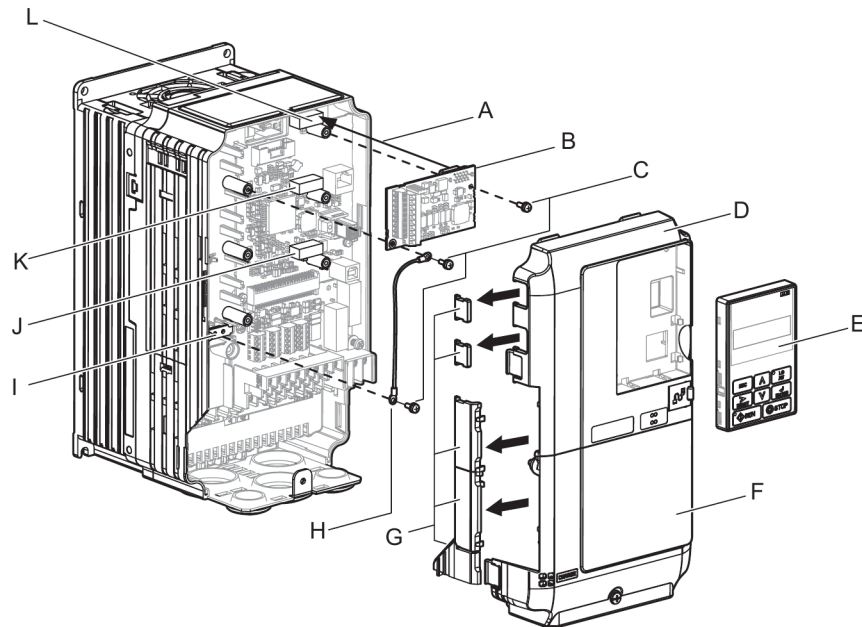
*Check wiring to ensure that all connections are correct after installing the option and connecting any other devices.*

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.



- |                             |                                     |
|-----------------------------|-------------------------------------|
| A – Insertion point for CN5 | G – Removable tabs for wire routing |
| B – Option card             | H – Ground wire                     |
| C – Included screws         | I – Drive grounding terminal (FE)   |
| D – Front cover             | J – Connector CN5-A                 |
| E – Digital operator        | K – Connector CN5-B                 |
| F – Terminal cover          | L – Connector CN5-C                 |

**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).

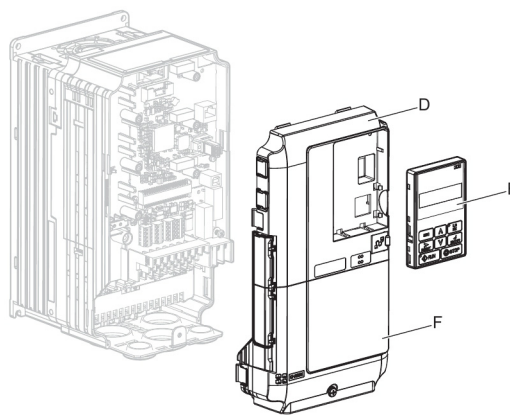
1. Shut off power to the drive, wait the appropriate amount of time specified on the drive for voltage to dissipate, then remove the digital operator (E) and front covers (D, F).



**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.

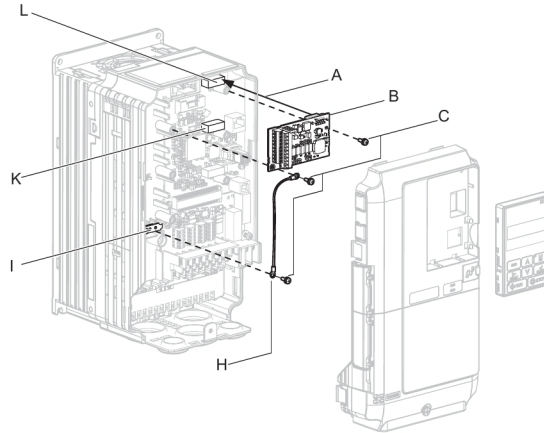


**Figure 4: Remove the Front Covers and Digital Operator**

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**

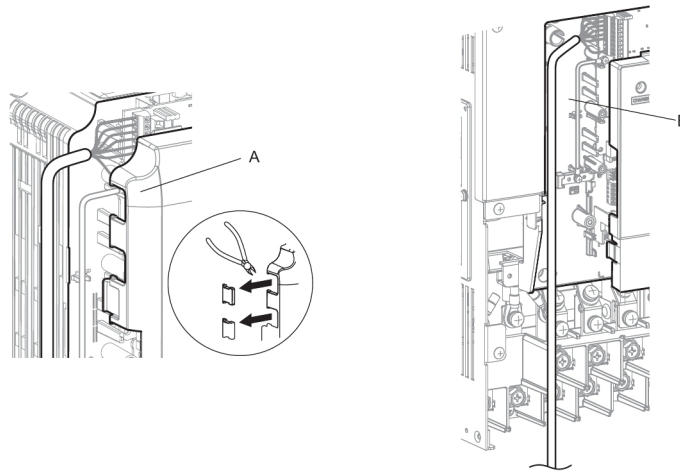
- NOTE:**
1. The option package includes two ground wires. Use the longer wire when plugging the option into connector CN5-C (L) on the drive side. Use the shorter wire when plugging the option into connector CN5-B (K). Refer to Option Package Contents on page 6 for more information.
  2. There are two 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 Wire Gauges and Tightening Torques 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.

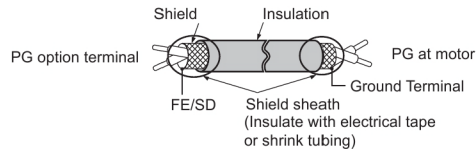


## WARNING

### 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: “PG-X3 Option and PG Connection Diagram” on page 15.

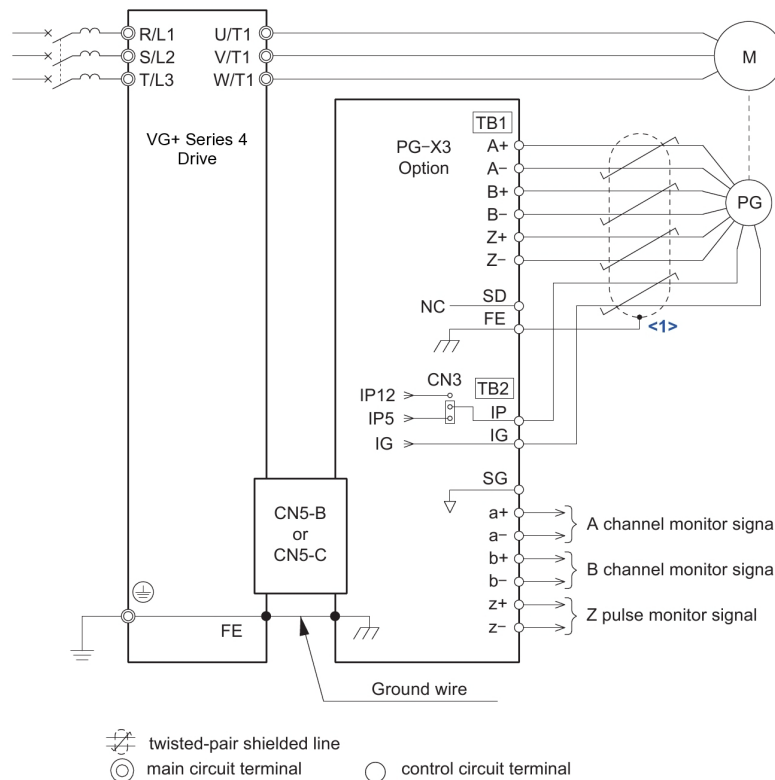
**NOTE:** *Use twisted-pair, shielded cable W100W impedance (Magnetek R-20/6, R-22/6, Belden 9730, or Brand Rex T-11651). Use 08/6 encoder wire on runs less than 100 feet. Strip the encoder wires .25 in. (5.5 mm). Keep the wiring length less than 300 feet. (For cable lengths greater than 300 feet, contact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

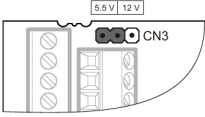
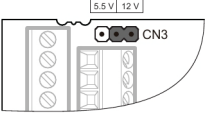
**Table 1-1: Encoder Wiring (Lakeshore Model: SL56 and SL85; Avtron Models: M56 and M85)**

Encoder Signal	Wire Color	PG-X3 Terminal
+5 to 15 VDC	Red	
OV	Black	
A+	Blue	
A-	Gray	
B+	Green	
B-	Yellow	
Shield	N/A	

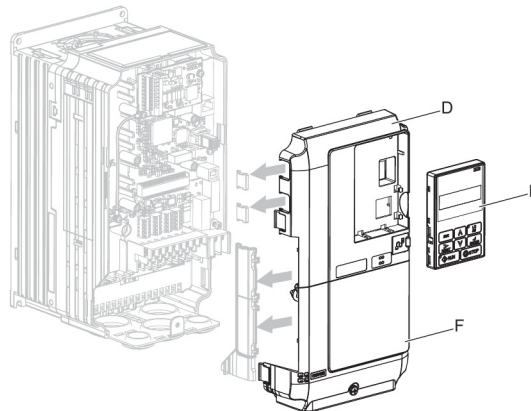
6. Set the voltage for the PG power supply using jumper CN3 located on the option. Position the jumper as shown in Table 2 to select the voltage level.

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

Voltage Level	5.5 V $\pm$ 5%	12.0 V $\pm$ 5% (default)
Jumper CN3		

7. Replace and secure the front covers of the drive (D, F) and replace the digital operator (E).

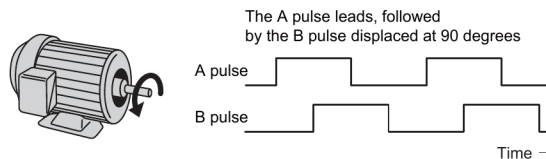


**Figure 9: Replace the Front Covers and Digital Operator**

**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 U1-05 on the digital operator.

Reverse motor rotation is indicated by a negative value for U1-05; forward motor rotation is indicated by a positive value.

If monitor U1-05 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 F1-02 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 A1-05 =1110 or 2220, the value for F1-02 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 3. Magnetek recommends using crimp terminals with the specifications listed in Table 4 to facilitate wiring and ensure proper connection.

**Table 3: Wire Gauges and Tightening Torques**

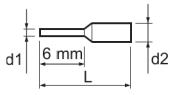
Terminal Size	Screw Size	Tightening Torque N-m (in-lb)	Bare Cable		Crimp Terminals		Wire Type
			Applicable Gauges mm <sup>2</sup> (AWG)	Recomm. Gauge mm <sup>2</sup> (AWG)	Applicable Gauges mm <sup>2</sup> (AWG)	Recomm. Gauge mm <sup>2</sup> (AWG)	
D0 to DF SI, SE, SP, SC, SN, SD, FE	M2	0.22 to 0.25 (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 4: 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 5: Option Terminal Functions**

Terminal Block	Terminal	Function	Description
TB1	A+	A pulse signal input	<ul style="list-style-type: none"> <li>Inputs for the A channel, B channel, and Z pulses from the PG</li> <li>Signal level matches RS-422</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> <li>Output signal for monitoring A channel, B channel, and Z pulses from the PG</li> <li>Signal level matches RS-422</li> </ul>
	IG	PG power supply common	
	SG	Monitor signal common	
	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.

## 6. 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 Quick Start Guide or Instruction Manual.

**Table 6: Related Parameters**

Parameter Code	Display	Function	Range	Initial Value
F1-01 <1> <2>	PG1 Pulses/Rev	Sets the number of PG (pulse generator or encoder) pulses. Sets the number of pulses per motor revolution.	1–60000	1024
F1-02 <2>	PG1 Rotation Sel	PG 1 Rotation Selection	0, 1	0
	<i>0: FWD = C.C.W. - (B-phase at motor REV. run)</i> <i>1: FWD = C.W. - (A-phase at motor REV. run)</i>			
F1-03 <2>	PG1 Output Ratio	Sets the division ratio for the pulse monitor used of the PG option card installed to CH1 (port CN5-C). Fpulse input = Fpulse output * [(1 + x)/yz], where setting is [x][yz]. Example: To have a ration of 1/32 between the PG card pulse input and output, set F1-06 = 032. By setting “xyz”, the division ratio becomes = [(1 + x)/yz]. If only using the A pulse for one-track input, the input ratio will be 1:1 regardless of F1-06 setting.	1–132	1
F1-04 <2>	PG1 #Gear Teeth1	Sets the gear ratio between the motor shaft and the encoder (PG). A gear ratio of 1 will be used if F1-13 or F1-14 are set to 0.	0–1000	0
F1-05 <2>	PG1 #Gear Teeth 2	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

<1> The number of output pulses for the PG can be calculated as follows:

$$f_{PG}(\text{Hz}) = (\text{Motor speed at max frequency output (min}^{-1}\text{)/60}) \times \text{PG rating (p/rev)}$$

<2> The parameter is available only for the drive connector CN5-C.

<3> Value changes according to the control mode selection in A1-02.

<4> Enabled only when using the V/f with PG control mode.

<5> The parameter is available only for the drive connector CN5-B.

Parameter Code	Display	Function	Range	Initial Value
F1-06 <2>	PGO-1-H	Detectes whether the input signals to the encoder are present. If enabled, a PGO-1-H fault will be displayed.	0, 1	1
	<i>0: Disabled</i> <i>1: Enabled</i>			
F1-11 <1> <5>	PG-2 Pulses/Rev	Sets the number of pulses for a PG option card connected to port CN5-B.	0–60000	1024
F1-13 <4><5>	PG2 #Gear Teeth 1	Sets the gear ratio between the motor shaft and the encoder (PG).	0–1000	0
F1-14 <5>	PG2 #Gear Teeth 2	A gear ratio of 1 will be used if F1-33 or F1-34 are set to 0.	0–1000	0
F1-15 <5>	PG2 Output Ratio	Sets the division ratio for the pulse monitor used of the PG option card installed to port CN5-B. Fpulse input = Fpulse output * [(1 + x)/yz], where setting is [x][yz] Example: To have a ration of 1/32 between the PG card pulse input and output, set F1-06 = 032 By setting “xyz”, the division ratio becomes = [(1 + x)/yz]. If only using the A pulse for one-track input, the input ratio will be 1:1 regardless of F1-06 setting.	1–132	1
F1-16 <5>	PGO-2-H	Detectes whether the input signals to the encoder are present. If enabled, a PG-2-H fault will be displayed.	0, 1	1
	<i>0: Disabled.</i> <i>1: Enabled.</i>			
F1-21	PG Fdbk Loss Sel	Stopping method when PGO-1-H, PGO-2-H, PGO-1-S, or PGO-2-S faults are detected.	<3>	1
	<i>0: Decel to stop</i> <i>1: Coast to stop</i> <i>2: Fast Stop</i> <i>3: Alarm Only</i>			
F1-22	PGO-1-S Det Time	PGO-1-S (CH1) disconnection detection time is set at a unit of second.  <i>NOTE: A setting of “0” Disables Software PGO-1-S Detection.</i>	0.0–10.0	0.5

<1> The number of output pulses for the PG can be calculated as follows:

$$f_{PG}(\text{Hz}) = (\text{Motor speed at max frequency output (min}^{-1}\text{)}/60) \times \text{PG rating (p/rev)}$$

<2> The parameter is available only for the drive connector CN5-C.

<3> Value changes according to the control mode selection in A1-02.

<4> Enabled only when using the V/f with PG control mode.

<5> The parameter is available only for the drive connector CN5-B.

Parameter Code	Display	Function	Range	Initial Value
F1-23	PG Overspeed Sel	Sets the stopping method when an overspeed (OS) fault occurs. See F1-24 and F1-25.  <i>NOTE: When A1-03 = 2 (NLB) or B3-03 = 6 (NLB), then Range is 1~1. Pulse comes from pulse input</i>  0: Decel to stop 1: Coast to stop 2: Fast Stop 3: Alarm only	0–3	1
F1-24	PG Overspd Level	Sets the overspeed detection level as a percentage of the maximum output frequency.	0–120	115
F1-25	PG Overspd Time	Sets the time in seconds for an overspeed situation to trigger a fault (oS).	0.0–2.0	<3>
F1-26	PG Deviation Sel	Stopping method at excessive speed deviation (DEV fault) 0: @Spd Agree-Decel (Stops by deceleration time 1 - B5-02.) 1: @Spd Agree-Coast (Coast to stop) 2: @SpdAgree-F-Stop (Decelerates by fast stop B5-08.) 3: @Spd Agree-Alm (DEV displayed, operation continues) 4: @Run-Decel (Stops by deceleration time 1 - B5-02) 5: @Run-Coast (Coast to stop) 6: @Run-Fast Stop (Decelerates by fast stop B5-08) 7: @Run-Alarm Only (DEV displayed, operation continues) <i>NOTE: Note: When A1-03 = 2 (NLB) or B3-03 = 6 (NLB), then Range is 5~5. Setting applies for the following DEV conditions: DEV-1 and DEV-2.</i>	0–7	5
F1-27	PG Deviate Level	Sets the speed deviation detection level as a percentage of the maximum output frequency.	0–50%	10
F1-28	PG Deviate Time	Sets the time required a speed deviation situation to trigger a fault.	0.0–10.0	0.3

<1> The number of output pulses for the PG can be calculated as follows:

$$f_{PG}(\text{Hz}) = (\text{Motor speed at max frequency output (min}^{-1}\text{)}/60) \times \text{PG rating (p/rev)}$$

<2> The parameter is available only for the drive connector CN5-C.

<3> Value changes according to the control mode selection in A1-02.

<4> Enabled only when using the V/f with PG control mode.

<5> The parameter is available only for the drive connector CN5-B.

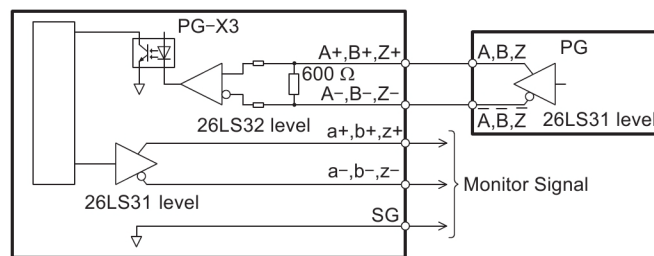
## 7. Troubleshooting

### 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**

## Drive-Side Error Codes

Table 7 lists the various fault codes related to the option and pulse generator. Refer to the drive Technical Manual for further details on fault codes.

Check the following items first when an error code occurs on the drive:

- Make sure the PG cable is properly connected.
- Check the cables between the PG and the option.
- Make sure the option is properly installed to the drive.

**Table 7: Fault Displays, Causes, and Possible Solutions**

Digital Operator Display		Fault Name
		Speed Deviation (for Control Mode with PG)
<i>dEv</i>	dEv	The deviation between the speed reference and speed feedback is greater than the setting in F1-27 for longer than the time set to F1-28.
<b>Cause</b>		<b>Possible Solution</b>
The load is too heavy.		Reduce the load.
The acceleration and deceleration times are set too short.		Increase the acceleration and deceleration times (B5-01 through B5-15).
The load is locked up.		Check the machine.
Parameters are set inappropriately.		Check the settings of parameters F1-27 and F1-28.
Motor brake is engaged.		Ensure the motor brake releases properly.
Digital Operator Display		Fault Name
		Z Channel Pulse Fault Detection
<i>dv1</i>	dv1	The motor turned one full rotation while failing to detect the Z channel pulse.
<b>Cause</b>		<b>Possible Solution</b>
The PG encoder is disconnected or is not wired properly, or the PG option or PG are damaged.		<ul style="list-style-type: none"> <li>• Rewire the PG encoder and make sure all wiring including shielded wiring is properly connected</li> <li>• If the problem continues after cycling power, replace the PG option or the PG encoder.</li> </ul>
Digital Operator Display		Fault Name
<i>oFA00</i>	oFA00	Non-Compatible Option connected to drive port CN5-A
<b>Cause</b>		<b>Possible Solution</b>
Non-compatible option connected to drive port CN5-A.		Use only compatible options. Connect PG-X3 to CN5-B or CN5-C. For other option cards, refer to the Installation Manual for that option card.

Digital Operator Display	Fault Name
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<i>oFb00</i>	oFb00	Non-Compatible Option connected to drive port CN5-B
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Cause	Possible Solution
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Non-compatible option connected to drive port CN5-B.	Use only compatible options. Connect PG-X3 to CN5-B or CN5-C. For other option cards, refer to the Installation Manual for that option card.
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Digital Operator Display	Fault Name
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<i>oFb01</i>	oFb01	Option Connection Error at drive port CN5-B
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Cause	Possible Solution
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Option at drive port CN5-B was changed during run.	Switch the power off and reconnect the option.
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Digital Operator Display	Fault Name
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<i>oFc01</i>	oFc01	Option Connection Error at drive port CN5-C
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Cause	Possible Solution
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Option at drive port CN5-C was changed during run.	Switch the power off and reconnect the option.
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Digital Operator Display	Fault Name
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<i>oPE06</i>	oPE06	Control Method Selection Error Correct the setting for the control method.
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Cause	Possible Solution
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Control mode requires installing a PG option, but no PG encoder is installed (A1-02 = 1 or 3).	<ul style="list-style-type: none"> <li>• Connect a PG option.</li> <li>• Correct the value set to A1-02.</li> </ul>
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Digital Operator Display		Fault Name
		Overspeed
<i>o5</i>	o5	The motor speed feedback exceeded the F1-24 setting.
Cause	Possible Solution	
Overshoot is occurring.	<ul style="list-style-type: none"> <li>Increase the settings for D4-01 (Speed Control Proportional Gain 1) and reduce C5-02 (Speed Control Integral Time 1).</li> <li>Enable Feed Forward Control and perform Inertia Auto-Tuning in CLV.</li> </ul>	
Incorrect speed feedback scaling when terminal RP is used as speed feedback input in V/f control.	<ul style="list-style-type: none"> <li>Set H6-02 to the value of the speed feedback signal frequency when the motor runs at the maximum speed.</li> <li>Adjust the input signal using parameters H6-03 through H6-05.</li> </ul>	
Incorrect PG pulse number set.	Check and correct parameter F1-01.	
Inappropriate parameter settings.	Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).	
Digital Operator Display		Fault Name
		PG Disconnected
<i>PGo</i>	PGo	Detected when no PG pulses received for a time longer than setting in F1-14.
Cause	Possible Solution	
PG cable is disconnected.	Reconnect the cable.	
PG cable wiring is wrong.	Correct the wiring.	
PG encoder does not have enough power.	Make sure the correct power supply is properly connected to the PG encoder.	
Brake is holding the PG.	Ensure the brake releases properly.	
Digital Operator Display		Fault Name
		PG Hardware Fault
<i>PGoH</i>	PGoH	PG cable is disconnected.
Cause	Possible Solution	
PG cable is disconnected.	Reconnect the cable.	

## 8. Specifications

**Table 8: Option Specifications**

<b>Items</b>	<b>Specifications</b>
Model	PG-X3
Compatible Pulse Generators	Line driver Single-channel (A pulse), 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	V/f with PG, Closed Loop 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