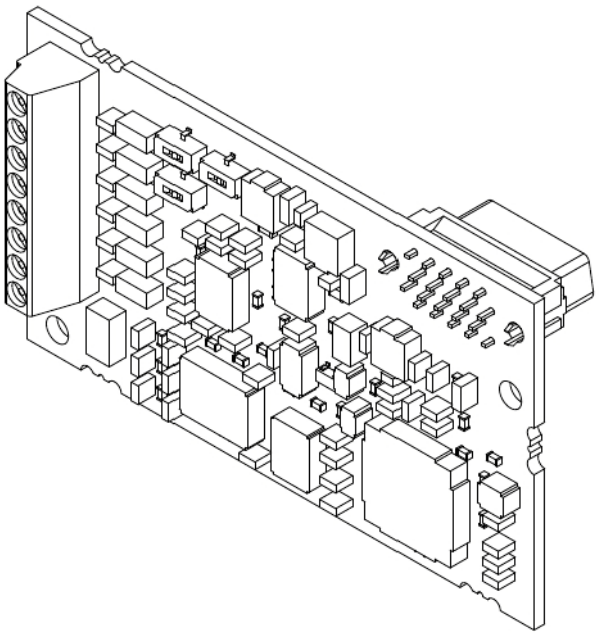

IMPULSE•G+ & VG+ Series 4

Adjustable Frequency/Vector Crane Controls

Analog Input Installation Manual

MAGNETEK
MATERIAL HANDLING

August 2011
Part Number: 144-23917
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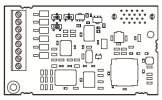
1. Preface and Safety

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.

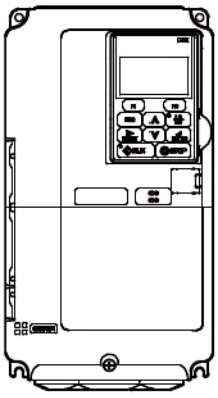
Applicable Documentation

The following manuals are available for the option:

Analog Input AI-A3 Option

	**IMPULSE®•G+/VG+ Series 4 Analog Input AI-A3 Installation Manual** **Manual No: 144-23917**	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.

MPULSE•G+/VG+ Series 4 Drive

	**IMPULSE®•G+/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.
	IMPULSE®•G+/VG+ Series 4 Instruction Manual	

Terms

Drive: IMPULSE®•G+/VG+ Series 4

Option: IMPULSE®•G+/VG+ Series 4 Option Analog Input AI-A3

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 drive or 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

Installation of the Analog Input Option AI-A3 allows the user to input a high precision, high resolution analog signal reference to the drive. The option terminals can be set either as separate functions for each terminal to use the multi-function analog input terminals on the option for a higher resolution signal, or as a combined input where the drive adds the input of all signals to the option to build the frequency reference.

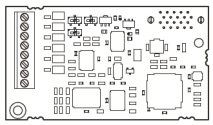
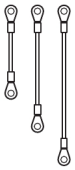
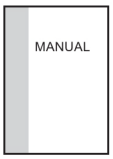
The option has an input signal of -10 to 10 Vdc (20 kΩ) or 4 to 20 mA (250 Ω) with three input channels, DIP switches to select voltage/current input, 13-bit signed (1/8192) input voltage resolution, and 1/4096 current input resolution.

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	3	3	1

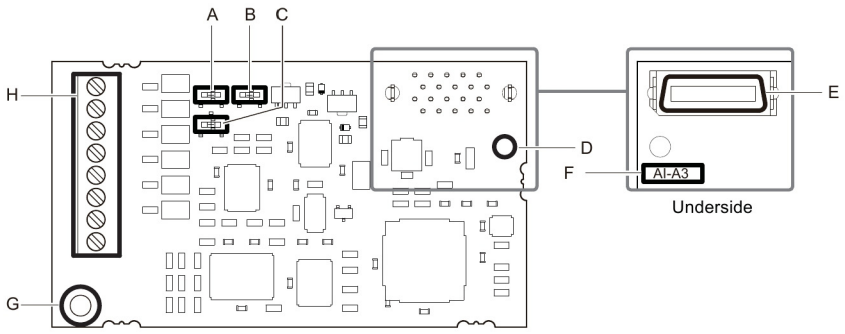
Tools Required for Installation

- A Phillips screwdriver (M3 metric / #1, #2 U.S. standard size) is required to install the option.
- A straight-edge screwdriver (blade depth: 0.015” [0.4 mm], width: 0.098” [2.5 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

Analog Input AI-A3 Option



A – DIP switch S1 for terminal V1 input signal selection (voltage/current)
B – DIP switch S2 for terminal V2 input signal selection (voltage/current)
C – DIP switch S3 for terminal V3 input signal selection (voltage/current)
D – Installation Hole
E – Connector (CN5)
F – Model number
G – Ground terminal and installation hole <1>
H – Terminal block TB1

<1> The ground wires provided in the option shipping package must be connected during installation.

Figure 1: Analog Input AI-A3 Option Components

Terminal Block TB1

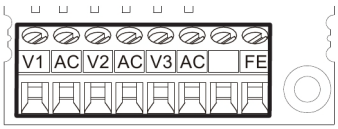


Figure 2: Terminal Block TB1

Refer to Table 3 on page 19 for details on TB1 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.
Failure to comply will result in death or serious injury.

Disconnect all power to the drive and wait at least the amount of time specified on the drive front cover safety label. After all indicators are off, measure the DC bus voltage to confirm safe level, and check for unsafe voltages. The internal capacitor remains charged after the power supply is turned off.

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, place excessive stress on 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.

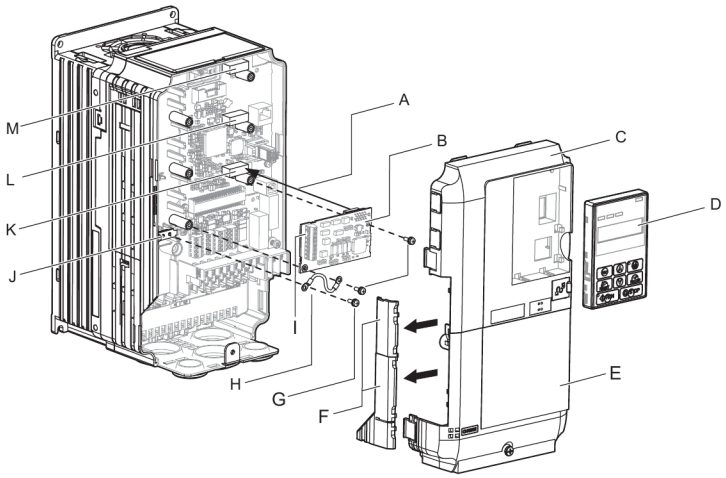
Properly connect all pins and connectors.
Failure to comply may prevent proper operation and possibly damage equipment.

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
B – Option card
C – Front cover
D – Digital operator
E – Terminal cover
F – Removable tabs for wire routing
G – Included screws
H – Ground wire
I – Terminal block TB1
J – Drive grounding terminal (FE)
K – Connector CN5-A
L – Connector CN5-B
M – Connector CN5-C

Figure 3: Drive Components with Option

Installing the Option

Refer to the instructions below to install the option.

1. Shut off power to the drive, wait the appropriate amount of time for voltage to dissipate, then remove the digital operator (D) and front covers (C, E). Refer to the Quick Start Guide packaged with the drive for directions on removing the front covers. Cover removal varies depending on drive size.

DANGER

Electrical Shock Hazard.

Disconnect all power to the drive and wait at least the amount of time specified on the drive front cover safety label. After all indicators are off, measure the DC bus voltage to confirm safe level, and check for unsafe voltages before servicing to prevent electric shock. The internal capacitor remains charged even after the power supply is turned off.

NOTICE

Damage to Equipment

Observe proper electrostatic discharge procedures (ESD) when handling the option, drive, and circuit boards. Failure to comply may result in ESD damage to circuitry.

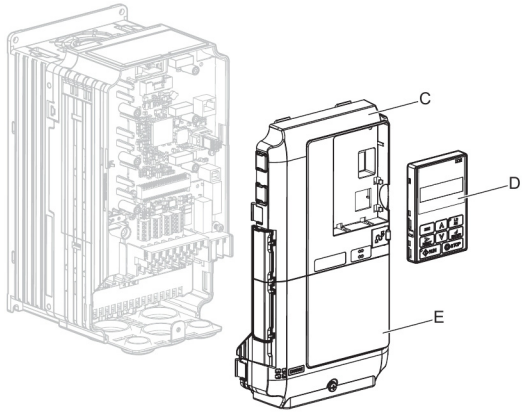


Figure 4: Remove the Front Covers and Digital Operator

2. Insert the option card (B) into the CN5-A (K), CN5-B (L), or CN5-C (M) connector located on the drive and fasten it into place using one of the included screws (G).

NOTE: Install the option to ports CN5-B and CN5-C on the drive for monitoring purposes only and input levels will be displayed in monitors U1-21 to U1-23. The option will not set the frequency reference or replace the drive analog input with higher resolution inputs when connected to ports CN5-B or CN5-C.

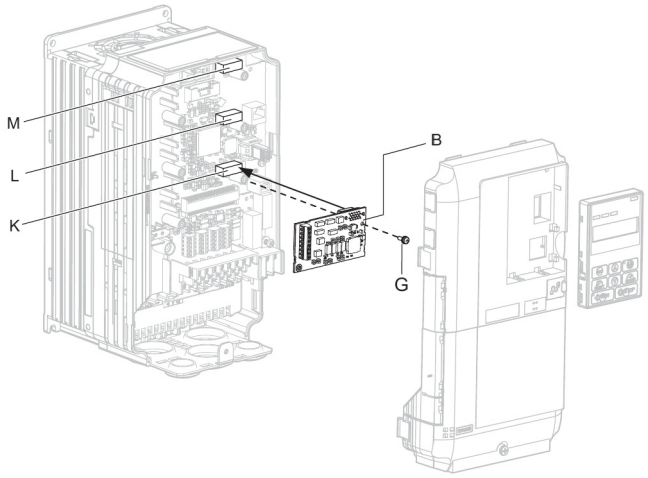


Figure 5: Insert the Option Card

3. Connect one end of the ground wire (H) to the ground terminal (J) using one of the remaining screws (G). Connect the other end of the ground wire (H) to the remaining ground terminal and installation hole on the option (B) using the last remaining provided screw (G).

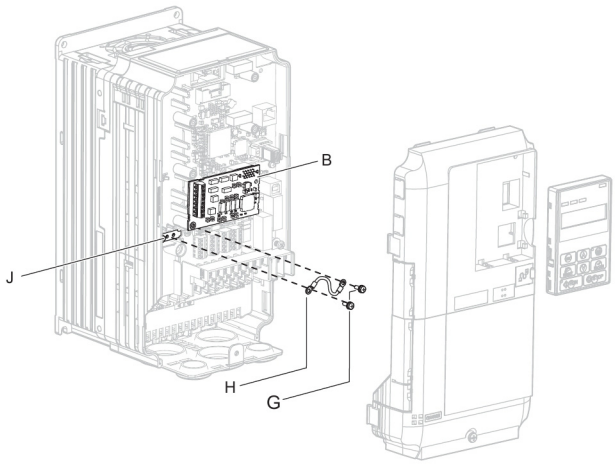


Figure 6: Connect the Ground Wire

NOTE: 1. The option package includes three ground wires. Use the longest wire when plugging the option into connector CN5-C on the drive side. Use the next longest wire when plugging the option into connector CN5-B. Use the shortest wire when plugging the option into connector CN5-A. 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 (J). When connecting three options, two ground wires will need to share the same drive ground terminal.

4. Set DIP switches S1, S2, and S3 on the option for current or voltage input on terminals V1, V2, and V3. The default configuration is set to voltage input for all terminals.

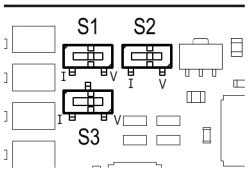


Figure 7: Option DIP Switches

5. Prepare and connect the wire ends as shown in Figure 8 and Figure 9. Refer to Wire Gauges, Tightening Torques, and Crimp Terminals on page 18 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.

NOTICE

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.

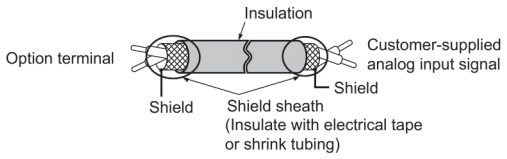


Figure 8: Preparing Ends of Shielded Cable

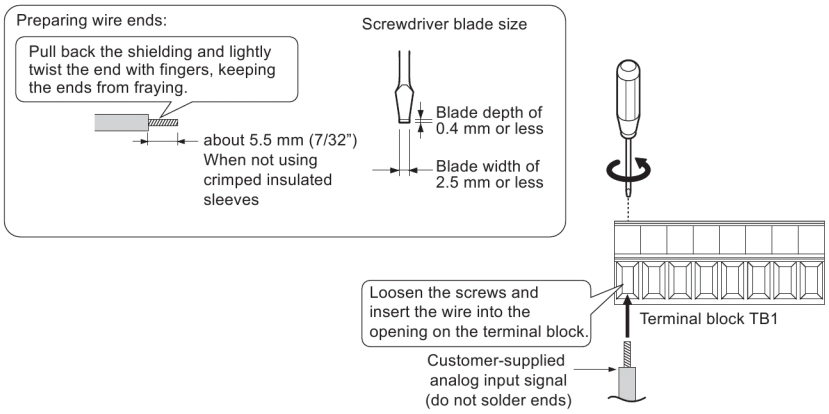


Figure 9: Preparing and Connecting Cable Wiring

6. Wire the customer-supplied analog input signal to terminal block TB1 on the option. Refer to Figure 10 for wiring instructions.

Connection Diagram

Refer to Table 3 on page 19 for a detailed description of the option board terminal functions. To ensure accurate control, use a stable power supply for the voltage reference source.

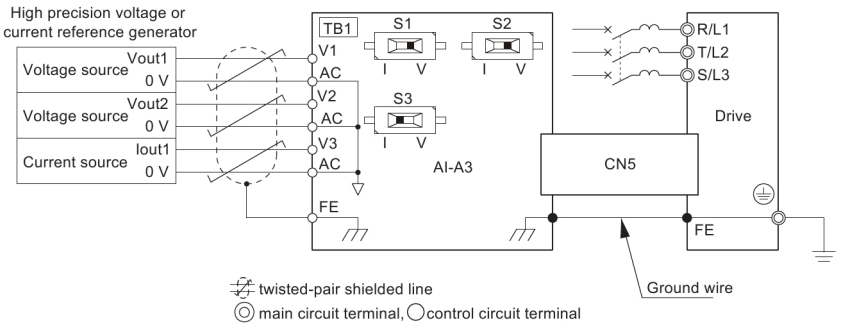


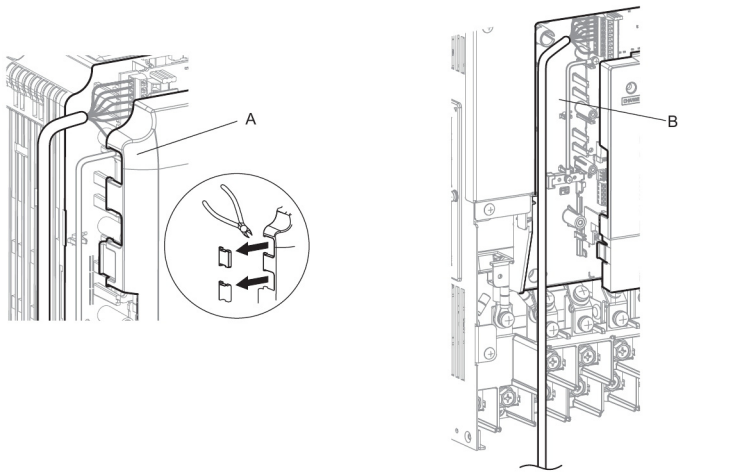
Figure 10: Option Connection Diagram

7. 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 11-A and leave no sharp edges to damage wiring.

Route the wiring inside the enclosure as shown in Figure 11-B for drives that do not require routing through the front cover.

Refer to the IMPULSE®•G+/VG+ Series 4 Instruction Manual for more information.



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 11: Wire Routing Examples

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

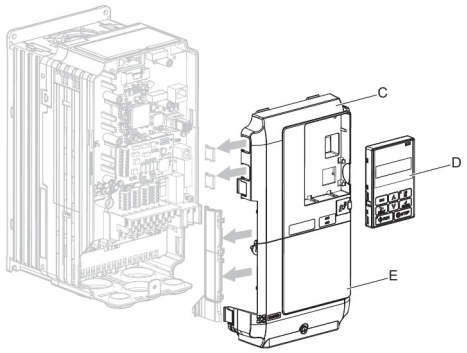


Figure 12: Replace the Front Covers and Digital Operator

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.

9. Set drive parameters in Table 4 for proper option performance.

Wire Gauges, Tightening Torques, and Crimp Terminals

Wire Gauges and Tightening Torques

Wire gauge and torque specifications are listed in Table 1.

Table 1: Wire Gauges and Tightening Torques

Terminal Size	Screw Size	Tightening Torque N-m (in-lb)	Bare Cable		Crimp Terminals		Wire Type
			Applicable Gauges mm^2	Recomm. Gauge mm^2	Applicable Gauges mm^2	Recomm. Gauge mm^2	
V1, V2, V3, AC, FE	M2	0.22 to 0.25 (1.95 to 2.21)	Stranded wire: 0.25 to 1.0 (24 to 17 AWG) Solid wire: 0.25 to 1.5 (24 to 16 AWG)	0.75 (18 AWG)	0.25 to 0.5 (24 to 20 AWG)	0.5 (20 AWG)	Shielded twisted pair, etc

Crimp Terminals

Magnetek recommends using CRIMPFOX 6 by Phoenix Contact or equivalent crimp terminals with the specifications listed in Table 2 for wiring to ensure proper connections.

Table 2: Crimp Terminal Sizes

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

Terminal Functions

Table 3: Option Terminal Functions

Terminal Block	Terminal	Signal Level	Description	Voltage/ Current DIP switch	Linear Accuracy
V1	Analog signal input 1	-10 to 10 V or 4 to 20 mA	• Input terminals for an analog voltage or current signal from voltage/current reference source • Use jumpers S1, S2, and S3 to select the type of input signal <1>	S1	±0.1% F.S. <2>
V2	Analog signal input 2			S2	
V3	Analog signal input 3			S3	
AC	Common	--	Common for analog voltage/current input	--	
FE	Ground	--	Used for grounding shielded lines	--	

<1> Default setting is for voltage input.
<2> At an ambient temperature of 25 °C (77 °F).

6. Related Parameters

The parameters outlined in the following sections 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.

Parameter F2-01

Set parameter F2-01 to select between separate input channels or combined inputs on the option.

Setting 0: Separate Input Channels (default)

This setting replaces drive analog inputs A1, A2, and A3 with higher resolution signals in terminals V1, V2, and V3 on the option.

H3-XX parameters set the function, gain, and bias for V1, V2, and V3. Refer to the drive Instruction Manual for details on setting these parameters.

NOTE: 1. When F2-01 = 0, the option cannot be selected as frequency reference source. Setting b3-01 to 3 (Option PCB as Frequency Reference Selection) when F2-01 is set to 0 will trigger an oPE05 error.
2. When F2-01 is set to 0, the drive automatically detects the selected signal level for each input. Parameters H3-01, H3-05, and H3-09 do not need to be set, and the previous settings for these parameters are disregarded.

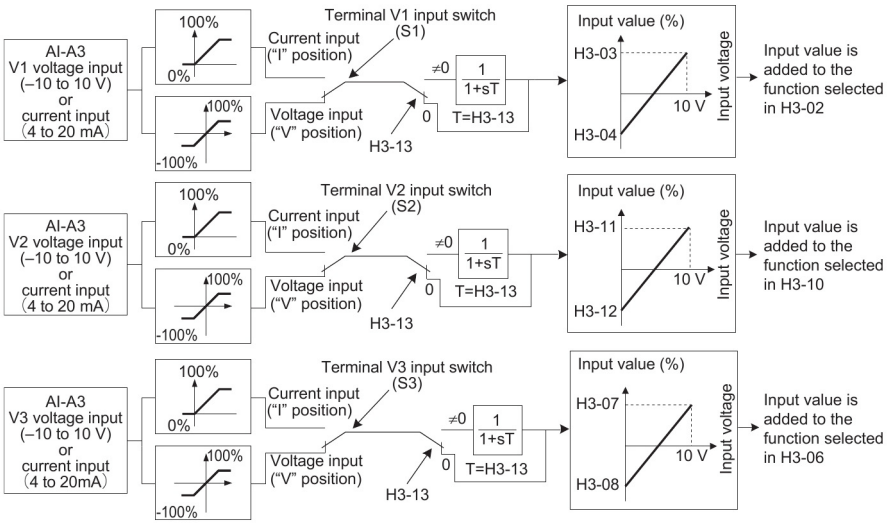


Figure 13: Using the Option for Multi-Function Analog Inputs

Setting 1: Combined Inputs

This setting combines the three input signals of the option into one frequency reference signal as illustrated in Figure 14.

Set parameter b3-01 to 3 and set parameters F2-02 and F2-03 to set the gain and bias settings for the combined input signal. Pay special attention to the internal gains and interaction among inputs as indicated in Figure 14 when setting this function.

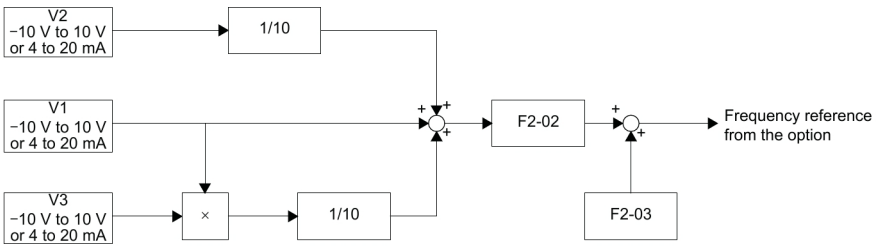


Figure 14: Combining Inputs for the Frequency Reference

Adjusting Input Levels with F2-02 and F2-03

The gain set to parameter F2-02 along with the combined input signal determines the percentage of maximum output frequency used as the frequency reference when the bias set to F2-03 is 0.

NOTE: For a single channel, a voltage input of 10 V or a current input of 20 mA is referred as 100%

The bias set to parameter F2-03 determines the percentage of the maximum output frequency used as the frequency reference when the combined input signal is 0%.

NOTE: For a single channel, a voltage input of 0 V or a current input of 4 mA is referred as 0%

Example 1: If the gain in F2-02 is set to 50% and the bias in F2-03 is set to 0%, a combined input signal of 100% yields a frequency reference 50% of the maximum frequency reference. A combined input of 200% yields a frequency reference equal to the maximum output frequency.

Example 2: If the gain in F2-02 is set to 200% and the bias in F2-03 is set to 0%, a combined input signal of 50% yields a frequency reference equal to the maximum output frequency. Increasing the input signal will not create a higher reference since maximum frequency reference has already been reached.

Example 3: If the bias in F2-02 is set to 30% and the gain in F2-03 is set to 100%, a 0% combined signal yields a frequency reference 30% of the maximum output frequency. Inputting a combined reference of 70% will yield a reference of equal to the maximum output frequency. Increasing the input signal will not create a higher reference since maximum frequency reference has already been reached.

Parameter Table

Table 4: Related Parameters

Parameter Code	Display	Function	Range	Initial Value
F2-01	AI Function Sel		0, 1	0
	0 3ch Individual	Option card input terminals V1, V2, and V3 replace drive input terminals A1, A2, and A3.		
	1 3ch Addition	Input signals to terminals V1, V2, and V3 are added together to create the frequency reference.		
F2-02	AI Input Gain	Sets the gain for the input signal to the analog card.	-999.9–999.9%	100.0
F2-03	AI Input Bias	Sets the bias for the input signal to the analog card.	-999.9–999.9%	0.0
H3-02	Term A1 FuncSel	Sets the function of terminal A1.	0–31	0
H3-03	Terminal A1 Gain	Sets the level of the input value selected in H3-02 when 10 V is input at terminal A1.	-999.9–999.9%	100.0
H3-04	Terminal A1 Bias	Sets the level of the input value selected in H3-02 when 0 V is input at terminal A1.	-999.9–999.9%	0.0
H3-06	Terminal A3 Sel	Sets the function of terminal A3.	0–31	1F
H3-07	Terminal A3 Gain	Sets the level of the input value selected in H3-06 when 10 V is input at terminal A3.	-999.9–999.9%	100.0
H3-08	Terminal A3 Bias	Sets the level of the input value selected in H3-06 when 0 V is input at terminal A3.	-999.9–999.9%	0.0
H3-10	Terminal A2 Sel	Sets the function of terminal A2.	0–31	0
H3-11	Terminal A2 Gain	Sets the level of the input value selected in H3-10 when 10 V (20 mA) is input at terminal A2.	-999.9–999.9%	100.0
H3-12	Terminal A2 Bias	Sets the level of the input value selected in H3-10 when 0 V (0 or 4 mA) is input at terminal A2.	-999.9–999.9%	0.0
H3-13	Filter Avg Time	Sets a primary delay filter time constant for terminals A1, A2, and A3. Used for noise filtering.	0.00–2.00 sec	0.03

Parameter Code	Display	Function	Analog Output Level	Unit
U1-21	AI Opt Ch1 Level	Displays the input voltage to terminal V1 on analog input card AI-A3.	10 V: 100%	0.1%
U1-22	AI Opt Ch2 Level	Displays the input voltage to terminal V2 on analog input card AI-A3.	10 V: 100%	0.1%
U1-23	AI Opt Ch3 Level	Displays the input voltage to terminal V3 on analog input card AI-A3.	10 V: 100%	0.1%

7. Troubleshooting

Drive-Side Error Codes

Table 5 lists the various fault codes related to the option. Refer to the drive's Instruction Manual for further details on fault codes.

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

- Communication cable connections.
- Make sure the option is properly installed to the drive.
- Did a momentary power loss interrupt communications?

Table 5: Fault Displays, Causes, and Possible Solutions

Digital Operator Display		Fault Name
oFA01	oFA01	Option Fault (CN5-A) Option is not properly connected
Cause		**Possible Solution**
Option at drive port CN5-A was changed during run.		Turn the power off and check the connectors between the drive and option.
Digital Operator Display		**Fault Name**
oFb01	oFb01	Option Fault (CN5-B) Option is not properly connected
Cause		**Possible Solution**
Option at drive port CN5-B was changed during run.		Turn the power off and check the connectors between the drive and option.
Digital Operator Display		**Fault Name**
oFb02	oFb02	Option Fault (CN5-B) Two of the same options are connected simultaneously
Cause		**Possible Solution**
DI-A3 option connected to CN5-B port while another option was connected to CN5-A port.		Only one of the options, AI-A3, DI-A3, or SI-XX can be connected to the drive at the same time.
Digital Operator Display		**Fault Name**
oFC01	oFC01	Option connection error at drive port CN5-C
Cause		**Possible Solution**
Option at drive port CN5-C was changed during run.		Turn the power off and check the connectors between the drive and option.

Digital Operator Display		Fault Name
		Option Fault (CN5-C)
oFC02	oFC02	Two of the same options are connected simultaneously

Cause	Possible Solution
AI-A3 option connected to CN5-C port while another option was connected to CN5-A port.	Only one of these options, AI-A3, DI-A3, or SI-XX can be connected to the drive at the same time.

Digital Operator Display		Fault Name
oPE05	oPE05	Run command/frequency reference source selection error

Cause	Possible Solution
Frequency reference is assigned to an option (b3-01 = 3) but an option is not connected.	Reconnect the option to the drive.

Digital Operator Display		Fault Name
oPE07	oPE07	Multi-Function Analog Input Selection Error

Cause	Possible Solution
At least two analog input terminals are set to the same function. Analog input terminal and pulse train input are set to the same function.	Adjust H3-02, H3-06, and H3-10 settings so functions no longer conflict.

Preventing Noise Interference

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

- Use shielded wire for the signal lines.
- Limit the length of wiring under 10 m (32 ft.).
- Separate the control wiring to the option, main circuit wiring, and power lines.

Interface Circuit

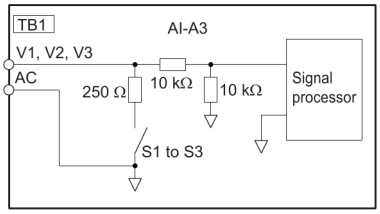


Figure 15: Interface Circuit

8. Specifications

Table 6: Option Specifications

Items	Specifications
Model	AI-A3
Input Terminals	3 terminals
Voltage Input	• Input signal voltage: -10 to 10 Vdc • Impedance: 20 kΩ • Input resolution: 13 bit plus sign (1/8192)
Current Input	• Input signal voltage: 4 to 20 mA • Impedance: 250 Ω • Input resolution: 12 bit (1/4096)
Linear Precision	± 0.1% at 25 °C (77 °F)
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