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Installation Instructions

SLC™ 500 4-Channel Analog I/O Modules

(Catalog Numbers 1746-NI4, -NIO4I, -NIO4V, -NO4I, -NO4V, -FIO4I, and -FIO4V)

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Publication 1746-IN008C-EN-P - May 2004

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Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.ab.com/manuals/gi) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual we use notes to make you aware of safety considerations.

WARNING 	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you: • identify a hazard • avoid a hazard • recognize the consequence

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For More Information

Related Publications

For	Refer to this Document	Pub. No.
A more detailed description on how to configure the SLC 500 Analog I/O Modules.	*SLC 500 Analog I/O Modules User Manual*	1746-UM005
A more detailed description on how to install and integrate SLC 500 Fast Analog I/O Modules.	*SLC 500 Fast Analog I/O Modules User Manual*	1746-6.9
A more detailed description on how to install and use your modular SLC 500 system.	*SLC 500 Modular Hardware Style User Manual*	1747-UM011
A reference manual that contains status file data, instruction set, and troubleshooting information.	*SLC 500 Instruction Set Reference Manual*	1747-RM001

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Types of Analog Modules

1746-NI4 Analog Input Module

The NI4 Analog Input module contains 4 analog input channels that are user selectable per channel for voltage or current to support a variety of monitoring and controlling applications.

1746-NO4I and NO4V Analog Output Modules

The NO4I and NO4V Analog Output Modules provide 4 analog output channels. The NO4I module contains 4 current outputs. The NO4V module contains 4 voltage outputs. Both of these modules support a variety of control applications.

1746-NIO4I and NIO4V Analog Combination Modules

The NIO4I and NIO4V Analog Combination I/O modules provide 2 input and 2 output channels in a single-slot module. The 1746-NIO4I module contains 2 current or voltage inputs (user selectable per channel) and 2 current outputs. The 1746-NIO4V module contains 2 current or voltage inputs (user selectable per channel) and 2 voltage outputs.

1746-FIO4I and FIO4V Fast Analog Combination Modules

The FIO4I and FIO4V Fast Analog Combination modules are 2-input/2-output combination modules ideal for high speed applications with more rapidly changing analog signals. These fast response modules are best suited for control of pressure and position in equipment such as hydraulic presses and molding machines.

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Analog Modules Operation

The module converts analog input signals to 16-bit binary values for storage in the SLC processor's input image table. The decimal range, number of significant bits, and converter resolution depend on the input range that you use for the channel.

Analog Input A/D Characteristics

NI4, NIO4I, & NIO4V Input Range	Decimal Range (input image table)	Number of Significant Bits	Nominal Resolution
±10V dc -1 LSB	-32,768 to +32,767	16	305.176 µV/LSB
0 to 10V dc -1 LSB	0 to 32,767	15	
0 to 5V dc	0 to 16,384	14	
1 to 5V dc	3,277 to 16,384	13.67	
±20 mA	±16,384	15	1.22070 µA/LSB
0 to 20 mA	0 to 16,384	14	
4 to 20 mA	3,277 to 16,384	13.67	

FIO4I and FIO4V Input Range	Decimal Range (input image table)	Number of Significant Bits	Nominal Resolution
0 to 10V dc -1 LSB	0 to 4095	12	2.4414 mV/LSB
0 to 5V dc	0 to 2047	11	
1 to 5V dc	409 to 2047	10.67	
0 to 20 mA	0 to 2047	11	9.7656 µA/LSB
4 to 20 mA	409 to 2047	10.67	

Analog Output D/A Characteristics

The analog modules have the same output characteristics.

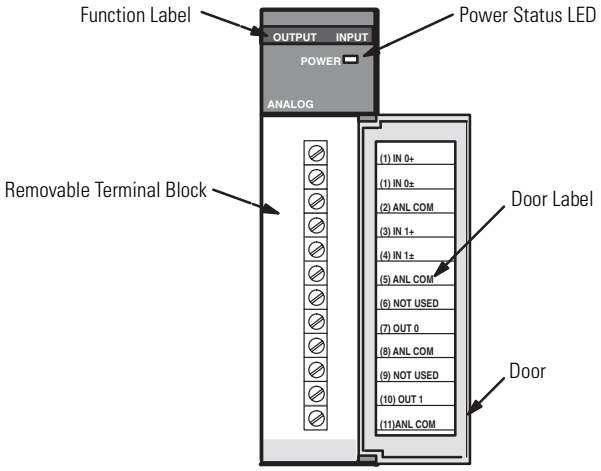
Module	Output Range	Decimal Range (output image table)	Significant Bits	Resolution
FIO4I	0 to 21 mA - 1 LSB	0 to 32,764	13 bits	2.56348 µA/LSB
	0 to 20 mA	0 to 31,208	12.92 bits	
NIO4I	4 to 20 mA	6,242 to 31,2089	12.6 bits	
NO4I				
FIO4V	±10V dc - 1 LSB	-32,768 to +32,764	14 bits	1.22070 mV/LSB
	0 to 10V dc -1 LSB	0 to 32,764	13 bits	
NIO4V	0 to 5V dc	0 to 16,384	12 bits	
NO4V	1 to 5V dc	3,277 to 16,384	11.67 bits	

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Analog Module Hardware Features

The module contains a removable terminal block providing connection for the analog input and/or output channels, which is specifically designed to interface with analog current and voltage input signals. The channels can be wired as either single-ended or differential inputs. There are DIP switches on the circuit board for selecting voltage or current input.



Hardware Feature	Function
Function Label	Indicates input, output, or both.
Power Status LED	Indicates when backplane power is applied to the module.
Removable Terminal Block	Provides physical connection to input devices.
Door Label	Permits easy terminal identification.
Door	Protects terminal connections and label.

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Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING



EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off.
- Do not connect or disconnect components unless power has been switched off.
- All wiring must comply with N.E.C. article 501-4(b).

Environnements dangereux

Cet équipement est conçu pour être utilisé dans des environnements de Classe 1, Division 2, Groupes A, B, C, D ou non dangereux. La mise en garde suivante s'applique à une utilisation dans des environnements dangereux.

AVERTISSEMENT



DANGER D'EXPLOSION

- La substitution de composants peut rendre cet équipement impropre à une utilisation en environnement de Classe 1, Division 2.
- Ne pas remplacer de composants ou déconnecter l'équipement sans s'être assuré que l'alimentation est coupée.
- Ne pas connecter ou déconnecter des composants sans s'être assuré que l'alimentation est coupée.

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Determining Your Power Requirements for a Modular Controller

Analog modules require both 5V dc and 24V dc power from the backplane of the SLC 500 system. However, the NO4I and NO4V analog modules can use an external 24V dc power supply. This eliminates the 24V dc backplane power requirements, providing configuration flexibility if SLC power supply loading is critical. These two modules provide user-supplied external 24V dc power supply connections.

The following table shows the power requirements for each analog module using backplane power. Use this table to calculate the total load on the modular system power supply. For more information refer to the *SLC 500 Modular Hardware Style User Manual*, publication 1747-UM011.

IMPORTANT The analog modules do not supply loop power for the input device. You must supply the appropriate loop power for loop-powered input devices.

Catalog Number	5 Volt Current	24 Volt Current
1746-NI4	35 mA	85 mA
1746-NIO4I	55 mA	145 mA
1746-NIO4V	55 mA	115 mA
1746-NO4I	55 mA	195 mA(1) (2)
1746-NO4V	55 mA	145 mA(1) (2)
1746-FIO4I	55 mA	150 mA
1746-FIO4V	55 mA	120 mA

(1) The 24V dc user power connection on a fixed SLC 500 can power an NO4I or NO4V analog module. However, the regulation of the 24V dc user connection on a modular SLC 500 power supply, catalog number 1746-P1, -P2, and -P4 is outside of the requirements of the NO4I and NO4V analog modules and cannot be used.

(2) Omit these values from your SLC power supply loading calculations if you decide to use an external power supply.

Determining Your Power Requirements for a Fixed Controller

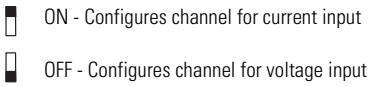
IMPORTANT The 2-slot, SLC 500 fixed I/O expansion chassis (1746-A2) will support only specific combinations of modules. If you wish to use an I/O module in a 2-slot expansion chassis with another SLC I/O or communication module, refer to the *SLC 500 Analog I/O Modules User Manual*, publication 1746-UM005 for valid combinations of modules.

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Configuring Your Module

The NI4, NIO4I, NIO4V, FIO4I, and FIO4V analog modules have user-selectable DIP switch settings, which allow you to configure the input channels as either current or voltage inputs. The switches are located on the analog module board. The following illustration shows the ON and OFF switch settings. Switch orientation is also provided on the nameplate of the module.



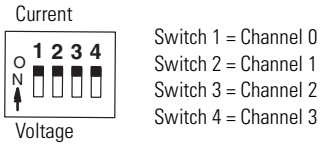
ATTENTION



Care should be taken to avoid connecting a voltage source without a current transmitter, etc. to a channel configured for current input. Improper module operation or damage to the module can occur.

Switch Settings for the 1746-NI4

The NI4 has 4 individual DIP switches that control the input mode of channels 0 through 3. A switch in the ON position configures the channel for current input. A switch in the OFF position configures the channel for voltage input.

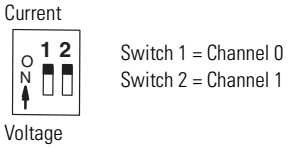


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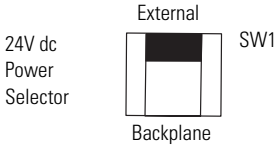
Switch Settings for the 1746-NIO4I, -NIO4V, -FIO4I, and -FIO4V

The NIO4I and NIO4V have 2 individual switches labeled 1 and 2. These switches control the input mode of channel 0 and 1. A switch in the ON position configures the channel for current input. A switch in the OFF position configures the channel for voltage input.



External Power Switch for the 1746-NO4I and -NO4V

The NO4I and NO4V analog output modules have an external 24V dc power switch, SW1, which gives you the option of using an external power supply. In the UP position, power is drawn from an external power source. In the DOWN position, power is drawn from the backplane of the module. The switch is located on the analog module board. Switch orientation is also provided on the nameplate of the module.



Choosing a Slot in the Chassis

Two factors determine where the analog module should be located in the chassis: ambient temperature and electrical noise. Consider the following conditions when selecting a slot for an analog module. Position the module:

- in a slot away from an ac or high voltage dc modules
- in the chassis closest to the bottom of the enclosure where the SLC 500 system is installed
- away from the chassis power supply if installed in a modular system

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Installing Your Module

All modules are mounted in a single slot. Remember that in a modular system the processor always occupies the first slot of the first chassis.

ATTENTION



Never install, remove, or wire modules with power applied to the chassis. Also, do not expose analog modules to surfaces or other areas that may typically hold an electrostatic charge. Electrostatic charges can destroy the analog circuitry.

IMPORTANT The potentiometer sets the voltage during factory calibration to 2.5 volts. It is set and sealed at the factory and does not require any adjustments.

1. Verify that all switches are set correctly for the application.

ATTENTION

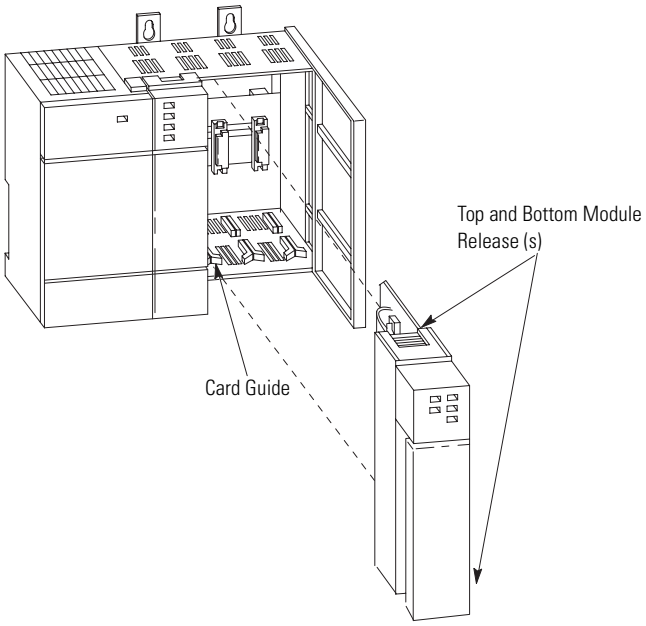


Care should be taken to avoid connecting a voltage source without a current transmitter, etc. to a channel configured for current input. Improper module operation or damage to the module can occur.

2. Align the circuit board of the analog module with the card guide of the chassis as shown on page 12.
3. Slide the module in until both top and bottom retaining clips are secured.
4. To remove the module, depress the retaining clips at the top and bottom of the module and slide the module out.

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Wiring Considerations

The following section provides system wiring guidelines, how to ground your Belden™ cable, and how to determine the cable length.

ATTENTION



Before wiring any analog module, disconnect power from the SLC 500 system and from any other source to the analog module.

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System Wiring Guidelines

Use the following guidelines in planning the system wiring for the analog modules:

- all analog common terminals (ANL COM) are electrically connected inside the module. ANL COM is *not* connected to earth ground inside the module.
- voltages on IN+ and IN- terminals must remain within ± 20 Volts with respect to ANL COM to ensure proper input channel operation. This is true for current and voltage input channel operation.
- voltage outputs (OUT 0 and OUT 1) of the NIO4V and NO4V are referenced to ANL COM. Load resistance (R1) for a voltage output channel must be greater than or equal to 1K ohms.
- current output channels (OUT 0 and OUT 1) of the NIO4I and NO4I source current that returns to ANL COM. Load resistance (R1) for a current output channel must remain between 0 and 500 ohms.

After the analog input module is properly installed in the chassis, follow the wiring procedure below using Belden 8761 cable.

ATTENTION



Care should be taken to avoid connecting a voltage source without a current transmitter, etc. to a channel configured for current input. Improper module operation or damage to the module can occur.

Grounding Your Cable

Belden cable #8761 has two signal wires (black and clear), one drain wire and a foil shield. Refer to illustration on page 14 for Belden cable #8761. The drain wire and foil shield must be grounded at one end of the cable. Do *not* earth ground the drain wire and foil shield at *both* ends of the cable.

Input Channel - Use a chassis mounting tab as a ground for the drain wire and foil shield.

Output Channel - Ground the drain wire and foil shield at the analog load.

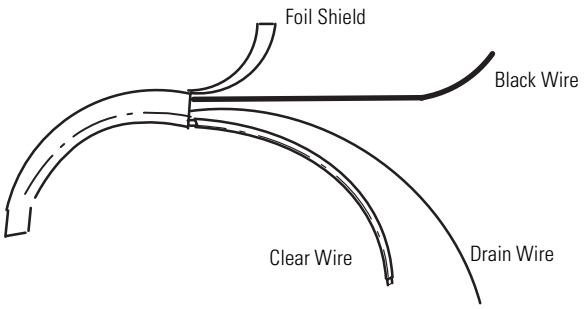
IMPORTANT

If you cannot ground the output channel at the load, ground the drain wire and foil shield at the chassis mounting tab. Do *not* connect the foil shield or drain wire to the analog terminal block. They *must be* connected to an earth ground, which is not provided at the analog module.

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Belden Cable #8761



Determining the Cable Length

Determine the length of cable you will need to connect a channel to its input or output device. Remember to leave additional length to route the drain wire and foil shield for earth grounding.

Wiring the Analog Module

After the analog module is properly installed in the chassis, use the following wiring procedure. Belden cable #8761 is recommended when wiring analog modules. This section assumes that you have properly installed the analog module.

ATTENTION



Before wiring any analog module, disconnect power from the SLC 500 system and from any other source to the analog module.

To wire your analog module, follow these steps and refer to the illustrations on page 15.

1. Designate the end of the cable where the drain wire and foil shield is earth grounded as END 1. Designate the other end as END 2.
2. At each end of the cable, strip some casing to expose the individual wires.
3. Trim the signal wires to 50 mm (2 inch) lengths. Strip 5 mm (about 3/16 inch) of insulation away to expose the end of the wire.

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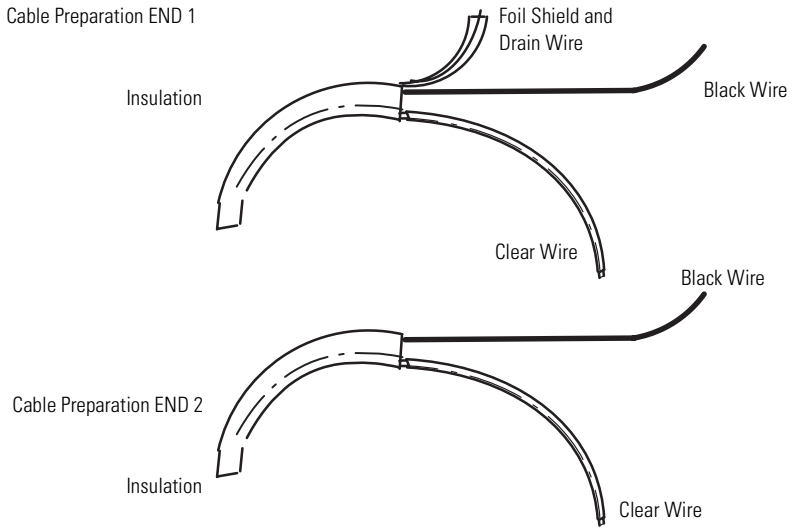
4. At END 1, twist the drain wire and foil shield together, bend them away from the cable, and apply shrink wrap.

5. At END 2, cut the drain wire and foil shield back to the cable and apply shrink wrap.

6. Connect the signal wires (black and clear) to the terminal block and the input and output devices. The recommended maximum torque is 0.57 Nm (5 lb-in) for all terminals.
   - Input channels - connect END 1 at module. Use a chassis mounting tab as a ground for the drain wire and foil shield.
   - Output channel- connect END 2 at the module. Ground the drain wire and foil shield at the analog load.

7. Repeat steps 1 through 6 for each channel on the analog module. Jumper the unused plus (+), minus (-) and common terminals of each input channel individually. Unused output and common terminals should be left unconnected.

The following illustrations depict the proper cable preparation for END 1 and END 2. Shrink wrap is applied to each cable end. Make sure the foil shield and drain wires on END 1 are long enough to reach their designated earth ground points.



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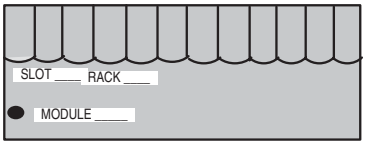
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Labeling and Installing the Terminal Block

The terminal block has a write-on label. Labeling the terminal block will help ensure that it is installed on the correct module.

When installing the analog module in a chassis, it is not necessary to remove the terminal block from the module. However, if the terminal block is removed, use the write–on label located on the side of the terminal block to identify the module location and type.

Terminal Block



TIP The black dot on the terminal block label indicates the position of terminal 0.

Once you have wired your analog module and properly labeled the terminal block, install the terminal block on the analog module. To install the terminal block:

1. Align the terminal block with the receptacle.
2. Insert the terminal block and press firmly at the top and bottom until it is properly secured.

To remove the terminal block, grasp it on the top and bottom and pull outward and down.

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Minimizing Electrical Noise on Analog Modules

Inputs on analog modules employ digital high frequency filters that significantly reduce the effects of electrical noise on input signals. However, because of the variety of applications and environments where analog modules are installed and operating, it is impossible to ensure that all environmental noise will be removed by the input filters.

Although it is not the purpose of this installation instruction to address SLC 500 system procedures, several specific steps can be taken to help reduce the effects of environmental noise on analog signals:

- Install the SLC 500 system in a properly rated (i.e., NEMA) enclosure. Make sure that the SLC 500 system is properly grounded.
- Use Belden cable #8761 for wiring the analog modules making sure that the drain wire and foil shield are properly earth grounded.
- Route the Belden cable separate from any other wiring. Additional noise immunity can be obtained by routing the cables in grounded conduit.
- Group analog and low voltage dc modules away from ac I/O or high voltage dc modules.

A system may malfunction due to a change in the operating environment after a period of time. Periodically check system operation, particularly when new machinery or other noise sources are installed near the SLC 500 system. For further details on system installation and start-up refer to:

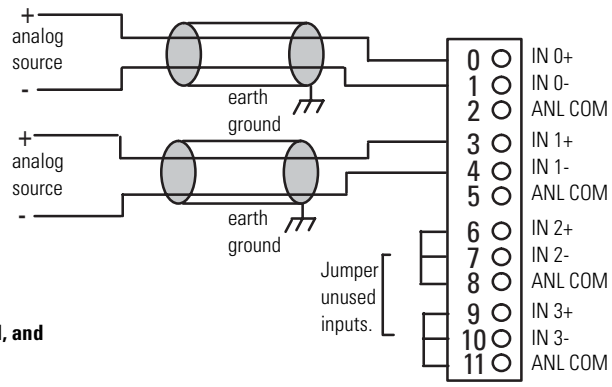
- *SLC 500 Modular Hardware Style User Manual*, publication 1747-UM011
- *SLC 500 Fixed Hardware Style User Manual*, publication 1747-6.21
- *Safety Guidelines for the Application, Installation Maintenance of Solid State Control*, publication SGI-1.1.

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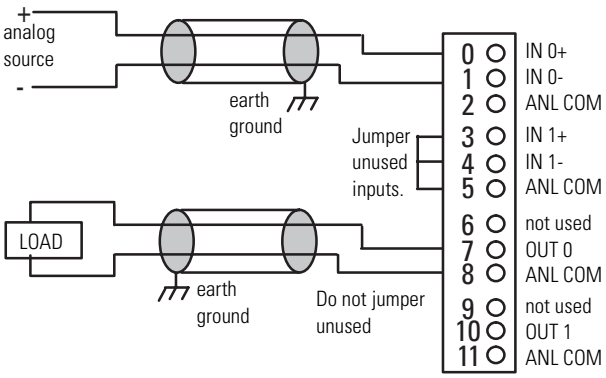
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Wiring Diagram (showing differential inputs)

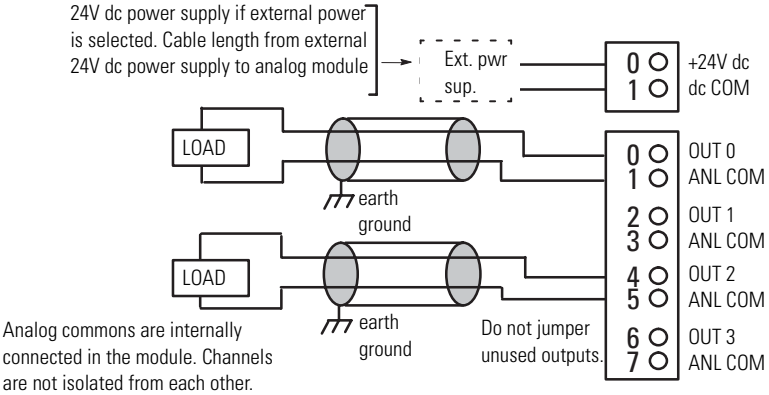
NI4



NIO4I, NIO4V, FIO4I, and FIO4V



NO4I and NO4V



Analog commons are internally connected in the module. Channels are not isolated from each other.

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ATTENTION

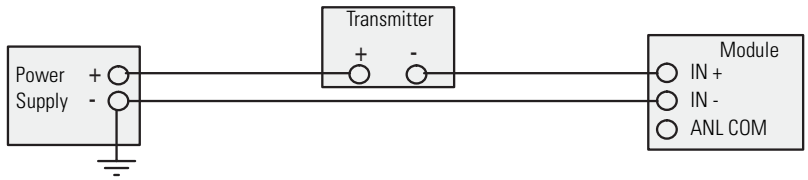


Any individual single-ended input device can be connected to any single differential input shown on page 18. The single-ended input common is connected to the negative differential input point.

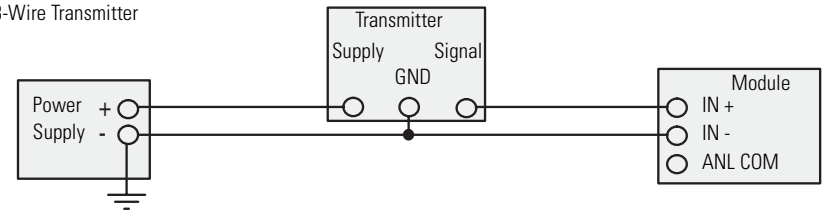
Wiring Schematics for 2, 3, and 4-Wire Analog Input Devices

IMPORTANT The module does not provide loop power for analog inputs. Use a power supply that matches the transmitter specifications.

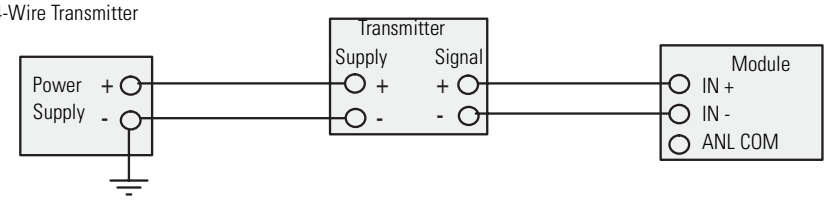
2-Wire Transmitter



3-Wire Transmitter



4-Wire Transmitter

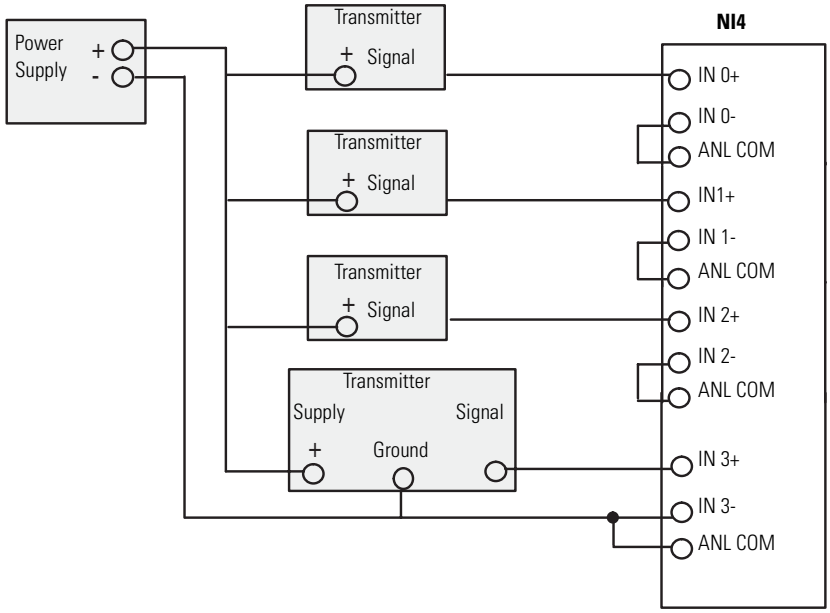


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Wiring Schematic for Single-Ended Analog Input Connections

When wiring single-ended analog input devices to the analog input card, the number of total wires necessary can be limited by using the ANALOG COMMON terminal. Note that differential inputs are more immune to noise than single-ended inputs.



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Specifications

General Specifications for NI4, NIO4I, NIO4V, NO4I, NO4V, FIO4I, FIO4V

Description	Specification
SLC Communication Format	16-Bit Two's Complement Binary
Field Wiring to Backplane Isolation	500V dc
Update Time	512 µs for all channels in parallel
Recommended Cable	Shielded Belden #8761
Maximum Wire Size	#14 AWG (maximum)
Terminal Block	Removable
Location	1746 chassis
Calibration	Factory Calibrated (1)
Noise Immunity	NEMA Standard ICS 2-230
Environmental Conditions	
Operating Temperature	0° to +60° C (+32° to +140° F)
Storage Temperature	-40° to +85° C (-40° to +185° F)
Relative Humidity	5 to 95% (non-condensing)
Agency Certification (when product or packaging is marked)	c UL us C-UL Listed Industrial Control Equipment CE Marked for all applicable directives C-Tick N223 Marked for all applicable acts TÜV Functional Safety 1oo2D (AK 1 to 6, SIL 1 to 3, according to DIN V 19250 and IEC 61508 respectively) Category 1 to 4, according to EN954-1

(1) For calibrating the 1746-FIO4I and 1746-FIO4V analog modules, refer to the customer calibration program and procedure in the *SLC 500 Fast Analog I/O Modules User Manual*, publication number 1746-6.9.

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Backplane Current Specification for NI4, NIO4I, NIO4V, NO4I, NO4V, FIo4I, and FIO4V

Catalog 1746-	Input Channels per Module	Output Channels per Module	Backplane Current Draw		External 24V dc Power Supply Tolerance
			5V (max.)	24V (max.)	
NI4	4 differential, voltage or current selectable per channel, not individually isolated	NA	35 mA	85 mA	NA
NIO4I	2 differential, voltage or current selectable per channel, not individually isolated	2 current outputs, not individually isolated	55 mA	145 mA	NA
NIO4V	2 differential, voltage or current selectable per channel, not individually isolated	2 voltage outputs, not individually isolated	55 mA	115 mA	NA
NO4I	NA	4 current outputs, not individually isolated	55 mA	195 mA	24V dc ±10% at 195 mA max. (21.6 to 26.4V dc)(1)
NO4V	NA	4 voltage outputs, not individually isolated	55 mA	145 mA	24V dc ±10% at 145 mA max. (21.6 to 26.4V dc)(1)
FIO4I	2 differential, select V or I per channel, not individually isolated	2 current outputs, not individually isolated	55 mA	150 mA	NA
FIO4V	2 differential, select V or I per channel, not individually isolated	2 voltage outputs, not individually isolated	55 mA	120 mA	NA

(1) Required for some applications if sufficient power is not available from SLC power supply.

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General Analog Input Specifications for NI4, NIO4I, NIO4V, FIO4I, and FIO4V

Description	Specification		
	NI4	NIO4I, NIO4V	FIO4I, FIO4V
Converter Resolution	16-Bit		12-bit
Repeatability	±1 LSB		
Location of LSB in I/O image word	0000 0000 0000 0001		
Non-linearity	0.01%		±0.073% of full scale max.
Common Mode Voltage Range	-20 to +20 volts		0 to +20 Volts (max)
Common Mode Rejection at 0 to 10 Hz (min.)	50 dB		
Common Mode Rejection at 60 Hz (min.)	105 dB		50 dB (min with 1K ohm imbalance)
Normal Mode Rejection at 60 Hz (min.)	55 dB		NA
Channel Bandwidth	10 Hz		7.0 kHz (min at 3dB point)
Step Response	60 ms at 95%		100 µsec
Conversion Method	Delta-Sigma Modulation		Successive approximation
Impedance to ANL COM	380K ohms(1)	500K ohms	
Impedance channel to channel	760K ohms(2)	1M ohms	

(1) The value listed is for Series B and greater. For series A, the impedance to ANL COM is 500K ohms.

(2) The value listed is for Series B and greater. For Series A, the impedance channel to channel is 1M ohms.

Other Analog Input Specification for FIO4I, and FIO4V

Descriptions	Specifications
Signal Convert from Hold	6.0 µsec (nominal)
Track and Hold Time to Acquire the Analog Signal Before Conversion	1.5 µsec (nominal)
Conversion Time	7.5 µsec every 512 msec (nominal)
Image Format (HEX)	OFF
Module Throughput Delay	1.10 ms (maximum(1)) 512 µsec (typical)

(1) Worst case throughput occurs when the module just misses seeing an event occur.

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Current-Loop Input Specifications for NI4, NIO4I, NIO4V, FIO4I, and FIO4V

Description	Specification	
	NI4, NIO4I, NIO4V	FIO4I, FIO4V
Input Range (Normal Operation)	-20 to +20 mA	0 to 20 mA (nominal)
Absolute Maximum Input Current	-30 to +30 mA	0 to 30 mA (maximum)
Absolute Maximum Input Voltage	±7.5V dc or 7.5V ac RMS	
Current Input Coding -20 to +20 mA	-16,384 to +16,384	0 to +2047
Input Impedance	250 Ohms	
Resolution	1.22070 µA per LSB	9.765 mA per bit
Full Scale	20 mA	
Overall Accuracy at +25° C (77°F) (max.)	±0.365% of full scale	±0.510% of full scale
Overall Accuracy at 0° to +60°C (32° to 140° F) (max.)	±0.642% of full scale(1)	±0.850% of full scale
Overall Accuracy Drift (max.)	+79ppm/5°C of full scale	±98 ppm/°C of full scale
Gain Error at +25° C (77° F) (max.)	+0.323%	±0.400% of full scale
Gain Error at 0° to +60°C (32° to 140°F) (max.)	±0.556%	±0.707% of full scale
Gain Error Drift (max.)	±67ppm/°C	±89 ppm/°C
Offset Error at +25° C (77°F) (max.) (Iin = 0, Vcm = 0)	±7 LSB	±2 LSB
Offset Error at 0° to +60°C (32° to 140° F) (max.) (Iin = 0, Vcm = 0)	±14 LSB	±4 LSB
Offset Error Drift (max.) (Iin = 0, Vcm = 0)	±0.20 LSB/°C	±.14LSB/°C(2)
Overvoltage Protection	7.5V ac RMS (maximum)	

(1) For improved accuracy over temperature, see *SLC 500 Analog I/O Modules User Manual*, publication 1746-UM005.

(2) See the *SLC 500 Fast Analog I/O Modules User Manual*, publication 1746-6.9.

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Voltage Input Specifications for NI4, NIO4I, NIO4V, FIO4I, and FIO4V

Description	Specification		
	NI4	**NIO4I, NIO4V**	**FIO4I, FIO4V**
Input Range	-10 to +10V dc - 1 LSB		0 to +10V dc
Voltage Input Coding (-10 to +10V dc - 1 LSB)	-32,768 to +32,767		0 to +4095
Input Impedance	760K ohms(1)	1M ohms	
Resolution	305.176 µV per LSB		2.4414 mV per LSB
Full Scale	10V dc		
Overall Accuracy at +25° C (77° F) (max.)	±0.284% of full scale		±0.440% of full scale
Overall Accuracy at 0° to +60° C (32° to 140° F) (max.)	±0.504% of full scale(2)		±0.750% of full scale
Overall Accuracy Drift (max.)	±63ppm/° C of full scale		±88 ppm/°C (max)
Gain Error at +25° C (77° F) (max.)	±0.263%		±0.323% of full scale
Gain Error at 0° to +60° C (32° to 140° F) (max.)	±0.461%		±0.530% of full scale
Gain Error Drift (max.)	±57ppm/° C		±79 ppm/°C (max)
Offset Error at +25° C (77° F) (max.)	±7 LSB		±2 LSB/°C (max)
Offset Error at 0° to +60° C (32° to 140° F) (max.)	±14 LSB		±4 LSB (max)
Offset Error Drift (max.)	±0.20 LSB/° C		±0.14 LSB/°C (max)(3)
Overvoltage Protection (max. across IN+ to IN- terminals)	either 220V ac RMS continuously or 220V dc continuously		220V ac RMS continuously

(1) The value listed is for Series B and greater. For series A, the input impedance is 1M ohm.

(2) For improved accuracy over temperature, see *SLC 500 Analog I/O Modules User Manual*, publication 1746-UM005.

(3) See the *SLC 500 Fast Analog I/O Modules User Manual*, publication 1746-6.9.

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Current Output Specifications for NIO4I, NO4I, and FIO4I

Description	Specification	
	NIO4I, NO4I	FIO4I
Converter Resolution	14 bit	
Location of LSB in I/O image word	0000 0000 0000 01XX	
Non–linearity	0.05%	
Conversion Method	R-2R Ladder	
Step Response	2.5 ms (at 95%)	
Load Range	0 to 500 Ohms	
Maximum Load Reactance	100 µH	
Current Output Coding (0 to +21 mA - 1 LSB)	0 to +32764	
Output Range (Normal)	0 to +20 mA	0 to +20 mA -1 LSB
Overrange Capability	5% (0 to +21 mA - 1 LSB)	5% (0 to +20 mA - 1 LSB)
Resolution	2.56348 µA per LSB	
Full Scale	21 mA	
Overall Accuracy at +25° C (77° F) (max.)	±0.298% of full scale	
Overall Accuracy at 0° to +60° C (32° to 140° F) (max.)	±0.541% of full scale	
Overall Accuracy Drift (max.)	±70ppm/° C of full scale	
Gain Error at +25° C (77° F) (max.)	±0.298%	
Gain Error at 0° to +60° C (32° to 140° F) (max.)	±0.516%	
Gain Error Drift (max.)	±62ppm/° C	
Offset Error at +25° C (77° F) (max.)	±10 LSB	
Offset Error at 0° to +60° C (32° to 140° F) (max.)	±12 LSB	
Offset Error Drift (max.)	±0.06 LSB/° C	

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Voltage Output Specifications for NIO4V, NO4V, and FIO4V

Description	Specification	
	NIO4V and NO4V	FIO4V
Converter Resolution	14 bit	
Location of LSB in I/O image word	0000 0000 0000 01XX	
Non-linearity	0.05%of full scale	
Conversion Method	R-2R Ladder	
Step Response	2.5 ms (at 95%)	2.5 ms (normal)
Load Range	1K to ∞Ohms	1K to ∞ ohms
Maximum Load Current	10 mA	
Maximum Load Reactance	1 µF	
Voltage Output Coding (-10 to +10V dc - 1 LSB)	-32,768 to +32,764	-32,768 to +32,764
Output Range (Normal)	-10 to +10 volts - 1 LSB	±10V dc - 1 LSB
Resolution	1.22070 mV per LSB	
Full Scale	10V dc	
Overall Accuracy at +25° C (77° F) (max.)	±0.208% of full scale	
Overall Accuracy at 0° to +60° C (32° to 140° F) (max.)	±0.384% of full scale	
Overall Accuracy Drift (max.)	±54ppm/° C of full scale	
Gain Error at +25° C (77° F) (max.)	±0.208%	
Gain Error at 0° to +60° C (32° to 140° F) (max.)	±0.374%	
Gain Error Drift (max.)	±47ppm/° C	
Offset Error at +25° C (77° F) (max.)	±9 LSB	
Offset Error at 0° to +60° C (32° to 140° F) (max.)	±11 LSB	
Offset Error Drift (max.)	±0.05 LSB/° C	

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