1746-NI4 Analog Input Module

The 1746-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-NIO4I and NIO4V Analog Combination Modules

The NIO4I and NIO4V Analog Combination I/O modules provide two input and two output channels in a single slot module. The 1746-NIO4I module contains two current or voltage inputs (user selectable per channel), and two current outputs. The 176-NIO4V module contains two current or voltage inputs (user selectable per channel) and two voltage outputs.

1746-NO4I and NO4V Analog Output Modules

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

Catalog 1746-	Input Channels per Module	Output Channels per Module	Backplane Current Draw		External 24V dc Power Supply Tolerances
			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	24 ±10% at 195 mA max. (21.6 to 26.4V dc)(1)
NO4V	NA	4 voltage outputs, not individually isolated	55 mA	145 mA	24 ±10% at 145 mA max. (21.6 to 26.4V dc)(1)

(1) Required for some applications if SLC 24V power is not readily available.

For more specification information, refer to Appendix A.

Quick Start for Experienced Users

This chapter can help you to get started using analog. The procedures are based on the assumption that you have an understanding of SLC 500 products. You should understand electronic process control and be able to interpret the ladder logic instructions required to generate the electronic signals that control your application.

Because it is a start–up guide for experienced users, this chapter *does not* contain detailed explanations about the procedures listed. It does, however, reference other chapters in this book where you can get more information.

If you have any questions or are unfamiliar with the terms used or concepts presented in the procedural steps, *always read the referenced chapters* and other recommended documentation before trying to apply the information.

This chapter:

- tells you what tools and equipment you need
- lists preliminary considerations
- describes when to configure the module
- explains how to install and wire the module
- discusses system power–up procedures

Required Tools and Equipment

Have the following tools and equipment ready:

- small blade screwdriver
- an adequate length of communication cable (Belden™ 8761) for your specific application. (See chapter 3, *Installing and Wiring Your Analog Module* for maximum cable distances.)
- programming equipment

Procedures

1.	**Check the contents of shipping box.**	**Reference**

Unpack the shipping box making sure that the contents include:

- Analog I/O module (Catalog Number 1746-Series)
- installation instructions (publication 1746-IN008)

If the contents are incomplete, call your local Allen–Bradley representative for assistance.

2.	**Determine your power requirements for the modular controller.**	**Reference**

Review the power requirements of your system to see that your chassis supports placement of the analog module.

Chapter 3 *(Installing and Wiring Your Analog Module)*

Appendix A *(Specifications)*

- For modular style systems, calculate the total load on the system power supply using the procedure described in the *SLC 500 Modular Hardware Style User Manual* (publication 1747-UM011) or the *SLC 500 Family System Overview* (publication 1747-SO001).
- For fixed SLC 500 controllers, refer to the *SLC 500 Fixed Hardware Style Installation & Operation Manual* (publication 1747-6.21).

Catalog Number	Backplane Current Draw		External 24V dc Power Supply Tolerance
	5V (max.)	24V (max.)	
1746-NI4	35 mA	85 mA	NA
1746-NIO4I	55 mA	145 mA	NA
1746-NIO4V	55 mA	115 mA	NA
1746-NO4I	55 mA	195 mA	24 ±10% at 195 mA max. (21.6 to 26.4V dc)[1]
1746-NO4V	55 mA	145 mA	24 ±10% at 145 mA max. (21.6 to 26.4V dc)[1]

(1) Required for some applications if SLC 24V power is not readily available.

3.	**Configure the module using the DIP switches (analog inputs only).**	**Reference**

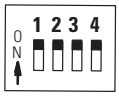
Each analog input channel can be configured for either voltage or current. Locate the DIP switches on your module and set them for your application.

Chapter 3 *(Installing and Wiring Your Analog Module)*

ON – Configures channel for current input

Off – Configures channel for voltage input

1746-NI4

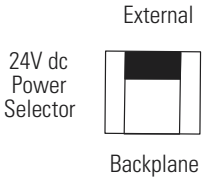


Switch 1 = Channel 0
Switch 2 = Channel 1
Switch 3 = Channel 2
Switch 4 = Channel 3

1746-NIO4I,NIO4V

Switch 1 = Channel 0
Switch 2 = Channel 1

1746-NO4I, NO4V



4.	**Install your module.**	**Reference**

When selecting a slot for an analog module, position the module:

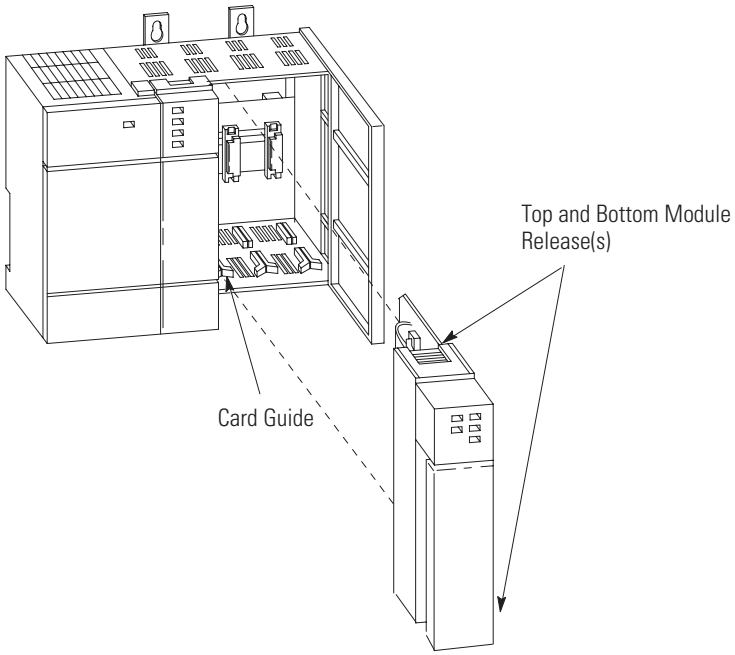
Chapter 3 *(Installing and Wiring Your Analog Module)*

- in a slot away from 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

ATTENTION

Never install, remove, or wire modules with power applied to the chassis or devices wired to the modules.

Make sure system power is off; then insert the analog module into your 1746 chassis. In this example procedure, local slot 1 is selected.



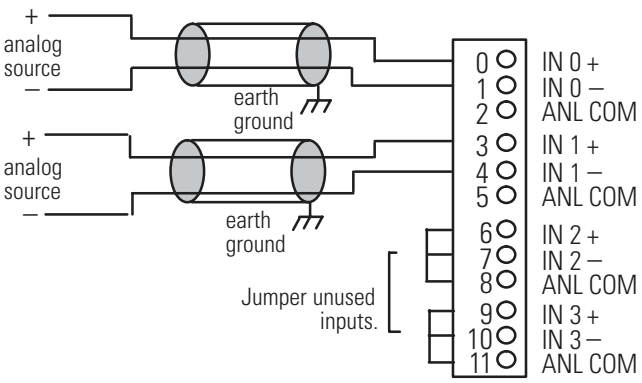
5.	**Wire the module.**	**Reference**

Important: Follow these guidelines when wiring the module.

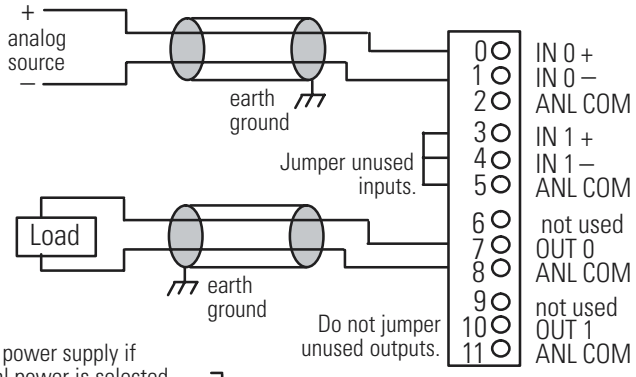
- Use shielded communication cable (Belden 8761) and keep length as short as possible.
- Connect only one end of the cable shield to earth ground.
- Channels are not isolated from each other. All analog commons are connected together internally.
- The module does not provide power for analog inputs.
- Use a power supply that matches the transmitter (sensor) specifications.

Chapter 3 *(Installing and Wiring Your Analog Module)*

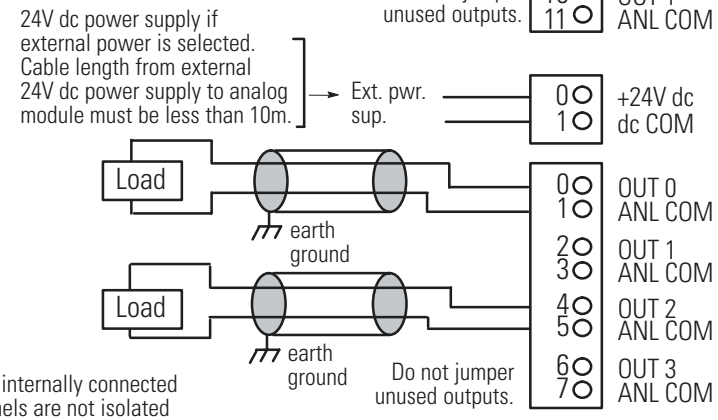
NI4



NI04I & NI04V



NO4I & NO4V



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

6.	Configure system I/O configuration.	Reference

Configure your system I/O configuration for the particular slot the analog module is in. When assigning an I/O module to a slot location, select the module from the displayed list. If not listed, select *OTHER* at the bottom of the list and enter the module's ID code at the prompt.

Chapter 4 *(Module Operation and System Considerations)*

Catalog No.	Module ID Code
1746-NI4	4401
1746-NIO4I	3201
1746-NIO4V	3202
1746-NO4I	5401
1746-NO4V	5402

7.	Check that the module is operating correctly.	Reference

Chapter 5 *(Testing Your Module)*

ATTENTION

Machine motion during system checkout can be hazardous to personnel. During all checkout procedures, you must disconnect all devices which, when energized, might cause machine motion.

Apply power to the fixed or modular system. The analog module LED (red) should be illuminated, indicating that the module is receiving 24V dc power.

8.	**Understanding analog inputs.**	**Reference**

Analog inputs convert current and voltage signals into 16–bit (max.) integer values and place them in the input image for the slot that the analog module resides in.

Chapter 4 *(Module Operation and System Considerations)*

Address	1746-NI4	1746-NI04I, -NI04V
I:e.0	Input Channel 0	Input Channel 0
I:e.1	Input Channel 1	Input Channel 1
I:e.2	Input Channel 2	
I:e.3	Input Channel 3	

Note: The e is the slot number.

Voltage/Current Range	Integer Representation
-10V dc to +10V dc	-32,768 to +32,767
0 to 10V dc	0 to 32,767±10V dc
0 to 5V dc	0 to 16, 384
1 to 5V dc	3,277 to 16,384
-20 mA to +20 mA	-16,384 to +16,384
0 to 20 mA	0 to 16,384±20 mA
4 to 20 mA	3,277 to 16,384

9.	**Understanding analog outputs.**	**Reference**

Analog outputs convert 16-bit integer values placed in the output image to voltage or current signals for the slot that the analog card is in.

Chapter 4 *(Module Operation and System Considerations)*

Address	1746-NO4	1746-NI04I, -NI04V
O:e.0	Output Channel 0	Output Channel 0
O:e.1	Output Channel 1	Output Channel 1
O:e.2	Output Channel 2	
O:e.3	Output Channel 3	

1746-NO4I, -NIO4I		1746-NO4V, -NIO4V	
Current Range	**Decimal Representation for Output Word**	**Voltage Range**	**Decimal Representation for Output Word**
0 to 21 mA	0 to 32,764	-10 to +10V dc	-32,768 to +32,764
0 to 20 mA	0 to 31, 208	0 to 10V dc	0 to 32,764
4 to 20 mA	6,242 to 31,208	0 to 5V dc	0 to 16,384
		1 to 5V dc	3,277 to 16,384

10.	**Write ladder logic to process the module's analog data.**	**Reference**

Several programming examples are provided in chapter 6 that demonstrate how to scale the raw data from the analog card into engineering units such as psi, percent, etc. Study these examples and apply them to your application as appropriate.

Chapter 5 *(Testing Your Module)*

Chapter 6 *(Programming Examples)*

Installing and Wiring Your Analog Module

To obtain the maximum performance from an analog module, proper module installation is imperative. This chapter describes the procedures that you must follow to install the analog module in an SLC 500 system. The following items are described:

- European Union Directive Compliance
- determining your power requirements
- configuring your module
- selecting a slot in the chassis
- installing your module
- wiring considerations
  - system wiring guidelines
  - grounding your cable
  - determining the cable length
- wiring the analog module
- minimizing electrical noise on the analog module

European Union Directive Compliance

If this product is installed within the European Union or EEA regions and has the CE mark, the following regulations apply.

EMC Directives

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081–2
  EMC - Generic Emission Standard, Part 2 - Industrial Environment

- EN 50082–2
  EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

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 requirement, providing configuration flexibility if SLC power supply loading is critical. These two modules provide user-supplied external 24V dc power supply connections.

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, -P4 is outside of the requirements of the NO4I and NO4V analog modules and cannot be used.

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 user manual for modular controllers.

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)
1746-NO4V	55 mA	145 mA(1)

(1) 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

The chart starting on the next page provides available analog module combinations in the expansion chassis of a fixed controller.

•	valid combination
	invalid combination
∇	valid combination when used with external power supply

BASIC net = Basic Module is supplying power to an AIC. No other device requiring power is connected to the AIC.

NI4	NIO4I	NIO4V	NO4I	NO4V	
•	•	•	_	•	IA4
•	•	•	∇	•	IA8
•	•	•	∇	•	IA16
•	•	•	∇	•	IM4
•	•	•	∇	•	IM8
•	•	•	∇	•	IM16
•	•	•	∇	•	OA8
			∇	∇	OA16
			∇	∇	OAP12
•	•	•	∇	•	IB8
•	•	•	∇	•	IB16
•	•	•	∇	•	IV8
•	•	•	∇	•	IV16
•	•	•	∇	•	IG16
•	•	•	∇	•	OV8
•		•	∇	∇	OV16
•	•	•	∇	•	OB8
•	•	•	∇	•	OG16
•		•	∇	∇	OW4
•			∇	∇	OW8
			∇	∇	OW16
•	•	•	∇	•	IO4
•		•	∇	∇	IO8
•			∇	∇	IO12
•			∇	∇	NI4
			∇	∇	NIO4I
			∇	∇	NIO4V
			∇	∇	DCM
•			∇	∇	HS
•			∇	∇	OB16
•	•	•	∇	•	IN16
			∇	∇	BASIC net
•		•	∇	∇	BASIC
					OB32
					OV32

NI4	NIO4I	NIO4V	NO4I	NO4V	
•	•	•	∇	•	IV32
•	•	•	∇	•	IB32
•			∇	∇	OX8
∇	∇	∇	∇	∇	NO4I
∇	∇	∇	∇	∇	NO4V
•	•	•	∇	•	ITB16
•	•	•	∇	•	ITV16
•	•	•	∇	•	IC16
•		•	∇	∇	OBP16
•		•	∇	∇	OVP16
•	•	•	∇	•	NT4
•	•	•	∇	•	NR4

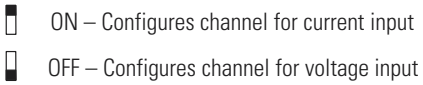
IMPORTANT The NO4I and NO4V modules provide user supplied external 24V dc power supply connections. When the NO4I module is used in a fixed controller, you must provide an external power supply.

When the NO4I or NO4V is used with an external 24V dc power supply and is placed in a fixed controller expansion chassis, it is compatible with those modules noted in the compatibility chart starting on the previous page. When set for external power, the module will only draw the 5V current off the backplane. Refer to the next section for details on how to configure your module for external power.

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.

Configuring Your Module

The NI4, NIO4I and NIO4V 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.

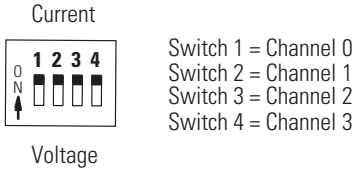


ATTENTION

Care should be taken to avoid connecting a voltage source to a channel configured for current input. Improper module operation or damage to the module can occur.

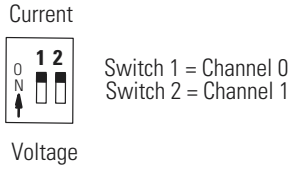
Switch Settings for the 1746–NI4

The NI4 has 4 individual DIP switches that control the input mode of input 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.



Switch Settings for the 1746-NIO4I and -NIO4V

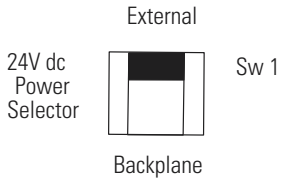
The NIO4I and NIO4V have 2 individual switches labeled 1 and 2. These switches control the input mode of input channel 0 and 1. A switch in the ON position configures the channel for current input. A switch in the OFF position configures the channel for voltage input.



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.

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, is outside of the requirements of the NO4I and NO4V analog modules and cannot be used.



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 ac or high voltage dc module
- 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

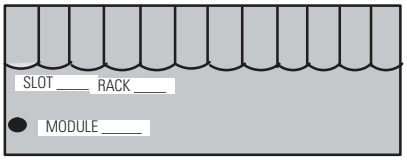
Installing Your Module

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.

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.

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.



Removing the Analog Module Terminal Block

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

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.

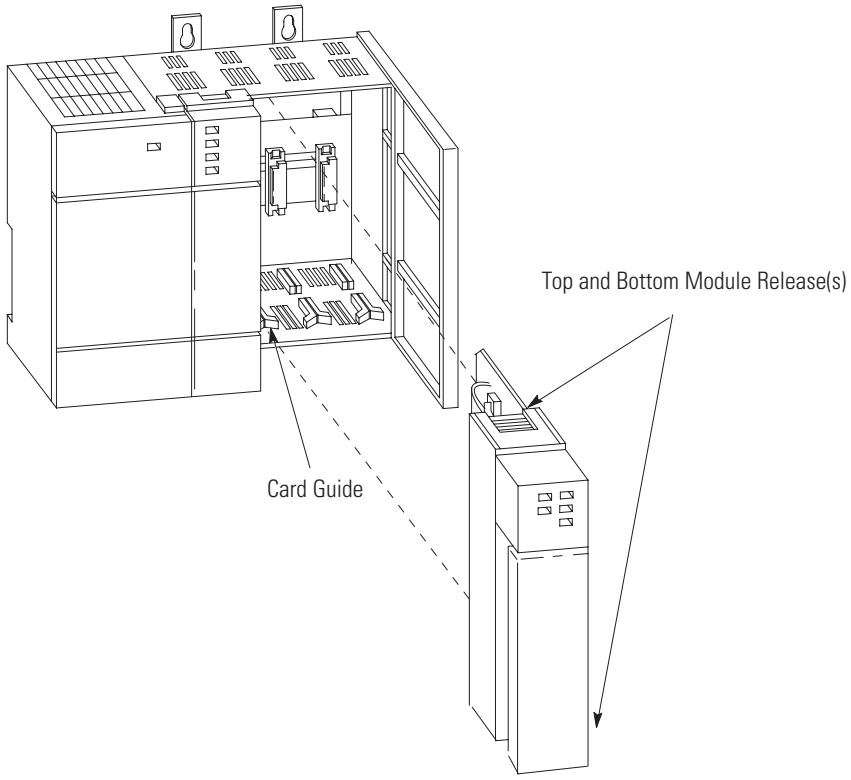
1. Verify that all switches are set correctly for the application.

ATTENTION

Care should be taken to avoid connecting a voltage source to a channel configured for a current input.

2. Align the circuit board of the analog module with the card guide of the chassis.

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.

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.