



## *Installation Instructions*

# SLC 500™ Analog Input Modules

(Catalog Numbers 1746-NI16I and 1746-NI16V)

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## Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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### ATTENTION



Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

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Attention statements help you to:

- identify a hazard
  - avoid the hazard
  - recognize the consequences
- 

### IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

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## For More Information

For detailed information on planning and installing your system, see the following publications:

<b>Publication</b>	<b>Publication Number</b>
Industrial Automation Wiring and Grounding Guidelines	1770-4.1
SLC 500™ Analog Input Modules User Manual	1746-UM001A-US-P
SLC 500™ Modular Hardware Style Operation and Installation Manual	1747-6.2
SLC 500™ Fixed Hardware Style Operation and Installation Manual	1747-6.21

If you would like a manual, you can:

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or **001.330.725.1574** (Outside USA/Canada)

## 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 ATTENTION statement applies to use in hazardous locations.

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**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.
  - This product must be installed in an enclosure.
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## 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.

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**MISE EN GARDE****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.
  - Ce produit doit être installé dans une armoire.
-

## Electrostatic Damage

Electrostatic discharge can damage semiconductor devices inside this module if you touch backplane connector pins. Guard against electrostatic damage by observing the following precautions.

### ATTENTION



Electrostatic discharge can degrade performance or cause permanent damage. Handle the module as stated below.

- Wear an approved wrist strap grounding device when handling the module.
- Touch a grounded object to rid yourself of electrostatic charge before handling the module.
- Handle the module from the front, away from the backplane connector. Do not touch backplane connector pins.
- Keep the module in its static-shield bag when not in use, or during shipment.

## 1746-NI16 Power Requirements

The 1746-NI16 module receives its power through the SLC 500 chassis backplane from the fixed or modular +5V dc/+24V dc chassis power supply. The +5V dc backplane supply powers the SLC circuitry and the +24V dc backplane supply powers the module analog circuitry. The maximum current drawn by the module is shown in the table below.

5V dc Amps	24V dc Amps
125 mA	75 mA

When you are using a *modular system* configuration, add the values shown in the table above to the requirements of all other modules in the SLC chassis to prevent overloading the chassis power supply.

# Module Location in Chassis

## Modular Chassis Considerations

Place your 1746-NI16 module in any slot of an SLC 500 modular, or modular expansion chassis, except for the extreme left slot (slot 0) in the first chassis. This slot is reserved for the processor or adapter modules.

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Operating Temperature Range	+0°C to +60°C (+32°F to +140°F)
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## Fixed Expansion Chassis Considerations

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**IMPORTANT**

The 2-slot, SLC 500 fixed I/O expansion chassis (1746-A2) supports only specific combinations of modules. If you are using the 1746-NI16 module in a 2-slot expansion chassis with another SLC I/O or communication module, refer to the 1746-NI16 user manual to determine whether the combination can be supported.

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## Heat and Noise Considerations

Most applications require installation in an industrial enclosure to reduce the effects of electrical interference. Analog inputs are highly susceptible to electrical noise. Electrical noise coupled to the analog inputs reduces the performance (accuracy) of the module.

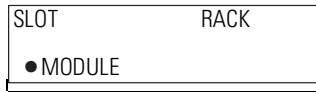
Group your modules to minimize adverse effects from radiated electrical noise and heat. Consider the following conditions when selecting a slot for the analog input module. Position the module:

- in a slot away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives
- away from modules which generate significant radiated heat, such as the 32-point I/O module (series C or earlier)

In addition, route shielded twisted-7pair analog input wiring away from any high-voltage I/O wiring.

## Module Installation and Removal

When installing the 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 (shown below) located on the side of the terminal block to identify the module location and type.



### ATTENTION



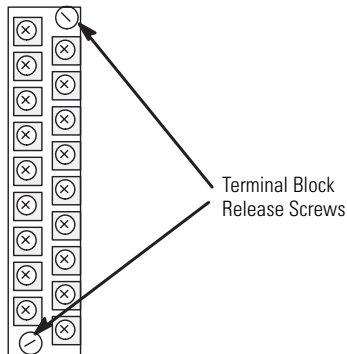
Remove power before removing or inserting this module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

## Terminal Block Removal

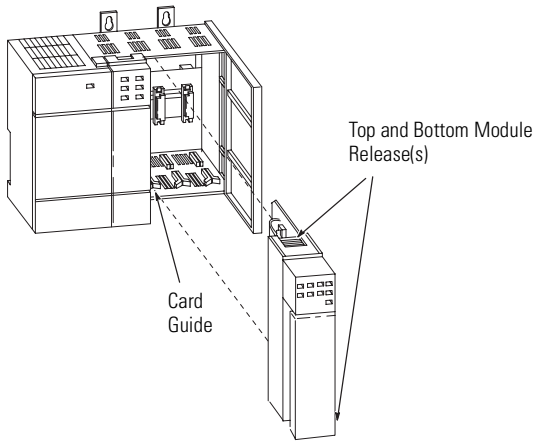
1. Loosen the two terminal block release screws.



2. Grasp the terminal block at the top and bottom and pull outward and down.

## Module Installation Procedure

1. Align the circuit board of the analog input module with the card guides located at the top and bottom of the chassis.
2. Slide the module into the chassis until both top and bottom retaining clips are secured. Apply firm even pressure on the module to attach it to its backplane connector. Never force the module into the slot.
3. Cover all unused slots with the Card Slot Filler, Catalog Number 1746-N2.



## Module Removal Procedure

1. Press the releases at the top and bottom of the module and slide the module out of the chassis slot.
2. Cover all unused slots with the Card Slot Filler, Catalog Number 1746-N2.



## Terminal Wiring

The 1746-NI16 module contains an 18-position, removable terminal block. The terminal pin-out is shown below.

### ATTENTION

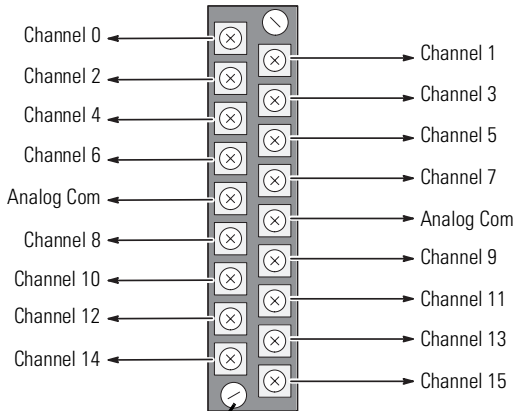


Disconnect power to the SLC before attempting to install, remove, or wire the removable terminal wiring block.

To avoid cracking the removable terminal block, alternate the removal of the slotted terminal block release screws.

## Terminal Block

(Terminal Block Spare Part Catalog Number 1746-RT25G)



Terminal Block Release Screw  
Maximum Torque = 0.7 to 0.9 Nm (6 to 8 in-lbs.)

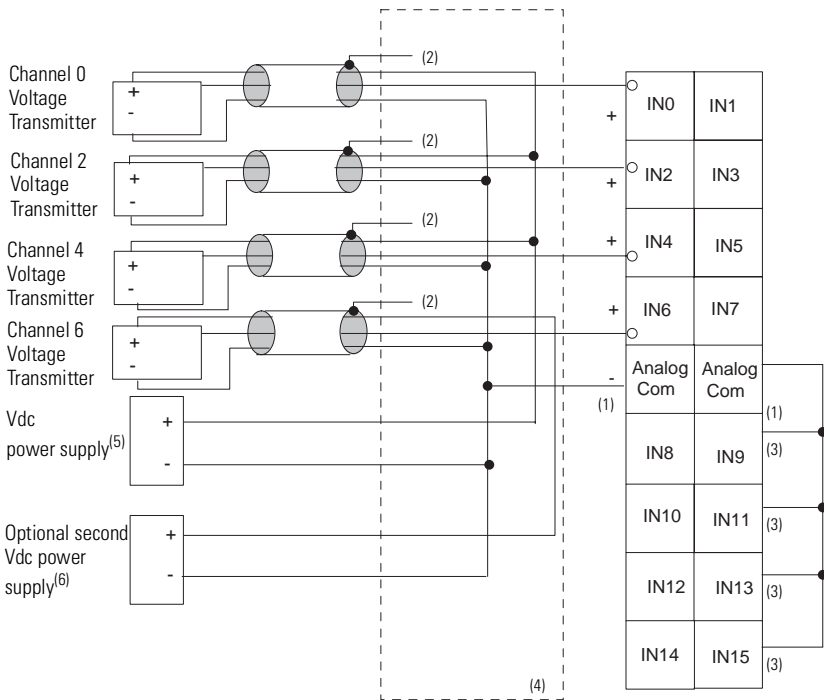
## Pre-wired Cables and Terminal Blocks

The following 1492 cables and terminal blocks are available to assist in wiring the 1746-NI16 module:

Allen-Bradley Prewired Cables	1492-ACAB005A46, 0.5m (1.6 ft.) 1492-ACAB010A46, 1.0 m (3.3 ft.) 1492-ACAB025A46, 2.5 m (8.2 ft.) 1492-ACAB050A46, 5.0 m (16.4 ft.)
Allen-Bradley User Terminal Blocks	1492-AIFM8-3 1492-AIFM16-F-3

## Wiring Single-Ended Inputs

The diagram below shows typical wiring for the 1746-NI16V module.



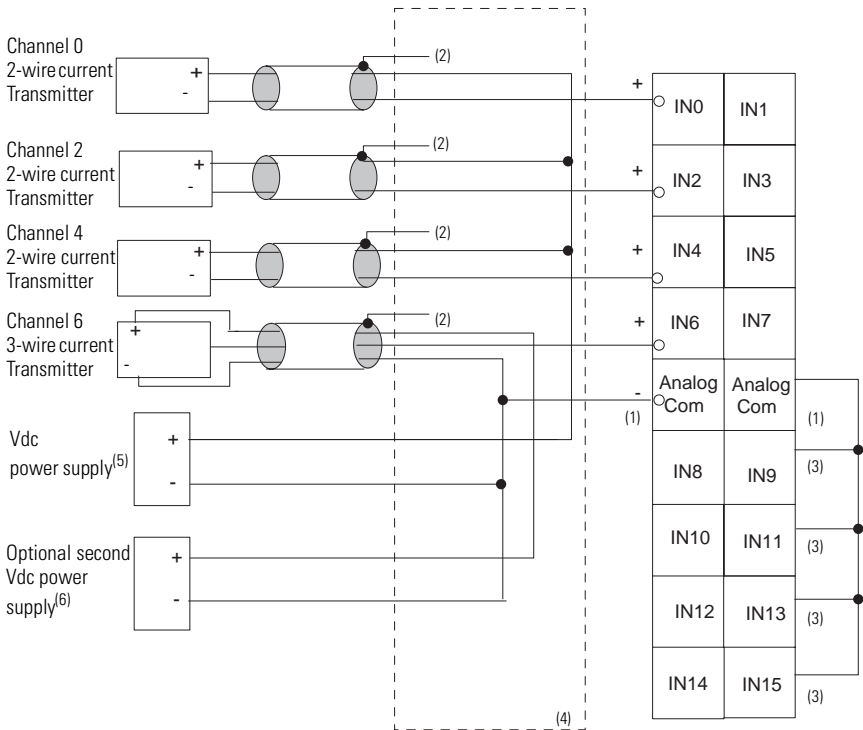
- (1) There are two common terminals for all of the 16 voltage inputs. These two analog common terminals are connected internally.
- (2) All shield wires should be connected to chassis mounting screws.
- (3) Unused channels should be connected to the analog common terminals (0 Volts).
- (4) If separate shielded cables are used for each analog input channel, interposing terminal blocks are needed to terminate up to 16 common wires. Then 1 to 4 common wires should be wired from the interposing terminal block to the 2 common terminals on the 1746-NI16V module.
- (5) The module does not provide loop power for analog inputs. Use a power supply that matches the transmitter specifications.
- (6) More than one power supply can be used if all supplies are class 2.

**NOTE**

Although the above diagram has 12 unused inputs, only 4 channels are shown connected to the Analog Com as an example.

## Wiring Single-Ended Inputs

The diagram below shows typical wiring for the 1746-NI16I module.



- (1) There are two common terminals for all of the 16 current inputs. These two analog common terminals are connected internally.
- (2) All shield wires should be connected to chassis mounting screws.
- (3) Unused channels should be connected to the analog common terminals (0 Volts).
- (4) If separate shielded cables are used for each analog input channel, interposing terminal blocks are needed to terminate up to 16 common wires. Then 1 to 4 common wires should be wired from the interposing terminal block to the 2 common terminals on the 1746-NI16I module.
- (5) The module does not provide loop power for analog inputs. Use a power supply that matches the transmitter specifications.
- (6) More than one power supply can be used if all supplies are class 2.

### NOTE

Although the above diagram has 12 unused inputs, only 4 channels are shown connected to the Analog Com as an example.

## Wiring Guidelines

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**ATTENTION**



To prevent shock hazard, care should be taken when wiring the module to analog signal sources. 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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Follow the guidelines below when planning your system wiring.

- To limit noise, keep signal wires as far away as possible from power and load lines.
- To ensure proper operation and high immunity to electrical noise, always use Belden™ 8761 (shielded, twisted pair) or equivalent wire.
- Connect the shield drain wire to the earth ground of the chassis.
- Tighten terminal screws using a standard or cross-head screwdriver. Each screw should be turned tight enough to immobilize the wire's end. Excessive tightening can strip the terminal screw. The torque applied to each screw should not exceed 0.7 to 0.9 Nm (6 to 8 in-lb) for each terminal.
- Follow system grounding and wiring guidelines found in your *SLC 500 Modular Hardware Style Installation and Operation Manual*, publication 1747-6.2.

# Input Devices

## Transducer Source Impedance

If the source impedance of the input device and associated cabling is too high, it will affect the accuracy of the channel data word. Source impedance of 2000 ohms will produce up to 0.01% of module error over and above the specified accuracy of the module.

You can compensate for device impedance error by implementing the following equation in your ladder program:

$$V_S = V_{measured} \times \frac{(R_s + R_{in})}{R_{in}}$$

$V_s$  = input device voltage

where:  $R_s$  = input device impedance

$R_{in}$  = 1746-NI16 input impedance  
(See Specifications on page 17)

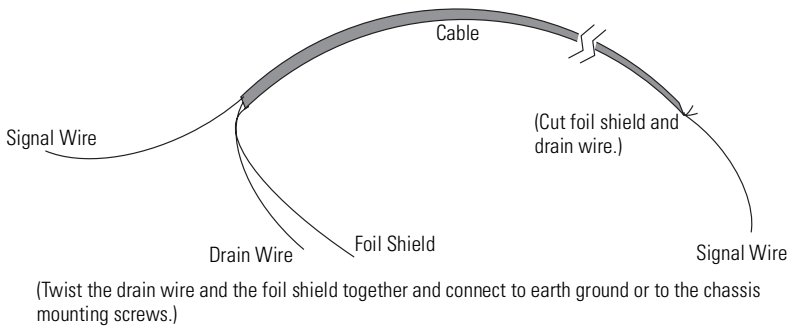
## Wiring Input Devices to the 1746-NI16

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 to a current input module. Improper module operation or damage to the voltage source can occur.



To wire your 1746-NI16 module follow these steps.

1. At each end of the cable, strip some casing to expose the individual wires.
2. Trim the signal wires to 50 mm (2 inch) lengths. Strip about 5 mm (3/16 inch) of insulation away to expose the end of the wire.
3. At one end of the cable, twist the drain wire and foil shield together.
4. At the other end of the cable, cut the drain wire and foil shield back to the cable.
5. Connect the signal wires to the 1746-NI16 terminal block or interposing terminal block.
6. Connect the shield drain wire to chassis ground.
7. Connect the other end of the cable to the voltage or current transmitter terminals.
8. Repeat steps 1 through 7 for each channel on the module.

# Specifications

## Electrical Specifications

Description	Specification
Backplane Current Consumption	125 mA at 5V dc 75 mA at 24V dc
Backplane Power Consumption	2.425W maximum (0.625W at 5V dc, 1.8W at 24V dc)
Number of Channels	16 (backplane isolated)
I/O Chassis Location	Any I/O module slot except slot 0
A/D Conversion Method	Sigma - Delta
Input Filtering	Low-pass digital filter with programmable filter frequencies
Normal Mode Rejection (between [+] input and [-] input)	>80 dB at 50/60 Hz >75 dB at dc >100 dB at 50/60 Hz
Common Mode Rejection (between inputs and chassis ground)	Greater than or equal to 75 dB at DC Greater than or equal to 100 dB at 50/60 Hz
Input Filter Frequencies	6 Hz, 10 Hz, 20 Hz, 40 Hz, 60 Hz, 80 Hz, 100 Hz, 250 Hz
Isolation	500V ac isolation for 1 second
Common-Mode Voltage Range	±10.25V relative to analog common terminal (20.5V maximum between any two signal input terminals)

## Physical Specifications

Description		Specification	
LED Indicators		5 green status indicators one for each group of 4 channels and one for module status	
Module ID Code		Class 1	Class 3
	NI16V	3505	10406
	NI16I	3504	10403
Recommended Cable		Belden #8761 or equivalent	
Maximum Wire Size		Two 14 AWG wires per terminal	
Maximum Cable Impedance	NI16V	Voltage Source (with less than 10 $\Omega$ impedance): 1250 $\Omega$ maximum loop impedance, for <1LSB error	
	NI16I	Current Source (transmitter properly wired to its power supply): 249 $\Omega$ maximum loop impedance, to meet common-mode voltage requirements	
Terminal Block		Removable, Allen-Bradley spare part Catalog Number 1746-RT25G	
Allen-Bradley Prewired Cables		1492-ACAB005A46, 0.5m (1.6 ft.) 1492-ACAB010A46, 1.0 m (3.3 ft.) 1492-ACAB025A46, 2.5 m (8.2 ft.) 1492-ACAB050A46, 5.0 m (16.4 ft.)	
Allen-Bradley User Terminal Blocks		1492-AIFM8-3 1492-AIFM16-F-3	

## Environmental Specifications

Description	Specification
Operating Temperature	+0°C to +60°C (+32°F to +140°F)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Relative Humidity	5% to 95% (without condensation)
Agency Certification	UL listed C-UL approved CE compliant for all applicable directives
Hazardous Environment Classification	Class I Division 2 Hazardous Environment Groups A, B, C, D



## Input Specifications

Description		Specification
Type of Input (Selectable)	NI16V	±10V dc, 1 to 5V, 0 to 5V, or 0 to 10V
	NI16I	±20 mA, 4 to 20 mA, 0 to 1 mA, 0 to 20 mA
Type of Data (Selectable)		Engineering Units (1 mV/step or 1 µA/step) Scaled-for-PID (0 to +16,383 range) Proportional Counts (-32,768 to +32,767 range) Proportional Counts (User Defined Range, Class 3 only) 1746-NI4 Data Format
Input Impedance	NI16V	20 MΩ
	NI16I	249 Ω
Maximum Voltage Input without damage	NI16V	±30V between any two signal terminals
Maximum Voltage Input without damage	NI16I	±8V between any two signal terminals
Current Input (maximum)		±30 mA (Between analog com and any input terminal)
Time to Detect Open Circuit		Less Than 5 seconds
Module Update Time		(1)
Input Resolution	NI16V	312 µV <sup>(2)</sup>
	NI16I	640 nA
Display Resolution		1 mV or 1 µA
Module Error Over Full Temperature Range (0°C to 60°C, 32°F to 140°F)	NI16V	Voltage input types (±10V dc, 1 to 5V dc, 0 to 5V dc, 0 to 10V dc): ±0.1%
	NI16I	Current input types (0 to 20 mA, 4 to 20 mA, 0 to 1mA, ±20 mA): ±0.3%
Input Offset Drift with Temperature	NI16V	90 µV/°C
	NI16I	360 nA/°C
Gain Drift with Temperature	NI16V	15 ppm/°C
	NI16I	20 ppm/°C
Calibrated Accuracy at 25°C	NI16V	Better than 0.05% of range
	NI16I	Better than 0.15% of range

(1) Depends on filter selected. Refer to the 1746-NI16 User Manual, publication 1746-UM001A-US-P.

(2) Depends on data mode: Engineering Units or Proportional Counts.

## Notes:



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