Overview

This chapter describes the 1746-NI8 analog input module and explains how the SLC 500™ processor gathers analog input from the module. Included is information about:

- the module's hardware and diagnostic features
- an overview of system operation

General Description

The module receives and stores digitally converted analog data into its image table for retrieval by all fixed and modular SLC 500 processors. The module supports connections from any combination of up to eight voltage or current analog sensors.

The 1746-NI8 is a multiclass (Class 1 or Class 3) single-slot module. Class 1① configuration utilizes 8 input words and 8 output words. Class 3 configuration utilizes 16 input words and 12 output words. Fixed and SLC 5/01™ processors can only operate as Class 1. The SLC 5/02™, SLC 5/03™, and SLC 5/04™ processors can be configured for either Class 1 or Class 3.

The 8 high-impedance input channels can be wired as either single-ended or differential inputs. The module provides a direct interface to the following input types:

- ±10V dc
- 1–5V dc
- 0–5V dc
- 0–10V dc
- 0–20 mA
- 4–20 mA
- ±20 mA
- 0–1 mA

The data presented to the processor can be configured as:

- Engineering Units
- Scaled-for-PID
- Proportional Counts (–32,768 to +32,767 range)
- Proportional Counts with User Defined Range (Class 3 only)
- 1746-NI4 Data Format

① Requires use of Block Transfer in a remote configuration.

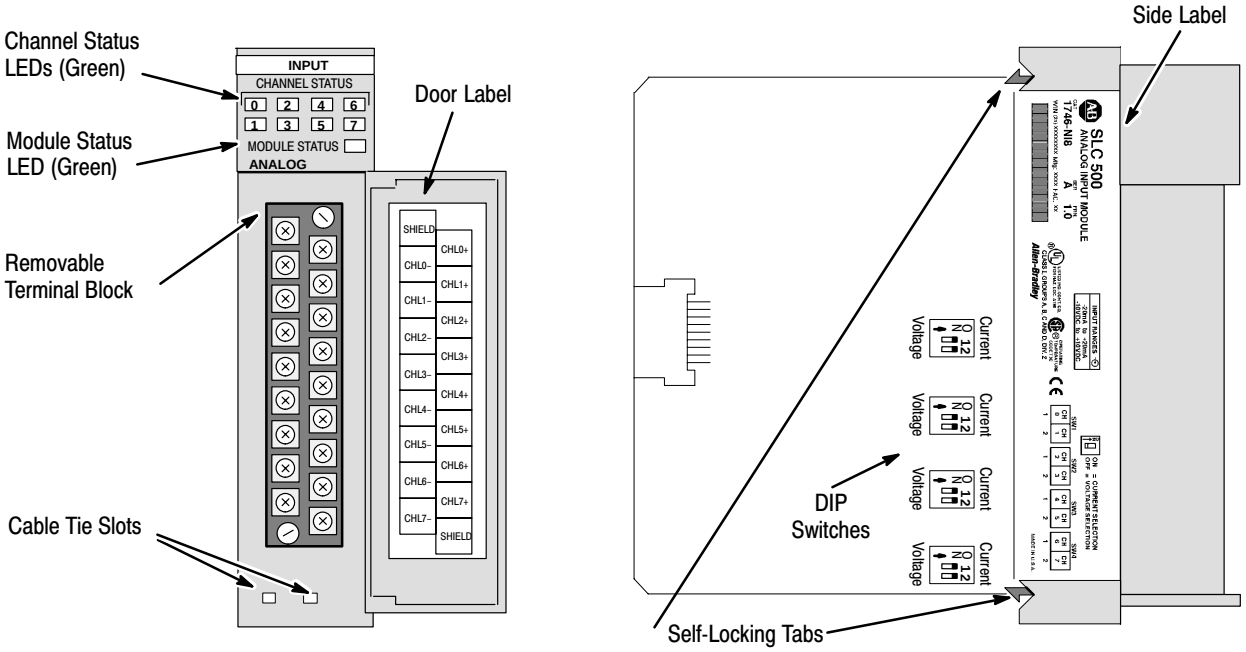
Each input channel also provides open-circuit, out-of-range, and invalid configuration indication via the LEDs. In Class 3 operation these conditions are also in the channel status word.

Important: Status words are only available when the module is configured for Class 3.

Hardware Features

The module fits into any slot, except the processor slot (0), in either an SLC 500 modular system or an SLC 500 fixed system expansion chassis (1746-A2).

The module contains a removable terminal block providing connection for eight analog input 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 no output channels on the module. Module configuration is done via the user program. There are DIP switches on the circuit board for selecting voltage or current input.



Hardware Feature	Function
Channel Status LED Indicators	Displays channel operating and fault status.
Module Status LED	Displays module operating and fault status.
Side Label (Nameplate)	Provides module information.
Removable Terminal Block	Provides physical connection to input devices.
Door Label	Permits easy terminal identification.
Cable Tie Slots	Secures and route wiring from module.
Self-Locking Tabs	Secures module in chassis slot.
Voltage/current Selection DIP Switches	Selects voltage or current input type to match the analog sensor.

General Diagnostic Features

The 1746-NI8 module contains diagnostic features that can help you identify the source of problems that may occur during power-up or during normal channel operation. These power-up and channel diagnostics are explained in chapter 7, *Module Diagnostics and Troubleshooting*.

System Overview

The module communicates to the SLC 500 processor through the parallel backplane interface and receives power from the SLC 500 power supply through the backplane. The +5V dc backplane supply powers the SLC circuitry, and the +24V dc backplane supply powers the module analog circuitry. No external power supply is required. You may install as many 1746-NI8 analog modules in your system as the power supply can support.

Each channel on the module can receive input signals from voltage or current analog input devices. You configure each channel individually to accept either a voltage or current input signal.

System Operation

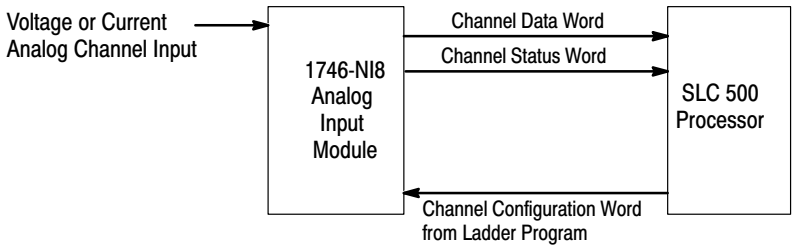
At power-up, the module performs a check of its internal circuits, memory, and basic functions. During this time the module status LED remains off. If no faults are found during the power-up diagnostics, the module status LED is turned on.

After power-up checks are complete, the module waits for valid channel configuration data from your SLC ladder logic program (channel status LEDs off). After configuration data is written to one or more channel configuration words and the channel enable status bits are set, the channel status LEDs go on and the module continuously converts the analog input to a value within the range you selected.

Each time a channel is read by the module, that data value is tested by the module for a fault condition (i.e., open-circuit, over-range, and under-range). If such a condition is detected, a unique bit is set in the channel status word and the channel status LED blinks.

The SLC processor reads the converted analog data from the module at the end of the program scan, or when commanded by the ladder program. The processor and module determine that the backplane data transfer was made without error, and the data is used in your ladder program. A graphic representation of this is shown below.

Data Transfer Between the Module and Processor (shown for one channel)



Module Operation

The 1746-NI8 module's input circuitry consists of eight differential analog inputs multiplexed into a single analog-to-digital (A/D) converter.

The A/D converter reads the selected input signal and converts it to a digital value. The multiplexer sequentially switches each input channel to the module's A/D converter. Multiplexing provides an economical means for a single A/D converter to convert multiple analog signals. However, multiplexing also affects the speed at which an input signal can change and still be detected by the converter.

Module Calibration

The module performs continuous autocalibration for all the channels that are enabled. There is no need to invoke a calibration cycle to compensate for changes in temperature.

Quick Start for Experienced Users

This chapter can help you to get started using the 1746-NI8 analog input module. We base the procedures here 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 about applying the procedures described in each step. It also references other documentation that may be helpful if you are unfamiliar with programming techniques or system installation requirements.

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 will:

- tell you what equipment you need
- explain how to install and wire the module
- show you how to set up one channel for analog input
- examine the state of the LEDs at normal startup
- examine the channel status word

Required Tools and Equipment

Have the following tools and equipment ready:

- medium blade screwdriver
- medium cross-head screwdriver
- analog input device
- cable for wiring inputs to module
- SLC processor and power supply installed in chassis
- analog input module (1746-NI8)
- programming device and software

Procedures

1.	Check the contents of shipping box.	Reference

Unpack the shipping box making sure that the contents include:
- analog input module (Catalog Number 1746-NI8)
- removable terminal block (factory-installed)

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

2.	Ensure that your chassis and power supply support the 1746-NI8 module.	Reference

Review the power requirements of your system to see that your chassis supports the module:
- If combining a 1746-NI8 module with another I/O module in a fixed controller, refer to the I/O module compatibility table found in chapter 3.
- For modular style systems, calculate the total load on the system power supply using the procedure described in the *SLC Installation & Operation Manual for Modular Style Controllers* (publication 1747-6.2) or the *SLC 500 Family System Overview* (publication 1747-2.30).
- The 1746-NI8 backplane current consumption is 200 mA at 5V dc and 100 mA at 24V dc.

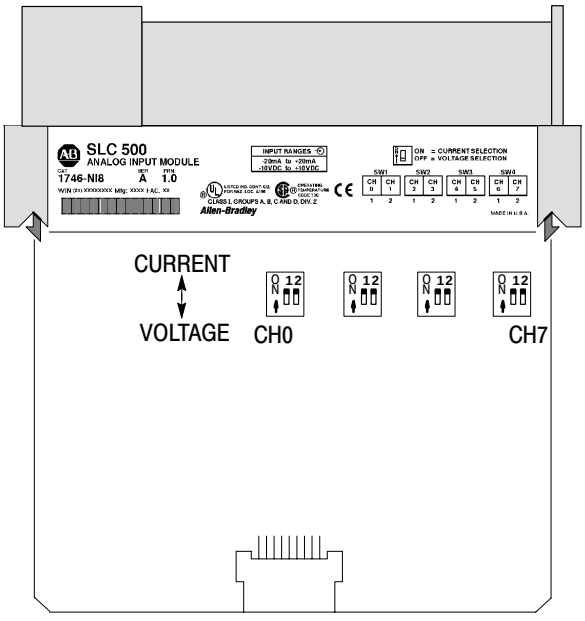
Chapter 3 *(Installation and Wiring)*

Appendix A *(Specifications)*

3.	Select voltage or current input type to match the analog sensor.	Reference

The voltage/current selection DIP switches are located on the side of the module. The switch settings are OFF = VOLTAGE INPUT and ON = CURRENT INPUT.

Chapter 3 *(Installation and Wiring)*



4. Insert the 1746-NI8 module into the chassis.

Reference

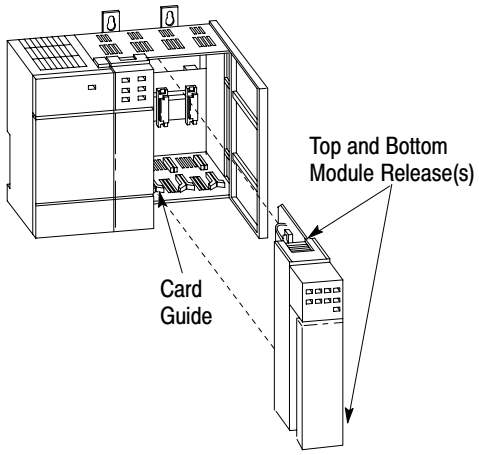
ATTENTION: Never install, remove, or wire modules with power applied to the chassis or devices wired to the module.

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

Chapter 3 *(Installation and Wiring)*

Important: For applications using the upper limit of the operating temperature range, the 1746-NI8 module (or multiple 1746-NI8 modules) should be placed in the right most slot(s) of the chassis. The specification for operating temperature is:

0°C to 55°C (32°F to 131°F) in any slot except slot 0
0°C to 60°C (32°F to 140°F) in right most slot of chassis



5. Connect sensor cable.

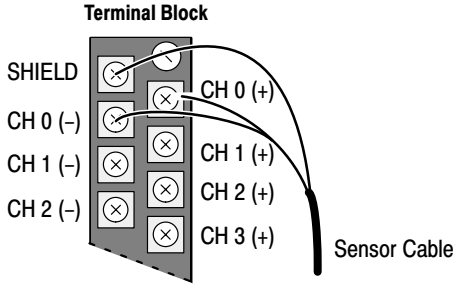
Reference

Connect sensor cable to the module's terminal block.

Chapter 3 *(Installation and Wiring)*

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.
- Connect the shield drain wires for channels 0–3 to the top shield terminal.
- Connect the shield drain wires for channels 4–7 to the bottom shield terminal.
- Shield terminals are internally connected to chassis ground which is connected to earth ground via the SLC backplane.
- Single-ended source commons may be jumpered together at the terminal block.
- Channels are not isolated from each other. All analog commons are connected together internally.
- If a differential signal source has an analog common, it can not and must not be connected to the module.
- Common mode voltage range is ± 10.5 volts. The voltage between any two terminals must be less than 21 volts.
- The module does not provide power for the analog inputs.
- Use a power supply that matches the transmitter (sensor) specifications.



6. Configure the system.

Reference

Configure your system I/O for the particular slot the 1746-NI8 is in (slot 1 in this example). Enter the module ID code. The ID code is 3526 for Class 1 interface, and 12726 for Class 3 interface. See chapter 4 for more information on Class 1 and Class 3 interfaces.

Chapter 4 *(Preliminary Operating Considerations)*

Important: All programming software does not support configuration for Class 3 operation.

- Advanced Programming Software (APS) supports Class 3 configuration. After entering the ID code (12726), enter 16 input words and 12 output words.
- SLC 500 A.I. Series™ Programming Software supports Class 3 configuration. After entering the ID code (12726), enter 16 input words and 12 output words.
- RSLogix 500™, version 1.30 or later, supports Class 3 configuration. After entering the ID code (12726), select Class 3 operation.
- Earlier versions of RSLogix 500 will only support configuration for Class 1 operation. Contact Rockwell Software for information on upgrading your software.

Appendix C *(Converting from 1746-NI4 to 1746-NI8)*

Your programming device's user manual.

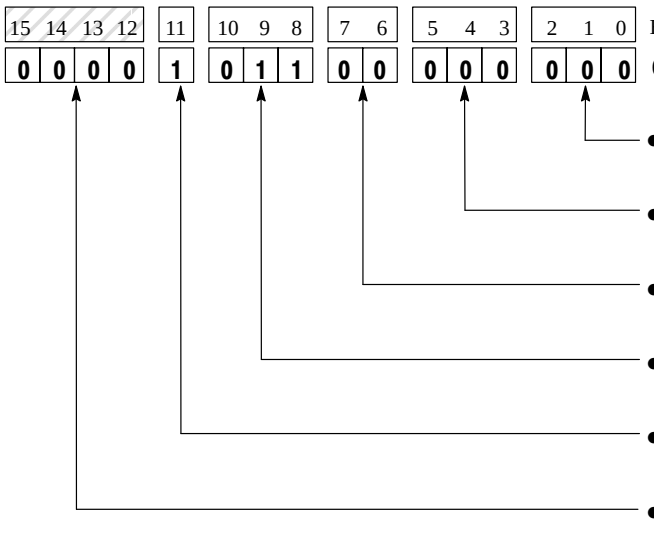
If you are converting from a 1746-NI4 to a 1746-NI8 based system, see Appendix C.

7. Determine the operating parameters.

Reference

Determine the operating parameters for channel 0. This example shows the channel 0 configuration word. The module is in slot 1. The default configuration word is all zero's.

Chapter 4 *(Preliminary Operating Considerations)*



Chapter 5 *(Channel Configuration, Data, and Status)*

Appendix B *(NI8 Configuration Worksheet)*

Appendix C *(Converting from 1746-NI4 to 1746-NI8)*

1746-NI8 Module Output Image – Channel Configuration				
			Class 1	Class 3
O:1.0	channel 0 configuration word	bit mapped field	•	•
O:1.1	channel 1 configuration word	bit mapped field	•	•
O:1.2	channel 2 configuration word	bit mapped field	•	•
O:1.3	channel 3 configuration word	bit mapped field	•	•
O:1.4	channel 4 configuration word	bit mapped field	•	•
O:1.5	channel 5 configuration word	bit mapped field	•	•
O:1.6	channel 6 configuration word	bit mapped field	•	•
O:1.7	channel 7 configuration word	bit mapped field	•	•
O:1.8	lower scale limit range 0	16 bit integer		•
O:1.9	upper scale limit range 0	16 bit integer		•
O:1.10	lower scale limit range 1	16 bit integer		•
O:1.11	upper scale limit range 1	16 bit integer		•

8. Program the configuration.

Reference

Do the programming necessary to establish the new configuration word setting in the previous step.

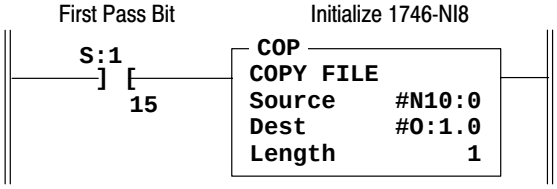
1. Create integer file N10. Integer file N10 should contain one element for each channel used. (For this example we only need one, N10:0.)
2. Enter the configuration parameters from step 7 for channel 0 into integer N10:0.
3. Program an instruction in your ladder logic to copy the contents of N10:0 to output word O:1.0.

Chapter 6 *(Ladder Logic Configuration Examples)*

Chapter 8 *(Application Examples)*

```
DATA FILE N10
```

Offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
N10:0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0



On power up, the first pass bit (S:1/15) is set for one scan, enabling the COPY instruction that transfers the channel configuration word 0. This configures and enables the channel.

9. Write the ladder program.

Reference

Write the remainder of the ladder logic program that specifies how your analog input data will be processed for your application. In this procedure the module is located in slot 1.

Chapter 5 *(Channel Configuration, Data, and Status)*

Chapter 6 *(Ladder Logic Configuration Examples)*

Chapter 8 *(Application Examples)*

Your programming device's user manual.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit Number
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Channel 0 Data Word (variable input data)**

1746-NI8 Module Input Image – Data Word

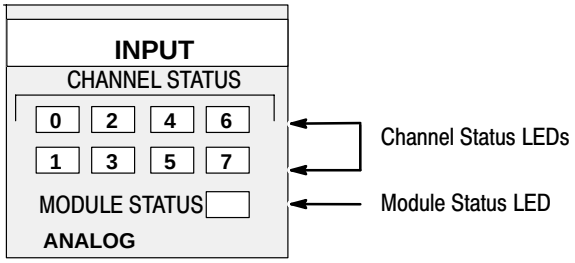
			Class 1	Class 3
I:1.0	channel 0 data word	16 bit integer	•	•
I:1.1	channel 1 data word	16 bit integer	•	•
I:1.2	channel 2 data word	16 bit integer	•	•
I:1.3	channel 3 data word	16 bit integer	•	•
I:1.4	channel 4 data word	16 bit integer	•	•
I:1.5	channel 5 data word	16 bit integer	•	•
I:1.6	channel 6 data word	16 bit integer	•	•
I:1.7	channel 7 data word	16 bit integer	•	•

10. Go through the system start-up procedure.

Reference

Apply power. Download your program to the SLC processor and put the controller into Run mode. During a normal start up, the module status LED and any enabled channel status LED turn on.

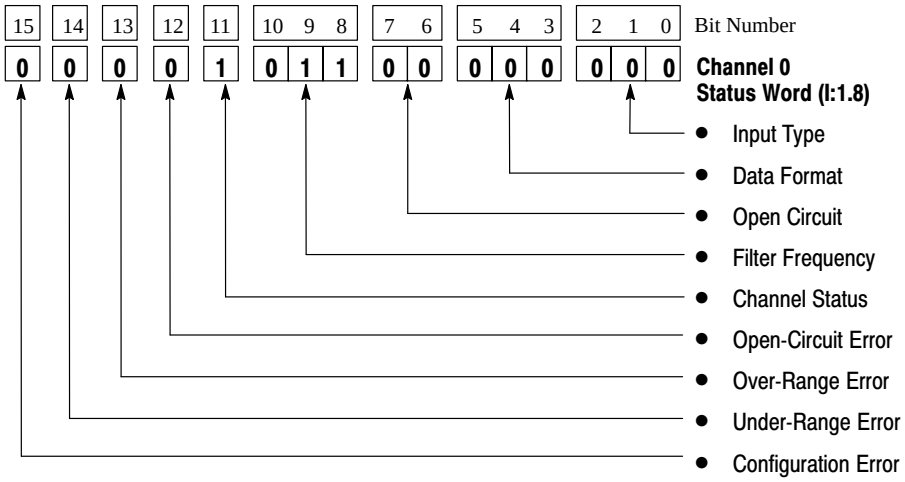
Chapter 7 *(Module Diagnostics and Troubleshooting)*



11.	Check that the module is operating correctly.	Reference

(Optional) If the Module Status LED is off, or if the Channel 0 LED is off or blinking, refer to chapter 7.

Class 3 Interface – Monitor the status of input channel 0 to determine its configuration setting and operational status. This is useful for troubleshooting when the blinking channel LED indicates that an error has occurred. The example below shows the configuration for channel 0 with no errors.



Chapter 5
(Channel Configuration, Data, and Status)

Chapter 7
(Module Diagnostics and Troubleshooting)

Chapter 8
(Application Examples)