



**SPECTRUM**  
C O N T R O L S

*An **Allient** Company*

User's Manual Pub. 0300127-05 Rev. A

# SLC 500™ Isolated Analog Input Module

Catalog Number: 1746sc-INI4i/1746sc-INI4vi

## Important Notes

1. Please read all the information in this owner's guide before installing the product.
2. The information in this owner's guide applies to hardware Series A and firmware version 1.00 or later.
3. This guide assumes that the reader has a full working knowledge of the relevant processor.

### Notice

The products and services described in this owner's guide are useful in a wide variety of applications. Therefore, the user and others responsible for applying the products and services described herein are responsible for determining their acceptability for each application. While efforts have been made to provide accurate information within this owner's guide, Spectrum Controls, Inc. assumes no responsibility for the accuracy, completeness, or usefulness of the information herein.

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## Preface

Read this preface to familiarize yourself with the rest of the manual. This preface covers the following topics:

- Who should use this manual
- What This Manual Covers
- Related documentation
- Technical Support
- Documentation
- Conventions used in this manual

## Who Should Use This Manual

Use this guide if you design, install, program, or maintain a control system that uses Allen-Bradley Small Logic Controllers.

You should have a basic understanding of SLC 500 products. You should also understand electronic process control, and the ladder program instructions required to generate the electronic signals that control your application. If you do not, contact your local Allen-Bradley representative for the proper training before using these products.

## What This Manual Covers

This guide covers the 1746sc-INI4i and 1746sc-INI4vi isolated analog input modules. It contains the information you need to install, wire, use, and maintain these modules. It also provides diagnostic and troubleshooting help should the need arise.

## Related Documentation

The table below provides a listing of publications that contain important information about Allen-Bradley PLC systems.

Refer to this Document	Allen-Bradley Pub. No.
SLC 500 System Overview	1747-2.30
Application Considerations for Solid State Controls	SGI-1.1
Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1
Installation & Operation Manual for Modular Hardware Style Programmable Controllers	1747-6.2
Installation & Operation Manual for Fixed Hardware Style Programmable Controllers	1747-NI001
Allen-Bradley Advanced Programming Software (APS) User Manual	1747-6.4

Refer to this Document	Allen-Bradley Pub. No.
Allen-Bradley Advanced Programming Software (APS) Reference Manual	1747-6.11
Getting Started Guide for Advanced Programming Software (APS)	1747-6.3
SLC 500 Software Programmers' Quick Reference	ABT-1747-TSG001 Guide
Allen-Bradley HHT (Hand-Held Terminal) User Manual	1747-NP002
Getting Started Guide for HHT (Hand-Held Terminal)	1747-NM009
Allen-Bradley Publication Index	SD499
Allen-Bradley Industrial Automation Glossary	AG-7.1

## Technical Support

For technical support, please contact your local Rockwell Automation TechConnect Office for all Spectrum products. Contact numbers are as follows:

- USA 1-440-646-6900
- United Kingdom 01-908-635-230
- Australia 1-800-809-929
- Mexico 001-888-365-8677
- Brazil 55-11-3618-8800
- Europe +49-211- 41553-630

or send an email to [support@spectrumcontrols.com](mailto:support@spectrumcontrols.com)


## Documentation



If you would like a manual, you can download a free electronic version from the Internet at [www.spectrumcontrols.com](http://www.spectrumcontrols.com)

## Conventions Used in This Manual

The following conventions are used throughout this manual:

- Bulleted lists (like this one) provide information, not procedural steps.
- Lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.
- **Bold** type identifies headings and sub-headings:

<b>WARNING</b> 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. These messages help you to identify a hazard, avoid a hazard, and recognize the consequences.
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<b>ATTENTION</b> 	Actions ou situations risquant d'entraîner des blessures pouvant être mortelles, des dégâts matériels ou des pertes financières. Les messages « Attention » vous aident à identifier un danger, à éviter ce danger et en discerner les conséquences.
<b>NOTE</b> 	Identifies information that is critical for successful application and understanding of the product.





# Chapter 1

## Module Overview

The 1746sc-INI4i monitors up to 4 isolated analog current inputs, while the 1746sc-INI4vi monitors up to 4 isolated analog current or voltage inputs (selectable by channel). In both modules, you can select different input ranges (for example, 4–20 mA or 1–5 Vdc) independently, by channel, for optimal use of rack space.



Read this chapter to familiarize yourself further with your isolated analog module (shown above). This chapter covers:

- General features and benefits.
- Detailed specifications.

### Section 1.1

#### General Features And Benefits

Both modules provide 750 VDC channel-to-channel isolation, which means no electrical crosstalk between channels (resulting in less noise and a high effective resolution). They also provide 750 VDC field wiring- to-backplane isolation to protect your processor and other rack components. And for state-of-the-art precision, they offer 16-bits of resolution.

For added reliability, both modules perform a battery of diagnostic tests at startup and can alert you to open input circuits through status bits and LEDs. The open-circuit response state is selectable. Onboard over-voltage and over-current protection also help prevent damage to the module due to wiring errors.

Because channel-to-channel isolation is built into these modules, they eliminate the need for expensive, external analog isolation blocks and the time and space required to install them. Both modules provide a single-slot solution for applications requiring up to 4, mixed, analog inputs.

They also feature auto-calibration, so you never have to perform this time-

consuming task.

These modules incorporate proprietary Allen-Bradley technology, so they operate and perform like the latest high-performance Allen-Bradley products for full compatibility. Four selectable filter frequencies are provided for signal/noise optimization. For even greater convenience, they are fully configured through software (no DIP switches), can alert the processor to a variety of errors through status bits, and can scale input signals to user-defined ranges without any ladder programming.

## Section 1.2

### Detailed Specifications

**Table 1-1. Electrical Specifications-Module**

Description	Specification
Backplane Current Consumption (typical)	
1746sc-INI4i	440 mA at 5 VDC 0 mA at 24 VDC
1746sc-INI4vi	550 mA at 5 VDC 0 mA at 24 VDC
Backplane Power Consumption (typical)	2.75 W
Number of Channels	4 (differential, individually isolated)
I/O Chassis Location	Any 1746 I/O module slot except slot 0
A/D Conversion Method	Sigma-Delta
Input Filtering	Programmable notch filters
Normal Mode Rejection (between _ and – inputs)	96 dB at 50 Hz 98 dB at 60 Hz
Common Mode Rejection (between inputs and chassis ground)	99 dB at 1 kHz, 25 degrees C
Calibration	Factory calibrated Auto-calibrated every 10 seconds (when enabled)
Opto-Electrical Isolation (10 seconds)	750 VDC channel-to-channel 750 VDC field wiring-to-backplane
Module ID Code	
1746sc-INI4i	3522
1746sc-INI4vi	3520
Thermal Dissipation	3.25 W maximum

**Table 1-2. Electrical Specifications-Inputs**

<b>Description</b>	<b>Specification</b>
Input Current Ranges (selectable for each channel)	4 to 20 mA 0 to 20 mA
Input Voltage Ranges—INI4vi only (selectable for each channel)	-10 to +10 VDC 0 to 10 VDC 0 to 5 VDC 1 to 5 VDC
SLC Communication Formats (selectable for each channel)	Scaled engineering units Scaled for PID Proportional counts 1746-INI4 format User-defined scale A User-defined scale B
Input Impedance Current Inputs Voltage Inputs—INI4vi only	Less than 250 Ohms Greater than 220 Ohms
Input Overcurrent Protection	70 mA non-continuous 33 mA continuous
Input Filter 3 dB Cutoff Frequencies (selectable for each channel)	13.1 Hz for 50 Hz filter 15.7 Hz for 60 Hz filter 65.5 Hz for 250 Hz filter 131 Hz for 500 Hz filter
Input Step Response Time	80 ms for 50 Hz filter 66.7 ms for 60 Hz filter 16 ms for 250 Hz filter 8 ms for 500 Hz filter
Channel Update Time (minimum) Current Inputs Voltage Inputs	14 ms with 500 Hz filters and all channels enabled 18 ms with 500 Hz filters and all channels enabled
Input Resolution (maximum) Current Inputs Voltage Inputs—INI4vi only	16-bit 312.8 nA/count 312.8 $\mu$ V/count
Overall Accuracy Current Inputs Voltage Inputs—INI4vi only	0.15% of full scale at 25 °C 0.25% of full scale at 60 °C 0.10% of full scale at 25 °C 0.25% of full scale at 60 °C

Description	Specification
Overall Drift Current Inputs  Voltage Inputs-INI4vi only	Offset: $\pm 539$ nA/°C Gain: $\pm 50.5$ ppm/°C Offset: $\pm 352$ $\mu$ V/°C Gain: 34.8 ppm/°C

**Table 1-3. Physical Specifications**

Description	Specification
LED Indicators	Four green channel status indicators, one for each channel One green module status indicator
Recommended Cable	Belden 8761 (shielded, twisted-pair) or equivalent
Wire Size (maximum)	One 12–24 AWG wire per terminal
Terminal Block	Removable (supplied)

**Table 1-4. Environmental Specifications**

Description	Specification
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 Certifications
Certifications	UL/CUL and CE
Hazardous Environment Classifications	Class I Division 2 Groups A, B, C, D

### Section 1.3 Regulatory Requirements

Compliance Standards	Industry Standards
UL Safety	UL 61010-2-201 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-201: Particular Requirements for Control Equipment (NRAQ, NRAQ7) CAN/CSA C22.2 No. 61010-1-12 (Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements)
UL Hazardous Locations	ANSI/ISA–12.12.01 Nonincendive Electrical Equipment for Use in Class I, Division 2 Hazardous (Classified) Locations (NRAG) CSA C22.2 No. 213-M1987 - Non-incendive Electrical Equipment for use in Class I Division 2 Hazardous Locations - March 1987 (NRAG7) Temp code T4 or better, Pollution degree 2, gas groups A, B, C, and D
CE EMC Directive	EN 61131-2 Programmable Controllers: Third Edition 2007-02, Clause 8, Zones A&B EN 61000-6-2: Generic Industrial Immunity EN 61000-6-4: Generic Industrial Emissions
UKCA	Electromagnetic Compatibility Regulations 2016 BS EN 61131-2, BS EN 61000-6-4, BS EN 61000-6-2
FCC	27 CFR Part 15, Class A
CMIM	Arrêté ministériel n° 6404-15 du 29 ramadan 1436 (16 juillet 2015) NM EN 61131-2, NM EN 61000-6-4, NM EN 61000-6-2





# Chapter 2


## Installation and Wiring

This chapter will cover:

- Avoiding electrostatic damage.
- Determining power requirements.
- Selecting a rack slot.
- Inserting your module into the rack.
- Wiring your module.

<b>NOTE</b> 	Although your module has a jumper on its printed circuit board, this jumper is for the manufacturer's use only. Your module was calibrated by the manufacturer, so no further calibration is required.
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<b>NOTE</b> 	For UL and CUL compliance, power and input/output (I/O) wiring must be in accordance with Class I, Division 2, wiring methods [Article 501-4 (b) of the National Electrical Code, NFPA 70] and in accordance with the authority having jurisdiction. Also, you must observe the warnings shown below. Failure to observe these warnings can cause personal injury.
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<b>WARNING</b> 	<b>EXPLOSION HAZARD</b> <ul style="list-style-type: none"><li>• Substitution of components may impair suitability for Class I, Division 2.</li><li>• Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous. Touch a grounded object to discharge static potential.</li><li>• Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.</li><li>• This product must be installed in an IP54 rated enclosure that requires a tool to open.</li><li>• All wiring must comply with N.E.C. article 501-4(b).</li></ul>
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The following documents contain information that may help you as you install and wire your module:


- *National Electrical Code*, published by the National Fire Protection Association of Boston, MA.
- IEEE Standard 518-1977, *Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources*.
- IEEE Standard 142-1982, *Recommended Practices for Grounding of*

*Industrial and Commercial Power Systems.*

- *Noise Reduction Techniques in Electronic Systems*, by Henry W. Ott; published by Wiley-Interscience of New York in 1976.

## Section 2.1

### Prevent Electrostatic Discharge

<p><b>WARNING</b></p> 	<p>Electrostatic discharge can damage integrated circuits or semiconductors if you touch analog module card bus connector pins or the terminal block on the module. Follow these guidelines when you handle the module:</p> <ul style="list-style-type: none"> <li>• Touch a grounded object to discharge static potential.</li> <li>• Wear an approved wrist-strap grounding device.</li> <li>• Do not touch the bus connector or connector pins.</li> <li>• Do not touch circuit components inside the module.</li> <li>• If available, use a static-safe workstation.</li> <li>• When it is not in use, keep the module in its static-shield bag.</li> </ul>
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## Section 2.2

### Compliance to European Directive

If this product bears the CE marking, it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

## Section 2.3

### EMC Directive

This product is tested to meet Council Directive 2014/30/EU Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 61000-6-4 Electromagnetic compatibility (EMC)–Part 6-4: Generic standards–Emission standard for industrial environments.
- EN 61000-6-2 Electromagnetic compatibility (EMC)–Part 6-2: Generic standards–Immunity for industrial environments.

UKCA Electromagnetic Compatibility Regulations 2016

- BS EN 61131-2, BS EN 61000-6-4, BS EN 61000-6-2.

This product is intended for use in an industrial environment.

## Section 2.4

### Low Voltage Directive

This product is tested to meet Council Directive 2014/35/EU Low Voltage, by applying the safety requirements of EN 61010-2-201 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-



**201: Particular Requirements for Control Equipment.**

For specific information required by EN 61010-2-201, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, publication 1770-4.1
- Automation Systems Catalog, publication B111.

This equipment is classified as open equipment and must be installed (mounted) in an enclosure during operation as a means of providing safety protection.

## Power Requirements

The module receives power through the bus interface from the +5 VDC/+24 VDC system power supply. The maximum current drawn by the module is shown in the table below:

Module	5 VDC	24 VDC
1746sc-INI4i	440 mA	0 mA
1746sc-INI4vi	550 mA	0 mA

Use the table above to calculate the total load on the system power supply. For more information, see the Allen-Bradley system *Installation and Operation Manual*.

**NOTE**

**IMPORTANT.** Your module does not supply power for input devices. You must supply the appropriate power

## Section 2.5 Selecting a Rack Slot

Two factors determine where you should install your module in the rack: ambient temperature and electrical noise. When selecting a slot for your module, try to position your module:

- In a rack close to the bottom of the enclosure (where the air is cooler).
- Away from modules that generate significant heat, such as 32-point input/output modules.
- In a slot away from AC or high-voltage DC modules, hard contact switches, relays, and AC motor drives.
- Away from the rack power supply (if using a modular system).

Remember that in a modular system, the processor always occupies the first slot of the rack.

## Section 2.6 Selecting a Location

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 will reduce 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 location for the analog module. Position the module:

- Away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives.
- Away from modules which generate significant radiated heat. Refer to the module's heat dissipation specification.

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

## Section 2.7

### Inserting your Module into the Rack

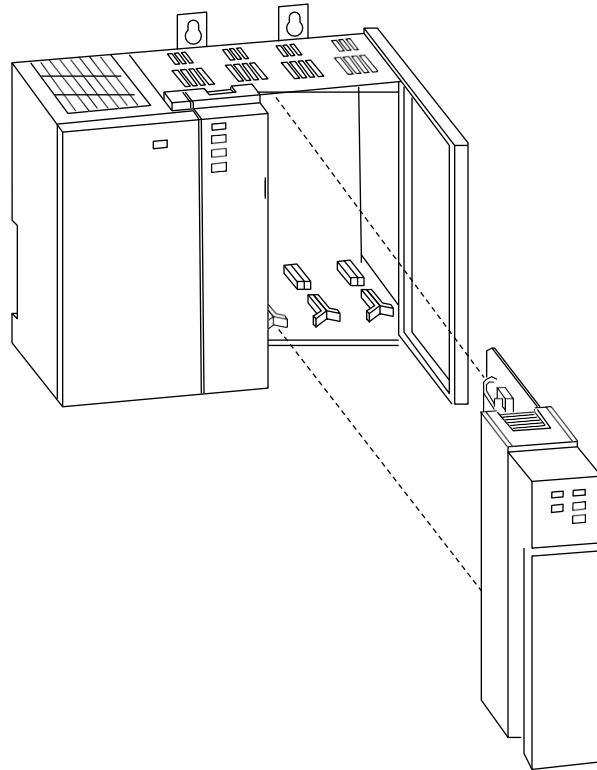
<b>WARNING</b> 	<b>POSSIBLE EQUIPMENT OPERATION</b> Before installing or removing your module, always disconnect power from the SLC 500 system and from any other source to the module (in other words, do not “hot swap” your module), and disconnect any devices wired to the module. Failure to observe this precaution can cause unintended equipment operation and damage.
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When inserting your module into the rack, you do not need to remove the supplied 16-position terminal block from the module. If, however, you do remove the terminal block, apply the supplied write-on label to the terminal block, and use the write-on label to identify your module's location.

To remove the terminal block, unscrew the two retaining screws at the top and bottom of the terminal block, and using a screwdriver or needle-nose pliers, carefully pry the terminal block loose.

To insert your module into the rack, follow these steps:

1. Align the circuit board of your module with the card guides at the top and bottom of the chassis.




2. Slide your module into the chassis until both top and bottom retaining clips are secure. Apply firm even pressure on your module to attach it to its backplane connector. Never force your module into the slot.
3. Cover all unused slots with the Card Slot Filler, Allen-Bradley part number 1746-N2.
4. To remove your module, press the retaining clips at the top and bottom of your module and slide it out.

## Section 2.8

### Wiring Your Module

To wire the terminal block, you need:

- A small, flat-blade screwdriver.
- Belden 8761 (shielded, twisted pair) cable or equivalent.

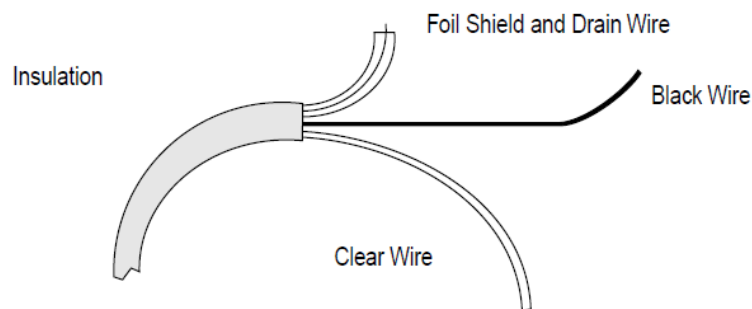
<p><b>WARNING</b></p> 	<p>Remove power before removing or inserting this module. When you remove, or insert, a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:</p> <ul style="list-style-type: none"> <li>• Sending an erroneous signal to your system's field devices, causing unintended machine motion.</li> <li>• Causing an explosion in a hazardous environment.</li> <li>• Electric arcing causes excessive wear to contacts on both the module and its mating connector and may lead to premature failure.</li> </ul>
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Before wiring the terminal block, take some time to plan your system:

- Ensure that the SLC 500 system is installed in a NEMA-rated enclosure and that the SLC 500 system is properly grounded.
- Ensure that the load resistance for a current output channel is less than 500  $\Omega$ .
- Ensure that the load resistance for a voltage output channel is greater than 1 k $\Omega$ .
- Route the field wiring away from any other wiring and as far as possible from sources of electrical noise, such as motors, transformers, contactors, and AC devices. Generally, allow at least 6 in. (about 15.2 cm) of separation for every 120 V of power.
- Routing the field wiring in a grounded conduit can reduce electrical noise further.
- If the field wiring must cross AC or power cables, ensure that they cross at right angles.

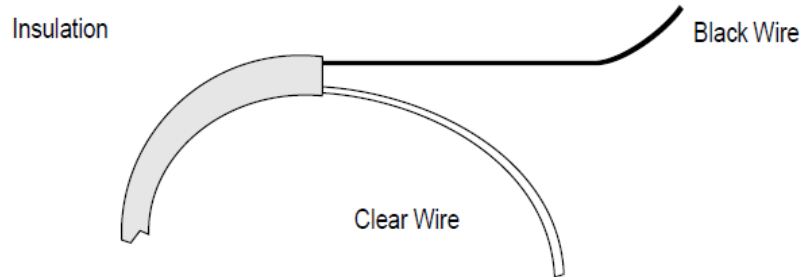
To wire your module, follow these steps:

1. Determine the length of cable you need to connect a channel to its field device. Remember to include additional cable to route the drain wire and foil shield to their ground points.
2. At each end of the cable, strip some casing to expose the individual wires.
3. Trim the exposed signal wires to 2 in. lengths. Strip about 3/16 in. (about 5 mm) of insulation away to expose the end of each wire.
4. At one end of the cable, twist the drain wire and foil shield together, bend them away from the cable, and apply shrink wrap.



5. At the other end of the cable, cut the drain wire and foil shield back to

the cable and apply shrink wrap.



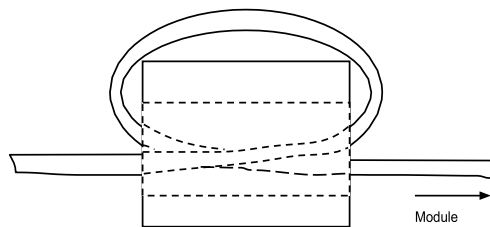
6. Connect the wires to the terminal block and field device as shown in the following figures and table. The recommended maximum torque is 5 in-lb. (0.565 Nm) for all terminal screws.
7. To guard against electrostatic damage and improve chassis grounding, connect one of the shield pins on the terminal block of your module to the chassis itself.

**NOTE**

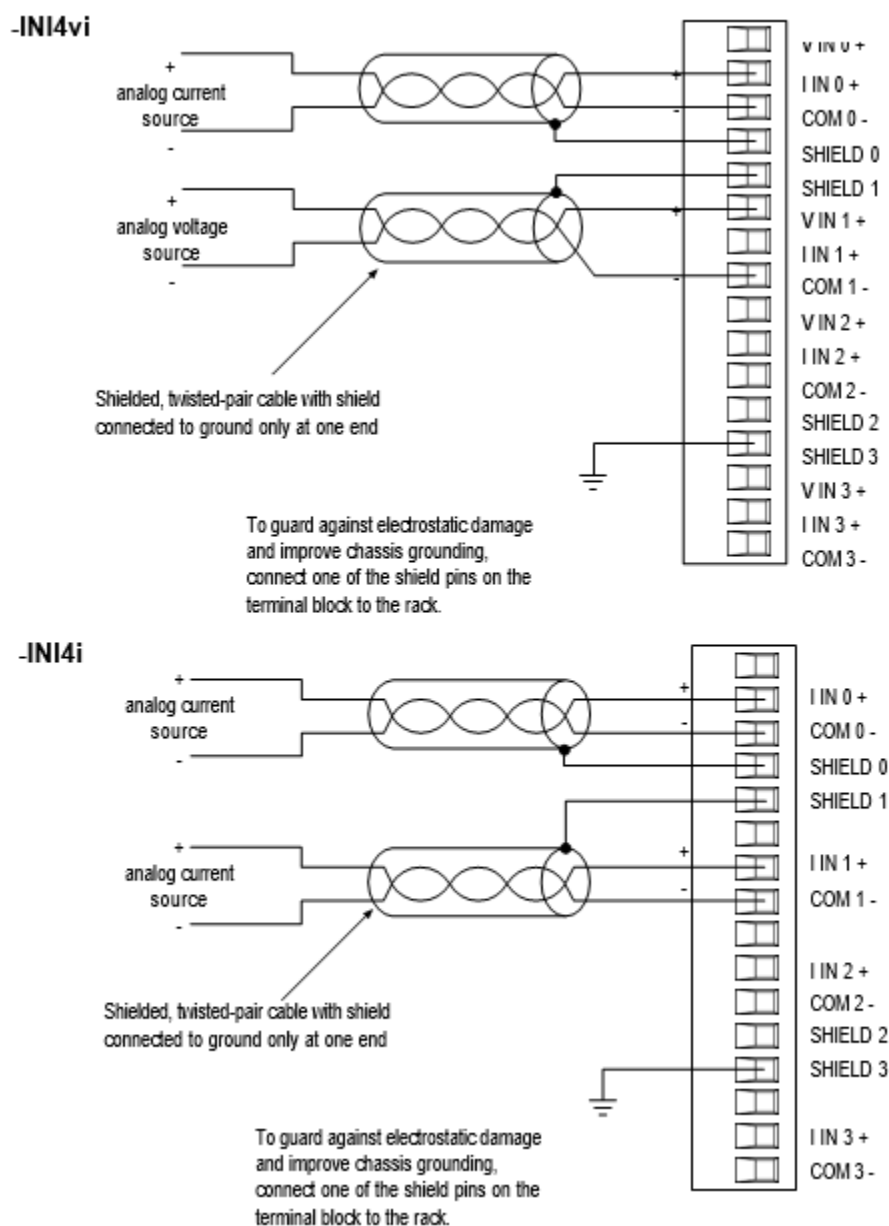


**IMPORTANT:** For CE compliance, Ferrite EMI Suppressors are needed on each channel's terminal block connection. Apply the suppressor close to the module terminal block, as shown below. A Steward Part 28B2024-0A0 or equivalent is recommended. The Steward 28B2024-0A0 has an impedance of 157  $\Omega$  at 25 MHz, 256  $\Omega$  at 100 MHz, and can accommodate one turn of wire.

**Figure 2-1. Ferrite EMI suppressor for CE compliance**



8. Repeat steps 1 through 7 for each channel on your module.  
A system may malfunction due to a change in its operating environment. After installing and wiring your module, check system operation. See the Allen-Bradley system *Installation and Operation Manual* for more information.

**Figure 2-2. Wiring Diagrams (Showing Differential Inputs)**

# Chapter 3

## Configuring the 1746sc- INI4I

This chapter covers the following subjects:

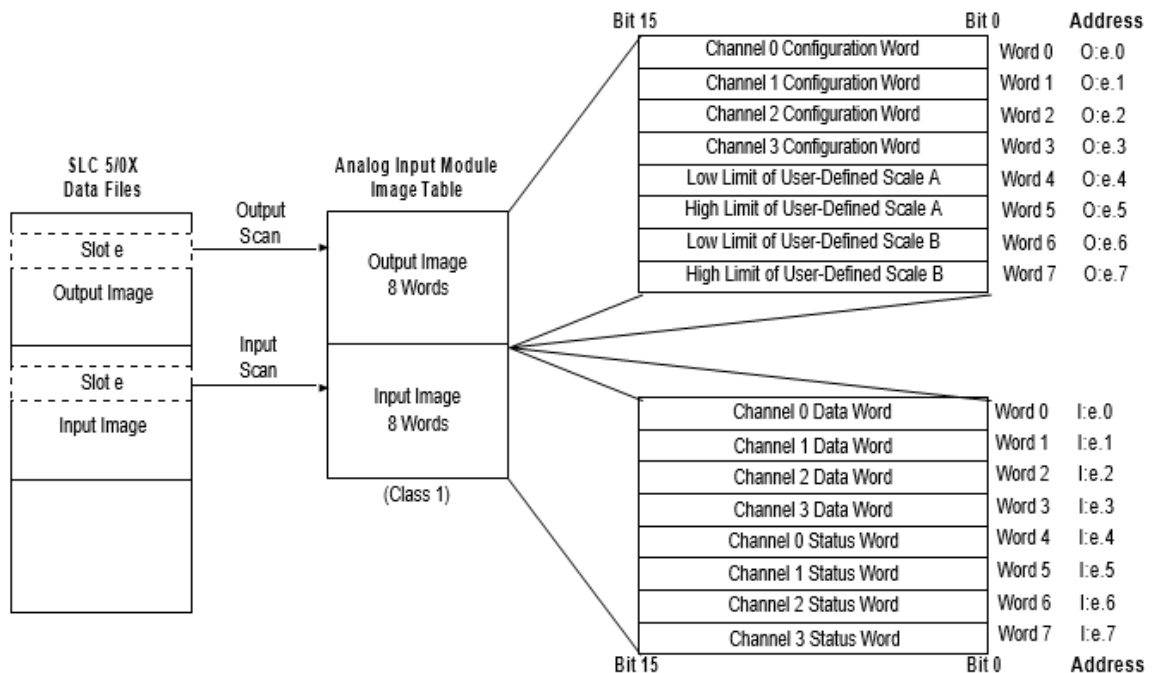
- How the processor communicates with your module.
- The difference between channel update time and step response time.
- Selecting an input filter frequency.
- Auto-calibration time.
- Channel enable and disable times.
- Your module's response to slot disabling.

### Section 3.1

#### How the Processor Communicates With Your Module

Your processor transfers data to (and receives data from) the processor through an image table residing in the data files of your processor. The processor updates this image table once during each scan of your ladder program. Figure 4 shows the output and input image table for your input module:

**Figure 3-1. Image Table for Your Isolated Analog Input Module**



**Example** – If you want to reconfigure channel 2 on your input module, and it is in slot 4 of the SLC chassis, you would modify the configuration word at address

O:4.2. Alternatively, if you want to obtain the status of channel 2, you would check the status word at address I:4.6.

The output and input image are described below.

### 3.1.1 Output Image—Configuration & User-Defined Scale Limits

The 8-word, output image (defined as the output from the SLC processor to your module) defines how each channel on your module works:

- The **configuration words** replace configuration DIP switches on your module. Each word configures a single channel.
- The **user-defined scale limits** define how your module scales analog input values to a binary input register value, if one of the user-defined scale data formats is selected.

### 3.1.2 Input Image—Data And Status Words

The 8-word, input image (defined as the input from your module to the SLC processor) holds the data received by your module and provides the status (configuration and operational state) of each channel.

#### NOTE



**Important** – A data word is valid only when the channel is enabled and there are no channel errors. A status word is valid only when the channel is enabled, and the module has processed all configuration changes.

## Section 3.2

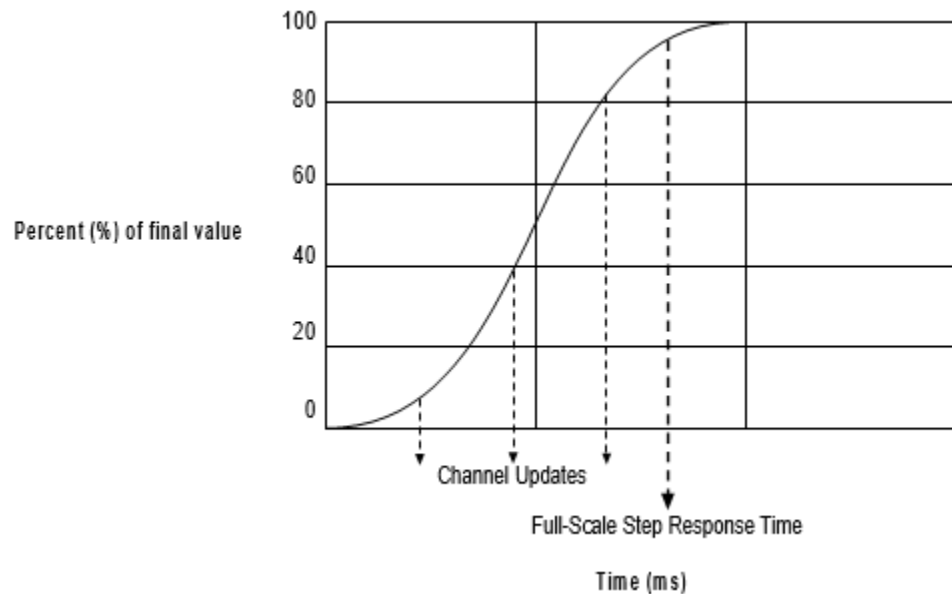
### The Difference Between Channel Update Time and Step Response Time

The speed of an analog module can be defined in 2 distinctly different ways: either by the channel update time or by the full-scale step response time.

- The **channel update time** is the time required for your module to sample and convert the input signal of an enabled channel and make the resulting data available to the processor.
- The **full-scale step response time** is the time required for a channel's data word to reach 95% of the expected, final value, given a full-scale step change in the input signal. This means that if an input signal changes faster than the full-scale step response time, the signal value provided to the processor has not reached 95%.

The following figure illustrates the difference between channel update time and full-scale step response time.



**Figure 3-2.. Channel Update Time and Full-scale Step Response Time**

The actual channel update time and full-scale step response time depend on a number of things, such as the filter frequency selected. Because of this, the number of channel updates that can occur before the channel data word reaches 95% of its expected value can vary.

In general, you can reduce the channel update time by doing any of the following:

- Disabling unused channels
- Selecting a higher frequency input filter

You can reduce the full-scale step response time by:

- selecting a higher frequency input filter

**NOTE**

Selecting a higher frequency input filter decreases the noise rejection and effective resolution, as described below.

For the fastest possible channel update time, enable only one channel and select a 250 or 500 Hz filter. Conversely, your module operates most slowly if you enable all 4 channels and select a 50 Hz filter for each.

### Section 3.3

#### Selecting An Input Filter Frequency

The 1746sc-INI4i and 1746sc-INI4vi input modules use a digital filter to reject the high-frequency noise that can couple into an analog input signal. This digital filter is programmable, letting you select one of four filter frequencies for each channel. The digital filter provides the highest noise rejection at the selected filter frequency. For example, to reject the noise associated with 60 Hz power, you may want to select the 60 Hz filter.

The filter frequency you select determines that channel's 3 dB cut-off frequency, full-scale step response time, worst-case effective resolution, and channel update

time, as shown in the following tables.

**Table 3-1. Cutoff Frequency, Step Response Time, and Effective Resolution (Based on Filter Frequency)**

<b>Worst-Case Effective Resolution<sup>1</sup></b>				
<b>Filter</b>	<b>3dB Cutoff</b>	<b>Full-Scale Step Response</b>	<b>Voltage Mode</b>	<b>Current Mode</b>
50 Hz	13.1 Hz	80 ms	12 bits	11 bits
60	15.7	66.7	12	11
250	65.5	16	11.5	10.5
500	131	8	9.5	9.5

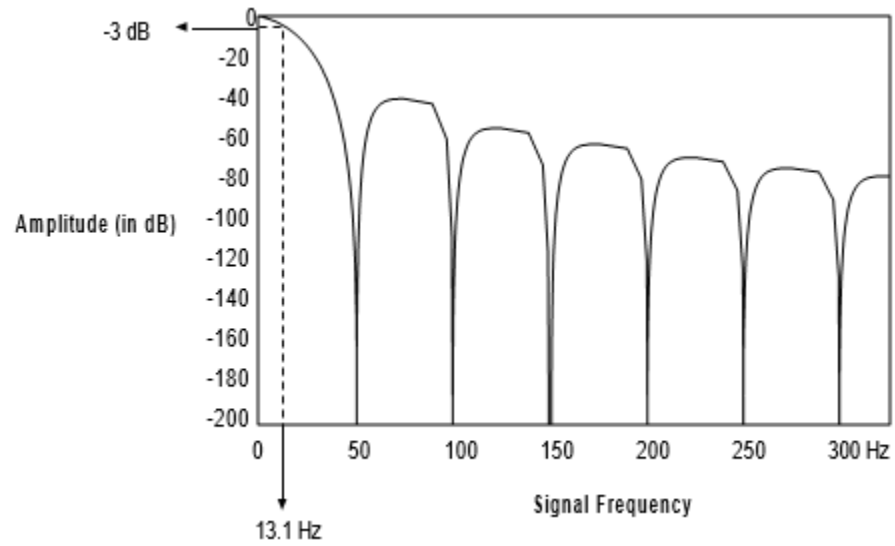
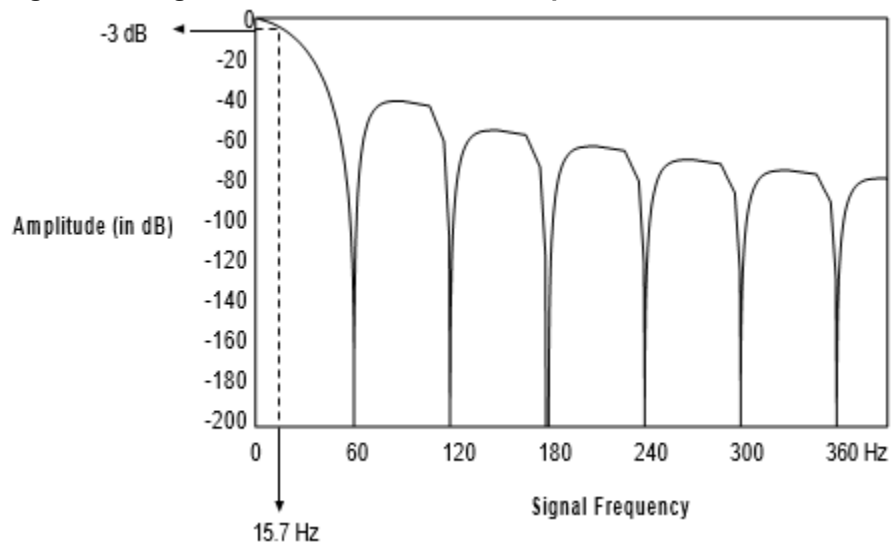
**Table 3-2 Channel Update Time (Based on Number of Channels Enabled and Filter Frequency)**

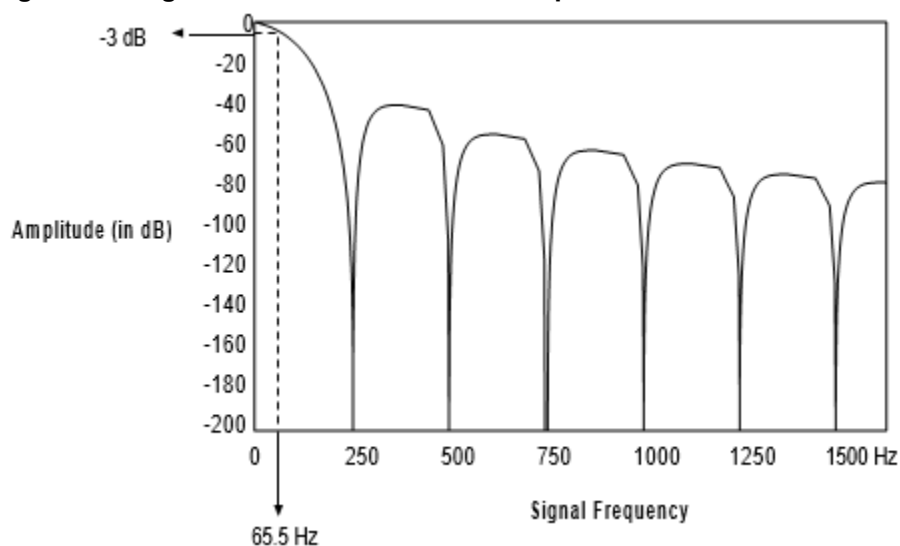
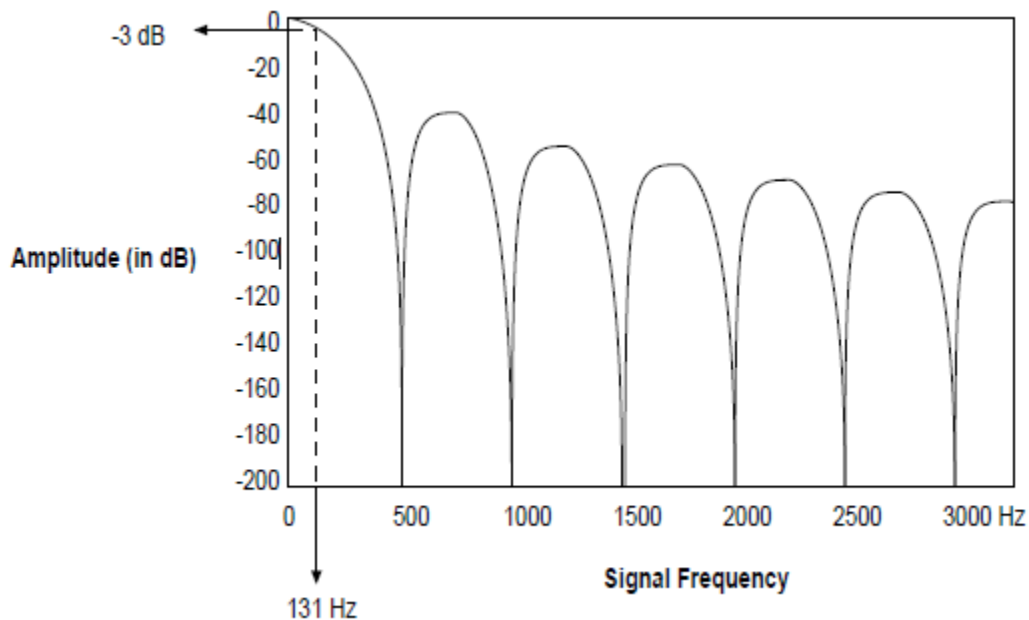
<b>Filter Frequency</b>					
	<b>Number of channels enabled</b>	<b>50 Hz</b>	<b>60 Hz</b>	<b>250 Hz</b>	<b>500 Hz</b>
Current Input	1	20.0 ms	16.6 ms	4.0 ms	4.1 ms
	2	20.5	17.7	7.3	7.3
	3	19.8	16.6	10.6	10.7
	4	21.0	17.0	13.8	13.8
	2	20.5	17.7	7.3	7.3
Voltage Input (-INI4vi only)	1	19.7 ms	16.6 ms	5.0 ms	5.0 ms
	2	19.7	17.2	9.2	9.2
	3	19.7	16.6	13.5	13.5
	4	19.7	18.0	18.0	18.0

The 3 dB cutoff frequency is the frequency at which input signals are passed with 3 dB of attenuation.

Choose a filter frequency so that the frequency of your fastest changing signal is lower than that filter's 3 dB cut-off frequency. All frequency components above the 3 dB cut-off frequency are increasingly attenuated, as shown in the following figures.

<sup>1</sup> For a 16-bit device like the 1746sc-INI4i and -INI4vi, a worst-case effective resolution of 12 bits means that the data may fluctuate by as much as 16 counts (4 bits). Typically, the effective resolution is greater than that listed here

**Figure 3-3. Signal Attenuation with 50 Hz Input Filter****Figure 3-4. Signal Attenuation with 60 Hz Input Filter**

**Figure 3-5. Signal Attenuation with 250 Hz Input Filter****Figure 3-6. Signal Attenuation with 500 Hz Input Filter**

### Section 3.4 Auto-Calibration Time

Your module requires some time to auto-calibrate a channel. During this time, your module cannot sample and convert input signals. The following table shows the time required for auto-calibration. When enabled, auto-calibration occurs every 10 seconds for each channel, independently.

**Table 3-3. Auto-calibration Time Per Channel (Based on Filter Frequency)**

	<b>Filter Frequency</b>			
	<b>50 Hz</b>	<b>60 Hz</b>	<b>250 Hz</b>	<b>500 Hz</b>
Current Input	182 ms	152 ms	39 ms	19.6 ms
Voltage Input (- ENI4vi only)	508 ms	430 ms	108 ms	56 ms

### Section 3.5 Channel Enable And Disable Times


Your module requires some time to enable or disable a channel. During this time, your module cannot sample and convert input signals. Table 11 shows the time required for enabling or disabling a channel.

**Table 3-4. Channel Enable and Disable Times.**

	<b>Duration</b>
Channel Enable	Up to 6.5 ms Enabling user-defined scaling may require an additional 0.1 ms.
Channel Disable	Up to 5.5 ms

### Section 3.6 Your Module's Response To Slot Disabling

By writing to the status file in the modular SLC processor, you can disable any chassis slot. Refer to your SLC programming manual for the slot disable/enable procedure.

<b>WARNING</b>  	<b>POSSIBLE EQUIPMENT OPERATION</b>  Always understand the implications of disabling a module before using the slot disable feature.  Failure to observe this precaution can cause unintended equipment operation.
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When you disable an input module's slot, the input data in the processor image table remains in its last state. When you re-enable the input module's slot, the processor image table is updated during the next scan.



# Chapter 4 Using Your Input Module

This chapter provides information about:

- Entering your input module's ID code.
- Configuring each input channel.
- Setting the user-defined scale limits (optional).
- Monitoring each input channel.
- Checking each input channel's configuration and status.

To use your module, you need:

- Programming equipment, such as an Allen-Bradley Hand-Held Terminal (HHT) or personal computer
- Allen-Bradley Advanced Programming Software (APS) or equivalent.
- For help with APS, see the Getting Started Guide for APS.

## Section 4.1 Entering Your Module's ID Code

Before using your module, you must configure the slot your module is in by entering your module's ID code in APS. To enter your module's ID code, select "other" from the list of modules on the APS system I/O configuration display, and enter your module's ID code at the prompt.

The module ID code for your input module is:

Catalog Number	Module ID Code
1746sc-INI4i	3522
1746sc-INI4vi	3520

No special I/O configuration (SPIO CONFIG) information is required. The module ID code automatically assigns the correct number of input and output words for the processor to access.

## Section 4.2 Configuring Each Input Channel

After installing your module, you must configure each channel by setting bit values in each configuration word. Output words 0 through 3 of the output image file (addresses O:e.0 through O:e.3), configure channels 0 through 3, respectively.

Address	15																		0
O.e.0																			
O.e.1																			
O.e.2																			
O.e.3																			

**NOTE**

Important - After reconfiguring a channel, you must toggle the channel enable bit (configuration bit 0) in order for your module to use the new configuration.



A detailed explanation appears in the following table:

**Table 4-1. Input Channel Configuration Word (O:e.0 through O:e.3)**

Use these bit settings in the channel configuration word															
To select...	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1 0
Input channel disable															0
Input channel enable															1
±10 Vdc input range (-IN14vi only)													0	0	0
1–5 Vdc input range (-IN14vi only)													0	0	1
0–5 Vdc input range (-IN14vi only)													0	1	0
0–10 Vdc input range (-IN14vi only)													0	1	1
0–20 mA input range													1	0	0
4–20 mA input range													1	0	1
Invalid													1	1	0
Invalid													1	1	1
Engineering units										0	0	0			
Scaled for PID										0	0	1			
Proportional counts										0	1	0			
1746-NI4 compatible format										0	1	1			
User-defined scale A										1	0	0			
User-defined scale B										1	0	1			
Invalid										1	1	0			
Invalid										1	1	1			
Zero on open input circuit <sup>①</sup>								0	0						
Max. on open input circuit <sup>①</sup>								0	1						
Min. on open input circuit <sup>①</sup>								1	0						
Invalid								1	1						
60 Hz input filter						0	0								
50 Hz input filter						0	1								
150 Hz input filter						1	0								
500 Hz input filter						1	1								
Auto-calibration disabled					0										
Auto-calibration enabled					1										
Unused	0	0	0	0											
Invalid	1	1	1	1											

<sup>①</sup> Applies only to the 1–5 Vdc and 4–20 mA input ranges.

#### 4.2.1 Input Channel Enable (configuration bit 0)

Use this bit to enable or disable a channel. To minimize update times, disable any unused channels.

When you set the channel enable bit to one, the module reads the configuration word. Before accepting any new data as valid, verify that the status word (described in the last subsection of this chapter) reflects the changes you made.

While the channel enable bit is set to zero, the channel data word and status word are also set to zero. When you reset the channel enable bit to one, the channel data word remains set to zero until your module updates the channel status word.

### 4.2.2 Input Range (configuration bits 1–3)

Use this bit field to configure the channel for the type of input device you want to connect to your module.

### 4.2.3 Data Format (configuration bits 4–6)

Use this bit field to select one of the following formats:

- Engineering units (mV or nA).
- Scaled for PID (works with the SLC PID instruction).
- Proportional counts (two's complement binary).
- 1746-NI4 compatible format (the format used by the 1746-NI4).
- User-defined scale A.
- User-defined scale B.

These data formats are defined in the following table.

**Table 4-2. Data format definitions**

Data Format	Selected Input Range	Actual Signal Limits		Count Limits	
		Min.	Max.	Min.	Max.
Engineering Units	±10 V	-10.25 V	+10.25 V	-10250	+10250
	0–10 V	-0.50 V	+10.25 V	-500	+10250
	0–5 V	-0.50 V	+5.50 V	-500	+5500
	1–5 V	+0.50 V	+5.50 V	+500	+5500
	0–20 mA	0.0 mA	+20.5 mA	0	+20500
	4–20 mA	+3.5 mA	+20.5 mA	+3500	+20500
Scaled for PID ③	±10 V	-10 V	+10 V	0	+16383
	0–10 V	0 V	+10 V	0	+16383
	0–5 V	0 V	+5 V	0	+16383
	1–5 V	+1 V	+5 V	0	+16383
	0–20 mA	0 mA	+20 mA	0	+16383
	4–20 mA	+4 mA	+20 mA	0	+16383
Proportional Counts	±10 V	-10.25 V	+10.25 V	-32768	+32767
	0–10 V	-0.50 V	+10.25 V	-32768	+32767
	0–5 V	-0.50 V	+5.50 V	-32768	+32767
	1–5 V	+0.50 V	+5.50 V	-32768	+32767
	0–20 mA	0.0 mA	+20.5 mA	-32768	+32767
	4–20 mA	+3.5 mA	+20.5 mA	-32768	+32767
1746-NI4-compatible①	±10 V	-10 V	+10 V	-32768	+32767
	0–10 V	0 V	+10 V	0	+32767
	0–5 V	0 V	+5 V	0	+16384
	1–5 V	+1 V	+5 V	+3277	+16384

Data Format	Selected Input Range	Actual Signal Limits		Count Limits	
		Min.	Max.	Min.	Max.
	0–20 mA	0 mA	+20 mA	0	+16384
	4–20 mA	+4 mA	+20 mA	+3277	+16384
User-defined scale A (and B)	±10 V	-10.25 V	+10.25 V	See note ②.	
	0–10 V	-0.50 V	+10.25 V		
	0–5 V	-0.50 V	+5.50 V		
	1–5 V	+0.50 V	+5.50 V		
	0–20 mA	0.0 mA	+20.5 mA		
	4–20 mA	+3.5 mA	+20.5 mA		

①Provides direct compatibility with the 1746-NI4 module.

②For user-defined scale A (or B), the data in output words 4 and 5 (or 6 and 7) determine the count limits. See the next subsection, Setting The User-Defined Scale Limits, for information on the User-Defined Scale data format.

③Modules marked Series B Revision 1.00 or earlier had different signal limits for the Scaled for PID data format (see the Owner's Guide that came with your module).

#### 4.2.4 Open Input Circuit Response (configuration bits 7 and 8)

For 1–5 Vdc and 4–20 mA inputs only, use this bit field to define the state of the channel data word when your module detects an open circuit for that channel:

- If you select zero on open input circuit, your module sets the channel data word to zero during an open circuit condition.
- If you select max. on open input circuit, your module sets the channel data word to its full-scale value during an open circuit.
- If you select min. on open input circuit, your module sets the channel data word to its low-scale value during an open circuit.

The full-scale and low-scale values (max. and min. count limits) are determined by the channel's data format and selected input range. See Table 4-2.

#### NOTE



**IMPORTANT:** If a circuit opens, your module provides input signal values until it detects and flags the open circuit.

#### 4.2.5 Input Filter Frequency (configuration bits 9 and 10)

Use this bit field to select one of four filters for a channel. The filter selected affects the channel update time and noise rejection characteristics:

- A lower filter frequency increases the noise rejection and effective resolution, but it also increases the channel update time.

- A higher filter frequency decreases the update time, but it also decreases the noise rejection and effective resolution.

Refer to Chapter 3, Items To Consider Before Using Your Module, for more information on selecting a filter frequency.

### 4.2.6 Auto-Calibration Enable (configuration bit 11)

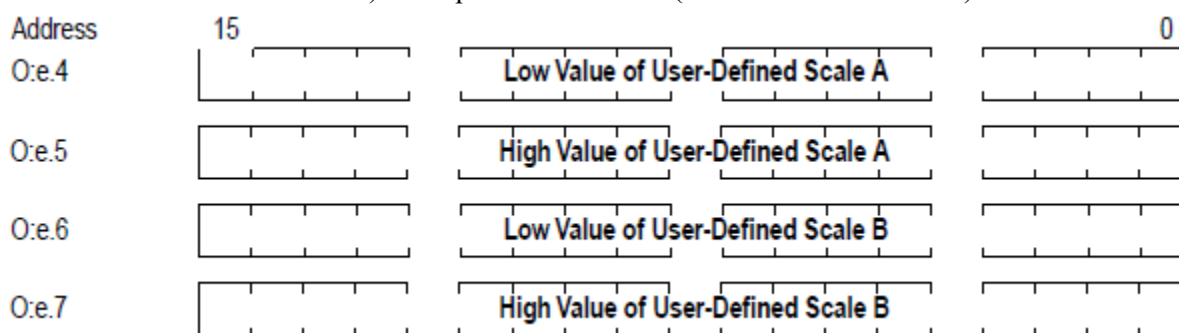
Use this bit to enable or disable auto-calibration. When enabled, auto-calibration occurs every 10 seconds. Auto-calibration also occurs whenever you configure a channel (regardless of the setting of this bit).

### 4.2.7 Unused Bits (configuration bits 12–15)

These bits are not defined. To prevent a configuration error, ensure that bits 12 through 15 are set to zero.

## Section 4.3 Setting The User- Defined Scale Limits (optional)

For special applications (such as when using a sensor with a non-standard operating range), the 1746sc-INI4i and 1746sc-INI4vi input modules let you define up to two custom data formats. These “user-defined scales” are very similar to the “proportional counts” data format provided by your module and many Allen-Bradley modules—except that instead of scaling the input signal to a previously defined range (-32,768 to +32,767), your module can scale the input signal to a range defined by the values in output words 4 and 5 (for user-defined scale A) or output words 6 and 7 (for user-defined scale B).



#### NOTE



After setting user-defined scale limits, you must toggle the channel enable bit (configuration bit 0) in order for your module to use the new limits.

Output word 4 (or 6) defines the low limit of the user-defined scale (down to -32768), while output word 5 (or 7) defines the high limit of the user-defined scale (up to +32767). The high limit value must be greater than the low limit value for proper operation.

You select the data format for each channel using that channel's configuration word, explained earlier in this chapter in Configuring Each Input Channel.

**Important -**

The following equations show you how to convert user-defined scale units (or any type of units) to engineering units, and vice versa:

$$S = \{(U - U_{\text{low}}) \times (\Delta S) \div (\Delta U)\} + S_{\text{low}}$$

$$D = \{(S - S_{\text{low}}) \square (\Delta U) \div (\Delta S)\} + U_{\text{low}}$$

Where S = signal value (in engineering units, such as psi).

$S_{\text{low}}$  = low limit of signal value.

$S_{\text{high}}$  = high limit of signal value.

$$\Delta S = S_{\text{high}} - S_{\text{low}}$$

D = data value (user-defined scale).

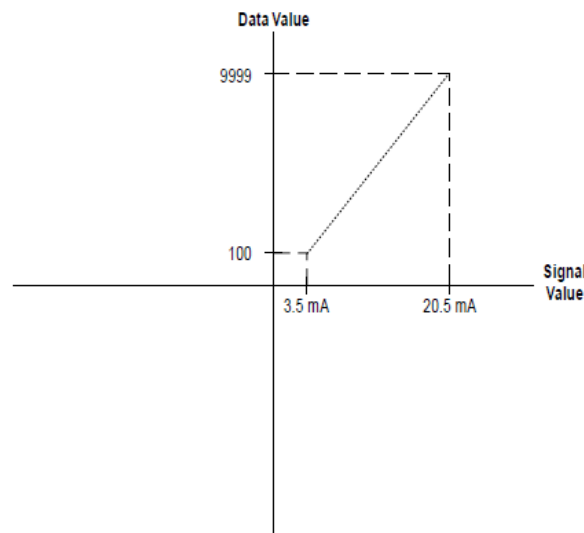
$U_{\text{low}}$  = low limit of user-defined scale.

$U_{\text{high}}$  = high limit of user-defined scale.

$$\Delta U = U_{\text{high}} - U_{\text{low}}$$

Example. You have a sensor with a 4–20 mA range, and you want to scale your data from 100 to 9999 counts. For a 4–20 mA input with user-defined scaling, your module sets the signal limits to 3.5 mA and 20.5 mA (see Table 4-2). After entering 100 and 9999 into output words 4 and 5 (or 6 and 7), respectively, the relationship between input signal and data value (counts) would be as follows:

**Figure 4-1. Graph of signal value vs data value**



In the preceding example:

$$S_{\text{low}} = 3.5$$

$$S_{\text{high}} = 20.5$$

$$\Delta S = 17$$

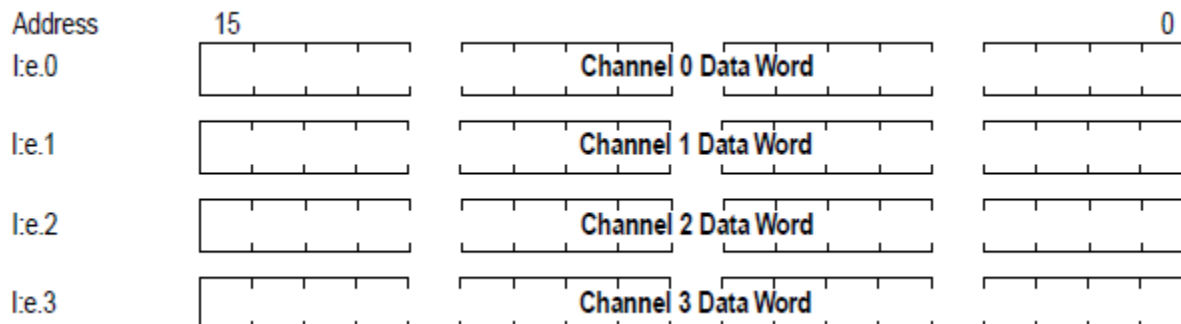
$$U_{\text{low}} = 100$$

$$U_{\text{high}} = 9999$$

$$\Delta U = 9899$$

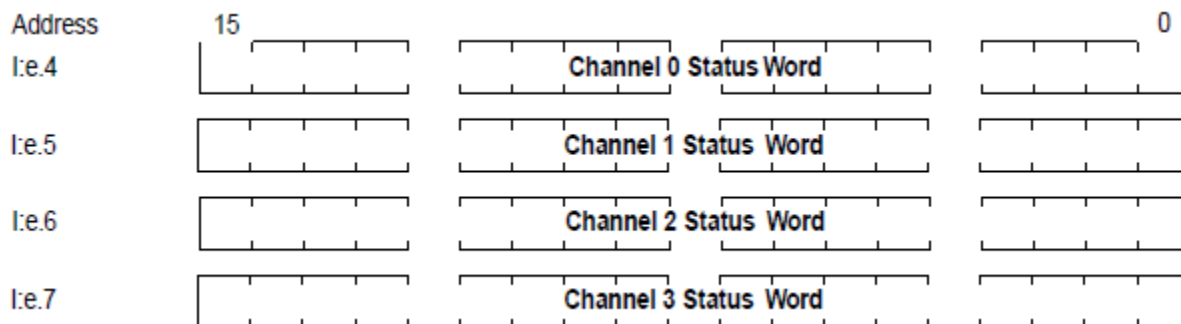
### Section 4.4 Monitoring Each Input Channel

The input signal data resides in words 0 through 3 of the input image file (addresses I:e.0 through I:e.3). The values present depend on the input types and data formats selected. When an input channel is disabled, its data word is set to zero.



### Section 4.5 Checking Each Input Channel's Configuration and Status

Words 4 through 7 of the input image file (addresses I:e.4 through I:e.7) reflect the configuration and status of each channel. Use the data provided in these status words to determine if the configuration data for any channel is valid.



Whenever a channel is disabled, its status word is set to zero. This condition tells you that input data in the data word for that channel is not valid and should be ignored.

A detailed explanation appears in Table 4-3.

**Table 4-3. Input channel status word (I:e.4 through I:e.7)**

These bit settings in the status word																Indicate this
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
															0	Input channel disabled
															1	Input channel enabled
												0	0	0		±10 Vdc input range
												0	0	1		1–5 Vdc input range
												0	1	0		0–5 Vdc input range
												0	1	1		0–10 Vdc input range
												1	0	0		0–20 mA input range
												1	0	1		4–20 mA input range
									0	0	0					Engineering units
									0	0	1					Scaled for PID
									0	1	0					Proportional counts
									0	1	1					1746-NI4 format
									1	0	0					User-defined scale A
									1	0	1					User-defined scale B
							0	0								Zero on open input circuit
							0	1								Max. on open input circuit
							1	0								Min. on open input circuit
					0	0										60 Hz input filter
					0	1										60 Hz input filter
					1	0										150 Hz input filter
					1	1										500 Hz input filter
				0												Auto-calibration disabled
				1												Auto-calibration enabled
			0													No error
			1													Over-range error
		0														No error
		1														Under-range error
	0															No error
	1															Non-fatal channel error
0																No error
1																Fatal channel error

The first 12 status bits reflect the settings in the channel configuration word. The remaining status bits flag the various errors that the module can detect.

#### **4.5.1 Over-Range Error (status bit 12)**

This bit is set to one whenever your module detects an over-range condition for a configured channel. An over-range condition exists when the input value is very near or above the upper limit for that channel's data format (see Table 14).

#### **4.5.2 Under-Range Error (status bit 13)**

This bit is set to one whenever your module detects an under-range condition for a configured channel. An under-range condition exists when the input value is very near or below the lower limit for that channel's data format (see Table 14).

#### **4.5.3 Non-Fatal Channel Error (status bit 14)**

This bit is set to one whenever your module detects a recoverable channel error, such as an invalid configuration word for that channel. This bit is reset to zero when the error is resolved.

#### **4.5.4 Fatal Channel Error (status bit 15)**

This bit is set to one whenever your module detects a “non-recoverable” channel error, such as a software power-up failure due to corrupt hardware or malfunctioning software. You may be able to recover from this type of error by resetting the SLC 500 processor or cycling power to your module.



# Chapter 5

## Programming Examples

Read this chapter to familiarize yourself with how to use the advanced features of your module for:

- PID control
- User-defined scaling

For information on how to use the Allen-Bradley Advanced Programming Software (APS) to create ladder programs, see the Getting Started Guide For APS.

### Section 5.1 PID Control

Your input module was designed to work directly with the SLC 5/02, 5/03, and 5/04 PID instruction—without an intermediate scaling operation. Use the input channel data as the process variable in the PID instruction.

**Example:** Suppose your input module is in slot 3, and you have a level sensor with a 4–20 mA range connected to channel 0. The following figures show you how to use it for PID control:

**Figure 5-1. PID Control Example**

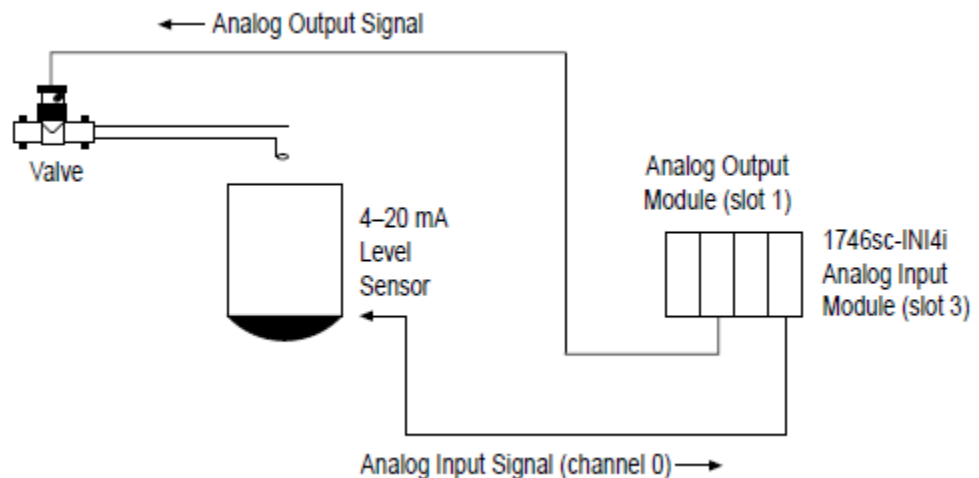


Figure 5-2. Programming for PID Control Example

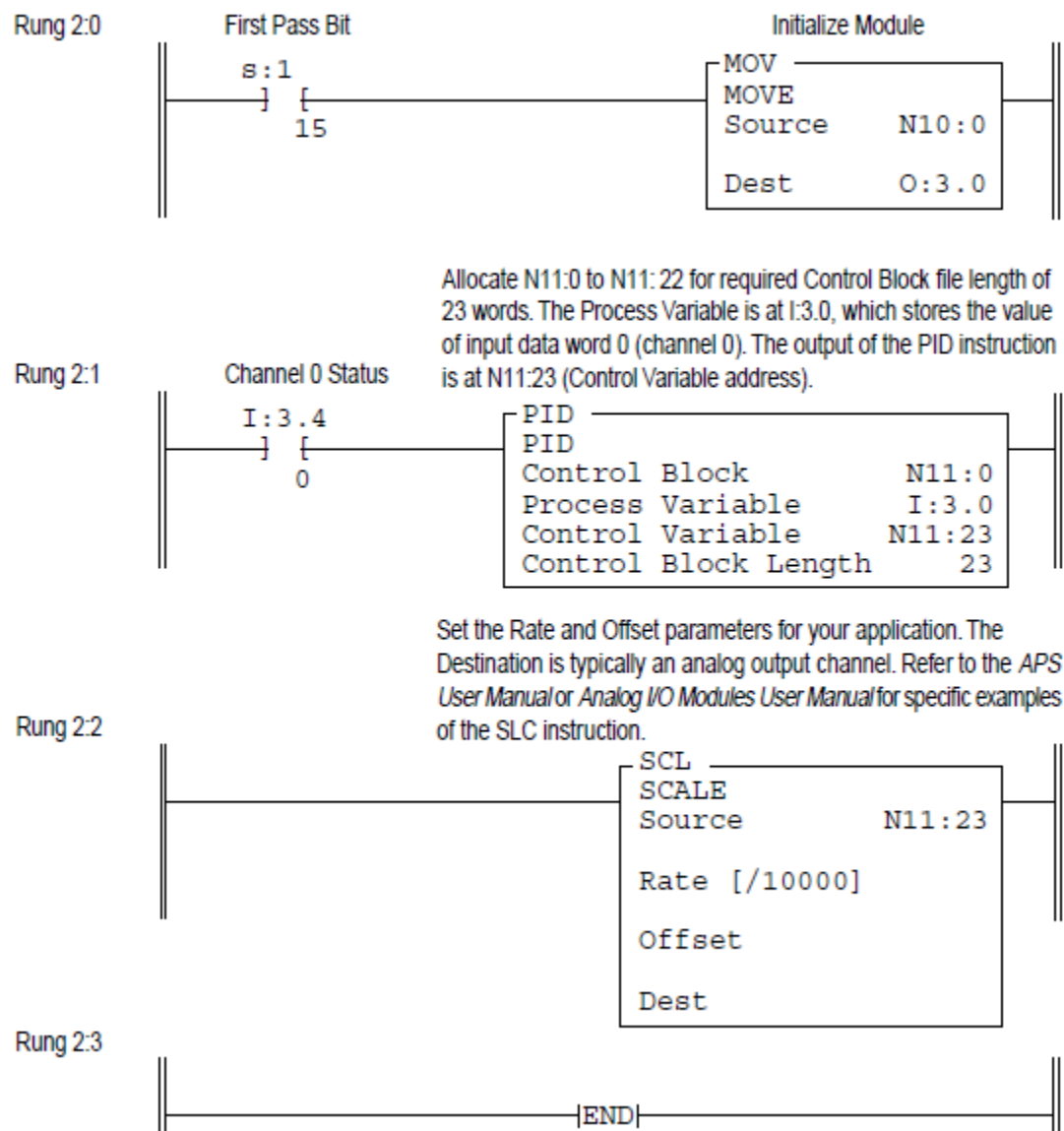


Figure 5-2. Data Table for PID Control

address	15	data	0	address	15	data	0
N10:0		0000 0000 0001 1011					

NOTE



**IMPORTANT:** When using your module’s *Scaled For PID* data format with the SLC PID function, ensure that the *Maximum Scaled  $S_{max}$*  (word 7) and *Minimum Scaled  $S_{min}$*  (word 8) PID instruction parameters match your module’s maximum and minimum scaled range in engineering units for that channel. This allows you to accurately enter the setpoint in engineering units.

Section 5.2

User-Defined Scaling

Your input module was designed to work directly with applications requiring special data scaling—without an intermediate scaling operation.

**Example.** Suppose your input module is in slot 3, and you have a pressure sensor with a 4–20 mA range connected to channel 0. The following figures show you how to use the User-Defined Scaling data format to send specially scaled data (100 to 9999 in this example) to a simple display-only operator interface:

Figure 5-3. User-Defined Scaling Example

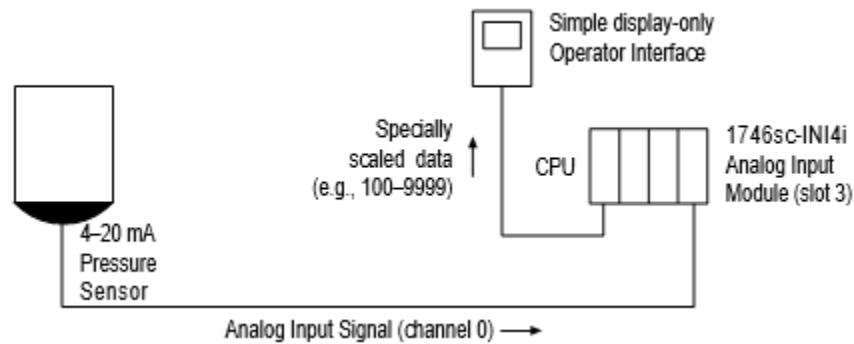


Figure 5-4. Programming for User-Defined Scaling Example

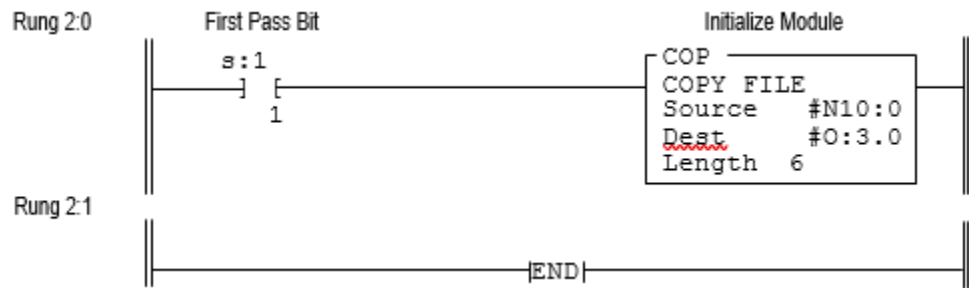


Figure 5-5. Data Table for User-Defined Scaling Example

address	15	data	0	address	15	data	0
N10:0	0000	0000	0100 1011	N10:3	0000	0000	0000 0000
N10:1	0000	0000	0000 0000	N10:4	0000	0000	0110 0100 (100 gallons)
N10:2	0000	0000	0000 0000	N10:5	0010	0111	0000 1111 (9999 gallons)

In this example, the operator interface is programmed to read I:3.0(channel 0 data word).



# Chapter 6

## Testing Your Module

Read this chapter to prevent potential problems. This chapter covers:


- Inspecting your module.
- Disconnecting prime movers.
- Powering up.
- Interpreting the LED indicators.
- Interpreting I/O error codes.
- Troubleshooting.

Before testing your module, test your SLC 500 system using the procedures described in your Allen-Bradley system Installation & Operation Manual.

### Section 6.1 Inspecting Your Module

You can prevent many potential problems by simply inspecting your analog module:

1. Ensure that all wire connections are correct and secure, and that no wires are missing or broken. Refer to Chapter 2, Installing And Wiring Your Module, for more information.

<b>WARNING</b> 	<b>FIELD WIRING ERRORS</b> Before enabling a channel (through your ladder program), ensure that you have not connected a voltage source to a channel configured for a current input (and vice versa). Failure to observe this precaution can cause improper module operation or equipment damage.
---	---

2. Ensure that the shield for the cable used to wire your module is properly grounded.
4. Ensure that the removable terminal block on your module is secure.

### Section 6.2 Disconnecting Prime Movers


Before testing your module, ensure that machine motion will not occur:

- Disconnect motor wires at the motor starter or the motor itself. This lets you test the operation of the starter coil, verifying that the output circuit is wired correctly and functioning.
- Disconnect solenoids by disengaging the solenoid valves, leaving the coils connected.

If you cannot disconnect a device in the preferred way, open the output circuit as

close as possible to the motion-causing device.

**Example** – If you have a relay coil that in turn energizes a motor starter, and you cannot disconnect the motor wires, open the circuit at a point between the motor starter and the relay contact.

<p><b>WARNING</b></p> 	<p><b>UNEXPECTED EQUIPMENT MOTION</b></p> <p>During all testing, always disconnect all devices that, when energized, might cause machine motion.</p> <p>Failure to observe this precaution can cause equipment damage or personal injury.</p>
---	---

### Section 6.3 Powering Up

When you apply power to the system, your module's status LED should illuminate, indicating that your module is receiving power and has completed its onboard self-test. If the LED does not illuminate after several seconds, your module is not functional. Discontinue testing until you can get the LED to illuminate.

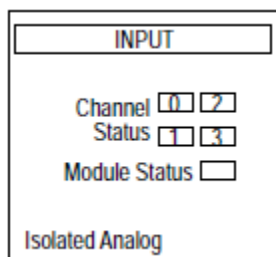
The most probable reasons for the LED not illuminating are:

- The SLC 500 system is not receiving power from its power supply.
- The rest of the SLC 500 system is not receiving power.
- The rack slot where your module is located is defective.
- Your module is defective.

### Section 6.4 Interpreting the LED Indicators

Your output module has 5 LEDs: 4 channel status LEDs (numbered 0–3 for channels 0–3, respectively) and 1 module status LED.

**Figure 6-1. LED Block**



**Table 4-1 LED Definition**

Use the following table to interpret LED indications:

If the module status LED is...	And the channel status LED is...	Then...
On	On	The channel is enabled.
	Blinking	One of the following channel errors occurred: <ul style="list-style-type: none"> <li>• Circuit open or no wiring is connected.</li> <li>• Signal is near or beyond end of range</li> <li>• Channel configured incorrectly</li> </ul> Refer to Troubleshooting.
	Off	Either your module is powering up or the channel is disabled.
Off	Off	Either the power is off, the module is powering up, or a module fault occurred. Cycle power. If the condition persists, call your local distributor or Spectrum Controls for assistance.

## Section 6.5

### Interpreting I/O Error Codes

I/O error codes appear in word S:6 of the SLC processor status file. The first two digits of the error code identify the slot (in hexadecimal) with the error. The last two digits identify the I/O error code (in hexadecimal).

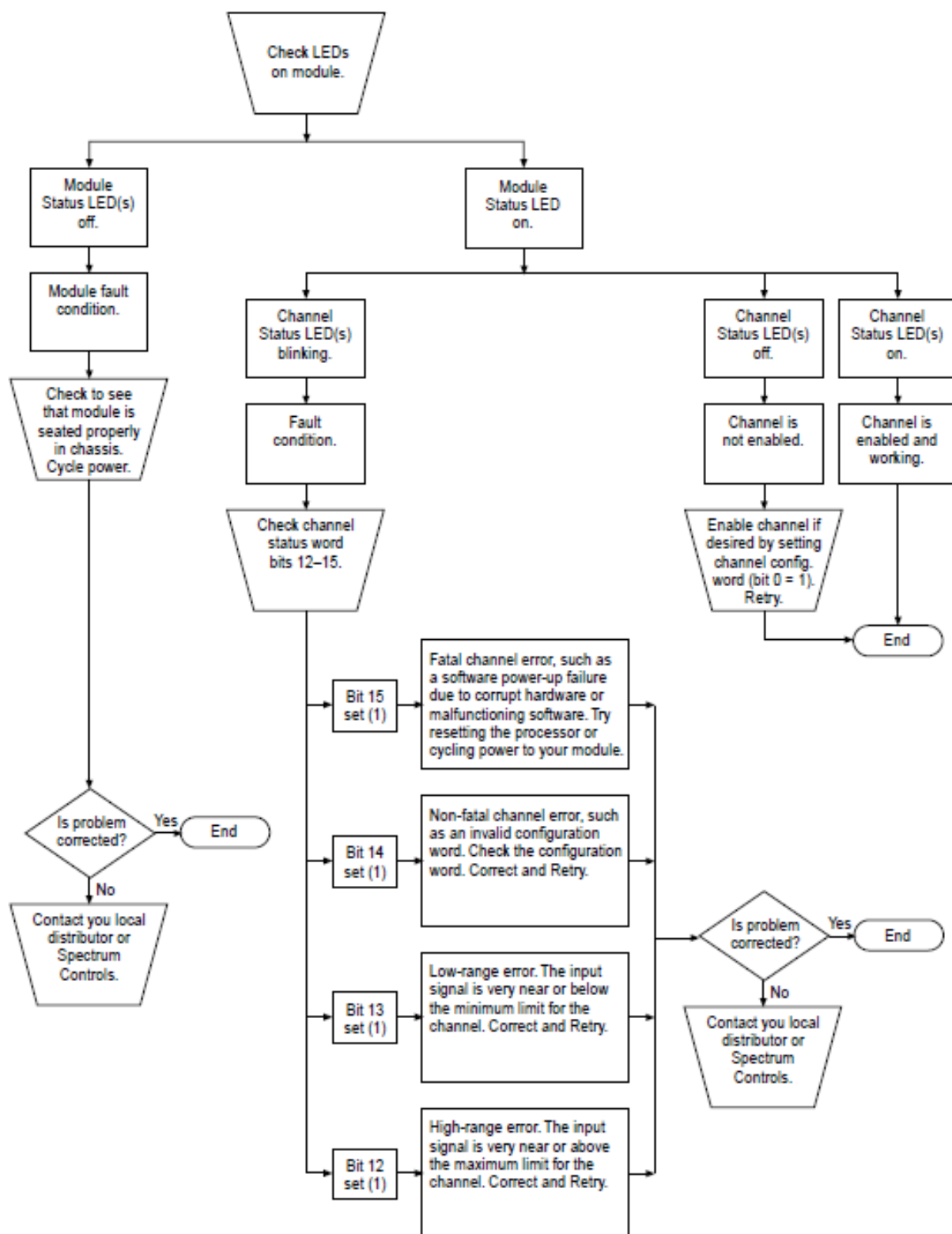
The error codes that apply to your module include (in hexadecimal):

- 50–5E
- 71 (watchdog error)
- 90–94

For a description of the error codes, refer to the *Allen-Bradley Advanced Programming Software (APS) Reference Manual*, Allen-Bradley publication 1746-6.11.

## Section 6.6 Troubleshooting

Figure 6-2. Problem Resolution Flowchart





# Chapter 7

## Maintaining your Module and Ensuring Safety


Read this chapter to familiarize yourself with:

- Preventive maintenance
- Safety considerations

The National Fire Protection Association (NFPA) recommends maintenance procedures for electrical equipment. Refer to article 70B of the NFPA for general safety-related work practices.

### Section 7.1 Preventive Maintenance

The printed circuit boards of your module must be protected from dirt, oil, moisture, and other airborne contaminants. To protect these boards, install the SLC 500 system in an enclosure suitable for its operating environment. Keep the interior of the enclosure clean, and whenever possible, keep the enclosure door closed. Also, regularly inspect the terminal connections for tightness. Loose connections may cause a malfunctioning of the SLC system or damage to the components.

<b>WARNING</b> 	<b>POSSIBILITY OF LOOSE CONNECTIONS.</b> Before inspecting connections, always ensure that incoming power is off. Failure to observe this precaution may cause personal injury and damage to equipment.
---	--


### Section 7.2 Safety Considerations

Safety is always the most important consideration. Actively think about the safety of yourself and others, as well as the condition of your equipment. The following are some things to consider:

**Indicator Lights** – When the module status LED on your module is illuminated, your module is receiving power.

**Activating Devices When Troubleshooting** – Never reach into a machine to activate a device; the machine may move unexpectedly. Use a wooden stick.

**Standing Clear Of Machinery** – When troubleshooting a problem with any SLC 500 system, have all personnel remain clear of machinery. The problem may be intermittent, and the machine may move unexpectedly. Have someone ready to operate an emergency stop switch.

<p><b>WARNING</b></p> 	<p><b>POSSIBLE EQUIPMENT OPERATION</b></p> <p>Never reach into a machine to actuate a switch. Also, remove all electrical power at the main power disconnect switches before checking electrical connections or inputs/ outputs causing machine motion. Failure to observe these precautions can cause personal injury or equipment damage.</p>
---	---

**Safety Circuits** – Circuits installed on machinery for safety reasons (like over-travel limit switches, stop push-buttons, and interlocks) should always be hard-wired to the master control relay. These circuits should also be wired in series so that when any one circuit opens, the master control relay is de-energized, thereby removing power. Never modify these circuits to defeat their function. Serious injury or equipment damage may result.

Refer to your system's Installation & Operation Manual for more information

### Section 7.3 Getting Technical Assistance

Note that your module contains electrostatic components that are susceptible to damage from electrostatic discharge (ESD). An electrostatic charge can accumulate on the surface of ordinary wrapping or cushioning material. **In the unlikely event that the module should need to be returned to Spectrum Controls Inc., please ensure that the unit is enclosed in approved ESD packaging (such as static-shielding/metallized bag or black conductive container).** Spectrum Controls, Inc. reserves the right to void the warranty on any unit that is improperly packaged for shipment.

RMA (Return Merchandise Authorization) form required for all product returns. For further information or assistance, please contact your local distributor, or call the Spectrum Controls Technical Support at:

For Rockwell Automation Compatible I/O Products:

- USA 1-440-646-6900
- United Kingdom 01-908-635-230
- Australia 1-800-809-929
- Mexico 001-888-365-8677
- Brazil 55-11-3618-8800
- Europe +49-211- 41553-630

### Section 7.4 Declaration of Conformity

Available upon request

# Chapter 8

## Verifying Calibration

Read this chapter to verify your module's calibration. To verify your module's calibration, you need:

- A precision input source whose accuracy is better than or equal to  $\pm 1$  mV on a 10 V scale and  $\pm 0.5$   $\mu$ A on a 20 mA scale (such as an Electronic Development Corporation Programmable IEEE 488 GP-IB DC Calibrator, Model 521).
- Programming equipment, such as an Allen-Bradley Hand-Held Terminal (HHT) or personal computer.
- Allen-Bradley Advanced Programming Software (APS) or equivalent.

Your module automatically calibrates a channel after it is successfully configured. It also calibrates a channel every 10 seconds if auto-calibration is enabled (see Chapter 4). For these reasons, your module should never need calibration. You may, however, want to verify the calibration periodically using the procedures provided in this chapter.

### Section 8.1 Recommended Schedule

Although not required, you should verify your module's calibration once a year or after any system failure that may have been due to input inaccuracy.

### Section 8.2 Verifying Current Inputs

To verify:

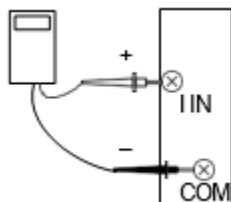
1. Configure your module for 0–20 mA input on all 4 channels using the following configuration word values:

Address	Binary Value	Decimal Equivalent
O:e.0	0000 0000 0010 1001	41
O:e.1	0000 0000 0010 1001	41
O:e.2	0000 0000 0010 1001	41
O:e.3	0000 0000 0010 1001	41

e = slot number

2. Let the operating temperature stabilize for 2 minutes.

- Use the precision input source to provide a 15 mA input across a channel's input terminals.



- Verify that the input data is between 15110 and 15260 counts.
- Repeat steps 3 and 4 for each remaining channel.

### Section 8.3 Verifying Voltage Inputs (INI4vi only)

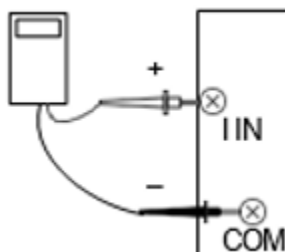
To verify:

- Configure your module for  $\pm 10$  V input on all 4 channels using the following configuration word values:

Address	Binary Value	Decimal Equivalent
O:e.0	0000 0000 0010 0001	33
O:e.1	0000 0000 0010 0001	33
O:e.2	0000 0000 0010 0001	33
O:e.3	0000 0000 0010 0001	33

e = slot number

- Let the operating temperature stabilize for 2 minutes.
- Use the precision input source to provide a 10 VDC input across a channel's input terminals.



- Verify that the input data is between 31805 and 32131 counts.
- Repeat steps 3 and 4 for each remaining channel.

### Section 8.4 Service

If the input data is out of range, call the Spectrum Controls Technical Services to make arrangements for returning your module for factory calibration.

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