

User's Manual Pub. 0300244-01 Rev. A

# 1769 6 Channel Isolated Thermocouple/mV Input Module

Catalog Number: 1769sc-IT6I



## 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

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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
- How to use this manual
- Related publications
- Conventions used in this manual
- Rockwell Automation support

## Who Should Use This Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Allen-Bradley I/O and/or compatible controllers, such as the MicroLogix 1500 and the CompactLogix system.

## How to Use This Manual

As much as possible, we organized this manual to explain, in a task-by-task manner, how to install, configure, program, operate and troubleshoot a control system using the 1769sc-IT6L.

## Related Documentation

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

<b>Document Title</b>	<b>Document Number</b>
MicroLogix™ 1500 User Manual	1764-UM001A-US-P
1769 Compact Discrete Input/Output Modules Product Data	1769-2.1
MicroLogix™ 1500 System Overview	1764-SO001B-EN-P
Compact™ I/O System Overview	1769-SO001A-EN-P
CompactLogix User Manual	1769-UM007B-EN-P
Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1

## Conventions Used in This Manual

The following conventions are used throughout this manual:

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



Attention Are used to identify critical information to the reader

# Chapter 1

## Overview

This chapter describes the 1769sc-IT6I Isolated Thermocouple/mV Input Module and explains how the module reads thermocouple or millivolt analog input data. Included is information about:

- The module's hardware and diagnostic features
- An overview of system and module operation
- Compatibility

### Section 1.1 General Description

The isolated thermocouple/mV input module supports thermocouple and millivolt signal measurement. It digitally converts and stores thermocouple and/or millivolt analog data from any combination of up to six thermocouple or millivolt analog sensors. Each input channel is individually configurable via software for a specific input device, data format and filter frequency, and provides open-circuit, over-range and under-range detection and indication.

#### 1.1.1 Thermocouple/mV Inputs and Ranges

The table below defines thermocouple types and their associated full-scale temperature ranges. The second table lists the millivolt analog input signal ranges that each channel will support. To determine the practical temperature range your thermocouple supports, see the specifications in Appendix A.

Thermocouple Type	Temperature Range (°C)	Temperature Range (°F)
J	-210 to 1200	-346 to 2192
K	-270 to 1370	-454 to 2498
T	-270 to 400	-454 to 752
E	-270 to 1000	-454 to 1832
R	0 to 1768	32 to 3214
S	0 to 1768	32 to 3214
B	300 to 1820	572 to 3308
N	-210 to 1300	-346 to 2372
C	0 to 2315	32 to 4199
L	-200 to 900	-328 to 1652

Millivolt Input Type	Range
± 50mV	-50 to 50 mV
± 100mV	-100 to 100 mV

### 1.1.2 Data Formats

The data can be configured on board each module as:

- Engineering units x 1
- Engineering units x 10
- Scaled-for-PID
- Percent of full-scale
- Raw/proportional data

### 1.1.3 Filter Frequencies

The module uses a digital filter that provides high frequency noise rejection for the input signals. The filter is programmable, allowing you to select from six different filter frequencies for each channel:

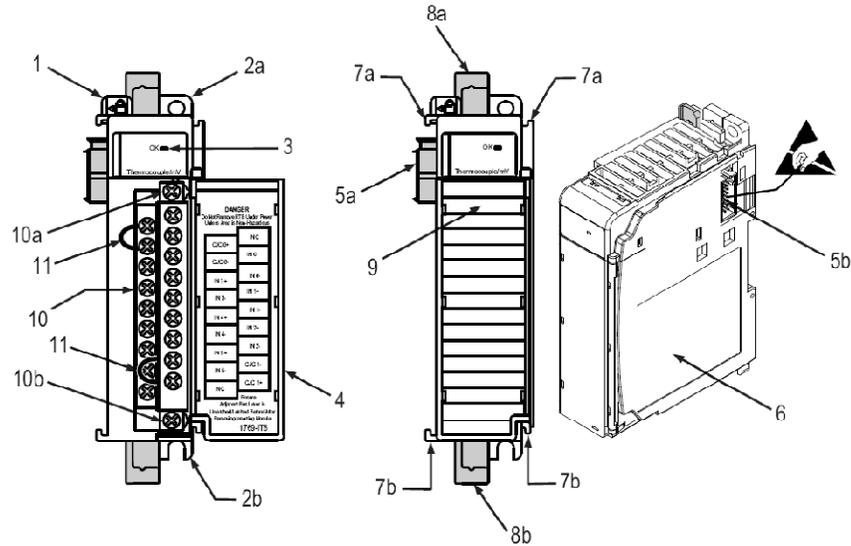
- 4.17 Hz
- 10 Hz
- 16.7 Hz
- 19.6 Hz
- 62 Hz
- 470 Hz

### 1.1.4 Hardware Features

The module contains a removable terminal block. Channels are wired as differential inputs. Two cold junction compensation (CJC) sensors are attached to the terminal block to enable accurate readings from each channel. These sensors compensate for offset voltages introduced into the input signal as a result of the cold-junction where the thermocouple wires are connected to the module.

Module configuration is normally done via the controller's programming software. In addition, some controllers support configuration via the user program. In either case, the module configuration is stored in the memory of the controller. Refer to your controller's user manual for more information.

The illustration below shows the module's hardware features.



Item	Description
1	Bus lever
2a	Upper panel mounting tab
2b	Lower panel mounting tab
3	Module status LED
4	Module door with terminal identification label
5a	Movable bus connector (bus interface) with female pins
5b	Stationary bus connector (bus interface) with male pins
6	Nameplate label
7a	Upper tongue-and-groove slots
7b	Lower tongue-and-groove slots
8a	Upper DIN rail latch
8b	Lower DIN rail latch
9	Write-on label for user identification tags
10	Removable terminal block (RTB) with finger-safe cover
10a	RTB upper retaining screw
10b	RTB lower retaining screw
11	CJC sensors

### 1.1.5 General Diagnostic Features

The module contains a diagnostic LED that helps you identify the source of problems that may occur during power-up or during normal channel operation. The LED indicates both status and power. Power-up and channel diagnostics are explained in Chapter 5, Diagnostics and Troubleshooting.

## Section 1.2 System Overview

The modules communicate to the controller through the bus interface. The modules also receive 5 and 24V dc power through the bus interface.

### 1.2.1 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 power-up diagnostics, the module status LED is turned on.

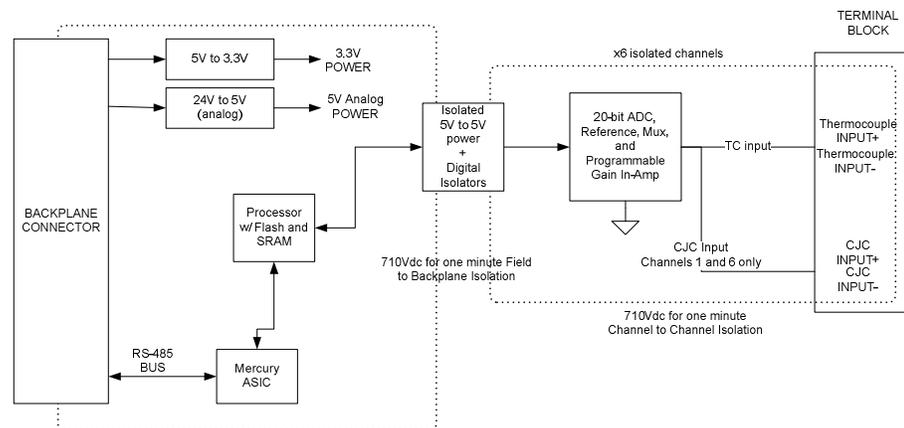
After power-up checks are complete, the module waits for valid channel configuration data. If an invalid configuration is detected, the module generates a configuration error. Once a channel is properly configured and enabled, it continuously converts the thermocouple or millivolt input to a value within the range selected for that channel.

Each time a channel is read by the input module, that data value is tested by the module for an over-range, under-range, open-circuit, or “input data not valid” condition. If such a condition is detected, a unique bit is set in the channel status word. The channel status word is described in Input Data File on page 4-10.

Using the module image table, the controller reads the two’s complement binary converted thermocouple or millivolt data from the module. This typically occurs at the end of the program scan or when commanded by the control program. If the controller and the module determine that the data transfer has been made without error, the data is used in the control program.

### 1.2.2 Module Operation

When the module receives a differential input from an analog device, the module’s circuitry multiplexes the input into an A/D converter. The converter reads the signal and converts it as required for the type of input. The module also continuously samples the CJC sensors and compensates for temperature changes at the terminal block cold junction, between the thermocouple wire and the input channel. See the block diagram below.



Each channel can receive input signals from a thermocouple or millivolt analog input device, depending upon how you configured the channel.

When configured for thermocouple input types, the module converts the analog input voltages into cold-junction compensated and linearized digital temperature readings. The module uses the National Institute of Standards and Technology (NIST) ITS-90 standard for linearization for all thermocouple types (J, K, T, E, R, S, B, N, C, L).

When configured for millivolt inputs, the module converts the analog values directly into digital counts.



# Chapter 2

## Quick Start for Experienced Users

### Section 2.1 Before You Begin

This chapter can help you to get started using the 1769sc-IT6I Isolated Thermocouple/mV Input Module. We base the procedures here on the assumption that you have an understanding of Allen-Bradley controllers. 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.

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.

### Section 2.2 Required Tools and Equipment

Have the following tools and equipment ready:

- Medium blade or cross-head screwdriver
- Thermocouple or millivolt analog input device
- Shielded, twisted-pair cable for wiring (Belden™ 8761 or equivalent for millivolt inputs, or shielded thermocouple extension wire for thermocouple inputs)
- Controller (for example, a MicroLogix™ 1500 or CompactLogix™ controller)
- Programming device and software (for example, RSLogix 500™ or RSLogix 5000™)

## Section 2.3

### What You Need To Do

This chapter covers:

- 1) Ensuring that your power supply is adequate
- 2) Attaching and locking the module
- 3) Wiring the module
- 4) Configuring the module
- 5) Going through the startup procedure
- 6) Monitoring module operation

<b>Step 1: Ensure that your 1769 system power supply<sup>1</sup> has sufficient current output to support your system configuration.</b>
--

<b>Reference</b> Chapter 3 (Installation and Wiring)
--

The module's maximum current draw is shown below.

5V dc	24V dc
150 mA	35 mA

*Note: The module cannot be located more than 8 modules away from the system power supply.*

<b>Step 2: Attach and lock the module.</b>
--

<b>Reference</b> Chapter 3 (Installation and Wiring)
--

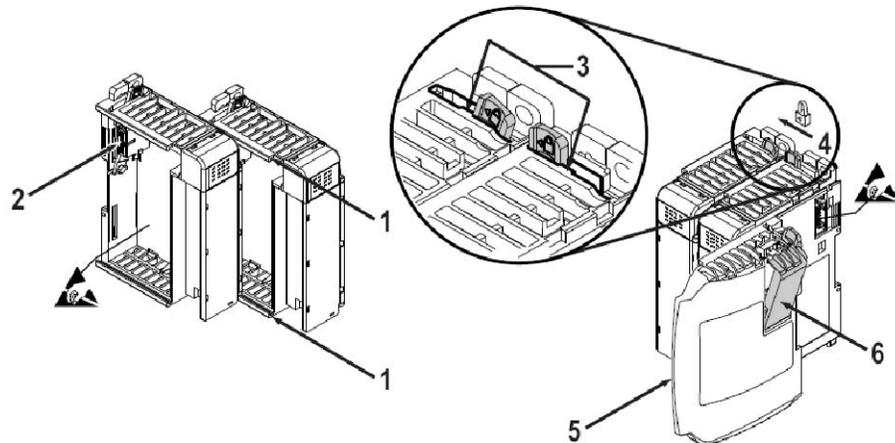
*Note: The module can be panel or DIN rail mounted. Modules can be assembled before or after mounting.*



Attention

**Remove power before removing or inserting this module. If you remove or insert a module with power applied, an electrical arc may occur.**

<sup>1</sup> The system power supply could be a 1769-PA2, -PB2, -PA4, -PB4, or the internal supply of the MicroLogix 1500 packaged controller.



- 1) Check that the bus lever of the module to be installed is in the unlocked (fully right) position.
- 2) Use the upper and lower tongue-and-groove slots (1) to secure the modules together (or to a controller).
- 3) Move the module back along the tongue-and-groove slots until the bus connectors (2) line up with each other.
- 4) Push the bus lever back slightly to clear the positioning tab (3). Use your fingers or a small screwdriver.
- 5) To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks. Ensure it is locked firmly in place.



Attention

**When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.**

- 6) Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.
- 7) Lock the end cap bus terminator (6).



Attention

**A 1769-ECR or 1769-ECL right or left end cap respectively must be used to terminate the end of the 1769 communication bus.**

### Step 3: Wire the module.

### Reference

Chapter 3  
(Installation and Wiring)

Follow the guidelines below when wiring the module.

#### *General*

- Power and input wiring must be in accordance with Class 1, Division 2 wiring methods, Article 501-4(b) of the National Electric Code, NFPA 70, and in accordance with the authority having jurisdiction.
- Channels are isolated from one another by 500V dc maximum.
- Route field wiring away from any other wiring and keep it as far as possible from sources of electrical noise, such as motors, transformers, contactors, and ac devices. As a general rule, allow at least 15.2 cm (6 in.) of separation for every 120V of power.
- Routing field wiring in a grounded conduit can reduce electrical noise.
- If field wiring must cross ac or power cables, ensure that they cross at right angles.
- If multiple power supplies are used with analog millivolt inputs, the power supply commons must be connected.

#### *Terminal Block*

- Do not use the module's NC terminals as connection points.
- Do not tamper with or remove the CJC sensors on the terminal block. Removal of either one or both sensors will reduce accuracy.
- For millivolt sensors, use Belden 8761 shielded twisted-pair wire (or equivalent) to ensure proper operation and high immunity to electrical noise.
- For a thermocouple, use the shielded, twisted-pair thermocouple extension lead wires specified by the thermocouple manufacturer. Using the incorrect type of thermocouple extension wire or not following the correct polarity will cause invalid readings.
- To ensure optimum accuracy, limit overall cable impedance by keeping a cable as short as possible. Locate the module as close to input devices as the application permits.

#### *Grounding*



**The possibility exists that a grounded or exposed thermocouple can become shorted to a potential greater than that of the thermocouple itself. Due to possible shock hazard, take care when wiring grounded or exposed thermocouples. See Appendix B, Using Thermocouple Junctions.**

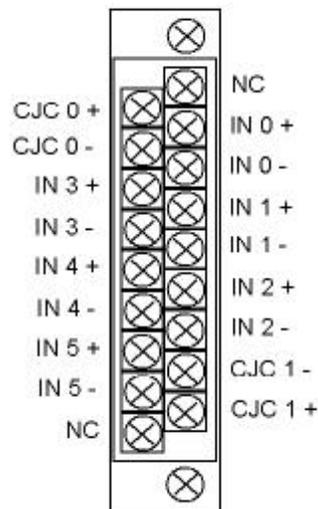
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- This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.
- Keep cable shield connections to ground as short as possible.

- Ground the shield drain wire at one end only. The preferred location is as follows.
  - For grounded thermocouples or millivolt sensors, this is at the sensor end.
  - For insulated/ungrounded thermocouples, this is at the module end. Contact your sensor manufacturer for additional details.
- Refer to Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional information.

The terminal connections with CJC sensors are shown below:

**1769sc-IT6I Terminal Block**



**Step 4: Configure the module.**

**Reference**

Chapter 4  
(Module Data, Status, and  
Channel Configuration)

The configuration file is typically modified using the programming software compatible with your controller. It can also be modified through the control program, if supported by the controller. See Channel Configuration on page 4-3 for more information.

**Step 5: Go through the startup procedure.**

**Reference**

Chapter 5(Diagnostics and  
Troubleshooting)

- 1) Apply power to the controller system.
- 2) Download your program, which contains the thermocouple module configuration settings, to the controller.

- 3) Put the controller in Run mode. During a normal start-up, the module status LED turns on.

*Note: If the module status LED does not turn on, cycle power. If the condition persists, contact your local distributor or Spectrum Controls for assistance.*

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**Step 6: Monitor the module status to check if the module is operating correctly**

**Reference**

Chapter 5(Diagnostics and Troubleshooting)

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Module and channel configuration errors are reported to the controller. These errors are typically reported in the controller's I/O status file.

Channel status data is also reported in the module's input data table, so these bits can be used in your control program to flag a channel error.

# Chapter 3

## Installation and Wiring

This chapter tells you how to:

- Determine the power requirements for the modules
- Avoid electrostatic damage
- Install the module
- Wire the module's terminal block
- Wire input devices

### Section 3.1

#### Compliance to European Union Directives

This product is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

##### 3.1.1 EMC Directive

The 1769sc-IT6I module is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2EMC – Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2EMC – Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

##### 3.1.2 Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 – Equipment Requirements and Tests.

For specific information required by EN61131-2, 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 B113

## Section 3.2

### Power Requirements

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

5V dc	24V dc
150 mA	35 mA

## Section 3.3

### General Considerations

Compact I/O is suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2<sup>2</sup>) and to circuits not exceeding Over Voltage Category II<sup>3</sup> (IEC 60664-1)<sup>4</sup>

#### 3.3.1 Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. Operating temperature code T5 is assumed. The following WARNING statement applies to use in hazardous locations.

#### WARNING



- **EXPLOSION HAZARD** Substitution of components may impair suitability for Class I, Division 2.
- **Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.**
- **Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.**
- **This product must be installed in an enclosure.**
- **All wiring must comply with N.E.C. article 501-4(b).**

<sup>2</sup> Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

<sup>3</sup> Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

<sup>4</sup> . Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

### 3.3.2 Prevent Electrical Discharge



Electrostatic discharge can damage integrated circuits or semiconductors if you touch analog I/O module bus connector pins or the terminal block on the input module. Follow these guidelines when you handle the module:

- Touch a grounded object to discharge static potential.
- Wear an approved wrist-strap grounding device.
- Do not touch the bus connector or connector pins.
- Do not touch circuit components inside the module.
- If available, use a static-safe work station.
- When it is not in use, keep the module in its static-shield bag.

### 3.3.3 Remove Power



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 and may lead to premature failure.

### 3.3.4 Selecting a Location

#### *Reducing Noise*

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:

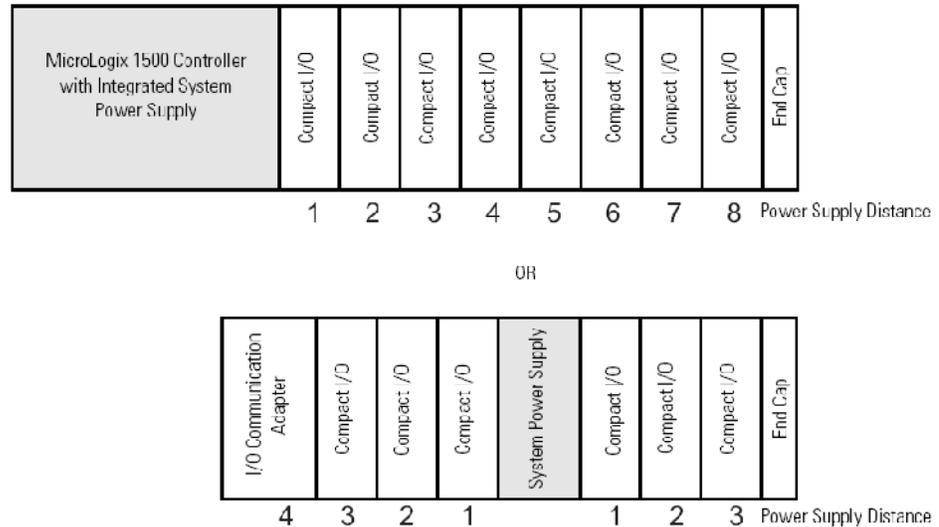
- Away from sources of electrical noise such as hard-contact switches, relays, and AC motor drives
- Away from modules which generate significant radiated heat, such as the 1769-IA16. Refer to the module's heat dissipation specification.

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

#### *Power Supply Distance*

You can install as many modules as your power supply can support. However, all 1769 I/O modules have a power supply distance ratings. The maximum I/O module rating is 8,

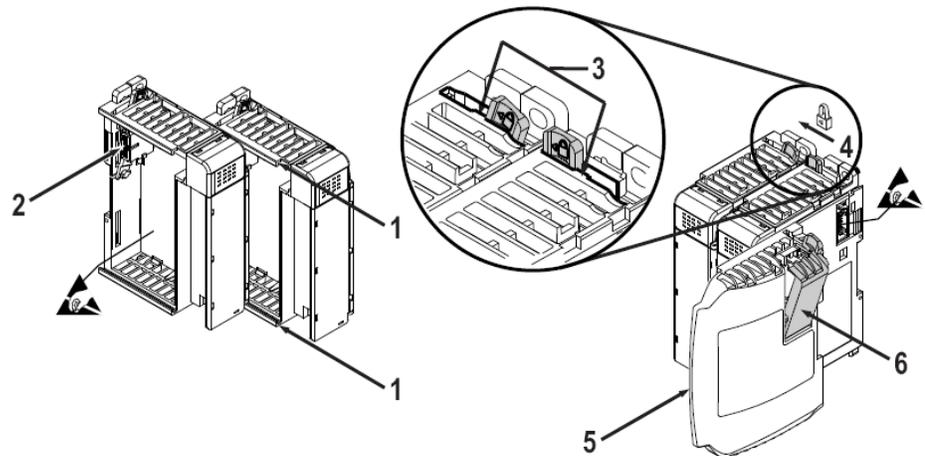
which means that a module may not be located more than 8 modules away from the system power supply.



## Section 3.4 System Assembly

The module can be attached to the controller or an adjacent I/O module *before or after* mounting. For mounting instructions, see Panel Mounting Using the Dimensional Template on page 3-6, or DIN Rail Mounting on page 3-7. To work with a system that is already mounted, see Replacing a Single Module within a System on page 3-7.

The following procedure shows you how to assemble the Compact I/O system.



- 1) Disconnect power.
- 2) Check that the bus lever of the module to be installed is in the unlocked (fully right) position.

**Note:** *If the module is being installed to the left of an existing module, check that the*

*right-side adjacent module's bus lever is in the unlocked (fully right) position.*

- 3) Use the upper and lower tongue-and-groove slots (1) to secure the modules together (or to a controller).
- 4) Move the module back along the tongue-and-groove slots until the bus connectors (2) line up with each other.
- 5) Push the bus lever slightly to clear the positioning tab (3). Use your fingers or a small screwdriver.
- 6) To allow communication between the controller and module, move the bus lever fully to the left (4) until it clicks. Ensure it is locked firmly in place.



Attention

**When attaching I/O modules, it is very important that the bus connectors are securely locked together to ensure proper electrical connection.**

---

- 7) Attach an end cap terminator (5) to the last module in the system by using the tongue-and-groove slots as before.
- 8) Lock the end cap bus terminator (6).



Attention

**A 1769-ECR or 1769-ECL right or left end cap respectively must be used to terminate the end of the bus.**

---

## Section 3.5 Mounting



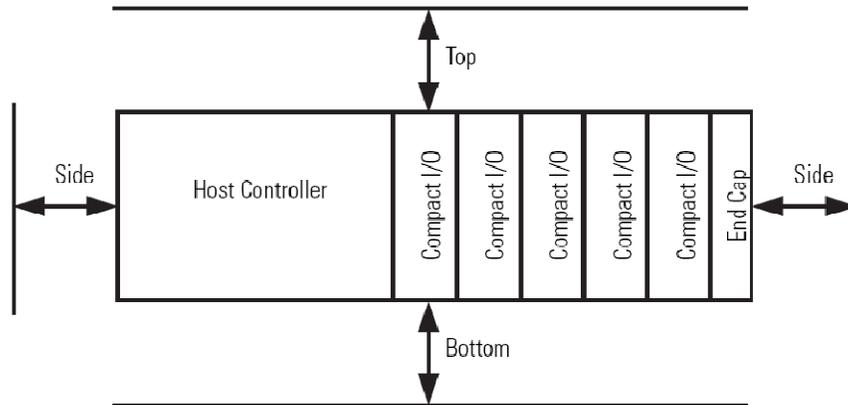
Attention

**During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire strands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage at power up.**

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### 3.5.1 Minimum Spacing

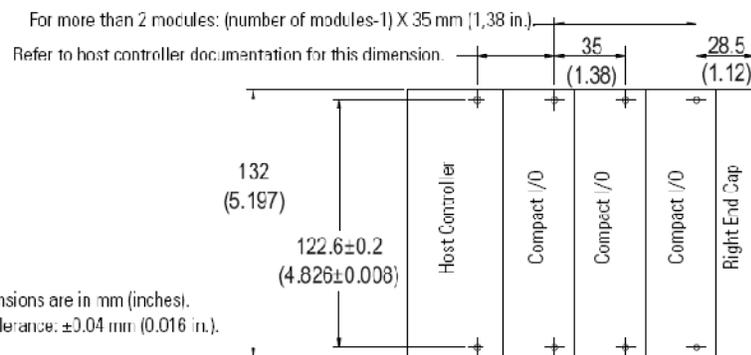
Maintain spacing from enclosure walls, wireways, adjacent equipment, etc. Allow 50 mm (2 in.) of space on all sides for adequate ventilation, as shown below:



### 3.5.2 Panel Mounting

Mount the module to a panel using two screws per module. Use M4 or #8 panhead screws. Mounting screws are required on every module.

#### *Panel Mounting Using the Dimensional Template*



#### *Panel Mounting Procedure Using Modules as a Template*

The following procedure allows you to use the assembled modules as a template for drilling holes in the panel. If you have sophisticated panel mounting equipment, you can use the dimensional template provided on 3-6. Due to module mounting hole tolerance, it is important to follow these procedures:

- 1) On a clean work surface, assemble no more than three modules.
- 2) Using the assembled modules as a template, carefully mark the center of all module-mounting holes on the panel.
- 3) Return the assembled modules to the clean work surface, including any previously mounted modules.
- 4) Drill and tap the mounting holes for the recommended M4 or #8 screw.
- 5) Place the modules back on the panel, and check for proper hole alignment.
- 6) Attach the modules to the panel using the mounting screws.

**Note:** *If mounting more modules, mount only the last one of this group and put the*

*others aside. This reduces remounting time during drilling and tapping of the next group.*

- 7) Repeat steps 1 to 6 for any remaining modules.

### 3.5.3 DIN Rail Mounting

The module can be mounted using the following DIN rails:

- 35 x 7.5 mm (EN 50 022 - 35 x 7.5), or
- 35 x 15 mm (EN 50 022 - 35 x 15).

Before mounting the module on a DIN rail, close the DIN rail latches. Press the DIN rail mounting area of the module against the DIN rail. The latches will momentarily open and lock into place.

## Section 3.6 Replacing a Single Module within a System

The module can be replaced while the system is mounted to a panel (or DIN rail). Follow these steps in order:

- 1) Remove power. See important note on page 3-3.
- 2) On the module to be removed, remove the upper and lower mounting screws from the module (or open the DIN latches using a flat-blade or phillips-style screwdriver).
- 3) Move the bus lever to the right to disconnect (unlock) the bus.
- 4) On the right-side adjacent module, move its bus lever to the right (unlock) to disconnect it from the module to be removed.
- 5) Gently slide the disconnected module forward. If you feel excessive resistance, check that the module has been disconnected from the bus, and that both mounting screws have been removed (or DIN latches opened).

**Note:** *It may be necessary to rock the module slightly from front to back to remove it, or, in a panel-mounted system, to loosen the screws of adjacent modules.*

- 6) Before installing the replacement module, be sure that the bus lever on the module to be installed and on the right-side adjacent module or end cap are in the unlocked (fully right) position.
- 7) Slide the replacement module into the open slot.
- 8) Connect the modules together by locking (fully left) the bus levers on the replacement module and the right-side adjacent module.
- 9) Replace the mounting screws (or snap the module onto the DIN rail).

## Section 3.7

### Field Wiring Connections

#### 3.7.1 System Wiring Guidelines

Consider the following when wiring your system:

##### *General*

- Power and input wiring must be in accordance with Class 1, Division 2 wiring methods, Article 501-4(b) of the National Electric Code, NFPA 70, and in accordance with the authority having jurisdiction.
- Channels are isolated from one another by 500 Vdc maximum.
- Route 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. As a general rule, allow at least 15.2 cm (6 in.) of separation for every 120V of power.
- Routing field wiring in a grounded conduit can reduce electrical noise.
- If field wiring must cross ac or power cables, ensure that they cross at right angles.
- If multiple power supplies are used with analog millivolt inputs, the power supply commons must be connected.

##### *Terminal Block*

- Do not use the module's NC terminals as connection points.
- Do not tamper with or remove the CJC sensors on the terminal block. Removal of one or both sensors will reduce accuracy.
- For millivolt sensors, use Belden 8761 shielded, twisted-pair wire (or equivalent) to ensure proper operation and high immunity to electrical noise.
- For a thermocouple, use the shielded, twisted-pair thermocouple extension lead wires specified by the thermocouple manufacturer. Using the incorrect type of thermocouple extension wire or not following the correct polarity will cause invalid readings.
- To ensure optimum accuracy, limit overall cable impedance by keeping a cable as short as possible. Locate the module as close to input devices as the application permits.

##### *Grounding*



**The possibility exists that a grounded or exposed thermocouple can become shorted to a potential greater than that of the thermocouple itself. Due to possible shock hazard, take care when wiring grounded or exposed thermocouples. See Appendix B, Using Thermocouple Junctions.**

---

- This product is intended to be mounted to a well-grounded mounting surface such as a metal panel. Additional grounding connections from the module's mounting tabs or DIN rail (if used) are not required unless the mounting surface cannot be grounded.
- Keep cable shield connections to ground as short as possible.
- Ground the shield drain wire at one end only. The typical location is as follows.
  - For grounded thermocouples or millivolt sensors, this is at the sensor end.
  - For insulated/ungrounded thermocouples, this is at the module end. Contact your sensor manufacturer for additional details.
- If it is necessary to connect the shield drain wire at the module end, connect it to earth ground using a panel or DIN rail mounting screw.
- Refer to Industrial Automation Wiring and Grounding Guidelines, Allen-Bradley publication 1770-4.1, for additional information.

#### *Noise Prevention*

- To limit the pickup of electrical noise, keep thermocouple and millivolt signal wires as far as possible from power and load lines.
- If noise persists for a device, try grounding the opposite end of the cable shield. (You can only ground one end at a time.)

### **3.7.2 Terminal Door Label**

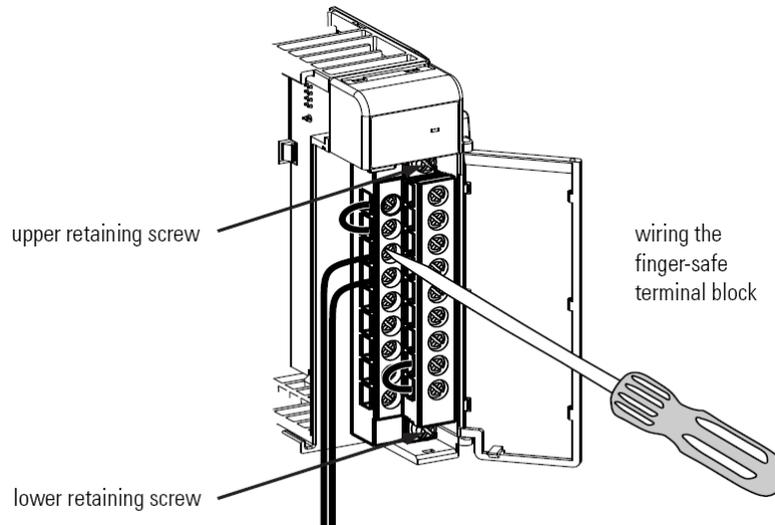
A removable, write-on label is provided with the module. Remove the label from the door, mark your unique identification of each terminal with permanent ink, and slide the label back into the door. Your markings (ID tag) will be visible when the module door is closed.

### **3.7.3 Removing and Replacing the Terminal Block**

When wiring the module, you do not have to remove the terminal block. If you remove the terminal block, use the write-on label located on the side of the terminal block to identify the module location and type.



To remove the terminal block, loosen the upper and lower retaining screws. The terminal block will back away from the module as you remove the screws. Be careful not to damage the CJC sensors. When replacing the terminal block, torque the retaining screws to 0.46 Nm (4.1 in-lbs).



### 3.7.4 Wiring the Finger Safe Terminal Block

When wiring the terminal block, keep the finger-safe cover in place.

- 1) Loosen the terminal screws to be wired.
- 2) Route the wire under the terminal pressure plate. You can use the bare wire or a spade lug. The terminals accept a 6.35 mm (0.25 in.) spade lug.

**Note:** *The terminal screws are non-captive. Therefore, it is possible to use a ring lug [maximum 1/4 inch o.d. with a 0.139 inch minimum i.d. (M3.5)] with the module.*

- 3) Tighten the terminal screw making sure the pressure plate secures the wire. Recommended torque when tightening terminal screws is 0.68 Nm (6 in-lbs).

**Note:** *If you need to remove the finger-safe cover, insert a screwdriver into one of the square, wiring holes and gently pry the cover off. If you wire the terminal block with the finger-safe cover removed, you may not be able to put it back on the terminal block because the wires will be in the way.*

#### Wire Size and Terminal Screw Torque

Each terminal accepts up to two wires with the following restrictions:

Wire Type	Wire Size	Terminal Screw Torque	Retaining Screw Torque
Solid Cu-90°C (194°F)	#14 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)
Stranded Cu-90°C (194°F)	#16 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)
TC Extension Wire	#16 to #22 AWG	0.68 Nm (6 in-lbs)	0.46 Nm (4.1 in-lbs)

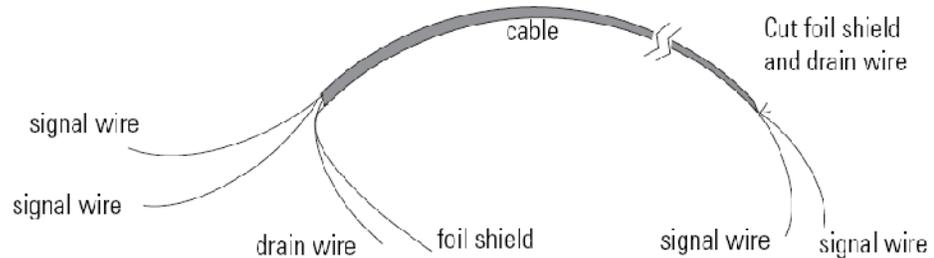
### 3.7.5 Wiring the Module



Attention

To prevent shock hazard, care should be taken when wiring the module to analog signal sources. Before wiring any module, disconnect power from the system power supply and from any other source to the module.

After the module is properly installed, follow the wiring procedure below, using the proper thermocouple extension cable, or Belden 8761 for non-thermocouple applications.



To wire your 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 2-inch (5 cm) lengths. Strip about 3/16 inch (5 mm) of insulation away to expose the end of the wire.



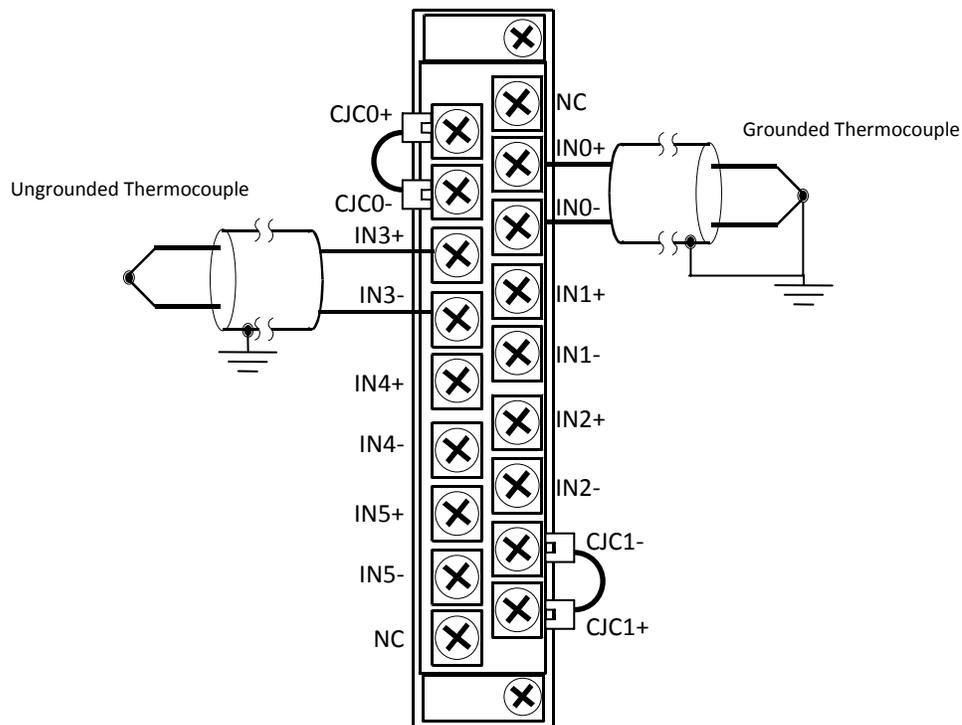
Attention

Be careful when stripping wires. Wire fragments that fall into a module could cause damage at power up.

- 3) At one end of the cable, twist the drain wire and foil shield together, bend them away from the cable, and apply shrink wrap. Then earth ground at the preferred location based on the type of sensor you are using. See Grounding on page 3-8.
- 4) At the other end of the cable, cut the drain wire and foil shield back to the cable and apply shrink wrap.
- 5) Connect the signal wires to the terminal block. Connect the other end of the cable to the analog input device.
- 6) Repeat steps 1 through 5 for each channel on the module.

*Note: See Appendix B Using Thermocouple Junctions for additional information on wiring grounded, ungrounded, and exposed thermocouple types.*

Figure 3-1 (Wiring Diagram)



*Note: When using an ungrounded thermocouple, the shield must be connected to ground at the module end.*

## Section 3.8 Cold Junction Compensation

To obtain accurate readings from each of the channels, the cold junction temperature (temperature at the module's terminal junction between the thermocouple wire and the input channel) must be compensated for. Two cold junction compensating thermistors have been integrated in the removable terminal block. These thermistors must remain installed to retain accuracy.



Attention

**Do not remove or loosen the cold junction compensating thermistor assemblies located on between the two upper and lower CJC terminals. Both thermistor assemblies are critical to ensure accurate thermocouple input readings at each channel. The module will operate in the thermocouple mode, but at reduced accuracy if either CJC sensor is removed. See Determining Open-Circuit Response (Bits 6 and 5) on page 4-6.**

If either of the thermistor assemblies are accidentally removed, re-install them by connecting each one across each pair of CJC terminals.

## **Section 3.9**

### **Calibration**

The thermocouple module is initially calibrated at the factory. The module must be returned to the factory for calibration.



# Chapter 4

## Module Data, Status, and Channel Configuration

After installing the 1769sc-IT6I Isolated Thermocouple/mV Input Module, you must configure it for operation, usually using the programming software compatible with the controller (for example, RSLogix 500 or RSLogix 5000). Once configuration is complete and reflected in the ladder logic, you need to operate the module and verify its configuration.

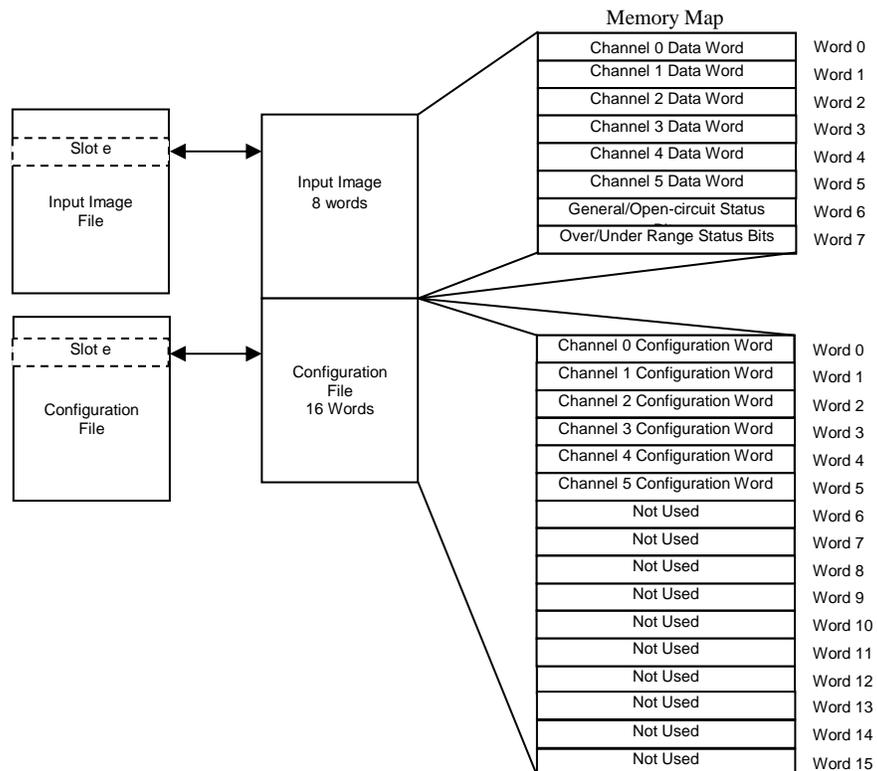
This chapter contains information on the following:

- Module memory map
- Configuring channels
- Accessing input image file data

### Section 4.1

#### Module Memory Map

The module uses eight input words for data and status bits (input image), and seven configuration words.



*Note: Not all controllers support program access to the configuration file. Refer to your controller's user manual.*

## Section 4.2 Configuring Channels

After module installation, you must configure operation details, such as thermocouple type, temperature units, etc., for each channel. Channel configuration data for the module is stored in the controller configuration file, which is both readable and writable.

The configuration data file is shown below. Bit definitions are provided in Channel Configuration, below. Detailed definitions of each of the configuration parameters follow the table.

### 4.2.1 Configuration Data File

The default value of the configuration data is represented by zeros in the data file. The structure of the channel configuration file is shown below.

**Table 4-1 (Configuration Data File)**

Word/ Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Disable Channel 0	Data Format Channel 0			Input Type Channel 0				Temp Units Channel 0	Open Circuit Condition Channel 0	Display CJC Channel 0	Not Used	ADC Filter Frequency Channel 0			
1	Disable Channel 1	Data Format Channel 1			Input Type Channel 1				Temp Units Channel 1	Open Circuit Condition Channel 1	Display CJC Channel 1	Not Used	ADC Filter Frequency Channel 1			
2	Disable Channel 2	Data Format Channel 2			Input Type Channel 2				Temp Units Channel 2	Open Circuit Condition Channel 2	Display CJC Channel 2	Not Used	ADC Filter Frequency Channel 2			
3	Disable Channel 3	Data Format Channel 3			Input Type Channel 3				Temp Units Channel 3	Open Circuit Condition Channel 3	Display CJC Channel 3	Not Used	ADC Filter Frequency Channel 3			
4	Disable Channel 4	Data Format Channel 4			Input Type Channel 4				Temp Units Channel 4	Open Circuit Condition Channel 4	Display CJC Channel 4	Not Used	ADC Filter Frequency Channel 4			
5	Disable Channel 5	Data Format Channel 5			Input Type Channel 5				Temp Units Channel 5	Open Circuit Condition Channel 5	Display CJC Channel 5	Not Used	ADC Filter Frequency Channel 5			
6	Not Used															
7	Not Used															
8	Not Used															
9	Not Used															
10	Not Used															
11	Not Used															
12	Not Used															
13	Not Used															
14	Not Used															
15	Not Used															

The configuration file can also be modified through the control program, if supported by the controller. For information on configuring the module using RSLogix 500 (with MicroLogix 1500 controller), see Appendix C; for RSLogix 5000 (CompactLogix controller), see Appendix D; for RSNetworx (1769-ADN), see Appendix E. The structure and bit settings are shown in the section below.

## 4.2.2 Channel Configuration

Each channel configuration word consists of bit fields, the settings of which determine how the channel operates. See the table below and the descriptions that follow for valid configuration settings and their meanings.

**Table 4-2 (Channel Configuration)**

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>Filter Frequency</b>																
4.17 Hz														1	1	0
10 Hz														0	0	0
16.7 Hz														0	0	1
19.6 Hz														0	1	1
62 Hz														1	0	0
470 Hz														1	0	1
<b>Unused</b>													0			
<b>Channel Display</b>																
Channel Data Value												0				
Channel CJC Value												1				
<b>Open Circuit</b>																
Upscale										0	0					
Downscale										0	1					
Last State										1	0					
Zero										1	1					
<b>Temp Units</b>																
Degrees C									0							
Degrees F									1							
<b>Input Type</b>																
Type J Thermocouple					0	0	0	0								
Type K Thermocouple					0	0	0	1								
Type T Thermocouple					0	0	1	0								
Type E Thermocouple					0	0	1	1								
Type R Thermocouple					0	1	0	0								
Type S Thermocouple					0	1	0	1								
Type B Thermocouple					0	1	1	0								
Type N Thermocouple					0	1	1	1								
Type C Thermocouple					1	0	0	0								
Type L Thermocouple*					1	0	1	1								
+/-50 mV					1	0	0	1								
+/-100 mV					1	0	1	0								
<b>Data Format</b>																
Raw/Proportional Data		0	0	0												
Engineering Units		0	0	1												
Engineering Units x10		1	0	0												
Scaled for PID		0	1	0												
Percent Range		0	1	1												
<b>Chan. Enable</b>																
Enable	0															
Disable	1															

*Note: Default settings for a particular function are indicated by zero(s). For example, the default filter frequency is 10 Hz.*

### 4.2.3 Enabling or Disabling a Channel (Bit 15)

You can enable or disable each of the six channels individually using bit 15. The module only scans enabled channels. Enabling a channel forces it to be recalibrated before it measures input data. Disabling a channel sets the channel data word to zero.

### 4.2.4 Selecting Data Formats (Bits 12 through 14)

This selection configures channels 0 through 5 to present analog data in any of the following formats:

- Raw/Proportional Data
- Engineering Units x 1
- Engineering Units x 10
- Scaled for PID
- Percent Range

**Table 4-3 (Channel Data Word Format)**

Input Type	Data Format					
	Engineering Units x 10		Engineering Units x 1		Scaled For PID	Proportional Counts
	• Celsius	• Fahrenheit	• Celsius	• Fahrenheit		
J	-210 to 1200	-346 to 2192	-2100 to 12000	-3460 to 21920	0 to 16383	-32767 to 32767
K	-270 to 1370	-454 to 2498	-2700 to 13700	-4540 to 24980	0 to 16383	-32767 to 32767
T	-270 to 400	-454 to 752	-2700 to 4000	-4540 to 7520	0 to 16383	-32767 to 32767
E	-270 to 1000	-454 to 1832	-2700 to 10000	-4540 to 18320	0 to 16383	-32767 to 32767
R	0 to 1768	32 to 3214	0 to 17680	320 to 32144	0 to 16383	-32767 to 32767
S	0 to 1768	32 to 3214	0 to 17680	320 to 32144	0 to 16383	-32767 to 32767
B	300 to 1820	572 to 3308	3000 to 18200	5720 to 32767 <sup>5</sup>	0 to 16383	-32767 to 32767
N	-210 to 1300	-346 to 2372	-2100 to 13000	-3460 to 23720	0 to 16383	-32767 to 32767
C	0 to 2315	32 to 4199	0 to 23150	320 to 32767 <sup>5</sup>	0 to 16383	-32767 to 32767
L	-200 to 900	-328 to 1652	-2000 to 9000	-3280 to 16520	0 to 16383	-32767 to 32767
+/- 50 mV	-500 to 500 <sup>2</sup>	-500 to 500 <sup>2</sup>	-5000 to 5000 <sup>2</sup>	-5000 to 5000 <sup>6</sup>	0 to 16383	-32767 to 32767
+/- 100 mV	-1000 to 1000 <sup>2</sup>	-1000 to 1000 <sup>2</sup>	-10000 to 10000 <sup>2</sup>	-10000 to 10000 <sup>6</sup>	0 to 16383	-32767 to 32767

**Note:** The engineering units data formats represent real engineering temperature units provided by the module to the controller. The raw/proportional counts, scaled-for-PID and percent of full-scale data formats may yield the highest effective resolutions, but may also require that you convert channel data to real engineering units in your control program.

#### Raw/Proportional Data

The value presented to the controller is proportional to the selected input and scaled into the maximum data range allowed by the bit resolution of the A/D converter and filter

<sup>5</sup> Type B and C thermocouples cannot be represented in engineering units x 1 (°F) above 3276.7°F. Software treats it as an over range error.

<sup>6</sup> When millivolts are selected, the temperature setting is ignored. Analog input data is the same for either °C or °F selection.

selected. The raw/proportional data format also provides the best resolution of all the data formats.

If you select the raw/proportional data format for a channel, the data word will be a number between -32767 and +32767. For example, if a type J thermocouple is selected, the lowest temperature of -210°C corresponds to -32767 counts. The highest temperature of 1200°C corresponds to +32767.

#### **Engineering Units x1**

When using this data format for a thermocouple or millivolt input, the module scales the thermocouple or millivolt input data to the actual engineering values for the selected millivolt input or thermocouple type. It expresses temperatures in 0.1°C or 0.1°F units. For millivolt inputs, the module expresses voltages in 0.01 mV units.

*Note: Use the engineering units x 10 setting to produce temperature readings in whole degrees Celsius or Fahrenheit.*

#### **Engineering Units x10**

When using a thermocouple input with this data format, the module scales the input data to the actual temperature values for the selected thermocouple type. With this format, the module expresses temperatures in 1°C or 1°F units. For millivolt inputs, the module expresses voltages in 0.1 mV units.

#### **Scaled for PID**

The value presented to the controller is a signed integer with 0 representing the lower input range and +16383 representing the upper input range.

To obtain the value, the module scales the input signal range to a 0 to +16383 range, which is standard to the PID algorithm for the MicroLogix 1500 and other Allen-Bradley controllers (e.g. SLC). For example, if type J thermocouple is used, the lowest temperature for the thermocouple is -210°C, which corresponds to 0 counts. The highest temperature in the input range, 1200°C, corresponds to +16383 counts.

#### **Percent Range**

Input data is presented to the user as a percent of the specified range. The module scales the input signal range to a 0 to +10000 range. For example, using a type J thermocouple, the range -210°C to +1200°C is represented as 0% to 100%.

### **4.2.5 Selecting Input Type (Bits 8 through 11)**

Bits 8 through 11 in the channel configuration word indicate the type of thermocouple or millivolt input device. Each channel can be individually configured for any type of input.

### **4.2.6 Selecting Temperature Units (Bit 7)**

The module supports two different linearized/scaled ranges for thermocouples, degrees Celsius (°C) and degrees Fahrenheit (°F). Bit 7 is ignored for millivolt input types, or when raw/proportional, scaled-for-PID, or percent data formats are used.



**If you are using engineering units x 1 data format and degrees Fahrenheit temperature units, thermocouple types B and C cannot achieve full-scale temperature with 16-bit signed numerical representation. An over-range error will occur for the configured channel if it tries to represent the full-scale value. The maximum representable temperature is 3276.7°F.**

---

### 4.2.7 Determining Open-Circuit Response (Bits 6 and 5)

An open-circuit condition occurs when an input device or its extension wire is physically separated or open. This can happen if the wire is cut or disconnected from the terminal block.

*Note: If either CJC sensor is removed from the module terminal block, its open-circuit bit is set (1) and the module continues to calculate thermocouple readings at reduced accuracy. If an open CJC circuit is detected at power-up, the module uses 25°C as the sensed temperature at that location. If an open CJC circuit is detected during normal operation, the last valid CJC reading is used. An input channel configured for millivolt input is not affected by CJC open-circuit conditions. See Open-Circuit Detection on page 5-3 for additional details.*

Bits 6 and 5 define the state of the channel data word when an open-circuit condition is detected for the corresponding channel. The module overrides the actual input data depending on the option that you specify when it detects an open circuit. The open-circuit options are explained in the table below.

**Table 4-4 (Open-Circuit Response)**

<b>Response Option</b>	<b>Definition</b>
Upscale	Sets the input data value to full upper scale value of channel data word. The full-scale value is determined by the selected input type and data format.
Downscale	Sets the input data value to full lower scale value of channel data word. The low scale value is determined by the selected input type and data format.
Last State	Sets the input data value to the last input value prior to the detection of the open-circuit.
Zero	Sets the input data value to 0 to force the channel data word to 0.

### 4.2.8 Display CJC Data (Bit 4)

When Bit 4 is set, the CJC compensated temperature is displayed for each channel instead of the measured thermocouple or millivolt reading. Setting bit 4 to 0 allows the measured thermocouple or millivolt reading to be displayed.

### 4.2.9 Selecting Input Filter Frequency (Bits 0 through 2)

The input filter selection field allows you to select the filter frequency for each channel 0 through 5. The filter frequency affects the following, as explained later in this chapter:

- Noise rejection characteristics for module inputs
- Cut-Off Frequency
- Repeatability
- Module update time

The table below summarizes the effects of each filter selection.

**Table 4-6 (Filter Effects)**

Input Filter	Channel Update Time (Ch 1 to 4) Normal Conversion Mode	Channel Update Time During CJC Sample (Ch 0 & 5) <sup>7</sup>	Cut-Off Frequency	Repeatability	NMRR 50 Hz Rejection	NMRR 60 Hz Rejection
4.17 Hz	246 msec	500 msec	1 Hz	See Appendix A	74 dB	74 dB
10.0 Hz	106 msec	220 msec	2 Hz	See Appendix A	70 dB	70 dB
16.7 Hz	66 msec	140 msec	4 Hz	2x(4.17 Hz values) From Appendix A	65 dB	NA
19.6 Hz	57 msec	122 msec	5 Hz	2x(4.17 Hz values) From Appendix A	NA	74 dB
62 Hz	26 msec	52 msec	14 Hz	4x(4.17 Hz values) From Appendix A	NA	NA
470 Hz	8 msec	24 msec	109 Hz	10x(4.17 Hz values) From Appendix A	NA	NA

### Effects of Filter Frequency on Noise Rejection

The filter frequency that you choose for a module channel determines the amount of noise rejection for the inputs. A lower frequency (4.17 Hz versus 470 Hz) provides better noise rejection and improves repeatability, but also increases channel update time. A higher filter frequency provides lower noise rejection, but decreases the channel update time and negatively affects repeatability.

When selecting a filter frequency, be sure to consider the cut-off frequency to obtain acceptable noise rejection. Choose a filter frequency so that your fastest-changing signal is below that of the filter's cut-off frequency.

Table 4-6 above lists the expected normal mode rejection for each of the filter settings.

**Note:** *Transducer power supply noise, transducer circuit noise, or process variable irregularities may also be sources of normal mode noise.*

### Cut-Off Frequency

The filter cut-off frequency, -3 dB, is the point on the frequency response curve where frequency components of the input signal are passed with 3 dB of attenuation. Table 4-6 shows cut-off frequencies for the supported filters.

All input frequency components at or below the cut-off frequency are passed by the digital filter with less than 3 dB of attenuation. All frequency components above the cut-off frequency are increasingly attenuated.

The cut-off frequency for each channel is defined by its filter frequency selection. Choose a filter frequency so that your fastest changing signal is below that of the filter's cut-off frequency. The cut-off frequency should not be confused with the update time. The cut-off frequency relates to how the digital filter attenuates frequency components of the input signal. The update time defines the rate at which an input channel is scanned and its channel data word is updated.

<sup>7</sup> Use channel update rates for channels 1 through 4 when CJC's are not being sampled.

**Repeatability**

Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal. The repeatability for an input channel depends upon the filter frequency selected for that channel. Table 4-6, above, describes the repeatability for each of the range selections at the six available frequencies. This table does not include the affects of unfiltered input noise. Choose the frequency that most closely matches your requirements.

**Module Update Time**

The module update time is defined as the total time required for the module to sample and convert the input signals of all enabled input channels and provide the resulting data values to the processor. On an isolated module with one ADC (Analog to Digital Converter) per channel, all channels convert the signal in parallel so the module update time is equal to the slowest channel update time in normal conversion mode (normal conversion mode is defined when CJC is not being sampled).

The update time can slow down for channels 0 and 5 during CJC sampling which occurs once every 10 seconds. At the 10 second interval the ADC switches from measuring the thermocouple voltage to measuring the CJC voltage. Once a sample of the CJC voltage is taken, the ADC will switch back to measuring the thermocouple voltage. This switching process increases the channel update time. Table 4-6 shows the increased update time for channels 0 and 5 during the CJC sampling process. After the CJC sampling process completes, channels 0 and 5 return to the, faster, normal conversion mode as described above.

For channels 1, 2, 3 and 4 the update rate is fixed and unaffected by the CJC measurement. Likewise, if all channels are configuring for measuring millivolts, then the CJC's are never sampled and the module update time is equal to the slowest configured channel update time.

Channel update time is also dependent upon the input filter selection. Table 4-6 shows the channel update times based on filter selection.

---

<b>Example 1</b>	<b>Channels enabled for different input types</b>
	Channel 0 Input: +/- 50 mV with 4.17 Hz Filter
	Channel (1 – 5) Input: Type J TC with 10 Hz Filter
	<b>Module update time before CJC update</b>
	= slowest channel update time
	= 246 ms
	<b>Module update time during CJC update</b>
	Channel 5 update time changes to 500 ms
	= slowest channel update time
	= 500 ms

---

---

**Example 2 All Channel enabled for thermocouple inputs**  
Channel (0 – 5) Input: Type J TC with 470 Hz Filter  
**Module update time before CJC update**  
= slowest channel update time  
= 8 ms  
**Module update time during CJC update**  
Channel 0 and 5 update time changes to 24ms  
= slowest channel update time  
= 24 ms

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**Example 3 All Channel enabled for millivolt inputs**  
Channel (0 – 5) Input: +/- 50 mV with 470 Hz Filter  
**CJCs not scanned**  
= slowest channel update time  
= 8 ms

---

### Section 4.3

#### Input Image File

The input image file represents data words and status words. Input words 0 through 5 hold the input data that represents the value of the analog inputs for channels 0 through 5. These data words are valid only when the channel is enabled and there are no errors. Input words 6 and 7 hold the status bits. To receive valid status information, the channel must be enabled.

You can access the information in the input image file using the programming software configuration screen. For information on configuring the module in a MicroLogix 1500 system using RSLogix 500, see Appendix C; for CompactLogix using RSLogix 5000, see Appendix D.

## Section 4.4

### Input Data File

The input data table allows you to access module read data for use in the control program, via word and bit access. The data table structure is shown in table below.

**Table 4-7 (Input Data File)**

Word/Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Analog Input Data Channel 0															
1	Analog Input Data Channel 1															
2	Analog Input Data Channel 2															
3	Analog Input Data Channel 3															
4	Analog Input Data Channel 4															
5	Analog Input Data Channel 5															
6	OC7	OC6	OC5	OC4	OC3	OC2	OC1	OC0	S7	S6	S5	S4	S3	S2	S1	S0
7	O7	O6	O5	O4	O3	O2	O1	O0	U7	U6	U5	U4	U3	U2	U1	U0

#### 4.4.1 Input Data Values

Data words 0 through 5 correspond to channels 0 through 5 and contain the converted analog input data from the input device. The most significant bit, bit 15, is the sign bit (SGN).

#### 4.4.2 General Status Bits (S0 to S7)

Bits S0 through S5 of word 6 contain the general status information for channels 0 through 5, respectively. Bits S6 and S7 contain general status information for the two CJC sensors (S6 corresponds to CJC0, S7 to CJC1). If set (1), these bits indicate an error (over- or under-range, open-circuit or input data not valid condition) associated with that channel. The data not valid condition is described below.

##### *Input Data Not Valid Condition*

The general status bits S0 to S5 also indicate whether or not the input data for a particular channel, 0 through 5, is being properly converted (valid) by the module. This “invalid data” condition can occur (bit set) when the download of a new configuration to a channel is accepted by the module (proper configuration) but before the A/D converter can provide valid (properly configured) data to the 1769 bus master/controller. The following information highlights the bit operation of the Data Not Valid condition.

- 1) The default and module power-up bit condition is reset (0).
- 2) The bit condition is set (1) when a new configuration is received and determined valid by the module. The set (1) bit condition remains until the module begins converting analog data for the previously accepted new configuration. When conversion begins, the bit condition is reset (0). The amount of time it takes for the module to begin the conversion process depends on the number of channels being configured and the amount of configuration data downloaded by the controller.

**Note:** *If the new configuration is invalid, the bit function remains reset (0) and the module posts a configuration error. See Configuration Errors on page 5-4.*

- 3) If A/D hardware errors prevent the conversion process from taking place, the bit condition is set (1).

### 4.4.3 Open-Circuit Flag Bits (OC0 to OC7)

Bits OC0 through OC5 of word 6 contain open-circuit error information for channels 0 through 5, respectively. Errors for the CJC sensors are indicated in OC6 and OC7. The bit is set (1) when an open-circuit condition exists. See Open-Circuit Detection on page 5-3 for more information on open-circuit operation.

### 4.4.4 Over-Range Flag Bits (O0 to O7)

Over-range bits for channels 0 through 5 and the CJC sensors are contained in word 7, even-numbered bits. They apply to all input types. When set (1), the over-range flag bit indicates an input signal that is at the maximum of its normal operating range for the represented channel or sensor. The module automatically resets (0) the bit when the data value falls below the maximum for that range.

### 4.4.5 Under Range Flag Bits (U0 to U7)

Under-range bits for channels 0 through 5 and the CJC sensors are contained in word 7, odd-numbered bits. They apply to all input types. When set (1), the under-range flag bit indicates an input signal that is at the minimum of its normal operating range for the represented channel or sensor. The module automatically resets (0) the bit when the under-range condition is cleared and the data value is within the normal operating range.



# Chapter 5

## Diagnostics and Troubleshooting

This chapter describes troubleshooting the isolated thermocouple/mV input module. This chapter contains information on:

- Safety considerations while troubleshooting
- Internal diagnostics during module operation
- Module errors

### Section 5.1 Safety Considerations

Safety considerations are an important element of proper troubleshooting procedures. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance.

The following sections describe several safety concerns you should be aware of when troubleshooting your control system.



**Never reach into a machine to actuate a switch because unexpected motion can occur and cause injury.  
Remove all electrical power at the main power disconnect switches before checking electrical connections or inputs/outputs causing machine motion.**

---

#### 5.1.1 Indicator Lights

When the green LED on the module is illuminated, it indicates that power is applied to the module and that it has passed its internal tests.

#### 5.1.2 Stand Clear of Equipment

When troubleshooting any system problem, have all personnel remain clear of the equipment. The problem could be intermittent, and sudden unexpected machine motion could occur. Have someone ready to operate an emergency stop switch in case it becomes necessary to shut off power.

#### 5.1.3 Program Alteration

There are several possible causes of alteration to the user program, including extreme environmental conditions, Electromagnetic Interference (EMI), improper grounding, improper wiring connections, and unauthorized tampering. If you suspect a program has been altered, check it against a previously saved master program.

#### 5.1.4 Safety Circuits

Circuits installed on the machine for safety reasons, like over-travel limit switches, stop push buttons, and interlocks, should always be hard-wired to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

## Section 5.2 Module Operation vs. Channel Operation

The module performs diagnostic operations at both the module level and the channel level. Module-level operations include functions such as power-up, configuration, and communication with a 1769 bus master, such as a MicroLogix 1500 controller, 1769-ADN DeviceNet Adapter, or CompactLogix controller.

Channel-level operations describe channel related functions, such as data conversion and over- or under-range detection.

Internal diagnostics are performed at both levels of operation. When detected, module error conditions are immediately indicated by the module status LED. Both module hardware and channel configuration error conditions are reported to the controller. Channel over-range or under-range and open-circuit conditions are reported in the module's input data table. Module hardware errors are typically reported in the controller's I/O status file. Refer to your controller manual for details.

## Section 5.3 Power-Up Diagnostics

At module power-up, a series of internal diagnostic tests are performed. If these diagnostic tests are not successfully completed, the module status LED remains off and a module error is reported to the controller.

<b>If module status LED is:</b>	<b>Indicated condition:</b>	<b>Corrective action:</b>
On	Proper Operation	No action required
Off	Module Fault	Cycle power. If condition persists, replace the module. Call your local distributor or Rockwell Automation for assistance.

## Section 5.4 Channel Diagnostics

When an input channel is enabled, the module performs a diagnostic check to see that the channel has been properly configured. In addition, the channel is tested on every scan for configuration errors, over-range and under-range, and open-circuit conditions.

### 5.4.1 Invalid Channel Configuration Detection

Whenever a channel configuration word is improperly defined, the module reports an error. See pages 5-3 to 5-5 for a description of module errors.

### 5.4.2 Over or Under Range Detection

Whenever the data received at the channel word is out of the defined operating range, an over-range or under-range error is indicated in input data word 7.

Possible causes of an out-of-range condition include:

- The temperature is too hot or too cold for the type of thermocouple being used.
- The wrong thermocouple is being used for the input type selected, or for the configuration that was programmed.
- The input device is faulty.
- The signal input from the input device is beyond the scaling range.

### 5.4.3 Open Circuit Detection

On each scan, the module performs an open-circuit test on all enabled channels. Whenever an open-circuit condition occurs, the open-circuit bit for that channel is set in input data word 6.

Possible causes of an open circuit include:

- The input device is broken
- A wire is loose or cut
- The input device is not installed on the configured channel
- A thermocouple is installed incorrectly

## Section 5.5 Non-critical vs. Critical Module Errors

Non-critical module errors are typically recoverable. Channel errors (over-range or under-range errors) are non-critical. Non-critical error conditions are indicated in the module input data table.

Critical module errors are conditions that may prevent normal or recoverable operation of the system. When these types of errors occur, the system typically leaves the run or program mode of operation until the error can be dealt with. Critical module errors are indicated in Table 5-3 Extended Error Codes on page 5-5.

## Section 5.6

### Module Error

#### Definition Table

Analog module errors are expressed in two fields as four-digit Hex format with the most significant digit as “don’t care” and irrelevant. The two fields are “Module Error” and “Extended Error Information”. The structure of the module error data is shown below.

**Table 5-1 (Module Error Table)**

“Don’t Care” Bits				Module Error				Extended Error Information							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hex Digit 4				Hex Digit 3				Hex Digit 2				Hex Digit 1			

#### 5.6.1 Module Error Field

The purpose of the module error field is to classify module errors into three distinct groups, as described in the table below. The type of error determines what kind of information exists in the extended error information field. These types of module errors are typically reported in the controller’s I/O status file. Refer to your controller manual for details.

**Table 5-2 (Module Error Types)**

Error Type	Module Error Field Value Bits 9 through 11 (Binary)	Description
No Errors	000	No error is present. The extended error field holds no additional information.
Hardware Errors	001	General and specific hardware error codes are specified in the extended error information field.
Configuration Errors	010	Module-specific error codes are indicated in the extended error field. These error codes correspond to options that you can change directly. For example, the input range or input filter selection.

#### 5.6.2 Extended Error Information Field

Check the extended error information field when a non-zero value is present in the module error field. Depending upon the value in the module error field, the extended error information field can contain error codes that are module-specific or common to all 1769 analog modules.

**Note:** *If no errors are present in the module error field, the extended error information field is set to zero.*

##### *Hardware Errors*

General or module-specific hardware errors are indicated by module error code 001. See Table 5-3 Extended Error Codes on page 5-5.

##### *Configuration Errors*

If you set the fields in the configuration file to invalid or unsupported values, the module generates a critical error.

Table 5-3 Extended Error Codes on page 5-5 lists the possible module-specific configuration error codes defined for the modules.

## Section 5.7 Error Codes

The table below explains the extended error code.

**Table 5-3 (Extended Error Codes)**

Error Type	Hex Equivalent	Module Error Code (Binary)	Extended Error Information Code (Binary)	Error Description
No Error	X000	000	0 0000 0000	No Errors
General Common Hardware Error	X200	001	0 0000 0000	General Hardware error; no additional information
	X201	001	0 0000 0001	Power-up reset state
Hardware Specific Error	X300	001	1 0000 0000	General Hardware Error (ASIC)
	X301	001	1 0000 0001	H/W ROM Error (Calibration Error)
	X30B	001	1 0000 1011	Channel 0 ADC Error
	X30C	001	1 0000 1100	Channel 1 ADC Error
	X30D	001	1 0000 1101	Channel 2 ADC Error
	X30E	001	1 0000 1110	Channel 3 ADC Error
	X30F	001	1 0000 1111	Channel 4 ADC Error
	X310	001	1 0001 0000	Channel 5 ADC Error
Module Specific Configuration Error	X400	010	0 0000 0000	General Config Error: no additional information
	X401	010	0 0000 0001	invalid input type selected ch0
	X402	010	0 0000 0010	invalid input type selected ch1
	X403	010	0 0000 0011	invalid input type selected ch2
	X404	010	0 0000 0100	invalid input type selected ch3
	X405	010	0 0000 0101	invalid input type selected ch4
	X406	010	0 0000 0110	invalid input type selected ch5
	X407	010	0 0000 0111	invalid input filter selected ch0
	X408	010	0 0000 1000	invalid input filter selected ch1
	X409	010	0 0000 1001	invalid input filter selected ch2
	X40A	010	0 0000 1010	invalid input filter selected ch3
	X40B	010	0 0000 1011	invalid input filter selected ch4
	X40C	010	0 0000 1100	invalid input filter selected ch5
	X40D	010	0 0000 1101	Invalid input format selected ch0
	X40E	010	0 0000 1110	Invalid input format selected ch1
	X40F	010	0 0000 1111	Invalid input format selected ch2
	X410	010	0 0001 0000	Invalid input format selected ch3
X411	010	0 0001 0001	Invalid input format selected ch4	
X412	010	0 0001 0010	Invalid input format selected ch5	
X413	010	0 0001 0011	An unused bit has been set for ch0 (C:e.0)	

<b>Error Type</b>	<b>Hex Equivalent</b>	<b>Module Error Code (Binary)</b>	<b>Extended Error Information Code (Binary)</b>	<b>Error Description</b>
	X414	010	0 0001 0100	An unused bit has been set for ch1 (C:e.1)
	X415	010	0 0001 0101	An unused bit has been set for ch2 (C:e.2)
	X416	010	0 0001 0110	An unused bit has been set for ch3 (C:e.3)
	X417	010	0 0001 0111	An unused bit has been set for ch4 (C:e.4)
	X418	010	0 0001 1000	An unused bit has been set for ch5 (C:e.5)
	X419	010	0 0001 1001	An unused bit has been set for Module Configuration Register (C:e.6)

## **Section 5.8**

### **Module Inhibit Function**

Some controllers support the module inhibit function. See your controller manual for details.

Whenever the 1769sc-IT6I module is inhibited, the module continues to provide information about changes at its inputs to the 1769 CompactBus master (for example, a CompactLogix controller).

# Appendix A

## Specifications

Specification	Description
Module ID Codes	Vendor ID = 58 (Decimal) Product Type = 10 (Decimal) Product Code = 100 (Decimal)
Configuration	6 isolated channels of thermocouple/millivolt inputs
Input Modes	Temperature or voltage
Input Types	Thermocouple types J, K, T, E, R, S, B, N, and L, and +/-50 mV and +/-100 mV
Dimensions	118 mm (height) x 87 mm (depth) x 35 mm (width) height including mounting tabs is 138 mm 4.65 in. (height) x 3.43 in (depth) x 1.38 in (width) height including mounting tabs is 5.43 in.
Approximate Shipping Weight (with carton)	276g (0.61 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +60°C (32°F to +140°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	5g@ 10–500Hz
<b>Shock</b>	
Unpackaged (Non-operating)	½ Sine Shock Wave 20g@9ms, 3 shocks/axis
Unpackaged (Operating)	½ Sine shock Wave 30g@11ms, 1 shock/axis
Agency Certification	C-UL certified (under CSA C22.2 No. 142) UL 508 listed CE compliant for all applicable directives
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (ISA 12.12.01, C-UL under CSA C22.2 No. 213) Operating Temperature Code T5
Radiated and Conducted Emissions	IEC61000-6-4 FCC Part 15B Class A
Electrical /EMC:	The module has passed testing at the following levels:
ESD Immunity (IEC61000-4-2)	4 kV contact, 8 kV air
Radiated Immunity (IEC61000-4-3)	10 V/m, 80 to 1000 MHz, 80% amplitude modulation, 900 MHz & 1890 MHz 100% amplitude modulation
Fast Transient Burst (IEC61000-4-4)	4 kV
Surge Immunity (IEC61000-4-5)	2 kV Line - Line, 4 kV Line - Gnd
Conducted Immunity (IEC61000-4-6)	10V, 0.15 to 80 MHz
Fault detection	Open circuit detection, over-range and under-range error bits. Open circuit detection time is equal to the channel update time.
CMRR	>100 dB at 50 Hz (4.17 Hz, 10 Hz, 16.7 Hz filter) >100 dB at 60 Hz (4.17 Hz, 10 Hz, 19.6 Hz filter)
NMRR	>65 dB at 50 Hz (4.17 Hz, 10 Hz, 16.7 Hz filter) >65 dB at 60 Hz (4.17 Hz, 10 Hz, 19.6Hz filter)
Input Impedance	> 1M ohms
<b>Calibrated Accuracy</b>	Linearization per ITS-90, DIN 43710
Thermocouple Type J	+/- 0.6 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 0.9 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.

Thermocouple Type N (-200°C to 1300°C)	+/- 1 degrees C maximum @ 25 degrees C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 1.5 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type N (-210°C to -200°C)	+/- 1.2 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 1.8 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type T (-230°C to 400°C)	+/- 1 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 1.5 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type T (-270°C to -230°C)	+/- 5.4 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 7.0 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type K (-225°C to 1370°C)	+/- 1 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 1.5 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type K (-270°C to -225°C)	+/- 7.5 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 10 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type E (-210°C to 1000°C)	+/- 0.5 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 0.8 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type E (-270°C to -210°C)	+/- 4.2 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 6.3 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Types S and R	+/- 1.7 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 2.6 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type C	+/- 1.8 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 3.5 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type B	+/- 3.0 degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 4.5 degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
Thermocouple Type L	+/- 0.6 (TBD) degrees C maximum @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 0.9 (TBD) degrees C maximum @ 0 – 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
CJC Sensor range	0 to 85 degrees C
CJC Sensor accuracy	+/- 0.2 degrees C maximum
CJC Measurement accuracy	+/- 0.1 degrees C maximum
CJC Profile accuracy	+/- 0.7 degrees C maximum
CJC Total accuracy (sum of above)	+/- 1.0 degrees C maximum
Millivolt Inputs	+/- 15 uV maximum for +/- 50 mV inputs @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 25 uV maximum for +/- 50 mV inputs @ 0 - 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 20 uV maximum for +/- 100 mV inputs @ 25°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters. +/- 30 uV maximum for +/- 100 mV inputs @ 0 - 60°C for 4.17 Hz, 10 Hz, 16.7 Hz, and 19.6 Hz filters.
	Note: Accuracy is dependent on the ADC filter selection, data format, and input noise.
<b>Repeatability (at 25°C)<sup>8</sup></b>	4.17 Hz and 10Hz filter
Thermocouple Types J, L and N	+/- 0.1°C
Thermocouple Types N (-110°C to 1300°C)	+/- 0.1°C
Thermocouple Types N (-210°C to -110°C)	+/- 0.25°C
Thermocouple Types T (-170°C to 400°C)	+/- 0.1°C
Thermocouple Types T (-270°C to -170°C)	+/- 1.5°C
Thermocouple Type K (-170°C to 1370°C)	+/- 0.1°C
Thermocouple Type K (-270°C to -170°C)	+/- 2.0°C
Thermocouple Type E (-220°C to 1000°C)	+/- 0.1°C
Thermocouple Type E (-270°C to -220°C)	+/- 1.0°C
Thermocouple Types S and R	+/- 0.4°C

<sup>8</sup> Repeatability for:

- 16.7 Hz filter is 2X the repeatability of the 4.17Hz filter
- 19.6 Hz filter is 2X the repeatability of the 4.17Hz filter
- 62 Hz filter is 4X the repeatability of the 4.17Hz filter
- 470 Hz filter is 10X the repeatability of the 4.17Hz filter

Thermocouple Type B	+/- 0.7°C
Thermocouple Type C	+/- 0.2°C
Millivolt Inputs	+/- 6.0 microvolts
Data formats	Eng units, Eng units X10, Scaled for PID, Prop. Counts, Percent of Full Scale
Input Filter	4.17 Hz, 10 Hz, 16.7 Hz, 19.6 Hz, 62 Hz and 470 Hz
<b>Channel Update Time</b>	See Module Update Time on page 4-8
Module or Single Channel Minimum	Millivolt input: 8 ms with 470 Hz filter Thermocouple input: 8 ms with 470 Hz filter, channels 2,3,4,5
Single Channel Max	Millivolt input: 246 ms with 4.17 Hz filter Thermocouple input: 246 ms with 4.17 Hz filter, channels 1, 2, 3, 4 Thermocouple input: 500 ms with 4.17 Hz filter, channels 0,5 during CJC measurement only
Module Max	Millivolt inputs only: 246 ms with 4.17 Hz filter Thermocouple or mixed Thermocouple/Millivolt inputs: 500 ms with 4.17 Hz filter (channels 0 or 5 enabled) 246ms with 4.17Hz filter (channels 0 and 5 disabled)
CJC Update time/intervals	CJC update time is 10ms and sampled once every 10 seconds
<b>Open Circuit Detection Time</b>	< 1s
<b>Isolation</b>	
Channel to Rack	500 VDC Maintained, 710 VDC for 1 minute
Channel to Channel	500 VDC Maintained, 710 VDC for 1 minute
Cable Impedance	25 ohms maximum for specified accuracy
Input Protection	Voltage Mode +/- 35VDC continuous Max Current input is limited due to input impedance
<b>Power Requirements</b>	
Internal rack +5V	150 mA maximum (continuous)
Internal rack +24V	35 mA maximum (continuous)
Thermal Dissipation	< 2 W
Distance Rating	8
Fusing	None



# Appendix B

## Using Thermocouple Junctions

This appendix describes the types of thermocouple junctions available, and explains the trade-offs in using them with the 1769sc-IT6I Isolated thermocouple/mV analog input module.



**Take care when choosing a thermocouple junction, and connecting it from the environment to the module. If you do not take adequate precautions for a given thermocouple type, the electrical isolation of the module might be compromised.**

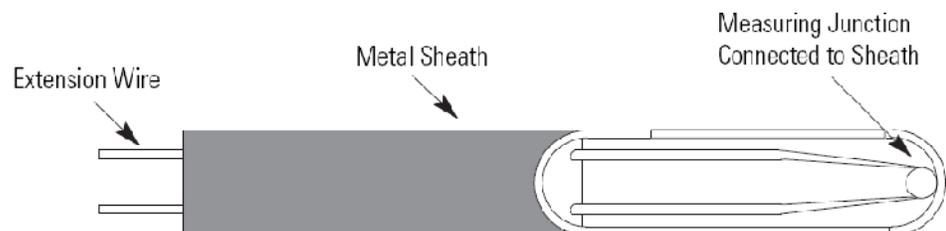
Available thermocouple junctions are:

- Grounded
- Ungrounded (isolated)
- Exposed

### Section B.1

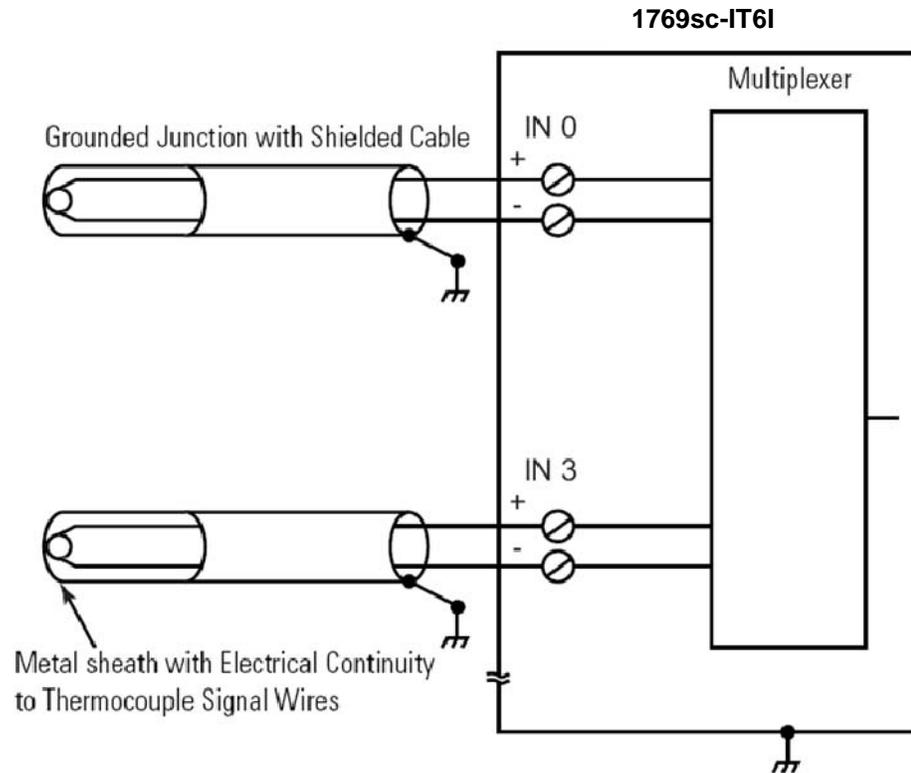
#### Using a Grounded Junction Thermocouple

With a grounded junction thermocouple, the measuring junction is physically connected to the protective sheath, forming a completely sealed integral junction. If the sheath is metal (or electrically conductive), there is electrical continuity between the junction and sheath. The junction is protected from corrosive or erosive conditions. The response time approaches that of the exposed junction type described in Using an Exposed Junction Thermocouple on page B-3.



The shield input terminals for a grounded junction thermocouple are connected together and then connected to chassis ground. Use of this thermocouple with an electrically conductive sheath removes the thermocouple signal to chassis ground isolation of the module. In addition, if multiple grounded junction thermocouples are used, the module

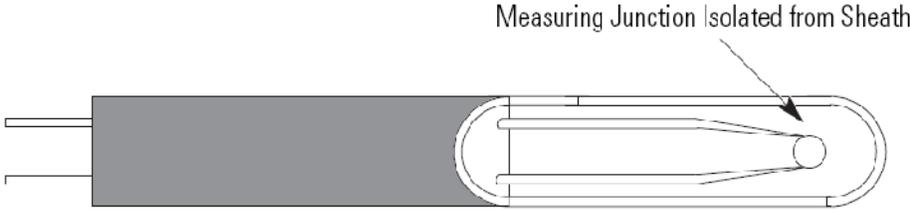
channel-to-channel isolation is removed, since there is no isolation between signal and sheath (sheaths are tied together). It should be noted that the isolation is removed even if the sheaths are connected to chassis ground at a location other than the module, since the module is connected to chassis ground.



Spectrum Controls recommends that a grounded junction thermocouple have a protective sheath made of electrically insulated material (for example, ceramic). An alternative is to float the metal sheath with respect to any path to chassis ground or to another thermocouple metal sheath. Thus, the metal sheath must be insulated from electrically conductive process material, and have all connections to chassis ground broken. Note that a floated sheath can result in a less noise-immune thermocouple signal.

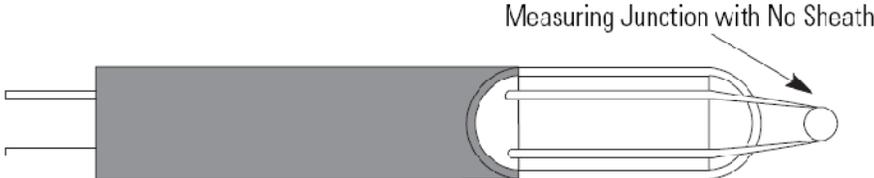
## Section B.2 Using an Ungrounded (Isolated) Junction Thermocouple

An ungrounded (isolated) junction thermocouple uses a measuring junction that is electrically isolated from the protective metal sheath. This junction type is often used in situations when noise will affect readings, as well as situations using frequent or rapid temperature cycling. For this type of thermocouple junction, the response time is longer than for the grounded junction.

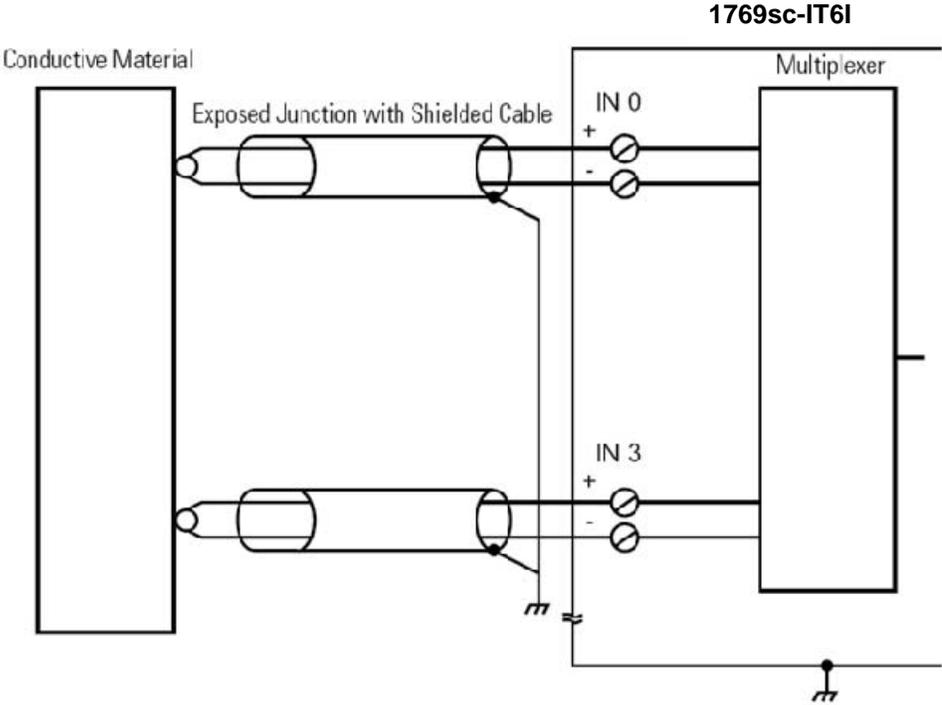


**Section B.3  
Using an Exposed  
Junction  
Thermocouple**

An exposed junction thermocouple uses a measuring junction that does not have a protective metal sheath. A thermocouple with this junction type provides the fastest response time but leaves thermocouple wires unprotected against corrosive or mechanical damage.



As shown in the next illustration, using an exposed junction thermocouple can result in removal of channel-to-channel isolation. Isolation is removed if multiple exposed thermocouples are in direct contact with electrically conductive process material.



To prevent violation of channel-to-channel isolation:

- For multiple exposed junction thermocouples, do not allow the measuring junctions to make direct contact with electrically conductive process material.
- Preferably use a single exposed junction thermocouple with multiple ungrounded junction thermocouples.
- Consider using all ungrounded junction thermocouples instead of the exposed junction type.

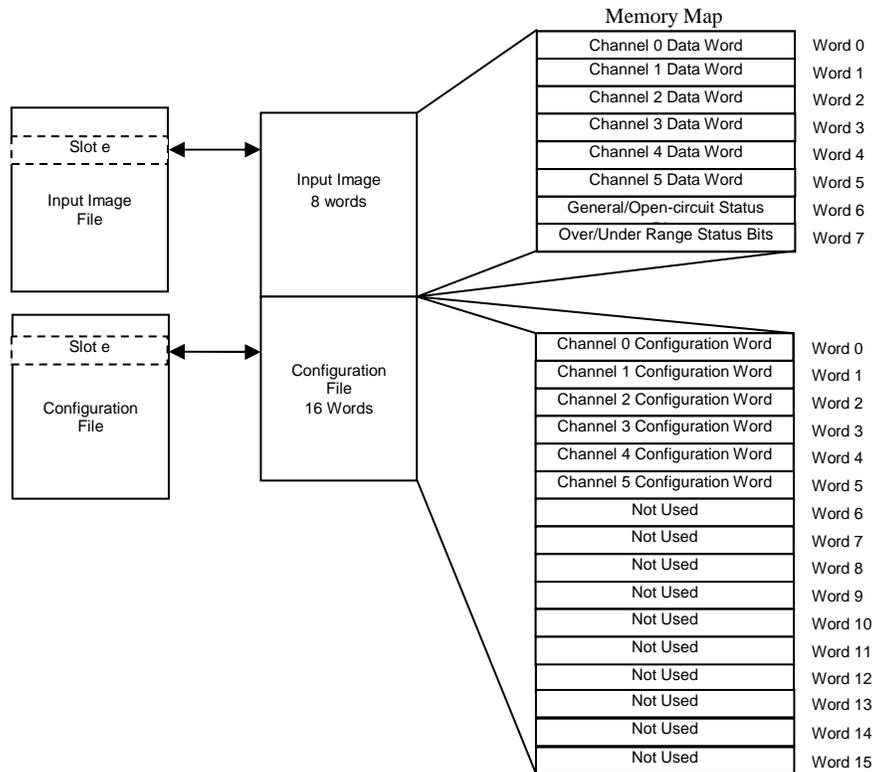
# Appendix C

## Module Configuration Using MicroLogix 1500 and RSLogix 500

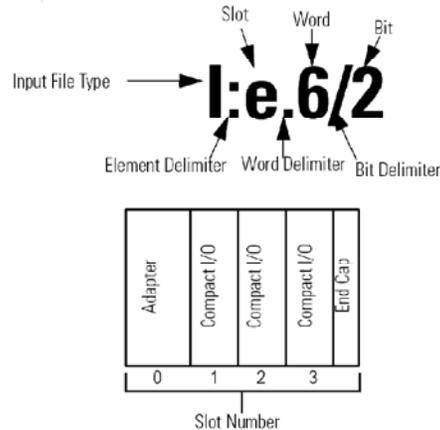
This appendix examines the 1769sc-IT6I module's addressing scheme and describes module configuration using RSLogix 500 and a MicroLogix 1500 controller.

### Section C.1 Module Addressing

The following memory map shows the input and configuration image tables for the module. Detailed information on the image table is located in Chapter 4.



For example, to obtain the general status of channel 2 of the module located in slot e, use address I:e.6/2.



**Note:** The end-cap does not use a slot address.

### C.1.1 1769sc-IT6I Configuration File

The configuration file contains information you use to define the way a specific channel functions. The configuration file is explained in more detail in Configuring Channels on page 4-2.

The configuration file is modified using the programming software configuration screen. For an example of module configuration using RSLogix 500, see Configuring the 1769sc-IT6I in a MicroLogix 1500 System on page C-2.

**Table C-1 (Software Configuration Channel Defaults)<sup>9</sup>**

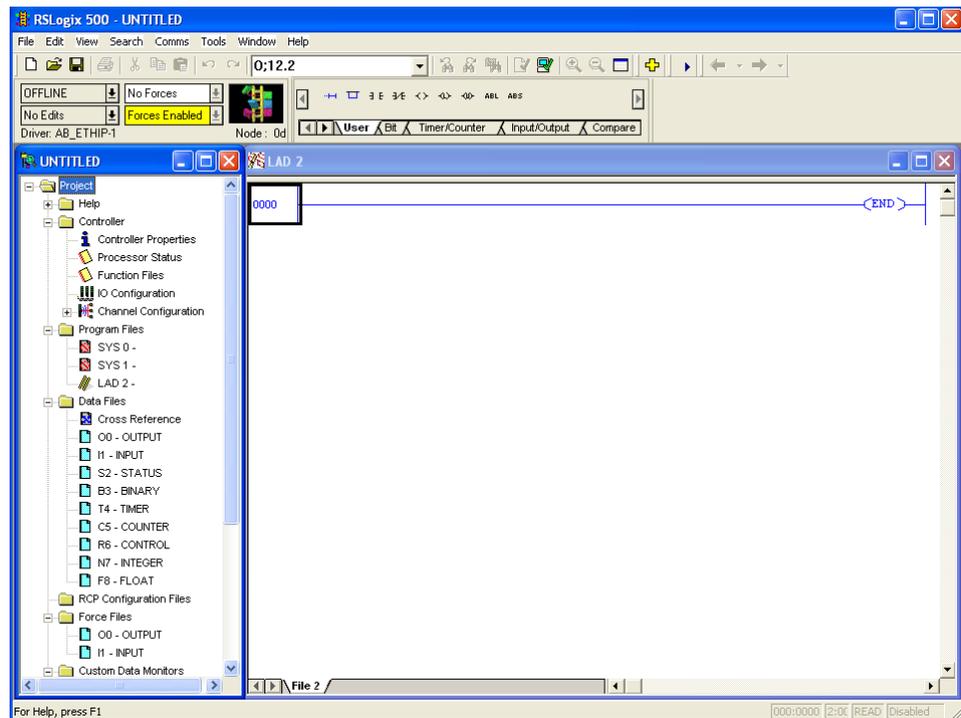
Parameter	Default Setting
Filter Frequency	10 Hz
Display CJC Temperature	No
Open-Circuit Response	Upscale
Temperature Units	C°
Input Type	J Type Thermocouple
Data Format	Raw/Proportional
Disable/Enable Channel	Enable

## Section C.2 Configuring the 1769sc-IT6I in a MicroLogix 1500 System

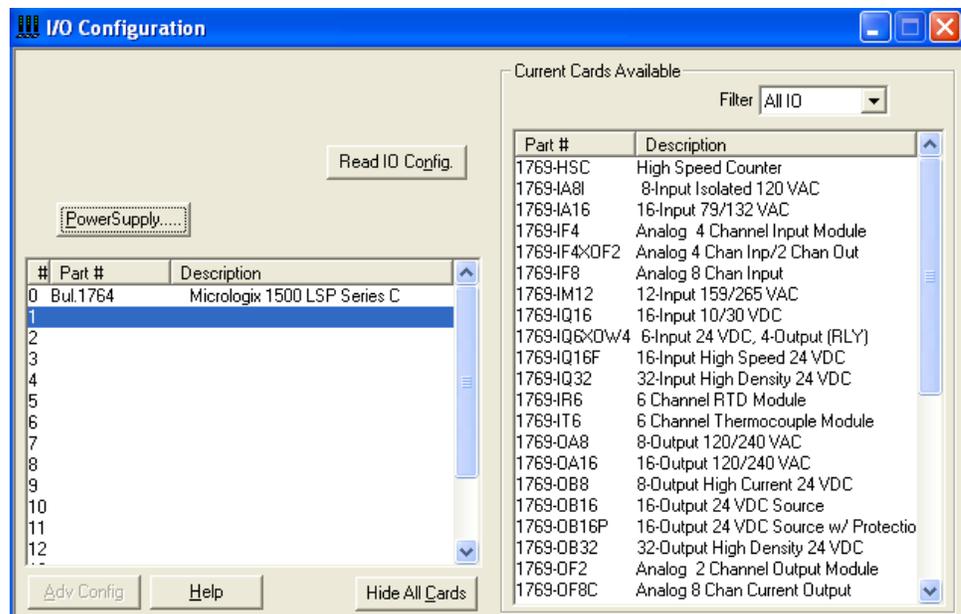
This example takes you through configuring your 1769sc-IT6I Isolated thermocouple/mV input module with RSLogix 500 programming software, assumes your module is installed as expansion I/O in a MicroLogix 1500 system, and that RSLinx™ is properly configured and a communications link has been established between the MicroLogix processor and RSLogix 500.

<sup>9</sup> May be overridden by the software.

Start RSLogix and create a MicroLogix 1500 application. The following screen appears:



While offline, double-click on the IO Configuration icon under the controller folder and the following IO Configuration screen appears.



This screen allows you to manually enter expansion modules into expansion slots, or to automatically read the configuration of the controller. In this example we will manually insert the module using the “other” option.

Click on an empty slot in the chassis. Under the “Current Cards Available” list, select the “other” option. The following screen should appear.

"Other" type IO card

Vendor ID:

Product Type:

Product Code:

Series/Major Rev/Minor Rev:

Input Words:

Output Words:

Input Bits:

Output Bits:

Extra Data Length:

Ignore Configuration Error:

OK

Cancel

Enter the settings from the table below.

**Table C-2 (Module ID Codes)**

Vendor ID	58
Product Type	10
Product Code	100
Series	A
Input Words	8
Output Words	0
Extra Data Length	16

After entering the data from the table above, the screen should look like the one shown below.

"Other" type IO card

Vendor ID:

Product Type:

Product Code:

Series/Major Rev/Minor Rev:

Input Words:

Output Words:

Input Bits:

Output Bits:

Extra Data Length:

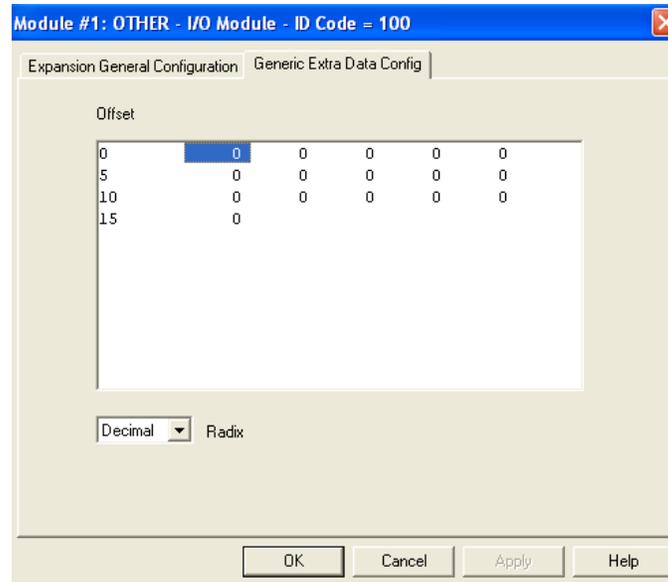
Ignore Configuration Error:

OK

Cancel

Click the "OK" button when finished.

To complete the configuration, double-click on the module from the IO configuration screen and select the "Generic Extra Data Confi" tab. The screen below should appear.



Enter the decimal equivalent of each configuration word. There are a total of 13 words that need to be configured. The module default settings are used if all the configuration words are left at zero. Refer to Chapter 4 for a complete description of each configuration word.

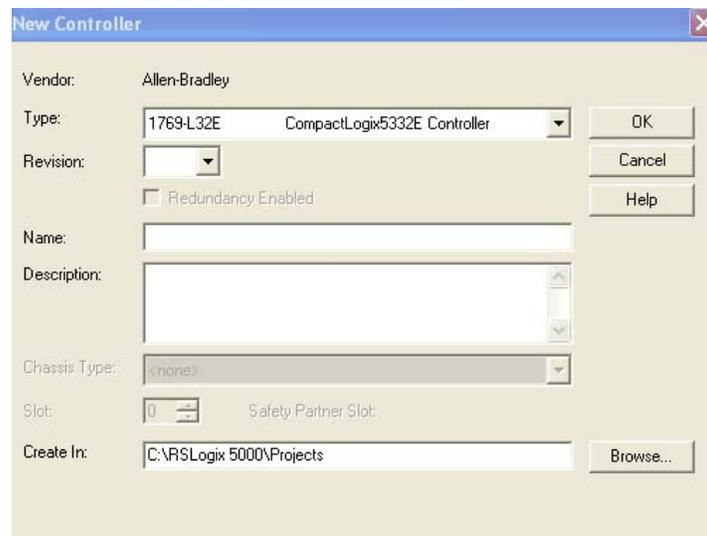


# Appendix D

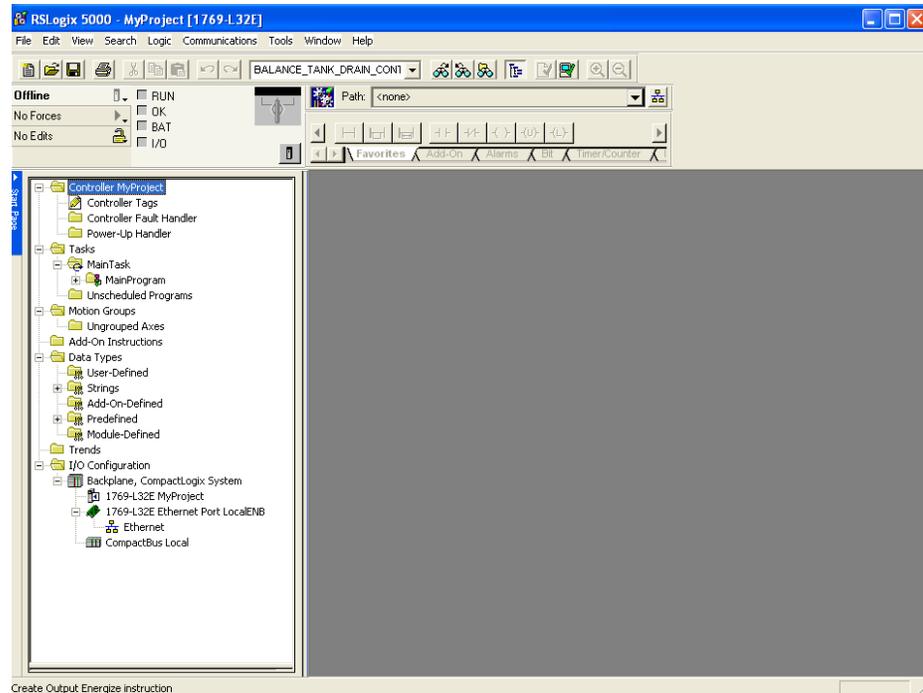
## Configuring the IT6I for CompactLogix Controllers in RSLogix 5000

The procedure in this example is used only when your 1769sc-IT6I Isolated Thermocouple module add-on profile is not available. An add-on profile for the 1769sc-IT6I will be made available on our website ([www.spectrumcontrols.com](http://www.spectrumcontrols.com)) after the initial release of the module.

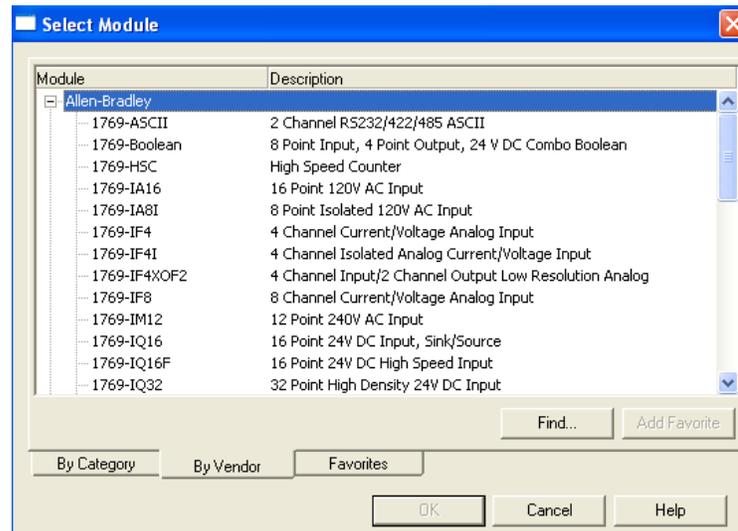
To configure a 1769sc-IT6I Isolated Thermocouple module for a CompactLogix Controller using RSLogix 5000 with the 1769 Generic Profile, begin a new project in RSLogix 5000. Click on the new project icon or on the FILE pull-down menu and select NEW. The following screen appears:



Choose your controller type and enter a name for your project, then click OK. The following main RSLogix 5000 screen appears:



In the Controller Organizer on the left of the screen, right click on “CompactBus Local”, select New Module, and the following screen appears:



This screen is used to narrow your search for I/O modules to configure into your system. From the list select the “Generic 1769 Module”. Click the OK button and the following default Generic Profile screen appears:

First, select the Comm Format (“Input Data – INT” for the 1769sc-IT6I), then fill in the name field. For this example, “IT6I” is used to help identify the module type in the Controller Organizer. The Description field is optional and may be used to provide more details concerning this I/O module in your application.

The slot number must be selected next, although it will begin with the first available slot number, 1, and increments automatically for each subsequent Generic Profile you configure. For this example, the 1769sc-IT6I Isolated Thermocouple module is located in slot 1.

The Comm Format, Assembly Instance and Size values are listed in the following table for the 1769sc-IT6I Thermocouple module:

**Table D-1 (Generic Profile Settings)**

1769 I/O Module	Comm. Format	Parameter	Assembly Instance	Size (16-Bit)
IT6I	Input Data - INT	Input	101	8
		Output	104	0
		Config.	102	16

Enter the Assembly Instance numbers and their associated sizes for the 1769sc-IT6I module into the Generic Profile. When complete, the Generic Profile for a 1769sc-IT6I module should look like the following:

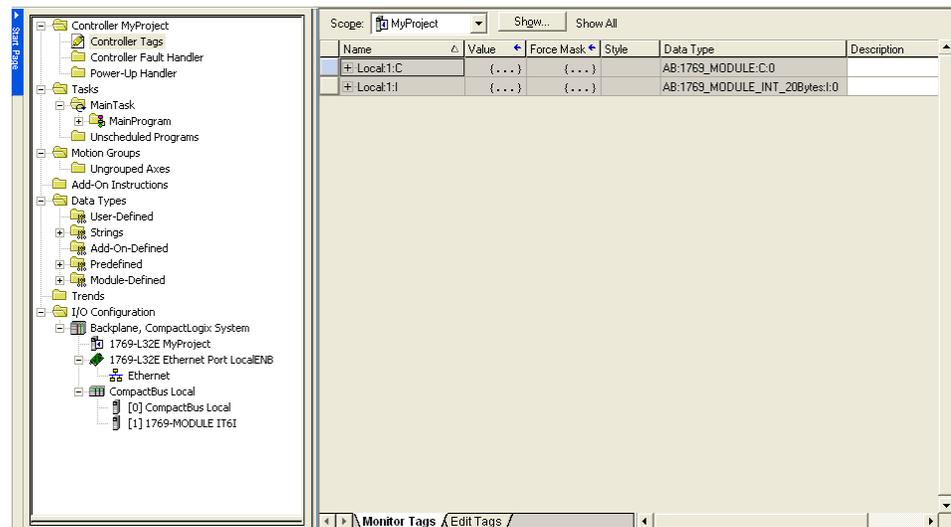
At this point you may click “Finish” to complete the configuration of your I/O module. Configure each I/O module in this manner.

### Section D.3 Configuring I/O Modules

Once you have created a Generic Profile for 1769sc-IT6I Isolated Thermocouple module, you must enter configuration information into the tag database that is automatically created from the Generic Profile information you entered. This configuration information is downloaded to each module at program download, at power up, and when an inhibited module is uninhibited.

First, enter the Controller Tag database by double-clicking on Controller Tags in the upper portion of the Controller Organizer.

Based on the Generic Profile created earlier for 1769sc- IT6I module, the Controller Tags screen looks like the following:



Tag addresses are automatically created for configured I/O modules. All local I/O addresses are preceded by the word Local. These addresses have the following format:

- Input Data: Local:s:I
- Configuration Data: Local:s:C

Where s is the slot number assigned to the I/O modules in the Generic Profiles.

In order to configure an I/O module, you must open up the configuration tag for that module by clicking on the plus sign to the left of its configuration tag in the Controller Tag data base.

## Section D.4 Configuring a 1769sc-IT6I Isolated Thermocouple Module

To configure the 1769sc-IT6I module in slot 1, click on the plus sign left of Local:1:C. Configuration data is entered under the Local:1:C.Data tag. Click the plus sign to the left of Local:1:C.Data to reveal the 13 integer data words where configuration data may be entered for the 1769sc-IT6I module. The tag addresses for these 13 words are Local:1:C.Data[0] through Local:1:C.Data[12]. Only the first 13 words of the configuration file apply.

The first 6 configuration words, 0 through 5, apply to 1769sc-IT6I channels 0 through 5 respectively. All 6 words configure the same parameters for the 6 different channels. The seventh configuration word is unused. The following table shows the various parameters to configure in each channel configuration word. For a complete description of each of these parameters and the choices available for each of them, see Configuration Data File on page 4-2.

Bit(s) (Words 0 to 5)	Parameter
0 to 2	Filter Frequency
3	Not Used
4	Display CJC Temperature
5 to 6	Open Circuit Condition
7	Temperature Units
8 to 11	Input Type
12 to 14	Data Format
15	Enable Channel

Once you have entered your configuration selections for each channel, enter your program logic, save your project, and download it to your CompactLogix Controller. Your module configuration data is downloaded to your I/O modules at this time. Your 1769sc-IT6I module input data is located in the following tag addresses when the controller is in Run mode.

1769sc-IT6I Channel	Tag Address
0	Local:1:I.Data[0]
1	Local:1:I.Data[1]
2	Local:1:I.Data[2]
3	Local:1:I.Data[3]
4	Local:1:I.Data[4]
5	Local:1:I.Data[5]

Where 1 represents the slot number of the 1769sc-IT6I module.



# Appendix E

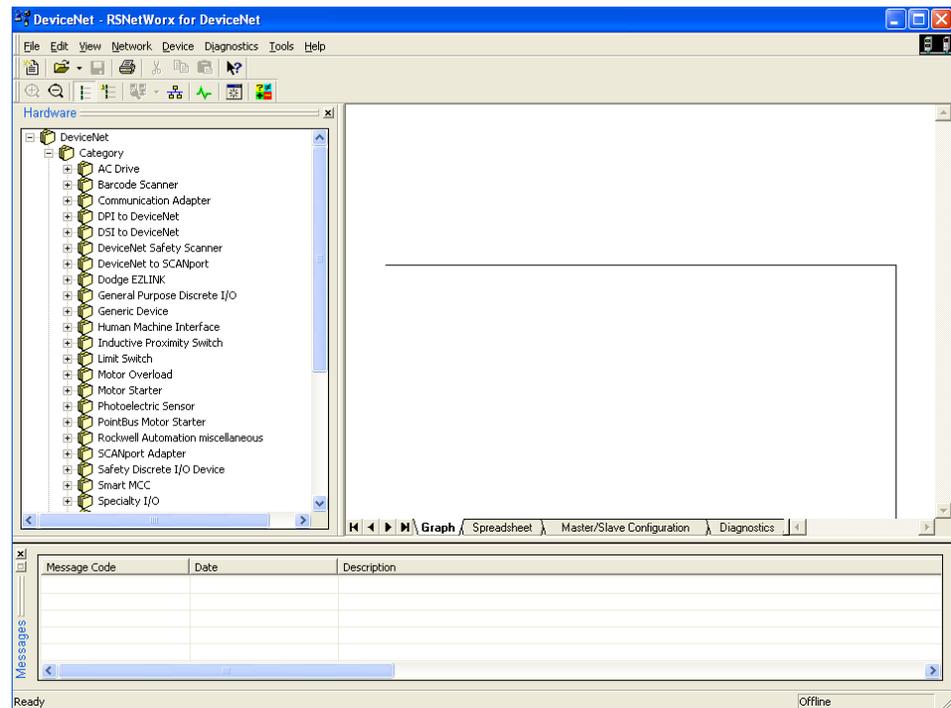
## Configuring the IT6I to be Used with a 1769-ADN DeviceNet Adapter

This application example assumes your 1769sc-IT6I isolated thermocouple input module is in a remote DeviceNet system controlled by a 1769-ADN DeviceNet adapter. RSNetworkx for DeviceNet is not only used to configure your DeviceNet network, but is also used to configure individual I/O modules in remote DeviceNet adapter systems.

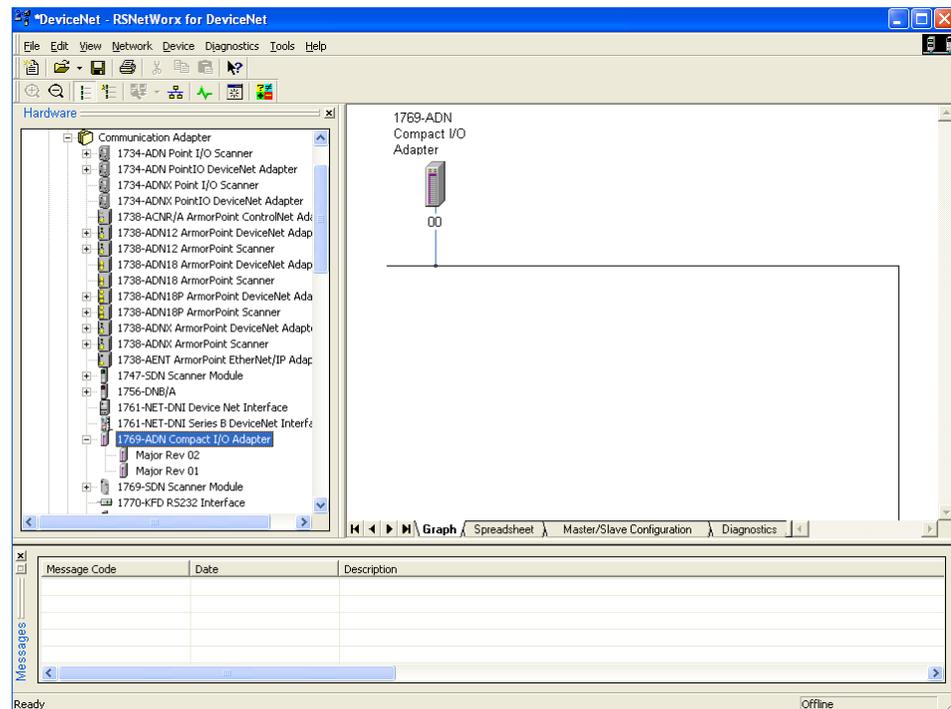
For additional information on configuring your DeviceNet scanners and adapters, please refer to the documentation for these products, including the *Compact™ I/O 1769-ADN DeviceNet Adapter user's manual*, publication 1769-UM001A-US-P. The adapter manual also contains examples on how to modify I/O module configuration with Explicit Messages while the system is running. Whether you are configuring an I/O module offline and downloading to the adapter or you accomplish the configuration online, the 1769sc-IT6I isolated thermocouple module must be configured prior to configuring the DeviceNet adapter in the DeviceNet scanner's scanlist. The only ways to configure or re-configure I/O modules after the adapter is placed in the scanner's scanlist are via Explicit Messages or by removing the adapter from the scanner's scanlist, modifying the configuration of the I/O module, then adding the adapter back into the scanner's scanlist.

This example takes you through configuring your 1769sc-IT6I isolated thermocouple input module with RSNetworkx for DeviceNet, version 6.00 or later, prior to adding your adapter to the scanlist of your DeviceNet scanner.

Start RSNetworx for DeviceNet. The following screen appears:

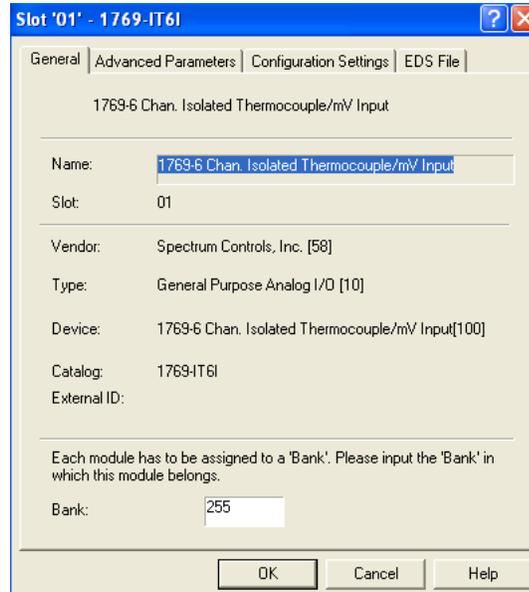


In the left column under Category, click on the “+” sign next to Communication Adapters. The list of products under Communication Adapters contains the 1769-ADN/A. Should this adapter not appear under Communication Adapters, your RSNetworx for DeviceNet software is not version 6.00 or later. To continue, you will need to obtain an upgrade for your software. If the 1769-ADN/A does appear, double-click it and it will be placed on the network to the right as shown below.





double-click on the first empty slot after the 1769-ADN. From the module list on the left, select the 1769sc-IT6I. The module should appear in the empty slot. Double-click on the 1769sc-IT6I module in slot 1 and the following 1769sc-IT6I configuration screen appears:



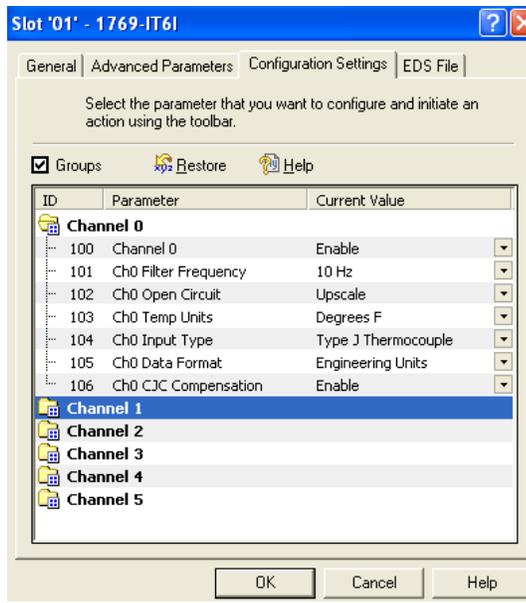
Enter 1 into the bank field at the bottom of the screen.

By default, the 1769sc-IT6I module contains eight input words and no output words. Click on the “Advanced Parameters” tab. This screen allows you to change the input data size. You can select from 1 word all the way up to the default, which is 8 words. Click OK or CANCEL to exit this screen and return to the Configuration screen.

You may leave the Electronic Keying to “Compatible Module”. It is not recommended to Disable Keying, but if you are not sure of the exact revision of your module, selecting Compatible Module requires that a 1769sc-IT6I module be installed in slot 1.

Click on the “Configuration Settings” tab. Each of the 6 thermocouple input channels are enabled by default. To disable a channel, double-click on the channel number and change the enable state to disabled. Go ahead and finish the module configuration by choosing your Data Format, Input Type, Temperature Units, Open-Circuit Condition and Filter Frequency for each channel you intend to use. See Channel Configuration on page 4-3 for a complete description of each of these configuration categories.

In this example, channels 0 through 5 are being used. All 6 channels have J-type thermocouples connected. A 10Hz Filter Frequency (the default) is used for all 6 channels, along with receiving the thermocouple input data in Engineering Units. We also chose °F for the Temperature Units. This selection, coupled with choosing Engineering Units for the data format allows us to receive the data into the controller’s tag database as actual temperature data in °F. The Open-Circuit Detection is Upscale. This means that if an open-circuit condition should occur at any of the 6 thermocouple input channels, the input value for that channel is the full-scale value selected by the input type and data format. We can therefore monitor each channel for full scale (open-circuit) as well as monitor the Open-Circuit bits in Input word 6, for each channel. When complete, the configuration screen looks like the following:



Click OK and your configuration for the 1769sc-IT6I isolated thermocouple input module is complete.

Refer to your *Compact™ I/O 1769-ADN DeviceNet Adapter user's manual*, publication number 1769-UM001A-US-P, for information concerning DeviceNet network configuration and operation.



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## Getting Technical Assistance

Note that your module contains electronic components which are susceptible to damage from electrostatic discharge (ESD). An electrostatic charge can accumulate on the surface of ordinary plastic wrapping or cushioning material. **In the unlikely event that the module should need to be returned to Spectrum Controls, please ensure that the unit is enclosed in approved ESD packaging (such as static-shielding / metalized bag or black conductive container).** Spectrum Controls 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:

USA - 425-746-9481

## Declaration of Conformity

Available upon request



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