



Thermocouple/mV Isolated Input Module

Cat. No. 1746-INT4

Contents

Use this document as a guide to install and wire the 1746-INT4 module. If you need more detailed information, refer to the *Thermocouple/mV Isolated Input Module User Manual*, publication 1746-6.16.

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Important User Information

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

In no event will Rockwell Automation be responsible or liable for indirect or consequential damage resulting from the use or application of these products.

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

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

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Throughout this publication, notes may be used to make you aware of safety considerations. The following annotations and their accompanying statements help you to identify a potential hazard, avoid a potential hazard, and recognize the consequences of a potential hazard:

WARNING



Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION



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

IMPORTANT

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

ATTENTION

Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC publication 60664-1), at altitudes up to 2000 meters without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR Publication 11. Without appropriate precautions, there may be potential difficulties ensuring electromagnetic compatibility in other environments due to conducted as well as radiated disturbance.

This equipment is supplied as "open type" equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

See NEMA Standards publication 250 and IEC publication 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure. Also, see the appropriate sections in this publication, as well as the Allen-Bradley publication 1770-4.1 ("Industrial Automation Wiring and Grounding Guidelines"), for additional installation requirements pertaining to this equipment.

Prevent Electrostatic Discharge

ATTENTION

This equipment is sensitive to electrostatic discharge which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- touch a grounded object to discharge potential static
- wear an approved grounding wrist strap
- do not touch connectors or pins on component boards
- do not touch circuit components inside the equipment
- if available, use a static-safe workstation
- when not in use, store the equipment in appropriate static-safe packaging

How to Get the Related User Manual

The following table describes the related user manual that is available for this module. To order a copy or to view or download an online version, visit The Automation Bookstore at: **www.theautomationbookstore.com**

For more detailed information about:	See this document:	Publication number:
Installation, configuration, programming, diagnostics and troubleshooting	<i>Thermocouple.mV Isolated Input Module User Manual</i>	1746-6.16

Unpack the Module

Unpack the module making sure that the contents include:

- module (catalog number 1746-INT4)
- factory-installed removable terminal block with CJC sensors attached (catalog number 1746-RT32)
- this *Quick Start* document (publication number 1746-QS002B-EN-P)

If the contents are incomplete, contact your local Rockwell Automation representative for assistance.

Review Power Requirements

Review the power requirements of the modules drawing power from the chassis power supply.

1. The fixed 2-slot chassis supports 2 1746-INT4 modules. If combining an INT4 module with a different type of module, refer to *Considerations for a Fixed Controller* in Chapter 3 of the user manual.
2. For a modular system, compute the total load on the system power supply using the procedure described in the *SLC Installation and Operation Manual for Modular Controllers* (publication number 1747-UM011) or the *SLC 500 Family System Overview* (publication 1747-SO001).

TIP

For more detailed information on these procedures, refer to **Chapter 3** (*Installation and Wiring*) and **Appendix A** (*Module Specifications*) of the user manual, publication 1746-6.16.

Install the Module and Connect the Thermocouples

WARNING



If you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Insert/remove the module into/from the I/O chassis (slot 1 in this example procedure).

Important:

Thermocouple inputs are highly susceptible to electrical noise.

To minimize interference:

Place processor and I/O chassis in an industrial enclosure.

Keep signal wires as far from power and load lines as possible.

Use shielded, twisted-pair thermocouple extension wire.

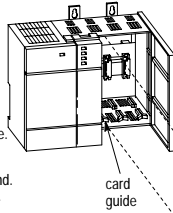
Ground each shield only at one end.

Use correct thermocouple polarity.

Keep all unshielded leads *short*.

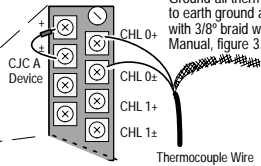
Connect the terminal block GND

(#18) to nearest I/O chassis mtg. bolt with 12 gauge stranded wire.



Connect thermocouple wires to channels 0-3. We show an example for channel 0. Make sure both cold junction compensation (CJC) devices are securely attached with correct polarity.

Terminal Block



Important: Ground all thermocouple shields to earth ground at I/O chassis with 3/8" braid wire. See User Manual, figure 3.2.

To install your module into the chassis:

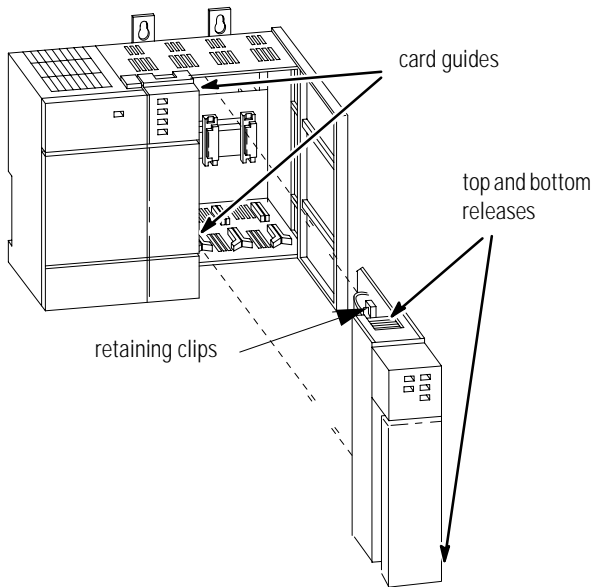
1. Turn off the chassis power supply.

WARNING



If you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

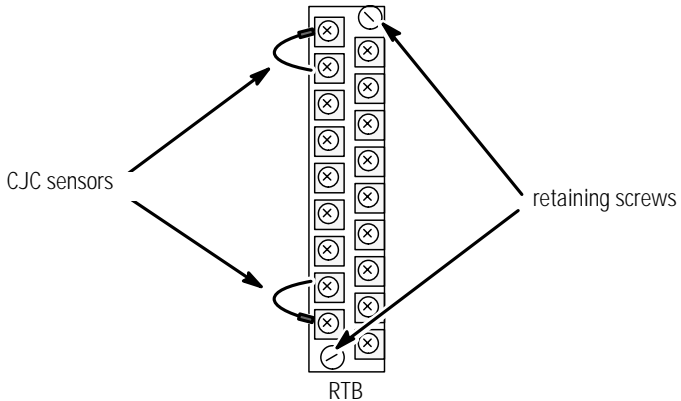
2. Align the circuit board of the thermocouple module with the card guides located at the top and bottom of the chassis.
3. Slide the module into the chassis until both top and bottom retaining clips are secured. Apply firm even pressure on the module to attach it to its backplane connector. Never force the module into the slot.
4. Cover unused slots with the card slot filler, catalog number 1746-N2.
5. To remove, press the releases at the top and bottom of the module, and slide the module out of the chassis slot.



Remove/Install the Removable Terminal Block

The module ships with an attached an 18-position removable terminal block (RTB). When you install the module, it is not necessary to remove the RTB. If you ever need to remove it, follow this procedure:

1. Alternately loosen the two retaining screws to avoid cracking the RTB.



2. Grasp the RTB at the top and bottom and pull outward and down. When removing the RTB, be careful not to damage the CJC sensors.
3. Use the write-on label to identify the slot, chassis and module type.

SLOT _____	RACK _____
MODULE _____	

To install the RTB:

1. Remove power from the SLC 500 chassis.

WARNING



When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

2. Make certain the color of the RTB matches the color band on the module.
-

ATTENTION

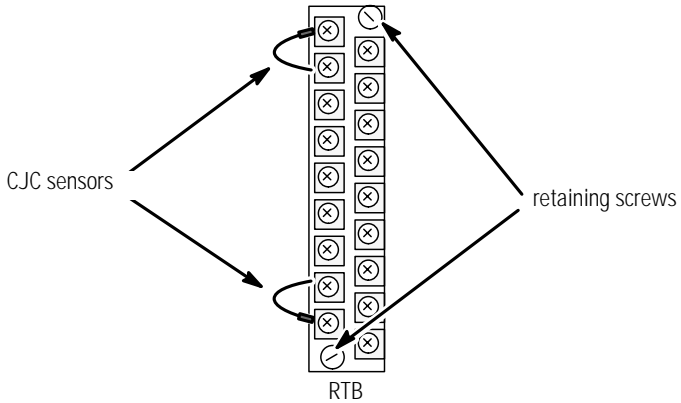
Inserting a wired RTB on an incorrect module can damage the module's circuitry when power is restored.



3. View the write-on label to identify the slot, chassis and module type.

SLOT _____	RACK _____
MODULE _____	

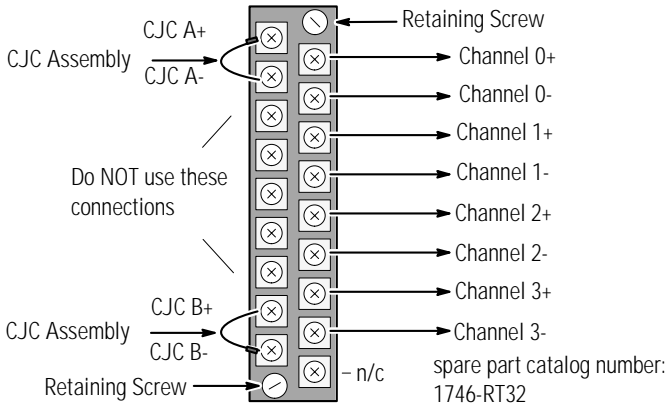
4. Align the RTB retaining screws with the mating connector on the module. Be careful not to damage the CJC sensors.



5. Press the RTB firmly onto the connector contacts.
6. Alternately tighten the two retaining screws to avoid cracking the RTB. Tighten to a maximum 6-8 inch-pounds.

Wire the RTB

Use the following illustration to wire the RTB:



Cold Junction Compensation (CJC)

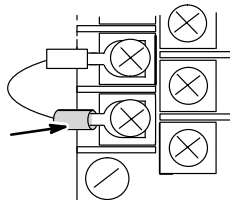
ATTENTION



Do not remove or loosen the cold junction compensating thermistors located on the terminal block. **Both thermistors are critical to ensure accurate thermocouple input readings at each channel.** The module will not operate in the thermocouple mode if a thermistor is removed

In case of accidental removal of one or both thermistors (part number A40845-221-01), replace them by connecting them across the CJC terminals located at the top and/or bottom left side of the terminal block. Always connect the red lug to the (+) terminal (to CJC A+ or CJC B+) as shown below.

Always attach red lug to the CJC+ terminal



CJC Sensor part number
A40845-221-01

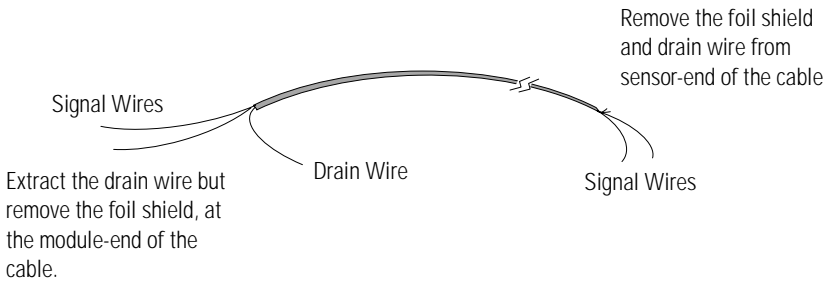
Wiring Guidelines

Follow these guidelines when planning your system wiring.

- To limit the pickup of electrical noise, keep thermocouple and millivolt signal wires away from power and load lines.
- For high immunity to electrical noise, use Alpha 5121 (shielded, twisted pair) or equivalent wire for millivolt sensors; or use shielded, twisted pair thermocouple extension lead wire specified by the thermocouple manufacturer. Using the incorrect type of thermocouple extension wire or not following the correct polarity may cause invalid readings. See IEEE Std. 518, Section 6.4.2.7 or contact your sensor manufacturer for additional details.
- When trimming cable leads, minimize the length of unshielded wires.
- Ground the shield drain wire at only one end of the cable. The preferred location is at the I/O chassis ground.
- For maximum noise reduction, use 3/8 inch braid wire to connect cable shields to the nearest I/O chassis mounting bolt. Then connect the I/O chassis to earth ground. These connections are a requirement regardless of cable type.
- Tighten terminal screws to 6-8 inch-pounds. Excessive tightening can strip the screw.
- The open-circuit detector generates approximately 20 nano-amperes into the thermocouple cable. A total lead resistance of 25 ohms (12.5 one-way) will produce 0.5 mV of error.
- Follow system grounding and wiring guidelines found in your SLC 500 Modular Hardware Style User Manual, publication 1747-UM011.

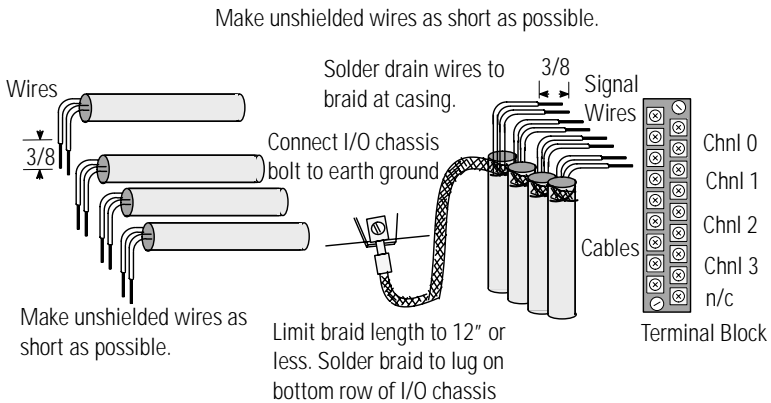
Preparing and Wiring the Cables

To prepare and connect cable leads and drain wires, follow these steps:



1. At each end of the cable, strip some casing to expose individual wires.
2. Trim signal wires to 5-inch lengths beyond the cable casing. Strip about 3/16 inch (4.76 mm) of insulation to expose the ends of the wires.
3. At the module-end of the cables:
 - extract the drain wire and signal wires
 - remove the foil shield
 - bundle the input cables with a cable strap
4. Connect drain wires together and solder them to a 3/8" wire braid, 12" long. Keep drain wires as short as possible.
5. Connect the 3/8" wire braid to the nearest chassis mounting bolt.
6. Connect the signal wires of each channel to the terminal block.

7. At the source-end of cables from mV devices (see following figure):
- remove the drain wire and foil shield
 - apply shrink wrap as an option
 - connect to mV devices keeping the leads short

**IMPORTANT**

If noise persists, try grounding the opposite end of the cable. Ground one end only.

Configure the Software

With your programming software already loaded and your computer set for off-line programming:

1. Identify the type of SLC processor and operating system on the PROG DIRECTORY FOR PROCESSORS screen.
2. With the SLC system installed and wired, use the READ CONFIG feature and follow the prompts to configure the I/O.
3. Enter the rack configuration.
4. Select the type of module in each slot. If 1746-INT4 is not listed, enter ID code 3515 for OTHER at the bottom of the list.
5. Exit and save to file.

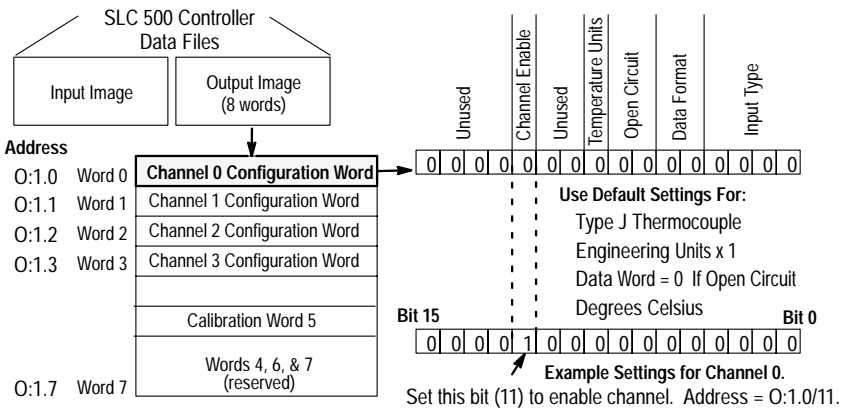
No manual entry of special I/O configuration (SPIO CONFIG) information is required. Module ID code automatically assigns the number of input and output words required by the module. Refer to your configuration software documentation for more information..

TIP

For more detailed information on these procedures, refer to **Chapter 5** (*Accessing Files to Configure I/O*) of the user manual.

Set Up Channel 0

Determine the operating parameters for channel 0. The following example shows the channel 0 configuration word defined with all defaults (0) except for the channel enable (bit 11-1). The module is installed in slot 1. For details on channel configuration, refer to the channel configuration worksheet on page 19.

**TIP**

For more detailed information on these procedures, refer to **Chapter 6** (*Channel Configuration, Data and Status*) of the user manual.

Program the Transfer of the Configuration Word

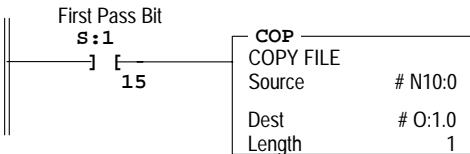
Program the transfer of the configuration word (from previous section) to the module:

1. Using the memory map function, create integer file N10. Integer file N10 should contain one element for each channel used. For this example, we used N10:0.
2. Enter configuration parameters for channel 0 (from previous section) into N10:0. In this example, all the bits of N10:0 are zero except for the channel enable bit (N10:0/11).
3. Program a ladder logic instruction to copy the contents of N10:0 to output word O:1.0.

Data Table Display of Integer File N10:0

address	15	data	0	address	15	data	0
N10:0	0000	1000	0000	0000			

Ladder Logic to Transfer N10:0 to the Module:



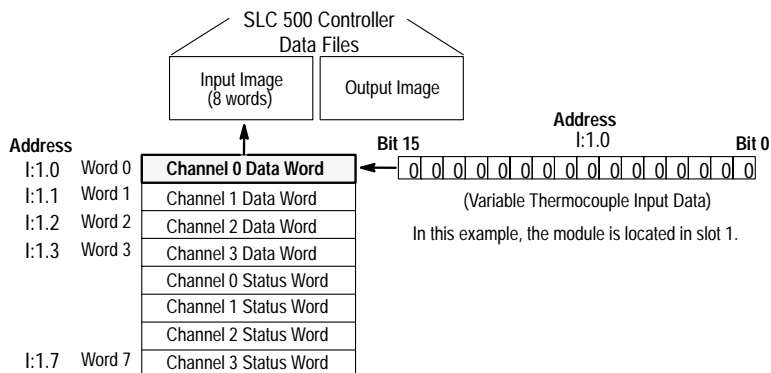
On power up, the first pass bit (S:1/15) is set for one scan, enabling the COPY instruction to transfer the configuration word to the processor's output image table. From there it is transferred to the module in the processor's I/O scan.

TIP

For more detailed information on these procedures, refer to **Chapter 7 (Ladder Programming Examples)** and **Chapter 9 (Application Programming Examples)** of the user manual.

Write Ladder Logic to Process Input Data

Write ladder logic to process the thermocouple input data for your application:

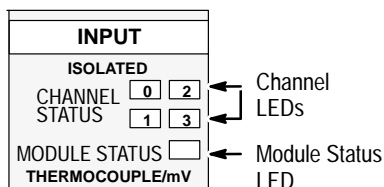


TIP

For more detailed information on these procedures, refer to **Chapter 7** (*Ladder Programming Examples*) and **Chapter 9** (*Application Programming Examples*) of the user manual.

Apply Power and Download Your Program

Apply power. Download your program to the SLC and put the controller into RUN mode. In this example, during a normal startup, the module status LED and channel status 0 LED illuminate.



If channel LED is blinking:

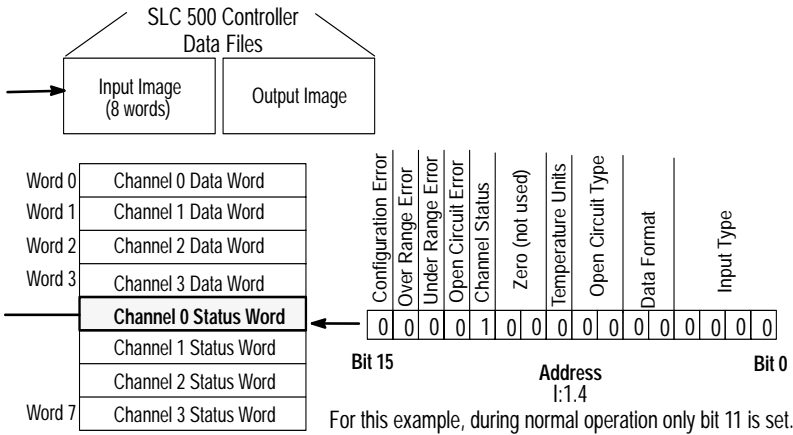
Module detected:	and status word:
open circuit	bit 12 = 1
under range	bit 13 = 1
over range	bit 14 = 1
config error	bit 15 = 1

TIP

For more detailed information on these procedures, refer to **Chapter 8** (*Module Diagnostics and Troubleshooting*) of the user manual.



Troubleshoot the Module

Monitor the status of input channel 0 to determine its configuration setting and operational status. This is useful for troubleshooting when the flashing channel LED indicates that an error has been flagged. If the module status LED is off, or if the channel 0 LED is off or flashing, refer to step 8.



TIP

For more detailed information on these procedures, refer to **Chapter 8** (*Module Diagnostics and Troubleshooting*) of the user manual.

<p>The following information applies when operating this equipment in hazardous locations:</p>	<p>Informations sur l'utilisation de cet équipement en environnements dangereux :</p>
<p>Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.</p>	<p>Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.</p>
<p>WARNING</p> 	<p>EXPLOSION HAZARD</p> <ul style="list-style-type: none"> Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. Substitution of components may impair suitability for Class I, Division 2. If this product contains batteries, they must only be changed in an area known to be nonhazardous.
<p>AVERTISSEMENT</p> 	<p>RISQUE D'EXPLOSION</p> <ul style="list-style-type: none"> Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. La substitution de composants peut rendre cet équipement inadapte à une utilisation en environnement de Classe I, Division 2. S'assurer que l'environnement est classé non dangereux avant de changer les piles.

Specifications

Module Location	SLC chassis - any I/O module slot except 0
Input from System Backplane	5Vdc @ 0.110 A, 24Vdc @ 0.085A
Thermocouple Types	b, c, d, e, j, k, n, r, s, t
Input Voltage	-50 to +50mV and -100 to +100mV
Number of Channels	4 (backplane and channel-to-channel isolated)
A/D Conversion Method	Sigma-Delta modulation
Input Filtering	Analog filter with low-pass digital filter
Normal mode rejection between [+] input and [-] input	Greater than 50dB @ 50Hz Greater than 60dB @ 60Hz
Common mode rejection between inputs and chassis ground	Greater than 120dB @ 50/60 Hz with 1K ohm imbalance
Channel bandwidth (-3db)	8Hz
Calibration	Once every six months
Isolation	Tested to 1000Vac for 60 sec. between channels and between user connections and backplane connections
Operating Temperature	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bc, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): 0-60°C (32-140°F)
Storage Temperature	IEC 60068-2-1 (Test Ab, Un-packaged Non-operating Cold), IEC 60068-2-2 (Test Bc, Un-packaged Non-operating Dry Heat), IEC 60068-2-14 (Test Na, Un-packaged Non-operating Thermal Shock): -40 to 85°C (-40 to 185°F)
Relative Humidity	IEC 60068-2-30 (Test Db, Un-packaged Non-operating Damp Heat): 5-95% non condensing
Required Terminal Block	Cat. No. 1746-RT32
Wiring Wire Category ¹ Torque	24-14 AWG 2 6-8 in-lbs.
Enclosure Type Rating	None (open style)
Certifications ² (when product is marked)	UL UL Listed Industrial Control Equipment CSA CSA Certified Process Control Equipment CSA CSA Certified Process Control Equipment for Class I, Division 2 Group A,B,C,D Hazardous Locations CE European Union 89/336/EEC EMC Directive, compliant with: EN 50082-2: Industrial Immunity EN 61326: Meas./Control/Lab., Industrial Requirements EN 61000-6-2: Industrial Immunity EN 61000-6-4: Industrial Emissions C-Tick Australian Radiocommunications Act, compliant with: AS/NZS 2064: Industrial Emissions
User Manual	Publication 1746-6.16, Thermocouple/mV Isolated Input Module User Manual

¹Use this conductor category information for planning conductor routing as described in publication 1770-4.1, *Industrial Automation Wiring and Grounding Guidelines*.

²See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates, and other certification details.

Channel Configuration Worksheet

Channel Configuration Word (O:e.0 through O:e.3) - Bit Descriptions

Bit(s)	Define	To Select	Set these bits in the Channel Configuration Word																Description	
			15-12	11	10	9	8	7	6	5	4	3	2	1	0					
0-3	Input Type	TC Type J														0	0	0	0	Project _____ Slot Number _____ Channel Number _____ Configure the channel for the input type connected to it. Valid inputs are thermocouples and analog input signals of +50mV and +100mV. You can configure the channel to read the cold-junction (CJC) temperature. When reading the CJC temperature, the channel ignores the physical input signal.
		TC Type K														0	0	0	1	
		TC Type T														0	0	1	0	
		TC Type E														0	0	1	1	
		TC Type R														0	1	0	0	
		TC Type S														0	1	0	1	
		TC Type B														0	1	1	0	
		TC Type N														0	1	1	1	
		50mV														1	0	0	0	
		100mV														1	0	0	1	
		TC Type C														1	0	1	0	
		TC Type D														1	0	1	1	
		Invalid														1	1	0	0	
Invalid														1	1	0	1			
Invalid														1	1	1	0			
CJC Temp.														1	1	1	1			
4, 5	Data Format	Engr. Units x1														0	0			Select the channel data format from: Engineering units (EU) x1 or x10 For EU x1, values are in 0.1 degrees or 0.01mV. For EU x10, values are in whole °C or °F or 0.1mV. Scaled-for-PID (value is the same for any input type) Proportional input signal range is scaled to 0-16,383 counts. Proportional counts (value is same for any input type) Proportional input signal range is scaled to +32,767 counts.
		Engr. Units x10														0	1			
		Scaled-for-PID														1	0			
		Counts														1	1			
6, 7	Open Circuit Mode	Zero													0	0			Select module response to a detected open circuit from: Zero to force the channel data word to zero. Upscale to force the channel data word to full scale. Downscale to force channel data word to low scale. Important: A bit selection of 1 1 is invalid. For an open CJC thermistor, mV channels are not affected. Important: The module requires 500 msec. or one module update to flag the error while it ramps the channel input.	
		Upscale													0	1				
		Downscale														1	0			
		Invalid														1	1			
8	Units °F, °C	Degrees C													0				Select SC/SF for thermal inputs. Ignored for mV inputs. Important: For EU x1 and 5F (0.15F), an over-range error will occur above 3276.75F (cannot exceed 32767 counts).	
		Degrees F													1					
9, 10	Unused	Unused													0	0			These bits must be zero for a valid configuration.	
11	Chnl Enable	Channel Off													0				Disable unused channels for faster response. When set, module configures the channel and reads channel input before setting this bit in status word. If you change the configuration word, the status word must reflect the change before new data is valid. If you clear configuration word, module clears channel and status words. For new configuration word, channel data and status words remain cleared until the module sets this bit (11) in the status word.	
		Channel On													1					
12-15	Unused	Unused	0000																These bits must be zero for a valid configuration.	
Enter Your Bit Selections >>			0000																For the Channel Configuration Word	

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