FLEX I/O Thermocouple/RTD/ Millivolt Input Module

Catalog Numbers 1794-IRT8,1794-IRT8XT

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

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. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

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

These labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

Rockwell Automation recognizes that some of the terms that are currently used in our industry and in this publication are not in alignment with the movement toward inclusive language in technology. We are proactively collaborating with industry peers to find alternatives to such terms and making changes to our products and content. Please excuse the use of such terms in our content while we implement these changes.

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About This Publication

This manual is a reference guide for the FLEX™ I/O Thermocouple, RTD, Millivolt Input Modules. It describes the procedures for installing, configuring, and troubleshooting your module.

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Updated template	throughout
Added inclusive terminology statement	2
Corrected wording in an Important table	18

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation. You can view or download publications at rok.auto/literature.

Resource	Description
FLEX I/O Thermocouple/RTD Input Analog Module Installation Instructions, publication 1794-IN050	Information on how to install the Thermocouple/Millivolt Input Modules (1794-IRT8, 1794-IRT8XT).
EtherNet/IP Network Devices User Manual, publication ENET-UM006	Describes how to configure and use EtherNet/IP™ devices to communicate on the EtherNet/IP network.
ControlNet Network Configuration User Manual, publication CNET-UM001	Describes how to use ControlNet® communication modules with Logix 5000® controllers.
Ethernet Reference Manual, publication ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.

Notes:

Overview of FLEX I/O and Your Thermocouple, RTD, and Millivolt Input Module

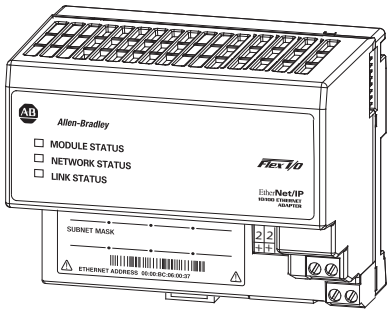
Overview

This chapter provides a description of the FLEX I/O Thermocouple, RTD, and Millivolt Input module and an overview of how it communicates with programmable controllers.

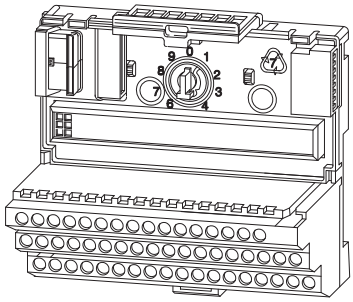
The FLEX System

FLEX I/O is a small, modular I/O system for distributed applications that performs all functions of rack-based I/O. The FLEX system contains the following components shown:

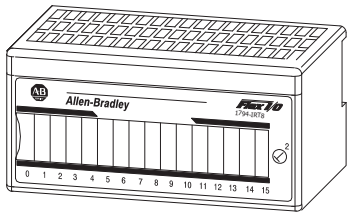
Adapter



Terminal base



I/O module



- Adapter – Transfers read and write configuration data to and from the I/O module.
- Terminal base – Contains a terminal strip to terminate wiring for two- or three-wire devices.
- I/O module – Contains the bus interface and circuitry that is needed to perform specific functions that are related to your application.

The FLEX system consists of an adapter, terminal base unit, DIN rail, power supply, and adapter cabling components. You can use up to eight terminal bases per adapter.

For detailed instructions on how to set up and install your module, see Install Your FLEX I/O Input Module on page 11.

Types of Modules

The module refers to the following catalogs:

Catalog Number	Voltage	Inputs	Description
1794-IRT8	24V DC	8	Analog – 8 pt, 16 bit non-isolated RTD, thermocouple, and mV Input module
1794-IRT8XT	24V DC	8	Analog – 8 pt, 16 bit non-isolated RTD, thermocouple, and mV Input module designed for extended temperature.

The module accepts up to eight thermocouple or RTD inputs. The inputs are nonisolated and are selected with analog multiplexers. The inputs accept millivolt or resistive inputs. Default input spans are -40.00 mV... +100.00 mV or 0.0...500.0 Ω. Fault indicators are located field side.

No switches or jumpers are used on the TC and RTD Input module. The inputs have both fixed hardware filters and selectable firmware digital filters.

What the FLEX I/O Input Module Does

The module is a high-speed, high-accuracy temperature and millivolt measuring module that accepts thermocouple inputs, 2-, 3-, and 4-wire RTD inputs, and mV source inputs.

It offers the following:

- Wire-off, overrange, and underrange detection
- Good common mode rejection
- Usage with long thermocouple wiring
- Usage with grounded or ungrounded thermocouples

The Series B version of 1794-IRT8 provides capability to work with grounded thermocouples.

Use cold junction compensators (catalog number 1794-CJC2) in thermocouple mode. Two cold junction compensators are shipped with the 1794-IRT8.

The FLEX I/O Module in a Logix Control System

The FLEX I/O Thermocouple, RTD, and Millivolt modules are intelligent modules that interface analog signals with Allen-Bradley® programmable controllers through a FLEX I/O adapter.

The adapter transfers data to and from the module. These transfers allow:

- The adapter to obtain input or output values and status from the module.
- Establishing the mode of operation through a process called configuration.

Figure 1 shows the flow of communication between the adapter and the I/O module.

Figure 1 - Typical Communication Between the Adapter and a Module

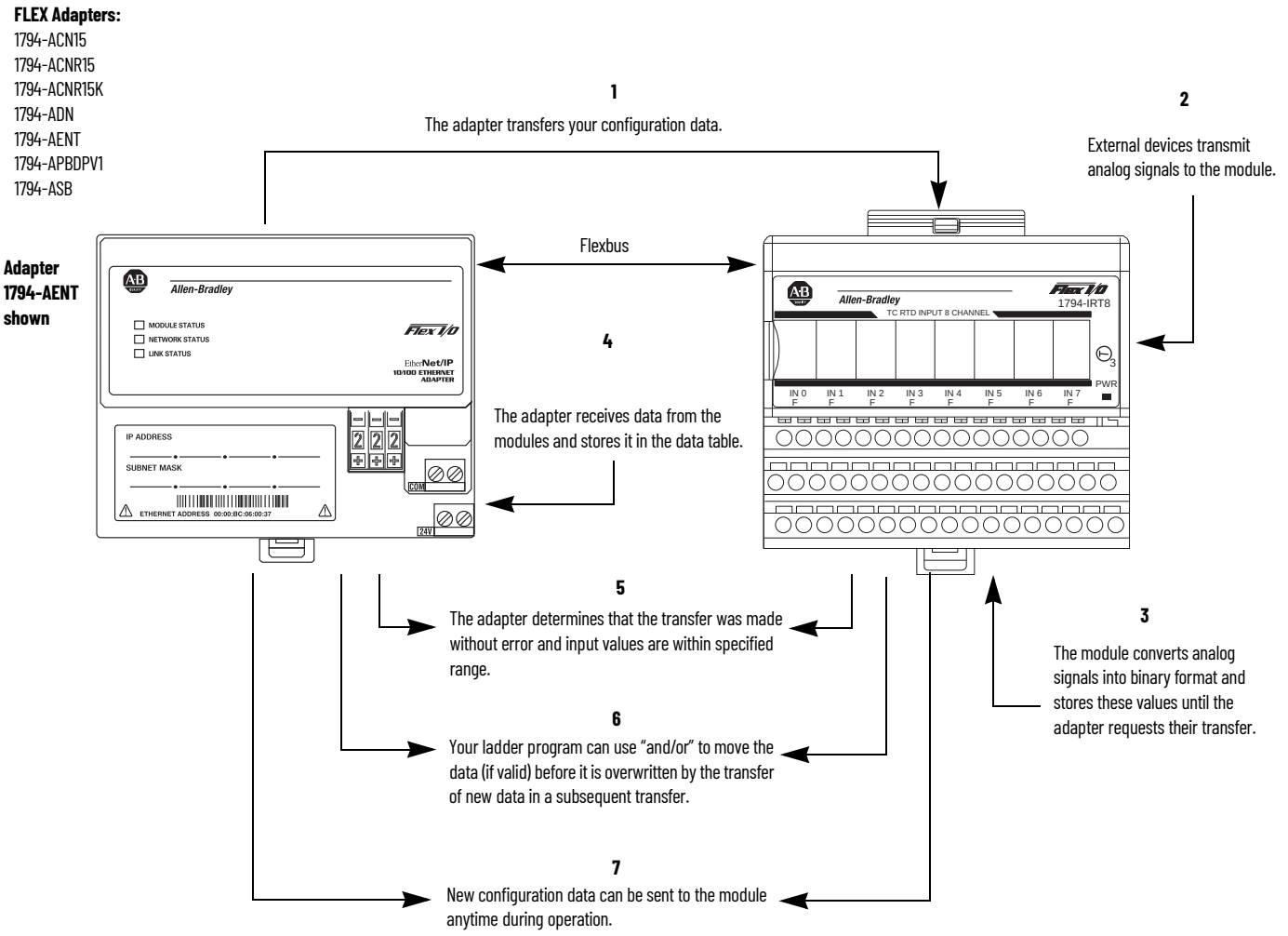
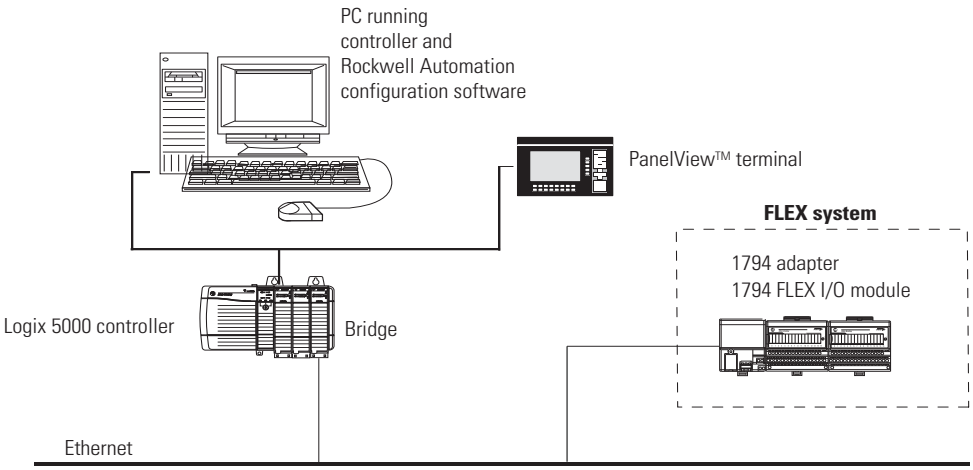


Figure 2 shows a broader view of how the FLEX I/O module interfaces with the different elements in a Logix system.

Figure 2 - FLEX I/O Modules in a Logix System



In this example, the FLEX I/O module communicates with the controller through the adapter. The controller can produce and consume tags. It can initiate MSG instructions that send and receive data or configure devices. Configuration of devices and the network is done through the personal computer running the controller and configuration software.

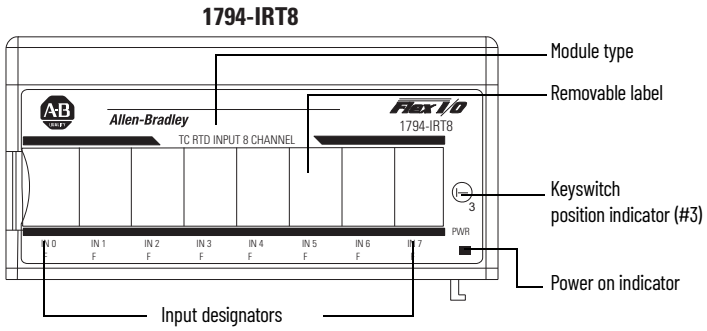
To learn about the prerequisites and steps to configure your FLEX I/O module using Studio 5000 Logix Designer® application[1], see Configure Your FLEX I/O Module with RSLogix 5000 Software on page 21.

ATTENTION: The following publications provide more information about EtherNet/IP, and ControlNet modules in a Logix 5000 system:
- EtherNet/IP Network Devices User Manual, publication ENET-UM006.
- ControlNet Network Configuration User Manual, publication CNET-UM001.

Physical Features of Your Module

The module label identifies the keyswitch position, wiring, and module type. A removable label provides space for writing individual designations per your application. Indicators are provided to identify input fault conditions, and to show when power is applied to the module.

Figure 3 - Module Label and Indicators



(1) Studio 5000 Logix Designer is the replacement for RSLogix 5000® (version 20 or later). It provides one software package for discrete, process, batch, motion, safety, and drive-based applications.

Notes:

Install Your FLEX I/O Input Module

Overview

This chapter provides you with pre-installation requirements and instructions on how to install your FLEX I/O thermocouple, RTD, and millivolt input module.

Before You Install Your Module

Before installing your FLEX I/O Thermocouple, RTD, and mV module, you must:

- Verify that a suitable enclosure is available for installation of the module, and
- Position the keyswitch on the terminal base.

ATTENTION:
- These modules do not receive primary operational power from the backplane. You must apply 24V DC power to your module before installation. If you don't apply power, the module position may appear to the adapter as an empty slot in your chassis.
- If using a Series B product to replace a Series A product, connect a wire between terminals 39 and 48 on the 1794-TB3G or 1794-TB3GS terminal base unit. If not connected, the Series B product defaults to Series B functionality.

Series A and Series B

Table 1 describes the differences between Series A and Series B of the FLEX I/O Thermocouple, RTD, and mV Input modules.

Table 1 - Series A and Series B Differences

Mode	1794-IRT8 Series A	1794-IRT8, 1794-IRT8XT Series B
Isolation	Between user side and system side	Between user 24V DC and user I/O; between user side and system side
Common Mode Range	±4V DC	±15V DC
Thermocouple Mode Wire-off Detection	When an open sensor is detected, data defaults to **maximum** value	When an open sensor is detected, data defaults to **minimum** value

ATTENTION:
- In the Studio 5000 Logix Designer application, if you use a series B product to replace a series A product, the module is accepted without an electronic key mismatch warning.
- This is true for 1794-IRT8 and 1794-IRT8XT modules that are installed on EtherNet/IP, ControlNet, or Remote I/O networks.
- The CJC Status bit, Read Word 9, Bit 3 are added with Firmware C release of the 1794-IRT8 Series B module.
- The CJC Status bit is turned on when the temperature between the CJCs is greater than 6 °C but less than 12 °C.
- When this temperature difference is above 12 °C, then the CJC Alarm bits are set.
- If a CJC temperature is overrange or underrange the associated CJC Alarm bit is set. In this condition, the CJC Status bit is not set.
- The CJC Status bit did not exist in Series A.

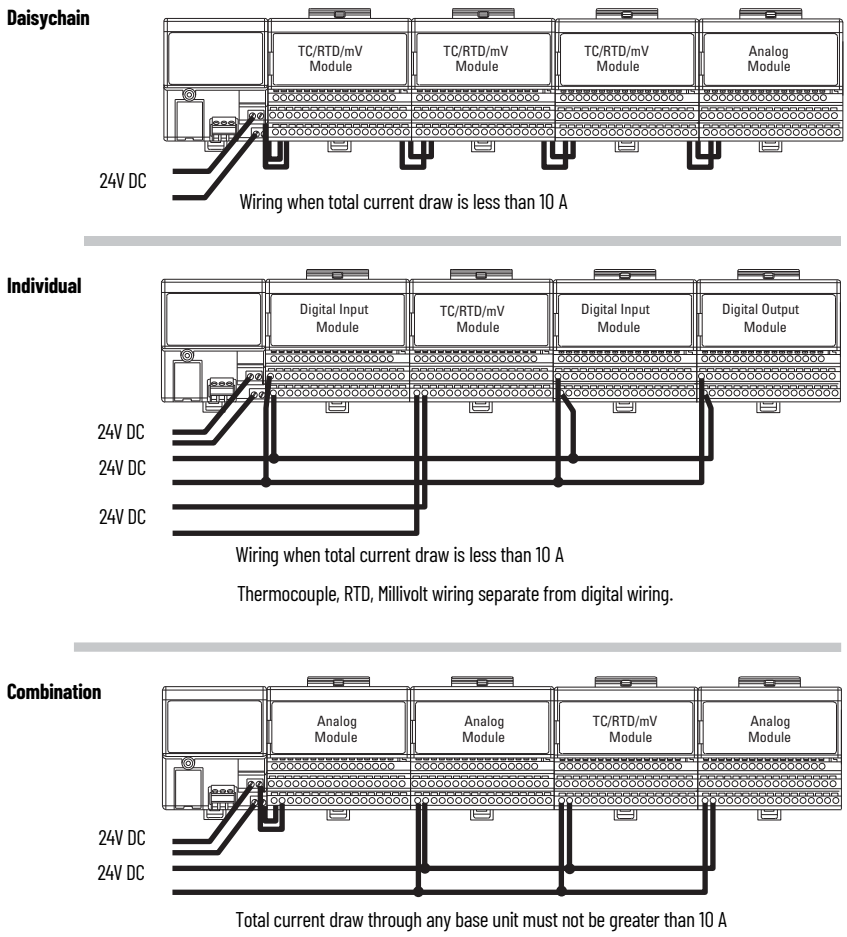
Power Requirements

The wiring of the terminal base unit is determined by the current draw through the terminal base. Verify that the current draw does not exceed 10 A.

ATTENTION:
- Total current draw through the terminal base unit is limited to 10 A. Separate power connections may be necessary.
- Do not daisychain power or ground from the terminal base unit to any AC or DC digital module terminal base unit.

Methods of wiring the terminal base units are shown in Figure 4.

Figure 4 - Terminal Base Wiring



ATTENTION: Note the following considerations for each type of wiring configuration:
- Daisychain – All modules must be analog or Thermocouple, RTD, and mV modules for this configuration.
- Individual – Use this type of configuration for any "noisy" DC digital I/O modules in your system.
- Combination – All modules that are powered by the same power supply must be analog or Thermocouple, RTD, and mV modules for the combination type of configuration.

Install the Module

Installation of the FLEX I/O module consists of:

- Mounting the terminal base unit
- Installing the Thermocouple, RTD, and mV module into the terminal base unit
- Installing the connecting wiring to the terminal base unit

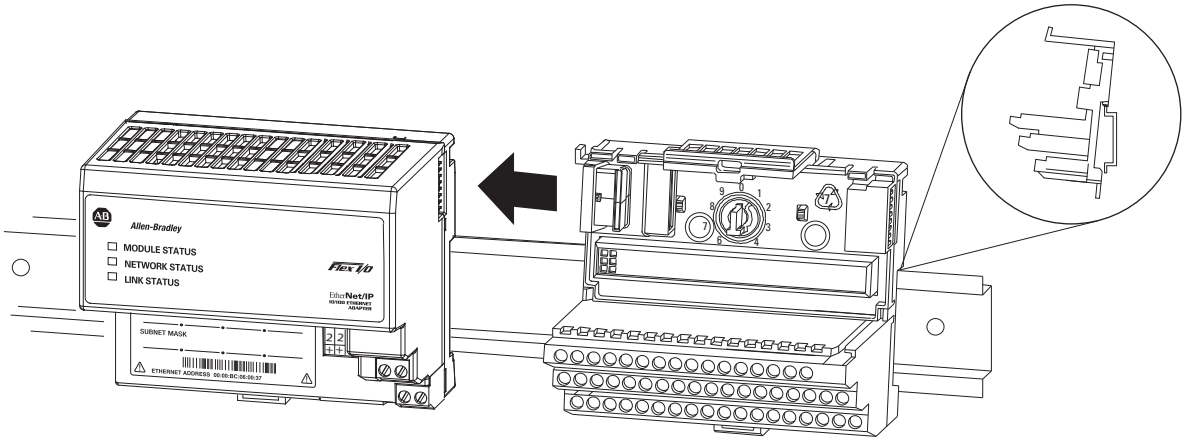
If you are installing your module into a terminal base unit that is already installed, proceed to the section, Mount the FLEX I/O Module on the Terminal Base Unit on page 16.

Mount on a DIN Rail

ATTENTION: Do not remove or replace a terminal base unit when power is applied. Interruption of the Flexbus can result in unintended operation or machine motion.

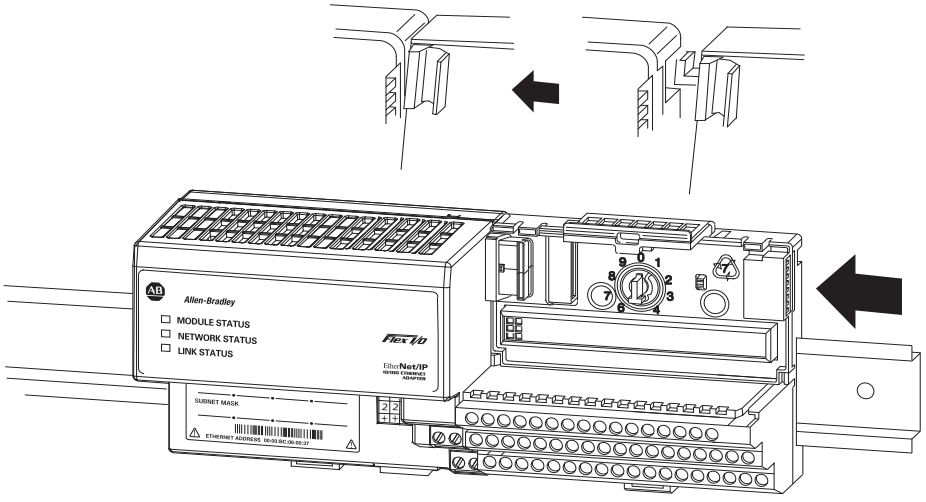
Install the Terminal Base Unit

1. Remove the cover plug in the male connector of the unit to which you are connecting this terminal base unit.
2. Make sure that the 16 pins in the male connector on the adjacent device are straight and in line so that the mating connector on this terminal base unit mate correctly.



Verify that the female Flexbus connector is fully retracted into the base unit.

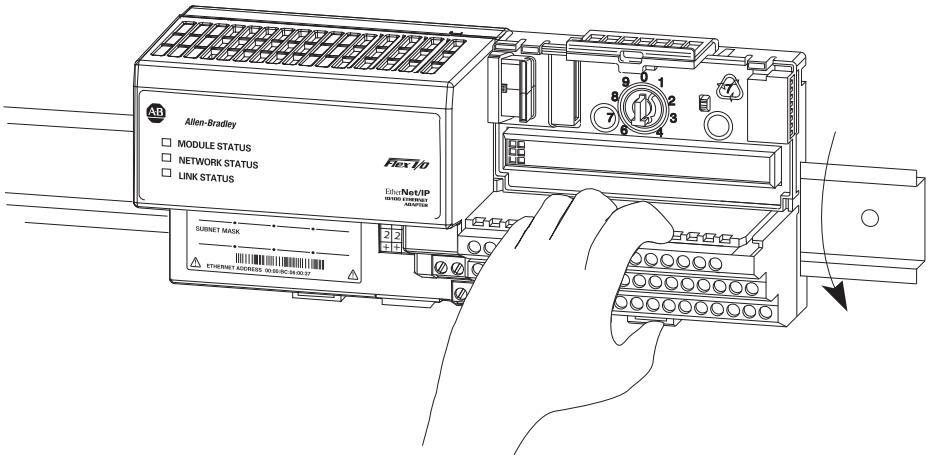
3. Position the terminal base at a slight angle and hooked over the top of the 35 x 7.5 mm DIN rail (Allen-Bradley part number 199-DR1; 46277-3).



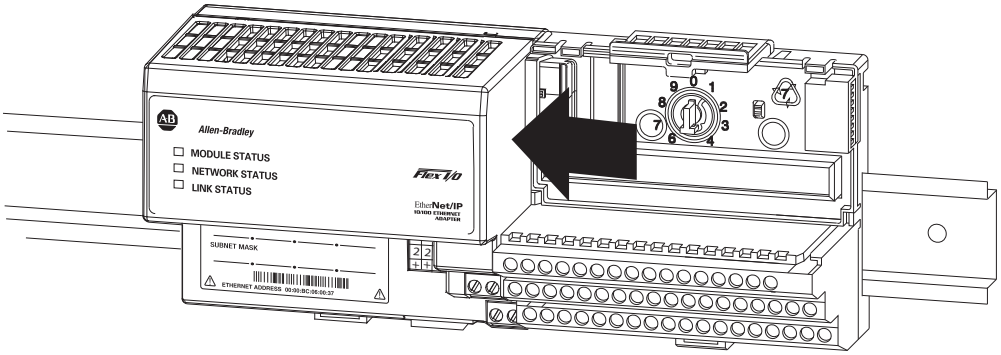
4. Slide the terminal base over tight against the adapter, or proceeding terminal base. Make sure the hook on the terminal base slides under the edge of the adapter, or proceeding terminal base, and the Flexbus connector is fully retracted.
5. Rotate the terminal base onto the DIN rail with the top of the rail hooked under the lip on the rear of the terminal base.

   Make sure that the female Flexbus connector does not strike any of the pins in the mating connector.

6. Press down on the terminal base unit to lock the terminal base on the DIN rail. If the terminal base does not lock into place, use a screwdriver or similar device to open the locking tab, press down on the terminal base until flush with the DIN rail and release the locking tab to lock the base in place.



Gently push the Flexbus connector into the side of the adapter, or proceeding terminal base, to complete the backplane connection.



For specific wiring information, see the installation instructions for the module you are installing in this terminal base unit.

7. Repeat the above steps to install the next terminal base unit.

   Ensure that the cover of the Flexbus connector on the last terminal base unit is in place.

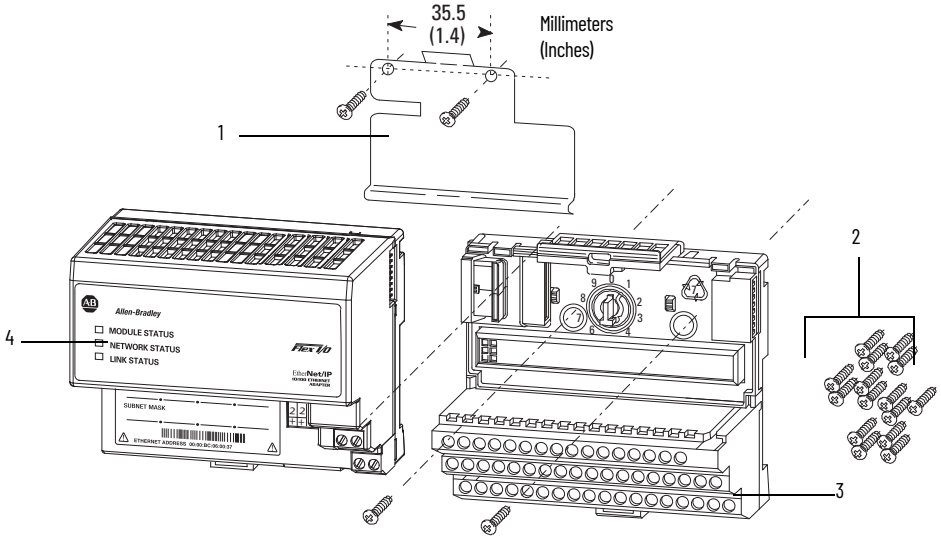
Mount on a Panel or Wall

Installation of a FLEX system on a wall or panel consists of:

- Laying out the drilling points on the wall or panel
- Drilling the pilot holes for the mounting screws
- Mounting the adapter mounting plate
- Installing the terminal base units and securing them to the wall or panel

If you are installing your module into a terminal base unit that is already installed, proceed to Mount the FLEX I/O Module on the Terminal Base Unit on page 16.

Use the mounting kit Catalog Number 1794-NM1 for panel or wall mounting.

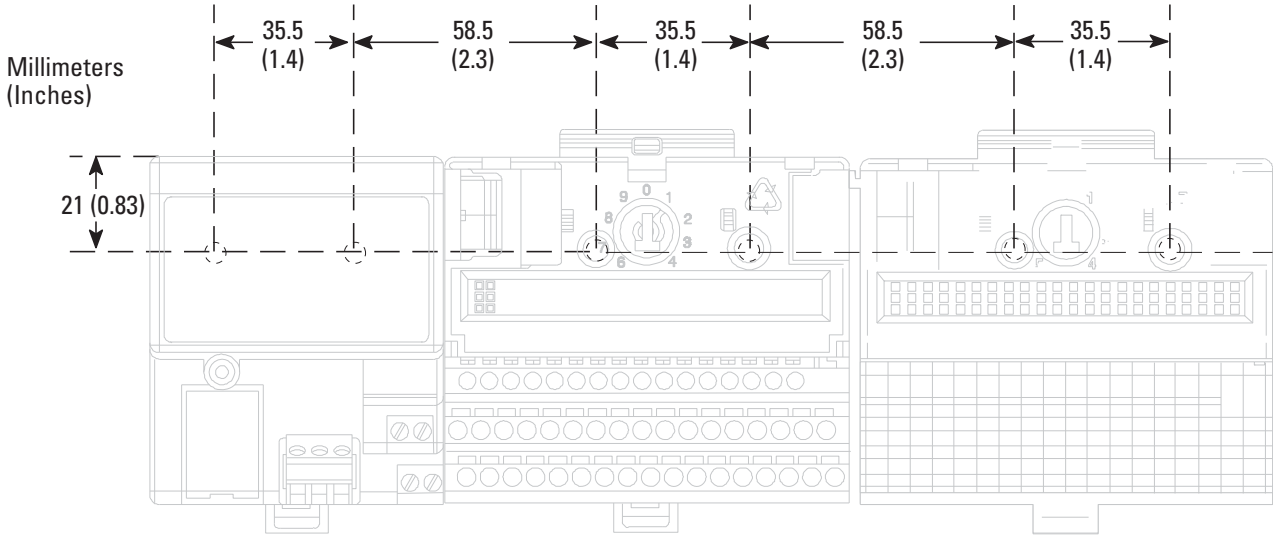


	Description		Description
1	Mounting plate for adapter	3	Terminal base unit (not included)
2	#6 Self-tapping screws	4	Adapter (not included)

To install the mounting plate on a wall or panel:

1. Lay out the required points on the wall or panel as shown in Figure 5.

Figure 5 - Drilling Dimensions for Panel or Wall Mounting



2. Drill the necessary holes for the #6 self-tapping mounting screws.
3. Mount the mounting plate for the adapter using two #6 self-tapping screws – 18 screws are included for mounting up to 8 modules and the adapter.

IMPORTANT Verify that the mounting plate is properly grounded to the panel. See Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

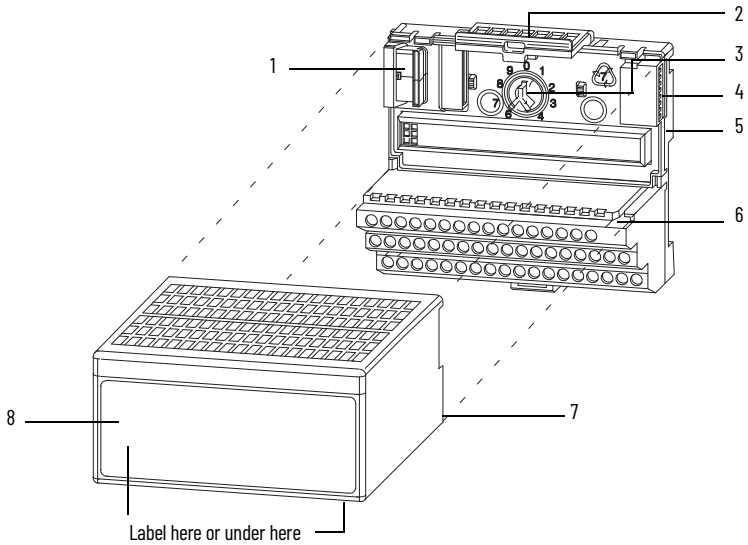
4. Hold the adapter at a slight angle and engage the top of the mounting plate in the indention on the rear of the adapter.
5. Press the adapter down flush with the panel until the locking lever locks.
6. Position the terminal base unit up against the adapter and push the female bus connector into the adapter.
7. Secure to the wall with two #6 self-tapping screws.
8. Repeat for each remaining terminal base unit.

Mount the FLEX I/O Module on the Terminal Base Unit

The Thermocouple, RTD, and mV input module mounts on a 1794-TB3G or 1794-TB3GS terminal base unit.

1. Rotate keyswitch (3) on terminal base unit (4) clockwise to position 3 as required for the module.

   Do not change the position of the keyswitch after wiring the terminal base unit.



	Description		Description
1	Flexbus connector	5	Base unit
2	Latching mechanism	6	Alignment groove
3	Keyswitch	7	Alignment bar
4	Cap plug	8	Module

2. Verify that the Flexbus connector (1) is pushed all the way to the left to connect with the neighboring terminal base or adapter.

   You cannot install the module unless the connector is fully extended.

3. Make sure the pins on the bottom of the module are straight so that they align properly with the connector in the terminal base unit.

If you remove or insert the module while the backplane power is on, an electric 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.

4. Position the module (8) with its alignment bar (7) aligned with the groove (6) on the terminal base.
5. Press firmly and evenly to seat the module in the terminal base unit.

   The module is seated when the latching mechanism is locked into the module.

6. Remove the cap plug and attach another terminal base unit to the right of this terminal base unit if necessary.

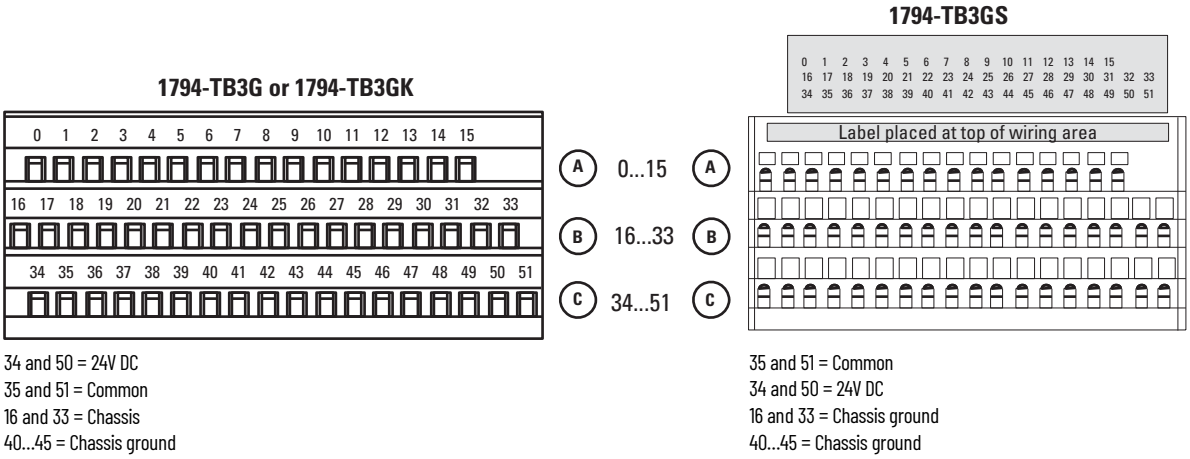
   Make sure that the last terminal base has the cap plug in place.

IMPORTANT The adapter is capable of addressing eight modules. Do not exceed a maximum of eight terminal base units in your system.

Wiring Information

Wire the module using a 1794-TB3G, 1794-TB3GK, or 1794-TB3GS terminal base unit.

Figure 6 - 1794-TB3G, 1794-TB3GK, and 1794-TB3GS Wiring



Connect Wiring to the FLEX I/O Module

Wire the Thermocouple, RTD, and mV module through the terminal base unit on which the module mounts.

The module is compatible with the 1794-TB3G, 1794-TB3GK, and 1794-TB3GS terminal base units.

Connect Wiring Using a 1794-TB3G, 1794-TB3GK, or 1794-TB3GS Terminal Base Unit

1. Connect individual signal wiring to numbered terminals on 0...15 row (A), and 17...32 row (B), on the terminal base unit as indicated in Table 2 on page 18. Use a Belden 8761 cable for mV signal wiring, or the appropriate thermocouple wire for your thermocouples.

   Signal wiring shields can be connected to terminals 16 or 33 on row B or terminals 40...45 on row C.
2. Connect the +V DC power lead to terminal 34 on row C, terminals 34...51.
3. Connect the -V DC common (return-) to terminal 35 on row C, terminals 34...51.

ATTENTION: Do not daisychain power or ground from this terminal base unit to any AC or DC digital module terminal base units.

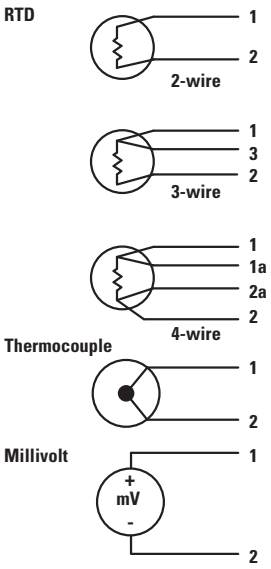
4. If daisychaining power to the next terminal base unit, connect a jumper from terminal 50 (+V DC) on this base unit to the +V terminal on the next terminal base unit.
5. Connect a jumper from terminal 51 (-V DC common) to the -V DC common terminal on the next terminal base unit.
6. If using cold junction compensators, make these connections as shown in the Table 3 on page 18.

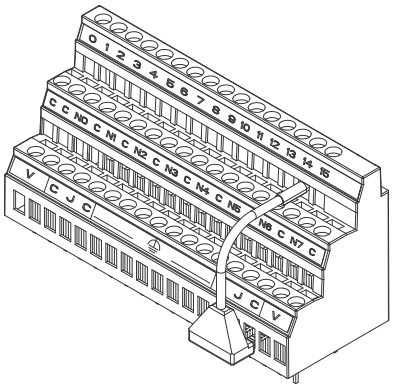
Identify RTD Wire Pairs

If the RTD wires are color-coded, the wires that are the same color are connected together. If the wires are not color-coded, use an ohmmeter to determine the pairs.

How to Connect a 4-wire RTD

If the 4-wire RTD wires are all different colors, use an ohmmeter to determine which leads are connected together. One of the leads in each pair is the compensation lead. Either lead of the pair can be the compensation lead. Attach one pair to terminals L and -, and the other pair to + and H.





How to Connect a 3-wire RTD

If the 3-wire RTD wires are all different colors, use an ohmmeter to determine which leads are connected together. Either lead of the pair can be the compensation lead. Attach one lead of the pair to terminal L, and the other to +. Attach the single lead to -.

Table 2 - Wiring Connections for the FLEX I/O Input Module

Input Types	Connect the Following:				
	H	L	+	-	Shield[1]
RTD – 2-wire			1	2	
RTD – 3-wire		3	1	2	
RTD – 4-wire	1a	2a	1	2	
Thermocouple		1		2	
Millivolt		1		2	

(1) Terminals 37, 38 and 39 and 46, 47 and 48 are for cold junction compensation, with 38 and 47 as chassis ground.

Table 3 - CJC Sensor Connections

	CJC Sensor			
Input	+	Chassis Ground	-	CJC Tail[1]
CJC1	C-37	C-38	C-39	A-5 (B-22)
CJC2	C-46	C-47	C-48	A-12 (B-29)

(1) Terminals 37, 38, and 39, and 46, 47, and 48 are for cold junction compensation, with 38 and 47 as chassis ground. Connect the tail of CJC1 to terminal 5 and CJC2 to terminal 12 if channels 0…3 or 0…7 are configured for thermocouples. Connect the tail of CJC1 to terminal 22 and CJC2 to 29 if channels 4…7 are configured for thermocouples.

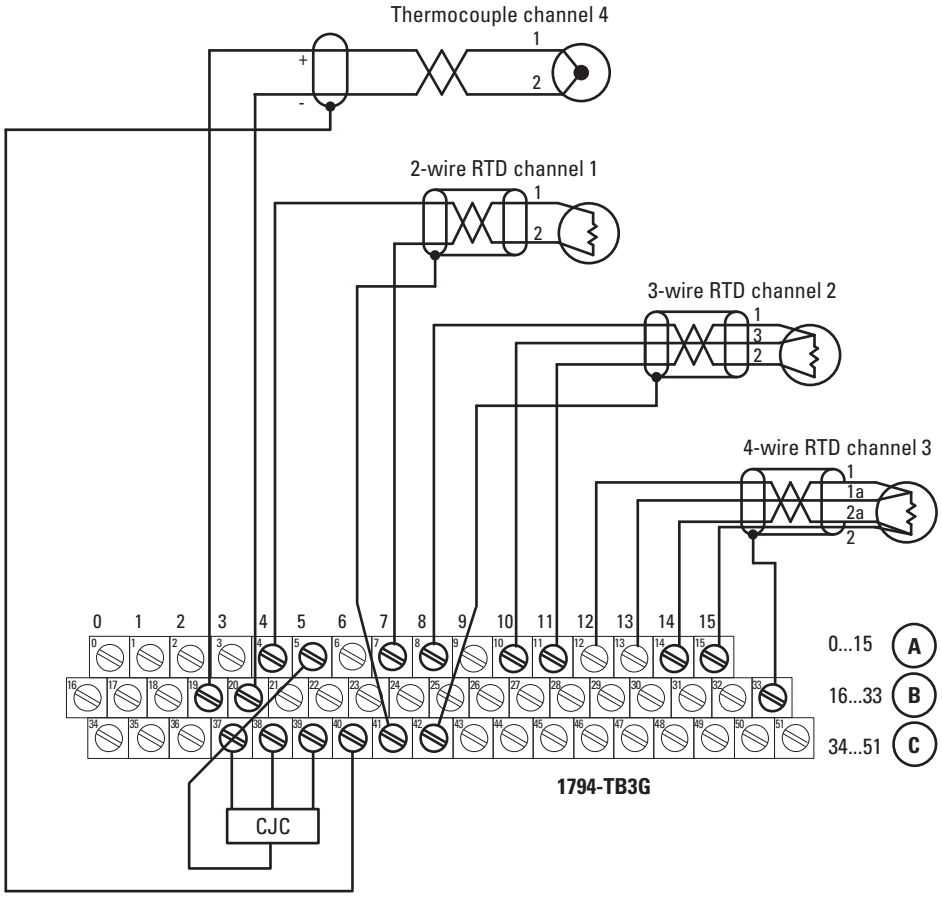
Table 4 - Terminal Base Unit Wiring Connections

RTD or TC Channel	1794-TB3G, 1794-TB3GK, and 1794-TB3GS Terminal Base Units[1]			
	High Signal Terminal (H)	Low Signal Terminal (L)	RTD Source Current (+)	Signal Return (-)
0	A-1	A-2	A-0	A-3
1	A-5	A-6	A-4	A-7
2	A-9	A-10	A-8	A-11
3	A-13	A-14	A-12	A-15
4	B-18	B-19	B-17	B-20
5	B-22	B-23	B-21	B-24
6	B-26	B-27	B-25	B-28
7	B-30	B-31	B-29	B-32
+24V DC Power	34 and 50			
24V DC Common	35 and 51			

(1) Terminals 37, 38, and 39, and 46, 47 and 48 are for cold junction compensation. Terminals 16, 33 and 40…45 are chassis ground. Connect the tail of CJC1 to terminal 5 and CJC2 to 12 if channels 0…3 or 0…7 are thermocouples. Connect the tail of CJC1 to terminal 22 and CJC2 to 29 **only** if channels 4…7 are used.

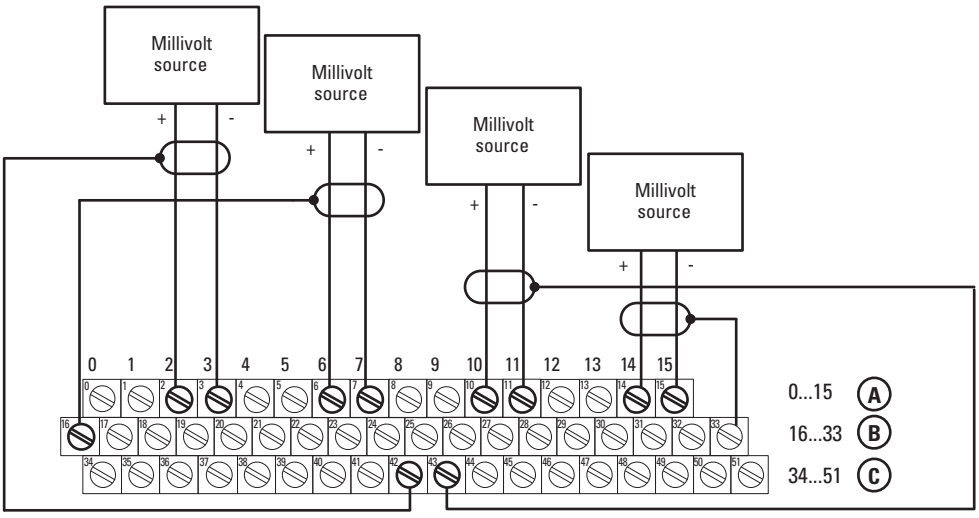
IMPORTANT
- Disconnecting and reconnecting RTDs, Thermocouples, or CJCs with power applied temporarily disturbs the channel steady state data. Allow 2 minutes for settling time after finishing connections.
- If using RTD isolators, use 2- or 4-wire configurations only, and add digital filtering to the inputs.

Figure 7 - 2-, 3-, and 4-wire RTD and Thermocouple Wiring to a 1794-TB3G Terminal Base Unit



ATTENTION: Keep exposed area of inner conductor as short as possible.

Figure 8 - Millivolt Wiring to a 1794-TB3G Terminal Base Unit



Notes:

Configure Your FLEX I/O Module with RSLogix 5000 Software

Overview

This chapter describes how to configure the FLEX I/O Thermocouple, RTD, and mV module for the ControlLogix® and CompactLogix™ system with the Studio 5000 Logix Designer application. The 1794-IRT8 module can communicate through different networks such as ControlNet, Ethernet, PROFIBUS, among others. In the examples below, the Ethernet adapter is used for communication between the Logix processor and the Flexbus.

ATTENTION:
- If using an SLC™ controller with ControlNet, see the associated I/O scanner documentation.
- If using a PLC-5® controller, see the PLC-5 controller documentation for ControlNet configuration information.

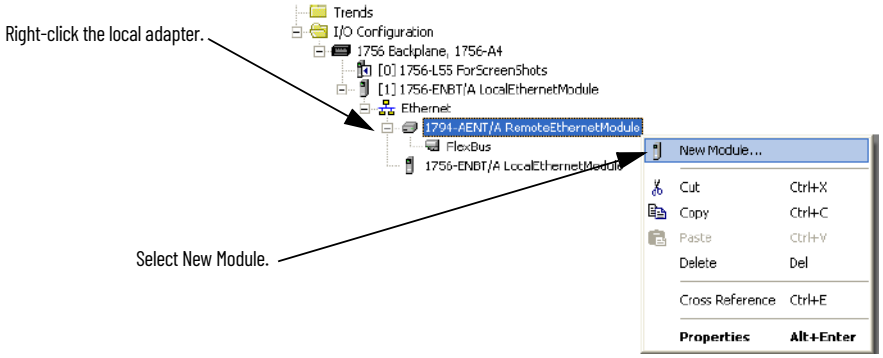
You must follow these series of steps to configure your FLEX I/O module in the Studio 5000 Logix Designer.

1. Add and configure the new local bridge, such as 1756-ENBT, to your project. This user manual assumes that you have properly configured this module. See the associated documentation.
2. Add and configure the new adapter, such as a 1794-AENT FLEX I/O EtherNet/IP adapter. This user manual assumes that you have properly configured this module. See the associated documentation.
3. Add and configure your FLEX I/O module as shown in Add and Configure the FLEX I/O Module.
4. Download the configuration to the controller.

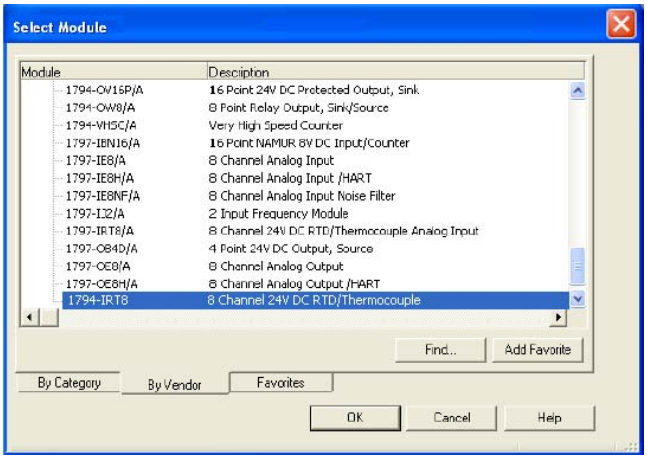
Add and Configure the FLEX I/O Module

In order to add your FLEX I/O Thermocouple, RTD, mV module, you should have added and configured your Ethernet bridge and/or adapter.

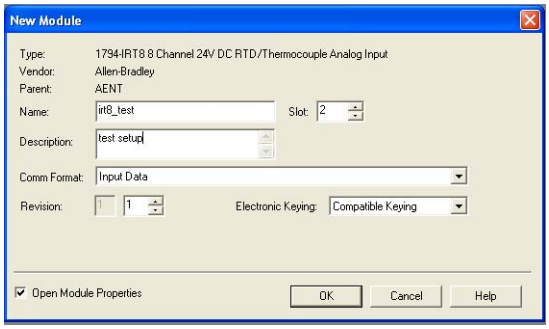
1. In the I/O Configuration tree, right-click the 1794-AENT adapter, and select New Module.



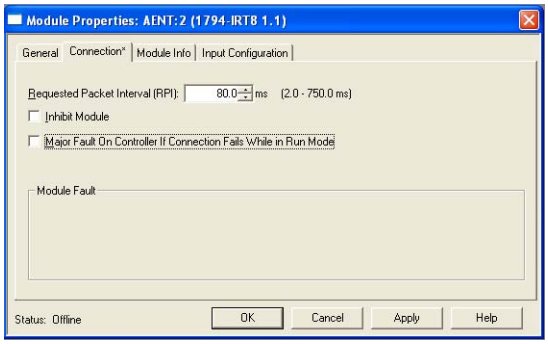
2. The Select Module dialog appears. Select the FLEX I/O module and select OK.



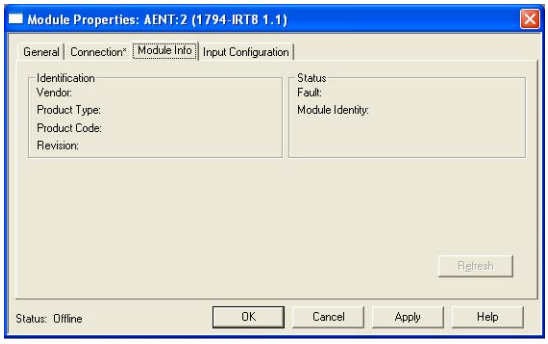
3. Complete the following fields in the New Module dialog that appears. Select OK.
   - Name
   - Description
   - Comm Format
   - Electronic Keying



4. On the Connection tab, specify a value for the Requested Packet Interval (RPI).



5. Click the Module Info tab to see Module Identification and Status information. These fields are populated when the module goes online.



6. Click the Input Configuration tab and specify the values for the following fields:
   - Channel
   - Sensor
   - Sensor Mode
   - Input Filter Cutoff
   - Data Format

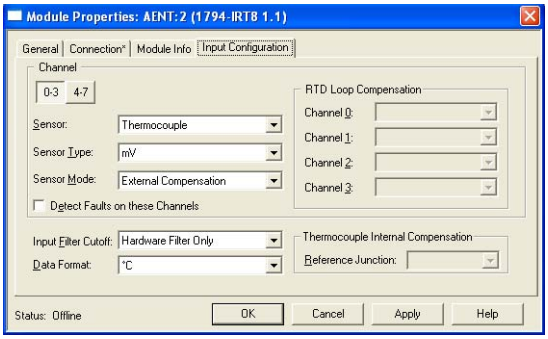


Table 5 - Configuration Parameters

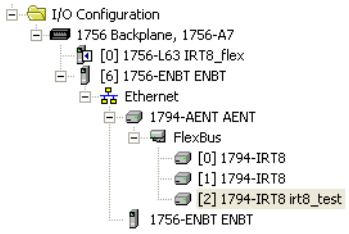
Field Name	Description	Configuration Options	
Sensor	Allows you to select the main sensor function of your module, whether Thermocouple or RTD. You must configure your module based on this main configuration by specifying the next parameters.	• Thermocouple • RTD	
Sensor Type	Allows you to select one of nine thermocouple types or one of eight RTD types. Default unit is mV for thermocouples and ohms for RTDs.	For Thermocouple • mV • Type B • Type E • Type J • Type K • Type TXK/XKL(L) • Type N • Type R • Type S • Type T	To help you select the proper operating range of your thermocouple, see Resolution Curves for Thermocouples on page 51.
		For RTD • Resistance • 100 Ω Pt 385 • 200 Ω Pt 385 • 100 Ω Pt 3916 • 200 Ω Pt 3916 • 100 Ω Ni 618 • 200 Ω Ni 618 • 120 Ω Ni 672 • 10 Ω Cu 427	To help you specify the value for your RTD, see Sensor Types on page 27.

Table 5 - Configuration Parameters (Continued)

Field Name	Description	Configuration Options	
Sensor Mode	Allows you to select the operational mode for the thermocouple or RTD inputs. • For thermocouple inputs, you can choose the cold junction compensation mode. – Default for thermocouples is external compensation. • For RTD inputs, you can choose 2-wire, 2-wire with user-selected RTD offset, 3-wire, and 4-wire. – Default for RTD is 2-wire (with no offsets).	For Thermocouple • External compensation • Internal compensation • No compensation • Differential compensation	For a description of the different sensor mode options, for both Thermocouple and RTD, see Table 10 on page 30.
		For RTD • 2-wire compensation (default) • 2-wire with Loop compensation • 3-wire • 4-wire	When you select Internal Compensation for your Thermocouple, you must specify a corresponding Reference Junction value. This parameter sets a fixed reference junction to compensate all thermocouple channels and ranges from 0 °C...70 °C. When you select 2-wire with Loop compensation for your RTD, you must specify values for each channel for the RTD Loop Compensation.
Input Filter Cutoff	Allows you to select one of eight levels on input filtering. The module microprocessor accomplishes the single pole, low-pass filtering. The filter selections range from Hardware Only to 5 s time constant. The times are approximate because they are based on the module scan time, which varies. The default is Hardware Only.	• Hardware Filter Only (default) • 25 ms • 100 ms • 250 ms • 500 ms • 1 s • 2 s • 5 s	
Data Format	Allows you to specify the format of the data reported. Module defaults to -4000...+10000 in millivolt mode, and 0...5000 in Ω mode with implied decimal points (that is -40.00 mV, 0.1 Ω) whenever °C, °F, °K is selected.	• °C • °F • °K • -32767...+32767 • 0...65535	

7. After you have completed all Module Configuration parameters, click OK in the Module Properties dialog box.

   The FLEX I/O module shows in the I/O Configuration tree.



   To be able to check if your configured parameters are acceptable and the configuration is successful, you must go online.

   See the Studio 5000 Logix Designer Online Help for detailed descriptions of the configuration parameters.

Read and Write Configuration Maps for the FLEX I/O Module

Overview

This chapter describes how to configure, read data from, and map data to your FLEX I/O Thermocouple, RTD, and mV Input module.

Configure Your Input Module

The Thermocouple, RTD, and mV input module is configured using a group of data table words that are mapped by the processor that is used when the connection to the module is established.

The software configurable features available are:

- Input range selection
- Selectable single pole low pass filter
- Data reported in °F, °C, °K, mV, Ω, unipolar or bipolar count
- Fault detection

Configurable Options and Their Effect on the Channels

There are two types of configurable options: those that affect all channels, and those that affect each group of four input channels.

Options that Affect All Channels

Input Filter Selection

This combination of bits allows you to select one of eight levels on input filtering. The module microprocessor accomplishes the single pole, low pass filtering. The filter selections range from Hardware Only to 5 s time constant. The times are approximate because they are based on the module scan time, which varies. The default is Hardware Only.

Data Format Selection

This set of bits allows you to select one of these five formats:

- Degree C
- Degree F
- Degree K
- Unipolar — The endpoints for Unipolar are scaled to the endpoints of the thermocouple or RTD range. The default unit is mV.
- Bipolar — The endpoints for Bipolar are scaled to the endpoints of the thermocouple or RTD range. It uses Ω as the default unit.

Options that Affect Each Group of Four Inputs

Sensor Type

This set of bits allows you to select one of nine thermocouple types or one of eight RTD types. Default unit is mV for thermocouples and ohms for RTDs.

Sensor Mode

This set of bits allows you to select the operational mode for the thermocouple or RTD inputs. For thermocouple inputs, you can choose the cold junction compensation mode: internal, external, no CJC and differential measurement between two channels, for example, the value of channel 0 minus the value of channel 1 appears in the channel 0 and channel 1 data table locations. For RTD inputs, you can choose 2-wire, 2-wire with user-selected RTD offset, 3-wire, and 4-wire. Default for thermocouples is external CJC; default for RTDs is 2-wire (with no offsets).

Input Types

This set of bits allows you to select one of two input types: thermocouple (millivolt) or RTD (resistance). The default input type is thermocouple.

Reference Junction

These bits allow you to select from seven fixed temperatures for the CJC value that is used by the module in thermocouple mode. Use this mode when the ambient temperature surrounding the thermocouple connection point is known and steady. The default temperature is 0 °C (32 °F).

Fault Mode

You can enable or disable the fault detection. When enabled in thermocouple mode, each channel is monitored for an open circuit. If an open is detected, the overrange and fault bits are set for that channel, and the channel data is set to the maximum value (Series A), or minimum value (Series B) for the chosen mode of operation.

When enabled in RTD mode, each channel is monitored for an open circuit (RTD and wires) and short circuits (RTD). If an open is detected, the overrange and fault bits are set for that channel, and the channel data is set to the maximum value for the chosen mode of operation. If a short is detected, the underrange bit is set for that channel, except when in Ω mode. The channel data is set to the minimum value for the chosen mode of operation.

RTD Offset

You can select from four fixed resistive values that are used by the module when inputs are configured for 2-wire with user-selected RTD offset. The RTD offset is used to nullify the effects of the resistance of long lead wires. Each value represents the total resistance of both leads of a 2-wire RTD. For example, if you choose 5 Ω, the module compensates for a total of 5 Ω of lead resistance.

You can perform a calibration operation that measures the actual total lead resistance with RTD replaced with a short circuit. The value that is stored from this operation is used when the option Use Channel Loop Compensation Value is selected. This is also the default setting and is initially set to 0 at the factory. Each channel has its own pair of RTD offset bits and a Channel Loop Compensation value.

Sensor Types

Individual input channels are configurable to operate with the following sensor types:

Table 6 - Sensor Types

RTD Type	Thermocouple Type
Sensor type for channels 0...3	Sensor type for channels 0...3
Sensor type for channels 4...7	Sensor type for channels 4...7
Resistance (default)	mV (default)
100 Ω Pt α = 0.00385 Euro (-200...+870 °C) (-328...+1598 °F)	B 300...1800 °C (572...3272 °F)
200 Ω Pt α = 0.00385 Euro (-200...+400 °C) (-328...+752 °F)	E -270...+1000 °C (-454...+1832 °F)
100 Ω Pt α = 0.003916 U.S. (-200...+630 °C) (-328...+1166 °F)	J -210...+1200 °C (-346...+2192 °F)
200 Ω Pt α = 0.003916 U.S. (-200...+400 °C) (-328...+752 °F)	K -270...+1372 °C (-454...+2502 °F)
100 Ω Nickel α = 0.00618 (-60...+250 °C) (-76...+482 °F)	TXK/XK(L) -200...+800 °C (-328...+1472 °F)
200 Ω Nickel α = 0.00618 (-60...+200 °C) (-76...+392 °F)	N -270...+1300 °C (-450...+2372 °F)
120 Ω Nickel α = 0.00672 (-80...+320 °C) (-112...+608 °F)	R -50...+1768 °C (-58...+3214 °F)
10 Ω Copper α = 0.00427 (-200...+260 °C) (-328...+500 °F)	S -50...+1768 °C (-58...+3214 °F)
	T -270...+400 °C (-454...+752 °F)

Select individual channel ranges using write word 1 of the block-transfer write instruction.

ATTENTION:
- Disconnecting and reconnecting RTDs with power applied temporarily disturbs the steady state data of the channel. Allow 2 minutes for settling time or cycle power to the module after terminating connections.
- If using RTD isolators, we recommend using 2- or 4-wire configurations only and digital filtering to the inputs.
- The range -32,768...+32,767 should only be used with mV selection.
  Signals from a thermocouple or RTD are non-linear, the mV selection is not recommended for thermocouple or RTD real-time readings.
  If selected, the module returns the mV generated by the thermocouple or RTD, in addition to any offsets generated by wiring without any correction for the non-linearity of the device.
- When the module is configured for mV the CJC compensation is not applied for thermocouple devices.
  For thermocouples and RTDs you should use F or C data format. When configured as thermocouple or RTD the module uses an internal table to adjust for the non-linear mV returned by the field devices. After the internal calculations are performed the module provides results in degrees F or C.

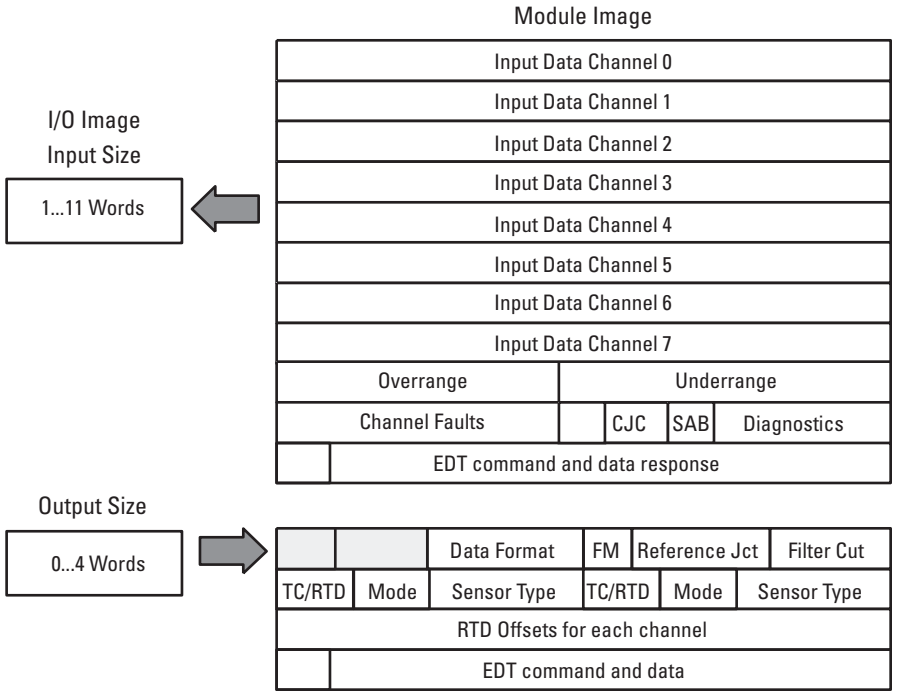
Read Data From the Module

Read programming transmits status and data from the TC and RTD input module to the processor data table in one I/O scan. The processor user program initiates the request to transfer data from the TC and RTD input module to the processor.

Map Data for the Module

The following read and write words and bit/word descriptions describe the information that is written to and read from the TC and RTD input module. The module uses up to 11 words of input data and up to 4 words of output data. Each word is composed of 16 bits.

Figure 9 - Thermocouple and RTD Input Module Image Table Mapping



Block-transfer Read and Write

The following block-transfer read and write word bit information is presented for experienced users only.

Table 7 - Input Map (Block-transfer Read)

Dec.	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Oct.	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Word 0	Channel 0 Input Data															
Word 1	Channel 1 Input Data															
Word 2	Channel 2 Input Data															
Word 3	Channel 3 Input Data															
Word 4	Channel 4 Input Data															
Word 5	Channel 5 Input Data															
Word 6	Channel 6 Input Data															
Word 7	Channel 7 Input Data															
Word 8	Overrange Alarm Bits (channel 0 = bit 8, and so on.)								Underrange Alarm Bits (channel 0 = bit 0, and so on.)							
Word 9	CH 7 Flt	CH 6 Flt	CH 5 Flt	CH 4 Flt	CH 3 Flt	CH 2 Flt	CH 1 Flt	CH 0 Flt	Res	CJC2 Alm	CJC1 Alm	SAB	CJC Status	Reserved		
Word 10	Resp Flag	Command Response							Response Data							
Where:	CH Flt = Channel Fault CJC = Cold Junction Compensation SAB = Series of unit; 0 = Series A, 1 = Series B Alm = Alarm															

Table 8 - Output Map (Block-transfer Write)

Dec.	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Oct.	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**07**	**06**	**05**	**04**	**03**	**02**	**01**	**00**
Word 0	Reserved				Data Format				Flt Mode CH 4...7	Flt Mode CH 0...3	Reference Junction			Filter Cutoff		
Word 1	TC/RTD CH 4...7		Sensor Mode CH 4...7		Sensor Type CH 4...7				TC/RTD CH 0...3		Sensor Mode CH 0...3		Sensor Type CH 0...3			
Word 2	RTD Offset CH 7		RTD Offset CH 6		RTD Offset CH 5		RTD Offset CH 4		RTD Offset CH 3		RTD Offset CH 2		RTD Offset CH 1		RTD Offset CH 0	
Word 3	Cmd Flag	EDT Command							EDT Command Data							
Where:	Flt = Fault CH = Channel TC/RTD = Thermocouple/Resistance Temperature Detector EDT = Extended Data Transfer															

Table 9 - Bit/Word Descriptions for the Input Module Block Transfer Read Words

Word	Dec. Bits (Octal Bits)	Description
Read Word 0	00...15 (00...17)	Channel 0 Input data
Read Word 1	00...15 (00...17)	Channel 1 Input data
Read Word 2	00...15 (00...17)	Channel 2 Input data
Read Word 3	00...15 (00...17)	Channel 3 Input data
Read Word 4	00...15 (00...17)	Channel 4 Input data
Read Word 5	00...15 (00...17)	Channel 5 Input data
Read Word 6	00...15 (00...17)	Channel 6 Input data
Read Word 7	00...15 (00...17)	Channel 7 Input data
Read Word 8	00...07	**Underrange Bits** – These bits are set if the input signal is below the minimum range of the input channel. Bit 00 corresponds to channel 0...bit 07 corresponds to channel 7.
	08...15 (10...17)	**Overrange Bits** – These bits are set if 1), the input signal is above the maximum range of the input channel; or 2), an input is disconnected. Bit 08 (10) corresponds to channel 0, bit 09 (11) corresponds to channel 1, and so on.
Read Word 9	00...03	**Diagnostic Bits** – Represent module configuration and/or hardware errors.

Bit	03	02	01	00	
	0	0	0	0	Reserved for factory use
	0	0	1	0	Improper module configuration
	0	1	1	0	RAM fault
	0	1	1	1	EEPROM fault
	0001, 0100, and 0011...1111 Reserved for factory use				

Read Word 9	04	Series of Unit (SAB) – 0 = Series A, 1 = Series B
	05...06	**Cold Junction Compensation Fault Bits** – These bits are set (1) when the corresponding cold junction compensator lead is broken, unattached, or shorted, and the thermocouple is set to "external compensation." Bit 05 corresponds to CJC1, and bit 06 to CJC2.
	07	Not used
	08...15 (10...17)	**Fault Alarm Bits** – An alarm bit is set (1) when an individual input lead opens (broken, disconnected). If the alarm is enabled, the channel reads maximum value. Bit 08 (10) corresponds to input channel 0, bit 09 (11) to channel 1, and so on.

Table 9 - Bit/Word Descriptions for the Input Module Block Transfer Read Words (Continued)

Word	Dec. Bits (Octal Bits)	Description
Read Word 10	00…07	**Extended Data Table Data Response Bits** – These bits echo the EDT command data written to the module during calibration.
	08…14 (10…16)	**Extended Data Table Command Response Bits** – These bits echo the EDT command written to the module during calibration.
	15 (17)	Reserved for factory use

Table 10 - Bit/Word Descriptions for Block-transfer Write Words

Word	Dec. Bits (Octal Bits)	Description					
Write Word 0	00…02	Input Filter Selection bits					
		Bit	**02**	**01**	**00**	**Filter Time Constants** – Actual filtering depends on the module mode of operation	
			0	0	0	Hardware filtering only (default filtering)	
			0	0	1	25 ms	
			0	1	0	100 ms	
			0	1	1	250 ms	
			1	0	0	500 ms	
			1	0	1	1 s	
			1	1	0	2 s	
			1	1	1	5 s	
	Bits 03…05	**Reference Junction** – Used when input type is set to thermocouple and sensor mode is set to internal compensation. Sets a fixed reference junction to compensate all thermocouple channels.					
		Bit	**05**	**04**	**03**	**Reference Junction**	
			0	0	0	0 °C (32 °F)	
			0	0	1	20 °C (68 °F)	
			0	1	0	25 °C (77 °F)	
			0	1	1	30 °C (86 °F)	
			1	0	0	40 °C (104 °F)	
			1	0	1	50 °C (122 °F)	
			1	1	0	60 °C (140 °F)	
			1	1	1	70 °C (158 °F)	
	Bits 06…07	**Fault Mode Bits** – When a bit is set (1), fault mode is enabled for that channel. Bit 06 corresponds to channels 0…3; bit 07 corresponds to channels 4…7. 0 = Disabled 1 = Enable wire-off detection					
	Bits 08…11 (10…13)	**Data format** – Module defaults to -4000…+10000 in millivolt mode, and 0…5000 in Ω mode with implied decimal points (that is -40.00…+40.00 mV, 0.1 Ω) whenever °C, °F, °K is selected.					
	Bits 08…11 (10…13)	**Bit**	**11**	**10**	**09**	**08**	**Data type for channels 0…7**
			0	0	0	0	°C (implied decimal point xxxx.x)
			0	0	0	1	°F (implied decimal point xxxx.x)
			0	0	1	0	°K (implied decimal point xxxx.x)
			0	0	1	1	-32767…+32767
			0	1	0	0	0…65535
			0101…1111 not used				
	Bits 12…15 (14…17)	Not used					

Table 10 - Bit/Word Descriptions for Block-transfer Write Words (Continued)

Word	Dec. Bits (Octal Bits)	Description					
Write Word 1	Bits 00...03	**Sensor Type (Thermocouple or RTD)**					
		RTD Type					
		Bit	**03**	**02**	**01**	**00**	**Sensor Type for Channels 0...3**
			0	0	0	0	Resistance (default)
			0	0	0	1	100 Ω Pt α = 0.00385 Euro (-200...+870 °C) (-328...+1598 °F)
			0	0	1	0	200 Ω Pt α = 0.00385 Euro (-200...+400 °C) (-328...+752 °F)
			0	0	1	1	100 Ω Pt α = 0.003916 U.S. (-200...+630 °C) (-328...+1166 °F)
			0	1	0	0	200 Ω Pt α = 0.003916 U.S. (-200...+400 °C) (-328...+752 °F)
			0	1	0	1	100 Ω Nickel (-60...+250 °C) (-76...+482 °F)
			0	1	1	0	200 Ω Nickel (-60...+200 °C) (-76...+392 °F)
			0	1	1	1	120 Ω Nickel (-80...+320 °C) °F) (-112...+608 °F)
			1	0	0	0	10 Ω Copper (-200...+260 °C) °F) (-328...+500 °F)
			1001...1111 not used				
		Thermocouple Type					
		Bit	**03**	**02**	**01**	**00**	**Sensor Type for Channels 0...3**
			0	0	0	0	mV (default)
			0	0	0	1	B 300...1800 °C (572...3272 °F)
			0	0	1	0	E -270...+1000 °C (-454...+1832 °F)
			0	0	1	1	J -210...+1200 °C (-346...+2192 °F)
			0	1	0	0	K -270...+1372 °C (-454...+2502 °F)
			0	1	0	1	TXK/XK(L) -200...+800 °C (-328...+1472 °F)
			0	1	1	0	N -270...+1300 °C (-450...+2372 °F)
			0	1	1	1	R -50...+1768 °C (-58...+3214 °F)
			1	0	0	0	S -50...+1768 °C (-58...+3214 °F)
			1	0	0	1	T -270...+400 °C (-454...+752 °F)
			1010...1111 not used				
	Bits 04...05	**Sensor Mode Select bits**					
		Bit	**05**	**04**	**Sensor Mode Select for Channels 0...3**		
		Thermocouple					
			0	0	**External Compensation** – Uses cold junction sensors. Both CJC sensors must be used when external compensation is selected.		
			0	1	**Internal Compensation** – Uses the user-selected Reference Junction Selection.		
			1	0	No compensation. Data is referenced to 0 °C (32 °F).		
			1	1	Differential measurement between 2 channels (0...1, 2...3, 4...5, 6...7)		
		RTD					
			0	0	2-wire RTD no compensation		
			0	1	2-wire RTD with user-selected RTD offset		
			1	0	3-wire RTD		
			1	1	4-wire RTD		
	Bits 06...07	**Input Type Select**					
			07	06	Input type selection for channels 0...3		
			0	0	Thermocouple		
		Bit	0	1	RTD		
			1	0	Not used		
			1	1	Not used		

Table 10 - Bit/Word Descriptions for Block-transfer Write Words (Continued)

Word	Dec. Bits (Octal Bits)	Description					
Write Word 1 (continued)	Bits 08...11 (10...13)	**Sensor Type (Thermocouple or RTD)**					
		RTD Type					
		Bit	**11**	**10**	**09**	**08**	**Sensor Type for Channels 4...7**
			0	0	0	0	Resistance (default)
			0	0	0	1	100 Ω Pt α = 0.00385 Euro -200...+870 °C (-328...+1598 °F)
			0	0	1	0	200 Ω Pt α = 0.00385 Euro -200...+400 °C (-328...+752 °F)
			0	0	1	1	100 Ω Pt α = 0.003916 U.S. -200...+630 °C (-328...+1166 °F)
			0	1	0	0	200 Ω Pt α = 0.003916 U.S. -200...+400 °C (-328...+752 °F)
			0	1	0	1	100 Ω Nickel -60...+250 °C (-76...+482 °F)
			0	1	1	0	200 Ω Nickel -60...+200 °C (-76...+362 °F)
			0	1	1	1	120 Ω Nickel -80...+320 °C (-112...+608 °F)
			1	0	0	0	10 Ω Copper -200...+260 °C (-328...+470 °F)
			1001...1111 not used				
	Bits 08...11 (10...13)	**Thermocouple Type**					
		Bit	**11**	**10**	**09**	**08**	**Sensor Type for Channels 4...7**
			0	0	0	0	mV (default)
			0	0	0	1	B 300...1800 °C (572...3272 °F)
			0	0	1	0	E -270...+1000 °C (-454...+1832 °F)
			0	0	1	1	J -210...+1200 °C (-346...+2192 °F)
			0	1	0	0	K -270...+1372 °C (-454...+2502 °F)
			0	1	0	1	TXK/XK(L) -200...+800 °C (-328...+1472 °F)
			0	1	1	0	N -270...+1300 °C (-450...+2372 °F)
			0	1	1	1	R -50...+1768 °C (-58...+3214 °F)
			1	0	0	0	S -50...+1768 °C (-58...+3214 °F)
			1	0	0	1	T -270...+400 °C (-454...+752 °F)
			1010...1111 not used				
	Bits 12...13 (14...15)	**Sensor Mode Select bits**					
		Bit	**13**	**12**	**Sensor Mode Select for Channels 4...7**		
		Thermocouple					
			0	0	**External Compensation** – Uses cold junction sensors. Both CJC sensors must be used when external compensation is selected.		
			0	1	**Internal Compensation** – Uses the user-selected Reference Junction.		
			1	0	No compensation. Data is referenced to 0 °C (32 °F).		
			1	1	Differential measurement between 2 channels.		
		RTD					
			0	0	2-wire RTD no compensation		
			0	1	2-wire RTD with user-selected offset		
			1	0	3-wire RTD		
			1	1	4-wire RTD		
	Bits 14...15 (16...17)	**Input Type Select**					
		Bit	**15**	**14**	**Input Type Selection for Channels 4...7**		
			0	0	Thermocouple		
			0	1	RTD		
			1	0	Not used		
			1	1	Not used		

Table 10 - Bit/Word Descriptions for Block-transfer Write Words (Continued)

Word	Dec. Bits (Octal Bits)	Description
Write Word 2	00...15 (00...17)	**RTD Offset Select Bits** – used when input type is set to RTD and sensor mode select is set to 2-wire with user-selected RTD offset. Allows you to set the type of RTD loop resistance compensation that is used for all RTDs or one of three fixed values for all channels. **NOTE:** Not applicable to 10 Ω copper RTD.

Bit	01	00	RTD Offset Select Bits – Channel 0
	03	02	RTD Offset Select Bits – Channel 1
	05	04	RTD Offset Select Bits – Channel 2
	07	06	RTD Offset Select Bits – Channel 3
	09	08	RTD Offset Select Bits – Channel 4
	11	10	RTD Offset Select Bits – Channel 5
	13	12	RTD Offset Select Bits – Channel 6
	15	14	RTD Offset Select Bits – Channel 7
	0	0	Use channel loop compensation value stored during calibration procedure for 2-wire RTD (default = 0 Ω).
	0	1	5 Ω (total lead resistance)
	1	0	10 Ω (total lead resistance)
	1	1	15 Ω

Write Word 3	00...07	**Extended Data Table Data Bits** – These bits are written to the module during calibration. They are used to define offset, gain, and general channel calibration.
	08...14 (10...16)	**Extended Data Table Command Bits** – These bits are written to the module during calibration. They are used to select channel calibration action.
	15 (17)	Reserved for factory use only

Series A Functionality in a Series B Module

To employ Series A functionality when using a Series B 1794-IRT8 module, connect a wire from terminal 39 to terminal 48 on the 1794-TB3G or 1794-TB3GS terminal base unit. When terminals 39 and 48 are wired together, bit 4 in Read Word 9 are **not** set (0), indicating that the module is in Series A functionality.

ATTENTION: If these terminals are not connected together, the Series B product defaults to Series B functionality.

Notes:

Calibrate Your Module

Overview

This chapter explains the tools, equipment, and procedure for calibrating your FLEX I/O Thermocouple, RTD, and mV input module.

When and How to Calibrate Your FLEX I/O Module

This module is shipped to you already calibrated. If a calibration check is required, the module must be in a FLEX system. We recommend recalibrating your module, if the module is going to be used in an environment with temperature other than 25 °C (77 °F) and 30% humidity.

ATTENTION: Perform module calibration periodically, based on your application, or at least once a year. Module calibration may also be required to remove module error caused by aging components in your system.
Offset calibration must be done first, followed by gain calibration.

IMPORTANT You must use a 1794-TB3G or 1794-TB3GS terminal base when calibrating this module.

Calibration can be accomplished using the manual calibration procedure described in the following sections.

Tools and Equipment

To calibrate your Thermocouple, RTD, and mV input module, you need the following tools and equipment:

Tool or Equipment	Description	
Precision Resistors	High Precision Resistors: 383 W, 0.01%, 5ppm/°C 100 W, 0.01%, 5ppm/°C 10 KΩ, 0.5%, 5ppm/°C	
Precision Voltage Source	320 mV, 1 µV resolution	Analogic 3100, Data Precision 8200 or equivalent
Industrial Terminal and Interconnect Cable	Programming terminal for Allen-Bradley family processors	

Calibrate Your Input Module

ATTENTION: You must calibrate the module in a FLEX system. The module must communicate with the processor and an industrial terminal. You can calibrate input channels in any order, or all at once.

IMPORTANT To allow the internal module temperature to stabilize, apply power to the module at least 20 minutes before calibration.

When using remote I/O, before calibrating your module, you must enter ladder logic into the processor memory, so that you can initiate block-transfer writes (BTW) to the module, and read inputs (BTR) from the module.

To calibrate the module manually:

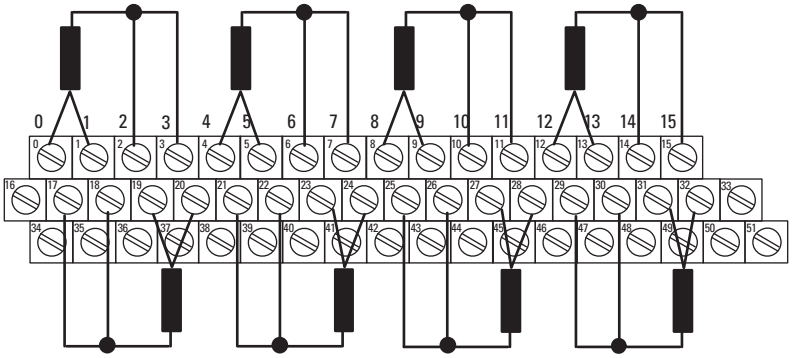
1. Apply a reference to the desired inputs.
2. Send a message to the module to indicate which inputs to read and what calibration step is being performed (offset).

   The module returns a response which echoes the message sent to the module. The module stores this input data.
3. Apply a second reference signal to the module.
4. Send a second message to indicate which inputs to read and what calibration step is being performed (gain).

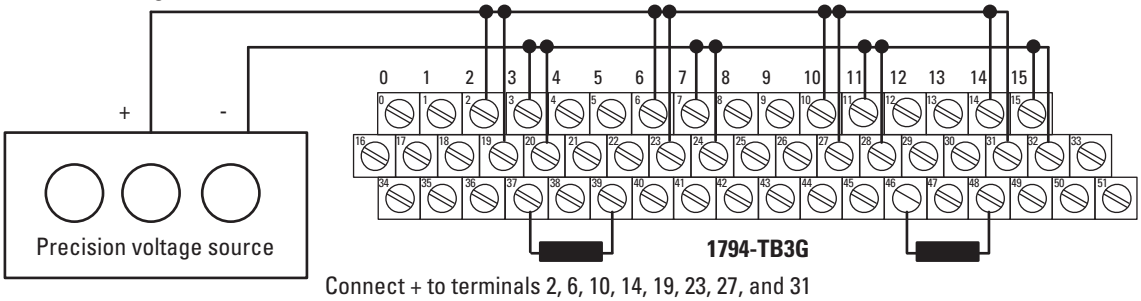
   The module computes the new calibration values for the inputs and returns a response which echoes back the message sent to the module. If the calibration cannot be completed, the module returns a fault message.

Calibration Setup

Use precision resistors -
for 383 Ω and 100 Ω calibration



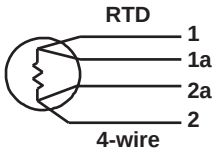
Use precision voltage source –
for offset and gain calibration



Connect + to terminals 2, 6, 10, 14, 19, 23, 27, and 31
Connect - to terminals 3, 7, 11, 15, 20, 24, 28 and 32
Connect one 10 kΩ, 0.5% resistor across terminals 37 and 39 and another across 46 and 48.

Table 11 - Wiring Connections for Calibrating the Thermocouple and RTD Input Module

Type of Input	Connect the Following:				
	H	L	+	-	Shield
RTD – 4-wire	1a	2a	1	2	
Millivolt		1		2	



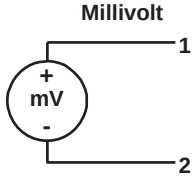


Table 12 - Wiring to the 1794-TB3G and 1794-TB3GS Terminal Base Units

RTD or Thermocouple Channel	1794-TB3G and 1794-TB3GS Terminal Base Units[1]			
	High Signal Terminal (H)	Low Signal Terminal (L)	RTD Source Current (+)	Signal Return (-)
0	1	2	0	3
1	5	6	4	7
2	9	10	8	11
3	13	14	12	15
4	18	19	17	20
5	22	23	21	24

Table 12 - Wiring to the 1794-TB3G and 1794-TB3GS Terminal Base Units (Continued)

RTD or Thermocouple Channel	1794-TB3G and 1794-TB3GS Terminal Base Units[1]			
	High Signal Terminal (H)	Low Signal Terminal (L)	RTD Source Current (+)	Signal Return (-)
6	26	27	25	28
7	30	31	29	32
24V DC Power	34 and 50			
24V DC Common	35 and 51			

(1) Terminals 16, 33, and 40...45 are chassis ground.

Read and Write Words for Calibration

Table 13 and Table 14 provide read and write words for module calibration.

Table 13 - Write Words for Calibration

Decimal	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Octal	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Word	Write															
0	Reserved				Data Format				Flt Mode CH 0...3	Flt Mode CH 4...7	Reference Junction			Filter Select		
1	TC/RTD Ch. 4...7		Sensor Mode CH 4...7		Sensor Type CH 4...7				TC/RTD Ch. 0...3		Sensor Mode CH 0...3		Sensor Type CH 0...3			
2	RTD Offset CH 7		RTD Offset CH 6		RTD Offset CH 5		RTD Offset CH 4		RTD Offset CH 3		RTD Offset CH 2		RTD Offset CH 1		RTD Offset CH 0	
3		EDT command							EDT command data							
Where:	Flt = Fault TC/RTD = Thermocouple/Resistance Temperature Detector EDT = Extended Data Transfer															

Table 14 - Read Words for Calibration

Decimal	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Octal	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Word	Read															
0	Channel 0 Input Data															
1	Channel 1 Input Data															
2	Channel 2 Input Data															
3	Channel 3 Input Data															
4	Channel 4 Input Data															
5	Channel 5 Input Data															
6	Channel 6 Input Data															
7	Channel 7 Input Data															
8	Overrange Alarm Bits (channel 0 = bit 08, and so on.)								Underrange Alarm Bits (channel 0 = bit 00, and so on.)							
9	Ch7 Flt	Ch6 Flt	Ch5 Flt	Ch4 Flt	Ch3 Flt	Ch2 Flt	Ch1 Flt	Ch0 Flt		CJC 2 Flt	CJC 1 Flt	SAB	Diagnostic Status			
10		EDT command response							EDT data response							
Where:	Flt = Fault CJC = Cold Junction Compensation SAB = Series of unit; 0 = Series A; 1 = Series B															

ATTENTION: The CJC Status bit, Read Word 9, Bit 3 is added with Firmware C release of the 1794-IRT8 Series B module.

- The CJC Status bit is turned On when the temperature between the CJC is greater than 6 °C but less than 12 °C.
- When this temperature difference is above 12 °C, then the CJC Alarm bits are set.
- If a CJC temperature is overrange or underrange, then the associated CJC Alarm bit is set. In this condition, the CJC Status bit is not set.
- The CJC Status bit does not exist in Series A.

Table 15 - EDT Calibration Command and Command Data Summary

Config Word 3 EDT Command Bits 8...15	Meaning	Config Word 3 Bits 4...7	Config Word 3 Bits 0...3	Meaning
Dec. (Hex)		Channel No.	Command data	
4 (4)	General calibration by channel	0...7	1	Channel internal current source and current sense resistor, with 4-wire external 383 Ω inputs.
		0...7	2	Channel internal current source and current sense resistor with 4-wire external 100 Ω inputs.
		0...7	3	Loop channel compensation for 2-wire RTD
		0...7	4	CJC calibration
5 (5)	Offset calibration by channel	0...7	0	Gain= 1, input = -320 mV
		0...7	1	Gain = 2, input = 0.0 mV
		0...7	2	Gain = 4, input = -50 mV
		0...7	3	Gain = 8, input = -10.0 mV
		0...7	4	Gain = 16, input = -9 mV
		0...7	5	Gain = 32, input = 1.0 mV
6 (6)	Gain calibration by channel		0	Gain = 1, input = 320 mV
			1	Gain = 2, input = 320 mV
			2	Gain = 4, input = 110 mV
			3	Gain = 8, input = 70 mV
			4	Gain = 16, input = 29 mV
			5	Gain = 32, input = 19 mV
36 (24)	Calibration all channels			
	General calibration all channels	0	1	Channel internal current source and current sense resistor, with 4-wire external 383 Ω inputs.
		0	2	Channel internal current source and current sense resistor with 4-wire external 100 Ω inputs.
		0	3	Loop channel compensation for 2-wire RTD
		0	4	CJC calibration
	Offset calibration all channels	1	0	Gain = 1, input = -320 mV
		1	1	Gain = 2, input = 0.0 mV
		1	2	Gain = 4, input = -50 mV
		1	3	Gain = 8, input = -10.0 mV
		1	4	Gain = 16, input = -9 mV
		1	5	Gain = 32, input = 1.0 mV
	Gain calibration all channels	2	0	Gain = 1, input = 320 mV
		2		Gain = 2, input = 320 mV
		2		Gain = 4, input = 110 mV
		2		Gain = 8, input = 70 mV
		2		Gain = 16, input = 29 mV
		2		Gain = 32, input = 19 mV

Offset Calibration

Inputs can be calibrated one at a time or simultaneously. To calibrate the offsets, proceed as follows:

1. Apply power to the module for 20 minutes before calibrating.
2. Connect a precision millivolt source across each input channel. Set the source to -320.00 mV for a gain of 1. Connect all (L) signal terminals together and attach to the positive lead from the precision voltage source. Connect all (-) signal terminals together and attach to the negative lead.

Table 16 - EDT Commands for Offset Calibration

		All Channels		Single Channel		
		EDT Command		EDT Command Dec. or Hex	EDT Command Data Dec. or Hex	
Gain Selected	Input (mV)	Hex	Decimal	Bits 8...15	Bits 4...7	Bits 0...3
1	-320.00 + 0.064 mV	2410	9232	05	0...7	0
2	0.000 + 0.032 mV	2411	9233	05	0...7	1
4	-50.00 + 0.016 mV	2412	9234	05	0...7	2
8	-10.00 + 0.008 mV	2413	9235	05	0...7	3
16	-9.00 + 0.004 mV	2414	9236	05	0...7	4
32	1.000 + 0.002 mV	2415	9237	05	0...7	5

3. Initiate a write to the module with the appropriate value in the EDT command location (Write Word 3, bits 00...15), as shown in Table 16.
4. Monitor the EDT response location (Read Word 11 bits 00...15) for an echo of the EDT command. Depending on which command you sent, it should show 241X Hex.

   If the EDT response word reads 80FF (Hex), repeat step 3. Make sure that you allow sufficient time for the module to respond to your request. If there is no change, calibration has failed. Check the wiring and try again.
5. Set the precision millivolt source to the value required for a gain of 2. Repeat steps 3 and 4 for gain 2. Repeat for each gain setting.
6. When all offset calibrations are successful, proceed to Gain Calibration.

Gain Calibration

After completing the offset calibration, proceed with the gain calibration.

1. Connect a precision millivolt source across each input channel. Set the source to 320.00 mV for a gain of 1. Connect all (L) signal terminals together and attach to the positive lead from the precision voltage source. Connect all (-) signal terminals together and attach to the negative lead.

Table 17 - EDT Commands for Gain Calibration

		All Channels		Single Channel		
		EDT Command		EDT Command Dec. or Hex	EDT Command Data Dec. or Hex	
Gain Selected	Input (mV)	Hex	Decimal	Bits 8...15	Bits 4...7	Bits 0...3
1	-320.00 + 0.064 mV	2420	9248	06	0...7	0
2	320.00 + 0.032 mV	2421	9249	06	0...7	1
4	110 + 0.016 mV	2422	9250	06	0...7	2
8	70.00 + 0.008 mV	2423	9251	06	0...7	3
16	29.00 + 0.004 mV	2424	9252	06	0...7	4
32	19.00 + 0.002 mV	2425	9253	06	0...7	5

2. Apply power to the module for 20 minutes before calibrating.
3. After the connections stabilize, initiate a Write Word with the appropriate EDT command location (Write Word 3, bits 00...15) as shown in Table 17.

4. Monitor the value in the EDT response location (Read Word 11, bits 00…15) for an echo of the EDT command. Depending on which command you sent, it should show 242X Hex.

   If the EDT response word reads 80FF (Hex), repeat step 3. Make sure that you allow sufficient time for the module to respond to your request. If there is no change, calibration has failed. Check the wiring and try again.
5. Set the precision millivolt source to the value required for a gain of 2. Repeat steps 3 and 4 for gain 2. Repeat for each gain setting.

When all gain calibrations are successful, proceed to perform Current Source Calibration.

Current Source Calibration

The current sources can be calibrated one at a time or all at once. To calibrate all current sources, proceed as follows:

1. Connect a 383 Ω, 0.01% resistor across (H, +) and (L, -) of each input channel (8 resistors).
2. Apply power to the module for 20 minutes before calibrating.
3. Initiate a write to the module with a 2401 (Hex) value in EDT command location (Write Word 3, bits 00…15), as shown, for calibrating all channels at once. For individual channel calibrations, use the 04X1 (Hex) (0401, 0411, 0421…0471 Hex).
4. Monitor the EDT response location (Read Word 10, bits 00…15) for an echo of the EDT command.
5. If the EDT response word reads 80FF (Hex), repeat step 3. Make sure that you allow sufficient time for the module to respond to your request. If there is no change, calibration has failed. Check the wiring and try again.
6. Connect a 100 Ω, 0.01% resistor across (H, +) and (L, -) of each input channel (8 resistors). Repeat steps 3 and 4 using the EDT command value of 2402 (Hex) for calibrating all channels at once. For individual channel calibrations, use the 04X2 (Hex) (0402, 0412, 0422…0472 Hex).

When all calibrations are successful, proceed to the Cold Junction Calibration.

Cold Junction Calibration

Both cold junction compensation inputs must be calibrated at the same times. To calibrate both simultaneously, proceed as follows:

1. Connect 10 KΩ, 0.5% resistors across terminals 37 and 39 (CJC 1) and terminals 46 and 48 (CJC 2).
2. Apply power to the module for 20 minutes before calibrating.
3. Initiate a write to the module with a 2404 (Hex) value in the EDT command location (Write Word 3, bits 00…15).
4. Monitor the EDT response location (Read Word 11, bits 00…15) for an echo of the EDT command.

If the EDT response word reads 80FF (Hex), repeat step 3. Make sure that you allow sufficient time for the module to respond to your request. If there is no change, calibration has failed. Check the wiring and try again.

Channel Loop Compensation Calibration

Each 2-wire RTD can be calibrated individually, or simultaneously. Proceed as follows.

1. Short circuit the end of each input cable at the RTD element. Do this for all channels to be calibrated.
2. Apply power to the module for 20 minutes before calibrating.
3. Initiate a write to the module with 2403 (Hex) (calibrate all channels) in the EDT command location (Write Word 3, bits 00…15). For individual channel calibrations, use 04X3 (Hex) (0403, 0413, 0423…0473).
4. Monitor the EDT response location (Read Word 1X, bits 00…15) for an echo of the EDT command.

If the EDT response word reads 80FF (Hex), repeat step 3. Make sure that you allow sufficient time for the module to respond to your request. If there is no change, calibration has failed. Check the wiring and try again.

Notes:

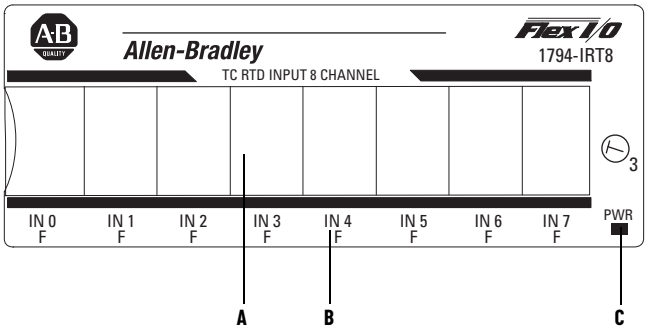
Troubleshoot the Module

Overview

This appendix provides a description of the different status indicators for the FLEX I/O Thermocouple, RTD, and mV module to help you troubleshoot.

Module Indicators

The FLEX I/O module has one status indicator (PWR) that is on when power is applied to the module, and one fault indicator (F) for each input.



A – Insertable label for writing individual input designations
B – Fault Indicator - Indicates a noncritical fault
C – Power Indicator - Indicates that power is applied to module A

Table 18 - Status Indicators

Indicator	Color	State	Description
Fault	Red	On	At power-up – Channel 0 indicator lights at power-up until all internal diagnostics are checked. After successful power-up, the indicator goes off if no fault is detected and the module has started communicating with an adapter. After successful power-up – Indicates a critical fault, such as diagnostic failure. If the channel indicator stays solid red after power-up, there is an internal module error. Try cycling power. If the problem persists, replace the module. If the channel indicator continues to blink after power-up, communication between the module and the adapter has not been established.
		Blinking (when faults are enabled, and bit set)	Indicates a noncritical fault (such as an open sensor). Input is data set to maximum, and the indicator flashes at about 1 Hz rate.
Power		Off	Module not powered
	Green	On	Module receiving power

The FLEX I/O Thermocouple, RTD, and mV module returns diagnostics to the processor in Word 9 of the block-transfer read (BTR) file. These diagnostics give you information on the status or condition of the module.

Table 19 - Diagnostic Bits in Word 9

Word	Dec. Bits (Octal Bits)	Description					
Read Word 9	00...03	**Diagnostic Bits** – Represent module configuration and/or hardware errors.					
		Bit	**03**	**02**	**01**	**00**	
			0	0	0	0	Reserved for factory use
			0	0	1	0	Improper module configuration
			0	1	1	0	RAM fault
			0	1	1	1	EEPROM fault
			0001, 0100, and 0011...1111 Reserved for factory use				
	04	Series of Unit (SAB) – 0 = Series A, 1 = Series B					
	05...06	**Cold Junction Compensation Fault Bits** – These bits are set (1) when the corresponding cold junction compensator lead is broken, unattached, or shorted, and the thermocouple is set to "external compensation." Bit 05 corresponds to CJC1, and bit 06 to CJC2.					
	07	Not used					
	08...15 (10...17)	**Fault Alarm Bits** – An alarm bit is set (1) when an individual input lead opens (broken, disconnected). If the alarm is enabled, the channel reads maximum value. Bit 08 (10) corresponds to input channel 0, bit 09 (11) to channel 1, and so on.					

Electronic Data Sheet (EDS) Files

Overview

EDS provides the definition for a device's configurable parameters and public interfaces to those parameters.

Every type of configurable device has its own unique EDS. It is a simple text file that allows product-specific information to be made available to third-party vendors.

This makes updating of configuration tools easier without having to constantly revise the configuration software tool.

With the following revisions, EDS files are required for RSNetWorx™ for DeviceNet® and ControlNet, RSLinx®, RSLogix 5, and Studio 5000 Logix Designer application to recognize a device:

RSNetWorx	Version 2.21
RSLinx	Version 1.10.176
RSLogix 5	Version 4.0
Studio 5000 Logix Designer	Version 20

Updating EDS File

Most EDS files are installed with RSLinx, RSNetWorx, and other Rockwell Software® as long as you enable the option during installation.

There are instances where you will must acquire and register EDS files on your own even after all the software is installed.

- If you go online with RSNetWorx and it shows a device with a "?", a globe, or a message that says the device is unrecognized, this means the EDS file for that device **does not** exist on your PC.
- If RSLinx can see a processor but is not able to go online, upload, or download.

With ControlLogix modules the backplane **does not** show after expanding the tree or ControlLogix modules in the backplane show up as a yellow question mark without a red X sign.

An EDS file is also required if a bridge such as a 1756-CNB or DNB **does not** show the "+" sign to expand the tree to show its network.

You can download EDS files from the Product Compatibility and Download Center at rok.auto/pcdc. It allows you to search for devices by the type of network and their catalog number.

ATTENTION:

- Make sure to match the major firmware revision of the device as each major firmware revision is associated with a specific EDS file.
- Download the EDS file and place it in any folder, except the /Program Files/ Rockwell Software/RSCommon/EDS folder where your Rockwell Automation software is installed.
- Register EDS files with RSNetWorx by selecting Tools EDS Wizard.
- Select Register an EDS File, then click the Browse button on the Next page to find your file.

EDS Installation

You can register EDS files with the EDS Hardware Installation tool.

1. In Windows®, go to Rockwell Software —> RSLinx Tools —> EDS Hardware Installation Tool.
2. Click Add to register an EDS file.

   When an EDS file is registered, a copy of the file is made and placed in the /RSCommon/EDS folder, where your Rockwell Automation software is installed and your Windows registry is updated. Once the registration is complete you can move, copy, or delete the original files.

ATTENTION:

- Only one EDS file is required to support both the Series A and Series B modules. The module ID for the Series A and B is identical because there is no change in software functionality.
- The Series B hardware jumper determines how the module data reacts to an open circuit condition.
- Download the Series A and B EDS file from the Product Compatibility and Download Center at rok.auto/pcdc.
- The EDS file is installed using the RSLinx Tools EDS Hardware Installation Tool.

Program Your Module with PLC Family Processors

Overview

This appendix serves as a reference to users of the PLC Family Processors to program their modules.

To initiate communication between the Thermocouple, RTD, and Millivolt modules and your PLC processor, you must enter block transfer instructions into your ladder logic program. Use this chapter to enter the necessary block transfer instructions into your ladder logic program.

Enter Block Transfer Instructions

The Thermocouple, RTD, and Millivolt modules communicate with the PLC processor through bidirectional block transfers. This is the sequential operation of both read and write block transfer instructions.

Before you configure the module, you must enter block-transfer instructions into your ladder logic. The following example programs illustrate the minimum programming that is required for communication to take place between the module and a PLC processor. These programs can be modified to suit your application requirements.

A configuration block-transfer write (BTW) is initiated when the frequency module is first powered up, and then only when the programmer wants to enable or disable features of the module. The configuration BTW sets the bits that enable the programmable features of the module, such as scalars and alarm values. Block transfer reads are performed to retrieve information from the module.

Block-transfer read (BTR) programming transmits status and data from the module to the processor data table. The processor user program initiates the request to transfer data from the module to the processor. The transferred words contain module status, channel status, and input data from the module.

Your program should monitor status bits, block-transfer read and block-transfer write activity.

PLC-2 Family Processor

The FLEX Thermocouple, RTD, and Millivolt modules are not recommended for use with PLC-2® family programmable controllers due to the number of digits needed for high resolution.

IMPORTANT	The Thermocouple, RTD, and Millivolt modules function with reduced performance in PLC-2 systems. Because the modules do not support BCD and the PLC-2 processor is limited to values of 4095 (12 bit binary), many values that are returned in the BTR file may not provide meaningful data to the PLC-2 processor.

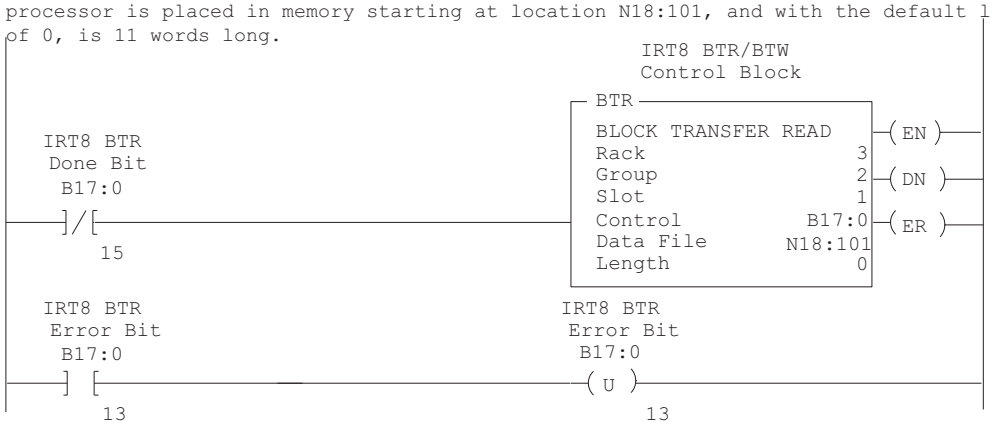
PLC-3 Family Processor

Block transfer instructions with the PLC-3® processor use a control file and a data file. The block transfer control file contains the data table section for module location, the address of the block transfer data file and other related data. The block transfer data file stores data that you want transferred to the module (when programming a BTW) or from the module (when programming a BTR).

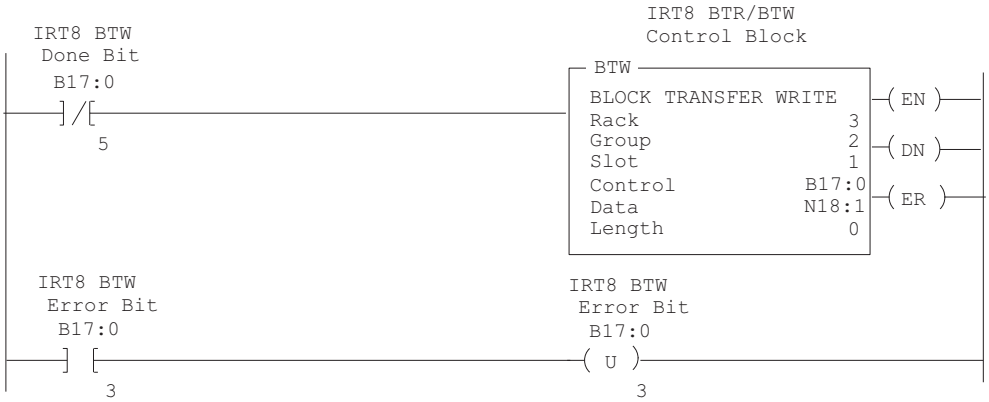
The programming terminal prompts you to create a control file when a block transfer instruction is being programmed. The same block transfer control file is used for both the read and write instructions for your module. A different block transfer control file is required for every module.

PLC-3 Processor Program Example

```
Rung M:0
The IRT8 module is located in rack 3, I/O group 2, slot 1. The control file is a 10 word
file starting at B17:0 that is shared by the BTR/BTW.  The data obtained by the PLC3
processor is placed in memory starting at location N18:101, and with the default length
of 0, is 11 words long.
```




```
The IRT8 module is located in rack 3, I/O group 2, slot 1. The control file is a 10 word
file starting at B17:0 that is shared by the BTR/BTW.  The data sent by the PLC-3
processor to the IRT8 module is from PLC memory starting at N18:1, and with the default
length of 0, is 4 words long.
```



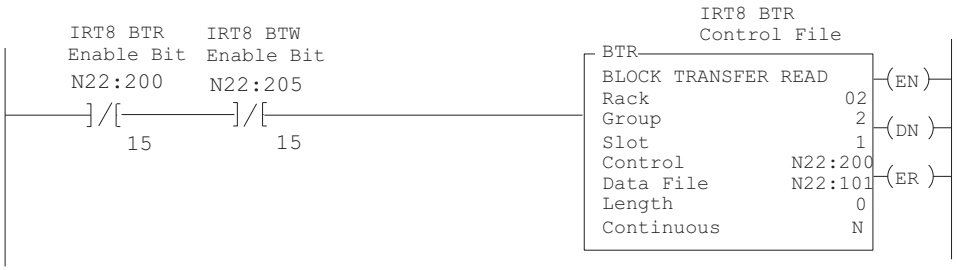
PLC-5 Family Processor

Block transfer instructions with the PLC-5 processor use a control file and a data file. The block transfer control file contains the data table section for module location, the address of the block transfer data file and other related data. The block transfer data file stores data that you want transferred to the module (when programming a BTW) or from the module (when programming a BTR).

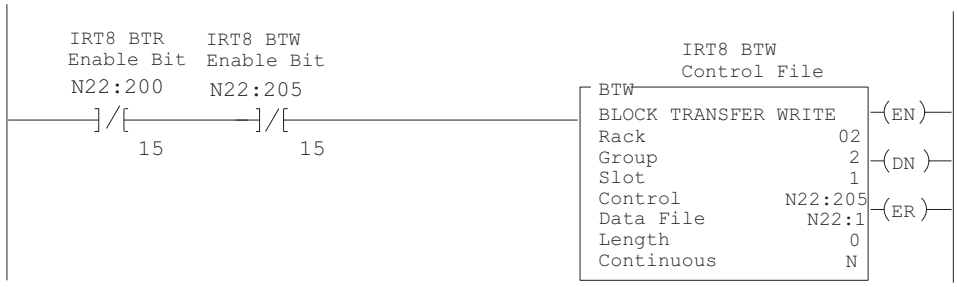
The programming terminal prompts you to create a control file when a block transfer instruction is being programmed. A different block transfer control file is used for the read and write instructions for your module.

PLC-5 Processor Program Example

Rung 2:0
The IRT8 module is located in rack 2, I/O group 2, slot 1. The integer control file starts at N22:200, is 5 words long and is compatible with all PLC-5 family members. The data obtained by the PLC-5 processor from the IRT8 module is placed in memory starting at N22:101, and with the default length of 0, is 11 words long. The length can be any number



Rung 2:1
The IRT8 module is located in rack 2, group 2, slot 1. The integer control file starts at N22:205, is a 5 words long and is compatible will all PLC-5 family members. The data sent by the PLC-5 processor to the IRT8 module starts at N22:1, and with the default length of 0, is 4 words long. Valid BTW lengths: 0, 1, 2, 3, and 4. In enhanced PLC-5 processors[1], the block transfer data type may be used as a control file.



[1] Enhanced PLC-5 processors include: PLC-5/11, -5/20, -5/3x, -5/4x, and -5/6x.

PLC-5/250 Family Processor

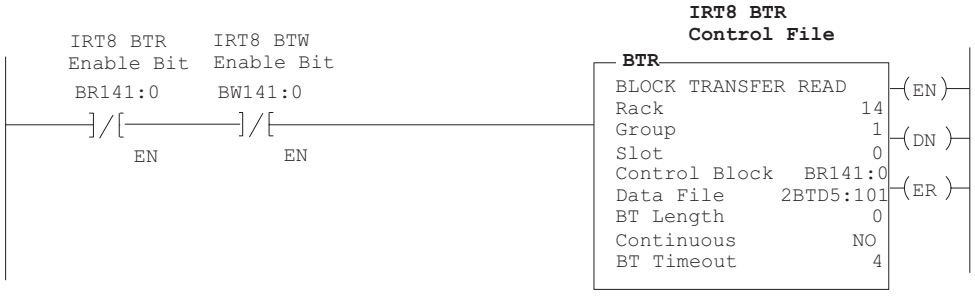
Block transfer instructions with the PLC-5/250 processor use a control file and a data file. The block transfer control file contains the data table section for module location, the address of the block transfer data file and other related data. The block transfer data file stores data that you want transferred to the module (when programming a BTW) or from the module (when programming a BTR).

The programming terminal automatically selects the control file based on rack, group and module, and whether it is a read or write. A different block transfer control file is used for the read and write instructions for your module. A different block transfer control file is required for every module.

PLC-5/250 Processor Program Example

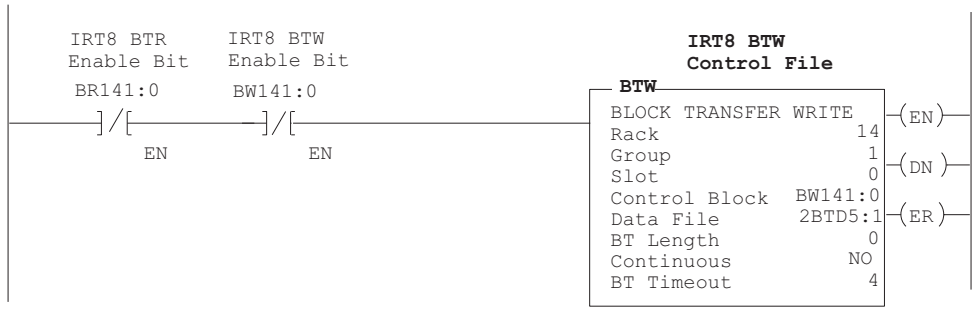
Rung 1STEPO:1

The IRT8 module is located in rack 14, I/O group 1, slot 0. The data obtained by the PLC-5/250 processor from the IRT8 module is placed in the data table starting at 2BTD5:101, and with the default length of 0, is 11 words long. The length can be any number between 0 and 11.



Rung 1STEPO:1

The IRT8 module is located in rack 14, I/O group 1, slot 0. The data sent to the IRT8 module from the PLC-5/250 processor is from the data table starting at 2BTD5:1, and with a default length of 0, is 4 words long. Valid BTW lengths: 0, 1, 2, 3, and 4.



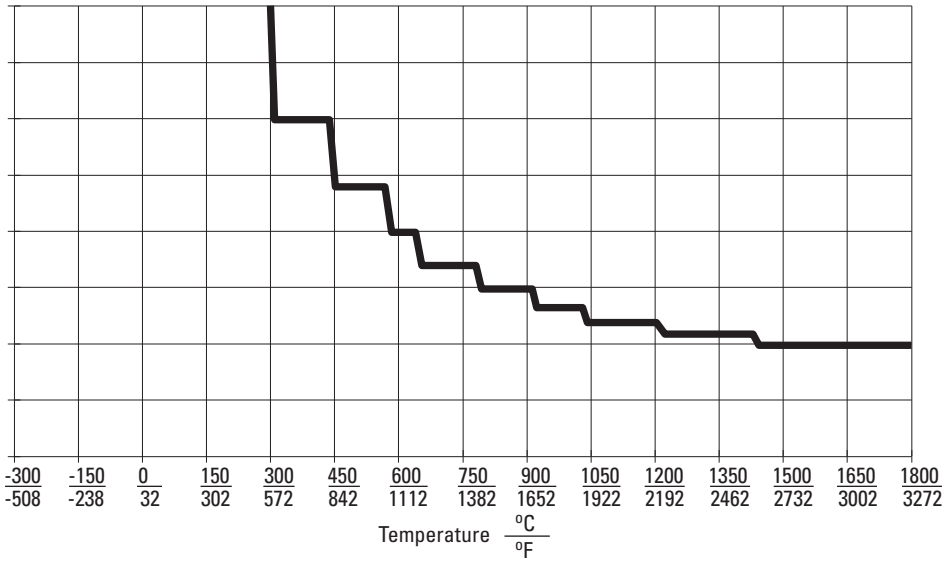
Resolution Curves for Thermocouples

Use the resolution curves to help select the proper operating range of your thermocouple. They show the resolution that the module provides internally depending on thermocouple type and filter selection. The lower the resolution, the higher the accuracy. Note that the maximum resolution displayed is 0.1 °C (32.18 °F).

Type B Thermocouple

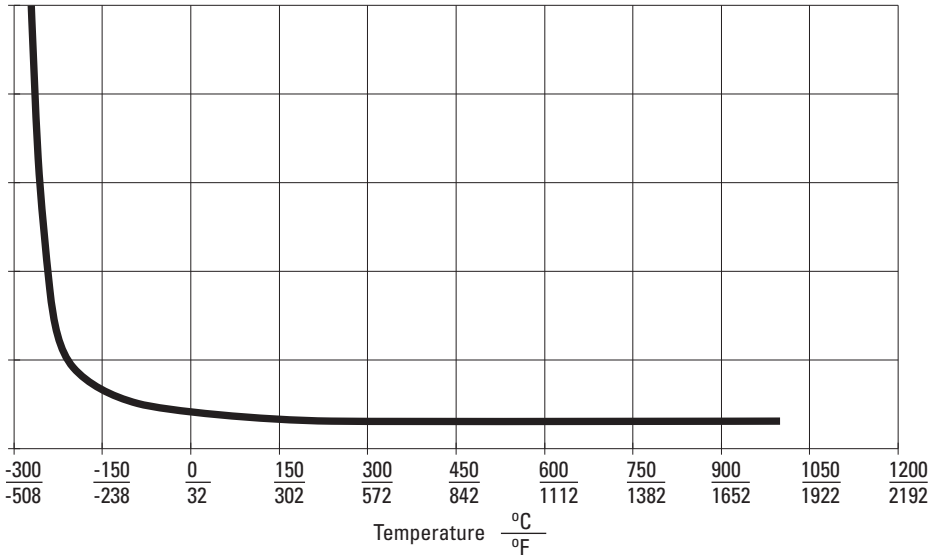
Resolution °C / °F

1000 Hz	500 Hz	250 Hz	10…100 Hz
102.4 / 184.3	25.60 / 46.08	6.40 / 11.52	0.80 / 1.44
89.60 / 161.3	22.40 / 40.32	5.60 / 10.08	0.70 / 1.26
76.80 / 138.2	19.20 / 34.56	4.80 / 8.64	0.60 / 1.08
64.00 / 115.2	16.00 / 28.80	4.00 / 7.20	0.50 / 0.90
51.20 / 92.16	12.80 / 23.04	3.20 / 5.76	0.40 / 0.72
38.40 / 69.12	9.60 / 17.28	2.40 / 4.32	0.30 / 0.54
25.60 / 46.08	6.40 / 11.52	1.60 / 2.88	0.20 / 0.36
12.80 / 23.04	3.20 / 5.76	0.80 / 1.44	0.10 / 0.18
			0



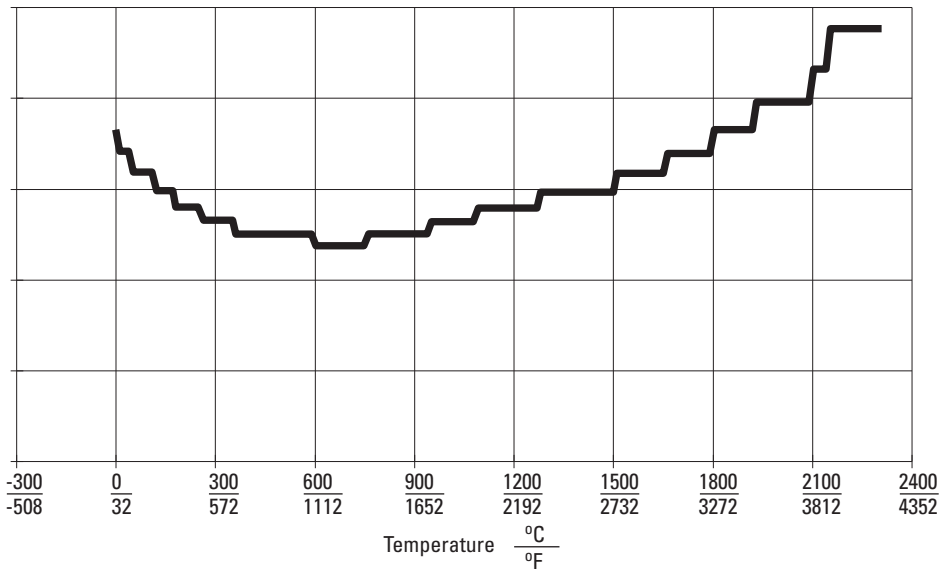
Type E Thermocouple

Resolution $\frac{^{o}C}{^{o}F}$			
1000 Hz	500 Hz	250 Hz	10…100 Hz
64.00 115.2	16.00 28.80	4.00 7.20	0.50 0.90
51.20 92.16	12.80 23.04	3.20 5.76	0.40 0.72
38.40 69.12	9.60 17.28	2.40 4.32	0.30 0.54
25.60 46.08	6.40 11.52	1.60 2.88	0.20 0.36
12.80 23.04	3.20 5.76	0.80 1.44	0.10 0.18
0			



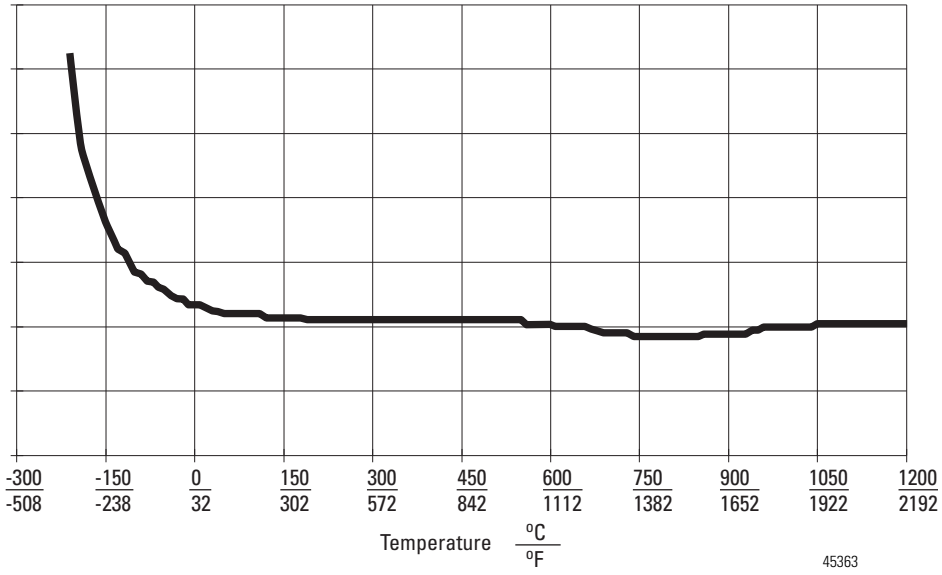
Type C Thermocouple

Resolution $\frac{^{o}C}{^{o}F}$			
1000 Hz	500 Hz	250 Hz	10…100 Hz
32.00 57.60	8.00 14.4	2.00 3.60	0.25 0.45
25.60 46.08	6.40 11.52	1.60 2.88	0.20 0.36
19.20 34.56	4.80 8.64	1.20 2.16	0.15 0.27
12.80 23.04	3.20 5.76	0.80 1.44	0.10 0.18
6.400 11.52	1.60 2.88	0.40 0.72	0.05 0.09
0			



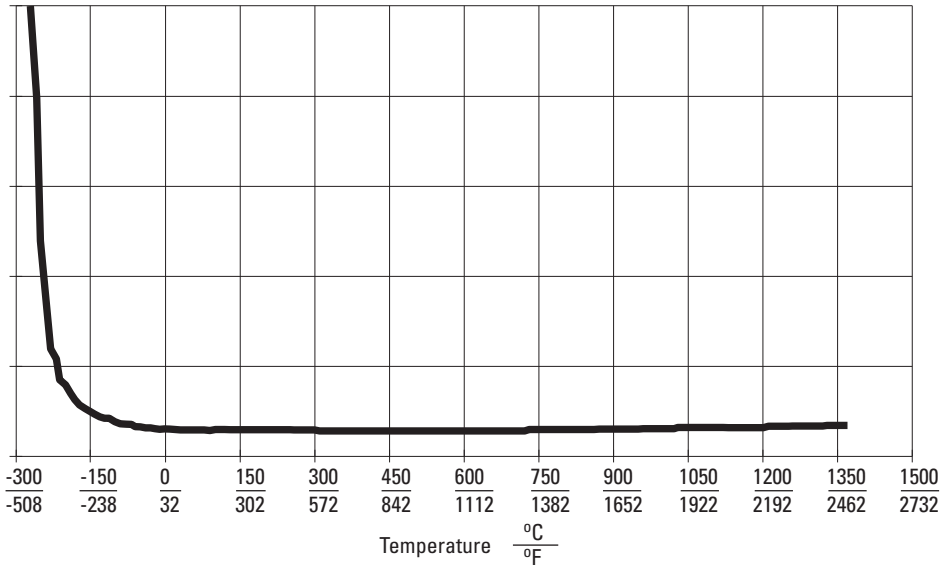
Type J Thermocouple

Resolution °C / °F			
1000 Hz	500 Hz	250 Hz	10…100 Hz
17.92 / 32.25	4.480 / 8.064	1.120 / 2.016	0.140 / 0.252
15.36 / 27.65	3.840 / 6.912	0.960 / 1.728	0.120 / 0.216
12.80 / 23.04	3.200 / 5.760	0.800 / 1.440	0.100 / 0.180
10.24 / 18.43	2.560 / 4.608	0.640 / 1.152	0.080 / 0.144
7.680 / 13.82	1.920 / 3.456	0.480 / 0.864	0.060 / 0.108
5.120 / 9.216	1.280 / 2.304	0.320 / 0.576	0.040 / 0.072
2.560 / 4.608	0.640 / 1.152	0.160 / 0.288	0.020 / 0.036
0			



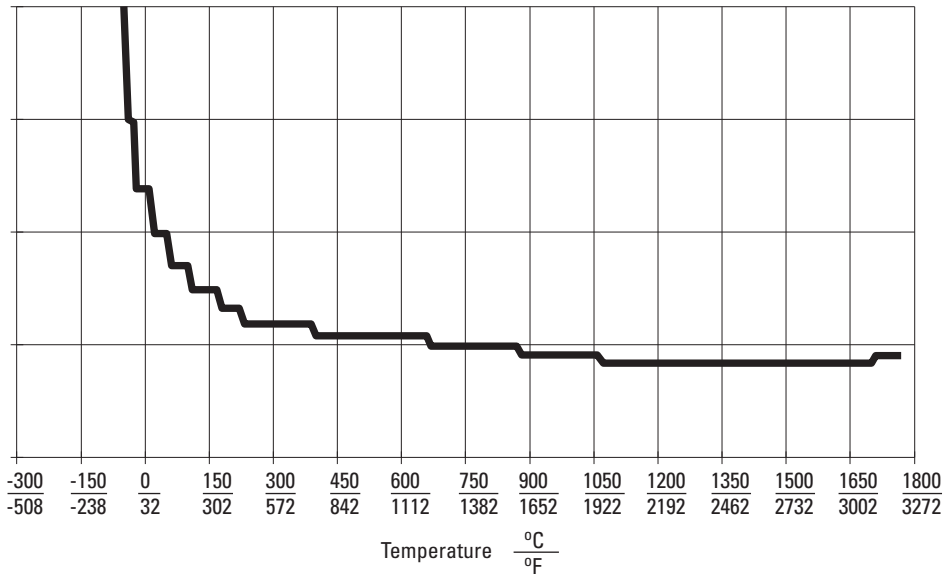
Type K Thermocouple

Resolution °C / °F			
1000 Hz	500 Hz	250 Hz	10…100 Hz
128.0 / 230.4	32.00 / 57.60	8.000 / 14.40	1.000 / 1.800
102.4 / 184.3	25.60 / 46.08	6.400 / 11.52	0.800 / 1.440
76.80 / 138.2	19.20 / 34.56	4.800 / 8.640	0.600 / 1.080
51.20 / 92.16	12.80 / 23.04	3.200 / 5.760	0.400 / 0.720
25.60 / 46.08	6.400 / 11.52	1.600 / 2.880	0.200 / 0.360
0			



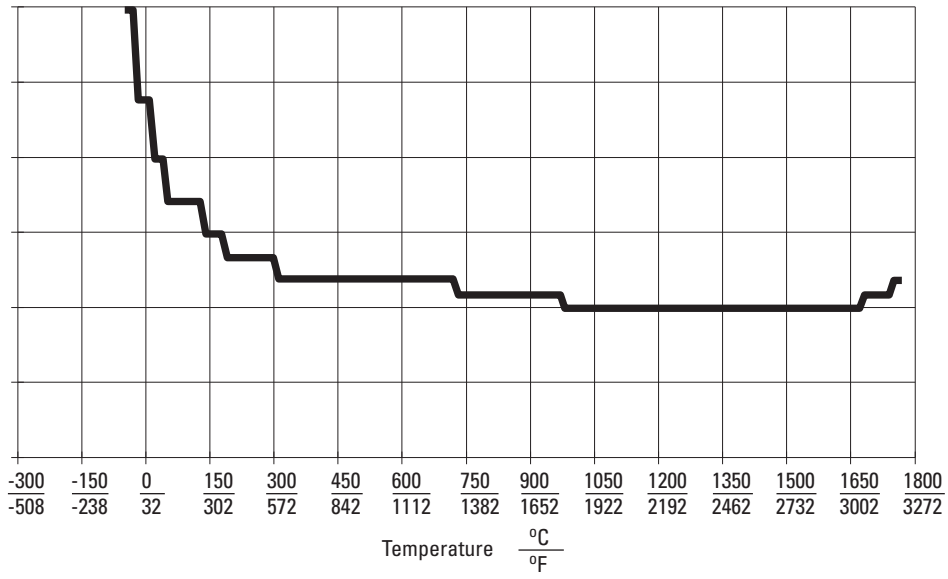
Type R Thermocouple

Resolution $\frac{^{o}C}{^{o}F}$			
1000 Hz	500 Hz	250 Hz	10…100 Hz
102.4 / 184.3	25.60 / 46.08	6.40 / 11.52	0.80 / 1.44
76.80 / 138.2	19.20 / 34.56	4.80 / 8.64	0.60 / 1.08
51.20 / 92.16	12.80 / 23.04	3.20 / 5.76	0.40 / 0.72
25.60 / 46.08	6.40 / 11.52	1.60 / 2.88	0.20 / 0.36
0			



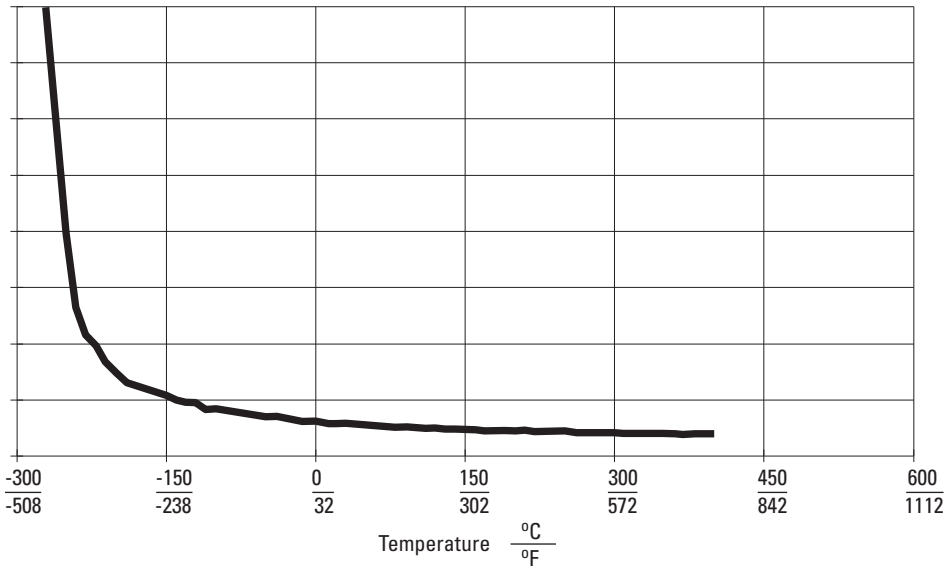
Type S Thermocouple

Resolution $\frac{^{o}C}{^{o}F}$			
1000 Hz	500 Hz	250 Hz	10…100 Hz
76.80 / 138.2	19.20 / 34.56	4.80 / 8.64	0.60 / 1.08
64.00 / 115.2	16.00 / 28.80	4.00 / 7.20	0.50 / 0.90
51.20 / 92.16	12.80 / 23.04	3.20 / 5.76	0.40 / 0.72
38.40 / 69.12	9.60 / 17.28	2.40 / 4.32	0.30 / 0.54
25.60 / 46.08	6.40 / 11.52	1.60 / 2.88	0.20 / 0.36
12.80 / 23.04	3.20 / 5.76	0.80 / 1.44	0.10 / 0.18
0			



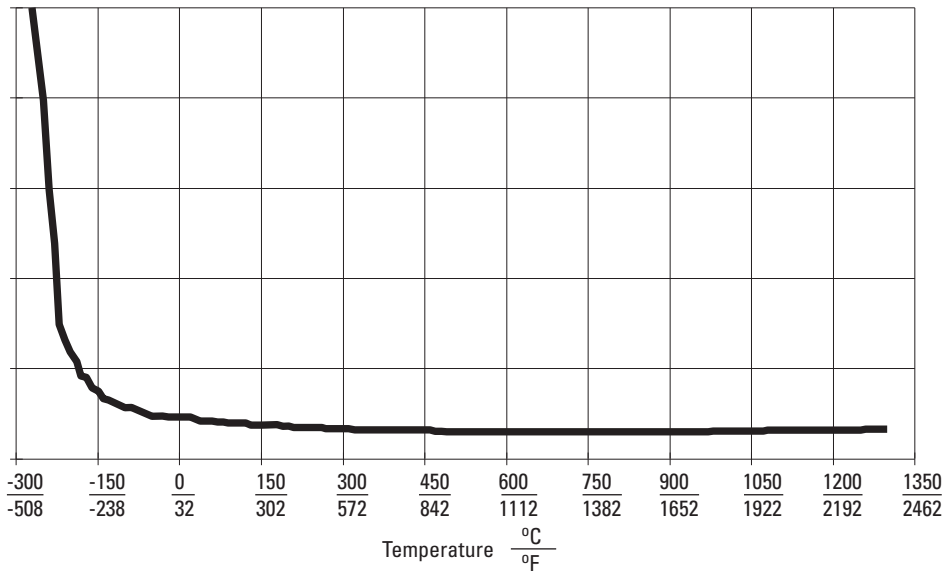
Type T Thermocouple

Resolution °C / °F			
1000 Hz	500 Hz	250 Hz	10…100 Hz
102.4 / 184.3	25.60 / 46.08	6.40 / 11.52	0.80 / 1.44
89.60 / 161.3	22.40 / 40.32	5.60 / 10.08	0.70 / 1.26
76.80 / 138.2	19.20 / 34.56	4.80 / 8.64	0.60 / 1.08
64.00 / 115.2	16.00 / 28.80	4.00 / 7.20	0.50 / 0.90
51.20 / 92.16	12.80 / 23.04	3.20 / 5.76	0.40 / 0.72
38.40 / 69.12	9.60 / 17.28	2.40 / 4.32	0.30 / 0.54
25.60 / 46.08	6.40 / 11.52	1.60 / 2.88	0.20 / 0.36
12.80 / 23.04	3.20 / 5.76	0.80 / 1.44	0.10 / 0.18
0			

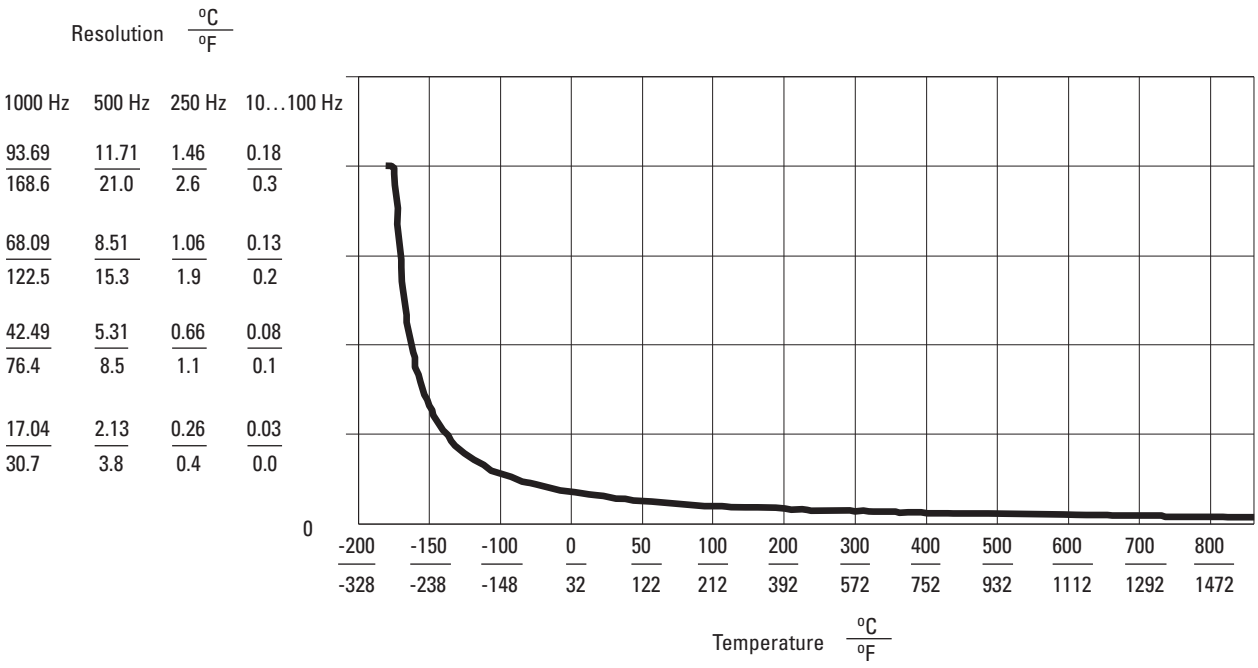


Type N Thermocouple

Resolution °C / °F			
1000 Hz	500 Hz	250 Hz	10…100 Hz
128.0 / 230.4	32.00 / 57.60	8.00 / 14.40	1.00 / 1.80
102.4 / 184.3	25.60 / 46.08	6.40 / 11.52	0.80 / 1.44
76.80 / 138.2	19.20 / 34.56	4.80 / 8.64	0.60 / 1.08
51.20 / 92.16	12.80 / 23.04	3.20 / 5.76	0.40 / 0.72
25.60 / 46.08	6.40 / 11.52	1.60 / 2.88	0.20 / 0.36
0			



Type TXK/XK(L) Thermocouple



Numerics

A

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Rockwell Automation Support

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Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

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