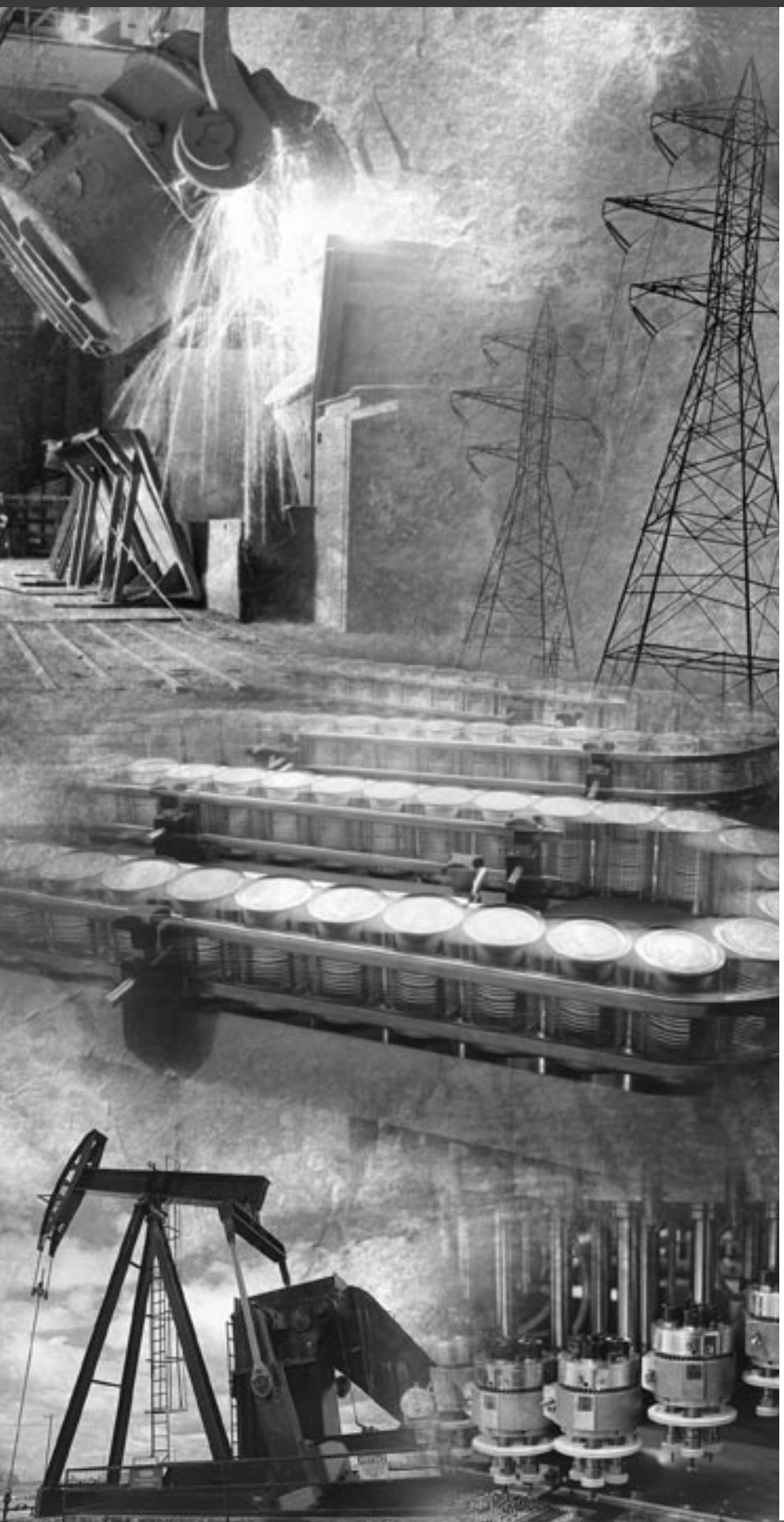


Allen-Bradley

# FLEX Ex Thermocouple/ RTD/mV Input Module

**Cat. No. 1797-IRT8**

**User Manual**

Rockwell Automation

## Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment 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.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley 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 Allen-Bradley 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.



Throughout this manual we use notes to make you aware of safety considerations:

**ATTENTION**

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

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

**IMPORTANT**

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

# Using This Manual

## Why Read this Manual

This manual shows you how to use your FLEX Ex™ thermocouple/RTD/mV module with the ControlNet Ex™ products and ControlNet network. The manual helps you install, program, and troubleshoot your module.

## Who Should Read this Manual

You must be able to program and operate a ControlNet Ex product and ControlNet™ network to make efficient use of a FLEX Ex module.

## About the Vocabulary

In this manual, we refer to the:

- 1797-IRT8 as the “input module”. or “module.”

## What this Manual Contains

The following chart lists each chapter with its corresponding title and a brief overview of the topics covered in that chapter.

| Chapter | Title | Contents |
|---|---|---|
| **1** | About the FLEX Ex Analog Modules | Describes features, capabilities, and hardware components |
| **2** | Understanding Configurable FLEX Ex thermocouple/RTD/mV Input Module Features | Describes configurable features of the input module |
| **3** | How to Install Your Thermocouple/RTD/mV Module | How to install and wire the module |
| **4** | Input, Output and Configuration Files for the hermocouple/RTD/mV Module on the ControlNet network | Describes communication over the I/O backplane between the module and the adapter, and how data is mapped into the image table |
| **5** | Calibrating Your Module | Lists the tools needed, and the methods used to calibrate the module |
| **6** | Applying FLEX Ex Analog Modules | Learn how to evaluate, define, select, match and optimize your system. |
| **7** | Troubleshooting Your Module | How to use the indicators to troubleshoot your module |
| **Appendix** | **Title** | **Contents** |
| **A** | Specifications | Outlines module specifications and accuracy |
| **B** | Programming the FLEX Ex Analog Module using RIO | Shows ladder diagramming for programming. |

## For Additional Information

For additional information on FLEX Ex systems and modules, refer to the following documents,

| Catalog Number | Description | Publications | |
|---|---|---|---|
| | | Installation Instructions | User Manual |
| 1797 Series | FLEX Ex Product Data | 1797-2.1 (Product data) | |
| 1797 Series | FLEX Ex System Overview | 1797-2.2 (System overview) | |
| 1797 Series | ControlNet Ex System Cable Guide | 1797-6.2.1 (System guide) | |
| 1797 Series | FLEX Ex System Certification Reference Manual | 1797-6.2.6 | |
| 1797-TB3 | FLEX Ex Terminal Base | 1797-5.1 | |
| 1797-TB3S | FLEX Ex Spring Clamp Terminal Base | 1797-5.2 | |
| 1797-OE8 | FLEX Ex 8 Output Analog Module | 1797-5.3 | 1797-6.5.1 |
| 1797-IRT8 | FLEX Ex RTD/Thermocouple/mV Module | 1797-5.4 | 1797-6.5.2 |
| 1797-IE8 | FLEX Ex 8 Input Analog Module | 1797-5.5 | 1797-6.5.1 |
| 1797-IE8NF | FLEX Ex 8 Input Analog Module w/ Noise Filter | 1797-5.31 | 1797-6.5.1 |
| 1797-OB4D | 4 Output Module | 1797-5.6 | |
| 1797-IBN16 | FLEX Ex NAMUR Digital Input Module | 1797-5.7 | |
| 1797-IJ2 | 2 Frequency Input Module | 1797-5.9 | 1797-6.5.4 |
| 1797-PS2N 1797-PS2E | FLEX Ex Power Supplies | 1797-5.12 | |
| 1797-ACNR15 | ControlNetEx Adapter | 1797-5.14 | 1797-6.2.1 |
| 1797-RPA, -RPFM | Fiber Hub | 1797-5.15 | 1797-6.2.1 |
| 1797-BIC | Bus Isolator | 1797-5.13 | |
| 1797-TPR, - TPRS, -TPYR, -TPYS | FLEX Ex Taps | 1797-5.18 | 1797-6.2.1 |
| 1797-CE1S, -CE3S, -CEFTN, -CEFTE | Interconnect Cables | 1797-5.20 | |
| 1797-EXMK | Marker Kit | 1797-5.23 | |
| 1797 | FLEX Ex System Certification | | 1797-6.5.6 |

## In Summary

This preface gave you information on how to use this manual efficiently. The next chapter introduces you to the 1797-IRT8 Thermocouple/RTD/mV Input module.

## Chapter 3

**How to Install Your FLEX Ex Thermocouple/RTD/mV Module**



## Chapter 4

**Input, Status, Output and Configuration Files for the Thermocouple/RTD/mV Module on the ControlNet Network**

# About the FLEX Ex Thermocouple/RTD/mV Input Module

## What this Chapter Contains

Read this chapter to familiarize yourself with the 1797-IRT8 input module.



## What the FLEX Ex Thermocouple/RTD/mV Modules Do

The 1797-IRT8 module accepts up to 8 thermocouple, RTD or mV inputs. The inputs are nonisolated and are selected with analog multiplexers which have a common-mode input range of -0.5 to +3.6 volts. The inputs will accept a millivolt or resistive input. Default input spans are –40.00mV to +100.00mV or 0.00 to 500.00 ohms. Fault Indicators are located on the field side.

No switches or jumpers are used on the thermocouple/RTD/mV input module. The Inputs have both fixed hardware filters and selectable firmware digital filters.

This module offers:

- local microprocessor intelligence for advanced features
- full functionality without switches or jumpers
- multiple data ranges that can be independently programmed in channel groups
- lead breakage detection
- overrange/underrange alarms

as well as a host of other module features.

## How FLEX Ex Thermocouple/RTD/mV Modules Communicate with Programmable Controllers

FLEX Ex thermocouple/RTD/mV modules provide best utility when used with ControlNet Ex products on the ControlNet network. Data connections are established between the I/O module and an Allen-Bradley programmable controller to transfer information between the two at a scheduled rate.

Input module information is then automatically made available in the PLC data table.

When the data connection is established, configuration information for the module is automatically transferred to it via the network.

### Events following Power-Up

You must apply intrinsically safe +/-V power to your FLEX Ex I/O modules. The following sequence of events occurs after power has initially been applied to your module:

1. The module begins an interal diagnostic check. The channel 0 LED indicator turns ON to indicate the check has begun. The indicator turns OFF when the check is finished.

2. After the diagnostic check, module configuration information, selected by the user and downloaded over the network, is applied by the module.

   For more information on configuration options, see Chapter 2.

3. Following the module configuration download for the **1797-IRT8 module**, the module begins producing runtime data for the PLC.

4. If any diagnostics or alarms are generated during normal module operation, the data is returned to the PLC.

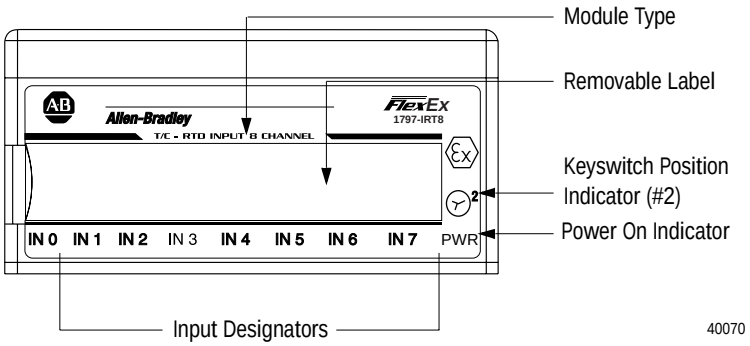
## Features of Your Module

The module label identifies the keyswitch position, wiring and module type. Use the removable label to note individual designations per your application.

## Indicators

Indicators are provided to identify input or output fault conditions, and to show when power is applied to the module.

**1797-IRT8**




## Using Alarms on the 1797-IRT8 Module

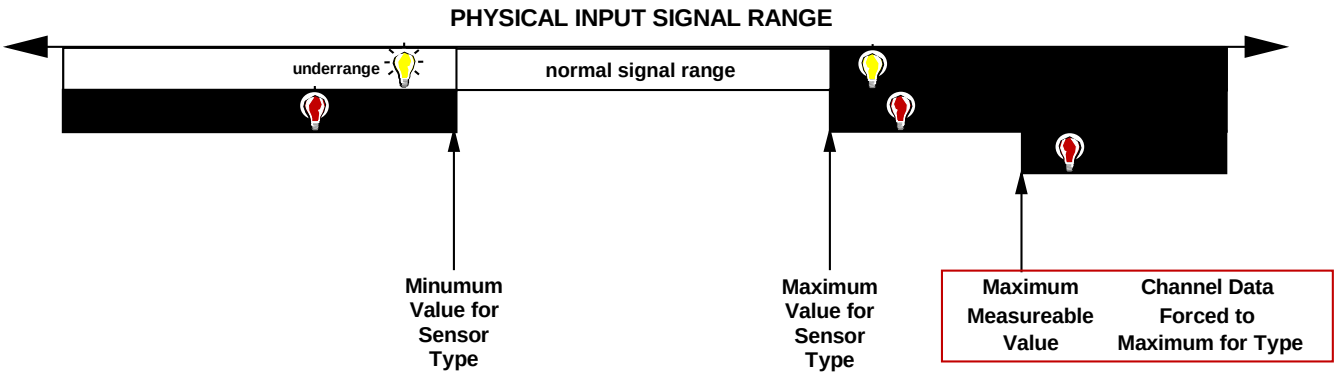
The 1797-IRT8 FLEX Ex module is capable of generating four alarms:

- Underrange
- Overrange
- Fault (open wire)
- Cold junction compensation Fault

These alarm conditions are described in general terms and as they relate to bits on the FLEX Ex I/O module on the following pages. The graphic below shows at what values these alarms are generated for Data Format 4.

## Data Format Alarm Example

In this example, the normal active data range is 4-20mA. The alarms are generated in three overlapping bands.




### *Overrange*

If the input is greater than the maximum temperature of the thermocouple or RTD range, millivolt (+100mV), or resistance (500W) the overrange bit for that channel will be set.

### *Underrange*

If the input is less than the minimum temperature of the thermocouple or RTD range, millivolt (-40mV), or resistance (0W) the underrange bit for that channel will be set.

### *Open Wire*

Individual channel fault alarm for broken wire. If a broken wire/ detached lead is detected, the data value is forced to maximum. In RTD/W mode, input levels above 540W will set this bit; in thermocouple/mV mode, input levels above 210mV will set this bit.

### *Cold Junction Compensation Alarm*

Broken or detached lead or shorted lead detection is included for CJCs. This detection is only available when the input type selected is thermocouple and sensor mode is set to CJC compensation.

When either CJC fails its fault is reported. Both CJCs ae normally used in compensation calculations. If one CJC fails, calculations use the remaining good device. If both fail, calculations use the last good value.

## Data Formats and Fault Modes

The tables below shows the bit settings for the data formats and fault modes for your FLEX Ex thermocouple/RTD/mV module.

### Data Formats

| Bit | 11 | 10 | 09 | 08 | Data type for channels 0 thru 7 |
|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | °C (see note) |
| | 0 | 0 | 0 | 1 | °F (see note) |
| | 0 | 0 | 1 | 0 | °K (see note) |
| | 0 | 0 | 1 | 1 | -32767 to +32767 |
| | 0 | 1 | 0 | 0 | 0 to 65535 |
| | 0101 thru 1111 not used | | | | |

Note: Module defaults to -4000 to 10,000 in millivolt mode, and 0 to 5000 in ohms mode

### Fault Mode

| Bit | 06 | Fault enable for channels 0-3 |
|---|---|---|
| | 07 | Fault enable for channels 4-7 |
| | | 0 = disabled<br>1 = enable wire-off detection |

## Chapter Summary

In this chapter, we told you about the FLEX Ex system and the thermocouple/RTD/mV module, and how it communicates with programmable controllers.

# Understanding Configurable FLEX Ex Thermocouple/RTD/mV Input Module Features

## What this Chapter Contains

Read this chapter to familiarize yourself with configurable features on the 1797-IRT8 module.



This chapter describes the following features:

- Input type
- Sensor type
- Data formats
- Preset temperature selection
- RTD loop resistance offset selections
- Fault mode
- Overrange Alarms
- Underrange alarms
- Fault alarms

**Important:** You must use your programming software to configure these features. A brief description of each module feature is provided in this chapter, but you must use the online help included with your programming software to perform specific configuration.

# Setting a FLEX Ex Thermocouple/RTD Module's Operating Status

## Input Type Select

Select the thermocouple or RTD mode for input channel groups 0-3 and 4-7. If 2 is selected, the module defaults to thermocouple. If 3 is selected, the module defaults to RTD.

Range: 0 = thermocouple, 1 = RTD, 2 and 3 not used

| Bits 06-07 | **Input Type Select** | | | |
|---|---|---|---|---|
| | Bit | 07 | 06 | Input type selection for channels 0-3 |
| | | 0 | 0 | Thermocouple |
| | | 0 | 1 | RTD |
| | | 1 | 0 | Not used |
| | | 1 | 1 | |

Input type select for channels 4 through 7 use bits in word 1.

## Sensor Type Select

Select the type of sensor for input channel groups 0-3 and 4-7.

Thermocouple mode 0 = mV, 1 = B, 2 = E, 3 = J, 4 = K, 5 = TXK/XK(L), 6 = N, 7 = R, 8 = S, 9 = T, 10-15 not used.

RTD mode: 0 = W, 1 = Pt100 IEC 751 Amendment 2, 2 = Pt200 IEC 751 Amendment 2, 3 = Pt100 JIS C1604-1989, 4 = Pt200 JIS C1604-1989, 5 = Ni100 DIN 43760-1987, 6 = Ni200 DIN 43760-1987, 7 = Ni120 Minco, 8 = Cu10 Minco, 9-15 not used.

If unused settings are chosen, diagnostic status "2 = configuration failure" will be set, and the last valid configuration will be used. The default = 0.

| Bits 00-03 | **Sensor Type (Thermocouple or RTD)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **RTD Type** | | | | | | |
| | Bit | 03 | 02 | 01 | 00 | Sensor type for channels 0 through 3 | |
| | | 0 | 0 | 0 | 0 | Resistance (default) | |
| | | 0 | 0 | 0 | 1 | 100 ohm Pt $\alpha$ = 0.00385 Euro (–200 to +870°C) | |
| | | 0 | 0 | 1 | 0 | 200 ohm Pt $\alpha$ = 0.00385 Euro (–200 to +400°C) | |
| | | 0 | 0 | 1 | 1 | 100 ohm Pt $\alpha$ = 0.003916 U.S. (–200 to +630°C) | |
| | | 0 | 1 | 0 | 0 | 200 ohm Pt $\alpha$ = 0.003916 U.S. (–200 to +400°C) | |
| | | 0 | 1 | 0 | 1 | 100 ohm Nickel (–60 to +250°C) | |
| | | 0 | 1 | 1 | 0 | 200 ohm Nickel (–60 to +200°C) | |
| | | 0 | 1 | 1 | 1 | 120 ohm Nickel (–80 to +320°C) | |
| | | 1 | 0 | 0 | 0 | 10 ohm Copper (–200 to +260°C) | |
| | | 1001 through 1111 not used | | | | | |
| Bits 00-03 | **Thermocouple Type** | | | | | | |
| | Bit | 03 | 02 | 01 | 00 | Sensor type for channels 0 through 3 | |
| | | 0 | 0 | 0 | 0 | mV (default) | |
| | | 0 | 0 | 0 | 1 | B | 300 to 1800°C (572 to 3272°F) |
| | | 0 | 0 | 1 | 0 | E | –250 to 1000°C (–418 to 1832°F) |
| | | 0 | 0 | 1 | 1 | J | –210 to 1200°C (–346 to 2192°F) |
| | | 0 | 1 | 0 | 0 | K | –250 to 1372°C (–418 to 2502°F) |
| | | 0 | 1 | 0 | 1 | L | –200 to 800°C (–328 to 1472°F) |
| | | 0 | 1 | 1 | 0 | N | –250 to 1300°C (–418 to 2372°F) |
| | | 0 | 1 | 1 | 1 | R | –0 to 1768°C (32 to 3214°F) |
| | | 1 | 0 | 0 | 0 | S | –0 to 1768°C (32 to 3214°F) |
| | | 1 | 0 | 0 | 1 | T | –250 to 400°C (–418 to 752°F) |
| | | 1010 through 1111 not used | | | | | |

## Input Filter Cutoff

A series of eight available input filters – filters are hardware and software – allow you to choose the best rolloff frequency for input channels on your I/O module. When choosing a filter, remember that time frequency rolloff may affect your input signal's accuracy.

For example, in configuration word 0, if you choose the fastest time frequency of 600Hz (hardware filter only), little noise is added, but the slowest frequency of 0.2Hz will provide the most accurate process noise filtering. See below to decide which input filter to use in your application:

| **Input Filter Cutoff bits** | | | | |
|---|---|---|---|---|
| Bit | 02 | 01 | 00 | Definition |
| | 0 | 0 | 0 | Hardware filtering only (default filtering) 600Hz (1.7ms) |
| | 0 | 0 | 1 | 40Hz (25ms) |
| | 0 | 1 | 0 | 10Hz (100ms) |
| | 0 | 1 | 1 | 4Hz (250ms) |
| | 1 | 0 | 0 | 2Hz (500ms) |
| | 1 | 0 | 1 | 1Hz (1s) |
| | 1 | 1 | 0 | 0.5Hz (2s) |
| | 1 | 1 | 1 | 0.2Hz (5s) |

Choose the best input filter cutoff in your programming software.

## Data Format

You must choose a module data format in your user program. Select the format by setting bits as shown below. Note that this parameter affects channel accuracy.

| **Data format** – module defaults to –4000 to 10000 in millivolt mode, and 0 to 5000 in ohms mode | | | | | |
|---|---|---|---|---|---|
| Bit | 11 | 10 | 09 | 08 | Data type for channels 0-7 |
| | 0 | 0 | 0 | 0 | °C |
| | 0 | 0 | 0 | 1 | °F |
| | 0 | 0 | 1 | 0 | ×K |
| | 0 | 0 | 1 | 1 | –32767 to +32767 |
| | 0 | 1 | 0 | 0 | 0 to 65535 |
| | 0101 through 1111 not used | | | | |

$^{o}$C, $^{o}$F and $^{o}$K will have formats appropriate to the selected thermocouple or RTD range (e.g. -xxxx to +xxxx with 1 decimal place implied - 3500 = 350.0). For Cu10 RTD, 2 decimal points are implied.

If using mV, data format defaults to -4000 to +10000 (2 decimal points implied (e.g. -40 to 100.00). If using W mode selection, data format defaults to 0 to 5000 (1 decimal point implied, e.g. 0.- to 500.0).

In the thermocouple and RTD modes, if unused data formats are chosen, the module will default to $^{o}$C.

## Sensor Mode Select

Selects the sensor mode for input channels 0-3 and 4-7.

If using cold junction compensation, both CJCs must be installed. The difference between the CJCs will be linearly apportioned to each thermocouple channel based on its position across the base. If one CJC is broken or missing, the remaining CJC is used to compensate all channels. The appropriate CJC alarm will be set in this case. If the second CJC fails, the last valid reading is frozen for compensation use. The second CJC alarm will also be set.

When using only channels 0-3 for thermocouples, connect the CJCs to terminals 5 and 12. If only using channels 4-7, connect the CJCs to terminals 22 and 29. If all channels are configured for thermocouples, connect the CJCs to terminals 5 and 29.

When CJC thermistor temperature compensation is selected for one channel group, all channels configured for thermocouple inputs will use the CJC compensation.

| | | | |
|---|---|---|---|
| Bit | 05 | 04 | Sensor mode for channels 0 thru 3 |
| | 13 | 12 | Sensor mode for channels 4 thru 7 |
| | | | **Thermocouple Mode** |
| | 0 | 0 | External compensation - uses cold junction sensors |
| | 0 | 1 | Internal compensation - Uses the value selected for reference junction |
| | 1 | 0 | No compensation (Data is referenced to $0^{o}C$) |
| | 1 | 1 | Differential measurement between 2 channels |
| | | | **RTD Mode** |
| | 0 | 0 | 2-wire RTD - no compensation |
| | 0 | 1 | 2-wire RTD with user compensation |
| | 1 | 0 | 3-wire RTD |
| | 1 | 1 | 4-wire RTD |

## Preset Temperature Select

This parameter is used if Input Type Select is set to thermocouple and Sensor Mode Select is set to fixed compensation. This parameter then sets a fixed reference temperature used to compensate all thermocouple channels.

The default = 0.

| | | | | | |
|---|---|---|---|---|---|
| Bits 03-05 | **Reference Junction** – used when input type is set to thermocouple and sensor mode is set to fixed compensation. Sets a fixed reference junction to compensate all thermocouple channels. | | | | |
| | Bit | 05 | 04 | 03 | **Reference Junction** |
| | | 0 | 0 | 0 | 0°C |
| | | 0 | 0 | 1 | 20°C |
| | | 0 | 1 | 0 | 25°C |
| | | 0 | 1 | 1 | 30°C |
| | | 1 | 0 | 0 | 40°C |
| | | 1 | 0 | 1 | 50°C |
| | | 1 | 1 | 0 | 60°C |
| | | 1 | 1 | 1 | 70°C |

## RTD Loop Resistance Offset Select

This parameter is used if Input Type Select is set to RTD and Sensor Mode Select is set to 2-wire with loop resistance compensation. This parameter then sets total RTD loop resistance compensation for each RTD channel. Either the value stored for each channel during calibration is used to compensate the module RTD channels, or one of 3 fixed values is used to compensate module RTD channels.

This parameter is disabled for Cu10 RTDs.

| | | | | |
|---|---|---|---|---|
| 00-15 (00-17) | **RTD loop resistance offset select bits** – used input type is set to RTD and sensor mode select is set to 2-wire with loop resistance compensation. Allows you to set the type of RTD loop resistance compensation used for all RTDs or one of three fixed values for all channels. **NOTE:** Not applicable to 10W copper RTD, which defaults to 0W. | | | |
| | Bit | 01 | 00 | RTD channel 0 |
| | Bit | 03 | 02 | RTD channel 1 |
| | Bit | 05 | 04 | RTD channel 2 |
| | Bit | 07 | 06 | RTD channel 3 |
| | Bit | 09 | 08 | RTD channel 4 |
| | Bit | 11 | 10 | RTD channel 5 |
| | Bit | 13 | 12 | RTD channel 6 |
| | Bit | 15 | 14 | RTD channel 7 |
| | | 0 | 0 | Use channel loop compensation value stored during calibration procedure for 2-wire RTD (default = 0W) |
| | | 0 | 1 | 5W |
| | | 1 | 0 | 10W |
| | | 1 | 1 | 15W |

Range: 0 = use channel loop compensation value determined and stored during calibration procedure for 2-wire RTD, 1 = 5Ω, 2 = 10Ω, 3 = 15Ω. Default = 0.

### Fault Mode Select

Select whether the channel fault detection is enabled or disabled for channels 0-3 and 4-7.

Range: 0 = disable, 1 = fault detection enabled (wire off, mV overvoltage, RTD open). Default = 0.

| | |
|---|---|
| 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.<br>0 = disabled<br>1 = enable wire-off detection |

## Using Module Alarms

FLEX Ex I/O modules are capable of generating four alarms:

- Overrange
- Underrange
- Fault
- Cold Junction Compensation (CJC) Fault

These alarm conditions are described in general terms and as they relate to bits on the FLEX Ex I/O module on the following pages.

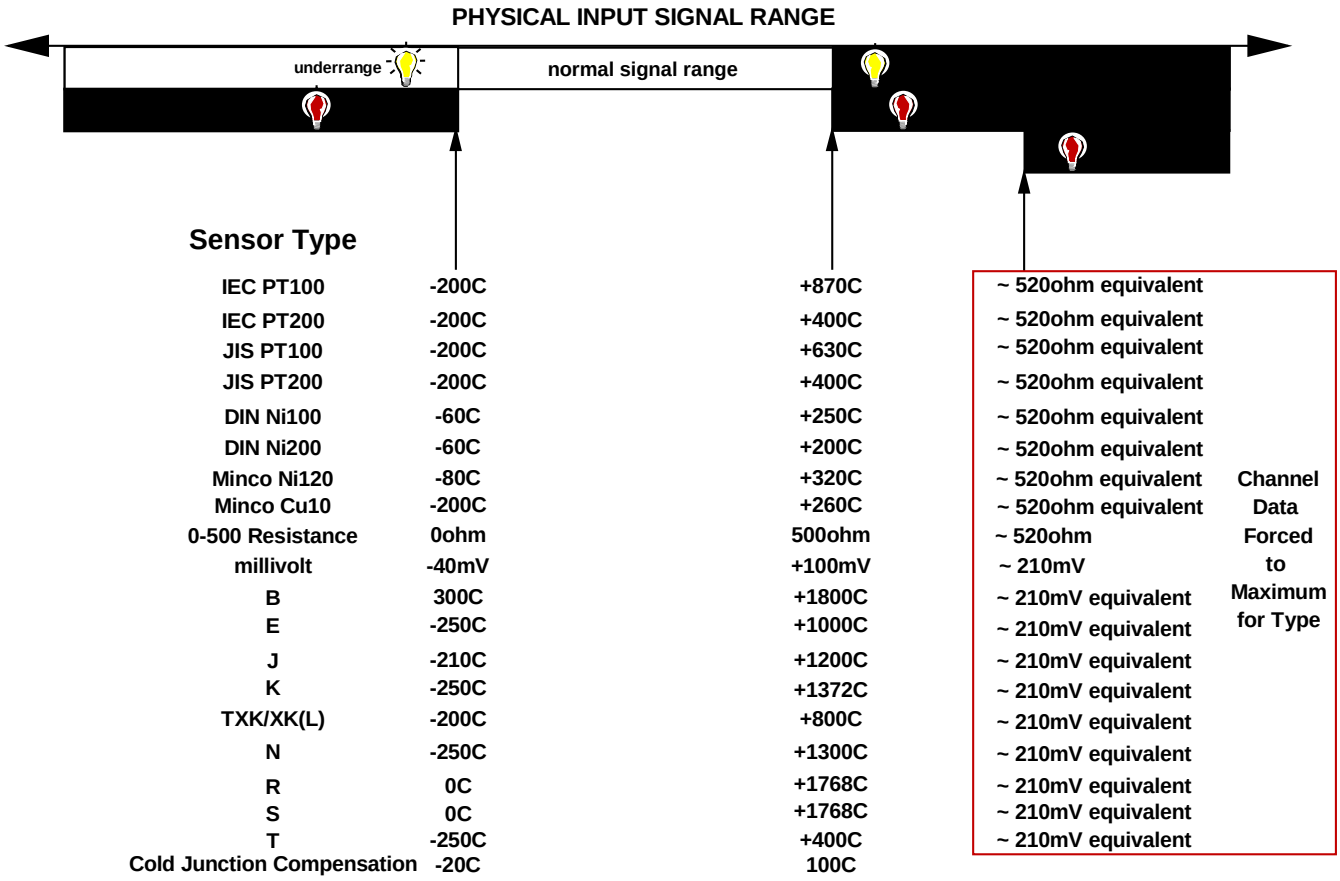
### Overrange Alarm

The channel overrange alarm is set if the input is greater than the maximum temperature (thermocouple or RTD range dependent), millivolt (+100mV) or resistance (500Ω) range value.

Range: 0 = normal, 1 = input overrange. Default = 0.

This alarm stays active at any value above 100% of range and is always enabled by the module. Refer to the figure below for the sensor dependent signal which causes this alarm to be generated.

# IRT8 Specific alarming performance




## Underrange Alarm

The channel underrange alarm is set if the input is less than the minimum temperature (thermocouple or RTD range dependent), millivolt (-40mV) or resistance (0Ω) range value.

Range: 0 = normal, 1 = input overrange. Default = 0.

This alarm stays active at any value below 0% of range and is always enabled by the module.

Range: 0 = normal, 1 = input overrange. Default = 0.

### Fault Alarm

The module has individual channel fault alarms for a broken or detached wire. In any mode, if a broken/detached lead is detected, the data value is forced to maximum. Once the alarm is issued, it remains active as long as the input signal is faulted.

In mV mode, for input levels above 210mV, this bit is set.

In RTD mode, an open input will set this bit.

Range: 0 = normal,1 = wire off, excessive input fault detected.

Default = 0.

## Chapter Summary

In this chapter, we told you about the FLEX Ex system and the analog I/O modules, and how they communicate with programmable controllers.

# How to Install Your FLEX Ex Thermocouple/ RTD/mV Module

## What this Chapter Contains

Read this chapter to install the 1797-IRT8 thermocouple/RTD/mV module.



## Before You Install Your Analog Module

Before installing your FLEX Ex analog module:

| You need to: | As described under: |
|---|---|
| Verify that the module will be installed in a suitable metal enclosure | Installation in Zone 1, page 3-2 |
| Position the keyswitch on the terminal base | Installing the Module, page 3-8 |

**ATTENTION**

These modules do not receive primary operational power from the backplane. +/-V dc power must be applied to your module before installation. If power is not applied, the module position will appear to the adapter as an empty slot in your chassis.

## Compliance to European Union Directives

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

### EMC Directive

This product is tested to meet the Council Directive 89/336/EC Electromagnetic Compatibility (EMC) by applying the following standards, in whole or in part, documented in a technical construction file:

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

This product is intended for use in an industrial environment.

### Ex Directive

This product is tested to meet the Council Directive 94/9/EC (ATEX 100a) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres by applying the following standards:

- EN50014:1992, Electrical Apparatus for Potentially Explosive Atmospheres
- EN50020:1994, Electrical Apparatus for Potentially Explosive Atmospheres - Intrinsic Safety “i”
- prEN50284:1997, Special requirements for construction, test and marking of electrical apparatus of equipment group II, category 1G

## Installation in Zone 1

This module must not be exposed to the environment. Provide a suitable metal enclosure.

**ATTENTION**

This module cannot be used in an intrinsically safe environment after it has been exposed to non-intrinsically safe signals.

## Electrostatic Charge

Protect the system against electrostatic charge. Post a sign near this module: **Attention! Avoid electrostatic charge.** For your convenience, a sign which can be cut out and posted is included in this user manual before the back cover.

## Removal and Insertion Under Power

**ATTENTION**

This module is designed so you can remove and insert it under power. However, take special care when removing or inserting this module in an active process. I/O attached to any module being removed or inserted can change states due to its input/output signal changing conditions.

## Installing the Module

Installation of this module consists of:

- mounting the terminal base unit
- installing the analog I/O 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 “Mounting the 1797-IRT8 Module on the Terminal Base” on page 8.

**ATTENTION**

Make certain that you power this terminal base module combination with an instrinsically safe power supply. Do not exceed the values listed in the specifications for the terminal base or module.

Do not use the unused terminals on the terminal base unit. Using the terminals as supporting terminals can result in damage to modules and/or unintended operation of your system.

### Mounting on a DIN Rail

**ATTENTION**

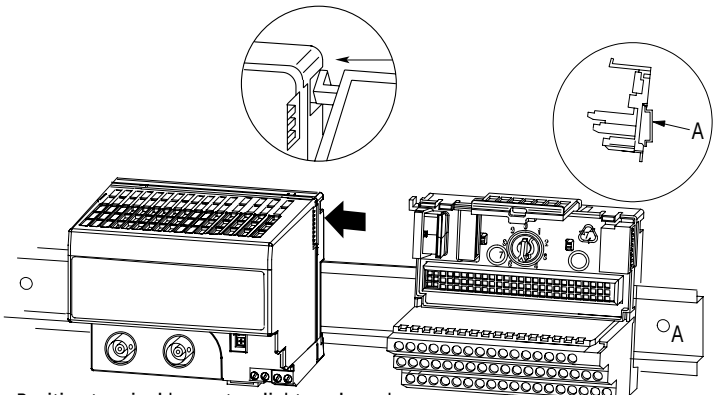
Do not remove or replace a terminal base unit when power is applied. Interruption of the flexbus can result in unintended operation or machine motion.

1. Remove the cover plug in the male connector of the unit to which you are connecting this terminal base unit.

2. Check to make sure that the 16 pins in the male connector on the adjacent device are straight and in line so that the mating female connector on this terminal base unit will mate correctly.

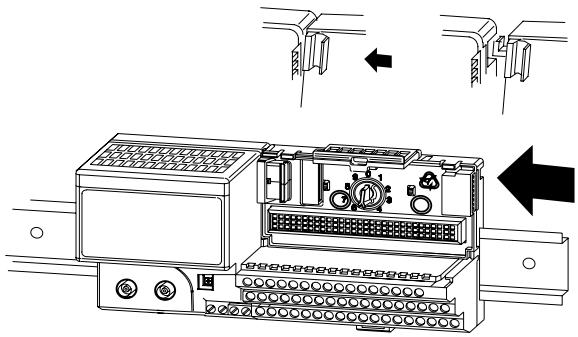
3. Make certain that the female flexbus connector is **fully retracted** into the base unit.

4. Position the terminal base over the 35 x 7.5mm DIN rail **A** (A-B pt. no. 199-DR1).




Position terminal base at a slight angle and hooked over the top of the DIN rail A.

41106



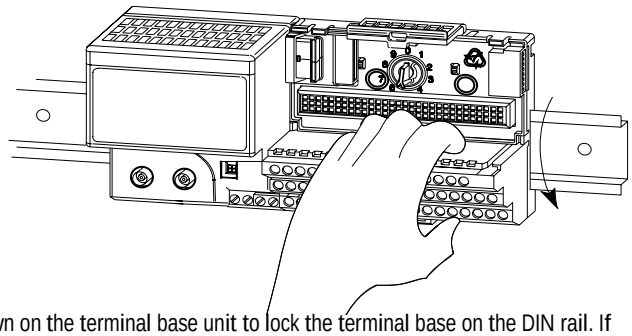
41107

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.

**ATTENTION**

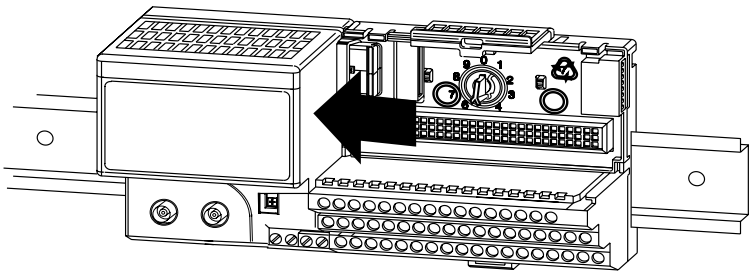
Do not force the terminal base into the adjacent modules. Forcing the units together can bend or break the hook and allow the units to separate and break communication over the backplane.

**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. **Use caution to make sure that the female flexbus connector does not strike any of the pins in the mating male connector.**



41108

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.



41109

**Gently** push the flexbus connector into the side of the adapter (or proceeding terminal base) to complete the backplane connection.

**6.** For specific wiring information, refer to the installation instructions for the module you are installing in this terminal base unit. Terminal assignments are also given later in this chapter, see page 3-10.

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

**8.** Install the flexbus connector cover on the last terminal base is in place.

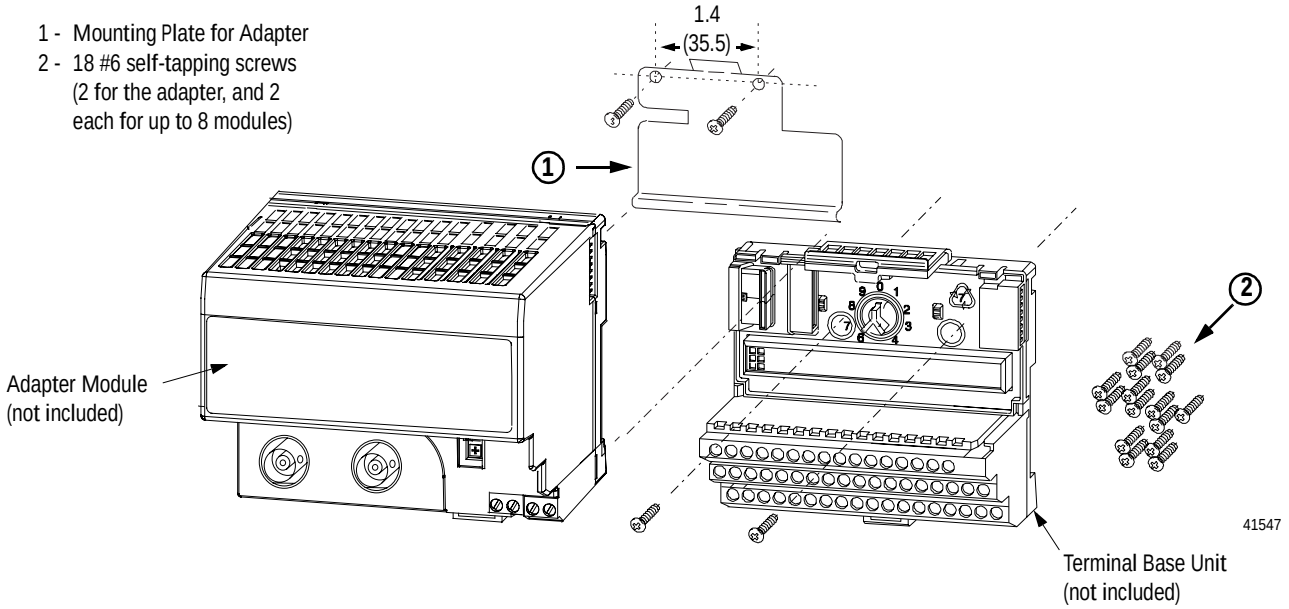
## Panel/Wall Mounting

Installation 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 Mounting the 1797-IRT8 Module on the Terminal Base Unit on page 3-8.

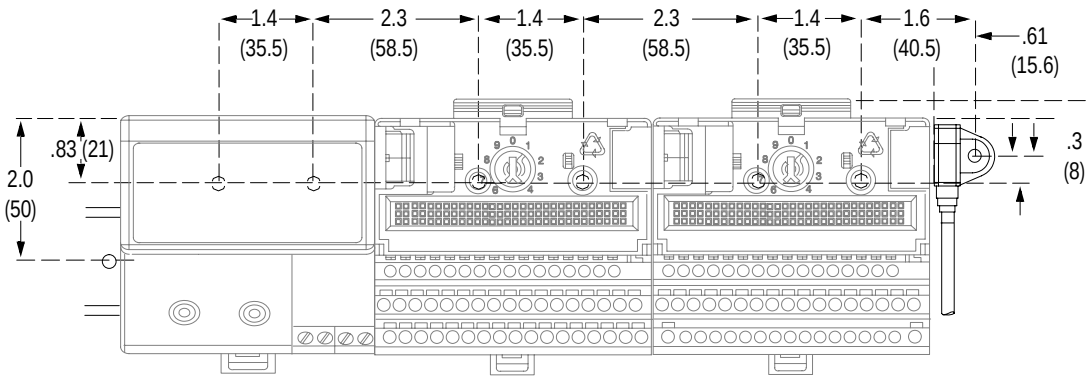
Use the mounting kit Cat. No. 1794-NM1 for panel/wall mounting.




To install the mounting plate on a wall or panel:

1. Lay out the required points on the wall/panel as shown in the drilling dimension drawing.

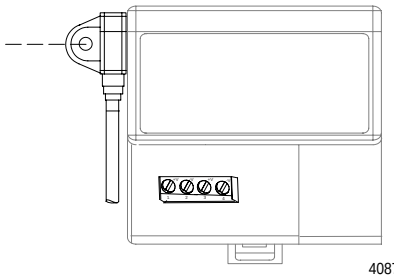
**Drilling Dimensions for Panel/Wall Mounting of FLEX Ex I/O**




Inches
(Millimeters)

**ATTENTION:** Be careful of metal chips when drilling cable mounting holes. Do not drill holes above a system that has any modules installed.

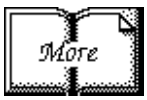
Cable length approximately 11.5 (292.1) or 35.5 (901.0) from upper connector [length depends upon cable -1ft (0.3m) or 3ft (0.091m)]



40871

2. Drill the necessary holes for the #6 self-tapping mounting screws.

3. Mount the mounting plate (1) for the adapter module using two #6 self-tapping screws (18 included for mounting up to 8 modules and the adapter).




Make certain that the mounting plate is properly grounded to the panel. Refer to “Industrial Automation Wiring and Grounding Guidelines,” publication 1770-4.1.

4. Hold the adapter (2) at a slight angle and engage the top of the mounting plate in the indention on the rear of the adapter module.

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.

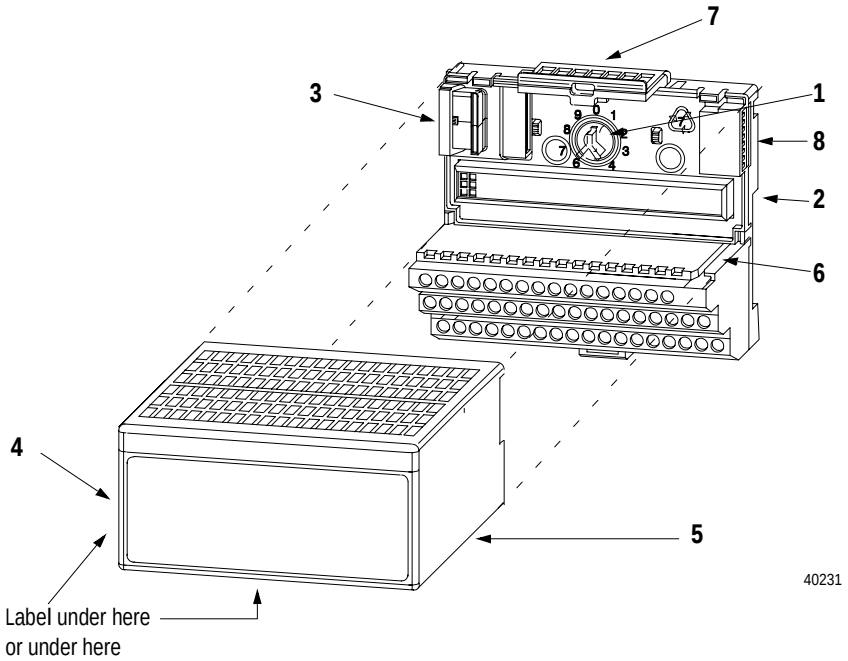
7. Secure to the wall with two #6 self-tapping screws.

8. Repeat for each remaining terminal base unit.

## Mounting the 1797-IRT8 Module on the Terminal Base Unit

The 1797-IRT8 module mounts on a 1797-TB3 or TB3S intrinsically safe terminal base unit.

1. Rotate keyswitch (1) on terminal base unit (2) clockwise to position 2 as required for this type of module. **Do not change the position of the keyswitch after wiring the terminal base unit.**




2. Make certain the flexbus connector (3) is pushed all the way to the left to connect with the neighboring terminal base/adapter. You cannot install the module unless the connector is fully extended.

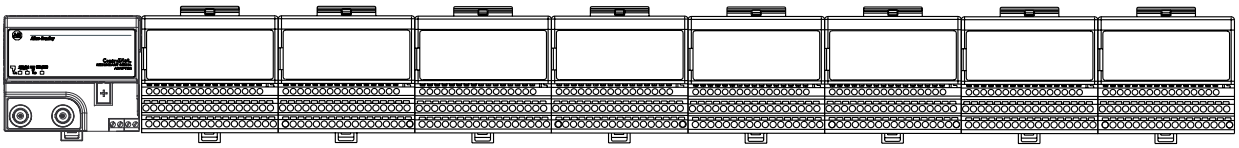
3. Make sure the pins on the bottom of the module are straight so they will align properly with the connector in the terminal base unit.

4. Position the module (4) with its alignment bar (5) 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 (7) is locked into the module.

6. Make certain that you only connect terminal base units to other intrinsically safe system modules or adapters to maintain the integrity of the intrinsically-safe backplane.

7. Remove cap plug (8) and attach another intrinsically safe terminal base unit to the right of this terminal base unit if required. Make sure the last terminal base has the cap plug (8) in place.



41307

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

## Wiring the Terminal Base Units

Wiring the FLEX Ex I/O modules is done through the 1797-TB3 and 1797-TB3S terminal base units.

**ATTENTION**

The FLEX Ex I/O modules do not receive primary operational power from the backplane. +/-V dc power must be applied to your module before operation. If power is not applied, the module position will appear to the adapter as an empty slot in your chassis. If the adapter does not recognize your module after installation is completed, cycle power to the adapter.

Make certain that you power these modules with an intrinsically safe power supply. Do not exceed the values listed in the specifications for the modules.

# Connecting Wiring to the FLEX Ex Thermocouple/ RTD/mV Module

## Inputs/Outputs

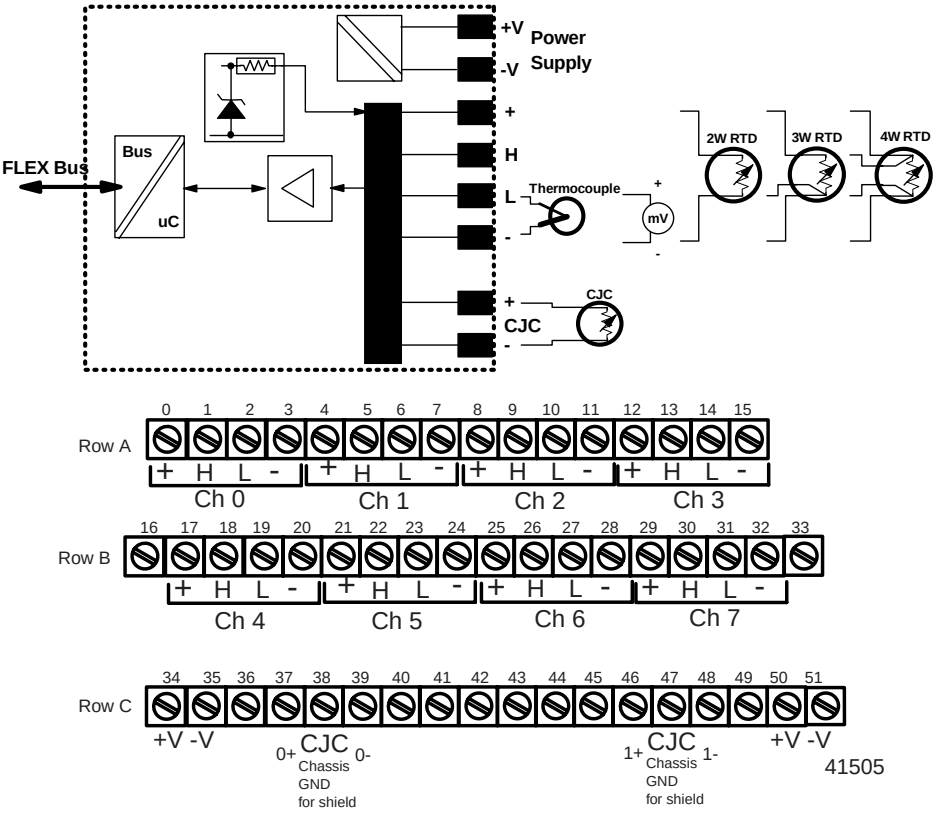
Each input can be operated from a thermocouple (TC), resistance temperature detector (RTD), or millivolt. **Do not apply any non-intrinsically safe signals to this module.**

When using an intrinsically safe electrical apparatus according to EN50020, the European directives and regulations must be followed.

The channels in this module are electrically connected to each other and have a common plus-line.

When interconnecting several lines, you must consider the total accumulated power and check for intrinsic safety.

### Connections for the 1797-IRT8 Module




No connection allowed to terminals 36 and 49

## Wiring connections for the 1797-IRT8 Module

**1.** For RTD inputs:

**a**. connect the individual source current input wiring to (+) terminals for each individual channel (0, 4, 8 and 12) on the 0-15 row (A) and terminals 17, 21, 25, and 29 on the 16-33 row (B) as indicated in the table below.

**b.** connect the associated signal return (-) to the corresponding (-) terminals (3, 7, 11, and 15) on the 0-15 row (A), and terminals 20, 24, 28 and 32 on the 16-33 row (B).

**2.** For thermocouple inputs:

**a**. connect the individual high signal input wiring to (L) terminals for each individual channel (2, 6, 10, and 14) on the 0-15 row (A) and terminals 19, 23, 27 and 31 on the 16-33 row (B) as indicated in the table below.

**b.** connect the associated low signal (-) to the corresponding (-) terminals (3, 7, 11 and 15) on the 0-15 row (A), and terminals 20, 24, 28, and 32 on the 16-33 row (B).

**c.** connect cold junction compensation wiring to terminals 37, 38 and 39, and terminals 46, 47 and 48.

**d.** Connect the tail of the CJC as follows:

- when using inputs 0-3 (row A) only for thermocouple inputs: connect the tail of CJC1 to terminal 5 and CJC2 to terminal 12 on row A.
- when using inputs 4-7 (row B) only for thermocouple inputs: connect the tail of CJC1 to terminal 22 and CJC2 to terminal 29 on row B.
- when using thermocouple inputs 0-7: connect the tail of CJC1 to terminal 5 on row A, and CJC2 to terminal 29 on row B.

**Important:** Whenever you use thermocouple inputs, you must use both cold junction compensators.

**3.** Connect +V to terminal 34 on the 34-51 row (C).

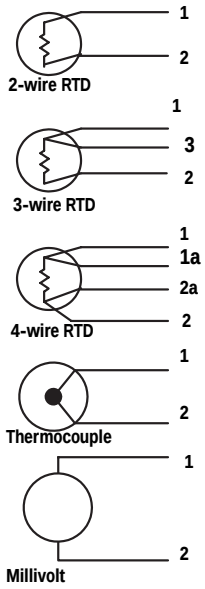
**4.** Connect -V to terminal 35 on the 34-51 row (C).

**ATTENTION**

**ATTENTION:** Make certain that you power this module with an intrinsically safe power supply. Do not exceed the values listed in the specifications for this module.

**5.** If continuing power to the next terminal base unit, connect a jumper from terminal 50 (+V) on this base unit to terminal 34 on the next base unit.

**6.** If continuing common to the next terminal base unit, connect a jumper from terminal 51 (-V) on this base unit to terminal 35 on the next base unit.




| Type of Input | Connect the following: | | | | |
|---|---|---|---|---|---|
| | + | H | L | - | Shield[1] |
| RTD - 2-wire | 1 | | | 2 | |
| RTD - 3-wire | 1 | | 3 | 2 | |
| RTD - 4-wire | 1 | 1a | 2a | 2 | |
| Thermocouple | | | 1 | 2 | |
| Millivolt | | | 1 | 2 | |

1Terminals 16, 33, 40 thru 45 are chassis ground.

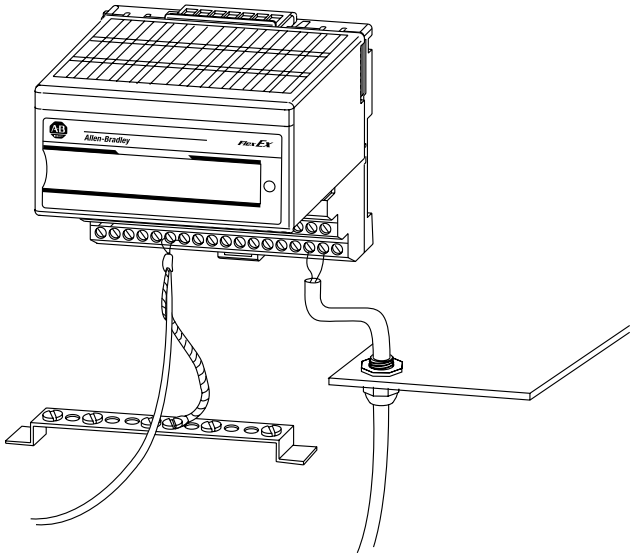
| RTD or Thermocouple Channel | RTD Source Current (+) | High Signal Terminal (H) | Low Signal Terminal (L) | Signal Return (-) |
|---|---|---|---|---|
| 0 | 0 | 1 | 2 | 3 |
| 1 | 4 | 5 | 6 | 7 |
| 2 | 8 | 9 | 10 | 11 |
| 3 | 12 | 13 | 14 | 15 |
| 4 | 17 | 18 | 19 | 20 |
| 5 | 21 | 22 | 23 | 24 |
| 6 | 25 | 26 | 27 | 28 |
| 7 | 29 | 30 | 31 | 32 |
| +V | | Terminals 34 and 50 | | |
| -V | | Terminals 35 and 51 | | |

1 Terminals 37, 38 and 39 and 46, 47 and 48 are for cold junction compensation (with 38 and 47 chassis ground). Connect CJC1 to terminal 5 or 21, CJC2 to terminal 12 or 29

2 Terminals 16, 33, and 40 thru 45 are chassis ground.

## Grounding the Module

All I/O wiring must use shielded wire. Shields must be terminated external to the module, such as bus bars and shield-terminating feed throughs.




## Chapter Summary

In this chapter, we told you how to install your thermocouple/RTD/mV module in an existing programmable controller system and how to wire to the terminal base units.

Move to chapter 3 to learn about input, output and configuration files for the thermocouple/RTD/mV module on ControlNet.

# Input, Status, Output and Configuration Files for the Thermocouple/RTD/mV Module on the ControlNet Network

## What this Chapter Contains

Read this chapter to familiarize yourself with input, output and configuration files for the thermocouple/RTD/mV module on ControlNet.



In this chapter, you will learn about:

- using software to configure the FLEX Ex I/O modules
- ControlNet Ex Adapter
- I/O structure
- fault state data
- communication fault data
- idle state behavior
- input data behavior upon module removal

This chapter provides a brief description of the steps you must take in your programming software to configure FLEX Ex I/O modules and an overview of what occurs during configuration.

> For a full explanation of how to use your programming software to perform module configuration, use the software online help.

## Using Programming Software in Your FLEX Ex Application

When using FLEX Ex thermocouple/RTD/mV modules, you must perform I/O mapping and configure the ControlNet network before generating configuration data for your I/O modules.

For example, you may use **RS**NetWorx™ to connect FLEX Ex I/O modules to a ControlNet processor or scanner through a FLEX Ex ControlNet Ex adapter (cat. no. 1797-ACNR15). The I/O configuration portion of another programming software, for example **RS**Logix5™ could be used to generate the configuration data for each I/O module in the control system.

Configuration data is then transferred to the controller during the program download and subsequently transferred to the appropriate I/O modules.

Follow these general guidelines when configuring I/O modules:

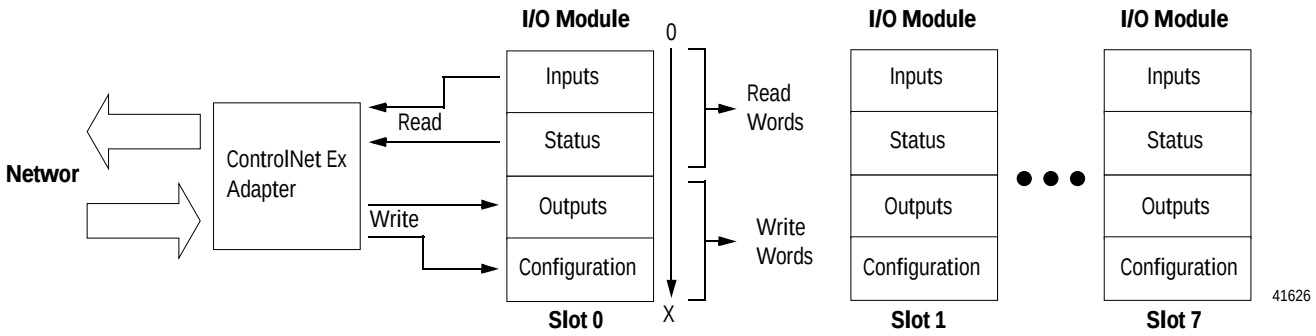
1. Perform I/O mapping.
2. Instruct the FLEX Ex I/O modules to use I/O mapping file from step 1.
3. Configure all I/O modules.

## About the ControlNet Ex Adapter

The FLEX Ex ControlNet Ex adapter (cat. no. 1797-ACNR15) interfaces up to 8 FLEX Ex modules to a ControlNet processor or scanner. The adapter can support ControlNet real-time data connections to individual modules or module groups. Each connection is independent of the others and can be from different processors or scanners.

## Communication Over the FLEX Ex Backplane

One 1797-ACNR15 ControlNet Ex adapter can interface up to eight terminal base units with installed FLEX Ex modules, forming a FLEX Ex system of up to eight slots. The adapter communicates to other network system components (typically one or more controllers or scanners, and/or programming terminals) over the ControlNet network. The adapter communicates with its I/O modules over the FLEX Ex backplane.



## Scheduled Data-Transfer

Scheduled data transfer:

- is continuous.
- is asynchronous to the controller program scan.
- occurs at the actual rate displayed in the Actual Packet Interval field on the programming software ControlNet I/O mapping (monitor) screen

## Unscheduled Data-Transfer

Unscheduled operations include:

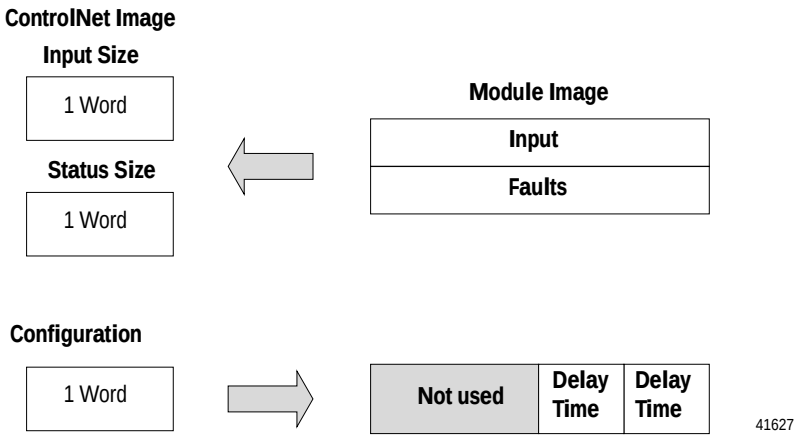
- unscheduled non-discrete I/O data transfers–through ControlNet I/O Transfer (CIO) instructions
- peer-to-peer messaging–through message (MSG) instructions
- messaging from programming devices

Unscheduled messaging on a ControlNet network is non-deterministic. Your application and your configuration–number of nodes, application program, NUT, amount of scheduled bandwidth used, etc.–determine how much time there is for unscheduled messaging.

## Module I/O Mapping

The I/O map for a module is divided into read words and write words. Read words consist of **input and status words**, and write words consist of **output and configuration words**. The number of read words or write words can be 0 or more. The length of each I/O module's read words and write words vary in size depending on module complexity. Each I/O module will support at least 1 input word or 1 output word. Status and configuration are optional, depending on the module.

For example, a 16 point discrete input module will have up to 2 read words and 1 write word.

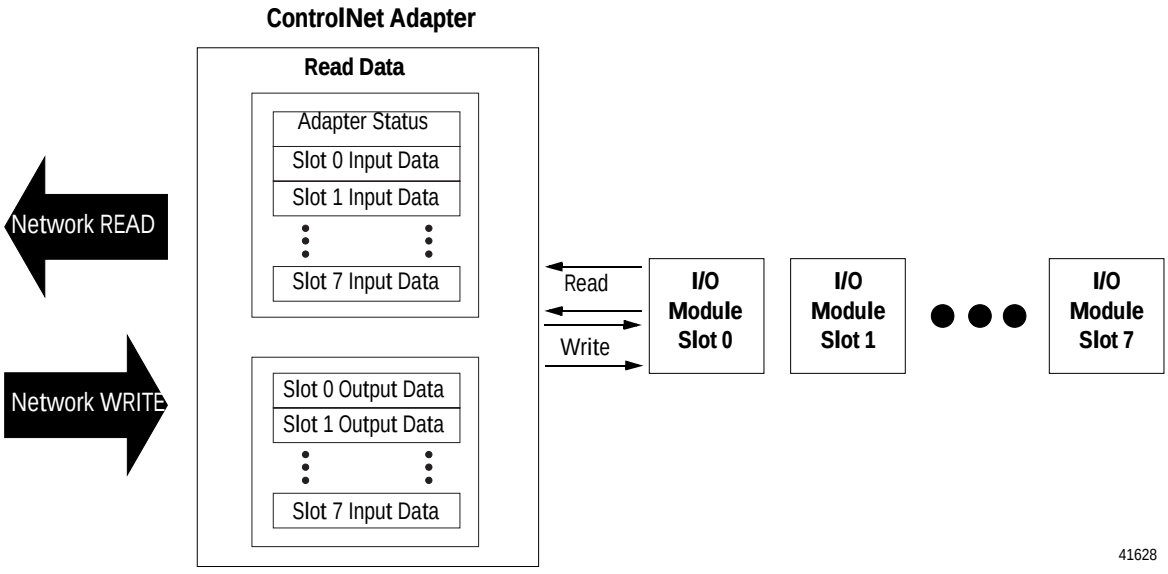



Check the I/O map for the module for the exact mapping.

## I/O Structure

Output data is received by the adapter in the order of the installed I/O modules. The output data for slot 0 is received first, followed by the output data for slot 1, and so on up to slot 7.

The first word of input data sent by the adapter is the Adapter status word. This is followed by the input data from each slot, in the order of the installed I/O modules. The input data from slot 0 is first after the status word, followed by input data from slot 1, and so on up to slot 7.



## Adapter Status Word

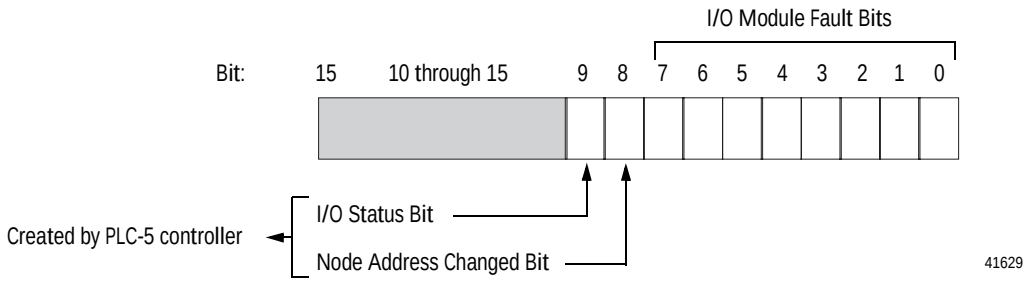
The status word consists of:

- I/O module fault bits – 1 status bit for each slot

Additionally, in the case of a PLC-5 controller, it adds:

- node address changed – 1 bit (created by PLC-5 controller)
- I/O status – 1 bit (created by PLC-5 controller)

Resulting in the following FLEX Ex adapter status word for a PLC-5 controller.




As an example, in a PLC-5 system, the adapter status word bit descriptions are shown in the following table.

**Table 4.A**

| Bit Description: | Bit: | Explanation: |
|---|---|---|
| I/O Module Fault | 0 | This bit is set (1) when an error is detected in slot position 0. |
| | 1 | This bit is set (1) when an error is detected in slot position 1. |
| | 2 | This bit is set (1) when an error is detected in slot position 2. |
| | 3 | This bit is set (1) when an error is detected in slot position 3. |
| | 4 | This bit is set (1) when an error is detected in slot position 4. |
| | 5 | This bit is set (1) when an error is detected in slot position 5. |
| | 6 | This bit is set (1) when an error is detected in slot position 6. |
| | 7 | This bit is set (1) when an error is detected in slot position 7. |
| Node Address Changed (Created by PLC-5 controller.) | 8 | This bit is set (1) when the node address switch setting has been changed since power-up. |
| I/O State (Created by PLC-5 controller.) | 9 | Bit = 0 -idle<br>bit = 1 - run |
| | 10 though 15 | Not used – set to 0 |

Possible causes for an **I/O Module Fault** are:

- transmission errors on the FLEX Ex backplane
- a failed module
- a module removed from its terminal base
- incorrect module inserted in a slot position
- the slot is empty
- the slot contains a non-discrete module

## Fault State Data

The ControlNet Ex adapter provides storage for alternate module output data during communication faults or processor idle state. This "fault state data" assures that a known output will be applied to the output devices during the previously mentioned modes. The processor or scanner software must include the means to specify this fault state data for each module. If applicable, this data is sent in the configuration block, see Image Table Mapping on pages 4-8.

## Device Actions

Device actions include:

- communication fault behavior
- idle state behavior
- input data behavior upon module removal

### Communication Fault Behavior

You can configure the adapter response to a communication fault for each I/O module in its system. Upon detection of a communication fault,
the adapter can:

- leave the module output data in its last state (hold last state)
- reset the module output data to zero (reset)
- apply fault state data to the module output

## Idle State Behavior

The ControlNet Ex adapter can detect the state of the controlling processor or scanner. Only 2 states can be detected:

- run mode,
- or program mode (idle).

When run mode is detected, the adapter copies the output data received from the processor to the corresponding module output. When program mode is detected, the adapter can be configured to:

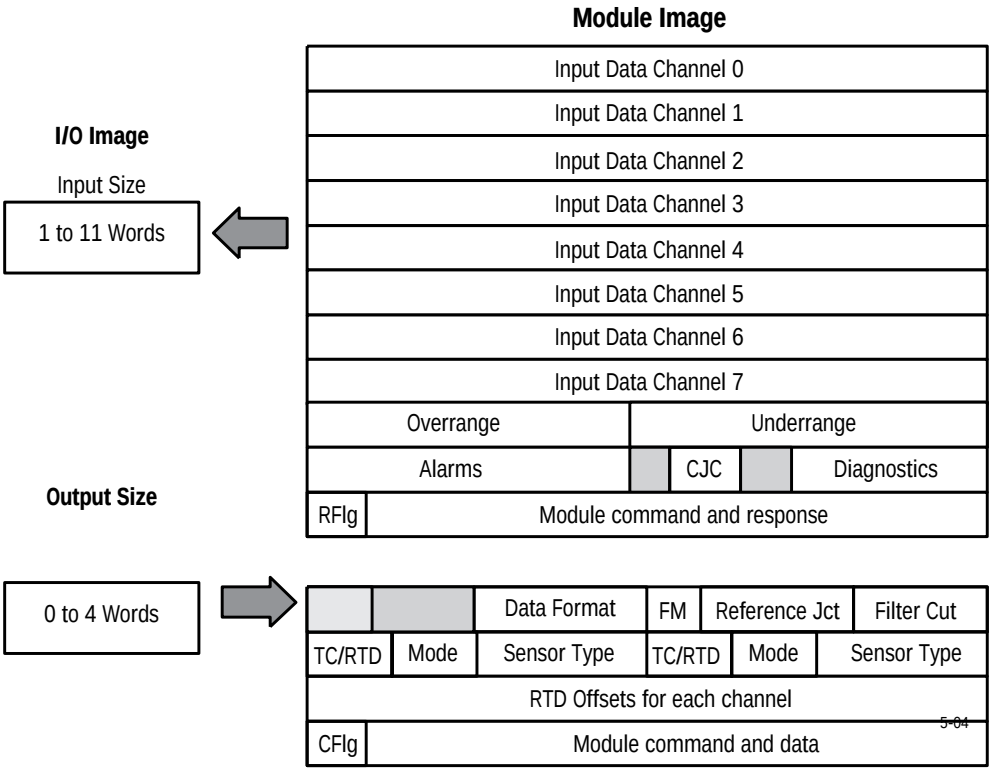
- leave the module output data in its last state (hold last state)
- reset the module output data to zero (reset)
- apply fault state data to the module output

## Input Data Behavior upon Module Removal

I/O module input data sent by the adapter upon module removal is configurable. The adapter can:

- reset the module input data sent by the adapter to zero (reset)
- leave the module input data sent by the adapter in the last state before module removal (hold last state)

## Thermocouple/RTD/mV Input Module (1797-IRT8) Image Table Mapping




## Bit/Word Description for the Thermocouple/RTD/mV Input Module (1797-IRT8)

| Input Word | Dec. Bits (Octal Bits) | Description |
|---|---|---|
| Input Word 0 | 00-15 (00-17) | Channel 0 Input data |
| Input Word 1 | 00-15 (00-17) | Channel 1 Input data |
| Input Word 2 | 00-15 (00-17) | Channel 2 Input data |
| Input Word 3 | 00-15 (00-17) | Channel 3 Input data |
| Input Word 4 | 00-15 (00-17) | Channel 4 Input data |
| Input Word 5 | 00-15 (00-17) | Channel 5 Input data |
| Input Word 6 | 00-15 (00-17) | Channel 6 Input data |
| Input Word 7 | 00-15 (00-17) | Channel 7 Input data |

<table>
<tr><th>Input Word</th><th>Dec. Bits<br>(Octal Bits)</th><th>Description</th></tr>
<tr><td>Input Word 8</td><td>00-07</td><td>Underrange bits – these bits are set if the input signal is below the input channel's minimum range. Bit 00 corresponds to channel 0, bit 01 corresponds to channel 1, etc.</td></tr>
<tr><td></td><td>08-15 (10-17)</td><td>Overrange bits – these bits are set if 1), the input signal is above the input channel's maximum range, or 2), an open detector is detected. Bit 08 (10) corresponds to channel 0, bit 09 (11) corresponds to channel 1, etc.</td></tr>
<tr><td>Input Word 9</td><td>00-03</td><td>Diagnostic bits – represent module configuration and/or hardware errors.
<table>
<tr><td>Bit</td><td>03</td><td>02</td><td>01</td><td>00</td><td></td></tr>
<tr><td></td><td>0</td><td>0</td><td>0</td><td>0</td><td>Reserved for factory use</td></tr>
<tr><td></td><td>0</td><td>0</td><td>1</td><td>0</td><td>Improper module configuration</td></tr>
<tr><td></td><td colspan="5">0001 and 0011 thru 1111 Reserved for factory use</td></tr>
</table></td></tr>
<tr><td></td><td>04</td><td>Not used.</td></tr>
<tr><td></td><td>05-06</td><td>Cold junction compensation alarm bits – These bits are set (1) when the corresponding cold junction compensator lead is broken, unattached or shorted. Bit 05 corresponds to CJC1, and bit 06 to CJC2.</td></tr>
<tr><td></td><td>07</td><td>Not used</td></tr>
<tr><td></td><td>08-15 (10-17)</td><td>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, etc.</td></tr>
<tr><td>Input Word 10</td><td>00-07</td><td>Module command response data bits – These bits echo the module command data written to the module during calibration.</td></tr>
<tr><td></td><td>08-14 (10-16)</td><td>Module command response bits – These bits echo the module command written to the module during calibration.</td></tr>
<tr><td></td><td>15 (17)</td><td>Reserved for factory use</td></tr>
</table>

| Configuration Word | Dec. Bits (Octal Bits) | Description |
|---|---|---|
| Configuration Word 0 | Bits 00-02 | **Input Filter Cutoff bits** |

| Bit | 02 | 01 | 00 | Definition |
|---|---|---|---|---|
| | 0 | 0 | 0 | Hardware filtering only (default filtering) |
| | 0 | 0 | 1 | 40Hz (25ms) |
| | 0 | 1 | 0 | 10Hz (100ms) |
| | 0 | 1 | 1 | 4Hz (250ms) |
| | 1 | 0 | 0 | 2Hz (500ms) |
| | 1 | 0 | 1 | 1Hz (1s) |
| | 1 | 1 | 0 | 0.5Hz (2s) |
| | 1 | 1 | 1 | 0.2Hz (5s) |

Bits 03-05 — **Reference Junction** – used when input type is set to thermocouple and sensor mode is set to Fixed Temperature Compensation. Sets a fixed reference junction to compensate all thermocouple channels.

| Bit | 05 | 04 | 03 | **Reference Junction** |
|---|---|---|---|---|
| | 0 | 0 | 0 | 0°C |
| | 0 | 0 | 1 | 20°C |
| | 0 | 1 | 0 | 25°C |
| | 0 | 1 | 1 | 30°C |
| | 1 | 0 | 0 | 40°C |
| | 1 | 0 | 1 | 50°C |
| | 1 | 1 | 0 | 60°C |
| | 1 | 1 | 1 | 70°C |

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 to 10000 in millivolt mode, and 0 to 5000 in ohms mode

| Bit | 11 | 10 | 09 | 08 | Data type for channels 0-7 |
|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | °C |
| | 0 | 0 | 0 | 1 | °F |
| | 0 | 0 | 1 | 0 | °K |
| | 0 | 0 | 1 | 1 | –32767 to +32767 |
| | 0 | 1 | 0 | 0 | 0 to 65535 |
| | 0101 through 1111 not used | | | | |

Bits 12-15 (14-17) — Not used

| Configuration Word | Dec. Bits (Octal Bits) | Description | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Configuration Word 1 | Bits 00-03 | **Sensor Type (Thermocouple or RTD)** | | | | | | |
| | | **RTD Type** | | | | | | |
| | | Bit | 03 | 02 | 01 | 00 | Sensor type for channels 0 through 3 | |
| | | | 0 | 0 | 0 | 0 | Resistance (default) | |
| | | | 0 | 0 | 0 | 1 | 100 ohm Pt $\alpha$ = 0.00385 Euro (–200 to +870°C) | |
| | | | 0 | 0 | 1 | 0 | 200 ohm Pt $\alpha$ = 0.00385 Euro (–200 to +400°C) | |
| | | | 0 | 0 | 1 | 1 | 100 ohm Pt $\alpha$ = 0.003916 U.S. (–200 to +630°C) | |
| | | | 0 | 1 | 0 | 0 | 200 ohm Pt $\alpha$ = 0.003916 U.S. (–200 to +400°C) | |
| | | | 0 | 1 | 0 | 1 | 100 ohm Nickel (–60 to +250°C) | |
| | | | 0 | 1 | 1 | 0 | 200 ohm Nickel (–60 to +200°C) | |
| | | | 0 | 1 | 1 | 1 | 120 ohm Nickel (–80 to +320°C) | |
| | | | 1 | 0 | 0 | 0 | 10 ohm Copper (–200 to +260°C) | |
| | | | 1001 through 1111 not used | | | | | |
| | Bits 00-03 | **Thermocouple Type** | | | | | | |
| | | Bit | 03 | 02 | 01 | 00 | Sensor type for channels 0 through 3 | |
| | | | 0 | 0 | 0 | 0 | mV (default) | |
| | | | 0 | 0 | 0 | 1 | B | 300 to 1800°C (572 to 3272°F) |
| | | | 0 | 0 | 1 | 0 | E | –270 to 1000°C (–454 to 1832°F) |
| | | | 0 | 0 | 1 | 1 | J | –210 to 1200°C (–346 to 2192°F) |
| | | | 0 | 1 | 0 | 0 | K | –270 to 1372°C (–454 to 2502°F) |
| | | | 0 | 1 | 0 | 1 | L | –200 to 800°C (–328 to 1472°F) |
| | | | 0 | 1 | 1 | 0 | N | –270 to 1300°C (–450 to 2372°F) |
| | | | 0 | 1 | 1 | 1 | R | –50 to 1768°C (–58 to 3214°F) |
| | | | 1 | 0 | 0 | 0 | S | –50 to 1768°C (–58 to 3214°F) |
| | | | 1 | 0 | 0 | 1 | T | –270 to 400°C (–454 to 752°F) |
| | | | 1010 through 1111 not used | | | | | |

| Configuration Word | Dec. Bits (Octal Bits) | Description | | | |
|---|---|---|---|---|---|
| Configuration word 1 cont. | Bits 04-05 | **Sensor Mode Select bits** | | | |
| | | Bit | 05 | 04 | Sensor mode select for channels 0-3 |
| | | **Thermocouple** | | | |
| | | | 0 | 0 | CJC compensation – uses cold junction sensor |
| | | | 0 | 1 | Fixed Temperature compensation – uses the value selected for reference junction |
| | | | 1 | 0 | No compensation (Data is referenced to 0°C.) |
| | | | 1 | 1 | Differential measurement between 2 channels |
| | | **RTD** | | | |
| | | | 0 | 0 | 2-wire RTD no compensation |
| | | | 0 | 1 | 2-wire RTD with loop resistance compensation |
| | | | 1 | 0 | 3-wire RTD |
| | | | 1 | 1 | 4-wire RTD |
| | Bits 06-07 | **Input Type Select** | | | |
| | | Bit | 07 | 06 | Input type selection for channels 0-3 |
| | | | 0 | 0 | Thermocouple |
| | | | 0 | 1 | RTD |
| | | | 1 | 0 | Not used |
| | | | 1 | 1 | |

| Configuration Word | Dec. Bits (Octal Bits) | Description | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Configuration Word 1 cont. | Bits 08-11 (10-13) | **Sensor Type (Thermocouple or RTD)** | | | | | | |
| | | **RTD Type** | | | | | | |
| | | Bit | 11 | 10 | 09 | 08 | Sensor type for channels 4 through 7 | |
| | | | 0 | 0 | 0 | 0 | Resistance (default) | |
| | | | 0 | 0 | 0 | 1 | 100 ohm Pt $\alpha$ = 0.00385 Euro (–200 to +870°C) | |
| | | | 0 | 0 | 1 | 0 | 200 ohm Pt $\alpha$ = 0.00385 Euro (–200 to +400°C) | |
| | | | 0 | 0 | 1 | 1 | 100 ohm Pt $\alpha$ = 0.003916 U.S. (–200 to +630°C) | |
| | | | 0 | 1 | 0 | 0 | 200 ohm Pt $\alpha$ = 0.003916 U.S. (–200 to +400°C) | |
| | | | 0 | 1 | 0 | 1 | 100 ohm Nickel (–60 to +250°C) | |
| | | | 0 | 1 | 1 | 0 | 200 ohm Nickel (–60 to +200°C) | |
| | | | 0 | 1 | 1 | 1 | 120 ohm Nickel (–80 to +320°C) | |
| | | | 1 | 0 | 0 | 0 | 10 ohm Copper (–200 to +260°C) | |
| | | | 1001 through 1111 not used | | | | | |
| | | **Thermocouple Type** | | | | | | |
| | | Bit | 11 | 10 | 09 | 08 | Sensor type for channels 4 through 7 | |
| | | | 0 | 0 | 0 | 0 | mV (default) | |
| | | | 0 | 0 | 0 | 1 | B | 300 to 1800°C (572 to 3272°F) |
| | | | 0 | 0 | 1 | 0 | E | –250 to 1000°C (–418 to 1832°F) |
| | | | 0 | 0 | 1 | 1 | J | –210 to 1200°C (–346 to 2192°F) |
| | | | 0 | 1 | 0 | 0 | K | –250 to 1372°C (–418 to 2502°F) |
| | | | 0 | 1 | 0 | 1 | L | –200 to 800°C (–328 to 1472°F) |
| | | | 0 | 1 | 1 | 0 | N | –250 to 1300°C (–418 to 2372°F) |
| | | | 0 | 1 | 1 | 1 | R | 0 to 1768°C (32 to 3214°F) |
| | | | 1 | 0 | 0 | 0 | S | 0 to 1768°C (32 to 3214°F) |
| | | | 1 | 0 | 0 | 1 | T | –250 to 400°C (–418 to 752°F) |
| | | | 1010 through 1111 not used | | | | | |
| | Bits 12-13 (14-16) | **Sensor Mode Select bits** | | | | | | |
| | | Bit | 13 | 12 | Sensor mode select for channels 4-7 | | | |
| | | **Thermocouple** | | | | | | |
| | | | 0 | 0 | CJC compensation – uses cold junction sensor | | | |
| | | | 0 | 1 | Fixed temperature compensation – uses the value selected for reference junction | | | |
| | | | 1 | 0 | No compensation (Data is referenced to 0°C.) | | | |
| | | | 1 | 1 | Differential measurement between 2 channels | | | |
| | | **RTD** | | | | | | |
| | | | 0 | 0 | 2-wire RTD no compensation | | | |
| | | | 0 | 1 | 2-wire RTD with loop resistance compensation | | | |
| | | | 1 | 0 | 3-wire RTD | | | |
| | | | 1 | 1 | 4-wire RTD | | | |

| Configuration Word | Dec. Bits (Octal Bits) | Description | | | |
|---|---|---|---|---|---|
| Configuration Word 1 cont. | 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 | |
| Configuration Word 2 | 00-15 (00-17) | **RTD loop resistance offset select bits** – used input type is set to RTD and sensor mode select is set to 2-wire with loop resistance compensation. Allows you to set the type of RTD loop resistance compensation used for all RTDs or one of three fixed values for all channels. **NOTE:** Not applicable to 10Ω copper RTD, which defaults to 0Ω. | | | |
| | | Bit | 01 | 00 | RTD channel 0 |
| | | Bit | 03 | 02 | RTD channel 1 |
| | | Bit | 05 | 04 | RTD channel 2 |
| | | Bit | 07 | 06 | RTD channel 3 |
| | | Bit | 09 | 08 | RTD channel 4 |
| | | Bit | 11 | 10 | RTD channel 5 |
| | | Bit | 13 | 12 | RTD channel 6 |
| | | Bit | 15 | 14 | RTD channel 7 |
| | | | 0 | 0 | Use channel loop compensation value stored during calibration procedure for 2-wire RTD (default = 0Ω) |
| | | | 0 | 1 | 5Ω |
| | | | 1 | 0 | 10Ω |
| | | | 1 | 1 | 15Ω |
| Configuration Word 3 | 00-07 | **Module command 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) | **Module 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. | | | |

## Chapter Summary

In this chapter you learned about input, output and configuration files for the analog I/O modules on ControlNet. Move to Chapter 5 to learn how to calibrate your module

# Calibrating Your Module

## What This Chapter Contains

Use this chapter to calibrate the thermocouple/RTD/mV input module. We tell you about:



## When and How to Calibrate Your FLEX Ex Thermocouple/RTD/mV Input Module

**Your module is shipped to you already calibrated.** If a calibration check is required, the module must be in a FLEX Ex I/O system.

Perform module calibration periodically, based on your application. Module calibration may also be required to remove module error due to aging of components in your system.

**ATTENTION**

Your FLEX Ex thermocouple/RTD/mV modules are intrinsically safe equipment. This module cannot be used in instrinsically safe environment after having been exposed to non-intrinsically safe signals.

Use one of the following general methods to calibrate your module:

- Use intrinsically safe equipment to calibrate the module.
- Use factory trained personnel under controlled conditions to calibrate the modules with non-intrinsically safe equipment to maintain your module's intrinsic safety certification.

**ATTENTION**

With the second method, extreme care must be exercised by the calibration personnel to avoid compromising the intrinsically safe characteristics or your modules. This method may never be used in a hazardous environment.

## Tools and Equipment

To calibrate your analog I/O modules, you will need the following tools and equipment:

| Tool or Equipment: | Description: |
|---|---|
| Precision Resistors | High precision resistors:<br>383W, 0.01%, 5ppm/$^{0}$C<br>100W, 0.01%, 5ppm/$^{0}$C<br>10kW, 0.5%, 5ppm/$^{0}$C |
| Precision Voltage Source | +320mV, 1mV resolution |
| PC and Interconnect Cable | Programming terminal for A-B family processors |

## Calibration Method

Calibration is done through the I/O Configuration Software which is part of your programming software package, such as RSLogix 5.

Select the Calibration tab in the software and follow the instructions for complete module calibration..

# Applying FLEX Ex Thermocouple/RTD/mV Input Modules

## What this Chapter Contains

Read this chapter to learn how to use entity parameters when electrically interconnecting your FLEX Ex thermocouple/RTD/mV input module in a hazardous area.



The FLEX Ex system is different from traditional control systems used the intrinsic safety in its ability to be located directly in hazardous areas and to embrace high speed network-based control.

## Evaluate the Application

Follow these steps when designing a FLEX Ex system for your application:

1. Define the area classification.
2. Select protection method(s).
3. Match field devices and I/O modules.
4. Optimize power distribution.
5. Layout the ControlNet Ex network.

An explanation of each of these steps is provided in this chapter.

## Define the Area Classification

Before you can determine what components will make up your FLEX Ex system, you must define the area in which that system will operate. You must determine the following:

- classification method
- hazard
- temperature rating

### Decide Classification Method

Your application location will usually decide whether the classification method is Zone or Class/Division, but the system designer may make this determination. **FLEX Ex is presently certified for Zone method only**.

### Determine Hazard

Hazard–typically gas, dust, or fibers–is determined by the material being processed. For example, a coal mine will generally be rated for dust and methane gas hazards. **FLEX Ex is presently certified for gas hazard method only**.

### Determine Temperature Rating

The spontaneous ignition temperature of the hazardous in your application determines the temperature rating. For example, an application with a hydrogen hazard uses a temperature rating of T1 because hydrogen's ignition temperature is 450°C. **FLEX Ex is presently certified as a T4 system**.

## Select Protection Method(s)

The following table shows protection methods, method designation, and how each provides protection. Although the FLEX Ex system primarily uses the Intrinsic Safety protection method, the system uses all methods listed below.

**Table 6.A**
**Protection Methods for Hazardous Applications**

| Protection Method | Designation[1] | Method of Achieving Protection |
|---|---|---|
| Intrinsic Safety | $EEx_{ia}/EEx_{ib}$ | Energy Limiting |
| Encapsulation | $EEx_{m}$ | Segregation |
| Increased Safety | $EEx_{e}$ | Refined Mechanical Design |
| FlameProof | $EEx_{d}$ | Containment |

1 In the Non-Incendive protection method, n: used locally in the United States and United Kingdom.
In the Intrinsic Safety method, ia: Zone 0, 1, 2 & ib: Zone 1, 2

As not all protection methods are applicable for all locations, consult local certifying agencies to determine acceptable protection methods for your application.

## Match Field Devices and I/O Modules

You must match field devices and I/O modules for your application to function properly. Consider the following:

- Verify field device and I/O module operational characteristics - These characteristics will vary with sensor and application. For example, RTD's convert temperature to resistance change and are generally slow responding devices. Is its resistance range and speed appropriate for the module.
- Match entity parameters of field devices and I/O modules - for more specific information on matching entity parameters of field devices and the 1797-IRT8 module are shown later in this chapter.

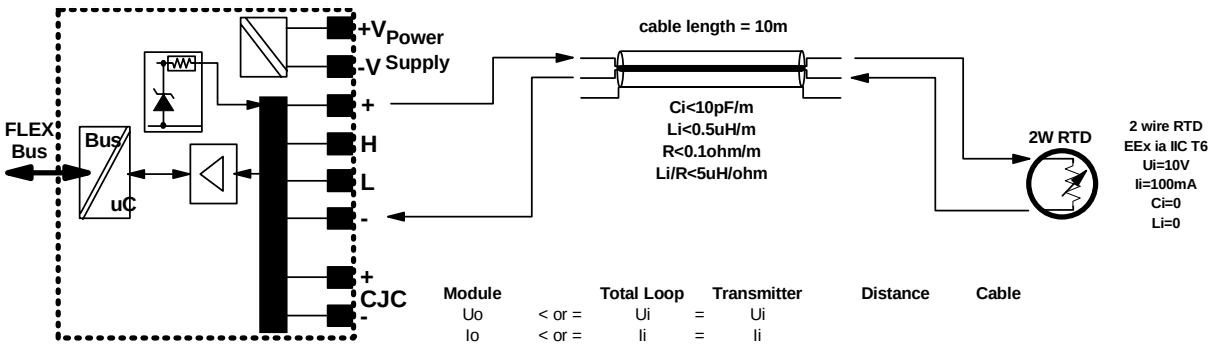
### 1797-IRT8 and Thermocouple and RTD Functional and IS Verification

Thermocouples and RTDs are available in a number of industry standard types. These are generally designated by letter codes, such as N, K, T, etc for thermocouples. The IRT8 is designed to work with a variety of these types. Functional compatibility is simply a matter of selecting the correct sensor type when configuring the IRT8 module with the system I/O configuration software.

Similarly for RTDs an number of industry standard types are available, such as PT100, Ni100, etc. Again, the IRT8 is designed to work with a variety of these types. Functional compatibility is simply a matter of selecting the correct sensor type when configuring the IRT8 module with the system I/O configuration software.

Thermocouples and RTDs are known as “simple devices” from an IS standpoint. Basically this means they either have no mechanism by which to produce or store energy or they are so simple and produce such low energy, that they are intrinsically safe.

Below is the IRT8 with its IS entity parameters for the main measuring input used for thermocouples and RTDs. The example shown is for an RTD, IRT8 and the loop’s associated wiring.




**Thermocouple, RTD, mV Input**
**EEx ia/ib IIB/IIC T4**
**Uo=9V, Io=37mA, Po=83mW**

| IIB | IIC |
|---|---|
| Ca=40uF | Ca=4.9uF |
| La=80mH | La=20mH |
| Lo/Ro=1.7mH/ohm | Lo/Ro=0.4mH/ohm |

| Module | | Total Loop | | Transmitter | | Distance | | Cable |
|---|---|---|---|---|---|---|---|---|
| Uo | < or = | Ui | = | Ui | | | | |
| Io | < or = | Ii | = | Ii | | | | |
| Ca | > or = | Ci | = | Ci | + | (length | * Ci per lengh) | |
| La | > or = | Li | = | Li | + | (length | * La per length) | |
| Lo/Ro | > or = | Li/R | = | | | Li/R | | |

| Module | | Total Loop | | Transmitter | | Distance | | Cable |
|---|---|---|---|---|---|---|---|---|
| Uo<9V | < or = | Ui=10V | = | Ui=10V | | | | |
| Io<37A | < or = | Ii=100mA | = | Ii=100mA | | | | |
| Ca=4.9uF | > or = | Ci=100pF | = | Ci=0 | + | (10m | * Ci=10pF/m) | |
| La=20mH | > or = | Li=5uH | = | Li=0 | + | (10m | * La=0.5uH/m) | |
| Lo/Ro=0.4mH/ohm | > or = | Li/R=5uH/ohm | = | | | Li/R=5uH/ohm | | |

In the figure above, three items are shown:

- the field device
- the interconnecting cable
- and the Flex Ex module.

The entity verification is done for the gas group IIC. As the table shows, the module’s entity parameters are compared to the combination of the RTD and the wiring entity parameters.

The module’s entity parameters are shown in the Module column on the left. They must be compared with the parameters shown in the

Total Loop column, in the manner shown. The values in the Total Loop column are determined in the following manner:

- Total Loop $U_i$ is equal to the transmitter $U_i$.
- Total Loop $I_i$ is equal to the transmitter $I_i$.
- Total Loop $C_i$ is the addition of the transmitter $C_i$ and the cabling $C_i$ per length multiplied by the cable length.
- Total Loop $L_i$ is the addition of the transmitter $L_i$ and the cabling $L_i$ per length multiplied by the cable length.

As long as the Module and Total Loop entity parameters satisfy the inequalities shown the loop is acceptable for use in the hazardous environment.

## Using the Entity Method

The entity method of device to device electrical interconnect in hazardous areas certifies individual products for use in those areas (as opposed to the Loop Method which certifies specific instrumentation loops for use in hazardous areas).

Using the entity method, individual products are certified based on their intrinsic ability to produce/store energy and produce/reject heat. Each part of an instrumentation loop is individually certified and specified with a set of entity parameters.

Because the FLEX Ex system has been designed to use the entity method in hazardous areas, the user can design application-specific instrumentation loops by appropriately matching the devices to be interconnected.

## Entity Parameters

Entity parameters are a system of quantified safe levels for voltage, current, inductance, and capacitance used when connecting multiple devices.

The following table details the entity parameters that must be taken into account when designing a FLEX Ex system.

**Table 6.B**

| Entity Terms: | Applied to: | CENELEC | FM/CSA |
|---|---|---|---|
| Maximum output (open-circuit) voltage | Power sources | $U_o$ | $V_{oc}$ |
| Maximum output (short circuit) current | Power sources | $I_o$ | $I_{sc}$ |
| Maximum allowed capacitance | Power sources | $C_o$ | $C_a$ |
| Maximum allowed inductance | Power sources | $L_o$ | $L_a$ |
| Maximum input voltage | Power receivers | $U_i$ | $V_{max}$ |
| Maximum input current | Power receivers | $I_i$ | $I_{max}$ |
| Maximum internal capacitance | Power receivers | $C_i$ | $C_l$ |
| Maximum internal inductance | Power receivers | $L_i$ | $L_l$ |

In the table above, power sources are devices such as outputs or inputs, and power receivers are devices such as transmitters.

In use, the sum of all the input internal capacitance ($C_i$) or internal inductance ($L_i$) in a control loop cannot exceed the allowed capacitance ($C_o$) or allowed inductance ($L_o$).

Also, the open-circuit voltage ($U_o$) or short circuit current ($I_o$) cannot exceed the maximum input voltage ($U_i$) or maximum input current ($I_i$).

## General Example

Entity parameters allow a user to design an instrumentation loop by selecting entities such as I/O, wiring and field devices that meet parameters defined by local manufacturers and certifying agencies.

For example, a user may have an input channel and a transmitter sending that channel information.

In this application, the **transmitter can withstand**:

– maximum input voltage ($U_i$)=40V and
maximum input current ($I_i$)=100mA

while the **input will provide**:

– maximum output voltage ($U_o$)=28V and
maximum output current ($I_o$)=93mA

In the same application, the **transmitter's**:

– maximum internal capacitance ($C_i$)=0.5nF and
maximum internal inductance ($L_i$)=1mH

are both **less than the input's**:

– allowed capacitance ($C_o$)=66nF and
allowed inductance ($L_o$)=2.5mH will accept

According to the defined entity parameters, this example's combination is compatible. Interconnect wiring and communications ports must also be considered in regard to the entity parameters.

### *Interconnect Wiring*

Interconnect wiring is rated with maximum internal capacitance ($C_i$) and maximum internal inductance ($L_i$) on a per foot/meter basis. The actual length of cable must be multiplied by these parameters and considered with the any application.

### I/O

The 1797-IRT8 module complies fully to and provides simple entity parameters. This module can directly interface with a wide variety of intrinsically safe controls and instrumentation. Because all field device power is supplied directly from the I/O module, no extra wiring or power sources are needed in a hazardous area.

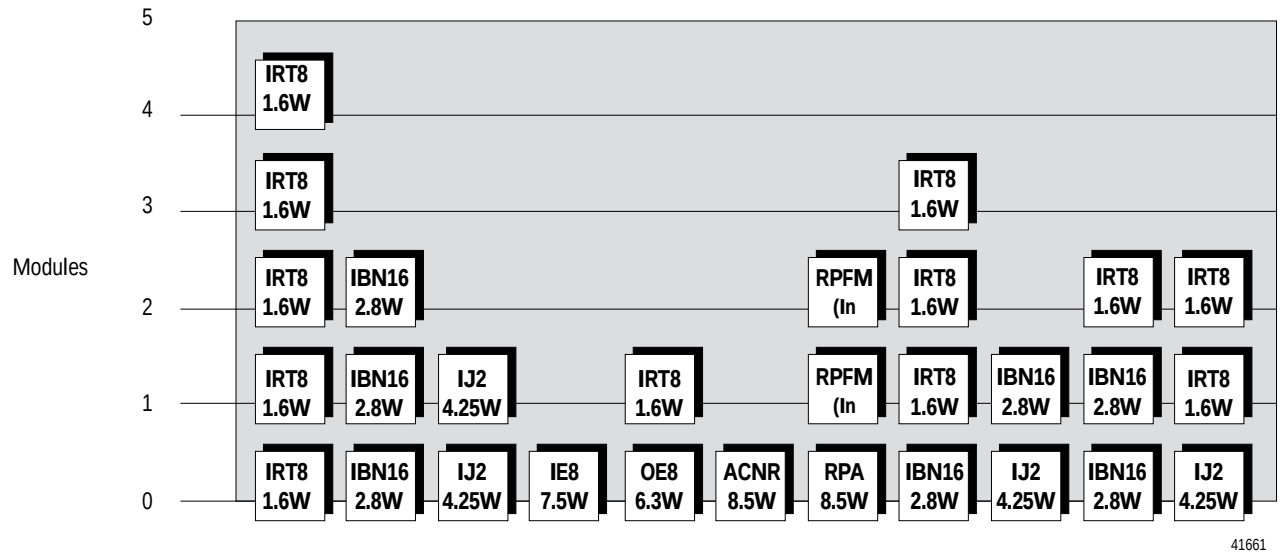
Finally, these modules maintain intrinsic safety in hazardous areas by providing isolation from other modules in the system as well as intrinsic safety segregation between channels on the same module.

## Optimize Power Distribution

Your FLEX Ex system must use adequate power supplies to support the physical locations determined earlier in this chapter. Each FLEX Ex I/O module in the system is rated for input power, and the FLEX Ex power supply is rated in the number of output channels and power available from each channel.

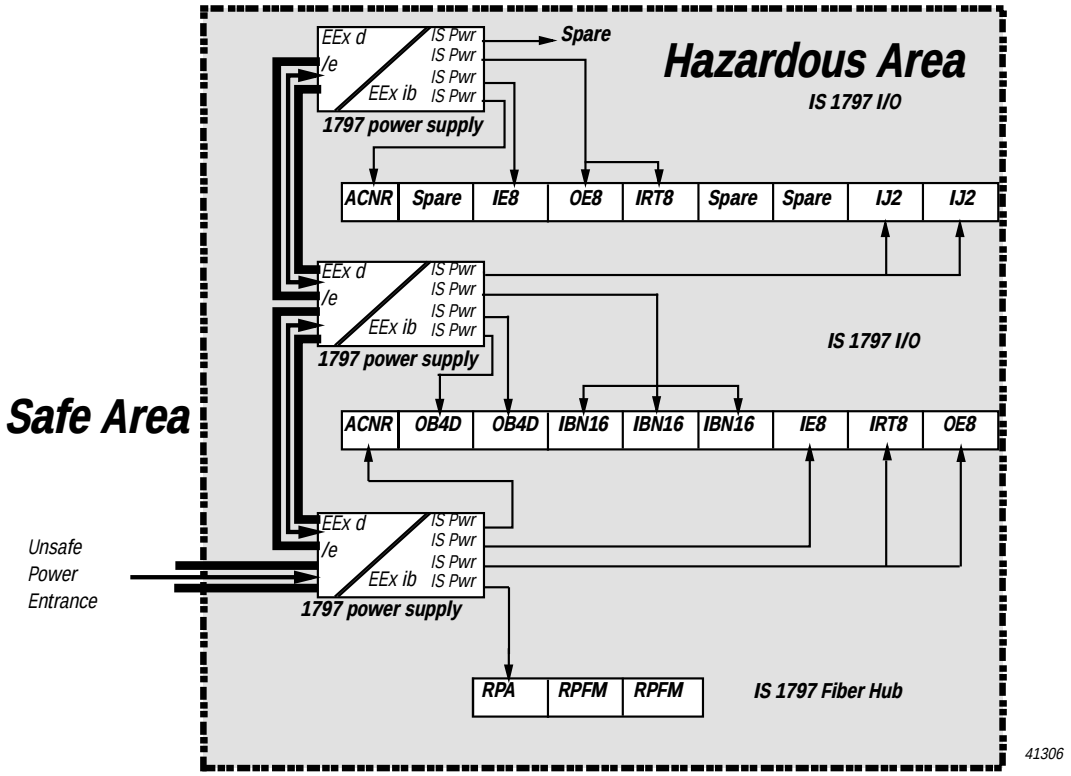
### Assigning Power Supplies

Note the amount of power each module requires and assign it to a power supply output. Continue to assign modules to the power supply output until the supply's output power rating is consumed. The graphic below shows the number of modules per power supply output.



Each power supply output in the FLEX Ex system is rated for 8.5W. Modules can be attached to the output until their combined power equals that number. Do not exceed the power supply maximum of 8.5W.

Assign the next module to another output as before. When all four power supply outputs are utilized, add another power supply to the system, see the figure below.




## Power Supply Considerations

When applying power, consider the certain characteristics of the wire connecting the power supply output to a module's power input. The wire cannot exhibit more than:

- 0.1Ω of resistance (+V and -V combined)
- 800nF of capacitance
- 10mF of inductance

Typically, these restrictions will yield wiring lengths of not more than 3.5m or 5.8m (1.5mm$^2$ and 2.5mm$^2$ wire respectively) without the use of special wiring or wiring methods.

## Chapter Summary

In this chapter you learned how to troubleshoot the FLEX Ex analog I/O modules. Move to chapter 6 to learn about troubleshooting your modules.

# Troubleshooting the FLEX Ex Thermocouple/ RTD/mV Input Module

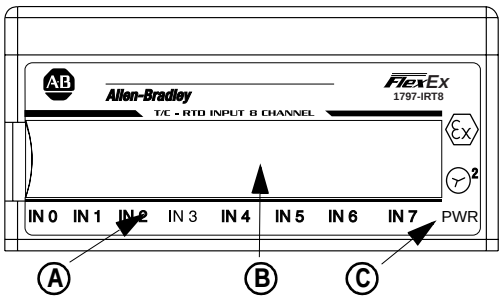
## What this Chapter Contains

Read this chapter to troubleshoot your I/O module.



## Status Indicators

The 1797-IRT8 module has one status indicator for each input (8 in all) and one power indicator that is on when power is applied to the module .




A = Status indicators
B = Insertable labels for writing individual input designations
C = Power indicator

40070

| Indicator | Color | State | Meaning |
|---|---|---|---|
| Status | Red | On | At power up – Channel 0 indicator lights at powerup until all internal diagnostics are checked. After successful powerup, the indicator goes off if no fault is present. After successful powerup – Indicates a critical fault (diagnostic failure, etc.) |
| | | Blinking (when faults are enabled, and bit set) | Indicates a noncritical channel fault |
| Power | | Off | Module not powered |
| | Green | On | Module receiving power |

## Repair

This module is not field repairable. Any attempt to open this module will void the warranty and IS certification. If repair is necessary, return this module to the factory.

## Chapter Summary

In this chapter you learned how to troubleshoot the FLEX Ex thermocouple/RTD/mV module. Move to Appendix A to see the specifications for your module.

# Specifications

The following specifications apply to the 1797-IRT8 thermocouple/RTD/mV input module.

| Specifications - 1797-IRT8 Thermocouple/RTD Module | |
|---|---|
| Number of Inputs | 8 channels |
| IS Input Type | EEx ia IIB/IIC T4, AEx ia IIC T4, Class I, II, III Division 1 Group A-G T4 |
| IS Module Type | EEx ib IIB/IIC T4, AEx ib IIC T4, Class I, Division 1 & 2 Group A-D T4 |
| Input Type | Suitable for Pt 100, Pt200, Ni 100, Ni120, Ni200, 10Cu RTD, thermocouple Type B, E, J, K, N, R, S, T, TXK/XK (L)<br>Configuration via internal bus |
| Signal Input Range | 0 to 500 ohms; -40 to 100mV |
| Settling Time to 99% of Final Value | 8ms (mV mode, $^{0}$F thermocouple) |
| Open RTD Detection | Out of range upscale reading |
| Lead Resistance Compensation | < 15 ohm total |
| Transfer Characteristics | |
| Accuracy | RTDs: 0.1% of span @ 20$^{o}$C, filter cutoff < 1Hz<br>Thermocouples: 0.1% of span @ 20$^{o}$C, filter cutoff < 1Hz |
| Temperature Effect | Cold junction compensation = $\pm$1$^{o}$C<br>150ppm/$^{o}$C (primary range) |
| Indicators | 8 red fault indicators<br>1 green module power indicator |
| Data Organization | |
| Overrange Alarm | Individually for each channel |
| Lead Breakage Alarm | Individually for each channel |
| Fault State | Individually for each channel (includes overrange, lead breakage and short circuit) |
| Sensor Mode RTD 2, 3, or 4-wire, | Common to groups of 4 channels (ch 0-3, ch 4-7) |
| TC Sensor Type (e.g. TC, Type B, E, J..., RTD or mV | Common to groups of 4 channels (ch 0-3, ch 4-7) |
| Internal Reference Junction (TC mode) | Common to all channels (0$^{o}$C, 20$^{o}$C, 25$^{o}$C, 30$^{o}$C, 40$^{o}$C, 50$^{o}$C, 60$^{o}$C, 70$^{o}$C selectable |
| Output (intrinsically safe) (16 position male/female flexbus connector) | $U_i \leq$ 5.8V<br>$I_i \leq$ 400mA<br>Li = Negligible<br>Ci $\leq$ 1.35$\mu$F |
| Isolation Path<br>Input to power supply<br>Input to flexbus<br>Input to input<br>Power supply to flexbus | Isolation Type<br>Galvanic to DIN EN50020<br>Galvanic to DIN EN50020<br>None<br>Galvanic to DIN EN50020 |
| Power Supply (+V, -V intrinsically safe) | $U_i \leq$ 9.5V dc<br>$I_i \leq$ 1A<br>Li = Negligible<br>Ci = Negligible |
| Module Field-Side Power Consumption | 1.6W |

**Specifications continued on next page.**

| | |
|---|---|
| Power Dissipation | 1.6W |
| Thermal Dissipation | Maximum 5.46BTU/hr |
| Module Location | Cat. No. 1797-TB3 or -TB3S Terminal Base Unit |
| Conductor Wire Size | 12 gauge ($4mm^2$) stranded maximum<br>3/64in (1.2mm) insulation maximum |
| Dimensions | 46mm x 94mm x 75mm<br>(1.8in x 3.7in x 2.95in) |
| Weight | 200g (approximate) |
| Keyswitch Position | 2 |
| Environmental Conditions | |
| Operational Temperature | -20 to +70°C (-4 to +158°F) |
| Storage Temperature | -40 to +85°C (-40 to +185°F) |
| Relative Humidity | 5 to 95% noncondensing |
| Shock Operating | Tested to 15g peak acceleration, 11(+1)ms pulse width |
| Shock Nonoperating | Tested to 15g peak acceleration, 11(+1)ms pulse width |
| Vibration | Tested 2g @ 10-500Hz per IEC68-2-6 |
| Agency Certification | |
| CENELEC | II (1) 2G EEx ia/ib IIB/IIC T4 |
| UL/C-UL | Class I Division 1 and 2 Groups A-D T4<br>Class I Zone 1 and 2 AEx ib/[ia] IIC T4 |
| | Class I Division 1 and 2 Groups A-D T4 |
| FM | Class I Zone 1 AEx ib/[ia] IIC T4 |
| Certificate of Conformity | DMT 98 ATEX E 023 X<br>UL, C-UL Certificate Number 99.19699<br>FM Certificate Number 3009806 |

## CE/CENELEC I/O Entity Parameters

Input circuits (+ to -) for ch0 to ch7 (terminals: 0-3; 4-7; 8-11; 12-15; 17-20; 21-24; 25-28; 29-32)

| | Protection | Group | Allowed Capacitance | Allowed Inductance | $L_o/R_o$ Ratio |
|---|---|---|---|---|---|
| $U_o$ = 9V<br>$I_o$ = 37mA<br>$P_o$ = 83mW | EEx ia | IIB | 40µF | 80mH | 1.7mH/Ω |
| | EEx ia | IIC | 4.9µF | 20mH | 0.4mH/Ω |

CJC circuits (+ to -) for CJC0 and CJC1 (terminals: 37, 39; 46, 48)

| | Protection | Group | Allowed Capacitance | Allowed Inductance | $L_o/R_o$ Ratio |
|---|---|---|---|---|---|
| $U_o$ = 9V<br>$I_o$ = 1mA<br>$P_o$ = 3mW | EEx ia | IIB | 40µF | 1H | 63mH/Ω |
| | EEx ia | IIC | 4.9µF | 1H | 15mH/Ω |

Input circuits (+ to -) for ch0 to ch7 and CJC circuits (+ to -) for CJC0 and CJC1 (terminals 0-3, 37, 39; 4-7, 37, 39; 8-11, 37, 39; 12-15, 37, 39; 17-20, 37, 39; 21-24, 37, 39; 25-28, 37, 39; 29-32, 37, 39; 0-3, 46, 48; 4-7, 46, 48; 8-11, 46, 48; 12-15, 46, 48; 17-20, 46, 48; 21-14, 46, 48; 25-28, 46, 48; 29-32, 46, 48)

| | Protection | Group | Allowed Capacitance | Allowed Inductance | $L_o/R_o$ Ratio |
|---|---|---|---|---|---|
| $U_o$ = 9V<br>$I_o$ = 38mA<br>$P_o$ = 86mW | EEx ia | IIB | 40µF | 80mH | 1.7mH/Ω |
| | EEx ia | IIC | 4.9µF | 20mH | 0.4mH/Ω |

## UL, C-UL I/O Entity Parameters

If the product has the UL/C-UL mark, it has been designed, evaluated, tested, and certified to meet the following standards:

- UL 913, 1988, Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II, and III Division 1, Hazardous (Classified) Locations
- UL 1203, Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
- UL 2279, Electrical Equipment for Use in Class I, Zone 0, 1, and 2 Hazardous (Classified) Locations
- UL 508, Industrial Control Equipment
- CSA C22.2 No. 157-92, Intrinsically Safe and Non-Incindive Equipment for Use in Hazardous Locations
- CSA C22.2 No. 30-M1986, Explosion-Proof Enclosures for Use in Class I Hazardous Locations
- CSA-E79-0-95, Electrical Apparatus for Explosive Gas Atmospheres, Part 0: General Requirements
- CSA-E79-11-95, Electrical Apparatus for Explosive Gas Atmospheres, Part 11: Intrinsic Safety "i"
- CSA C22.2 No. 14-95, Industrial Control Equipment

**Table 1**

| Wiring Method | Channel | Terminals | $V_{oc}$ (V) | $I_{sc}$ (mA) | $V_t$ (V) | $I_t$ (mA) | Groups | $C_a$ (μF) | $L_a$ (mH) |
|---|---|---|---|---|---|---|---|---|---|
| 1 and 2 | Any one channel e.g. ch0 | 0(+), 1(H), 2(L), 3(-) | 9.0 | 37.0 | - | - | A, B | 4.9 | 20.0 |
| | | | | | | | C, E | 14.7 | 80.0 |
| | | | | | | | D, F, G | 39.2 | 160.0 |
| | | 37, 38, 39 (CJC0) or 46, 47, 48 (CJC1) | 9.0 | 1.0 | - | - | A, B | 4.9 | 1000.0 |
| | | | | | | | C, E | 14.7 | 1000.0 |
| | | | | | | | D, F, G | 39.2 | 1000.0 |
| | | 0(+), 1(H), 2(L), 3(-) 37, 38, 39 (CJC0) or 46, 47, 48 (CJC1) | - | - | 9.0 | 38.0 | A, B | 4.9 | 20.0 |
| | | | | | | | C, E | 14.7 | 80.0 |
| | | | | | | | D, F, G | 39.2 | 160.0 |

## Wiring Methods

- Wiring method 1 - Each channel is wired separately.
- Wiring method 2 - Multiple channels in one cable, providing each channel is separated in accordance with the National Electric Code (NEC) or Canadian Electric Code (CEC).

**Table 2**

| Terminals | $V_t$ (V) | $I_t$ (mA) | Groups | $C_a$ (μF) | $L_a$ (μH) |
|---|---|---|---|---|---|
| Male Bus Connector | 5.8 | 400 | A-G | 3.0 | 3.0 |

① The entity concept allows interconnection of intrinsically safe apparatus with associated apparatus not specifically examined in combination as a system when the approved values of $V_t$ and $I_t$ of the associated apparatus are less than or equal to $V_{oc}$ and $I_{sc}$ or $V_{max}$ and $I_{max}$ of the intrinsically safe apparatus and the approved values of $C_a$ and $L_a$ of the associated apparatus are greater than $C_i + C_{cable}$ and $L_i + L_{cable}$ respectively for the intrinsically safe apparatus.

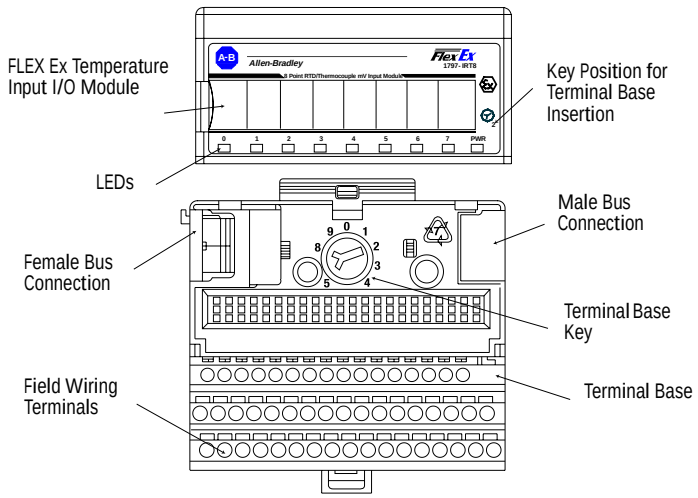
② Simple apparatus is defined as a device which neither generates nor stores more than 1.2V, 0.1A, 20µJ, or 25mW.

③ Wiring methods must be in accordance with the National Electric Code, ANSI/NFPA 70, Article 504 and 505 or the Canadian Electric Code CSA C22.1, Part 1, Appendix F. For additional information refer to ANSI/ISA RP12.6.

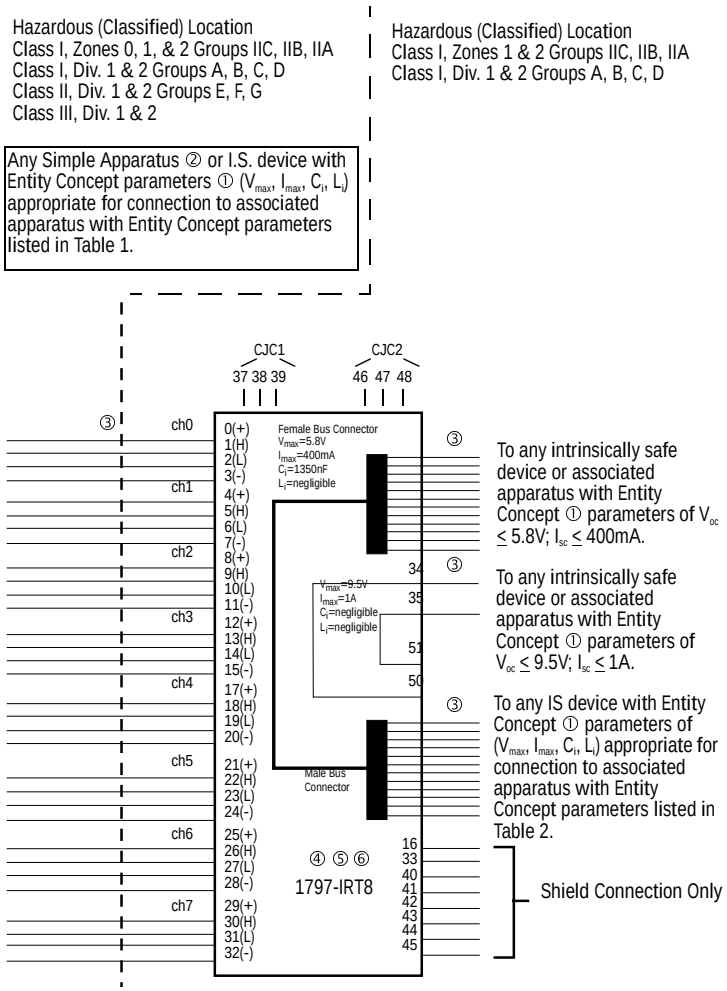
④ This module, 1797-IRT8, must be used with terminal base 1797-TB3 or 1797-TB3S.

⑤ Terminals 36 and 49 shall not be connected.

⑥ **WARNING:** Substitution of components may impair intrinsic safety.
**AVERTISSEMENT:** La substitution de composant peut compromettre la securite intrinseque.




Note: A terminal base may not have an I/O module installed.




**IMPORTANT** For detailed certification information, refer to the FLEX Ex System Certification Reference Manual, publication 1797-6.5.6

## FM I/O Entity Parameters

f this product has the FM mark, it has been designed, evaluated, tested and certified to meet the following standards:

- FM C1. No 3600:1998, Electrical Equipment for Use in Hazardous (Classified) Locations General Requirements
- FM C1. No 3610:1999, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III Division 1 Hazardous (Classified) Locations
- FM C1. No 3615:1989, Explosionproof Electrical Equipment General Requirements
- FM C1. No 3810:1989, 1995, Electrical and Electronic Test, Measuring and Process Control Equipment
- ANSI/NEMA 250, 1991, Enclosures for Electrical Equipment

## Wiring Methods

- Wiring method 1 - Each channel is wired separately.
- Wiring method 2 - Multiple channels in one cable, providing each channel is separated in accordance with the National Electric Code (NEC).

**Table 1**

| Wiring Method | Channel | Terminals | $V_{oc}$ (V) | $I_{sc}$ (mA) | $V_t$ (V) | $I_t$ (mA) | Groups | $C_a$ (μF) | $L_a$ (mH) |
|---|---|---|---|---|---|---|---|---|---|
| 1 and 2 | Any one channel e.g. ch0 | 0(+), 1(H), 2(L), 3(-) | 9.0 | 37.0 | - | - | A, B | 3.0 | 20.0 |
| | | | | | | | C, E | 9.0 | 60.0 |
| | | | | | | | D, F, G | 24.0 | 160.0 |
| | | 37, 38, 39 (CJC0) or 46, 47, 48 (CJC1) | 9.0 | 1.0 | - | - | A, B | 3.0 | 1000.0 |
| | | | | | | | C, E | 9.0 | 1000.0 |
| | | | | | | | D, F, G | 24.0 | 1000.0 |
| | | 0(+), 1(H), 2(L), 3(-) 37, 38, 39 (CJC0) or 46, 47, 48 (CJC1) | - | - | 9.0 | 38.0 | A, B | 3.0 | 20.0 |
| | | | | | | | C, E | 9.0 | 60.0 |
| | | | | | | | D, F, G | 24.0 | 160.0 |

**Table 2**

| Terminals | $V_t$ (V) | $I_t$ (mA) | Groups | $C_a$ (μF) | $L_a$ (μH) |
|---|---|---|---|---|---|
| Male Bus Connector | 5.8 | 400 | A-G | 3.0 | 3.0 |

① The entity concept allows interconnection of intrinsically safe apparatus with associated apparatus not specifically examined in combination as a system when the approved values of $V_{oc}$ and $I_{sc}$ or $V_t$ and $I_t$ of the associated apparatus are less than or equal to $V_{max}$ and $I_{max}$ of the intrinsically safe apparatus and the approved values of $C_a$ and $L_a$ of the associated apparatus are greater than $C_i + C_{cable}$ and $L_i + L_{cable}$ respectively for the intrinsically safe apparatus.

② Simple apparatus is defined as a device which neither generates nor stores more than 1.2V, 0.1A, 20μJ, or 25mW.

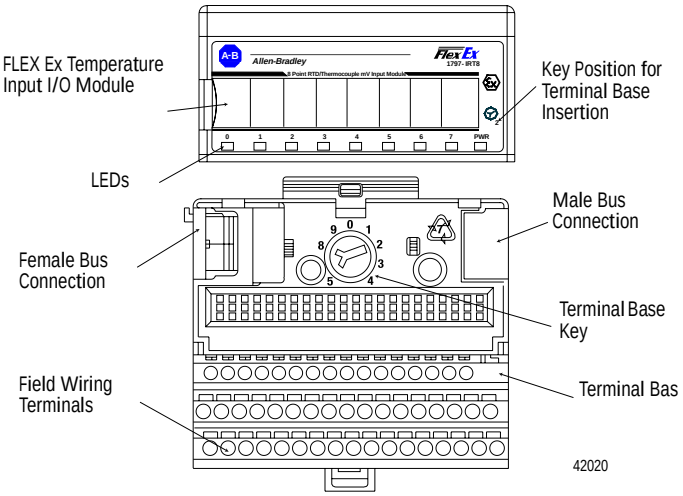
③ Wiring methods must be in accordance with the National Electric Code, ANSI/NFPA 70, Article 504 and 505. For additional information refer to ANSI/ISA RP12.6.

④ This module, 1797-IRT8, must be used with terminal base 1797-TB3 or 1797-TB3S.

⑤ Terminals 36 and 49 shall not be connected.

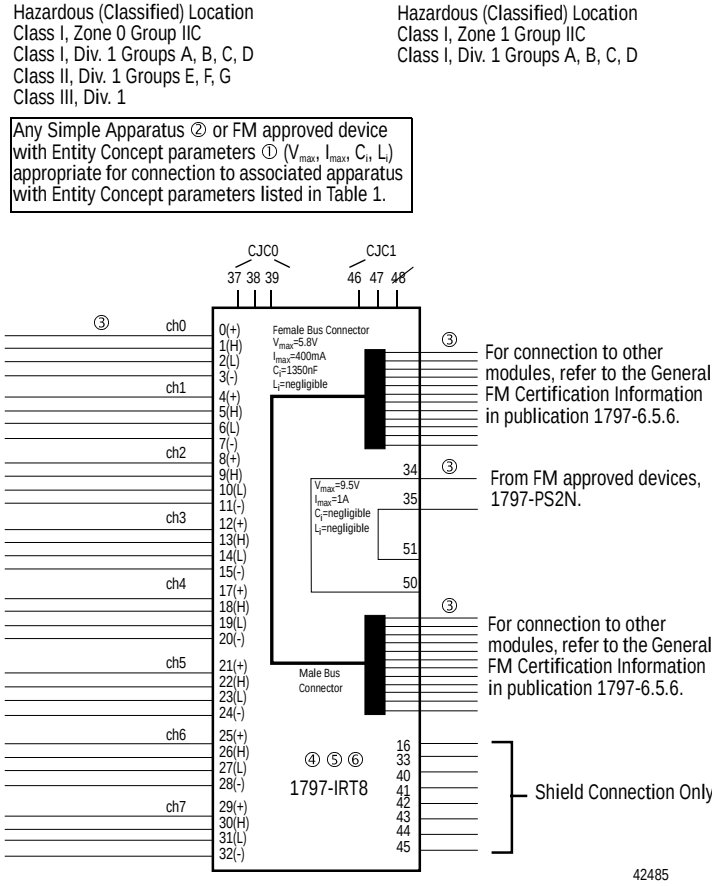
⑥ **WARNING:** Substitution of components may impair intrinsic safety.

**AVERTISSEMENT:** La substitution de composant peut compromettre la securite intrinseque.




**ATTENTION**

A terminal base may or may not have an I/O module installed.




**Attention: Avoid electrostatic charge.**

**Attention: Avoid electrostatic charge.**

# Programming the FLEX Ex I/O Modules Using RIO

## What this Chapter Contains

Read this appendix to program the 1797-IRT8 thermocouple/RTD/mV input module.

## Enter Block Transfer Instructions

The FLEX Ex thermocouple/RTD/mV 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 need to enter block transfer instructions into your ladder logic. The following example programs illustrate the minimum programming 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 module is first powered up, and subsequently only when the programmer wants to enable or disable features of the module. The configuration BTW sets the bits which enable the programmable features of the module, such as filters and signal ranges, etc. Block transfer reads are performed to retrieve information from the module.

Block transfer read (BTR) programming moves status and data from the module to the processor's 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.

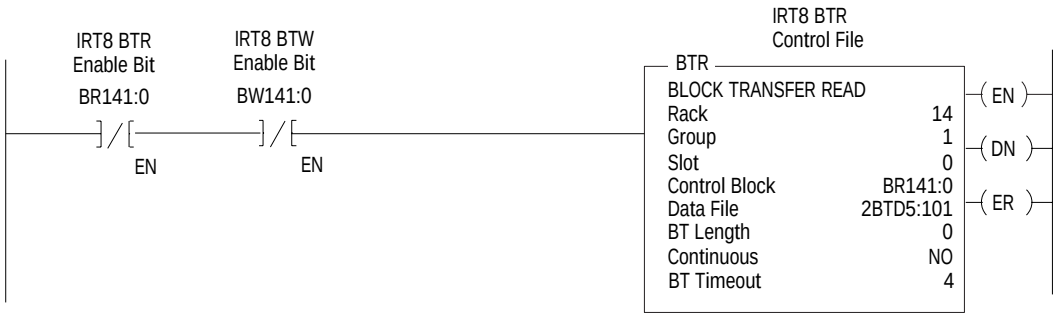
## Using the PLC-5C Processor

Block transfer instructions with the PLC-5C 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).

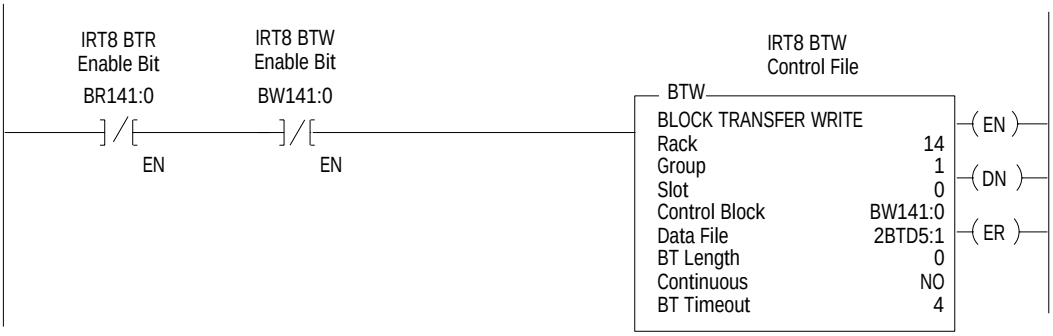
The programming terminal will automatically select the control file based on rack, group and module, and whether it is a read or write. **A different block transfer control file is used for the read and write instructions for your module.** A different block transfer control file is required for every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



## Numerics



## A



## B



## C



## D



## E



## I



## M



## P



## T



## U



## W

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