FLEX 5000 Analog I/O Modules

Catalog Numbers 5094-IF8, 5094-IF8XT, 5094-IY8, 5094-IY8XT, 5094-OF8, 5094-OF8XT, 5094-IRT8S, 5094-IRT8SXT

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual

Original Instructions

Important User Information

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

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

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

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

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

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

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

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

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

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

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

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

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

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

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

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

Table of Contents

Chapter 3

5094-IF8 Analog Input Module Features

Chapter 4

Current/Voltage/Temperature-sensing (5094-IY8) and RTD/Thermocouple (5094-IRT8S) Analog Input Module Features

Chapter 5

5094-OF8 Analog Output Module Features

Chapter 6

Safety I/O Module Features

Chapter 7

Configure Standard Analog I/O Modules

Chapter 8

Configure and Replace Safety Analog I/O Modules

Chapter 9

Calibrate the Modules

Appendix A

Troubleshoot Your Module

Notes:

About This Publication

This manual describes how to use FLEX 5000® analog standard and safety I/O modules in Logix 5000® control systems.

Make sure that you are familiar with the following:

- Use of a controller in a Logix 5000 control system
- Operation of safety systems
- Use of an EtherNet/IP™ network, if the analog I/O modules are installed in a remote location from the controller that is accessible via the EtherNet/IP network
- Studio 5000 Logix Designer environment

Download Firmware, AOP, EDS, and Other Files

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

Summary of Changes

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

Topic	Page
Updated Additional Resources	11
Replaced publication reference ENET-UM004 with 5094-UM005	11, 18, 75, 80, 91
Updated topic Remote Cold Junction (5094-IY8 Only)	59
Updated section Chxx Category for 5094-IY8 module	84
Updated 5094-IY8 module configuration tag definitions for tags CJChxx.Disable and CJChxx.Remote	136

Manual Conventions

Within this manual, we simplified product names and added product icons for your ease of use.

We use **standard** module to indicate a module that does not have functional safety capability. We use **safety** module to indicate a module with functional safety capability (catalog numbers ending in "S" or "SXT"). Further, we use FLEX 5000 I/O module to indicate when a concept or task applies to **both** the standard and safety analog I/O modules.

Throughout this publication, the term Logix 5000 controller refers to the controllers with which you can use FLEX 5000 I/O modules in a given capacity. The term does not refer to all Logix 5000 controllers.

Feature Support

Applies to these modules:
5094 Standard HART I/O Modules
5094 Safety HART I/O Modules

Throughout this manual, the table at left indicates the analog I/O modules that support the feature that is described in that chapter or section.

- If both standard and safety modules support a feature, both module types are in the table. Any difference in operation between the modules for that feature is communicated in the text in the chapter or section.
- If only one type of module, standard or safety, supports a feature, only that module type appears in the table.

Terminology

This table defines terms that are used in this manual.

Abbreviation	Full Term	Definition
CIP™	Common Industrial Protocol	An industrial communication protocol that is used by Logix 5000-based automation systems on EtherNet/IP, ControlNet®, and DeviceNet® communication networks.
CIP Sync™	Common Industrial Protocol Synchronization	CIP Sync provides the increased control coordination needed for control applications where absolute time synchronization is vital to achieve real-time synchronization between distributed intelligent devices and systems.
CIP Safety™	Common Industrial Protocol – Safety Certified	SIL-rated version of CIP.
—	Connection	Logical communication channel for communication between nodes. Connections are maintained and controlled between masters and slaves.
CL	Claim Limit	The maximum safety integrity level (SIL) that can be achieved.
DC	Diagnostic Coverage	The ratio of the detected failure rate to the total failure rate.
EDS	Electronic Data Sheet	A template that is used in RSNetWorx™ software to display the configuration parameters, I/O data profile, and connection-type support for a given I/O module. RSNetWorx software uses these simple text files to identify products and commission them on a network.
EN	European Norm.	The official European Standard.
ESS	Energy Storage System	Used for backup for memory retention at powerdown on controllers. The ESS is inside the controller and cannot be removed.
GSV	Get System Value	A ladder logic instruction that retrieves specified controller status information and places it in a destination tag.
MTTF	Mean Time To Failure	The length of time that a device or other product is expected to remain reliable in operation.
—	Multicast	The transmission of information from one sender to multiple receivers.
NAT	Network Address Translation	The translation of an Internet Protocol (IP) address to another IP address on another network.
ODVA	Open DeviceNet Vendor Association	A nonprofit association of vendors that are established for the promotion of CIP networks.
PC	Personal computer	Computer that is used to interface with and control a Logix-based system via the Studio 5000® environment.
PFD	Probability of Failure on Demand	The average probability of a system to fail to perform its design function on demand.
PFH	Average frequency of a dangerous failure per hour	The probability of a system to have a dangerous failure occur per hour.
PL	Performance Level	ISO 13849-1 safety rating.
—	Proof test	Periodic test that detects failures in a safety-related system so that, if necessary, the system can be restored to an as-new condition or as close as practical to this condition.
—	Safety (devices)	Devices or portions of devices that have functional safety capability.
SIL	Safety Integrity Level	A relative level of risk-reduction provided by a safety function, or to specify a target level of risk reduction.
SNN	Safety Network Number	A unique number that identifies a section of a safety network.
SRT	Safety Reaction Time	A consideration of delays or latencies within the safety system.
SSV	Set System Value	A ladder logic instruction that sets controller system data.
—	Standard (devices)	Devices or portions of devices that do not have functional safety capability.
—	Unicast	The transmission of information from one sender to one receiver.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
FLEX 5000 Module Specifications Technical Data, publication 5094-TD001	Provides specifications for FLEX 5000 EtherNet/IP adapters and FLEX 5000 modules.
FLEX 5000 EtherNet/IP Adapters with RJ45 Ports Installation Instructions, publication 5094-IN001	Describes how to install and wire the EtherNet/IP adapters with RJ45 ports.
FLEX 5000 EtherNet/IP Adapters with SFP Support Installation Instructions, publication 5094-IN002	Describes how to install and wire the EtherNet/IP adapters with SFP support.
FLEX 5000 Analog 8-channel Current/Voltage Input Modules Installation Instructions, publication 5094-IN006	Describes how to install and wire the 5094-IF8 and 5094-IF8XT analog input modules.
FLEX 5000 Analog 8-channel Current/Voltage Output Modules Installation Instructions, publication 5094-IN007	Describes how to install and wire the 5094-OF8 and 5094-OF8XT analog output modules.
FLEX 5000 Analog 8-channel Current/Voltage/RTD/Thermocouple Input Modules Installation Instructions, publication 5094-IN008	Describes how to install and wire the 5094-IY8 and 5094-IY8XT analog input modules.
FLEX 5000 Analog 8-channel RTD/Thermocouple Safety Input Modules Installation Instructions, publication 5094-IN018	Describes how to install and wire the 5094-IRT8S and 5094-IRT8SXT analog safety input modules.
FLEX 5000 Terminal Base Assembly Modules Installation Instructions, publication 5094-IN010	Describes how to install and wire the terminal base assemblies for the FLEX 5000 system.
FLEX 5000 EtherNet/IP Adapter User Manual, publication 5094-UM005	Describes how to configure, operate, and troubleshoot FLEX 5000 EtherNet/IP adapters.
CompactLogix 5380 and Compact GuardLogix 5380 Controllers User Manual, publication 5069-UM001	Describes how to configure, operate, and troubleshoot CompactLogix® and Compact GuardLogix® 5380 controllers.
ControlLogix 5580 and GuardLogix 5580 Controllers User Manual, publication 1756-UM543	Describes how to configure, operate, and troubleshoot ControlLogix® and GuardLogix 5580 controllers.
GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Reference Manual, publication 1756-RM012	Contains detailed requirements for achieving and maintaining SIL 2/PLd and SIL 3/PLe with the GuardLogix 5580 and Compact GuardLogix 5380 controller systems, using the Studio 5000 Logix Designer application.
Electronic Keying in Logix 5000 Control Systems Application Technique, publication LOGIX-AT001	Describes how to use electronic keying in Logix 5000 control system applications.
EtherNet/IP Network Devices User Manual, publication ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, publication ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, publication SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001	Provides information about CIP Sync technology and how to synchronize clocks within the Rockwell Automation Integrated Architecture® system.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Selection and Configuration tools, rok.auto/systemtools	Helps configure complete, valid catalog numbers and build complete quotes based on detailed product information.
Rockwell Automation Global SCCR tool, rok.auto/sccr	Provides coordinated high-fault branch circuit solutions for motor starters, soft starters, and component drives.
Product Certifications website, rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.
Safety Automation Builder and SISTEMA Library, https://rok.auto/sistema	Download Safety Automation Builder® software to help simplify machine safety design and validation, and reduce time and costs. Integration with our risk assessment software provides you with consistent, reliable, and documented management of the Functional Safety Lifecycle. The SISTEMA tool, also available for download from the Safety Automation Builder page, automates calculation of the attained Performance Level from the safety-related parts of a machine's control system to (EN) ISO 13849-1.

You can view or download publications at rok.auto/literature.

Notes:

FLEX 5000 Analog I/O Module Operation in a Logix 5000 Control System

IMPORTANT	You cannot use FLEX 5000 I/O modules with all Logix 5000 controllers. For example, you can use FLEX 5000 I/O modules with CompactLogix 5380 and ControlLogix 5580 controllers but not with CompactLogix 5370 and ControlLogix 5570 controllers. You can use FLEX 5000 I/O modules with Logix 5000 controllers as remote I/O modules only. Throughout this publication, the term **Logix 5000 controller** refers to the controllers with which you can use FLEX 5000 I/O modules in a given capacity. The term does not refer to all Logix 5000 controllers. For the most current information on the Logix 5000 controllers with which you can use FLEX 5000 I/O modules, see the product description at http://www.ab.com.

Logix 5000 controllers use FLEX 5000 analog I/O modules to control devices in a control system. The controllers access the modules over an EtherNet/IP network. FLEX 5000 analog I/O modules use terminal base (TB) assemblies to connect field-side wiring.

FLEX 5000 analog I/O modules convert analog signals to digital values for inputs and convert digital values to analog signals for outputs. Controllers use these signals for control purposes.

FLEX 5000 analog I/O modules use the Producer/Consumer network communication model. This communication is an intelligent data exchange between modules and other system devices in which each module produces data without first being polled.

You use the Studio 5000 Logix Designer application, version 31 or later, to configure the standard I/O modules.

You use the Studio 5000 Logix Designer application, version 33 or later, to configure the safety I/O modules.

You use FLEX 5000 analog I/O modules as remote I/O modules that are accessible via an EtherNet/IP network. The modules are installed to the right of a FLEX 5000 EtherNet/IP adapter.

Logix 5000 controllers can exchange data with the modules over the network.

Figure 1 shows a standard controller with standard I/O modules. Standard controllers do not support safety I/O modules.

Figure 1 - FLEX 5000 Standard I/O Modules in a Logix 5000 Control System

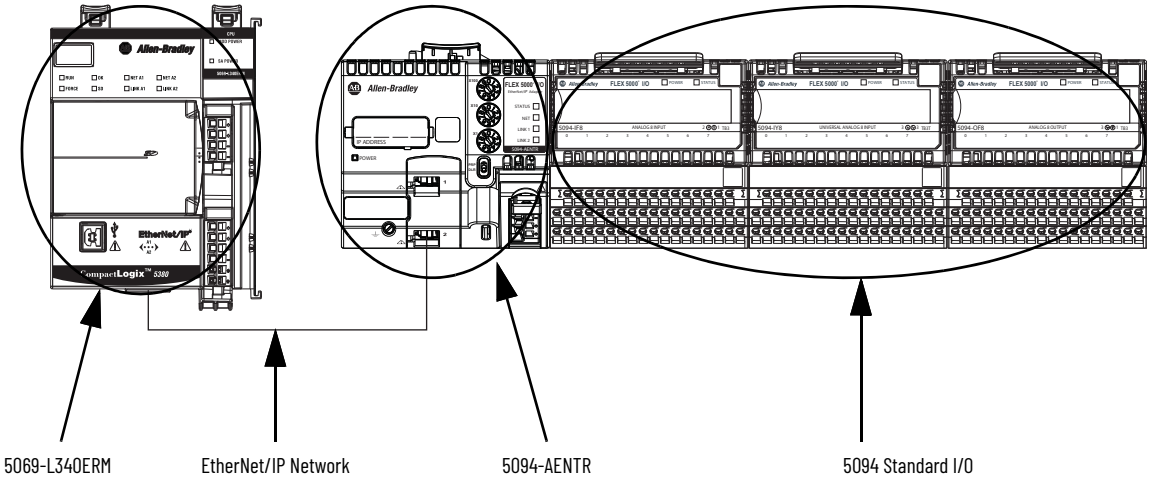
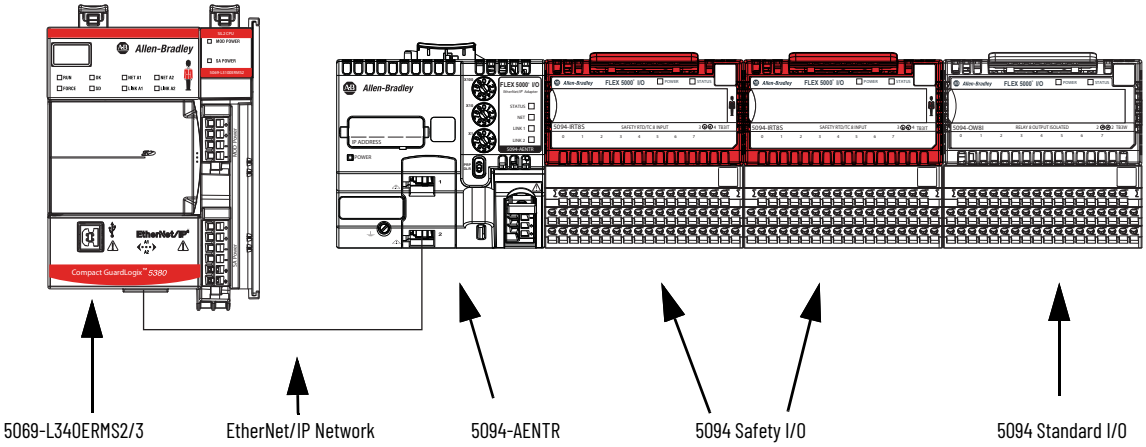


Figure 2 shows a safety controller with standard and safety I/O modules. Safety controllers support both standard and safety I/O modules.

Figure 2 - FLEX 5000 Safety I/O Modules in a Logix 5000 Control System

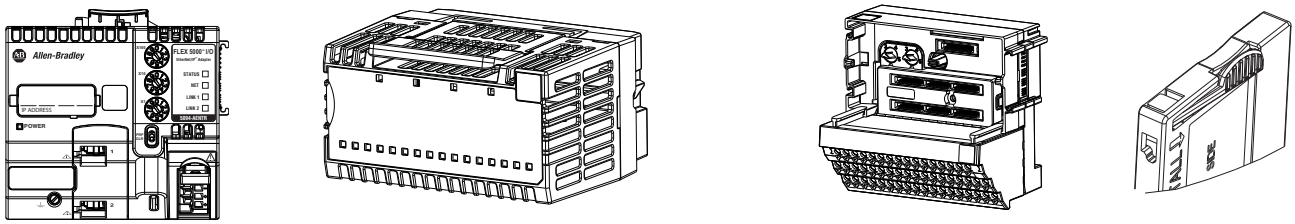


Construct a 5094 FLEX 5000 I/O System

FLEX 5000 I/O is a small, modular I/O system for distributed applications that performs all of the functions of rack-based I/O. The FLEX system contains the components pictured below.

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Adapter I/O Module Terminal Base End Caps



- Adapter - Transfers read and write configuration data to and from the I/O module
- Terminal base - Contains a terminal strip to terminate wiring for two- or three-wire devices
- I/O modules - Contains the bus interface and circuitry needed to perform specific functions related to your application
- End cap - Basically a dust cap for the last module in a rack

Before You Begin

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Before you use your analog I/O module, you must complete the following:

a. Install a FLEX 5000 EtherNet/IP adapter.
b. Install the FLEX 5000 I/O modules to the right of adapter.
c. Install an EtherNet/IP network.
d. Install the Logix 5000 controller that accesses the FLEX 5000 I/O modules via an EtherNet/IP network.

Make sure that you have enough FLEX 5000 terminal base (TB) assemblies to satisfy your application needs. For more information, see the FLEX 5000 Terminal Base Assembly Modules Installation Instructions, publication 5094-IN010.

IMPORTANT	TBs are not included with your module and are not available for purchase. TBs consist of a mounting base (MB) and removable terminal block (RTB). You must purchase MBs and RTBs separately and assemble them together.

Controller and Software Compatibility

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Controller and programming software compatibility requirements apply when you use FLEX 5000 standard and safety I/O modules. A module type and how it is used affect which requirements apply.

You must also consider Studio 5000 Logix Designer application version requirements when you design your system. For example, you can use FLEX 5000 safety I/O modules with only version 33 or greater of the Studio 5000 Logix Designer application.

Controller Compatibility

Compatibility between Logix 5000 controllers and FLEX 5000 I/O modules varies based on module type, that is, whether the module is standard or safety.

While you must pair safety I/O with a safety controller, you can also pair standard I/O with a safety controller. For example, ControlLogix 5580 and CompactLogix 5380 controllers are compatible with FLEX 5000 standard I/O modules. GuardLogix 5580 and Compact GuardLogix 5380 controllers are compatible with FLEX 5000 standard and safety I/O modules.

Firmware and Software Compatibility

Table 1 shows module compatibility when you use FLEX 5000 I/O standard and safety modules with Logix 5000 controllers. For full product compatibility information, see the Product Compatibility and Download Center (PCDC) at rok.auto/pcdc.

IMPORTANT	You must use adapter firmware version 3.011 or later with standard I/O firmware version 2.011 and safety I/O modules.

Table 1 - FLEX 5000 I/O Standard and Safety Modules Controller Compatibility Requirements

Modules	Controllers
Standard Modules 5094-IF8, 5094-IF8XT, 5094-IY8, 5094-IY8XT, 5094-OF8, 5094-OF8XT	CompactLogix 5380 Compact GuardLogix 5380 CompactLogix 5480 ControlLogix 5580 GuardLogix 5580
Safety Modules 5094-IRT8S, 5094-IRT8SXT	Compact GuardLogix 5380 GuardLogix 5580

Secure Access to the System

To secure access to the [device] by authorized users only, consider these options:

- Password helps protect the source and execution of the control program
- Remove the key from the controller
- Implement physical barriers, such as locked cabinets

To secure access to the system, consider these options:

- Follow industry best practices to harden your personal computers and servers, including anti-virus/anti-malware and application allow-list solutions.

  The recommendations are published at the Rockwell Automation technical support center in Knowledgebase Technote *Rockwell Automation Customer Hardening Guidelines*.
- Develop and deploy backup and disaster recovery policies and procedures. Test backups on a regular schedule.
- Minimize network exposure for all control system devices and systems, and confirm that they are not accessible from the Internet.
- Locate control system networks and devices behind firewalls and isolate them from the business network.
- Subscribe to the Knowledgebase Technote *Industrial Security Advisory Index*, so you have access to information about security matters that affect Rockwell Automation products.

Follow recommended network practices for products with network interfaces, such as communication ports or web servers. These practices help minimize risk or exposure by unauthorized activity or users. For more information, see:

- Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001
- EtherNet/IP Network Devices User Manual, publication ENET-UM006
- Configure System Security Features User Manual, publication SECURE-UM001

Types of Analog I/O Modules

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Table 2 describes the types of FLEX 5000 analog I/O modules.

Table 2 - FLEX 5000 Analog I/O Modules

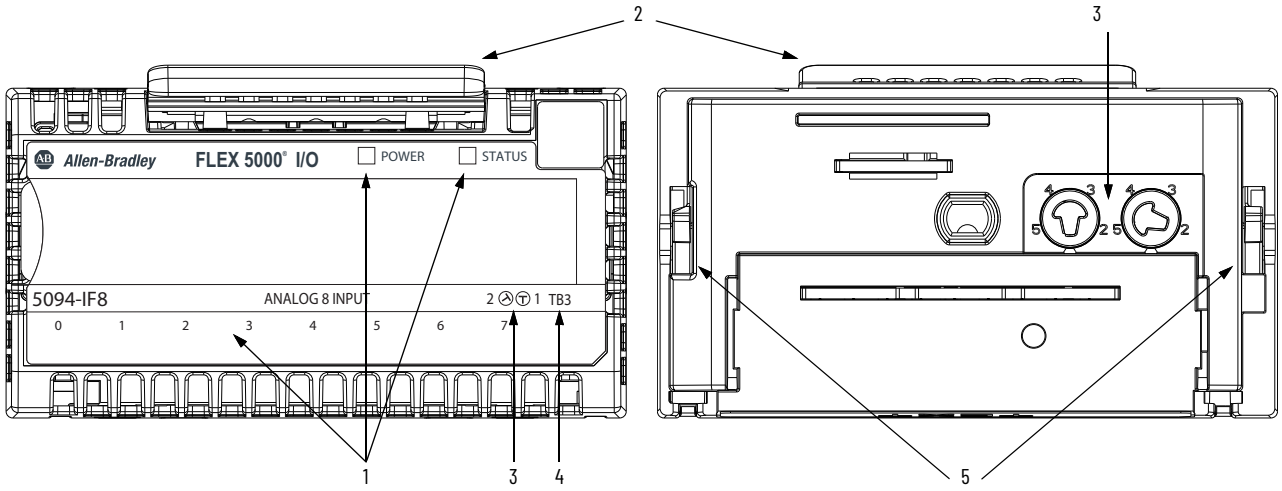
Cat. No.	Description
5094-IF8, 5094-IF8XT	8-channel current/voltage input modules
5094-IY8, 5094-IY8XT	8-channel current/voltage/RTD/Thermocouple input modules
5094-OF8, 5094-OF8XT	8-channel current/voltage output modules
5094-IRT8S, 5094-IRT8SXT	8-channel RTD/Thermocouple safety input modules

Module Overview

Figure 3 shows the parts of an example FLEX 5000 analog standard I/O module.

Figure 4 shows the parts of an example FLEX 5000 analog safety I/O module.

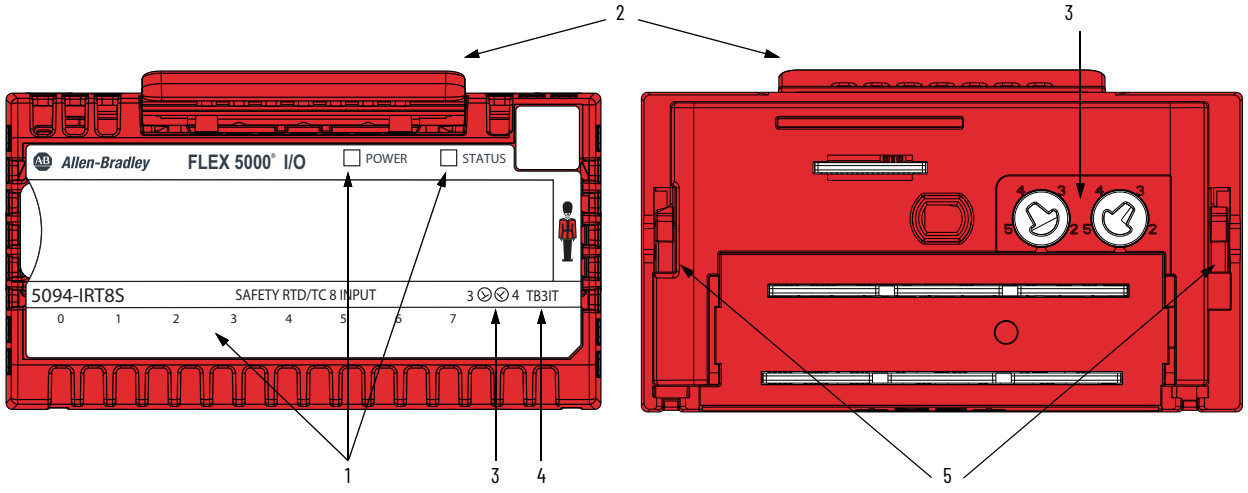
Figure 3 - Example FLEX 5000 Analog Standard I/O Module



FLEX 5000 Analog I/O Module Parts

Item	Description
1	**Status indicators** - Displays the status of communication, module health, and input/output devices. Indicators help with troubleshooting anomalies.
2	**Release lever** - Disengages the latching hooks to allow removal of the module from the terminal base assembly.
3	**Module keying** - Indicates the keying position the terminal base assembly must be configured to before installing the module.
4	**Terminal base** - Indicates the type of terminal base assembly to use with the module.
5	**Latching hooks** - Securely installs FLEX 5000 modules on the terminal base assembly.

Figure 4 - Example FLEX 5000 Analog Safety I/O Module



FLEX 5000 I/O System Power

FLEX 5000 analog I/O modules receive the following power types:

- System-side power that powers the system and lets modules transfer data and execute logic. System-side power is also known as Backplane power.
- Field-side power that powers field-side devices that are connected to some FLEX 5000 I/O modules. Field-side power is also known as SA power.

ATTENTION: Power to this equipment and all connected I/O must be supplied from a source that is isolated from Mains power via an approved isolating transformer constructed with basic insulation.

System-side power begins at the FLEX 5000 EtherNet/IP adapter and passes across the FLEX 5000 module internal circuitry via terminal base power bus, that is, Backplane power.

Field-side power, that is, SA power begins at the first terminal base assembly and can be daisy chained to the next terminal base assembly on the right. You can also install a separate field-side power source to each terminal base assembly.

For more information on how to power FLEX 5000 modules, see FLEX 5000 EtherNet/IP Adapter User Manual, publication 5094-UM005.

SA Power Requirements

Take note of the following when supplying SA power to your system:

- You must limit the SA field-side power source to 10 A, max, at 18...32V DC.
- Confirm that the external module power supply is adequately sized for the total module power bus current draw in the system.

  For example, if the total module power current draw, including current inrush requirements, is 5 A, you can use a module power supply that is limited to 5 A.
- You must use SELV-listed power supplies for module power if there are functional safety modules that are connected to the FLEX 5000 I/O family.
- Not all power supplies are certified for use in all applications, for example, nonhazardous and hazardous environments.

IMPORTANT We recommend that you use separate external power supplies for the adapter and the adjacent terminal base. This practice can prevent unintended consequences that can result if you use one supply.

Ownership

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Every I/O module in a Logix 5000 control system must be owned by a controller, also known as the owner-controller. When the FLEX 5000 analog I/O modules are used in a Logix 5000 control system, the owner-controller performs the following:

- Stores configuration data for every module that it owns.
- Can reside in a location that differs from the FLEX 5000 I/O modules.
- Sends the I/O module configuration data to define module behavior and begin operation in the control system.

Each FLEX 5000 I/O module must continuously maintain communication with its owner-controller during normal operation.

Typically, each I/O module in a FLEX 5000 I/O system has only one owner-controller. Output modules are limited to one owner-controller.

Configure the Modules

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

You must create a Studio 5000 Logix Designer application project for the Logix 5000 controller that owns the FLEX 5000 I/O modules. The project includes module configuration data for the FLEX 5000 I/O modules.

The Studio 5000 Logix Designer application transfers the project to the owner-controller during the program download. Data is then transferred to the FLEX 5000 I/O modules over the EtherNet/IP network.

The FLEX 5000 I/O modules can operate immediately after receiving and applying the configuration data.

Connections for Standard Analog I/O Modules

Applies to these modules:
5094 Standard I/O Modules

During module configuration, you must define the module. Among the Module Definition parameters, you must choose a connection type for the module. A connection is a real-time data transfer link between the owner-controller and the module that occupies the slot that the configuration references.

When you download module configuration to a controller, the controller attempts to establish a connection to each module in the configuration.

Because part of module configuration includes a slot in the FLEX 5000 I/O system, the owner-controller checks for the presence of a module there. If a module is detected, the owner-controller sends the configuration. One of the following occurs:

- If the configuration is appropriate to the module detected, a connection is made and operation begins.
- If the configuration is not appropriate to the module detected, the data is rejected and the Studio 5000 Logix Designer application indicates that an error occurred.

  The configuration can be inappropriate for many reasons. For example, a mismatch in electronic keying that helps prevents normal operation.

The owner-controller monitors its connection with a module. Any break in the connection, for example, the loss of power to the FLEX 5000 I/O system, causes a fault. The Studio 5000 Logix Designer application monitors the fault status tags to indicate when a fault occurs on a module.

Connection Types Available with Standard Analog I/O Modules

When configuring a FLEX 5000 analog I/O module, you must define the module. Connection is a required parameter in the Module Definition. The choice determines what data is exchanged between the owner-controller and the module.

Table 3 describes the connection types that you can use with FLEX 5000 analog I/O modules.

Table 3 - Connections - FLEX 5000 Analog I/O Modules

Connection Type	Description	
	FLEX 5000 Analog Input Modules	**FLEX 5000 Analog Output Modules**
Data	The module returns the following to the owner-controller: • General fault data • Input data	The module returns the following to the owner-controller: • General fault data • Output data
Data with Calibration	The module returns the following to the owner-controller: • General fault data • Input data • Calibration data	The module returns the following to the owner-controller: • General fault data • Output data • Calibration data
Listen Only	When a Listen Only data connection is used, another controller owns the module. A controller that makes a Listen Only connection to the module does not write configuration for the module. It merely listens to the data exchanged with the owner-controller. **IMPORTANT**: If a controller uses a Listen Only connection, the connection must use the Multicast option. For more information on Listen Only connections, see Listen Only Mode on page 24. In this case, all other connections to the module, for example, the connection to the owner-controller must also use the Multicast option.	

Data Types Available with Standard Analog I/O Modules

The Module Definition includes a Data parameter that matches the module type. Analog input modules use Input Data, and analog output modules use Output Data.

The available Data parameter choices are as follows:

- Analog input modules - The Input Data choice is always Analog Data.
- Analog output modules - The Output Data choices are Analog Data or None. The Output Data choice None is only available if you choose the Connection parameter Listen Only.

For more information on the Connection and Data parameter choices available with FLEX 5000 I/O modules, see the Studio 5000 Logix Designer application.

Requested Packet Interval

The Requested Packet Interval (RPI) is a configurable parameter that defines a specific rate at which data is exchanged between the owner-controller and the module.

You set the RPI value during initial module configuration and can adjust it as necessary after module operation has begun. Valid RPI values are 0.2...750 ms.

IMPORTANT	If you change the RPI while the project is online, the connection to the module is closed and reopened in one of the following ways: • You inhibit the connection to the module, change the RPI value, and uninhibit the connection. • You change the RPI value. In this case, the connection is closed and reopened immediately after you apply the change to the module configuration.

For more information on guidelines for specifying RPI rates, see the Logix 5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

Connections for Safety Analog I/O Modules

Applies to these modules:
5094 Safety I/O Modules

IMPORTANT	This section shows some Studio 5000 Logix Designer application screens that are used when you configure FLEX 5000 I/O safety modules. For a complete description of how to configure the modules, see Configure and Replace Safety Analog I/O Modules on page 91.

During module configuration, you must define the module. Among the Module Definition parameters with FLEX 5000 safety I/O modules, you must choose how module is configured.

The choice depends on whether the project is downloaded to the controller that owns the module configuration, that is, the owner-controller, or to a controller that is listening to input modules in a project.

A real-time data transfer link is established between the controller and the module that occupies the slot that the configuration references.

When you download module configuration to a controller, the controller attempts to establish a connection to each module in the configuration.

Because part of module configuration includes a slot number in the remote FLEX 5000 I/O system, the owner-controller checks for the presence of a module there. If a module is detected, the owner-controller sends the configuration. One of the following occurs:

- If the configuration is appropriate to the module detected, a connection is made and operation begins.
- If the configuration is not appropriate to the module detected, the data is rejected and the Studio 5000 Logix Designer application indicates that an error occurred.

  The configuration can be inappropriate for many reasons. For example, a mismatch in electronic keying that helps prevents normal operation.

The owner-controller monitors its connection with a module. Any break in the connection, for example, the loss of power to a remote FLEX 5000 I/O system, causes a fault. The Studio 5000 Logix Designer application monitors the fault status tags to indicate when a fault occurs on a module.

'Configured By' Options Available for Safety Analog I/O Modules

The 'Configured By' choice determines what data is exchanged between the owner-controller and the module. This is an example Module Definition dialog box, and available Connection choices, for FLEX 5000 I/O safety modules.

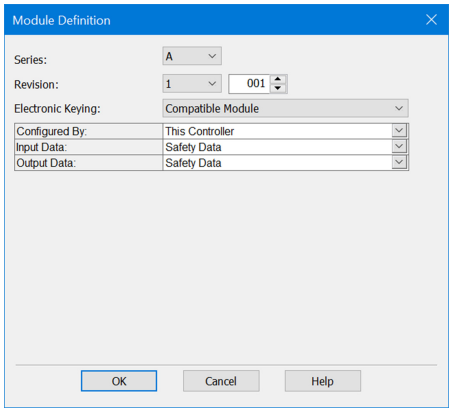


Table 4 describes the connection types that you can use with FLEX 5000 I/O safety modules.

Table 4 - Configured By Choices - FLEX 5000 Safety I/O Modules

Configured by Choice	Description
	FLEX 5000 Safety Input Module
This controller	The module returns the following to the owner-controller: General fault data Safety input data
External means	When the External Means option is chosen, another controller owns the module. A controller that chosen this option does not write configuration for the module. It merely listens to the data exchanged with the owner-controller. That is, it receives Safety input data.

Requested Packet Interval

The valid RPI values for FLEX 5000 I/O safety modules are 2...500 ms.

IMPORTANT

- For standard applications, you can change the RPI while the project is online.
- For safety applications, you can change the RPI while the project is online only if the safety application does not have a generated safety signature. If the safety application has a generated safety signature, you cannot change the RPI while the project is online.
- Safety output connection RPI is configured via the Safety task period. The safety task period cannot be set to values outside of the 2 ms to 500 ms range.

If you change the RPI while the project is online, however, the connection to the module is closed and reopened in one of the following ways:

- You inhibit the connection to the module, change the RPI value, and uninhibit the connection.
- You change the RPI value. In this case, the connection is closed and reopened immediately after you apply the change to the module configuration.

Connection Reaction Time Limit

Setting the RPI on FLEX 5000 I/O safety modules is not as straightforward as setting it on FLEX 5000 I/O standard modules. With FLEX 5000 I/O safety modules, the Connection Reaction Time Limit configuration affects the RPI that is used for a module.

The Connection Reaction Time Limit defines the predicted period of safety packets on the associated connection. If the Max Network Delay exceeds the Connection Reaction Time Limit, a connection fault occurs.

By default, the Connection Reaction Time Limit is four times the RPI for safety input connection. Use the default values for Timeout Multiplier (2) and Network Delay Multiplier (200). The Network Delay Multiplier value is in terms of percentage. Thus, 200 means 200%.

IMPORTANT To determine what is appropriate, analyze each safety channel. The default Timeout Multiplier of 2 and Network Delay Multiplier of 200 creates a worst-case input connection reaction time limit of 4 times the RPI, and an output connection reaction time limit of 3 times the RPI.

Changes to these parameters must be approved only after a thorough review by a safety administrator.

For more information on specifying RPI rates, see the following:

- FLEX 5000 I/O safety I/O modules - Safety Category on page 95
- Logix 5000 Controllers Design Considerations Reference Manual, publication 1756-RM094

Connection Over an EtherNet/IP Network

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

During module configuration, you must configure the Connection over EtherNet/IP parameter. The configuration choice dictates how input data is broadcast over the network.

The FLEX 5000 analog I/O modules use one of the following methods to broadcast data:

- Multicast - Data is sent to all network devices in a multi-cast group
- Unicast - Data is sent to a specific controller depending on the module configuration

  Unicast is the default setting. We recommend that you use Unicast because it reduces network bandwidth usage.

Input Module Operation

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Logix 5000 controllers do not poll the FLEX 5000 analog input modules for input data. Instead, the input modules send their input data, that is channel and status data, at the RPI.

FLEX 5000 analog input modules reside in a FLEX 5000 I/O system that is accessible to a Logix 5000 controller over an EtherNet/IP network. A FLEX 5000 EtherNet/IP adapter is the first component in a FLEX 5000 I/O system and connects the system to the EtherNet/IP network.

FLEX 5000 analog input modules communicate input data to the FLEX 5000 EtherNet/IP adapter at the defined RPI. The input data consists of channel and status data.

At the RPI, the following events occur.

1. The remote analog input module scans its channels for input data.
2. The module sends the data to the FLEX 5000 EtherNet/IP adapter.
3. The FLEX 5000 EtherNet/IP adapter in the FLEX 5000 I/O system sends the data over the EtherNet/IP network.
4. One of the following:
   - If the controller is directly connected to the EtherNet/IP network, it receives the input data immediately.
   - If the controller is connected to the EtherNet/IP network through another communication module, the module sends the data to its backplane and the controller receives it.

Output Module Operation

Applies to these modules:
5094 Standard I/O Modules

The controller sends data to an output module at the RPI or after an Immediate Output (IOT) instruction is executed.

The RPI defines when the controller sends data to the FLEX 5000 analog output module and when the output module echoes data.

At the RPI, not only does the controller send data to the output module, but also the output module sends data to the controller. For example, the output module sends an indication of the channel data quality.

FLEX 5000 analog output modules reside in a FLEX 5000 I/O system that is accessible to a Logix 5000 controller over an EtherNet/IP network. A FLEX 5000 EtherNet/IP adapter is the first component in a FLEX 5000 I/O system and connects the system to the EtherNet/IP network.

FLEX 5000 analog output modules receive output data from a controller. The output module also sends data to the controller.

Controller to Remote Analog Output Module Data Transmission

The controller broadcasts data to its local backplane at one of the following:

- RPI
- An IOT instruction is executed.

IMPORTANT	An IOT instruction sends data to all output modules in the system immediately, and resets the RPI timer.

Based on the RPI rate and the length of the controller program scan, the output module can receive and echo data multiple times during one program scan.

When the RPI is less than the program scan length, the output channels can change values multiple times during a program scan. The owner-controller does not depend on the program scan to complete to send data.

These events occur when the controller sends data to a FLEX 5000 output module.

1. Data is sent in one of the following ways:
   - If the controller is directly connected to the EtherNet/IP network, it broadcasts data to the network.

     In this case, skip to step 3.
   - If the controller is connected to the EtherNet/IP network via a communication module, the controller transmits the data to the backplane.

     In this case, proceed to step 2.
2. The EtherNet/IP communication module transmits the data to the EtherNet/IP network.
3. The FLEX 5000 EtherNet/IP adapter in the FLEX 5000 I/O system receives the data from the network and transmits it to the backplane.
4. The analog output module receives the data from the backplane and behaves as dictated by its configuration.

Remote Analog Output Module to Controller Data Transmission

When a FLEX 5000 analog output module receives new data and the requested data value is present on the RTB, the output module sends, or 'echoes', a data value back to the controller and to the rest of the control system. The data value corresponds to the signal present at its terminals. This feature is called Data Echo.

In addition to the Data Echo, the output module sends other data to the controller at the RPI. For example, the module alerts the controller if a short circuit condition exists on the module.

The following events occur when a remote FLEX 5000 analog output module sends data to the controller at the RPI.

1. The module sends the data to the backplane.
2. The FLEX 5000 EtherNet/IP adapter in the FLEX 5000 I/O system sends the data over the EtherNet/IP network.
3. One of the following:
   - If the controller is directly connected to the EtherNet/IP network, it receives the input data from the network without need for a communication module.
   - If the controller is connected to the EtherNet/IP network through another communication module, the module transmits the data to its backplane and the controller receives it.

Listen Only Mode

Applies to these modules:
5094 Standard I/O Modules

Any controller in the system can listen to the data from an I/O module. An owner-controller, as described in Ownership on page 18, exchanges data with analog I/O modules.

Other controllers can use a Listen Only connection with the analog I/O module. In this case, the 'listening' controller can only listen to input data or 'echoed' output data. The listening controller does not own the module configuration or exchange other data with the module.

During the I/O configuration process, you can specify a Listen Only connection. For more information on Connection options, see Module Definition on page 80.

IMPORTANT Remember the following:

- If a controller uses a Listen Only connection, the connection must use the Multicast option. In this case, all other connections to the module, for example, the connection of the owner-controller, must also use the Multicast option.
- If a controller attempts to use a Listen Only connection to a module but the owner-controller connection uses the Unicast option, the attempt at a Listen Only connection fails.

The 'Listen Only' controller receives data from the module as long as a connection between an owner-controller and module is maintained.

- If the connection between an owner-controller and the module is broken, the module stops sending data and connections to all 'listening controllers' are also broken.

Protected Operations

To maintain the secure operation of your FLEX 5000 analog I/O module, operations that can disrupt module operation are restricted based on the module operating mode. Table 5 describes the restrictions.

Table 5 - Protected Operations on FLEX 5000 Analog I/O Modules

Current Module Operation	Activity							
	Firmware Update Request	Module Reset Request	Module Calibration Request(2)	Connection Request	Configuration Change	Connection or Data Format Change	Electronic Keying Change	RPI Change
Connection not running	Accepted							
Connection running	Rejected			Accepted(3)	Accepted(4)	Not allowed(5)	Accepted(6)	
Firmware update is in process	Rejected							
Calibration is in process	Accepted(1)							

(1) The module accepts the requests and changes listed. Keep in mind, when the request or change is made, the calibration process is automatically aborted. We recommend that you wait for the module calibration to finish before attempting any of the requests or changes.
(2) When the request is made through the Module Properties dialog box.
(3) Only requests for Listen Only connections are accepted.
(4) Configuration change is accepted in the following scenarios:
- Changes are made in the Module Properties dialog box and you click Apply.
- Changes are made in the Configuration tags and you send a Reconfigure Module MSG to the module.

(5) The difference between Rejected and Not allowed is that rejected activities can be attempted in the Studio 5000 Logix Designer application but do not take effect. The activities that are not allowed, that is, attempts to change the Connection or Data Format used, do not occur in the Studio 5000 Logix Designer application.
For example, if you attempt to reset a module that is connected to the owner-controller, the Studio 5000 Logix Designer application executes the request and alerts you that it was rejected. If you attempt to change the data format on a module that is connected to an owner-controller, the Studio 5000 Logix Designer application does not execute the attempted change. The application only alerts you that the change is not allowed. In the case, if the change is attempted online, the Module Definition dialog box field that changes the data format is disabled.
(6) The change occurs after the connection is closed and reopened. You can close and reopen the connection in the following ways:
- Change the project while it is offline and download the updated project before going online again.
- Change the project while it is online and click Apply or OK in the Module Properties dialog box. In this case, before the change is made, a dialog box alerts you of the ramifications before the change is made.

Notes:

Common Analog I/O Module Features

This chapter describes module features that are available on all FLEX 5000 analog I/O modules. FLEX 5000 analog input modules convert an analog signal to a digital value. For example, the modules can convert the following:

- Volts
- Millivolts
- Milliamps
- Ohms

FLEX 5000 analog output modules convert a digital value to an analog signal. For example, the modules can convert the following:

- Volts
- Milliamps

FLEX 5000 RTD/Thermocouple modules convert Ohms or mV input analog signals into digital values.

Rolling Timestamp of Data

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The rolling timestamp is a continuously running 15-bit rolling timestamp that counts in milliseconds from 0...32,767 ms.

The rolling timestamp value is reported in the *I.Chxx.RollingTimestamp* tag for the FLEX 5000 analog I/O modules.

Rolling Timestamp with the 5094-IF8 and 5094-IY8, and 5094-IRT8S Modules

Typically, the FLEX 5000 analog input modules scan their inputs at the RPI. Standard modules also updates the rolling timestamp data at the RPI. The 5094-IRT8S module produces data on input RPI. Scanning and rolling time stamp update depends on the safety configuration.

The controller program uses the last two rolling timestamp values to calculate the amount of time between the samples.

A system time change can cause a slight change in input sample timing. The rolling timestamp accurately reflects the change.

There can be jitter in the timing between samples before and after the system time change.

Rolling Timestamp with the 5094-OF8 Module

For the FLEX 5000 analog output modules, the rolling timestamp value is updated only when new values are applied to the Digital to Analog Converter (DAC).

Floating Point Data Format

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The FLEX 5000 analog I/O modules return channel data to the controller in the IEEE 32-bit floating point data format. In your Studio 5000 Logix Designer application, the data type is REAL.

The floating point data format lets you change the data representation of the selected channel. Although the full range of the module does not change, you can scale your module to represent I/O data in specific terms for your application.

For more information on using scaling, see page 32.

Calibration

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The FLEX 5000 analog I/O modules use precise analog components that maintain their specifications over time. The modules are calibrated via the following methods:

- Factory calibration when the modules are built.
- User-executed calibration.

For more information on how to calibrate a module:

- For 5094 standard I/O modules see Calibrate the Modules on page 109.
- For 5094 safety I/O modules see Calibrate a Safety Analog I/O Module on page 100.

Module Data Quality Reporting

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The FLEX 5000 analog I/O modules indicate the quality of channel data that is returned to the owner-controller. Data quality represents accuracy. Levels of data quality are reported via module input tags.

We recommend that you monitor the tags in your program to make sure that the application is operating as expected with accurate channel input data.

IMPORTANT

- For Standard modules: Once the condition that causes the Fault or Uncertain tag to change to 1 is removed, the tag automatically resets to 0. The Studio 5000 Logix Designer application controls the tags. You cannot change the status of the tags. Keep in mind that in some system configurations, the tag is not reset immediately after the condition is removed. The tag typically resets after a small delay.
- For Safety Input modules, see: Reset FLEX 5000 safety I/O Modules to Out-of-Box State on page 74 and Fault and Status Reporting on page 60.

The following inputs indicate the level of data quality.

- I.Chxx.Fault - This tag indicates that the reported channel data is inaccurate and cannot be trusted for use in your application. Do not use the reported channel data for control.

  You must troubleshoot the module to correct the cause of the inaccuracy.

  Example causes of inaccurate data include the following:

  - Channel is disabled
  - Open Wire condition (input modules)
  - No Load condition (output modules)
  - Underrange/Overrange condition
  - Short Circuit condition (Standard modules only)
  - Field Power Loss condition
  - Discrepancy Check Failure (Safety modules only)

  We recommend that you troubleshoot the module for the typical causes first.
- I.Chxx.Uncertain - This tag indicates that the reported channel data can be inaccurate but the degree of inaccuracy is unknown. We recommend that you do not use the reported channel data for control.

IMPORTANT Safety Consideration

You must monitor the uncertain bit on Safety modules.

If the tag is set to 1, you know that the data can be inaccurate. You must troubleshoot the module to discover what degree of inaccuracy exists.

Example causes of uncertain data include the following:

- Data signal outside the channel operating range
- Module is out of operating temperature range.
- Invalid sensor offset value
- Calibration fault on the channel
- For Standard modules, calibration is in process on the channel. Active calibration process on one channel can cause an indication of Uncertain data quality on other module channels simultaneously.

Calibration Causes Uncertain Data Quality Indication on Input Module Groups

Applies to these modules:
5094 Standard I/O Modules

When a channel on a FLEX 5000 analog input module is being calibrated, the Notch Filter setting for that channel changes to 5 Hz. This results in the *I.Chxx.Uncertain* tag being set to 1 for that channel until calibration is completed.

Grouped inputs share an Analog-to-Digital converter. As a result when any input channel is in the calibration process, the *I.Chxx.Uncertain* tag is set to 1 for the other input channels in that group. This setting is because the data sampling rate slows for all input channels in the group.

The Notch Filter settings for the other input channels in the group remain the same.

Software Configurable

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

You use the Studio 5000 Logix Designer application to configure the module, monitor system operation, and troubleshoot issues. You can also use the Studio 5000 Logix Designer application to retrieve the following information from any module in the system:

- Serial number
- Firmware revision information
- Product code
- Vendor
- Error and fault information
- Diagnostic information

By minimizing the need for tasks, such as setting hardware switches and jumpers, the software makes module configuration easier and more reliable.

Fault and Status Reporting

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The FLEX 5000 analog I/O modules report fault and status data along with channel data. Fault and status data is reported in the following ways:

- Studio 5000 Logix Designer application
- Module status indicators

IMPORTANT	Do not use the module status indicators or I/O status indicators on FLEX 5000 I/O safety modules for safety operations.

For more information on fault reporting, see the individual module feature chapters and Troubleshoot Your Module on page 119.

Module Inhibiting

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Module inhibiting lets you indefinitely suspend a connection, including Listen Only connections, between a controller and an analog I/O module without removing the module from the configuration. This process lets you temporarily disable the connection a module, such as to perform maintenance.

IMPORTANT	You cannot inhibit a connection when the safety controller is safety-locked or a safety signature exists for the controller.

ATTENTION: Safety Consideration
If you inhibit the I/O module from going to the Safety State when it detects a loss in communication to the network or the controller, you are responsible for making sure that your application has other means to maintain a safe state

You can use module inhibiting in the following ways:

- You write a configuration for an I/O module but inhibit the module to help prevent it from communicating with the owner-controller. The owner does not establish a connection and the configuration is not sent to the module until the connection is uninhibited.
- In your application, a controller already owns a module, has downloaded the configuration to the module, and is exchanging data over the connection between the devices.

  In this case, you can inhibit the module and the connection to the module is closed.

IMPORTANT Whenever you inhibit an output module that is ProgMode enabled, it enters Program mode, and all outputs change to the state configured for Program mode.

For example, if an output module is configured so that the state of the outputs transition to zero during Program mode, whenever that module is inhibited, outputs transition to zero.

You can use module inhibiting in these instances:

- You want to update an analog I/O module, for example, update the module firmware revision. Use the following procedure.
  a. Inhibit the module.
  b. Perform the update.
  c. Uninhibit the module.

IMPORTANT For the 5094-IRT8S module, it is recommended to wait for 2 to 3 minutes after the firmware upgrade, before you Uninhibit the module.

- You use a program that includes a module that you do not physically possess yet. You do not want the controller to look for a module that does not yet exist. In this case, you can inhibit the module in your program until it physically resides in the proper slot.

To see where to inhibit a FLEX 5000 analog I/O module, see page 80.

Electronic Keying

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Electronic Keying reduces the possibility that you use the wrong device in a control system. It compares the device that is defined in your project to the installed device. If keying fails, a fault occurs. These attributes are compared.

Attribute	Description
Vendor	The device manufacturer.
Device Type	The general type of the product, for example, analog I/O module.
Product Code	The specific type of the product. The Product Code maps to a catalog number.
Major Revision	A number that represents the functional capabilities of a device.
Minor Revision	A number that represents behavior changes in the device.

The following Electronic Keying options are available.

Keying Option	Description
Compatible Module	Lets the installed device accept the key of the device that is defined in the project when the installed device can emulate the defined device. With Compatible Module, you can typically replace a device with another device that has the following characteristics: Same catalog number Same or higher Major Revision Minor Revision as follows: If the Major Revision is the same, the Minor Revision must be the same or higher. If the Major Revision is higher, the Minor Revision can be any number. Non-XT and XT version as follows: You can use an XT version of the module in place of a non-XT module. You **cannot** use a non-XT version of the module in place of an XT module.
Disable Keying	Indicates that the keying attributes are not considered when attempting to communicate with a device. With Disable Keying, communication can occur with a device other than the type specified in the project. **ATTENTION**: Be extremely cautious when using Disable Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss. We **strongly recommend** that you **do not use** Disable Keying. If you use Disable Keying, you must take full responsibility for understanding whether the device being used can fulfill the functional requirements of the application. **IMPORTANT**: This option is not available for Safety modules.
Exact Match	Indicates that all keying attributes must match to establish communication. If any attribute does not match precisely, communication with the device does not occur.

Carefully consider the implications of each keying option when selecting one.

IMPORTANT	Changing Electronic Keying parameters online interrupts connections to the device and any devices that are connected through the device. Connections from other controllers can also be broken. If an I/O connection to a device is interrupted, the result can be a loss of data.

For more detailed information on Electronic Keying, see Electronic Keying in Logix 5000 Control Systems Application Technique, publication LOGIX-AT001.

Producer/Consumer Communication

FLEX 5000 analog I/O modules use the Producer/Consumer communication model to produce data without a controller polling them first. The modules produce the data and controllers consume it. That is, the owner-controller and controllers with a Listen Only connection to the module can consume it.

When an input module produces data, the controllers can consume the data simultaneously. Simultaneous data consumption eliminates the need for one controller to send the data to other controllers.

IMPORTANT	Keep in mind, **only one controller** can own the I/O module. The FLEX 5000 analog I/O modules do not support multiple owners of the same module. Other controllers must use a Listen Only connection to the module.

Use CIP Sync Time with I/O Modules

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The following FLEX 5000 analog I/O modules use CIP Sync for timestamps:

- 5094-IF8, 5094-IF8XT
- 5094-IY8, 5094-IY8XT
- 5094-IRT8S, 5094-IRT8SXT
- 5094-OF8, 5094-OF8XT

CIP Sync is a CIP implementation of the IEEE 1588 PTP (Precision Time Protocol). CIP Sync provides accurate real-time (Real-World Time) or Universal Coordinated Time (UTC) synchronization of controllers and devices that are connected over CIP networks. This technology supports highly distributed applications that require timestamping, sequence of events recording, distributed motion control, and increased control coordination.

These modules are CIP Sync slave-only devices. There must be another module on the network that functions as a master clock. For more information on how to use CIP Sync technology, see the Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001.

I/O modules can be used to capture timestamps. The advantage is that CIP Sync is system-wide, so timestamp values are consistent across all modules in the system.

Alarm Latching

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

When enabled, Alarm Latching lets you latch a module alarm in the set position once the alarm is triggered. The alarm remains set even if the condition causing it to occur disappears, until the alarm is unlatched.

Alarm latching is available on a per channel basis. You can latch the following alarms:

- Input modules - Process and Rate alarms
- Output modules - Clamp and Rate alarms

For more information on latching alarms on FLEX 5000 analog HART I/O modules, see the module-specific chapters and:

- See Configure Standard Analog I/O Modules on page 75.
- See Configure and Replace Safety Analog I/O Modules on page 91.

Enable Latching

You can enable alarm latching in the following ways:

- Module Properties dialog box - To see where to latch alarms, see the following:
  - Input modules - *Alarms* category
  - Output modules - *Limits* category

  For more information on how to use the Module Properties dialog box:
  - See Configure Standard Analog I/O Modules on page 75.
  - See Configure and Replace Safety Analog I/O Modules on page 91.
- Module tags - The alarm type determines which tag to change.

  For more information on module tags and how to use them, see Module Tag Definitions on page 129.

Unlatch Alarms

IMPORTANT	Before you unlatch an alarm, make sure the condition that triggered the alarm no longer exists

Once an alarm is latched, you must manually unlatch it. You can use the module tags to unlatch an alarm. The alarm type determines which module tag to change.

For example, to unlatch a Low Low alarm on a FLEX 5000 analog input module, you set the Chxx.LLAlarmUnlatch output tag to 1.

For more information on how to use the module tags, see Module Tag Definitions on page 129.

Scaling

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

When you scale a channel, you select two points that represent signal units, that is, a Low Signal and a High Signal. You also select two points that represent engineering units, that is, Low Engineering and High Engineering.

The Low Signal point equates to the Low Engineering point and the High Signal point matches the High Engineering point.

IMPORTANT	In choosing two points for the low and high value of your application, you do not limit the range of the module. The module range remains constant regardless of how you scale it.

Scaling lets you configure the module to return data to the controller in signal units or in engineering units (listed as Percent of Full Scale in the Studio 5000 Logix Designer application).

For example, if you use the 5094-IF8 module in Current mode with an input range of 4...20 mA, consider the following:

- To receive values in signal units, configure the module as follows:
  - Low Signal = 4 mA
  - High Signal = 20 mA
  - Low Engineering = 4 EU
  - High Engineering = 20 EU
- To receive values in Percent of Full Scale, configure the module as follows:
  - Low Signal = 4 mA
  - High Signal = 20 mA
  - Low Engineering = 0%
  - High Engineering = 100%

The returned value is indicated in the I.Chxx.Data tag.

The following table shows values that can appear when using Percent of Full Scale.

Table 6 - Current Values Represented in Engineering Units

Current (mA)	Engineering Units Value (%)	Value in *I.Chxx.Data* Tag
0.0	-25.00	-25.00
3.0	-6.00	-6.00
4.0	0.0	0.00
12.0	50.0	50.0
20.0	100.0	100.0
23.0	118.75	118.75

You configure Scaling on the Chxx category in the Module Properties dialog box for each module. For more information on using the Module Properties dialog box, see Configure Standard Analog I/O Modules on page 75.

Data Offset

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The FLEX 5000 analog I/O modules support offset features that let you compensate for any inaccuracy inherent to the input or output device connected to the channel. The offset value adjusts the input or output data value.

The following channel offset features are available:

- Sensor Offset - Available on FLEX 5000 analog input modules.
  For more information on using the Sensor Offset feature, see page 41 and page 56.
- Channel Offset - Available on FLEX 5000 analog output modules.
  For more information on using the Channel Offset feature, see page 63.

Module Accuracy

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Module accuracy represents the module accuracy when its ambient temperature is the same as the temperature at which the module was calibrated.

The following specifications are related to Module Accuracy:

- Absolute Accuracy at 25 °C (77 °F)
- Module Accuracy Drift with Temperature

Absolute Accuracy at 25 °C (77 °F)

This specification matches the temperature at which the module was calibrated in the factory during manufacturing. FLEX 5000 analog input modules absolute accuracy when operating in 25 °C (77 °F) conditions = 0.05%. FLEX 5000 analog output modules absolute accuracy when operating in 25 °C (77 °F) conditions = 0.10%.

The level of module accuracy remains the same, whether it is operating in Current (mA), Voltage (V), RTD, or Thermocouple mode. The 5094-IY8 and 5094-IRT8S modules support the RTD or Thermocouple modes.

Module Accuracy Drift with Temperature

Module Accuracy Drift with Temperature represents the error that occurs if the module's ambient temperature changes for every degree change. That is, from -40...+70 °C (-40...+158 °F).

The module accuracy drift with temperature varies by module and the mode being used. The following table lists module accuracy drift values:

Cat. No.	Mode	Module Accuracy Drift with Temperature
5094-IF8	Voltage (V)	28 ppm/°C
	Current (mA)	47 ppm/°C
5094-IY8	Voltage (V)	28 ppm/°C
	Current (mA)	24 ppm/°C
	RTD	60 ppm/°C
	Thermocouple/millivolt	15 ppm/°C
5094-OF8	Voltage (V)	47 ppm/°C
	Current (mA)	60 ppm/°C
5094-IRT8S	RTD	36 ppm/°C
	Thermocouple/millivolt	26 ppm/°C

Module Firmware

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The FLEX 5000 analog I/O modules are manufactured with module firmware installed. If updated module firmware revisions are available in the future, you can update the firmware.

Updated firmware revisions are made available for various reasons, for example, to correct an anomaly that existed in previous module firmware revisions.

You access updated firmware files at the Rockwell Automation Product Compatibility and Download Center (PCDC). A link to the PCDC is available at rok.auto/pcdc.

At the PCDC, you can use the module catalog number to check for firmware updates. If the catalog number is not available, no updates exist then.

Verify that the firmware revision of the FLEX 5000 I/O modules that you use is correct before commissioning the system.

IMPORTANT Only download firmware and access product release notes from the Product Compatibility and Download Center (PCDC) at rok.auto/pcdc.
Do not download firmware from non-Rockwell Automation sites.

For safety consideration for the 5094-IRT8S module see Safety Considerations for Module Firmware on page 70.

5094-IF8 Analog Input Module Features

The 5094-IF8 input module has eight single-ended, non-isolated channels. Each channel supports connection to the following input types:

- Current
- Voltage

IMPORTANT Remember the following:

- This module also has features that apply to all FLEX 5000 analog I/O modules that are described in Common Analog I/O Module Features on page 27.
- You can configure the features that are described in this chapter with the Studio 5000 Logix Designer application.

For more information on how to configure the module, see Configure Standard Analog I/O Modules on page 75.

Multiple Input Ranges

The 5094-IF8 module supports multiple input ranges. The input type that you choose during module configuration determines the available input ranges. An input type is chosen on a channel-by-channel basis.

Table 7 - Input Ranges

Input Type	Available Input Range
Current (mA)	0...20 mA 4...20 mA
Voltage (V)	-10...10V 0...5V 0...10V

To see where to choose an input range for the 5094-IF8 module, see page 82.

Notch Filter

The Notch Filter is a built-in feature of the Analog-to-Digital converter (ADC) that removes line noise in your application. The removal of line noise is also known as noise immunity.

The Notch Filter attenuates the input signal at the specified frequency.

Choose a Notch Filter based on what noise frequencies are present in the module operating environment and any sampling requirements that are needed for control. For example if the Notch Filter setting is 60 Hz, 60 Hz AC line noise and its overtones are filtered out.

The following Notch Filter settings are available on a 5094-IF8 module:

- 5 Hz
- 10 Hz
- 15 Hz
- 20 Hz
- 50 Hz
- 60 Hz
- 100 Hz
- 200 Hz
- 500 Hz
- 1000 Hz

- 2500 Hz
- 5000 Hz
- 10000 Hz
- 15625 Hz
- 25000 Hz
- 31250 Hz
- 62500 Hz

If you want to filter lower frequency noise, you get a slower input sample rate.

To see where to choose a notch filter for the 5094-IF8 module, see page 82.

Relationship between Notch Filter Settings and RPI Setting

There is a relationship between a Notch Filter setting and the RPI rate.

- If you want greater noise suppression at the selected Notch Filter frequency and improved resolution, you use a slower input sample rate.

  For example, if you choose the 60 Hz notch filter setting and need better noise suppression and resolution, the recommended module minimum RPI is 60 ms.
- If you want a faster input sample rate at the selected Notch Filter frequency, the noise suppression and resolution is lesser.

  Using the previous example, if you choose the 60 Hz notch filter setting and need faster input sampling, the recommended module minimum RPI is 20 ms.

In Table 8, each Notch Filter setting has two recommended minimum module RPI values that allow the required time to collect samples from each channel. One setting provides faster sample speed and the other provides slightly better resolution at slower sample speeds.

Table 8 - Notch Filter and Recommended Minimum Module RPI Values - Effect on Noise Rejection

Notch Filter	Recommended Minimum Module RPI Value			
	Application That is Configured With Only One Channel Enabled		Application With All Channels Enabled and Using the Same Notch Filter Setting on All Channels	
	Faster Sampling Speed	Better Noise Rejection	Faster Sampling Speed	Better Noise Rejection
5 Hz	211 ms	631 ms	750 ms(1)	N/A
10 Hz	106 ms	316 ms	422 ms	N/A
15 Hz	64 ms	190 ms	254 ms	N/A
20 Hz	53 ms	158 ms	212 ms	632 ms
50 Hz	22 ms	64 ms	86 ms	254 ms
60 Hz (default)	18 ms	53 ms	72 ms	212 ms
100 Hz	11 ms	32 ms	44 ms	127 ms
200 Hz	5.6 ms	16.1 ms	22.2 ms	65 ms
500 Hz	2.5 ms	6.7 ms	9.6 ms	26.5 ms
1000 Hz	1.4 ms	3.5 ms	5.4 ms	13.8 ms
2500 Hz	0.8 ms	1.6 ms	2.9 ms	6.2 ms
5000 Hz	0.6 ms	1 ms	2 ms	3.7 ms
10000 Hz	0.5 ms	0.7 ms	1.6 ms	2.4 ms
15625 Hz	0.5 ms	0.6 ms	1.6 ms	2 ms
25000 Hz	0.4 ms	0.5 ms	1.5 ms	1.7 ms
31250 Hz	0.4 ms	0.5 ms	1.5 ms	1.6 ms
62500 Hz	0.4 ms	0.4 ms	N/A	1.4 ms

(1) If you use the 5 Hz Notch Filter setting with four or more channels, the input data cannot be refreshed at every RPI, even if the maximum RPI allowed is used. Instead, fresh data is delivered approximately every other RPI.

Noise Rejection When Using Different Notch Filter Selections

When input channels on the same module use different Notch Filter selections, you must consider the sample time for each channel. This helps you to find the recommended RPI that provides enough time for sampling all channels.

The eight input channels on the 5094-IF8 module are grouped into two groups. Channels 00...03 are grouped, and channels 04...07 are grouped. When you determine the recommended minimum module RPI value, remember:

- The recommended minimum module RPI value when channels use different Notch Filter selections is determined by group.

  The recommended minimum RPI rates for all enabled channels are added together. If any channel in the other group is enabled, the recommended minimum RPI rate for each enabled channel is increased by 0.2 ms.
- If the groups have different recommended minimum RPI values, use the higher RPI value when you configure the module.

Table 9 lists the values in an application that needs a **faster sampling rate**.

Table 9 - Example Application That Requires Faster Sampling Speed

Channel Group	Channel	Notch Filter	Recommended Minimum Module RPI for Each Channel (1)	Recommended Minimum Module RPI	Recommended Minimum Module RPI to Use in Module Configuration
Grouped together	Ch00	50 Hz	21.6 ms	28.3 ms	72.2 ms
	Ch01	1000 Hz	1.6 ms		
	Ch02 - Disabled	N/A	N/A		
	Ch03	62500 Hz	0.6 ms		
Grouped together	Ch04	60 Hz	18.2 ms	72.2 ms	
	Ch05	60 Hz	18.2 ms		
	Ch06	60 Hz	18.2 ms		
	Ch07	60 Hz	18.2 ms		

(1) The values in this column represent the corresponding recommended minimum RPI value listed in Table 8 with an additional 0.2 ms added to it because at least one channel is enabled in the other group.

Table 10 lists the values in an application that needs **better noise rejection**.

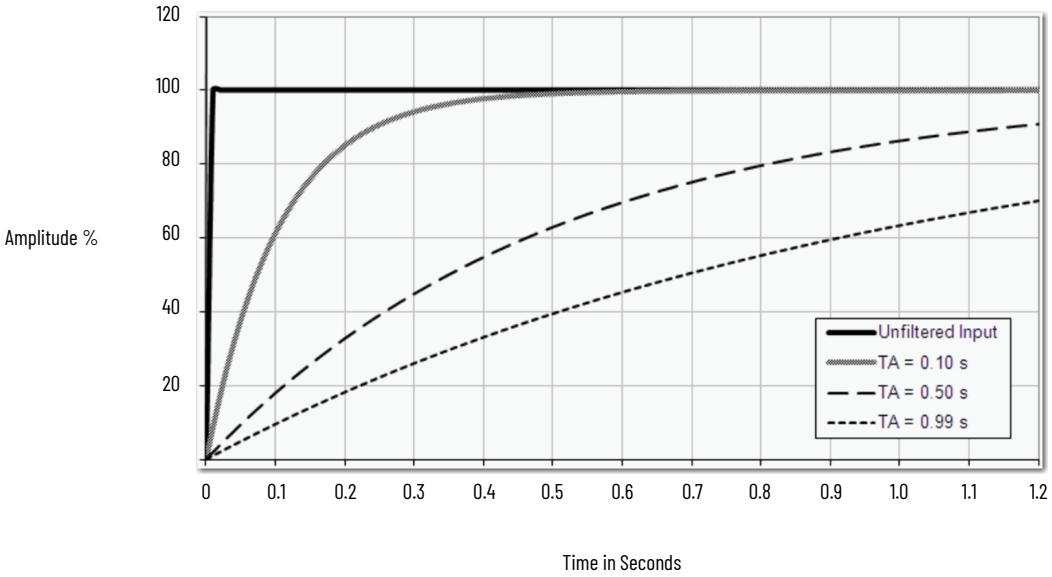
Table 10 - Example Application That Requires Better Noise Rejection

Channel Group	Channel	Notch Filter	Recommended Minimum Module RPI for Each Channel(1)	Recommended Minimum Module RPI	Recommended Minimum Module RPI to Use in Module Configuration
Grouped together	Ch00	50 Hz	63.6 ms	67.8 ms	212.2 ms
	Ch01	1000 Hz	3.8 ms		
	Ch02 - Disabled	N/A	N/A		
	Ch03	62500 Hz	0.6 ms		
Grouped together	Ch04	60 Hz	53.2 ms	212.2 ms	
	Ch05	60 Hz	53.2 ms		
	Ch06	60 Hz	53.2 ms		
	Ch07	60 Hz	53.2 ms		

(1) The values in this column represent the corresponding recommended minimum RPI value listed in Table 8 with an additional 0.2 ms added to it because at least one channel is enabled in the other group.

Digital Filter

The Digital Filter is a first-order lag filter. It smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital, first-order lag filter on the input. The input is 63% of the step change after the first time constant elapses.



The filter value is specified in units of milliseconds. A value of 0 (zero) disables the filter. The digital filter equation is as shown.

$$Y_n = Y_{n-1} + \frac{\Delta t * (X_n - Y_{n-1})}{\Delta t + TA}$$

Y_n = Present Output, Filtered Peak Voltage (PV)

Y_{n-1} = Previous Output, Filtered PV

Δt = Module Channel Update Time (seconds)

TA = Digital Filter time Constant (seconds)

X_n = Present Input, Unfiltered PV

IMPORTANT Remember the following:

- Digital Filter input data changes only when new input data is collected.
- If an Overrange or Underrange condition is detected before the Digital Filter input data is collected, the condition is indicated immediately. An immediate indication also applies to the Fault data for the input.

To see where to choose a digital filter for the 5094-IF8 module, see page 82.

Underrange/Overrange Detection

Underrange/Overrange Detection detects when the 5094-IF8 module is operating beyond limits set by the input range.

The module can read input signal levels outside the low and high signal values for each input range. The signal limits to which the module can read are thresholds. Only when the signal is beyond a threshold is an underrange or overrange condition that is detected and indicated.

For example, if you configure a 5094-IF8 module channel to use the ± 10V input range, an overrange condition does not exist until the input signal exceeds 12V.

Table 11 lists the input ranges of the 5094-IF8 module and the thresholds in each range before the module detects an underrange/overrange condition.

Table 11 - Input Signal Threshold Ranges

Input Type	Range	Underrange Threshold	Overrange Threshold	Deadband Example(1)
Current (mA)	0...20 mA	< -0.07 mA	> 23.00 mA	0.07 mA
	4...20 mA	< 3 mA(2)		
Voltage (V)	±10.00V	< -12.00V	>12.00V	0.04V
	0...5V	< -0.02V	> 6.00V	0.02V
	0...10V	< -0.04V	> 12.00V	0.04V

(1) The module has alarm deadband values for each range. The deadband lets a condition remain set despite it disappearing. For example, if a module uses a Current input type in the 4...20 mA range and the signal value goes below 3 mA, the underrange condition is triggered. Because of the 0.07 mA deadband, the condition is not cleared until the signal value reaches 3.07 mA. For more information on Alarm Deadbands, see page 40.

(2) Underrange is set at < 3 mA, but the *I:Chxx.Data* tag reports values as low as 0.0 mA. The condition is clamped when the signal reaches 3 mA.

IMPORTANT The Disable All Alarms feature, does not disable the underrange/overrange detection feature.

The Disable All Alarms feature disables **alarms** on the module. Underrange/Overrange detection is not an alarm. It is an indicator that channel data has gone beyond the absolute maximum or minimum, respectively, for the channel range.

To disable the Underrange/Overrange detection feature, you must disable the channel.

Underrange/overrange conditions are indicated when the following tags change to 1:

- I.Chxx.Underrange
- I.Chxx.Overrange

For more information on how to use the module tags, see Module Tag Definitions on page 129.

Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. The following are the user-configurable, alarm trigger points:

- High high
- High
- Low
- Low low

To use the Process Alarms, you must complete the following tasks:

- Enable the alarms
- Configure the trigger points

Enable Process Alarms

When the module tags are created, the Process Alarm tags are disabled by default.

To see where to enable Process Alarms for the 5094-IF8 module, see page 83.

Configure Alarm Trigger Points

You must configure the Process Alarm with a trigger point. That is, set values in Engineering Units that, once the signal reaches the value, the alarm is triggered.

Process Alarm trigger points are related to the Scaling parameters that you configure for the channel. The Engineering Units that are established in Scaling determine the Process Alarm trigger points. That is, the available trigger point values can be in signal units or engineering units.

For example, consider a channel that uses the Current (mA) input type, the 4 mA...20 mA input range, and scales the High and Low Engineering values of 100 and 0, respectively. The available Process Alarm values range from 0...100.

In this case, if the High Limit alarm is set to 50 EU, when the input signal reaches 12 mA, the High Limit alarm is set. The alarm is set because Scaling was configured for Percentage of Full Scale and a signal value of 12 mA is 50% of the full scale of engineering units.

To see where to set the Process Alarm trigger points for the 5094-IF8 module, see page 83.

Latch Alarms

Check Latch Process Alarms on the *Alarms* category to latch the process alarms. To see where to see where to latch Process Alarms on the 5094-IF8 module, see page 83.

Unlatch Alarms

IMPORTANT	Before you unlatch an alarm, make sure the condition that triggered the alarm no longer exists.

Once an alarm is latched, you must manually unlatch it. To unlatch an alarm, change the output tag for that alarm.

For example, change the *O.Chxx.LAlarmUnlatch* tag for the low alarm that you want to unlatch from 0 to 1.

IMPORTANT	After an alarm is unlatched, change the tag back from 1 to 0. You must change the tag from 0 to 1 to unlatch the alarm each time it is triggered. If you do not change the tag back to 0 and the alarm is latched again in the future, the alarm remains latched despite the Unlatch tag value being 1.

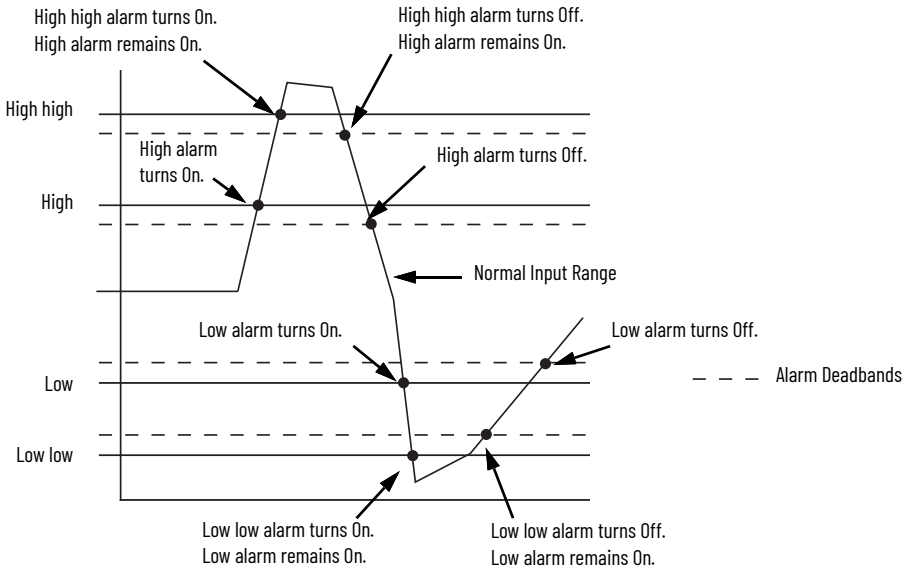
For more information on how to use the module tags, see Module Tag Definitions on page 129.

Alarm Deadband

You can configure an alarm deadband to work with these alarms. The deadband lets the process alarm status bit remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

The following graphic shows input data that sets each of the four alarms at some point during module operation. In this example, latching is disabled; therefore, each alarm turns Off when the condition that caused it to set ceases to exist.

Figure 5 - Alarm Deadband Alarm Settings



To see where to set the Alarm Deadband on the 5094-IF8 module, see page 83.

Rate Alarm

The Rate Alarm defines the maximum rate of change between input samples in Engineering Units per second. If the Rate Alarm Limit is exceeded, the *I.Chxx.RateAlarm* tag set to 1.

You can enable Rate Alarm latching. To see where to enable the Rate Alarm latching on the 5094-IF8 module, see page 83.

Once the Rate Alarm is latched, you must change the *O.Chxx.RateAlarmUnlatch* tag to 1.

You can unlatch the alarm at any point in the system operation. If you change the unlatch tag to 1 and the triggering condition remains, the alarm is immediately latched again.

We suggest that you unlatch the Rate Alarm only after the rate of change between input samples has returned below the Rate Alarm Limit value.

Sensor Offset

The Sensor Offset compensates for any known error on the sensor or channel to which the sensor is connected. The value is set in signal units and is added to the data value.

For example, consider an application that uses the Current (mA) input type with the 4...20 mA range and scaling at 0...100%. If a sensor has an error and the channel consistently reports current signal values by 0.2 mA lower than the actual value, you must set Sensor Offset to 1.25%.

You must use the *O.Chxx.SensorOffset* tag to set the Sensor Offset. In the example above, the *O.Chxx.SensorOffset* tag = 1.25.

For more information on how to use the module tags, see Module Tag Definitions on page 129.

Open Wire Detection

Open Wire Detection detects when a wire is disconnected from the channel. You must enable Open Wire Detection in the module configuration.

To see where to enable Open Wire Detection on the 5094-IF8 module, see page 82.

Table 12 describes the results of an Open Wire condition occurring when the module is operating in each mode.

Table 12 - Open Wire Conditions

Mode	Cause of Detection	Resulting Module Behavior
Current (mA)	The input signal for a channel is below 100 µA. **IMPORTANT**: This feature is available in Current mode only when the channel uses the 4...20 mA input range.	Input data for the channel changes to a specific scaled value corresponding to the Underrange value for the channel's Input Range. The *I:Chxx.OpenWire* tag changes to 1. A fault occurs and the *I:Chxx.Fault* tag is set to 1.
Voltage	The input signal value reaches full scale of the input range used.	Input data for the channel changes to a specific scaled value corresponding to the Overrange value for the channel's Input Range. The *I:Chxx.OpenWire* tag changes to 1. A fault occurs and the *I:Chxx.Fault* tag is set to 1.

IMPORTANT

The Disable All Alarms feature, does not disable the Open Wire Detection feature. The Disable All Alarms feature disables all alarms on the module.

The Open Wire Detection feature is not an alarm. It is an indicator that a wire has been disconnected from the channel but does not trigger an alarm.

To disable the Open Wire Detection feature, you must clear the Open Wire Detection checkbox in the module configuration.

Over Temperature Detection

The Over Temperature Detection feature indicates that the temperature of the conditions within which the module is operating are higher than the module operating limits.

When an Over Temperature condition exists, the I.Ch*xx*.OverTemperature tag is set to 1.

Field Power Loss Detection

The Field Power Loss Detection feature monitors for the loss of power at an input module channel. When field power to the module is lost, a channel-level fault is sent to the controller to identify the exact channel faulted.

Field Power Loss Detection has a corresponding tag that can be examined in the user program if a fault occurs. For information on modules, see Module Tag Definitions on page 129.

To see where to enable or disable field power detection, see page 81.

Fault and Status Reporting

The 5094-IF8 module sends fault and status data with channel data to the owner-controller and listening controllers. The data is returned via module tags that you can monitor in your Studio 5000 Logix Designer application.

With some exceptions, the 5094-IF8 module provides the fault and data status in a channel-centric format. The tag names in the following table that include **Chxx** represent channel-centric data. The **xx** represents channel number.

Table 13 - 5094-IF8 Module - Fault and Status Data Tags

Data Type	Tag Name	Triggering Event That Sets the Tag
Fault	ConnectionFaulted[1]	The owner-controller loses its connection to the module.
	Ch*xx*.Fault	The channel data quality is bad.
	Chxx.OpenWire	The following conditions: The channel uses a **Voltage** input type in any input range and the input signal value reaches full scale. The channel uses a **Current** input type in only the 4...20 mA input range and the input signal goes below 100 µA. The input signal at the channel is below 100 µA.
	Chxx.Underrange	The channel data is beneath the absolute minimum for this channel.
	Chxx.Overrange	The channel data is above the absolute maximum for this channel.
	Chxx.OverTemperature	The module is at a higher temperature than its rated operating limits.

Table 13 - 5094-IF8 Module - Fault and Status Data Tags (Continued)

Data Type	Tag Name	Triggering Event That Sets the Tag
Status	RunMode[1]	The module is in Run Mode.
	DiagnosticActive	Indicates if any diagnostics are active or if the prognostics threshold is reached.
	DiagnosticSequenceCount	A counter that increments when a diagnostic condition occurs or goes away. The counter is a rolling counter that skips 0 on rollovers.
	Chxx.Uncertain	The channel data can be imperfect but it is not known to what degree of inaccuracy.
	Chxx.FieldPowerOff	Field power is not present on the channel.
	Chxx.NotANumber	The most recently received data value was not a number.
	Chxx.LLAlarm	The following conditions exist: The I.Chxx.Data tag value is less than the C.Chxx.LLAlarmLimit tag value or the alarm is latched. The O.Chxx.LLAlarmEn tag is set. Alarms are enabled for the channel.
	Chxx.LAlarm	The following conditions exist: The I.Chxx.Data tag value is less than the C.Chxx.LAlarmLimit tag value or the alarm is latched. The O.Chxx.LAlarmEn tag is set. Alarms are enabled for the channel.
	Chxx.HAlarm	The following conditions exist: The *I.Chxx.Data* tag value is greater than the *C.Chxx.HAlarmLimit* tag value or the alarm is latched. The *O.Chxx.HAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.HHAlarm	The following conditions exist: The *I.Chxx.Data* tag value is greater than the *C.Chxx.HHAlarmLimit* tag value or the alarm is latched. The *O.Chxx.HHAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.RateAlarm	The following conditions exist: The absolute change between consecutive channel samples exceeds the *C.Chxx.RateAlarmLimit* tag value or the alarm is latched. The *O.Chxx.RateAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.Data	The channel data in scaled Engineering Units.
	Chxx.RollingTimestamp	A continuously running, 15-bit timer that counts in milliseconds and is not related to CIP Sync. Whenever a module scans its channels, it records the value of RollingTimestamp then. The controller program uses the last two rolling timestamp values to calculate the amount of time between the samples.

(1) This tag provides module-wide data and affects all channels simultaneously.

Notes:

Current/Voltage/Temperature-sensing (5094-IY8) and RTD/Thermocouple (5094-IRT8S) Analog Input Module Features

The 5094-IY8 input module has eight single-ended and differential, non-isolated channels. The 5094-IRT8S input module has four isolated groups of two, non-isolated channels.

Each channel supports connection to the following input types:

Input Type	5094-IY8	5094-IRT8S
Current	Yes	No
Voltage	Yes	No
RTD	Yes	Yes
Thermocouple	Yes	Yes

Differential inputs have a greater resistance to the effects of electromagnetic noise and provide improved flexibility regarding cable length when wiring your module.

IMPORTANT Remember the following:

- This module also has features that apply to all FLEX 5000 analog I/O modules that are described in Common Analog I/O Module Features on page 27.
- You can configure the features that are described in this chapter with the Studio 5000 Logix Designer application.

For more information on how to configure standard modules, see Configure Standard Analog I/O Modules on page 75.

For more information on how to configure safety modules, see Configure and Replace Safety Analog I/O Modules on page 91.

Multiple Input Ranges

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The modules offer multiple input ranges. The input type that you choose during module configuration determines the available input ranges.

For the RTD input type, the sensor type that you choose determines the available input ranges. The Studio 5000 Logix Designer application automatically sets the Input Range to the valid setting after you select a sensor type.

Table 14 describes the available module input ranges.

Table 14 - 5094-IY8 and 5094-IRT8S Module - Channel Input Ranges

Input Type	5094-IY8 Support	5094-IRT8S Support	Sensor Type	Available Input Ranges
Current (mA)	Yes	No	N/A	One of the following: • 0...20 mA • 4...20 mA
Voltage (V)	Yes	No	N/A	One of the following: • -10...10V • 0...5V • 0...10V

Table 14 - 5094-IY8 and 5094-IRT8S Module - Channel Input Ranges (Continued)

Input Type	5094-IY8 Support	5094-IRT8S Support	Sensor Type	Available Input Ranges
RTD	Yes	Yes	Ohm	One of the following: • 1...500 Ω • 2...1000 Ω • 4...2000 Ω • 8...4000 Ω
			100 Ω PT 385	1...500 Ω
			200 ΩPT 385	2...1000 Ω
			500 Ω PT 385	4...2000 Ω
			1000 Ω PT 385	8...4000 Ω
			100 Ω PT 3916	1...500 Ω
			200 Ω PT 3916	2...1000 Ω
			500 Ω PT 3916	4...2000 Ω
			1000 Ω PT 3916	8...4000 Ω
			10 Ω CU 427	1...500 Ω
			120 Ω NI 672	1...500 Ω
			100 Ω NI 618	1...500 Ω
			120 Ω NI 618	1...500 Ω
			200 Ω NI 618	2...1000 Ω
			500 Ω NI 618	4...2000 Ω
Thermocouple	Yes	Yes	mV	-100...+100 mV
Any Thermocouple Type	Yes	Yes	Any Thermocouple type	-78...+78 mV

To see where to choose an input range:

- For the 5094-IY8 module, see page 84.
- For the 5094-IRT8S module, see page 97.

Notch Filter

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The Notch Filter is a built-in feature of the Analog-to-Digital converter (ADC) that removes line noise in your application. The removal of line noise is also known as noise immunity.

The Notch Filter attenuates the input signal at the specified frequency.

Choose a Notch Filter based on what noise frequencies are present in the module operating environment and any sampling requirements that are needed for control. For example if the Notch Filter setting is 60 Hz, 60 Hz AC line noise and its overtones are filtered out.

These Notch Filter settings are available on the modules:

Notch Filter Settings

Notch Filter	5094-IY8 Support	5094-IRT8S Support
5 Hz	Yes	Yes
10 Hz	Yes	Yes
15 Hz	Yes	No
20 Hz	Yes	Yes
50 Hz	Yes	Yes
60 Hz	Yes	Yes
100 Hz	Yes	Yes
200 Hz	Yes	Yes
500 Hz	Yes	Yes
1000 Hz	Yes	Yes
2500 Hz	Yes	Yes
5000 Hz	Yes	Yes
10000 Hz	Yes	Yes
15625 Hz	Yes	No

Notch Filter Settings (Continued)

Notch Filter	5094-IY8 Support	5094-IRT8S Support
25000 Hz	Yes	No
31250 Hz	Yes	No
62500 Hz	Yes	No

If you want to filter lower frequency noise, you get a slower input sample rate.

To see where to choose a notch filter:

- For the 5094-IY8 module, see page 84.
- For the 5094-IRT8S module, see page 97.

Relationship between Notch Filter Settings and RPI Setting (5094-IY8 Only)

There is a relationship between a Notch Filter setting and the RPI rate.

- If you want greater noise suppression at the selected Notch Filter frequency and improved resolution, you use a slower input sample rate.
- If you want a faster input sample rate at the selected Notch Filter frequency, the noise suppression and resolution is lesser.

In Table 15, each Notch Filter setting has two recommended minimum module RPI values that allow the required time to collect samples from each channel. One setting provides faster sample speed and the other provides slightly better resolution at slower sample speeds.

Table 15 - Notch Filter and Recommended Minimum Module RPI Values - Effect on Noise Rejection

Notch Filter	Recommended Minimum Module RPI Value			
	Application That is Configured With Only One Channel Enabled		Application With All Channels Enabled and Using the Same Notch Filter Setting on All Channels	
	Faster Sampling Speed	Better Noise Rejection	Faster Sampling Speed	Better Noise Rejection
5 Hz	215 ms	635 ms	750 ms(1)	N/A
10 Hz	110 ms	320 ms	440 ms	N/A
15 Hz	65 ms	195 ms	260 ms	N/A
20 Hz	60 ms	165 ms	240 ms	660 ms
50 Hz	25 ms	70 ms	100 ms	280 ms
60 Hz (default)	20 ms	60 ms	80 ms	240 ms
100 Hz	15 ms	35 ms	60 ms	140 ms
200 Hz	10 ms	20 ms	40 ms	80 ms
500 Hz	5 ms	10 ms	20 ms	40 ms
1000 Hz	2 ms	5 ms	8 ms	20 ms
2500 Hz	1.5 ms	2.5 ms	6 ms	10 ms
5000 Hz	1 ms	2 ms	4 ms	8 ms
10000 Hz	0.8 ms	1 ms	3.2 ms	4 ms
15625 Hz	0.8 ms	0.9 ms	3.2 ms	3.5 ms
25000 Hz(2)	0.8 ms	0.8 ms	3.2 ms	3.2 ms
31250 Hz(2)	0.8 ms	0.8 ms	3.2 ms	3.2 ms
62500 Hz(2)	N/A	0.7 ms	N/A	2.8 ms

(1) If you use the 5 Hz Notch Filter setting with four channels, the input data cannot be refreshed at every RPI, even if the maximum RPI allowed is used. Instead, fresh data is delivered approximately every other RPI.
(2) Not supported by 5094-IRT8S modules.

Considerations When Using Different Notch Filter Selections (5094-IRT8S only)

When input channels on the same module use different Notch Filter selections, you must consider the sample time for each channel. This helps you to find the recommended RPI that provides enough time for sampling all channels.

Table 16 - Conversion Time Table

Notch Filter	Conversion Time (ms)
5 Hz	322
10 Hz	302
20 Hz	152
50 Hz	62
60 Hz	52
100 Hz	28
200 Hz	18
500 Hz	8
1000 Hz	6
2500 Hz	4
5000 Hz	2
10,000 Hz	2

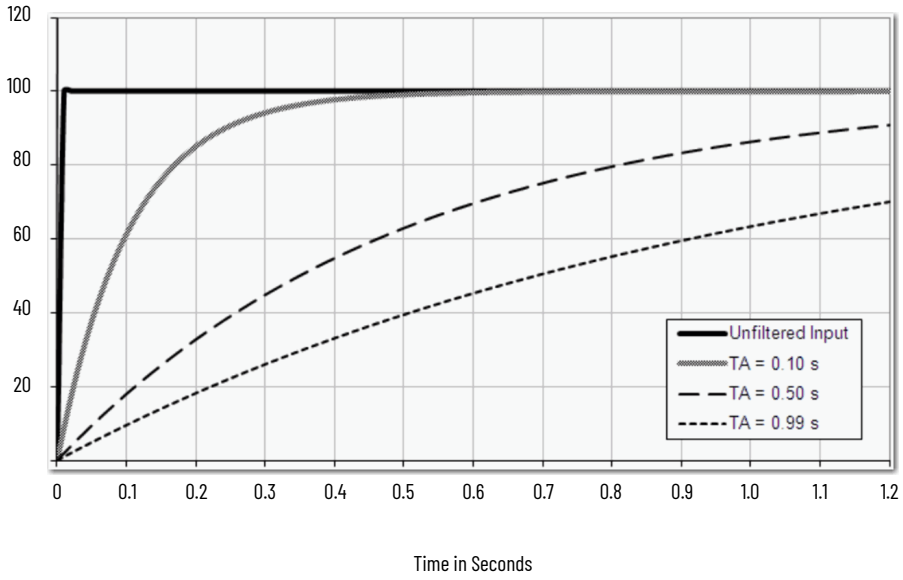
Table 17 - Resolution vs. Notch Filter

Notch Filter	TC/mV Resolution (bits)	RTD 500 Ohm Range Resolution (bits)	RTD 1000 Ohm Range Resolution (bits)	RTD 2000 Ohm Range Resolution (bits)	RTD 4000 Ohm Range Resolution (bits)
5 Hz	17	17	16	16	16
10 Hz	17	17	16	16	16
20 Hz	16	16	16	16	15
50 Hz	16	16	15	15	14
60 Hz	16	16	15	15	14
100 Hz	15	15	15	14	14
200 Hz	15	15	14	14	13
500 Hz	14	14	14	13	13
1000 Hz	14	14	13	13	12
2500 Hz	13	13	13	12	11
5000 Hz	11	11	10	10	9
10,000 Hz	9	9	8	8	6

Digital Filter

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The Digital Filter is a first-order lag filter. It smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital, first-order lag filter on the input. The input is 63% of the step change after the first time constant elapses.



The filter value is specified in units of milliseconds. A value of 0 (zero) disables the filter. The digital filter equation is as shown.

$$Y_n = Y_{n-1} + \frac{\Delta t \ * \ (X_n - Y_{n-1})}{\Delta t + TA}$$

Y_n = Present Output, Filtered Peak Voltage (PV)

Y_{n-1} = Previous Output, Filtered PV

Δt = Module Channel Update Time (seconds)

TA = Digital Filter time Constant (seconds)

X_n = Present Input, Unfiltered PV

IMPORTANT Remember the following:

- Digital Filter input data changes only when new input data is collected.
- If an Overrange or Underrange condition is detected before the Digital Filter input data is collected, the condition is indicated immediately. An immediate indication also applies to the Fault data for the input.

To see where to choose a digital filter:

- For the 5094-IY8 module, see page 84.
- For the 5094-IRT8S module, see page 97.

Underrange/Overrange Detection

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Underrange/Overrange Detection detects when the module is operating beyond limits set by the input range.

The module can read input signal levels outside the low and high signal values for each input range. The signal limits to which the module can read are thresholds. Only when the signal is beyond a threshold is an underrange or overrange condition that is detected and indicated.

For example, if you configure a 5094-IY8 module channel to use the ± 10V input range, an overrange condition does not exist until the input signal exceeds 12V.

Table 18 lists the input ranges of the 5094-IY8 and 5094-IRT8S modules and the thresholds in each range before the module detects an underrange/overrange condition.

Table 18 - Input Type Underrange/Overrange Thresholds

Input Type	Range - Current and Voltage Input Type Sensor Type - RTD and Thermocouple Input Type	Underrange Threshold	Overrange Threshold	Deadband Example(1)
Current (mA)(2)	0...20 mA	< -0.07 mA	> 23.00 mA	0.07 mA
	4...20 mA	< 3 mA(3)		
Voltage (V)(2)	±10.00V	< -12.00V	>12.00V	0.04V
	0...5V	< -0.02V	> 6.00V	0.02V
	0...10V	< -0.04V	> 12.00V	0.04V
RTD(4)	Pt385	< -200 °C < -328 °F < 73 °K < 132 °R	> 870 °C > 1598 °F > 1143 °K > 2058 °R	N/A
	Pt3916	< -200 °C < -328 °F < 73 °K < 132 °R	> 630 °C > 1166 °F > 903 °K > 1626 °R	
	Cu427	< -200 °C < -328 °F < 73 °K < 132 °R	> 260 °C > 500 °F > 533 °K > 960 °R	
	Ni672	< -80 °C < -112 °F < 193 °K < 348 °R	> 320 °C > 608 °F > 593 °K > 1068 °R	
	Ni618	< -60 °C < -76 °F < 213 °K < 384 °R	> 250 °C > 482 °F > 523 °K > 942 °R	
Thermocouple	B	< 21 °C < 68 °F < 293 °K < 528 °R	> 1820 °C > 3308 °F > 2093 °K > 3768 °R	N/A
	C	< 0.00 °C < 32 °F < 273 °K < 492 °R	> 2315 °C > 4199 °F > 2588 °K > 4659 °R	
	E	< -270 °C < -454 °F < 3 °K < 6 °R	> 1000 °C > 1832 °F > 1273 °K > 2292 °R	
	J	< -210 °C < -346 °F < 63 °K < 114 °R	> 1200 °C > 2192 °F > 1473 °K > 2652 °R	
	K	< -270 °C < -454 °F < 3 °K < 6 °R	> 1372 °C > 2502 °F > 1645 °K > 2961 °R	

Table 18 - Input Type Underrange/Overrange Thresholds (Continued)

Input Type	Range - Current and Voltage Input Type Sensor Type - RTD and Thermocouple Input Type	Underrange Threshold	Overrange Threshold	Deadband Example(1)
Thermocouple (continued)	N	< -270 °C < -454 °F < 3 °K < 6 °R	> 1300 °C > 2372 °F > 1573 °K > 2832 °R	N/A
	R	< -50 °C < -58 °F < 223 °K < 402 °R	> 1768 °C > 3215 °F > 2041 °K > 3674 °R	
	S	< -50 °C < -58 °F < 223 °K < 402 °R	> 1768 °C > 3215 °F > 2041 °K > 3674 °R	
	T	< -270 °C < -454 °F < 3 °K < 6 °R	> 400 °C > 752 °F > 673 °K > 1212 °R	
	TXK/XK(L)	< -200 °C < -328 °F < 73 °K < 132 °R	> 800 °C > 1472 °F > 1073 °K > 1932 °R	
	D	< 0.00 °C < 32 °F < 273 °K < 492 °R	> 2315 °C > 4199 °F > 2588 °K > 4659 °R	

(1) The module has alarm deadband values for each range. The deadband lets a condition remain set despite it disappearing. For example, if a module uses a Current input type in the 4...20 mA range and the signal value goes below 3 mA, the underrange condition is triggered. Because of the 0.07 mA deadband, the condition is not cleared until the signal value reaches 3.07 mA. For more information on Alarm Deadbands, see page 53.
(2) 5094-IY8 module only.
(3) Underrange is set at < 3 mA, but the *I:Chxx.Data* tag reports values as low as 0.0 mA. The condition is clamped when the signal reaches 3 mA.
(4) For two-wire, the cable length contributes to the inaccuracy of the results. You should consider the accuracy of the sensor separately.

IMPORTANT The Disable All Alarms feature, does not disable the underrange/overrange detection feature.

The Disable All Alarms feature disables **alarms** on the module. Underrange/Overrange detection is not an alarm. It is an indicator that channel data has gone beyond the absolute maximum or minimum, respectively, for the channel range.

To disable the Underrange/Overrange detection feature, you must disable the channel.

Underrange/overrange conditions are indicated when the following tags change to 1:

- I.Chxx.Underrange
- I.Chxx.Overrange

For more information on how to use the module tags, see Module Tag Definitions on page 129.

Process Alarms

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. The following are the user-configurable, alarm trigger points:

- High high
- High
- Low
- Low low

To use the Process Alarms, you must complete the following tasks:

- Enable the alarms
- Configure the trigger points

Enable Process Alarms

When the module tags are created, the Process Alarm tags are disabled by default.

To see where to enable Process Alarms:

- For the 5094-IY8 module, see page 85.
- For the 5094-IRT8S module, see page 98.

Configure Alarm Trigger Points

You must configure the Process Alarm with a trigger point. That is, set values in Engineering Units that, once the signal reaches the value, the alarm is triggered.

Process Alarm trigger points are related to the Scaling parameters that you configure for the channel. The Engineering Units that are established in Scaling determine the Process Alarm trigger points. That is, the available trigger point values can be in signal units or engineering units.

For example, consider a channel that uses the Current (mA) input type, the 4 mA...20 mA input range, and scales the High and Low Engineering values of 100 and 0, respectively. The available Process Alarm values range from 0...100.

In this case, if the High Limit alarm is set to 50 EU, when the input signal reaches 12 mA, the High Limit alarm is set. The alarm is set because Scaling was configured for Percentage of Full Scale and a signal value of 12 mA is 50% of the full scale of engineering units.

To see where to set the Process Alarm trigger points:

- For the 5094-IY8 module, see page 85.
- For the 5094-IRT8S module, see page 98.

Latch Alarms

Check Latch Process Alarms on the *Alarms* category to latch the process alarms.

To see where to latch Process Alarms:

- For the 5094-IY8 module, see page 85.
- For the 5094-IRT8S module, see page 98.

Unlatch Alarms

IMPORTANT	Before you unlatch an alarm, make sure the condition that triggered the alarm no longer exists.

Once an alarm is latched, you must manually unlatch it. To unlatch an alarm, change the output tag for that alarm.

For example, change the *O.Chxx.LAlarmUnlatch* tag for the low alarm that you want to unlatch from 0 to 1.

IMPORTANT	After an alarm is unlatched, change the tag back from 1 to 0. You must change the tag from 0 to 1 to unlatch the alarm each time it is triggered. If you do not change the tag back to 0 and the alarm is latched again in the future, the alarm remains latched despite the Unlatch tag value being 1.

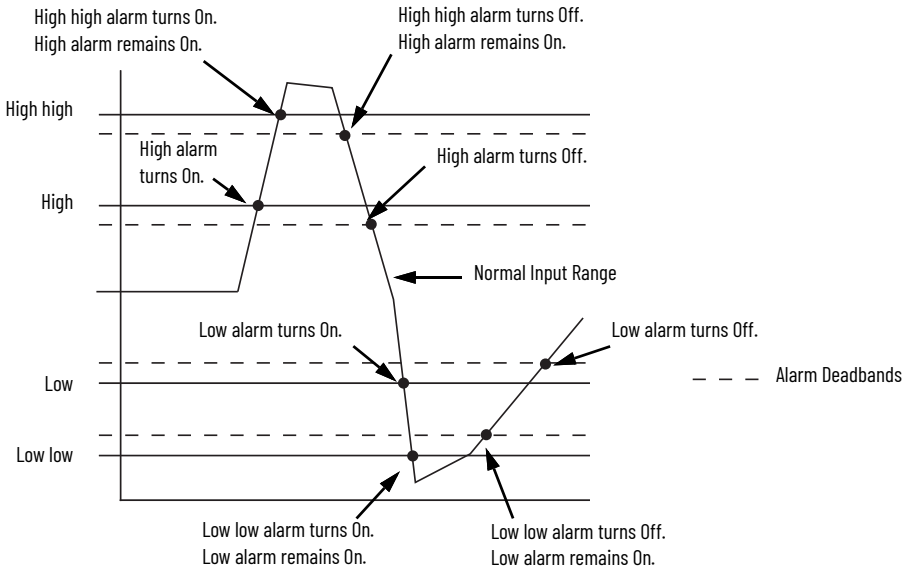
For more information on how to use the module tags, see Module Tag Definitions on page 129.

Alarm Deadband

You can configure an alarm deadband to work with these alarms. The deadband lets the process alarm status bit remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

The following graphic shows input data that sets each of the four alarms at some point during module operation. In this example, latching is disabled; therefore, each alarm turns Off when the condition that caused it to set ceases to exist.

Figure 6 - Alarm Deadband Alarm Settings



To see where to set the Alarm Deadband:

- For the 5094-IY8 module, see page 85.
- For the 5094-IRT8S module, see page 98.

Rate Alarm

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The Rate Alarm defines the maximum rate of change between input samples in Engineering Units per second. If the Rate Alarm Limit is exceeded, the *I.Chxx.RateAlarm* tag set to 1.

You can enable Rate Alarm latching.

To see where to enable the Rate Alarm latching:

- For the 5094-IY8 module, see page 85.
- For the 5094-IRT8S module, see page 98.

Once the Rate Alarm is latched, you must change the *O.Chxx.RateAlarmUnlatch* tag to 1 to unlatch.

You can unlatch the alarm at any point in the system operation. If you change the unlatch tag to 1 and the triggering condition remains, the alarm is immediately latched again.

We suggest that you unlatch the Rate Alarm only after the rate of change between input samples has returned below the Rate Alarm Limit value.

Sensor Types

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The modules support multiple sensor types with the available selections dictated by the input type configuration.

Table 19 - Available Sensor Types

Input Type	Available Sensor Types
RTD	100 Ω PT 385 200 Ω PT 385 500 Ω PT 385 1000 Ω PT 385 100 Ω PT 3916 200 Ω PT 3916 500 Ω PT 3916 1000 Ω PT 3916 10 Ω CU 427 120 Ω NI 672 100 Ω NI 618 120 Ω NI 618 200 Ω NI 618 500 Ω NI 618
Thermocouple	B, C, D, E, J, K, N, R, S, T, TXK/XK (L)

To see where to select a Sensor Type for a channel:

- For the 5094-IY8 module, see page 84.
- For the 5094-IRT8S module, see page 97.

Sensor Type Temperature Limits

The 5094-IY8 and 5094-IRT8S modules let you set temperature limits when the module uses the RTD or Thermocouple input types.

The choices made during module configuration for the following parameters determine Sensor Type temperature limits:

- Input Type
- Sensor Type
- Temperature Units

To see where to set the parameters that affect temperature limits:

- For the 5094-IY8 module, see page 84.
- For the 5094-IRT8S module, see page 97.

IMPORTANT When you make the configuration choices that are listed previously, the **Scaling parameters are automatically set** on the *Chxx* category of the Module Properties dialog box. They **cannot be changed** in the software.

The Low Signal value equals the Low Engineering value. The High Signal value equals the High Engineering value.

For example, you can configure a channel with the following parameters:

- Input Type = RTD
- Sensor Type = 120 ohms NI 672
- Input Range = 1 ohms to 500 ohms 3-wire
- Temperature Units = Celsius

In this case, the Scaling parameters are set as follows:

- Low Signal = -80.0 °C
  Low Engineering = -80.0 °C
- High Signal = 320.0 °C
  High Engineering = 320.0 °C

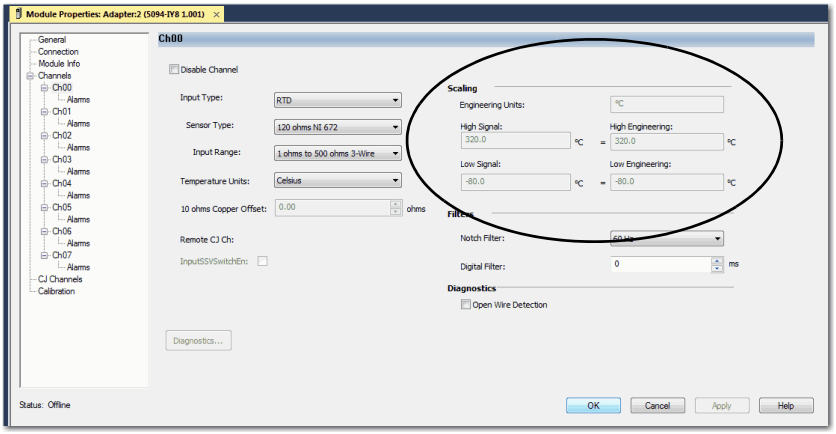


Table 20 lists temperature range limits on the modules.

Table 20 - Temperature Limits for RTD and Thermocouple Sensor Types

Input Type	Sensor Type	Temperature Range Limits
RTD	100 Ohm PT 385 200 Ohm PT 385 500 Ohm PT 385 1000 Ohm PT 385	-200...870 °C -328...1598 °F 73...1143 °K 132...2058 °R
	100 Ohm PT 3916 200 Ohm PT 3916 500 Ohm PT 3916 1000 Ohm PT 3916	-200...630 °C -328...1166 °F 73...903 °K 132...1626 °R
	10 Ohm CU 427	-200...260 °C -328...500 °F 73...533 °K 132...960 °R
	120 Ohm NI 672	-80...320 °C -112...608 °F 193...593 °K 348...1068 °R
	100 Ohm NI 618 120 Ohm NI 618 200 Ohm NI 618 500 Ohm NI 618	-60...250 °C -76...482 °F 213...523 °K 384...942 °R
Thermocouple (mV)	TC Type B	21...1820 °C 68...3308 °F 293...2093 °K 528...3768 °R
	TC Type C	0...2315 °C 32...4199 °F 273...2588 °K 492...4659 °R
	TC Type D	0...2315 °C 32...4199 °F 273...2588 °K 492...4659 °R
	TC Type E	-270...1000 °C -454...1832 °F 3...1273 °K 6...2292 °R
	TC Type J	-210...1200 °C -346...2192 °F 63...1473 °K 114...2652 °R

Table 20 - Temperature Limits for RTD and Thermocouple Sensor Types (Continued)

Input Type	Sensor Type	Temperature Range Limits
Thermocouple (mV) (continued)	TC Type K	-270...1372 °C -454...2502 °F 3...1645 °K 6...2961 °R
	TC Type N	-270...1300 °C -454...2372 °F 3...1573 °K 6...2832 °R
	TC Type R	-50...1768 °C -58...3215 °F 223...2041 °K 402...3674 °R
	TC Type S	-50...1768 °C -58...3215 °F 223...2041 °K 402...3674 °R
	TC Type T	-270...400 °C -454...752 °F 3...673 °K 6...1212 °R
	TC Type TXK/XK (L)	-200...800 °C -328...1472 °F 73...1073 °K 132...1932 °R

Sensor Offset

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The Sensor Offset compensates for any known error on the sensor or channel to which the sensor is connected. The value is set in signal units and is added to the data value.

For example, consider an application that uses the Current (mA) input type with the 4...20 mA range and scaling at 0...100%. If a sensor has an error and the channel consistently reports current signal values by 0.2 mA lower than the actual value, you must set Sensor Offset to 1.25%.

You must use the *O.Chxx.SensorOffset* tag to set the Sensor Offset. In the example above, the *O.Chxx.SensorOffset* tag = 1.25.

IMPORTANT A change in SensorOffset value will not trigger rate alarm.

WARNING: If the sensor offset is not set appropriately, the channel faults.

For more information on using module tags, see Module Tag Definitions on page 129.

10 Ohm Copper Offset

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

With 10 Ohm Copper Offset, you can compensate for a small offset error in a 10 ohm copper RTD. The channel must be connected to the 10 Ohm CU 427 Sensor Type to use this feature. The offset value is indicated in units of 0.01 Ohm.

For example, if the resistance of a copper RTD used with a channel is 9.74 Ω at 25 °C, the 10 Ohm Copper Offset lets you account for the error. You must set the 10 Ohm Copper Offset field on the Configuration tab to -0.26 or by setting the *C.Chxx.TenOhmOffset* to -26.

To see where to set the 10 Ohm Copper Offset:

- For the 5094-IY8 module, see page 84.
- For the 5094-IRT8S module, see page 97.

Open Wire Detection

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Open Wire Detection detects when a wire is disconnected from the channel. You must enable Open Wire Detection in the module configuration.

For the 5094-IRT8S module, open wire detection is always enabled. The value reported during an Open Wire detection depends on the Diagnostics selection (min/max eng) on the channel (see Chxx Category on page 97).

To see where to enable Open Wire Detection:

- For the 5094-IY8 module, see page 84.

Table 21 describes the results of an Open Wire condition occurring when the module is operating in each mode.

Table 21 - Open Wire Conditions

Mode	5094-IY8 Support	5094-IRT8S Support	Cause of Detection	Resulting Module Behavior
Current (mA)	Yes	No	The input signal for a channel is below 100 µA. **IMPORTANT**: This feature is available in Current mode only when the channel uses the 4...20 mA input range.	• Input data for the channel changes to a specific scaled value corresponding to the Underrange value for the channel's Input Range. • The *I:Chxx.OpenWire* tag changes to 1. • A fault occurs and the *I:Chxx.Fault* tag is set to 1.
Voltage	Yes	No	The input signal value reaches full scale of the input range used.	• Input data for the channel changes to a specific scaled value corresponding to the Overrange value for the channel's Input Range. • The *I:Chxx.OpenWire* tag changes to 1. • A fault occurs and the *I:Chxx.Fault* tag is set to 1.
RTD	Yes	Yes	A wire is disconnected from the channel.	• For the 5094-IY8 module, the input data for the channel changes to the highest scaled temperature value associated with the selected sensor type. • For the 5094-IRT8S module, input data for the channel changes to the highest or lowest scaled temperature value associated with the selected sensor type based on the user selection. • The *I:Chxx.OpenWire* tag changes to 1. • The *I.Chxx.Overrange* tag may be set to 1. • A fault occurs and the *I:Chxx.Fault* tag is set to 1.
Thermocouple with Sensor Type = Any TC Type	Yes	Yes	A wire is disconnected from the channel.	• For the 5094-IY8 module, the input data for the channel changes to the highest scaled temperature value associated with the selected sensor type. • For the 5094-IRT8S module, input data for the channel changes to the highest or lowest scaled temperature value associated with the selected sensor type based on the user selection. • The *I:Chxx.OpenWire* tag changes to 1. • The *I.Chxx.Overrange* tag may be set to 1. • A fault occurs and the *I:Chxx.Fault* tag may be set to 1.
Thermocouple with Sensor Type = mV	Yes	Yes	A wire is disconnected from the channel.	• For the 5094-IY8 module, the input data for the channel changes to a specific scaled value corresponding to the Overrange value for the channel's Input Range. • For the 5094-IRT8S module, Input data for the channel changes to a specific scaled value corresponding to the highest and lowest value for the channel's Input Range. • The *I:Chxx.OpenWire* tag changes to 1. • The *I.Chxx.Overrange* tag may be set to 1. • A fault occurs and the *I:Chxx.Fault* tag is set to 1.

IMPORTANT The Disable All Alarms feature, does not disable the Open Wire Detection feature. The Disable All Alarms feature disables all alarms on the module.

The Open Wire Detection feature is not an alarm. It is an indicator that a wire has been disconnected from the channel but does not trigger an alarm.

To disable the Open Wire Detection feature, you must clear the Open Wire Detection checkbox in the module configuration.

Temperature Units

You can use the following temperature units with the modules:

- Celsius
- Kelvin
- Fahrenheit
- Rankine
- Custom

Each channel is individually configurable for its temperature units. To see where to select the temperature units for a channel:

- For the 5094-IY8 module, see page 84.
- For the 5094-IRT8S module, see page 97.

Over Temperature Detection

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The Over Temperature Detection feature indicates that the temperature of the conditions within which the module is operating is higher than the module operating limits.

For 5094 standard I/O modules, when an Over Temperature condition exists, the I.Chxx.OverTemperature tag is set to 1.

For 5094 safety I/O modules, when an Over Temperature condition exists, OverTemperature is set to 1 in the diagnostic assembly.

Critical Temperature Detection

Applies to these modules:
5094 Safety I/O Modules

The Critical Temperature Detection feature indicates that the temperature of the conditions within which the module is operating is outside the module operating limits and can result in an immediate module failure.

When a critical temperature condition exists, CriticalTemperature is set to 1 in the diagnostic assembly.

Field Power Loss Detection

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The Field Power Loss Detection feature monitors for the loss of power at an input module channel. When field power to the module is lost, a channel-level fault is sent to the controller to identify the exact channel faulted.

Field Power Loss Detection has a corresponding tag that can be examined in the user program if a fault occurs. For information on modules, see Module Tag Definitions on page 129.

Cold Junction Compensation

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The junction at which temperature is measured is the hot junction. The junction where the thermocouple wire interfaces with copper are the cold junction. The transition from thermocouple wire to copper typically happens at the RTB terminal.

The thermoelectric effect alters the input signal and must be compensated for to measure temperatures accurately. To compensate the input signal from your module accurately, you must use cold junction compensation to account for the increased voltage.

When using the 5094-IY8 or 5094-IRT8S module with a thermocouple input type, the channel must account for the thermoelectric effect of a junction of the thermocouple field wires and the terminal base (TB) assembly. The cold junction temperature should be within the valid sensor range. You must also make sure that the configured thermocouple sensor operating range includes the RTB ambient temperature.

IMPORTANT TBs are not included with your module and are not available for purchase. TBs consists of a mounting base (MB) and removable terminal block (RTB). You must purchase MBs and RTBs separately and assemble them together.

You must use a cold junction compensation (CJC) RTB when a 5094-IY8 module uses a thermocouple input type. The CJC RTBs account for the thermoelectric effect.

The following CJC RTBs are available for order for the 5094-IY8 module:

- 5094-RTB3T, 5094-RTB3TXT
- 5094-RTB3TS, 5094-RTB3TSXT

The following RTBs are available for order for the 5094-IRT8S:

- 5094-RTB3IT, 5094-RTB3ITXT
- 5094-RTB3ITS, 5094-RTB3ITSXT

Remote Cold Junction (5094-IY8 Only)

Remote cold junction means that cold junction sensor is mounted on a remote termination block, rather than on the local terminal block of the input module.

When remote CJC is enabled for a channel, the embedded CJC in the channel is not used and you can use another channel of the module as a remote CJC.

Only channels with input type as thermocouple can use other channels (the other channels can be set as RTD or thermocouple) as a remote CJC.

For more information, see CJChxx.Remote on page 136.

Cold Junction Disable Option

You can disable cold junction compensation on your 5094-IY8 or 5094-IRT8S module. To see where to disable cold junction compensation, see page 86.

Input SSV Switch Enable (5094-IY8 only)

Applies to these modules:
5094 Standard I/O Modules

The 5094-IY8 has eight non-isolated differential inputs.

Select only when the channel is connected to a 2-wire current device. This shorts the analog input channel and analog common ground to avoid the need to install an additional jumper wire on the terminal. The channel will behave as a single-ended channel and the module will source current (maximum 25 A) to the device using the specific terminals marked 24V (terminals 32, 34, 36, 38, 40, 42, 44, and 46).

Do not attempt to have the 5094-IY8 source current through Sensor Source Voltage (SSV) in any other configurations.

The 5094-IY8 does not support 3-wire current or voltage devices. We recommend to use the 5094-IF8 if you need to connect to a 3-wire device. The 5094-IY8 only supports 4-wire current or voltage devices that are using external power.

To see where to enable the Input SSV Switch on the 5094-IY8 module, see page 84.

Safety Input Fault Reset (5094-IRT8S only)

Applies to these modules:
5094 Safety I/O Modules

The I/O channel supports a module-level user-configurable 'Latch Fault until reset via output tag' mode and recovers from these faults:

- Field Power Off Detection
- Open Wire Detection

If disabled, the Safety State could be exited once the fault is no longer present.

'Latch Fault until reset via output tag' mode is Enabled

When Latch Fault... mode is Enabled, the I/O channel holds safety input fault indications until it checks that the fault is removed. If the fault is removed, the channel clears the fault status only upon detecting that the ResetFault in its consume assembly channel sees a rising edge.

'Latch Fault until reset via output tag' mode is Disabled

When Latch Fault... mode is Disabled (default), the I/O channel holds safety input fault indications for 1 second until it checks if the fault is removed. If the fault is removed, the channel clears the fault status.

ATTENTION: When disabled, the safe state could be exited once the fault is no longer present. You are responsible for confirming compliance with the applicable standards for the entire system. You must read, understand, and fulfill the functional safety requirements of the standard applicable to your safety application.

Recoverable and Unrecoverable Faults

List of recoverable and nonrecoverable faults for 5094-IRT8S safety module:

Fault Type	TC/RTD		CJC	
	Recoverable	Note	Recoverable	Note
Underrange	Y	Autorecovery as soon as possible.	Y	Autorecovery as soon as possible.
Overrange	Y	Autorecovery as soon as possible.	Y	Autorecovery as soon as possible.
Open Wire	Y	Recovery behavior depends on FaultResetMode(1)	Y	Autorecovery as soon as possible.
Field Power Off	Y	Recovery behavior depends on FaultResetMode(1)	Y	Autorecovery as soon as possible.
Other faults	N	Module power cycle is required.	N	Module power cycle is required.

(1) For more information, see 'Latch Fault until reset via output tag' mode is Enabled

Fault and Status Reporting

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

The 5094-IY8 and 5094-IRT8S modules send fault and status data with channel data to the owner-controller and listening controllers. The data is returned via module tags that you can monitor in your Studio 5000 Logix Designer application.

With some exceptions, the modules provide the fault and data status in a channel-centric format. The tag names in Table 22 and Table 23 that include **Chxx** represent channel-centric data. The **xx** represents channel number.

Table 22 - Module Fault Tags

Type	Tag Name	Event
Fault	ConnectionFaulted(1)	The owner-controller loses its connection to the module.
	Chxx.Fault	The channel data quality is bad.
	CJChxx.Fault	The cold junction data quality is bad.
	Chxx.OpenWire	The following conditions: 5094-IY8 module only: The channel uses a **Voltage** input type in any input range and the input signal value reaches full scale. 5094-IY8 module only: The channel uses a **Voltage** input type in any input range and the input signal value reaches full scale.The channel uses a **Current** input type in only the 4...20 mA input range and the input signal goes below 100 µA. The input signal at the channel is below 100 µA. When the channel uses **RTD or Thermocouple** input type and a wire is disconnected from the channel.
	CJChxx.OpenWire	The 5094-TB3IT terminal block has an internal open wire.
	Chxx.Underrange	The channel data is beneath the absolute minimum for this channel.
	CJChxx.Underrange	The cold junction at the channel is beneath the absolute minimum for this channel.
	Chxx.Overrange	The channel data is above the absolute maximum for this channel.
	CJChxx.Overrange	The cold junction at the channel is above the absolute maximum for this channel.
	Chxx.FieldPowerOff	Field power is not present on the channel.
	CJChxx.FieldPowerOff	Field power is not present at the cold junction.

(1) This tag provides module-wide data and affects all channels simultaneously.

Table 23 - Module Status Tags

Type	Tag Name	Event
Status	RunMode[1]	The module is in Run Mode.
	DiagnosticActive	Indicates if any diagnostics are active or if the prognostics threshold is reached.
	DiagnosticSequenceCount	A counter that increments when a diagnostic condition occurs or goes away. The counter is a rolling counter that skips 0 on rollovers.
	Chxx.Uncertain	The channel data can be imperfect but it is not known to what degree of inaccuracy.
	CJChxx.Uncertain	The cold junction data can be inaccurate but it is not known to what degree of inaccuracy.
	Chxx.OverTemperature[2]	The module is operating at a higher temperature than its rated operating limits.
	CJChxx.Temperature	Current temperature of the cold junction.
	CJChxx.NotANumber[3]	The most recently received data value was not a number.
	Chxx.NotANumber	The most recently received data value was not a number.
	Chxx.LLAlarm	The following conditions exist: The *I.Chxx.Data* tag value is less than the *C.Chxx.LLAlarmLimit* tag value or the alarm is latched. The *O.Chxx.LLAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.LAlarm	The following conditions exist: The *I.Chxx.Data* tag value is less than the *C.Chxx.LAlarmLimit* tag value or the alarm is latched. The *O.Chxx.LAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.HAlarm	The following conditions exist: The *I.Chxx.Data* tag value is greater than the *C.Chxx.HAlarmLimit* tag value or the alarm is latched. The *O.Chxx.HAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.HHAlarm	The following conditions exist: The *I.Chxx.Data* tag value is greater than the *C.Chxx.HHAlarmLimit* tag value or the alarm is latched. The *O.Chxx.HHAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.RateAlarm	The following conditions exist: The absolute change between consecutive channel samples exceeds the *C.Chxx.RateAlarmLimit* tag value or the alarm is latched. The *O.Chxx.RateAlarmEn* tag is set. Alarms are enabled for the channel.
	Chxx.Data	The channel data in scaled Engineering Units.
	Chxx.RollingTimestamp	A continuously running, 15-bit timer that counts in milliseconds and is not related to CIP Sync. Whenever a module scans its channels, it records the value of RollingTimestamp then. The controller program uses the last two rolling timestamp values to calculate the amount of time between the samples.
	Chxx.CalFault	Indicates if the calibration did not fail, or a calibration session for a channel was interrupted or failed. CalFault is reset by product reset or power cycle.
	Chxx.Calibrating	Indicates if the channel is being calibrated or is not being calibrated.
	Chxx.Status[3]	Indicates if the status of the channel is good or causing a fault.
	CJChxx.Status[3]	Indicates if the status of the channel is good or causing a fault.

(1) This tag provides module-wide data and affects all channels simultaneously.
(2) 5094-IY8 module only.
(3) 5094-IRT8S module only.

Notes:

5094-OF8 Analog Output Module Features

The 5094-OF8 output module has eight non-isolated channels. Each channel supports connection to the following output types:

- Current
- Voltage

IMPORTANT Remember the following:

- This module also has features that apply to all FLEX 5000 analog I/O modules that are described in Common Analog I/O Module Features on page 27.
- You can configure the features that are described in this chapter with the Studio 5000 Logix Designer application.

For more information on how to configure the module, see Configure Standard Analog I/O Modules on page 75.

Multiple Output Ranges

The 5094-OF8 module offers multiple output ranges. The output type that you choose during module configuration determines the available ranges.

Table 24 - Output Ranges

Input Type	Available Output Range
Current (mA)	• 0...20 mA • 4...20 mA
Voltage (V)	• -10...10V • 0...5V • 0...10V

To see where to choose an output range for the 5094-OF8 module, see page 87.

Channel Offset

The Channel Offset feature compensates for any known error on the sensor or channel to which the sensor is connected. The value is set in signal units and is added to the output data.

For example, consider an application that uses the Current (mA) input type with the 4...20 mA range and scaling at 0...100%. If a channel used in the output range 4...20 mA has an error that results in it consistently reporting 8 mA as 7.8 mA, you must account for the error by setting the Channel Offset to 1.25.

To see where to set the channel offset for the 5094-OF8 module, see page 87.

Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

If Hold for Initialization is selected, outputs hold if there is an occurrence of any of these three conditions:

- Initial connection is established after power-up.
- A new connection is established after a communication fault occurs.
- There is a transition to Run mode from Program state.
- The module loses SA power. In this case, the data echo value goes to 0.0.

The *I.Chxx.InHold* tag for a channel indicates that the channel is holding. To see where to enable Hold for Initialization for the 5094-OF8 module, see page 87.

Connection Fault Handling

You can configure 5094-OF8 output module behavior when a connection fault occurs, that is, the connection between the owner-controller and the output module breaks.

You must define the following:

- Output Behavior Immediately After a Connection Fault
- Fault State Duration After Connection Fault
- Final Fault State Value

Output Behavior Immediately After a Connection Fault

When the connection between an owner-controller and output module breaks, the output can behave in the following ways. The available options Fault Mode parameter is configured:

- Transition to a specific, user-defined value.
- Hold its last state.

  If you configure the output to hold its last state, the output remains at that state value until the following occurs:
  - The connection to the owner-controller is re-established.
  - The output returns to normal operation, as defined in the module configuration.

Fault State Duration After Connection Fault

If you configure the output to transition to a specific value after the connection breaks, you must define how long the output remains at the specified value before it transitions to a Final Fault State.

You can configure the output to remain at the specific value for the following times:

- Forever
- One second
- Two seconds
- Five seconds
- Ten seconds

After the Fault State Duration time expires, the output transitions to user-defined Final Fault State Value.

Final Fault State Value

The Final Fault State Value defines the value to which the output goes after the Fault State Duration time expires.

Output State Once Connection is Re-established

Once the connection between the owner-controller and output module is re-established, the output resumes normal operation.

To see where to set the Connection Fault Handling parameters for the 5094-OF8 module, see page 87.

Output Clamping

Output Clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range.

Once clamp values are set, if data received from the controller exceeds those clamps, the following events occur:

- The output value transitions to the clamp limit but not to the requested value.
- The appropriate limit alarm is triggered.

  For more information on limit alarms, see Clamp Alarming on page 65.

For example, an application can set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module applies only 8V to its screw terminals.

You can disable or latch clamping alarms on a per channel basis. The alarms are disabled by default.

IMPORTANT	Clamp values are in engineering units and are **not automatically updated** when the scaling high and low engineering units are changed. Failure to update the clamp values can generate a very small output signal that could be misinterpreted as a hardware problem. For example, a FLEX 5000 analog output module channel that uses a Current (mA) output type with Clamping enabled has the following configuration parameters: Scaling values: • High Engineering = 100.0000% • Low Engineering = 0.0000% Clamp Limits: • High Clamp = 100.0000% • Low Clamp = 0.0000% If you change the Scaling High Engineering value to 90.0000%, the High Clamp value remains at 100.0000. **You must change** the High Clamp value to 90.0000 to make sure that the application continues to operate as expected.

To see where to set the high clamp and low clamp parameters for the 5094-OF8 module, see page 88.

Clamp Alarming

Clamp Alarming works directly with Output Clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies signal values to the clamping limit. In addition, a limit alarm is triggered.

The following tags indicate that a clamping alarm was triggered. That is, the tag is set to 1.

- *I.Chxx.LLimitAlarm*
- *I.Chxx.HLimitAlarm*

For more information on using module tags, see Module Tag Definitions on page 129.

Output Ramping/Rate Limiting

Output Ramping limits the speed at which an analog output signal can change. This prevents fast transitions in the output from damaging the devices that an output module controls. Output Ramping is also known as Rate Limiting.

Table 25 describes the types of ramping that are possible.

Table 25 - Output Ramping Types

Ramping type	Description
Ramp in Run mode	When the module is in Run mode, ramping occurs to all new output values at the maximum ramp rate.
Ramp to Program mode	When the present output value changes to the Program value after a Program command is received from the controller.
Ramp to Fault mode	When the present output value changes to the Fault value after a communication fault occurs.

The maximum rate of change in outputs is expressed in engineering units per second (EU/s), is called the maximum ramp rate and set in the Ramp Rate field.

To see where to enable the **Ramp in Run mode** for the 5094-OF8 module, see page 88.

To enable the other Output Ramping parameters, you must change module tags to 1.

- Ramp to Program Mode - *C.Chxx.RampToProg*
- Ramp to Fault Mode and Final Fault State - *C.Chxx.RampToFault*

For more information on using module tags, see Module Tag Definitions on page 129.

Data Echo

Data Echo automatically sends channel data values that match the analog value that was sent to the module's screw terminals then.

A FLEX 5000 analog output module returns a value that was sent to it by the owner-controller. The echoed value is indicated in the *I.Chxx.Data* and is represented in Engineering Units.

Fault and status data are also sent. This data is sent at the RPI.

No Load Detection

No Load Detection detects when a wire is disconnected from the channel or a missing load for each output channel.

IMPORTANT This feature is available only in Current (mA) mode.

The output range used with a FLEX 5000 analog output module determines the current below which a load is considered missing. For example, if an operating 5094-OF8 uses the 4...20 mA output range, the presence of a no load condition is detected when the channel is connected to a load that draws less than 4 mA.

The *I.Chxx.NoLoad* tag indicates the presence of a no load condition when it is set to 1.

The No Load Detection feature is disabled by default. You must enable the feature in your Studio 5000 Logix Designer application project. To enable No Load Detection, you must change the *C.Chxx.NoLoadEn* tag to 1.

For more information on using module tags, see Module Tag Definitions on page 129.

Short Circuit Protection

Short Circuit Protection prevents damage that can result from driving a current from the channel greater than the maximum current level the channel can handle.

IMPORTANT This feature is available only in Voltage (V) mode.

When a short circuit condition is detected, the following occurs:

- The output turns off.
- The *I.Chxx.ShortCircuit* tag is set to 1.

For more information on using module tags, see Module Tag Definitions on page 129.

For more information on the maximum current that you can apply to an output, see the FLEX 5000 Module Specifications Technical Data, publication 5094-TD001.

Over Temperature Detection

The Over Temperature Detection feature indicates that the temperature of the conditions within which the module is operating are higher than the module operating limits.

When an Over Temperature condition exists, the *I.Chxx.OverTemperature* tag is set to 1.

Field Power Loss Detection

The Field Power Loss Detection feature monitors for the loss of power at an output module channel. When field power to the module is lost, a channel-level fault is sent to the controller to identify the exact channel faulted.

Field Power Loss Detection has a corresponding tag that can be examined in the user program if a fault occurs. For information on modules, see Module Tag Definitions on page 129.

To see where to enable or disable field power detection, see page 86.

Fault and Status Reporting

The FLEX 5000 analog output modules send fault and status data with channel data to the owner and listening controllers. The data is returned via module tags that you can monitor in your Studio 5000 Logix Designer application.

With some exceptions, as noted in the following table, the FLEX 5000 analog output modules provides the fault and data status in a channel-centric format.

Table 26 lists the FLEX 5000 analog output modules's fault and status tags available in the Studio 5000 Logix Designer application.

Table 26 - 5094-OF8 Module- Fault and Status Data Tags

Data Type	Tag Name	Triggering Event That Sets Tag
Fault	ConnectionFaulted(1)	The owner-controller loses its connection to the module.
	Chxx.Fault	The channel data quality is bad.
	Chxx.NoLoad	A no load condition exists on the channel.
	Chxx.ShortCircuit	A short circuit condition exists on the channel.
	Chxx.OverTemperature	The module is at a higher temperature than its rated operating limits.
Status	RunMode(1)	The module is in Run Mode.
	DiagnosticActive	Indicates if any diagnostics are active or if the prognostics threshold is reached.
	DiagnosticSequenceCount	A counter that increments when a diagnostic condition occurs or goes away. The counter is a rolling counter that skips 0 on rollovers.
	Chxx.Uncertain	The channel data can be imperfect.
	Chxx.FieldPowerOff	Field power is not present on the channel.
	Chxx.InHold	The channel is holding until the received channel data is within 0.1% of the current channel data value.
	Chxx.NotANumber	The most recently received data value was not a number.
	Chxx.LLimitAlarm	The following conditions exist: • Alarms are enabled on this channel. • The channel data requested, indicated in the *O.Chxx.Data* tag, is currently less than the configured LowLimit or the alarm is latched.
	Chxx.HLimitAlarm	The following conditions exist: • Alarms are enabled on this channel. • The channel data requested, indicated in the *O.Chxx.Data* tag, is currently greater than the configured HighLimit or the alarm is latched.
	Chxx.RampAlarm	The channel is currently limited to changing the output at the Maximum Ramp rate or once was and is now latched.
	Chxx.Data	The channel data in scaled Engineering Units. This data is the Output Data Echo data returned from the D/A converter.
	Chxx.RollingTimestamp	15-bit timestamp that 'rolls' from 0...32,767 ms. Compatible with existing PID instruction to calculate sample deltas automatically.

(1) This tag provides module-wide data and affects all channels simultaneously.

Notes:

Safety I/O Module Features

This chapter describes features that are specific to FLEX 5000 safety I/O modules. FLEX 5000 safety I/O modules have additional items to be aware of. Type approval, certification, and suitability for use in safety applications vary by catalog number.

These modules can be used with GuardLogix 5580 and Compact GuardLogix 5380 safety controllers in applications up to SIL 3, PLe, Cat. 4 in single-channel and dual-channel configurations. The SIL rating for the channel (SIL 1, SIL 2, SIL 3) depends on the device connected to the channel.

These restrictions apply to the modules:

- Type-approved and certified for use in safety applications up to and including SIL 3 per IEC 61508
- Suitable for use in safety applications up to and including SIL CL 3 per IEC 62061
- Suitable for use in safety applications up to and including Performance Level e (PLe), category 4 per ISO 13849-1

The Studio 5000 Logix Designer application, version 33.00 or later, is the configuration and programming tool for these modules.

IMPORTANT	TÜV Rheinland has approved GuardLogix 5580 and Compact GuardLogix 5380 controller systems for use in safety-related applications where the de-energized state is always considered to be the safe state.

IMPORTANT	Functional safety certification and performance of FLEX 5000 safety I/O modules requires that the modules operate in conditions at or below the ambient operating temperature specification. The Probability of Failure on Demand (PFD) and average frequency of a dangerous failure per hour (PFH) calculations for these modules are based on the module operating conditions adhering to the ambient operating temperature specification. For more information on the maximum ambient operating temperature specification for FLEX 5000 safety I/O modules, see the FLEX 5000 Module Specifications Technical Data, publication 5094-TD001.

IMPORTANT	Requirements are based on the ISO standards that are current at the time of certification. For more information on safety application suitability levels with the FLEX 5000 safety I/O modules, see Safety Application Suitability Levels on page 70.

Safety Application Suitability Levels

Table 27 describes the safety application suitability levels for a 5094-IRT8S and 5094-IRT8SXT module.

Table 27 - Safety Application Suitability for 5094-IRT8S and 5094-IRT8SXT Modules

Suitability Level	Conditions	Notes
Applications that are rated up to, and including, SIL CL3, PLe, Cat.4, as defined in IEC 61508, IEC61551, IEC 62061, and ISO 13849-1	• Input is Thermocouple, RTD 2-wire or RTD 3-wire – Use other measures against external wiring faults. • Input is RTD 4-wire – Use 2 channels and cross compare the data using ladder logic. – Use other measures against external wiring faults. • Use sheathed cable or cable trunk to separate channel wiring to mitigate short-circuit faults.	Consider the following: • To achieve SIL CL3 single-channel, the sensor that is used must be SIL CL3 single-channel as well. • The safety I/O module provides diagnostics to a specific Suitability Level with conditions. The larger safety system within which the safety I/O module resides can provide the diagnostic necessary to achieve the stated Suitability Level without the conditions imposed by the safety I/O module. To achieve the specific Safety Integrity Level, see Application/Wiring Examples for Safety I/O Modules on page 155.

Safety Considerations for Module Firmware

Verify that the firmware revision of the device is correct before commissioning the system.

IMPORTANT
- Safety Consideration You must inhibit a safety I/O module before updating its firmware with ControlFLASH™ software.
- We recommend that you wait three minutes before using the module after a firmware update via ControlFLASH.

Firmware information for safety I/O devices is available at the Rockwell Automation Product Compatibility and Download Center (PCDC).

Only download firmware and access product release notes from the (PCDC).

Do not download firmware from non-Rockwell Automation sites.

ATTENTION: Safety Function During Firmware Update
The FLEX 5000 I/O safety modules are not safety capable when a firmware update is in process. You must use other methods to maintain the safety function during the update process.

Single-channel or Dual-channel Mode

You can use FLEX 5000 safety I/O modules in single-channel mode or dual-channel configuration. The configuration affects the safety application suitability level for a module.

In single-channel mode, the signal status on one channel is evaluated. Based on that status, safety input data and safety input status can be off or on.

In dual-channel mode, the consistency between the signal status on two channels is evaluated in the controller. Based on the status on both channels, safety input data and safety input status can be off or on. This consistency check needs to be conducted in the controller with the Dual Channel Analog Input instruction. The Dual Channel Analog Input instruction monitors two analog input channels originating from an analog input module. Output 1 turns on when both analog inputs, Channel A and Channel B, are within the Tolerance and the High and Low Limit settings, and correct reset actions have been performed

Determine Conformity

ATTENTION: Use only appropriate components or devices that comply with the relevant safety standards and meet the required safety integrity level or performance level and safety category.

- Conformity to the requirements of the relevant safety standards must be determined for the entire system by conducting a risk assessment.
- Use devices properly according to the installation environment, performance rating, and functions of the machine.
- Use devices within their specified ratings.
- We recommend that you consult a certification body regarding assessment of conformity to the required safety integrity level or performance level.

You are responsible for confirming compliance with the applicable standards for the entire system. You must read, understand, and fulfill the functional safety requirements of the standard applicable to your safety application.

Safety Precautions

ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in the use of the system.

Observe these precautions for the proper use FLEX 5000 safety I/O modules.

ATTENTION: As serious injury can occur due to loss of required safety function, follow these safety precautions.

- Do not use standard I/O data or explicit message data as safety data.
- Do not use light-emitting diode (LED) status indicators on the I/O modules for safety operations.
- Do not connect loads beyond the rated value to the safety outputs.
- Apply properly specified voltages to the module. Applying inappropriate voltages can cause the module to fail to perform its specified function, which could lead to loss of safety functions or damage to the module.
- Wire the FLEX 5000 safety I/O modules as shown in the FLEX 5000 Module Specifications Technical Data, publication 5094-TD001.
- Set unique network node addresses before connecting devices to the network.
- Perform testing to confirm that device wiring, configuration, and operation is correct before starting system operation.
- Do not disassemble, repair, or modify the module. This can result in loss of safety functions.

Installing and Replacing Modules

ATTENTION:

- Clear previous configuration data before connecting devices to the network or connecting input or output power to the device.
- Configure the replacement device properly and confirm that it operates correctly.
- After installation of the module, a safety administrator must confirm the installation and conduct trial operation and maintenance.

Safety Application Requirements

Safety application requirements include evaluating the following:

- Probability of failure rates (PFD and PFH)
- System reaction time settings
- Functional verification tests that fulfill appropriate safety-level criteria

Creating, recording, and verifying the safety signature is also a required part of the safety application development process. The safety controller creates the safety signatures. The safety signature consists of an identification number, date, and time that uniquely identifies the safety portion of a project. This number includes all safety logic, data, and safety I/O configuration.

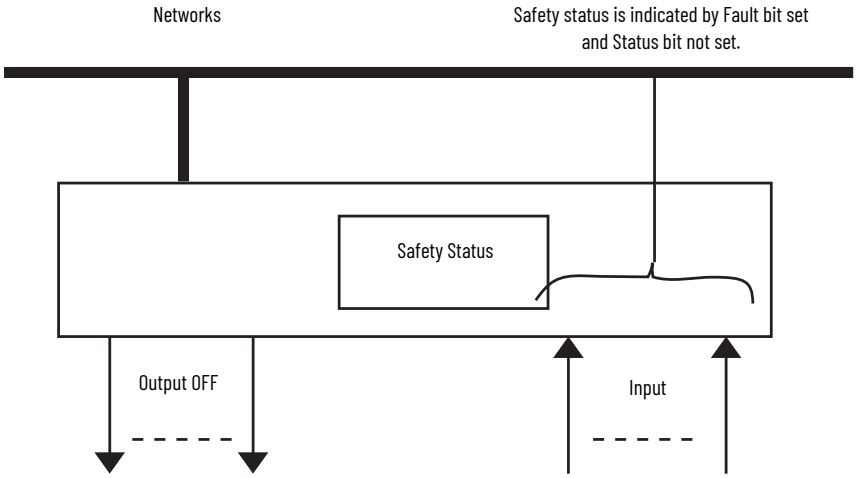
For safety system requirements, including information on the safety network number (SNN), verifying the safety signature, functional verification test intervals, system reaction time, and PFD/PFH calculations, see the GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Reference Manual, publication 1756-RM012.

You must read, understand, and fulfill the requirements that are described in this publication before you operate a safety system that uses FLEX 5000 safety I/O modules.

Safe State

ATTENTION: The channel safe state is defined as Chxx.Fault is 1 and Chxx.Status is 0. You must validate the data using the safety status before use.

Figure 7 - Safety Status



IMPORTANT If you inhibit a safety module from transitioning to a safe state when a fault occurs because an I/O connection is lost, you accept responsibility for any consequences that result from your decision to inhibit.

We recommend that you use other means to maintain the safe state if you inhibit the safety module from transitioning to a safe state.

Configuration Signature and Ownership

Every FLEX 5000 I/O safety module in a system has a configuration signature and configuration ownership.

Configuration Signature

Each safety device has a unique configuration signature that defines the module configuration. The configuration signature includes the following:

- ID number
- Date
- Time

The configuration signature is used to verify a module's configuration.

IMPORTANT	The signature can only be considered "verified" (and configuration locked) after user testing.

Configuration Ownership

The connection between the owner-controller and the FLEX 5000 I/O safety module is based on the following:

- FLEX 5000 I/O safety module node number
- FLEX 5000 I/O safety module safety network number
- Controller node or slot number

IMPORTANT	If the owner-controller is a Compact GuardLogix 5380 controller, the controller has a node number. If the owner-controller is a GuardLogix 5580 controller, the controller has a slot number.

- Controller safety network number
- Path from the controller to the FLEX 5000 I/O safety module
- Configuration signature

If any differences are detected, the connection between the owner-controller and the FLEX 5000 I/O safety module is lost, the yellow yield icon appears in the controller project tree.

Different Configuration Owner

When a controller owns the I/O module configuration, other controllers can listen to the input module. In this case, the module configuration signature in the Studio 5000 Logix Designer project for any listening controller must match the one in the owner-controller project.

If the safety module is configured for inputs only, you can copy and paste the configuration signature from one project to the other.

If the safety module has safety outputs, the configuration signature parameter is disabled.

Reset FLEX 5000 safety I/O Modules to Out-of-Box State

If a FLEX 5000 safety I/O module was used previously, you must clear the configuration ownership before you can install it on a safety network. That is, you must return the module configuration to its out-of-box state.

When a FLEX 5000 safety I/O module is in the out-of-box state, its configuration is not owned by a controller.

The Safety category on the Module Properties dialog box displays the module Configuration Ownership. The Studio 5000 Logix Designer application project must be online to check.

If the module configuration is owned, the Safety category displays whether the controller for the opened project owns the module configuration or another controller owns it.

For information on how to reset the module in the Studio 5000 Logix Designer application, see Reset to Out-of-Box Configuration on page 106.

You cannot reset the module to its out-of-box configuration if either of the following conditions is true:

- Pending edits to the module properties exist
- Safety signature exists in the controller project

Configure Standard Analog I/O Modules

This chapter describes how to configure these FLEX 5000 analog I/O modules in a Studio 5000 Logix Designer application project:

- 5094-IF8
- 5094-IF8XT
- 5094-IY8
- 5094-IY8XT
- 5094-OF8
- 5094-OF8XT

You can use the default module configuration or edit the module configuration.

IMPORTANT Consider the following:

- You must use the Studio 5000 Logix Designer application, version 31 or later, to configure the FLEX 5000 I/O modules. Version 31 or later is slightly different from previous programming software versions. For example, in some cases, instead of tabs across the top of the Module Properties dialog box, the application uses categories on the left side of the dialog box.
- This chapter does not explain the user-configurable module features that you can edit on different screens in your Studio 5000 Logix Designer application project.

For detailed information about module features, see the following:

- Common Analog I/O Module Features
- 5094-IF8 Analog Input Module Features
- Current/Voltage/Temperature-sensing (5094-IY8) and RTD/Thermocouple (5094-IRT8S) Analog Input Module Features
- 5094-OF8 Analog Output Module Features

When a controller establishes a connection to a 5094-IY8 module, it uses a Class 3 connection. We recommend that you reserve one Class 3 connection on the FLEX 5000 EtherNet/IP adapter to establish a connection to the module. Otherwise, you can encounter a "Connection Request Error: Module connection limit exceeded" error.

Before You Begin

You must complete the following tasks before you can configure the module:

1. Create a Studio 5000 Logix Designer application project.
2. Add a FLEX 5000 EtherNet/IP adapter to the project.

   For more information on how to add a FLEX 5000 EtherNet/IP adapter to a Studio 5000 Logix Designer application project, see FLEX 5000 EtherNet/IP Adapter User Manual, publication 5094-UM005.

Create a New Module

After you create a Studio 5000 Logix Designer application project and add a FLEX 5000 EtherNet/IP adapter to the project, you can use the following methods to add modules to the project.

- Discover Modules
- New Module

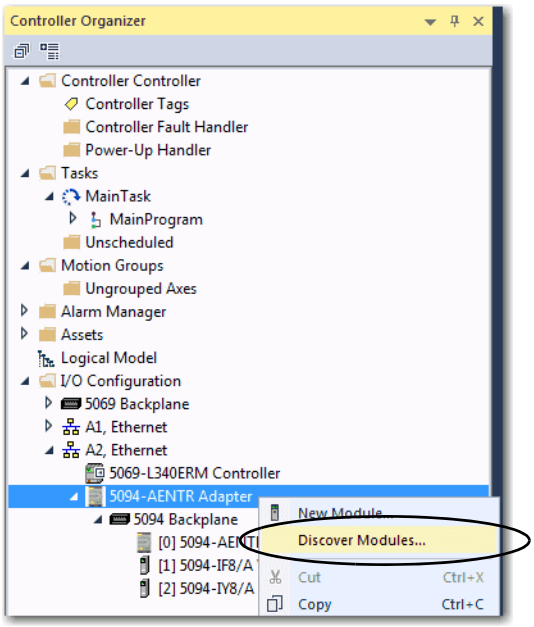
Discover Modules

To use the Discover Modules method with FLEX 5000 I/O modules, complete these steps.

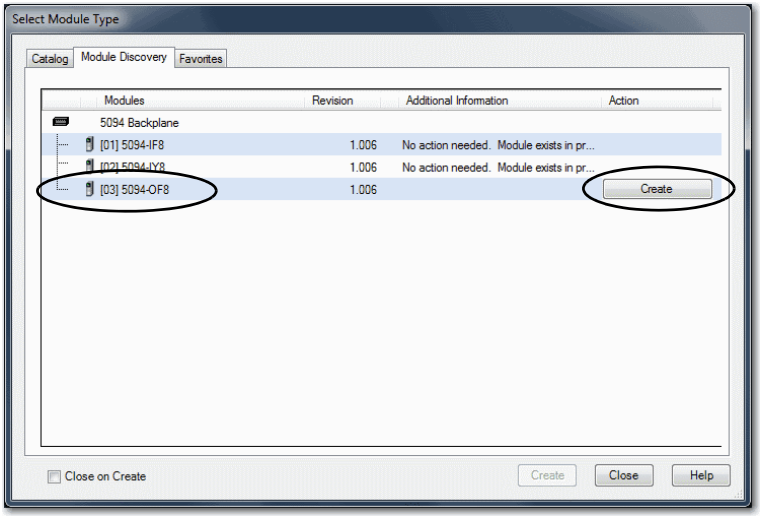
1. Go online with your Studio 5000 Logix Designer application.

   The project must include a FLEX 5000 EtherNet/IP adapter.
2. Right-click the FLEX 5000 EtherNet/IP adapter and choose Discover Modules.

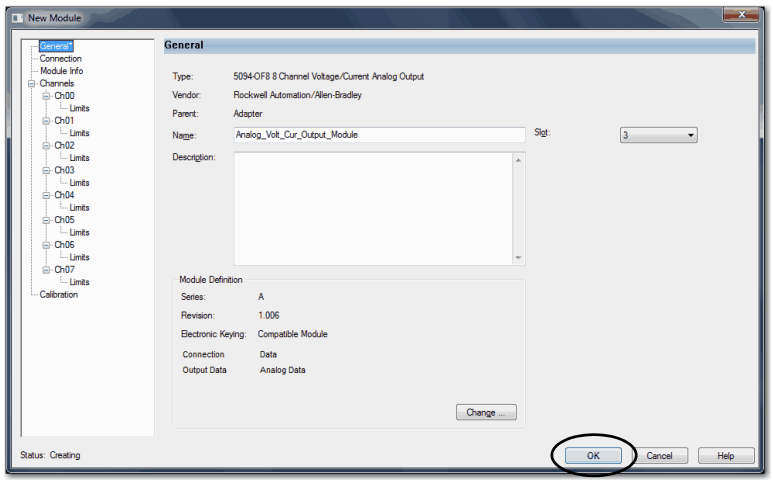
   The Studio 5000 Logix Designer application automatically detects available modules that are connected to the backplane.



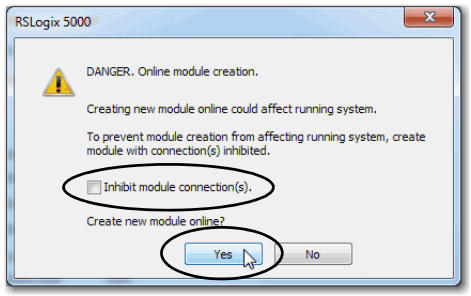
3. At the Select Module Type window, click Create to add the discovered module to your project.



4. At the New Module window, configure the module properties and select OK.



5. At the warning dialog box, make sure that Inhibit module connection(s) is selected and click Yes.



6. Close the Select Module Type dialog box.

To add additional I/O modules with this method, complete one of the following:

- If you cleared the Close on Create check box when you created the first I/O module, repeat Step 3...Step 6.
- If you did not clear the Close on Create checkbox when you created the first I/O module, repeat Step 2...Step 6.

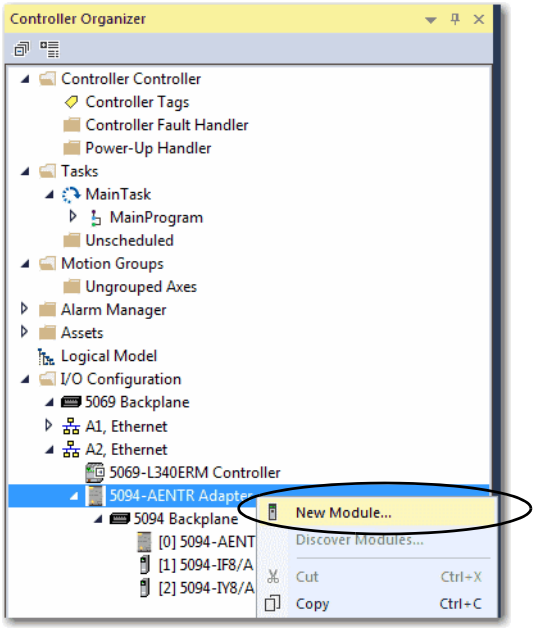
New Module

To use the New Module method with FLEX 5000 I/O modules, complete these steps.

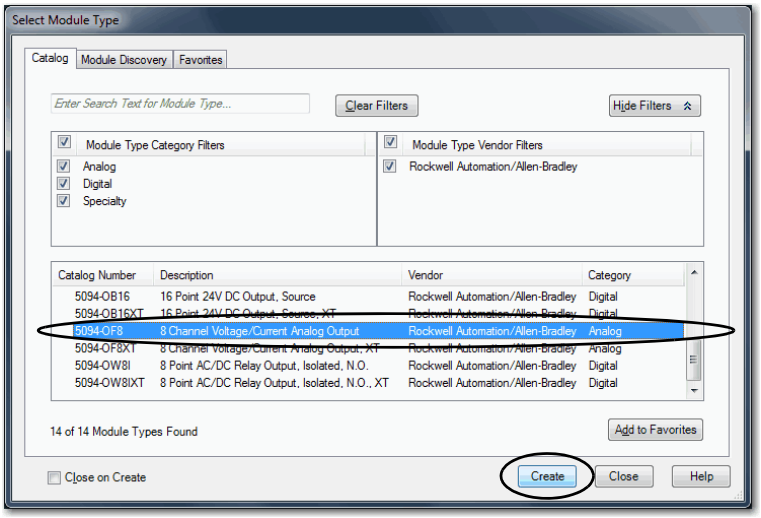
This example shows how to add an I/O module when the Studio 5000 Logix Designer application project is offline.

You can add new modules when the project is online, if desired. In this case, the steps are similar to the steps described in Discover Modules on page 76. One exception is that, in step 1, you choose New Module instead of Discover Modules.

1. Right-click FLEX 5000 EtherNet/IP adapter and choose New Module.

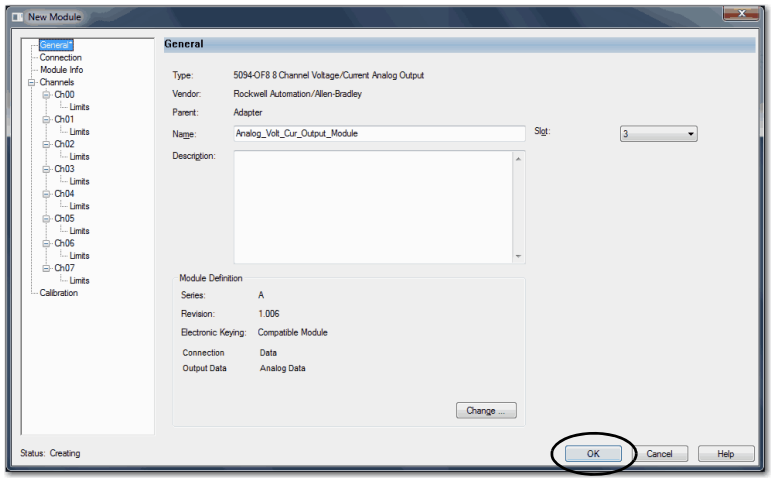


2. Select the module and click Create.



The New Module dialog box appears. It includes a list of categories on the left side. The number and type of categories varies by module type.

3. You can click OK to use the default configuration as shown or edit the module configuration. The rest of this chapter describes how to edit module configuration categories.



To add additional remote I/O modules with this method, complete one of the following:

- If you cleared the Close on Create checkbox when you created the first I/O module, repeat Step 2...Step 3.
- If you did not clear the Close on Create checkbox when you created the first I/O module, repeat Step 1...Step 3.

Edit the Module Configuration Common Categories

You click the category names in the New Module dialog box to view and change the configuration parameters that are associated with that module.

IMPORTANT	This chapter shows how to edit configuration when you add the module to the Studio 5000 Logix Designer application project. If you access the module configuration after it has been added to the project, the dialog box is named Module Properties. The Module Properties dialog box shows the same categories as the New Module dialog box.

Some new module configuration categories apply to all FLEX 5000 analog I/O modules. Some categories are specific to the module type.

For example purposes, the figures in this section are from a 5094-IF8 module.

The following categories apply to all FLEX 5000 analog I/O modules and are described in this section:

- General Category
- Connection Category
- Module Info Category

General Category

The General category appears first when you create a module. The parameters in this category are the same for all FLEX 5000 analog I/O modules.

You use this category to complete the following tasks:

- Name the module.
- Assign a slot number. (required)
- Describe the module.
- Access the Module Definition.

Module Definition

Module Definition parameters are available on the General tab of the Module Properties dialog box in the Studio 5000 Logix Designer application project.

Table 28 describes the parameters on the Module Definition dialog box.

IMPORTANT The graphic is an example of a Module Definition dialog box. The same set of fields and options are not available on all FLEX 5000 I/O modules.

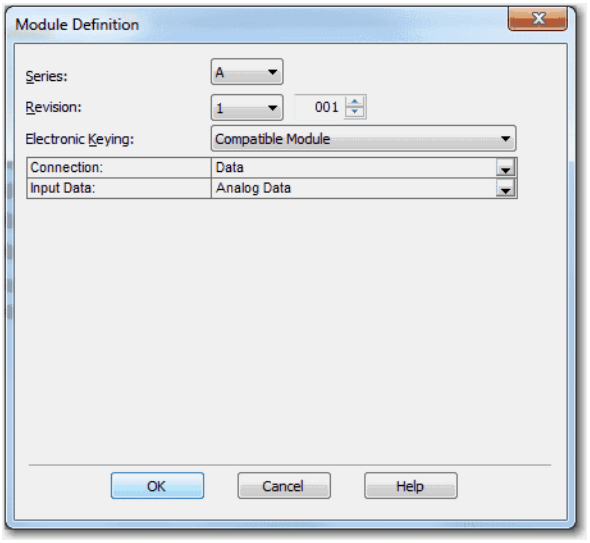


Table 28 - Module Definition Parameters

Parameter	Definition	Available Choices[1]
Series	Module hardware series	Module-specific
Revision	Module firmware revision, including major and minor revision levels	Module-specific
Electronic Keying	Software method by which you reduce the possibility of using the wrong device in a control system. For more information, see the following: • View the Module Tags on page 89 • Electronic Keying in Logix 5000 Control Systems Application Technique, publication LOGIX-AT001	Exact Match Compatible Module Disable Keying
Connection	Determines the following for the module type you configure: • Available configuration parameters • Data type transferred between the module and the controller • Which tags are generated when configuration is complete	Data with Calibration Data Listen Only[2]
Input Data - Input modules only	All available configuration, input, and output data for the input module that is being defined.	Analog Data
Output Data - Output module only	All available configuration, input, and output data for the output module that is being defined.	Analog Data None - This choice is available only if you use the Listen Only Connection choice.

(1) The range of available choices varies by module type.
(2) Controller and module establish communication without the controller sending any configuration or output data to the module. A full input data connection is established but depends on the connection between the owner-controller and the module.

Connection Category

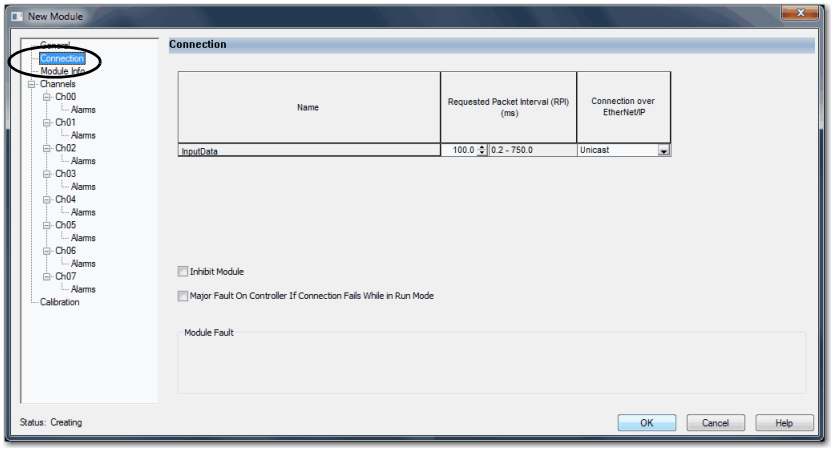
The Connection category lets you complete the following tasks:

- Set the RPI rate. For more information about the RPI, see Requested Packet Interval on page 20.
- Set the connection type to use on the EtherNet/IP network.

  For more information on Unicast and Multicast connections, see the FLEX 5000 EtherNet/IP Adapter User Manual, publication 5094-UM005.

- Inhibit the module. For more information on how to inhibit the module, see Module Inhibiting on page 29.
- Configure whether a connection failure while the controller is in Run module causes a major or minor fault.

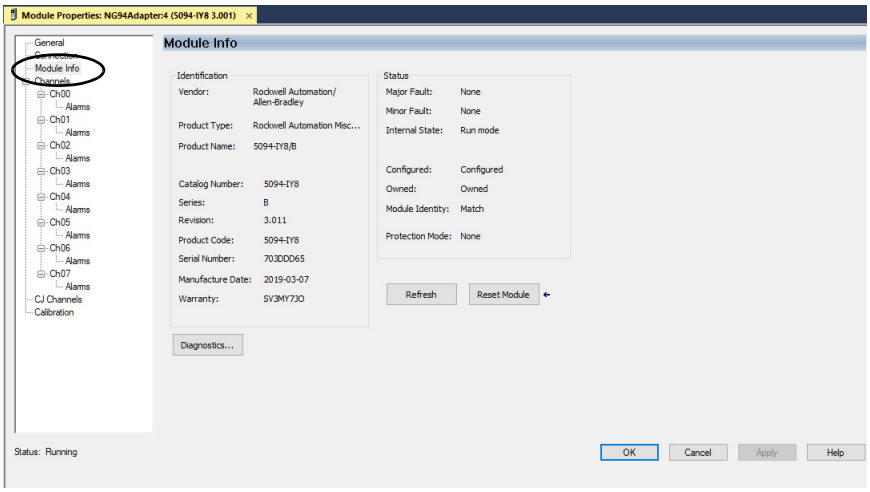
The Module Fault area of the Connection category is useful during module troubleshooting. For more information on the Module Fault area, see page 125



Module Info Category

The Module Info category displays module and status information about the module when the project is online. You can use this category to complete the following:

- Determine the identity of the module.
- Access module diagnostics
- Refresh the data on the screen
- Reset the module



Edit 5094-IF8 Module Configuration Categories

In addition to the General, Connection, and Module Info categories, the following categories are available when you configure a 5094-IF8 module:

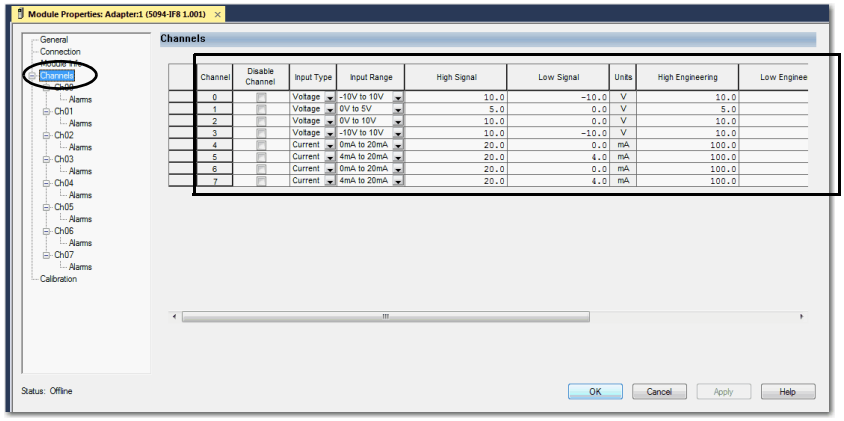
- Channels Category
- Calibration Category

IMPORTANT	If you use the Listen Only connection type, the Channels Category and Calibration Category do not appear.

Channels Category

The Channels category shows an overview of the configuration values for all module channels. The values for each parameter indicate how that particular channel is configured on that channel's category.

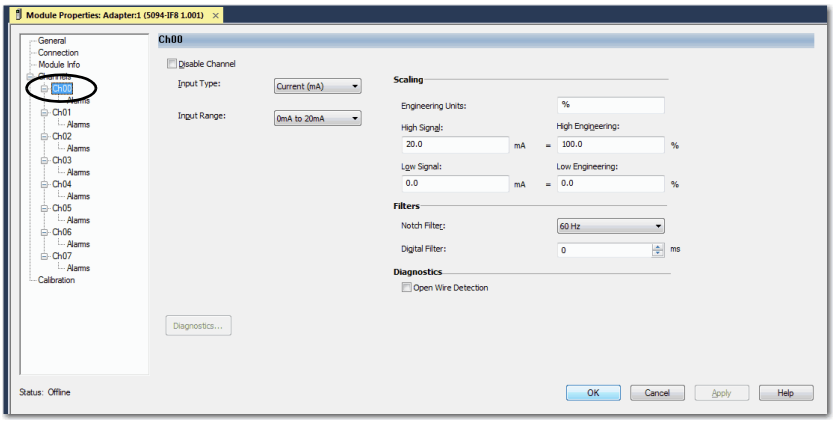
The following shows the Channels category for the 5094-IF8 module.



IMPORTANT	You can edit the fields on the Channels category dialog box. We recommend that you change channel configuration on the specific channel categories as described in the rest of this section. Use this view to monitor configuration for all channels on the module.

Chxx Category

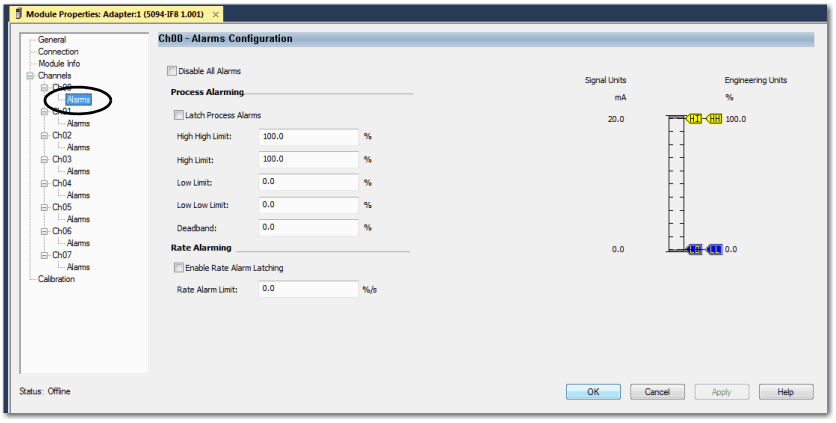
The Ch*xx* category, where *xx* represents the channel number, shows the configuration options available for the channel. The Scaling and Filter options correspond to the input type and range for the channel.



If desired, you can disable the channel on this dialog box.

Alarms Category

Each channel on the 5094-IF8 module has an Alarms category with which it is associated. The Signal Units correspond to the input type and range for the channel.

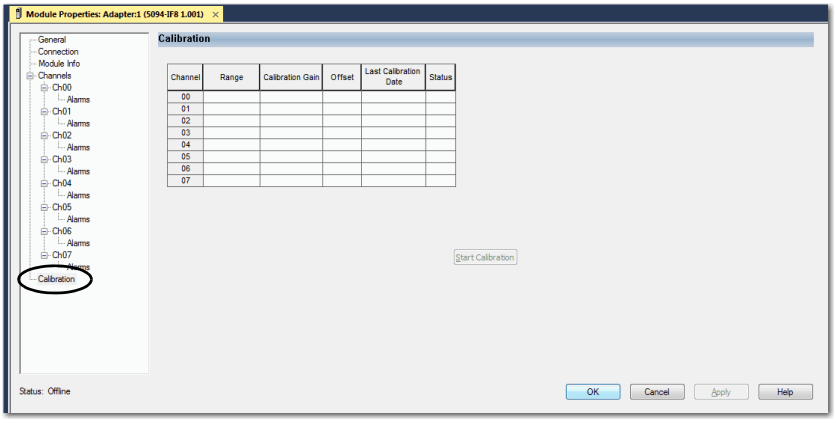


If desired, you can disable alarms on this dialog box.

Calibration Category

The Calibration category provides calibration information for all channels on the module. This category is blank when you add a module to the project.

Use this category during the calibration process. For more information on how to calibrate a module, see Calibrate the Modules on page 109.



Edit 5094-IY8 Module Configuration Categories

In addition to the General, Connection, and Module Info categories, the following categories are available when you configure a 5094-IY8 module:

- Channels Category
- CJ Channels Category
- Calibration Category

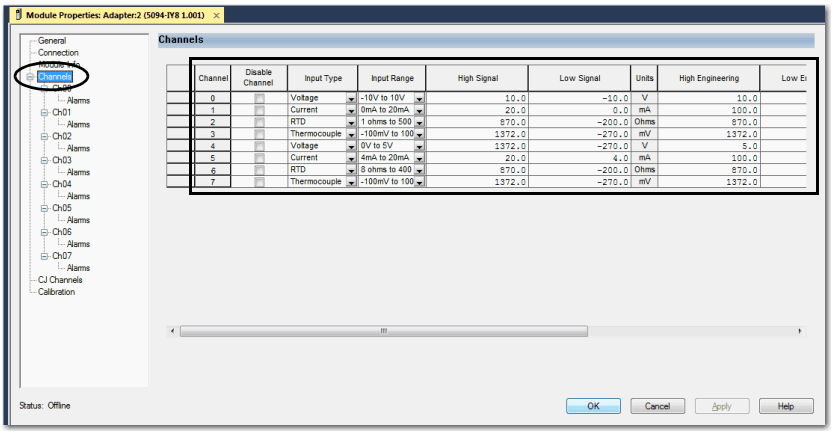
IMPORTANT If you use the Listen Only connection type, the Channels Category and Calibration Category do not appear.

Channels Category

The Channels category shows an overview of the configuration values for all module channels. The values for each parameter indicate how that particular channel is configured on that channel's category.

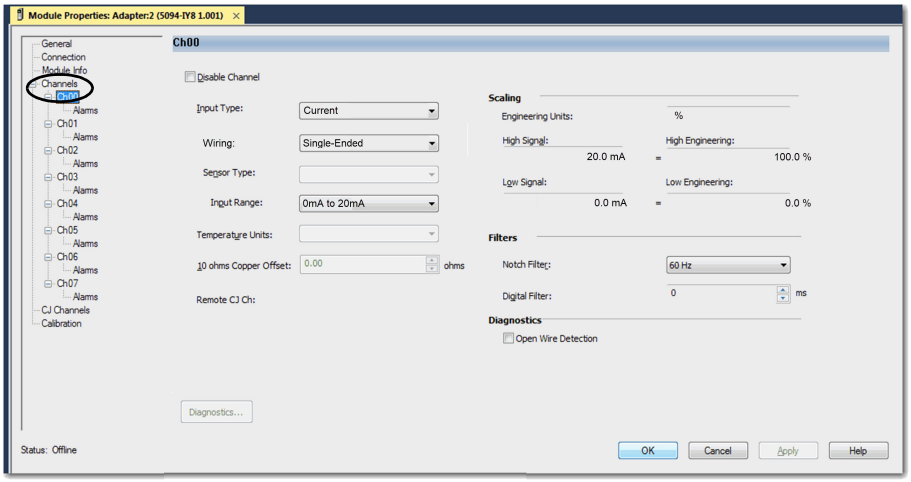
The following shows the Channels category for the 5094-IY8 module.

IMPORTANT	You can edit the fields on the Channels category dialog box. We recommend that you change channel configuration on the specific channel categories as described in the rest of this section. Use this view to monitor configuration for all channels on the module.



Chxx Category

The Ch*xx* category, where *xx* represents the channel number, shows the configuration options available for the channel. The Scaling and Filter options correspond to the input type and range for the channel.



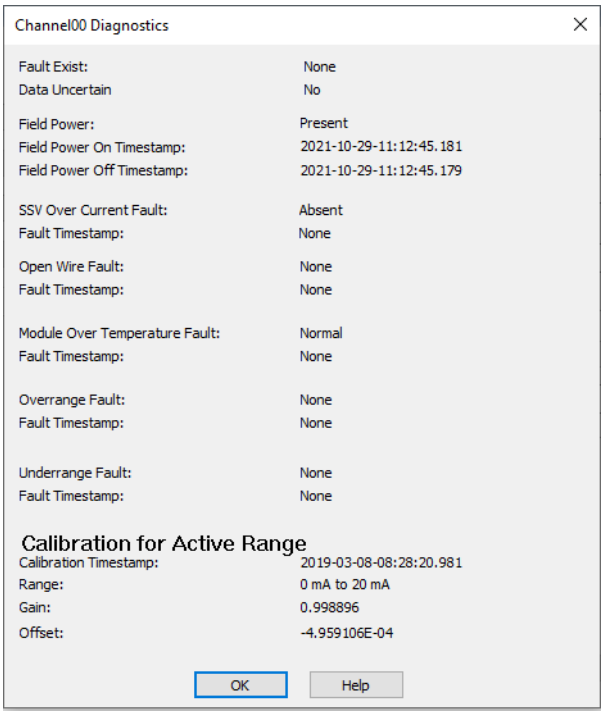
If desired, you can disable the channel on this dialog box.

Wiring parameter has two options. You must select one option based on your application:

- Single-Ended
  - For use in 2-wire or 3-wire voltage or current transmitter application where the transmitter power is taken from the 5094-IY8 module.
- Differential
  - For use in RTD or thermocouple mode.

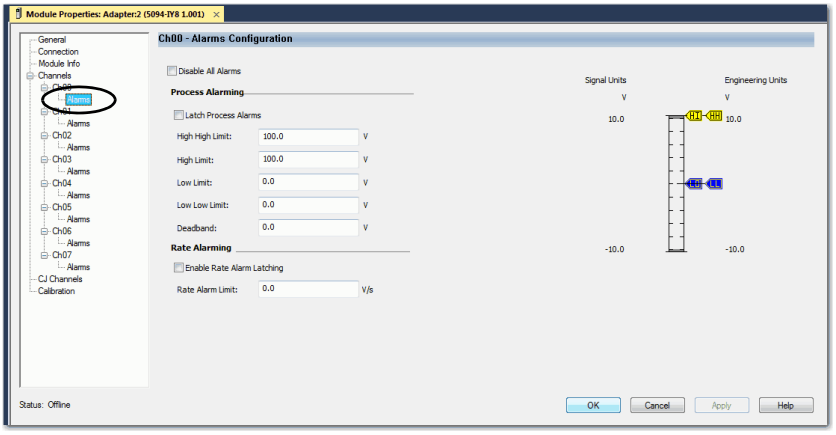
Channel Diagnostics Page

Displays the diagnostics channel information when connected with the module. When online with the module, click the Diagnostics button on the Chxx category to see diagnostic information.



Alarms Category

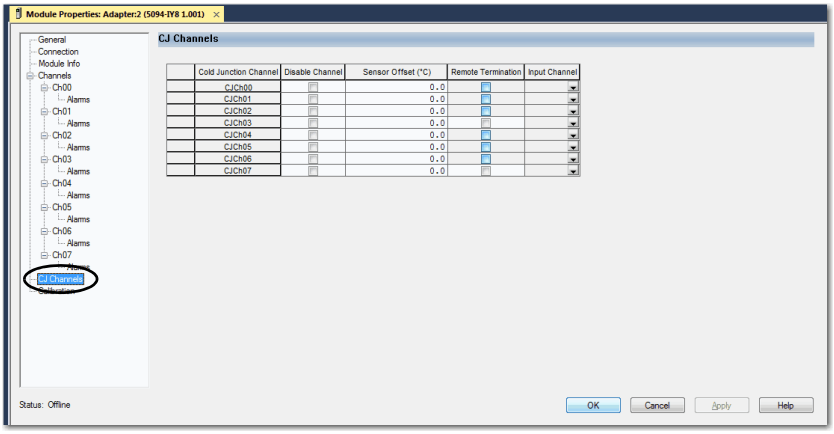
Each channel on the 5094-IY8 module has an Alarms category with which it is associated. The Signal Units correspond to the input type and range for the channel.



If desired, you can disable alarms on this dialog box.

CJ Channels Category

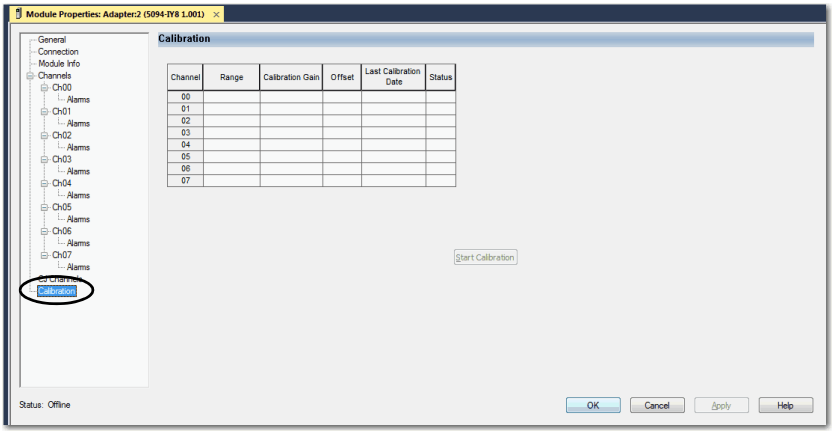
The CJ Channels category is used when you connect a module channel to a Thermocouple input type. You can select the input channel that is used as an external CJ channel.



Calibration Category

The Calibration category provides calibration information for all channels on the module. This category is blank when you add a module to the project.

Use this category during the calibration process. For more information on how to calibrate a module, see Calibrate the Modules on page 109.



Edit 5094-OF8 Module Configuration Categories

In addition to the General, Connection, and Module Info categories, the following categories are available when you configure a 5094-OF8 module:

- Channels Category
- Calibration Category

IMPORTANT If you use the Listen Only connection type, the Channels Category and Calibration Category do not appear.

Channels Category

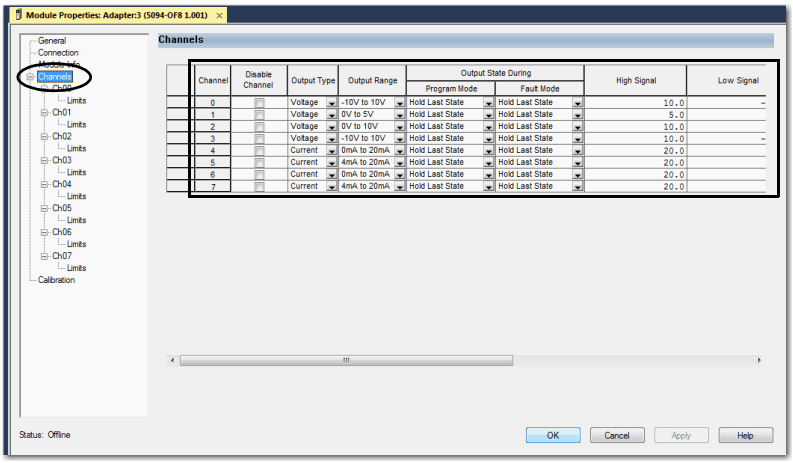
The Channels category shows an overview of the configuration values for all module channels. The values for each parameter indicate how that particular channel is configured on that channel's category.

The following shows the Channels category for the 5094-OF8 module.

IMPORTANT You can edit the fields on the Channels category dialog box.

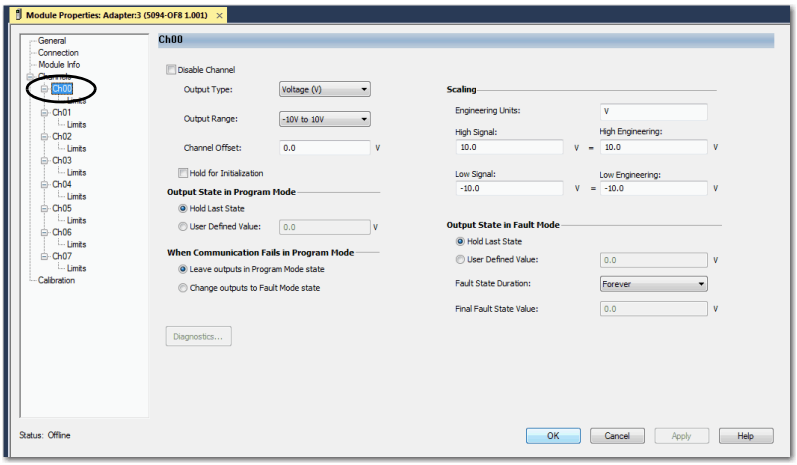
We recommend that you change channel configuration on the specific channel categories as described in the rest of this section.

Use this view to monitor configuration for all channels on the module.



Chxx Category

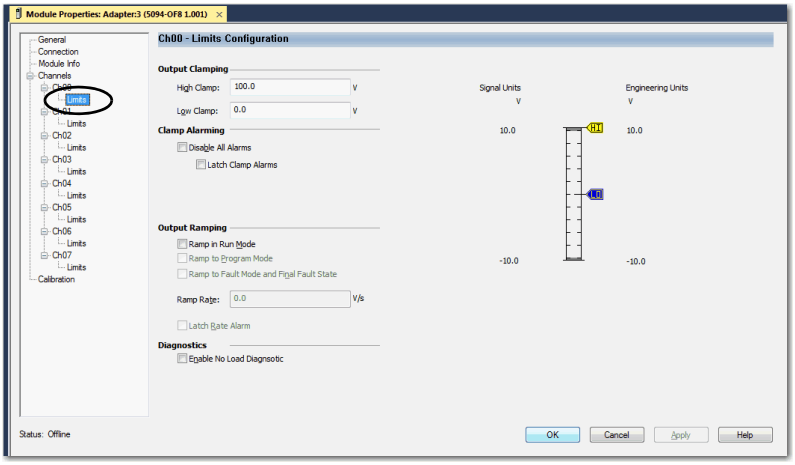
The Ch*xx* category, where *xx* represents the channel number, shows the configuration options available for the channel. The Scaling options correspond to the input type and range for the channel.



If desired, you can disable the channel on this dialog box.

Limits Category

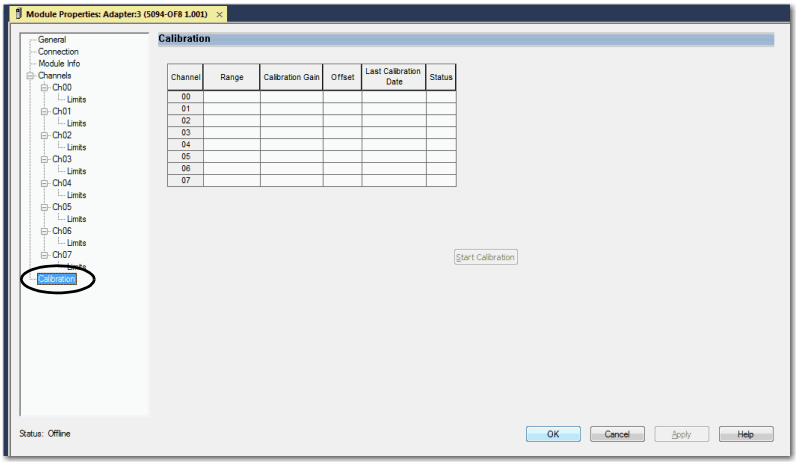
Each channel on the 5094-OF8 module has a Limits category with which it is associated. The Signal Units options correspond to the input type and range for the channel.



Calibration Category

The Calibration category provides calibration information for all channels on the module. This category is blank when you add a module to the Studio 5000 Logix Designer application project.

You use this category during the calibration process. For more information on how to calibrate a module, see Calibrate the Modules on page 109.

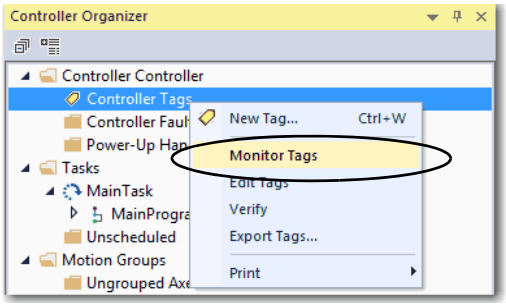


View the Module Tags

When you create a module, the Studio 5000 Logix Designer application creates a set of tags that you can view in the Tag Editor. Each configured feature on your module has a distinct tag that is available for use in the controller program logic.

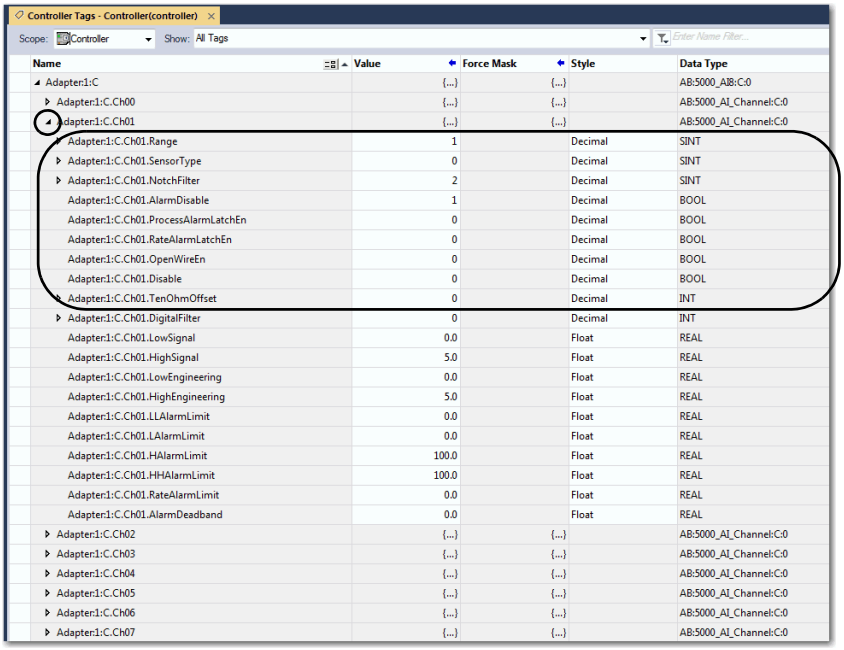
Complete the following steps to access the module tags.

1. In the Controller Organizer, right-click Controller Tags and choose Monitor Tags.



   The Controller Tags dialog box appears with data.

2. To view module tags as shown, click the ▷ symbols.



For more information on module tags, see Module Tag Definitions on page 129.

Notes:

Configure and Replace Safety Analog I/O Modules

This chapter describes how to configure your FLEX 5000 safety I/O modules in a Studio 5000 Logix Designer application project.

IMPORTANT	You must use the Studio 5000 Logix Designer application, version 33 or greater with the modules.

This chapter does not explain the user-configurable parameters, or corresponding module features, in your Studio 5000 Logix Designer application project.

IMPORTANT	By default, all safety input and output channels on FLEX 5000 safety I/O modules are disabled. You must configure each channel that is used in a safety application.

Before You Begin

You must complete the following tasks before you can configure the module:

1. Create a Studio 5000 Logix Designer application project.
2. If you use the FLEX 5000 safety I/O modules as remote I/O modules, add a FLEX 5000 I/O EtherNet/IP adapter to the project.

   For more information on how to add a FLEX 5000 I/O EtherNet/IP adapter to a Studio 5000 Logix Designer application project, see the FLEX 5000 EtherNet/IP Adapter User Manual, publication 5094-UM005.

Once the project is created and, if necessary, the adapter is added, you can create a new module in the Studio 5000 Logix Designer application project.

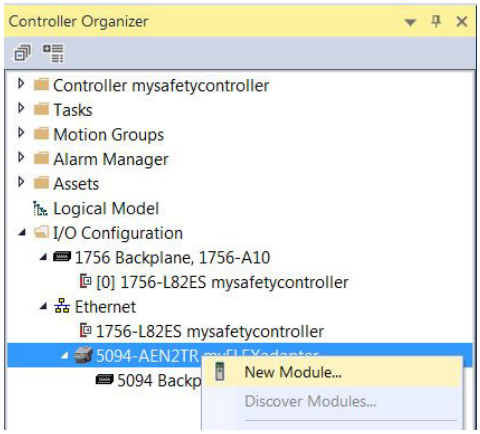
Create a New Module

Unlike FLEX 5000 standard I/O modules, you cannot add FLEX 5000 safety I/O modules to a Studio 5000 Logix Designer project while the project is online. The project must be offline to add FLEX 5000 safety I/O modules to it.

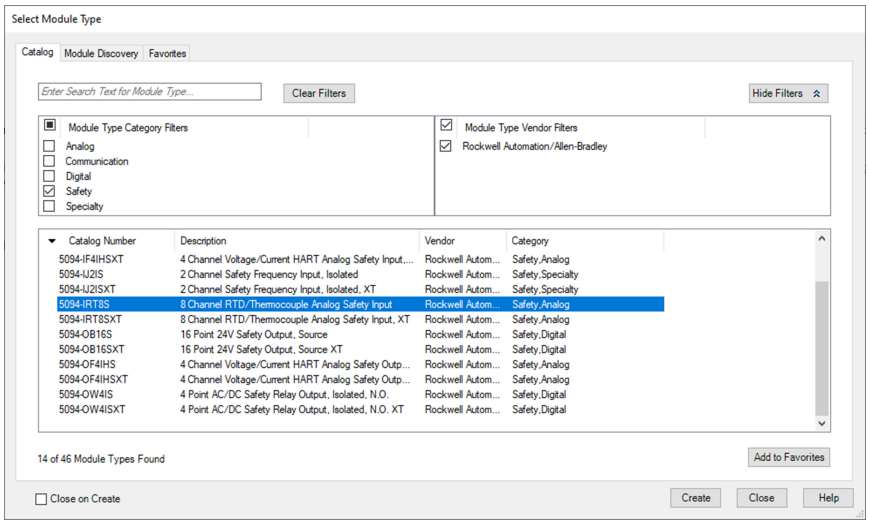
To create a new FLEX 5000 safety I/O module, complete these steps.

1. Add a FLEX 5000 I/O EtherNet/IP adapter to the project.

   This example uses a 5094-AENTR or 5094-AEN2TR adapter.
2. Right-click the FLEX 5000 I/O EtherNet/IP adapter and choose New Module.

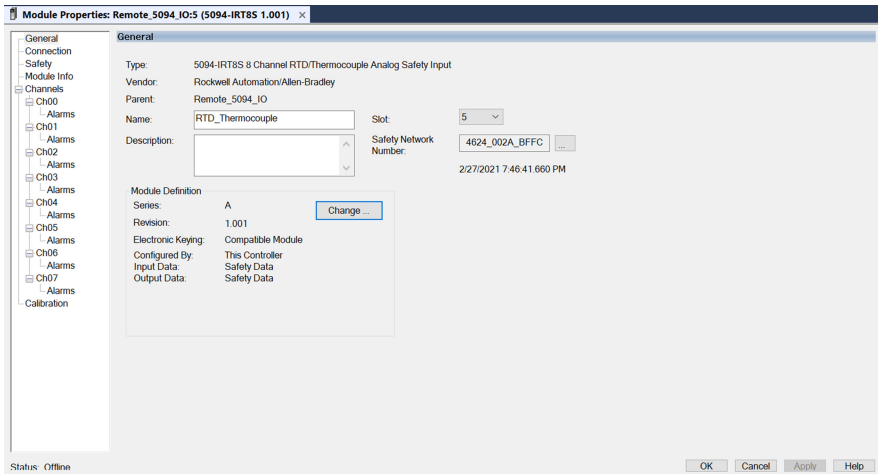


3. Select the module and click Create.



The New Module dialog box appears with a list of categories on the left side. The number and type of categories varies by module type.

4. You can click OK to use the default configuration as shown or edit the module configuration. The rest of this chapter describes how to edit module configuration categories.



To add additional I/O modules with this method, complete one of the following:

- If you cleared the Close on Create checkbox when you created the first I/O module, repeat Step 3...Step 4.
- If you did not clear the Close on Create checkbox when you created the first I/O module, repeat Step 2...Step 4.

Edit the Module Configuration Common Categories

You click the category names in the New Module dialog box to view and change the configuration parameters. Before you edit the module configuration, consider the following:

- This chapter shows how to edit configuration when you add the module to the Studio 5000 Logix Designer application project.

  If you access the module configuration after it is added to the project, the dialog box is named Module Properties. The same categories are displayed as the categories displayed on the New Module dialog box.
- Some new module configuration categories apply to all FLEX 5000 analog safety I/O modules. Some categories are specific to the module type.

IMPORTANT By default, all safety input and output channels on FLEX 5000 safety I/O modules are disabled.

You must configure each point that is used in a Safety application.

The following categories apply to all FLEX 5000 analog safety I/O modules and are described in these sections:

- General Category
- Connection Category
- Safety Category
- Module Info Category

General Category

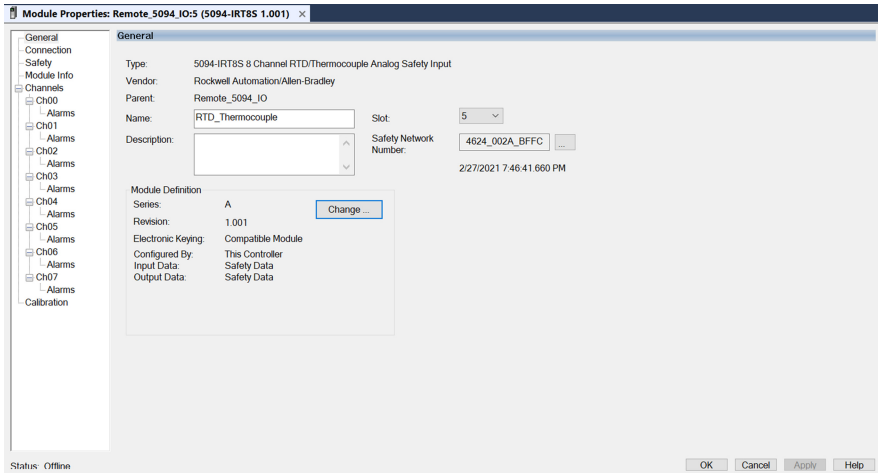
The General category appears first when you create a module. The parameters in this category are the same for all FLEX 5000 analog I/O modules.

You use this category to complete the following tasks:

- Name the module.
- Assign a node number.
- Describe the module.
- Access the Module Definition.

Safety Network Number

The Studio 5000 Logix Designer application automatically assigns a Safety Network Number (SNN) to FLEX 5000 safety I/O modules as they are added to the project.



The SNN is a time-based number that uniquely identifies subnets across all networks in the safety system. All FLEX 5000 safety I/O modules in a same system use the same SNN and are automatically assigned the same SNN by default.

The Studio 5000 Logix Designer application assigns an SNN to the first safety module that is added to a remote system. The application assigns the same SNN to additional safety modules that are added to this remote I/O system.

For more information on Safety Network Numbers, see the GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Reference Manual, publication 1756-RM012.

Module Definition

Module Definition parameters are available on the General tab of the Module Properties dialog box in the Studio 5000 Logix Designer application project.

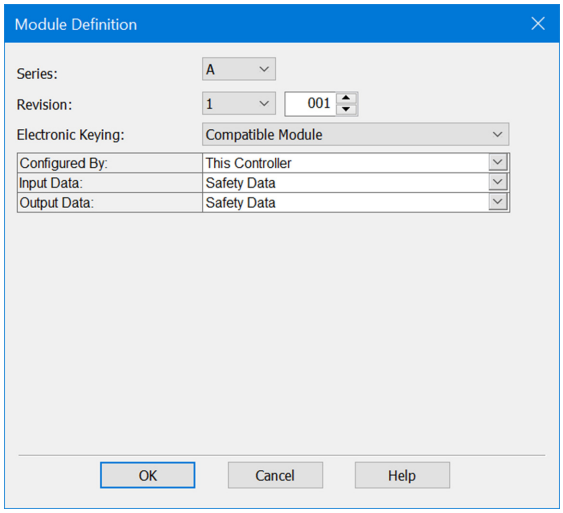


Table 29 describes the parameters that are available on the Module Definition dialog box.

Table 29 - Module Definition Parameters

Parameter	Definition	Available Choices
Series	Module hardware series	Module-specific
Revision	Module firmware revision, including major and minor revision levels	Module-specific
Electronic Keying	Software method by which you reduce the possibility of using the wrong device in a control system. For more information, see the following: • Electronic Keying on page 30 • Electronic Keying in Logix 5000 Control Systems Application Technique, publication LOGIX-AT001	• Exact Match • Compatible Module
Configured By	Determines the following for the module type you configure: • Which controller tags are generated when configuration is complete	• This Controller • External Means(1)
Input Data	Determines what type of input data is exchanged between the module and the controller. Creates all controller tags specific to the module type being used.	Safety data
Output Data	Determines what type of output data is exchanged between the module and the controller.	Safety data

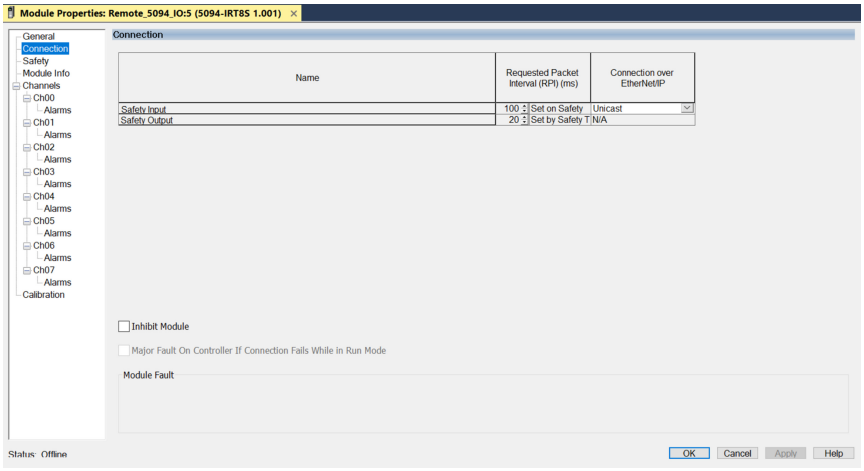
(1) Controller and module establish communication without the controller sending any configuration or output data to the module. A full input data connection is established but depends on the connection between the owner-controller and the module.

Connection Category

The Connection category lets you inhibit the module.

Before you inhibit the module, make sure that you are aware of the impact it has on your application. For more information on inhibiting the module, see Module Inhibiting on page 29.

IMPORTANT	Unlike FLEX 5000 standard I/O modules, you cannot set the RPI for FLEX 5000 safety I/O modules on the Connections category. For FLEX 5000 safety I/O modules, you set the RPI on the Safety category.



Connection Over the EtherNet/IP Network

Remote FLEX 5000 safety I/O modules support the Connection over EtherNet/IP parameter.

- With safety input data, you can choose Unicast or Multicast.
- With safety output data, you **must** choose Unicast.

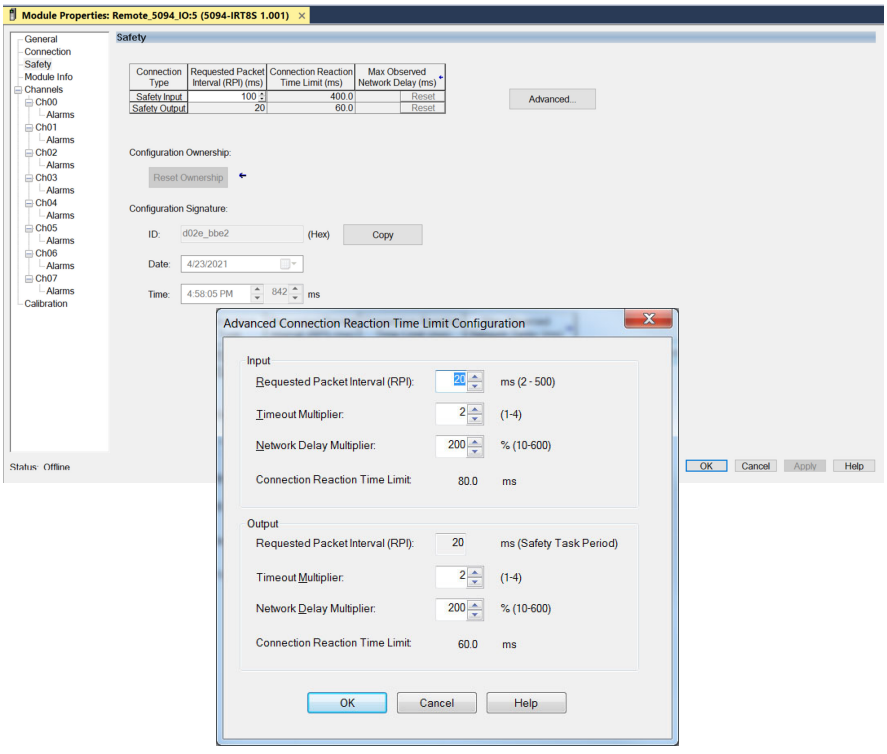
For more information on unicast and multicast connections, see the FLEX 5000 EtherNet/IP Adapter User Manual, publication 5094-UM005.

Safety Category

The Safety category lets you set the RPI rate.

To change the Connection Reaction Time Limit configuration, click Advanced.

IMPORTANT Remember, the Safety Task period determines the 5094-IRT8S module safety output connection RPI.

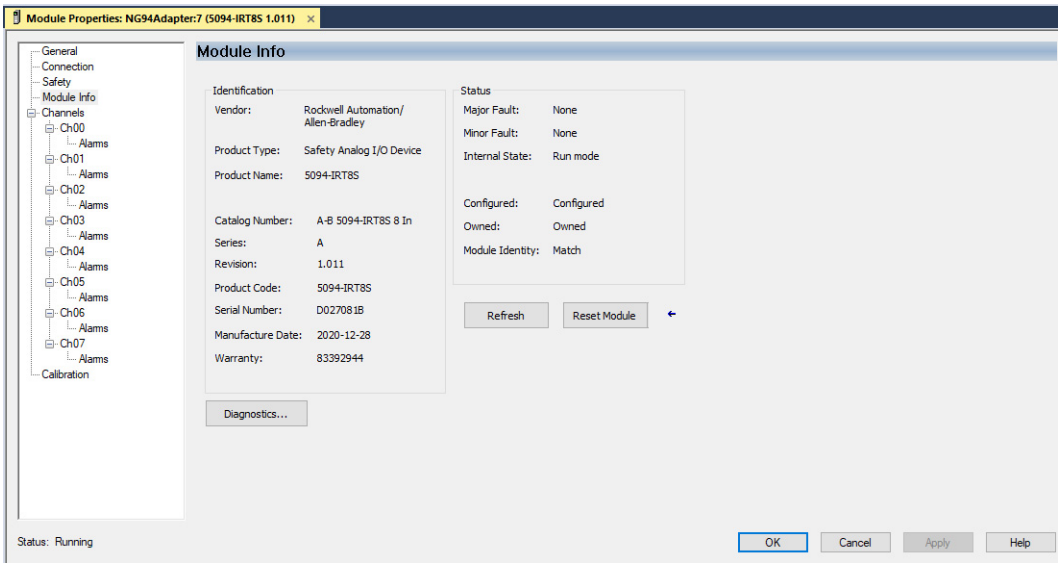


For more information on the RPI and the Connection Reaction Time Limit parameters, see Requested Packet Interval on page 20.

Module Info Category

The Module Info category displays module and status information about the module when the project is online. You can use this category to complete the following:

- Determine the identity of the module.
- Access module diagnostics.
- Refresh the data on the screen.
- Reset the module.



Edit 5094-IRT8S Module Configuration Categories

In addition to the General, Connection, and Module Info categories, the following categories are available when you configure a 5094-IRT8S module:

- Channels Category
- Calibration Category

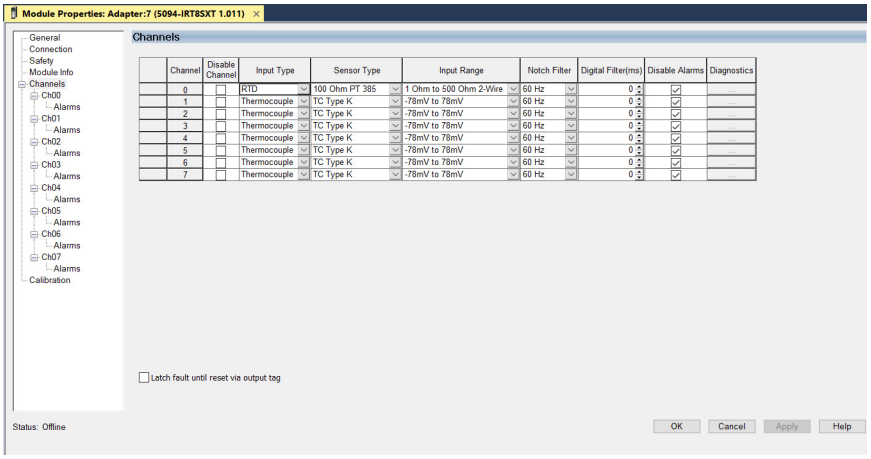
IMPORTANT	If you use the Listen Only connection type, the Channels Category and Calibration Category do not appear.

Channels Category

The Channels category shows an overview of the configuration values for all module channels. The values for each parameter indicate how that particular channel is configured on that channel's category.

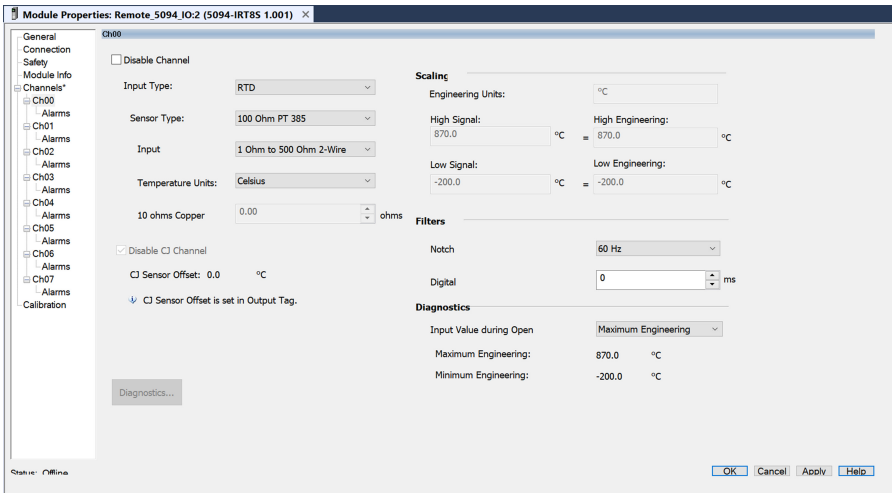
The following shows the Channels category for the 5094-IRT8S module.

IMPORTANT	You can edit the fields on the Channels category dialog box. We recommend that you change channel configuration on the specific channel categories as described in the rest of this section. Use this view to monitor configuration for all channels on the module.



Chxx Category

The Chxx category, where *xx* represents the channel number, shows the configuration options available for the channel. The Scaling and Filter options correspond to the input type and range for the channel. If desired, you can disable the channel on this dialog box.



CJ Sensor Offset

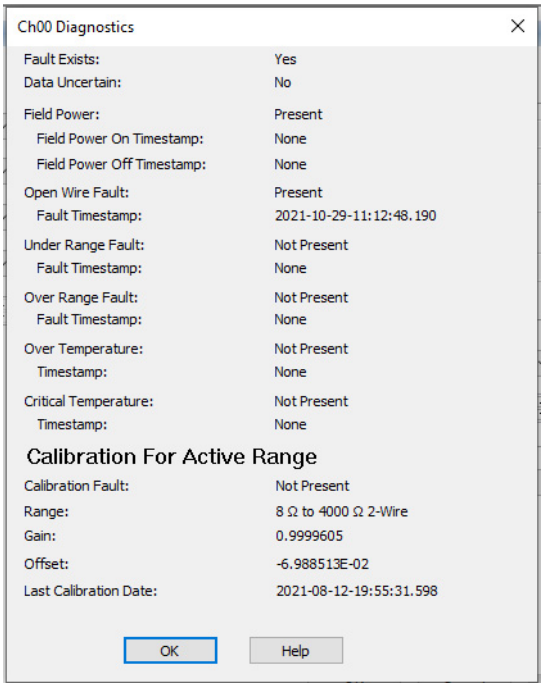
A user-defined offset in engineering units added directly into the measured data, used to compensate for inherent sensor offset. Commonly used with thermocouple sensors. You can also disable the CJ Channel.

When the 5094-IRT8S module is operating in environment where the temperature is outside thermocouple range, the channel can be faulted.

When the 5094-IRT8S module is operating in environment where the temperature is outside thermocouple range, the channel can be faulted.

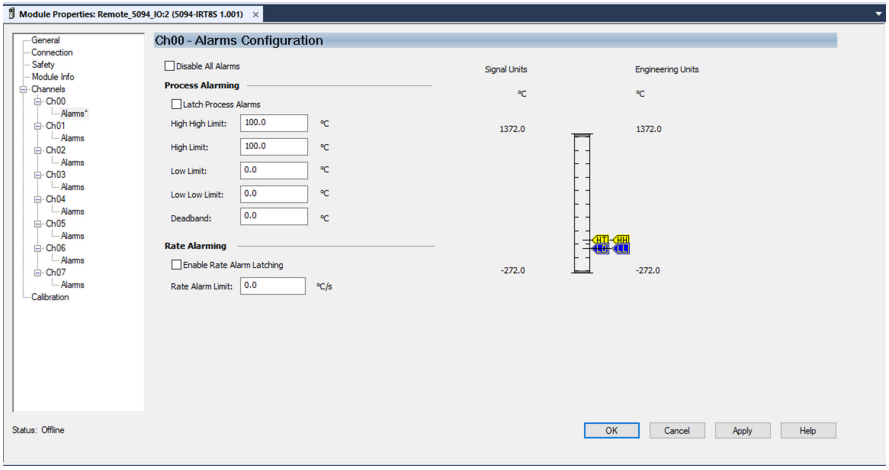
Channel Diagnostics Page

Displays the diagnostics channel information when connected with the module. When online with the module, click the Diagnostics button on the Chxx category to see diagnostic information.



Alarms Category

Each channel on the 5094-IRT8S module has an Alarms category with which it is associated. The Signal Units correspond to the input type and range for the channel.

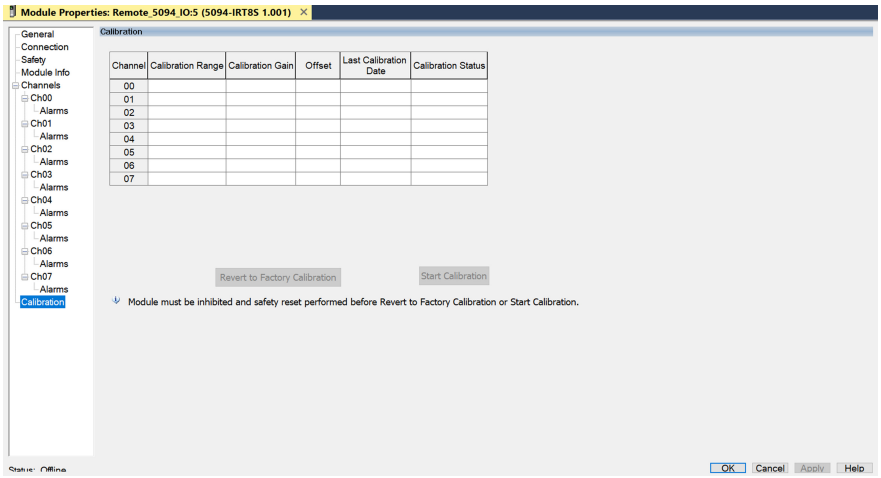


If desired, you can disable alarms on this dialog box.

Calibration Category

The Calibration category provides calibration information for all channels on the module. This category is blank when you add a module to the project.

Use this category during the calibration process. For more information on how to calibrate a module, see Calibrate a Safety Analog I/O Module on page 100.



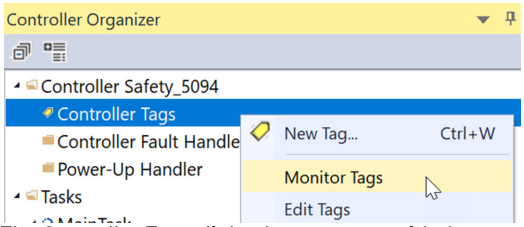
View the Module Tags

When you create a module, the Studio 5000 Logix Designer application creates a set of tags that you can view in the Tag Editor.

Each configured feature on your module has a distinct tag that is available for use in the controller program logic.

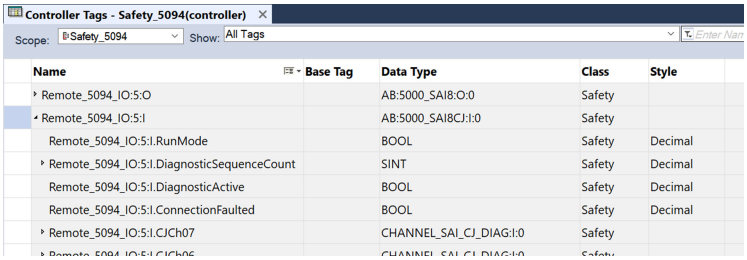
Complete the following steps to access the tags for a module.

1. In the Controller Organizer, right-click Controller Tags and choose Monitor Tags.



The Controller Tags dialog box appears with data.

2. To view the tags, click the triangle symbols.



For more information on module tags, see Module Tag Definitions on page 129.

Calibrate a Safety Analog I/O Module

The modules are calibrated during the manufacturing process. Each module's accuracy remains high throughout its lifespan. You are not required to calibrate the module.

ATTENTION: After calibration, IEC 61508 requires the user to perform various functional verification tests of the equipment used in the system.

Before You Begin

You can calibrate on a per channel basis or in groups.

IMPORTANT You must inhibit the module and perform a safety reset before starting the calibration or reverting to factory calibration.

The purpose of calibrating the module is to improve the module's accuracy and repeatability. When you calibrate 5094-IRT8S input modules, you use a precision mV source or ohms reference signals to send a signal to the module to calibrate it.

To maintain your module's factory calibration accuracy, we recommend instrumentation with the specifications listed below. A high resolution DMM can also be used to adjust a voltage/current calibrating source to its value.

Cat. No.	Channel Input Type	Recommended Instrument Specifications
5094-IRT8S	RTD	1.0...448 Ω resistors ±0.01%
	Thermocouple (mV)	0...50 mV source ±0.5 µV 0...100 mV source ±0.5 µV

IMPORTANT Do not calibrate your module with an instrument that is less accurate than those recommended. The following events can result:

- Calibration appears to occur normally but the module gives inaccurate data during operation.
- A calibration fault occurs, forcing you to abort calibration.
- The *I.Chxx.CalFault* tag is set for the channel you attempted to calibrate.
- You can clear the tag by completing a valid calibration or cycling power to the module.

Controller State During Calibration

You must add the module to your Studio 5000 Logix Designer application project, before you can calibrate it. The project must be online with the owner-controller to calibrate the modules. You can calibrate in the following conditions:

- The controller in Program mode--either Remote Program or Program mode.
- If there are no connections to the module.

Calibration Impacts Data Quality on Entire Input Module Group

When a channel on the module is being calibrated, the Notch Filter setting for that channel changes to 10 Hz. This results in the *I.Chxx.Uncertain* tag being set to 1 for that channel until calibration is completed.

Since you cannot calibrate a channel on the 5094-IRT8S module until after a safety reset, the other channels not being calibrated are not affected, as the module is not running.

Start the Calibration

You apply low and high signal references to the module to calibrate it. The references must match the input range the channel is using.

IMPORTANT You must inhibit the module and perform a safety reset before Start Calibration or Revert to Factory Calibration. You can only calibrate a safety module when there is no safety signature.

Table 30 lists the input ranges and corresponding references used to calibrate the modules.

Table 30 - 5094-IRT8S Calibration References

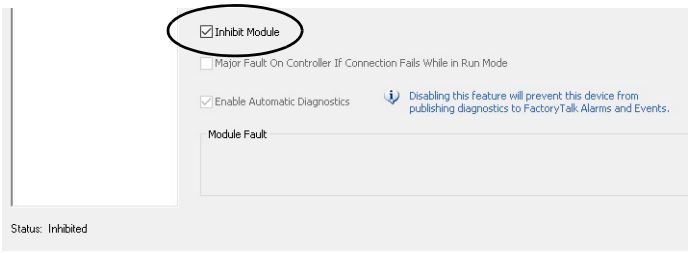
Input Type	Input Range	Low Calibration Reference	High Calibration Reference
RTD	1...500 Ω 2...1000 Ω 4...2000 Ω 8...4000 Ω	1 Ω	448 Ω
Thermocouple	-100...100 mV	0.0 mV	100.0 mV
Thermocouple	-78...78 mV	0.0 mV	50.0 mV

This example describes how to calibrate a channel on the 5094-IRT8S module for use with the RTD input type. The 5094-IRT8S module uses the following resistors to calibrate in ohms:

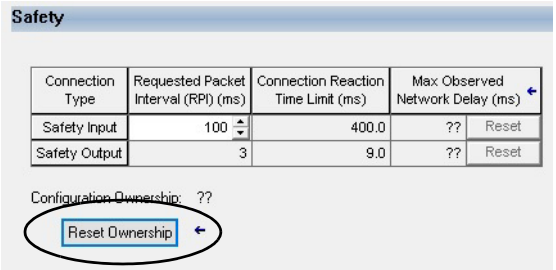
- 1 Ω resistor for low reference calibration
- 448 Ω resistor for high reference calibration

Complete the following steps:

1. Go online with the project.
2. On the Module Properties Connection Category, inhibit the module.

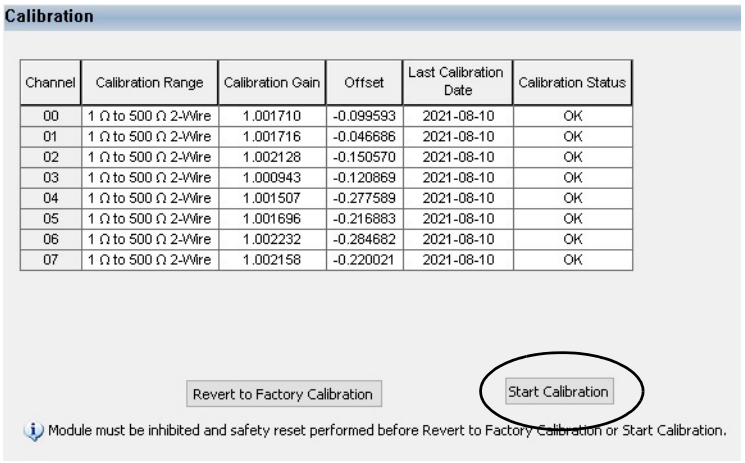


3. On the Module Properties Connection Category, perform a safety reset.

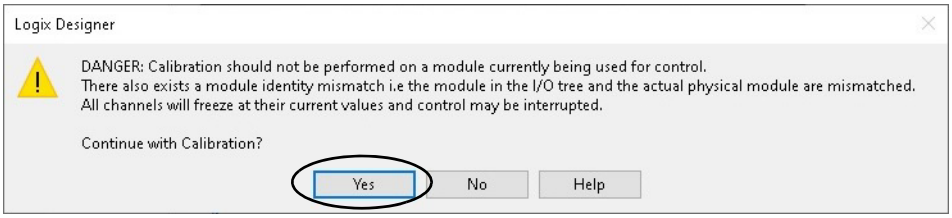


4. Confirm that the channel to be calibrated is configured for the correct Input Range.

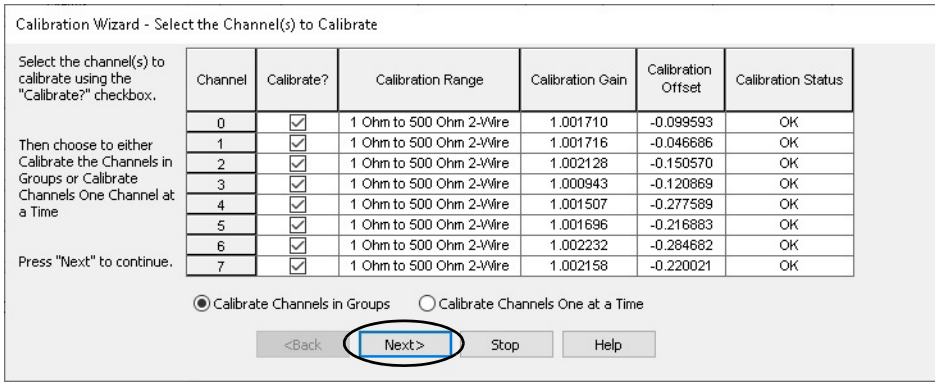
5. On the Calibration category in the Module Properties dialog box, click Start Calibration.



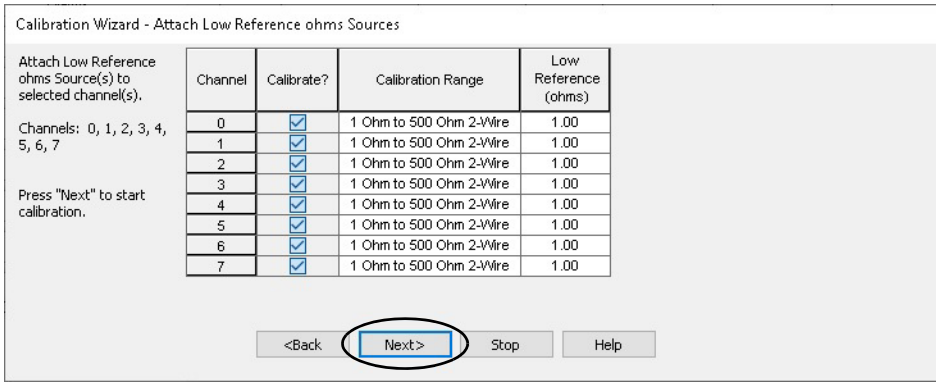
6. When the dialog box appears to confirm that you want to calibrate the channel, click Yes.



7. Select the channel to calibrate and click Next.

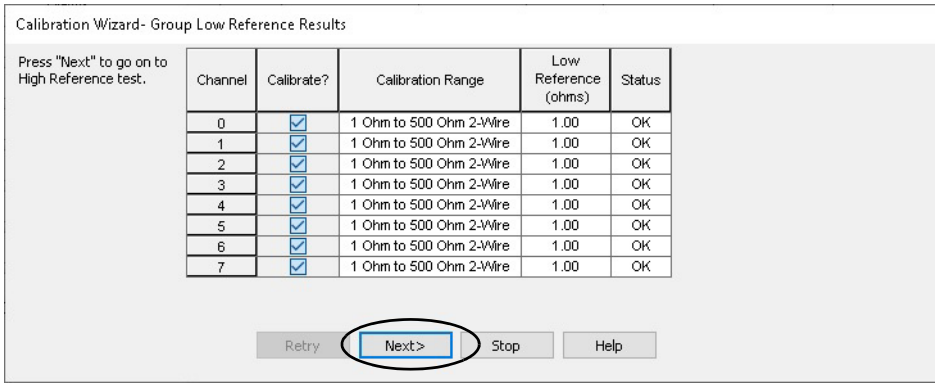


8. When the Attach Low Reference Ohm Sources dialog box appears, connect a 1 Ω resistor to the channel being calibrated.
9. Click Next.



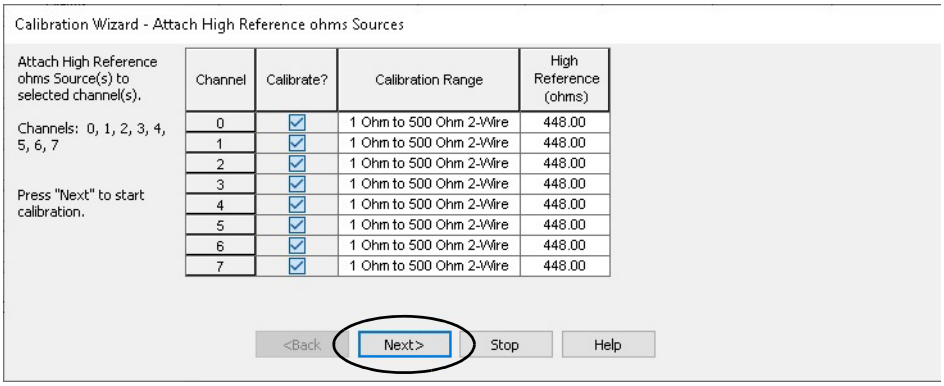
The One At a Time Low Reference Results dialog box appears and indicates the status of the calibrated channel.

10. If the status is OK, click Next.



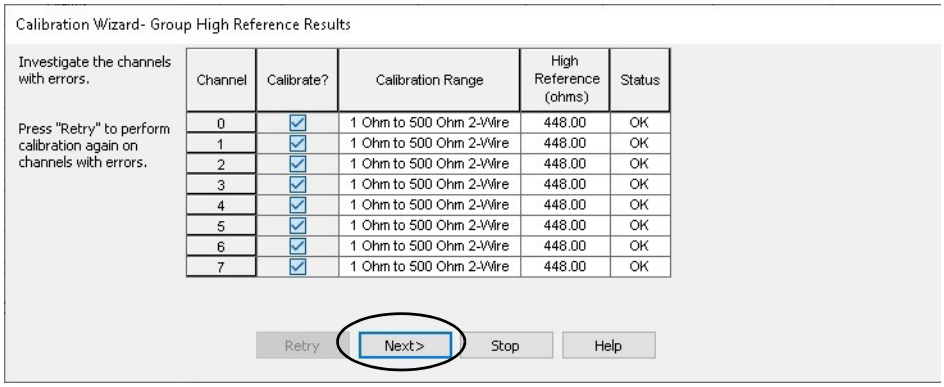
If the status is not OK, repeat the calibration process.

11. When the Attach High Reference Ohm Sources dialog box appears, connect a 448 Ω resistor to the channel being calibrated.
12. Click Next.



The One At a Time High Reference Results dialog box appears and indicates the status of the calibrated channel.

13. If the status is OK, click Next.



If the status is not OK, repeat the calibration process.

14. When the Calibration Completed dialog box appears, click Finish.

Revert to Factory Calibration

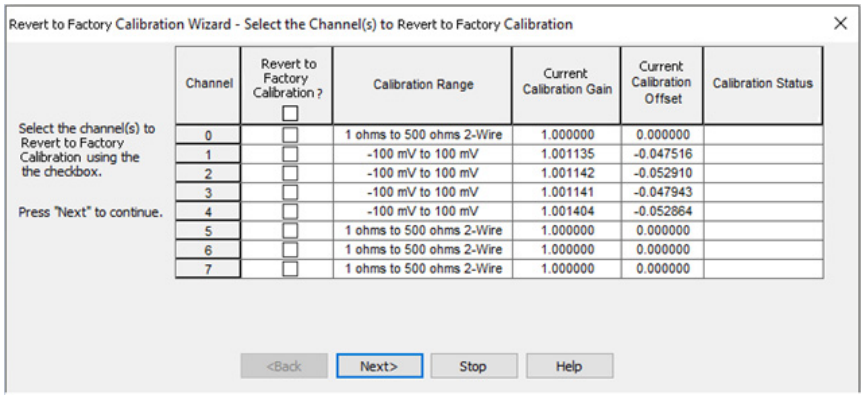
You can revert a channel's gain and offset to the factory calibrated value.

ATTENTION: After calibration, IEC 61508 requires the user to perform various functional verification tests of the equipment used in the system.

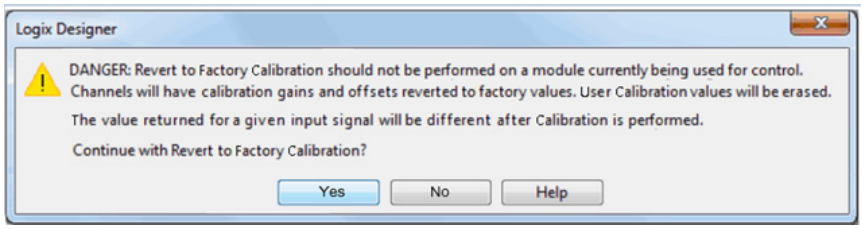
IMPORTANT You must inhibit the module and perform a safety reset before starting the revert to factory calibration.

EXAMPLE: Complete the following steps:

1. Go online with the project and make sure the controller is in Program mode.
2. On the Calibration category in the Module Properties dialog box, select the channel(s) to revert to factory calibration.
3. Click Next.



4. When the dialog box appears to confirm that you want to calibrate the channel, click Yes.



The channels start reverting to the corresponding factory gain and offset values of the range for which the selected channels are configured.

The Calibration Status column displays the progress of the revert to factory calibration.

Replace a Module

Replacing a safety module that sits on a CIP Safety network is more complicated than replacing standard devices because of the safety network number (SNN).

Safety devices require this more complex identifier to make sure that module numbers that are duplicated on separate subnets across all of the networks in the application do not compromise communication between the correct safety devices.

The SNN is a unique identifier that is automatically assigned to each subnet in a safety application. The same SNN is also assigned to all safety devices on the subnet.

For example, when a FLEX 5000 I/O EtherNet/IP adapter is used in a safety application, the Studio 5000 Logix Designer project assigns it an SNN. All FLEX 5000 I/O safety modules that are installed with that adapter, are automatically assigned the same SNN.

However, each FLEX 5000 safety I/O modules require a unique identifier within the same subnet. A DeviceID is used to uniquely identify each safety module. The SNN and module slot number make up the DeviceID of the safety module.

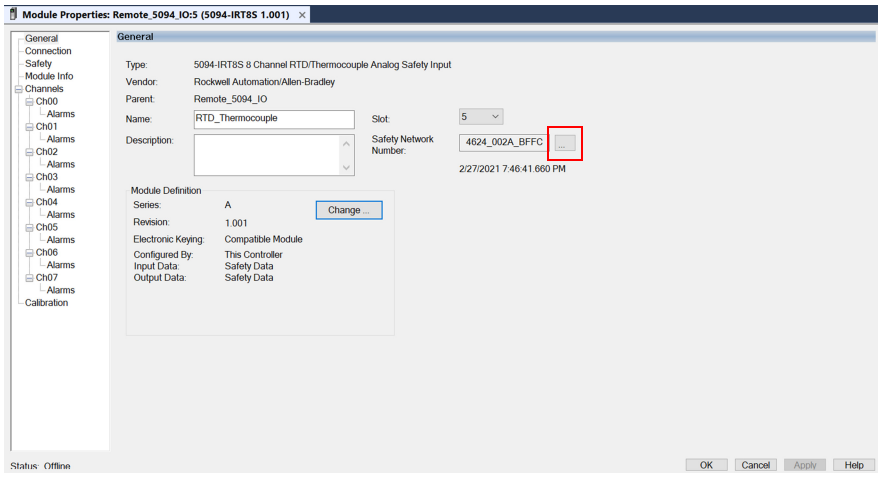
Set the SNN Manually

The SNN is used to provide integrity on the initial download to a FLEX 5000 I/O safety module.

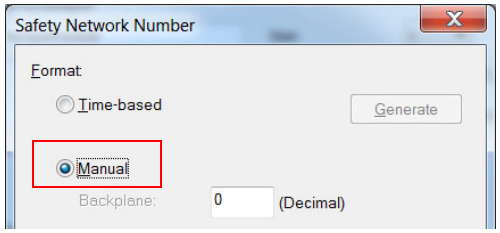
If a safety signature exists, the FLEX 5000 I/O safety module must have DeviceID that matches the module in the safety controller project, before it can receive its configuration.

To maintain integrity, the module SNN must be set manually.

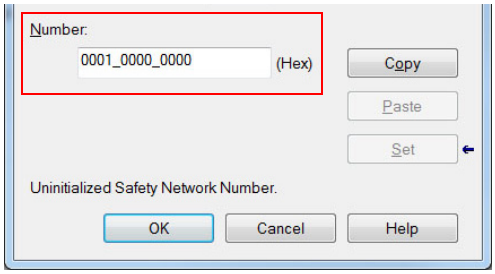
1. On the General category of the Module Properties dialog box, click the ellipsis next to the Safety Network Number.



2. On the Safety Network Number dialog box, click Manual.



3. Type the SNN in the Number field and click OK.



4. On the Module Properties dialog box, click OK.

Reset to Out-of-Box Configuration

When the Studio 5000 Logix Designer application is online, the Safety tab of the Module Properties dialog box displays the current configuration ownership. When the opened project owns the configuration, Local is displayed.

When a second device owns the configuration, Remote is displayed, along with the SNN, and node address or slot number of the configuration owner. Communication error is displayed if the module read fails.

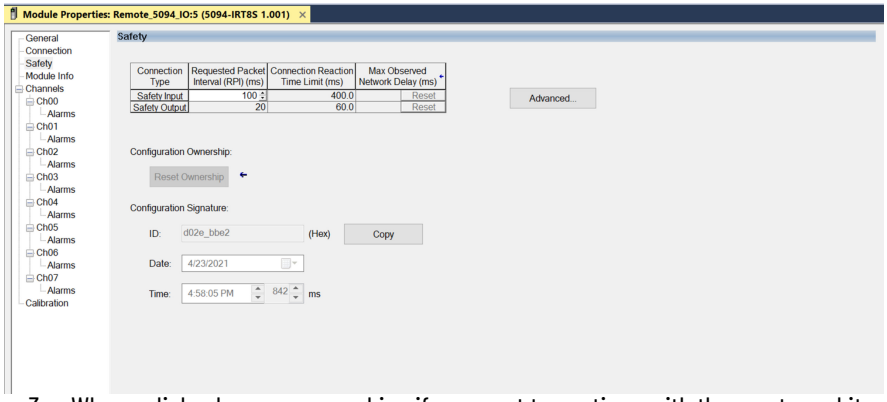
If the connection is Local, you must inhibit the module connection before you reset ownership.

To inhibit the module, follow these steps.

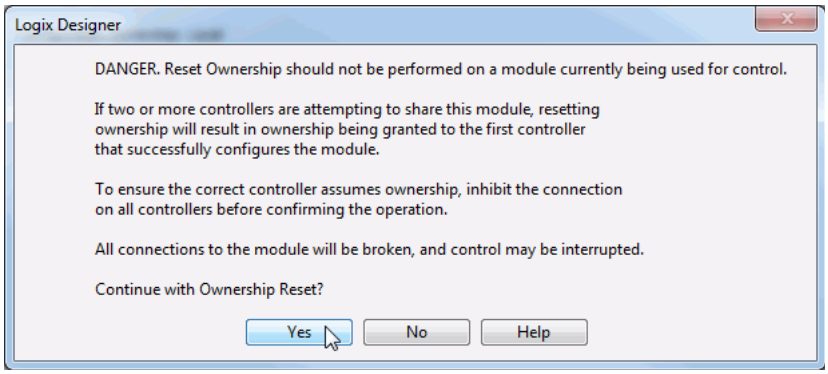
1. Right-click the module and choose Properties.
2. On the Connection tab, click Inhibit module.
3. Click Apply and then OK.

Follow these steps to reset the module to its out-of-box configuration when online.

1. Right-click the module and choose Properties.
2. On the Safety tab, click Reset Ownership.



3. When a dialog box appears asking if you want to continue with the reset, read it and click Yes.



Replace a Module in a Logix 5000 System

Consider the following conditions before you replace a FLEX 5000 safety I/O module in a Logix 5000 system:

- If you rely on a portion of the CIP Safety system to maintain SIL 3 behavior during module replacement and functional testing, you must use the Configure Only When No Safety Signature Exists feature.
- If you rely on the entire routable CIP Safety control system to maintain SIL 3/PL (*d* or *e*) during the replacement and functional testing of a module, you can use the Configure Always feature.

Replacement with 'Configure Only When No Safety Signature Exists' Enabled

When a module is replaced, the configuration is downloaded from the safety controller if the DeviceID of the new module matches the original. The DeviceID is updated whenever the SNN is set.

If the project is configured with Configure Only When No Safety Signature Exists enabled, follow the appropriate instructions in to replace a FLEX 5000 safety I/O module.

After you complete the steps in a scenario correctly, the DeviceID matches the original. This match enables the safety controller to download the proper module configuration, and re-establish the safety connection.

Table 31 - Replace a FLEX 5000 Safety I/O Module

Controller Safety Signature Exists	Replacement Module Condition	Action Required
No	No SNN (Out-of-box)	None. The module is ready for use.
Yes or No	Same SNN as original safety task configuration	None. The module is ready for use.
Yes	No SNN (Out-of-box)	Complete the steps in Set the SNN Manually on page 105.
Yes	Different SNN from original safety task configuration	1. Reset to Out-of-Box Configuration on page 106. 2. Set the SNN Manually on page 105.
No		1. Reset to Out-of-Box Configuration on page 106. 2. Follow your company-prescribed procedures to functionally test the replaced I/O device and system and to authorize the system for use.

Replacement with 'Configured Always' Enabled

ATTENTION: Enable the 'Configure Always' feature only if the entire CIP Safety Control System is not being relied on to maintain SIL 3 behavior during the replacement and functional testing of a module.
Do not place modules that are in the out-of-box condition on a CIP Safety network when the Configure Always feature is enabled, except while following this replacement procedure.

When the 'Configure Always' feature is enabled, the controller automatically checks for and connects to a replacement module that meets all the following requirements:

- The controller has configuration data for a compatible module at that network address.
- The module is in out-of-box condition or has an SNN that matches the configuration.

If the project is configured for 'Configure Always', follow the appropriate steps to replace a FLEX 5000 safety I/O module.

1. Remove the old I/O module and install the new module.

If	Then
The module is in out-of-box condition	Go to Step 6. No action is needed for the controller to take ownership of the module.
An SNN mismatch error occurs	Go to the next step to reset the module to out-of-box condition.

2. Right-click your I/O module and choose Properties.
3. Click the Safety tab.
4. Click Reset Ownership.
5. Click OK.
6. Follow your company-prescribed procedures to functionally test the replaced I/O module and system and to authorize the system for use.

Notes:

Calibrate the Modules

Applies to these modules:
5094 Standard I/O Modules

The FLEX 5000 analog I/O modules are calibrated during the manufacturing process. Each module's accuracy remains high throughout its lifespan. You are not required to calibrate the module.

Use this chapter to calibrate these modules:

- 5094-IF8, 5094-IF8XT
- 5094-IY8, 5094-IY8XT
- 5094-OF8, 5094-OF8XT

To calibrate 5094-IRT8S and 5094-IRT8SXT safety I/O modules, see Calibrate a Safety Analog I/O Module on page 100.

You can calibrate on a per channel basis or in groups.

IMPORTANT This chapter describes a few example module calibration scenarios. It does not cover how to calibrate every FLEX 5000 analog I/O module in all of the operating modes that the module supports.

Before You Begin

Consider the following before you begin:

- Controller State During Calibration
- Calibration Impacts Data Quality on Entire Input Module Group

Controller State During Calibration

You must add the module to your Studio 5000 Logix Designer application project, as described in Configure Standard Analog I/O Modules on page 75, before you can calibrate it.

The project must be online with the owner-controller to calibrate FLEX 5000 analog I/O modules. You can calibrate in the following conditions:

- The controller in Program mode--either Remote Program or Program mode.

  We **recommend** that your module be in Program mode and not be actively controlling a process when you calibrate it.
- If there are no connections to the module.

Calibration Impacts Data Quality on Entire Input Module Group

When a channel on a FLEX 5000 analog input module is being calibrated, the Notch Filter setting for that channel changes to 5 Hz. This results in the *I.Chxx.Uncertain* tag being set to 1 for that channel until calibration is completed.

Grouped inputs share an Analog-to-Digital converter. As a result when any input channel is in the calibration process, the *I.Chxx.Uncertain* tag is set to 1 for the other input channels in that group. This setting is due to the fact that the data sampling rate slows for all input channels in the group.

Difference Between Calibrating an Input Module and an Output Module

The purpose of calibrating the FLEX 5000 analog I/O modules is the same for input and output modules, to improve the module's accuracy and repeatability. The procedures involved differs by module type:

- When you calibrate input modules, you use current, voltage, or ohms reference signals to send a signal to the module to calibrate it.
- When you calibrate output modules, you use a digital multimeter (DMM) to measure the current or voltage signal the module is sending out.

To maintain your module's factory calibration accuracy, we recommend instrumentation with the specifications listed below. A high resolution DMM can also be used to adjust a voltage/current calibrating source to its value.

Cat. No.	Channel Input Type	Recommended Instrument Specifications
5094-IF8	Current (mA)	1.00...20.00 mA source ±100 nA current
	Voltage (V)	0...10V source ±2 µV voltage
5094-IY8	Current (mA)	1.00...20.00 mA source ±100 nA current
	Voltage (V)	0...10V source ±2 µV voltage
	RTD	1.0...487.0 Ω resistors ±0.01%
	Thermocouple (mV)	0...100 mV source ±0.5 µV
5094-OF8	Current (mA)	DMM with resolution better than 0.15 µA
	Voltage (V)	DMM with resolution better than 1.0 µV

IMPORTANT Do not calibrate your module with an instrument that is less accurate than those recommended. The following events can result:

- Calibration appears to occur normally but the module gives inaccurate data during operation.
- A calibration fault occurs, forcing you to abort calibration.
- The *I.Chxx.CalFault* tag is set for the channel you attempted to calibrate.
- You can clear the tag by completing a valid calibration or cycling power to the module. In this case, you must recalibrate the module with an instrument as accurate as recommended.

Calibrate the Input Modules

You apply low and high signal references to the FLEX 5000 analog input module to calibrate it. The references must match the input range the channel is using.

Table 32 lists the input ranges and corresponding references used to calibrate the modules.

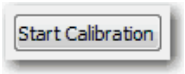
Table 32 - FLEX 5000 Analog Input Module Calibration References

Input Type	Input Range	Low Calibration Reference	High Calibration Reference
Voltage (V)	-10...10V 0...10V	0.0V	10.0V
	0...5V	0.0V	5.0V
Current (mA)	0...20 mA 4...20 mA	4.0 mA	20.0 mA
RTD (5094-IY8 only)	1...500 Ω 2...1000 Ω 4...2000 Ω 8...4000 Ω	1 Ω	487 Ω
Thermocouple (5094-IY8 only)	-100...100 mV	0.0 mV	100.0 mV

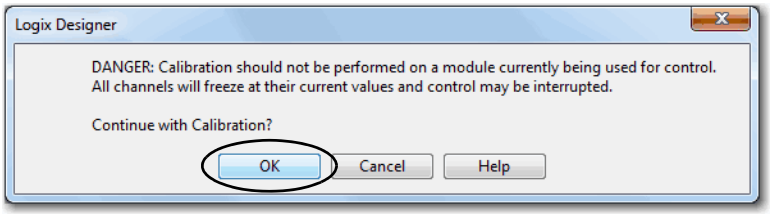
Calibrate the 5094-IF8 Module

This example describes how to calibrate a channel on the 5094-IF8 module for use with a Voltage (V) input type. Complete the following steps:

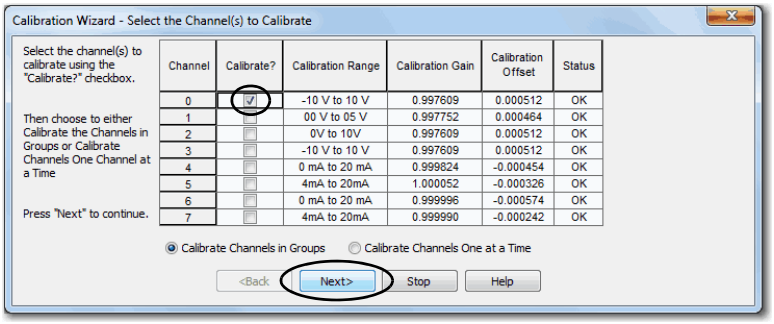
1. Connect the voltage calibrator to the channel being calibrated.
2. Go online with the project and make sure the controller is in Program mode.
3. Confirm that the channel to be calibrated is configured for the correct Input Range.
4. On the Calibration category in the Module Properties dialog box, click Start Calibration.



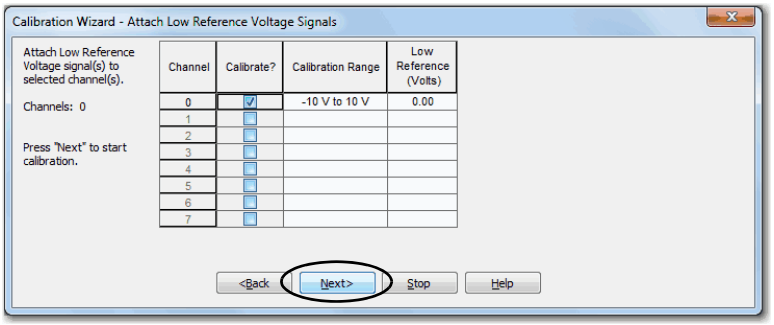
5. When the dialog box appears to confirm that you want to calibrate the channel, click OK.



6. Select the channel to calibrate and click Next.

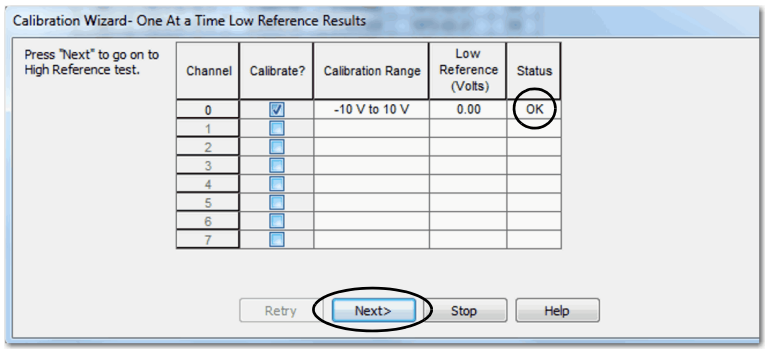


7. When the Attach Low Reference Voltage Signals dialog box appears, set the calibrator to the low reference and apply it to the channel.
8. Click Next.



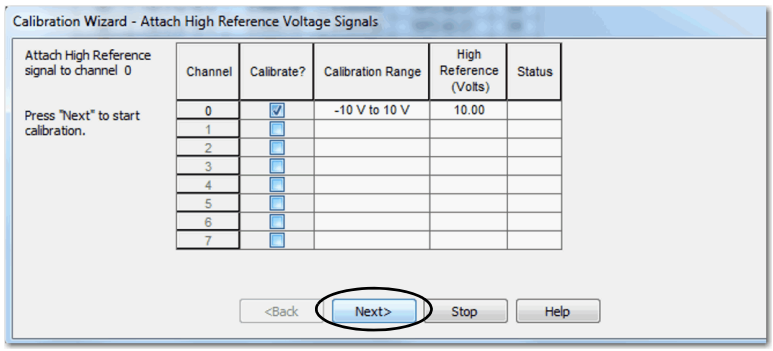
The One At a Time Low Reference Results dialog box appears and indicates the status of the calibrated channel.

9. If the status is OK, click Next.



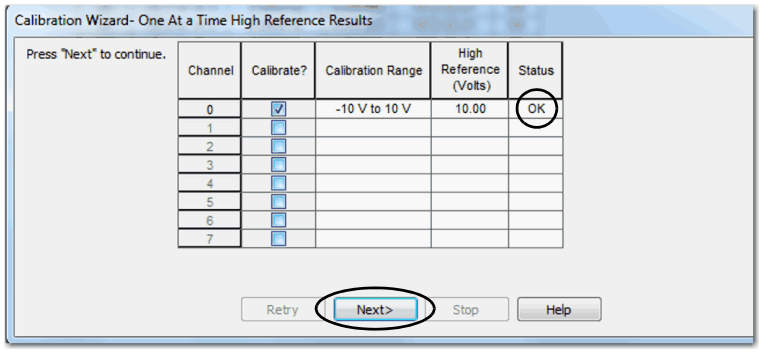
If the status is not OK, repeat the calibration process.

10. When the Attach High Reference Voltage Signals dialog box appears, set the calibrator to the high reference and apply it to the module.
11. Click Next.



The One At a Time High Reference Results dialog box appears and indicates the status of the channel after applying the low reference.

12. If the status is OK, click Next.



If the status is not OK, repeat the calibration process.

13. When the Calibration Completed dialog box appears, click Finish.

Calibrate the 5094-IY8 Module

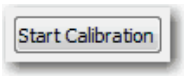
This example describes how to calibrate a channel on the 5094-IY8 module for use with the RTD input type. The 5094-IY8 module uses the following resistors to calibrate in ohms:

- 1 Ω resistor for low reference calibration
- 487 Ω resistor for high reference calibration

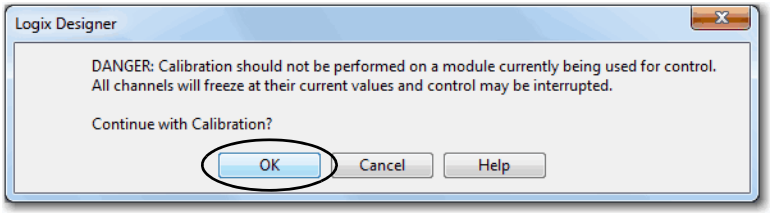
Complete the following steps:

1. Connect the low reference resistor to the channel being calibrated.

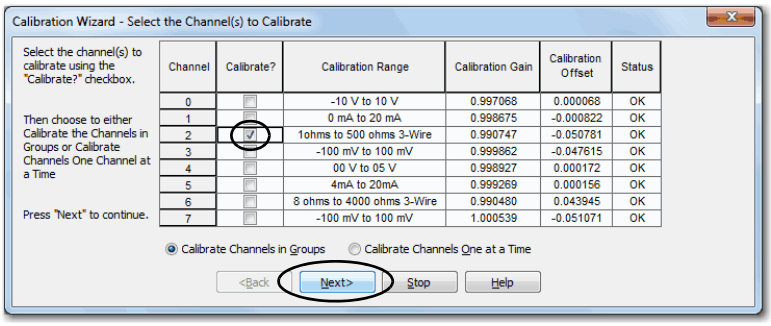
2. Go online with the project and make sure the controller is in Program mode.
3. Confirm that the channel to be calibrated is configured for the correct Input Range.
4. On the Calibration category in the Module Properties dialog box, click Start Calibration.



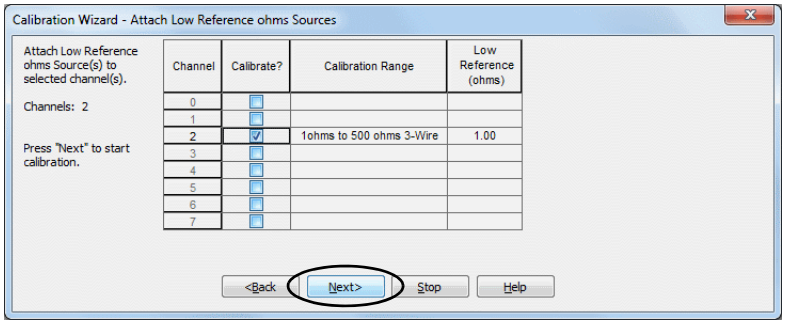
5. When the dialog box appears to confirm that you want to calibrate the channel, click OK.



6. Select the channel to calibrate and click Next.

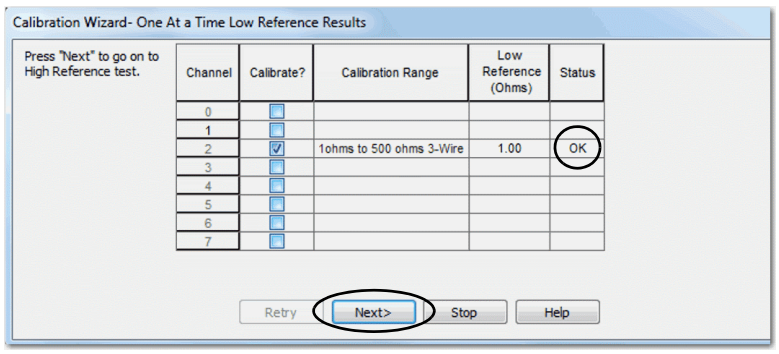


7. When the Attach Low Reference Ohm Sources dialog box appears, connect a 1 Ω resistor to the channel being calibrated.
8. Click Next.



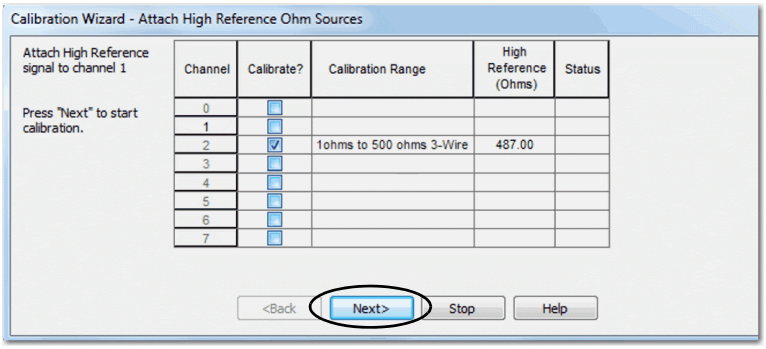
The One At a Time Low Reference Results dialog box appears and indicates the status of the calibrated channel.

9. If the status is OK, click Next.



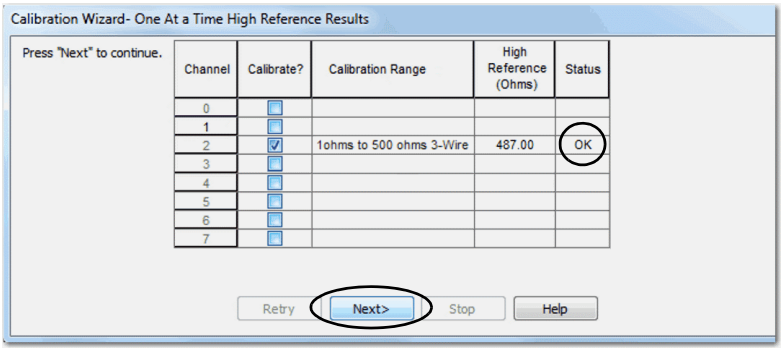
If the status is not OK, repeat the calibration process.

10. When the Attach High Reference Ohm Sources dialog box appears, connect a 487 Ω resistor to the channel being calibrated.
11. Click Next.



The One At a Time High Reference Results dialog box appears and indicates the status of the calibrated channel.

12. If the status is OK, click Next.



If the status is not OK, repeat the calibration process.

13. When the Calibration Completed dialog box appears, click Finish.

Calibrate the Output Modules

When calibrating a FLEX 5000 analog output channel, the Studio 5000 Logix Designer application commands the module to output specific signal levels. The signal type is determined by the output type being used by the channel.

Table 33 lists the output ranges and corresponding references used to calibrate the module.

Table 33 - FLEX 5000 Analog Output Module Calibration References

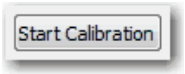
Output Type	Output Range	Low Calibration Reference Level	High Calibration Reference Level
Voltage (V)	-10...10V	-10.0V	10.0V
	0...10V	1.0V	10.0V
	0...5V	1.0V	5.0V
Current (mA)	0...20 mA	1.0 mA	20.0 mA
	4...20 mA	5.0 mA	20.0 mA

You must measure the actual level and record the results to account for any module inaccuracies.

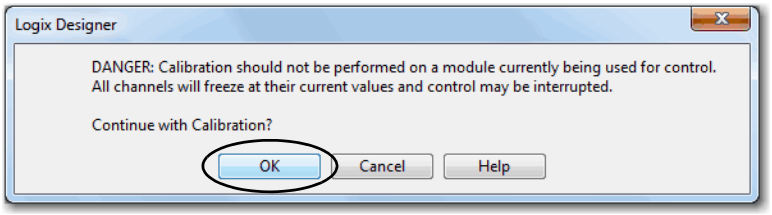
Calibrate a 5094-OF8 Module

This example describes how to calibrate a channel on the 5094-OF8 module for use with a Voltage (V) output type. Complete the following steps:

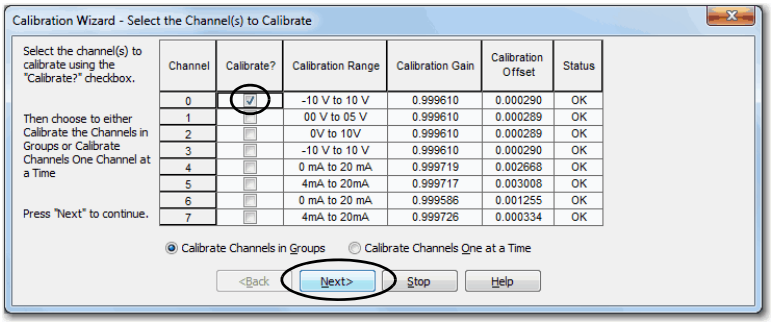
1. Connect the DMM to the channel being calibrated.
2. Go online with the project and make sure the controller is in Program mode.
3. Confirm that the channel to be calibrated is configured for the correct Output Range.
4. On the Calibration category in the Module Properties dialog box, click Start Calibration.



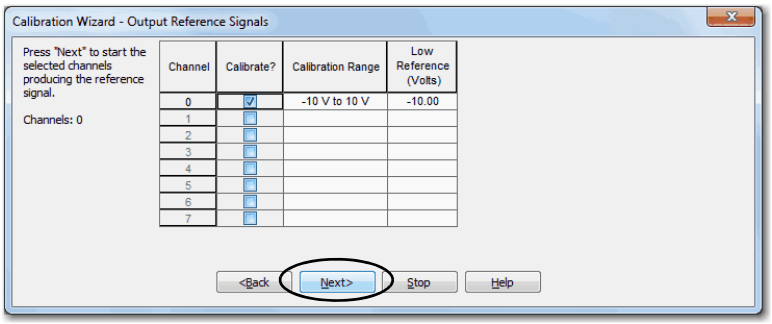
5. When the dialog box appears to confirm that you want to calibrate the channel, click OK.



6. Select the channel to calibrate and click Next.



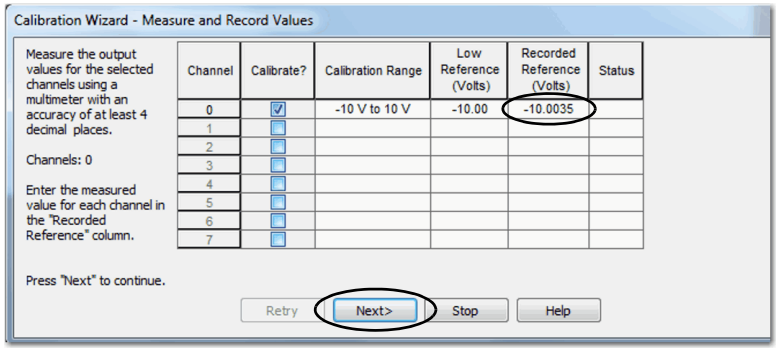
7. When the Output Reference Signals dialog box appears, click Next.



The Measure and Record Values dialog box appears.

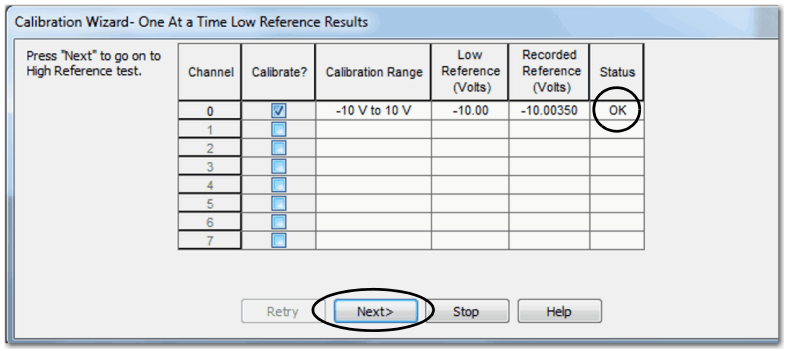
8. Use a multimeter to measure the reference value of the channel.

9. In the Recorded Reference (Volts) column record the measured value and click Next.



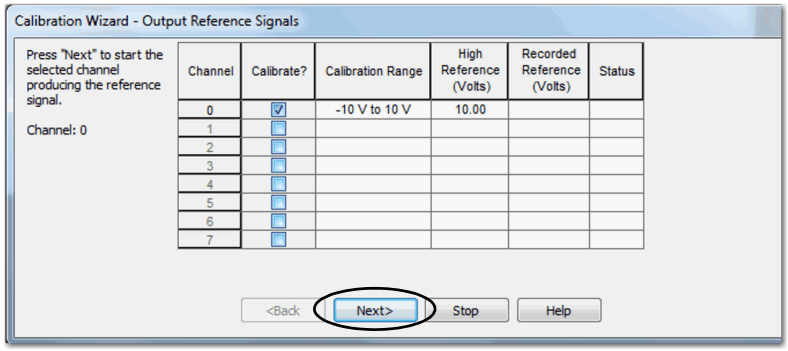
The One At a Time Low Reference Results dialog box appears and indicates the status of the calibrated channel.

10. If the status is OK, click Next.



If the status is not OK, repeat the calibration process.

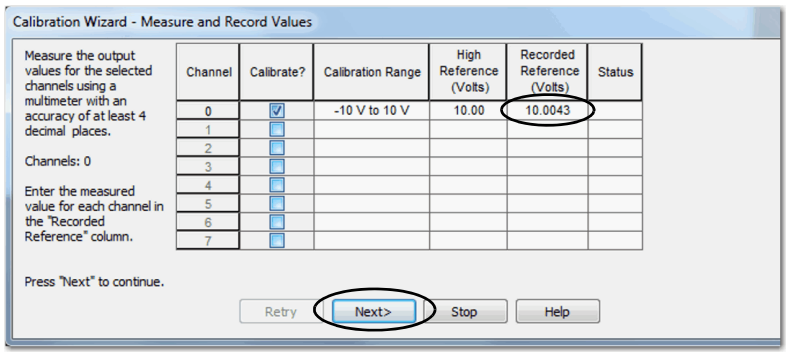
11. When the Output Reference Signals dialog box appears and indicates the channel to be calibrated for the high reference, click Next.



The Measure and Record Values dialog box appears.

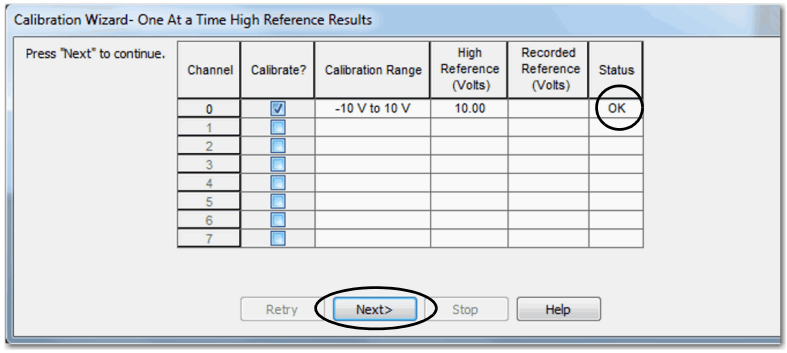
12. Use a multimeter to measure the reference value of the channel.

13. In the Recorded Reference (Volts) column record the measured value and click Next.



The One At a Time High Reference Results dialog box appears and indicates the status of the calibrated channel.

14. If the status is OK, click Next.



If the status is not OK, repeat the calibration process.

15. When the Calibration Completed dialog box appears, click Finish.

Notes:

Troubleshoot Your Module

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

FLEX 5000 analog I/O modules use the following status indicators:

- SA Power Indicator - This indicator operates the same for all FLEX 5000 analog I/O modules.
- Module Status Indicator - This indicator operates the same for all FLEX 5000 analog I/O modules.
- I/O Status Indicator - This indicator operates differently based on the module type.

SA Power Indicator

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Table 34 describes the SA Power indicator on FLEX 5000 analog I/O modules.

Table 34 - SA Power Indicator - FLEX 5000 Analog I/O Modules

Indicator State	Description	Recommended Action
Off	The module is not powered.	Complete the following actions: 1. Confirm that the system is powered. 2. Confirm that the module is installed properly.
Steady green	There is SA power to the module.	None
Steady red	• Standard Modules: There is no SA power to the module. • Safety Modules: There is no SA power to the module, or when SA voltage is not in the valid range .	Complete the following actions: 1. Confirm that the SA Power wiring on the terminal base is installed properly. 2. Check the following: – Confirm that there is sufficient voltage supplied to the module. – If an external power supply is used, confirm that the power supply is turned on. – If power is daisychained from the previous terminal base, confirm that the wiring on the previous terminal base is installed properly. – Check that the SA voltage is in the correct range (18...32V).

Module Status Indicator

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Table 35 describes the Module Status indicator on FLEX 5000 analog I/O modules.

Table 35 - Module Status Indicator - FLEX 5000 Analog I/O Modules

Indicator State	Description	Recommended Action
Off	The module is not powered.	Complete the following actions: 1. Confirm that the system is powered. 2. Confirm that the module is installed properly.
Steady green	The module has a connection to the owner-controller and is operating normally.	None
Flashing green	One of the following conditions exist: • The module has powered up successfully. • The module does not have a connection to the controller. • A no connection can result from missing, incomplete, or incorrect module configuration. • Connection to an output module is in the idle state. • Safety modules: A connection can be established with the controller, but initial time coordination exchange is not complete.	Complete the following actions: • Troubleshoot your Studio 5000 Logix Designer application to determine what is preventing a connection from the module to the controller and correct the issue. • Confirm that the system conditions require the controller to be in Remote Run mode or Run mode, transition the controller to one of those modes.

Table 35 - Module Status Indicator - FLEX 5000 Analog I/O Modules (Continued)

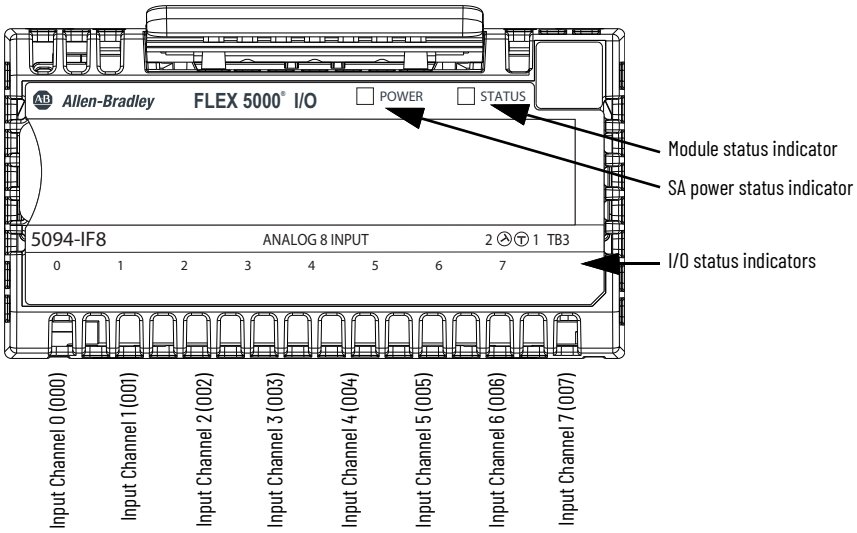
Indicator State	Description	Recommended Action
Steady red	The module experienced a nonrecoverable fault.	Complete the following actions: 1. Cycle power to the module. 2. If the status indicator remains in the steady red state, replace the module.
Flashing red	One of the following conditions exist: • A module firmware update is in progress. • A module firmware update attempt failed. • The device has experienced a recoverable fault. • A connection to the module has timed out.	Complete one of the following: • Let the firmware update progress complete. • Reattempt a firmware update after one fails. • Use the Studio 5000 Logix Designer application to determine the cause of the module fault. The Connection and Module Info categories of the modules configuration indicate the fault type. To clear a recoverable fault, complete one of the following: – Cycle module power. – Click Reset Module in the Studio 5000 Logix Designer project via the Module Info category of the Module Properties dialog box. If the fault does not clear after cycling power and clicking Reset Module, contact Rockwell Automation Technical Support. • Use the Studio 5000 Logix Designer application to determine if a connection has timed out. The Connection category in the Module Properties for the module indicates the module state, including if a connection has timed out. If a connection has timed out, determine the cause and correct it. For example, a cable failure can cause a connection timeout.
Alternating red/green	**For safety modules only** - Indicates that you must commission the UNID on the device.	Commission the UNID on the device. For more information on the UNID see the GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Reference Manual, publication 1756-RM012.

FLEX 5000 Analog Input Modules Status Indicators

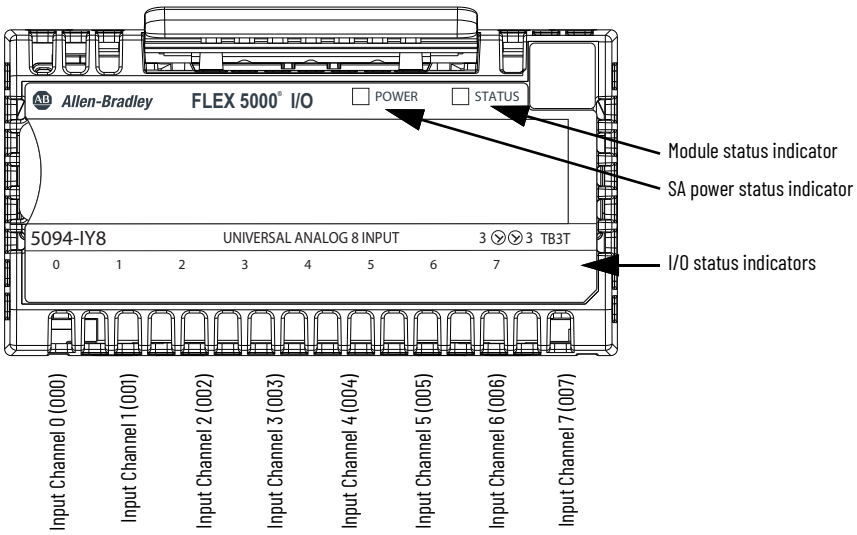
Figure 8 shows the status indicators on FLEX 5000 analog input modules.

Figure 8 - FLEX 5000 Analog Input Module Status Indicators

5094-IF8, 5094-IF8XT



5094-IY8, 5094-IY8XT



5094-IRT8S

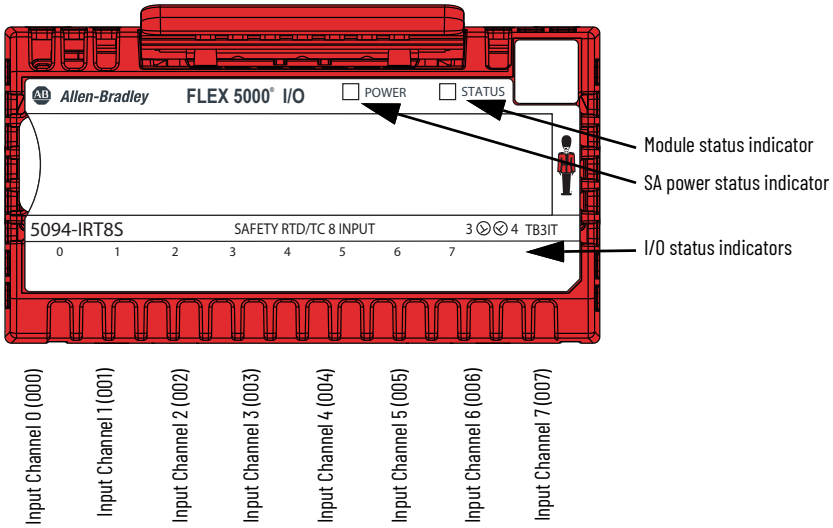


Table 36 describes the I/O status indicators on FLEX 5000 analog input modules.

Table 36 - I/O Status Indicators - FLEX 5000 Analog Input Modules

Indicator State	Description	Recommended Action
Off	One of the following conditions exists: • The module is not powered. • The module is powered but no connection from the controller to module has been established. • The module is powered, but the input channel is disabled.	Complete one of the following: • None - If your application does not use the input channel. • If you expect the module to be powered but it is not, complete the following: – Confirm that the system is powered. – Confirm that the module is installed properly. • If the module is powered but the channel is not operating as expected, use the Studio 5000 Logix Designer application to confirm that the channel is not disabled and has a connection to the controller. The Connection category in the Module Properties for the module indicates if the module is running or faulted. If the module is faulted, the Connection category indicates error information affecting the state of the module.
Steady yellow	The input channel is operating normally.	None
Steady red	An issue has occurred that is internal to the module. The following are example issues that can cause the status indicator to be steady red: • The module has experienced a non-recoverable fault. • There is no SA power to the module, or SA power voltage is not in the valid range (18...32V). • Standard modules: A calibration fault occurred on the channel. • Standard modules: The module is operating over its specified temperature. That is, an Over Temperature condition exists. • Safety modules: When a non-recoverable fault happens on one channel, the other channel in the same channel group will show non-recoverable fault as well. • Safety modules: For a 5094-IRT8S module operating in TC mode, if the input voltage is out of range, negative voltages, it can cause the channel enter to non-recoverable fault state.	Complete one of the following: • If the indicator is in the steady red state following the initial power-up sequence and remains in that state, replace the module. • If a calibration fault occurred, cycle power to the module. When the power-up sequence completes, the channel returns to the factory calibration setting. • If the indicator remains in the steady red state after you cycle power, replace the module. • To return the module to the specified operating temperature range, check the temperature at the module installation location and lower it if necessary. • Check the wiring at the SA terminals to make sure 24V DC power is present and in the valid range (18...32V). If 24V DC power is not present, troubleshoot the SA power connection. • Module specifications, for example, acceptable operating temperature or applied current levels, are available in the FLEX 5000 Module Specifications Technical Data, publication 5094-TD001.
Flashing red	One of the following conditions exists: • The input signal is overrange or underrange. • The signal range is set in your Studio 5000 Logix Designer application project. • An Open Wire condition, that is, a wire is disconnected from the input channel. • Standard modules: An over temperature warning is present on the channel.	Complete one of the following: • Check the input signal to determine if it is overrange or underrange. • If so, make changes to return the input signal to within the range limits. • Check the wiring at the input channel. • If necessary, reconnect the wire. • Locate and correct the cause of over temperature warning.
Alternating yellow/red	Calibration is in progress.	Finish the calibration process in the Studio 5000 Logix Designer application.

FLEX 5000 Analog Output Modules Status Indicators

Figure 9 shows the status indicators on FLEX 5000 analog output modules.

Figure 9 - FLEX 5000 Analog Output Module Status Indicators

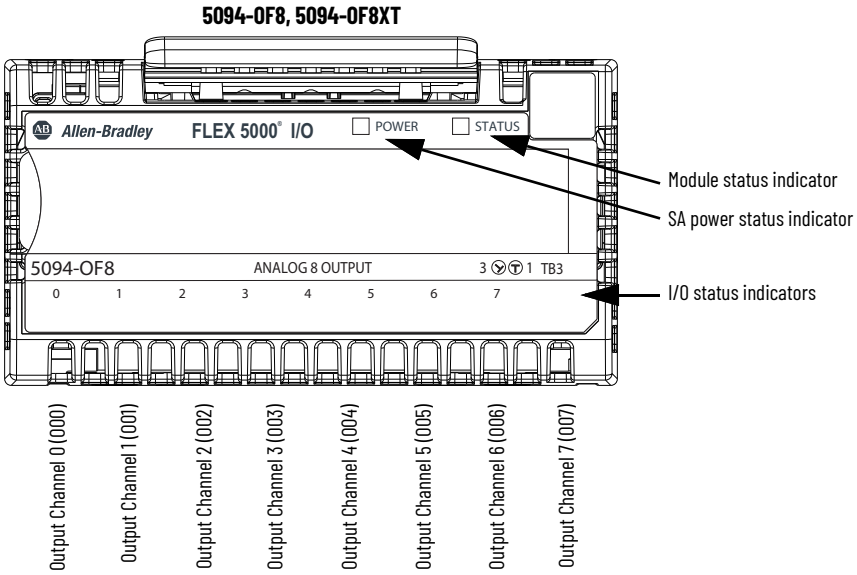


Table 37 describes the I/O status indicators on FLEX 5000 analog output modules.

Table 37 - I/O Status Indicators - FLEX 5000 Analog Output Modules

Indicator State	Description	Recommended Action
Off	One of the following conditions exists: • The module is not powered. • The module is powered but no connection from the controller to module was ever established. • The module is powered, but the output channel is disabled.	Complete one of the following: • None - If your application does not use the output channel. • If you expect the module to be powered but it is not, complete the following: – Confirm that the system is powered. – Confirm that the module is installed properly. • If the module is powered but the channel is not operating as expected, use the Studio 5000 Logix Designer application to confirm that the channel is not disabled and has a connection to the controller. The Connection category in the Module Properties for the module indicates if the module is running or faulted. If the module is faulted, the Connection category indicates error information affecting the state of the module.
Steady yellow	The output channel is operating normally.	No action necessary.
Steady red	An issue has occurred that is internal to the module. The following are example issues that can cause the status indicator to be steady red: • The module has experienced a non-recoverable fault. • A calibration fault occurred on the channel. • The module is operating over its specified temperature. That is, an Over Temperature condition exists.	Complete one of the following: • If the indicator is in the steady red state following the initial power-up sequence and remains in that state, replace the module. • If a calibration fault occurred, cycle power to the module. When the power-up sequence completes, the channel returns to the factory calibration setting. • If the indicator remains in the steady red state after you cycle power, replace the module. • To return the module to the specified operating temperature range, complete the following: – Check the temperature at the module installation location and lower it if necessary. – Make sure the proper level of current is applied to the module. If not, change the current applied to an acceptable level. Module specifications, for example, acceptable operating temperature or applied current levels, are available in the FLEX 5000 Module Specifications Technical Data, publication 5094-TD001.

Table 37 - I/O Status Indicators - FLEX 5000 Analog Output Modules (Continued)

Indicator State	Description	Recommended Action
Flashing red	One of the following conditions exists: • A wire is disconnected from the output. That is, a No Load condition exists. • The module is driving a current from the channel greater than the maximum current level the channel can handle. That is, a Short Circuit condition exists. • An SSV Over Current condition exists. • An over temperature warning is present on the channel. • There is no SA power to the module.	One of the following: • Check the wiring at the output channel. • If necessary, reconnect the wire. • Troubleshoot the application to make sure an acceptable level of current is driven from the channel. • Locate and correct the cause of SSV Over Current. • Locate and correct the cause of over temperature warning. • Check the wiring at the SA terminals to make sure 24V DC power is present. If 24V DC power is not present, troubleshoot the SA power connection.
Alternating yellow/red	Calibration is in progress.	Finish the calibration process in the Studio 5000 Logix Designer application.

Use the Studio 5000 Logix Designer Application for Troubleshooting

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

In addition to the status indicator display on the module, the Studio 5000 Logix Designer application indicates the presence of fault conditions.

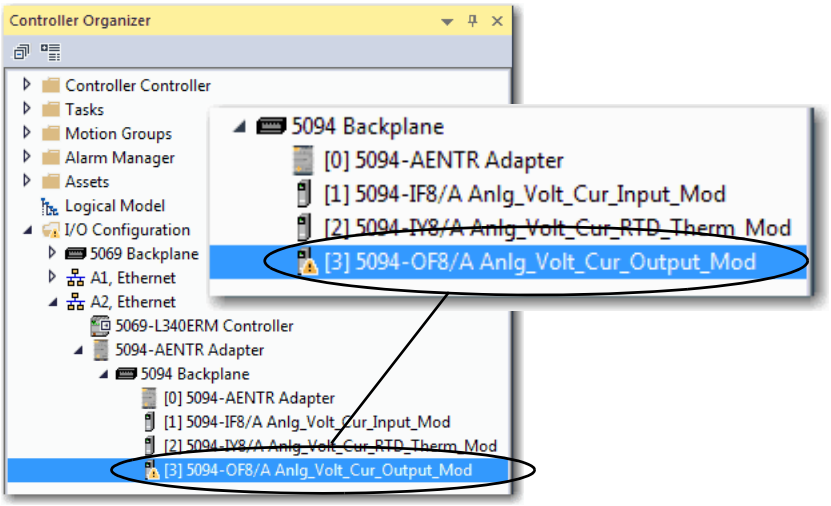
Fault conditions are reported in the following ways:

- Warning Signal in the I/O Configuration Tree
- Status and Fault Information in Module Properties Categories
- Studio 5000 Logix Designer Application Tag Editor

Warning Signal in the I/O Configuration Tree

As shown in Figure 10, a warning icon appears in the I/O Configuration tree when a fault occurs.

Figure 10 - Warning Signal in Controller Organizer



Status and Fault Information in Module Properties Categories

The Module Properties section in the Studio 5000 Logix Designer applications includes a series of categories. The number and types of categories varies by module type.

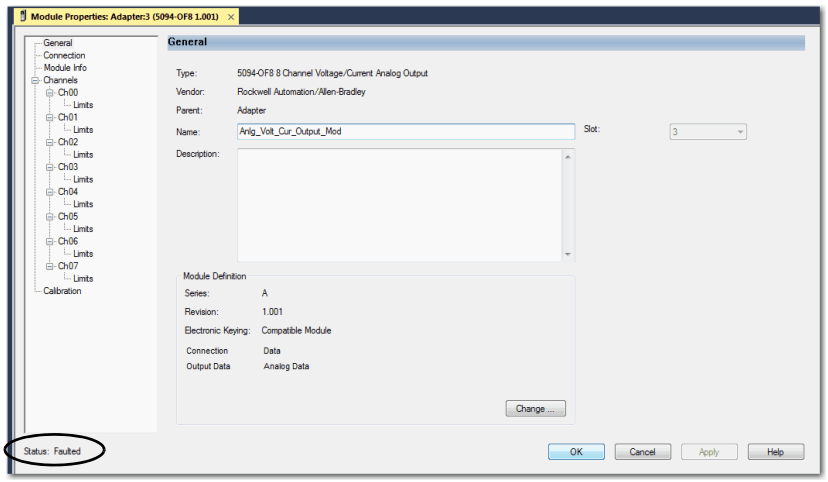
Each category includes options to configure the module or monitor the module's current status. The following are ways to monitor a module's state for faults:

- Module Status on General Category
- Module Fault Descriptions on Connection Category
- Module Fault Descriptions on Module Info Category
- Module Diagnostics Dialog Box
- Channel Diagnostics

Module Status on General Category

As shown in Figure 11, the status of a module is indicated on the General category of the Modules Properties.

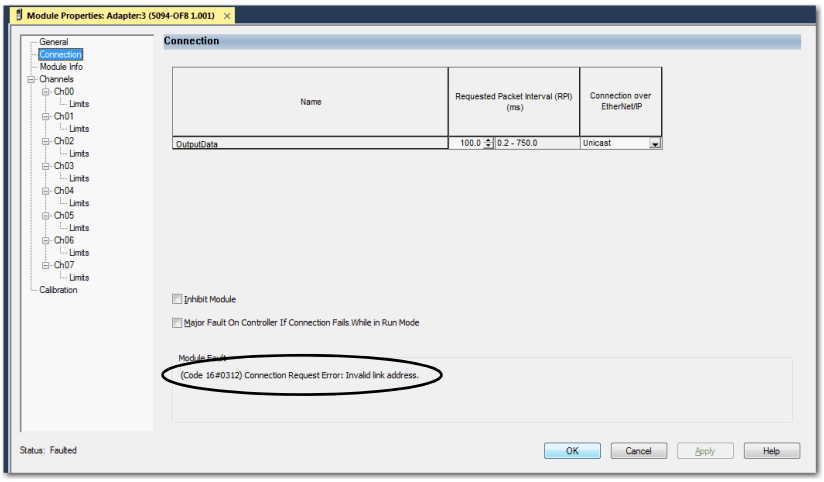
Figure 11 - Fault Message in Status Line



Module Fault Descriptions on Connection Category

As shown in Figure 12, a module fault description that includes an error code associated with the specific fault type is listed on the Connection category.

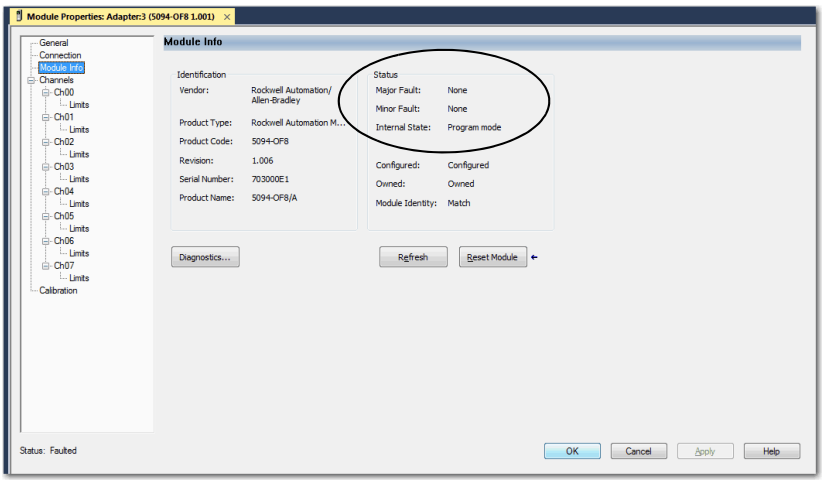
Figure 12 - Fault Description with Error Code



Module Fault Descriptions on Module Info Category

As shown in Figure 13, major and minor fault information is listed on the Module Info category.

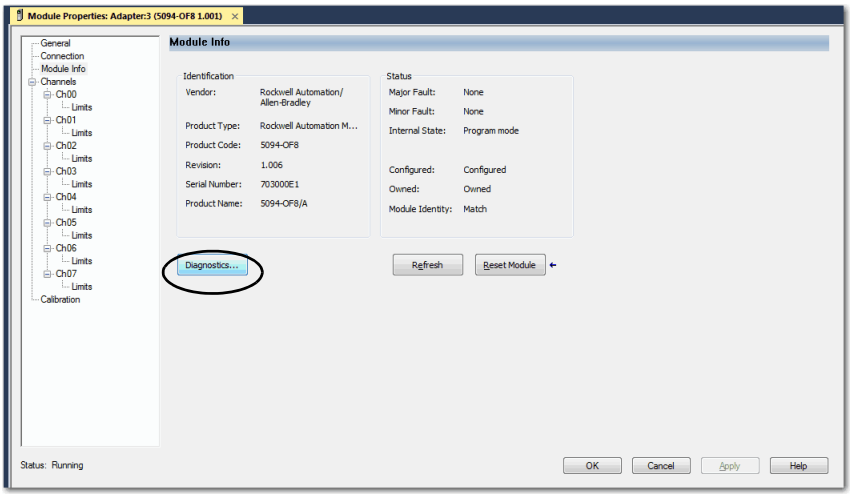
Figure 13 - Major and Minor Fault Information

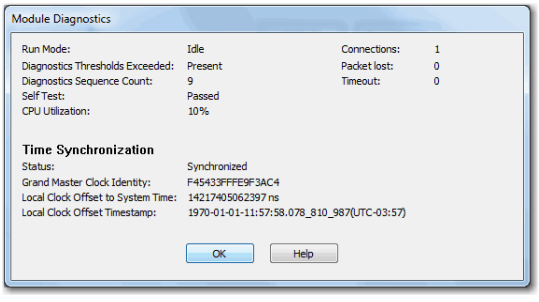


Module Diagnostics Dialog Box

Module Diagnostics are accessible from the Module Properties dialog box, as shown in Figure 14.

Figure 14 - Module Diagnostics



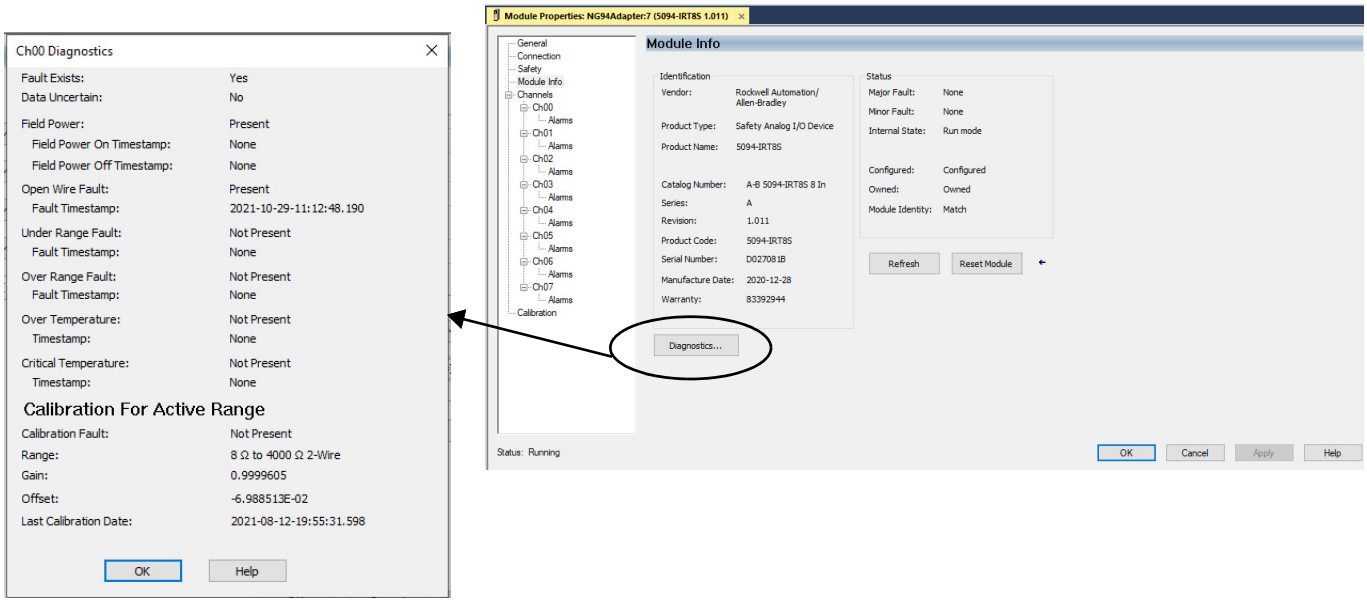


Channel Diagnostics

You can use diagnostics in a Studio 5000 Logix Designer project to monitor channel operating conditions and to troubleshoot issues that affect a channel. You can use diagnostics only when the project is online.

Channel diagnostics provide information on an individual channel basis. To open the channel diagnostics, select Diagnostics...

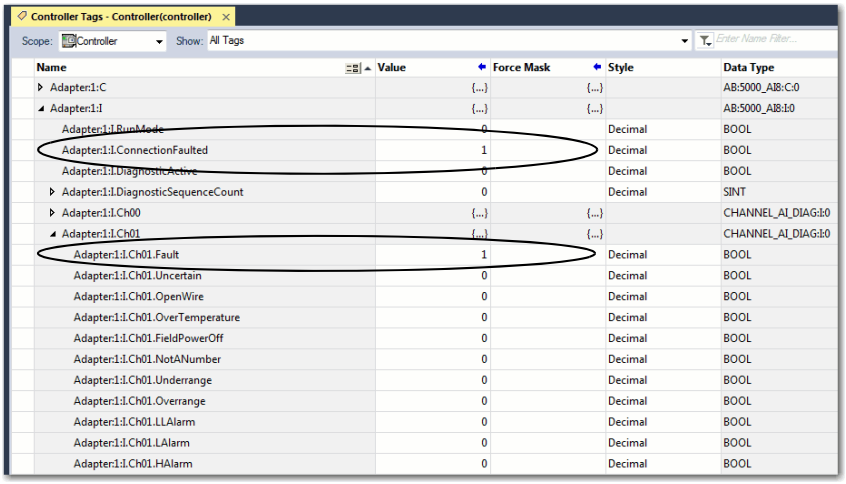
Figure 15 - Channel Diagnostics



Studio 5000 Logix Designer Application Tag Editor

Figure 16 shows how fault conditions are indicated in the controller tags for the module.

Figure 16 - Fault Indication in Controller Tags



Notes:

Module Tag Definitions

Applies to these modules:
5094 Standard I/O Modules
5094 Safety I/O Modules

Module tags are created when you add a module to the Studio 5000 Logix Designer application project.

The set of module tags associated with a module depends on the module type and Module Definition choices made during module configuration. For example, if you use a Listen Only Connection in the Module Definition, the Studio 5000 Logix Designer application creates only Input tags for that module.

The following types of tags are available with FLEX 5000 analog I/O modules:

- Configuration
- Input
- Output

The tables contained in this section list all of the tags available with a module. Not all tags in the list are used when that module type is added to a project. Tag use varies by module configuration.

Tag Name Conventions

The module tag names use defined naming conventions. The conventions are as follows:

Example tag name = Adapter:1:I.Ch00.Data

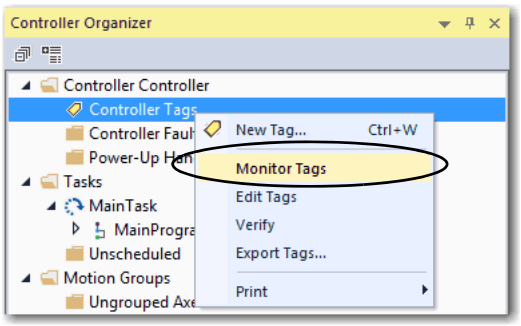
- Adapter = name of the FLEX 5000 EtherNet/IP adapter in the FLEX 5000 I/O system
- 1 = slot number
- I = tag type
- The possible FLEX 5000 analog I/O tag types are C (configuration), I (input), and O (output).
- Ch00 = module channel number
- Data = tag function

  In this case, Data represents the input data returned to the owner-controller.

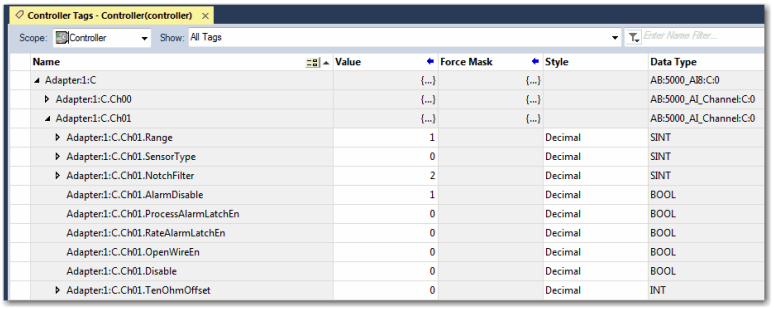
Access the Tags

You view tags from the Tag Editor.

1. Open your Studio 5000 Logix Designer application project.
2. Right-click Controller Tags and choose Monitor Tags.



3. Open the tags as necessary to view specific tags.



5094-IF8 Module Tags

This section describes the tags associated with the 5094-IF8 module.

Configuration Tags

Table 38 describes the 5094-IF8 module configuration tags.

Table 38 - 5094-IF8 Module - Configuration Tags

Name	Data Type	Definition	Valid Values
Chxx.Range	SINT	Channel's operating range	• 0 = -10...10V • 1 = 0...5V • 2 = 0...10V • 4 = 0...20 mA • 5 = 4...20 mA
Chxx.NotchFilter	SINT	Notch Filter removes line noise for the channel.	• 0 = 5 Hz • 1 = 10 Hz • 2 = 15 Hz • 3 = 20 Hz • 4 = 50 Hz • 5 = 60 Hz • 6 = 100 Hz • 7 = 200 Hz • 8 = 500 Hz • 9 = 1,000 Hz • 10 = 2,500 Hz • 11 = 5,000 Hz • 12 = 10,000 Hz • 13 = 15,625 Hz • 14 = 25,000 Hz • 15 = 31,250 Hz • 16 = 62,500 Hz
Chxx.AlarmDisable	BOOL	Disables all alarms on the channel. IMPORTANT: Consider the following: • When if you change this tag to 0, that is, so alarms are not disabled, you must also enable the individual alarms for them to work. For example, if you want to use the Low Low alarm for a channel, you must set the Chxx.AlarmDisable to 0 and set the Chxx.LLAlarmEn output tag to 1 so the alarm is enabled. This applies to all alarms on the module. • Conversely, if you set this tag to 1, alarms are disabled regardless of the setting on the alarm enable tag for any alarm.	• 0 = Alarms are enabled • 1 = Alarms are disabled (default)
Chxx.ProcessAlarmLatchEn	BOOL	Configures Process alarms to latch until they are explicitly unlatched. The Process alarms include: • HighHigh alarm • High alarm • Low alarm • LowLow alarm	• 0 = Latching disabled (default) • 1 = Latching enabled
Chxx.RateAlarmLatchEn	BOOL	Configures the Rate alarm to latch until it is explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled

Table 38 - 5094-IF8 Module - Configuration Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.OpenWireEn	BOOL	Enable the input Open Wire diagnostic	• 0 = Disabled (default) • 1 = Enabled
Chxx.Disable	BOOL	Disables the channel. When a channel is disabled, the following occurs: • The I/O status indicator for the channel turns off. • The Chxx.Fault input tag is set to 1.	• 0 = Channel is enabled (default) • 1 = Channel is disabled
Chxx.TenOhmOffset	INT	Offset used to linearize a 10 Ω copper sensor type's input	-1.00 to 1.00 Ω
Chxx.DigitalFilter	INT	A non-zero value enables the filter, providing a time constant in milliseconds used in a first order lag filter to smooth the input signal.	0 = Filter is turned off. Any value greater than zero = Filter value in milliseconds
Chxx.LowSignal	REAL	One of four points used in scaling. The low signal is in terms of the inputs signal units and corresponds to the low engineering term when scaled.	Current applications - Any value less than the high signal in range. • 0 = default for 0…20 mA range • 4 = default for 4…20 mA Voltage applications - Any value less than the high signal in range. • -10 = default for -10…10V range • 0 = default for 0…5V and 0…10V ranges
Chxx.HighSignal	REAL	One of four points used in scaling. The high signal is in terms of the inputs signal units and corresponds to the high engineering term when scaled.	Current applications - Any value greater than the low signal in range. • 20 = default for either current input range Voltage applications - Any value greater than the low signal in range. • 10 = default for 0…10V and -10…10V ranges • 5 = default for 0…5V range
Chxx.LowEngineering	REAL	One of four points used in scaling. The low engineering helps determine the engineering units the signal values scale into. The low engineering term corresponds to the low signal value.	Any value less than the high engineering value. • Current applications: 0.0 = default • Voltage applications: Low signal = default. For example, with the -10…10V range, the default = -10.
Chxx.HighEngineering	REAL	One of four points used in scaling. The high engineering helps determine the engineering units the signal values scale into. The high engineering term corresponds to the high signal value.	Any value greater than the low engineering value. • Current applications: 100.0 = default • Voltage applications: High signal = default. For example, with the -10…10V range, the default = 10.
Chxx.LLAlarmLimit	REAL	The Low Low alarm trigger point. Causes the Chxx.LLAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units.	0.0 = Default
Chxx.LAlarmLimit	REAL	The Low alarm trigger point. Causes the ChxxLAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units.	0.0 = Default
Chxx.HAlarmLimit	REAL	The High alarm trigger point. Causes the ChxxHAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units.	100.0 = Default
Chxx.HHAlarmLimit	REAL	The High High alarm trigger point. Causes the ChxxHHAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units.	100.0 = Default
Chxx.RateAlarmLimit	REAL	The Rate alarm trigger point. Causes the ChxxRateAlarm to trigger when the input signal changes at a rate faster than the configured rate alarm. Configured in Engineering Units per second.	0 = Rate Alarm is not used Any value greater than zero = Trigger point
Chxx.AlarmDeadband	REAL	Allows a process alarm to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm. The deadband value is subtracted from the High and High High Alarm Limits to calculate the deadband thresholds for these alarms. The deadband value is added to the Low and Low Low Alarm Limits to calculate the deadband thresholds for these alarms.	Any non-negative value 0 = Default

Input Tags

Table 39 describes the 5094-IF8 module input tags.

Table 39 - 5094-IF8 Module - Input Tags

Name	Data Type	Definition	Valid Values
RunMode	BOOL	Channel's operating state	• 0 = Idle • 1 = Run
ConnectionFaulted	BOOL	Indicates if a connection is running. The module sets this tag to 0 when connected. If the module is not connected, it changes the tag to 1.	• 0 = Connection running • 1 = Connection not running
DiagnosticActive	BOOL	Indicates if any diagnostics are active or if the prognostics threshold is reached.	• 0 = No diagnostics active • 1 = One or more diagnostics are active or the prognostics threshold is reached
DiagnosticSequenceCount	SINT	Increments for each time a distinct diagnostic condition is detected, and when a distinct diagnostic condition transitions from detected to not detected. Set to zero by product reset or power cycle. Wraps from 255 (-1) to 1 skipping zero.	-128...127 The value of 0 is skipped except during module power-up.
Chxx.Fault	BOOL	Indicates that channel data is inaccurate and **cannot be trusted** for use in the application. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good • 1 = Bad, causing fault The typical causes of a fault are the following: – Channel is disabled – Open Wire (input modules) or No Load (output modules) condition – Underrange/Overrange condition – Short Circuit condition We recommend that you first troubleshoot the module to see if the typical causes exist.
Chxx.Uncertain	BOOL	Indicates that the channel data can be inaccurate but the **degree of inaccuracy is not known**. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good data • 1 = Uncertain data The typical causes of uncertain data are the following: – Data signal slightly outside the channel operating range – The channel is slightly over temperature. – Invalid sensor offset value – Calibration fault on the channel – Calibration is in process on the channel We recommend that you first troubleshoot the module to see if the typical causes exist.
Chxx.OpenWire	BOOL	The signal wire is disconnected from the channel or the RTB is removed from the module.	• 0 = Open Wire condition does not exist or Open Wire Detection is disabled • 1 = Open Wire condition exists. That is, a signal wire is disconnected from the channel or the RTB is removed from the module.
Chxx.OverTemperature	BOOL	Module is higher temperature than its operating limits. • If this tag is set to 1 but a fault does not exist on the channel, this tag is only an indication of operating conditions but the channel is functioning. • If this tag is set to 1 and a fault exists on the channel, the channel is not functioning.	• 0 = Module temperature is not over the operating limits • 1 = Module temperature is over the operating limits
Chxx.FieldPowerOff	BOOL	Field power is not present at the channel.	• 0 = Field Power is present • 1 = Field Power is not present
Chxx.NotANumber	BOOL	Indicates if the last received channel data was not a number.	• 0 = Last channel data received was a number • 1 = Last channel data received was not a number
Chxx.Underrange	BOOL	Indicates the channel data is beneath the underrange threshold for this channel. For example, when the channel operates in the 4...20 mA input range, the underrange threshold on the channel is ≤ 3.0 mA. If the input signal is 0 mA, this tag is set to 1.	• 0 = Channel data is not beneath the underrange threshold • 1 = Channel data is beneath the underrange threshold
Chxx.Overrange	BOOL	Indicates the channel data is above the overrange threshold for this channel. For example, when the channel operates in the 4...20 mA output range, the overrange threshold on the channel is ≥ 23.0 mA. If the input signal is 24 mA, this tag is set to 1.	• 0 = Channel data is not above the overrange threshold • 1 = Channel data is above the overrange threshold

Table 39 - 5094-IF8 Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.LLAlarm	BOOL	Triggered when the input data value is less than the Low Low alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is greater than the Low Low limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.LAlarm	BOOL	Triggered when the input data value is less than the Low alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is greater than the Low limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.HAlarm	BOOL	Triggered when the input data value is greater than the High alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is less than the High limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.HHAlarm	BOOL	Triggered when the input data value is greater than the High High alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is less than the High High limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.RateAlarm	BOOL	Triggered when the change between consecutive channel samples divided by the period of time between when the samples were taken exceeds the Rate Alarm. If latched, this tag remains set until it is unlatched.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.CalFault	BOOL	Indicates the last attempted Calibration for this channel failed or there is no calibration data present. This tag is cleared, that is, set to 0, when power is cycled to the module.	• 0 = Calibration did not fail • 1 = Calibration failed
Chxx.Calibrating	BOOL	Indicates the channel is currently being calibrated.	• 0 = Channel is not being calibrated • 1 = Channel is being calibrated
Chxx.CalGoodLowRef	BOOL	Indicates that a valid Low Reference signal has been sampled on this channel. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80.	• 0 = Valid Low Reference signal has not been sampled on this channel • 1 = Valid Low Reference signal has been sampled on this channel
Chxx.CalBadLowRef	BOOL	Indicates that an invalid Low Reference signal has been sampled on this channel.You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid Low Reference signal, the Chxx.CalFault tag is set for this channel until a successful calibration is performed. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Invalid Low Reference signal has not been sampled on this channel • 1 = Invalid Low Reference signal has been sampled on this channel
Chxx.CalGoodHighRef	BOOL	Indicates that a valid High Reference signal has been sampled on this channel. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Valid High Reference signal has not been sampled on this channel • 1 = Valid High Reference signal has been sampled on this channel

Table 39 - 5094-IF8 Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.CalBadHighRef	BOOL	Indicates that an invalid High Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid High Reference signal, the Chxx.CalFault tag is set for this channel until a successful calibration is performed. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Invalid High Reference signal has not been sampled on this channel • 1 = Invalid High Reference signal has been sampled on this channel
Chxx.CalSuccessful	BOOL	Indicates calibration on this channel is complete and the Calibrating state has been exited. This tag remains set after valid calibration as long as connection is open. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Calibration was not successful • 1 = One of the following: – Calibration was successful and calibrating state has been exited. – Calibration data is present and applied.
Chxx.Data	REAL	Channel data in scaled Engineering Units.	Any positive or negative value.
Chxx.RollingTimestamp	INT	Continuously-running 15-bit timer that counts in milliseconds. Whenever an input module scans its channels, it also records the value of RollingTimestamp at that time. The user program can then use the last two RollingTimestamp values and calculate the interval between receipt of data or the time when new data has been received.	0 ...32767

Output Tags

Table 40 describes the 5094-IF8 module output tags.

Table 40 - 5094-IF8 Module - Output Tags

Name	Data Type	Definition	Valid Values
Chxx.LLAlarmEn	BOOL	Enables the Low Low alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.LAlarmEn	BOOL	Enables the Low alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.HAlarmEn	BOOL	Enables the High alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.HHAlarmEn	BOOL	Enables the High High alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled

Table 40 - 5094-IF8 Module - Output Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.RateAlarmEn	BOOL	Enables the Rate alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.LLAlarmUnlatch	BOOL	Unlatches a latched Low Low Alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Low Low Alarm remains latched • 1 = Low Low Alarm unlatches
Chxx.LAlarmUnlatch	BOOL	Unlatches a latched Low Alarm at the first instance of the bit transition from 0 to 1.	• 0 = Low Alarm remains latched • 1 = Low Alarm unlatches
Chxx.HAlarmUnlatch	BOOL	Unlatches a latched High Alarm at the first instance of the bit transition from 0 to 1.	• 0 = High Alarm remains latched • 1 = High Alarm unlatches
Chxx.HHAlarmUnlatch	BOOL	Unlatches a set High High Alarm at the first instance of the bit transition from 0 to 1.	• 0 = High High Alarm remains latched • 1 = High High Alarm unlatches
Chxx.RateAlarmUnlatch	BOOL	Unlatches a set Rate Alarm at the first instance of the bit transition from 0 to 1.	• 0 = Rate Alarm remains latched • 1 = Rate Alarm unlatches
Chxx.Calibrate	BOOL	Initiates the Calibration process. This tag must remain set until a valid Low Reference and High Reference values are applied to the input. If the tag value transitions to 0 before calibration is finished, the process stops and calibration fails.	• 0 = Calibration process is not started • 1 = Calibration process is started
Chxx.CalLowRef	BOOL	Rising edge triggers the Low Calibration at the Low Reference Point for the current input range value. A valid Low Reference signal must be connected to the channel before setting this tag. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Channel data value has not passed the Low Reference Point value for the current *InputRange* tag value • 1 = Channel data value has passed the Low Reference Point value for the current *InputRange* tag value
Chxx.CalHighRef	BOOL	Rising edge triggers a High Calibration at the High Reference Point for the current input range value. A valid High Reference signal must be connected to the channel before setting tag. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Channel data value has not passed the High Reference Point for the current *InputRange* tag value • 1 = Channel data value has passed the High Reference Point for the current *InputRange* tag value
Chxx.SensorOffset	REAL	Compensates for any known offset error on the sensor or channel to which the sensor is connected. In terms of engineering units. The value of this tag is added to the measured value in engineering units and is used in the Chxx.Data input tag.	Any valid float value (We recommend that you use a value in the channel's operating range.) 0.0 = Default

5094-IY8 Module Tags

This section describes the tags associated with the 5094-IY8 module.

Configuration Tags

Table 41 describes the 5094-IY8 module configuration tags.

Table 41 - 5094-IY8 Module - Configuration Tags

Name	Data Type	Definition	Valid Values
CJChxx.Disable	BOOL	If this tag set to 1, the embedded Cold Junction measurement is not used when the module calculates the compensation. There is a CJC embedded in each input channels. Consider the following: • If you enable each CJChxx without remote CJ channel, it can be used as CJ measurement for the corresponding input channel. • If you disable CJChxx measurement, it is assumed that the cold junction temperature is 0 in the CJ compensation.	• 0 = Cold junction measurement is used to calculate CJ compensation • 1 = Cold junction measurement is not used to calculate CJ compensation
CJChxx.Remote	BOOL	Indicates if the cold junction sensor is mounted on a remote termination block when set, rather than the embedded CJ in each channel. If the cold junction sensor is mounted on remote termination block, the module uses the respective remote CJC measurement on the chosen channel to calculate the CJC compensation. Only one channel can be assigned as a remote CJ channel.	• 0 = Cold junction sensor is not mounted on a remote termination block • 1 = Cold junction sensor is mounted on a remote termination block
CJChxx.RemoteCJChannel		Shows the remote termination input channel number.	
CJChxx.SensorOffset	REAL	Offset added directly to the measured CJ temperature. Used to compensate for cold junction temperature sensor error.	Any
Chxx.Range	SINT	Channel's operating range	• 0 = -10...10V • 1 = 0...5V • 2 = 0...10V • 4 = 0...20 mA • 5 = 4...20 mA • 6 = -100...100 mV • 7 = unused • 8 = 1...500 Ω 2-wire • 9 = 2...1,000 Ω 2-wire • 10 = 4...2,000 Ω 2-wire • 11 = 8...4,000 Ω 2-wire • 12 = 1...500 Ω 3-wire • 13 = 2...1,000 Ω 3-wire • 14 = 4...2,000 Ω 3-wire • 15 = 8...4,000 Ω 3-wire • If the input type is Thermocouple/RTD, the additional values below are included. • 16 = 1...500 Ω 4-wire • 17 = 2...1,000 Ω 4-wire • 18 = 4...2,000 Ω 4-wire • 19 = 8...4,000 Ω 4-wire

Table 41 - 5094-IY8 Module - Configuration Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.SensorType	SINT		RTD Mode: • 0 = no linearization, Ω (if "Remote termination" is used as the input channel, this value is not shown) • 1 = 100 Ω Platinum 385 • 2 = 200 Ω Platinum 385 • 3 = 500 Ω Platinum 385 • 4 = 1000 Ω Platinum 385 • 5 = 100 Ω Platinum 3916 • 6 = 200 Ω Platinum 3916 • 7 = 500 Ω Platinum 3916 • 8 = 1000 Ω Platinum 3916 • 9 = 10 Ω Copper 427 • 10 = 120 Ω Nickel 672 • 11 = 100 Ω Nickel 618 • 12 = 120 Ω Nickel 618 • 13 = 200 Ω Nickel 618 • 14 = 500 Ω Nickel 618 • Thermocouple Mode: • 0 = mV (if "Remote termination" is used as the input channel, this value is not shown) • 1 = B • 2 = C • 3 = E • 4 = J • 5 = K • 6 = N • 7 = R • 8 = S • 9 = T • 10 = TXK/XK (L) • 11 = D
Chxx.NotchFilter	SINT	Notch Filter removes line noise for the channel.	• 0 = 5 Hz • 1 = 10 Hz • 2 = 15 Hz • 3 = 20 Hz • 4 = 50 Hz • 5 = 60 Hz • 6 = 100 Hz • 7 = 200 Hz • 8 = 500 Hz • 9 = 1,000 Hz • 10 = 2,500 Hz • 11 = 5,000 Hz • 12 = 10,000 Hz • 13 = 15,625 Hz • 14 = 25,000 Hz • 15 = 31,250 Hz • 16 = 62,500 Hz
Chxx.AlarmDisable	BOOL	Disables all alarms on the channel. **IMPORTANT**: Consider the following: • When if you change this tag to 0, that is, so alarms are not disabled, you must also enable the individual alarms for them to work. For example, if you want to use the Low Low alarm for a channel, you must set the Chxx.AlarmDisable to 0 and set the Chxx.LLAlarmEn output tag to 1 so the alarm is enabled. This applies to all alarms on the module. • Conversely, if you set this tag to 1, alarms are disabled regardless of the setting on the alarm enable tag for any alarm.	• 0 = Alarms are enabled • 1 = Alarms are disabled (default)

Table 41 - 5094-IY8 Module - Configuration Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.ProcessAlarmLatchEn	BOOL	Configures Process alarms to latch until they are explicitly unlatched. The Process alarms include: • HighHigh alarm • High alarm • Low alarm • LowLow alarm	• 0 = Latching disabled (default) • 1 = Latching enabled
Chxx.RateAlarmLatchEn	BOOL	Configures the Rate alarm to latch until it is explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Chxx.OpenWireEn	BOOL	Enable the input Open Wire diagnostic	• 0 = Disabled (default) • 1 = Enabled
Chxx.Disable	BOOL	Disables the channel.	• 0 = Channel is enabled (default) • 1 = Channel is disabled
Chxx.InputSSVSwitchEn	BOOL	Select when using 2-wire current transmitter that is powered from Sensor Source Voltage (SSV). This shorts the analog input channel and analog common ground to avoid the need to install an additional jumper wire on the terminal.	• 0 = Analog input and analog common ground are opened (default) (For use with RTD, thermocouple, or transmitters (V/I output) that are powered by an external power source) • 1 = Analog input and analog common ground are shorted (For use with 2-wire current transmitter that are powered from SSV)
Chxx.TenOhmOffset	INT	Offset used to linearize a 10 Ω copper sensor type's input	-1.00...1.00 Ω
Chxx.DigitalFilter	INT	A non-zero value enables the filter, providing a time constant in milliseconds used in a first order lag filter to smooth the input signal.	All positive values
Chxx.LowSignal	REAL	One of four points used in scaling. The low signal is in terms of the inputs signal units and corresponds to the low engineering term when scaled.	• **Current input type** - Any value less than the high signal in range. – 0 = default for 0...20 mA range – 4 = default for 4...20 mA • **Voltage input type**- Any value less than the high signal in range. – -10 = default for -10...10V range – 0 = default for 0...5V and 0...10V ranges • **RTD input type** - By default, this tag value is the lowest temperature supported by the Sensor Type connected to the channel. You can change the value, if necessary. The value is always Celsius units. For a list of the temperature values associated with each RTD input sensor type, see Table 18. • **Thermocouple input type** - By default, this tag value is the lowest temperature supported by the Thermocouple type connected to the channel. The value is always in Celsius units. For a list of the temperature values associated with each Thermocouple input sensor type, see Table 18.

Table 41 - 5094-IY8 Module - Configuration Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.HighSignal	REAL	One of four points used in scaling. The high signal is in terms of the inputs signal units and corresponds to the high engineering term when scaled.	• **Current input type** - Any value greater than the low signal in range. – 20 = default for either current input range • **Voltage input type** - Any value greater than the low signal in range. – 10 = default for 0...10V and -10...10V ranges – 5 = default for 0...5V range • **RTD input type** - By default, this tag value is the highest temperature supported by the Sensor Type connected to the channel. You can change the value, if necessary. The value is always Celsius units. For a list of the temperature values associated with each RTD input sensor type, see Table 18. • **Thermocouple input type** - By default, the tag value is the highest temperature supported by the Thermocouple type connected to the channel. You can change the value, if necessary. The value is always in Celsius units. For a list of the temperature values associated with each Thermocouple input sensor type, see Table 18.
Chxx.LowEngineering	REAL	One of four points used in scaling. The low engineering helps determine the engineering units the signal values scale into. The low engineering term corresponds to the low signal value.	Any value less than the high engineering value. • **Current input type**: 0.0 = default • **Voltage input type**: Low signal = default. For example, with the -10...10V range, the default = -10. • **RTD input type** - By default, the tag value is the lowest temperature supported by the Sensor Type connected to the channel. You can change the value, if necessary. The engineering units value matches the Temperature Units that you choose. For a list of the temperature values associated with each RTD input sensor type, see Table 18. • **Thermocouple input type** - By default, the tag value is the lowest temperature supported by the Thermocouple type connected to the channel. You can change the value, if necessary. The engineering units value matches the Temperature Units that you choose. For a list of the temperature values associated with each Thermocouple input sensor type, see Table 18.

Table 41 - 5094-IY8 Module - Configuration Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.HighEngineering	REAL	One of four points used in scaling. The high engineering helps determine the engineering units the signal values scale into. The high engineering term corresponds to the high signal value.	Any value greater than the low engineering value. • **Current input type**: 100.0 = default • **Voltage input type**: High signal = default. For example, with the -10...10V range, the default = 10. • **RTD input type** - By default, the tag value is the highest temperature supported by the Sensor Type connected to the channel. You can change the value, if necessary. The engineering units value matches the Temperature Units that you choose. For a list of the temperature values associated with each RTD input sensor type, see Table 18. • **Thermocouple input type** - By default, the tag value is the highest temperature supported by the Thermocouple type connected to the channel. You can change the value, if necessary. The engineering units value matches the Temperature Units that you choose. For a list of the temperature values associated with each Thermocouple input sensor type, see Table 18.
Chxx.LLAlarmLimit	REAL	The Low Low alarm trigger point. Causes the ChxxLLAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units.	0.0 = default
Chxx.LAlarmLimit	REAL	The Low alarm trigger point. Causes the ChxxLAlarm to trigger when the input signal moves beneath the configured trigger point. In terms of engineering units.	0.0 = default
Chxx.HAlarmLimit	REAL	The High alarm trigger point. Causes the ChxxHAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units.	100.0 = default
Chxx.HHAlarmLimit	REAL	The High High alarm trigger point. Causes the ChxxHHAlarm to trigger when the input signal moves above the configured trigger point. In terms of engineering units.	100.0 = default
Chxx.RateAlarmLimit	REAL	The Rate alarm trigger point. Causes the ChxxRateAlarm to trigger when the input signal changes at a rate faster than the configured rate alarm. Configured in Engineering Units per second.	0...100 0 = default
Chxx.AlarmDeadband	REAL	Allows a process alarm to remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm. The deadband value is subtracted from the High and High High Alarm Limits to calculate the deadband thresholds for these alarms. The deadband value is added to the Low and Low Low Alarm Limits to calculate the deadband thresholds for these alarms.	Any non-negative value 0 = default

Input Tags

Table 42 describes the 5094-IY8 module input tags.

Table 42 - 5094-IY8 Module - Input Tags

Name	Data Type	Definition	Valid Values
RunMode	BOOL	Channel's operating state	• 0 = Idle • 1 = Run
ConnectionFaulted	BOOL	Indicates if a connection is running. The module sets this tag to 0 when connected. If the module is not connected, it changes the tag to 1.	• 0 = Connection running • 1 = Connection not running
DiagnosticActive	BOOL	Indicates if any diagnostics are active or if the prognostics threshold is reached.	• 0 = No diagnostics active • 1 = One or more diagnostics are active or the prognostics threshold is reached

Table 42 - 5094-IY8 Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
DiagnosticSequenceCount	SINT	Increments for each time a distinct diagnostic condition is detected, and when a distinct diagnostic condition transitions from detected to not detected. Set to zero by product reset or power cycle. Wraps from 255 (-1) to 1 skipping zero.	-128...+127 The value of 0 is skipped except during module power-up.
CJChxx.Fault	BOOL	Indicates that the cold junction data is inaccurate and **cannot be trusted** for use in the application. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good • 1 = Bad, causing fault The typical causes of a fault are the following: – Channel is disabled – Open Wire condition – Underrange/Overrange condition – Short Circuit condition We recommend that you first troubleshoot the module to see if the typical causes exist.
CJChxx.Uncertain	BOOL	Indicates that the cold junction data can be inaccurate but the **degree of inaccuracy is not known**. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good data • 1 = Uncertain data The typical causes of uncertain data are the following: – Data signal slightly outside the channel operating range – The channel is slightly over temperature. – Invalid sensor offset value – Calibration fault on the channel – Calibration is in process on the channel We recommend that you first troubleshoot the module to see if the typical causes exist.
CJChxx.OpenWire	BOOL	The cold junction wire is disconnected from the channel or the RTB is removed from the module. If this condition exists, confirm that you are using one of the following RTBs: • 5094-RTB3T • 5094-RTB3TS	• 0 = Open Wire condition does not exist • 1 = Open Wire condition exists. That is, a signal wire is disconnected from the channel or the RTB is removed from the module.
CJChxx.FieldPowerOff	BOOL	Field power is present at the cold junction.	• 0 = Field Power is present • 1 = Field Power is not present
CJChxx.Underrange	BOOL	The cold junction at the channel is below the minimum of its operating range.	• 0 = Channel data is not beneath the absolute minimum • 1 = Channel data is beneath the absolute minimum
CJChxx.Overrange	BOOL	The cold junction at the channel is above the maximum of its operating range.	• 0 = Channel data is not above the absolute minimum • 1 = Channel data is above the absolute minimum
CJChxx.Temperature	REAL	Current temperature of the cold junction in degrees C. This tag **must** use Celsius.	Any
Chxx.Fault	BOOL	Indicates that channel data is inaccurate and **cannot be trusted** for use in the application. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good • 1 = Bad, causing fault The typical causes of a fault are the following: – Channel is disabled – Open Wire condition – Underrange/Overrange condition – Short Circuit condition We recommend that you first troubleshoot the module to see if the typical causes exist.
Chxx.Uncertain	BOOL	Indicates that the channel data can be inaccurate but the **degree of inaccuracy is not known**. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good data • 1 = Uncertain data The typical causes of uncertain data are the following: – Data signal slightly outside the channel operating range – The channel is slightly over temperature. – Invalid sensor offset value – Calibration fault on the channel – Calibration is in process on the channel We recommend that you first troubleshoot the module to see if the typical causes exist.

Table 42 - 5094-IY8 Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.OpenWire	BOOL	The signal wire is disconnected from the channel or the RTB is removed from the module.	• 0 = Open Wire condition does not exist • 1 = Open Wire condition exists. That is, a signal wire is disconnected from the channel or the RTB is removed from the module.
Chxx.OverTemperature	BOOL	Module is higher temperature than its operating limits. • If this tag is set to 1 but a fault does not exist on the channel, this tag is only an indication of operating conditions but the channel is functioning. • If this tag is set to 1 and a fault exists on the channel, the channel is not functioning.	• 0 = Module temperature is not over the operating limits • 1 = Module temperature is over the operating limits
Chxx.FieldPowerOff	BOOL	Field power is not present at the channel.	• 0 = Field Power is present • 1 = Field Power is not present
Chxx.NotANumber	BOOL	Indicates if the last received channel data was not a number.	• 0 = Last channel data received was a number • 1 = Last channel data received was not a number
Chxx.Underrange	BOOL	Indicates the channel data is beneath the underrange threshold for this channel. For example, when the channel operates in the 4...20 mA input range, the underrange threshold on the channel is ≤ 3.0 mA. If the input signal is 0 mA, this tag is set to 1.	• 0 = Channel data is not beneath the underrange threshold • 1 = Channel data is beneath the underrange threshold
Chxx.Overrange	BOOL	Indicates the channel data is above the overrange threshold for this channel. For example, when the channel operates in the 4...20 mA input range, the overrange threshold on the channel is ≥ 23.0 mA. If the input signal is 24 mA, this tag is set to 1.	• 0 = Channel data is not above the overrange threshold • 1 = Channel data is above the overrange threshold
Chxx.LLAlarm	BOOL	Triggered when the input data value is less than the Low Low alarm value. If latched, this alarm remains triggered until unlatched or if the input data value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.LAlarm	BOOL	Triggered when the input data value is less than the Low alarm value. If latched, this alarm remains triggered until unlatched or if the input data value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.HAlarm	BOOL	Triggered when the input data value is greater than the High alarm value. If latched, this alarm remains triggered until unlatched or if the input data value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.HHAlarm	BOOL	Triggered when the input data value is greater than the High High alarm value. If latched, this alarm remains triggered until unlatched or if the input data value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.RateAlarm	BOOL	Triggered when the change between consecutive channel samples divided by the period of time between when the samples were taken exceeds the Rate Alarm. If latched, this tag remains set until it is unlatched.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.CalFault	BOOL	Indicates the last attempted Calibration for this channel failed. This tag is cleared, that is, set to 0, when power is cycled to the module.	• 0 = Calibration did not fail • 1 = Calibration failed
Chxx.Calibrating	BOOL	Indicates the channel is currently being calibrated.	• 0 = Channel is not being calibrated • 1 = Channel is being calibrated
Chxx.CalGoodLowRef	BOOL	Indicates that a valid Low Reference signal has been sampled on this channel. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Valid Low Reference signal has not been sampled on this channel • 1 = Valid Low Reference signal has been sampled on this channel

Table 42 - 5094-IY8 Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.CalBadLowRef	BOOL	Indicates that an invalid Low Reference signal has been sampled on this channel.You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid Low Reference signal, the Chxx.CalFault tag is set for this channel until a successful calibration is performed. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Invalid Low Reference signal has not been sampled on this channel • 1 = Invalid Low Reference signal has been sampled on this channel
Chxx.CalGoodHighRef	BOOL	Indicates that a valid High Reference signal has been sampled on this channel. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Valid High Reference signal has not been sampled on this channel • 1 = Valid High Reference signal has been sampled on this channel
Chxx.CalBadHighRef	BOOL	Indicates that an invalid High Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid High Reference signal, the Chxx.CalFault tag is set for this channel until a successful calibration is performed. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Invalid High Reference signal has not been sampled on this channel • 1 = Invalid High Reference signal has been sampled on this channel
Chxx.CalSuccessful	BOOL	Indicates calibration on this channel is complete and the Calibrating state has been exited. This tag remains set after valid calibration as long as connection is open. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Calibration was not successful • 1 = Calibration was successful and calibrating state has been exited.
Chxx.Data	REAL	Channel data in scaled Engineering Units.	Any positive or negative value.
Chxx.RollingTimestamp	INT	Continuously-running 15-bit timer that counts in milliseconds. Whenever an input module scans its channels, it also records the value of RollingTimestamp at that time. The user program can then use the last two RollingTimestamp values and calculate the interval between receipt of data or the time when new data has been received.	0 ...32767

Output Tags

Table 43 describes the 5094-IY8 module output tags.

Table 43 - 5094-IY8 Module - Output Tags

Name	Data Type	Definition	Valid Values
Chxx.LLAlarmEn	BOOL	Enables the Low Low alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.LAlarmEn	BOOL	Enables the Low alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.HAlarmEn	BOOL	Enables the High alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.HHAlarmEn	BOOL	Enables the High High alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.RateAlarmEn	BOOL	Enables the Rate alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.LLAlarmUnlatch	BOOL	Unlatches a latched Low Low Alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Low Low Alarm remains latched • 1 = Low Low Alarm unlatches
Chxx.LAlarmUnlatch	BOOL	Unlatches a latched Low Alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Low Alarm remains latched • 1 = Low Alarm unlatches
Chxx.HAlarmUnlatch	BOOL	Unlatches a latched High Alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = High Alarm remains latched • 1 = High Alarm unlatches
Chxx.HHAlarmUnlatch	BOOL	Unlatches a set High High Alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = High High Alarm remains latched • 1 = High High Alarm unlatches
Chxx.RateAlarmUnlatch	BOOL	Unlatches a set Rate Alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Rate Alarm remains latched • 1 = Rate Alarm unlatches
Chxx.Calibrate	BOOL	Initiates the Calibration process. This tag must remain set until a valid Low Reference and High Reference values are applied to the input. If the tag value transitions to 0 before calibration is finished, the process stops and calibration fails.	• 0 = Calibration process is not started • 1 = Calibration process is started

Table 43 - 5094-IY8 Module - Output Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.CalLowRef	BOOL	Rising edge triggers the Low Calibration at the Low Reference Point for the current input range value. A valid Low Reference signal must be connected to the channel before setting this tag. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Low Reference Signal is not applied to the RTB • 1 = Low Reference Signal is applied to RTB
Chxx.CalHighRef	BOOL	Rising edge triggers a High Calibration at the High Reference Point for the current input range value. A valid High Reference signal must be connected to the channel before setting tag. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = High Reference Signal is not applied to the RTB • 1 = High Reference Signal is applied to RTB
Chxx.SensorOffset	REAL	Compensates for any known offset error on the sensor or channel to which the sensor is connected. In terms of engineering units. The value of this tag is added to the measured value in engineering units and is used in the Chxx.Data input tag.	Any (We recommend that you use a value in the channel's operating range.) 0.0 = default

5094-OF8 Module Tags

This section describes the tags associated with the 5094-OF8 module.

Configuration Tags

Table 44 describes the 5094-OF8 module configuration tags.

Table 44 - 5094-OF8 Module - Configuration Tags

Name	Data Type	Definition	Valid Values
Chxx.Range	SINT	Channel's operating range	• 0 = -10...+10V • 1 = 0...5V • 2 = 0...10V • 4 = 0...20 mA • 5 = 4...20 mA
Chxx.AlarmDisable	BOOL	Disables all alarms on the channel.	• 0 = Alarms are enabled • 1 = Alarms are disabled (default)
Chxx.LimitAlarmLatchEn	BOOL	Configures Limit alarms to latch until they are explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Chxx.RampAlarmLatchEn	BOOL	Latches Ramp alarm when set so that does not clear until explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Chxx.NoLoadEn	BOOL	Enable the input No Load diagnostic	• 0 = Disabled (default) • 1 = Enabled
Chxx.Disable	BOOL	Disables the channel.	• 0 = Channel is enabled (default) • 1 = Channel is disabled
Chxx.FaultMode	BOOL	Determines output action when a connection fault occurs. At the fault occurrence, the output holds its last state or transitions to the value set in the Fault Value parameter. The channel continues the Fault Mode for the length of time set in the Fault Value State Duration parameter.	• 0 = Transition to user-defined value • 1 = Hold Last State (default)
Chxx.ProgMode	BOOL	Determines output action when the controller transitions to Program mode or the connection to the module is inhibited. At the transition to Program mode, the output holds its last state or transitions to the value set in the Program Value parameter.	• 0 = Transition to user-defined value • 1 = Hold Last State (default)

Table 44 - 5094-OF8 Module - Configuration Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.ProgramToFaultEn	BOOL	Determines channel action if a connection faults while the module is in a safe state for Program mode. The channel can remain in the safe state for Program mode or transition to a safe state for Fault mode. If the channel remains in safe state for Program mode, the Final Fault State parameter is ignored.	• 0 = Remains in the Program state • 1 = Transitions to the safe state for the Fault mode
Chxx.RampInRun	BOOL	Enables Output Ramping when the module is in Run mode. Output changes during Run mode are limited to the Maximum Ramp Rate value.	• 0 = Ramping disabled (default) • 1 = Ramping enabled in Run mode
Chxx.RampToProg	BOOL	Enables Output Ramping when the controller transitions to Program mode. Output changes during Program mode are limited to the Maximum Ramp Rate value.	• 0 = Ramping disabled (default) • 1 = Ramping enabled to Program mode state
Chxx.RampToFault	BOOL	Enables Output Ramping when the connection to the module faults. Output transitions to FaultValue and FaultFinalState are limited to the MaximumRampRate.	• 0 = Ramping disabled (default) • 1 = Ramping enabled to Fault mode state
Chxx.HoldForInit	BOOL	When set, configures the channel to hold, or not change, until initialized with a value within 0.1% of full scale of its current value when one of the following conditions occurs. • Module initial connection (power up) • Controller transition from Program mode back to Run mode • Module reestablishes communication after a fault • SA power is restored after being lost.	• 0= Output O.Chxx.Data signal immediately • 1= Hold last signal until initialization match
Chxx.FaultValueStateDuration	SINT	Determines the length of time the FaultMode or FaultValue parameter value is held prior to the Final Fault State.	• 0 = Hold forever (default) • Any of the following: – 1, 2, 5, or 10 seconds
Chxx.MaxRampRate	REAL	Maximum rate at which the channel can transition to in Engineering Units/Second. This tag is used only if at least one of the following output ramping modes is enabled: • Ramp In Run • Ramp To Fault • Ramp To Program	Any value ≥ 0.0 1,000,000.00 = default If the MaxRampRate = 0.0, the ramp rate is limited to ramping the range full scale in one RPI.
Chxx.LowSignal	REAL	One of four points used in scaling. The low signal is in terms of the inputs signal units and corresponds to the low engineering term when scaled.	Current applications - Any value less than the high signal in range. • 0 = default for 0…20 mA range • 4 = default for 4…20 mA Voltage applications - Any value less than the high signal in range. • -10 = default for -10…10V range • 0 = default for 0…5V and 0…10V range
Chxx.HighSignal	REAL	One of four points used in scaling. The high signal is in terms of the inputs signal units and corresponds to the high engineering term when scaled.	Current applications - Any value greater than the low signal in range. • 20 = default for either current input range Voltage applications - Any value greater than the low signal in range. • 10 = default for 0…10V and -10…10V ranges • 5 = default for 0…5V range
Chxx.LowEngineering	REAL	One of four points used in scaling. The low engineering helps determine the engineering units the signal values scale into. The low engineering term corresponds to the low signal value.	Any value less than the high engineering value. • Current applications: 0.0 = default • Voltage applications: Low signal = default. For example, with the -10…10V range, the default = -10.
Chxx.HighEngineering	REAL	One of four points used in scaling. The high engineering helps determine the engineering units the signal values scale into. The high engineering term corresponds to the high signal value.	Any value greater than the low engineering value. • Current applications: 100.0 = default • Voltage applications: High signal = default. For example, with the -10…10V range, the default = 10.
Chxx.LowLimit	REAL	Lowest value to which the output can go based on the operating range established by the Output Clamping feature. The tag value is engineering units.	Any value lower than the HighLimit 0.0 = default

Table 44 - 5094-OF8 Module - Configuration Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.HighLimit	REAL	Highest value to which the output can go based on the operating range established by the Output Clamping feature. The tag value is engineering units.	Any value higher than the LowLimit 0.0 = default
Chxx.Offset	REAL	Compensates for any known error on the sensor or channel to which the sensor is connected. The value is set in engineering units.	Any value (We recommend that you use a small value.) 0.0 = default
Chxx.FaultValue	REAL	Value to which the output changes if the following events exist: • Fault Mode = 0 • Either of the following: – Controller is in Run mode and the connection is lost – Controller is in Program mode, the connection is lost, and the ProgamToFaultEn tag is set	Any value 0.0 = default
Chxx.ProgValue	REAL	Value to which the channel changes if the following events exist: • Program Mode = 0 • Controller transitions to Program mode	Any value 0.0 = default
Chxx.FaultFinalState	REAL	Value to which the channel changes if the following events exist: • Connection is lost • Time defined by the FaultValueStateDuration parameter has been exceeded Output transitions to FaultValue and FaultFinalState are limited to the MaximumRampRate.	Any value 0.0 = default

Input Tags

Table 45 describes the 5094-OF8 module input tags.

Table 45 - 5094-OF8 Module - Input Tags

Name	Data Type	Definition	Valid Values
RunMode	BOOL	Channel's operating state	• 0 = Idle • 1 = Run
ConnectionFaulted	BOOL	Indicates if a connection is running. The module sets this tag to 0 when connected. If the module is not connected, it changes the tag to 1.	• 0 = Connection running • 1 = Connection not running
DiagnosticActive	BOOL	Indicates if any diagnostics are active or if the prognostics threshold is reached.	• 0 = No diagnostics active • 1 = One or more diagnostics are active or the prognostics threshold is reached
DiagnosticSequenceCount	SINT	Increments for each time a distinct diagnostic condition is detected, and when a distinct diagnostic condition transitions from detected to not detected. Set to zero by product reset or power cycle. Wraps from 255 (-1) to 1 skipping zero.	-128...127 The value of 0 is skipped except during module power-up.
Chxx.Fault	BOOL	Indicates that channel data is inaccurate and **cannot be trusted** for use in the application. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good • 1 = Bad, causing fault The typical causes of a fault are the following: – Channel is disabled – No Load condition – Underrange/Overrange condition – Short Circuit condition We recommend that you first troubleshoot the module to see if the typical causes exist.
Chxx.Uncertain	BOOL	Indicates that the channel data can be inaccurate but the **degree of inaccuracy is not known**. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good data • 1 = Uncertain data The typical causes of uncertain data are the following: – Data signal slightly outside the channel operating range – The channel is slightly over temperature. – Invalid sensor offset value – Calibration fault on the channel – Calibration is in process on the channel We recommend that you first troubleshoot the module to see if the typical causes exist.

Table 45 - 5094-OF8 Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.NoLoad	BOOL	The signal wire is disconnected from the channel or the RTB is removed from the module. This condition is detected only when the channel is used in current mode.	• 0 = No Load condition does not exist • 1 = No Load condition exists. That is, a signal wire is disconnected from the channel or the RTB is removed from the module.
Chxx.ShortCircuit	BOOL	A Short Circuit or Overcurrent condition exists. This condition is detected only when the channel is used in voltage mode.	• 0 = No Short Circuit or Overcurrent condition exists • 1 = Short Circuit or Overcurrent condition exists
Chxx.OverTemperature	BOOL	Module is higher temperature than its operating limits. • If this tag is set to 1 but a fault does not exist on the channel, this tag is only an indication of operating conditions but the channel is functioning. • If this tag is set to 1 and a fault exists on the channel, the channel is not functioning.	• 0 = Module temperature is not over the operating limits • 1 = Module temperature is over the operating limits
Chxx.FieldPowerOff	BOOL	Field power is not present at the channel.	• 0 = Field Power is present • 1 = Field Power is not present
Chxx.InHold	BOOL	Indicates that the channel is currently holding until the received data value is within 0.1% range full scale of the current data value.	• 0 = Channel is not holding • 1 = Channel is holding
Chxx.NotANumber	BOOL	Indicates that the last value received for the channel output data value was not a number.	• 0 = Last channel data received was a number • 1 = Last channel data received was not a number
Chxx.Underrange	BOOL	Indicates the channel data is beneath the underrange threshold for this channel. For example, when the channel operates in the 4...20 mA output range, the underrange threshold on the channel is ≤ 3.6 mA. If the output signal is 0 mA, this tag is set to 1.	• 0 = Channel data is not beneath the underrange threshold • 1 = Channel data is beneath the underrange threshold
Chxx.Overrange	BOOL	Indicates the channel data is above the overrange threshold for this channel. For example, when the channel operates in the 4...20 mA output range, the overrange threshold on the channel is ≥ 21.0 mA. If the output signal is 21 mA, this tag is set to 1.	• 0 = Channel data is not above the overrange threshold • 1 = Channel data is above the overrange threshold
Chxx.LLimitAlarm	BOOL	Triggered when the requested output value is below the configured Low Limit value. It remains set until the requested output is above the Low Limit. If the Chxx.AlarmDisable tag is set to 1, that is, the output signal is still clamped at the Low Limit value. But the Low Limit alarm is not triggered.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.HLimitAlarm	BOOL	Triggered when the requested output value is above the configured High Limit value. It remains set until the requested output is below the High Limit. If the Chxx.AlarmDisable tag is set to 1, that is, the output signal is still clamped at the High Limit value. But the High Limit alarm is not triggered.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.RampAlarm	BOOL	Indicates that the analog output has been commanded to change value in a way such that the Maximum Ramp Rate is exceeded	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.CalFault	BOOL	Indicates the last attempted Calibration for this channel failed. This tag is cleared, that is, set to 0, when power is cycled to the module.	• 0 = Calibration did not fail • 1 = Calibration failed
Chxx.Calibrating	BOOL	Indicates the channel is currently being calibrated.	• 0 = Channel is not being calibrated • 1 = Channel is being calibrated
Chxx.CalGoodLowRef	BOOL	Indicates that a valid Low Reference measurement was passed through the output tag to the module. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Valid Low Reference measurement was not passed to the module • 1 = Valid Low Reference measurement was passed to the module

Table 45 - 5094-OF8 Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.CalBadLowRef	BOOL	Indicates that an invalid Low Reference signal has been sampled on this channel.You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid Low Reference signal, the Chxx.CalFault tag is set for this channel until a successful calibration is performed. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Invalid Low Reference signal has not been sampled on this channel • 1 = Invalid Low Reference signal has been sampled on this channel
Chxx.CalGoodHighRef	BOOL	Indicates that a valid High Reference measurement was passed through the output tag to the module. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Valid High Reference measurement was not passed to the module • 1 = Valid High Reference measurement was passed to the module
Chxx.CalBadHighRef	BOOL	Indicates that an invalid High Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid High Reference signal, the Chxx.CalFault tag is set for this channel until a successful calibration is performed. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Invalid High Reference signal has not been sampled on this channel • 1 = Invalid High Reference signal has been sampled on this channel
Chxx.CalSuccessful	BOOL	Indicates calibration on this channel is complete and the Calibrating state has been exited. This tag remains set after valid calibration as long as connection is open. **IMPORTANT**: This tag is available only when you use the Data with Calibration connection type in the Module Definition. If you use the Data connection type, this tag does not appear in the module tags. For more information on how to define a module, see Module Definition on page 80	• 0 = Calibration was not successful • 1 = Calibration was successful and calibrating state has been exited.
Chxx.Data	REAL	Indicates the signal value currently output at the RTB in scaled Engineering Units.	Any positive or negative value.
Chxx.RollingTimestamp	INT	Continuously-running 15-bit timer that counts in milliseconds. Whenever the data echo value changes, the output module updates the value of the RollingTimestamp.	0...32767

Output Tags

Table 46 describes the 5094-OF8 module output tags.

Table 46 - 5094-OF8 Module - Output Tags

Name	Data Type	Definition	Valid Values
Chxx.LLimitAlarmUnlatch	BOOL	Unlatches a latched Low Limit alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Alarm remains latched (default) • 1 = Alarm is unlatched
Chxx.HLimitAlarmUnlatch	BOOL	Unlatches a latched High Limit alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Alarm remains latched (default) • 1 = Alarm is unlatched
Chxx.RampAlarmUnlatch	BOOL	Unlatches a latched Ramp alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Alarm remains latched (default) • 1 = Alarm is unlatched
Chxx.Calibrate	BOOL	Initiates the Calibration process. This tag must remain set until a valid Low Reference and High Reference values are applied to the channel.	• 0 = Calibration process is not started (default) • 1 = Calibration process is started

Table 46 - 5094-OF8 Module - Output Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.CalOutputLowRef	BOOL	A 0 to 1 transition commands the channel to produce the Low Calibration Reference Point for the chosen current or voltage output range.	• 0 = Do not output Cal Low Reference • 1 = Output Calibration Low Reference Do not set this tag and the CalOutputHighRef tag to 1 simultaneously.
Chxx.CalOutputHighRef	BOOL	A 0 to 1 transition commands the channel to produce the High Calibration Reference Point for the chosen current or voltage output range.	• 0 = Do not Output Cal High Reference • 1 = Output Calibration High Reference Signal Do not set this tag and the CalOutputLowRef tag to 1 simultaneously.
Chxx.CalLowRefPassed	BOOL	A 0 to 1 transition indicates that the Chxx.Data output tag data contains the recorded Low Reference value for the channel that is used by the module in Calibration.	• 0 = Not sending Recorded Cal Low Ref • 1 = Sending Recorded Cal Low Reference in Output Data for Calibration Verification
Chxx.CalHighRefPassed	BOOL	A 0 to 1 transition indicates that the Chxx.Data output tag data contains the recorded High Reference value for the channel that is used by the module in Calibration.	• 0 = Not sending Cal High Reference • 1 = Sending recorded Calibration High Reference Signal in Output Data for Calibration Verification
Chxx.CalFinish	BOOL	Data value change that triggers the channel to complete the Calibration procedure, applying the Valid Low and High References received. Channel exits the Calibration state if successful.	• 0 = Channel not triggered to complete the calibration procedure • 1 = Channel triggered to complete the calibration procedure
Chxx.Data	REAL	The value that is converted to the signal on the RTB in scaled Engineering Units.	Any valid engineering unit

5094-IRT8S Module Tags

This section describes the tags associated with the 5094-IRT8S module.

Input Tags

Table 47 describes the 5094-IRT8S module input tags.

Table 47 - 5094-IRT8S Module - Input Tags

Name	Data Type	Definition	Valid Values
RunMode	BOOL	Module's operating state	• 0 = Idle • 1 = Run
ConnectionFaulted	BOOL	Indicates if a connection is running. The module sets this tag to 0 when connected. If the module is not connected, it changes the tag to 1.	• 0 = Connection running • 1 = Connection not running
DiagnosticActive	BOOL	Indicates if any diagnostics are active or if the prognostics threshold is reached.	• 0 = No diagnostics active • 1 = One or more diagnostics are active or the prognostics threshold is reached
DiagnosticSequenceCount	SINT	Increments for each time a distinct diagnostic condition is detected, and when a distinct diagnostic condition transitions from detected to not detected. Set to zero by product reset or power cycle. Wraps from 255 (-1) to 1 skipping zero.	-128...+127 The value of 0 is skipped except during module power-up.
CJChxx.Fault	BOOL	Indicates that channel data is inaccurate and **cannot be trusted** for use in the application. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. The channel is set to Disable.	• 0 = Good • 1 = Bad, causing fault The typical causes of a fault are the following: – Data signal is under or over range. – Channel open wire. – Field Power is off. We recommend that you first troubleshoot the module to see if the typical causes exist. For more information, see Reset FLEX 5000 safety I/O Modules to Out-of-Box State on page 74.

Table 47 - 5094-IRT8S Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
CJChxx.Uncertain	BOOL	Indicates that the channel data can be inaccurate but the **degree of inaccuracy is not known**. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good data • 1 = Uncertain data The typical causes of uncertain data are the following: – Data signal outside channel operating range. – Module has reached a critical operating temperature or is higher than the acceptable operating temperature. – Data value is NotANumber – Calibration fault on the channel. We recommend that you first troubleshoot the module to see if the typical causes exist.
Chxx.OpenWire	BOOL	The signal wire is disconnected from the channel or the RTB is removed from the module.	• 0 = Open Wire condition does not exist. • 1 = Open Wire condition exists. That is, a signal wire is disconnected from the channel or the RTB is removed from the module.
CJChxx.FieldPowerOff	BOOL	Field power is not present at the channel.	• 0 = Field Power is present • 1 = Field Power is not present
CJChxx.Status	BOOL	Indicates the status of the channel.	• 0 = Bad, causing a fault • 1 = Good
CJChxx.NotANumber	BOOL	Indicates if the received Sensor Offset or produced Data is not a number.	• 0 = Sensor offset or Data is a number • 1 = Sensor offset or Data is not a number
CJChxx.Underrange	BOOL	Indicates the channel data is beneath the underrange threshold for this channel.	• 0 = Channel data is not beneath the underrange threshold • 1 = Channel data is beneath the underrange threshold
CJChxx.Overrange	BOOL	Indicates the channel data is above the overrange threshold for this channel.	• 0 = Channel data is not above the overrange threshold • 1 = Channel data is above the overrange threshold
CJChxx.Temperature	REAL	The current temperature of the cold junction.	Any
Chxx.Fault	BOOL	Indicates that channel data is inaccurate and **cannot be trusted** for use in the application. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. The channel is set to Disable. For more information, see Module Data Quality Reporting on page 28.	• 0 = Good • 1 = Bad, causing fault The typical causes of a fault are the following: – Data signal is under or over range. – Channel open wire. – Field Power is off. We recommend that you first troubleshoot the module to see if the typical causes exist. For more information, see Reset FLEX 5000 safety I/O Modules to Out-of-Box State on page 74.
Chxx.Uncertain	BOOL	Indicates that the channel data can be inaccurate but the **degree of inaccuracy is not known**. If the tag is set to 1, you must troubleshoot the module to correct the cause of the inaccuracy. **IMPORTANT**: Once the condition that causes the tag to change to 1 is removed, the tag automatically resets to 0.	• 0 = Good data • 1 = Uncertain data The typical causes of uncertain data are the following: – Data signal outside channel operating range. – Module has reached a critical operating temperature or is higher than the acceptable operating temperature. – Data value is NotANumber – Calibration fault on the channel. We recommend that you first troubleshoot the module to see if the typical causes exist.
Chxx.OpenWire	BOOL	The signal wire is disconnected from the channel or the RTB is removed from the module.	• 0 = Open Wire condition does not exist. • 1 = Open Wire condition exists. That is, a signal wire is disconnected from the channel or the RTB is removed from the module.
Chxx.FieldPowerOff	BOOL	Field power is not present at the channel.	• 0 = Field Power is present • 1 = Field Power is not present
Chxx.Status	BOOL	Indicates the status of the channel.	• 0 = Bad, causing a fault • 1 = Good
Chxx.NotANumber	BOOL	Indicates if the received Sensor Offset or produced Data is not a number.	• 0 = Sensor offset or Data is a number • 1 = Sensor offset or Data is not a number

Table 47 - 5094-IRT8S Module - Input Tags (Continued)

Name	Data Type	Definition	Valid Values
Chxx.Underrange	BOOL	Indicates the channel data is beneath the underrange threshold for this channel.	• 0 = Channel data is not beneath the underrange threshold • 1 = Channel data is beneath the underrange threshold
Chxx.Overrange	BOOL	Indicates the channel data is above the overrange threshold for this channel.	• 0 = Channel data is not above the overrange threshold • 1 = Channel data is above the overrange threshold
Chxx.LLAlarm	BOOL	Triggered when the input data value is less than the Low Low alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is greater than the Low Low limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.LAlarm	BOOL	Triggered when the input data value is less than the Low alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is greater than the Low limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.HAlarm	BOOL	Triggered when the input data value is greater than the High alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is less than the High limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.HHAlarm	BOOL	Triggered when the input data value is greater than the High High alarm value. If latching is enabled, this alarm remains triggered until unlatched. If latching is not enabled, the alarm clears after the input data value is less than the High High limit and the Alarm Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.RateAlarm	BOOL	Triggered when the change between consecutive channel samples divided by the period of time between when the samples were taken exceeds the Rate Alarm. If latched, this tag remains set until it is unlatched.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Chxx.CalFault	BOOL	Indicates the last attempted Calibration for this channel failed or there is no calibration data present. This tag is cleared, that is, set to 0, when power is cycled to the module.	• 0 = Calibration did not fail • 1 = Calibration failed
Chxx.Calibrating	BOOL	Indicates the channel is currently being calibrated.	• 0 = Channel is not being calibrated • 1 = Channel is being calibrated
Chxx.Data	REAL	Channel data in scaled Engineering Units.	Any positive or negative value.
Chxx.RollingTimestamp	INT	Continuously-running 15-bit timer that counts in milliseconds. The user program can then use the last two RollingTimestamp values and calculate the interval between receipt of data or the time when new data has been received.	0...32767

Output Tags

Table 48 describes the 5094-IRT8S module output tags.

Table 48 - 5094-IRT8S Module - Output Tags

Name	Data Type	Definition	Valid Values
CJChxx.SensorOffset	REAL	Offset added directly to the measured CJ temperature. Used to compensate for cold junction temperature sensor error.	Any
Chxx.ResetFault	BOOL	When the 'Latch Fault until reset via output tag' mode is Enabled, the IO channel will hold safety input fault indications until it checks that the fault is removed. If the fault is removed, it only clears the fault status upon detecting that the ResetFault bit in its channel sees a rising edge.	Rising edge: the fault status is released if the fault has been removed.
Chxx.LLAlarmEn	BOOL	Enables the Low Low alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.LAlarmEn	BOOL	Enables the Low alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.HAlarmEn	BOOL	Enables the High alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.HHAlarmEn	BOOL	Enables the High High alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.RateAlarmEn	BOOL	Enables the Rate alarm. **IMPORTANT**: To use this alarm, you must not only set the tag to 1. You must also make sure the Chxx.AlarmDisable configuration tag for the same channel is set to 0. If the Chxx.AlarmDisable configuration tag is set to 1, that is, alarms are disabled, this alarm does not work regardless of the tag value.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Chxx.LLAlarmUnlatch	BOOL	Unlatches a latched Low Low Alarm at the first instance of the bit transitioning from 0 to 1.	• 0 = Low Low Alarm remains latched • 1 = Low Low Alarm unlatches
Chxx.LAlarmUnlatch	BOOL	Unlatches a latched Low Alarm at the first instance of the bit transition from 0 to 1.	• 0 = Low Alarm remains latched • 1 = Low Alarm unlatches
Chxx.HAlarmUnlatch	BOOL	Unlatches a latched High Alarm at the first instance of the bit transition from 0 to 1.	• 0 = High Alarm remains latched • 1 = High Alarm unlatches
Chxx.HHAlarmUnlatch	BOOL	Unlatches a set High High Alarm at the first instance of the bit transition from 0 to 1.	• 0 = High High Alarm remains latched • 1 = High High Alarm unlatches
Chxx.RateAlarmUnlatch	BOOL	Unlatches a set Rate Alarm at the first instance of the bit transition from 0 to 1.	• 0 = Rate Alarm remains latched • 1 = Rate Alarm unlatches
Chxx.SensorOffset	REAL	Compensates for any known offset error on the sensor or channel to which the sensor is connected. In terms of engineering units. The value of this tag is added to the measured value in engineering units and is used in the Chxx.Data input tag.	Any valid float value (We recommend that you use a value in the channel's operating range.) 0.0 = Default

Notes:

Application/Wiring Examples for Safety I/O Modules

This appendix provides example wiring diagrams for the FLEX 5000 I/O safety modules that can be used in functional safety applications.

Applies to these modules:

5094 Safety I/O Modules

IMPORTANT	• Do not connect unused input terminals. • You must disable 5094-IRT8S module channels during wiring, otherwise the channels may go into non-recoverable fault due to bouncing of the signal at the screw. • Performing a wiring change while the channels are running can trigger a discrepancy fault.

The wiring configuration affects the safety application level to which a FLEX 5000 I/O safety module is suitable.

IMPORTANT	Conformity to requirements of the safety category and safety integrity level must be determined **for the entire system**. You need to consider fault exclusion specified in each of the wiring configurations.

5094-IRT8S and 5094-IRT8SXT Module Wiring Diagrams

The following wiring diagrams show the input modules for Thermocouple and RTD.

IMPORTANT	The Safety level shown in the diagrams is applicable to the module itself. Connected devices must have their own status monitoring to achieve application safety level.

Figure 17 - 5094-IRT8S Module – SIL 3, PIe, Cat. 4 Thermocouple

SIL Level and Category: Up to SIL 3, PLe, Cat.4
Fault Exclusion: External Wiring fault
Input Type: Thermocouple
Other: Use suitable qualified sensor.

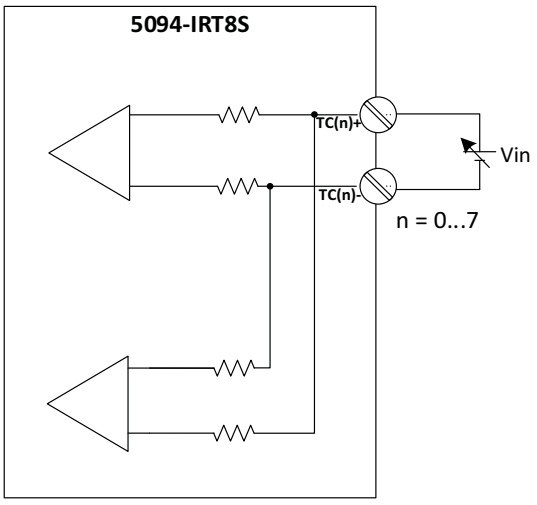


Figure 18 - 5094-IRT8S Module – SIL 3, Ple, Cat. 4 RTD 2 Wire

SIL Level and Category: Up to SIL 3, PLe, Cat.4
Fault Exclusion: External Wiring Fault
Input Type: RTD
Input Range: xxx 2 wire
Other: Use suitable qualified sensor.

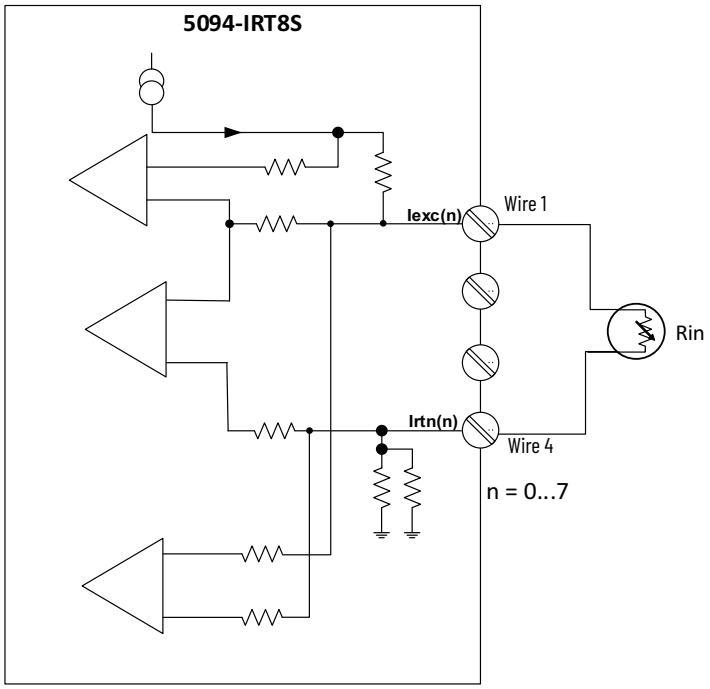


Figure 19 - 5094-IRT8S Module – SIL 3, Ple, Cat. 4 RTD 3 Wire

SIL Level and Category: Up to SIL 3, PLe, Cat.4
Fault Exclusion: External Wiring fault
Input Type: RTD
Input Range: xxx 3 wire
Other: Use suitable qualified sensor.

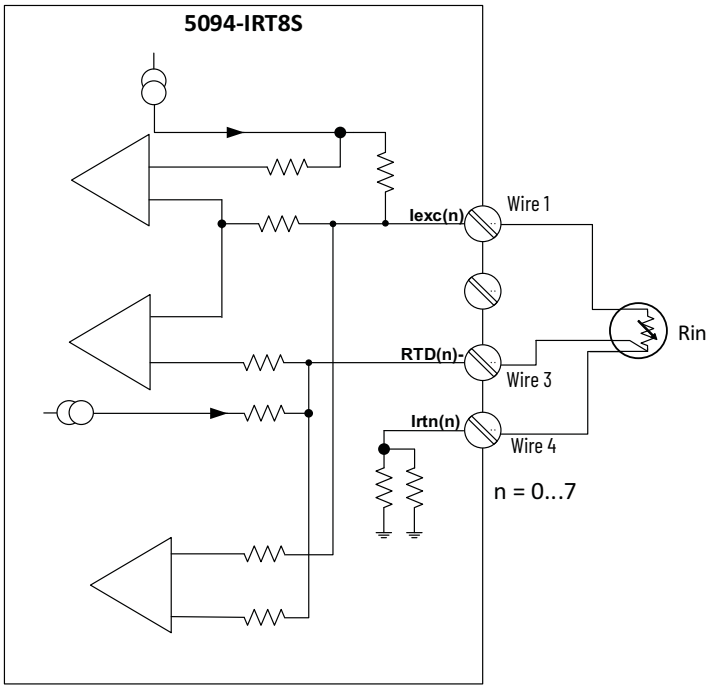
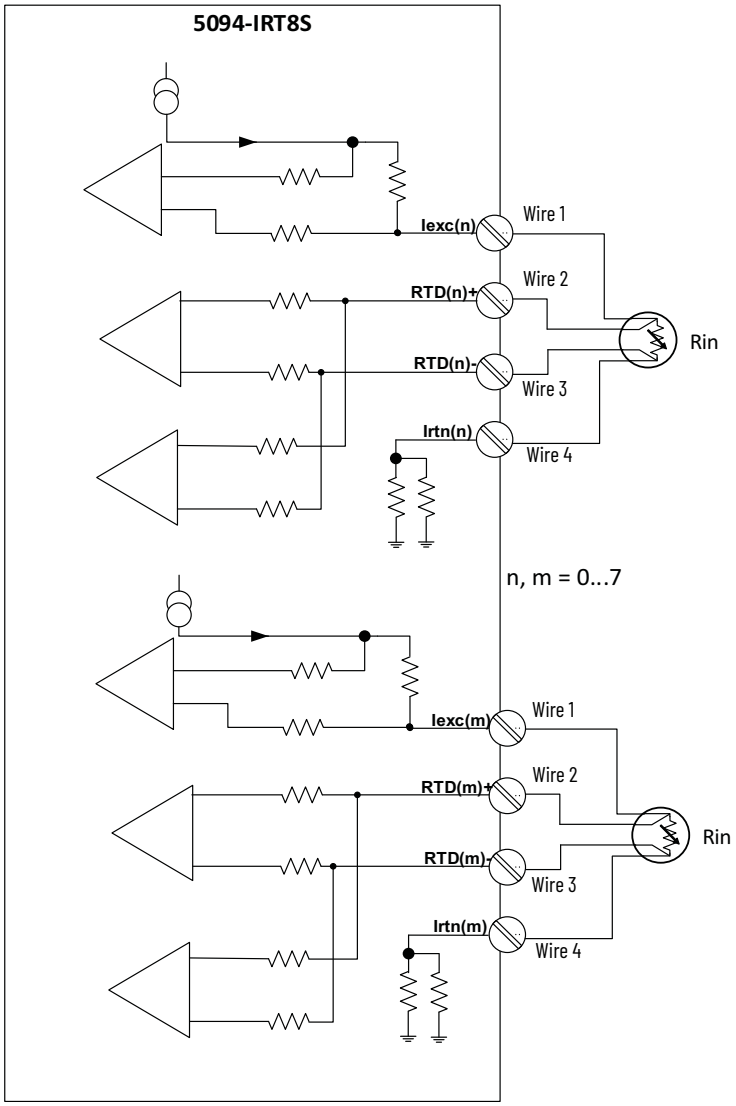


Figure 20 - 5094-IRT8S Module – SIL 3, Ple, Cat. 4 RTD 4 Wire

SIL Level and Category: Up to SIL 3, PLe, Cat.4
Fault Exclusion: External Wiring Fault
Input Type: RTD
Input Range: xxx 4 wire
Other: Cross comparison between channel n data and channel m data by ladder logic must be implemented. Use suitable qualified sensor.



Notes:

Safety Data for Safety I/O Modules

This appendix lists calculated values for probability of a dangerous failure on demand (PFD), average frequency of a dangerous failure per hour (PFH), and mean time to failure (MTTF). PFD and PFH calculations comply with IEC61508, edition 2, 2010.

Calculated values of PFD and PFH appear in Table 49. PFD and PFH must be calculated for the devices within the system to comply with the SIL level that is required for application.

You must be responsible for following the requirements of ISO 13849-1:2015, to assess Performance Levels in their safety system.

You must functionally test every I/O module by individually toggling each input channel and also verify that the controller detects it within the safety reaction time (SRT).

For more information, refer to the FLEX 5000 safety controller manuals listed in Additional Resources on page 11.

FLEX 5000 I/O Safety Input Module Safety Data

Table 49 lists the safety data for the 5094-IRT8S, 5094-IRT8SXT modules.

Table 49 - 5094-IRT8S, 5094-IRT8SXT Safety Parameter Data

Attribute	Channel Operation Type		
	Single Channel	Dual-channel in the Same Group(1)	Dual-channel in Different Group Combinations(2)
Total Failure Rate (λ (safety related))	1.175E-06	1.26E-06	1.770E-06
Safe Failure Fraction (SFF)	99.96%	99.97%	99.99%
Safe Failure Rate (λS)	7.503E-07	7.945E-07	1.060E-06
Diagnostic Coverage (DC)	99.90%	99.91%	99.97%
Safe Detected Failure Rate (λSD)	7.496E-07	7.938E-07	1.060E-06
Safe Undetected Failure Rate (λSU)	7.545E-10	7.160E-10	3.460E-10
Dangerous Failure Rate (λD)	4.243E-07	4.685E-07	7.103E-07
Dangerous Detected Failure Rate (λDD)	4.239E-07	4.681E-07	7.100E-07
Dangerous Undetected Failure Rate (λDU)	4.267E-10	4.222E-10	2.318E-10
Diagnostic Test Interval (hours)	4	4	4
Hardware Fault Tolerance (HFT)	0	1	1
Spurious Trip Rate (STR)	3.900E-06	5.222E-06	6.026E-06
Mean Time to Failure, Spurious (MTTF-spurious), (hours)	256381	191516	165936
PFH (1/hours)	4.267E-10	4.222E-10	2.318E-10
PFD_{AVE}, at Mission Time of 20 years	3.738E-05	3.699E-05	2.030E-05
Safety Reaction Time (SRT), (millisecond)	10	10	10

(1) Group definitions: Group 0 (Channel 0 and 2), Group 1 (Channel 1 and 3), Group 2 (Channel 4 and 6), Group 3 (Channel 5 and 7).
(2) Group combinations not represented in note (1).

Safety Reaction Time (5094-IRT8S, 5094-IRT8SXT)

The safety reaction time (SRT) is a consideration of delays or latencies within the safety system.

- **SRT on Demand** is the response time interval between a signal change on the input terminal and producing or providing the safety packet on the backplane.
- **SRT on Fault** is the response time between the occurrence of an internal fault in the channel/module and the channel/module going into a safe state.
- **SRT on External Wiring Fault** is the response time between the occurrence of an external wiring fault and the channel/s going into a safe state.

Table 50 - Safety Reaction Time

SRT (Safety Demand Rate less than once per 2.1 s)	
SRT on Demand	10 ms
SRT on Fault	10 ms
SRT on Open Wire detected	100 ms (RTD), 200 ms (TC), 350 ms (mV)

4. Timing subjected to an RPI of 2 ms and same 10 KHz Notch filter for both channels in same isolation group.
5. For different RPI, extend the timing by the RPI value.
6. For different notch filters:
   a. SRT on Demand and on Fault – Extend the timing with the value in Table 51:

Table 51 - SRT on Demand and on Fault

CH_n/CH_{n+2}	Not Used	10 KHz	5 KHz	2.5 KHz	1 KHz	500 Hz	200 Hz	100 Hz	60 Hz	50 Hz	20 Hz	10 Hz	5 Hz
Not Used	–	0	2	8	14	20	50	80	152	182	452	902	962
10 KHz	0	0	2	8	14	20	50	80	152	182	452	902	962
5 KHz	2	2	8	8	14	20	50	80	152	182	452	902	962
2.5 KHz	8	8	8	8	14	20	50	80	158	188	458	908	962
1 KHz	14	14	14	14	20	26	56	86	158	188	458	908	968
500 Hz	20	20	20	20	26	38	62	92	170	200	470	920	980
200 Hz	50	50	50	50	56	62	92	122	194	224	494	944	1004
100 Hz	80	80	80	80	86	92	122	152	224	254	524	974	1034
60 Hz	152	152	152	158	158	170	194	224	302	332	602	1052	1112
50 Hz	182	182	182	188	188	200	224	254		362	632	1082	1142
20 Hz	452	452	452	458	458	470	494	524	602	632	902	1352	1412
10 Hz	902	902	902	908	908	920	944	974	1052	1082	1352	1802	1862
5 Hz	962	962	962	962	968	980	1004	1034	1112	1142	1412	1862	1922

CH0 and CH2 has notch filter 60 Hz and 20 Hz respectively.

The SRT on Demand for CH0 = 10 + 602 = 612 ms

The SRT on Demand for CH2 = 10 + 602 = 612 ms

b. SRT on Open Wire detected – Extend the timing with the value in Table 52:

Table 52 - SRT on Open Wire Detected

Notch Filter	RTD	TC	mV
5...60 Hz	1900 ms	1800 ms	1500 ms
100 Hz...10 KHz	0	0	0

Numerics

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Rockwell Automation Support

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Waste Electrical and Electronic Equipment (WEEE)

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

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

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