MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Reference package for procurement and maintenance review

ALLEN-BRADLEY FLEX 5000

5094-IF8

EIGHT-CHANNEL ANALOG INPUT MODULE

Used with the applicable Allen-Bradley FLEX 5000 configuration.

REFERENCE PACKAGE

OFFICIAL DOCUMENT

Selected official manufacturer pages follow this cover.

Source: Allen-Bradley official manufacturer documentation

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**.

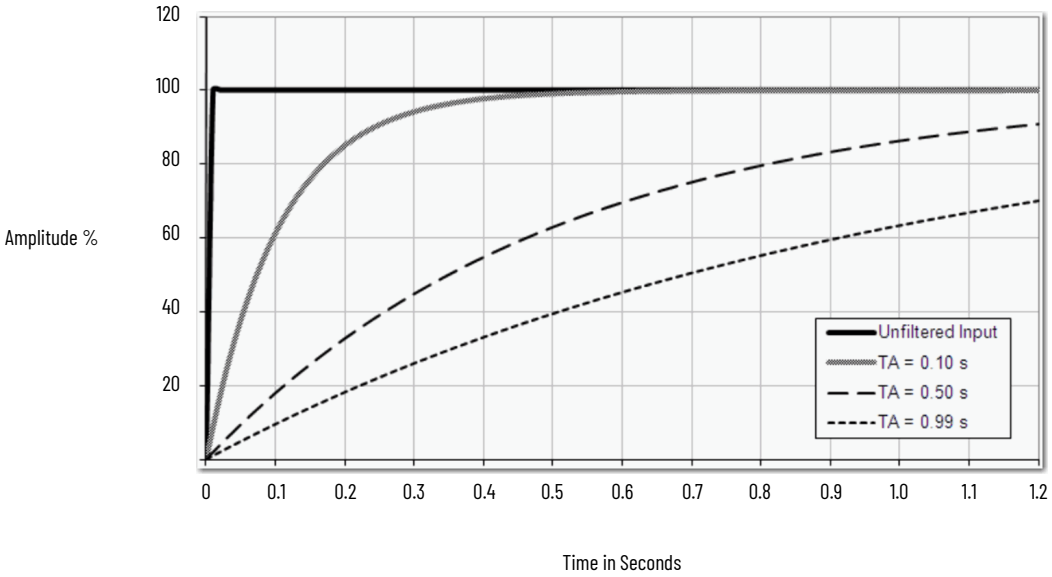
Table 10 - Example Application That Requires Better Noise Rejection

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.