General Specifications

GS 34M06H11-04E

FA-M3
Analog Input Modules

FA-M3

Contents

FA-M3

General Specification

GS 34M06H11-04E

F3AD04-5R
F3AD08-6R, -5R, -4R
High-Resolution Analog Input Module

■ General

F3AD04-5R, F3AD08-6R, F3AD08-5R and F3AD08-4R are analog-to-digital conversion input modules for the FA-M3.

F3AD04-5R and all F3AD08-☐R models are equipped with 16-bit A/D converters.

- Super-high conversion speed of 50 μs per point
- A single module can handle four or eight differential signal inputs.
- Input signal range can be selected on channel basis from 0 to 5V, 1 to 5V, -10 to 10V, 0 to 10V DC, 0 to 20mA DC and 4 to 20mA DC.
- 4 input points / 8 input points can be multiplexed during sequential A/D conversion.
- The input terminals are isolated from the internal circuit by photocouplers.
- Conversion cycle can be selected on module basis from 50μs, 100μs, 250μs, 500μs, 1ms, 16.6ms, 20ms and 100ms.
- Advanced and easy-to-use features such as scaling and filtering are provided.

■ Specifications

Item	Specifications			
	F3AD04-5R	F3AD08-6R	F3AD08-5R	F3AD08-4R
Number of inputs	4 differential inputs	8 differential inputs		
Absolute maximum rating	18 V DC or 25 mA DC max. -18 V DC or -25 mA DC min.			
Input signal range[*1]	Voltage signal only 0 to 5 V DC (-0.25 to 5.25 V DC) 1 to 5 V DC (-0.25 to 5.25 V DC) -10 to 10 V DC (-11.0 to 11.0 V DC) 0 to 10 V DC (-0.5 to 10.5 V DC)	Voltage signal or current signal 0 to 5 V DC (-0.25 to 5.25 V DC) 1 to 5 V DC (-0.25 to 5.25 V DC) -10 to 10 V DC (-11.0 to 11.0 V DC) 0 to 10 V DC (-0.5 to 10.5 V DC) 0 to 20mA DC (-1.0 to 21.0 mA DC) 4 to 20mA DC (-1.0 to 21.0 mA DC)	Voltage signal only 0 to 5 V DC (-0.25 to 5.25 V DC) 1 to 5 V DC (-0.25 to 5.25 V DC) -10 to 10 V DC (-11.0 to 11.0 V DC) 0 to 10 V DC (-0.5 to 10.5 V DC)	Current signal only 0 to 20mA DC (-1.0 to 21.0 mA DC) 4 to 20mA DC (-1.0 to 21.0 mA DC)
Conversion cycle [*2]	50μs/100μs/250μs/500μs/1ms/16.6ms/20ms/100ms × (number of inputs); selectable on module basis.			
Allowable common-mode voltage	±6 V DC max. (0 to 5 V DC, 1 to 5 V DC, 0 to 20mA DC, 4 to 20mA DC) ±1 V DC max. (-10 to 10 V DC, 0 to 10 V DC)			
Isolation method	Across input terminals and internal circuit: Photocoupler isolation Across input terminals: Not isolated			
Withstanding voltage	500 V DC for one minute			
Input resistance	1M Ω min. [*3]	1M Ω min. when configured for voltage input[*3] 250 Ω when configured for current input	1M Ω min. [*3]	250Ω
Maximum Resolution[*4]	0.4mV : 0 to 5V DC or 1 to 5V DC or -10 to 10V DC or 0 to 10V DC input signal range(16bitA/D conversion)	0.4 mV for 0 to 5 V DC, 1 to 5 V DC ,-10 to 10 V DC or 0 to 10 V DC input signal range 1.6 μA for 0 to 20mA DC or 4 to 20mA DC input signal range (16-bit A/D conversion)		
Overall accuracy	23±2ºC: ± 0.1% (full scale) 0 to 55ºC: ± 0.2% (full scale) [*5]			

Item	Specifications			
	F3AD04-5R	F3AD08-6R	F3AD08-5R	F3AD08-4R
Scaling	Upper and lower limit values can be set to any value between -30,000 and 30,000. *6			
Offset	Offset value can be set to any value between -5,000 and 5,000			
Filter*7	First-order lag filter or moving average computation can be enabled or disabled for individual channels. *8			
Hold data	Supports recording of peak values and trough values			
Self diagnosis	Hardware self-diagnosis during operation Over-range input detection			
Current consumption	210 mA (5 V DC)			
External connection	18-point terminal block, M3.5 screws			
External dimensions	28.9 (W) × 100 (H) × 106.1 (D) mm *9			
Weight	200 g			

*1: The default input signal range is 0 to 20mA DC for F3AD08-4R, and -10 to 10 V DC for F3AD04-5R, F3AD08-5R and F3AD08-6R. Conversion results are valid within the selected input signal range.

*2: The conversion cycle is configurable on module basis. It is affected by the number of channels in use (number of unskipped channels). By default, the conversion cycle is 1 ms . Data of 8 channel module is updated every 8 ms (=Conversion cycle 1 ms × 8 inputs). Data of 4 channel module is updated every 4 ms (=Conversion cycle 1 ms × 4 inputs).

*3: The input resistance is about 2 MΩ for channels where the input terminal IN□- is not connected to the AG terminal.

*4: The module uses 16-bit A/D converters internally. The maximum resolution given here is due to scaling computation. The available input signal ranges vary with module type (see “Input Signal Range” row)

*5: Accuracy is ±1% (full scale) when drift compensation is disabled.

*6: Upper and lower limit values can be set to any value between -20,000 and 20,000 with a firmware prior to Rev.03.

*7: First-order lag filter or moving average cannot be used when the conversion cycle is set to 50 µs.

*8: First-order lag filter and moving average computation cannot be used concurrently on the same channel. When first-order lag filter is enabled, the actual time constant during operation is affected by the conversion cycle and number of skipped channels. The filter time constant is specified in milliseconds. The number of data points to be used for moving average computation can be set to any integer from 2 to 32.

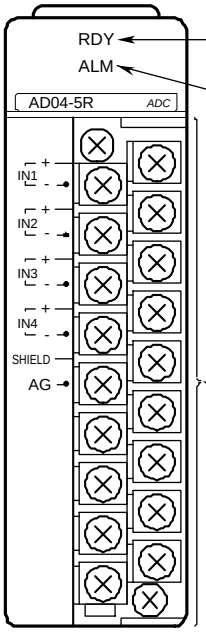
*9: Dimensions excluding protrusions (for details, see external dimensions drawing)

■ Environment specification

Item	Specifications
Surrounding air temperature range	Operating : 0 to 55°C Storage : -20°C to 75°C
Surrounding humidity range	Operating : 10 to 90% RH (non-condensing) Storage : 10 to 90% RH (non-condensing)
Surrounding atmosphere	Must be free of corrosive gases, flammable gases or heavy dust.

■ Components and Functions

●F3AD04-5R



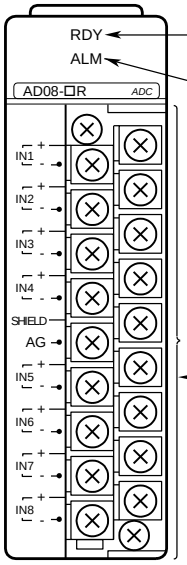
RDY indicator:
Lit when the internal circuit is operating normally.

ALM indicator:
Lit:
Lit when calibration data is lost; A/D conversion is still performed but its accuracy is not assured. Lit also when hardware fault is detected. The module requires repair.
Blinks:
Blinks when parameter setup is invalid or applied input signal is out of range.

Detachable terminal block:
18-point terminal block. M3.5 screws with square captive washers.

*: Calibration data is stored in the module to achieve the intended accuracy. These data are written during calibration at the factory and cannot be overwritten by a user.

●F3AD08-6R, F3AD08-5R, F3AD08-4R



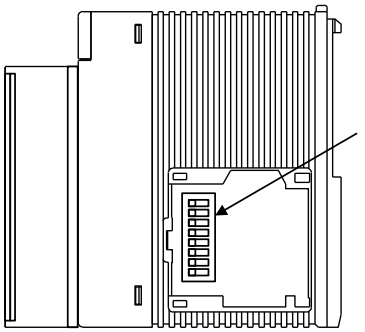
RDY indicator:
Lit when the internal circuit is operating normally.

ALM indicator:
Lit:
Lit when calibration data is lost; A/D conversion is still performed but its accuracy is not assured. Lit also when hardware fault is detected. The module requires repair.
Blinks:
Blinks when parameter setup is invalid or applied input signal is out of range.

Detachable terminal block:
18-point terminal block. M3.5 screws with square captive washers.

*: Calibration data is stored in the module to achieve the intended accuracy. These data are written during calibration at the factory and cannot be overwritten by a user.

F109-2.vsd

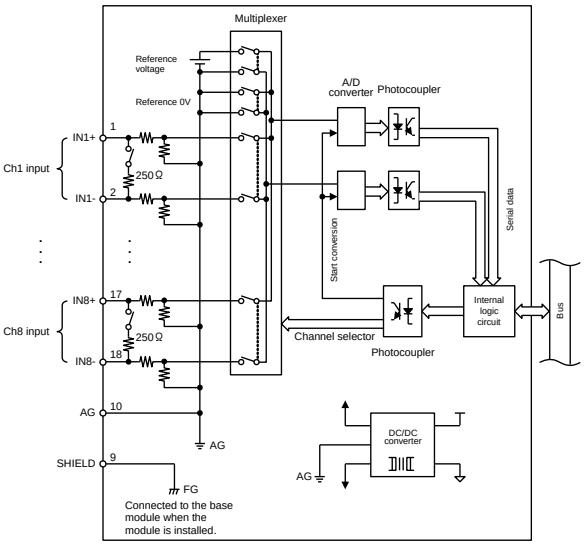


Input switches for channels 1 to 8
OFF: voltage input
ON : current input

This figure shows the F3AD08-6R module with its cover removed.

F109-3.vsd

■ Internal Circuit Diagram



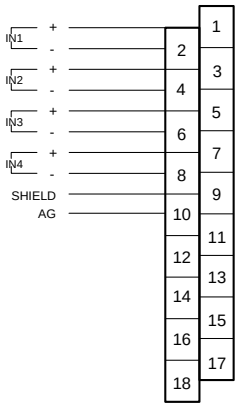
F110-2.vsd

Note: The above figure shows the internal circuit diagram for F3AD08-6R.

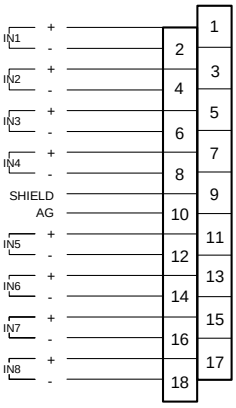
The 250Ω resistor is not provided in F3AD04-5R or F3AD08-5R, but is always connected in F3AD08-4R. F3AD04-5R module has channels from 1 to 4 only.

■ External Connection Diagram

●F3AD04-5R



●F3AD08-6R, -5R, -4R



- The SHIELD terminal is connected to the frame ground of the power supply module via the base module.
- The AG terminal is grounded to the analog ground in the base module.

■ Operating Environment

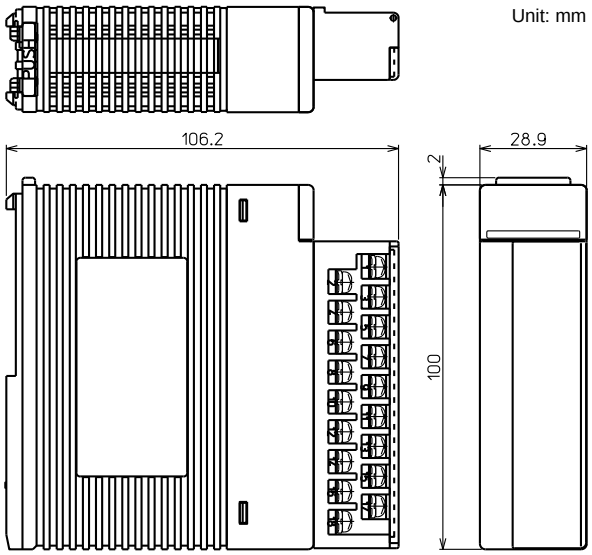
There is no restriction on the type of CPU modules that can be used with this module.

■ Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3AD04	-5R	.....	.....	0 to 5 V,1 to 5 V,-10 to 10 V, 0 to 10 V DC 4 differential inputs, 16-bit A/D conversion
F3AD08	-6R	.....	.....	0 to 5 V, 1 to 5 V, -10 to 10 V, 0 to 10 V DC, 0 to 20 mA, 4 to 20 mA DC 8 differential inputs, 16-bit A/D conversion
	-5R	.....	.....	0 to 5 V, 1 to 5 V, -10 to 10 V, 0 to 10 V DC 8 differential inputs, 16-bit A/D conversion
	-4R	.....	.....	0 to 20 mA, 4 to 20 mA DC 8 differential inputs, 16-bit A/D conversion

■ External Dimensions

Unit: mm



FA-M3

General Specification

GS 34M06H11-04E

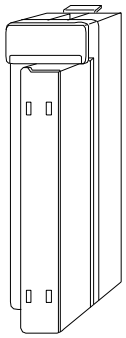
F3AD04-5V
F3AD08-5V
F3AD08-4W
Analog Input Module

■ General

F3AD04-5V , F3AD08-5V , F3AD08-4W are analog-to-digital conversion input modules for the FA-M3.

These models are equipped with 12-bit A/D converters.

- Conversion speed of 1ms per point.
- A single module can handle four or eight differential signal inputs.
- Input signal range can be selected on channel basis from 0 to 5V, 1 to 5V, -10 to 10V, 0 to 10 V DC, 0 to 20mA DC and 4 to 20 mA DC.
- 4 input points / 8 input points can be multiplexed during sequential A/D conversion.
- The input terminals are isolated from the internal circuit by photocouplers.
- Advanced and easy-to-use features such as scaling and filtering are provided.



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■ Specifications

Item	Specifications		
	F3AD04-5V	F3AD08-5V	F3AD08-4W
Number of inputs	4 differential inputs	8 differential inputs	
Absolute maximum rating	18 V DC or 25 mA DC max. -18 V DC or -25 mA DC min.		
Input signal range*1	Voltage signal only 0 to 5 V DC (-0.25 to 5.25 V DC) 1 to 5 V DC (-0.25 to 5.25 V DC) -10 to 10 V DC (-11.0 to 11.0 V DC) 0 to 10 V DC (-0.5 to 10.5 V DC)		Current signal only 0 to 20mADC (-1.0 to 21.0 mA DC) 4 to 20mADC (-1.0 to 21.0 mA DC)
Conversion cycle *2	1ms×(number of inputs)		
Allowable common-mode voltage	±6 V DC max. (0 to 5 V DC, 1 to 5 V DC, 0 to 20mA DC, 4 to 20mA DC) ±1 V DC max. (-10 to 10 V DC, 0 to 10 V DC)		
Isolation method	Across input terminals and internal circuit: Photocoupler isolation Across input terminals: Not isolated		
Withstanding voltage	500 V DC for one minute		
Input resistance	1M Ω min. *3		250 Ω
Maximum Resolution	1.4mV : 0 to 5V DC or 1 to 5V DC or 0 to 10V DC input signal range 5.7mV : -10 to 10V DC input signal range (12bitA/D conversion)		5.6 µA for 0 to 20mA DC or 4 to 20mA DC input signal range (12-bit A/D conversion)
Overall accuracy	23±2ºC: ± 0.2% (full scale) 0 to 55ºC: ± 0.5% (full scale) *4		
Scaling	Upper and lower limit values can be set to any value between -30,000 and 30,000. *5		
Offset	Offset value can be set to any value between -5,000 and 5,000		
Filter	First-order lag filter or moving average computation can be enabled or disabled for individual channels. *6		
Hold data	Supports recording of peak values and trough values		
Self diagnosis	Hardware self-diagnosis during operation Over-range input detection		
Current consumption	210 mA (5 V DC)		
External connection	18-point terminal block, M3.5 screws		
External dimensions	28.9 (W) × 100 (H) × 106.1 (D) mm *7		
Weight	200 g		

*1: The default input signal range is -10 to 10 V DC for F3AD04-5V, F3AD08-5V and 0 to 20mA DC for F3AD08-4W.
Conversion results are valid within the selected input signal range.

*2: By default, data of 8 channel module is updated every 8 ms (= Conversion cycle 1 ms × 8 inputs).
Data of 4 channel module is updated every 4 ms (= Conversion cycle 1 ms × 4 inputs).

*3: The input resistance is about 2 MΩ for channels where the input terminal IN□- is not connected to the AG terminal.

*4: Accuracy is ±1% (full scale) when drift compensation is disabled.

*5: Upper and lower limit values can be set to any value between -20,000 and 20,000 with a firmware prior to Rev.03.

*6: First-order lag filter and moving average computation cannot be used concurrently on the same channel.
When first-order lag filter is enabled, the actual time constant during operation is affected by the conversion cycle and number of skipped channels. The filter time constant is specified in milliseconds.
The number of data points to be used for moving average computation can be set from 2 to 32.

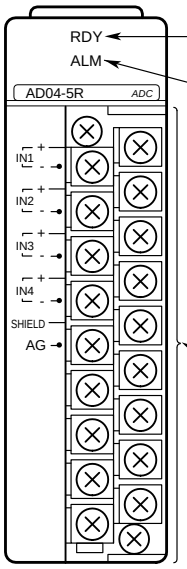
*7: Dimensions excluding protrusions (for details, see external dimensions drawing)

■ Environment specification

Item	Specifications
Surrounding air temperature range	Operating : 0 to 55°C
	Storage : -20°C to 75°C
Surrounding humidity range	Operating : 10 to 90% RH (non-condensing)
	Storage : 10 to 90% RH (non-condensing)
Surrounding atmosphere	Must be free of corrosive gases, flammable gases or heavy dust.

■ Components and Functions

●F3AD04-5V



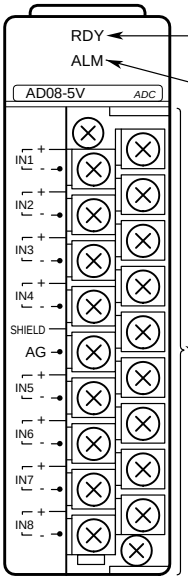
RDY indicator:
Lit when the internal circuit is operating normally.

ALM indicator:
Lit:
Lit when calibration data is lost; A/D conversion is still performed but its accuracy is not assured. Lit also when hardware fault is detected. The module requires repair.
Blinks:
Blinks when parameter setup is invalid or applied input signal is out of range.

Detachable terminal block:
18-point terminal block. M3.5 screws with square captive washers.

*: Calibration data is stored in the module to achieve the intended accuracy. These data are written during calibration at the factory and cannot be overwritten by a user.

●F3AD08-5V, F3AD08-4W



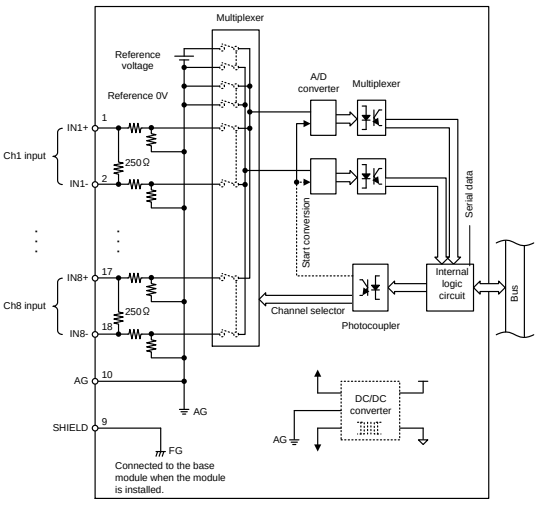
RDY indicator:
Lit when the internal circuit is operating normally.

ALM indicator:
Lit:
Lit when calibration data is lost; A/D conversion is still performed but its accuracy is not assured. Lit also when hardware fault is detected. The module requires repair.
Blinks:
Blinks when parameter setup is invalid or applied input signal is out of range.

Detachable terminal block:
18-point terminal block. M3.5 screws with square captive washers.

*: Calibration data is stored in the module to achieve the intended accuracy. These data are written during calibration at the factory and cannot be overwritten by a user.

■ Internal Circuit Diagram

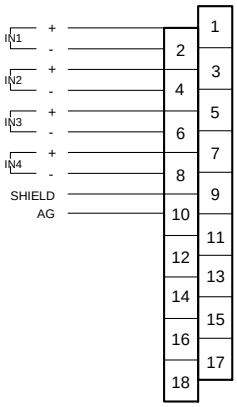


F110-3.vsd

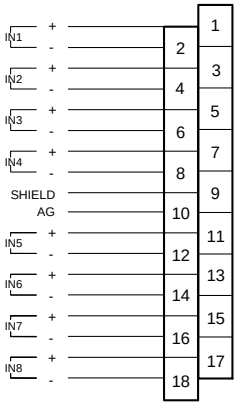
The above figure shows the internal circuit diagram for F3AD08-4W.
The 250Ω resistor is not provided in F3AD04-5V, F3AD08-5V.
F3AD04-5V module has channels from 1 to 4 only.

External Connection Diagram

●F3AD04-5V



●F3AD08-5V, F3AD08-4W



- The SHIELD terminal is connected to the frame ground of the power supply module via the base module.
- The AG terminal is grounded to the analog ground in the base module.

Operating Environment

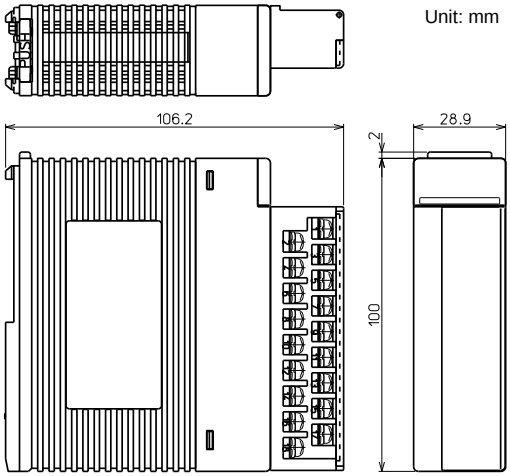
There is no restriction on the type of CPU modules that can be used with this module.

Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3AD04	-5V	…	…	0 to 5 V, 1 to 5 V, -10 to 10 V, 0 to 10 V DC
		…	…	4 differential inputs, 12-bit A/D conversion
F3AD08	-5V	…	…	0 to 5 V, 1 to 5 V, -10 to 10 V, 0 to 10 V DC
		…	…	8 differential inputs, 12-bit A/D conversion
	-4W	…	…	0 to 20 mA, 4 to 20 mA DC
		…	…	8 differential inputs, 12-bit A/D conversion

External Dimensions

Unit: mm



Functional Overview

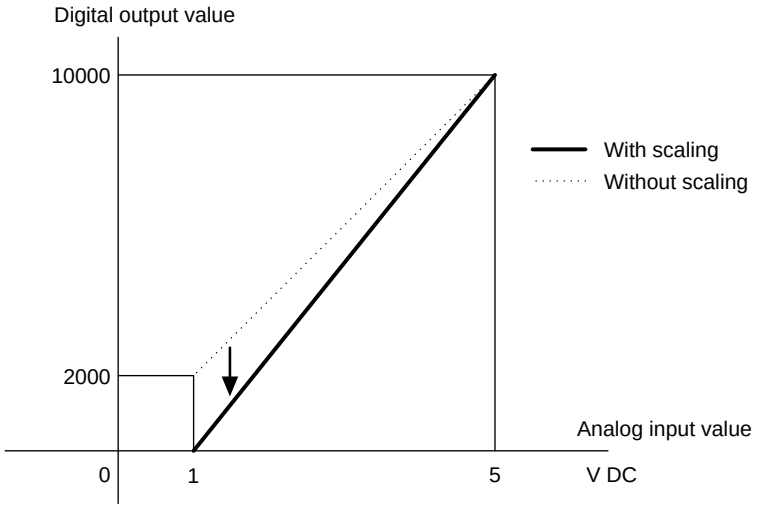
For F3AD04-5R, F3AD08-6R, F3AD08-5R, F3AD08-4R, F3AD04-5V, F3AD08-5V, F3AD08-4W

1. Scaling

1.1 Scaling

The scaling function maps the digital output values of the upper limit and lower limit of the input signal range to user-specified values between -30,000 and 30,000.

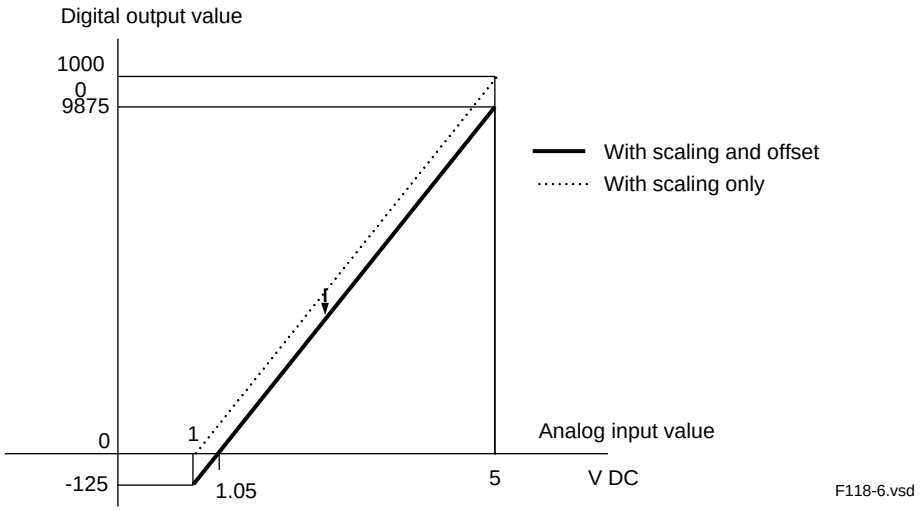
Example: Input signal range: 1 to 5 V DC; upper limit for scaling: 10,000; lower limit for scaling: 0



1.2 Offset

The offset function applies a user-specified offset amount between -5,000 and 5,000 to the digital output.

Example: Input signal range: 1-5V DC; upper limit for scaling: 10,000; lower limit for scaling: 0; offset amount: -125

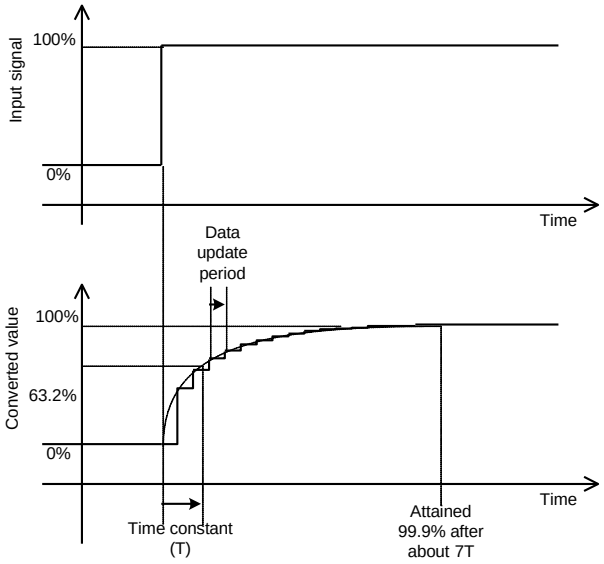


2. Filtering

2.1 First-order Lag Filter

Filtering is used to suppress sudden changes in the digital output. A digital low-pass first-order lag filter can be configured for each input channel by specifying the time constant in ms.

Response of Filter to Step Change in Input Signal



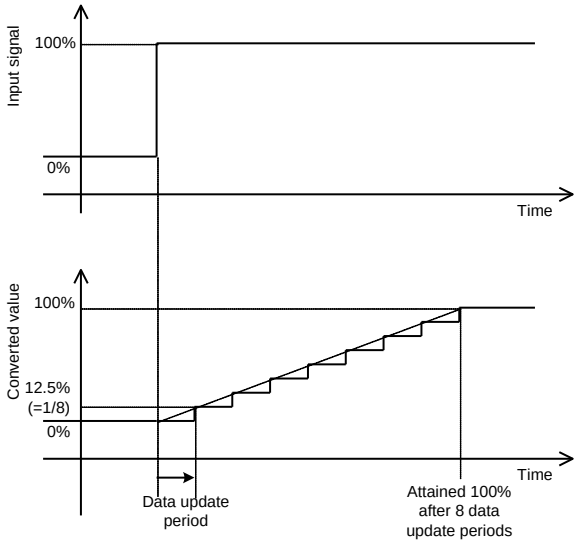
Note: The conversion output responds in small steps at each data update period, given by conversion cycle × number of channels in use.

TIP: Time constant (*T*) and the cutoff frequency (*fc*) are related by the equation: $fc = \frac{1}{2\pi T}$

2.2 Moving Average Computation

The moving average function is used to suppress sudden changes in the digital output by computing moving averages of converted values for an input channel using a user-specified number of up to 32 data points.

Example: Response of Moving Average Computation to Step Change in Input Signal (when 8 data points are using for averaging)



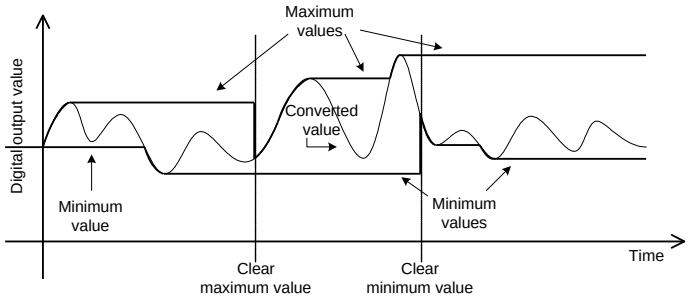
(*) Data update period is given by:
conversion cycle × Number of unskipped channels

Note: The conversion output responds in small steps at each data update period, given by conversion cycle × number of channels in use.

3. Hold Data

The Hold Data function records maximum and minimum digital output values for each channel internally. These values can be read by a program, just like conversion output values, or cleared by a program at any time.

Conceptual Diagram of Hold Data Operation



Note: The hold data function stores final conversion output values after scaling, offset and filtering. It records the minimum and maximum values periodically according to the data update period, given by conversion cycle × number of channels in use.