



Analog Input Module

IM 34M6H11-02E

Applicable Modules:

Model Code	Model Name
F3AD04-0V	Analog Input Module
F3AD04-0R	Analog Input Module
F3AD08-1V	Analog Input Module
F3AD08-4V	Analog Input Module
F3AD08-1R	Analog Input Module
F3AD08-4R	Analog Input Module
F3AD08-5R	Analog Input Module
F3AD08-6R	Analog Input Module

Applicable Product:

● Range-free Controller FA-M3

- Model Name : F3AD04-0R, F3AD04-0V, F3AD08-1R, F3AD08-1V, F3AD08-4V, F3AD08-4R, F3AD08-5R, F3AD08-6R
- Name : Analog Input Module

The document number and document model code for this manual are given below.
Refer to the document number in all communications; also refer to the document number and the document model code when purchasing additional copies of this manual.

- Document No. : IM 34M6H11-02E
- Document Model Code : DOCIM

Important

■ About This Manual

- This Manual should be passed on to the end user.
- Before using the controller, read this manual thoroughly to have a clear understanding of the controller.
- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.
- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Precautions when Using/Maintaining the Product

- The following safety symbols are used on the product as well as in this manual.



Danger. This symbol on the product indicates that the operator must follow the instructions laid out in this instruction manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument. The manual describes what special care the operator must exercise to prevent electrical shock or other dangers that may result in injury or the loss of life.



Protective Ground Terminal. Before using the instrument, be sure to ground this terminal.



Function Ground Terminal. Before using the instrument, be sure to ground this terminal.



Alternating current. Indicates alternating current.



Direct current. Indicates direct current.

The following symbols are used only in the instruction manual.

**WARNING**

Indicates a “Warning”.

Draws attention to information essential to prevent hardware damage, software damage or system failure.

**CAUTION**

Indicates a “Caution”

Draws attention to information essential to the understanding of operation and functions.

TIP

Indicates a “TIP”

Gives information that complements the present topic.

SEE ALSO

Indicates a “SEE ALSO” reference.

Identifies a source to which to refer.

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.
- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.
- If component parts or consumable are to be replaced, be sure to use parts specified by the company.
- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, air navigation facilities, aviation facilities or medical equipment. If so used, it is the user's responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Do not attempt to modify the product.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the user or any unpredictable defect of the product.

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- Reverse engineering, such as decompiling of the software, is strictly prohibited.
- No portion of the software supplied by Yokogawa Electric may be transferred, exchanged, or sublet or leased for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using the FA-M3

● Avoid installing the FA-M3 in the following locations:

- Where the instrument will be exposed to direct sunlight, or where the operating temperature exceeds the range 0°C to 55°C (32°F to 131°F).
- Where the relative humidity is outside the range 10 to 90%, or where sudden temperature changes may occur and cause condensation.
- Where corrosive or flammable gases are present.
- Where the instrument will be exposed to direct mechanical vibration or shock.
- Where the instrument may be exposed to extreme levels of radioactivity.

● Use the correct types of wire for external wiring:

- Use copper wire with temperature ratings greater than 75°C.

● Securely tighten screws:

- Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.
- Tighten terminal block screws with the correct tightening torque as given in this manual.

● Securely lock connecting cables:

- Securely lock the connectors of cables, and check them thoroughly before turning on the power.

● Interlock with emergency-stop circuitry using external relays:

- Equipment incorporating the FA-M3 must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

● Ground for low impedance:

- For safety reasons, connect the [FG] grounding terminal to a Japanese Industrial Standards (JIS) Class 3 Ground. For compliance to CE Marking, use braided or other wires which can ensure low impedance even at high frequencies for grounding.

● Configure and route cables with noise control considerations:

- Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

● Configure for CE Marking Conformance:

- For compliance with CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the "Hardware Manual" (IM34M6C11-01E).

● Keep spare parts on hand:

- Stock up on maintenance parts including spare modules, in advance.

- **Discharge static electricity before operating the system:**

- Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.

- **Never use solvents such as paint thinner for cleaning:**

- Gently clean the surfaces of the FA-M3 with a cloth that has been soaked in water or a neutral detergent and wringed.
- Do not use volatile solvents such as benzine or paint thinner or chemicals for cleaning, as they may cause deformity, discoloration, or malfunctioning.

- **Avoid storing the FA-M3 in places with high temperature or humidity:**

- Since the CPU module has a built-in battery, avoid storage in places with high temperature or humidity.
- Since the service life of the battery is drastically reduced by exposure to high temperatures, take special care (storage temperature should be from -20°C to 75°C).
- There is a built-in lithium battery in a CPU module and temperature control module which serves as backup power supply for programs, device information and configuration information. The service life of this battery is more than 10 years in standby mode at room temperature. Take note that the service life of the battery may be shortened when installed or stored at locations of extreme low or high temperatures. Therefore, we recommend that modules with built-in batteries be stored at room temperature.

- **Always turn off the power before installing or removing modules:**

- Failing to turn off the power supply when installing or removing modules, may result in damage.

- **Do not touch components in the module:**

- In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules may fail to work.

Introduction

■ Overview of the Manual

This manual describes the specifications and use of the Analog Input Modules F3AD04-0V, F3AD04-0R, F3AD08-4V, F3AD08-1V, F3AD08-1R, F3AD08-4R, F3AD08-5R and F3AD08-6R.

■ Other Manuals

This manual does not describe the Analog Input Modules F3AD04-0N and F3AD08-1N, or the Analog Output Modules F3DA02-0N, F3DA04-1N, F3DA08-5N. For information on these modules, please refer to the following instruction manuals.

● F3AD04-0N, F3AD08-1N

- Analog Input/Output Module (IM34M6H11-01E)

● F3DA02-0N, F3DA04-1N, F3DA08-5N

- Analog Input/Output Module (IM34M6H11-01E)

For individual sequence CPU modules, please refer to the relevant instruction manuals. Refer to the latest editions of the instruction manuals, as required.

● For F3SP28, F3SP38, F3SP53, F3SP58 and F3SP59 Modules

For Functions:

- Sequence CPU Instruction Manual – Functions (for F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S and F3SP58-6H/6S, F3SP59-7S) (IM 34M6P13-01E)

For Read, Write and Other instructions of Analog Modules:

- Sequence CPU Instruction Manual – Instructions (IM34M6P12-03E)

For ladder programming:

- FA-M3 Programming Tool WideField2 (IM34M6Q15-01E)

● For F3SP21, F3SP25, F3SP35, F3SP05 and F3SP08 Modules

For Functions:

- Sequence CPU Modules - Functions (for F3SP21, F3SP25 and F3SP35) (IM34M6P12-02E), 2nd Edition or later.

For Read, Write and Other instructions of Analog Modules:

- Sequence CPU Instruction Manual – Instructions (IM34M6P12-03E)

For ladder programming:

- FA-M3 Programming Tool WideField2 (IM34M6Q15-01E)

● Common for all sequence CPU modules

For the FA-M3 specifications and configurations*¹, installation and wiring, test run, maintenance, and module installation limits for the whole system:

*1: Refer to the relevant product manuals for specifications except for power supply modules, base modules, input/output modules, cables and terminal units.

- Hardware Manual (IM 34M6C11-01E)

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FA-M3**Analog Input Module****Part A**

IM 34M6H11-02E 3rd Edition

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A1. Analog Input Module

This chapter describes the specifications and operation modes of the analog input modules F3AD08-4R, F3AD08-5R and F3AD08-6R.

Models F3AD08-4R, F3AD08-5R and F3AD08-6R are 8-channel analog-to-digital conversion input modules. The main features of these models are:

- Super-high conversion speed of 50 μ s per point
- A single module can accommodate eight input points.
- 16-bit A/D converters enable high-resolution analog to digital conversion.
- Easy-to-use features such as scaling and filtering.
- Model F3AD08-4R is designed for current input; Model F3AD08-5R is designed for voltage input; while model F3AD08-6R allows each channel to be independently configured for voltage input or current input. Other than input type, the three models have the same specifications.
- The input signal range is selectable from any of the following ranges: voltage input 0 to 5V, 1 to 5V, -10 to 10V or 0 to 10 VDC, current input 0 to 20mA DC or 4 to 20 mA DC.
- The functional specifications of F3AD08-5R and F3AD08-6R are downward compatible with F3AD08-1R and F3AD08-1V so migration to these models does not require rewriting of user applications.

Special module instructions in ladder, as well as BASIC statements are provided for implementing analog input-output using F3AD08-4R, F3AD08-5R and F3AD08-6R modules.

A1.1 Module Specifications

■ Functional Specifications

Table A1.1 Functional Specifications

Item	Specifications		
	F3AD08-4R	F3AD08-5R	F3AD08-6R
Number of inputs	8 differential inputs		
Absolute maximum rating	18 V DC or 25 mA DC maximum -18 V DC or -25 mA DC minimum		
Input signal range ^{*1}	Current signal only 0 to 20mADC (-1.0 to 21.0 mADC) 4 to 20mADC (-1.0 to 21.0 mADC)	Voltage signal only 0 to 5 VDC (-0.25 to 5.25 VDC) 1 to 5 VDC (-0.25 to 5.25 VDC) -10 to 10 VDC (-11.0 to 11.0 VDC) 0 to 10 VDC (-0.5 to 10.5 VDC)	Voltage signal or current signal 0 to 5 VDC (-0.25 to 5.25 VDC) 1 to 5 VDC (-0.25 to 5.25 VDC) -10 to 10 VDC (-11.0 to 11.0 VDC) 0 to 10 VDC (-0.5 to 10.5 VDC) 0 to 20mADC (-1.0 to 21.0 mADC) 4 to 20mADC (-1.0 to 21.0 mADC)
Allowable common-mode voltage	±6 VDC max. (0 to 5 VDC, 1 to 5 VDC, 0 to 20mA DC, 4 to 20mA DC) ±1 VDC max. (-10 to 10 VDC, 0 to 10 VDC)		
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	250Ω	1M Ω min. ^{*2}	1M Ω min. when configured for voltage input ^{*2} 250 Ω when configured for current input
Maximum Resolution ^{*3} (16-bit A/D conversion)	0.4 mV for 0 to 5 VDC, 1 to 5 VDC or 0 to 10 VDC input signal range 0.5 mV for -10 to 10 VDC input signal range 1.6 μA for 0 to 20mA DC or 4 to 20mA DC input signal range		
Overall accuracy	23±2°C: ± 0.1% (full scale) 0 to 55°C: ± 0.2% (full scale) ^{*4}		
Conversion period ^{*5}	50 μs, 100 μs, 250 μs, 500 μs, 1 ms, 16.6 ms, 20 ms, 100 ms per channel Configurable on module basis		
Scaling	Upper and lower limit values can be set to any value between -20,000 and 20,000.		
Offset	Offset value can be set to any value between -5000 and 5000		
Filter	First-order lag low-pass filter or moving average computation can be enabled or disabled for individual channels ^{*6, *7}		
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 ^{*8}		
Weight	200 g		
Ambient operating temperature	0 to 55°C		
Ambient operating humidity	10 to 90% RH (non-condensing)		
Ambient operating atmosphere	Must be free of corrosive gases or heavy dust.		
Ambient storage temperature	-20 to 75°C		
Ambient storage humidity	10 to 90% RH (non-condensing)		

*1: Conversion results are valid within the selected input signal range.

The default input signal range is 0 to 20mADC for F3AD08-4R, and -10 to 10 VDC for F3AD08-5R and F3AD08-6R

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

*3: 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)

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

*5: The conversion period is configurable on module basis. It is affected by the number of channels in use (number of unskipped channels).

By default, the conversion period is 1 ms and data of each channel is updated every 8 ms (= 1 ms × 8 inputs).

*6: Filtering and moving average computation cannot be used concurrently on the same channel.

The actual filter time constant value depends on the number of channels in use (number of unskipped channels) and the conversion period setting

The filter time constant is specified in units of ms.

The number of data points to be used for moving average computation can be set to any integer from 2 to 32.

*7: Filtering cannot be used when the conversion period is set to 50 μs.

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



CAUTION

Never apply any voltage (or current) exceeding the absolute maximum rating, even for a short period of time, or it may cause permanent damage to the internal circuitry, and thus failure to meet specifications.

■ Input/Output Conversion Characteristics

The following table shows the input/output conversion characteristics with no scaling for various input signal ranges. The input/output conversion characteristics show analog input values versus digital output values.

For details on scaling, see Section A3.5.

Table A1.2 Input/Output Conversion Characteristics with No Scaling

Input Signal Range	Analog Input Value	Digital Output Value	
-10 to 10 V DC range	-10 to 10 V DC	-20000 to 20000	Default input signal range for F3AD08-5R and F3AD08-6R
0 to 10 V DC range	0 to 10V DC	0 to 20000	
0 to 5 V DC range	0 to 5 V DC	0 to 10000	
1 to 5 V DC range	1 to 5 V DC	2000 to 10000	
0 to 20mA DC range	0 to 20mA DC	0 to 10000	Default input signal range for F3AD08-4R
4 to 20mA DC range	4 to 20mA DC	2000 to 10000	

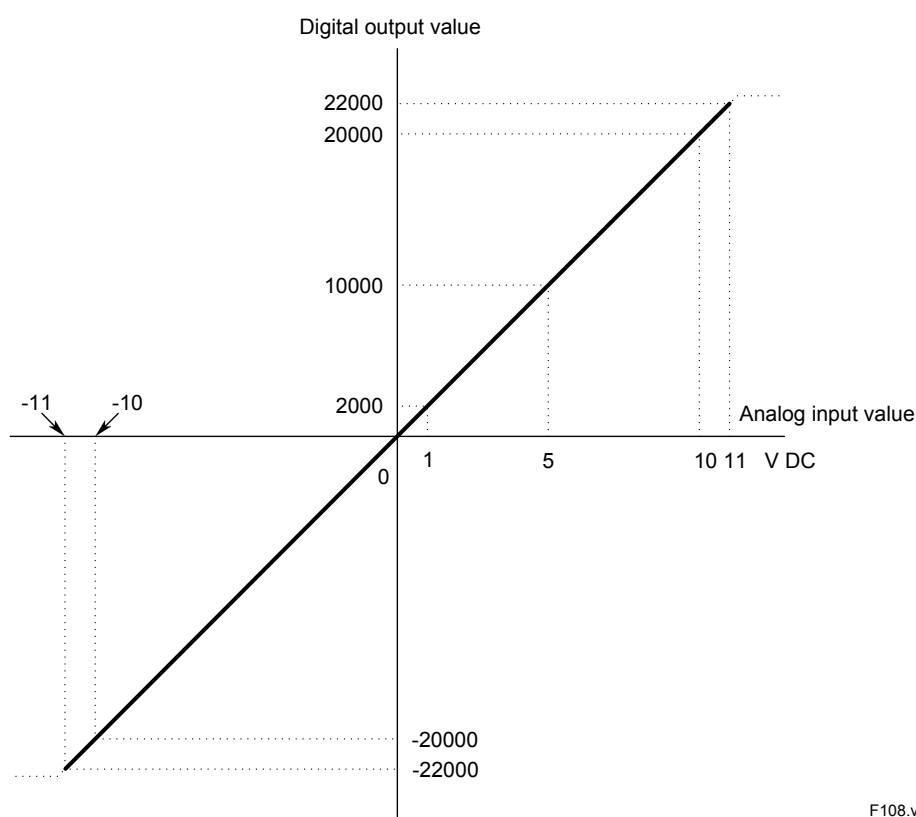


Figure A1.1 Input/Output Conversion Characteristics with No Scaling for voltage input

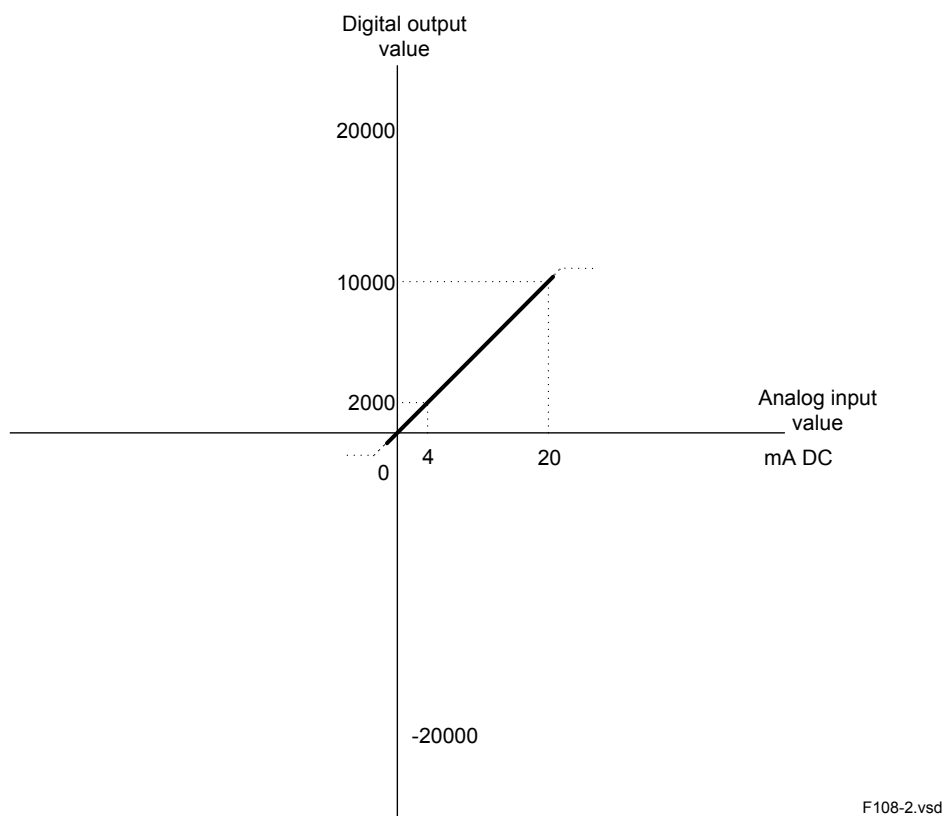


Figure A1.2 Input/Output Conversion Characteristics with No Scaling for current input

TIP

If the digital output value computed for an input signal value based on the input signal range, scaling and offset preset values is below -32700 or above 32700, it defaults to -32700 and 32700 respectively.



CAUTION

If an input signal exceeds the input signal range, an over-range input error is generated. For more details on this type of error, see Chapter A4.

■ Components and Functions

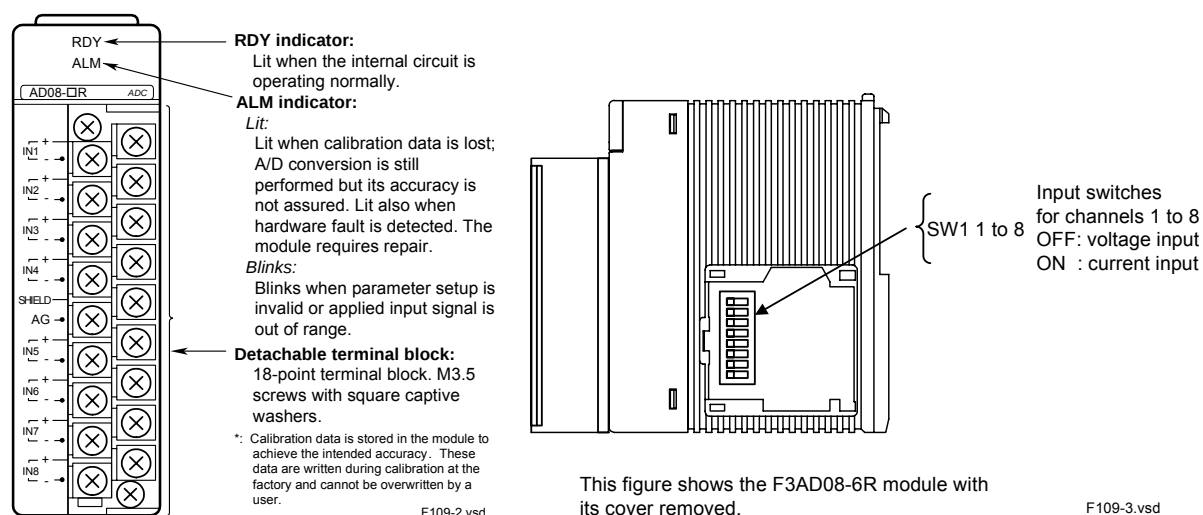
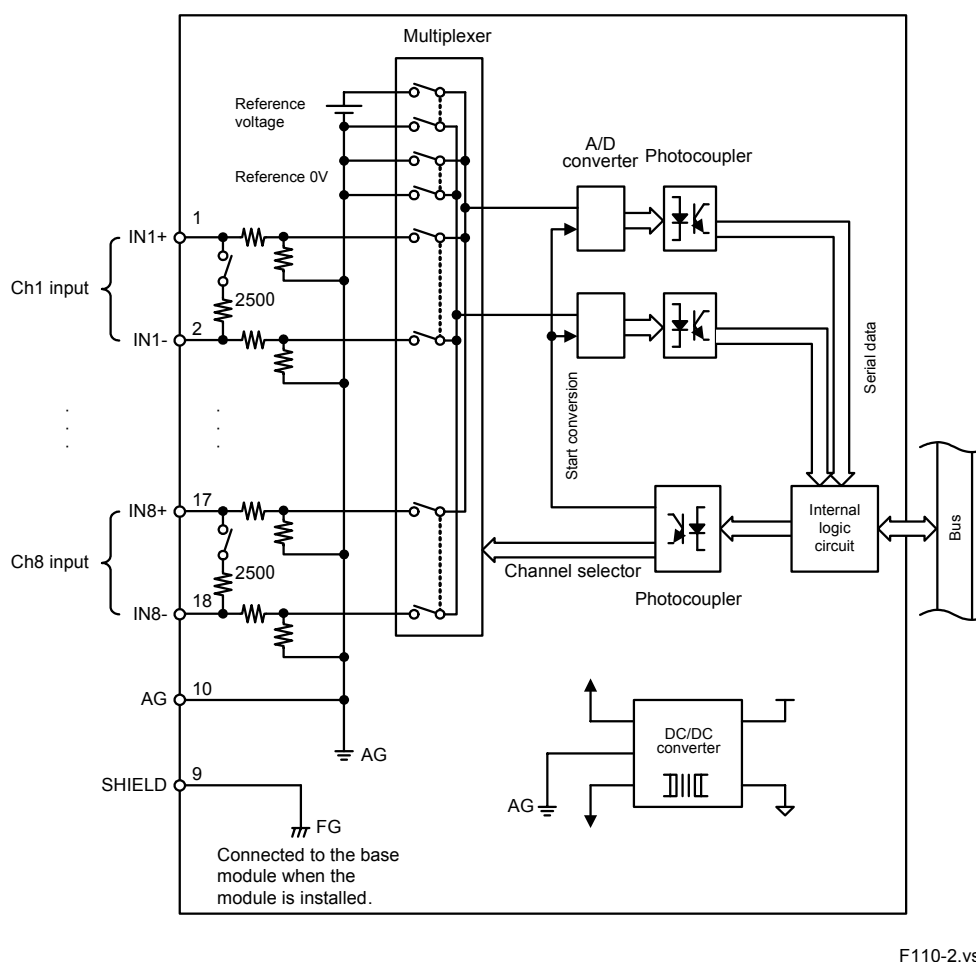


Figure A1.3 Components and Functions

■ Internal Circuit

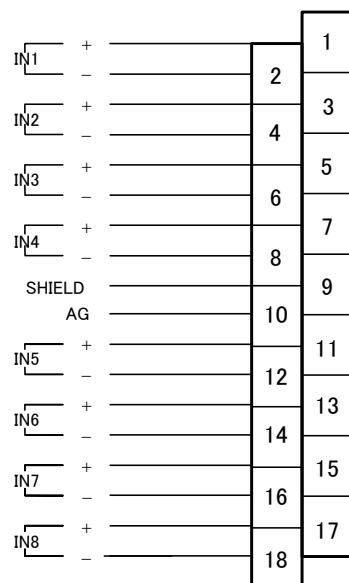


Note: The above figure shows the internal circuit diagram for F3AD08-6R.
The 250Ω resistor is not provided in F3AD08-5R, but is always connected in F3AD08-4R.

Figure A1.4 Internal Circuit Diagram

■ External Connections and Wiring Precautions

● External Connections



- 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.

F111.vsd

Figure A1.5 External Connection Diagram

Table A1.3 Wires and Terminals

Applicable wire size		AWG22-16 (0.3 to 1.25 mm ²)
Wire type		Shielded twisted pair
Wire connections		Crimp-on type
Crimp-on terminals	Crimp-on terminals	For 3.5 mm
	Tightening torque	0.8 N • m (7.1 lbf • in)
	Applicable crimp-on terminals	Examples: Type V1.25-M3 (from Japan Solderless Terminal Mfg. Co., Ltd.) or RAV1.25-3.5 (from Nippon Tanshi Co., Ltd.)



CAUTION

Always use an appropriate crimping tool specified by the manufacturer.

● Wiring Precautions



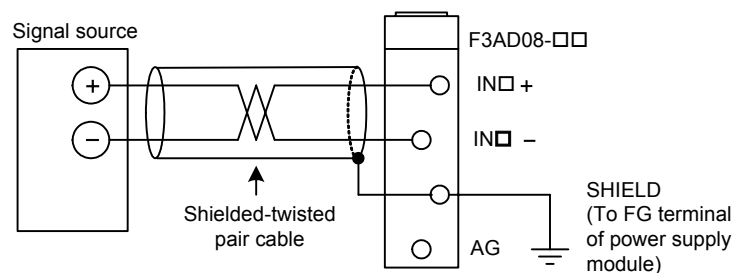
CAUTION

The analog input module uses a differential input circuit in each channel. This enables multiple signal sources superimposing common-mode voltage to connect to one F3AD08-4R, F3AD08-5R or F3AD08-6R module. However, if the common-mode voltage exceeds its allowable limits, input read error may occur and the module may be damaged. The common-mode voltage here refers to the potential of IN□- in each channel, which is connected to the AG terminal.

1. As analog signals are susceptible to noise, use shielded twisted-pair wires to connect signal sources to F3AD08-□□ modules to suppress noise.
2. Ground the shield of the twisted-pair cables to FG. The following are some possible ways to perform grounding:

- Connecting the shield to the SHIELD terminal of the F3AD08-□□ module

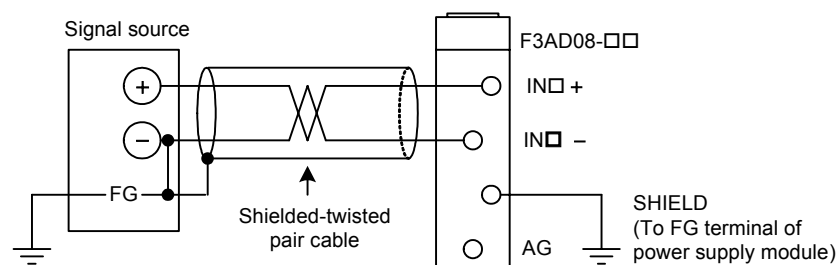
(The SHIELD terminals are connected to the FG terminal of the power supply module via the base module.)



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Figure A1.6 Wiring Example

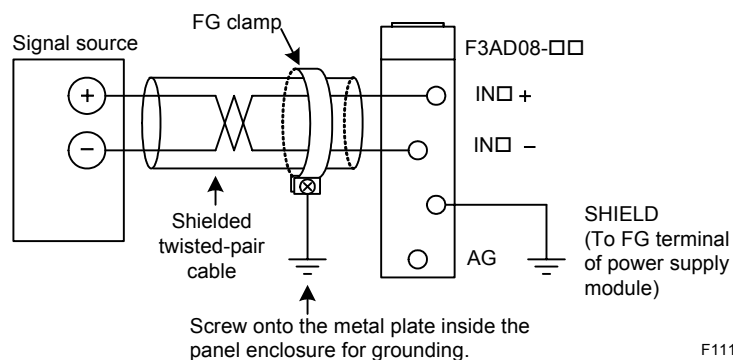
- Connecting the shield to SHIELD terminal (FG terminal) provided at the signal source



F11102-2.vsd

Figure A1.7 Wiring Example

- Removing the cable covering to expose the wire and clamp it to the FG terminal using a FG clamp to ground it.



F11103-2.vsd

Figure A1.8 Wiring Example

Depending on the stability of the grounding points, it may be better to perform grounding either at the F3AD08 module or at the signal source. Select the more stable grounding point.

3. For compliance with EMC-related specifications, use FG clamps to perform grounding for systems installed with this module.
4. For common mode voltage reference (the potential of the signal connected to the AG terminal becomes the reference voltage), to connect a signal not superimposing the common mode voltage and a floating signal with an ungrounded negative input, connect the negative of the respective input signals to the AG terminal of the F3AD08-□□ module

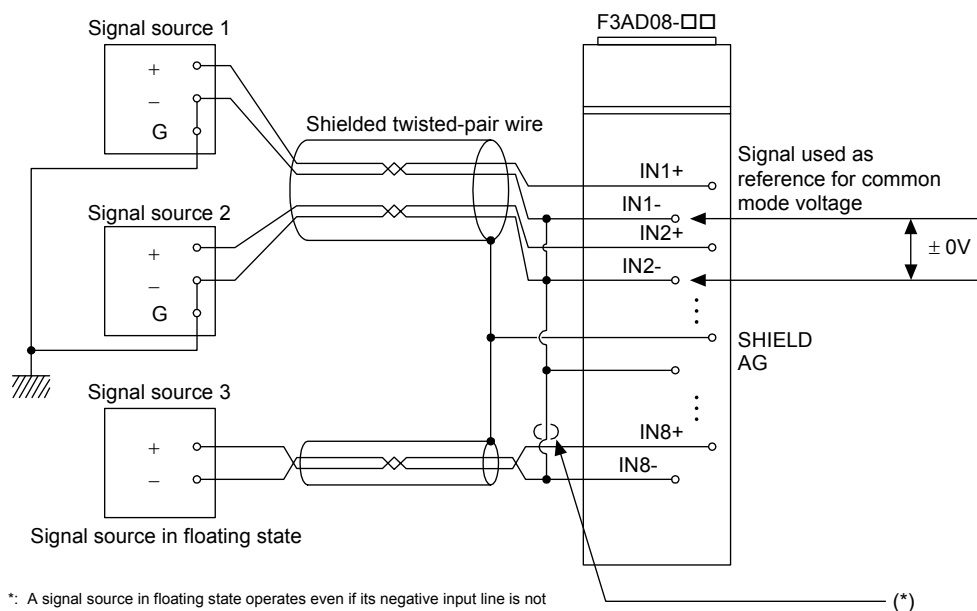


Figure A1.9 Wiring Example

- When the negative terminal of a signal source is grounded, it may be better to connect the shield of the twisted-pair to the SHIELD terminal (or FG terminal) at the signal source.

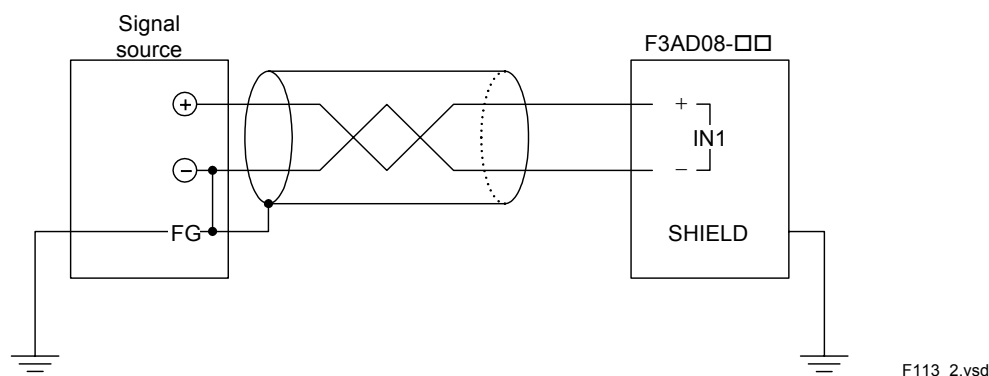


Figure A1.10 Example Wiring with the Negative Terminal of the Signal Source Grounded

- If a signal is used as the reference for common mode voltage, you can directly connect to the F3AD08-□□ module other signal sources superimposing the common mode voltage that are within allowable limits given in the module specifications. In this case, do not connect signal sources superimposing the common-mode voltage to the AG terminal.

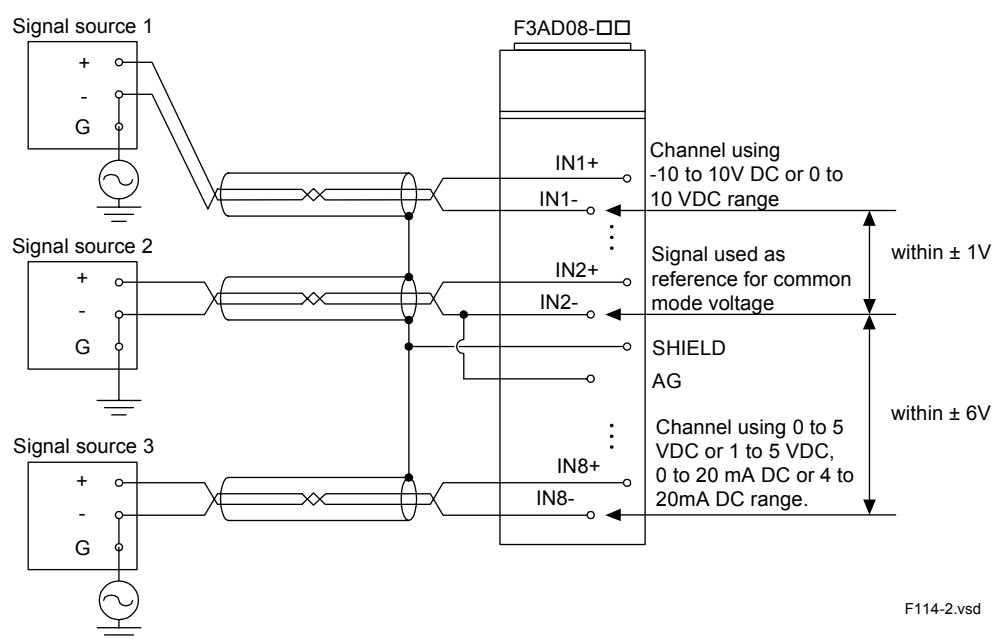


Figure A1.11 When Signal Sources Are Within Allowable Limits of the Common Mode Voltage

- If a signal is used as the reference for common mode voltage, then for signal sources superimposing the common mode voltage that are beyond allowable limits given in the module specifications, connect them as follows:
 - (1) Use an insulated signal conditioner to bring the common mode voltage within allowable limits before connecting the input signals to the F3AD08-□□ module.
 - (2) Connect the signal lines separately to multiple F3AD08-□□ modules to lower the common mode voltages of individual F3AD08-□□ modules within allowable limits given in the module specifications. In this case, multiple F3AD08-□□ modules may be installed on the same base module.

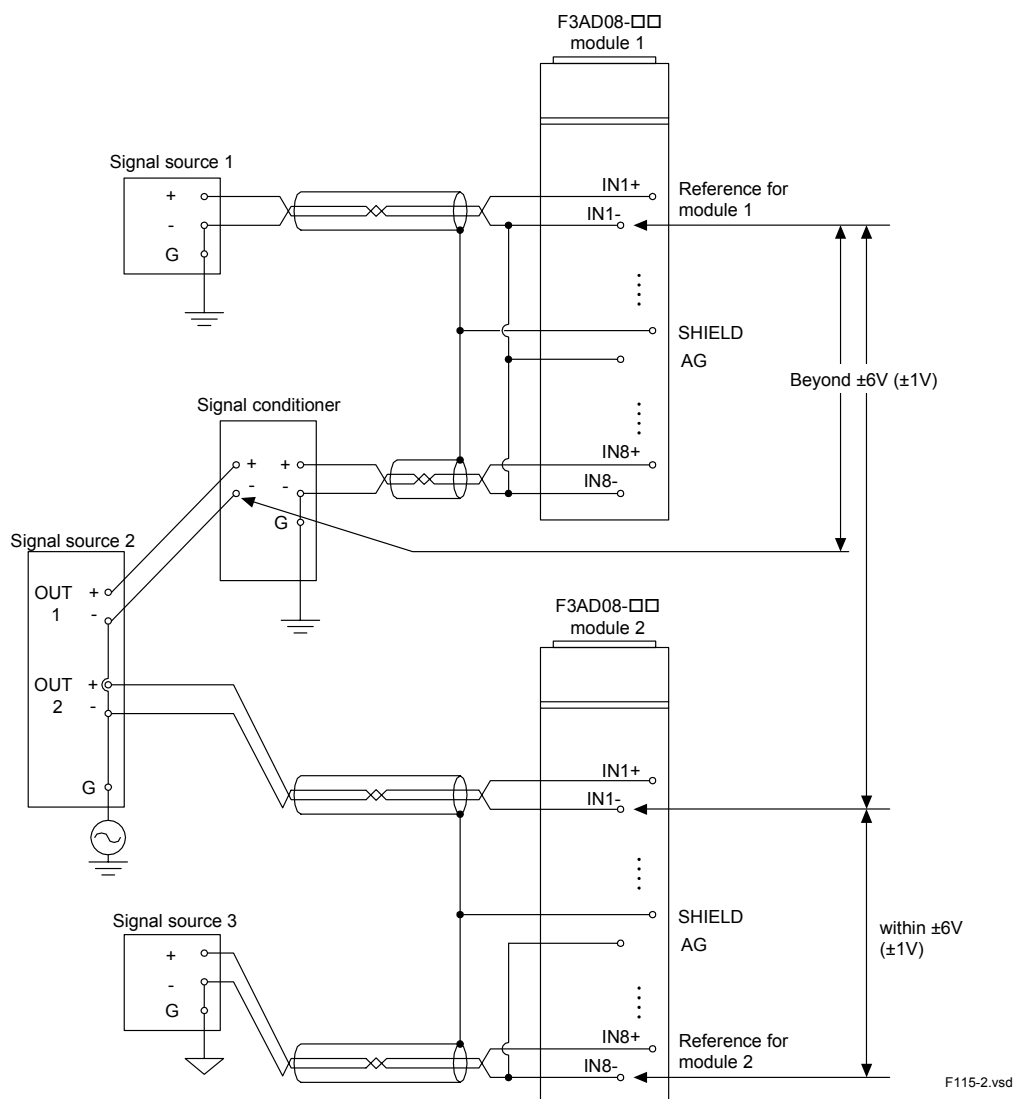


Figure A1.12 When Signal Sources Are Beyond Allowable Limits of the Common Mode Voltage

■ External Dimensions

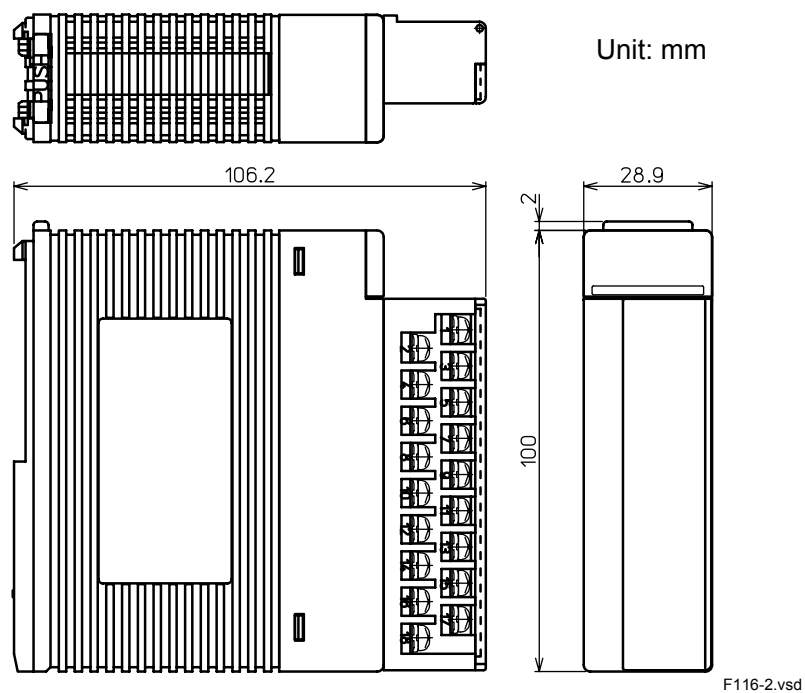


Figure A1.13 External Dimensions

A2. List of Data Position Numbers

Data position numbers for the analog input module (F3AD08-4R, F3AD08-5R or F3AD08-6R) are classified into the following 4 data areas:

- Input data : Area for storing input data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data: Area for setting upper and lower limits for scaling and filter preset value
- Error status : Area for storing module error information

A2.1 List of Data Position Numbers

Table A2.2 lists the data position numbers for input data. Table A2.1 lists the commands for accessing data in this area. For more details on how to use these commands, see Chapter A6 or Chapter A7. For more details on individual input data items, see Chapter A3.

Table A2.1 Commands for Accessing Input Data

	Read	Write
Ladder	READ or HRD	Not allowed
BASIC	ENTER	Not allowed

Table A2.2 Data Position Numbers for F3AD08-4R, F3AD08-5R and F3AD08-6R

Ladder	BASIC	Description
1	1	Input conversion value for channel 1
2	2	Input conversion value for channel 2
3	3	Input conversion value for channel 3
4	4	Input conversion value for channel 4
5	5	Input conversion value for channel 5
6	6	Input conversion value for channel 6
7	7	Input conversion value for channel 7
8	8	Input conversion value for channel 8
21	21	Maximum value for channel 1
22	22	Maximum value for channel 2
23	23	Maximum value for channel 3
24	24	Maximum value for channel 4
25	25	Maximum value for channel 5
26	26	Maximum value for channel 6
27	27	Maximum value for channel 7
28	28	Maximum value for channel 8
41	41	Minimum value for channel 1
42	42	Minimum value for channel 2
43	43	Minimum value for channel 3
44	44	Minimum value for channel 4
45	45	Minimum value for channel 5
46	46	Minimum value for channel 6
47	47	Minimum value for channel 7
48	48	Minimum value for channel 8

A2.2 List of Mode Registers

Table A2.4 lists the data position numbers for operation mode. Table A2.3 lists the commands for accessing data in this area. For more details on how to use these commands, see Chapter A6 or Chapter A7. For more details on operation mode, see Chapter A3.

Table A2.3 Commands for Accessing Operation Mode

	Read	Write
Ladder	READ or HRD	WRITE or HWR
BASIC	STATUS	CONTROL

**Table A2.4 Data Position Numbers of Operation Mode
for F3AD08-4R, F3AD08-5R and F3AD08-6R**

Ladder	BASIC	Description
501	1	Operation mode preset value for channel 1 (range, skip, scaling, offset and filter)
502	2	Operation mode preset value for channel 2 (range, skip, scaling, offset and filter)
503	3	Operation mode preset value for channel 3 (range, skip, scaling, offset and filter)
504	4	Operation mode preset value for channel 4 (range, skip, scaling, offset and filter)
505	5	Operation mode preset value for channel 5 (range, skip, scaling, offset and filter)
506	6	Operation mode preset value for channel 6 (range, skip, scaling, offset and filter)
507	7	Operation mode preset value for channel 7 (range, skip, scaling, offset and filter)
508	8	Operation mode preset value for channel 8 (range, skip, scaling, offset and filter)
517	17	Drift compensation and conversion period preset value (common to channels 1 to 8)
518	18	Maximum limit (common to channels 1 to 8)
519	19	Minimum limit (common to channels 1 to 8)

Table A2.6 lists the data position numbers for operation details data. Table A2.5 lists the commands for accessing data in this area. For more details on how to use these commands, see Chapter A6 or Chapter A7. For more details on operation details data, see Chapter A3.

Table A2.5 Commands for Accessing Operation Details Data

	Read	Write
Ladder	READ or HRD	WRITE or HWR
BASIC	STATUS	CONTROL

**Table A2.6 Data Position Numbers of Operation Details Data
for F3AD08-4R, F3AD08-5R and F3AD08-6R**

Ladder	BASIC	Description
520	20	Upper limit preset value for scaling for channel 1
521	21	Lower limit preset value for scaling for channel 1
522	22	Filter preset value for channel 1
523	23	Offset preset value for channel 1
530	30	Upper limit preset value for scaling for channel 2
531	31	Lower limit preset value for scaling for channel 2
532	32	Filter preset value for channel 2
533	33	Offset preset value for channel 2
540	40	Upper limit preset value for scaling for channel 3
541	41	Lower limit preset value for scaling for channel 3
542	42	Filter preset value for channel 3
543	43	Offset preset value for channel 3
550	50	Upper limit preset value for scaling for channel 4
551	51	Lower limit preset value for scaling for channel 4
552	52	Filter preset value for channel 4
553	53	Offset preset value for channel 4
560	60	Upper limit preset value for scaling for channel 5
561	61	Lower limit preset value for scaling for channel 5
562	62	Filter preset value for channel 5
563	63	Offset preset value for channel 5
570	70	Upper limit preset value for scaling for channel 6
571	71	Lower limit preset value for scaling for channel 6
572	72	Filter preset value for channel 6
573	73	Offset preset value for channel 6
580	80	Upper limit preset value for scaling for channel 7
581	81	Lower limit preset value for scaling for channel 7
582	82	Filter preset value for channel 7
583	83	Offset preset value for channel 7
590	90	Upper limit preset value for scaling for channel 8
591	91	Lower limit preset value for scaling for channel 8
592	92	Filter preset value for channel 8
593	93	Offset preset value for channel 8

Table A2.8 and Table A2.10 list the data position numbers related to error status. Table A2.7 and Table A2.9 list the commands for accessing data in this area. For more details on how to use these commands, see Chapter A6 or Chapter A7. For more details on error status, see Chapter A4.

Table A2.7 Commands for Accessing Error Status

	Read	Write
Ladder	READ or HRD	Not allowed
BASIC	ENTER	Not allowed

**Table A2.8 Data Position Numbers of Error Status
for F3AD08-4R, F3AD08-5R and F3AD08-6R**

Ladder	BASIC	Description
201	201	Error status

Table A2.9 Commands for Resetting Error Status

	Read	Write
Ladder	READ or HRD	WRITE or HWR
BASIC	STATUS	CONTROL

**Table A2.10 Data Position Numbers for Resetting Error Status
for F3AD08-4R, F3AD08-5R and F3AD08-6R**

Ladder	BASIC	Description
700	200	Reset error status

A3. Operation Mode and Operation Setup

The operation mode contains two types of settings: settings that apply to all channels, and settings that apply to individual channels. The former includes conversion period and drift compensation settings, while the latter includes input signal range, channel skip, scaling, offset, filter and hold data settings.

Table A3.1 lists the operation mode settings common to all channels with their default values.

Table A3.1 Operation Mode Settings (Common to all channels)

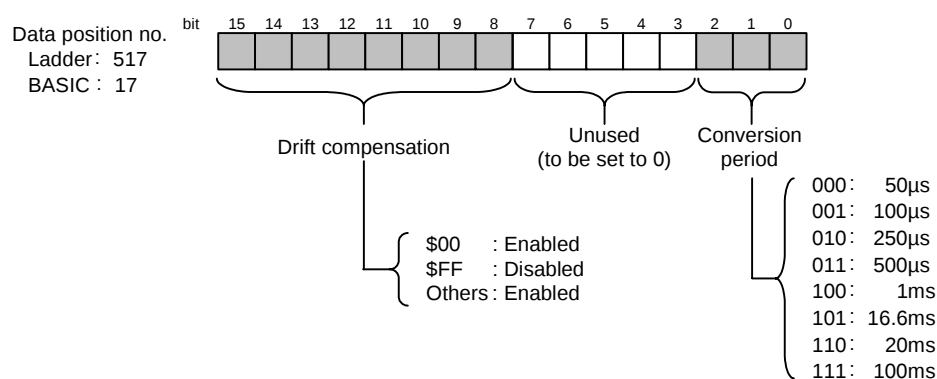
Operation Mode	Settings	Default Value	Description
Conversion period	50 μ s, 100 μ s, 250 μ s, 500 μ s, 1 ms, 16.6 ms, 20 ms or 100 ms	1 ms	See Section A3.1
Drift compensation	Enabled or disabled	Enabled	See Section A3.2

You can set the operation mode of a channel by writing 16-bit data to its corresponding operation mode data position number using Special Module Write (WRITE or HWR) ladder instructions or BASIC (CONTROL) statements.

For more details on these ladder instructions and BASIC instruction, see Section A6.2 and A7.5 respectively.

Table A3.2 Data Position Number for Operation Mode (common to all channels)

	Drift compensation and conversion period
Ladder	517
BASIC	17



F117-2.vsd

Figure A3.1 Operation Mode Bitmap

Table A3.3 lists the setup items for individual channels with their default values. The default values apply when no setting is performed by software.

Table A3.3 Operation Mode Settings (for individual channels)

Operation Mode	Settings	Default Value	Description
Input signal range ^{*1}	-10 to 10V, 0 to 10V, 0 to 5V, 1 to 5V DC, 0 to 20 mA or 4 to 20 mA DC	-10 to 10V DC 0 to 20mA DC	See Section A3.3
Skip channel	Yes or No	No	See Section A3.4
Scaling	Yes or No	No	See Section A3.5
Offset	Yes or No	No	See Section A3.6
Filter	No, first-order lag filter or moving average	No	See Section A3.7

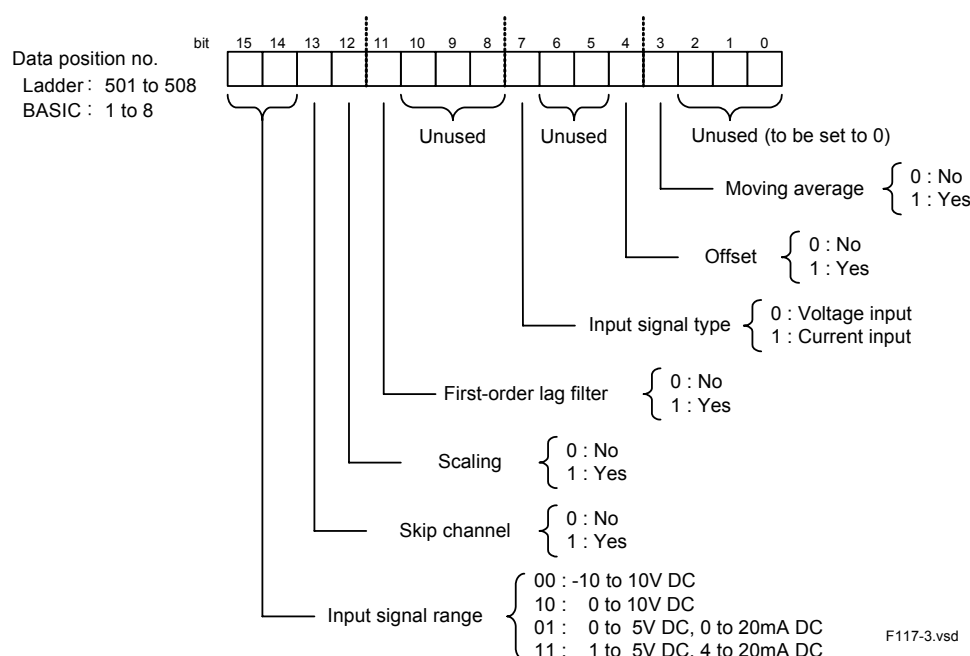
*1: The available input signal range options depend on module type.

The default input signal range is -10 to 10V DC for F3AD08-6R and F3AD08-5R, and 0 to 20 mA DC for F3AD08-4R

Table A3.4 Data Position Numbers of Operation Mode (for individual channels)

	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Ladder	501	502	503	504	505	506	507	508
BASIC	1	2	3	4	5	6	7	8

You can set the operation mode of a channel by writing 16-bit data into its corresponding operation mode data position number using Special Module Write ladder instructions or BASIC statements.

**Figure A3.2 Operation Mode Bitmap**

*: By default, bit numbers 0 through 15 is 0.

*: For details on setup, see the respective description for individual functions.

The input signal type setting can be used to switch the input signal range setting between voltage ranges and current ranges but this feature is only supported on F3AD08-6R. F3AD08-5R always operate on voltage input, while F3AD08-4R always operate on current input, regardless of the input signal type setting.

**CAUTION**

If the F3AD08-6R is configured for current input using its hardware switch, you must also set input signal type to current input, and must not set input signal range to "00" or "10" in the operation mode. Otherwise, input values will not be read correctly.

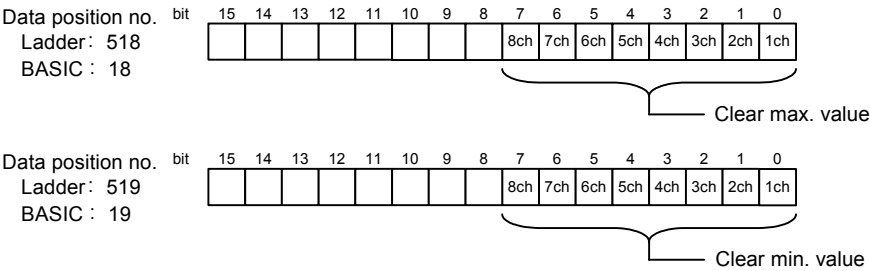
The module has a hold data function that stores the minimum and maximum conversion output values of each channel. This function is always enabled. The stored value for a channel can be cleared by writing bit values to appropriate data position numbers using Special Module Write ladder instructions or BASIC statements.

Table A3.5 Operation Mode Settings (Hold data function)

Operation Mode	Settings	Default Value	Description
Hold data	Clear hold value	Hold	See Section A3.8

Table A3.2 Data Positions for Operation Mode (Hold data function)

	Data Position Number
Ladder	518,519
BASIC	18,19



F117-4.vsd

Figure A3.3 Operation Mode Bitmaps

Writing a value of 1 to the bit corresponding to a channel clears its stored minimum conversion output value or stored maximum conversion output value. After the value is cleared, the corresponding bit of the operation mode register resets to 0.

TIP

The operation mode preset values reset whenever power is turned off. When power is turned on again, the module operates with default values. Thus, you need to set the operation mode each time power is turned on.

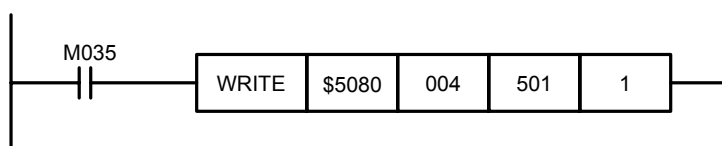
■ Example 1

This example configures channel 1 of the F3AD08-6R module installed in slot number 004 as follows.

Function	Setting
Input signal range	0 to 20mADC (current input) *
Skip channel	No
Scaling	Yes
Offset	No
Filter	No

*: You need to set the DIP switch to ON.

● Using Special Module Write instructions in ladder



F11704-2.vsd

● Using BASIC statements

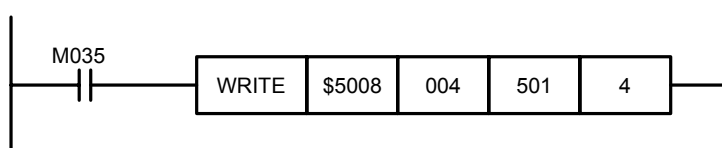
CONTROL 4,1; \$ 5080

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

■ Example 2

This example configures channels 1-4 of the F3AD08-5R module installed in slot number 004 as follows.

Function	Setting
Input signal range	0 to 5 VDC (voltage input)
Skip channel	No
Scaling	Yes
Offset	No
Filter	Moving average



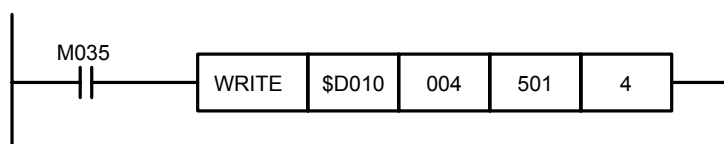
F11705-2.vsd

F3AD08-5R supports only voltage input so there is no need to specify its input signal type. The input signal type bit value is ignored.

■ Example 3

This example configures channels 1-4 of the F3AD08-4R module installed in slot number 004 as follows.

Function	Setting
Input signal range	4 to 20 mA DC (current input)
Skip channel	No
Scaling	Yes
Offset	Yes
Filter	No



F11706-2.vsd

F3AD08-4R supports only current input so there is no need to specify its input signal type. The input signal type bit value is ignored.

A3.1 Setting Conversion Period

The module provides 8 conversion period options for selection. The default conversion period is 1 ms, which is the processing time per channel. The conversion period can be set to 50μs, 100μs, 250μs or 500μs for high-speed signal processing. To remove noise components due to interference from the mains, the conversion period can be set to 20ms or 100 ms (for 50 Hz mains), 16.6 ms or 100 ms (for 60 Hz mains)

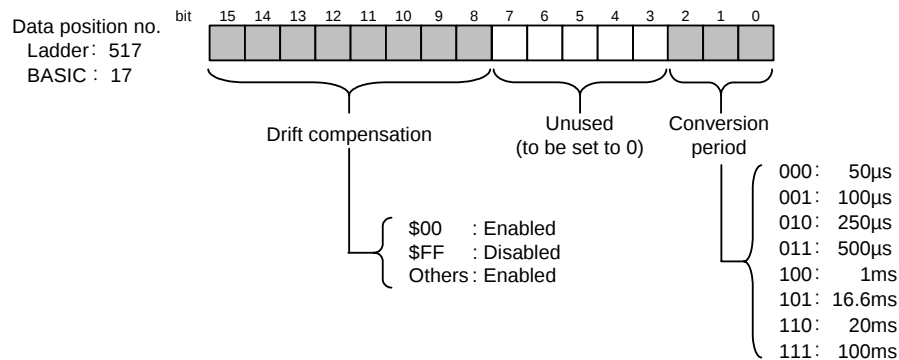
You can set the conversion period by writing to bits 0, 1 and 2 of the mode register for conversion period. The default value of “1 ms” is represented by bits (1, 0, 0) or hexadecimal value \$0004.

The conversion period setting represents the conversion processing time per channel. The period at which conversion output data is updated for each channel, known as the data update period, is given by: number of unskipped channels x conversion period.

For more details on skipping channels, see Section A3.4.

Table A3.7 Data Position Number for Conversion Period

	Conversion Period
Ladder	517 (low byte)
BASIC	17 (low byte)



F117-2.vsd

Figure A3.4 Operation Mode (Conversion Period) Bitmap

Note: The default preset value is \$0004.

The conversion period setting and the drift compensation setting share the same data position so conversion period and drift compensation must be set at the same time.

TIP

The module performs multiple A/D conversions within one conversion period, and uses the average of these conversion output values as the final A/D conversion output value for that data conversion period, and thus is less susceptible to sporadic noise.

Moreover, if the conversion period is set to, say, 20 ms, the module performs multiple consecutive A/D conversions within the 20 ms duration, and computes the final conversion output value by averaging these values so it is capable of suppressing high-frequency (say 50 Hz) noise.

TIP

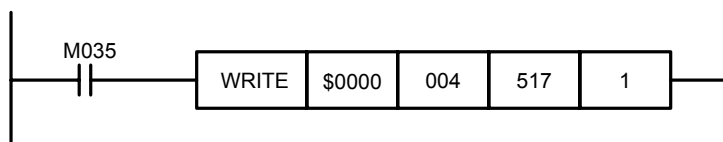
A preset value of 16.6 ms for the conversion period maps to actual conversion period of 16.66...ms ($= \frac{1}{60}$ s).

■ Example 1

This example sets the conversion period of the module installed in slot 004 to 50 μ s.

When using 8 channels, the data for each channel is updated every 400 μ s, which is given by 50 μ s per channel x 8 channels.

- **Using Special Module Write instructions in ladder**



F11701-2.vsd

- **Using BASIC statements**

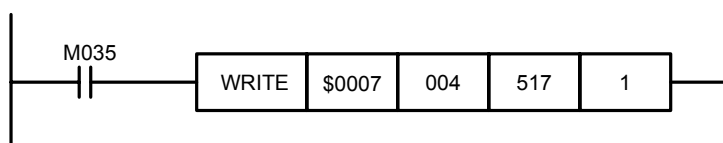
CONTROL 4,17; \$ 0000

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

■ Example 2

This example sets the conversion period of the module installed in slot 004 to 100 ms.

When using 8 channels, the data for each channel is updated every 0.8 s, which is given by 100 ms per channel x 8 channels.



F11702-2.vsd

A3.2 Drift Compensation

The module has a built-in drift compensation function, which is used to compensate for any drift in the conversion output values caused by temperature variations during operation or other reasons. The module automatically and regularly monitors the reference voltage, and updates the drift compensation amount accordingly. The monitoring period depends on the specified conversion period. Monitoring the reference voltage also enables the module to check whether the A/D converter is operating normally.

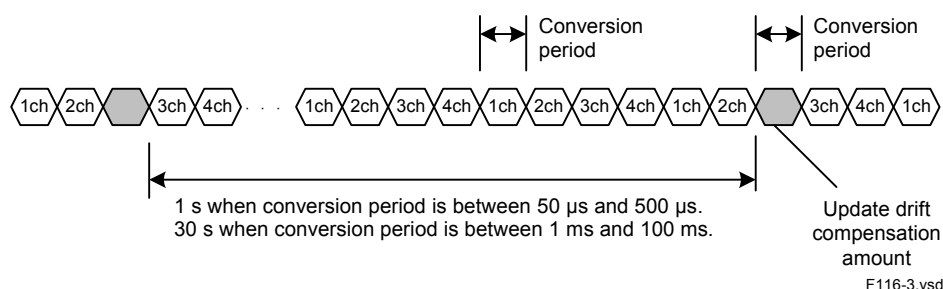
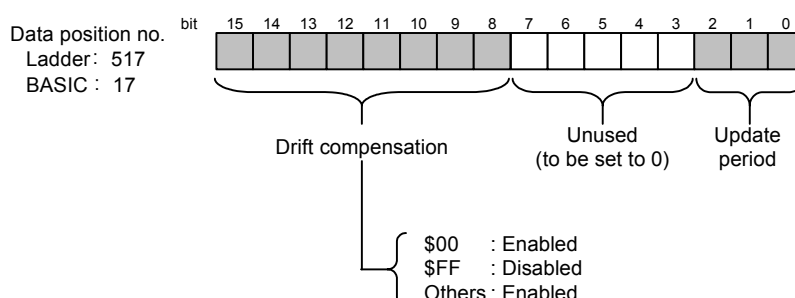


Figure A3.5 Timing for Updating Drift Compensation Amount

Table A3.8 Data Position Number for Drift Compensation

	Drift Compensation
Ladder	517 (high byte)
BASIC	17 (high byte)



F117-2-1.vsd

Figure A3.6 Operation Mode Bitmap

Table A3.9 Drift Compensation Preset Values

Preset Value	Drift Compensation
\$00	Enabled
\$FF	Disabled
Any other value	Enabled

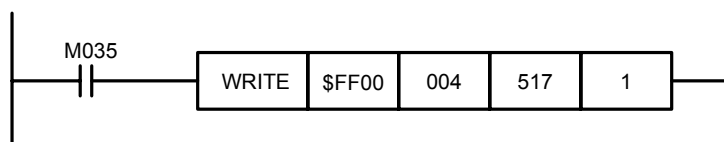
Writing a value of \$FF to the high-byte of the data position number for drift compensation stops updating of the drift compensation amount. Writing \$00 to the same data position number resumes updating of the drift compensation amount approximately 1 s or 30 s later.

The conversion period setting and the drift compensation setting share the same data position so conversion period and drift compensation must be set at the same time.

■ Example 1

This example stops updating of the drift compensation amount for the module installed in slot number 004 (assuming that conversion period is 50 μ s).

- **Using Special Module Write instructions in ladder**



F11710-2.vsd

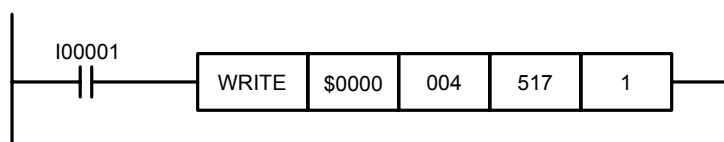
- **Using BASIC statements**

CONTROL 4,17; \$ FF00

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

■ Example 2

This example resumes updating of the drift compensation amount for the module installed in slot number 004 (assuming that conversion period is 50 μ s)



F11711-2.vsd

- **Using BASIC statements**

CONTROL 4,17; \$ 0000

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.



CAUTION

The drift compensation function should usually be enabled.

It should only be disabled for applications with stringent conversion period requirements. When disabled, the overall accuracy becomes $\pm 1\%$ (full scale).

Even when the drift compensation function is disabled, the module continues with drift compensation using the last computed drift compensation amount (internal value). Disabling the drift compensation function essentially only stops updating of the compensation amount.

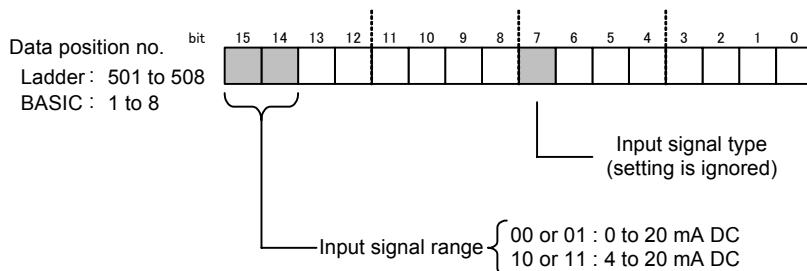
The module performs drift compensation together with checking of A/D conversion errors, so disabling the drift compensation function also stops error checking, and thus, A/D conversion errors will no longer be detected. Other self-diagnostic errors, however, will continue to be detected. For more details on self-diagnostic errors, see Section A4.1, "Self-diagnostic Errors."

A3.3 Input Signal Range

■ F3AD08-4R

The module provides two current input signal range options for selection. The following table shows the effective signal range for A/D conversion for each of these input signal range options. The default input signal range is “0 to 20 mA DC”.

You can switch between input signal ranges by manipulating the bits of the mode register shown in the figure below.



F117-7.vsd

Figure A3.7 Bits for Setting Input Signal Range for F3AD08-4R

Table A3.10 Input Signal Range for F3AD08-4R

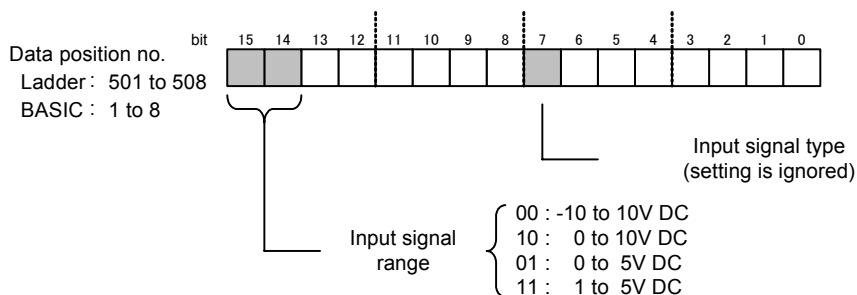
Input Signal Range Preset Value	Effective Input Signal Range	Bit values of Mode Register		
		Bit 15	Bit 14	Bit 7
0 to 20mA DC	-1.0 to 21.0mA DC	0	Any	Any
4 to 20mA DC	-1.0 to 21.0mA DC	1	Any	Any

Note: F3AD08-4R only supports current input so bit 7 of the mode register is ignored.

■ F3AD08-5R

The module provides four voltage input signal range options for selection. The following table shows the effective signal range for A/D conversion for each of these input signal range options. The default input signal range is “-10 to 10 VDC”.

You can switch between input signal ranges by manipulating the bits of the mode register shown in the figure below.



F117-6.vsd

Figure A3.8 Bits for Setting Input Signal Range for F3AD08-5R

Table A3.11 Input Signal Range of F3AD08-5R

Input Signal Range Preset Value	Effective Input Signal Range	Bit values of Mode Register		
		Bit 15	Bit 14	Bit 7
-10 to 10V DC	-11.0 to 11.0V DC	0	0	Any
0 to 10V DC	-0.5 to 10.5V DC	1	0	Any
0 to 5V DC	-0.25 to 5.25V DC	0	1	Any
1 to 5V DC	-0.25 to 5.25V DC	1	1	Any

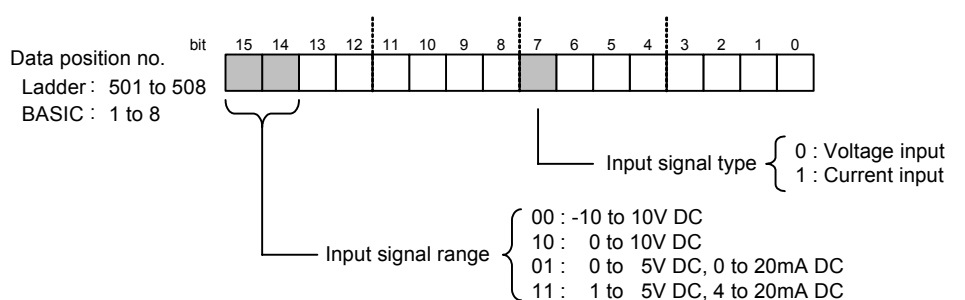
Note: F3AD08-5R only supports voltage input so bit 7 of the mode register is ignored.

■ F3AD08-6R

The module provides four voltage input signal range options and two current input signal range options for selection. The following table shows the effective signal range for A/D conversion for each of these input signal range options. The default input signal range is “-10 to 10V DC”.

You can switch between input signal ranges by manipulating the bits of the mode register shown in the figure below.

You must also set the hardware switch to match the selected input signal type.



F117-5.vsd

Figure A3.9 Bits for Setting Input Signal Range for F3AD08-6R

Table A3.12 Input Signal Range for F3AD08-6R

Input Signal Range Preset Value	Effective Input Signal Range	Bit values of Mode Register			Switch Setting
		Bit 15	Bit 14	Bit 7	
-10 to 10V DC	-11.0 to 11.0V DC	0	0	0	OFF
0 to 10V DC	-0.5 to 10.5V DC	1	0	0	OFF
0 to 5V DC	-0.25 to 5.25V DC	0	1	0	OFF
1 to 5V DC	-0.25 to 5.25V DC	1	1	0	OFF
0 to 20mA DC	-1.0 to 21.0mA DC	0	1	1	ON
4 to 20mA DC	-1.0 to 21.0mA DC	1	1	1	ON
Undefined	(Do not specify this preset value)	0	0	1	ON
		1	0	1	ON



CAUTION

If the hardware switch is configured for current input, you must also set the input signal type to current input. Moreover, you should not set bits (15, 14) to (0, 0) or (1, 0).

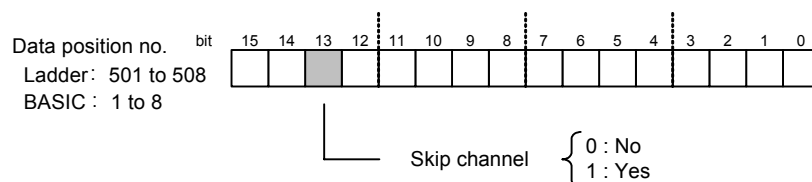
Inconsistent input signal type setting and hardware switch setting will not damage the module, but will cause input signals to be incorrectly applied and their values incorrectly read.

A3.4 Skip Channel

The Skip Channel feature can be used to disable A/D conversion for unused channels.

When it is turned on for a channel, data is not updated for that channel. This helps to shorten the data update period, which is given by: conversion period x number of channels in use (unskipped channels). By default, skipping is disabled and A/D conversion is performed for all channels.

For more details on conversion period, see Section A3.1.

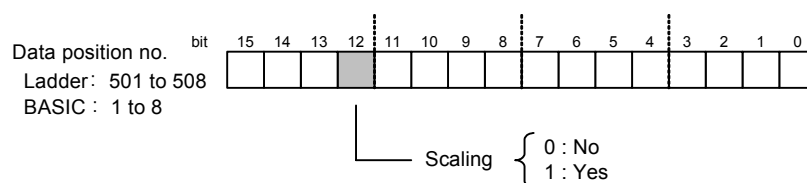


F117-10.vsd

Figure A3.10 Bits of Mode Register for Skipping Channels

A3.5 Scaling and Setting Upper and Lower Limits

The digital output values corresponding to the upper and lower limits of the input signal range can be set to any value from –20000 to 20000. Scaling can be used to convert data to a suitable form for processing.



F117-11.vsd

Figure A3.11 Bits of Mode Register for Configuring Scaling

To set up the scaling function, use the following procedure.

1. Set scaling to “Yes” in the operation mode.
2. Write the digital output values corresponding to the upper and lower limits of the input signal range to the scaling data position number defined for each channel using a special module WRITE ladder instruction or a BASIC statement.

Table A3.13 Scaling Data Position Numbers

Description		Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Digital output value corresponding to upper limit of input signal range	Ladder	520	530	540	550	560	570	580	590
	BASIC	20	30	40	50	60	70	80	90
Digital output value corresponding to lower limit of input signal range	Ladder	521	531	541	551	561	571	581	591
	BASIC	21	31	41	51	61	71	81	91

The specified digital output values corresponding to the upper and lower limits of the input signal range must satisfy the following condition:

$$-20000 \leq N \leq 20000 \text{ (where } N \text{ is an integer)}$$

No scaling will be performed with any of the following setup and the input/output characteristics will be as shown in Figure A1.1 or Figure A1.2.

$N < -20000$ or $20000 < N$ where N is the upper limit or the lower limit.



CAUTION

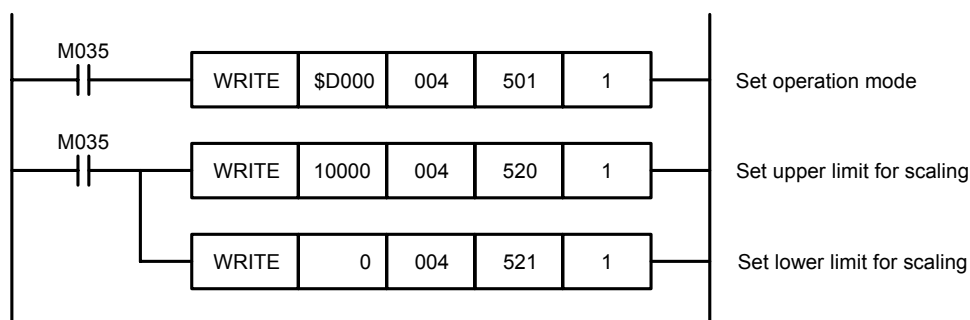
If the upper limit and the lower limit for scaling are set to the same value, the conversion result will be a constant value equal to the preset value.

■ Example

This example configures channel 1 of the F3AD08-6R module installed in slot number 004 as follows.

Function	Setting
Input signal range	1 to 5VDC (voltage input)
Skip channel	No
Scaling	Yes (0 to 10000)
Offset	No
Filter	No

● Using Special Module Write instructions in ladder



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- **Using BASIC statements**

CONTROL 4,1;\$D000 Set operation mode
 CONTROL 4,20;10000 Set upper limit for scaling
 CONTROL 4,21;0 Set lower limit for scaling

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

The following figure shows the change in the input/output characteristics for the above example.

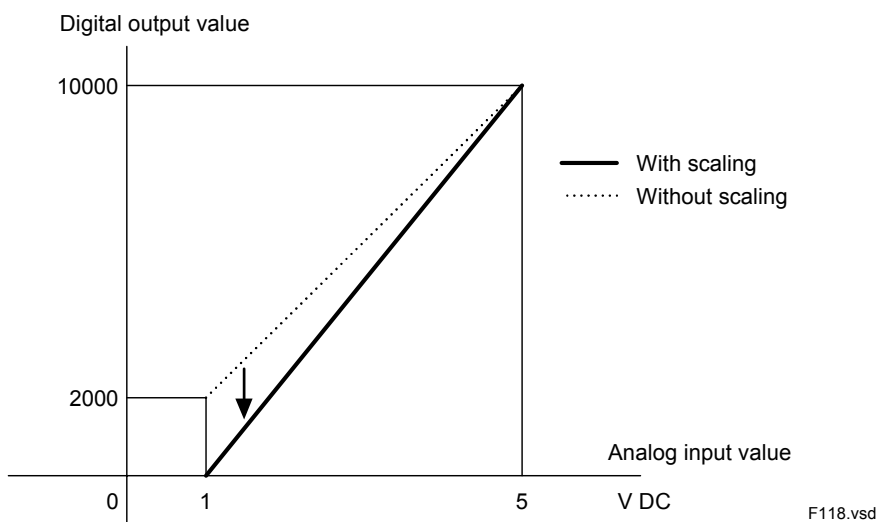
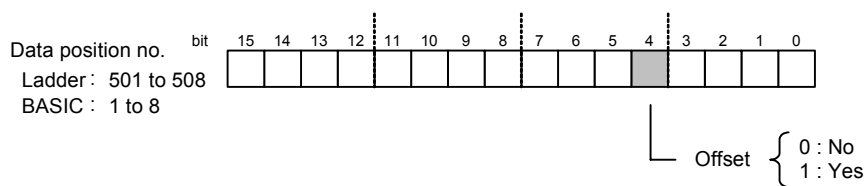


Figure A3.12 Changes in the Input/Output Characteristics When Scaling is Used

A3.6 Offset Function and Setting Offset Preset Value

The module provides an offset function for canceling the effect of any offset signal due to temperature drift of the input signal source or some other reasons.

The offset preset value is specified as a digital conversion output value between -5000 and 5000.



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Figure A3.13 Bits of Mode Register for Configuring Offset Function

To configure the offset function, use the following procedure.

1. Set offset to "Yes" in the operation mode.
2. Write the digital output value corresponding to the offset amount to the offset data position number defined for each channel using a special module WRITE ladder instruction or a BASIC statement.

Table A3.14 Data Position Number for Offset

Description		Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Offset Preset value	Ladder	523	533	543	553	563	573	583	593
	BASIC	23	33	43	53	63	73	83	93

The specified offset preset value must satisfy the following condition:

$$-5000 \leq N \leq 5000 \text{ (where } N \text{ is an integer)}$$

The following preset values will generate a parameter setup error, and the module will default to operating with the offset function disabled (offset amount = 0).

$$N < -5000 \text{ or } N > 5000, \text{ where } N \text{ is the offset preset value.}$$

TIP

The offset function can be used to remove the effect of an offset in the input signal source, but cannot remove the effect of a gain variation in the input signal source.

To remove the gain variation of a signal source, set the upper and lower limits for scaling instead.

■ Example

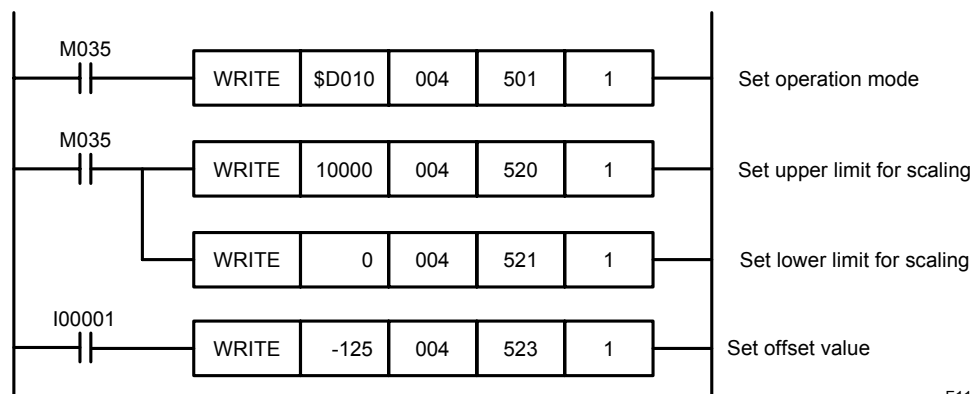
This example configures channel 1 for of the F3AD08-6R module installed in slot number 004 as follows.

Function	Setting
Input signal range	1 to 5VDC (voltage input)
Skip channel	No
Scaling	Yes (0 to 10000)
Offset	Yes (-50 mV)
Filter	No

With the above scaling setup, the specified offset value of -50 mV will be equivalent to

$$-125 \left(= -50mV \times \frac{10000 - 0}{5V - 1V} \right) \text{ in the digital output after A/D conversion.}$$

● Using Special Module Write instructions in ladder



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- **Using BASIC statements**

CONTROL 4,1;\$D010 Set operation mode

CONTROL 4,20;10000 Set upper limit for scaling

CONTROL 4,21;0 Set lower limit for scaling

CONTROL 4,23;-125 Set offset preset value

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

The following figure shows the change in the input/output characteristics for the above example.

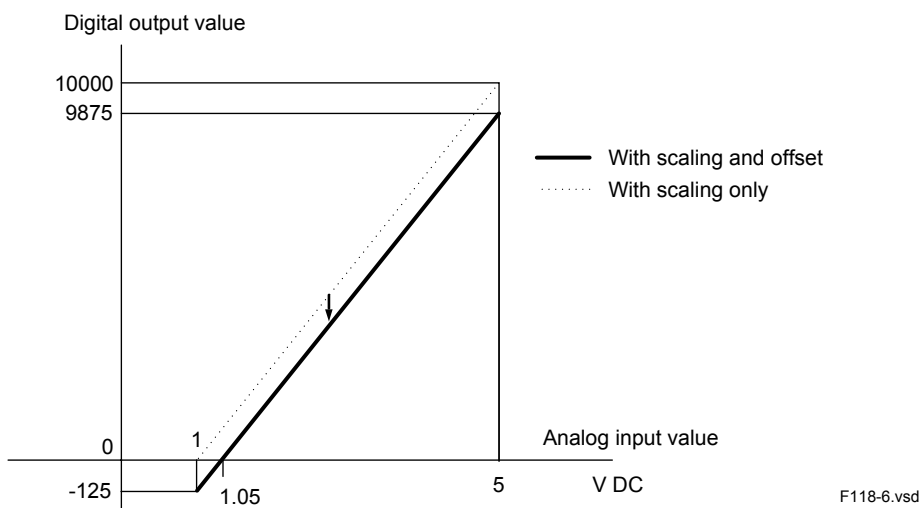
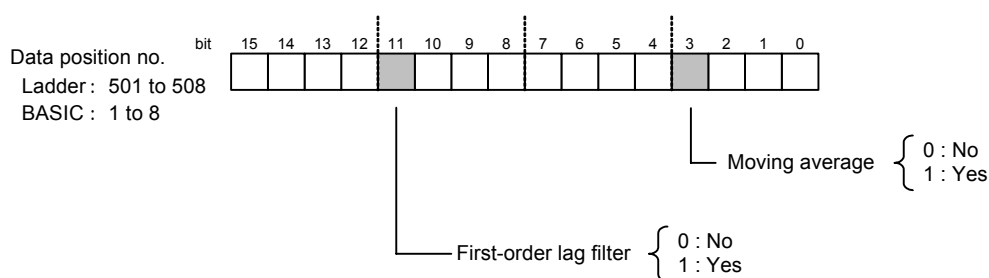


Figure A3.14 Changes in the Input/Output Characteristics when Offset is Used

A3.7 Filter Function and Setting the Filter Preset Value

The filter function can be used to remove noise superimposed on the input signal, or to expand the computation range for conversion to obtain more stable conversion output. The following filter options are available:

- First-order lag filter
- Moving average



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Figure A3.15 Bits of Mode Register for Configuring Filter Function

We can configure the filter function by setting bits 11 and 3 of the mode register for filter function.

Table A3.15 Filter Options

Filter function	Bit Value	
	Bit 11	Bit 3
Disabled	0	0
Moving average	0	1
First-order lag filter	1	Any



CAUTION

Do not enable the filter function when conversion period is set to 50 μ s. Otherwise, a parameter setup error will be generated.



CAUTION

First-order lag filter and moving average computation cannot be used concurrently on the same channel. The first-order lag filter takes precedence during operation.

■ First-order Lag Filter

This is a low-pass first-order lag filter. You can specify the filter time constant in ms as an operation parameter. The update period of data processed by filtering is given by: conversion period × number of unskipped channels.

To set up a first-order lag filter, use the following procedure:

1. Set the operation mode to enable first-order lag filtering by setting bit 11 of the mode register to 1. Bit 3 of the mode register is ignored.
2. Write the filter preset value to the filter data position number defined for each channel using a special module WRITE ladder instruction or a BASIC statement. The filter preset value represents the first-order lag time constant in ms.

Table A3.16 Data Position Number for First-order Lag Filter Time Constant

Description		Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Filter preset value	Ladder	522	532	542	552	562	572	582	592
	BASIC	22	32	42	52	62	72	82	92

The first-order lag filter and moving average functions share the same data position number.

If the filter time constant is set to a value smaller than 0 or larger than 30,000, a parameter setup error is generated and the module defaults to operating with filter time constant of 1 ms.

TIP

The actual time constant of the first-order lag filter depends on the preset time constant value, the conversion period and the number of channels in use (not skipped).

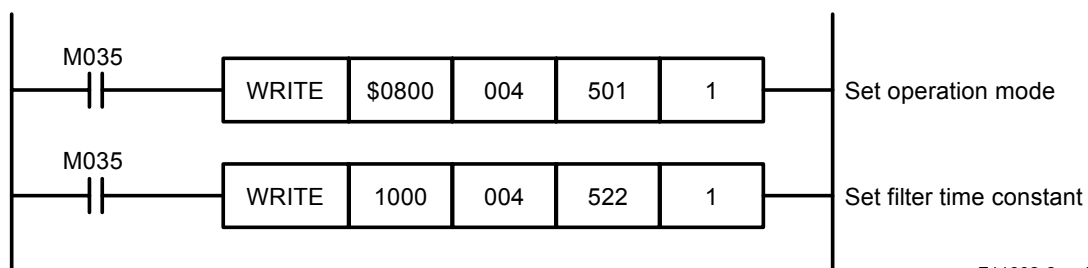
For details, see Appendix A.

■ Example

This example configures channel 1 of the F3AD08-6R module installed in slot number 004 as follows:

Function	Setting
Input signal range	-10 to 10 VDC (voltage input)
Skip channel	No
Scaling	No (-20000 to 20000)
Offset	No
Filter	First-order lag filter Time constant: 1000 ms

● Using Special Module Write instructions in ladder



● Using BASIC statements

CONTROL 4,1;\$0800 Set operation mode

CONTROL 4,22;1000 Set filter time constant

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

■ Operation Example

The following figure illustrates an example of filter operation.

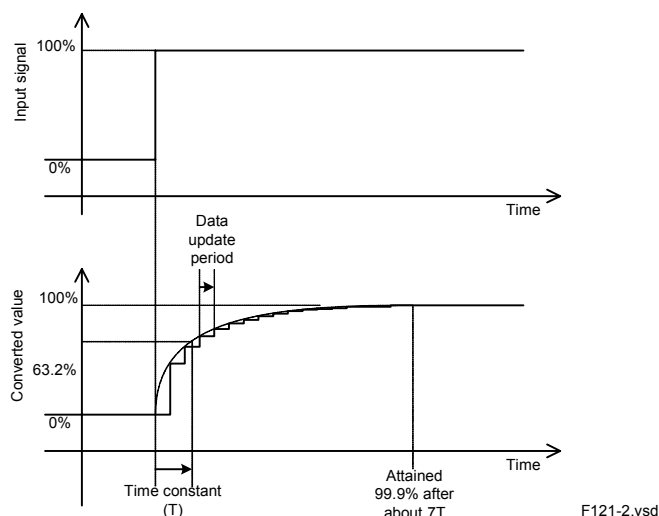


Figure A3.16 Operation When Using a Filter

As shown in Figure A3.16, when the input signal makes a step transition, the conversion output after filtering rises gradually to approach the final value. The time constant is the time taken for the conversion output value to rise by 63.2% of the difference between its final value and the initial value. If we denote the time constant by T , the conversion output value will arrive at 99.9% of the final value after duration of $7T$.

TIP

The time constant, T (in seconds), and the cutoff frequency, f_c (in Hz), of a first-order lag low-pass filter is related by the following equation:

$$f_c = \frac{1}{2\pi T}$$

You should specify an appropriate time constant value, taking into consideration signal variation speed and noise frequencies.

■ Moving Average

You can configure the module to perform moving average computation on the input signal. You can specify the number of data points (2 to 32) to be used for averaging as an operation parameter. The update period of data processed by moving average computation is given by: conversion period × number of unskipped channels.

To set up moving average computation, use the following procedure:

1. Set the operation mode to disable filtering but enable moving average computation by setting bit 11 of the mode register to 0, and bit 3 to 1.
2. Write the number of data points to be used for averaging to the filter data position number defined for each channel using a special module WRITE ladder instruction or a BASIC statement.

Table A3.16 Data Position Number for First-order Lag Filter Time Constant

Description		Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Filter preset value	Ladder	522	532	542	552	562	572	582	592
	BASIC	22	32	42	52	62	72	82	92

The first-order lag filter and moving average functions share the same data position number.

The table below shows the mapping between the preset value and actual value of the number of data points used for averaging.

Preset value	≤ -1	0 to 2	3 to 4	5 to 8	9 to 16	17 to 32	≥ 33
Actual number of data points used for averaging	2	2	4	8	16	32	2

If N is less than 0 or greater than 32, a parameter setup error is generated.

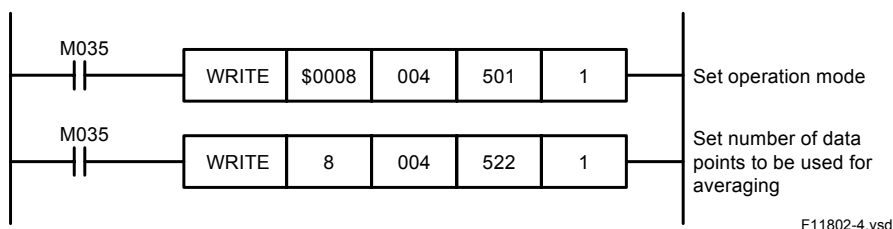
If N is equal to 0 or 1, the module defaults to using 2 data points for averaging.

■ Example

This example configures channel 1 of the F3AD08-6R module installed in slot number 004 as follows:

Function	Setting
Input signal range	-10 to 10 VDC (voltage input)
Skip channel	No
Scaling	No (-20000 to 20000)
Offset	No
Filter	Moving average computation using 8 data points for averaging

● Using Special Module Write instructions in ladder



● Using BASIC statements

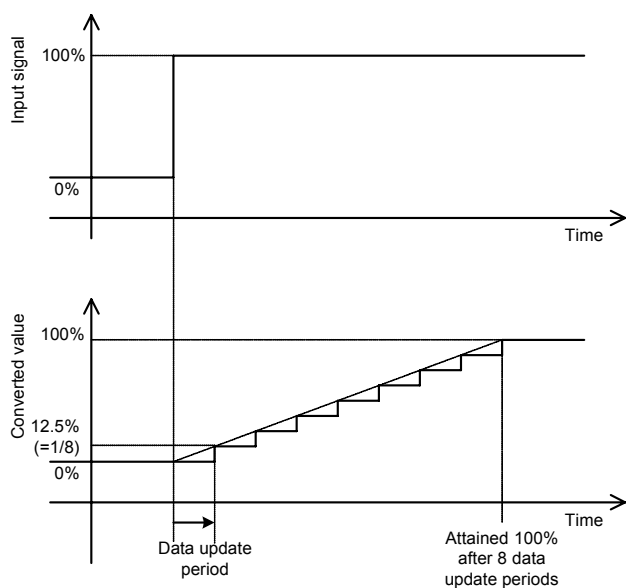
CONTROL 4, 1; \$0008 Set operation mode

CONTROL 4, 22; 8 Set number of data points to be used for averaging

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

■ Operation Example

The following figure shows the operation of moving average computation for the above example.



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

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Figure A3.17 Operation Example of Moving Average Computation

As shown in the above figure, when the input signal makes a step transition, the conversion output after moving average computation rises linearly in small steps to approach the final value. The conversion output value is updated every data update period by computing the average value of the conversion output values of a specified number of preceding data update periods.

A3.8 Hold Data Function

The hold data function stores the minimum and maximum conversion output values of each channel internally. The hold data function cannot be disabled but the stored values for individual channels can be cleared.

The stored values of each channel can be read from the data positions given below.

Table A3.18 Data Position Numbers for Hold Data Function

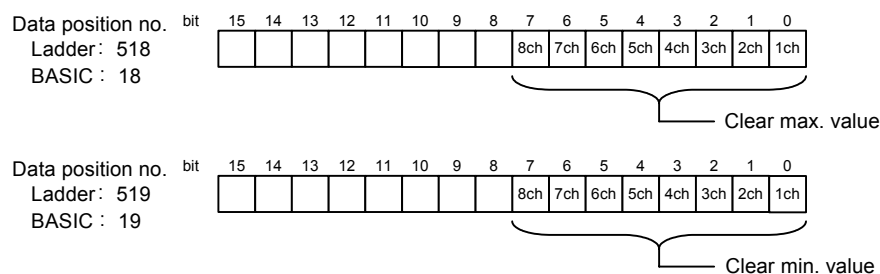
Description		Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
Stored Maximum Value	Ladder	21	22	23	24	25	26	27	28
	BASIC	21	22	23	24	25	26	27	28
Stored Minimum Value	Ladder	41	42	43	44	45	46	47	48
	BASIC	41	42	43	44	45	46	47	48

You can read the stored values using READ or HRD instructions in ladder, or ENTER instructions in BASIC. For more details on these ladder instructions, see Section A6.1. For more details on the ENTER BASIC instruction, see Section A7.3.

Writing a value of 1 to a bit of the mode register at the data position number given below clears the stored minimum value or stored maximum value of the corresponding channel. After the value is cleared, the corresponding bit resets to 0, and the hold data operation continues.

Table A3.19 Data Position Numbers for Clearing Stored Values

	Data Position Number
Ladder	518,519
BASIC	18,19



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Figure A3.18 Operation Mode Bitmap for Clearing Hold Data

TIP

The mode register for clearing hold data are also used to report completion of clearing.

Clear hold data values only if necessary.

Use ↑Write instruction to clear hold data values in ladder.

TIP

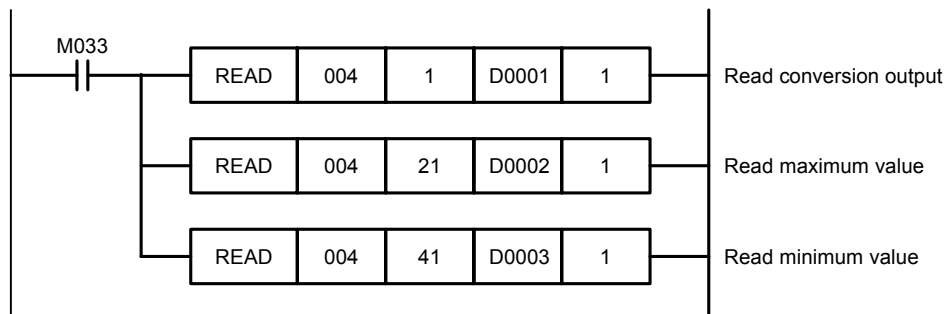
Clearing a hold value does not reset it to 0 but to the current conversion output value.

Thus, the reset value is not a constant but varies.

■ Example 1

This example reads the stored maximum and minimum conversion output values of channel 1 of the F3AD08-6R module installed in slot number 004.

- **Using Special Module Read instructions in ladder**



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- **Using BASIC statements**

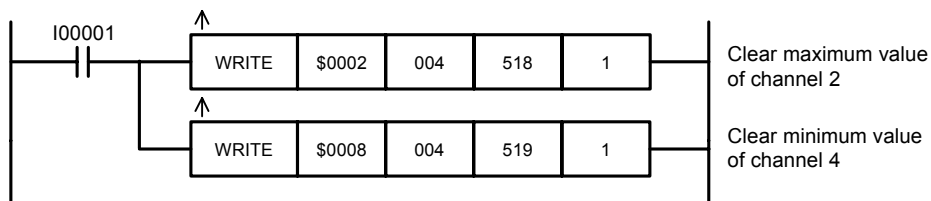
```
ENTER      4, 1 NOFORMAT; D1      (Read conversion output value)
ENTER      4, 21 NOFORMAT; D2     (Read maximum value)
ENTER      4, 41 NOFORMAT; D3     (Read minimum value)
```

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

■ Example 2

This example clears the stored minimum conversion output value of channel 1 of the F3AD08-6R module installed in slot number 004.

- **Using Special Module Write instructions in ladder**



F11708-2.vsd

- **Using BASIC statements**

```
CONTROL 4,18; $0002
CONTROL 4,19; $0008
```

Note: You should always declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

■ Operation Example

The figure below illustrates the operation of the hold data function.

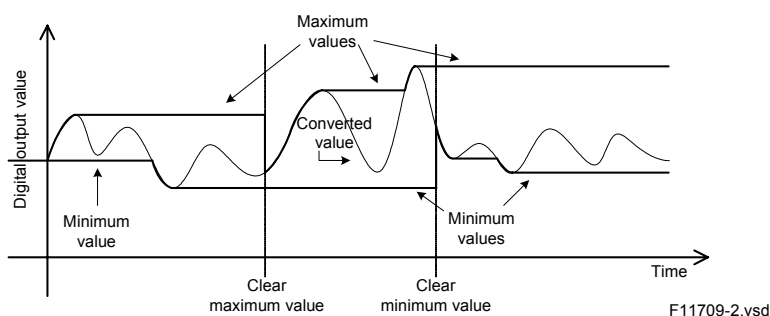


Figure A3.19 Operation Example of Hold Data Function

TIP

The hold data function stores final conversion output values after scaling, offset and filtering.

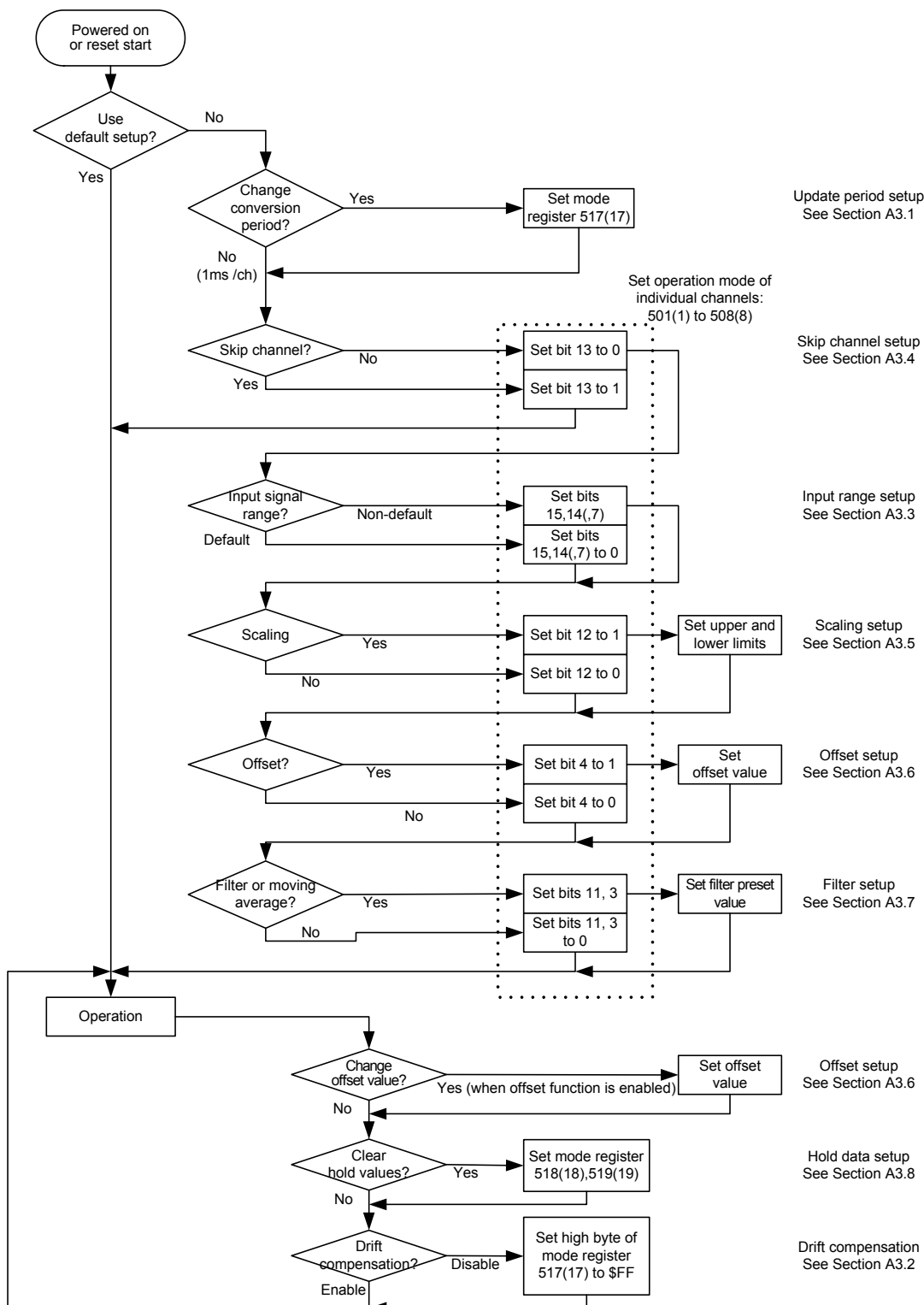


CAUTION

Even if scaling or offset preset value has been changed, the hold data function proceeds as usual, without re-computing stored values using the new preset values.

A3.9 Flowchart for Setting Operation Mode

Operation mode resets to its default value when the module is switched on or reset. To use the default operation mode, no setup is required. To change the default operation mode, use the following procedure.



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Figure A3.20 Flowchart for Setting Operation Mode

A4. Error Status

When the module detects an error during self-diagnosis, or when it detects a setup error, it returns an error status, and the ALM LED indicator located on the side of the module blinks. If no error is detected, the module returns an error status value of \$0000 and the ALM LED is off.

Table A4.1 Data Position Numbers for Error Status

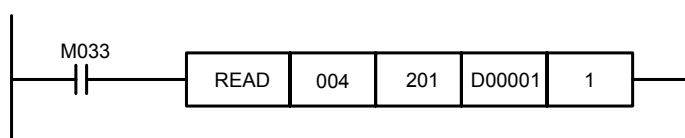
Ladder	201
BASIC	201

The error status reports only one error. If multiple errors are detected, the error with the largest error code, deemed to be the most important, is reported. For more details on error codes, see Sections A4.1 and A4.2.

■ Sample Program Code for Reading Error Status

- **Using Special Module Read Instructions in Ladder**

This program code reads the error status of the analog input module installed in slot 004 into device D00001.



F11701-3.vsd

For more details on this ladder instruction, see Section A6.1.

- **Using BASIC Statements**

This program code reads the error status of the analog input module installed in slot 004 into variable ERRSTAT.

```
ENTER 4,201 NOFORMAT;ERRSTAT
```

Note: You should execute the ASSIGN statement to declare module use before executing any BASIC statement to access the module.

For more details on this BASIC instruction, see Section A7.3.

A4.1 Self-diagnostic Errors

The module monitors the state of its hardware, and if and when it detects an error, it returns one of the following error codes as error status.

Table A4.2 Self-diagnostic Error Codes

Error Code	Error Description	State of LED		Detailed Error Description	Troubleshooting
		RDY	ALM		
\$0000	No error	●	○	Normal operation	
/\$C0□□	Fatal hardware failure	○	/\$	ROM or RAM hardware has failed.	These errors indicate a module hardware failure. Repair or replace the module.
\$C0□□	DC/DC error	●	●	An internal voltage error has occurred	
\$B0□□	ADC error	●	●	An error has been detected in A/D conversion values. An A/D converter has failed.	
\$A000	Calibration value error	●	●	Failed to read calibration values. Loss of calibration values.	A/D conversion continues even though accuracy may not meet specifications.

Error Code	Error Description	State of LED		Detailed Error Description	Troubleshooting
		RDY	ALM		
\$0F0■	Over-range input	●	◎	The applied input signal is out of range. (see note below)	Remove input signal that is out of range, Or modify the input signal range setting to match the applied input signal.

'□□' within an error code denotes undefined digit values.

'■' indicates the channel number (1-8) where an error was detected.

In the "State of LED" column, '●' denotes lit, '○' denotes not lit, and '◎' denotes blinks.

The ALM LED stops blinking when the cause of an error is removed.

Note: An over-range input error is generated if the input signal exceeds the range given in the table below.

Input Signal Range	Signal Applied between IN $\blacksquare$ + and IN $\blacksquare$	Signal Level between IN $\blacksquare$ + and AG or between IN $\blacksquare$ — and AG
-10 to 10VDC	-11.5 to 11.5 VDC (approx.)	-13.0 to 13.0 VDC (approx.)
0 to 10VDC	-0.75 to 10.75 VDC (approx.)	
0 to 5VDC	-0.37 to 5.37 VDC (approx.)	
1 to 5VDC		
0 to 20mADC	-1.5 to 21.5 mA DC (approx.)	-13.0 to 13.0 VDC (approx.) (Input impedance is 250 Ω .)
4 to 20mADC		

A4.2 Operation Setup Errors

Operation setup errors are reported when preset values of operation parameters are out of range.

Table A4.3 Operation Setup Error Codes

Error Code	Error Description	State of LED		Detailed Error Description	Troubleshooting
		RDY	ALM		
\$00F0	All channels skipped	●	◎	The Skip Channel bit is set to 'Yes' in the operation mode of all channels.	Clear the Skip Channel bit for channels that require A/D conversion.
\$00E■	Invalid scaling preset value	●	◎	The lower limit is less than -20000 or the upper limit is more than 20000.	Set the lower limit and upper limit for scaling within the valid range of -20000 to 20000.
\$00D■	Invalid offset preset value	●	◎	The offset preset value is out of the valid range of -5000 to 5000.	Set the offset preset value within the valid range of -5000 to 5000.
\$00C■	Invalid filter preset value	●	◎	The preset value of the first-order lag filter is out of the valid range of 0 to 30000; Or the preset value for moving average computation is out of the valid range of 0 to 32; Or filter or moving average is enabled and the conversion period preset value is 50 μ s.	Set the preset value of the first-order lag filter within the valid range of 0 to 30000; Or set the preset value for moving average computation within the valid range of 0 to 32, Or disable filter and moving average computation when the conversion period is set to 50 μ s.

'■' indicates the channel number (1-8) where an error was detected.

In the "State of LED" column, '●' denotes lit, '○' denotes not lit, and '◎' denotes blinks.

The ALM LED stops blinking when the cause of error is removed.

A4.3 Resetting Error Status

You can reset an error status, and thus reset the error code to \$0000. The LED indicators will revert to their normal states – lit for the RDY indicator and OFF for the ALM indicator.

To reset an error status, write \$FFFF to the data position number given in the table below. After resetting the error code to \$0000, the module resets the value at the following data position number from \$FFFF to \$0000.

Table A4.4 Data Position Numbers for Resetting Error Status

Ladder	700
BASIC	200

TIP

The data position number for resetting error status is also used to report the completion of error status reset.

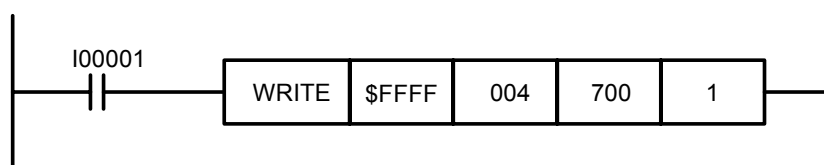
Reset error status only if necessary.

Use ↑Write instruction in ladder to do so.

■ Example

- **Resetting Error Status Using Special Module Write Instructions in Ladder**

This program code resets the error status for the analog input module installed in slot 004.



F11701-4.vsd

For more details on this ladder instruction, see Section A6.2.

- **Resetting Error Status Using BASIC Statements**

This sample code resets the error status for the analog input module installed in slot 004.

```
CONTROL 4, 200; $FFFF
```

Note: You should execute the ASSIGN statement to declare module use before executing any BASIC statement to access the module.

For more details on this BASIC instruction, see Section A7.5.



CAUTION

An error status may be reported again immediately after reset.

In this case, you need to identify and remove the cause of the error to permanently reset the error status.

A4.4 Flowchart for Checking Error Status

You can easily identify the cause of an error by reading and checking the error status.

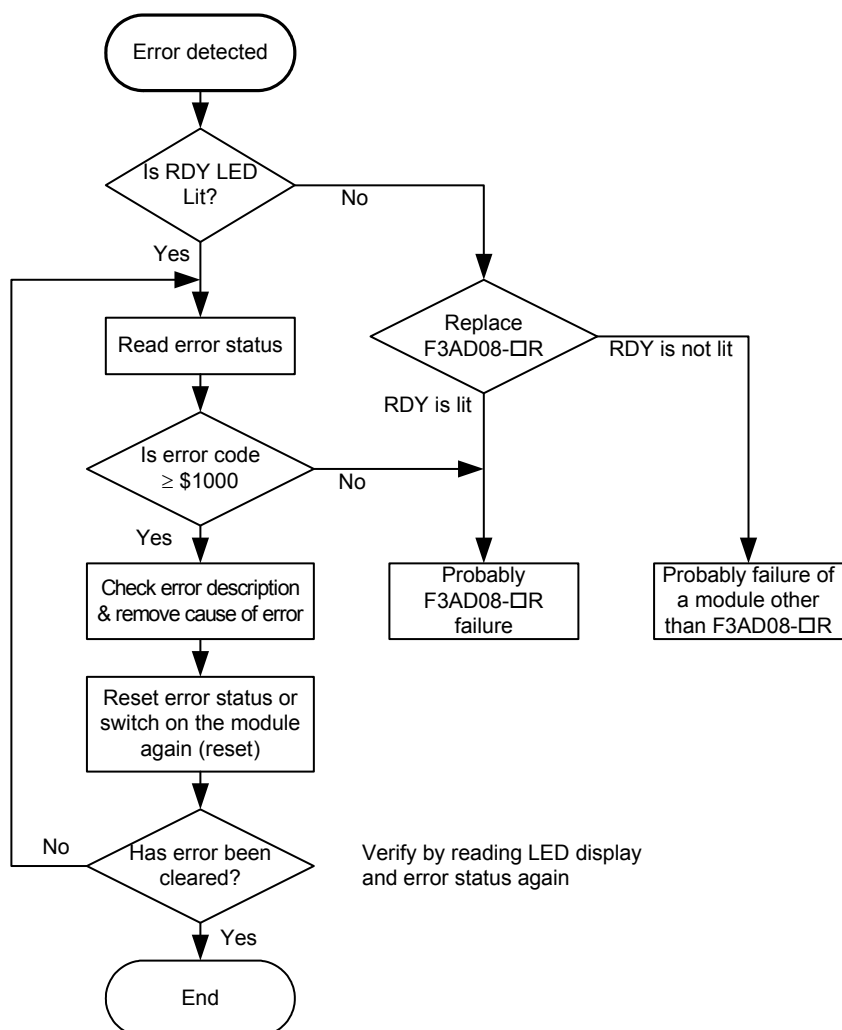


Figure A4.1 Flowchart for Checking Error Status

A5 Attaching and Detaching Modules

■ Attaching/Detaching Modules

Figure A5.1 shows how to attach this module to the base module. First hook the anchor slot at the bottom of the module to be attached onto the anchor pin on the bottom of the base module. Push the top of this module towards the base module until the anchor/release button clicks into place.



CAUTION

Always switch off the power before attaching or detaching a module.

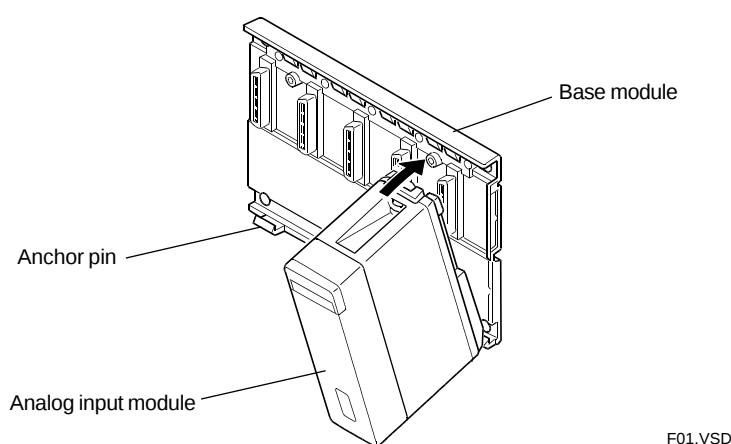


Figure A5.1 Attaching Modules



CAUTION

DO NOT bend the connector on the rear of the module by force during the above operation. If the module is pushed with improper force, the connector may bend causing an error.

■ Detaching Modules

To remove this module from the base module, reverse the above operation. Press the anchor/release button on the top of this module to unlock it and tilt the module away from the base module. Then lift the module off the anchor pin at the base.

■ Attaching Modules in Intense Vibration Environments

If the module is used in intense vibration environments, fasten the module with a screw. Use screws of type listed in the table below. Insert these screws into the screw holes on top of the module and tighten them with a Phillips screwdriver.

Screw Required
M4-size Binder screw 12 to 15 mm long (or 14 to 15 mm if fitted with a washer)

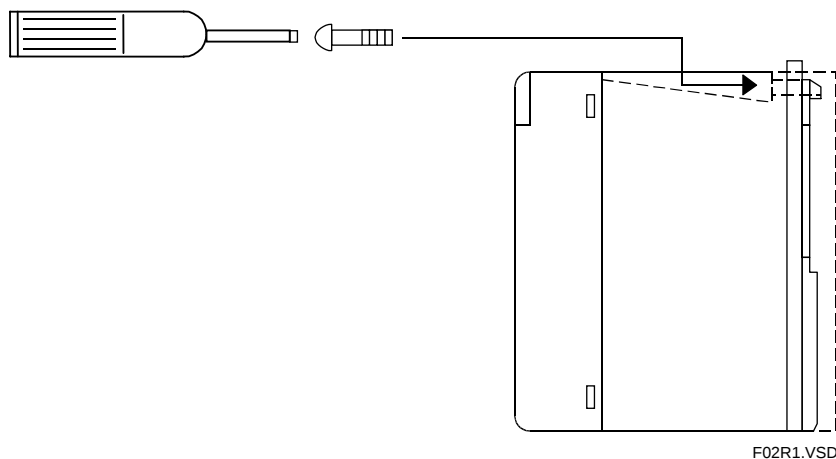


Figure A5.2 Tightening the Module

A6. Data Access Using Special Module Instructions in Ladder

A6.1 Reading Data (READ/HRD)

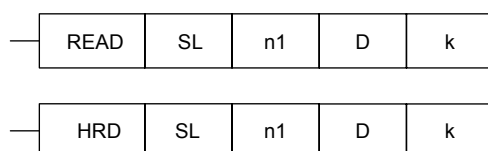
To read data from the analog input module, use the Special Module Read instruction or Special Module High Speed Read instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

● Description of Instructions

Table A6.1 Special Module Read Instruction and Special Module High Speed Read Instruction

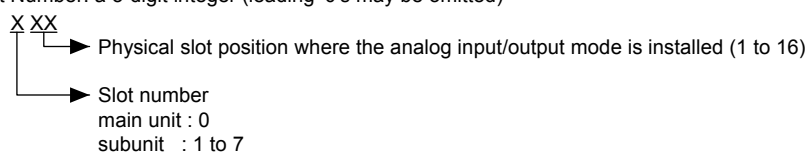
Function No.	Instruction	Mnemonic	Symbol	Is Input condition Required?		Condition for Execution	Step count	Processing unit	Carry
				Yes	No				
81	Special module read	READ		●	—		5	16 bits	—
81P		↑READ					6		
83	Special module high speed read	HRD		●	—		5	16 bits	—
83P		↑HRD					6		

● Symbols



SL : Slot Number
 n1 : First Data Position Number for Reading
 D : First Device Number for Writing Read Data
 k : Transfer Data Count

Slot Number: a 3-digit integer (leading '0's may be omitted)



First Data Position Number for Reading : Data position number from which to start reading (see Table A2.2, A2.4, A2.6, A2.8 or A2.10)

First Device Number for Writing Read Data : For available devices, (see "Sequence CPU Modules - Instructions" manual.)

Transfer Data Count : Number of data to read

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Special Module Long Word Read instructions cannot be used to read data from analog input modules. The results of such operations are not guaranteed.

■ Reading Data from the Analog Input Module

- Specify the data position number of the input data in the First Data Position Number for Reading (n1).
- Ensure that the specified data position number of the input data matches the required channel number.

● Sample Program for Reading Analog Data

This program reads data from channels 1 to 4 of the analog input module installed in slot 106 into data registers (D0001 to D0004) when relay X00501 turns on.

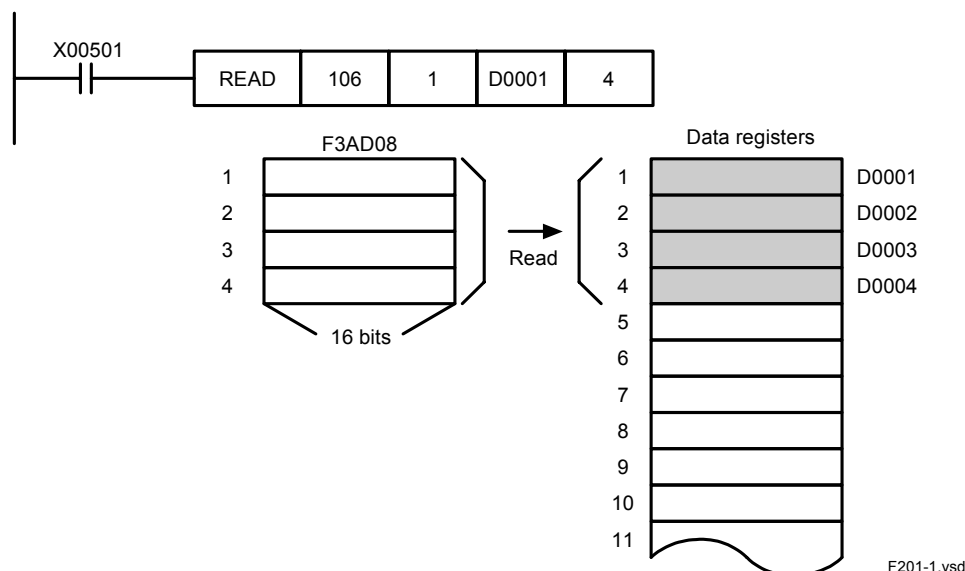


Figure A6.1 Reading Analog Data

■ Reading Operation Mode, Scaling Limits and Other Data

Specify the data position number of the operation mode, operation details data or scaling data in the First Data Position Number for Reading (n1).

● Sample Program for Reading Operation Mode

This program reads operation mode data of for channels 1 to 3 of the analog input module installed in slot 106 into data registers (D0001 to D0003) when relay X00501 turns on.

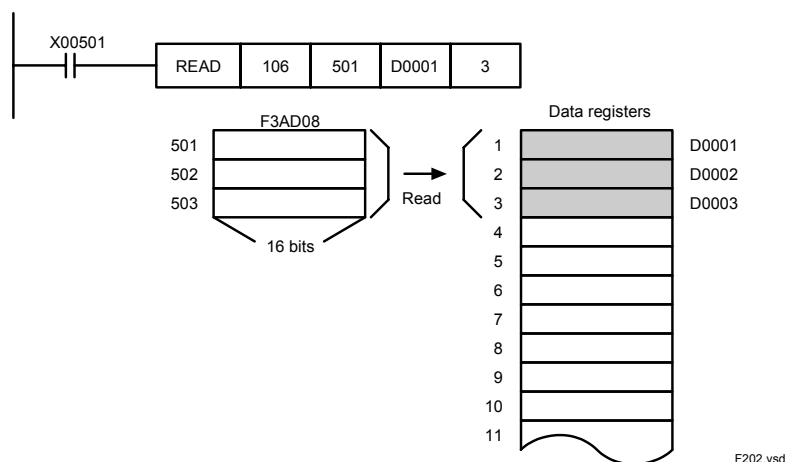


Figure A6.2 Reading Operation Mode

A6.2 Writing Data (WRITE/HWR)

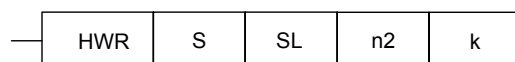
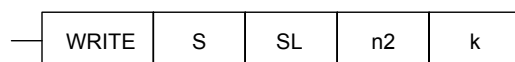
To write data to the analog input module, use the Special Module Write instruction or Special Module High Speed Write instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

● Description of Instructions

Table A6.2 Special Module Write Instruction and Special Module High Speed Write Instruction

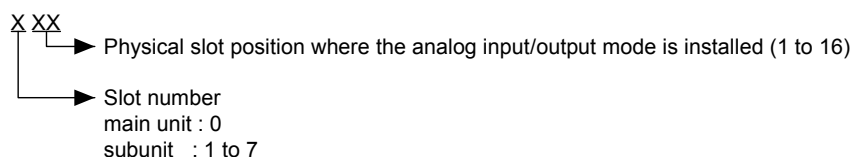
Function No.	Instruction	Mnemonic	Symbol	Is Input condition Required?		Condition for Execution	Step count	Processing unit	Carry
				Yes	No				
82	Special module write	WRITE		●	—		5	16 bit	—
82P		↑ WRITE					6		
84	Special module high speed write	HWR		●	—		5	16 bit	—
84P		↑ HWR					6		

● Symbols



S : First Device Number for Write Data
 SL : Slot Number
 n2 : First Data Position Number for Writing
 k : Transfer Data Count

First Device Number for Write Data : For evaluable devices, see "Sequence CPU Modules - Instructions" manual.
 Slot Number : a 3-digit integer (leading '0's may be omitted)



First Data Position Number for Writing : Data position number from which to start writing
 (see Table A2.2, A2.4, A2.6, A2.8 or A2.10)

Transfer Data Count : Number of write data

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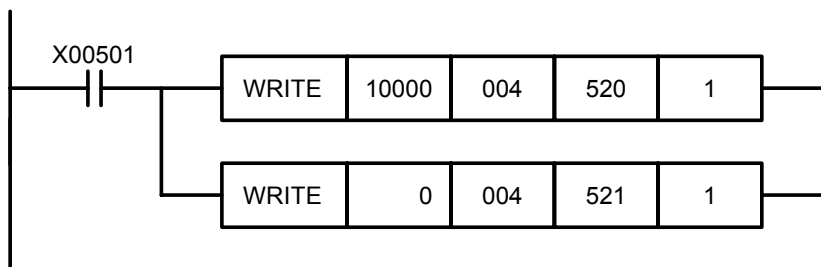
Special Module Long Word Write instructions cannot be used to write data to analog input modules. The results of such operations are not guaranteed.

■ Writing Operation Mode, Scaling Limits and Other Data

Specify the data position number of the operation mode, operation details data or scaling data in the First Data Position Number for Writing (n2).

● Sample Program for Setting Scaling Limits

This program sets the lower limit and upper limit for scaling for channel 1 of the analog input module installed in slot 004 to 0 and 1000 respectively when X00501 turns on.



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Figure A6.3 Setting Scaling Limits

A7. Data Access Using BASIC Statements

A7.1 List of BASIC Statements

Table A7.1 lists the BASIC statements that can be used in the analog input module. Module operation is not guaranteed when statements not listed in Table A7.1 are used.

Table A7.1 Usable BASIC Statements

Function	Syntax	Description
Declare use of module	Example: ASSIGN AD08=SL SL : Slot number	Defines the mapping between modules and slot numbers. Always execute this statement before accessing an analog input module. Execute this statement in the main program.
Read data from analog input module	ENTER SL, n NOFORMAT; I or ENTER SL NOFORMAT; I(*) SL: Slot number n : Data position number (channel number) I : Name of variable for storing read data	Reads analog data of channel n of the analog input module installed in slot SL and stores it in input variable I. If the channel number is omitted, reads analog data sequentially starting from channel 1 into input array variable I(*).
Read operation mode, scaling limits, etc.	STATUS SL, n; P or STATUS SL; P(*) SL : Slot number n : Data position number P : Name of variable for storing read data	Reads operation mode, scaling limit or other data at data position number n of the analog input module installed in slot SL and stores it in input variable P.
Set operation mode, scaling limits, etc.	CONTROL SL, n; P or CONTROL SL; P(*) SL : Slot number n : Data position number P : Preset data	Sets operation mode, scaling limit or other data at data position number n of the analog input module installed in slot number SL using preset data P.

A7.2 Declaring Use of Module (ASSIGN)

Always declare module use before accessing an analog input module using an ASSIGN statement. The ASSIGN statement defines the module name and slot number. Use the ASSIGN statement in the main program.

```
ASSIGN AD08 = SL
```

Module name
AD08: Analog input module

SL: Slot number. Numerical value or numerical variable
A 3-digit integer (leading '0's may be omitted)

X XX

Physical slot position where the module is installed (1 to 16)

Unit number
Main unit : 0
Subunit : 1 to 7

A7.3 Reading Data from the Analog Input Module (ENTER)

Use the ENTER statement to read data from the analog input module. The data read is stored in the specified input variable or input variable array. If the channel number is omitted, the statement reads data, starting from channel number 1. The number of channels read is determined by the number of input variables.

```
ENTER SL, n NOFORMAT ; I
```

Channel number. Numerical value or numerical variable
n: 1 to 8 (for F3AD08)

Slot number. Numerical value or numerical variable

Input variable. Numerical variable (integer-type)

```
ENTER SL NOFORMAT ; I1, I2, . . . I□
```

I1 to I□: List of variables for storing input data (integer-type numerical variable)
(Number of variables should not exceed number of channels in use)
□: 1 to 8
Other parameters are the same as above.

```
ENTER SL NOFORMAT ; I (*)
```

I (*): Integer-type array variable for storing input data
Other parameters are the same as above.

Only integer variables can be used for input variables or variables for storing input data. Long integer variables cannot be used. Operation is not guaranteed if a long integer variable is used as an input variable or a variable for storing input data.

A7.4 Reading Operation Mode, Scaling Limits and Other Data (STATUS)

Use the STATUS statement to read the operation mode and scaling limits of an analog input module. This statement reads the operation mode or other data in the specified data position number and stores it in an input variable or input variable array.

STATUS SL, n ; P

- Input variable. Numerical variable
- Data position number (See Table A3.2 or A3.3)
- Numerical value or numerical variable
- Slot number. Numerical value or numerical variable

A7.5 Writing Operation Mode, Scaling Limits and Other Data (CONTROL)

Use the CONTROL statement to read the operation mode, scaling, filter or other preset values of an analog input module.

CONTROL SL, n ; P

- Preset data. Numerical value or numerical variable
- Data position number (See Table A3.2 or A3.3)
- Numerical value or numerical variable
- Slot number. Numerical value or numerical variable

A8 Sample Programs

This sample program sets the following operation modes for each channel of the analog input module (F3AD08-6R) installed in slot 004, and then reads input data.

Table 4.1 Operation Mode for Analog Input Module

	Conversion period	Drift compensation
All channels	250 μ s	Yes

	Input Signal Range	Scaling	Filter Setting	Offset
Channel 1	4 to 20 mADC	0 to 10000	First-order lag filter with time constant =1000 ms	No
Channel 2	0 to 5 VDC	—	Number of data points used for moving average computation	No
Channel 3	-10 to 10 VDC	—	Not used	No
Channels 4 to 8	Not used (skipped)			

Set the DIP switches as shown in the table below to match the above setup.

Table A8.2 DIP Switch Settings of Analog Input Module

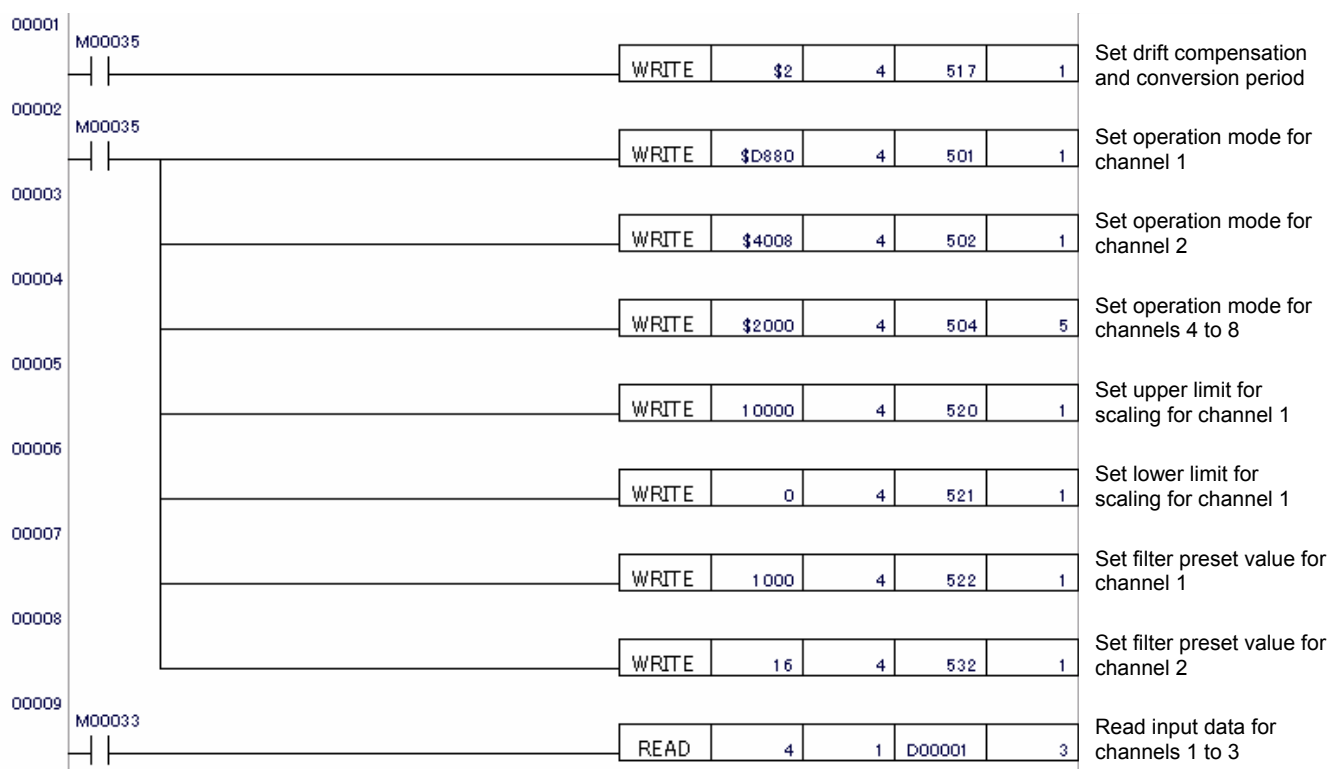
	DIP Switch Setting
Channel 1	ON
Channel 2	OFF
Channel 3	OFF
Channels 4 to 8	Any

The operation mode is given below in binary (16-bit) and hexadecimal notation.

Channel 1	<table><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table> \$ D 8 8 0	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0
1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0		
Channel 2	<table><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table> \$ 4 0 0 0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Channel 3	Using default values so no setup is required.																
Channel 4	<table><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table> \$ 2 0 0 0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		

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• Ladder Sample Program



- **BASIC Sample Program**

```
10 ! F3AD08 program
20 !
30 DEFINT A-Z
40 OPTION BASE 1
50 DIM ENTBUFF(3)
60 SL=4
70 ASSIGN AD08=SL           Declare module use
80 CONTROL SL,17;$0003      Set drift compensation and conversion period
90 CONTROL SL,1;$D880       Set operation mode for channel 1
100 CONTROL SL,2;$4008      Set operation mode for channel 2
110 CONTROL SL,4;$2000      Set operation mode for channel 4
120 CONTROL SL,20;10000     Set upper limit for scaling for channel 1
130 CONTROL SL,21;0         Set lower limit for scaling for channel 1
140 CONTROL SL,22;1000      Set filter preset value for channel 1
150 CONTROL SL,32;16        Set filter preset value for channel 2
:
:
300 ENTER SL NOFORMAT;ENTBUFF(*) Read input data for channels 1-3
310 DISP ENTBUFF(*)
```


A9. Q&A

This chapter lists some frequently-asked questions with their answers.

A9.1 Troubleshooting

Q: What should I do when the ALM LED turns on? Can I leave it alone?

A : A module error has occurred. The accuracy of the module may no longer meet specifications. Read Section A4.4 for more details on how to check the detailed error status. Contact the dealer and have the module repaired or replaced.

Q: What should I do when the ALM LED blinks? Can I leave it alone?

A : This may be caused by an input signal that is too large or an invalid parameter. Check the error status for the cause of the error, and remove it accordingly.

Q: The A/D conversion results cannot be read.

A: Check the following:

(1) Is the RDY LED lit?

Yes → A1

No → (2)

(2) Is the RDY LED lit when the module is inserted in a different slot?

Yes → A2

No → A3



CAUTION

Always switch off the power before inserting or removing the module. Otherwise, the module may be damaged.

A1: Check the read address and the operation mode of each channel. If no error is found, there is probably a hardware failure. Contact your dealer.

A2: There is probably a base module failure. Contact your dealer.

A3: There is probably a module failure. Contact your dealer.

Q: The accuracy of converted values does not meet specifications.

A: Check the following items:

- (1) If using F3AD08-6R, check whether the input signal type (voltage input or current input) settings of the mode registers (501 to 508) are consistent with the settings of the DIP switches located on the side of the module.

Yes → (2)

No → A1

- (2) Is drift compensation enabled?

Yes → A2

No → A3

A1: Make the mode register settings and the DIP switch settings consistent with each other.

A2: - The values may be changed because scaling or offset is enabled.

- The converted values may be lagging behind input signal changes because a filter with a long time constant is specified.
- The input signal may be subjected to interference from other signals or noise.
- There may be a module failure.

A3: Enable drift compensation if possible.

A9.2 Usage Tips

Q: How do I read a 4 to 20 mA signal?

A : Use a F3AD08-4R or F3AD08-6R analog input module. To read current signals using an F3AD08-5R analog input module, you need to perform the following setup. Secure a 250 Ω resistor between the positive and negative terminals of each channel to convert its current signal into voltage signal (0-5V). Select the resistor carefully because its accuracy and stability will affect the conversion result of the F3AD08 module. Accuracy of the resistance value is not important if scaling is used and system calibration is performed.

Q: Can I sample all channels simultaneously on models F3AD08-□R?

A: No. Channels are sampled sequentially according to the specified conversion period.

Appendix A. Filter Parameter and Actual Time Constant

When first-order lag filter is enabled, the actual time constant value during operation is determined by the specified time constant value, conversion period and number of channels in use (unskipped channels) as shown in the table below, where:

- 'Setting' refers to the specified filter time constant value.
- 'T' denotes the actual time constant value during operation.

Conversion period = 100 μ s		n=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8 ch. used	Setting	0 to 1	≤ 3	≤ 6	≤ 12	≤ 25	≤ 51	≤ 102	≤ 204	≤ 409	≤ 819	≤ 1638	≤ 3276	≤ 6553	≤ 13107	≤ 30000
	T (ms)	1.0	3.0	6.0	12.0	25.0	51.0	102.0	204.0	409.0	819.0	1638.0	3276.0	6553.0	13107.0	26214.0
7 ch. used	Setting	0 to 1	≤ 2	≤ 5	≤ 11	≤ 22	≤ 44	≤ 89	≤ 179	≤ 358	≤ 716	≤ 1433	≤ 2867	≤ 5734	≤ 11468	≤ 30000
	T (ms)	1.0	2.0	5.0	11.0	22.0	44.0	89.0	179.0	358.0	716.0	1433.0	2867.0	5734.0	11468.0	22937.0
6 ch. used	Setting	0 to 1	≤ 2	≤ 4	≤ 9	≤ 19	≤ 38	≤ 76	≤ 153	≤ 307	≤ 614	≤ 1228	≤ 2457	≤ 4915	≤ 9830	≤ 30000
	T (ms)	1.0	2.0	4.0	9.0	19.0	38.0	76.0	153.0	307.0	614.0	1228.0	2457.0	4915.0	9830.0	19660.0
5 ch. used	Setting		0 to 1	≤ 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 30000
	T (ms)		1.0	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0
4 ch. used	Setting		0 to 1	≤ 3	≤ 6	≤ 12	≤ 25	≤ 51	≤ 102	≤ 204	≤ 409	≤ 819	≤ 1638	≤ 3276	≤ 6553	≤ 30000
	T (ms)		1.0	3.0	6.0	12.0	25.0	51.0	102.0	204.0	409.0	819.0	1638.0	3276.0	6553.0	13107.0
3 ch. used	Setting		0 to 1	≤ 2	≤ 4	≤ 9	≤ 19	≤ 38	≤ 76	≤ 153	≤ 307	≤ 614	≤ 1228	≤ 2457	≤ 4915	≤ 30000
	T (ms)		1.0	2.0	4.0	9.0	19.0	38.0	76.0	153.0	307.0	614.0	1228.0	2457.0	4915.0	9830.0
2 ch. used	Setting			0 to 1	≤ 3	≤ 6	≤ 12	≤ 25	≤ 51	≤ 102	≤ 204	≤ 409	≤ 819	≤ 1638	≤ 3276	≤ 30000
	T (ms)			1.0	3.0	6.0	12.0	25.0	51.0	102.0	204.0	409.0	819.0	1638.0	3276.0	6553.0
1 ch. used	Setting				0 to 1	≤ 3	≤ 6	≤ 12	≤ 25	≤ 51	≤ 102	≤ 204	≤ 409	≤ 819	≤ 1638	≤ 30000
	T (ms)				1.0	3.0	6.0	12.0	25.0	51.0	102.0	204.0	409.0	819.0	1638.0	3276.0

Unit (ms)

Conversion period = 250 μ s		n=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8 ch. used	Setting	0 to 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000	
	T (ms)	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0	
7 ch. used	Setting	0 to 3	≤ 6	≤ 13	≤ 27	≤ 55	≤ 111	≤ 223	≤ 447	≤ 895	≤ 1791	≤ 3583	≤ 7167	≤ 14335	≤ 28671	≤ 30000
	T (ms)	3.0	6.0	13.0	27.0	55.0	111.0	223.0	447.0	895.0	1791.0	3583.0	7167.0	14335.0	28671.0	57343.0
6 ch. used	Setting	0 to 2	≤ 5	≤ 11	≤ 23	≤ 47	≤ 95	≤ 191	≤ 383	≤ 767	≤ 1535	≤ 3071	≤ 6143	≤ 12287	≤ 24575	≤ 30000
	T (ms)	2.0	5.0	11.0	23.0	47.0	95.0	191.0	383.0	767.0	1535.0	3071.0	6143.0	12287.0	24575.0	49151.0
5 ch. used	Setting	0 to 2	≤ 4	≤ 9	≤ 19	≤ 39	≤ 79	≤ 159	≤ 319	≤ 639	≤ 1279	≤ 2559	≤ 5119	≤ 10239	≤ 20479	≤ 30000
	T (ms)	2.0	4.0	9.0	19.0	39.0	79.0	159.0	319.0	639.0	1279.0	2559.0	5119.0	10239.0	20479.0	40959.0
4 ch. used	Setting	0 to 1	≤ 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000
	T (ms)	1.0	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0
3 ch. used	Setting	0 to 1	≤ 2	≤ 5	≤ 11	≤ 23	≤ 47	≤ 95	≤ 191	≤ 383	≤ 767	≤ 1535	≤ 3071	≤ 6143	≤ 12287	≤ 30000
	T (ms)	1.0	2.0	5.0	11.0	23.0	47.0	95.0	191.0	383.0	767.0	1535.0	3071.0	6143.0	12287.0	24575.0
2 ch. used	Setting		0 to 1	≤ 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 30000
	T (ms)		1.0	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0
1 ch. used	Setting			0 to 1	≤ 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 30000
	T (ms)			1.0	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0

Unit (ms)

Appx. A-2

Conversion period = 500 μ s		n=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8 ch. used	Setting	0 to 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000		
	T (ms)	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0		
7 ch. used	Setting	0 to 6	≤ 13	≤ 27	≤ 55	≤ 111	≤ 223	≤ 447	≤ 895	≤ 1791	≤ 3583	≤ 7167	≤ 14335	≤ 28671	≤ 30000	
	T (ms)	6.0	13.0	27.0	55.0	111.0	223.0	447.0	895.0	1791.0	3583.0	7167.0	14335.0	28671.0	57343.0	
6 ch. used	Setting	0 to 5	≤ 11	≤ 23	≤ 47	≤ 95	≤ 191	≤ 383	≤ 767	≤ 1535	≤ 3071	≤ 6143	≤ 12287	≤ 24575	≤ 30000	
	T (ms)	5.0	11.0	23.0	47.0	95.0	191.0	383.0	767.0	1535.0	3071.0	6143.0	12287.0	24575.0	49151.0	
5 ch. used	Setting	0 to 4	≤ 9	≤ 19	≤ 39	≤ 79	≤ 159	≤ 319	≤ 639	≤ 1279	≤ 2559	≤ 5119	≤ 10239	≤ 20479	≤ 30000	
	T (ms)	4.0	9.0	19.0	39.0	79.0	159.0	319.0	639.0	1279.0	2559.0	5119.0	10239.0	20479.0	40959.0	
4 ch. used	Setting	0 to 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000	
	T (ms)	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0	
3 ch. used	Setting	0 to 2	≤ 5	≤ 11	≤ 23	≤ 47	≤ 95	≤ 191	≤ 383	≤ 767	≤ 1535	≤ 3071	≤ 6143	≤ 12287	≤ 24575	≤ 30000
	T (ms)	2.0	5.0	11.0	23.0	47.0	95.0	191.0	383.0	767.0	1535.0	3071.0	6143.0	12287.0	24575.0	49151.0
2 ch. used	Setting	0 to 1	≤ 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000
	T (ms)	1.0	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0
1 ch. used	Setting		0 to 1	≤ 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 30000
	T (ms)		1.0	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0

Unit (ms)

Conversion period = 1 ms		n=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8 ch. used	Setting	0 to 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000			
	T (ms)	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0			
7 ch. used	Setting	0 to 13	≤ 27	≤ 55	≤ 111	≤ 223	≤ 447	≤ 895	≤ 1791	≤ 3583	≤ 7167	≤ 14335	≤ 28671	≤ 30000		
	T (ms)	13.0	27.0	55.0	111.0	223.0	447.0	895.0	1791.0	3583.0	7167.0	14335.0	28671.0	57343.0		
6 ch. used	Setting	0 to 11	≤ 23	≤ 47	≤ 95	≤ 191	≤ 383	≤ 767	≤ 1535	≤ 3071	≤ 6143	≤ 12287	≤ 24575	≤ 30000		
	T (ms)	11.0	23.0	47.0	95.0	191.0	383.0	767.0	1535.0	3071.0	6143.0	12287.0	24575.0	49151.0		
5 ch. used	Setting	0 to 9	≤ 19	≤ 39	≤ 79	≤ 159	≤ 319	≤ 639	≤ 1279	≤ 2559	≤ 5119	≤ 10239	≤ 20479	≤ 30000		
	T (ms)	9.0	19.0	39.0	79.0	159.0	319.0	639.0	1279.0	2559.0	5119.0	10239.0	20479.0	40959.0		
4 ch. used	Setting	0 to 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000		
	T (ms)	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0		
3 ch. used	Setting	0 to 5	≤ 11	≤ 23	≤ 47	≤ 95	≤ 191	≤ 383	≤ 767	≤ 1535	≤ 3071	≤ 6143	≤ 12287	≤ 24575	≤ 30000	
	T (ms)	5.0	11.0	23.0	47.0	95.0	191.0	383.0	767.0	1535.0	3071.0	6143.0	12287.0	24575.0	49151.0	
2 ch. used	Setting	0 to 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000	
	T (ms)	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0	
1 ch. used	Setting	0 to 1	≤ 3	≤ 7	≤ 15	≤ 31	≤ 63	≤ 127	≤ 255	≤ 511	≤ 1023	≤ 2047	≤ 4095	≤ 8191	≤ 16383	≤ 30000
	T (ms)	1.0	3.0	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0	16383.0	32767.0

Unit
(ms)

Conversion period
= 16.6 ms

		n=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8 ch. used	Setting	0 to 266	≤533	≤1066	≤2133	≤4266	≤8533	≤17066	≤30000							
	T (ms)	266.0	533.0	1066.0	2133.0	4266.0	8533.0	17066.0	34133.0							
7 ch. used	Setting	0 to 233	≤466	≤933	≤1866	≤3733	≤7466	≤14933	≤29866	≤30000						
	T (ms)	233.0	466.0	933.0	1866.0	3733.0	7466.0	14933.0	29866.0	59733.0						
6 ch. used	Setting	0 to 199	≤399	≤799	≤1599	≤3199	≤6399	≤12799	≤25599	≤30000						
	T (ms)	199.0	399.0	799.0	1599.0	3199.0	6399.0	12799.0	25599.0	51199.0						
5 ch. used	Setting	0 to 166	≤333	≤666	≤1333	≤2666	≤5333	≤10666	≤21333	≤30000						
	T (ms)	166.0	333.0	666.0	1333.0	2666.0	5333.0	10666.0	21333.0	42666.0						
4 ch. used	Setting	0 to 133	≤266	≤533	≤1066	≤2133	≤4266	≤8533	≤17066	≤30000						
	T (ms)	133.0	266.0	533.0	1066.0	2133.0	4266.0	8533.0	17066.0	34133.0						
3 ch. used	Setting	0 to 99	≤199	≤399	≤799	≤1599	≤3199	≤6399	≤12799	≤25599	≤30000					
	T (ms)	99.0	199.0	399.0	799.0	1599.0	3199.0	6399.0	12799.0	25599.0	51199.0					
2 ch. used	Setting	0 to 66	≤133	≤266	≤533	≤1066	≤2133	≤4266	≤8533	≤17066	≤30000					
	T (ms)	66.0	133.0	266.0	533.0	1066.0	2133.0	4266.0	8533.0	17066.0	34133.0					
1 ch. used	Setting	0 to 33	≤66	≤133	≤266	≤533	≤1066	≤2133	≤4266	≤8533	≤17066	≤30000				
	T (ms)	33.0	66.0	133.0	266.0	533.0	1066.0	2133.0	4266.0	8533.0	17066.0	34133.0				

Unit
(ms)

Conversion
period = 20 ms

		n=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8 ch. used	Setting	0 to 319	≤639	≤1279	≤2559	≤5119	≤10239	≤20479	≤30000							
	T (ms)	319.0	639.0	1279.0	2559.0	5119.0	10239.0	20479.0	40959.0							
7 ch. used	Setting	0 to 279	≤559	≤1119	≤2239	≤4479	≤8959	≤17919	≤30000							
	T (ms)	279.0	559.0	1119.0	2239.0	4479.0	8959.0	17919.0	35839.0							
6 ch. used	Setting	0 to 239	≤479	≤959	≤1919	≤3839	≤7679	≤15359	≤30000							
	T (ms)	239.0	479.0	959.0	1919.0	3839.0	7679.0	15359.0	30719.0							
5 ch. used	Setting	0 to 199	≤399	≤799	≤1599	≤3199	≤6399	≤12799	≤25599	≤30000						
	T (ms)	199.0	399.0	799.0	1599.0	3199.0	6399.0	12799.0	25599.0	51199.0						
4 ch. used	Setting	0 to 159	≤319	≤639	≤1279	≤2559	≤5119	≤10239	≤20479	≤30000						
	T (ms)	159.0	319.0	639.0	1279.0	2559.0	5119.0	10239.0	20479.0	40959.0						
3 ch. used	Setting	0 to 119	≤239	≤479	≤959	≤1919	≤3839	≤7679	≤15359	≤30000						
	T (ms)	119.0	239.0	479.0	959.0	1919.0	3839.0	7679.0	15359.0	30719.0						
2 ch. used	Setting	0 to 79	≤159	≤319	≤639	≤1279	≤2559	≤5119	≤10239	≤20479	≤30000					
	T (ms)	79.0	159.0	319.0	639.0	1279.0	2559.0	5119.0	10239.0	20479.0	40959.0					
1 ch. used	Setting	0 to 39	≤79	≤159	≤319	≤639	≤1279	≤2559	≤5119	≤10239	≤20479	≤30000				
	T (ms)	39.0	79.0	159.0	319.0	639.0	1279.0	2559.0	5119.0	10239.0	20479.0	40959.0				

Unit
(ms)

Conversion period
= 100 ms

		n=1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8 ch. used	Setting	0 to 1599	≤3199	≤6399	≤12799	≤25599	≤30000									
	T (ms)	1599.0	3199.0	6399.0	12799.0	25599.0	51199.0									
7 ch. used	Setting	0 to 1399	≤2799	≤5599	≤11199	≤22399	≤30000									
	T (ms)	1399.0	2799.0	5599.0	11199.0	22399.0	44799.0									
6 ch. used	Setting	0 to 1199	≤2399	≤4799	≤9599	≤19199	≤30000									
	T (ms)	1199.0	2399.0	4799.0	9599.0	19199.0	38399.0									
5 ch. used	Setting	0 to 999	≤1999	≤3999	≤7999	≤15999	≤30000									
	T (ms)	999.0	1999.0	3999.0	7999.0	15999.0	31999.0									
4 ch. used	Setting	0 to 799	≤1599	≤3199	≤6399	≤12799	≤25599	≤30000								
	T (ms)	799.0	1599.0	3199.0	6399.0	12799.0	25599.0	51199.0								
3 ch. used	Setting	0 to 599	≤1199	≤2399	≤4799	≤9599	≤19199	≤30000								
	T (ms)	599.0	1199.0	2399.0	4799.0	9599.0	19199.0	38399.0								
2 ch. used	Setting	0 to 399	≤799	≤1599	≤3199	≤6399	≤12799	≤25599	≤30000							
	T (ms)	399.0	799.0	1599.0	3199.0	6399.0	12799.0	25599.0	51199.0							
1 ch. used	Setting	0 to 199	≤399	≤799	≤1599	≤3199	≤6399	≤12799	≤25599	≤30000						
	T (ms)	199.0	399.0	799.0	1599.0	3199.0	6399.0	12799.0	25599.0	51199.0						

Unit
(ms)

The actual time constant value is determined by the following equation:

$$T = - \frac{T_0}{\ln \frac{2^n - 1}{2^n}}$$

T : Time constant (ms)

T₀ : Conversion speed (ms)

= Conversion period × No. of channels in use

n : 1 to 15

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FA-M3**Analog Input/Output Module Instruction Manual****PART-A F3AD08-4R,-5R,-6R**

IM 34M6H11-02E 3rd Edition

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FA-M3**Analog Input Module****Part B**

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B1. Analog Input Module

This chapter describes the specifications and operating modes of the analog input modules F3AD04-0V, F3AD04-0R, F3AD08-1V, F3AD08-4V and F3AD08-1R.

Models F3AD04-0V and F3AD04-0R are 4-channel analog-to-digital conversion input modules. The main features of these models are:

- The input signal range is selectable from any of the following ranges: 0 to 5V, 1 to 5V or -10 to 10V DC.
- A single module can accommodate four input points.
- High conversion speed of 1 ms per point
- Easy-to-use functions such as scaling and filtering.
- Model F3AD04-0R is equipped with 16-bit A/D converters that enable high-resolution analog to digital conversion.

Models F3AD08-1V and F3AD08-1R are 8-channel analog-to-digital conversion input modules. The main features of these models are:

- The input signal range is selectable from any of the following ranges: 0 to 5V, 1 to 5V or -10 to 10V DC.
- A single module can accommodate eight input points.
- High conversion speed of 1 ms per point
- Easy-to-use functions such as scaling and filtering.
- Model F3AD08-1R is equipped with 16-bit A/D converters that enable high-resolution analog to digital conversion.

Model F3AD08-4V is an 8-channel analog-to-digital conversion input module. The main features of this model are:

- The input signal range is selectable from any of the following ranges: 0 to 20mA DC or 4 to 20 mA DC
- A single module can accommodate eight input points.
- High conversion speed of 1 ms per point
- Easy-to-use functions such as scaling and filtering.

Special module instructions in ladder, as well as BASIC statements are provided for implementing analog input-output using F3AD04-0V, F3AD04-0R, F3AD08-1V, F3AD08-4V and F3AD08-1R modules.

B1.1 Specifications for F3AD04-0V and F3AD04-0R

■ Functional Specifications

Table B1.1 Functional Specifications

Item	Specifications for F3AD04-0V	Specifications for F3AD04-0R
Number of inputs	4	4
Absolute maximum rated voltage	18 V DC maximum -18 V DC minimum	18 V DC maximum -18 V DC minimum
Input signal range ^{*1} (Over range)	0 to 5 VDC (-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 5 VDC (-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)
Isolation method	Across input terminals and internal circuit: Photocoupler isolation Across input terminals: Not isolated, negative line common	Across input terminals and internal circuit: Photocoupler isolation Across input terminals: Not isolated, negative line common
Withstanding voltage	500 V DC for one minute	500 V DC for one minute
Input resistance	1 M Ω	1 M Ω
Resolution	0 to 5 V and 1 to 5 V DC: 1.4 mV -10 to 10 V DC: 5.7 mV (12-bit A/D)	0 to 5 V and 1 to 5 V DC: 0.175 mV -10 to 10 V DC: 0.72 mV (16-bit A/D)
Overall accuracy	23 $\pm$ 2°C: $\pm$ 0.2% (full scale) 0 to 55°C: $\pm$ 0.5% (full scale)	23 $\pm$ 2°C: $\pm$ 0.1% (full scale) 0 to 55°C: $\pm$ 0.3% (full scale)
Conversion speed	1 ms $\times$ (number of inputs)	1 ms $\times$ (number of inputs)
Scaling	Upper and lower limit values of the input signal range can be set to any value between -20,000 and 20,000.	Upper and lower limit values of the input signal range can be set to any value between -20,000 and 20,000.
Filter	Channels are enabled or disabled individually. ^{*2}	Channels are enabled or disabled individually. ^{*2}
Current consumption	210 mA (5 V DC)	210 mA (5 V DC)
External connection	10-point terminal block, M3.5 screws	10-point terminal block, M3.5 screws
External dimensions	28.9 (W) $\times$ 100 (H) $\times$ 83.2 (D) mm ^{*3}	28.9 (W) $\times$ 100 (H) $\times$ 83.2 (D) mm ^{*3}
Weight	170 g	170 g
Ambient operating temperature	0 to 55°C	
Ambient operating humidity	10 to 90% RH (non-condensing)	
Ambient operating atmosphere	Must be free of corrosive gases or heavy dust.	
Ambient storage temperature	-20 to 75°C	
Ambient storage humidity	10 to 90% RH (non-condensing)	

*1: Selectable for each channel using software. The default value is -10 to 10 V DC.

*2: The actual time constant value depends on the number of unskipped channels and other settings.

*3: Dimensions excluding protrusions (for details, see Figure B1.8, "External Dimensions").



CAUTION

Never apply any voltage exceeding the absolute maximum rated voltage, even for a short period of time, or it may cause permanent damage to the internal circuitry, and thus failure to meet specifications.

■ Input/Output Conversion Characteristics

The following table shows the input/output conversion characteristics with no scaling for various input signal ranges. The input/output conversion characteristics show analog input values versus digital output values.

For details on scaling, see Section B1.4.3.

Table B1.2 Input/Output Conversion Characteristics with No Scaling

Input Signal Range	Analog Input Value	Digital Output Value	
-10 to 10 V DC range	-10 to 10 V DC	-20000 to 20000	Default
0 to 5 V DC range	0 to 5 V DC	0 to 10000	
1 to 5 V DC range	1 to 5 V DC	2000 to 10000	

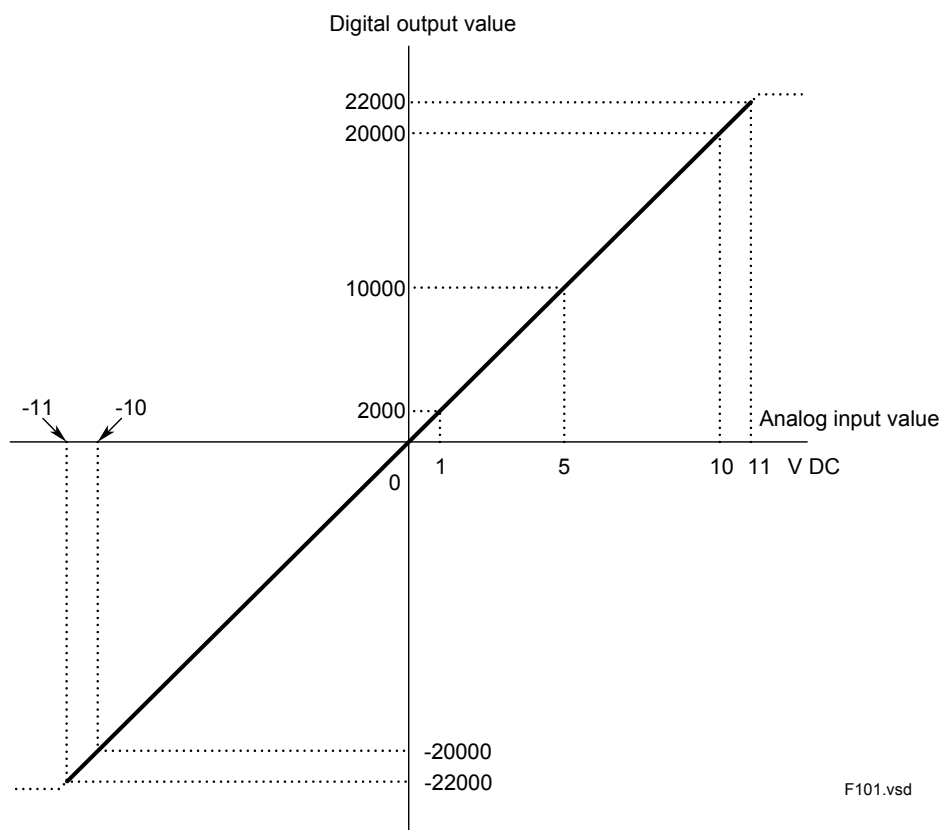


Figure B1.1 Input/Output Conversion Characteristics with No Scaling

■ Components and Functions

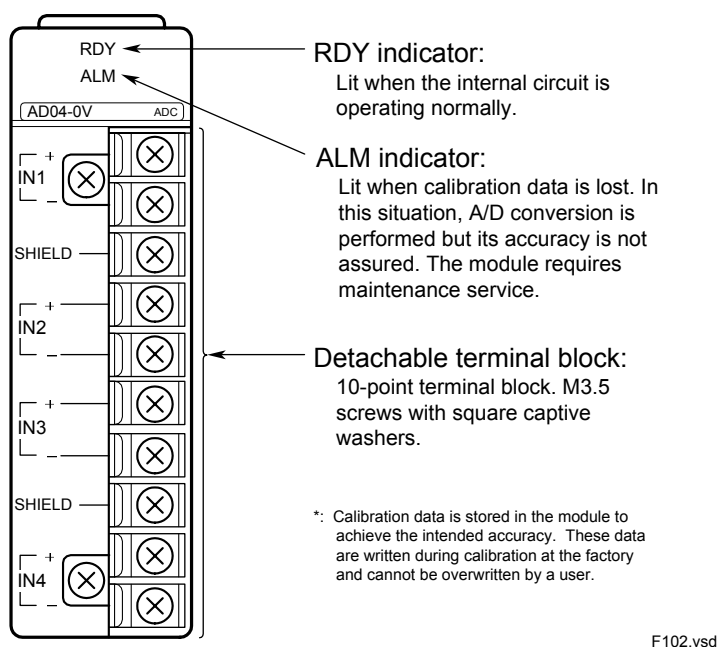


Figure B1.2 Components and Functions

Internal Circuit

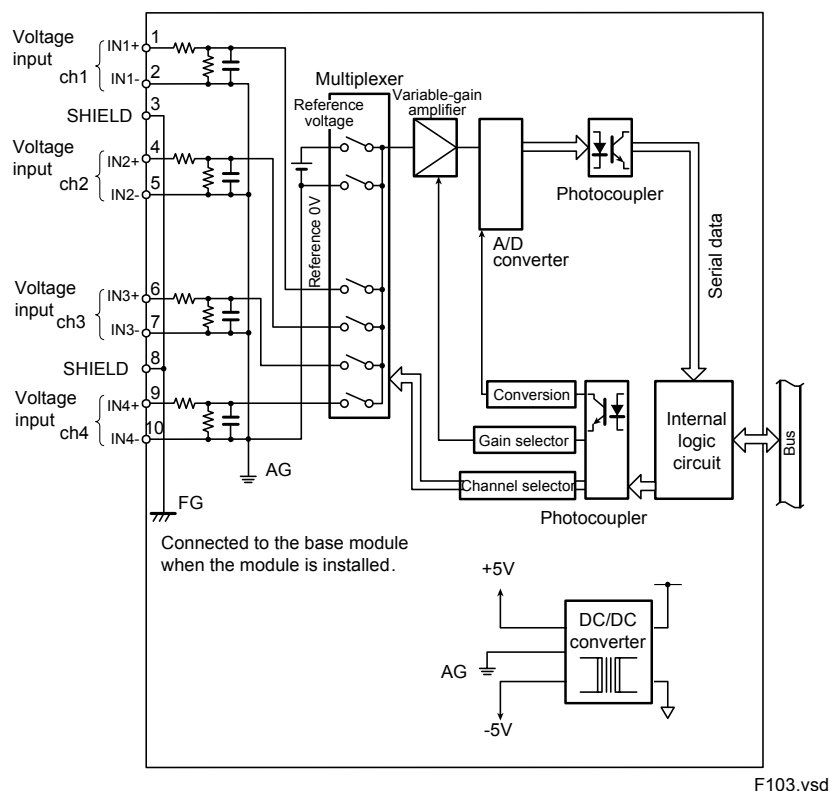
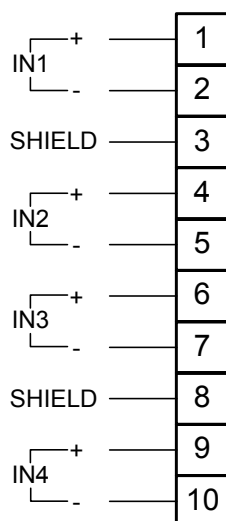


Figure B1.3 Internal Circuit Diagram

External Connections and Wiring Precautions

External Connections



- SHIELD terminal 3 is shared by IN1 and IN2.
- SHIELD terminal 8 is shared by IN3 and IN4.
- SHIELD terminals are connected to the frame ground of the power supply module via the base module.

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Figure B1.4 External Connection Diagram

Table B1.3 Wires and Terminals

Applicable wire size		AWG22-16 (0.3 to 1.25 mm ²)
Wire type		Shielded twisted pair
Wire connections		Crimp-on type
Crimp-on terminals	Crimp-on terminals	For 3.5 mm
	Tightening torque	0.8 N • m (7.1 lbf • in)
	Applicable crimp-on terminals	Examples: Type V1.25-M3 (from Japan Solderless Terminal Mfg. Co., Ltd.) or RAV1.25-3.5 (from Nippon Tanshi Co., Ltd.)

**CAUTION**

Always use an appropriate crimping tool specified by the manufacturer.

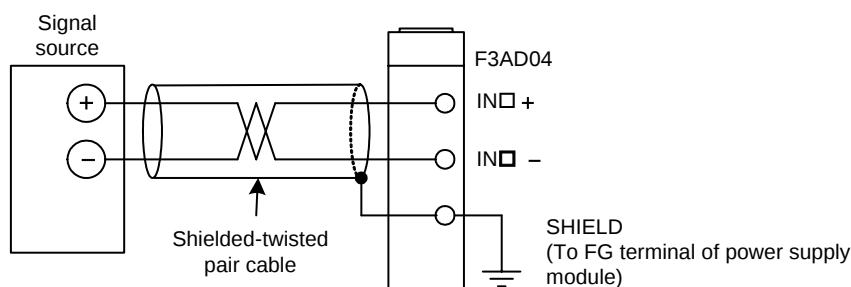
● Wiring Precautions

**CAUTION**

All IN□– terminals in the module are internally connected to the common analog ground, and thus have the same potential.

- As analog signals are susceptible to noise, use shielded twisted-pair wires to connect signal sources to F3AD04-0V or F3AD04-0R modules to suppress noise.
- Ground the shield of the twisted-pair cables to FG. The following are some possible ways to perform grounding:

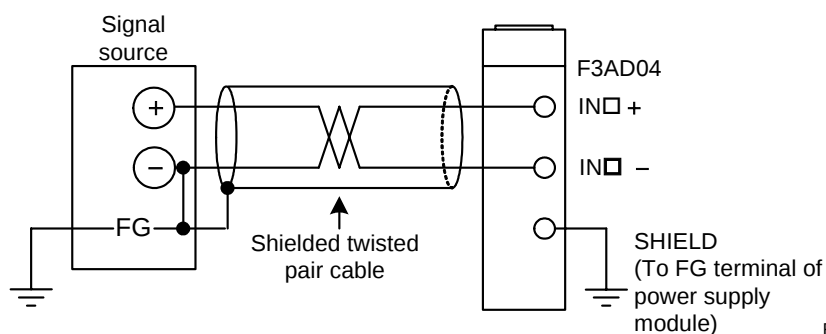
- Connecting the shield to the SHIELD terminal of the F3AD04-0V or F3AD04-0R module
(The SHIELD terminals are connected to the FG terminal of the power supply module via the base module.)



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Figure B1.5 Wiring Example

- Connecting the shield to shielded terminal (FG terminal) provided at the signal source



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Figure B1.6 Wiring Example

- Removing the cable covering to expose the wire and clamp it to the FG terminal using a FG clamp to ground it.

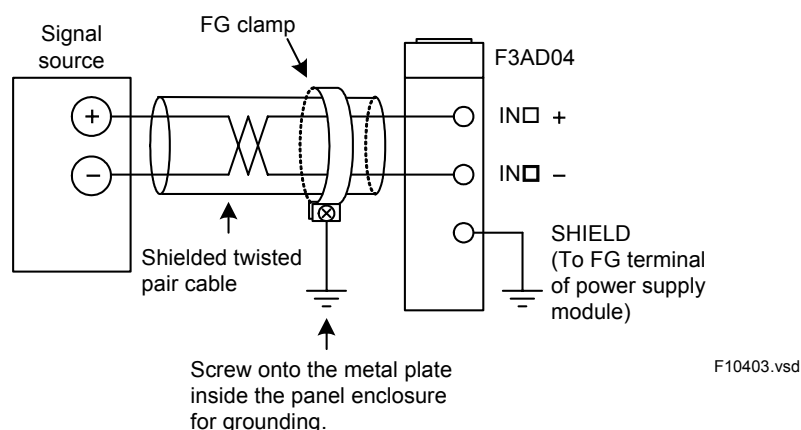


Figure B1.7 Wiring Example

Depending on the stability of the grounding points, it may be better to perform grounding either at the F3AD04 module or at the signal source. Select the more stable grounding point.

3. For compliance with EMC-related specifications, use FG clamps to perform grounding for systems installed with this module.

■ External Dimensions

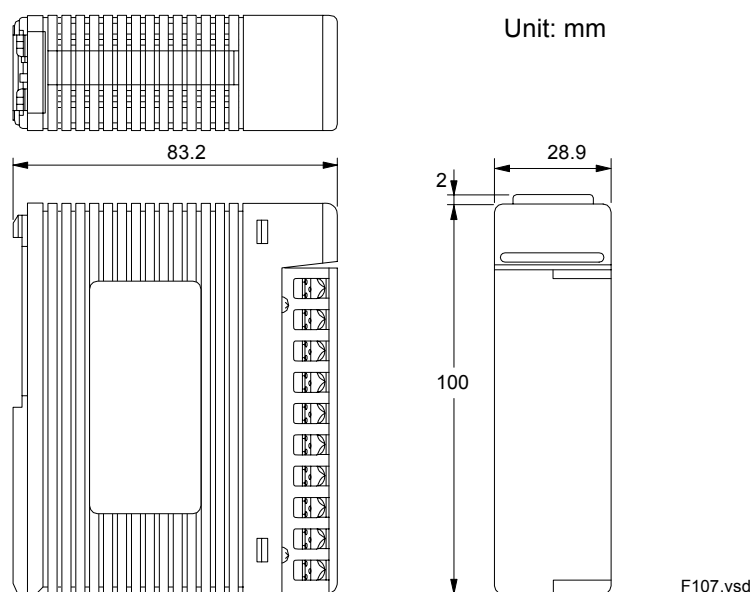


Figure B1.8 External Dimensions Diagram

B1.2 Specifications for F3AD08-1V and F3AD08-1R

■ Functional Specifications

Table B1.4 Functional Specifications

Item	Specifications for F3AD08-1V	Specifications for F3AD08-1R
Number of inputs	8 (differential input)	8 (differential input)
Absolute maximum rated voltage	18 V DC maximum -18 V DC minimum	18 V DC maximum -18 V DC minimum
Input signal range ^{*1} (Over range)	0 to 5 VDC (-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 5 VDC (-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)
Allowable common mode voltage	±6V DC max. (0 to 5V or 1 to 5V DC) ±1V DC max. (-10 to 10V DC)	±6V DC max. (0 to 5V or 1 to 5V DC) ±1V DC max. (-10 to 10V DC)
Isolation method	Across input terminals and internal circuit: Photocoupler isolation Across input terminals: Not isolated.	Across input terminals and internal circuit: Photocoupler isolation Across input terminals: Not isolated
Withstanding voltage	500 V DC for one minute	500 V DC for one minute
Input resistance	1 MΩ min. ^{*2}	1 MΩ min. ^{*2}
Resolution	0 to 5 V and 1 to 5 V DC: 1.4 mV -10 to 10 V DC: 5.7 mV (12-bit A/D)	0 to 5 V and 1 to 5 V DC: 0.175 mV -10 to 10 V DC: 0.72 mV (16-bit A/D)
Overall accuracy	23±2°C: ± 0.2% (full scale) 0 to 55°C: ± 0.5% (full scale)	23±2°C: ± 0.1% (full scale) 0 to 55°C: ± 0.3% (full scale)
Conversion period	1 ms × (number of inputs)	1 ms × (number of inputs)
Scaling	Upper and lower limit values of the input signal range can be set to any value between -20,000 and 20,000.	Upper and lower limit values of the input signal range can be set to any value between -20,000 and 20,000.
Filter	Channels are enabled or disabled independently. ^{*3}	Channels are enabled or disabled independently. ^{*3}
Current consumption	210 mA (5 V DC)	210 mA (5 V DC)
External connection	18-point terminal block, M3.5 screws	18-point terminal block, M3.5 screws
External dimensions	28.9 (W) × 100 (H) × 83.2 (D) mm ^{*4}	28.9 (W) × 100 (H) × 83.2 (D) mm ^{*4}
Weight	200 g	200 g
Ambient operating temperature	0 to 55°C	
Ambient operating humidity	10 to 90% RH (non-condensing)	
Ambient operating atmosphere	Must be free of corrosive gases or heavy dust.	
Ambient storage temperature	-20 to 75°C	
Ambient storage humidity	10 to 90% RH (non-condensing)	

*1: Selectable for each channel using software. The default value is -10 to 10 V DC.

*2: Input resistance is 2MΩ for channels with input IN□- terminal not connected to AG terminal.

*3: The actual time constant value depends on the number of channels not skipped and other settings.

*4: Dimensions excluding any protrusions (for details, see Figure B1.20, "External Dimensions").



CAUTION

Never apply any voltage exceeding the absolute maximum rated voltage, even for a short period of time, or it may cause permanent damage to the internal circuitry, and thus failure to meet specifications.

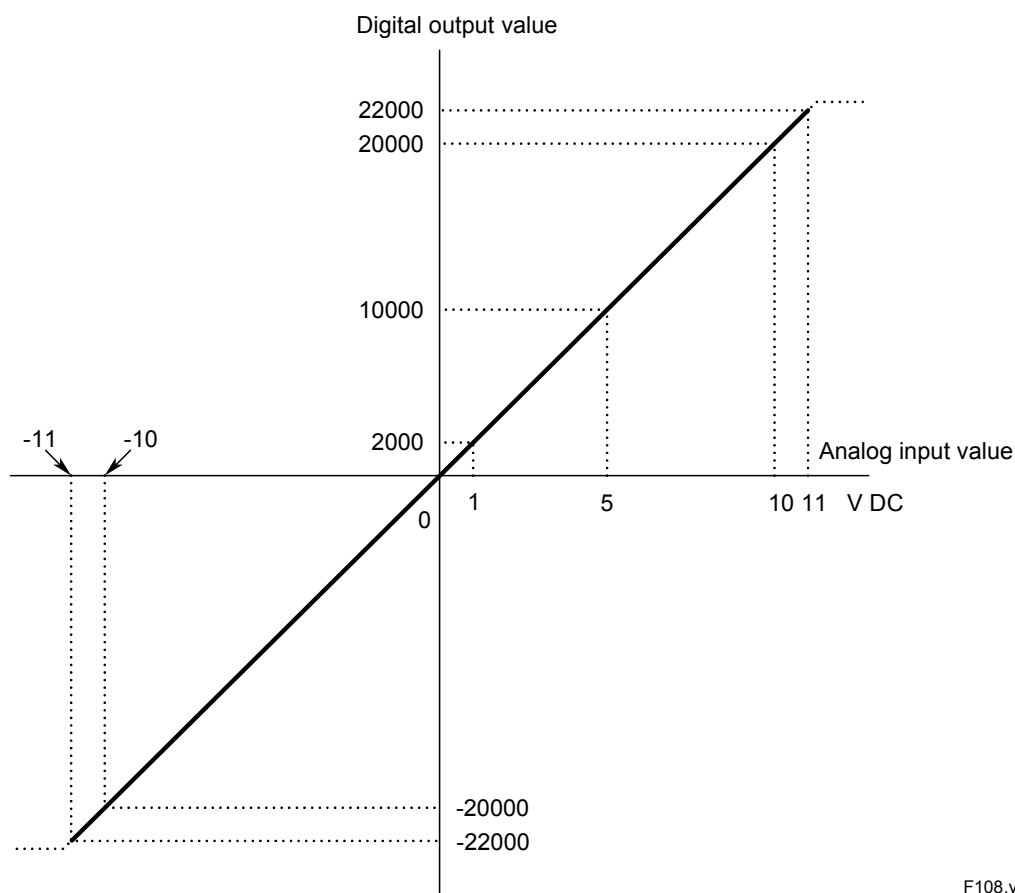
■ Input to Output Conversion Characteristics

The following table shows the input to output conversion characteristics with no scaling function for various input signal ranges. The input to output conversion characteristics show analog input values versus digital output values.

For details on scaling, see Section B1.4.3.

Table B1.5 Input to Output Conversion Characteristics with No Scaling

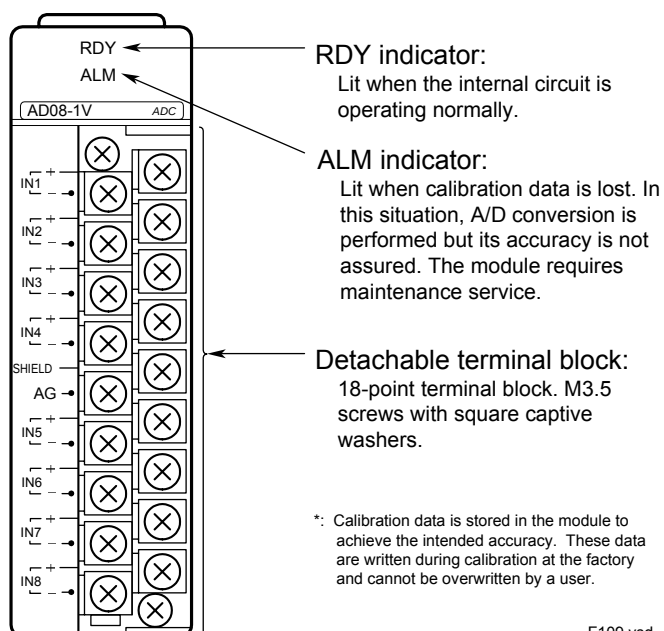
Input Signal Range	Analog Input Value	Digital Output Value	Default
-10 to 10 V DC range	-10 to 10 V DC	-20000 to 20000	
0 to 5 V DC range	0 to 5 V DC	0 to 10000	
1 to 5 V DC range	1 to 5 V DC	2000 to 10000	



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Figure B1.9 Input to Output Conversion Characteristics with No Scaling

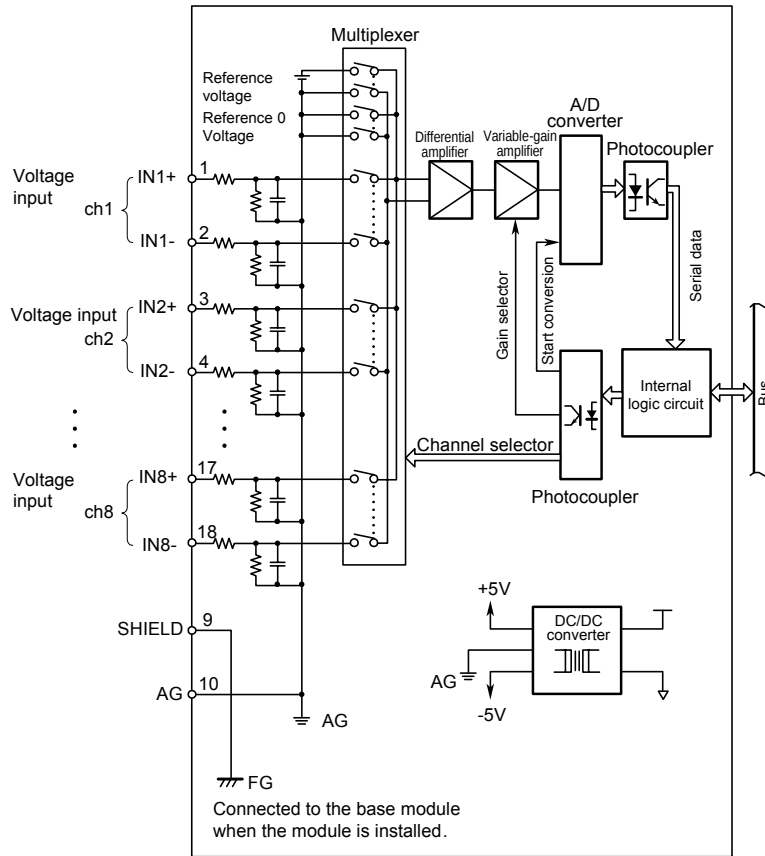
■ Components and Functions



F109.vsd

Figure B1.10 Components and Functions

Internal Circuit

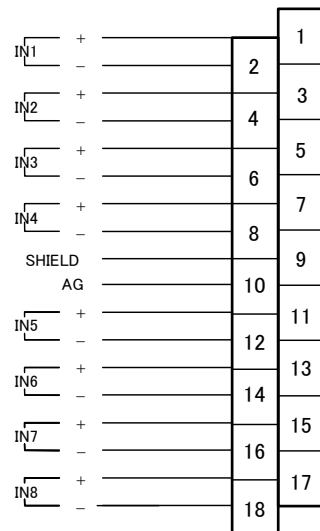


F110.vsd

Figure B1.11 Internal Circuit Diagram

External Connections and Wiring Precautions

External Connections



- 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.

F111.vsd

Figure B1.12 External Connection Diagram

Table B1.6 Wires and Terminals

Applicable wire size		AWG22-16 (0.3 to 1.25 mm ²)
Wire type		Shielded twisted pair
Wire connections		Crimp-on type
Crimp-on terminals	Crimp-on terminals	For 3.5 mm
	Tightening torque	0.8 N • m (7.1 lbf • in)
	Applicable crimp-on terminals	Examples: Type V1.25-M3 (from Japan Solderless Terminal Mfg. Co., Ltd.) or RAV1.25-3.5 (from Nippon Tanshi Co., Ltd.)

**CAUTION**

Always use an appropriate crimping tool specified by the manufacturer.

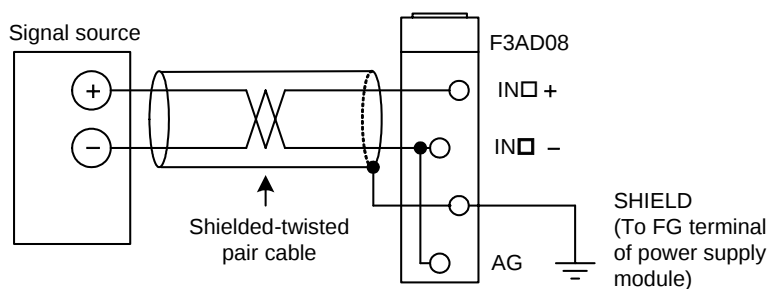
● Wiring Precautions

**CAUTION**

The analog input module uses a differential input circuit in each channel. This enables multiple signal sources superimposing common-mode voltage to connect to one F3AD08-1V or F3AD08-1R module. However, if the common-mode voltage exceeds its allowable limits, input read error may occur and the module may be damaged. The common-mode voltage here refers to the potential of IN□– in each channel, which is connected to the AG terminal.

1. As analog signals are susceptible to noise, use shielded twisted-pair wires to connect signal sources to F3AD08-1V or F3AD08-1R modules to suppress noise.
2. Ground the shield of the twisted-pair cable to FG. The following are some possible ways to perform grounding:
 - Connecting the shield to the SHIELD terminal of the F3AD08-1V or F3AD08-1R module

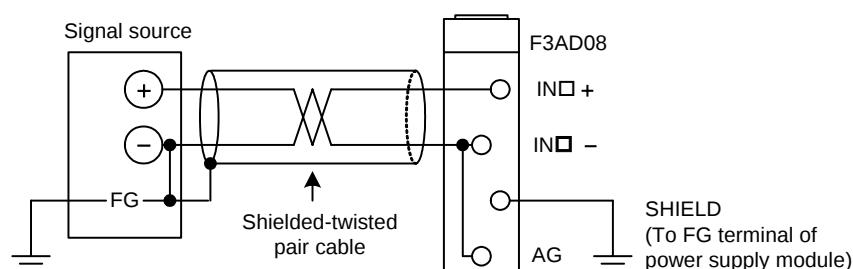
(The SHIELD terminals are connected to the FG terminal of the power supply module via the base module.)



F11101.vsd

Figure B1.13 Wiring Example

- Connecting the shield to shielded terminal (FG terminal) provided at the signal source



F11102.vsd

Figure B1.14 Wiring Example

- Removing the cable covering to expose the wire and clamp it to the FG terminal using a FG clamp to ground it.

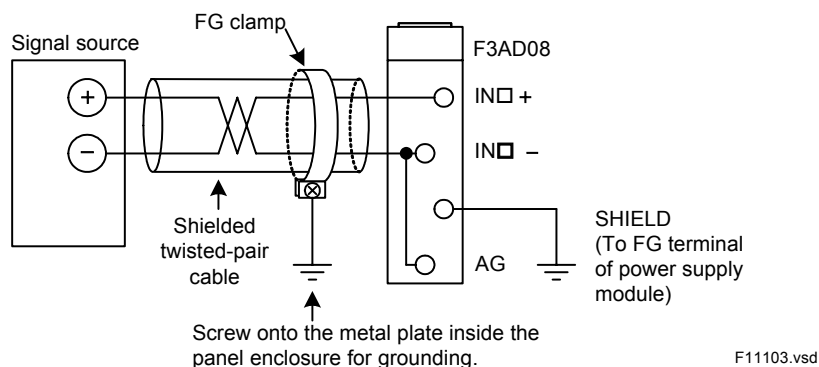


Figure B1.15 Wiring Example

Depending on the stability of the grounding points, it may be better to perform grounding either at the F3AD08 module or at the signal source. Select the more stable grounding point

3. For compliance with EMC-related specifications, use FG clamps to perform grounding for systems installed with this module.
4. For common mode voltage reference (the potential of the signal connected to the AG terminal becomes the reference voltage), to connect a signal not superimposing the common mode voltage and a floating signal with an ungrounded negative input, connect the negative of the respective input signals to the AG terminal of the F3AD08-1V or F3AD08-1R module.

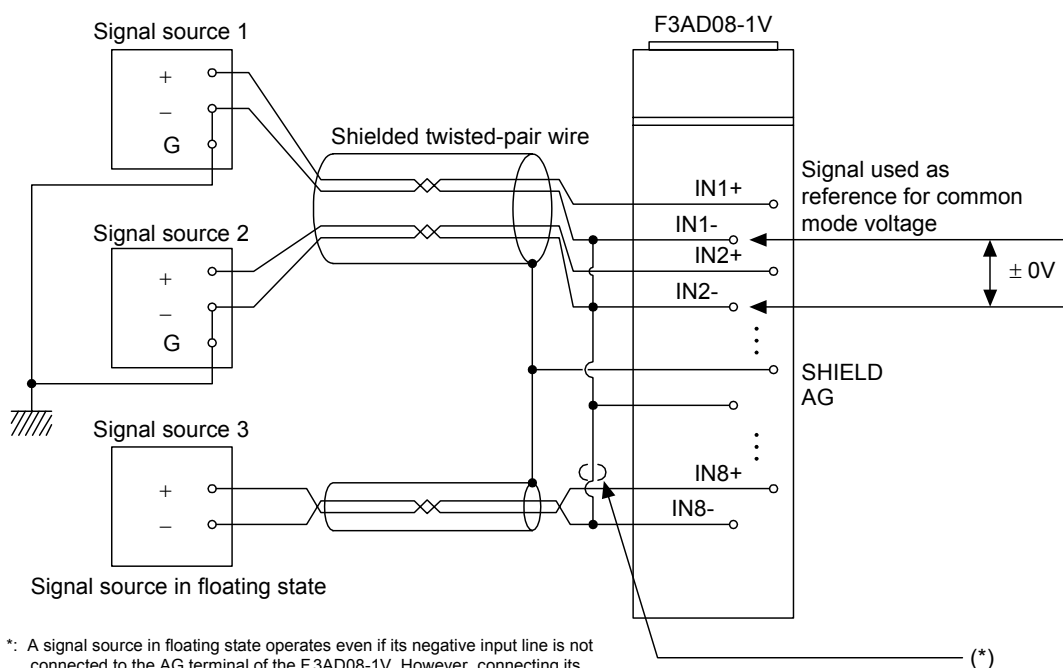


Figure B1.16 Wiring Example

- When the negative terminal of a signal source is grounded, it may be better to connect the shield of the twisted-pair to the SHIELD terminal (or FG terminal) at the signal source.

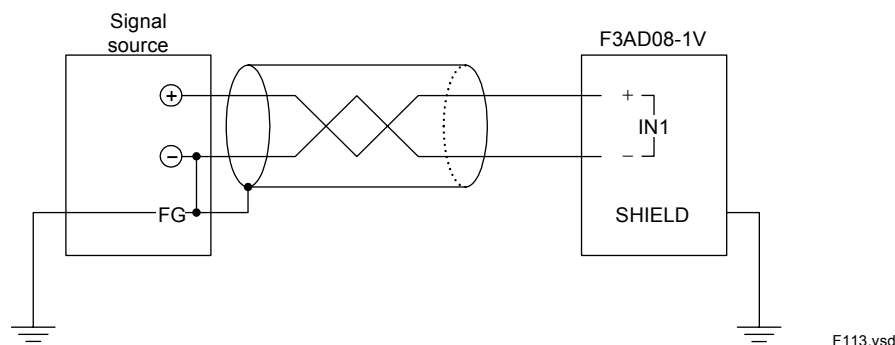


Figure B1.17 Example Wiring with the Negative Terminal of the Signal Source Grounded

- If a signal is used as the reference for common mode voltage, you can directly connect to the F3AD08-1V or F3AD08-1R module other signal sources superimposing the common mode voltage that are within allowable limits given in the module specifications. In this case, do not connect signal sources superimposing the common-mode voltage to the AG terminal.

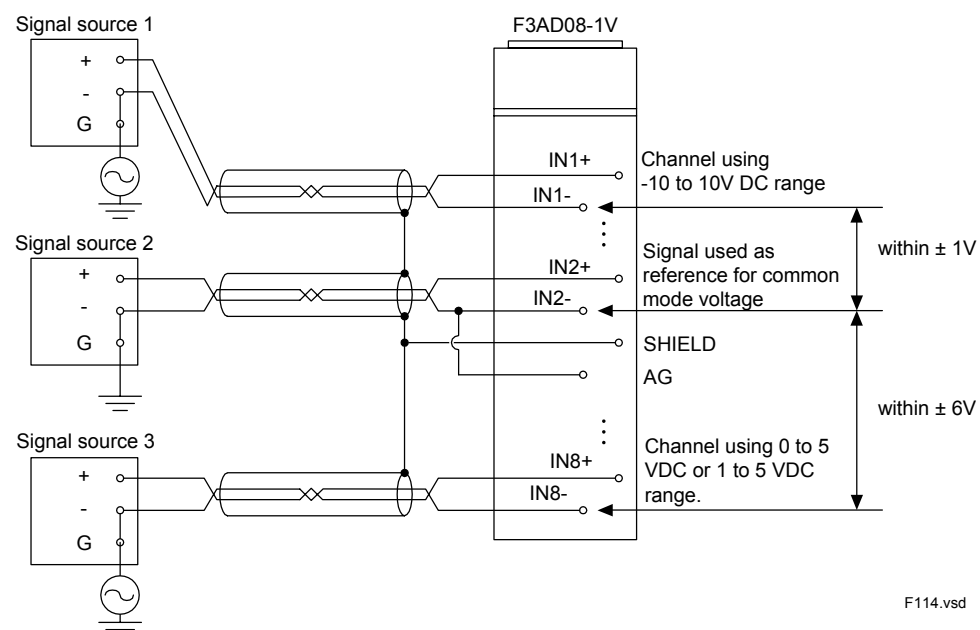


Figure B1.18 When Signal Sources Are Within Allowable Limits of the Common Mode Voltage

- If a signal is used as the reference for common mode voltage, then for signal sources superimposing the common mode voltage that are beyond allowable limits given in the module specifications, connect them as follows:
 - (1) Use an insulated signal conditioner to bring the common mode voltage within allowable limits before connecting the input signals to the F3AD08-1V or F3AD08-1R module.
 - (2) Connect the signal lines separately to multiple F3AD08-1N and F3AD08-1R modules to lower the common mode voltages of individual F3AD08-1V or F3AD08-1R modules within allowable limits given in the module specifications. In this case, multiple F3AD08-1V and F3AD08-1R modules may be installed on the same base module.

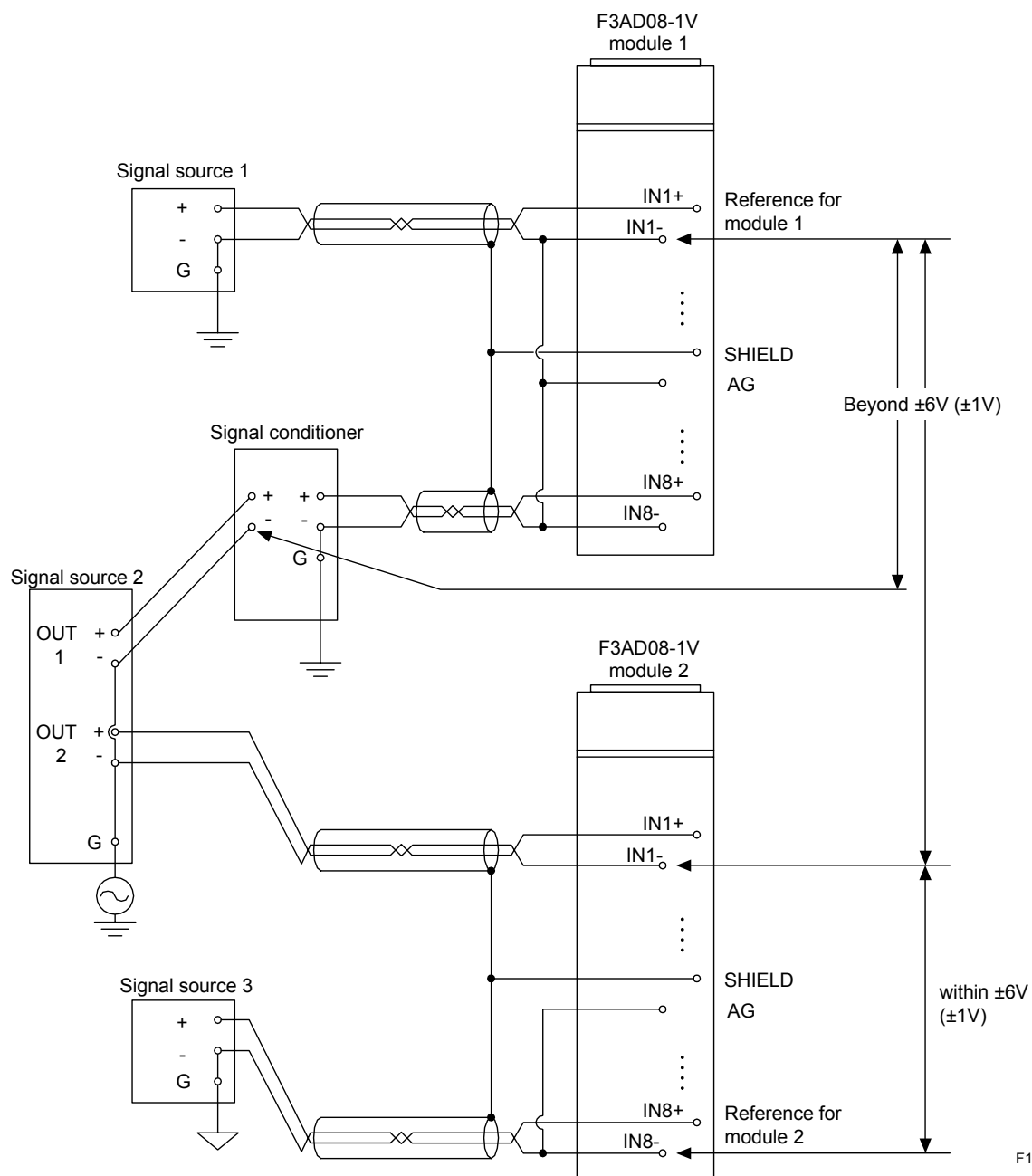
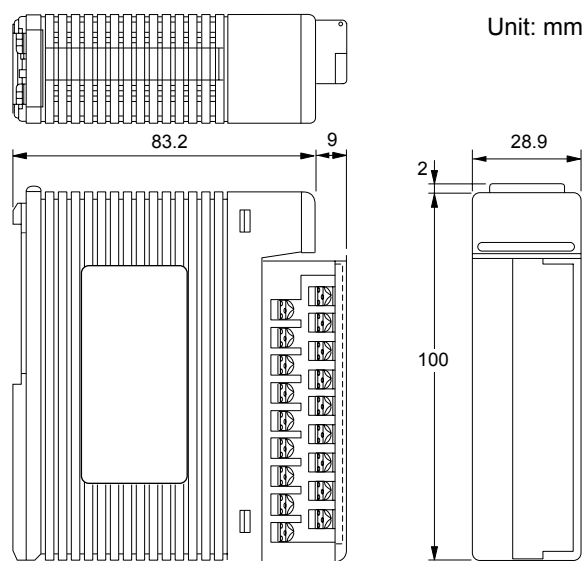


Figure B1.19 When Signal Sources Are Beyond Allowable Limits of the Common Mode Voltage

■ External Dimensions



F116.vsd

Figure B1.20 External Dimensions

B1.3 Specifications for F3AD08-4V

■ Functional Specifications

Table B1.7 Functional Specifications

Item	Specifications for F3AD08-4V
Number of inputs	8 (differential input)
Absolute maximum rated voltage	25 mA DC maximum -25 mA DC minimum
Input signal range ^{*1} (Over range)	0 to 20 mA DC (-1.0 to 21.0 mA DC) 4 to 20 mA DC (-1.0 to 21.0 mA DC)
Allowable common mode voltage	±6V DC max. (0 to 20 mA DC or 4 to 20 mA 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	250 Ω
Resolution	0 to 20 mA DC and 4 to 20 mA DC: 5.6 μA (12-bit A/D)
Overall accuracy	23±2°C: ± 0.2% (full scale) 0 to 55°C: ± 0.5% (full scale)
Conversion period	1 ms × (number of inputs)
Scaling	Upper and lower limit values of the input signal range can be set to any value between -20,000 and 20,000.
Filter	Channels are enabled or disabled independently. ^{*2}
Current consumption	210 mA (5 V DC)
External connection	18-point terminal block, M3.5 screws
External dimensions	28.9 (W) × 100 (H) × 83.2 (D) mm ^{*3}
Weight	200 g
Ambient operating temperature	0 to 55°C
Ambient operating humidity	10 to 90% RH (non-condensing)
Ambient operating atmosphere	Must be free of corrosive gases or heavy dust.
Ambient storage temperature	-20 to 75°C
Ambient storage humidity	10 to 90% RH (non-condensing)

*1: Selectable for each channel using software. The default value is 0 to 20 mA DC.

*2: The actual time constant value depends on the number of channels not skipped and other settings.

*3: Dimensions excluding any protrusions (for details, see Figure B1.32, "External Dimensions").



CAUTION

Never apply any voltage exceeding the absolute maximum rated voltage, even for a short period of time, or it may cause permanent damage to the internal circuitry, and thus failure to meet specifications.

■ Input to Output Conversion Characteristics

The following table shows the input to output conversion characteristics with no scaling function for various input signal ranges. The input to output conversion characteristics show analog input values versus digital output values.

For details on scaling, see Section B1.4.3.

Table B1.8 Input to Output Conversion Characteristics with No Scaling

Input Signal Range	Analog Input Value	Digital Output Value	
0 to 20 mA DC range	0 to 20 mA DC	0 to 10000	Default
4 to 20 mA DC range	4 to 20 mA DC	2000 to 10000	

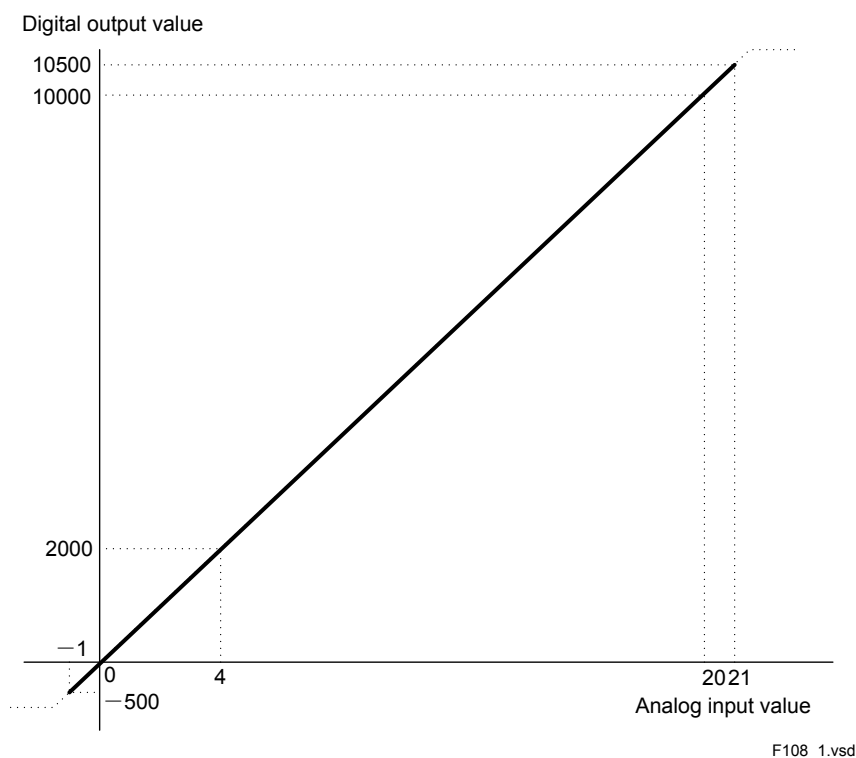


Figure B1.21 Input to Output Conversion Characteristics with No Scaling

■ Components and Functions

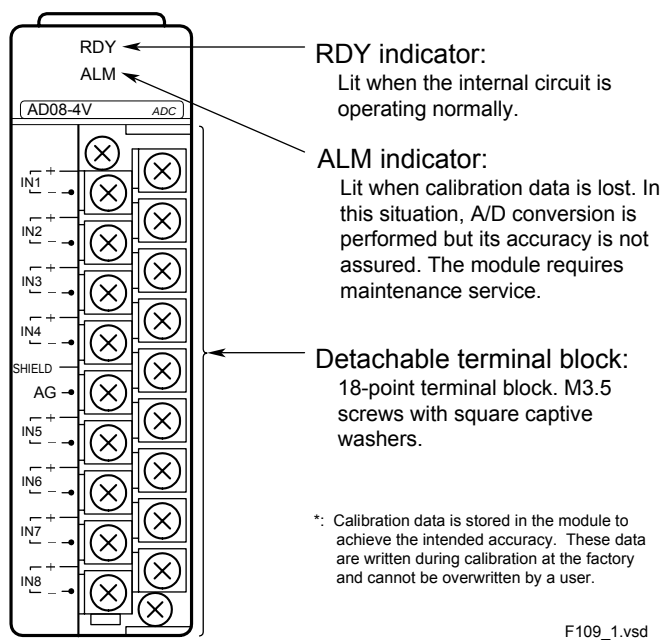
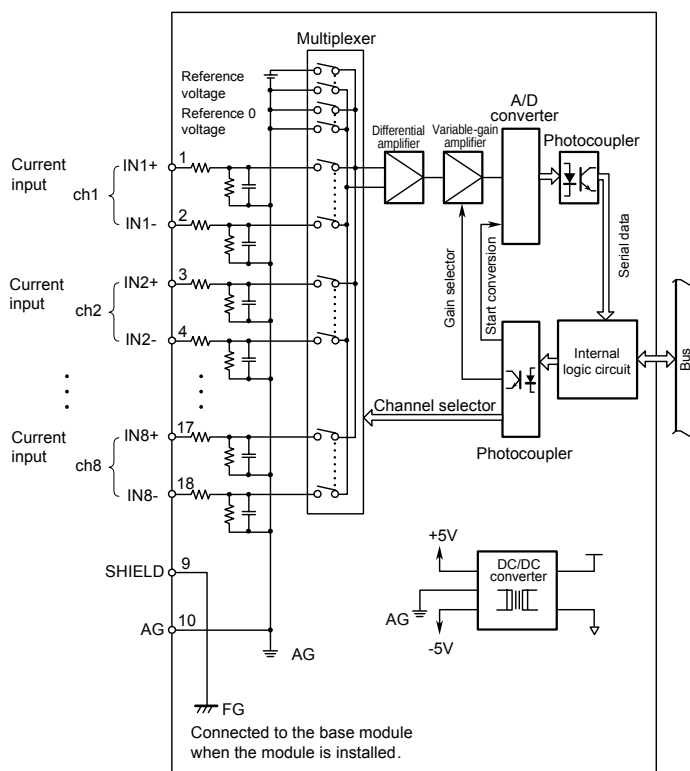


Figure B1.22 Components and Functions

Internal Circuit

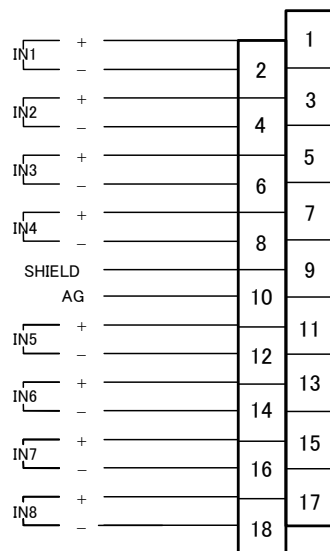


F110_1.vsd

Figure B1.23 Internal Circuit Diagram

External Connections and Wiring Precautions

External Connections



- 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.

F111.vsd

Figure B1.24 External Connection Diagram

Table B1.9 Wires and Terminals

Applicable wire size		AWG22-16 (0.3 to 1.25 mm ²)
Wire type		Shielded twisted pair
Wire connections		Crimp-on type
Crimp-on terminals	Crimp-on terminals	For 3.5 mm
	Tightening torque	0.8 N · m
	Applicable crimp-on terminals	Examples: Type V1.25-M3 (from Japan Solderless Terminal Mfg. Co., Ltd.) or RAV1.25-3.5 (from Nippon Tanshi Co., Ltd.)

**CAUTION**

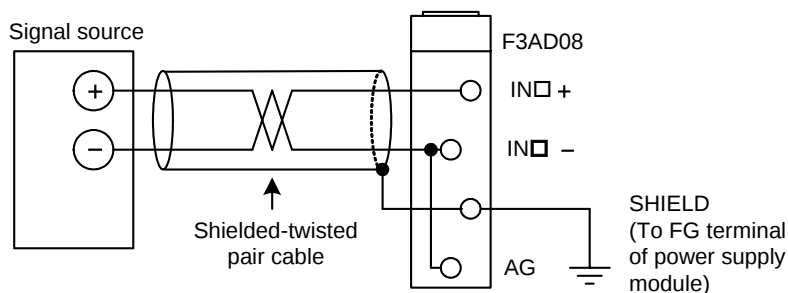
Always use an appropriate crimping tool specified by the manufacturer.

● Wiring Precautions

**CAUTION**

The analog input module uses a differential input circuit in each channel. This enables multiple signal sources superimposing common-mode voltage to connect to one F3AD08-4V module. However, if the common-mode voltage exceeds its allowable limits, input read error may occur and the module may be damaged. The common-mode voltage here refers to the potential of IN□– in each channel, which is connected to the AG terminal.

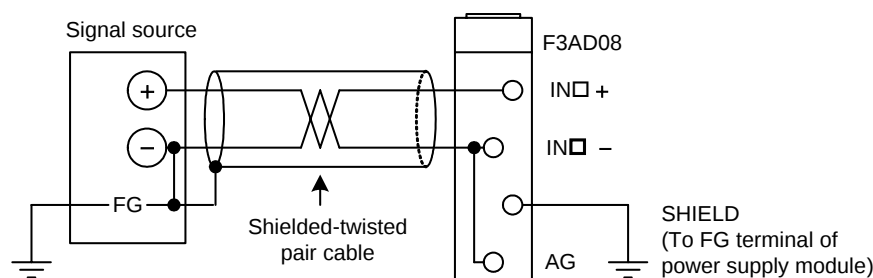
1. As analog signals are susceptible to noise, use shielded twisted-pair wires to connect signal sources to F3AD08-4V modules to suppress noise.
2. Ground the shield of the twisted-pair cable to FG. The following are some possible ways to perform grounding:
 - Connecting the shield to the SHIELD terminal of the F3AD08-4V module
(The SHIELD terminals are connected to the FG terminal of the power supply module via the base module.)



F11101.vsd

Figure B1.25 Wiring Example

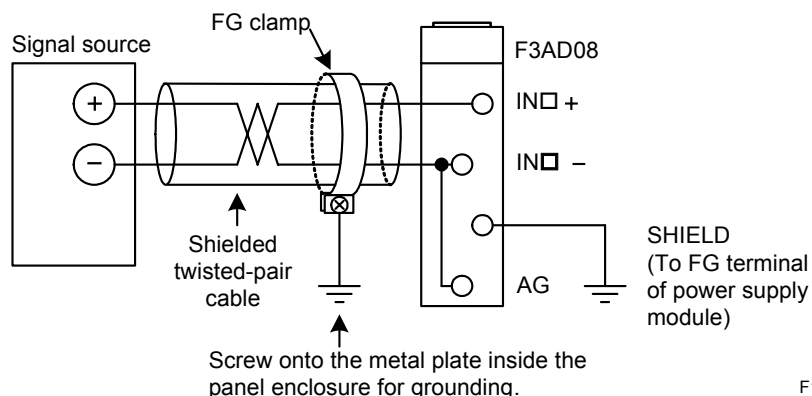
- Connecting the shield to shielded terminal (FG terminal) provided at the signal source



F11102.vsd

Figure B1.26 Wiring Example

- Removing the cable covering to expose the wire and clamp it to the FG terminal using a FG clamp to ground it.

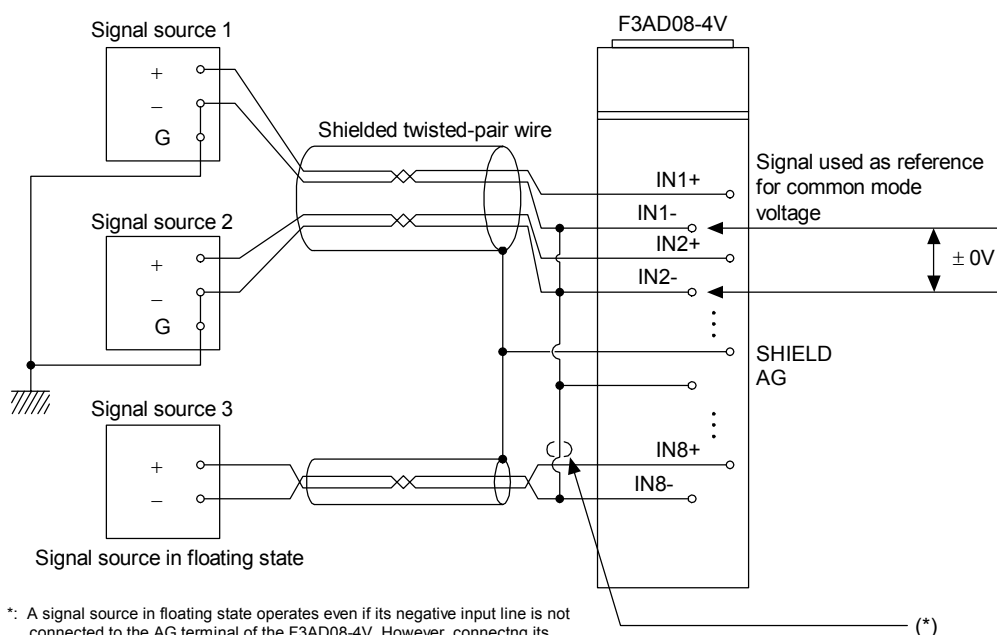


F11103.vsd

Figure B1.27 Wiring Example

Depending on the stability of the grounding points, it may be better to perform grounding either at the F3AD08 module or at the signal source. Select the more stable grounding point.

3. For compliance with EMC-related specifications, use FG clamps to perform grounding for systems installed with this module.
4. For common mode voltage reference (the potential of the signal connected to the AG terminal becomes the reference voltage), to connect a signal not superimposing the common mode voltage and a floating signal with an ungrounded negative input, connect the negative of the respective input signals to the AG terminal of the F3AD08-4V module.



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Figure B1.28 Wiring Example

- When the negative terminal of a signal source is grounded, it may be better to connect the shield of the twisted-pair to the SHIELD terminal (or FG terminal) at the signal source.

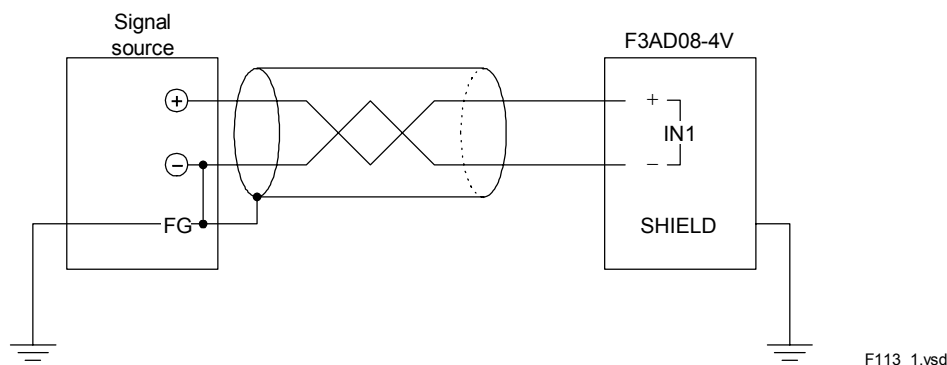


Figure B1.29 Example Wiring with the Negative Terminal of the Signal Source Grounded

- If a signal is used as the reference for common mode voltage, you can directly connect to the F3AD08-4V module other signal sources superimposing the common mode voltage that are within allowable limits given in the module specifications. In this case, do not connect signal sources superimposing the common-mode voltage to the AG terminal.

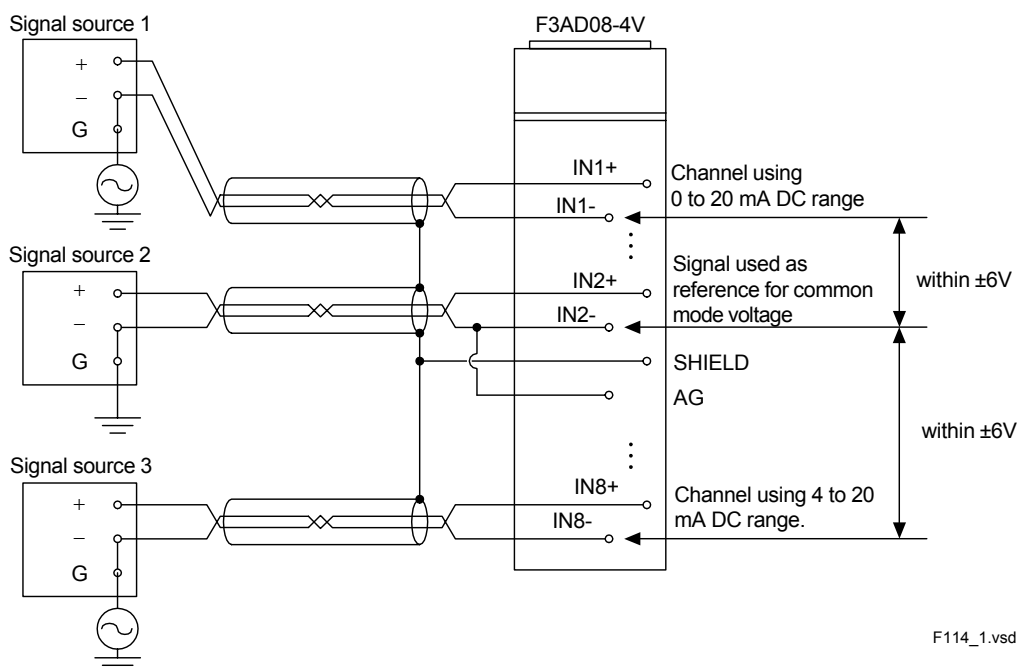


Figure B1.30 When Signal Sources Are Within Allowable Limits of the Common Mode Voltage

- If a signal is used as the reference for common mode voltage, then for signal sources superimposing the common mode voltage that are beyond allowable limits given in the module specifications, connect them as follows:
 - (1) Use an insulated signal conditioner to bring the common mode voltage within allowable limits before connecting the input signals to the F3AD08-4V module.
 - (2) Connect the signal lines separately to multiple F3AD08-4V modules to lower the common mode voltages of individual F3AD08-4V modules within allowable limits given in the module specifications. In this case, multiple F3AD08-4V modules may be installed on the same base module.

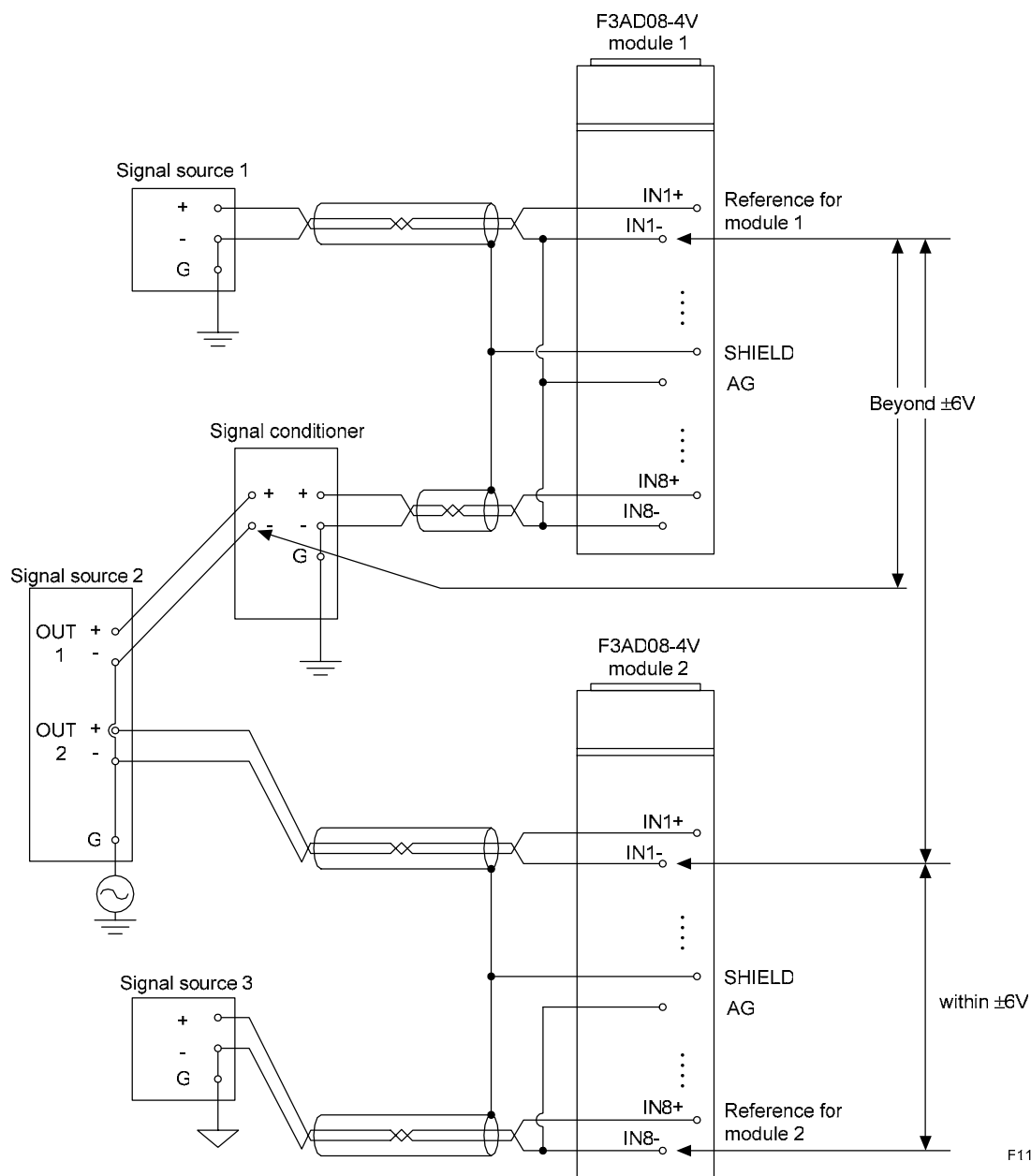
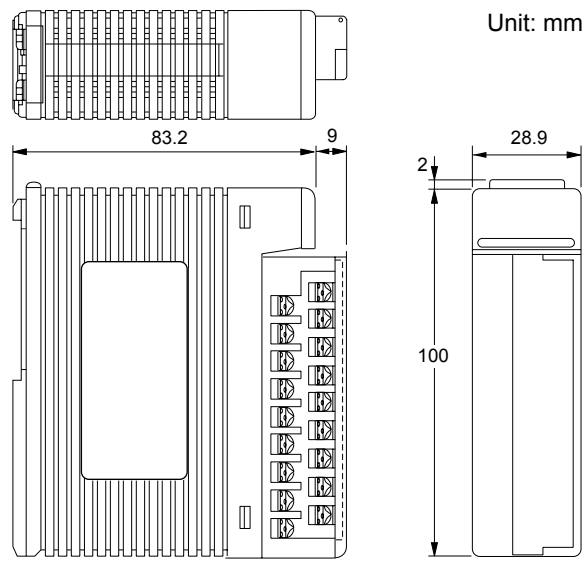


Figure B1.31 When Signal Sources Are Beyond Allowable Limits of the Common Mode Voltage

■ External Dimensions



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Figure B1.32 External Dimensions

B1.4 Operation Mode and Operation Setup

■ F3AD04-0V, F3AD04-0R, F3AD08-1V and F3AD08-1R

The Operation mode comprises 4 functions: the input signal range, channel skipping, scaling, and filtering. Table B1.7 lists the items to be set for each function with their default values.

Table B1.10 Operation Mode and Settings

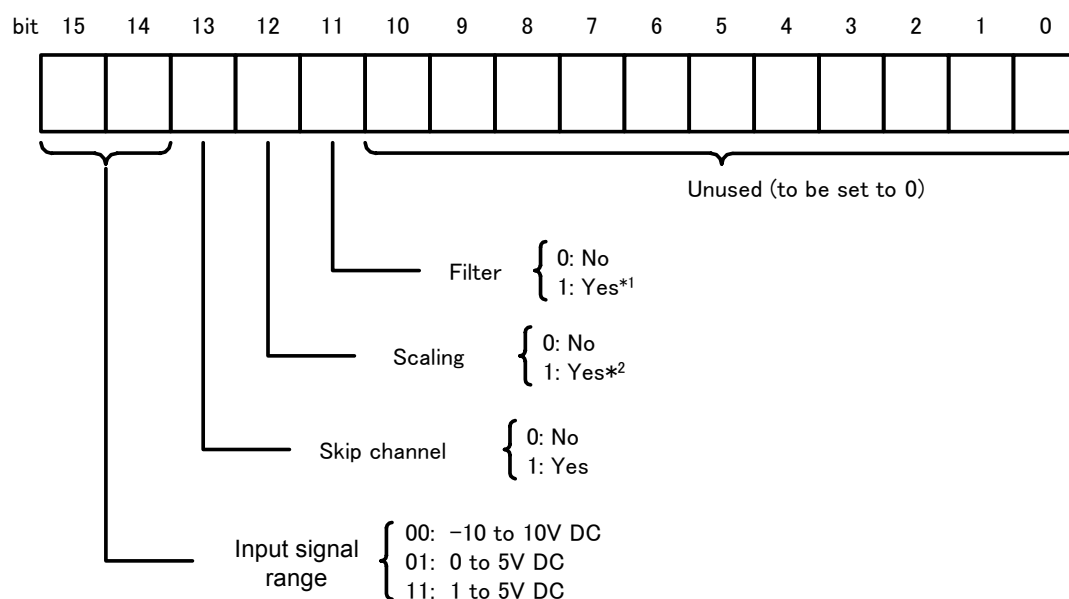
Operation Mode	Settings	Default Value	Description
Input signal range	-10 to 10 V, 0 to 5 V or 1 to 5 V DC	- 10 to 10 V DC	See Subsection B1.4.1
Skip channel	Yes or No	No	See Subsection B1.4.2
Scaling	Yes or No	No	See Subsection B1.4.3
Filter	Yes or No	No	See Subsection B1.4.4

You can set the operation mode for a channel by writing 16-bit data into its respective operation mode data position numbers using Special Module Write ladder instructions or BASIC statements.

Table B1.11 Operation Mode Data Position Numbers

	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5*	Channel 6*	Channel 7*	Channel 8*
Ladder	501	502	503	504	505	506	507	508
BASIC	1	2	3	4	5	6	7	8

*: Applies only to F3AD08.



*1 Set the filter preset values too (see Section B1.4.4)

*2 Set the upper and lower limits too (see Section B1.4.3)

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Figure B1.33 Operation Mode Bitmap

*: By default, bit numbers 0 through 15 is 0.

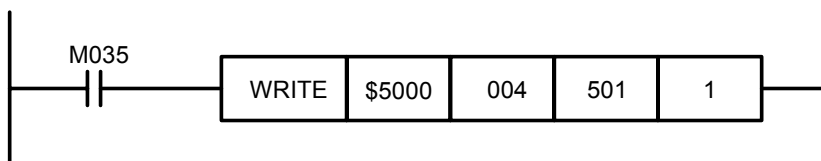
TIP

The operation mode preset values reset whenever power is turned off. When power is turned on again, the module operates with default values. Thus, you need to set the operation mode each time power is turned on.

Example 1

This example sets channel 1 for the module installed in slot number 004 to 'input range 0-5 V DC, no skipping, scaling and no filtering.'

● Using Special Module Write instructions in ladder



For details on ladder instructions, see Section B2.3.

● Using BASIC statements

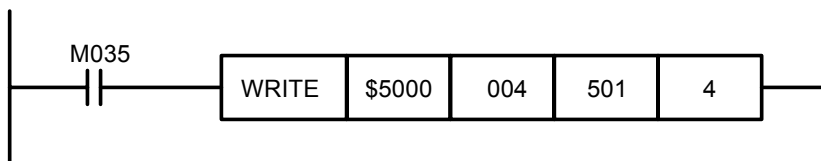
CONTROL 4,1; \$5000

Note: You should declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

For details on BASIC instructions, see Section B3.6.

Example 2

This example sets channels 1-4 for the module installed in slot number 004 to 'input range 0-5 V DC, no skipping, scaling and no filtering.'



■ F3AD08-4V

The Operation mode comprises 4 functions: the input signal range, channel skipping, scaling and filtering. Table B1.12 lists the items to be set for each function with their default values.

Table B1.12 Operation Mode and Settings

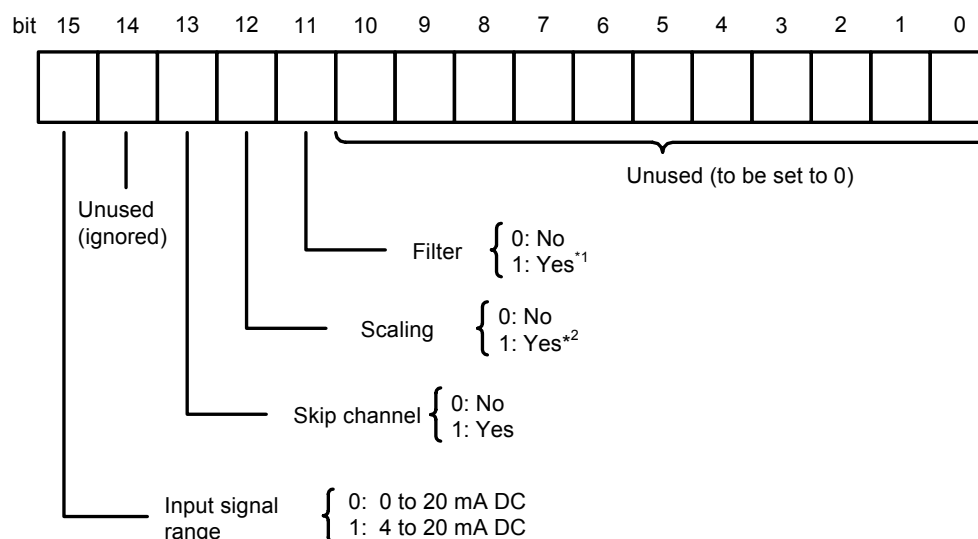
Operation Mode	Settings	Default Value	Description
Input signal range	0 to 20 mA DC or 4 to 20 mA DC	0 to 20 mA DC	See Subsection B1.4.1
Skip channel	Skipped or not skipped	Not skipped	See Subsection B1.4.2
Scaling	Scaling or no scaling	No scaling	See Subsection B1.4.3
Filter	Used or not used	Not used	See Subsection B1.4.4

You can set the operation mode for a channel by writing 16-bit data into its respective operation mode data position numbers using Special Module Write ladder instructions or BASIC statements.

Table B1.13 Operation Mode Data Position Numbers

	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5*	Channel 6*	Channel 7*	Channel 8*
Ladder	501	502	503	504	505	506	507	508
BASIC	1	2	3	4	5	6	7	8

*: Applies only to F3AD08.



*1 Set the filter preset values too (see Section B1.4.4)

*2 Set the upper and lower limits too (see Section B1.4.3)

F117_1.vsd

Figure B1.34 Operation Mode Bitmap

*: By default, bit numbers 0 through 15 is 0.

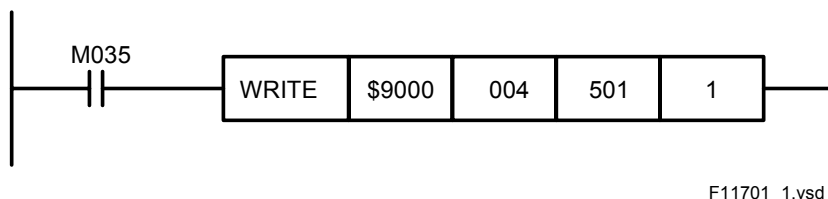
TIP

The operation mode preset values reset whenever power is turned off. When power is turned on again, the module operates with default values. Thus, you need to set the operation mode each time power is turned on.

Example 1

This example sets channel 1 for the module installed in slot number 004 to 'input range 4-20 mA DC, no skipping, scaling and no filtering.'

● Using Special Module Write instructions in ladder



For details on ladder instructions, see Section B2.3.

● Using BASIC statements

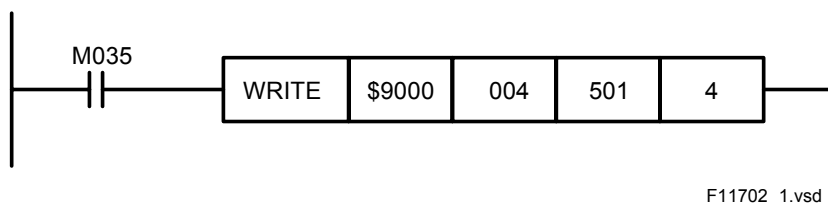
CONTROL 4,1; \$9000

Note: You should declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

For details on BASIC instructions, see Section B3.6.

Example 2

This example sets channels 1-4 for the module installed in slot number 004 to 'input range 4-20 mA DC, no skipping, scaling and no filtering.'



B1.4.1 Input Signal Range

The module provides various options for setting the input signal range. The following table shows the effective signal range for A/D conversion for each of these setting options.

Table B1.14 Input Signal Range (F3AD04-0V, F3AD04-0R, F3AD08-1V, F3AD08-1R)

Input Signal Range Setting	Effective Input Signal Range	
-10 to 10V DC	-11.0 to 11.0V DC	Default
0 to 5V DC	-0.25 to 5.25V DC	
1 to 5V DC	-0.25 to 5.25V DC	

Table B1.15 Input Signal Range (F3AD08-4V)

Input Signal Range Setting	Effective Input Signal Range	
0 to 20 mA DC	-1.0 to 21.0 mA DC	Default
4 to 20 mA DC	-1.0 to 21.0 mA DC	

B1.4.2 Skip Channel

The Skip Channel feature can be used to disable A/D conversion for unused channels.

When it is turned on for a channel, data is not updated for that channel. This helps to shorten the data update period, which is given by $1\text{ms} \times \text{number of channels in use}$ (channels that are not skipped). By default, skipping is turned off and A/D conversion is performed for all channels. The data update period in the default case is 4 ms for model F3AD04 and 8ms for model F3AD08.

B1.4.3 Scaling and Setting Upper and Lower Limits

The digital output values corresponding to the upper and lower limits of the input signal range can be set to any value from -20000 to 20000 . Scaling can be used to convert data to a form suitable for processing. To set up the scaling function, use the following procedure.

1. Set scaling to "Yes" in the operation mode.
2. Write the digital output values corresponding to the upper and lower limits of the input signal range to the scaling data position number defined for each channel using a special module WRITE ladder instruction or a BASIC statement.

Table B1.16 Scaling Data Position Numbers

Description		Channel 1	Channel 2	Channel 3	Channel 4	Channel 5*	Channel 6*	Channel 7*	Channel 8*
Digital output value corresponding to upper limit of input signal range	Ladder	520	530	540	550	560	570	580	590
	BASIC	20	30	40	50	60	70	80	90
Digital output value corresponding to lower limit of input signal range	Ladder	521	531	541	551	561	571	581	591
	BASIC	21	31	41	51	61	71	81	91

*: Applies to F3AD08 models only.

The specified digital output values corresponding to the upper and lower limits of the input signal range must satisfy the following conditions.

- $-20000 \leq N \leq 20000$ (where N is an integer)
- Upper limit > lower limit

No scaling will be performed with any of the following setup and the input/output characteristics will be as shown in Figure B1.1, Figure B1.9 or Figure B1.21.

- $N < -20000$ or $20000 < N$ where N is set either as the upper limit or the lower limit.
- The upper or lower limit is a non-integer.
- Upper limit $\leq$ lower limit
- Scaling is turned on in the operation mode but the upper or lower limit is not set.



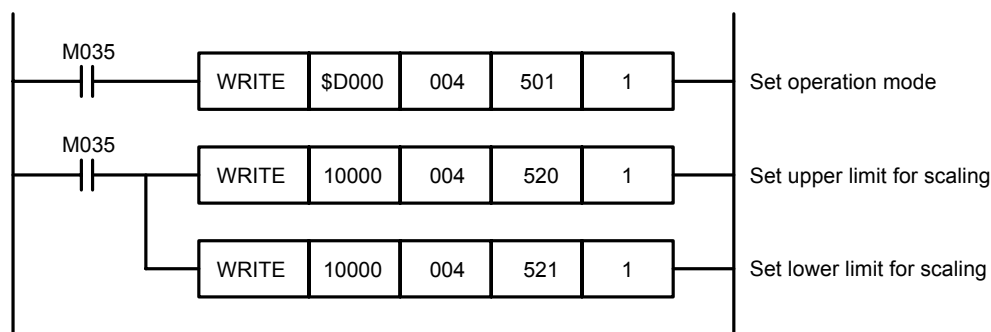
CAUTION

After scaling, all digits after the decimal point will be discarded.

Example:

This example sets channel 1 for the module F3AD08-1V installed in slot number 004 to 'input range 1-5 V DC, no channel skipping, scaling to range 0-10000, no filtering.'

● Using Special Module Write instructions in ladder



For details on ladder instructions, see Section B2.3.

● Using BASIC statements

CONTROL 4,1;\$D000 Set operation mode

CONTROL 4,20;10000 Set upper limit for scaling

CONTROL 4,21;0 Set lower limit for scaling

Note: You should declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

For details on BASIC instructions, see Section B3.6.

- The following figure shows the change in the input/output characteristics for the above example (where the input signal range is 1 to 5V DC).

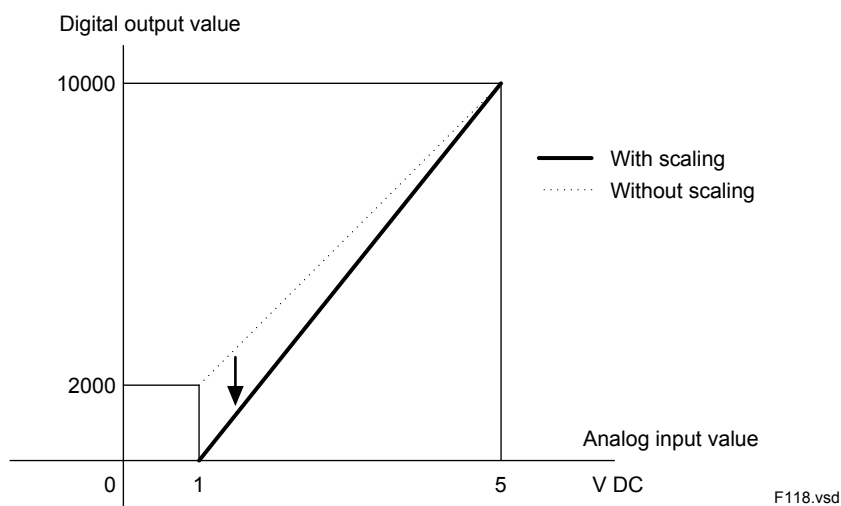


Figure B1.35 Changes in the Input/output Characteristics When Scaling Is Used

B1.4.4 Filter Function and Setting Filter Preset Value

To remove noise superimposed on the input signal, you can set up a low-pass filter function with first order lag by software using the following procedure.

1. Set filter to "Yes" in the operation mode.
2. Write the filter preset value to the filter data position number defined for each channel using a special module WRITE ladder instruction or a BASIC statement.
The filter preset value represents the first-order lag time constant in ms.

Table B1.17 Filter Data Position Numbers

Description		Channel 1	Channel 2	Channel 3	Channel 4	Channel 5*	Channel 6*	Channel 7*	Channel 8*
Filter preset value	Ladder	522	532	542	552	562	572	582	592
	BASIC	22	32	42	52	62	72	82	92

* : Applies only to F3AD08 models.

TIP

The filter preset values can be any values. How they are converted to time constants in actual module operation depends on the number of channels used (number of channels that are not skipped). The details are given in Table B1.18 to Table B1.25.

**Table B1.18 Relationship between Filter Preset Value and Time Constant
When 8 Channels are Used***

Filter preset value	0 to 15	16 to 31	32 to 63	64 to 127	128 to 255	256 to 510	511 to 1021	1022 to 2043	2044 to 4087	4088 to 8175	8176 to 16351	16352 to 32767
Time Constant (ms)	11.5	27.8	59.9	123.0	252.0	508.0	1020.0	2044.0	4092.0	8188.0	16380.0	32764.0

* : Applies to F3AD08 models only.

**Table B1.19 Relationship between Filter Preset Value and Time Constant
When 7 Channels are Used***

Filter preset value	0 to 13	14 to 27	28 to 55	56 to 111	112 to 223	224 to 447	448 to 894	895 to 1788	1789 to 3576	3577 to 7153	7154 to 14307	14308 to 32767
Time constant (ms)	10.1	24.3	52.4	108.5	220.5	444.5	892.5	1788.5	3580.5	7164.5	14332.5	28668.5

* : Applies to F3AD08 models only.

**Table B1.20 Relationship between Filter Preset Value and Time Constant
When 6 Channels are Used***

Filter preset value	0 to 11	12 to 23	24 to 47	48 to 95	96 to 191	192 to 383	384 to 766	767 to 1532	1533 to 3065	3066 to 6131	6132 to 12263	12264 to 32767
Time constant (ms)	8.7	20.9	44.9	93.0	189.0	381.0	765.0	1533.0	3069.0	6141.0	12285.0	24573.0

* : Applies to F3AD08 models only.

**Table B1.21 Relationship between Filter Preset Value and Time Constant
When 5 Channels are Used***

Filter preset value	0 to 9	10 to 19	20 to 39	40 to 79	80 to 159	160 to 319	320 to 638	639 to 1277	1278 to 2554	2555 to 5109	5110 to 10219	10220 to 32767
Time constant (ms)	7.2	17.4	37.4	77.5	157.5	317.5	637.5	1277.5	2557.5	5117.5	10237.5	20477.5

* : Applies to F3AD08 models only.

**Table B1.22 Relationship between Filter Preset Value and Time Constant
When 4 Channels are Used***

Filter preset value	0 to 7	8 to 15	16 to 31	32 to 63	64 to 127	128 to 255	256 to 510	511 to 1021	1022 to 2043	2044 to 4087	4088 to 8175	8176 to 32767
Time constant (ms)	5.8	13.9	30.0	62.0	126.0	254.0	510.0	1022.0	2046.0	4094.0	8190.0	16382.0

**Table B1.23 Relationship between Filter Preset Value and Time Constant
When 3 Channels are Used***

Filter preset value	0 to 5	6 to 11	12 to 23	24 to 47	48 to 95	96 to 191	192 to 383	384 to 766	767 to 1532	1533 to 3065	3066 to 6131	6132 to 32767
Time constant (ms)	4.3	10.4	22.5	46.5	94.5	190.5	382.5	766.5	1534.5	3070.5	6142.5	12286.5

**Table B1.24 Relationship between Filter Preset Value and Time Constant
When 2 Channels are Used***

Filter preset value	0 to 3	4 to 7	8 to 15	16 to 31	32 to 63	64 to 127	128 to 255	256 to 510	511 to 1021	1022 to 2043	2044 to 4087	4088 to 32767
Time constant (ms)	2.9	7.0	15.0	31.0	63.0	127.0	255.0	511.0	1023.0	2047.0	4095.0	8191.0

**Table B1.25 Relationship between Filter Preset Value and Time Constant
When 1 Channel are Used***

Filter preset value	0 to 1	2 to 3	4 to 7	8 to 15	16 to 31	32 to 63	64 to 127	128 to 255	256 to 510	511 to 1021	1022 to 2043	2044 to 32767
Time constant (ms)	1.4	3.5	7.5	15.5	31.5	63.5	127.5	255.5	511.5	1023.5	2047.5	4095.5

The minimum actual time constant is used with either of the following setup:

- The operation mode is set to turn on the filter, but a filter preset value is not set.
- The filter preset value is negative.

Actual time constants are calculated using the following equation:

$$T = - \frac{T_0}{\ln \frac{2^n - 1}{2^n}}$$

T : Time constant [ms]

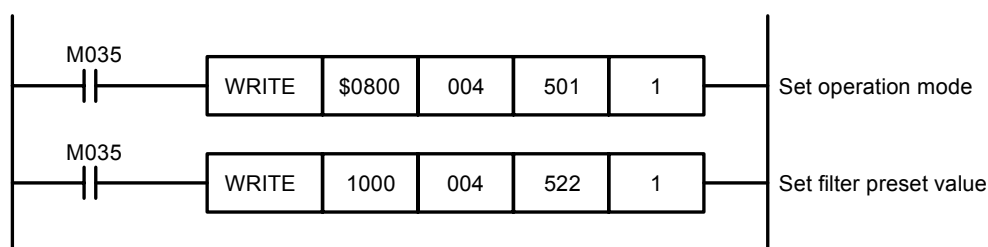
T₀: Converted speed (1ms x number of channels) [ms]

n : 1 to 12

Example

This example sets the filter preset value of channel 1 for the module installed in slot 004 to 1000.

● Using Special Module Write instructions in ladder



For details on ladder instructions, see Section B2.3.

● Using BASIC statements

CONTROL 4,1;\$0800 Set operation mode

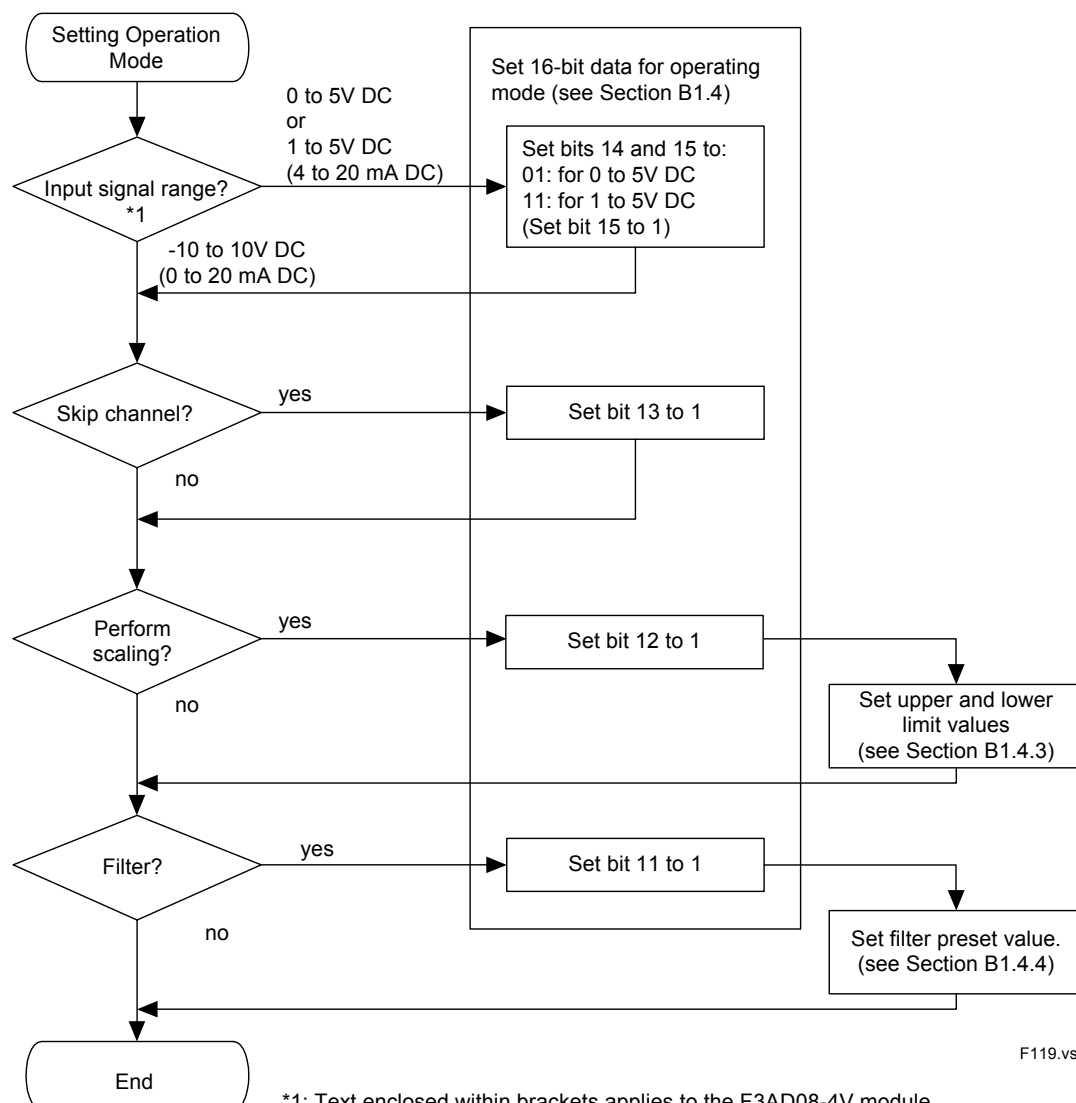
CONTROL 4,22;1000 Set filter preset value

Note: You should declare the use of the module using an ASSIGN statement before executing any BASIC statement to access the module.

For details on BASIC instructions, see Section B3.6.

B1.4.5 Flowchart for Setting Operation Mode

To use the default operation mode, no setup is required. To change the default operation mode, use the following procedure.



F119.vsd

Figure B1.36 Flowchart for Setting Operation Mode

The operation mode, scaling and filter preset values reset whenever power is turned off. When power is turned on again, the module operates with default values. Thus, you need to set the operation mode each time power is turned on.

B1.5 Attaching and Detaching Modules

■ Attaching/Detaching Modules

Figure B1.37 shows how to attach this module to the base module. First hook the anchor slot at the bottom of the module to be attached onto the anchor pin on the bottom of the base module. Push the top of this module towards the base module until the anchor/release button clicks into place.



CAUTION

Always switch off the power before attaching or detaching a module.

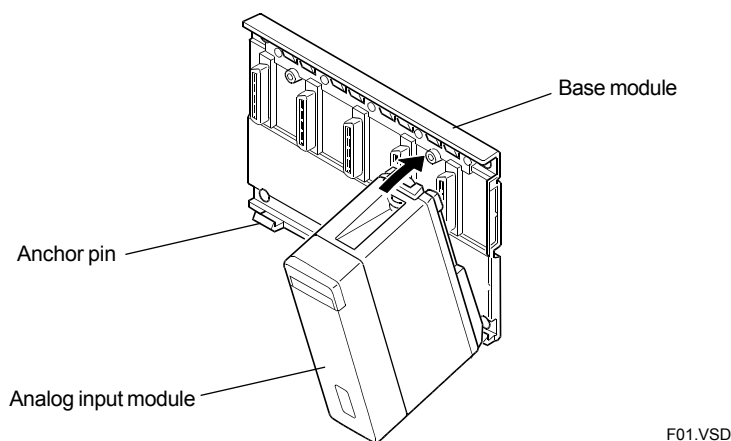


Figure B1.37 Attaching Modules



CAUTION

DO NOT bend the connector on the rear of the module by force during the above operation. If the module is pushed with improper force, the connector may bend causing an error.

■ Detaching Modules

To remove this module from the base module, reverse the above operation. Press the anchor/release button on the top of this module to unlock it and tilt the module away from the base module. Then lift the module off the anchor pin at the base.

■ Attaching Modules in Intense Vibration Environments

If the module is used in intense vibration environments, fasten the module with a screw. Use screws of type listed in the table below. Insert these screws into the screw holes on top of the module and tighten them with a Phillips screwdriver.

Screw Required
M4-size Binder screw 12 to 15 mm long (or 14 to 15 mm if fitted with a washer)

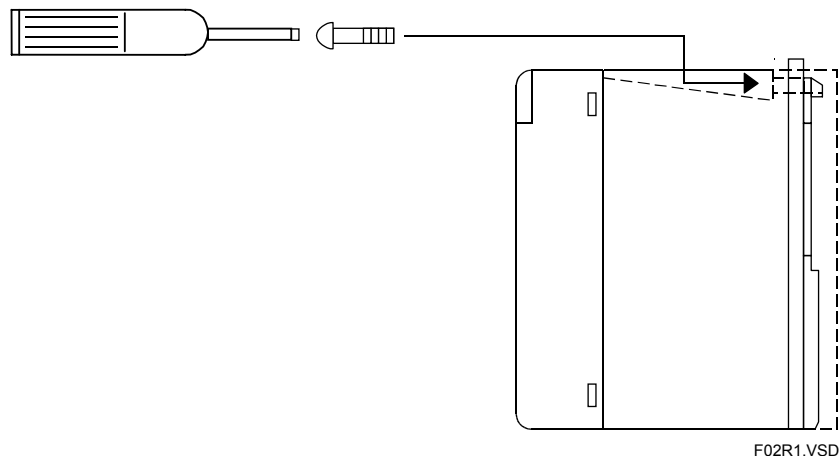


Figure B1.38 Tightening the Module

B2. Data Access Using Special Module Instructions in Ladder

B2.1 List of Data Position Numbers

■ F3AD04-0V, F3AD04-0R

Table B2.1 lists the data position numbers for the analog input module (F3AD04-0V, F3AD04-0R). There are 3 data areas.

- Input data : Area for storing input voltage data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data : Area for setting upper and lower limits for scaling and filter preset values

Table B2.1 Data Position Numbers for F3AD04-0V and F3AD04-0R (Ladder)

Area	Data Position Number	Description
Input data	1	Input voltage for channel 1
	2	Input voltage for channel 2
	3	Input voltage for channel 3
	4	Input voltage for channel 4
Operation mode	501	Operation mode preset value for channel 1 (Input signal range, skip, scaling, filter)
	502	Operation mode preset value for channel 2 (Input signal range, skip, scaling, filter)
	503	Operation mode preset value for channel 3 (Input signal range, skip, scaling, filter)
	504	Operation mode preset value for channel 4 (Input signal range, skip, scaling, filter)
Operation details data	520	Upper limit preset value for scaling for channel 1
	521	Lower limit preset value for scaling for channel 1
	522	Filter preset value for channel 1
	530	Upper limit preset value for scaling for channel 2
	531	Lower limit preset value for scaling for channel 2
	532	Filter preset value for channel 2
	540	Upper limit preset value for scaling for channel 3
	541	Lower limit preset value for scaling for channel 3
	542	Filter preset value for channel 3
	550	Upper limit preset value for scaling for channel 4
	551	Lower limit preset value for scaling for channel 4
	552	Filter preset value for channel 4

■ F3AD08-1V, F3AD08-1R

Table B2.1 lists the data position numbers for the analog input module (F3AD08-1V, F3AD08-1R). There are 3 data areas.

- Input data : Area for storing input voltage data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data : Area for setting upper and lower limits for scaling and filter preset values

Table B2.2 Data Position Numbers for F3AD08-1V and F3AD08-1R (Ladder)

Area	Data Position Number	Description
Input data	1	Input voltage for channel 1
	2	Input voltage for channel 2
	3	Input voltage for channel 3
	4	Input voltage for channel 4
	5	Input voltage for channel 5
	6	Input voltage for channel 6
	7	Input voltage for channel 7
	8	Input voltage for channel 8
Operation mode	501	Operation mode preset value for channel 1 (Input signal range, skip, scaling, filter)
	502	Operation mode preset value for channel 2 (Input signal range, skip, scaling, filter)
	503	Operation mode preset value for channel 3 (Input signal range, skip, scaling, filter)
	504	Operation mode preset value for channel 4 (Input signal range, skip, scaling, filter)
	505	Operation mode preset value for channel 5 (Input signal range, skip, scaling, filter)
	506	Operation mode preset value for channel 6 (Input signal range, skip, scaling, filter)
	507	Operation mode preset value for channel 7 (Input signal range, skip, scaling, filter)
	508	Operation mode preset value for channel 8 (Input signal range, skip, scaling, filter)
Operation details data	520	Upper limit preset value for scaling for channel 1
	521	Lower limit preset value for scaling for channel 1
	522	Filter preset value for channel 1
	530	Upper limit preset value for scaling for channel 2
	531	Lower limit preset value for scaling for channel 2
	532	Filter preset value for channel 2
	540	Upper limit preset value for scaling for channel 3
	541	Lower limit preset value for scaling for channel 3
	542	Filter preset value for channel 3
	550	Upper limit preset value for scaling for channel 4
	551	Lower limit preset value for scaling for channel 4
	552	Filter preset value for channel 4
	560	Upper limit preset value for scaling for channel 5
	561	Lower limit preset value for scaling for channel 5
	562	Filter preset value for channel 5
	570	Upper limit preset value for scaling for channel 6
	571	Lower limit preset value for scaling for channel 6
	572	Filter preset value for channel 6
	580	Upper limit preset value for scaling for channel 7
	581	Lower limit preset value for scaling for channel 7
	582	Filter preset value for channel 7
	590	Upper limit preset value for scaling for channel 8
	591	Lower limit preset value for scaling for channel 8
	592	Filter preset value for channel 8

■ F3AD08-4V

Table B2.3 lists the data position numbers for the analog input module (F3AD08-4V). There are 3 data areas.

- Input data : Area for storing input current data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data : Area for setting upper and lower limits for scaling and filter preset values

Table B2.3 Data Position Numbers for F3AD08-4V (Ladder)

Area	Data Position Number	Description
Input data	1	Input current for channel 1
	2	Input current for channel 2
	3	Input current for channel 3
	4	Input current for channel 4
	5	Input current for channel 5
	6	Input current for channel 6
	7	Input current for channel 7
	8	Input current for channel 8
Operation mode	501	Operation mode preset value for channel 1 (Input signal range, skip, scaling, filter)
	502	Operation mode preset value for channel 2 (Input signal range, skip, scaling, filter)
	503	Operation mode preset value for channel 3 (Input signal range, skip, scaling, filter)
	504	Operation mode preset value for channel 4 (Input signal range, skip, scaling, filter)
	505	Operation mode preset value for channel 5 (Input signal range, skip, scaling, filter)
	506	Operation mode preset value for channel 6 (Input signal range, skip, scaling, filter)
	507	Operation mode preset value for channel 7 (Input signal range, skip, scaling, filter)
	508	Operation mode preset value for channel 8 (Input signal range, skip, scaling, filter)
Operation details data	520	Upper limit preset value for scaling for channel 1
	521	Lower limit preset value for scaling for channel 1
	522	Filter preset value for channel 1
	530	Upper limit preset value for scaling for channel 2
	531	Lower limit preset value for scaling for channel 2
	532	Filter preset value for channel 2
	540	Upper limit preset value for scaling for channel 3
	541	Lower limit preset value for scaling for channel 3
	542	Filter preset value for channel 3
	550	Upper limit preset value for scaling for channel 4
	551	Lower limit preset value for scaling for channel 4
	552	Filter preset value for channel 4
	560	Upper limit preset value for scaling for channel 5
	561	Lower limit preset value for scaling for channel 5
	562	Filter preset value for channel 5
	570	Upper limit preset value for scaling for channel 6
	571	Lower limit preset value for scaling for channel 6
	572	Filter preset value for channel 6
	580	Upper limit preset value for scaling for channel 7
	581	Lower limit preset value for scaling for channel 7
	582	Filter preset value for channel 7
	590	Upper limit preset value for scaling for channel 8
	591	Lower limit preset value for scaling for channel 8
	592	Filter preset value for channel 8

B2.2 Reading Data (READ/HRD)

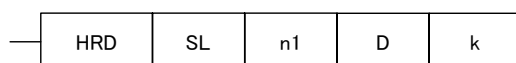
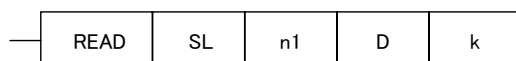
To read data from the analog input module, use the Special Module Read instruction or Special Module High Speed Read instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

● Description of Instructions

Table B2.4 Special Module Read Instruction and Special Module High Speed Read Instruction

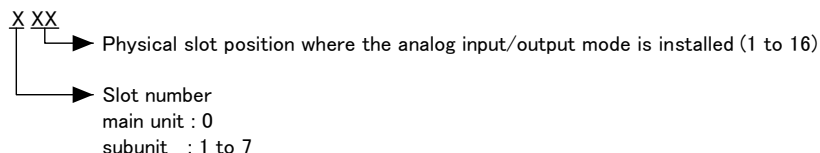
Function No.	Instruction	Mnemonic	Symbol	Is Input condition Required?		Condition for Execution	Step count	Processing unit	Carry
				Yes	No				
81	Special module read	READ		•	—		5	16 bits	—
81P		↑READ					6		
83	Special module high speed read	HRD		•	—		5	16 bits	—
83P		↑HRD					6		

● Symbols



SL : Slot Number
 n1 : First Data Position Number for Reading
 D : First Device Number for Writing Read Data
 k : Transfer Data Count

Slot Number: a 3-digit integer (leading '0's may be omitted)



First Data Position Number for Reading : Data position number from which to start reading (see Table B2.1, B2.2 or B2.3)
 First Device Number for Writing Read Data : For available devices, (see "Sequence CPU Modules – Instructions" manual.)
 Transfer Data Count : Number of data to read

Special Module Long Word Read instructions cannot be used to read data from analog input modules. The results of such operations are not guaranteed.

■ Reading Data from the Analog Input Module

- Specify the data position number of the input data in the First Data Position Number for Reading (n1).
- Ensure that the specified data position number of the input data matches the required channel number.

● Sample Program for Reading Analog Data

This program reads data from channels 1 to 4 of the analog input module installed in slot 106 into data registers (D0001 to D0004) when relay X00501 turns on.

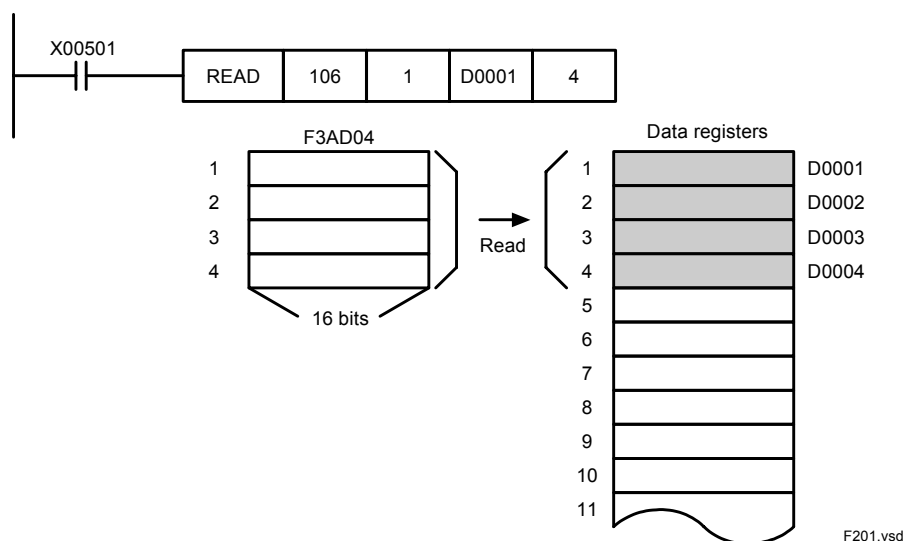


Figure B2.1 Reading Analog Data

■ Reading Operation Mode, Scaling Limits and Other Data

Specify the data position number of the operation mode, operation details data or scaling data in the First Data Position Number for Reading (n1).

● Sample Program for Reading Operation Mode

This program reads operation mode data of for channels 1 to 3 of the analog input module installed in slot 106 into data registers (D0001 to D0003) when relay X00501 turns on.

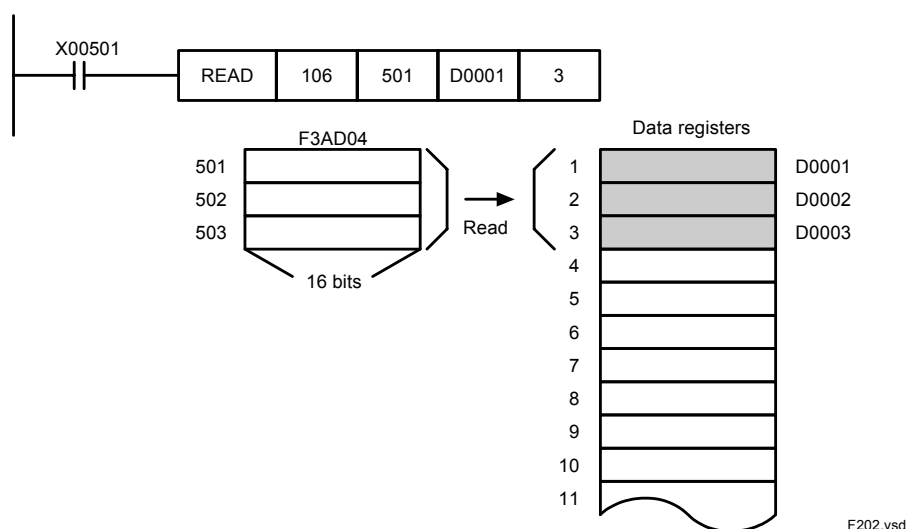


Figure B2.2 Reading Operation Mode

B2.3 Writing Data (WRITE/HWR)

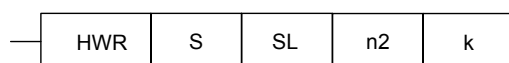
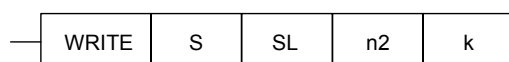
To write data to the analog input module, use the Special Module Write instruction or Special Module High Speed Write instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

● Description of Instructions

Table B2.5 Special Module Write Instruction and Special Module High Speed Write Instruction

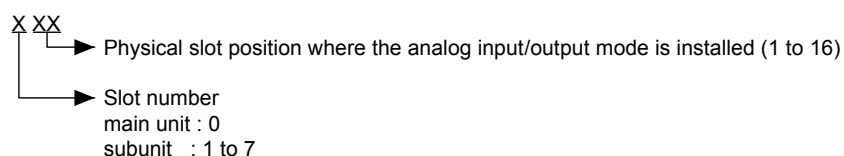
Function No.	Instruction	Mnemonic	Symbol	Is Input condition Required?		Condition for Execution	Step count	Processing unit	Carry
				Yes	No				
82	Special module write	WRITE		•	—		5	16 bit	—
82P		↑ WRITE					6		
84	Special module high speed write	HWR		•	—		5	16 bit	—
84P		↑ HWR					6		

● Symbols



S : First Device Number for Write Data
 SL : Slot Number
 n2 : First Data Position Number for Writing
 k : Transfer Data Count

First Device Number for Write Data : For evaliable devices, see "Sequence CPU Modules - Instructions" manual.
 Slot Number : a 3-digit integer (leading '0's may be omitted)



First Data Position Number for Writing : Data position number from which to start writing (see Table B2.1, B2.2 or B2.3)
 Transfer Data Count : Number of write data

Special Module Long Word Write instructions cannot be used to write data to analog input modules. The results of such operations are not guaranteed.

■ Writing Operation Mode, Scaling Limits and Other Data

Specify the data position number of the operation mode, operation details data or scaling data in the First Data Position Number for Writing (n2).

● Sample Program for Setting Scaling Limits

This program sets the lower limit and upper limit for scaling for channel 1 of the analog input module installed in slot 004 to 0 and 1000 respectively when X00501 turns on.

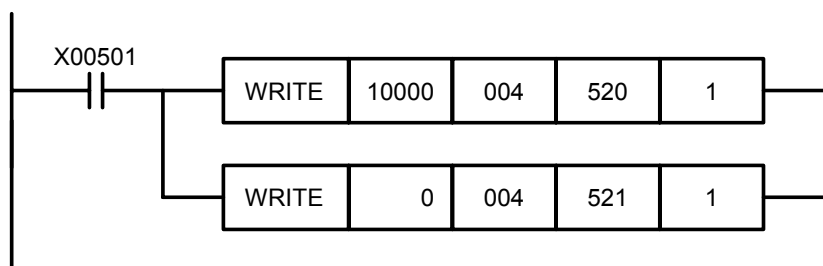


Figure B2.3 Setting Scaling Limits

B3. Data Access Using BASIC Statements

B3.1 List of BASIC Statements

Table B3.1 lists the BASIC statements that can be used in the analog input module. Module operation is not guaranteed when statements not listed in Table B3.1 are used.

Table B3.1 Usable BASIC Statements

Function	Syntax	Description
Declare use of module	Example: ASSIGN AD04=SL SL : Slot number	Defines the mapping between modules and slot numbers. Always execute this statement before accessing an analog input module. Execute this statement in the main program.
	Example: ASSIGN AD08=SL SL : Slot number	
Read data from analog input module	ENTER SL, n NOFORMAT; I or ENTER SL NOFORMAT; I(*) SL: Slot number n : Data position number (channel number) I : Name of variable for storing read data	Reads analog data of channel n of the analog input module installed in slot SL and stores it in input variable I. If the channel number is omitted, reads analog data sequentially starting from channel 1 into input array variable I(*).
Read operation mode, scaling limits, etc.	STATUS SL, n; P or STATUS SL; P(*) SL : Slot number n : Data position number P : Name of variable for storing read data	Reads operation mode, scaling limit or other data at data position number n of the analog input module installed in slot SL and stores it in input variable P.
Set operation mode, scaling limits, etc.	CONTROL SL, n; P or CONTROL SL; P(*) SL : Slot number n : Data position number P : Preset data	Sets operation mode, scaling limit or other data at data position number n of the analog input module installed in slot number SL using preset data P.

B3.2 List of Data Position Numbers

■ F3AD04-0V, F3AD04-0R

Table B3.2 lists the data position numbers (BASIC) for the analog input module (F3AD04-0V, F3AD04-0R). There are 3 data areas.

- Input data : Area for storing input voltage data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data : Area for setting upper and lower limits for scaling and filter preset values

Table B3.2 Data Position Numbers for F3AD04-0V and F3AD04-0R (BASIC)

Area	Data Position Number	Description
Input data	1	Input voltage for channel 1
	2	Input voltage for channel 2
	3	Input voltage for channel 3
	4	Input voltage for channel 4
Operation mode	1	Operation mode preset value for channel 1 (Input signal range, skip, scaling, filter)
	2	Operation mode preset value for channel 2 (Input signal range, skip, scaling, filter)
	3	Operation mode preset value for channel 3 (Input signal range, skip, scaling, filter)
	4	Operation mode preset value for channel 4 (Input signal range, skip, scaling, filter)
Operation details data	20	Upper limit preset value for scaling for channel 1
	21	Lower limit preset value for scaling for channel 1
	22	Filter preset value for channel 1
	30	Upper limit preset value for scaling for channel 2
	31	Lower limit preset value for scaling for channel 2
	32	Filter preset value for channel 2
	40	Upper limit preset value for scaling for channel 3
	41	Lower limit preset value for scaling for channel 3
	42	Filter preset value for channel 3
	50	Upper limit preset value for scaling for channel 4
	51	Lower limit preset value for scaling for channel 4
	52	Filter preset value for channel 4

■ F3AD08-1V, F3AD08-1R

Table B3.3 lists the data position numbers (BASIC) for the analog input module (F3AD08-1V, F3AD08-1R). There are 3 data areas.

- Input data : Area for storing input voltage data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data : Area for setting upper and lower limits for scaling and filter preset values

Table B3.3 Data Position Numbers for F3AD08-1V and F3AD08-1R (BASIC)

Area	Data Position Number	Description
Input data	1	Input voltage for channel 1
	2	Input voltage for channel 2
	3	Input voltage for channel 3
	4	Input voltage for channel 4
	5	Input voltage for channel 5
	6	Input voltage for channel 6
	7	Input voltage for channel 7
	8	Input voltage for channel 8
Operation mode	1	Operation mode preset value for channel 1 (Input signal range, skip, scaling, filter)
	2	Operation mode preset value for channel 2 (Input signal range, skip, scaling, filter)
	3	Operation mode preset value for channel 3 (Input signal range, skip, scaling, filter)
	4	Operation mode preset value for channel 4 (Input signal range, skip, scaling, filter)
	5	Operation mode preset value for channel 5 (Input signal range, skip, scaling, filter)
	6	Operation mode preset value for channel 6 (Input signal range, skip, scaling, filter)
	7	Operation mode preset value for channel 7 (Input signal range, skip, scaling, filter)
	8	Operation mode preset value for channel 8 (Input signal range, skip, scaling, filter)
Operation details data	20	Upper limit preset value for scaling for channel 1
	21	Lower limit preset value for scaling for channel 1
	22	Filter preset value for channel 1
	30	Upper limit preset value for scaling for channel 2
	31	Lower limit preset value for scaling for channel 2
	32	Filter preset value for channel 2
	40	Upper limit preset value for scaling for channel 3
	41	Lower limit preset value for scaling for channel 3
	42	Filter preset value for channel 3
	50	Upper limit preset value for scaling for channel 4
	51	Lower limit preset value for scaling for channel 4
	52	Filter preset value for channel 4
	60	Upper limit preset value for scaling for channel 5
	61	Lower limit preset value for scaling for channel 5
	62	Filter preset value for channel 5
	70	Upper limit preset value for scaling for channel 6
	71	Lower limit preset value for scaling for channel 6
	72	Filter preset value for channel 6
	80	Upper limit preset value for scaling for channel 7
	81	Lower limit preset value for scaling for channel 7
	82	Filter preset value for channel 7
	90	Upper limit preset value for scaling for channel 8
	91	Lower limit preset value for scaling for channel 8
	92	Filter preset value for channel 8

■ F3AD08-4V

Table B3.4 lists the data position numbers (BASIC) for the analog input module (F3AD08-4V). There are 3 data areas.

- Input data : Area for storing input current data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data : Area for setting upper and lower limits for scaling and filter preset values

Table B3.4 Data Position Numbers for F3AD08-4V (BASIC)

Area	Data Position Number	Description
Input data	1	Input current for channel 1
	2	Input current for channel 2
	3	Input current for channel 3
	4	Input current for channel 4
	5	Input current for channel 5
	6	Input current for channel 6
	7	Input current for channel 7
	8	Input current for channel 8
Operation mode	1	Operation mode preset value for channel 1 (Input signal range, skip, scaling, filter)
	2	Operation mode preset value for channel 2 (Input signal range, skip, scaling, filter)
	3	Operation mode preset value for channel 3 (Input signal range, skip, scaling, filter)
	4	Operation mode preset value for channel 4 (Input signal range, skip, scaling, filter)
	5	Operation mode preset value for channel 5 (Input signal range, skip, scaling, filter)
	6	Operation mode preset value for channel 6 (Input signal range, skip, scaling, filter)
	7	Operation mode preset value for channel 7 (Input signal range, skip, scaling, filter)
	8	Operation mode preset value for channel 8 (Input signal range, skip, scaling, filter)
Operation details data	20	Upper limit preset value for scaling for channel 1
	21	Lower limit preset value for scaling for channel 1
	22	Filter preset value for channel 1
	30	Upper limit preset value for scaling for channel 2
	31	Lower limit preset value for scaling for channel 2
	32	Filter preset value for channel 2
	40	Upper limit preset value for scaling for channel 3
	41	Lower limit preset value for scaling for channel 3
	42	Filter preset value for channel 3
	50	Upper limit preset value for scaling for channel 4
	51	Lower limit preset value for scaling for channel 4
	52	Filter preset value for channel 4
	60	Upper limit preset value for scaling for channel 5
	61	Lower limit preset value for scaling for channel 5
	62	Filter preset value for channel 5
	70	Upper limit preset value for scaling for channel 6
	71	Lower limit preset value for scaling for channel 6
	72	Filter preset value for channel 6
	80	Upper limit preset value for scaling for channel 7
	81	Lower limit preset value for scaling for channel 7
	82	Filter preset value for channel 7
	90	Upper limit preset value for scaling for channel 8
	91	Lower limit preset value for scaling for channel 8
	92	Filter preset value for channel 8

B3.3 Declaring Use of Module (ASSIGN)

Always declare module use before accessing an analog input module using an ASSIGN statement. The ASSIGN statement defines the module name and slot number. Use the ASSIGN statement in the main program.

ASSIGN AD04 = SL

Module name
AD04: Analog input module
AD08: Analog input module

SL: Slot number. Numerical value or numerical variable
A 3-digit integer (leading '0's may be omitted)

X XX

Physical slot position where the module is installed (1 to 16)

Unit number
Main unit : 0
Subunit : 1 to 7

B3.4 Reading Data from the Analog Input Module (ENTER)

Use the ENTER statement to read data from the analog input module. The data read is stored in the specified input variable or input variable array. If the channel number is omitted, the statement reads data, starting from channel number 1. The number of channels read is determined by the number of input variables.

ENTER SL, n NOFORMAT ; I

Channel number. Numerical value or numerical variable
n : 1 to 4 (for F3AD04)
1 to 8 (for F3AD08)

Slot number. Numerical value or numerical variable

Input variable. Numerical variable (integer-type)

ENTER SL NOFORMAT ; I1, I2, . . . I□

I1 to I□: List of variables for storing input data (integer-type numerical variable)
(Number of variables should not exceed number of channels in use)
□: 1 to 4 (for F3AD04)
1 to 8 (for F3AD08)
Other parameters are the same as above.

ENTER SL NOFORMAT ; I (*)

I (*): Integer-type array variable for storing input data
Other parameters are the same as above.

Only integer variables can be used for input variables or variables for storing input data. Long integer variables cannot be used. Operation is not guaranteed if a long integer variable is used as an input variable or a variable for storing input data.

B3.5 Reading Operation Mode, Scaling Limits and Other Data (STATUS)

Use the STATUS statement to read the operation mode and scaling limits of an analog input module. This statement reads the operation mode or other data in the specified data position number and stores it in an input variable or input variable array.

STATUS SL, n ; P

- Input variable. Numerical variable
- Data position number (See Table B3.2, B3.3 or B3.4)
- Numerical value or numerical variable
- Slot number. Numerical value or numerical variable

B3.6 Writing Operation Mode, Scaling Limits and Other Data (CONTROL)

Use the CONTROL statement to read the operation mode, scaling, filter or other preset values of an analog input module.

CONTROL SL, n ; P

- Preset data. Numerical value or numerical variable
- Data position number (See Table B3.2, B3.3 or B3.4)
- Numerical value or numerical variable
- Slot number. Numerical value or numerical variable

B4. Sample Programs

This sample program sets the following operation modes for each channel of the analog input module (F3AD04-0V) installed in slot 004, and then reads input data.

Table B4.1 Operation Mode for Analog Input Module

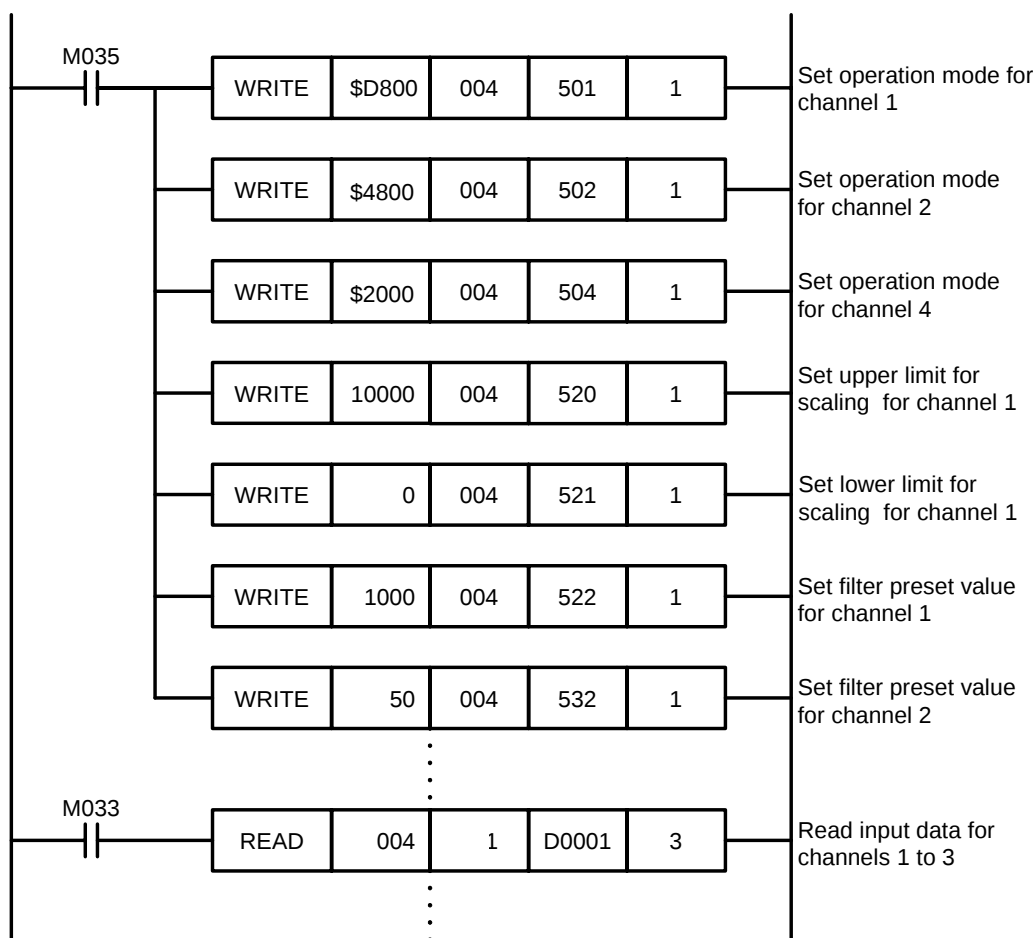
	Input Signal Range (V DC)	Scaling	Filter Time Constant (ms)
Channel 1	1 to 5	0 to 10000	1000
Channel 2	0 to 5	—	50
Channel 3	-10 to 10	—	—
Channel 4	Unused (skipped)		

The operation mode is given below in binary (16-bit) and hexadecimal notation.

Channel 1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0
	\$		D				8				0				0
Channel 2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
	\$		4				8				0				0
Channel 3	Using default values so no setup is required.														
Channel 4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	\$		2				0				0				0

F401.vsd

● Ladder Sample Program



F402.vsd

● BASIC Sample Program

```

10 ! F3AD04 Program
20 !
30 DEFINT A-Z
40 OPTION BASE 1
50 DIM ENTBUFF(3)
60 SL=4
70 ASSIGN AD04=SL           Declare module use
80 CONTROL SL,1;$D800       Set operation mode for channel 1
90 CONTROL SL,2;$4800       Set operation mode for channel 2
100 CONTROL SL,4;$2000      Set operation mode for channel 4
110 CONTROL SL,20;10000     Set upper limit for scaling for channel 1
120 CONTROL SL,21;0        Set lower limit for scaling for channel 1
130 CONTROL SL,22;1000     Set filter preset value for channel 1
140 CONTROL SL,32;50       Set filter preset value for channel 2
150 :
160 :
300 ENTER SL NOFORMAT;ENTBUFF(*)Read input data for channels 1 to 3
310 DISP ENTBUFF(*)

```

B5. Q&A

This chapter lists some frequently-asked questions with their answers.

B5.1 Troubleshooting

Q: What should I do when the ALM LED turns on? Can I leave it alone?

A : A module error has occurred. The accuracy of the module may no longer meet specifications. Contact the dealer and have the module repaired or replaced.

Q: The A/D conversion results cannot be read.

A: Check the following:

(1) Is the RDY LED lit?

Yes → A1

No → (2)

(2) Is the RDY LED lit when the module is inserted in a different slot?

Yes → A2

No → A3



CAUTION

Always switch off the power before inserting or removing the module. Otherwise, the module may be damaged.

A1 : Check the read address and the operation mode of each channel. If no error is found, there is probably a hardware failure. Contact your dealer.

A2 : There is probably a base module failure. Contact your dealer.

A3 : There is probably a module failure. Contact your dealer.

B5.2 Usage Tips

Q: How do I read a 4 to 20 mA signal?

A: The simplest way is to use a F3AD08-4V model. If you are using any other model, you need to perform the following setup. Secure a 250Ω resistor between the positive and negative terminals of each channel to convert its current signal into voltage signal. Select the resistor carefully because its accuracy and stability will affect the conversion result of the F3AD04 or F3AD08 module. Accuracy of the resistance value is not important if scaling is used and system calibration is performed. For details on the scaling function, see Section B1.4, "Operation Mode".

Q: Can I sample all channels simultaneously on models F3AD04 and F3AD08?

A: No. Channels are sampled sequentially with a 1-ms time lapse between two channels.

Q: How much time is required for verifying a signal change using ladder?

A: The time required depends on the number of channels used in the analog input module, the ladder scan time and the time of occurrence of the signal change to be detected. The shortest time required is 1 ms. The longest time required is $(1 + \text{number of channels used} + \text{period of ladder})$ ms.



CAUTION

The above time required assumes that no digital filter is used. When a digital filter is used, you should also consider the filter delay.

FA-M3

Analog Input/Output Module Instruction Manual

PART B

IM 34M6H11-02E 3rd Edition

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