



## **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 |

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# 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

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# 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.

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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.

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## ■ 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.

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- **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 benzene 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  $-20^{\circ}\text{C}$  to  $75^{\circ}\text{C}$ ).
- 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\*<sup>1</sup>, 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  $\mu$ 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<br>-18 V DC or -25 mA DC minimum   |  |   |
| Input signal range <sup>*1</sup>                            | Current signal only<br><br>0 to 20mADC (-1.0 to 21.0 mADC)<br>4 to 20mADC (-1.0 to 21.0 mADC)  | Voltage signal only<br>0 to 5 VDC (-0.25 to 5.25 VDC)<br>1 to 5 VDC (-0.25 to 5.25 VDC)<br>-10 to 10 VDC (-11.0 to 11.0 VDC)<br>0 to 10 VDC (-0.5 to 10.5 VDC) | Voltage signal or current signal<br>0 to 5 VDC (-0.25 to 5.25 VDC)<br>1 to 5 VDC (-0.25 to 5.25 VDC)<br>-10 to 10 VDC (-11.0 to 11.0 VDC)<br>0 to 10 VDC (-0.5 to 10.5 VDC)<br>0 to 20mADC (-1.0 to 21.0 mADC)<br>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)<br>±1 VDC max. (-10 to 10 VDC, 0 to 10 VDC)   |  |   |
| Isolation method  | Across input terminals and internal circuit: Photocoupler isolation<br>Across input terminals: Not isolated  |  |   |
| Withstanding voltage  | 500 V DC for one minute  |  |   |
| Input resistance  | 250Ω   | 1M Ω min. <sup>*2</sup>  | 1M Ω min. when configured for voltage input <sup>*2</sup><br>250 Ω when configured for current input  |
| Maximum Resolution <sup>*3</sup><br>(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<br>0.5 mV for -10 to 10 VDC input signal range<br>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)<br>0 to 55°C: ± 0.2% (full scale) <sup>*4</sup>  |  |   |
| Conversion period <sup>*5</sup>                             | 50 μs, 100 μs, 250 μs, 500 μs, 1 ms, 16.6 ms, 20 ms, 100 ms per channel<br>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 <sup>*6-7</sup>   |  |   |
| Hold data   | Supports recording of peak values and trough values  |  |   |
| Self diagnosis  | Hardware self-diagnosis during operation<br>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 <sup>*8</sup>  |  |   |
| 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.

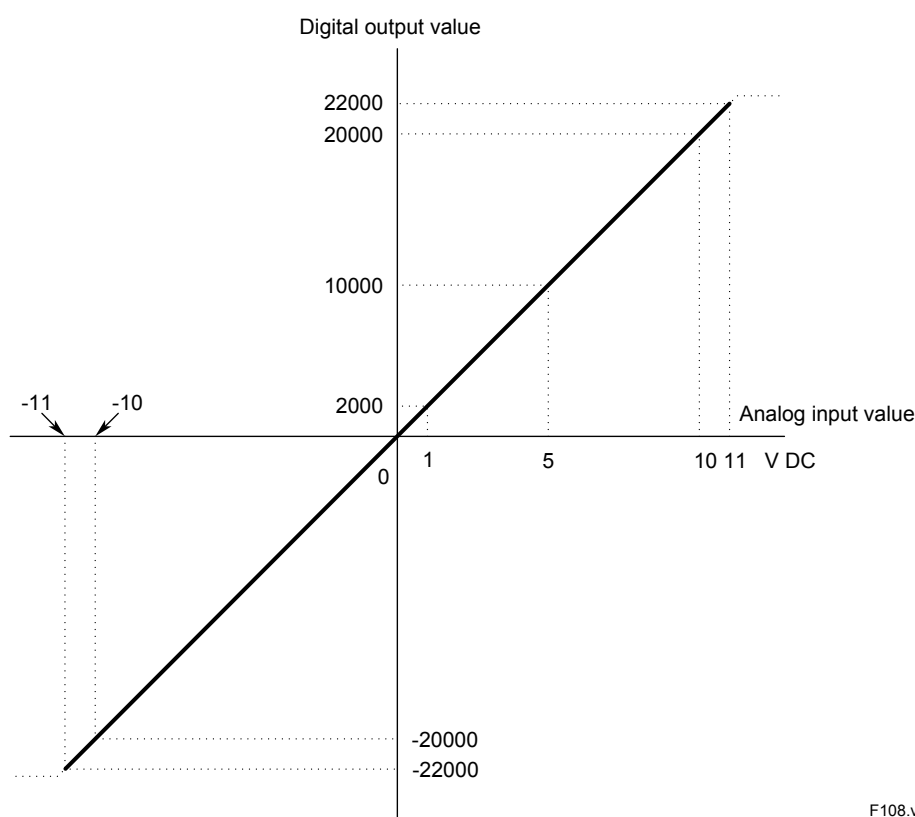
## ■ Input/Output Conversion Characteristics

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.

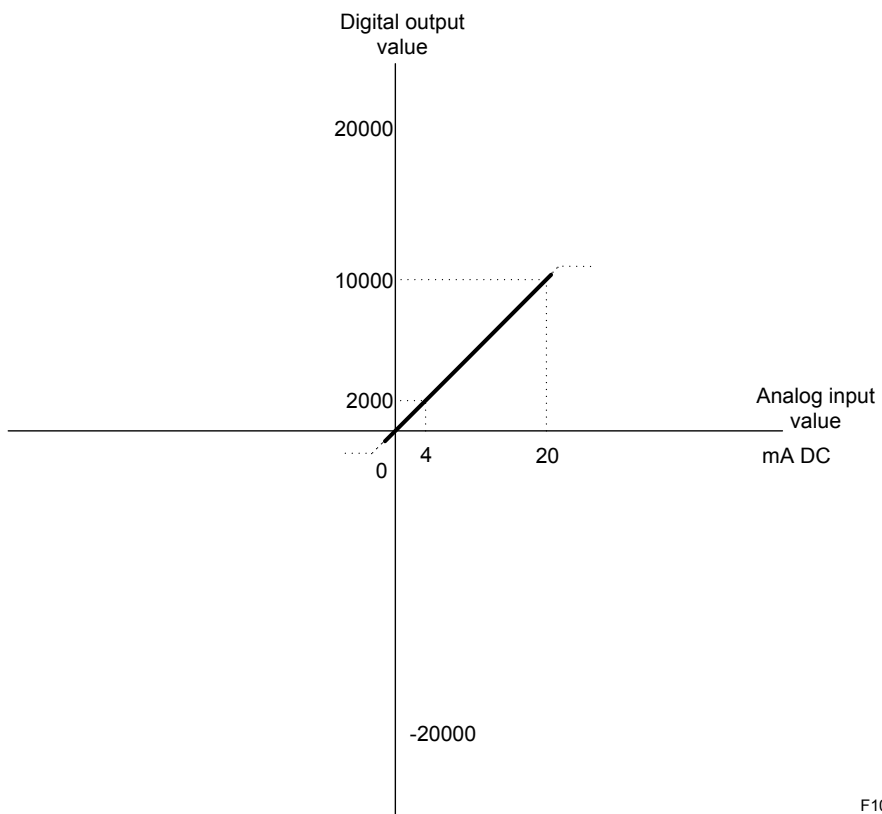
For details on scaling, see Section A3.5.

**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

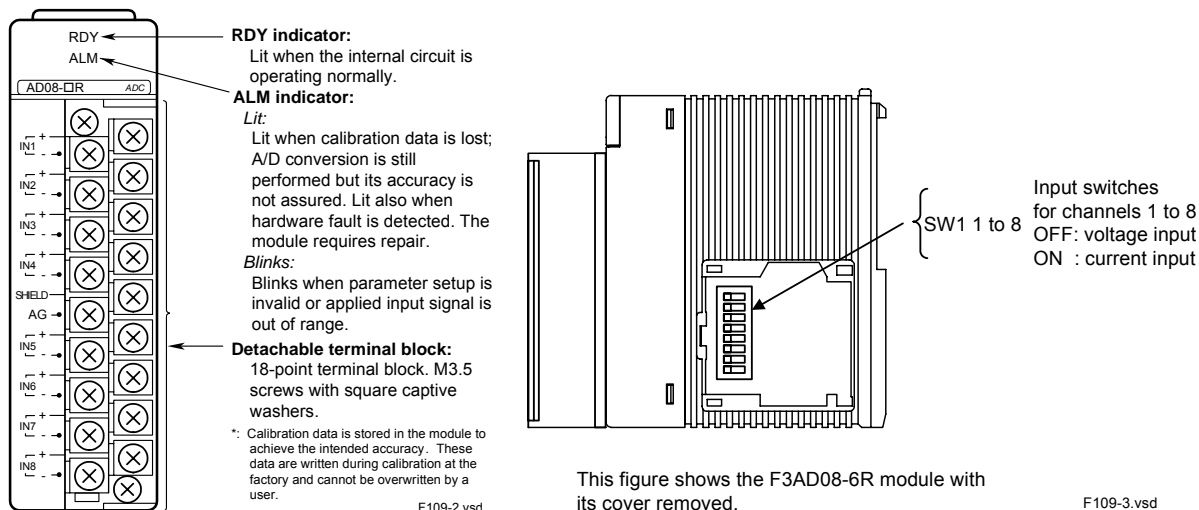
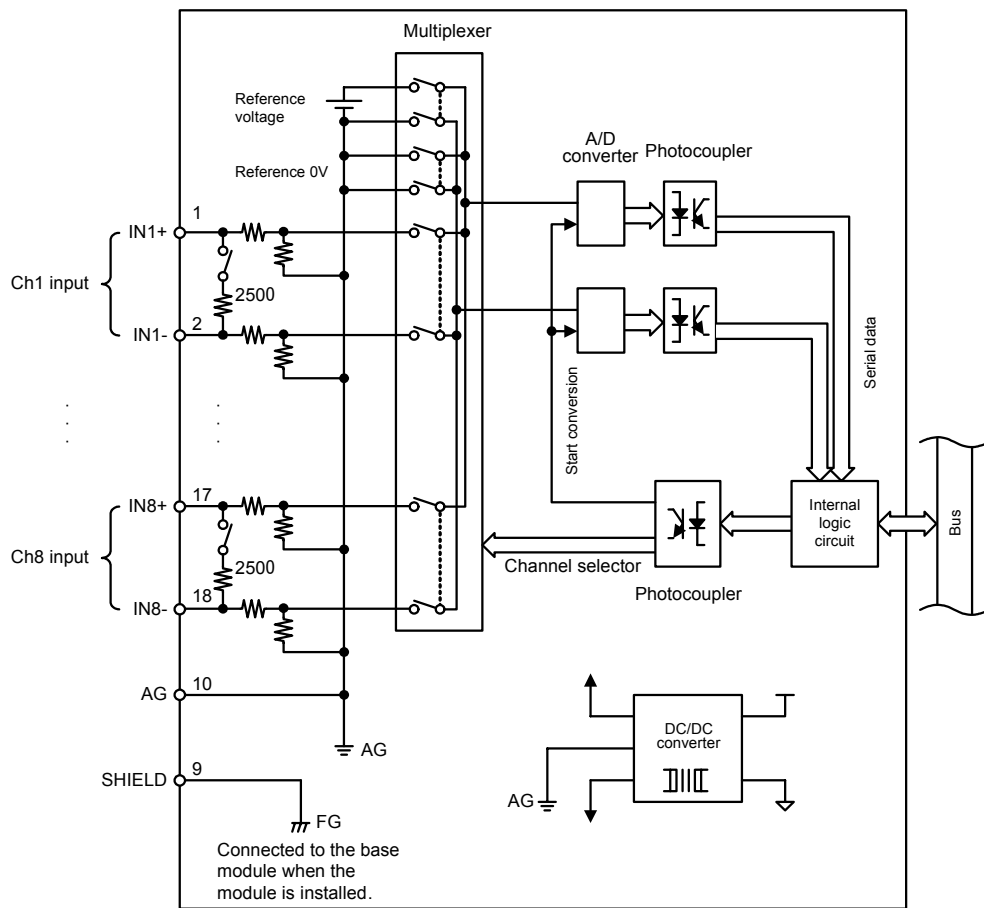


Figure A1.3 Components and Functions

## ■ Internal Circuit



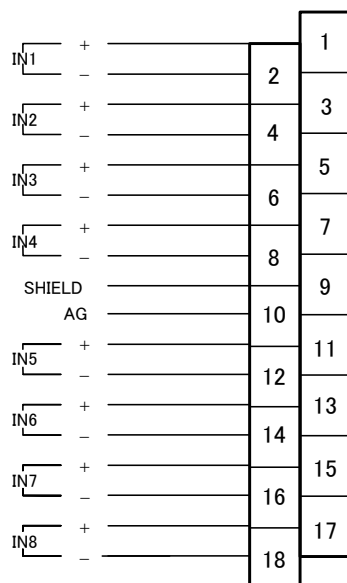
F110-2.vsd

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 <sup>2</sup> )   |
| 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:<br>Type V1.25-M3 (from Japan Solderless Terminal Mfg. Co., Ltd.) or<br>RAV1.25-3.5 (from Nippon Tanshi Co., Ltd.) |



### CAUTION

Always use an appropriate crimping tool specified by the manufacturer.

### Wiring Precautions



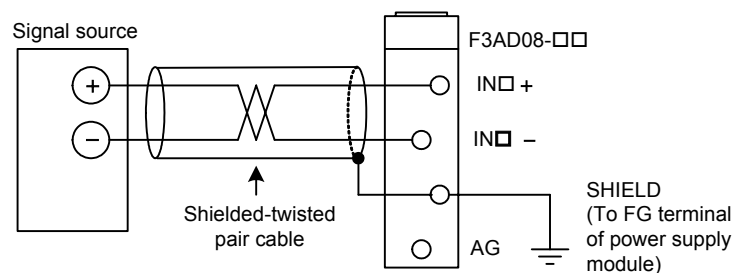
### CAUTION

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

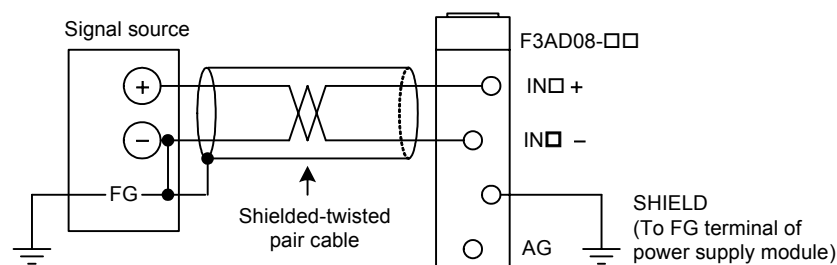
(The SHIELD terminals are connected to the FG terminal of the power supply module via the base module.)



F11101-2.vsd

**Figure A1.6 Wiring Example**

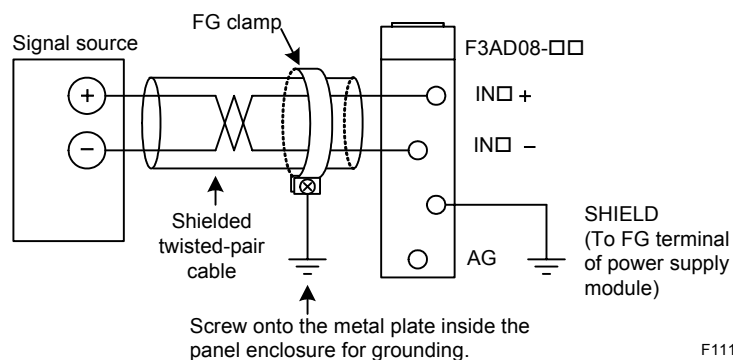
- Connecting the shield to SHIELD terminal (FG terminal) provided at the signal source



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**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.

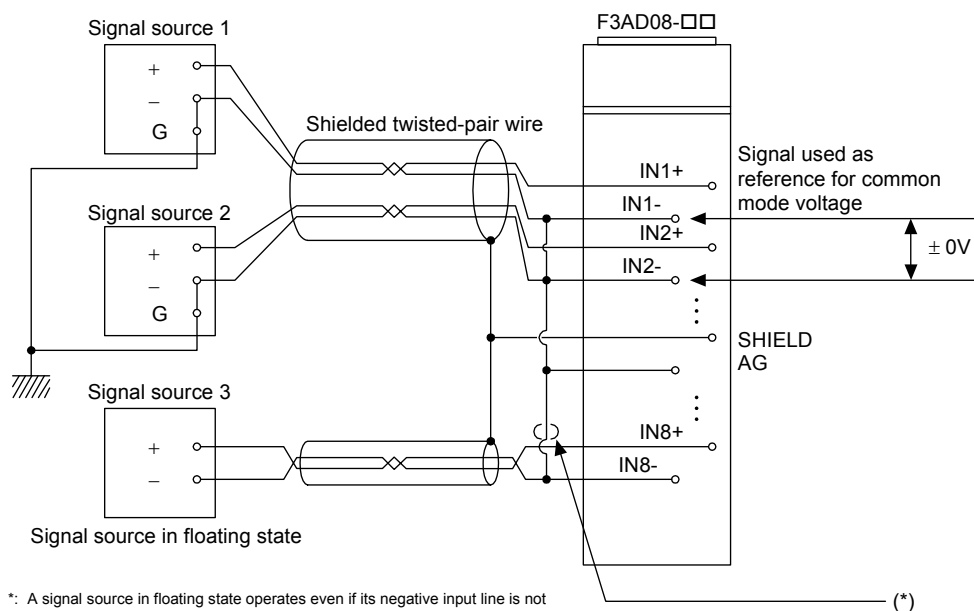


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**Figure A1.8 Wiring Example**

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.

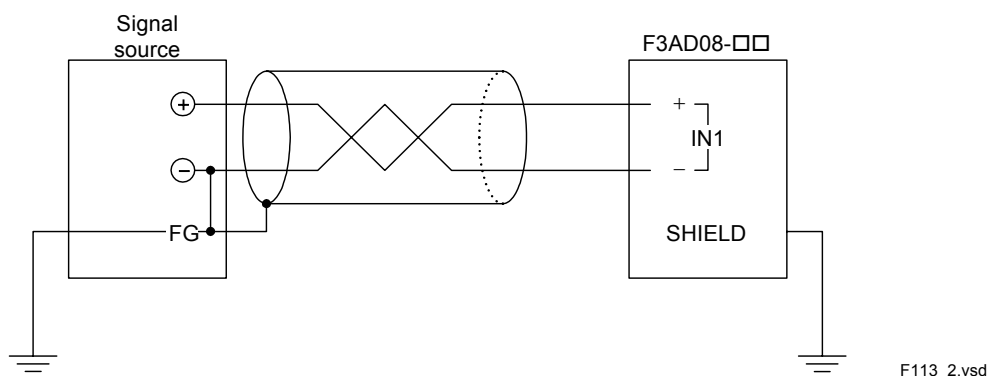
3. For compliance with EMC-related specifications, use FG clamps to perform grounding for systems installed with this module.
4. For common mode voltage reference (the potential of the signal connected to the AG terminal becomes the reference voltage), to connect a signal not superimposing the common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



F112\_2.vsd

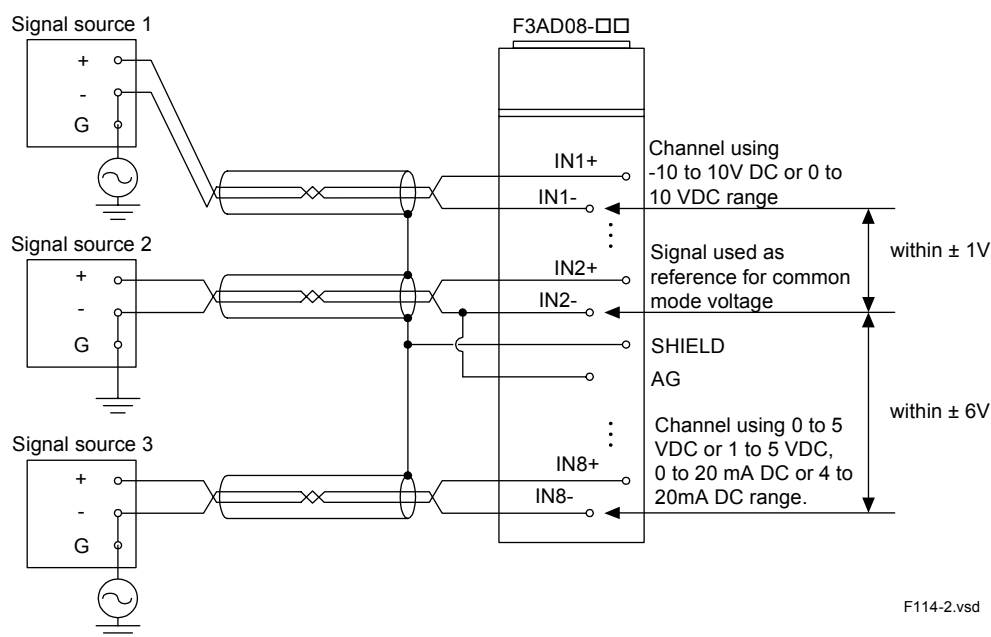
Figure A1.9 Wiring Example

- 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.



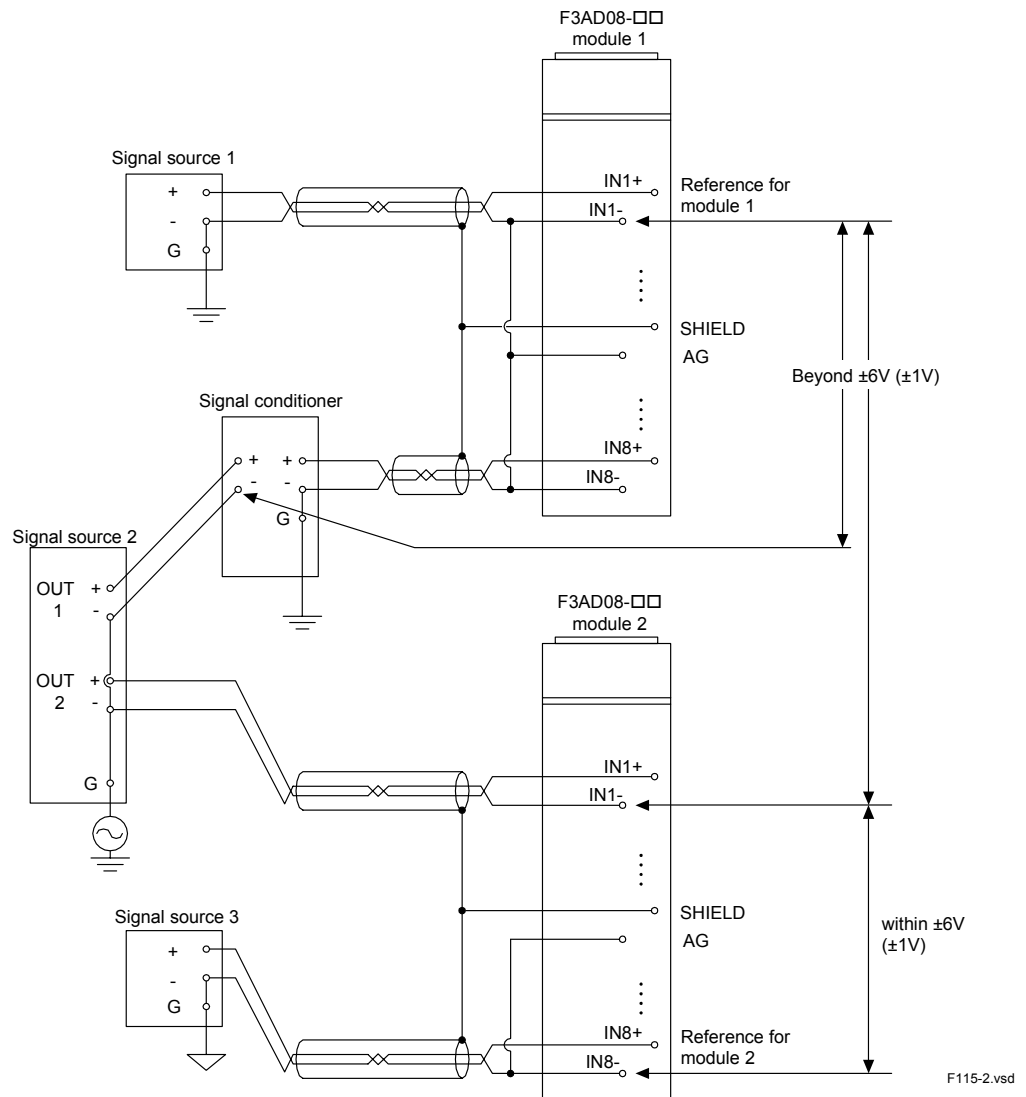
**Figure A1.10 Example Wiring with the Negative Terminal of the Signal Source Grounded**

- 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

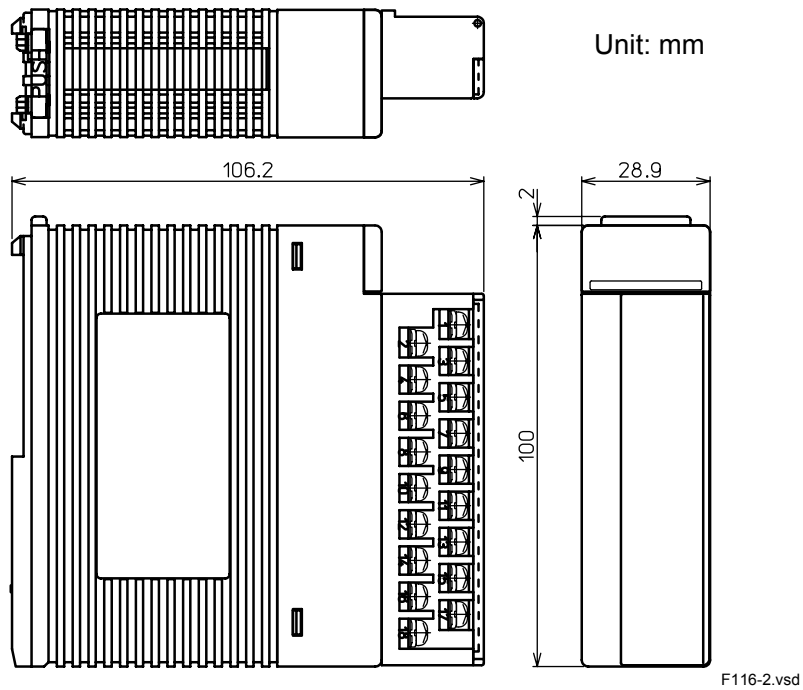


Figure A1.13 External Dimensions

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## 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)**

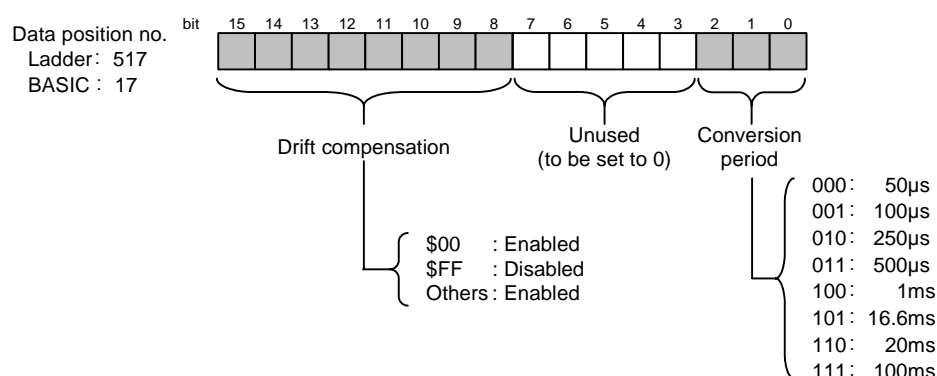
| Operation Mode     | Settings  | Default Value | Description      |
|--------------------|---|---------------|------------------|
| Conversion period  | 50 $\mu$ s, 100 $\mu$ s, 250 $\mu$ s, 500 $\mu$ s, 1 ms, 16.6 ms, 20 ms or 100 ms | 1 ms          | See Section A3.1 |
| Drift compensation | Enabled 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)**

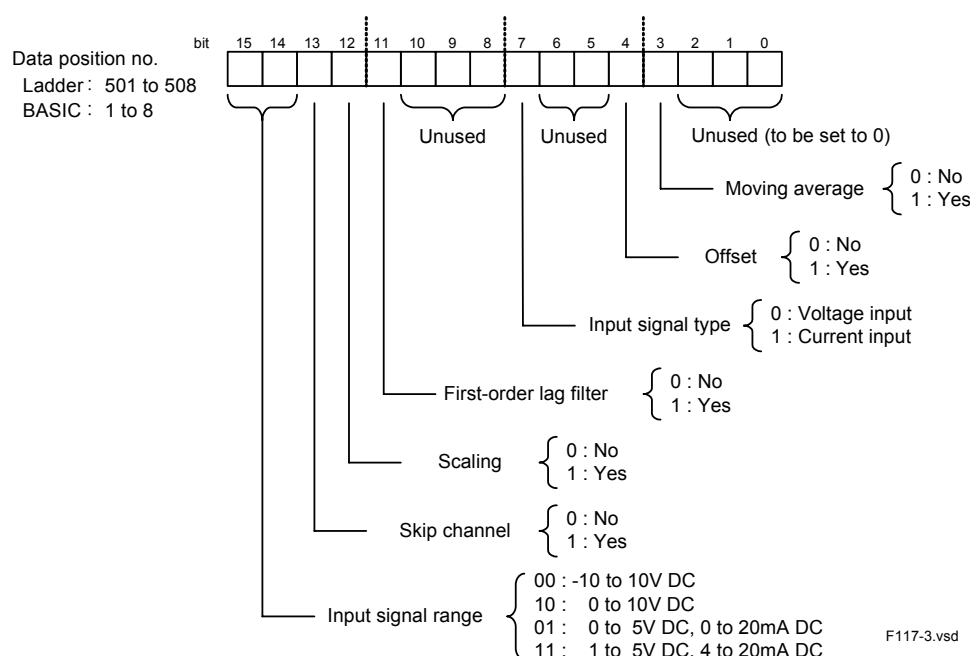
| Operation Mode        | Settings   | Default Value                 | Description      |
|-----------------------|--|-------------------------------|------------------|
| Input signal range *1 | -10 to 10V, 0 to 10V, 0 to 5V, 1 to 5V DC, 0 to 20 mA or 4 to 20 mA DC | -10 to 10V DC<br>0 to 20mA DC | 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.

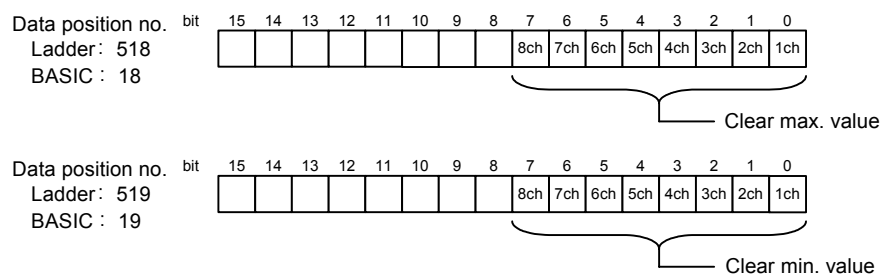
The module has a hold data function that stores the minimum and maximum conversion output values of each channel. This function is always enabled. The stored value for a channel can be cleared by writing bit values to appropriate data position numbers using Special Module Write ladder instructions or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

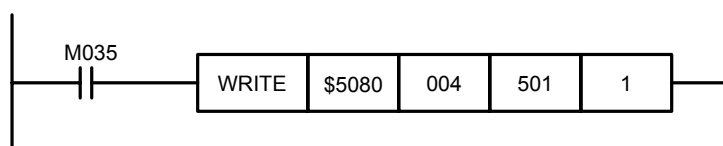
## ■ Example 1

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

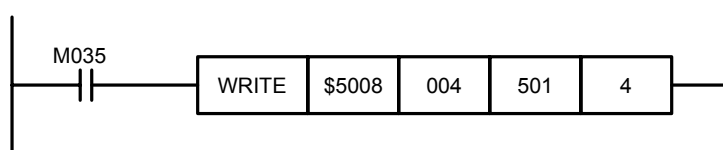
```
CONTROL 4,1; $ 5080
```

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

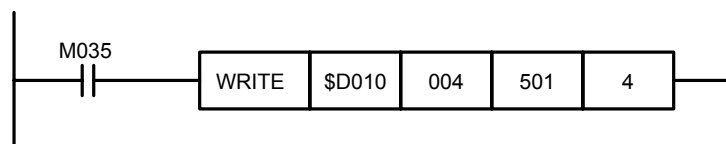
F3AD08-5R supports only voltage input so there is no need to specify its input signal type. The input signal type bit value is ignored.



### ■ 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 50 $\mu$ s, 100 $\mu$ s, 250 $\mu$ s or 500 $\mu$ s 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)

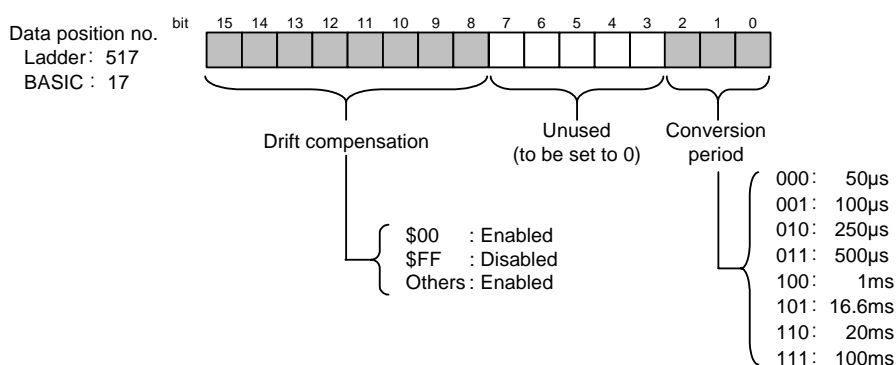
You can set the conversion period by writing to bits 0, 1 and 2 of the mode register for conversion period. The default value of "1 ms" is represented by bits (1, 0, 0) or hexadecimal value \$0004.

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

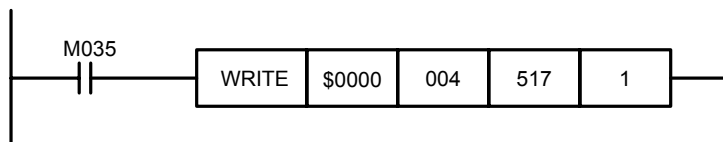
A preset value of 16.6 ms for the conversion period maps to actual conversion period of 16.66...ms ( $= \frac{1}{60}$  s).

## ■ Example 1

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

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

### ● Using Special Module Write instructions in ladder



F11701-2.vsd

### ● Using BASIC statements

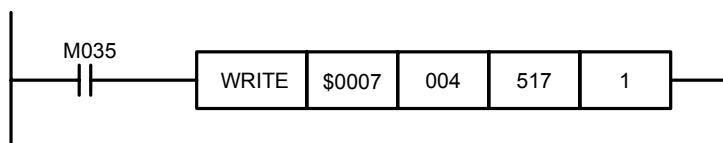
CONTROL 4,17; \$ 0000

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.

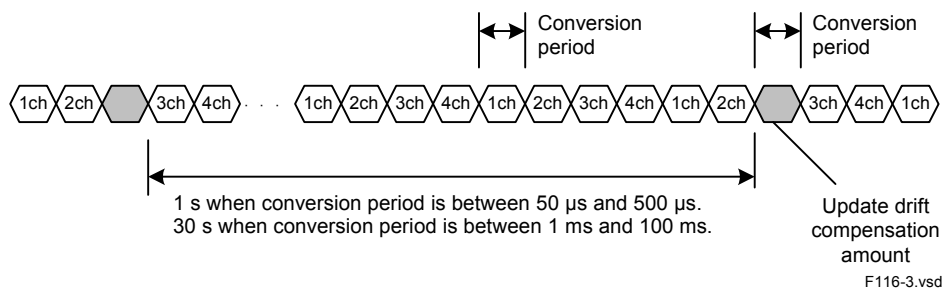


Figure A3.5 Timing for Updating Drift Compensation Amount

Table A3.8 Data Position Number for Drift Compensation

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

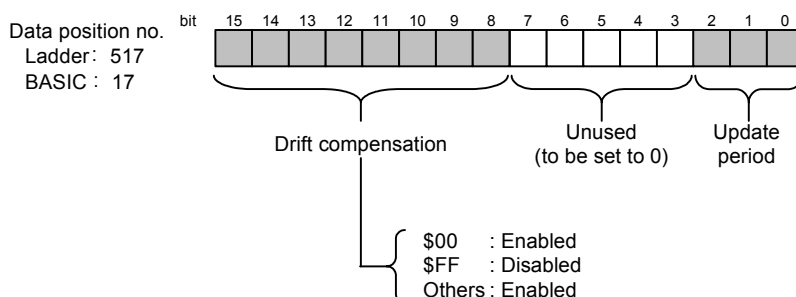


Figure A3.6 Operation Mode Bitmap

Table A3.9 Drift Compensation Preset Values

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

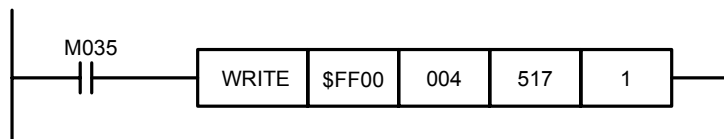
Writing a value of \$FF to the high-byte of the data position number for drift compensation stops updating of the drift compensation amount. Writing \$00 to the same data position number resumes updating of the drift compensation amount approximately 1 s or 30 s later.

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  $\mu$ s).

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



F11710-2.vsd

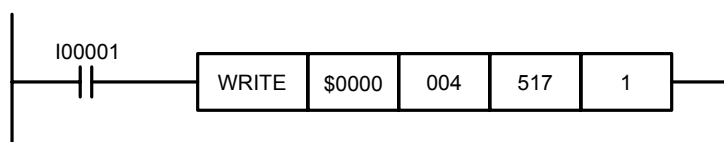
- **Using BASIC statements**

```
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  $\mu$ 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.

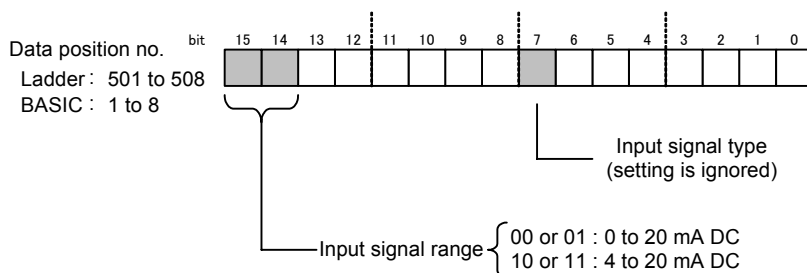
The module performs drift compensation together with checking of A/D conversion errors, so disabling the drift compensation function also stops error checking, and thus, A/D conversion errors will no longer be detected. Other self-diagnostic errors, however, will continue to be detected. For more details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

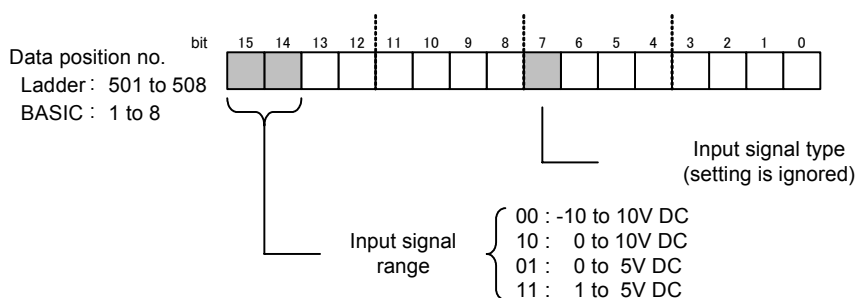
| Input Signal Range<br>Preset Value | Effective Input Signal Range | Bit values of Mode Register |        |       |
|------------------------------------|------------------------------|-----------------------------|--------|-------|
|                                    |                              | 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<br>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   |

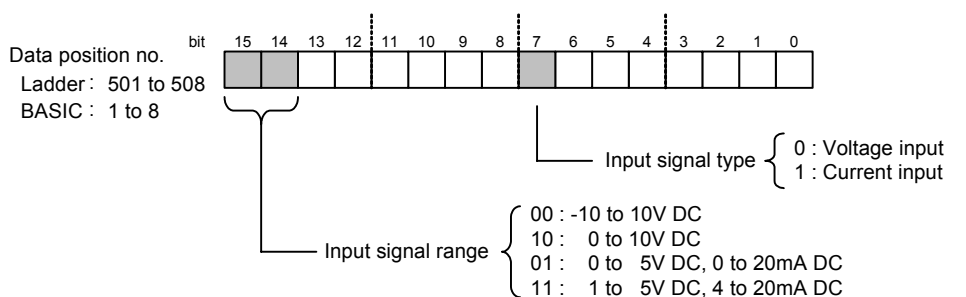
Note: F3AD08-5R only supports voltage input so bit 7 of the mode register is ignored.

## ■ 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<br>Preset Value | Effective Input<br>Signal Range       | Bit values of Mode Register |        |       | Switch<br>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<br>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).

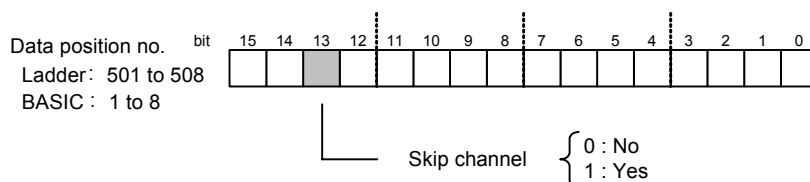
Inconsistent input signal type setting and hardware switch setting will not damage the module, but will cause input signals to be incorrectly applied and their values incorrectly read.

## 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.

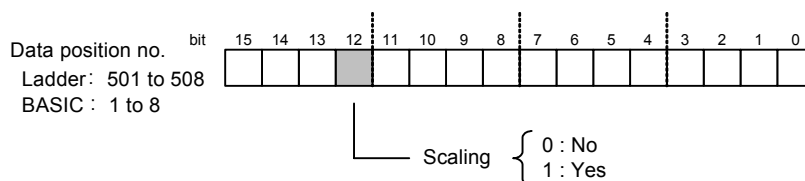


F117-10.vsd

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.

$$N < -20000 \text{ or } 20000 < N \text{ where } N \text{ is the upper limit or the lower limit.}$$



## CAUTION

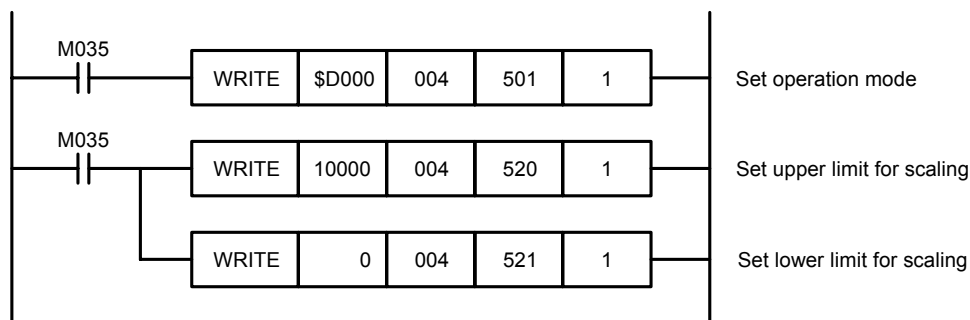
If the upper limit and the lower limit for scaling are set to the same value, the conversion result will be a constant value equal to the preset value.

## ■ 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



F11703.vsd

- **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.

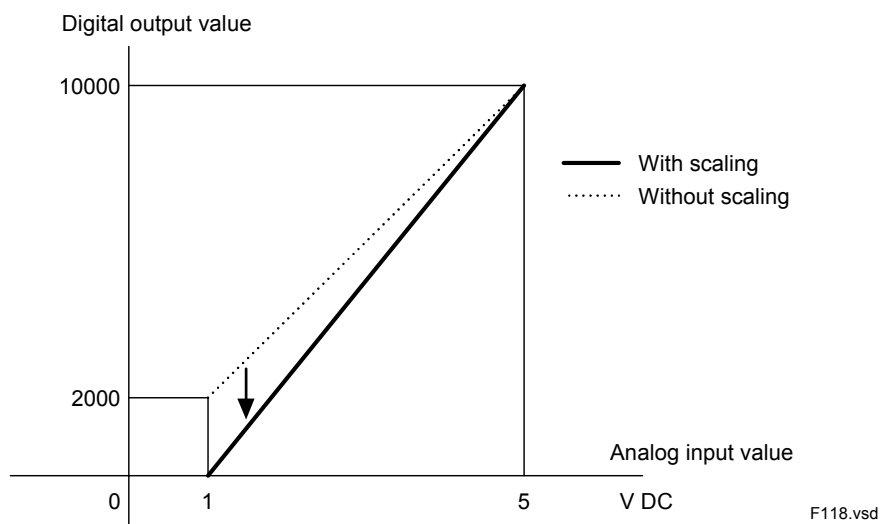


Figure A3.12 Changes in the Input/Output Characteristics When Scaling is Used

## 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.

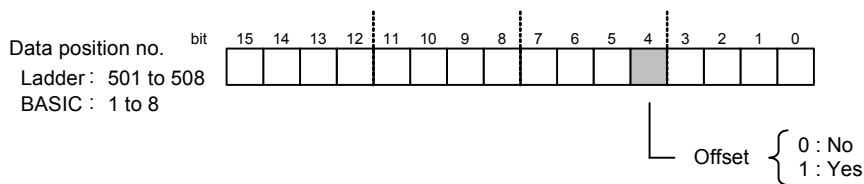


Figure A3.13 Bits of Mode Register for Configuring Offset Function

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

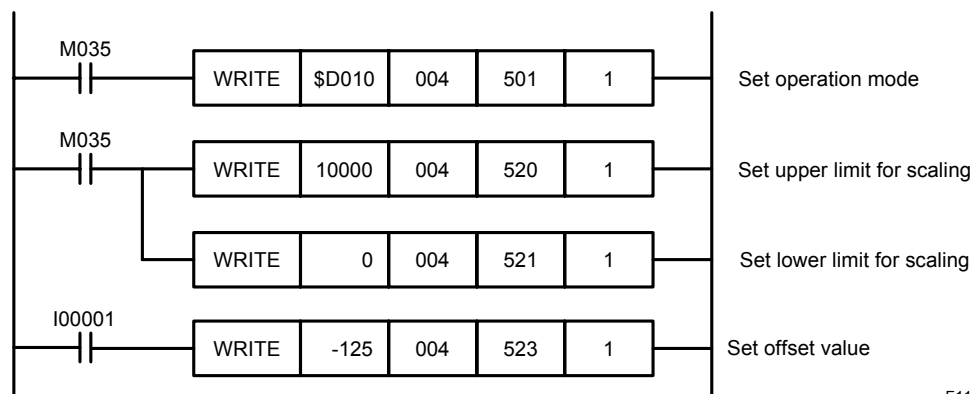
This example configures channel 1 for of the F3AD08-6R module installed in slot number 004 as follows.

| 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



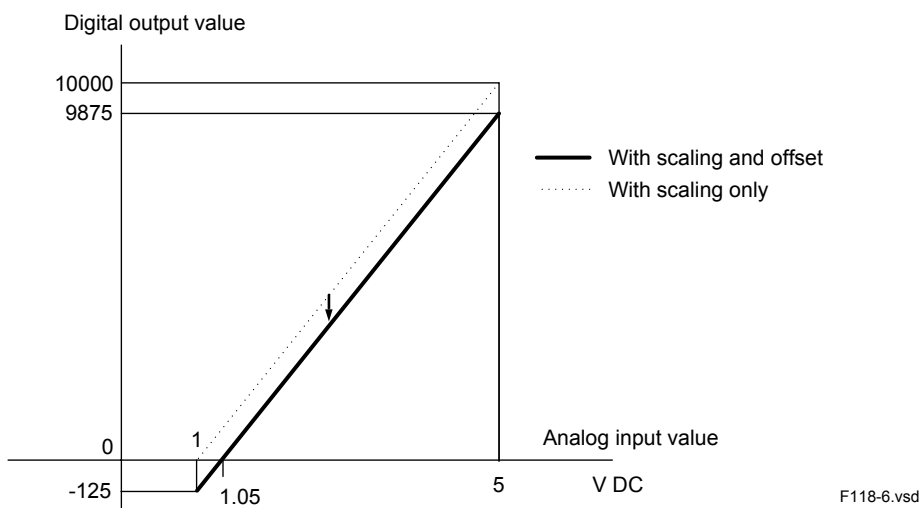
F117-8.vsd

- **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.

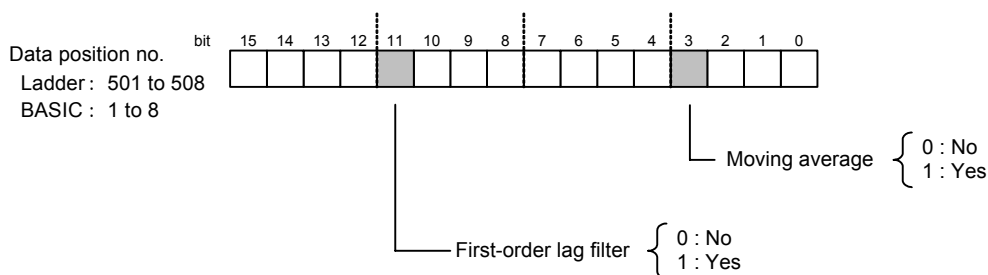


**Figure A3.14 Changes in the Input/Output Characteristics when Offset is Used**

## 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



F117-9.vsd

**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  $\mu$ 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).

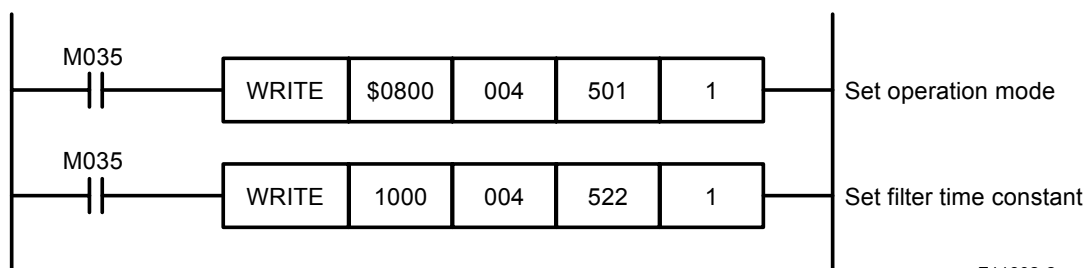
For details, see Appendix A.

## ■ 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<br>Time constant: 1000 ms |

### ● Using Special Module Write instructions in ladder



F11802-2.vsd

### ● Using BASIC statements

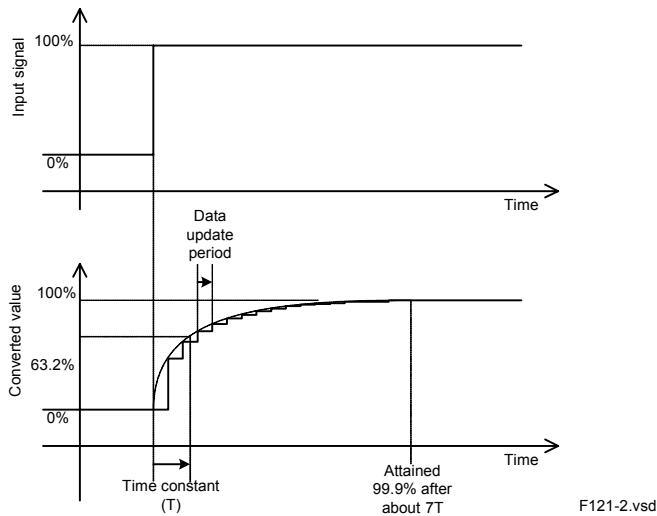
CONTROL 4,1;\$0800 Set operation mode

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.

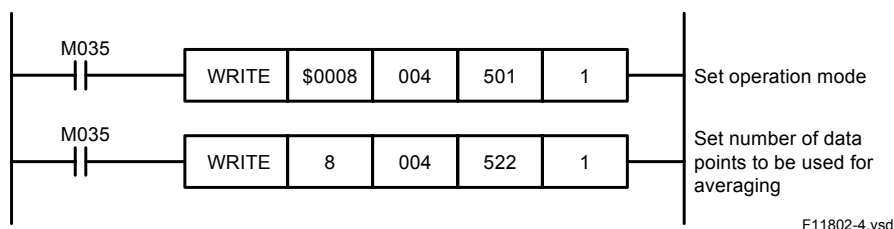
If N is equal to 0 or 1, the module defaults to using 2 data points for averaging.

## ■ 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

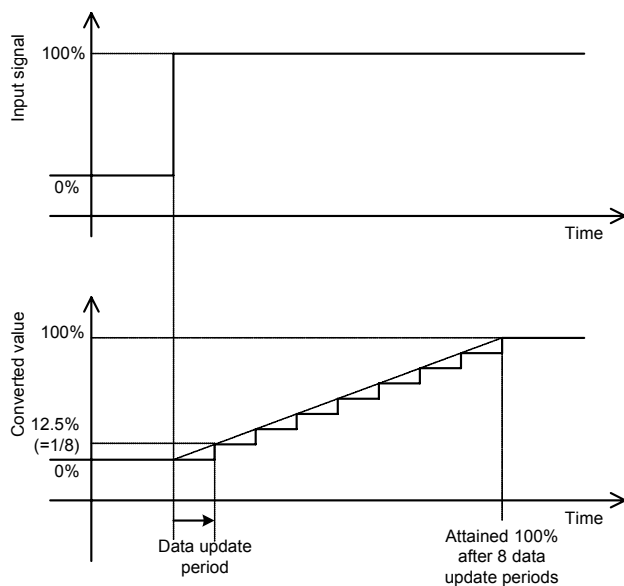
CONTROL 4, 1; \$0008 Set operation mode

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:  
 $\text{conversion period} \times \text{Number of unskipped channels}$

F121-4.vsd

**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**

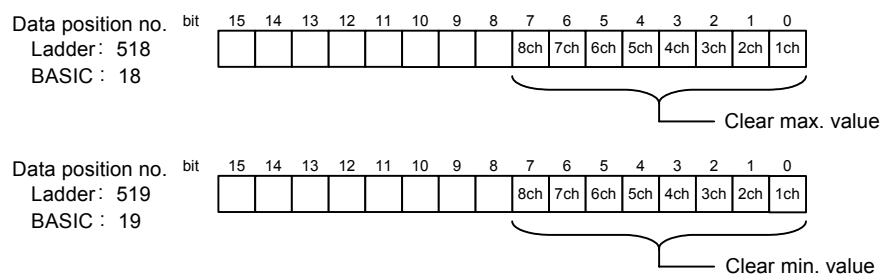
| Description          |        | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Channel 7 | Channel 8 |
|----------------------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Stored Maximum Value | Ladder | 21        | 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                |



F117-4.vsd

**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

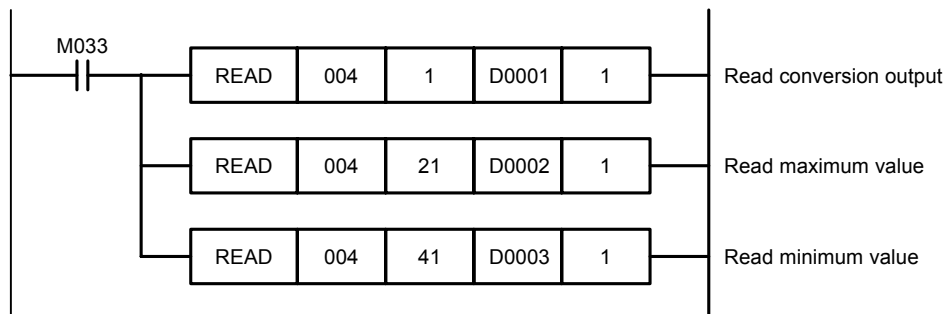
Clearing a hold value does not reset it to 0 but to the current conversion output value.

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



F11707-2.vsd

### ● Using BASIC statements

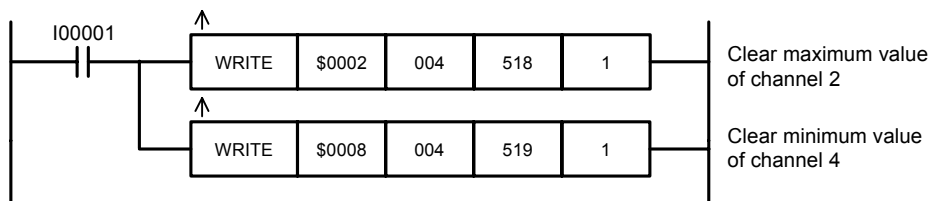
```
ENTER      4, 1 NOFORMAT; D1      (Read conversion output value)
ENTER      4, 21 NOFORMAT; D2     (Read maximum value)
ENTER      4, 41 NOFORMAT; D3     (Read minimum value)
```

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.



# 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.

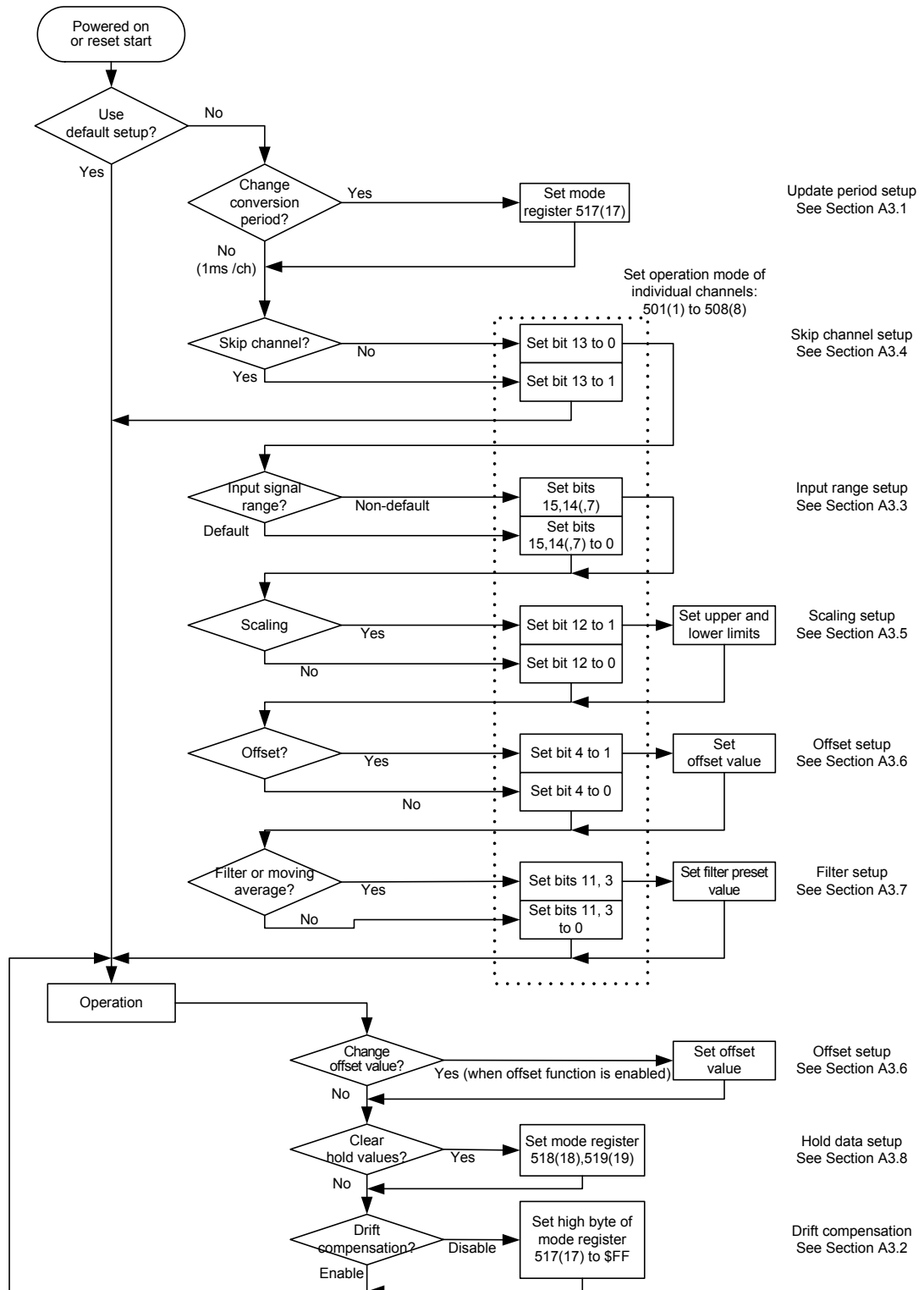


Figure A3.20 Flowchart for Setting Operation Mode

F119-3.vsd

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## 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**

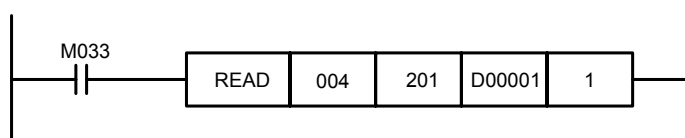
|        |     |
|--------|-----|
| Ladder | 201 |
| BASIC  | 201 |

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   |  |
|            | 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.<br>An A/D converter has failed. |  |
| \$A000     | Calibration value error | ●            | ●   | Failed to read calibration values.<br>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,<br>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<br>between IN■+ and IN■ | Signal Level<br>between IN■+ and AG<br>or between IN■- 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.)                                   |
| 4 to 20mADC        |  | (Input impedance is 250Ω.)                                    |

## 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;<br>Or the preset value for moving average computation is out of the valid range of 0 to 32;<br>Or filter or moving average is enabled and the conversion period preset value is 50 $\mu$ s. | Set the preset value of the first-order lag filter within the valid range of 0 to 30000;<br>Or set the preset value for moving average computation within the valid range of 0 to 32,<br>Or disable filter and moving average computation when the conversion period is set to 50 $\mu$ 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.

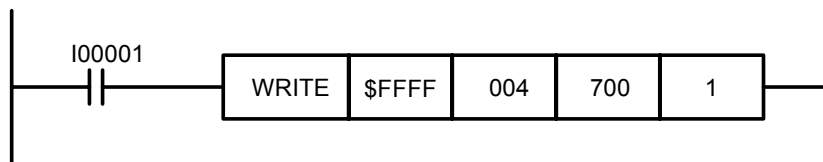
Reset error status only if necessary.

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.



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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.

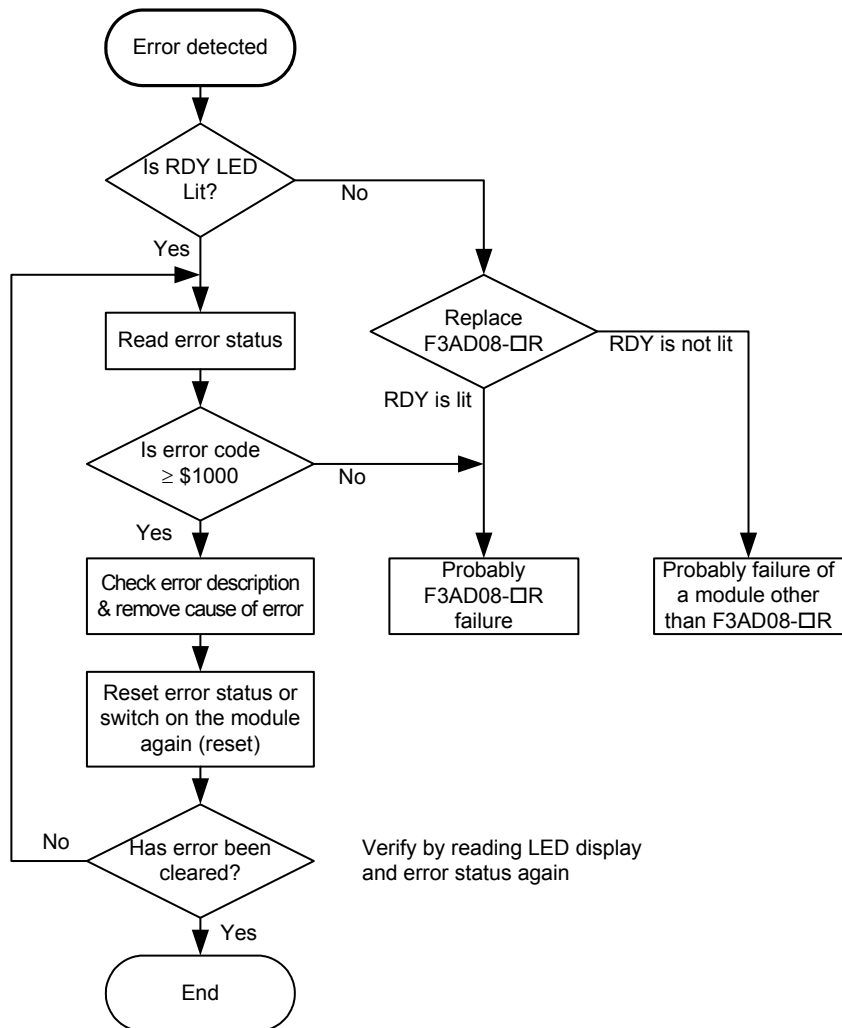


Figure A4.1 Flowchart for Checking Error Status

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## 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.

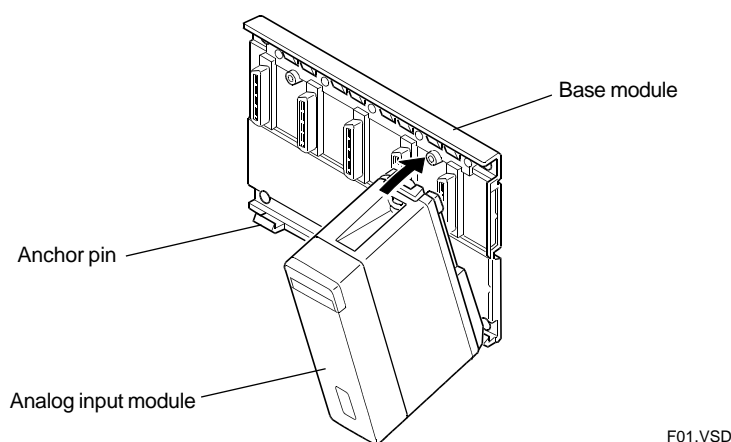


Figure A5.1 Attaching Modules



#### 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.

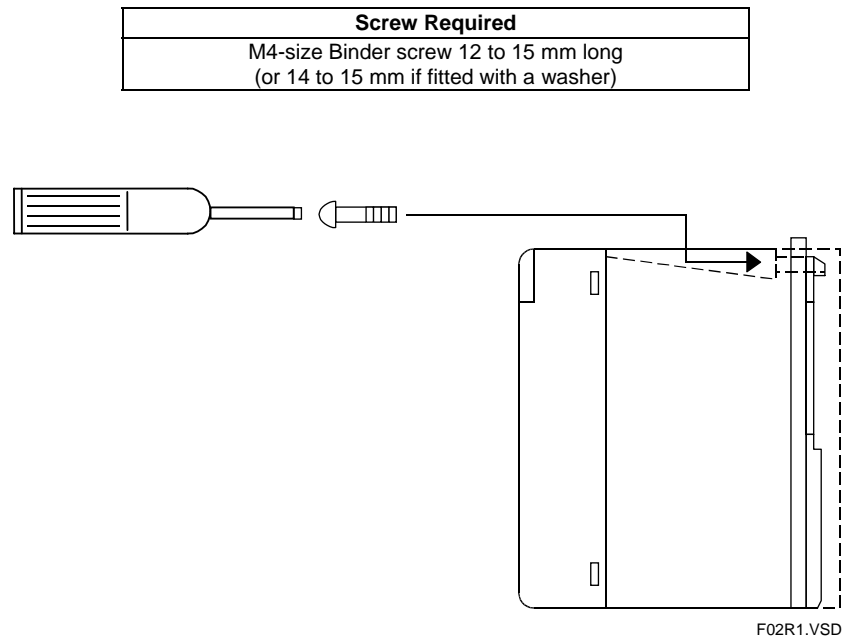


Figure A5.2 Tightening the Module



# A6. Data Access Using Special Module Instructions in Ladder

## A6.1 Reading Data (READ/HRD)

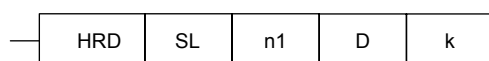
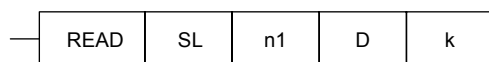
To read data from the analog input module, use the Special Module Read instruction or Special Module High Speed Read instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

### ● Description of Instructions

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

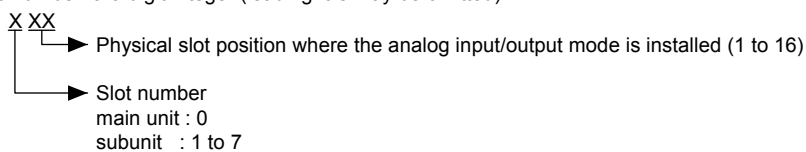
| Function No. | Instruction                    | Mnemonic | Symbol | Is Input condition Required? |    | Condition for Execution | Step count | Processing unit | Carry |
|--------------|--------------------------------|----------|--------|------------------------------|----|-------------------------|------------|-----------------|-------|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

### ● 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.

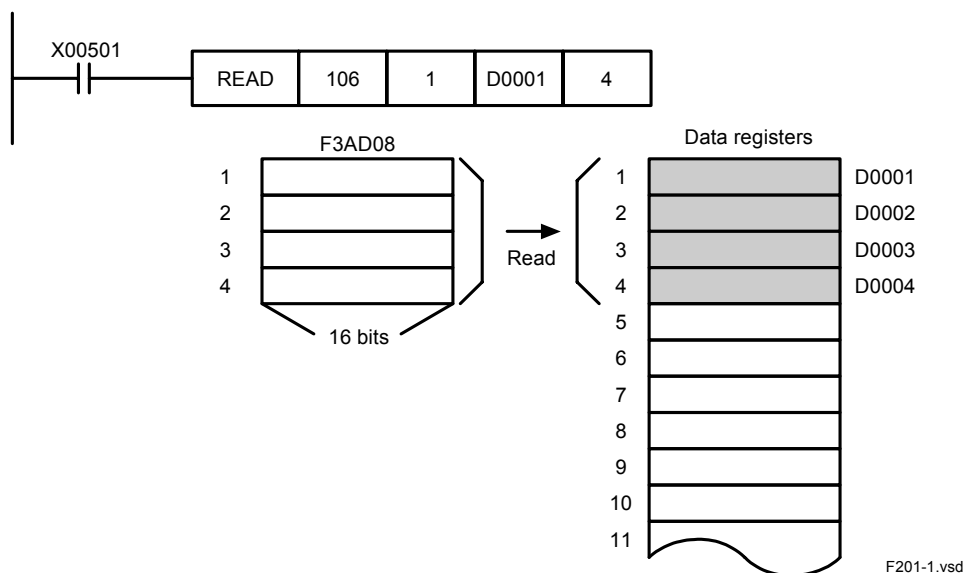


Figure A6.1 Reading Analog Data

## ■ 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.

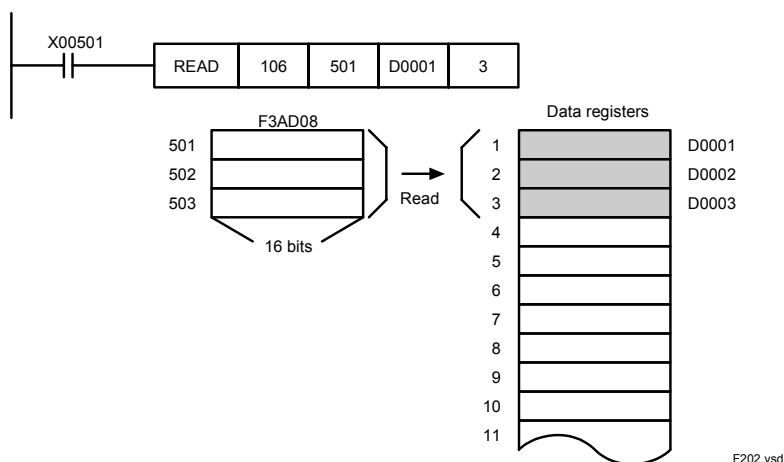


Figure A6.2 Reading Operation Mode

## A6.2 Writing Data (WRITE/HWR)

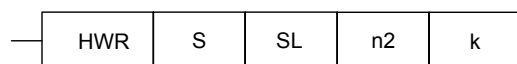
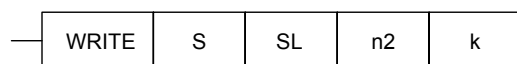
To write data to the analog input module, use the Special Module Write instruction or Special Module High Speed Write instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

### ● Description of Instructions

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

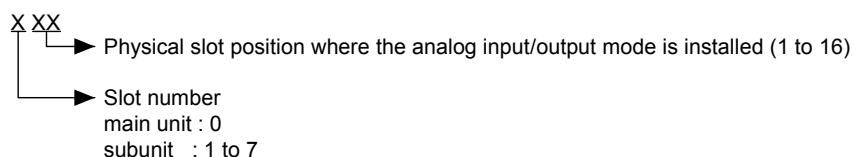
| Function No. | Instruction                     | Mnemonic | Symbol | Is Input condition Required? |    | Condition for Execution | Step count | Processing unit | Carry |
|--------------|---------------------------------|----------|--------|------------------------------|----|-------------------------|------------|-----------------|-------|
|              |                                 |          |        | 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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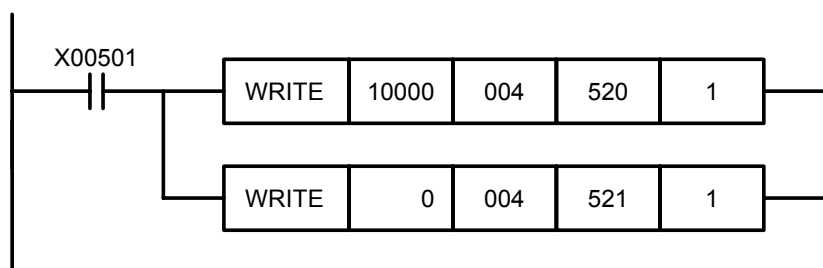
Special Module Long Word Write instructions cannot be used to write data to analog input modules. The results of such operations are not guaranteed.

## ■ 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

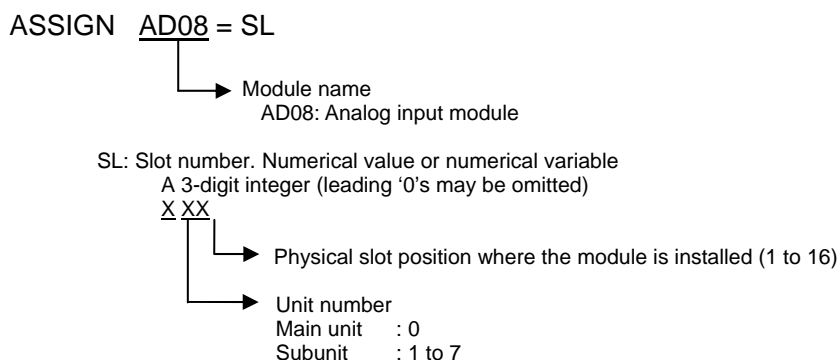
Table A7.1 lists the BASIC statements that can be used in the analog input module. Module operation is not guaranteed when statements not listed in Table A7.1 are used.

**Table A7.1 Usable BASIC Statements**

| Function                                  | Syntax   | Description   |
|---|--|---|
| Declare use of module                     | Example:<br>ASSIGN AD08=SL<br>SL : Slot number   | Defines the mapping between modules and slot numbers.<br>Always execute this statement before accessing an analog input module.<br>Execute this statement in the main program.  |
| Read data from analog input module        | ENTER SL, n NOFORMAT; I<br>or<br>ENTER SL NOFORMAT; I(*)<br>SL: Slot number<br>n : Data position number (channel number)<br>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.<br>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<br>or<br>STATUS SL; P(*)<br>SL : Slot number<br>n : Data position number<br>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<br>or<br>CONTROL SL; P(*)<br>SL : Slot number<br>n : Data position number<br>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.  |

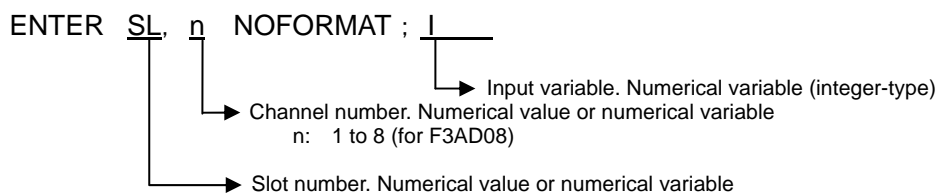
## A7.2 Declaring Use of Module (ASSIGN)

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.



## 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 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.

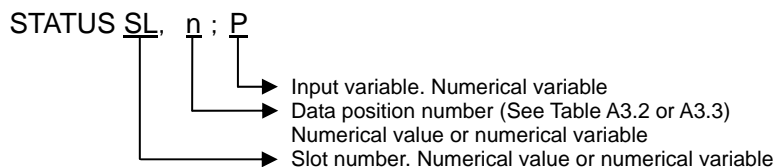
ENTER SL NOFORMAT ; I(\*)

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.

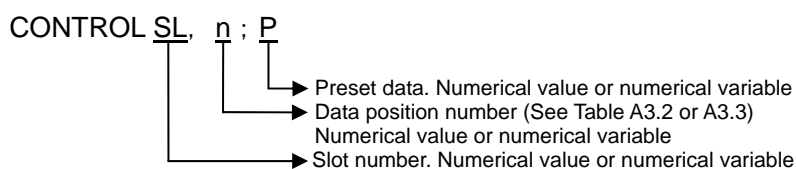
## A7.4 Reading Operation Mode, Scaling Limits and Other Data (STATUS)

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.



## 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.



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# 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 $\mu$ 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**

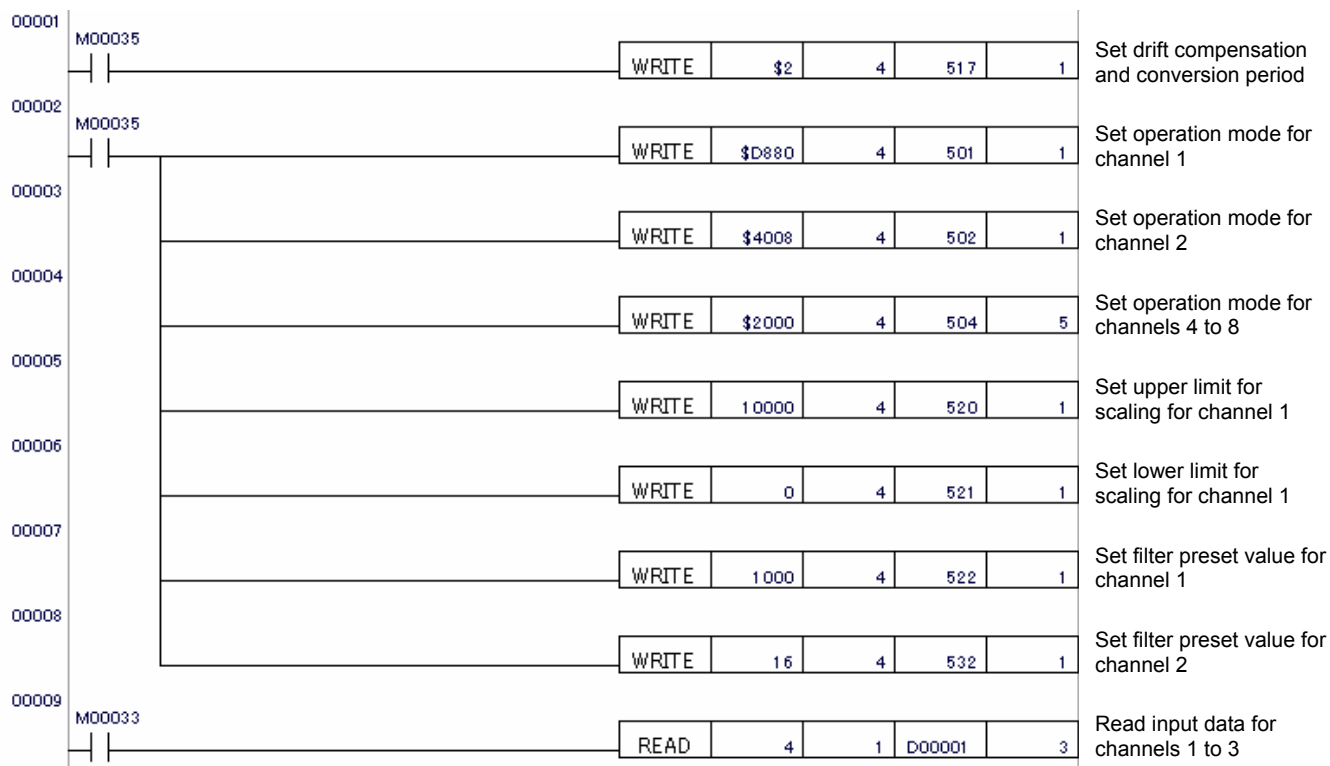
|                 | DIP Switch Setting |
|-----------------|--------------------|
| Channel 1       | ON                 |
| Channel 2       | OFF                |
| Channel 3       | OFF                |
| Channels 4 to 8 | Any                |

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

|           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|--|--|--|--|--|--|--|--|
| Channel 1 | <table border="1"> <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> <tr> <td>\$</td> <td>D</td> <td>:</td> <td>8</td> <td>:</td> <td>8</td> <td>:</td> <td>0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | \$ | D | : | 8 | : | 8 | : | 0 |  |  |  |  |  |  |  |  |
| 1         | 1   | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |    |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
| \$        | D   | : | 8 | : | 8 | : | 0 |   |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
| Channel 2 | <table border="1"> <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> <tr> <td>\$</td> <td>4</td> <td>:</td> <td>0</td> <td>:</td> <td>0</td> <td>:</td> <td>0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | \$ | 4 | : | 0 | : | 0 | : | 0 |  |  |  |  |  |  |  |  |
| 0         | 1   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |    |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
| \$        | 4   | : | 0 | : | 0 | : | 0 |   |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
| Channel 3 | Using default values so no setup is required.   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
| Channel 4 | <table border="1"> <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> <tr> <td>\$</td> <td>2</td> <td>:</td> <td>0</td> <td>:</td> <td>0</td> <td>:</td> <td>0</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | \$ | 2 | : | 0 | : | 0 | : | 0 |  |  |  |  |  |  |  |  |
| 0         | 0   | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |   |    |   |   |   |   |   |   |   |  |  |  |  |  |  |  |  |
| \$        | 2   | : | 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(*)
```

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## 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

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

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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.

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## 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 $\Omega$  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.

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# 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  $\mu$ 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  $\mu$ 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  $\mu$ 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)

## Appx. A-3

Conversion period  
= 16.6 ms

|               |         | n=1      | 2     | 3      | 4      | 5      | 6      | 7       | 8       | 9       | 10      | 11      | 12 | 13 | 14 | 15 |
|---------------|---------|----------|-------|--------|--------|--------|--------|---------|---------|---------|---------|---------|----|----|----|----|
| 8 ch.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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<br>= 100 ms |         | n=1       | 2      | 3      | 4       | 5       | 6       | 7       | 8       | 9       | 10 | 11 | 12 | 13 | 14 | 15 |
|-------------------------------|---------|-----------|--------|--------|---------|---------|---------|---------|---------|---------|----|----|----|----|----|----|
| 8 ch.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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.<br>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)

T<sub>0</sub> : 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<br>-18 V DC minimum   | 18 V DC maximum<br>-18 V DC minimum   |
| Input signal range <sup>1</sup><br>(Over range) | 0 to 5 VDC (-0.25 to 5.25 V DC)<br>1 to 5 V DC (-0.25 to 5.25 V DC)<br>-10 to 10 V DC (-11.0 to 11.0 V DC)                        | 0 to 5 VDC (-0.25 to 5.25 V DC)<br>1 to 5 V DC (-0.25 to 5.25 V DC)<br>-10 to 10 V DC (-11.0 to 11.0 V DC)                        |
| Isolation method                                | Across input terminals and internal circuit: Photocoupler isolation<br>Across input terminals: Not isolated, negative line common | Across input terminals and internal circuit: Photocoupler isolation<br>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 $\Omega$  | 1 M $\Omega$  |
| Resolution                                      | 0 to 5 V and 1 to 5 V DC: 1.4 mV<br>-10 to 10 V DC: 5.7 mV<br>(12-bit A/D)  | 0 to 5 V and 1 to 5 V DC: 0.175 mV<br>-10 to 10 V DC: 0.72 mV<br>(16-bit A/D)   |
| Overall accuracy                                | 23 $\pm$ 2 $^{\circ}$ C: $\pm$ 0.2% (full scale)<br>0 to 55 $^{\circ}$ C: $\pm$ 0.5% (full scale)                                 | 23 $\pm$ 2 $^{\circ}$ C: $\pm$ 0.1% (full scale)<br>0 to 55 $^{\circ}$ 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. <sup>2</sup>   | Channels are enabled or disabled individually. <sup>2</sup>   |
| 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 <sup>3</sup>   | 28.9 (W) $\times$ 100 (H) $\times$ 83.2 (D) mm <sup>3</sup>   |
| Weight  | 170 g   | 170 g   |
| Ambient operating temperature                   | 0 to 55 $^{\circ}$ 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 $^{\circ}$ 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        |         |

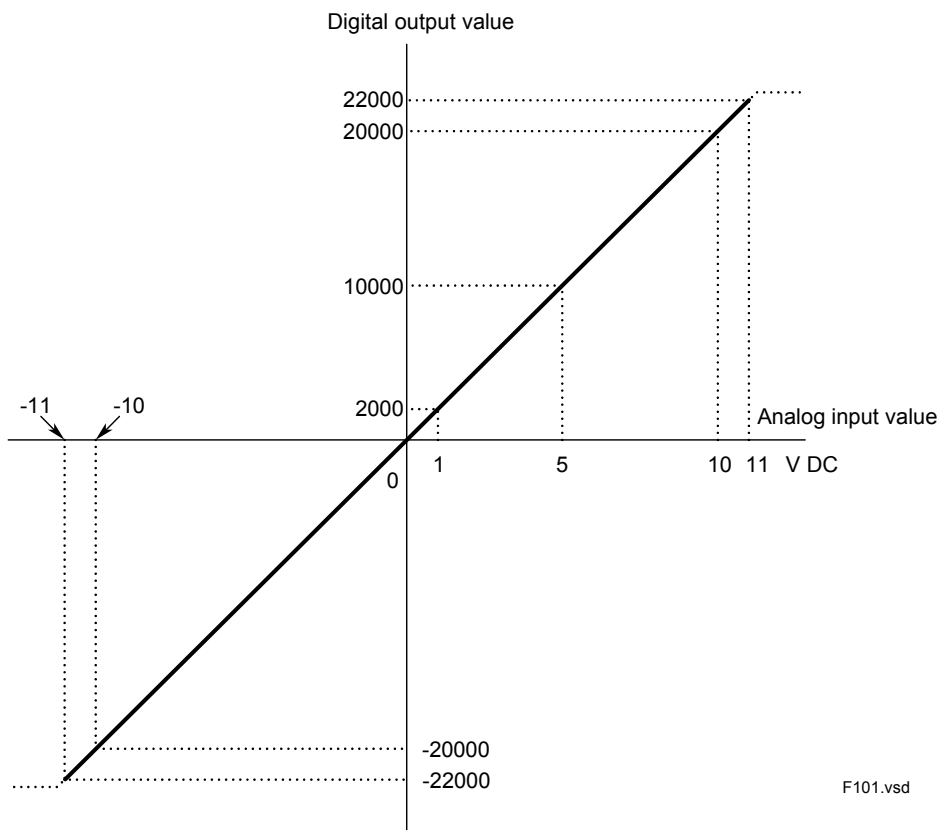


Figure B1.1 Input/Output Conversion Characteristics with No Scaling

## ■ Components and Functions

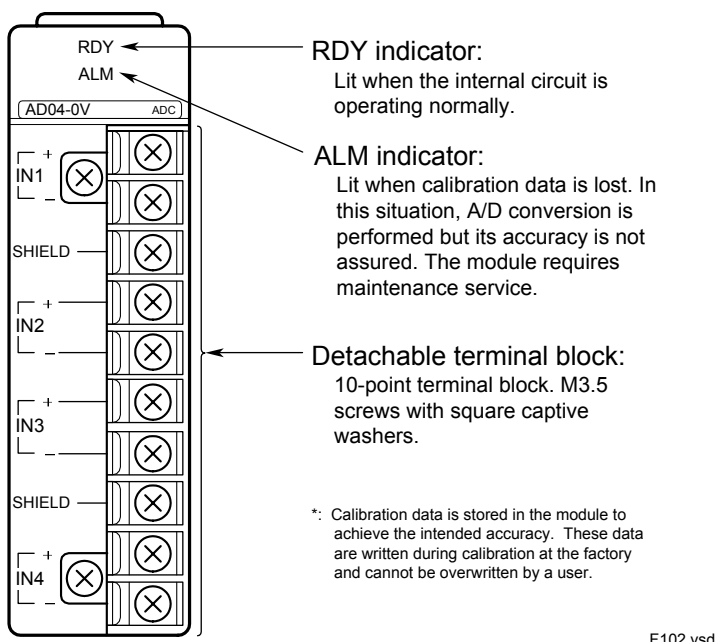


Figure B1.2 Components and Functions

## Internal Circuit

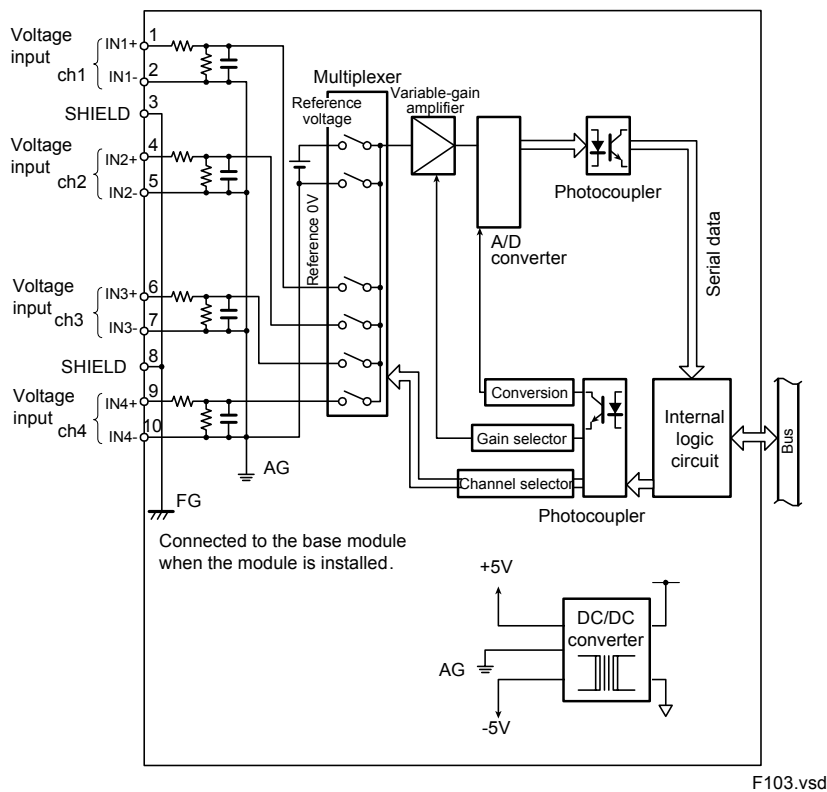
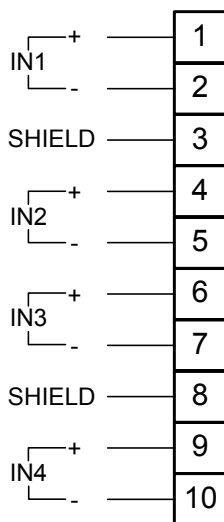


Figure B1.3 Internal Circuit Diagram

## 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 <sup>2</sup> )   |
| 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:<br>Type V1.25-M3 (from Japan Solderless Terminal Mfg. Co., Ltd.)<br>or RAV1.25-3.5 (from Nippon Tanshi Co., Ltd.) |

**CAUTION**

Always use an appropriate crimping tool specified by the manufacturer.

## ● Wiring Precautions

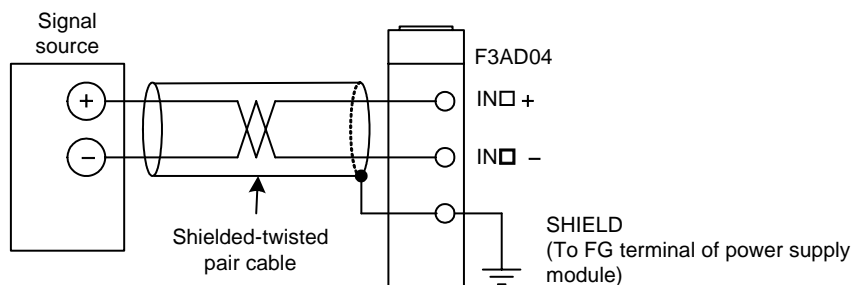
**CAUTION**

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

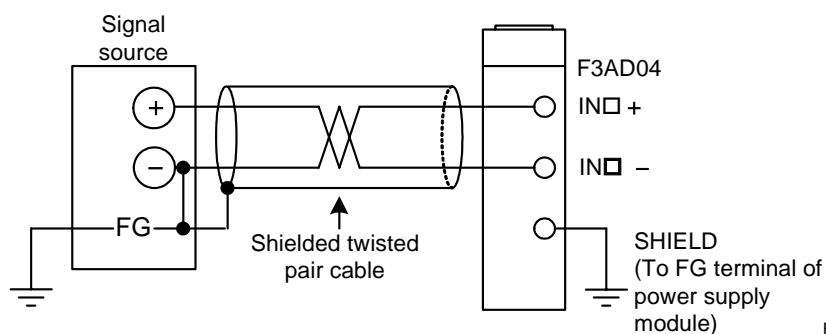
(The SHIELD terminals are connected to the FG terminal of the power supply module via the base module.)



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**Figure B1.5 Wiring Example**

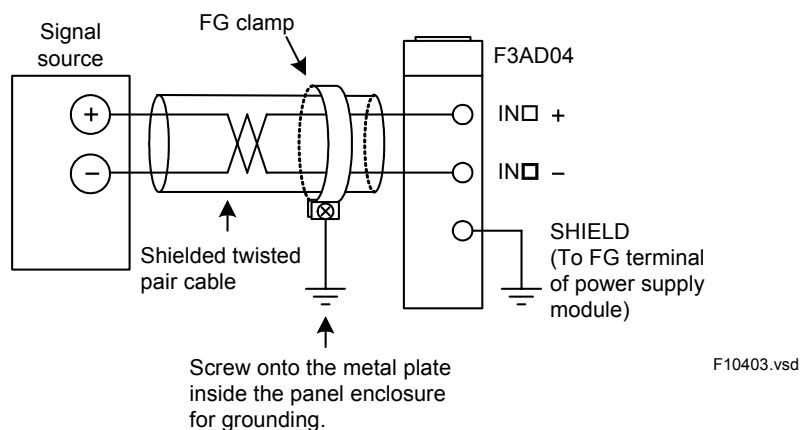
- Connecting the shield to shielded terminal (FG terminal) provided at the signal source



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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.

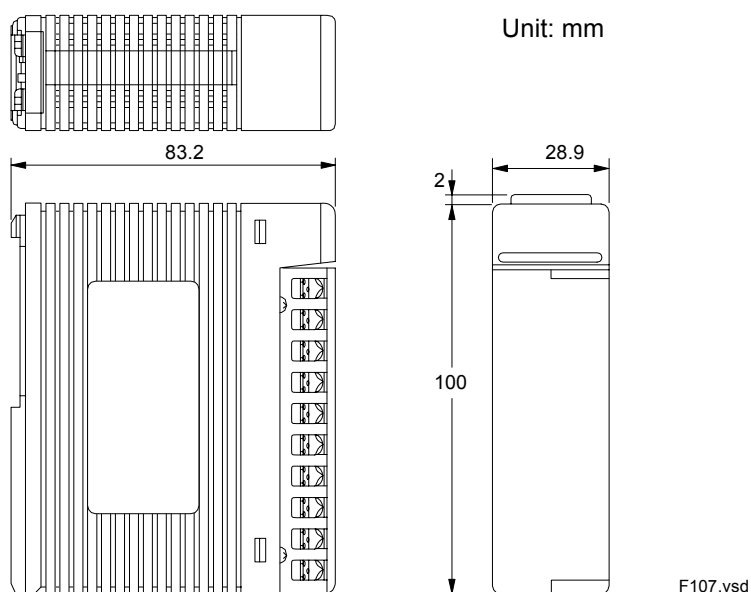


**Figure B1.7 Wiring Example**

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<br>-18 V DC minimum  | 18 V DC maximum<br>-18 V DC minimum   |
| Input signal range <sup>1</sup><br>(Over range) | 0 to 5 VDC (-0.25 to 5.25 V DC)<br>1 to 5 V DC (-0.25 to 5.25 V DC)<br>-10 to 10 V DC (-11.0 to 11.0 V DC)   | 0 to 5 VDC (-0.25 to 5.25 V DC)<br>1 to 5 V DC (-0.25 to 5.25 V DC)<br>-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)<br>±1V DC max. (-10 to 10V DC)   | ±6V DC max. (0 to 5V or 1 to 5V DC)<br>±1V DC max. (-10 to 10V DC)  |
| Isolation method                                | Across input terminals and internal circuit: Photocoupler isolation<br>Across input terminals: Not isolated. | Across input terminals and internal circuit: Photocoupler isolation<br>Across input terminals: Not isolated |
| Withstanding voltage                            | 500 V DC for one minute  | 500 V DC for one minute   |
| Input resistance                                | 1 MΩ min. <sup>2</sup>   | 1 MΩ min. <sup>2</sup>  |
| Resolution                                      | 0 to 5 V and 1 to 5 V DC: 1.4 mV<br>-10 to 10 V DC: 5.7 mV<br>(12-bit A/D)                                   | 0 to 5 V and 1 to 5 V DC: 0.175 mV<br>-10 to 10 V DC: 0.72 mV<br>(16-bit A/D)                               |
| Overall accuracy                                | 23±2°C: ± 0.2% (full scale)<br>0 to 55°C: ± 0.5% (full scale)  | 23±2°C: ± 0.1% (full scale)<br>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. <sup>3</sup>   | Channels are enabled or disabled independently. <sup>3</sup>  |
| 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 <sup>4</sup>  | 28.9 (W) × 100 (H) × 83.2 (D) mm <sup>4</sup>   |
| 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 |         |
|----------------------|--------------------|----------------------|---------|
| -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        |         |

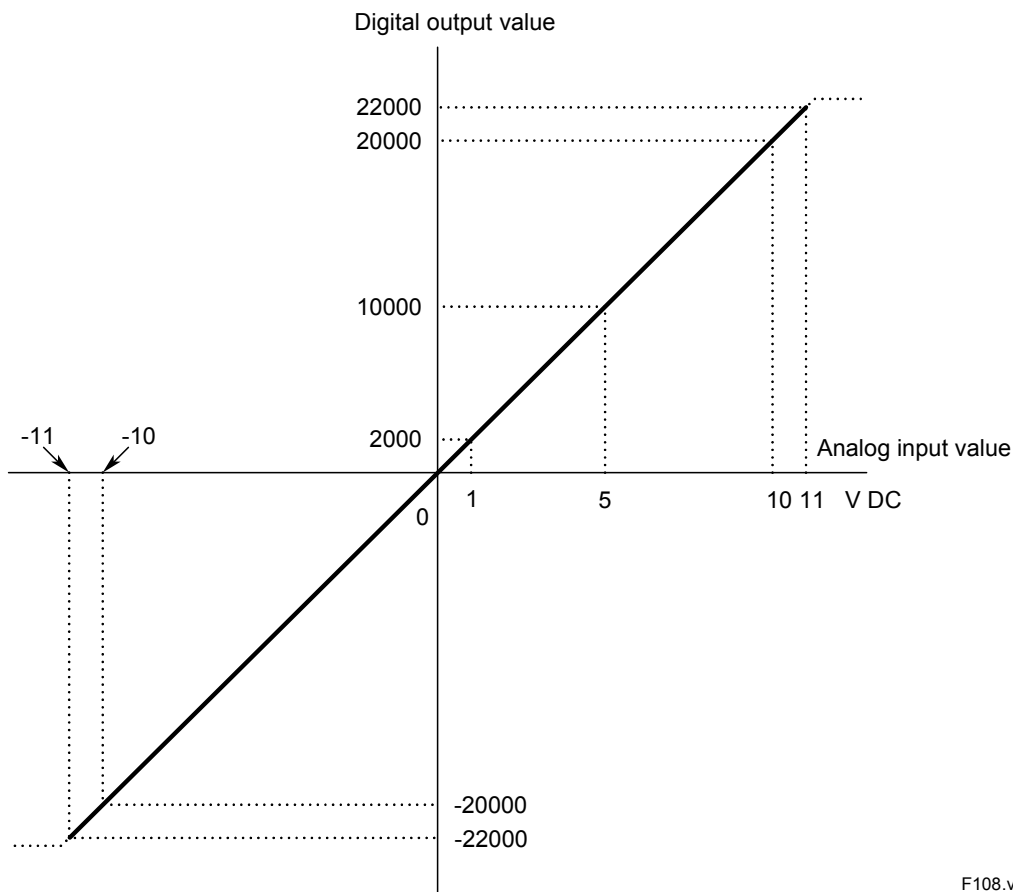


Figure B1.9 Input to Output Conversion Characteristics with No Scaling

## ■ Components and Functions

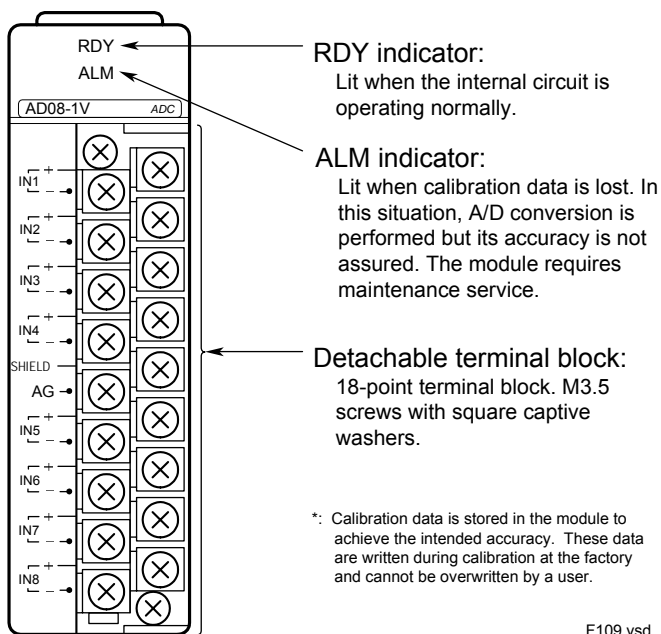
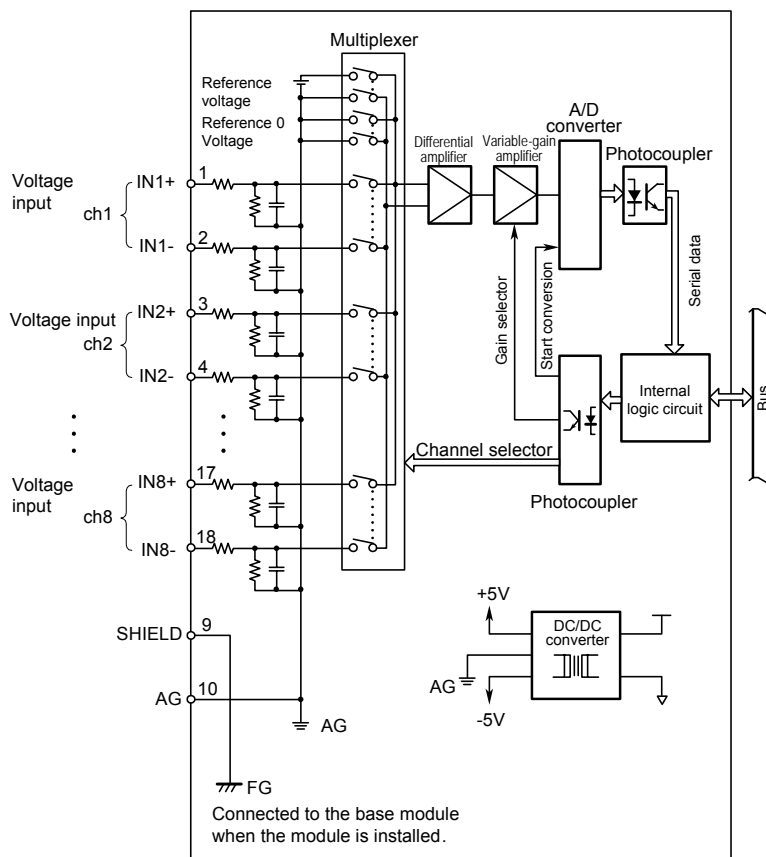


Figure B1.10 Components and Functions



## Internal Circuit

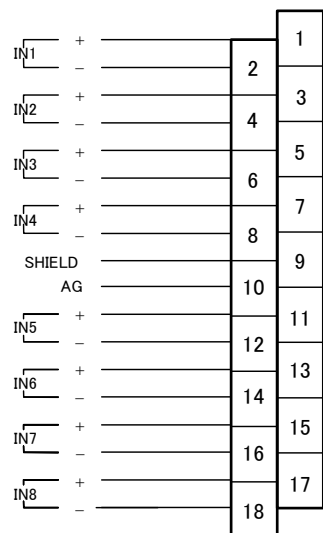


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Figure B1.11 Internal Circuit Diagram

## 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.

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Figure B1.12 External Connection Diagram

Table B1.6 Wires and Terminals

|                      |   |   |
|----------------------|---|---|
| Applicable wire size | AWG22-16 (0.3 to 1.25 mm <sup>2</sup> ) |   |
| 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:<br>Type V1.25-M3 (from Japan Solderless Terminal Mfg. Co., Ltd.)<br>or RAV1.25-3.5 (from Nippon Tanshi Co., Ltd.) |

**CAUTION**

Always use an appropriate crimping tool specified by the manufacturer.

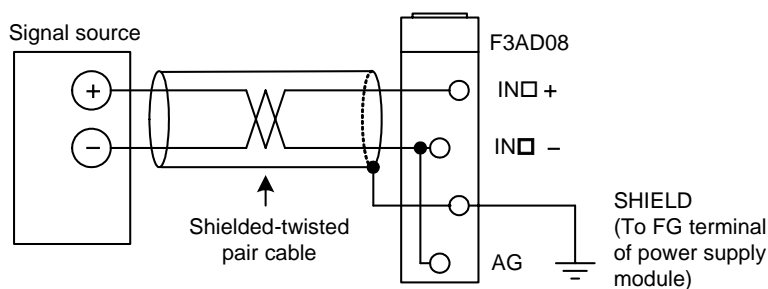
### ● Wiring Precautions

**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.

- 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.
- 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

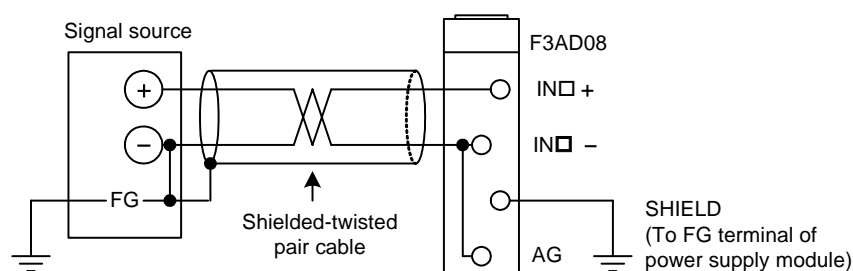
(The SHIELD terminals are connected to the FG terminal of the power supply module via the base module.)



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Figure B1.13 Wiring Example

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



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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.

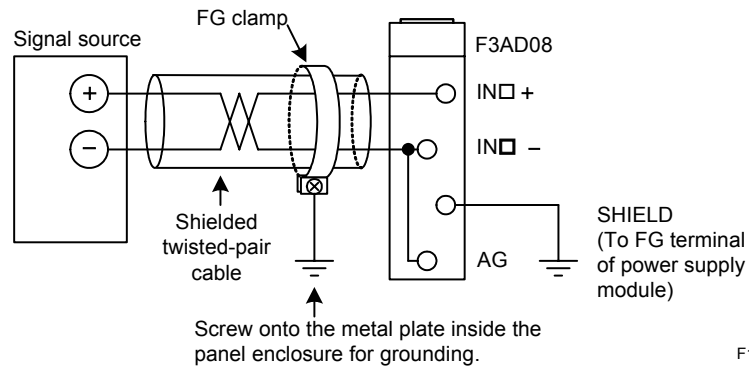


Figure B1.15 Wiring Example

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.

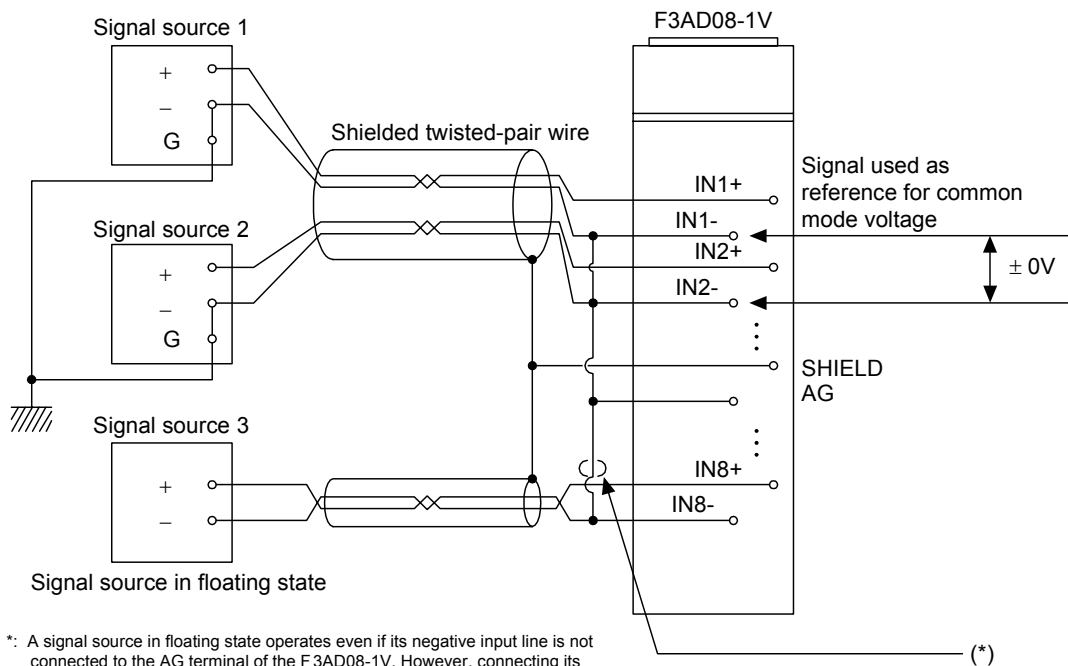
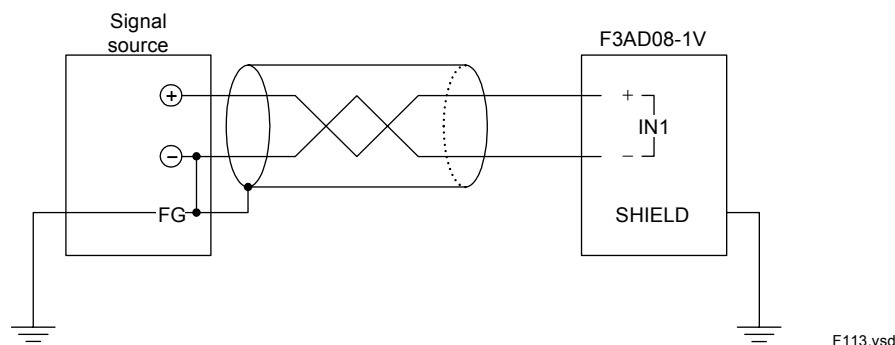


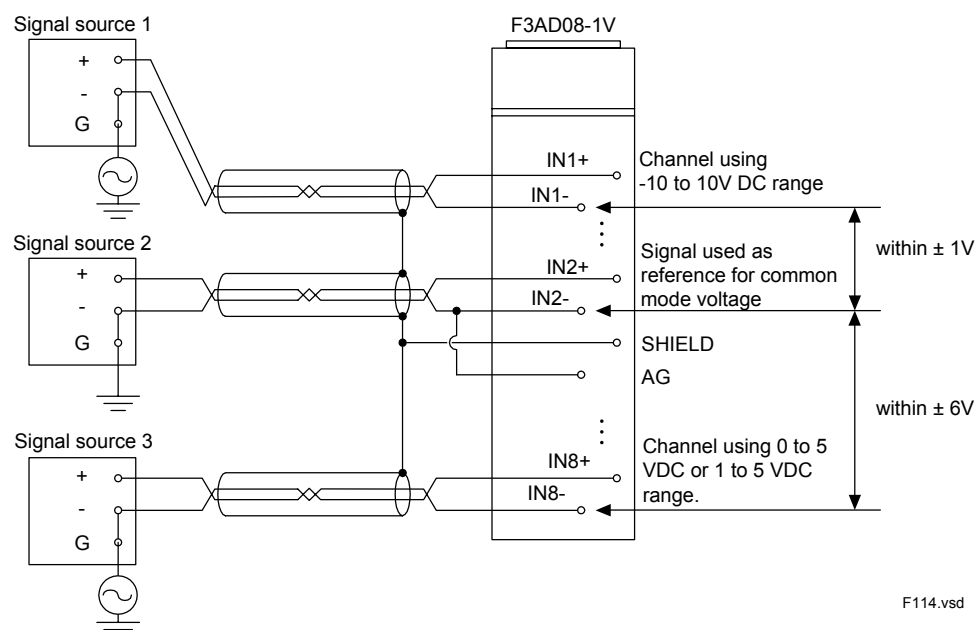
Figure B1.16 Wiring Example

- 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.



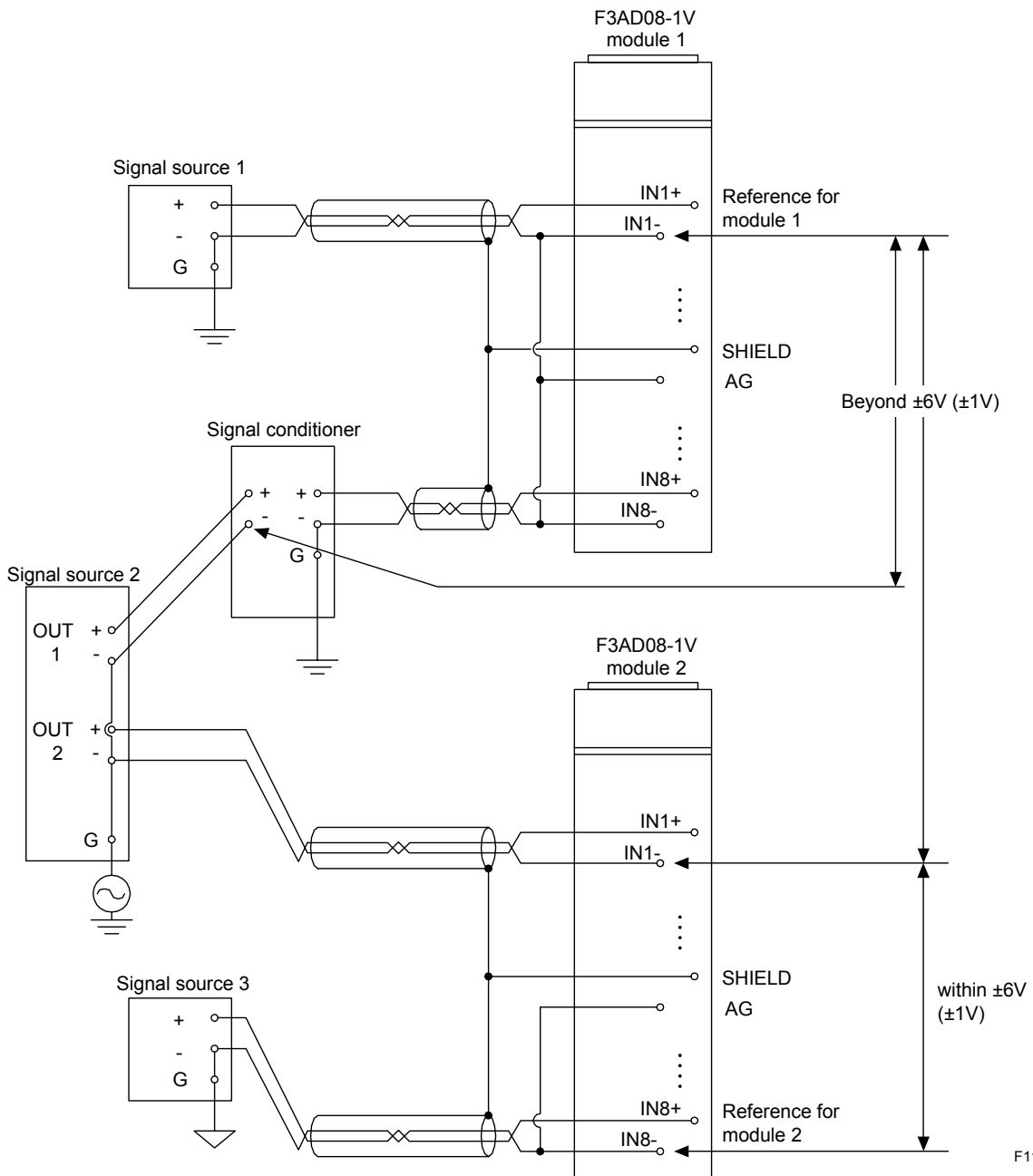
**Figure B1.17 Example Wiring with the Negative Terminal of the Signal Source Grounded**

- 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**

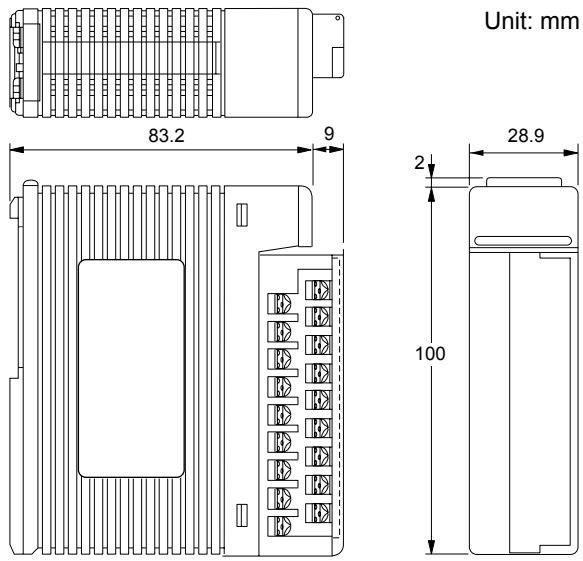
- If a signal is used as the reference for common mode voltage, then for signal sources superimposing the common mode voltage that are beyond allowable limits given in the module specifications, connect them as follows:
  - (1) Use an insulated signal conditioner to bring the common mode voltage within 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.



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

■ External Dimensions



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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<br>-25 mA DC minimum   |
| Input signal range <sup>1</sup><br>(Over range) | 0 to 20 mA DC (-1.0 to 21.0 mA DC)<br>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:<br>Photocoupler isolation<br>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<br>(12-bit A/D)   |
| Overall accuracy                                | 23±2°C: ± 0.2% (full scale)<br>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. <sup>2</sup>  |
| 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 <sup>3</sup>   |
| 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        |         |

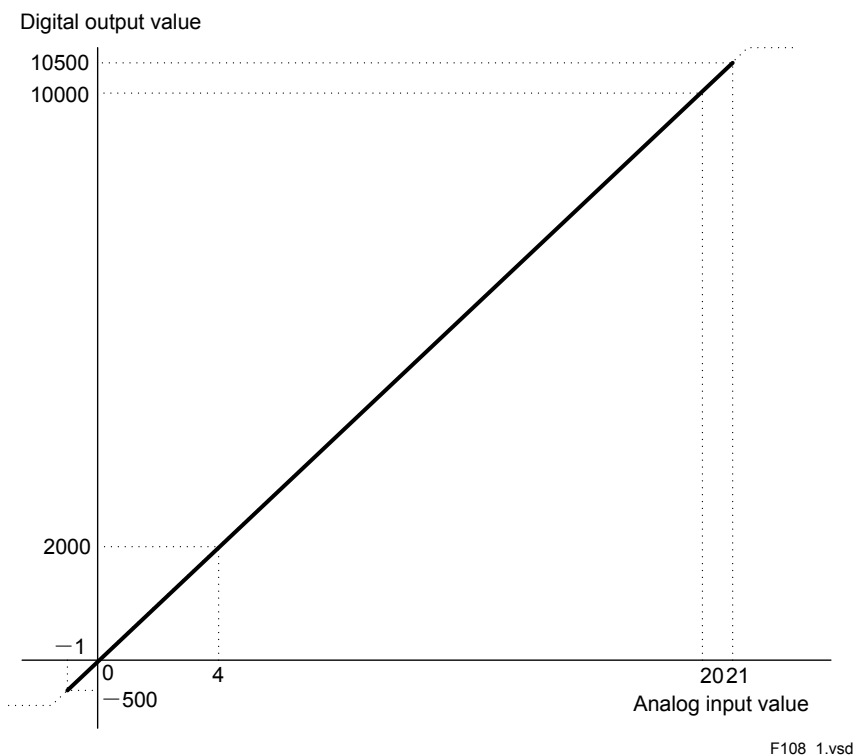


Figure B1.21 Input to Output Conversion Characteristics with No Scaling

## ■ Components and Functions

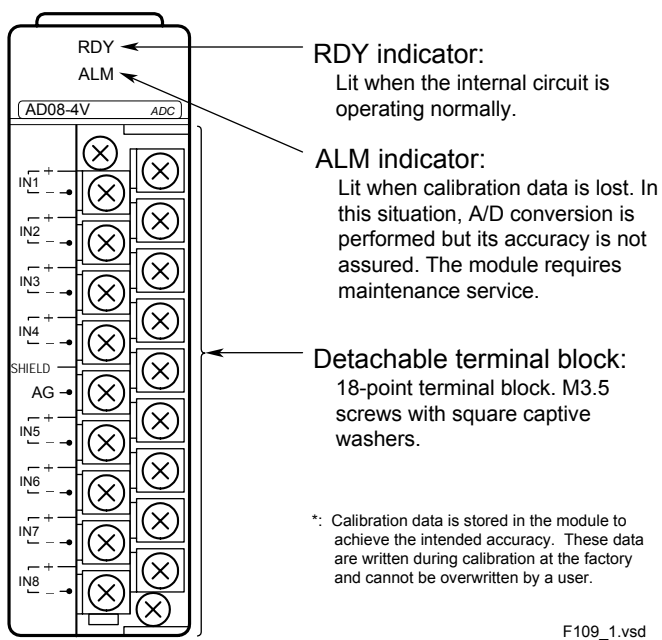
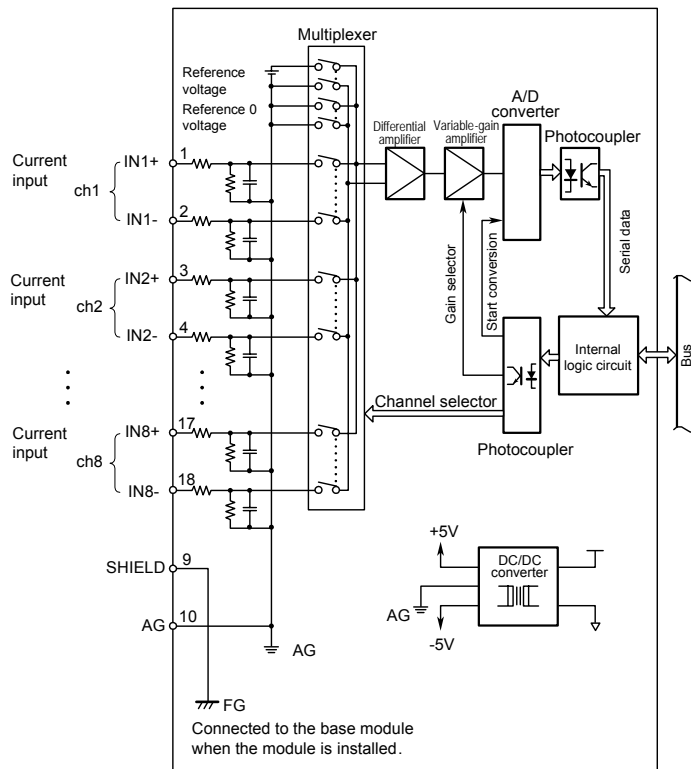


Figure B1.22 Components and Functions



## Internal Circuit

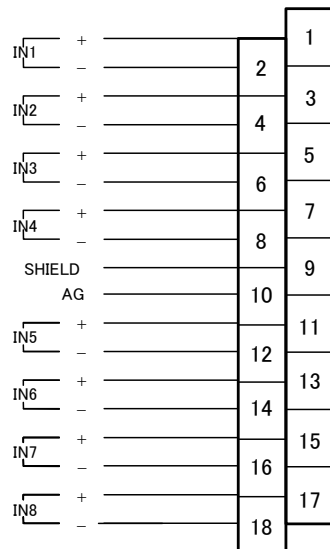


F110\_1.vsd

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.

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Figure B1.24 External Connection Diagram

**Table B1.9 Wires and Terminals**

|                      |                               |  |
|----------------------|-------------------------------|--|
| Applicable wire size |                               | AWG22-16 (0.3 to 1.25 mm <sup>2</sup> )  |
| 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:<br>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.

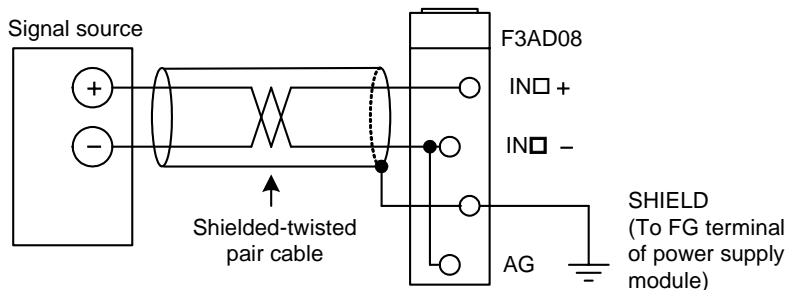
● **Wiring Precautions**



**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.

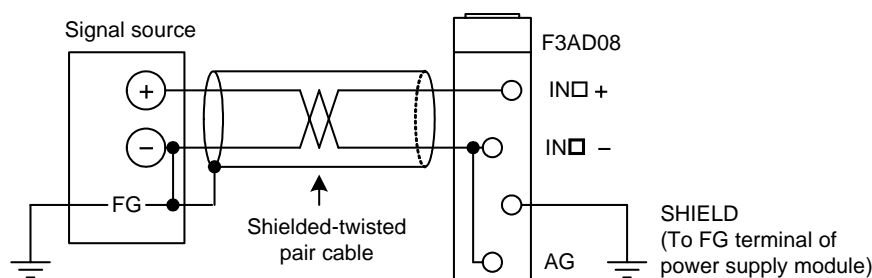
1. As analog signals are susceptible to noise, use shielded twisted-pair wires to connect signal sources to F3AD08-4V modules to suppress noise.
2. Ground the shield of the twisted-pair cable to FG. The following are some possible ways to perform grounding:
  - Connecting the shield to the SHIELD terminal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



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**Figure B1.25 Wiring Example**

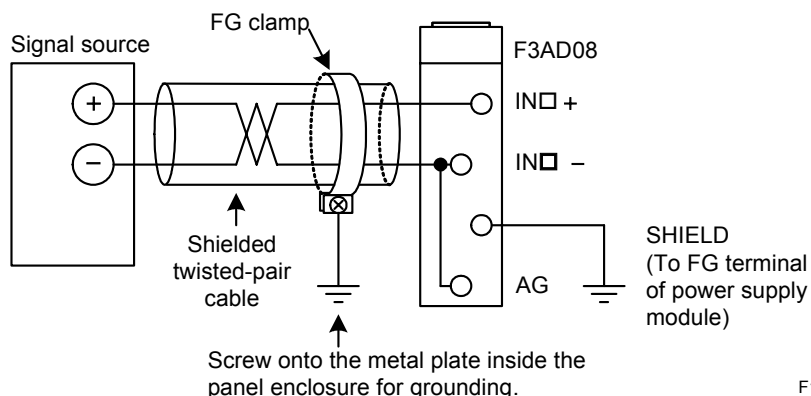
- Connecting the shield to shielded terminal (FG terminal) provided at the signal source



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**Figure B1.26 Wiring Example**

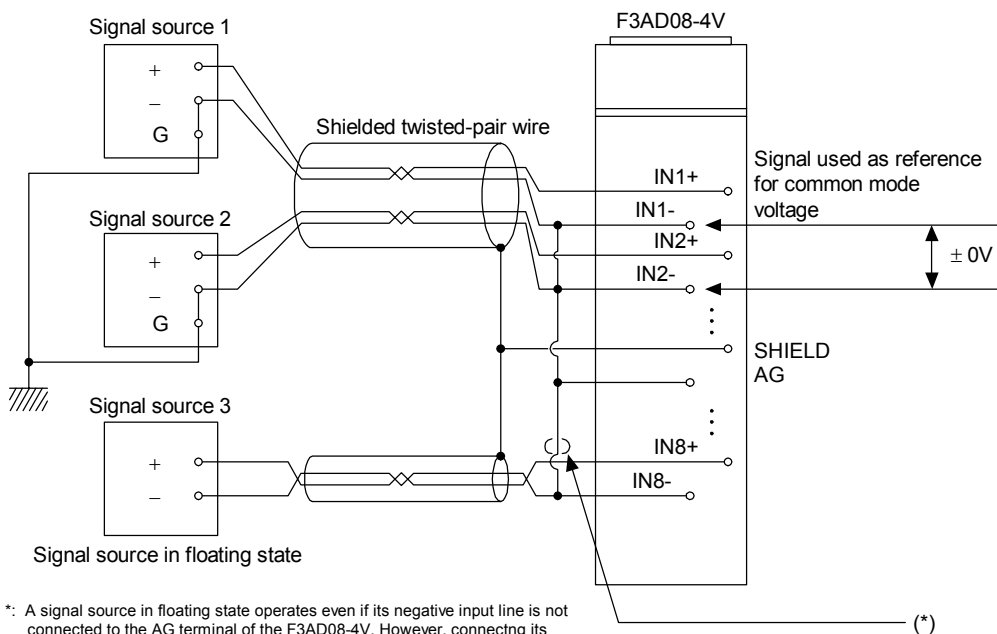
- Removing the cable covering to expose the wire and clamp it to the FG terminal using a FG clamp to ground it.



**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.

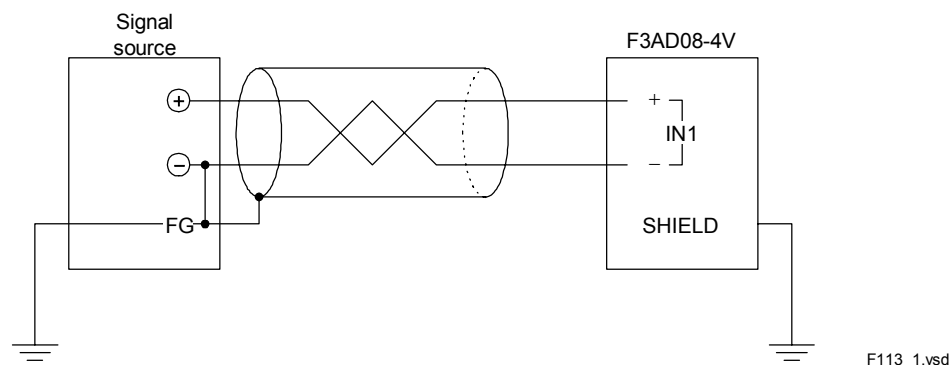


\*: A signal source in floating state operates even if its negative input line is not connected to the AG terminal of the F3AD08-4V. However, connecting its negative line to the AG terminal may improve stability in signal reading.

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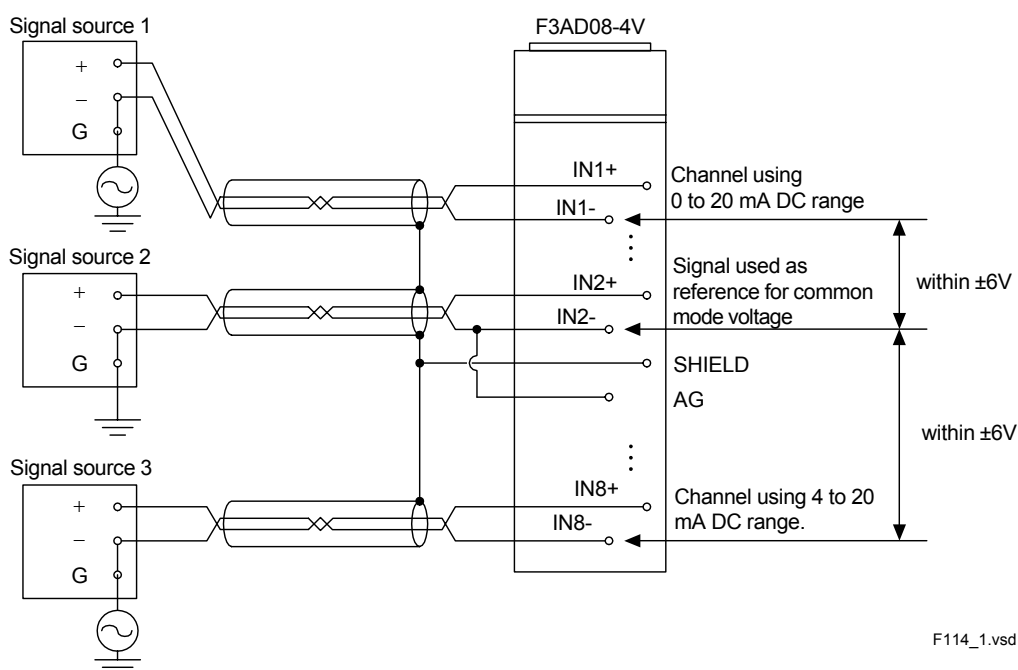
**Figure B1.28 Wiring Example**

- 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.



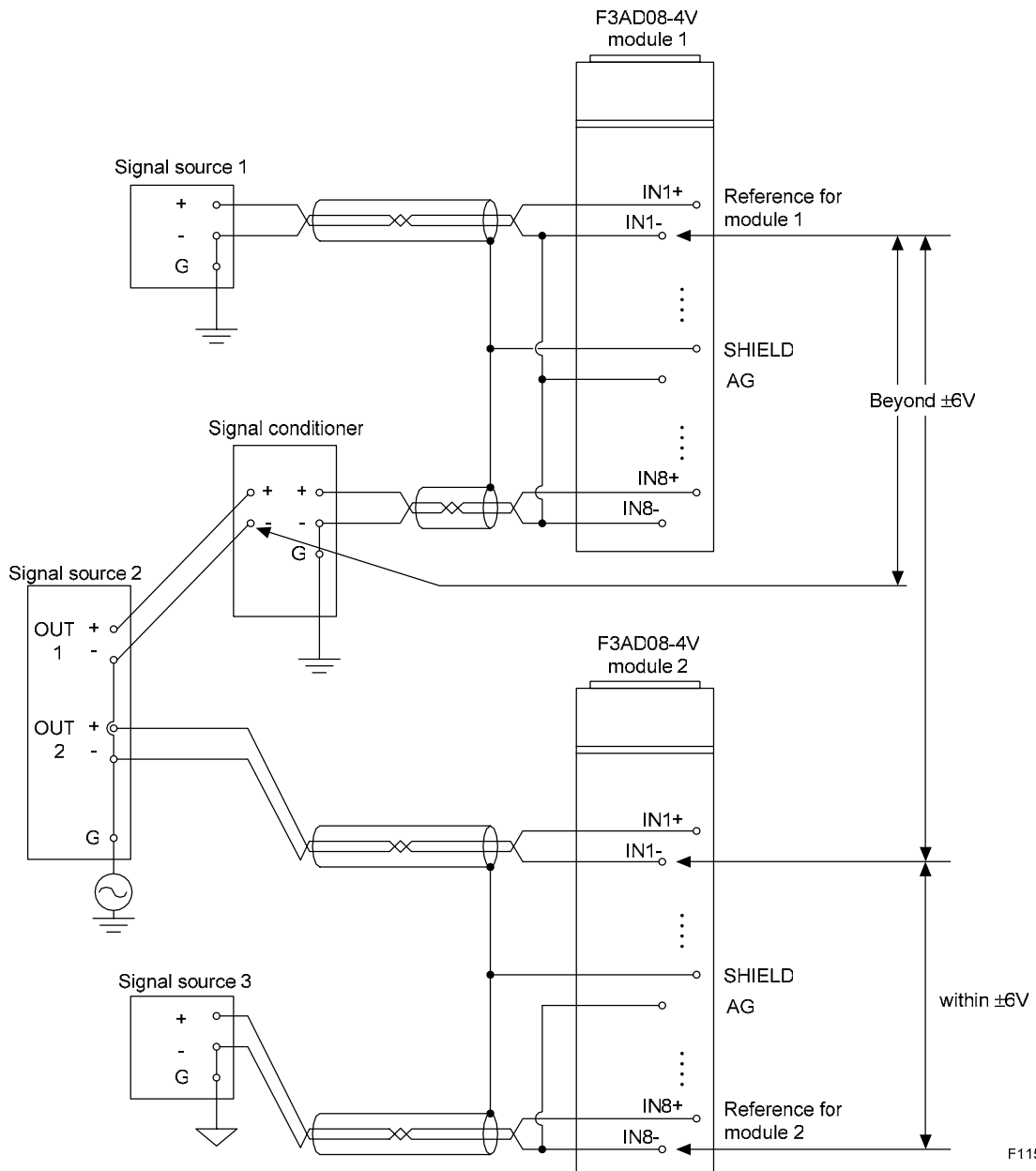
**Figure B1.29 Example Wiring with the Negative Terminal of the Signal Source Grounded**

- 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.



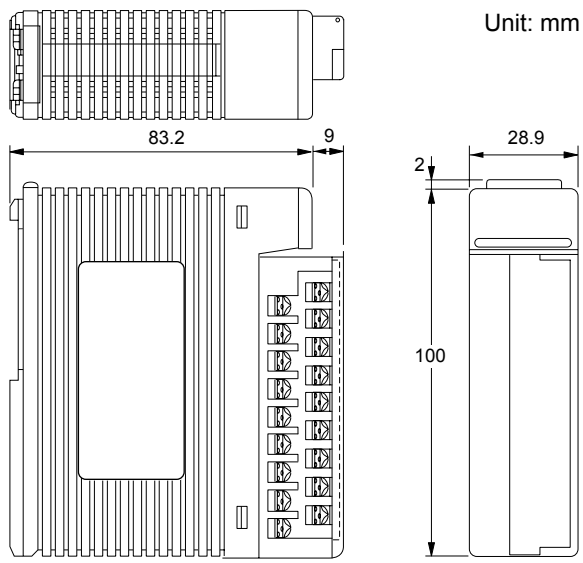
**Figure B1.30 When Signal Sources Are Within Allowable Limits of the Common Mode Voltage**

- 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**

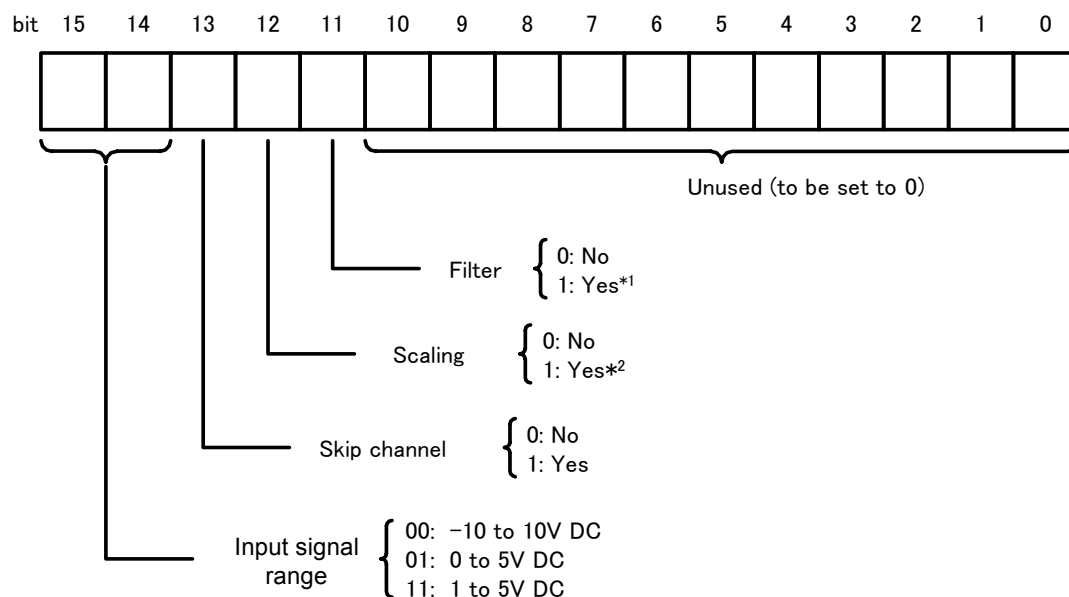
| Operation Mode     | Settings                             | Default Value   | Description           |
|--------------------|--------------------------------------|-----------------|-----------------------|
| Input signal range | -10 to 10 V, 0 to 5 V or 1 to 5 V DC | - 10 to 10 V DC | See Subsection 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.

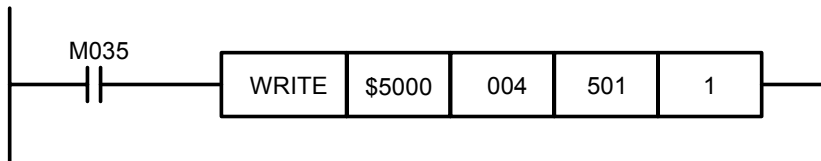
#### TIP

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

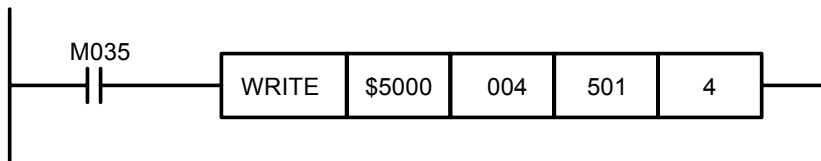
CONTROL 4,1; \$5000

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**

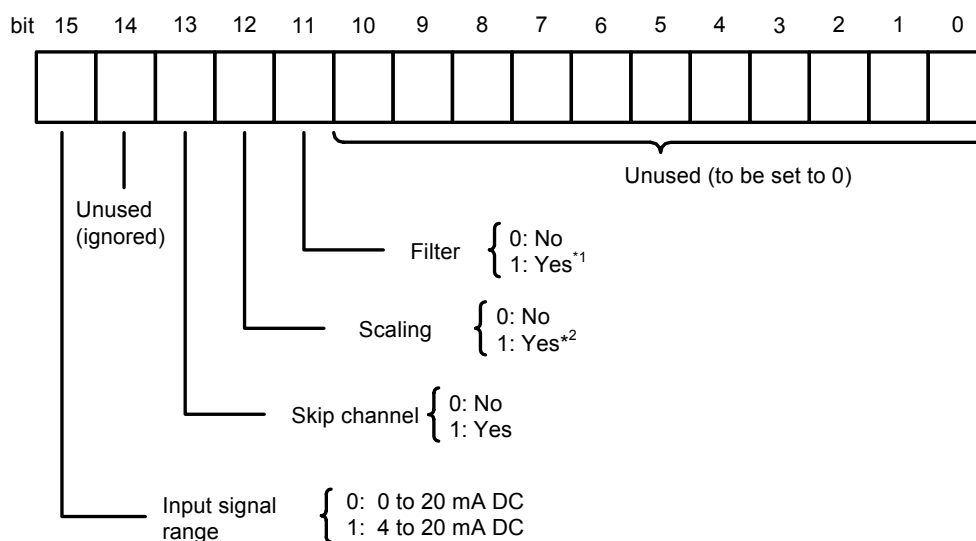
| Operation Mode     | Settings                       | Default Value | Description           |
|--------------------|--------------------------------|---------------|-----------------------|
| Input signal range | 0 to 20 mA DC or 4 to 20 mA DC | 0 to 20 mA DC | See Subsection B1.4.1 |
| Skip channel       | 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)

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**Figure B1.34 Operation Mode Bitmap**

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

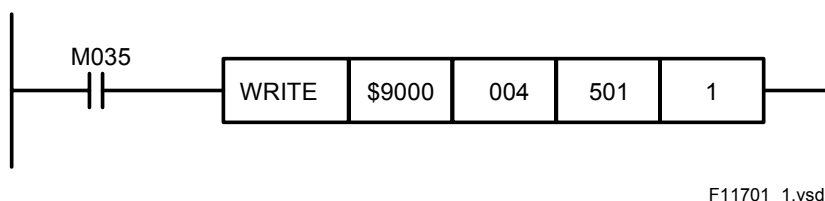
### TIP

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

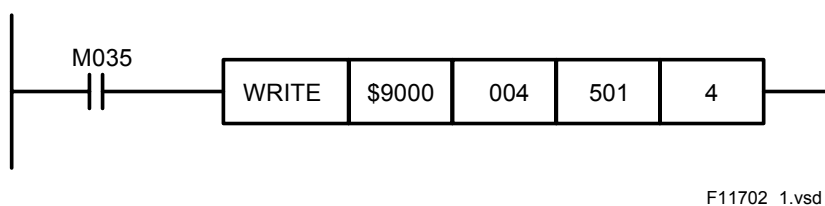
```
CONTROL 4,1; $9000
```

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.



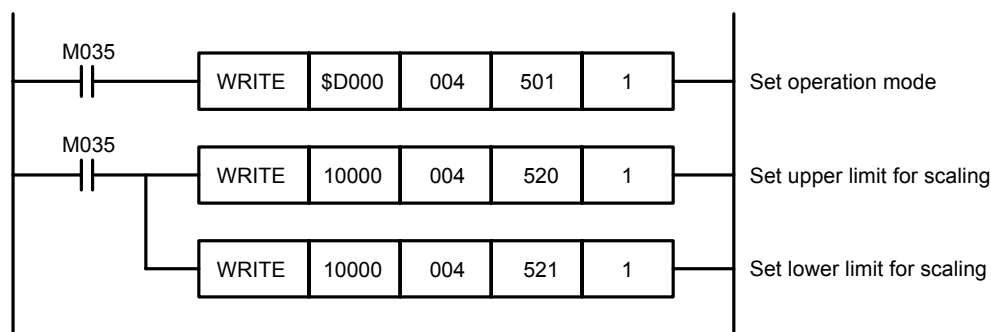
### CAUTION

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).

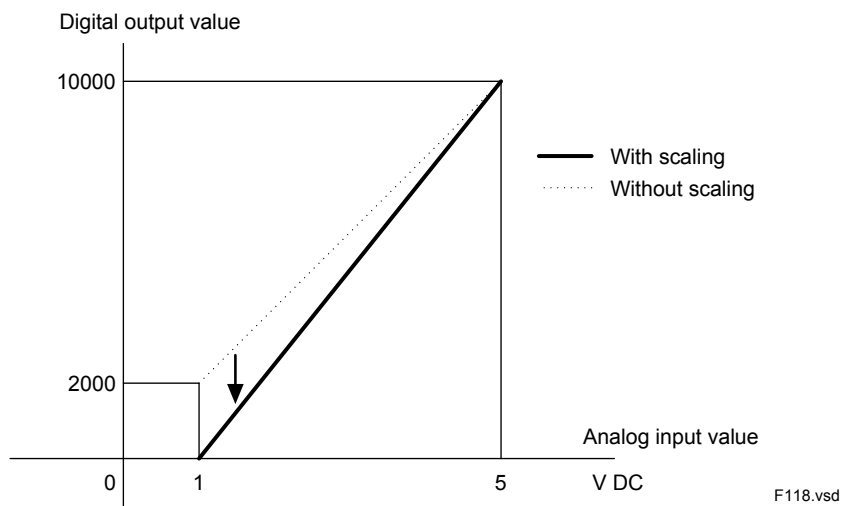


Figure B1.35 Changes in the Input/output Characteristics When Scaling Is Used

## 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]

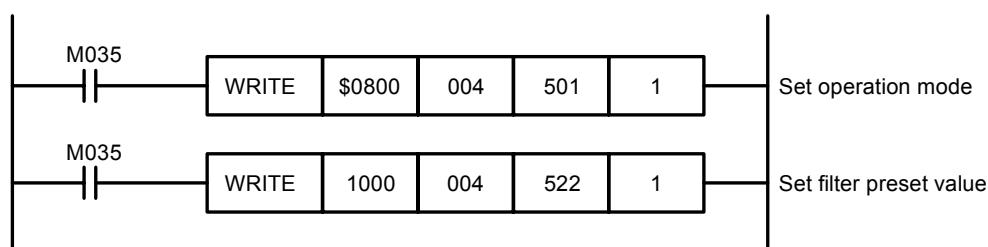
T<sub>0</sub>: Converted speed (1ms x number of channels) [ms]

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

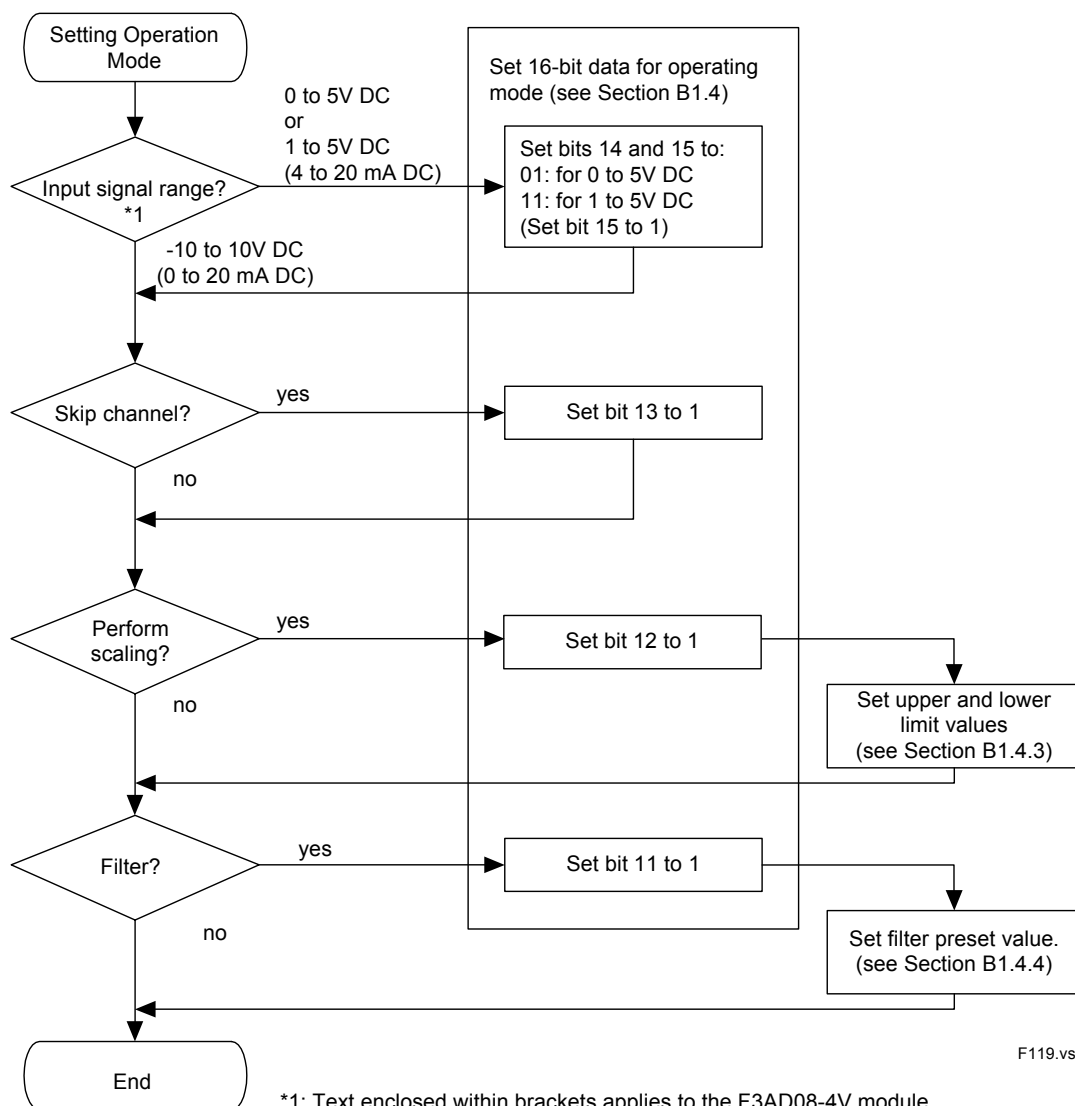
CONTROL 4,22;1000 Set filter preset value

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.

---

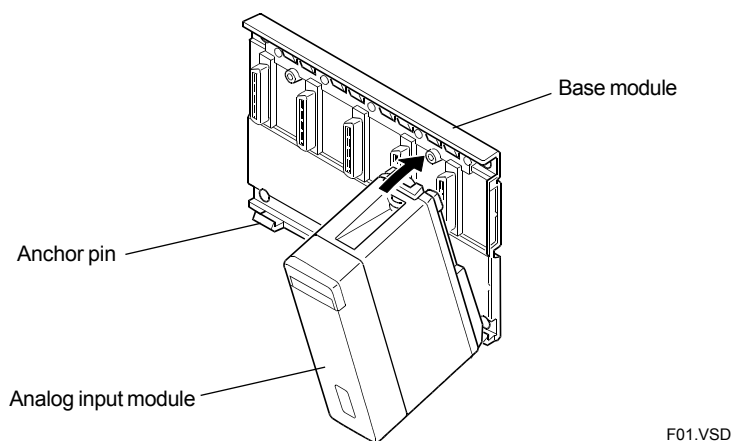


Figure B1.37 Attaching Modules



#### CAUTION

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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.

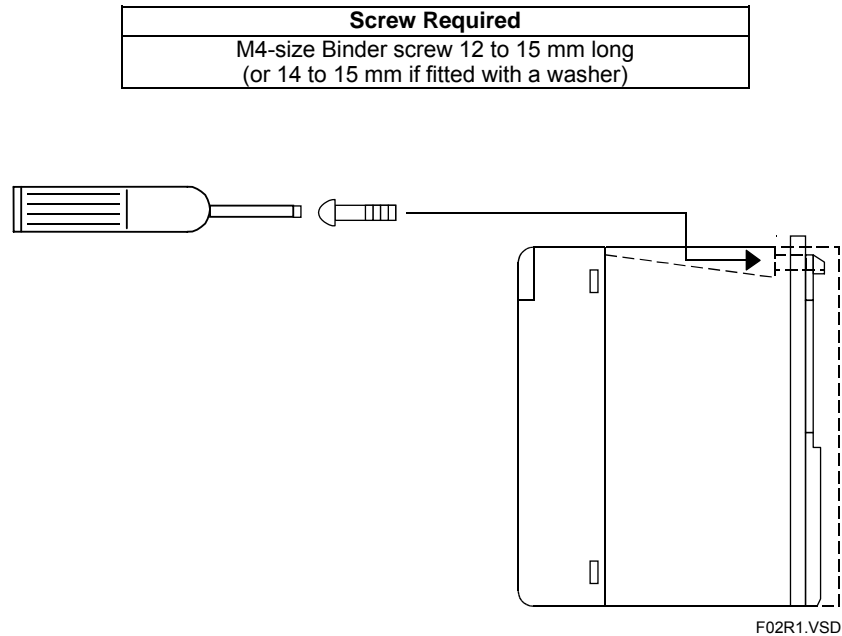


Figure B1.38 Tightening the Module

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## 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)

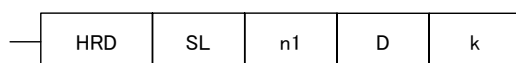
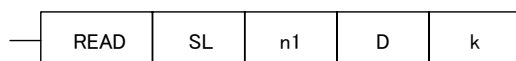
To read data from the analog input module, use the Special Module Read instruction or Special Module High Speed Read instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

### ● Description of Instructions

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

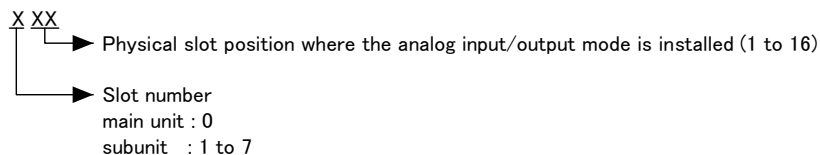
| Function No. | Instruction                    | Mnemonic | Symbol | Is Input condition Required? |    | Condition for Execution | Step count | Processing unit | Carry |
|--------------|--------------------------------|----------|--------|------------------------------|----|-------------------------|------------|-----------------|-------|
|              |                                |          |        | 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.

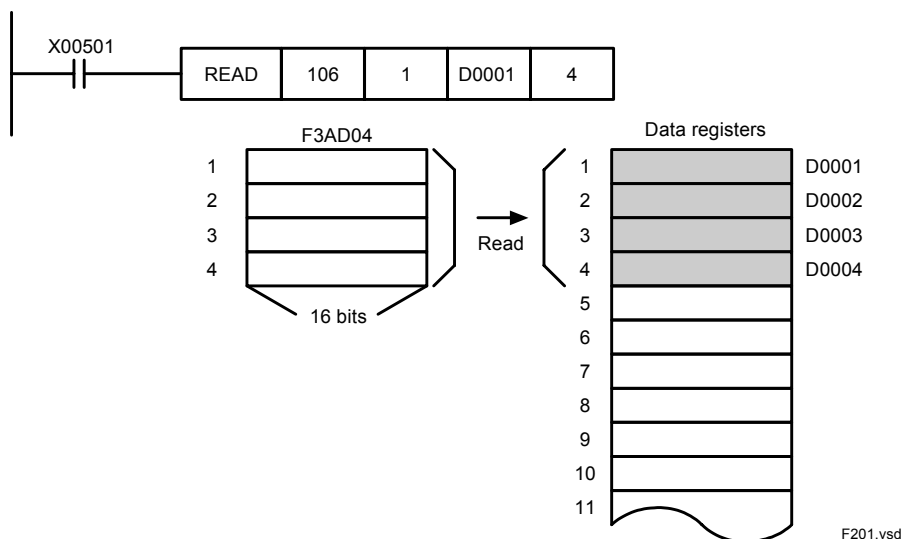


Figure B2.1 Reading Analog Data

## ■ 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.

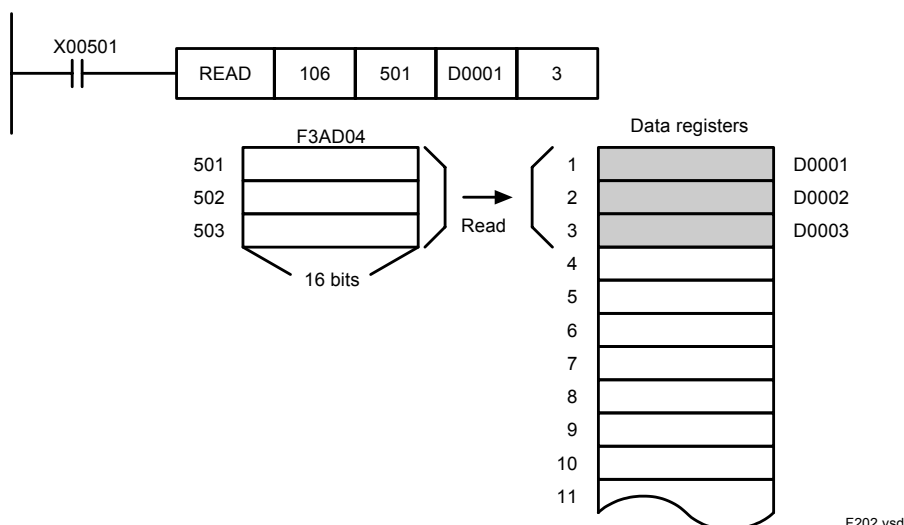


Figure B2.2 Reading Operation Mode

## B2.3 Writing Data (WRITE/HWR)

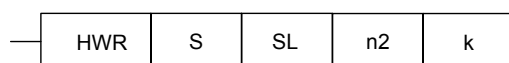
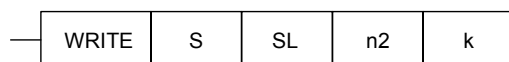
To write data to the analog input module, use the Special Module Write instruction or Special Module High Speed Write instruction. For details of these instructions, see "Sequence CPU Modules – Instructions" (IM34M6P12-03E).

### ● Description of Instructions

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

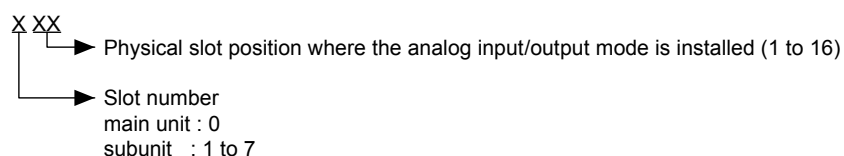
| Function No. | Instruction                     | Mnemonic | Symbol | Is Input condition Required? |    | Condition for Execution | Step count | Processing unit | Carry |
|--------------|---------------------------------|----------|--------|------------------------------|----|-------------------------|------------|-----------------|-------|
|              |                                 |          |        | 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.

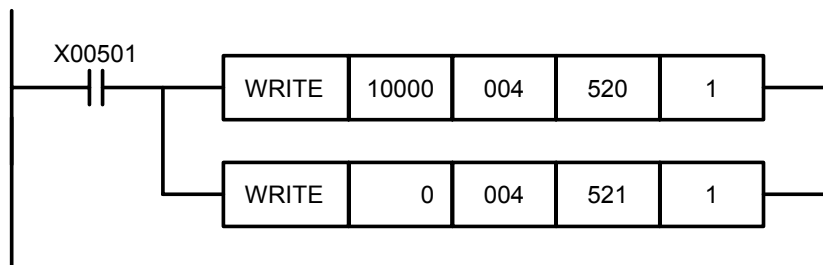


Figure B2.3 Setting Scaling Limits

---

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## 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:<br>ASSIGN AD04=SL<br>SL : Slot number  | Defines the mapping between modules and slot numbers.<br>Always execute this statement before accessing an analog input module. Execute this statement in the main program.  |
|   | Example:<br>ASSIGN AD08=SL<br>SL : Slot number  |  |
| Read data from analog input module        | ENTER SL, n NOFORMAT; I<br>or<br>ENTER SL NOFORMAT; I(*)<br>SL: Slot number<br>n : Data position number<br>(channel number)<br>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<br>or<br>STATUS SL; P(*)<br>SL : Slot number<br>n : Data position number<br>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<br>or<br>CONTROL SL; P(*)<br>SL : Slot number<br>n : Data position number<br>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.

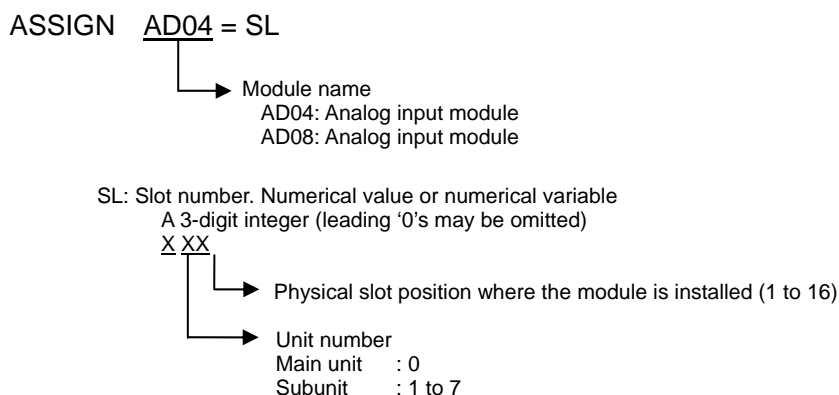
- Input data : Area for storing input current data for each channel
- Operation mode : Area for setting operation mode for each channel
- Operation details data : Area for setting upper and lower limits for scaling and filter preset values

**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   |

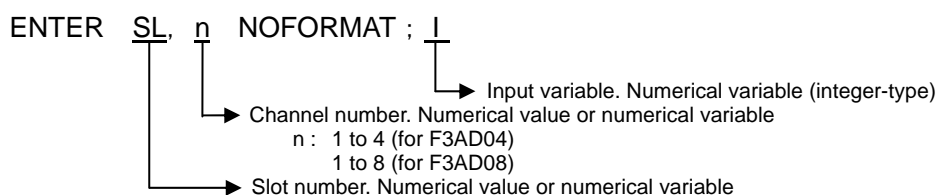
## B3.3 Declaring Use of Module (ASSIGN)

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.



## 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 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.

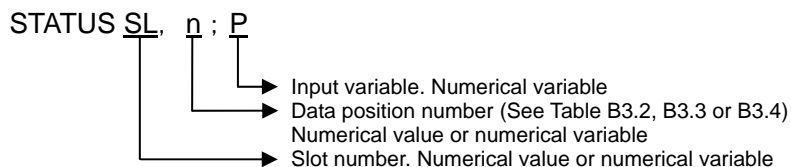
ENTER SL NOFORMAT ; I (\*)

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.

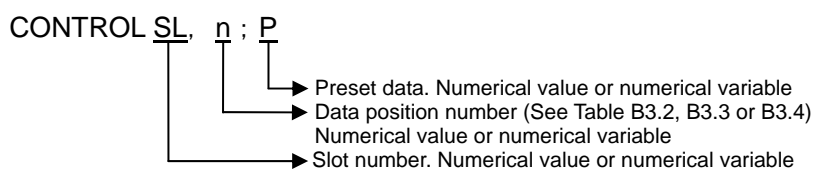
## B3.5 Reading Operation Mode, Scaling Limits and Other Data (STATUS)

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.



## 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.





## 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**

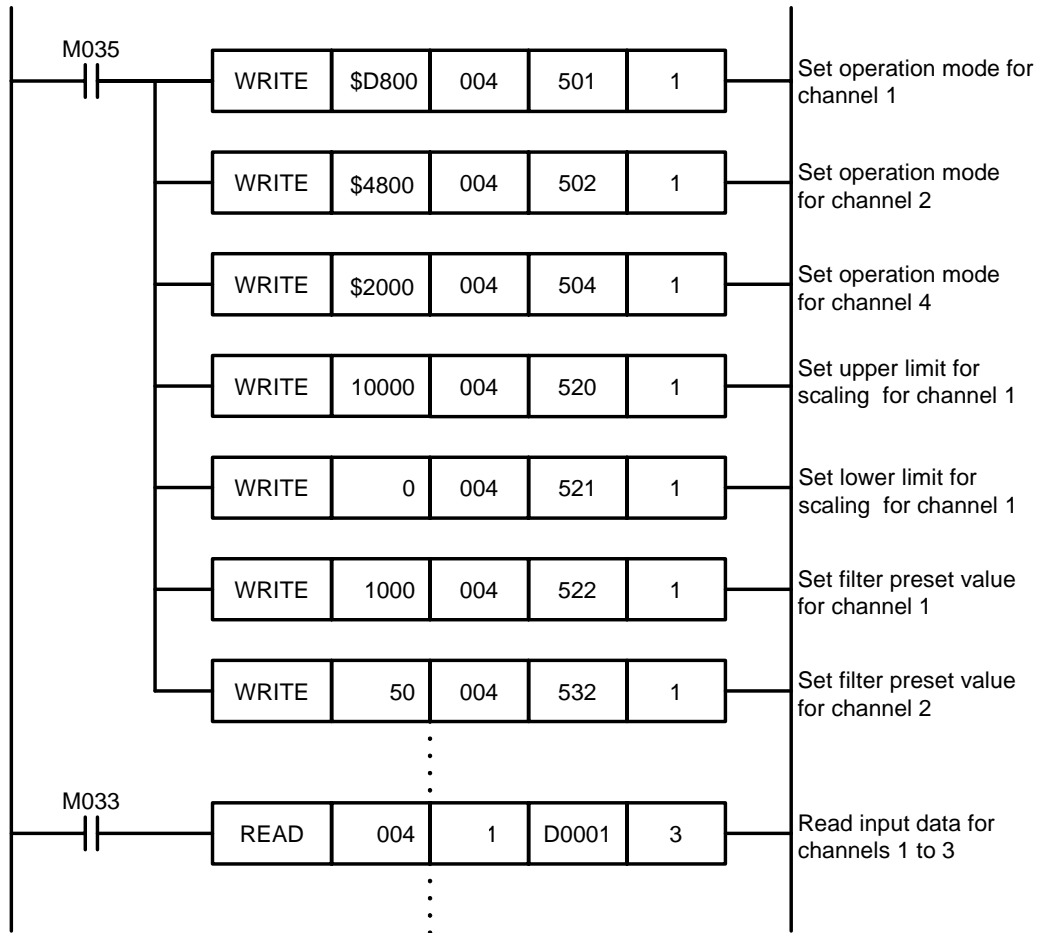
|           | Input Signal Range (V DC) | Scaling    | Filter Time Constant (ms) |
|-----------|---------------------------|------------|---------------------------|
| Channel 1 | 1 to 5                    | 0 to 10000 | 1000                      |
| Channel 2 | 0 to 5                    | —          | 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
    :
    :
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  $250\Omega$  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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# Revision Information

Document Name: Analog Input Module

Document No.: IM 34M6H11-02E

| <b>Edition</b> | <b>Date</b> | <b>Revised Item</b>  |
|----------------|-------------|--|
| 1st            | July, 2003  | New publication  |
| 2nd            | Aug, 2005   | F3AD08-4V model added.   |
| 3rd            | May 2006    | F3AD08-4R, 5R and 6R models added; division into parts A and B |

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