2. EXTERNAL DIMENSIONS

- Weight: Approx. 0.3 kg (0.66 lbs)
- Dimensions: mm (inches)

3. WIRING

- The analog input is received through a twisted pair shielded cable. This cable should be wired separately from power lines or any other lines which may induce electrical noise.
- If a voltage ripple occurs during input, or there is electrically induced noise on the external wiring, connect a smoothing capacitor of 0.1 to 0.47 μF, 25V.
- If you are using current input, connect the V+ and I+ terminals to each other.
- If there is excessive electrical noise, connect the FG terminal to the ground terminal of the FX2N-4AD (in CH1, there is no FG terminal). Use FG terminal of other channels.
- Connect the ground terminal on the FX2N-4AD unit with the grounded terminal on the main unit. Use the grounded terminal on the main unit, if available.

4. CONNECTION WITH PLC

The FX2N-4AD unit can be connected to the PLCs as follows. Restrictions apply to the maximum number of connectable units, depending on the power supply capacities and the Main Unit/Special Function Unit types. For details, refer to the respective PLC manual.

- FX3UC: The maximum connectable units is 8.
- FX2NC: The maximum connectable units is 4.
- FX1N: The maximum connectable units is 8.
- FX0N/FX1N/FX2N/FX2NC: (In CH1, there is no FG terminal. Use FG terminal of other channels.)

5. SPECIFICATIONS

5.1 General specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>General specifications</td>
<td>Same as those for the main unit</td>
</tr>
<tr>
<td>Dielectric withstand voltage</td>
<td>500V AC, 1min (between all terminals and ground)</td>
</tr>
</tbody>
</table>

5.2 Performance specification and others

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuits</td>
<td>24V DC ±10%, 5mA (external power supply from the main unit)</td>
</tr>
<tr>
<td>Digital circuits</td>
<td>5V DC, 30mA (internal power supply from main unit)</td>
</tr>
<tr>
<td>Isolation</td>
<td>Photo-coupler isolation between analog and digital circuits. DC/DC converter isolation of power from the main unit. No isolation between analog channels.</td>
</tr>
<tr>
<td>Number of occupied I/O points</td>
<td>The analog block occupies 8 points. (can be either inputs or outputs)</td>
</tr>
</tbody>
</table>

Guidelines for the Safety of the User and Protection of the FX2N-4AD special function block.

This manual should be used by trained and competent personnel. The definition of such a person or persons is as follows:

- Any engineer using the product associated with this manual, should be of a competent nature, trained and qualified to the local and national standards. These engineers should be aware of all aspects of safety with regards to automated equipment.
- Any commissioning or service engineer must be of a competent nature, trained and qualified to the local and national standards.
- All operators of the completed equipment should be trained to use this product in a safe and coordinated manner in compliance to established safety practices.

Note: The term 'completed equipment' refers to a third party constructed device which contains or uses the product associated with this manual.

Notes on the Symbols Used in This Manual

At various times throughout this manual certain symbols will be used to highlight points of information which are intended to ensure the users personal safety and protect the integrity of equipment.

- Indicates that the identified danger WILL cause physical and property damage.
- Indicates that the identified danger could POSSIBLY cause physical and property damage.

- Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential damage that may arise as a result of the installation or use of the equipment.
- All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mitsubishi Electric will accept no responsibility for the actual use of the product based on these illustrative examples.
- Owing to the very great variety in possible application for this equipment, you must satisfy yourself as to its suitability for your specific application.

1. INTRODUCTION

- The FX2N-4AD analog special function block has four input channels. The input channels receive analog signals and convert them into a digital value. This is called an A/D conversion. The FX2N-4AD has maximum resolution of 12 bits.
- The selection of voltage or current input impedance is by user wiring. Analog ranges of -10 to 10 VDC (resolution: 5mV), and/or 4 to 20mA, -20 to 20mA (resolution: 20 μA) may be selected.
- The FX2N-4AD can be connected to the FX2N/FX3U/FX3UC/FX3UC series Programmable Controllers (PLC).
- Data transfer between the FX2N-4AD and the main unit is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the FX2N-4AD.
- The FX2N-4AD occupies 8 I/O points on the FX2N-expansion bus. The 8 I/O points can be allocated from either inputs or outputs. The FX2N-4AD draws 30mA from the 5V rail of the main unit or powered extension unit.

6. ALLOCATION OF BUFFER MEMORIES (BFM#)

<table>
<thead>
<tr>
<th>BFM#</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>#0</td>
<td>Channel selection Default = H0000</td>
</tr>
<tr>
<td>#1</td>
<td>Channel 1 Contains the number of samples (1 to 4096) to be used for an averaged result.</td>
</tr>
<tr>
<td>#2</td>
<td>Channel 2 The default setting is 8- normal speed. High speed operation can be selected with a value of 1.</td>
</tr>
<tr>
<td>#3</td>
<td>Channel 3</td>
</tr>
<tr>
<td>#4</td>
<td>Channel 4</td>
</tr>
<tr>
<td>#5</td>
<td>Channel 5</td>
</tr>
<tr>
<td>#6</td>
<td>Channel 6 These buffer memories contain the averaged input values for the number of samples entered for the channel in buffer memories #1 to #4 respectively.</td>
</tr>
<tr>
<td>#7</td>
<td>Channel 7</td>
</tr>
<tr>
<td>#8</td>
<td>Channel 8</td>
</tr>
<tr>
<td>#9</td>
<td>Channel 9</td>
</tr>
<tr>
<td>#10</td>
<td>Channel 10 These buffer memories contain the present value currently being read by each input channel.</td>
</tr>
<tr>
<td>#11</td>
<td>Channel 11</td>
</tr>
<tr>
<td>#12</td>
<td>Channel 12</td>
</tr>
<tr>
<td>#13 - #14</td>
<td>Reserved</td>
</tr>
<tr>
<td>#15</td>
<td>Selection of A/D conversion speed see note 2 When set to 0, a normal speed is selected of 15ms/ch (default) When set to 1, a high speed is selected of 6ms/ch</td>
</tr>
<tr>
<td>#16 - #19</td>
<td>Reserved</td>
</tr>
<tr>
<td>#20</td>
<td>Reset to Defaults and Preset. Default = 0</td>
</tr>
<tr>
<td>#21</td>
<td>Offset, Gain Adjust Prohibit. Default = (0, 1) Permit</td>
</tr>
<tr>
<td>#22</td>
<td>Offset, Gain Adjust</td>
</tr>
<tr>
<td>#23</td>
<td>Offset Value Default = 0</td>
</tr>
<tr>
<td>#24</td>
<td>Gain Value Default = 5,000</td>
</tr>
<tr>
<td>#25 - #28</td>
<td>Reserved</td>
</tr>
<tr>
<td>#29</td>
<td>Error status</td>
</tr>
<tr>
<td>#30</td>
<td>Identification code K2010</td>
</tr>
<tr>
<td>#31</td>
<td>Cannot be used</td>
</tr>
</tbody>
</table>

5.3 Performance specification

**Analog Inputs**

<table>
<thead>
<tr>
<th>Item</th>
<th>Voltage input</th>
<th>Current input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog input range</td>
<td>DC -10V to +10V</td>
<td>DC -20mA to +20mA</td>
</tr>
<tr>
<td>Warning: this unit may be damaged by an input voltage in excess of a 15V.</td>
<td>input resistance: 20kΩ</td>
<td>input resistance: 250Ω</td>
</tr>
<tr>
<td>Digital output</td>
<td>0.2-bit conversion stored in 16-bit 2's complement form. Max. value: +2047 Minimum value: -2048</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>5mV (10V default range) 1/2000</td>
<td>20μA (20mA default range 1/1000)</td>
</tr>
<tr>
<td>Overall accuracy</td>
<td>±1% (for the range of -10V to +10V)</td>
<td>±1% (for the range of -20mA to +20mA)</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>15ms/channel (Normal speed), 6ms/channel (High speed)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Preset ranges are selected by an appropriate setting in the buffer memory of the analog block. Current/Voltage input selection must match the correct input terminal connections.
2. EXTERNAL DIMENSIONS

<table>
<thead>
<tr>
<th>Weight</th>
<th>Dimensions: mm (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3 kg</td>
<td>0.66 lbs</td>
</tr>
</tbody>
</table>

3. Wiring

- The analog input is received through a twisted pair shielded cable. This cable should be wired separately from power lines or any other lines which may induce electrical noise.
- If a voltage ripple occurs during input, or there is electrically induced noise on the external wiring, connect a smoothing capacitor of 0.1 to 0.47 μF, 25V.
- If you are using current input, connect the V+ and I+ terminals to each other.
- If there is excessive electrical noise, connect the FG (frame ground) terminal with the grounded terminal on the FX2N-4AD. (In CH1, there is no FG terminal. Use FG terminal of other channels.)
- Connect the ground terminal on the FX2N-4AD unit with the grounded terminal on the main unit. Use grounding on the main unit, if available.

4. CONNECTION WITH PLC

The FX2N-4AD unit can be connected to the PLCs as follows. Restrictions apply to the maximum number of connectable units, depending on the DC24V/DC5V Power Supply capacities and the Main Unit/Special Function Unit types. For details, refer to the respective PLC manual.

- **Analog circuits**: 24V DC ±10%, 55mA (external power supply from the main unit)
- **Digital circuits**: 5V DC, 30mA (internal power supply from the main unit)
- **Isolation**: Photo-coupler isolation between analog and digital circuits. DC/DC converter isolation of power from the main unit. No isolation between analog channels.
- **Number of occupied I/O points**: The analog block occupies 8 points. (can be either inputs or outputs)

5. SPECIFICATIONS

5.1 General specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input type</td>
<td>Voltage or current can be selected with your choice of input terminal. Up to four input points can be used at one time.</td>
</tr>
<tr>
<td>Analog input range</td>
<td>DC: 10V to 10V (input resistance: 30kΩ)</td>
</tr>
<tr>
<td></td>
<td>Warning: this unit may be damaged by an input voltage in excess of ±15V.</td>
</tr>
<tr>
<td>Digital output</td>
<td>±20mA to ±20mA (input resistance: 25kΩ)</td>
</tr>
<tr>
<td></td>
<td>Warning: this unit may be damaged by an input current in excess of ±30mA.</td>
</tr>
</tbody>
</table>

5.2 Performance specification and others

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
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<tbody>
<tr>
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<tr>
<td>Digital circuits</td>
<td>5V DC, 30mA (internal power supply from the main unit)</td>
</tr>
<tr>
<td>Isolation</td>
<td>None</td>
</tr>
<tr>
<td>Number of occupied I/O points</td>
<td>The analog block occupies 8 points. (can be either inputs or outputs)</td>
</tr>
</tbody>
</table>

6. ALLOCATION OF BUFFER MEMORIES (BFM#)

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<th>Contents</th>
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<td>Channel selection Default = H0000</td>
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<tr>
<td>#1</td>
<td>Channel 1 Contains the number of samples (1 to 4096) to be used for an averaged result.</td>
</tr>
<tr>
<td>#2</td>
<td>Channel 2 The default setting is 8—normal speed. High speed operation can be selected with a value of 1.</td>
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<td>#3</td>
<td>Channel 3</td>
</tr>
<tr>
<td>#4</td>
<td>Channel 4</td>
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<td>#5</td>
<td>Channel 5</td>
</tr>
<tr>
<td>#6</td>
<td>Channel 6 These buffer memories contain the averaged input values for the number of samples entered for the channel in buffer memories #1 to #4 respectively.</td>
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<td>Channel 11</td>
</tr>
<tr>
<td>#12</td>
<td>Channel 12</td>
</tr>
<tr>
<td>#13 - #14</td>
<td>Reserved</td>
</tr>
<tr>
<td>#15</td>
<td>Selection of A/D conversion speed (default) When set to 0, a normal speed is selected of 15ms/channel. When set to 1, a high speed is selected of 6ms/channel</td>
</tr>
<tr>
<td>#16 - #19</td>
<td>Reserved</td>
</tr>
<tr>
<td>#20</td>
<td>Offset to Defaults and Preset. Default = 0</td>
</tr>
<tr>
<td>#21</td>
<td>Offset, Gain Adj Prohib. Default = (0, 1) Permit</td>
</tr>
<tr>
<td>#22</td>
<td>Offset, Gain Adjust</td>
</tr>
<tr>
<td>#23</td>
<td>Offset Value Default = 0</td>
</tr>
<tr>
<td>#24</td>
<td>Gain Value Default = 5000</td>
</tr>
<tr>
<td>#25 - #28</td>
<td>Reserved</td>
</tr>
<tr>
<td>#29</td>
<td>Error status</td>
</tr>
<tr>
<td>#30</td>
<td>Identification code K2010</td>
</tr>
<tr>
<td>#31</td>
<td>Cannot be used</td>
</tr>
</tbody>
</table>
### 1. INTRODUCTION

The FX2N-4AD unit can be expanded to 8 input channels. Each channel receives analog signals and converts them into a digital value. This is called an A/D conversion. The FX2N-4AD has a maximum resolution of 12 bits.

1. The selection of voltage or current based on input/output is by wiring. Analog ranges of –10 to 10V DC (resolution: 5mV), and/or 4 to 20mA, –20 to 20mA (resolution: 20 μA) may be selected.
2. The FX2N-4AD can be connected to the FX2N/FX3N/FX3UC/FX3UC-w-series Programmable Controllers (PLCs).
3. Data transfer between the FX2N-4AD and the main unit is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the FX2N-4AD.
4. The FX2N-4AD occupies 8 I/O points on the FX2N-expansion bus. The 8 I/O points can be allocated from either inputs or outputs. The FX2N-4AD draws 30mA from the 5V rail of the main unit or powered extension unit.

### 2. SPECIFICATIONS

#### 2.1 General specification

- **Terminals**
  - DI: 8 points
  - DO: 8 points
  - AO: 4 points
- **Power Supplies**
  - DI: 5 V DC, 30mA
  - DO: 24 V DC, 20mA
  - AO: 5 V DC, 20mA
- **Input/Output Specification**
  - DI: 5 V DC, 30mA
  - DO: 24 V DC, 20mA
  - AO: 5 V DC, 20mA

#### 2.2 Performance specification and others

- **Response time**
  - DI: 15 ms
  - DO: 15 ms
  - AO: 15 ms

### 3. WIRING

- **Input and Output Wiring**
  - DI: 5 V DC, 30mA
  - DO: 24 V DC, 20mA
  - AO: 5 V DC, 20mA

### 4. CONNECTION WITH PLC

- **Connect to PLC**
  - The FX2N-4AD unit can be connected to the PLCs as follows. Restrictions apply to the maximum number of connectable units, depending on the DC24V/DC5V Power Supply capacities and the Main Unit/Special Function Unit types. For details, refer to the respective PLC manual.

### 5. ALLOCATION OF BUFFER MEMORIES (BFM#)

- **BFM#**
  - **#1** Channel selection Default = H0000
  - **#2** Channel 1
  - **#3** Channel 2
  - **#4** Channel 3
  - **#5** Channel 4
  - **#6** Channel 5
  - **#7** Channel 6
  - **#8** Channel 7
  - **#9** Channel 8
  - **#10** Channel 9
  - **#11** Channel 10
  - **#12** Channel 11
  - **#13** - #14 Reserved
  - **#15** Selection of A/O conversion speed
  - **#16** - #19 Reserved
  - **#20** Reset to Defaults and Preset
  - **#21** Offset, Gain Adjust Permits
  - **#22** Offset, Gain Adjust
  - **#23** Offset Value
  - **#24** Gain Value
  - **#25** - #27 Reserved
  - **#28** Error status
  - **#30** Identification code K2010
  - **#31** Cannot be used

### 6. ALLOCA TION OF BUFFER MEMORIES (BFM#)

- **BFM**
  - **Contents**
    - **#2** Channel selection Default = H0000
    - **#2** Channel 1
    - **#3** Channel 2
    - **#4** Channel 3
    - **#5** Channel 4
    - **#6** Channel 5
    - **#7** Channel 6
    - **#8** Channel 7
    - **#9** Channel 8
    - **#10** Channel 9
    - **#11** Channel 10
    - **#12** Channel 11
    - **#13** - #14 Reserved
    - **#15** Selection of A/O conversion speed
    - **#20** Reset to Defaults and Preset
    - **#21** Offset, Gain Adjust Permits
    - **#22** Offset, Gain Adjust
    - **#23** Offset Value
    - **#24** Gain Value
    - **#25** - #27 Reserved
    - **#28** Error status
    - **#30** Identification code K2010
    - **#31** Cannot be used
In buffer memory locations (BFMs) marked with an *** mark, data can be written from the PLC using the TO instruction. For buffer memories (BFMs) except for *** marks, data can be read from the PLC using the FROM instruction.

Before reading from the analog special function block, ensure that the appropriate settings have been sent to the analog special function block. Otherwise, the previous values held in the analog block will be used. The buffer memory also gives a facility to adjust the offset and gain via software.

1) Channel Selection

Channel selection is made by a 4 character HEX number H0000 in buffer memory BFM #0. The least significant character controls channel 1 and the 4th character controls channel 4.

Setting of each character is as follows:
- O: Preset range (-10V to +10V)
- P: Preset range (-20mA to +20mA)
- I: Preset range (+4mA to +20mA)
- Q: Channel OFF

Example: H3310
- CH1 : Preset range (-10V to +10V)
- CH2 : Preset range (+4mA to +20mA)
- CH3, CH4: Channel OFF

2) Analog to Digital Conversion Speed Change

By writing 0 to 1 to BFM #15 of the FX2N-4AD, the speed at which A/D conversion is performed can be changed. However, the following points should be noted:

To maintain a high speed conversion rate, use the FROM/TO instructions as seldom as possible.

NOTE: When a conversion speed change is made, BFM #14 are set to their default values immediately afterward. This is regardless of the values they held originally. Bear this in mind if a speed change will be made as part of the normal program execution.

3) Adjusting Gain and Offset values

a) When buffer memory BFM #20 is activated by setting it to K1, all settings within the analog special function block are reset to their default settings. This is a very quick method to erase any undesired gain and offset adjustments.

b) if (b1, b0) of BFM #21 is set to (1,0), gain and offset adjustments are prohibited to prevent inadvertent changes by the operator. In order to adjust the gain and offset values, bits (b1, b0) must be set to (0,1). The default is (0,1).

c) Offset and gain values of BFM #23 and #24 are sent respectively to the offset and gain resistors in non-volatile memory of the specified input channels. Input channels to be adjusted are specified by the appropriate O (gain-offset) bits of BFM #22.

Example: If bits G1 and O1 are set to 1, input channel 1 will be adjusted when BFM #22 is written to by a TO instruction.

d) Channels can be adjusted individually or together with the same gain and offset values.

e) Offset and gain values in BFM #23 and #24 are in units of mV or mA. Due to the resolution of the unit the actual response will be in steps of 5mV or 20 mA.

4) Status Information BFM #29

Bit devices of BFM #29 ON OFF
b6: Error
- No error
b1: Offset/gain error
- Offset/Gain data in the EEPROM is corrupted or adjustment error.
- Offset/Gain data normal
b2: Power source abnormality
- 24V DC power supply failure.
- Power supply normal
b3: Hardware error
- A/D converter or other hardware failure.
- Hardware Normal
b10: Digital range error
- Digital output value is less than -5548 or more than +5547
- Digital output value is normal
b11: Averaging error
- Number of averaging samples is 4095 or more or less than the default of 8192 (could be used)
- Averaging is normal (between 1 and 4096)
b12: Offset/gain adjust prohibit
- Permits (b1, b0) of BFM #21 is set to (1,0)
- Permits (b1, b0) of BFM #21 is set to (0,1)

5) Identification Code BFM #30

The identification (or ID) code number for a Special Function Block is read using the FROM instruction.

This number for the FX2N-4AD Special Function Block unit is K2010. The user's program in the PLC can use this facility in the program to identify the special function block before commencing data transfer from and to the special function block.

CAUTION

- Values of BFM #0, #23 and #24 are copied to the EEPROM memory of the FX2N-4AD. BFM #21 and #22 are only copied when data is written to the gain/offset command buffer #22. Also, BFM #20 causes the re-setting of the EEPROM memory. The EEPROM has a life of about 10,000 cycles (changes), so do not use programs which frequently change these BFM's.

- Due to the time needed to write to the EEPROM memory, a delay of 300 ms is required between instructions that cause a write to the EEPROM memory.

Therefore, a delay timer should be used before writing to the EEPROM for a second time.

6. DEFINING GAIN AND OFFSET

Gain determines the angle or slope of the calibration line, identified at a digital value of 1000.

- Small gain value: Large steps in digital readings
- Zero gain value: default (5V or 20mA)
- Large gain value: Small steps in digital readings

Gain and offset can be set independently or together. Reasonable offset ranges are -5V to +5V or -20mA to +20mA, and gain value - offset value = 1V to 15V or 4mA to 32mA. Gain and offset can be adjusted by software in the main unit (see program example 2).

- Bit devices b1, b0 of the gain/offset BFM #21 should be set to 0, 1 to allow adjustment.
- Once adjustment is completed these bit devices should be set to 1, 0 to prohibit any further changes.

7. EXAMPLE PROGRAM

8.1 Basic Program

In the following example, channels CH1 and CH2 are used as voltage inputs. The FX2N-4AD block is connected at the position of special function block No. 0. The number of averaged samples is set at 4 and data registers D0 and D1 of the main unit receive the averaged digital data.

<table>
<thead>
<tr>
<th>FROM</th>
<th>K0</th>
<th>K2010</th>
<th>D1</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO</td>
<td>K0</td>
<td>K1</td>
<td>K4</td>
</tr>
</tbody>
</table>

The ID code for the special function block at position "0" is read from BFM #20 of that block and stored in D4 in the main unit. This is compared with K2010 to check that the block is a FX2N-4AD. If OK, K1 is set to ON. These two program steps are not strictly needed to perform an analog read. They are however a useful check and are recommended as good practice.

The analog input channels (CH1, CH2) are set by writing H3000 to the BFM #40 of the FX2N-4AD.

- The number of averaged samples for CH1 and CH2 is set to 4 by writing 4 to the BFM #1 and #2 respectively.
- Do not execute the pulse form of the instruction.

The operational status of the FX2N-4AD is read from BFM #29 and #21 as bit devices of the main unit.

8.2 Using gain and offset in a program

The following is an example of adjusting the change in offset value on input channel CH1 to 0V and the gain value to 2.5V.

The FX2N-4AD block is in the position of block No. 0 (i.e. closest to the main unit).

Example: Adjusting gain/offset by PLC programing

<table>
<thead>
<tr>
<th>Set</th>
<th>M8010</th>
<th>SET</th>
<th>M8002</th>
<th>SET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>((H1000)) to BFM #40 (input channel selection)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((H1000)) to BFM #21 (gain/offset prohibition) must be set to permission with ((b1, b0) = (0,1)).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((K1)) to BFM #22 (offset/gain adjustment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((K1)) to BFM #23 (offset)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((K1)) to BFM #24 (gain)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((K2500)) to BFM #24 (gain)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((H1000)) to BFM #22 (offset/gain adjustment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((H1011)) to (D1 = 1, \ D0 = 1).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>((K1)) to BFM #21 (gain/offset prohibition).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. DIAGNOSTICS

9.1 Preliminary checks

I. Check whether the input wiring and/or extension cables are properly connected on the FX2N-4AD analog special function block.

II. Check that the PLC system configuration limits have not been exceeded, i.e. the number of special function blocks, and the total system I/O are within the specified range.

III. Ensure that the correct operating range has been selected for the application.

IV. Check that there is no power overload on either the 5V or 24V power sources, remember the loading on a main unit or a powered extension unit varies according to the number of extension blocks or special function blocks connected.

V. Make sure that the main unit has been switched to RUN.

9.2 Error checking

If the FX2N-4AD special function block does not seem to operate normally, check the following items.

- Check the status of the POWER LED.
- Lit: The extension cable is properly connected.
- Otherwise: Check the connection of the extension cable.

- Check the status of the "24V" LED (top right corner of the FX2N-4AD).
- Lit: FX2N-4AD is OK, 24V DC power source is OK.
- Otherwise: Possible 24V DC power failure. If OK possible FX2N-4AD failure.

- Check the status of the "A/D" LED (top right corner of the FX2N-4AD).
- Lit: A/D conversion is proceeding normally.
- Otherwise: Check buffer memory read 2492 (error status). If any bits (b2 and b3) are ON, then this is why the A/D LED is OFF.
8.2 Using gain and offset in a program

The following is an example of changing the offset value on input channel CH1 to 0V and the gain value to 2.5V. The FX2N-4AD block is in the position of block No. 0 (i.e. closest to the main unit).

Example: Adjusting gain/offset by PLC programming

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FROM K0 H3310 K1</td>
<td>Read from BFM #30 of the FX2N-4AD and store at D4 in the main unit.</td>
</tr>
<tr>
<td>CMP K2010 D4 M0</td>
<td>Compare the average data at D4 to 2010 and set M0 to 1 for error or 0 for no error.</td>
</tr>
<tr>
<td>TO K0 K24 H3300</td>
<td>Write the result to BFM #24 of the FX2N-4AD.</td>
</tr>
<tr>
<td>TO K0 K25 H3300</td>
<td>Write the result to BFM #25 of the FX2N-4AD.</td>
</tr>
</tbody>
</table>

9. DIAGNOSTICS

9.1 Preliminary checks

I. Check whether the input wiring and/or extension cables are properly connected on the FX2N-4AD analog special function block.
II. Check that the PLC system configuration limits have not been exceeded, i.e. the number of special function blocks, and the total system I/O are within the specified range.
III. Ensure that the correct operating range has been selected for the application.
IV. Check that there is no power overload on either the 5V or 24V power sources, remember the loading on a main unit or a powered extension unit varies according to the number of extension blocks or special function blocks connected.
V. Make sure that the main unit has been switched to RUN.

9.2 Error checking

If the FX2N-4AD special function block does not seem to operate normally, check the following items:

I. Check the status of the POWER LED.
II. Check whether the channel number X0 to X7 are ON.
III. Check the status of the “24V” LED (top right corner of the FX2N-4AD).
IV. Check the status of the “A/D” LED (top right corner of the FX2N-4AD).
V. Check the status of the “24VDC power” LED, if OK possible FX2N-4AD failure.

Head Office: Head Office, Mitsubishi Electric Corporation, Head Office Building, 2-7-3 Marunouchi, Chiyoda-ku, Tokyo 100-8310, Japan

Manual revision: F

HEAD OFFICE: TOKYO BUILDING, 2-7-3 MARUNUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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5) Identification Code BFМ #30

The identification (or ID) code number for a Special Function Block is read using the FROM instruction.
This number for the FX2N-4AD Special Function Block unit is K010. The user's program in the PLC can use this facility in the program to identify the special function block before commencing data transfer from and to the special function block.

CAUTION

Values of BFМ #0, #23 and #24 are copied to the EEPROM memory of the FX2N-4AD. BFМ #21 and BFМ #22 are only copied when data is written to the gain/offset command BFМ #22. Also, BFМ #23 causes the resetting of the EEPROM memory. The EEPROM has a life of about 10,000 cycles (changes), so do not use programs which frequently change these BFМs.

Offset and gain values in BFМ #23 and #24 are in units of mV or mA. Due to the resolution of the unit the actual response will be in steps of 5mV or 20mA.

9. DIAGNOSTICS

9.1 Preliminary checks

I. Check whether the input wiring and/or extension cables are properly connected on the FX2N-4AD analog special function block.
II. Check that the PLC system configuration limits have not been exceeded, i.e. the number of special function blocks, and the total system I/O are within the specified range.
III. Ensure that the correct operating range has been selected for the application.
IV. Check that there is no power overload on either the 5V or 24V power sources, remembering the loading on a main unit or a powered extension unit varies according to the number of extension blocks or special function blocks connected.
V. Make sure that the main unit has been switched to RUN.

9.2 Error checking

If the FX2N-4AD special function block does not seem to operate normally, check the following items.

I. Check the status of the POWER LED.
   a) Light: The extension cable is properly connected.
   b) Off: Check the connection of the extension cable.

II. Check the status of the "24V" LED (top right corner of the FX2N-4AD).
   a) Light: FX2N-4AD is OK, 24V DC power source is OK.
   b) Off: Possible 24V DC power failure, if OK possible FX2N-4AD failure.

III. Check the status of the "A/D" LED (top right corner of the FX2N-4AD).
   a) Light: A/D conversion is proceeding normally.
   b) Off: Check buffer memory K29 (error status). If any bits (b2 and b3) are ON, then this is why the A/D LED is OFF.

8.2 Using gain and offset in a program

The following is an example of changing the offset value on input channel CH1 to 0V and the gain value to 2.5V.

The FX2N-4AD block is in the position of block No. 0 (i.e. closest to the main unit).

Example: Adjusting gain/offset by PLC programming

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>K0</td>
<td>from K0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K2</td>
<td>from K2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D0</td>
<td>from D0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>from D1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M0</td>
<td>from M0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>from M2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>from M4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>from M6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M8</td>
<td>from M8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K010</td>
<td>from K010</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.3 Basic Program

In the following example, channels CH1 and CH2 are used as voltage inputs. The FX2N-4AD block is connected at the position of special function block No. 0. The number of averaged samples is set at 4 and data registers D0 and D1 of the main unit receive the averaged digital data.

The ID code for the special function block at position "0" is read from BFМ #0 of that block and stored at D4 in the main unit.
This is compared with K2010 to check that the block is a FX2N-4AD. If OK K210 is turned ON. These two program steps are not strictly needed to perform an analog read. They are however a useful check and are recommended as good practice.

The analog input channels (CH1, CH2) are set up by writing H3000 to the BFМ #40 of the FX2N-4AD.

The number of averaged samples for CH1 and CH2 is set to 4 by writing to the BFМ #1 and #2 respectively. Do not execute the pulse form of the instruction.
The operational status of the FX2N-4AD is read from BFМ #29 as bit devices of the main unit.

If there are no errors in the operation of the FX2N-4AD, then the averaged digital data BFМs are read.
In the case of this example BFМ #4 and #6 are read into the main unit and stored in D0 and D1. These devices contain the averaged data for CH1 and CH2 respectively.

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5.3 Performance specification

### Analog Inputs

- **Voltage Input**
  - Either voltage or current input can be selected with your choice of input terminal. Up to four input points can be used at one time.

- **Analog Input range**
  - DC -10V to +10V
  - Warning: this unit may be damaged by an input voltage in excess of ±15V.

- **DC -20mA to +20mA**
  - Warning: this unit may be damaged by an input current in excess of ±32mA.

- **Digital output**
  - 12-bit conversion stored in 16-bit 2’s complement form.
  - Maximum value: +2047
  - Minimum value: -2048
  - Overall accuracy: ±1% (for the range of -10V to +10V)
  - ±1% (for the range of -20mA to +20mA)
  - Conversion speed: 15ms/channel (Normal speed), 6ms/channel (High speed)

### Analog Outputs

- **Resolution**
  - 5mV (10V default rage 1/2000)
  - 20μA (20mA default rage 1/1000)

- **Accuracy**
  - ±1% (for the range of -10V to +10V)
  - ±1% (for the range of -20mA to +20mA)

### Honda's 5VIN/4IOUT SPECIAL FUNCTION BLOCK

**USER'S GUIDE**

**JY992D65201F**

This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX2n-4AD and should be read and understood before attempting to install or use the unit.

Further information can be found in the FX SERIES PROGRAMMING MANUAL(II), FX2n/FX3U/FX3UC SERIES HARDWARE MANUAL.

**Guidelines for the Safety of the User and Protection of the FX2n-4AD special function block.**

This manual should be used by trained and competent personnel. The definition of such a person or persons as is as follows:

- **a)** Any engineer using the product associated with this manual, should be of a competent nature, trained and qualified to the local and national standards. These engineers should be fully aware of all aspects of safety with regards to automated equipment.
- **b)** Any commissioning or service engineer must be of a competent nature, trained and qualified to the local and national standards.
- **c)** All operators of the completed equipment should be trained to use this product in a safe and coordinated manner in compliance to established safety practices.

**Note:** The term `completed equipment` refers to a third party constructed device which contains or uses the product associated with this manual.

**Notes on the Symbols Used in this Manual**

At various times throughout this manual certain symbols will be used to highlight points of information which are intended to ensure the users personal safety and protect the integrity of equipment.

1. Indicates that the identified danger WILL cause physical and property damage.

2. Indicates that the identified danger could POSSIBLY cause physical and property damage.

- Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential damage that may arise as a result of the installation or use of this equipment.
- All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Mitsubishi Electric will accept no responsibility for the actual use of the product based on these illustrative examples.
- Owing to the very great variety in possible application for this equipment, you must satisfy yourself as to its suitability for your specific application.

1. INTRODUCTION

- The FX2n-4AD analog special function block has four input channels. The input channels receive analog signals and convert them into a digital value. This is called an A/D conversion. The FX2n-4AD has maximum resolution of 12 bits.
- The selection of voltage or current based input/output is by user wiring. Analog ranges of -10 to 10V DC (resolution: 0.5mV), and/or -20mA to 20mA (resolution: 20μA) may be selected.
- The FX2n-4AD can be connected to the FX2n/FX3U/FX3UC series Programmable Controllers (PLC).
- Data transfer between the FX2n-4AD and the main unit is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the FX2n-4AD.
- The FX2n-4AD occupies 8 I/O points on the FX2n expansion bus. The 8 I/O points can be allocated from either inputs or outputs. The FX2n-4AD draws 30mA from the 5V rail of the main unit or powered extension unit.

2. EXTERNAL DIMENSIONS

3. WIRING

- The analog input is received through a twisted pair shielded cable. This cable should be wired separately from power lines or any other lines which may induce electrical noise.
- If a voltage ripple occurs during input, or there is electrically induced noise on the external wiring, connect a smoothing capacitor of 0.1 to 0.47μF, 25V.
- If you are using current input, connect the V+ and I+ terminals to each other.
- If there is excessive electrical noise, connect FG (frame ground) terminal with the grounded terminal on the FX2n-4AD. (In CH1, there is no FG terminal. Use FG terminal of other channels.)
- Connect the ground terminal on the FX2n-4AD unit with the grounded terminal on the main unit. Use grounding on the main unit, if available.

4. CONNECTION WITH PLC

The FX2n-4AD unit can be connected to the PLCs as follows. Restrictions apply to the maximum number of connectable units, depending on the DC24V/DC5V Power Supply capacities and the Main Unit/Special Function Unit types. For details, refer to the respective PLC manual.

- **FX3U/FX3UC:** The maximum connectable units is 8.
- **FX3UC:** The maximum connectable units is 8.
- **FX2n:** The maximum connectable units is 4.
- **FX1n:** The maximum connectable units is 4.
- **FX1n:** Up to 7 units can be connected to an FX2n-32MT/LT PLC.

5. SPECIFICATIONS

5.1 General specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Same as for the main unit</td>
</tr>
<tr>
<td>Dielctric withstand voltage</td>
<td>500V AC, 1min (between all terminals and ground)</td>
</tr>
</tbody>
</table>

5.2 Performance specification and others

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuits</td>
<td>24V DC ±10%, 55mA (external power supply from the main unit)</td>
</tr>
<tr>
<td>Digital circuits</td>
<td>5V DC, 30mA (internal power supply from main unit)</td>
</tr>
<tr>
<td>Isolation</td>
<td>Photo-coupler isolation between analog and digital circuits, DC/DC converter isolation of power from the main unit. No isolation between analog channels.</td>
</tr>
<tr>
<td>Number of occupied I/O points</td>
<td>The analog block occupies 8 points. Can be either inputs or outputs.</td>
</tr>
</tbody>
</table>

6. ALLOCATION OF BUFFER MEMORIES (BFM#)

<table>
<thead>
<tr>
<th>BFM#</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2</td>
<td>Channel selection Default = H0000</td>
</tr>
<tr>
<td>#1</td>
<td>Channel 1 Contains the number of samples (1 to 4096) to be used for an averaged result.</td>
</tr>
<tr>
<td>#2</td>
<td>Channel 2 The default setting is 8- normal speed. High speed operation can be selected with a value of 1.</td>
</tr>
<tr>
<td>#3</td>
<td>Channel 3</td>
</tr>
<tr>
<td>#4</td>
<td>Channel 4</td>
</tr>
<tr>
<td>#5</td>
<td>Channel 5</td>
</tr>
<tr>
<td>#6</td>
<td>Channel 6 These buffer memories contain the averaged input values for the number of samples entered for the channel in buffer memories #1 to #4 respectively.</td>
</tr>
<tr>
<td>#7</td>
<td>Channel 7</td>
</tr>
<tr>
<td>#8</td>
<td>Channel 8</td>
</tr>
<tr>
<td>#9</td>
<td>Channel 9</td>
</tr>
<tr>
<td>#10</td>
<td>Channel 10 These buffer memories contain the present value currently being read by each input channel.</td>
</tr>
<tr>
<td>#11</td>
<td>Channel 11</td>
</tr>
<tr>
<td>#12</td>
<td>Channel 12</td>
</tr>
<tr>
<td>#13</td>
<td>#14 Reserved</td>
</tr>
<tr>
<td>#15</td>
<td>Selection of A/D conversion speed see note 2 When set to 0, a normal speed is selected of 15ms/ch (default) When set to 1, a high speed is selected of 6ms/ch</td>
</tr>
<tr>
<td>#16</td>
<td>#19 Reserved</td>
</tr>
<tr>
<td>#20</td>
<td>Reset to Defaults and Preset. Default = 0</td>
</tr>
<tr>
<td>#21</td>
<td>Offset, Gain Adjust Prohibit. Default = (0, 1) Permit</td>
</tr>
<tr>
<td>#22</td>
<td>Offset, Gain Adjust</td>
</tr>
<tr>
<td>#23</td>
<td>Offset, Gain Default</td>
</tr>
<tr>
<td>#24</td>
<td>Gain Value Default = 5,000</td>
</tr>
<tr>
<td>#25</td>
<td>#28 Reserved</td>
</tr>
<tr>
<td>#26</td>
<td>#32 Reserved</td>
</tr>
<tr>
<td>#29</td>
<td>Error status</td>
</tr>
<tr>
<td>#30</td>
<td>Identification code #2010</td>
</tr>
<tr>
<td>#31</td>
<td>Cannot be used</td>
</tr>
</tbody>
</table>
1) Channel Selection

Channel selection is made by a 4 character HEX number H0000 in buffer memory BFM #0. The least significant character controls channel 1 and the 4th character controls channel 4.

Setting of each character is as follows:
- CH1: Offset range (+10V to +10V)
- CH2: Gain range (+4mA to +20mA)
- CH3: Channel OFF
- CH4: Channel OFF

Example: H0003

CH1: Offset range (+10V to +10V)
CH2: Gain range (+4mA to +20mA)
CH3: Channel OFF
CH4: Channel OFF

2) Analog to Digital Conversion Speed Change

By writing 0 to 1 to BFM #15 of the FX-2N-4AD, the speed at which A/D conversion is performed can be changed. However, the following points should be noted:

- To maintain a high speed conversion rate, use the FROM/TO instructions as seldom as possible.
- The conversion speed change is made, BFM #1-#4 are set to their default values immediately after the change. This is regardless of the values they held originally. Breat this in mind if a speed change will be made as part of the normal program execution.

3) Adjusting Gain and Offset values

a) When buffer memory BFM #20 is activated by setting it to K1, all settings within the analog special function block are reset to their default settings. This is a very quick method to erase any unintended gain and offset adjustments.

b) If (b1, b0) of BFM #21 is set to (0,1), gain and offset adjustments are prevented inadvertent changes by the operator. In order to adjust the gain and offset values, bits (b1, b0) must be set to (1,0). The default is (0,1).

c) Offset and gain values of BFM #23 and #24 are sent respectively to the offset and gain resistors in non-volatile memory of the specified input channels. Input channels to be adjusted are specified by the appropriate G-O (gain-offset) bits of BFM #22.

Example: If bits G1 and O1 are set to 1, input channel 1 will be adjusted when BFM #22 is written to by a TO instruction.

- Channels can be adjusted individually or together with the same gain and offset values.
- Offset and gain values in BFM #23 and #24 are in units of mV or mA. Due to the resolution of the unit the actual response will be in steps of 5mV or 20mA.

4) Status Information BFM #29

- Bit devices of BFM #29
- ON
- OFF
  - b0: Error
    - When any of b1 to b4 is ON, any of b2 to b4 is ON, A/D conversion of all the channels is stopped.
    - No error
  - b1: Offset/gain error
    - Offset/Gain data in the EEPROM is corrupted or adjustment error.
    - Offset/Gain data normal
  - b2: Power source abnormality
    - 24V DC power supply failure.
    - Power supply normal
  - b3: Hardware error
    - A/D converter or other hardware failure.
    - Hardware Normal
  - b4: Digital range error
    - Digital output value is less than -5048 or more than +5047.
    - Digital output value is normal
  - b5: Averaging error
    - Number of averaging samples is 4097 or more or 0 or less (default of 8 will be used).
    - Averaging is normal (between 1 and 4096)
  - b6: Offset/gain adjust prohibit
    - Prohibit (-1,0) or G-O (gain-offset) bits of BFM #21 is set to (1,0).
    - Permit (-1,1) or G-O (gain-offset) bits of BFM #21 is set to (1,1).

5) Identification Code BFM #30

The identification (or ID) code number for a Special Function Block is read using the FROM instruction.

This number for the FX-2N-4AD Special Function Block unit is K2010.

The user's program in the PLC can use this facility in the program to identify the special function block before commencing data transfer from and to the special function block.

6) DEFINING GAIN AND OFFSET

Gain determines the angle or slope of the calibration line, identified at a digital value of 1000.

- Small gain value: Large steps in digital readings
- Zero gain value: Default (5V or 20mA)
- Large gain value: Small steps in digital readings

Offset and gain can be set independently or together. Reasonable offset ranges are -5V to +5V or -20mA to +20mA, and gain value - offset value = 1V to 15V or 4mA to 32mA. Gain and offset can be adjusted by software in the main unit (see program example 2)

- Bit device b1, b2 of the gain-offset BFM #21 should be set to 1, 0 to allow adjustment.
- Once adjustment is completed these bit devices should be set to 1, 0 to prohibit any further changes.

7) EXAMPLE PROGRAM

8.1 Basic Program

The following example, channels CH1 and CH2 are used as voltage inputs. The FX-2N-4AD block is connected at the position of special function block No. 0. The number of averaged samples is set at 4 and data registers D0 and D1 of the main unit receive the averaged digital data.

<table>
<thead>
<tr>
<th>Channel</th>
<th>Offset (mV)</th>
<th>Gain (mV per V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>CH2</td>
<td>1000</td>
<td>2</td>
</tr>
</tbody>
</table>

The ID code for the special function block at position “0” is read from BFM #0 of that block and stored at D4 in the main unit.

- M1 is compared with K2010 to check if the block is a FX-2N-4AD block.
- If K2010 is matched, ERROR is displayed.

8.2 Using gain and offset in a program

The following is an example of changing the offset value on input channel CH1 to 0V and the gain value to 2.5V.

Example: Adjusting gain/offset by PLC programming

9. DIAGNOSTICS

9.1 Preliminary checks

I. Check whether the input wiring and/or extension cables are properly connected on the FX-2N-4AD analog special function block.

II. Check that the PLC system configuration limits have not been exceeded, i.e. the number of special function blocks, and the total system I/O are within the specified range.

III. Ensure that the correct operating range has been selected for the application.

IV. Check that there is no power overload on either the 5V or 24V power sources, remember the loading on a main unit or a powered extension unit varies according to the number of extension blocks or special function blocks connected.

V. Make sure that the main unit has been switched to RUN.

9.2 Error checking

If the FX-2N-4AD special function block does not seem to operate normally, check the following items:

- Check the status of the POWER LED.
- Check the extension cable is properly connected.
- Check the connection of the extension cable.
- Check the operational range is selected for the application.
- Check that there is no power overload on either the 5V or 24V power sources, remember the loading on a main unit or a powered extension unit varies according to the number of extension blocks or special function blocks connected.
- Check that the main unit has been switched to RUN.

- Check the status of the "A/D" LED (top right corner of the FX-2N-4AD).
- The LED is OFF.
- Possible: Any of the status is not K2010.

- Check the status of the "POWER" LED.
- The LED is ON.
- Possible: The FX-2N-4AD block is not connected to the PLC.

- Check the status of the "ERROR" LED.
- The LED is ON.
- Possible: The FX-2N-4AD block is not operating normally.

- Check the status of the "ALARM" LED.
- The LED is ON.
- Possible: The FX-2N-4AD block is not operating normally.

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