The FX2N-2AD type analog input block (hereafter referred to as the FX2N-2AD) is used to convert the analog input of two points (voltage and current input) into a digital value of 12 bits, and to forward the values to the Programmable Controller (hereafter referred to as a PLC). FX2N-2AD can connected to the FX2N, FX3N, FX3NC, FX1NC, FX3GC, FX3G, and the FX3U series Programmable Controllers.

1. Introduction

2. External Dimensions and Parts

3. Wiring

4. Connection with Programmable controller

5. Specifications

5.1 General specification

5.2 Power supply specification and others

5.3 Defining gain and offset

6. Allocation of buffer memory (BFM)

Caution for EC Directive

Compliance with EMC directive (CE Marking)

Requirement for Compliance with EMC directive

Models: MELSEC FX series manufactured from December 1st, 1998 FX2N-2AD

Caution: The FX2N-2AD have been found to be compliant to the European standards in the aboved mentioned manual and directive. However, for the very best performance from what are in fact delicate measuring and controlled output device Mitsubishi Electric would like to make the following points:

- As analog devices are sensitive by nature, their use should be considered carefully.
- For users of proprietary cables (integral with sensors or actuators), these users should follow those manufactures installation requirements.
- Mitsubishi Electric recommend that shielded cables should be used. If NO other EMC protection is provided, then users may experience temporary loss or accuracy between ±1% in very heavy industrial areas.

- Sensitive analog cable should not be laid in the same trunking or cable conduit as high voltage power cables. Good cable shielding should be used. When terminating the shield at earth - ensure that no earth loops are accidentally created.
- When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the through a users program in the main unit.

- Sensitive analog cable should not be laid in the same trunking or cable conduit as high voltage power cables. Good cable shielding should be used. When terminating the shield at earth - ensure that no earth loops are accidentally created.

- When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the through a users program in the main unit.

- Sensitive analog cable should not be laid in the same trunking or cable conduit as high voltage power cables. Good cable shielding should be used. When terminating the shield at earth - ensure that no earth loops are accidentally created.

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- Sensitive analog cable should not be laid in the same trunking or cable conduit as high voltage power cables. Good cable shielding should be used. When terminating the shield at earth - ensure that no earth loops are accidentally created.

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- Sensitive analog cable should not be laid in the same trunking or cable conduit as high voltage power cables. Good cable shielding should be used. When terminating the shield at earth - ensure that no earth loops are accidentally created.

- When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the through a users program in the main unit.

- Sensitive analog cable should not be laid in the same trunking or cable conduit as high voltage power cables. Good cable shielding should be used. When terminating the shield at earth - ensure that no earth loops are accidentally created.
1. Introduction

The FX2N-2AD type analog input block (hereafter referred to as the FX2N-2AD) is used to convert the analog input of two points (voltage and current input) into a digital value of 12 bits, and to forward the values to the Programmable Controller (hereafter referred to as a PLC). The FX2N-2AD can connect to the FX0N, FX1N, FX2N, FX3G, FX3GC, FX3U, and the FX3UC series Programmable Controllers.

1) The analog input is selected from the voltage or current input by the method of connecting wires.
2) At this time, assume the setting to be two channels common analog input (voltage or current input).
3) The analog input is digital conversion characteristics can be adjusted.
4) The block occupies 8 I/O points which can be allocated from either inputs or outputs.
5) The data transfer with the PLC uses the FROM/TO instructions.
6) FX2N/2AD-series PLC can use direct specification of buffer memory.

2. External Dimensions and Parts

Dimensions (mm) (inch)

Mass (Weight): Approx. 0.2kg (0.44lbs)
Accessories: Special Function block number label

3. Wiring

Voltage input: 5-10V DC
Current input: ±4mA to ±20mA

4. Connection with Programmable controller

1) The FX2N-2AD and main unit are connected by a cable on the right of the main unit.
2) Up to 4 FX2N-2AD units can connect to the FX2N-series PLC, up to 8 for FX3G/FX1N to FX0N/1N.

5. Specifications

5.1 General specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric withstand voltage</td>
<td>500V AC 1 min (Between all terminals and case)</td>
</tr>
</tbody>
</table>

General specifications other than the above-mentioned are the same as the main unit of the Programmable controller. (Refer to the Hardware manual of the Programmable controller)

5.2 Power supply specification and others

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuits</td>
<td>24V DC ±10% 50mA (Internal power supplied from the main unit)</td>
</tr>
<tr>
<td>Digital circuits</td>
<td>5V DC 20mA (Internal power supplied from the main unit)</td>
</tr>
<tr>
<td>Isolation</td>
<td>Photo-coupler isolation between analog and digital circuits.</td>
</tr>
<tr>
<td>Number of occupied I/O points</td>
<td>The blocks occupies either 8 input or output points</td>
</tr>
</tbody>
</table>

5.3 Defining gain and offset

<table>
<thead>
<tr>
<th>Item</th>
<th>Voltage input</th>
<th>Current input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of analog input</td>
<td>0 to 10V DC, 0 to 5V DC (input resistance 200KΩ)</td>
<td></td>
</tr>
<tr>
<td>Warning this unit may be damaged if an input voltage in excess of ±0.5V, ±15V DC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital output</td>
<td>4mA (±20mA)</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>Change depending on the input characteristic</td>
<td></td>
</tr>
<tr>
<td>Integrated accuracy</td>
<td>±0.1V</td>
<td></td>
</tr>
<tr>
<td>Processing time</td>
<td>2ms/channel (synchronized to the sequence program)</td>
<td></td>
</tr>
</tbody>
</table>

6. Allocation of buffer memory (BFM)

<table>
<thead>
<tr>
<th>BFM number</th>
<th>0 to 15</th>
<th>16 to 31</th>
<th>32 to 63</th>
<th>64 to 127</th>
<th>128 to 255</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFM#0</td>
<td>Reserved</td>
<td>Current value of input data (lower 8bit data)</td>
<td>Reserved</td>
<td>Current value of input data (higher 8bit data)</td>
<td>Reserved</td>
</tr>
<tr>
<td>BFM#1</td>
<td>Reserved</td>
<td>Analog value 0 to 10V Digital value 0 to 4000</td>
<td>Analog value 0 to 20mA Digital value 0 to 4000</td>
<td>Analog value</td>
<td>Analog value</td>
</tr>
<tr>
<td>BFM#2</td>
<td>Reserved</td>
<td>Analog value</td>
<td>Analog value</td>
<td>Analog value</td>
<td>Analog value</td>
</tr>
</tbody>
</table>

BFM0: The current value of the input data for the channel specified with BFM0 (lower 8bit data) is stored. The current value data is stored by binary.
BFM1: The current value of the input data (higher 4bit data) is stored. The current value data is stored by binary.
BFM17: Analog to digital conversion beginning Analog to digital conversion channel

BFM17: 0 Channel (CH1, CH2) which does the analog to digital conversion is specified.
b0=0 CH1
b1=1 CH2
b0–b1=1 The A/D conversion process is started.
Write/read data to the above-mentioned buffer memory according to the programming example of "Program example".

Caution for EC Directive

The FX2N-2AD have been found to be compliant to the European standards in the above-mentioned and directive. However, for the very best performance from what are in fact delicate measuring and controlled output device Mitsubishi Electric would like to make the following points;

- As analog devices are sensitive by nature, their use should be considered carefully.
- For users of proprietary cables (integral with sensors or actuators), these users should follow those manufacturers installation requirements.
- Mitsubishi Electric recommend that shielded cables should be used. If NO other EMC protection is provided, then users may experience temporary loss or accuracy between ±10% in very heavy industrial areas.
- However, Mitsubishi Electric suggest that if adequate EMC precautions are followed for the users complete control system, users should expect accuracy as specified in this manual.

- Sensitive analog cable should not be laid in the same trunking or cable as high voltage cabling. Where possible users should run analog cables separately.
- Good cable shielding should be used. When terminating the shield at Earth - ensure that no earth loops are accidentally created.
- When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the through a users program in the main unit.
1. Introduction

The FX2N-2AD type analog input block (hereafter referred to as the FX2N-2AD) is used to convert the analog input of two points (voltage and current input) into a digital value of 12 bits, and to forward the values to the Programmable Controller (hereafter referred to as a PLC). FX2N-2AD can connect to the FX2N, FX3U, FX3UC, FX3GC, FX3UC, and the FX3C series Programmable Controllers.

1) The analog input is selected from the voltage or current input by the method of connecting wires. At this time, assume the setting to be two channels common analog input (voltage or current input).
2) The analog input to digital conversion characteristics can be adjusted.
3) The block occupies 8 I/O points which can be allocated from either inputs or outputs.
4) The data transfer with the PLC uses the PROMOTIO instructions. FX3U/FX3UC series PLC can use direct specification of buffer memory.

2. External Dimensions and Parts

3. Wiring

Voltage input: 0 to 10V DC

Current input: 4 to 20mA (input resistance 250 Ω)

Mass (Weight): Approx. 0.2kg (0.44lbs)
Accessories: Special Function block number label

Integrated accuracy
{COM} {AG}
250 Ω

Digital value: 0 to 4000 Digital value

Output current
4 to 20mA (input resistance 200K Ω)

Warning - this unit may be damaged by an input voltage in excess of -0.5V, +15V DC.

4. Connection with Programmable controller

1) The FX2N-2AD and main unit are connected by a cable on the right of the main unit.
2) Up to 4 FX2N-2AD units can connect to the FX3C series PLC, up to 8 for FX3U/FX3UC/FX3GC/FX3UC or up to 4 for the FX3C series PLC, all with powered extension units. However the following limitation exists when the undermentioned special function blocks are connected.
   FX2N: Main unit and powered extension units of 32 points I/O or less. Consumption current available for undermentioned special function blocks ≤ 300mA.
   FX3C: Main unit and powered extension units of I/O 48 points or more. Consumption current available for undermentioned special function blocks ≤ 100mA.
   FX3UC: Up to 4 undermentioned special function blocks can be connected regardless of the system I/O.
   FX3NC: Main unit and powered extension units. Up to 2 undermentioned special function blocks can be connected regardless of the system I/O.

5. Specifications

5.1 General specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric withstand voltage</td>
<td>500V AC 1 min (Between all terminals and case)</td>
</tr>
</tbody>
</table>

5.2 Power supply specification and others

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuits</td>
<td>24V DC ±10% 50mA (Internal power supplied from the main unit)</td>
</tr>
<tr>
<td>Digital circuits</td>
<td>5V DC 20mA (Internal power supplied from the main unit)</td>
</tr>
<tr>
<td>Isolation</td>
<td>Photo-coupler isolation between analog and digital circuits.</td>
</tr>
</tbody>
</table>

6. Allocation of buffer memory (BFM)

6.1 Buffer memory

<table>
<thead>
<tr>
<th>BFM number</th>
<th>b15 to b0</th>
<th>b7 to b4</th>
<th>b3</th>
<th>b2</th>
<th>b1</th>
<th>b0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reserved</td>
<td>Current value of input data (lower 8bit data)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Reserved</td>
<td>Current value of input data (higher 4bit data)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29 to 31</td>
<td>Reserved</td>
<td>Analog to digital conversion beginning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#17</td>
<td>Reserved</td>
<td>Analog to digital conversion channel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#18 or more</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BFM0: The current value of the input data for the channel specified with BFM0 (lower 8bit data) is stored. The current value data is stored by binary.
BFM17: The current value of the input data (higher 4bit data) is stored. The current value data is stored by binary.
BFM17:0 Channel (CH1,CH2) which does the analog to digital conversion is specified.
00 to 01: CH1
01 to 12: CH2
12 to 14: CH3
14 to 15: CH4
15 to 16: CH5
16 to 17: CH6
17 to 18: CH7
18 to 19: CH8
19 to 20: CH9
20 to 21: CH10
21 to 22: CH11
22 to 23: CH12
23 to 24: CH13
24 to 25: CH14
25 to 26: CH15
26 to 27: CH16
27 to 28: CH17
28 to 29: CH18
29 to 30: CH19
30 to 31: CH20

Write/read data to the above-mentioned buffer memory according to the programming example of "B.Program example".

Caution for EC Directive

The FX2N-2AD have been found to be compliant to the European standards in the abovementioned manual and directive. However, for the very best performance from what are in fact delicate measuring and controlled output device Mitsubishi Electric would like to make the following points:

As analog devices are sensitive by nature, their use should be considered carefully.

For users of proprietary cables (integral with sensors or actuators), these users should follow those manufacturers installation requirements.

Mitsubishi Electric recommend that shielded cables should be used. If NO other EMC protection is provided, users may experience temporary loss or accuracy between ±1% in very heavy industrial areas.

However, Mitsubishi Electric suggest that if adequate EMC precautions are followed for the users complete control system, users should expect accuracy as specified in this manual.

Sensible analog cable should not be laid in the same trunking or cable as high voltage cabling. Where possible users should run analog cables separately.

Good cable shielding should be used. When terminating the shield at Earth - ensure that no earth loops are accidentally created.

When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the through a users program in the main unit.

Requirement for Compliance with EMC directive

The following products have shown compliance through direct testing (of the identified standards below) and design analysis (through the creation of a technical construction file) to the European Directive for Electromagnetic Compatibility (2014/30/EU) when used as directed by the appropriate documentation.

Requirement for Compliance with EMC directive

All programmable controllers of this note will comply with the following standards. Compliance to EMC directive and LVD directive for the entire system must be checked by the user/manufacturer. For more information please consult with your nearest Mitsubishi product provider.

5.3 Defining gain and offset

- Gain and offset can be defined for each channel.
- The gain and offset can be saved to the buffer memory (BFM).
7. Adjustment of offset and gain

7.1 Change in input characteristic

At shipment, 0 to 4000 range is selected for 0 to 10V DC input. When using an FXn-2AD for current or differing voltage inputs except 0 to 10V DC, it is necessary to adjust the offset and gain. The module does not allow different input characteristics for two channels. Set analog values within the range specified in the table below when changing the input characteristic. (Range of input characteristic)

<table>
<thead>
<tr>
<th>Voltage Input</th>
<th>Current Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1V</td>
<td>0 to 4mA</td>
</tr>
<tr>
<td>5 to 10V</td>
<td>10mA</td>
</tr>
<tr>
<td>0 to 20V</td>
<td>40mA</td>
</tr>
</tbody>
</table>

Resolution changes depending on the set value when the input characteristic changes accordingly. Example: Resolution becomes (5 - 0V)/4000 = 1.25mV at voltage input 0 to 5V to 0V 4000. Integrated accuracy does not change. (Voltage input: 0 to 1V Current input: 0 to 4mA)

7.2 Adjustment of the input characteristic

The adjustment of the offset and gain values sets a digital equivalent to the analogue data. (The “FOOT” requires 18 revisions to move between MIN and MAX setting.)

Voltage input

Current input

Volume

Voltage generation

*1 The digital value increases if the volume is turned clockwise.

(PXn-A and PXn-2DA can be used instead of the voltage and current generator)

7.2.1 Adjustment of gain

The gain value can be set to an arbitrary digital value. However, use the maximum 12bit resolution provided with the user with a digital range of 0 to 4000.

7.2.2 Adjustment of offset

The offset value can be set to an arbitrary digital value. However, it is advisable to set the analog value when the digital value is set as follows.

Voltage input

Current input

Volume

Voltage generation

For instance, when a digital range of 0 to 4000 is used with the analog range of 0 to 10V, a digital value of 40 is equal to an analog input of 10mV (40 x 10V/4000 digital points)

1) The offset and gain adjustments for CH1 and CH2 are accomplished at the same time. When the offset and gain values of one channel are adjusted, the other channel is automatically adjusted.

2) Repeat the offset and gain adjustment alternately until a stable value is reached.

3) Each channel is common to the analog input circuit. However, check each channel individually for maximum accuracy.

4) Adjust offset / gain by using subsection 8-3 “Example of programming making average value data” when a digital value is not steady.

5) Adjust the gain before the offset.

8. Program example

The following program examples (8.1 and 8.3) are formula circuits.

8.1 Example of programming analog input

The device numbers that have been underlined can be assigned by the user during programming.

<table>
<thead>
<tr>
<th>Address</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X000</td>
<td>A/D input of CH1</td>
<td>0</td>
</tr>
<tr>
<td>X001</td>
<td>A/D input of CH2</td>
<td>0</td>
</tr>
<tr>
<td>X002</td>
<td>A/D conversion beginning of CH1</td>
<td>0</td>
</tr>
<tr>
<td>X003</td>
<td>A/D conversion beginning of CH2</td>
<td>0</td>
</tr>
<tr>
<td>X004</td>
<td>Reading of digital value of CH1</td>
<td>0</td>
</tr>
<tr>
<td>X005</td>
<td>Reading of digital value of CH2</td>
<td>0</td>
</tr>
</tbody>
</table>

Analogue to digital conversion execution input of CH1: X000
Analogue to digital conversion execution input of CH2: X001
At the same time X000 and X001 can be turned ON.

A/D input data CH1: D100 (Replace with auxiliary relay M100 to M115. Assign these numbers only once) A/D input data CH2: D101 (Replace with auxiliary relay M100 to M115. Assign these numbers only once)

Processing time: 2.5ms / 1 channel (Time from turning on X000 and X001 to storage of analog to digital conversion value in data register of main unit)

*1 Change the circuit of “*1” as follows when using a FXn PLC

<table>
<thead>
<tr>
<th>Address</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X002</td>
<td>A/D input of CH1</td>
<td>0</td>
</tr>
<tr>
<td>X003</td>
<td>A/D conversion beginning of CH1</td>
<td>0</td>
</tr>
<tr>
<td>X004</td>
<td>Reading of digital value of CH1</td>
<td>0</td>
</tr>
</tbody>
</table>

8.2 Connection to FXn, FXn/C (V3.00 or later), FXn/CX (V3.00 or later), FX3U, FX3UC, FX3UC or FX3UC series PLC

Please refer to FX Series Programming Manual II or FXn/FXn/C/FXn/CX/FXn/CX series Programming Manual.

8.3 Example of programming making average value data

Add the undermentioned program after “8.1 Example of programming analog input” and use the average value data when you cannot read a stable digital value.

The average value of CH1 is calculated, and the result is stored in D111, D110

The average value of CH2 is calculated, and the result is stored in D113, D112

9. Notes in drive

1) Confirm whether the input wiring of FXn-2AD and the connection of the extension cable is correctly done.

2) Confirm whether the “4. Connection with programmable controller” condition is satisfied.

3) When shipped from the factory, the input characteristic is adjusted to 0 to 10V DC. If a different input characteristic is desired, please adjust as required.

4) When the input characteristic is adjusted, the input characteristics of CH1 and CH2 are changed.

4) The coexistence use for the current and voltage input cannot be done with two channels.

10. Error check

Confirm the following items when it seems that the FXn-2AD does not operate normally.

1) Confirm the state of POWER LED.
2) Confirm whether the load resistance of the connected equipment corresponds to the specification of the FXn-2AD.
3) Confirm the Voltage and Current input values and a waveform and current generator. Confirm the analog to digital conversion from the input characteristic.
4) Readjust the offset and gain by “7. Adjustment of offset and gain” when the analog to digital conversion is not suitable for the input characteristic.

The input characteristic when shipped from the factory is 0 to 10V DC.

Guidelines for the safety of the user and protection of the FXn-2AD SPECIAL FUNCTION BLOCK

This manual has been written to be used by trained and competent personnel. This is defined by the European directives for machinery, low voltage and EMC.

If in doubt at any stage during the installation of the FXn-2AD always consult a professional electrical engineer who is qualified and trained to the local and national standards. If in doubt about the operation or use of the FXn-2AD please consult your local Mitsubishi Electric representative.

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.

Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

Owing to the very great variety in possible application of this equipment, you must satisfy yourself as to its suitability for your specific application.

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

Warranty

Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

1) Damages caused by any cause found not to be the responsibility of Mitsubishi

2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.

3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.

4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

For safe use

This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.

Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, consult with Mitsubishi Electric.

This product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or fail-safe systems in the system.
7. Adjustment of offset and gain

7.1 Change in input characteristic

At shipment, 0 to 4000 range is selected for 0 to 10V DC input. When using an FX2N-2AD for current or differing voltage inputs except 0 to 10V DC, it is necessary to adjust the offset and gain.

The module does not allow different input characteristics for two channels. Set analog values within the range specified in the table below when changing the input characteristic.

<table>
<thead>
<tr>
<th>Range of input characteristic</th>
<th>Voltage Input</th>
<th>Current Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog value when digital value is 0</td>
<td>0 to 1V</td>
<td>0 to 4mA</td>
</tr>
<tr>
<td>Analog value when digital value is 4000</td>
<td>5 to 10V</td>
<td>20mA</td>
</tr>
</tbody>
</table>

Resolution changes depending on the set value when the input characteristic changes accordingly. Example: Resolution becomes (5-0)4000=1.25mV at voltage input 0V to 5V0 to 4000.

7.2.1 Adjustment of gain

The gain value can be set to an arbitrary digital value. However, using the maximum 12bit resolution provides the user with a digital range of 0 to 4000.

Voltage input Current input Volume

7.2.2 Adjustment of offset

The offset value can be set to an arbitrary digital value. However, it is advisable to set the analog value when the digital value is set as following.

Voltage input Current input

2) Repeat the offset and gain adjustment alternately until a stable value is reached.

3) Each channel is common to the analog input circuit. However, check each channel individually for maximum accuracy.

4) Adjust offset / gain by using subsection 8-3 "Example of programming making average value data" when a digital value is not steady.

5) Adjust the gain before the offset.

8. Program example

The following program examples (8.1 and 8.3) are formula circuits. The device numbers that have been underlined can be assigned by the user during programming.

Add the undermentioned program after "8.1 Example of programming analog input" and use the average value data when you can not read a stable digital value.

A/D input data of CH1:D100 A/D input data of CH2:D102 Sampling frequency:D118 Agreement flag of sampling frequency and average frequency:M133

Average value of CH1:D111, D110 Average value of CH2:D113, D112

*1 The above program example has an average sampling frequency of 20. Make the average frequency within the range of 2 to 262143.

9. Notes in drive

1) Confirm whether the input wiring of FX2N-2AD and the connection of the extension cable is correctly done.

2) Confirm whether the "4. Connection with programmable controller" condition is satisfied.

3) When shipped from the factory, the input characteristic is adjusted to 0 to 10V DC. If a different input characteristic is desired, please adjust as required.

4) When the input characteristic is adjusted, the input characteristics of CH1 and CH2 are changed.

5) The coexistence use for the current and voltage input cannot be done with two channels.
### 7. Adjustment of offset and gain

#### 7.1 Change in input characteristic

At shipment, 0 to 4000 range is selected for 0 to 10V DC input. When using an FX2N-2AD for current or differing voltage inputs except 0 to 10V DC, it is necessary to adjust the offset and gain.

The module does not allow different input characteristics for two channels. Set analog values within the range specified in the table below when changing the input characteristic.

#### Range of input characteristic

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Current Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1V</td>
<td>0 to 4mA</td>
</tr>
<tr>
<td>5 to 10V</td>
<td>20mA</td>
</tr>
</tbody>
</table>

Resolution changes depending on the set value when the input characteristic changes accordingly. 
Example: Resistor becomes (50 Ω)4000-1.25mΩ at voltage input 5V to 4V0.

Integrated accuracy does not change. (Voltage input: 10V, Current input: 50mA)

#### 7.2 Adjustment of the input characteristic

The adjustment of the offset and gain values sets a digital equivalent to the analogue data. (The “POST” requires 18 revolutions to move between MIN and MAX setting.)

#### 8. Program example

The following program examples (8.1 and 8.3) are formula circuits.

**The device numbers that have been underlined can be assigned by the user during programming.**

**8.1 Example of programming analog input**

When using an FX2N-2AD for current or differing voltage inputs except 0 to 10V DC, it is necessary to adjust the offset and gain. The module does not allow different input characteristics for two channels.

1) Confirm the state of POWER LED.
   - Lit : The extension cable is correctly connected.
   - Turn off or blinks : Confirm the proper connection of the extension cable.

2) Readjust the offset and gain by “7. Adjustment of offset and gain” when the analog to digital conversion is not suitable for the input characteristic.

#### 8.2 Connection to FX1N, FX2N (V3.00 or later), FX2NC (V3.00 or later), FX3G, FX3GC, FX3U or FX4 series PLC

Please refer to FX Series Programming Manual III or FX2N/FX3N/FX3SC/FX3GC/Programming Manual.

**8.3 Example of programming making average value data**

Add the undermentioned program after “8.1 Example of programming analog input” and use the average value data when you can not read a stable digital value.

A/D input data of CH1 : D100
A/D input data of CH2 : D102
Sampling frequency : D118
Agreement flag of sampling frequency and average frequency : M133
Average value of CH1 : D111, D110
Average value of CH2 : D113, D112

1) The offset and gain adjustments for CH1 and CH2 are accomplished at the same time. When the offset and gain values of one channel are adjusted, the other channel is automatically adjusted.

2) Repeat the offset and gain adjustment alternately until a stable value is reached.

3) Each channel is common to the analog input circuit. However, check each channel individually for maximum accuracy.

4) Adjust offset / gain by using subsection 8.3 "Example of programming making average value data" when a digital value is not steady.

5) Adjust the gain before the offset.

### 10. Error check

Confirm the following items when it seems that the FX2N-2AD does not operate normally.

1) Confirm the state of POWER LED.
   - Lit : The extension cable is correctly connected.
   - Turn off or blinks : Confirm the proper connection of the extension cable.

2) Confirm the external wiring per section “3. Wiring”.

3) Confirm whether the load resistance of the connected equipment corresponds to the specification of the FX2N-2AD.

4) Confirm the Voltage and Current input values with a voltage and current generator. Confirm the analog to digital conversion from the input characteristic.

5) Readjust the offset and gain by “7. Adjustment of offset and gain” when the analog to digital conversion is not suitable for the input characteristic.

The input characteristic when shipped from the factory is 0 to 10V DC.

### Guidelines for the safety of the user and protection of the FX2N-2AD SPECIAL FUNCTION BLOCK

- This manual has been written to be used by trained and competent personnel. This is defined by the European directives for machinery, low voltage and EMC.
- If in doubt at any stage during the installation of the FX2N-2AD always consult a professional electrical engineer who is qualified and trained to the local and national standards. If in doubt about the operation or use of the FX2N-2AD please consult your local Mitsubishi Electric representative.
- 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 actual use of the product based on these illustrative examples.
- Owing to the very great variety in possible application of this equipment, you must satisfy yourself as to its suitability for your specific application.

### Warranty

Exclusion of loss in opportunity and secondary loss from warranty liability
Regardless of the grade warranty term, Mitsubishi shall not be liable for compensation to:
1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

### For safe use

- This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, consult with Mitsubishi Electric.
- This product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or fail-safe functions in the system.

**Manual number : JY992D74701**
**Manual revision : G**
**Date : December 2016**

Effective December 2016
Specifications are subject to change without notice.
1. Introduction

The FX2N-2AD type analog input block (hereafter referred to as the FX2N-2AD) is used to convert the analog input of two points (voltage and current input) into a digital value of 12 bits, and to forward the values to the Programmable Controller. The FX2N-2AD can connect the F0XN, FX1N, FX2N, FX3N, FX3C, FX3UC, FX3UC, and the FX5UC series Programmable Controllers.

1) The analog input is selected from the voltage or current input by the method of connecting wires. At this time, assume the setting to be two channels common analog input (voltage or current input).
2) The analog to digital conversion characteristics can be adjusted.
3) The block occupies 8 I/O points which can be allocated from either inputs or outputs.
4) The data transfer with the PLC uses the FROM/TO instructions.FX2N/FX2UC series PLC can use direct specification of buffer memory.

2. External Dimensions and Parts

Dimensions (mm (inch))

Mass (Weight): Approx. 0.2kg (0.44lbs)
Accessories: Special Function block number label

3. Wiring

Voltage input 5-10V DC

Current input 4-20mA

PLC

FX2N-2AD

Channel number enter 0

1) The FX2N-2AD cannot have 1 channel as an analog voltage input and one channel as current input because both channels use the same offset and gain values. For current input please short circuit VIN and IIN as shown in the diagram.
2) Connect a 0.1 to 0.47 Ω resistor to the low side of the input power supply, as shown in the diagram.

4. Connection with Programmable controller

1) The FX2N-2AD and main unit are connected by a cable on the right of the main unit.
2) Up to 4 FX2N-2AD units can connect to the FX2N series PLC, up to 8 for FX2N/FX3-series PLCs, or, up to 4 for the FX2N series PLC, all with powered extension units. However the following limitation exists when the undermentioned special function blocks are connected.

FWIN: Main unit and powered extension units of 32 points I/O or less. Consumption current available for undermentioned special function blocks ≤ 300mA

FWINC: Main unit and powered extension units of I/O 48 points or more. Consumption current available for undermentioned special function blocks ≤ 100mA

FWXXC: Up to 4 undermentioned special function blocks can be connected regardless of the system I/O.

FWXXC: Main unit and powered extension units. Up to 2 undermentioned special function blocks can be connected regardless of the system I/O.

The consumption current of the above units is to be subtracted from the service power supply of the host PLC.

5. Specifications

5.1 General specification

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diode withstand voltage</td>
<td>500V AC 1 min (Between all terminals and case)</td>
</tr>
</tbody>
</table>

General specifications other than the above-mentioned are the same as the main unit of the Programmable controller. (Refer to the Hardware manual of the Programmable controller)

5.2 Power supply specification and others

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog circuits</td>
<td>24 VDC ±10% 50mA (Internal power supplied from the main unit)</td>
</tr>
<tr>
<td>Digital circuits</td>
<td>5V DC 20mA (Internal power supplied from the main unit)</td>
</tr>
</tbody>
</table>

Isolation

Photocoupler isolation between analog and digital circuits.

Number of occupied I/O points

The blocks occupies either 8 input or output points (can be either inputs or outputs).

5.3 Defining gain and offset

<table>
<thead>
<tr>
<th>Item</th>
<th>Voltage input</th>
<th>Current input</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of Analog input</td>
<td>0 to 10V DC, 0 to 5V DC (Input resistance 200kΩ)</td>
<td>Warning this unit may be damaged by an input voltage in excess of 0.5V, 15V DC</td>
</tr>
<tr>
<td>4 to 20mA (Input resistance 250Ω)</td>
<td>Warning this unit may be damaged by an input current in excess of ±2mA, ±60mA</td>
<td></td>
</tr>
</tbody>
</table>

Resolution

2.5mV/10V/4000mA (16 channel)

Change depending on the input characteristic.

4mA, 20mA (4mA/40mA)

Change depending on the input characteristic.

Integrated accuracy

±0.1V

±0.1mA

Processing time

2.5ms/channel (synchronized to the sequence program)

Input characteristics

Analog value 0 to 10V Digital value 0 to 4000 (AA shipment)

Analog value 0 to 20mA Digital value 0 to 4000

The input characteristic is the same for each channel.

6. Allocation of buffer memory (BFM)

<table>
<thead>
<tr>
<th>BFM number</th>
<th>b15 to b0</th>
<th>b17 to b16</th>
<th>b18 to more</th>
<th>b00 to b01</th>
<th>b02 to b03</th>
<th>b04 to b05</th>
<th>b06 to b07</th>
<th>b08 to b09</th>
</tr>
</thead>
<tbody>
<tr>
<td>b0</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b1</td>
<td>Reserved</td>
<td>Current value of input data (lower 8bit data)</td>
<td>Current value of input data (higher 8bit data)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b2</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b3</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b4</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b5</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b6</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b7</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BFM00: The current value of the input data for the channel specified with BFM17 (lower 8bit data) is stored. The current value data is stored by binary.

BFM17: The current value of the input data (higher 4bit data) is stored. The current value data is stored by binary.

BFM17: Reserved Analog to digital conversion beginning Analog to digital conversion channel

BFM17: Reserved Analog to digital conversion beginning Analog to digital conversion channel

BFM17: Channel (CH1, CH2) which does the analog to digital conversion is specified.

b0=0 CH1

b0=1 CH2

Write/read data to the above-mentioned buffer memory according to the programming example of “8.Program example”.

Caution for EC Directive

The FX2N-2AD have been found to be compliant to the European standards in the aboved mandate and directive. However, for the very best performance from what are in fact delicate measuring and controlled output device Mitsubishi Electric would like to make the following points;

1. As analog devices are sensitive by nature, their use should be considered carefully.
2. Caution should be taken when installing the block in a highly industrial area.
3. Caution should be taken when installing the block in a highly industrial area.
4. Caution should be taken when installing the block in a highly industrial area.

For users of proprietary cables (integral with sensors or actuators), these users should follow those manufacturers installation requirements.

Mitsubishi Electric recommend that shielded cables should be used. If NO other EMC protection is provided, then users may experience temporary loss or accuracy between ±0.1% in very heavy industrial areas. However, Mitsubishi Electric suggest that if adequate EMC precautions are followed for the complete control system, users should expect accuracy as specified in this manual.

1. Sensitive analog cable should not be laid in the same trunking or cable conduit with high voltage cables.
2. Good cable shielding should be used. When terminating the shield at Earth - ensure that no earth loops are accidentially created.

When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the through a users program in the main unit.
7. Change in input characteristic

At shipment, 0 to 4000 range is selected for 0 to 10V DC input. When using an FX2N-2AD for current or differing voltage inputs except 0 to 10V DC, it is necessary to adjust the offset and gain. The module does not allow different input characteristics for two channels. Set analog values within the range specified in the table below when changing the input characteristic.

<table>
<thead>
<tr>
<th>Range of input characteristic</th>
<th>Voltage Input</th>
<th>Current Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>At shipment</td>
<td>0 to 4V</td>
<td>0 to 4mA</td>
</tr>
<tr>
<td>An analog value is 0</td>
<td>0 to 4V</td>
<td>0 to 4mA</td>
</tr>
<tr>
<td>An analog value is 4000</td>
<td>5 to 10V</td>
<td>20mA</td>
</tr>
</tbody>
</table>

Resolution changes depending on the set value when the input characteristic changes accordingly. Example: Resolution becomes (10V/4000)=2.5mV at voltage input 0V to 4V to 5V to 40V. Integrated accuracy does not change. (Voltage input: 0V Current input: 0.1mA)

7.2 Adjustment of the input characteristic

The adjustment of the offset and gain values sets a digital equivalent to the analogous data. (The “FOT” requires 18 revolutions to move between MIN and MAX setting.)

7.2.1 Adjustment of gain

The gain value can be set to an arbitrary digital value. However, when using the maximum 12bit resolution provides the user with a digital range of 0 to 4000.

7.2.2 Adjustment of offset

The offset value can be set to an arbitrary digital value. However, it is advisable to set the analog value when the digital value is set as follows.

8. Program example

The following program examples (8.1 and 8.3) are formula circuits.

8.1 Example of programming analog input

The device numbers that have been underlined can be assigned by the user during programming.

a) Selecting A/D input channel.

b) A/D conversion beginning of CH1.

c) Reading of CH1 in input characteristic.

3) Each channel is common to the analog input circuit. However, check each channel individually for maximum accuracy.

4) Adjust offset / gain by using subsection 8-3 “Example of programming making average value data” when a digital value is not steady.

5) Adjust the gain before the offset.

8.2 Connection to FX1N, FX2N (V3.00 or later), FX2NC (V3.00 or later), FX3G, FX3GC, FX3U or FX3UC series PLC

Please use FNC 176 (RD3A).

8.3 Example of programming making average value data

Add the undermentioned program after “Establishing characteristics of analog input channel” and use the average value data when you can not read a stable digital value.

For instance, when a digital range of 0 to 4000 is used with the analog range of 0 to 10V, a digital value of 40 is equal to an analog input of 100mV (40 × 10V/4000 digital points)

1) The offset and gain adjustments for CH1 and CH2 are accomplished at the same time. When the offset and gain values of one channel are adjusted, the other channel is automatically adjusted.

2) Repeat the offset and gain adjustment alternately until a stable value is reached.

3) Each channel is common to the analog input circuit. However, check each channel individually for maximum accuracy.

4) Adjust offset / gain by using subsection 8-3 “Example of programming making average value data” when a digital value is not steady.

5) Adjust the gain before the offset.

9. Notes in drive

1) Confirm whether the input wiring of FX2N-2AD and the connection of the extension cable is correctly done.

2) Confirm whether the “4. Connection with programmable controller” condition is satisfied.

3) When shipped from the factory, the input characteristic is adjusted to 0 to 10V DC. If a different input characteristic is desired, please adjust as required.

4) When the input characteristic is adjusted, the input characteristics of CH1 and CH2 are changed.

5) The gain value can be set to an arbitrary digital value.

6) The gain value can be set to an arbitrary digital value.

7) The gain value can be set to an arbitrary digital value.

8) The gain value can be set to an arbitrary digital value.

9) The gain value can be set to an arbitrary digital value.

10) Error check

Confirm the following items when it seems that the FX2N-2AD does not operate normally.

1) Confirm the state of POWER LED.

2) Confirm the external wiring per section “3. Wiring”.

3) Confirm whether the load resistance of the connected equipment corresponds to the specification of the FX2N-2AD.

4) Confirm the Voltage and Current input values with a voltage and current generator. Confirm the analog to digital conversion from the input characteristic.

5) Readjust the offset and gain by 7. “Adjustment of offset and gain” when the analog to digital conversion is not suitable for the input characteristic.

The input characteristic when shipped from the factory is 0 to 10V DC.

Guidelines for the safety of the user and protection of the FX2N-2AD SPECIAL FUNCTION BLOCK

- This manual has been written to be used by trained and competent personnel. This is defined by the European directives for machinery, low voltage and EMC.
- In doubt at any stage during the installation of the FX2N-2AD always consult a professional electrical engineer who is qualified and trained to the local and national standards. If in doubt about the operation or use of the FX2N-2AD please consult your local Mitsubishi Electric representative.
- 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.
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