

FX_{2N}

FX_{2N}-2AD SPECIAL FUNCTIONBLOCK

USER'S GUIDE

JY992D74701B

This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX_{2N}-2AD special function block 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, FX_{2N} SERIES HARDWARE MANUAL.

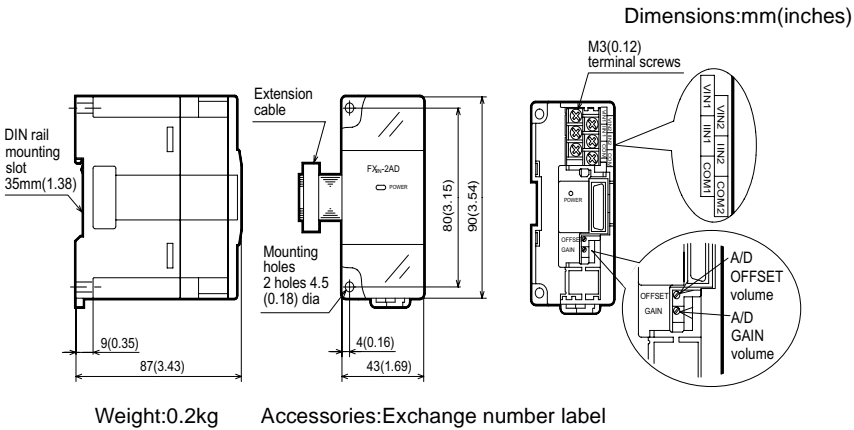
1. INTRODUCTION

The FX_{2N}-2AD type analog input block (Hereafter referred to as the FX_{2N}-2AD) is used to convert the analog input of two points (voltage input 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).

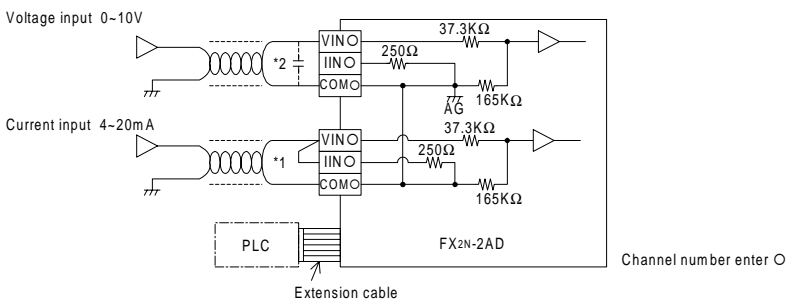
FX_{2N}-2AD can be connected with FX_{0N}, FX_{2N}, and the FX_{2NC} series Programmable controllers.

- 1) The analog input is selected from the voltage input or the current input by the method of connecting wires.
At this time, assume setting to be two channels common analog input (voltage input or current input).
- 2) The two analog input channels can accept inputs of 0 to 10V DC, 0 to 5V DC, or 4 to 20mA.
Make the input characteristic common with two channels.
- 3) The analog to 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 instruction.

2. EXTERNAL DIMENSIONS AND PARTS



3. WIRING



*1 The FX_{2N}-2AD cannot have 1 channel as an analog voltage input and one channel as a 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 μF 25V DC capacitor with the position of *2 when there is voltage ripple in the voltage input or there will be a lot of noise.

4. Connection with Programmable controller

- 1) The number of FX2N-2AD which can be connected is 4 or less in the FX0N series PLC, 8 or less in the FX2N series PLC, and 4 or less in the FX2NC series PLC per Main unit with powered extension units. However the following limitation exists when undermentioned special function blocks are connected.

FX2N :Main unit and powered extension units of I/O 32points or less.

24V DC consumption current total value of undermentioned special function blocks used \leq 190mA

FX2N :Main unit and powered extension units of I/O 48points or more.

24V DC consumption current total value of undermentioned special function blocks used \leq 300mA

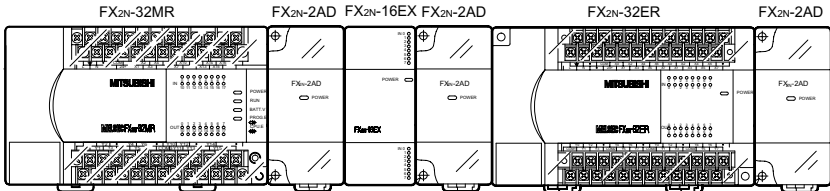
FX2NC:The undermentioned special function blocks can be connected up to 4 regardless of the I/O number of Main units.

FX0N :The undermentioned special function blocks can be connected up to 2 regardless of the I/O number of Main units and powerd extension units.

	FX2N-2AD	FX2N-2DA	FX0N-3A
Consumption current of 24V DC for one	50mA	85mA	90mA

The capacity of DC 24V power supply which can used for extension blocks of the service power supply and I/O reaches the value by which the total value of the consumption current of the above mentioned special function block is subtracted from a service voltage source capacity the programmable controller original. For instance, the service power supply the FX2N-32MT is 250mA. When two FX2N-2AD blocks are connected, the service power supply is reduced to 150mA.

- The blocks occupy 8 points (The 8 points can be allocated from either inputs or outputs).
- FX2N-2AD consumes 5V DC by 20mA.
The total of 5V of the special function block connected with the main unit of the PLC consumption current must not exceed 5V voltage source capacity of the main unit and the powered extension unit.
- The FX2N-2AD and the main unit are connected with the cable at the right of the main unit.



5. SPECIFICATIONS

5.1 Environment specification

Item	Content
Dielectric withstand voltage	500V AC 1min(Between all terminals and case)

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

5.2 Power supply specification and others

Item	Content
Analog circuits	24V DC \pm 10% 50mA (Internal power supplied from the main unit)
Digital circuits	5V DC 20mA (Internal power supplied from the main unit)

Item	Content
Isolation	Photo-coupler isolation between analog and digital circuits. DC/DC converter isolation of power from main unit. No isolation between analog channels.
Number of occupied I/O points	The blocks occupy either 8 input or output points (can be either inputs or outputs)

5.3 Defining gain and offset

Item	Voltage input	Current input
Range of analog input	At shipping, the unit is adjusted to a digital range of 0 to 4000 for an analog voltage input of 0 to 10V DC. When using FX2N-2AD by the current input, or the 0 to 5V DC input it is necessary to readjust by the offset and gain values.	
	0 to 10V DC, 0 to 5V DC (input resistance 200K Ω) Warning-this unit may be damaged by input voltage in excess of -0.5V, +15V DC	4 to 20mA (input resistance 250 Ω) Warning-this unit may be damaged by input currents in excess of -2mA, +60mA
Digital output	12bit	
Resolution	2.5mV(10V/4000) 1.25mV(5V/4000)	4 μ A {(20-4)/4000}
Integrated accuracy	\pm 1% (full scale 0 to 10V)	\pm 1% (full scale 4 to 20mA)
Processing time	2.5ms/1 channel (sequence program and synchronization)	

Item	Voltage input	Current input
Input characteristics	<p>Analogue value :0 to 10V Digital value :0 to 4000 (The factory is shipped)</p>	<p>Analogue value :0 to 20mA Digital value :0 to 4000</p>
	The input characteristic is the same for each channel.	

6. Allocation of buffer memory (BFM)

6.1 Buffer memory

BFM number	b15 to b8	b7 to b4	b3	b2	b1	b0
#0	Reserved	Current value of input data (subordinate position 8bit data)				
#1	Reserved		Current value of input data (high rank 4bit data)			
#2 to 16	Reserved					
#17	Reserved				Analog to digital conversion beginning	Analog to digital conversion channel
#18 or more	Reserved					

BFM#0 :The current value of the input data of the channel specified with BFM#17 (subordinate position 8bit data) is stored.The current value data is stored by binary.

BFM#1:The current value of input data (high rank 4bit data) is stored. The current value data is stored by binary.

BFM#17:b0...Channel (CH1,CH2) which does the analog to digital conversion is specified.

b0=0...CH1

b0=1...CH2

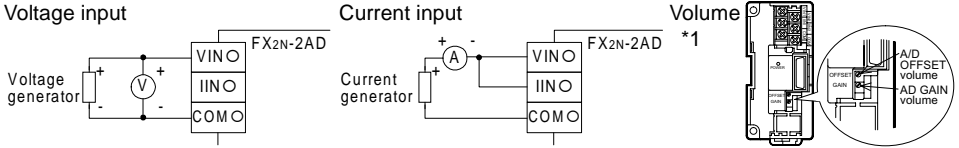
b1...0→1 The D/A conversion process is started.

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

7. Adjustment of offset and gain

7.1 Offset and gain

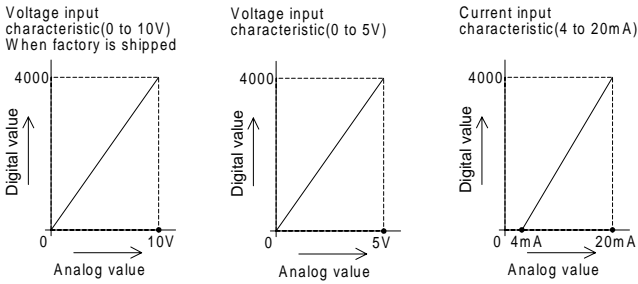
The offset value and the gain value when from shipped the factory is adjusted for a digital value of 0 to 4000 for the voltage input 0 to 10V. It is necessary to readjust the offset value and the gain value when FX2N-2AD is used by current input, the 0 to 5V DC voltage input, or with an input characteristic the factory setting. The adjustment of the offset value and the gain value sets a digital value to the analogue value actually input by using the voltage generator and the current generator according to the volume of FX2N-2AD.



*1 A digital value increases if the volume installed in FX2N-2AD is turned right (clockwise). (FX2N-4DA and FX2N-2DA can be used instead of the voltage generator and the current generator)

7.1.1 Adjustment of gain

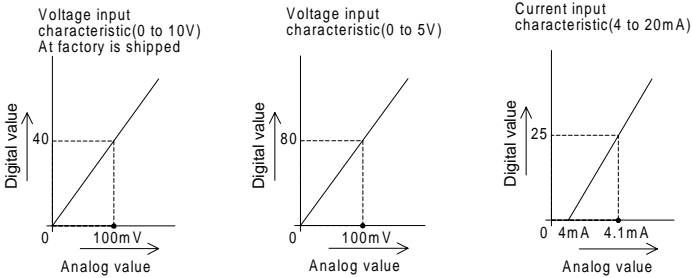
The gain value can be set to an arbitrary digital value. However, to demonstrate the resolution of 12bit to its maximum, a digital range of 0 to 4000 is available.



A digital value is adjusted to 4000 at 10V in the analog input value when the voltage is input.
A digital value is adjusted to 4000 at 20mA in the analog input value when the current is input.

7.1.2 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 at the following.



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. ($40 \times 10V/4000$ digital points)

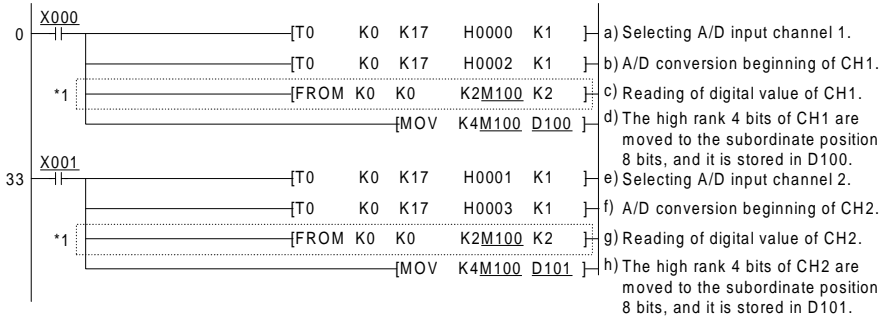
- 1) The offset adjustment and the gain adjustment are for CH1 and CH2 are accomplished at the same time. When the offset value/the gain value of one channel is adjusted, the other value is automatically adjusted.
- 2) Repeat the offset adjustment and gain adjustment alternately until a stable value is reached.
- 3) Each channel is common to the analog input circuit. There are the few differences between channels. However, check each channel individually for maximum accuracy.
- 4) Adjust offset / gain by using subsection 8-2 "Example of programming making average value data" when a digital value is not steady.
- 5) Do in order of the gain adjustment and the offset adjustment when you adjust offset/gain.

8. Program example

The following program examples (8.1 and 8.2) 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



Analog to digital conversion execution input of CH1:X000

Analog to digital conversion execution input of CH2:X001

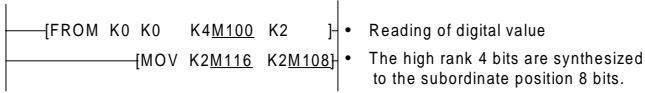
A/D input data CH1 :D100 (Replace with auxiliary relay M100 to M115. Assign these numbers only one time)

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

Processing time: Time from turning on X000 and X001 to storage of analog to digital conversion value in data register of main unit.

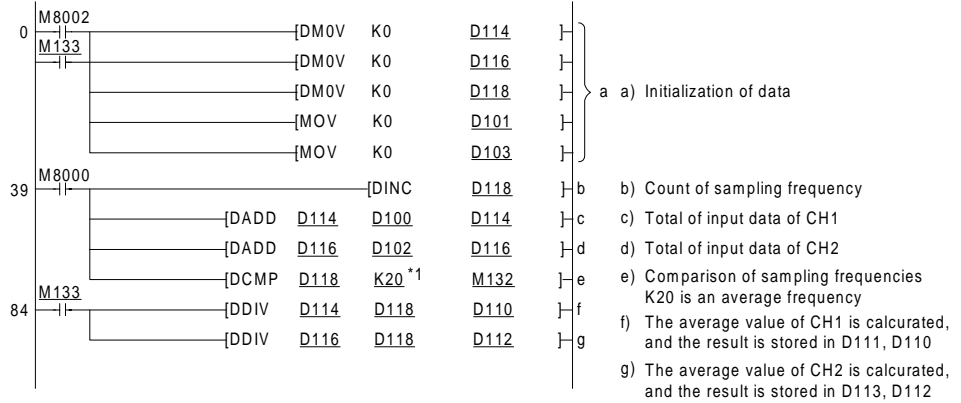
2.5ms / 1 channel

*1 Change the circuit of "*1" as follows when you use FX0N PLC



8.2 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 above-mentioned program example has gone in the average value by 20 times. Make the average frequency within the range of 1 to 262144.

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.
When the input characteristic is adjusted, the input characteristics of CH1 and CH2 are changed.
- 4) The coexistence use for the current input and the voltage input cannot be done with two channels.

10. Error check

Confirm the following items when it is thought 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.
- 3) Confirm whether the load resistance of the equipment connected with the analog input terminal is the one corresponding to the internal resistance of FX2N-2AD (In the voltage input, 200K Ω and the current input are 250 Ω).
- 4) Confirm the voltage and input Current values with a voltage generator and a current generator. Confirm the analog to digital conversion from the input characteristic.
- 5) Readjust the offset and gain by "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 the nearest Mitsubishi Electric distributor.
- 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.

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MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : MITSUBISHI DENKI BLDG MARUNOUTI TOKYO 100-8310 TELEX : J24532 CABLE MELCO TOKYO
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FX_{2N}

FX_{2N}-2AD SPECIAL FUNCTIONBLOCK

USER'S GUIDE

JY992D74701B

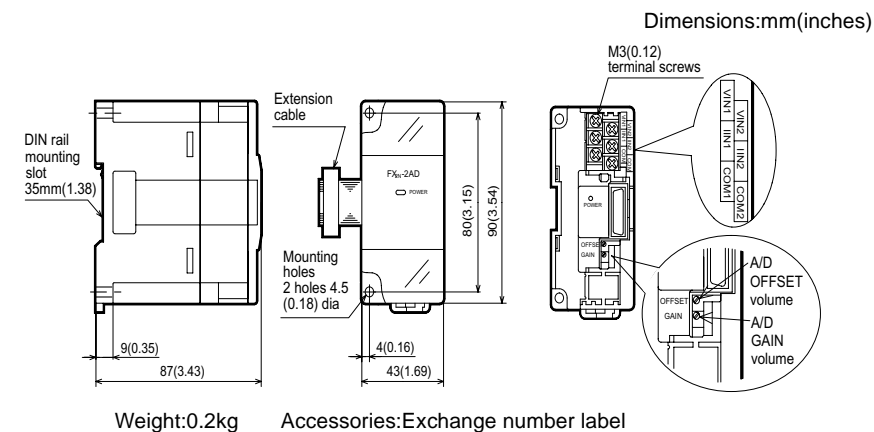
This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX_{2N}-2AD special function block and should be read and understood before attempting to install or use the unit.
Further information can be found in the FX SERIES PROGRAMMING MANUAL, FX_{2N} SERIES HARDWARE MANUAL.

1. INTRODUCTION

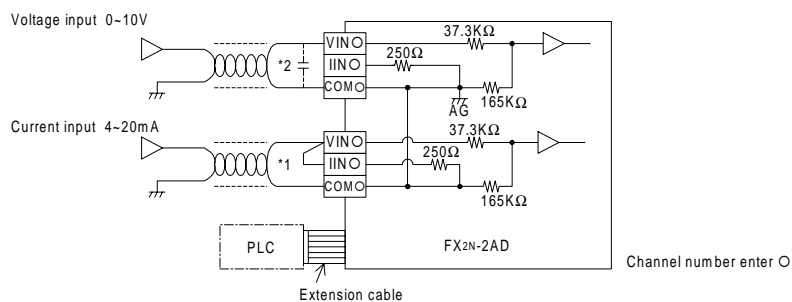
The FX_{2N}-2AD type analog input block (Hereafter referred to as the FX_{2N}-2AD) is used to convert the analog input of two points (voltage input and current input) into a digital value of 12 bits, and to forward the values to the Programmable controller (Hereafter referred to as a PLC).
FX_{2N}-2AD can be connected with FX_{0N}, FX_{2N}, and the FX_{2Nc} series Programmable controllers.

- The analog input is selected from the voltage input or the current input by the method of connecting wires.
At this time, assume setting to be two channels common analog input (voltage input or current input).
- The two analog input channels can accept inputs of 0 to 10V DC, 0 to 5V DC, or 4 to 20mA. Make the input characteristic common with two channels.
- The analog to digital conversion characteristics can be adjusted.
- The block occupies 8 I/O points which can be allocated from either inputs or outputs.
- The data transfer with the PLC uses the FROM/TO instruction.

2. EXTERNAL DIMENSIONS AND PARTS



3. WIRING



*1 The FX_{2N}-2AD cannot have 1 channel as an analog voltage input and one channel as a 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 μF 25V DC capacitor with the position of *2 when there is voltage ripple in the voltage input or there will be a lot of noise.

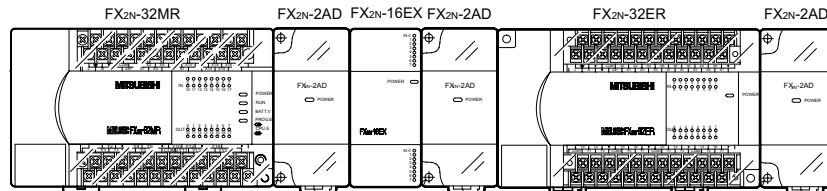
4. Connection with Programmable controller

- The number of FX_{2N}-2AD which can be connected is 4 or less in the FX_{0N} series PLC, 8 or less in the FX_{2N} series PLC, and 4 or less in the FX_{2Nc} series PLC per Main unit with powered extension units. However the following limitation exists when undermentioned special function blocks are connected.
FX_{2N} :Main unit and powered extension units of I/O 32points or less.
24V DC consumption current total value of undermentioned special function blocks used ≤ 190mA
FX_{2N} :Main unit and powered extension units of I/O 48points or more.
24V DC consumption current total value of undermentioned special function blocks used ≤ 300mA
FX_{2Nc}:The undermentioned special function blocks can be connected up to 4 regardless of the I/O number of Main units.
FX_{0N} :The undermentioned special function blocks can be connected up to 2 regardless of the I/O number of Main units and powerd extension units.

	FX _{2N} -2AD	FX _{2N} -2DA	FX _{0N} -3A
Consumption current of 24V DC for one	50mA	85mA	90mA

The capacity of DC 24V power supply which can used for extension blocks of the service power supply and I/O reaches the value by which the total value of the consumption current of the above mentioned special function block is subtracted from a service voltage source capacity the programmable controller original. For instance, the service power supply the FX_{2N}-32MT is 250mA. When two FX_{2N}-2AD blocks are connected, the service power supply is reduced to 150mA.

- The blocks occupy 8 points (The 8 points can be allocated from either inputs or outputs).
- FX_{2N}-2AD consumes 5V DC by 20mA.
The total of 5V of the special function block connected with the main unit of the PLC consumption current must not exceed 5V voltage source capacity of the main unit and the powered extension unit.
- The FX_{2N}-2AD and the main unit are connected with the cable at the right of the main unit.



5. SPECIFICATIONS

5.1 Environment specification

Item	Content
Dielectric withstand voltage	500V AC 1min(Between all terminals and case)

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

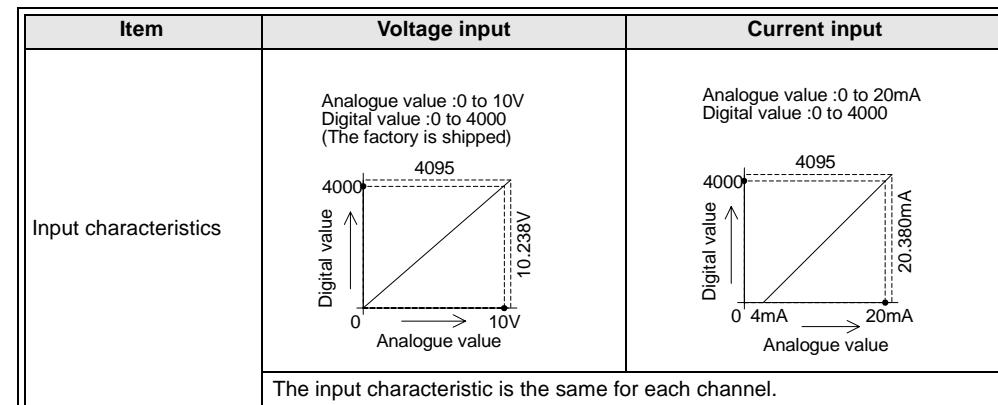
5.2 Power supply specification and others

Item	Content
Analog circuits	24V DC ±10% 50mA (Internal power supplied from the main unit)
Digital circuits	5V DC 20mA (Internal power supplied from the main unit)

Item	Content
Isolation	Photo-coupler isolation between analog and digital circuits. DC/DC converter isolation of power from main unit. No isolation between analog channels.
Number of occupied I/O points	The blocks occupy either 8 input or output points (can be either inputs or outputs)

5.3 Defining gain and offset

Item	Voltage input	Current input
Range of analog input	At shipping, the unit is adjusted to a digital range of 0 to 4000 for an analog voltage input of 0 to 10V DC. When using FX _{2N} -2AD by the current input, or the 0 to 5V DC input it is necessary to readjust by the offset and gain volumes. 0 to 10V DC, 0 to 5V DC (input resistance 200KΩ) Warning-this unit may be damaged by input voltage in excess of -0.5V, +15V DC	4 to 20mA (input resistance 250Ω) Warning-this unit may be damaged by input currents in excess of -2mA, +60mA
Digital output	12bit	
Resolution	2.5mV(10V/4000) 1.25mV(5V/4000)	4μA {(20-4)/4000}
Integrated accuracy	±1% (full scale 0 to 10V)	
Processing time	2.5ms/1 channel (sequence program and synchronization)	



6. Allocation of buffer memory (BFM)

6.1 Buffer memory

BFM number	b15 to b8	b7 to b4	b3	b2	b1	b0
#0	Reserved	Current value of input data (subordinate position 8bit data)				
#1	Reserved		Current value of input data (high rank 4bit data)			
#2 to 16	Reserved					
#17	Reserved			Analog to digital conversion beginning		Analog to digital conversion channel
#18 or more	Reserved					

BFM#0 :The current value of the input data of the channel specified with BFM#17 (subordinate position 8bit data) is stored.The current value data is stored by binary.

BFM#1:The current value of input data (high rank 4bit data) is stored. The current value data is stored by binary.

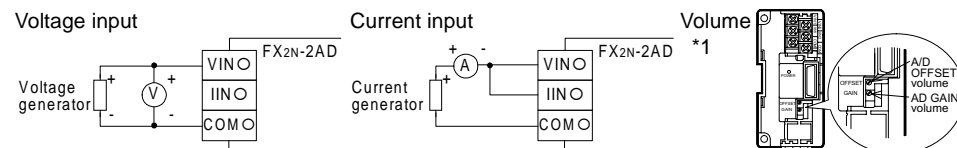
BFM#17:b0...Channel (CH1,CH2) which does the analog to digital conversion is specified.
b0=0...CH1
b0=1...CH2
b1...0→1 The D/A conversion process is started.

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

7. Adjustment of offset and gain

7.1 Offset and gain

The offset value and the gain value when from shipped the factory is adjusted for a digital value of 0 to 4000 for the voltage input 0 to 10V. It is necessary to readjust the offset value and the gain value when FX2N-2AD is used by current input, the 0 to 5V DC voltage input, or with an input characteristic the factory setting. The adjustment of the offset value and the gain value sets a digital value to the analogue value actually input by using the voltage generator and the current generator according to the volume of FX2N-2AD.

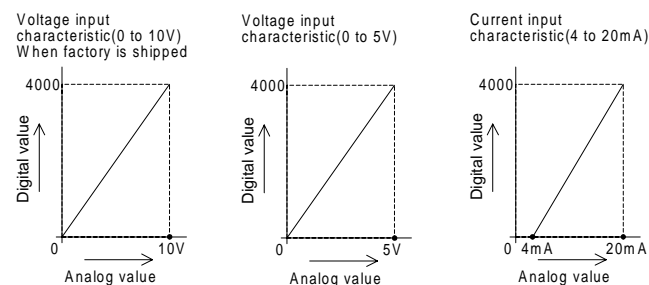


*1 A digital value increases if the volume installed in FX2N-2AD is turned right (clockwise).
(FX2N-4DA and FX2N-2DA can be used instead of the voltage generator and the current generator)

7.1.1 Adjustment of gain

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

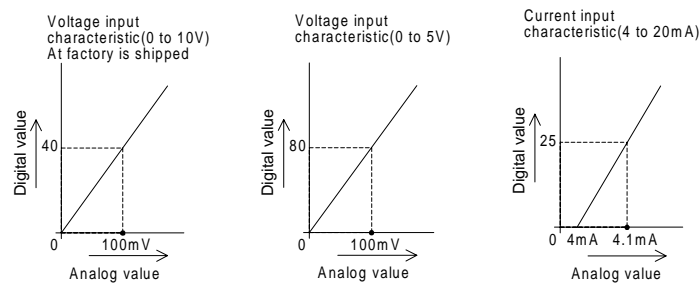
However, to demonstrate the resolution of 12bit to its maximum, a digital range of 0 to 4000 is available.



A digital value is adjusted to 4000 at 10V in the analog input value when the voltage is input.
A digital value is adjusted to 4000 at 20mA in the analog input value when the current is input.

7.1.2 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 at the following.



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)

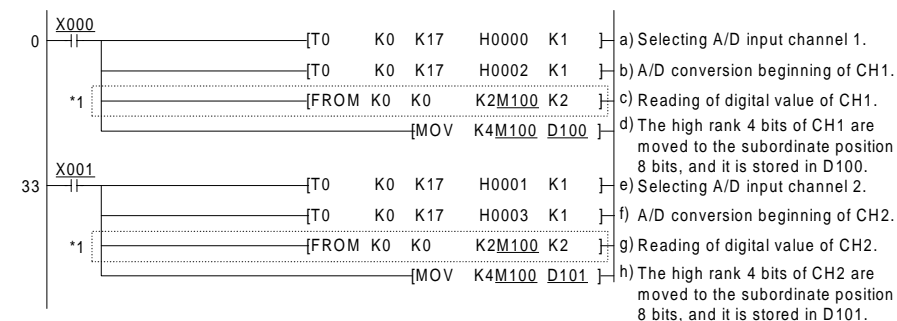
- 1) The offset adjustment and the gain adjustment are for CH1 and CH2 are accomplished at the same time. When the offset value/the gain value of one channel is adjusted, the other value is automatically adjusted.
- 2) Repeat the offset adjustment and gain adjustment alternately until a stable value is reached.
- 3) Each channel is common to the analog input circuit. There are the few differences between channels. However, check each channel individually for maximum accuracy.
- 4) Adjust offset / gain by using subsection 8-2 "Example of programming making average value data" when a digital value is not steady.
- 5) Do in order of the gain adjustment and the offset adjustment when you adjust offset/gain.

8. Program example

The following program examples (8.1 and 8.2) 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



Analog to digital conversion execution input of CH1:X000

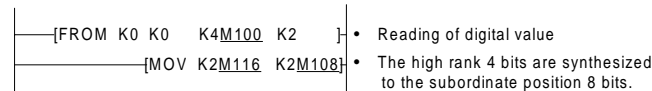
Analog to digital conversion execution input of CH2:X001

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

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

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

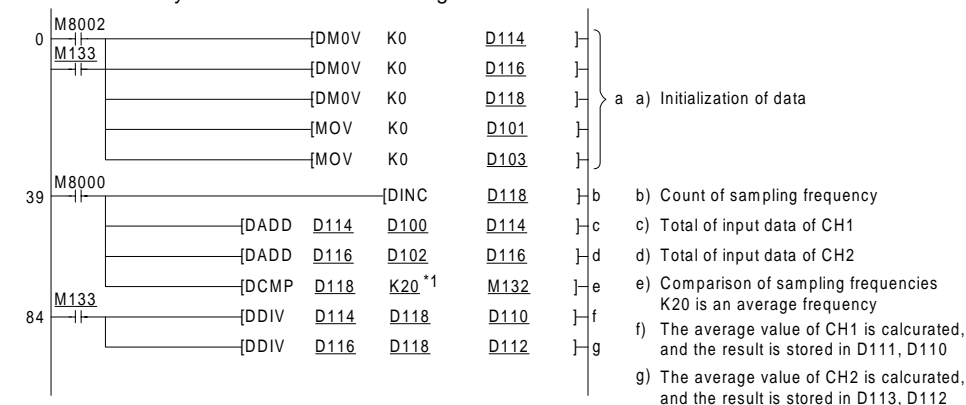
1 Change the circuit of "" as follows when you use FX0N PLC



- Reading of digital value
- The high rank 4 bits are synthesized to the subordinate position 8 bits.

8.2 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 above-mentioned program example has gone in the average value by 20 times. Make the average frequency within the range of 1 to 262144.

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. When the input characteristic is adjusted, the input characteristics of CH1 and CH2 are changed.
- 4) The coexistence use for the current input and the voltage input cannot be done with two channels.

10. Error check

Confirm the following items when it is thought 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.
- 3) Confirm whether the load resistance of the equipment connected with the analog input terminal is the one corresponding to the internal resistance of FX2N-2AD (In the voltage input, 200KΩ and the current input are 250Ω).
- 4) Confirm the voltage and input Current values with a voltage generator and a current generator. Confirm the analog to digital conversion from the input characteristic.
- 5) Readjust the offset and gain by "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 the nearest Mitsubishi Electric distributor.
- 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.

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MITSUBISHI ELECTRIC CORPORATION

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