MITSUBISHI

PROGRAMMABLE CONTROLLERS
MELSEC-F

Changes for the Better

FX2N

FX2N-4AD-PT SPECIAL FUNCTION BLOCK

USER'S GUIDE

JY992D65601B

This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX2N-4AD-PT 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 PROGRAMMING MANUAL(II) and FX0N/FX1N/FX2N/FX2NC SERIES HARDWARE MANUAL.

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

This manual should be used by trained and competent personnel. The definition of such a person or persons 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 applications for this equipment, you must satisfy yourself as to its suitability for your specific application.

1. INTRODUCTION

- The FX2N-4AD-PT analog block amplifies the input from four platinum temperature sensors (PT 100, 3 wire, 100 Ω) and converts the data into 12 bit reading's stored in the main unit. Both Centigrade (°C) and Fahrenheit (°F) can be read. Reading resolution is 0.2°C to 0.3°C / 0.36°F to 0.54°F.

- The FX2N-4AD-PT can connected to the FX0N, FX1N, FX2N and the FX2NC series Programmable Controllers (PLC).

- All data transfers and parameter setups are adjusted via software control of the FX2N-4AD-PT; by use of the TO/FROM applied instructions in the PLC.

- The FX2N-4AD-PT occupies 8 I/O points on the PLC expansion bus. The 8 I/O points can be allocated from either inputs or outputs. The FX2N-4AD-PT draws 30mA from the 5V rail of the main unit or powered extension unit.
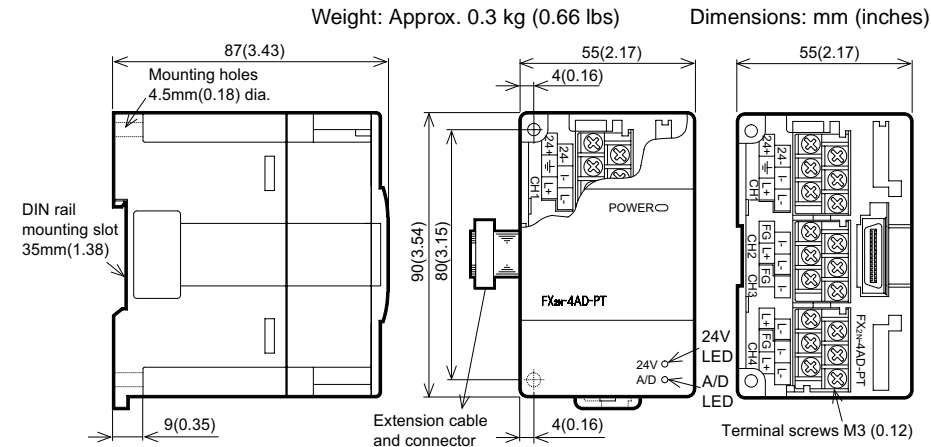
2. EXTERNAL DIMENSIONS

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

3. CONNECTION WITH PLC

3.1 Connection with PLC

1) Up to 4 FX2N-4AD-PT units can connect to the FX0N series PLC, up to 5 for FX1N, up to 8 for FX2N or, up to 4 for an FX2NC 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 I/O points or less. Current consumption available for the undermentioned special function blocks ≤ 190mA

FX2N: Main unit and powered extension units of 48 I/O points or more. Current consumption available for the undermentioned special function blocks ≤ 300mA
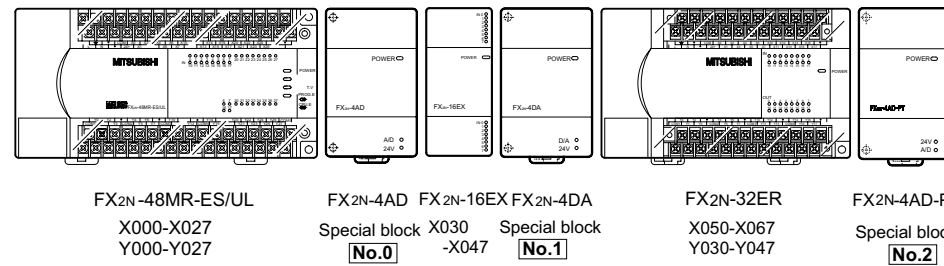
FX2NC: Up to 4 undermentioned special function blocks can be connected regardless of the system I/O.
When using an FX2NC an FX2NC-CNV-IF is required.

FX0N/1N: Main unit and powered extension units. Up to 2 undermentioned special function blocks can be connected regardless of the system I/O.

2) Each block occupies 8 I/O points (The 8 points can be allocated from either inputs or outputs).

3) FX2N-4AD-PT consumes 30mA from the 5V DC bus.
The total 5V consumption of all special function blocks connected to an FX2N or FX2NC main unit or FX2N extension unit must not exceed the 5V source capacity of the system.

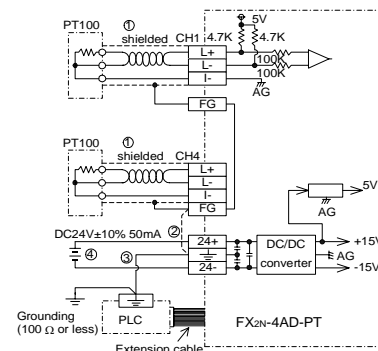4) The FX2N-4AD-PT and main unit are connected by a cable on the right of the main unit.

3.2 Special function block numbers

Other special units of blocks that use FROM/TO instructions, such as analog input blocks, analog output blocks and high-speed counter blocks, can be directly connected to the main unit of the PLC or to the right side of other extension blocks or units.
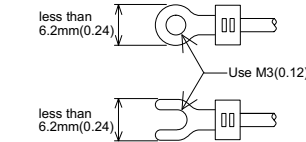

FX2N-48MR-ES/UL   FX2N-4AD FX2N-16EX FX2N-4DA   FX2N-32ER   FX2N-4AD-PT
X000-X027   Special block X030 Special block   X050-X067   Special block
Y000-Y027   No.0   -X047 No.1   Y030-Y047   No.2

4. WIRING

4.1 Wiring

① The cable of the PT 100 sensor or a twisted shielded cable should be used for the analog input cable. This analog input cable should be wired separately from power lines or any other lines which may induce noise. The three wire method improves the accuracy of the sensors by compensating voltage drops.

② If there is electrical noise, connect the FG (frame ground) terminal with the ground terminal. (In CH1, there is no FG terminal. Use FG terminal of other channels.)

③ Connect the ground terminal on the FX2N-4AD-PT unit with the grounded terminal on the main unit. Use grounding on the main unit, if grounding is possible.

④ Either an external or the 24V built-in supply in the PLC may be used.

For additional data regarding EMC considerations please see section 10.

4.2 Using crimp terminations

- Use crimp terminals as indicated on the left.
- Secure the terminal using a tightening torque of between 5 and 8 kg·cm.
- Wire only to the module terminals discussed in this manual. Leave all others vacant.

5. INSTALLATION NOTES AND USAGE

5.1 Environmental specification

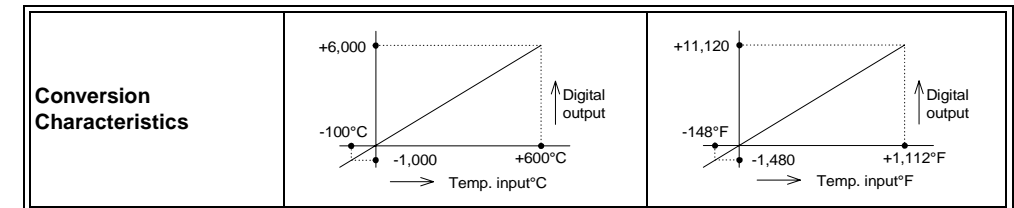| Item	Specification
Environmental specifications	Same as those for the main unit
Dielectric withstand voltage	500V AC, 1min (between all terminals and ground)

5.2 Power supply specification

Item	Specification
Analog circuits	24V DC ± 10%, 50mA
Digital circuits	5V DC, 30mA (internal power supply from the main unit)

5.3 Performance specification

Analog Inputs

Item	Centigrade	Fahrenheit
	Both °C and °F are available by reading the appropriate buffer memory (BFM).	
Analog input signal	Platinum Temperature PT 100 sensors (100 Ω), 3-wire, 4-channel (CH1, CH2, CH3, CH4), 3850 PPM/°C (DIN 43760, JIS C1604-1989)	
Current to sensor	1 mA. sensor: 100 Ω PT 100	
Compensated range	-100°C to +600°C	-148°F to +1112°F
Digital output	-1000 to 6000	-1480 to +11120
	12-bit conversion 11 data bits +1 sign bit	
Minimum resolvable temp.	0.2°C to 0.3°C	0.36°F to 0.54°F
Overall accuracy	± 1% full scale (compensated range) -see section 7.0 for special EMC considerations	
Conversion speed	15 ms for 4 channels	

Analog Inputs continued...

Conversion Characteristics		

Miscellaneous

Item	Specification
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 block occupies 8 I/O points (can be either inputs or outputs)

6. ALLOCATION OF BUFFER MEMORIES (BFM)

6.1 Buffer memories

BFM	CONTENTS
*# 1 - #4	CH1 to CH4 Averaged temperature reading to be averaged (1 to 256) Default = 8
#5 - #8	CH1 to CH4 Averaged temperature in 0.1°C units
#9 - #12	CH1 to CH4 Present temperature in 0.1°C units
#13 - #16	CH1 to CH4 Averaged temperature in 0.1°F units
#17 - #20	CH1 to CH4 Present temperature in 0.1°F units
#21 - #27	Reserved
*#28	Digital range error latch
#29	Error status
#30	Identification code K2030
#31	Reserved

The FX2N-4AD-PT communicates with the PLC via buffer memories.

BFMs (buffer memories) #21 to #27 and #31 are reserved.
All BFM data can be read by the PLC using the FROM instruction.

BFMs (buffer memories) marked with an "*" can be written to from the PLC using the TO instruction.

1) The number of samples to be averaged are assigned in BFMs #1 to #4. Only the range 1 to 4096 is valid. Values outside this range are ignored. The default value of 8 is used.

2) A number of recently converted readings are averaged to give a smoother read out. The averaged data is stored in BFMs #5 to #8 and #13 to #16.

3) BFMs #9 to #12 and #17 to #20 store the current value of the input data. This value is in units of 0.1°C or 0.1°F, but the resolution is only 0.2°C to 0.3°C or 0.36°F to 0.54°F.

6.2 Status Information

1) Buffer Memory BFM #28: Digital range error latch

BFM #29 b10(digital range error) is used to judge whether the measured temperature is within the unit's range or not.

BFM #28 latches the error status of each channel and can be used to check for thermocouple disconnection.

b15 or b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	High	Low	High	Low	High	Low	High	Low
	CH4		CH3		CH2		CH1	

Low : Latches ON when the temperature measurement data drops below the lowest temperature measurement limit.

High : Turns ON when the temperature measurement data rises above the highest temperature measurement limit.

When an error occurs the temperature data before the error is latched. If the measured value returns to within valid limits the temperature data returns to normal operation. (Note: The error remains latched in (BFM #28))
An error can be cleared by writing K0 to BFM #28 using the TO instruction or turning off the power.

2) Buffer Memory BFM #29: Error status

Bit devices of BFM #29	ON	OFF
b0 : Error	When either b1 or b3 is ON A/D conversion is stopped for the error channel.	No error
b1 : Reserved	Reserved	Reserved
b2 : Power source	24V DC power supply failure.	Power supply normal
b3 : Hardware error	A/D converter or other hardware failure.	Hardware Normal
b4 to b9 : Reserved	Reserved	Reserved
b10 : Digital range error	Digital output/analog input value is outside the specified range.	Digital output value is normal.
b11 : Averaging error	Selected number of averaged results is outside the available range -see BFM #1 to #4	Averaging is normal. (between 1 to 4096)
b12 to b15 : Reserved	Reserved	Reserved

3) Identification Code Buffer Memory BFM #30

The identification code or ID number for this Special Block is read from buffer memory BFM #30 using the FROM instruction. This number for the FX2N-4AD-PT unit is K2040.
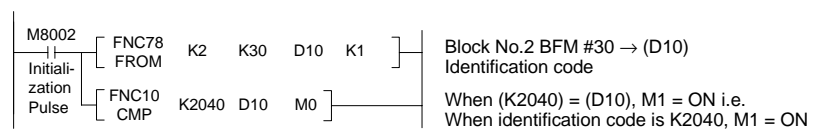The PLC can use this facility in its program to identify the special block before commencing data transfer from and to the special block.
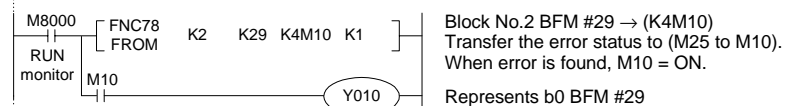
7. SYSTEM BLOCK DIAGRAM
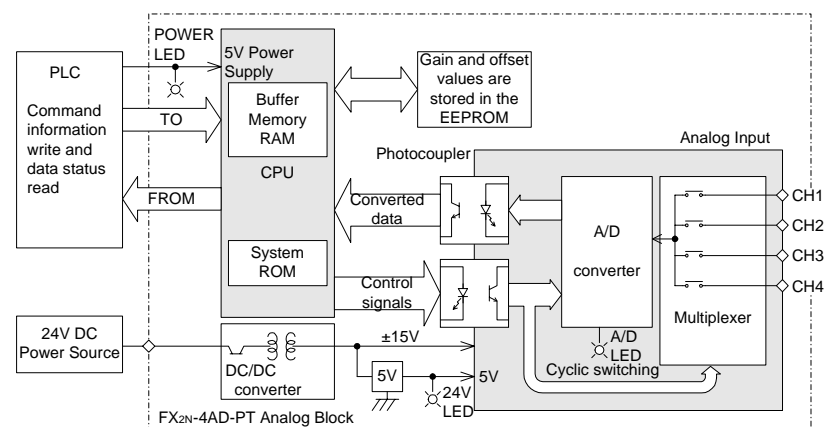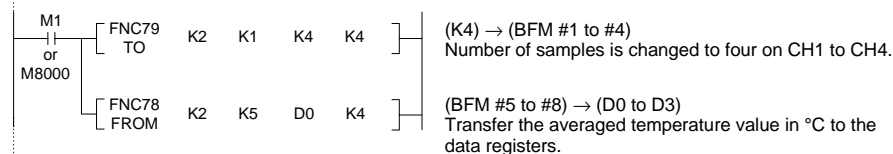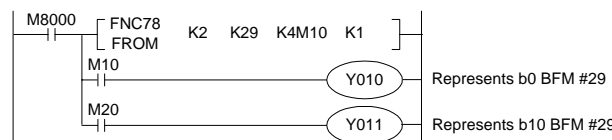

8. EXAMPLE PROGRAM

In the program shown below, the FX2N-4AD-PT block occupies the position of special block number 2 (that is the third closest block to the PLC). The averaging amount is four. The averaged values in degrees C of input channels CH1 to CH4 are stored respectively in data registers D0 to D3.

M8002
Initialization Pulse

| FNC78 FROM | K2 | K30 | D10 | K1 | Block No.2 BFM #30 → (D10) Identification code |

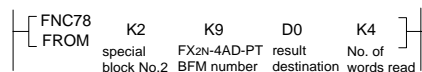| FNC10 CMP | K2040 | D10 | M0 | | When (K2040) = (D10), M1 = ON i.e. When identification code is K2040, M1 = ON |

This initial step checks that the special function block placed at position 2 is actually an FX2N-4AD-PT, i.e. its unit identification number is 2040 (BFM #30). This step is optional, but it provides a software check that the system has been configured correctly.

M8000
RUN monitor

| FNC78 FROM | K2 | K29 | K4M10 | K1 | Block No.2 BFM #29 → (K4M10) Transfer the error status to (M25 to M10). When error is found, M10 = ON. |

M10 — (Y010) Represents b0 BFM #29

This step provides optional monitoring of the FX2N-4AD-PT Error Buffer Memory (#29). If there is an Error on the FX2N-4AD-PT, bit b0 of BFM #29 will be set on. This can be read by this program step, and output as a bit device in the PLC (Y010 in this example). Additional Error devices can be output in a similar manner, i.e. b10 BFM #29. (see below)

M8000

| FNC78 FROM | K2 | K29 | K4M10 | K1 |

M10 — (Y010) Represents b0 BFM #29
M20 — (Y011) Represents b10 BFM #29

M1 or M8000

| FNC79 TO | K2 | K1 | K4 | K4 | (K4) → (BFM #1 to #4) Number of samples is changed to four on CH1 to CH4. |

| FNC78 FROM | K2 | K5 | D0 | K4 | (BFM #5 to #8) → (D0 to D3) Transfer the averaged temperature value in °C to the data registers. |

This step is the actual reading of the FX2N-4AD-PT input channels. It is essentially the only program step which is needed. The "TO" instruction in this example, sets the input channels, CH1 to CH4, to take the average reading of four samples. The "FROM" instruction reads the average temperatures (BFM #5 to #8) for input channels CH1 to CH4 of the FX2N-4AD-PT. If direct temperature readings are required BFM #9 to #12 should be read instead, ex.

| FNC78 FROM | K2 | K9 | D0 | K4 |
| | special block No.2 | FX2N-4AD-PT BFM number | result destination | No. of words read |

9. DIAGNOSTICS

9.1 Preliminary checks

I. Check whether the input/output wiring and/or extension cables are properly connected on the FX2N-4AD-PT 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 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-PT 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 external wiring.

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

• Check the status of the "A/D" LED (top right corner of the FX2N-4AD-PT).
 Lit : A/D conversion is proceeding normally.
 Otherwise : Check buffer memory #29 (error status). If any bits (b0, b2, b3) are ON, then this is why the A/D LED is OFF.

10. EMC CONSIDERATIONS

Electromagnetic compatibility or EMC must be considered before using the FX2N-4AD-PT.

Mitsubishi recommend that the PT 100 sensors used, should be fitted with a form of seild or screening as protection against EMC noise.

If some form of cable protection is used, the "Shield" must be terminated at the [FG] [⏚] terminals as shown in section 2.0.

Because of the delicate nature of all analog signals, failure to take good EMC precautions could lead to EMC noise induced errors; up to ±10% of actual values. This is an absolute worst case figure, users who do take good precautions can expect operation within normal tolerances.

EMC considerations should include selection of good quality cables, good routing of those cables away from potential noise sources.

Additionally it is recommended that signal averaging is used as this will reduce the effects of random noise "spikes".

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