



PROGRAMMABLE CONTROLLERS
MELSEC-F

FX_{2N}

FX2N-4AD-PT SPECIAL FUNCTION BLOCK

USER'S GUIDE

JY992D65601G

This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX_{2N}-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 main unit manual and programming manual.

Guidelines for the Safety of the User and Protection of the FX_{2N}-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:

- 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.
- Any commissioning or service engineer must be of a competent nature, trained and qualified to the local and national standards.
- All operators of the completed equipment should be trained to use this product in a safe and coordinated manner in compliance to established safety practices.

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

Notes on the Symbols Used in this Manual

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



- 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

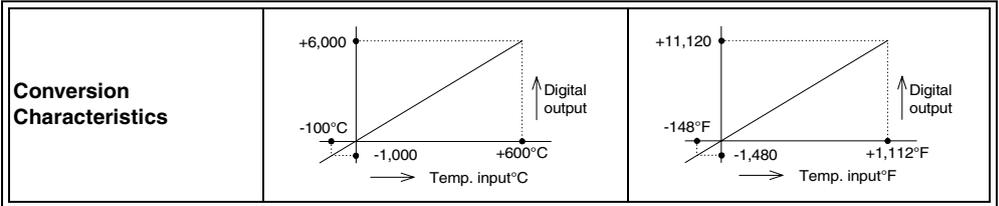
- The FX_{2N}-4AD-PT analog block amplifies the input from four platinum temperature sensors (Pt 100, 3 wire, 100 Ω) and converts the data into 12 bit reading's stored in the main unit. Both Centigrade (°C) and Fahrenheit (°F) can be read. Reading resolution is 0.2°C to 0.3°C / 0.36°F to 0.54°F.
- The FX_{2N}-4AD-PT can connected to the FX_{0N}/FX_{1N}/FX_{2N}/FX_{2NC}/FX_{3G}/FX_{3U}/FX_{3UC} series Programmable Controllers (PLC).
- All data transfers and parameter setups are adjusted via software control of the FX_{2N}-4AD-PT; by use of the TO/FROM applied instructions in the PLC.
- The FX_{2N}-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 FX_{2N}-4AD-PT draws 30mA from the 5V rail of the main unit or powered extension 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), (DIN 43760, JIS C 1604-1997, JIS C 1604-1981)	
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	16-bit binary with sign
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	60ms (15 ms for 4 channels)	

Analog Inputs continued...



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
*#0	Characteristic change
*# 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 K2040
#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.

PLC can read/write the BFMs (marked with “*”), using FROM /TO instructions.

- BFM #0 value (K0 or K1) decides the Pt100 characteristic to be used.
K0 : JIS C 1604-1997
K1 : JIS C 1604-1981
- 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.
- 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.
- 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.

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

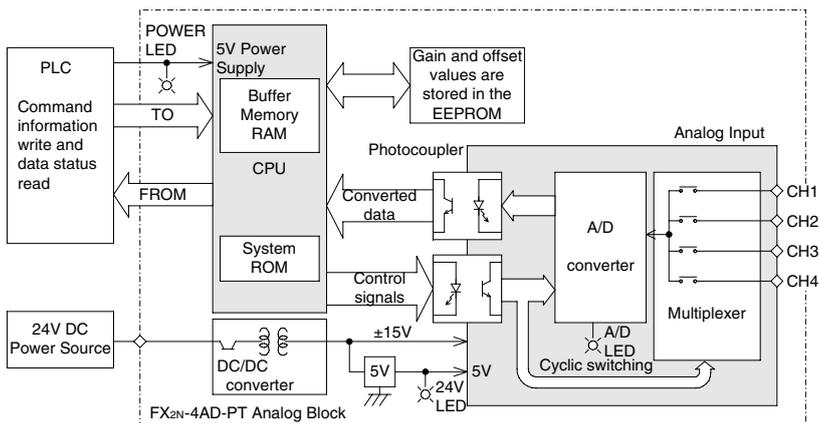
Bit devices of BFM #29	ON	OFF
b0 : Error	When either b2 or b3 is ON A/D conversion is stopped for the error channel.	No error
b1 : Reserved	Reserved	Reserved
b2 : Power source	24V DC power supply failure.	Power supply normal
b3 : Hardware error	A/D converter or other hardware failure.	Hardware Normal
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) Buffer Memory BFM #30: Identification Code

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.

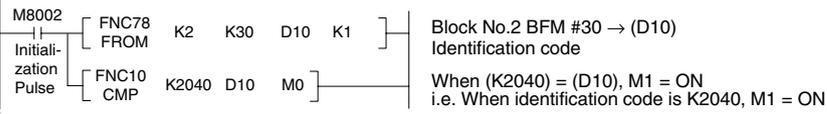
The PLC can use this facility in its program to identify the special block before commencing data transfer from and to the special block.

7. SYSTEM BLOCK DIAGRAM

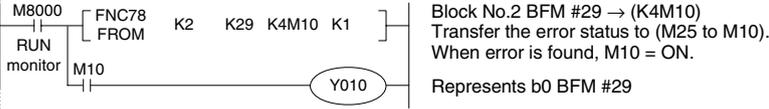


8. EXAMPLE PROGRAM

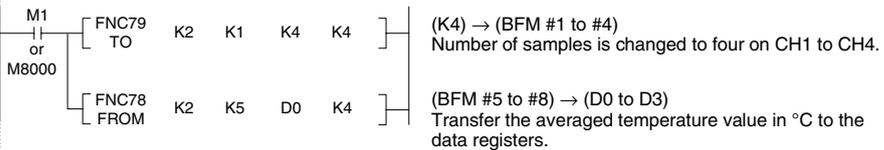
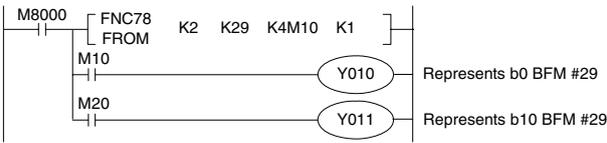
In the program shown below, the FX_{2N}-4AD-PT block occupies the position of special block number 2 (that is the third closest block to the PLC). The averaging amount is four. The averaged values in degrees C of input channels CH1 to CH4 are stored respectively in data registers D0 to D3.



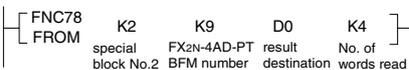
This initial step checks that the special function block placed at position 2 is actually an FX_{2N}-4AD-PT, i.e. its unit identification number is 2040 (BFM #30). This step is optional, but it provides a software check that the system has been configured correctly.



This step provides optional monitoring of the FX_{2N}-4AD-PT Error Buffer Memory (#29). If there is an Error on the FX_{2N}-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)



This step is the actual reading of the FX_{2N}-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 FX_{2N}-4AD-PT. If direct temperature readings are required BFM #9 to #12 should be read instead, ex.



9. DIAGNOSTICS

9.1 Preliminary checks

- I. Check whether the input/output wiring and/or extension cables are properly connected on the FX_{2N}-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 FX_{2N}-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 FX_{2N}-4AD-PT).
Lit : FX_{2N}-4AD-PT is ON, 24V DC power source is ON.
Otherwise : Possible 24V DC power failure, if ON possible FX_{2N}-4AD-PT failure.
- Check the status of the "A/D" LED (top right corner of the FX_{2N}-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 shield or screening as protection against EMC noise.

If some form of cable protection is used, the “Shield” must be terminated at the   terminals as shown in section 4.1.

Because of the delicate nature of all analog signals, failure to take good EMC precautions could lead to EMC noise induced errors; up to $\pm 10\%$ 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”.

Attention

- This product is designed for use in industrial applications.

Note

- Authorized Representative in the European Community: Mitsubishi Electric Europe B.V.
Gothaer Str. 8, 40880 Ratingen, Germany

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.

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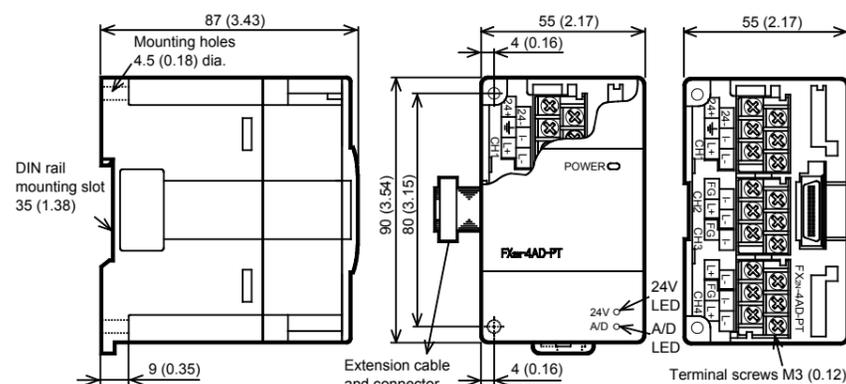
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1. INTRODUCTION

- 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/FX2NC/FX3G/FX3U/FX3UC 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)

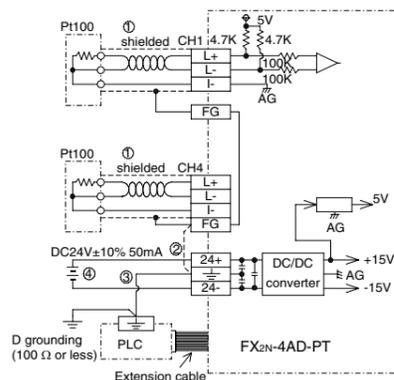


3. CONNECTION WITH PLC

The FX2N-4AD-PT unit can be connected to the FX0N/FX1N/FX2N/FX2NC/FX3G/FX3U/FX3UC PLCs. 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. For the connection with PLCs, refer to the respective PLC manual.

4. WIRING

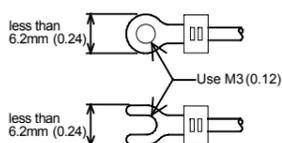
4.1 Wiring



- 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.
- 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.)
- 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.
- 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.
- The tightening torque must be 0.5 and 0.8 N-m. Do not tighten terminal screws exceeding the specified torque. Failure to do so may cause equipment failures or malfunctions.
- Wire only to the module terminals discussed in this manual. Leave all others vacant.

5. INSTALLATION NOTES AND USAGE

5.1 General specification

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

5.2 Power supply specification

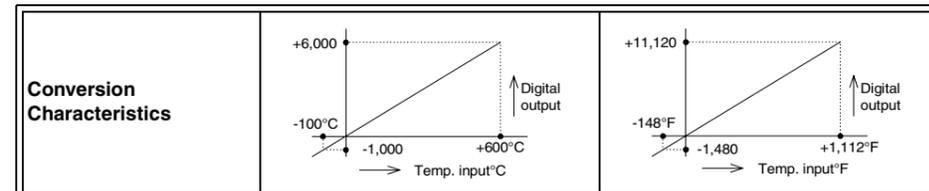
Item	Specification
Analog circuits	24V DC ± 10%, 50mA
Digital circuits	5V DC, 30mA (internal power supply from the main unit)

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), (DIN 43760, JIS C 1604-1997, JIS C 1604-1981)	
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
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	60ms (15 ms for 4 channels)	

Analog Inputs continued...



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
*#0	Characteristic change
*# 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 K2040
#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.

PLC can read/write the BFMs (marked with "*"), using FROM /TO instructions.

- BFM #0 value (K0 or K1) decides the Pt100 characteristic to be used.
K0 : JIS C 1604-1997
K1 : JIS C 1604-1981
- 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.
- 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.
- 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.

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

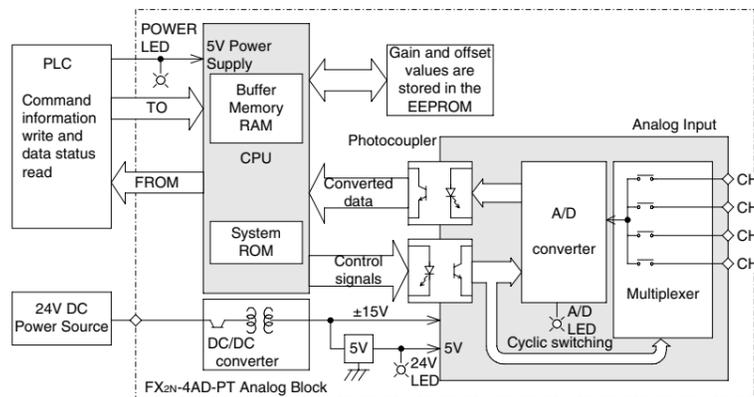
Bit devices of BFM #29	ON	OFF
b0 : Error	When either b2 or b3 is ON A/D conversion is stopped for the error channel.	No error
b1 : Reserved	Reserved	Reserved
b2 : Power source	24V DC power supply failure.	Power supply normal
b3 : Hardware error	A/D converter or other hardware failure.	Hardware Normal
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) Buffer Memory BFM #30: Identification Code

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.

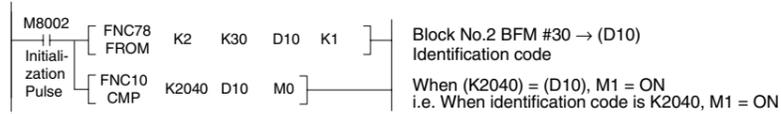
The PLC can use this facility in its program to identify the special block before commencing data transfer from and to the special block.

7. SYSTEM BLOCK DIAGRAM

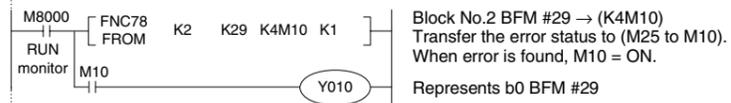


8. EXAMPLE PROGRAM

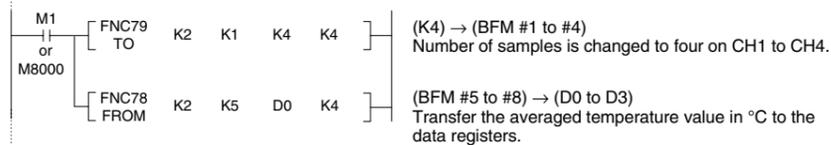
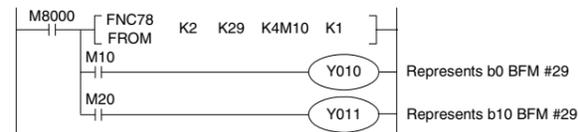
In the program shown below, the FX2N-4AD-PT block occupies the position of special block number 2 (that is the third closest block to the PLC). The averaging amount is four. The averaged values in degrees C of input channels CH1 to CH4 are stored respectively in data registers D0 to D3.



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.



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)



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.



9. DIAGNOSTICS

9.1 Preliminary checks

- Check whether the input/output wiring and/or extension cables are properly connected on the FX2N-4AD-PT analog special function block.
- 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.
- Ensure that the correct operating range has been selected for the application.
- 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.
- 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 shield or screening as protection against EMC noise.

If some form of cable protection is used, the "Shield" must be terminated at the $\overline{\text{FG}}$ terminals as shown in section 4.1.

Because of the delicate nature of all analog signals, failure to take good EMC precautions could lead to EMC noise induced errors; up to $\pm 10\%$ 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".

Attention

- This product is designed for use in industrial applications.

Note

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