MITSUBISHI

PROGRAMMABLE CONTROLLERS

MELSEC-F

FX-2AD-PT
SPECIAL FUNCTION BLOCK

USER'S GUIDE

JY992D55701A

This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX-2AD-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 and FX/FX2C SERIES HARDWARE MANUAL.

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1   INTRODUCTION

- The FX-2AD-PT analog block amplifies the input from two platinum temperature sensors (PT 100, 3 wire, 100Ω) and converts the data into 12 bit reading's stored in the Main Processing Unit (MPU). Both Centigrade (°C) and Fahrenheit (°F) can be read. Reading resolution is 0.2°C/0.36°F.

- All data transfers and parameter setups are adjusted through software control of the FX-2AD-PT ; by use of the TO/FROM applied instructions in the FX PC.

  Note : FX programmable controllers versions 2.0 or later (those with serial number 13✕✕✕✕ or larger) are required as these units have the TO/FROM applied instructions in their instruction set. All FX2C Models may be used.

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

1.1 External dimensions

Weight : Approx. 0.5kg (1.1 lbs)   Dimensions : mm (inches)

⚠ Any connection to these terminals may damage the FX-2AD-PT.

M3.5 (0.14) terminal screws
24V LED
A-D LED
Mounting holes 5.5mm (0.27) dia.

FX-2AD-PT
POWER

125 (4.92)
140 (5.51)

35mm (1.38) DIN rail mounting slot

Extension cable and connector

63 (2.48)
73 (2.87)
10 (0.39)
95 (3.74)

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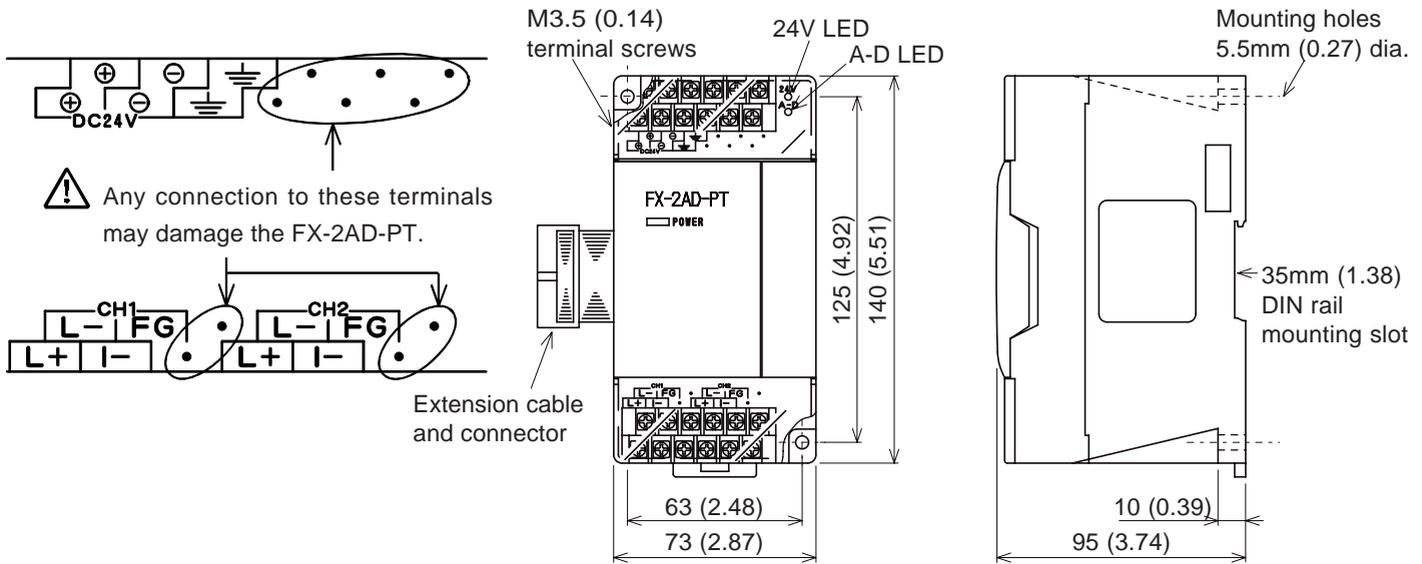
2 TERMINAL LAYOUTS
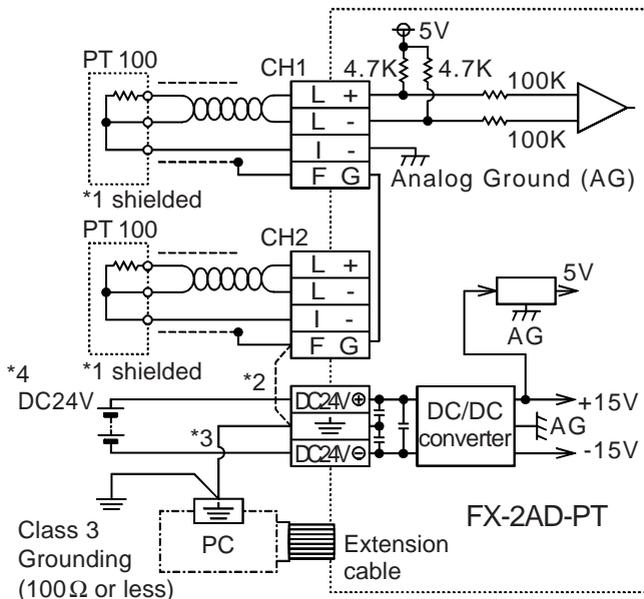
*1 : The cable of the PT 100 sensor or a twisted shielded cable should be used for the analog input cable. This analog input cable should be wired separately from power lines or any other lines which may induce noise.
The three wire method improves the accuracy of the sensors by compensating voltage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

*2 : If there is electrical noise, connect the frame ground terminal (FG) with the ground terminal.

*3 : Connect the ground terminal on the FX-2AD-PT unit with the grounded terminal on the base unit. Use class 3 grounding on the base unit, if grounding is possible.

*4 : Either an external or the 24V built-in supply in the programmable controller may be used.

For additional data regarding EMC considerations please see section 7.0.

2.1 Using crimp terminations

less than 6.8mm (0.27)

Use M3.5 (0.14)

less than 6.8mm (0.27)
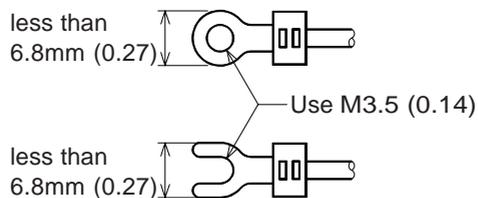
- Use crimp terminations of the type indicated on the left.

- Secure the termination 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.

3 INSTALLATION NOTES AND USAGE

3.1 General specification

Item	Specification
General specifications	Same as those for the FX base unit

3.2 Power supply specification

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

3.3 Performance specifications

Analog inputs

Item	Centigrade	Fahrenheit
	Both °C and °F readings are available by reading the appropriate buffer memory area.	
Analog input signal	Platinum temperature PT 100 sensors (100Ω), 3-wire, 2-channel (CH1,CH2), 3850 PPM/°C (DIN 43760, JIS C1604-1989)	
Current to sensor	1mA. sensor : 100Ω 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	0.36°F
Overall accuracy	±1% full scale (compensated range) -see section 7.0 for special EMC considerations	
Conversion speed	15 ms for 2 channels	

Analog inputs continued...

Conversion Characteristics	
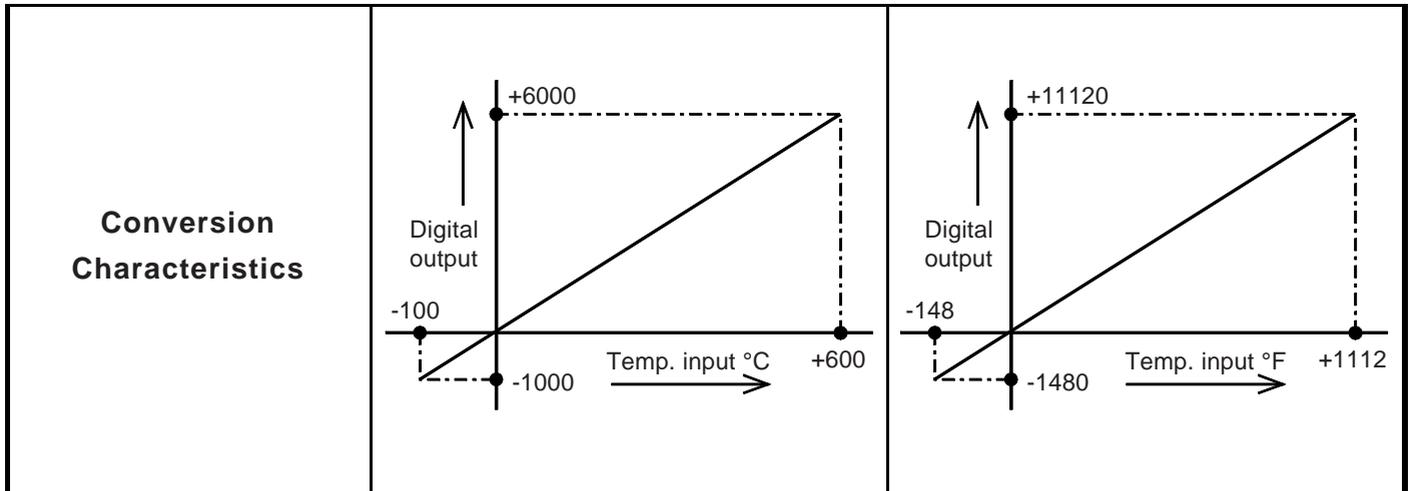
Miscellaneous

Item	Specification
Isolation	Photo-coupler isolation between analog and digital circuits. DC/DC converter isolation of power from FX MPU. No isolation between analog channels
Number of occupied I/O points	8 points taken from the FX expansion bus (can be either inputs or outputs)

3.4 Buffer memory assignment

BFM		
*# 1	CH1	Number of samples for averaging
*# 2	CH2	Default = 8 Range = 1 to 4096
# 5	CH1	Averaged temperature
# 6	CH2	in units of 0.1°C
# 9	CH1	Present/Current temperature
#10	CH2	in units of 0.1°C
#13	CH1	Averaged temperature
#14	CH2	in units of 0.1°F
#17	CH1	Present/Current temperature
#18	CH2	in units of 0.1°F
#29	Error status -see section 3.5	
#30	FX-2AD-PT ID CODE, K2020-see section 3.5	

The FX-2AD-PT communicates with the programmable controller through use of buffer memories.

BFMs #0, #3, #4, #7, #8, #11, #12, #15, #16, #19 to #28 and #31 are reserved.
For BFMs without the " * " hmark, data can be read by the programmable controller using the FROM command.

BFMs (buffer memories) marked with an " * " can be written to from the programmable controller using the TO command.

(1) BFMs #9, #10 and #17, #18 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 or 0.36°F.

(2) A number of recently converted readings are averaged to give a smoother read out. The averaged data is stored in BFMs #5, #6 and #13, #14.

(3) The number of samples to be averaged are assigned in BFMs #1 and #2. Only the range 1 to 4096 is valid. Values outside this range are ignored. The default value of 8 is used.

3.5 Status information

(1) Identification Code Buffer Memory BFM #30

The identification code or ID number for a Special Block is read from buffer memory BFM #30 using the FROM command.

This number for the FX-2AD-PT unit is K2020.

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

(2) Status information Buffer Memory BFM #29

Bit devices of BFM #29	ON	OFF
b 0 : Error	When any of b1 to b3 is ON A/D conversion is stopped for the error channel	No error
b 1 : Reserved	Reserved	Reserved
b 2 : Power source	DC 24V power supply failure	power supply normal
b 3 : Hardware error	A/D converter or other hardware failure	Hardware normal
b 4 to b 9 : 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 and #2.	Averaging is normal. (between 1 and 4096)
b12 to b15 : Reserved	Reserved	Reserved

SYSTEM BLOCK DIAGRAM
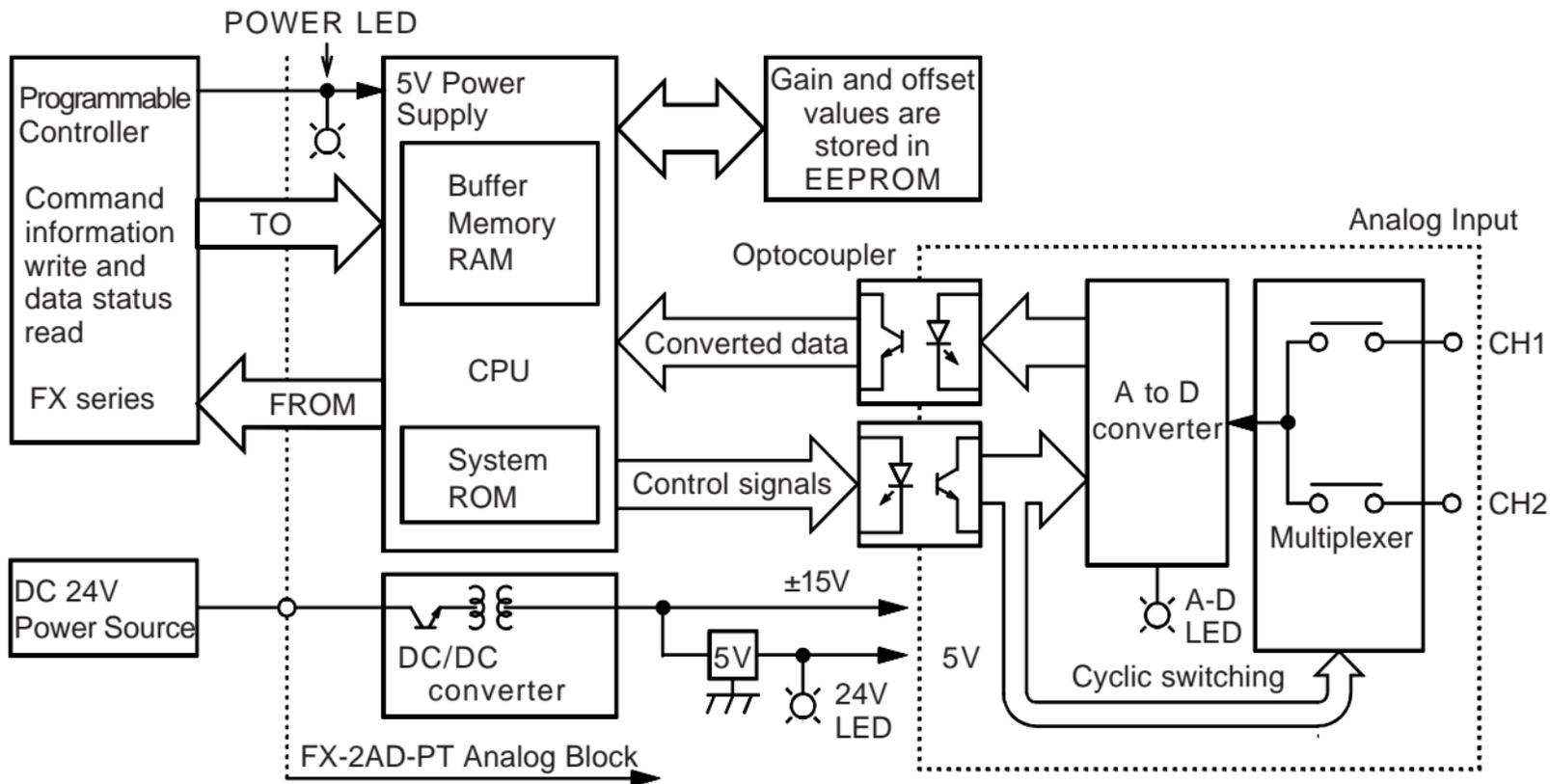
In the program shown below, the FX-2AD-PT block occupies the position of special block number 2 (that is the third closest block to the programmable controller). The averaging amount is four. The averaged values in degrees C of input channels CH1 and CH2 are stored respectively in data registers D0 and D1.

```
M8002       ┌ FNC 78
─┤ ├────────┤ FROM    K2      K30     D2      K1 ┐  Block No.2 BFM #30 → (D2)
Initiali-   └                                       Identification code
zation      ┌ FNC 10
Pulse       ┤ CMP     K2020   D2      M0         ┐  When (K2020) = (D2) , M1 = ON. i.e.
            └                                       When identification code is K2020, M1 = ON
```
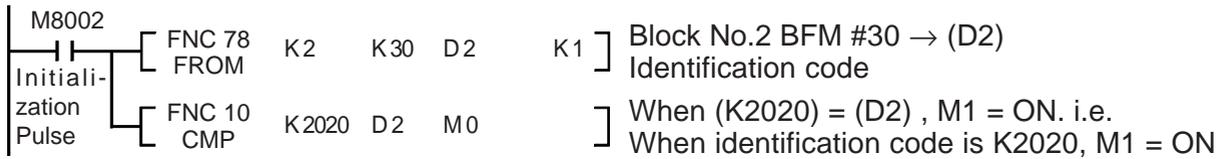
This initial step checks that the special function block placed at position 2 is actually an FX-2AD-PT, i.e. its unit identification number is 2020 (BFM #30). This step is optional, but it provides a software check that the system has been configured correctly.

```
M8000       ┌ FNC 78
─┤ ├────────┤ FROM    K2      K29     K4M10   K1 ┐  Block No.2 BFM #29 → (K4M10)
RUN         └                                       Transfer the error status to (M25 to M10).
monitor  M 10                                       When error is found, M10 = ON.
         ─┤ ├──────────────────────────( M 3 )      Represents b0  BFM #29
```
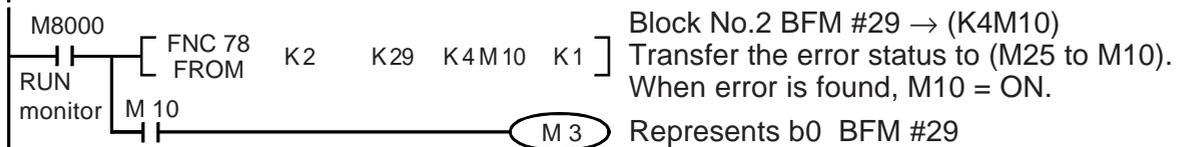
This step provides optional monitoring of the FX-2AD-PT Error Buffer Memory (#29). If there is an Error on the FX-2AD-PT, bit b0 of BFM #29 will be set on. This can be read by this program step, and output as a bit device in the FX programmable controller (M3 in this example). Additional Error devices can be output in a similar manner, i.e. b10 BFM #29. (see below)

```
      M8000       ┌ FNC 78
      ─┤ ├────────┤ FROM    K2      K29     K4M10   K1 ┐
                  └
                M 10
                ─┤ ├──────────────( M 3 )  Represents b0   BFM #29

                M 20
                ─┤ ├──────────────( M 4 )  Represents b10  BFM #29
```

```
M 1         ┌ FNC 79
─┤ ├────────┤ TO      K2      K1      K4      K2 ┐  (K4) → (BFM #1), (K4) → (BFM #2)
or M8000    └                                       Number of samples is changed to four on both CH1
                                                    and CH2.
            ┌ FNC 78
            ┤ FROM    K2      K5      D0      K2 ┐  (BFM #5) → (D0), (BFM #60) → (D1)
            └                                       Transfer the averaged temperature value in °C to the
                                                    data registers.
```
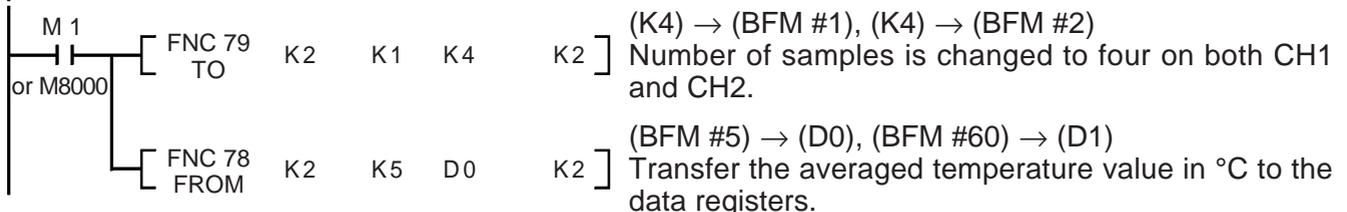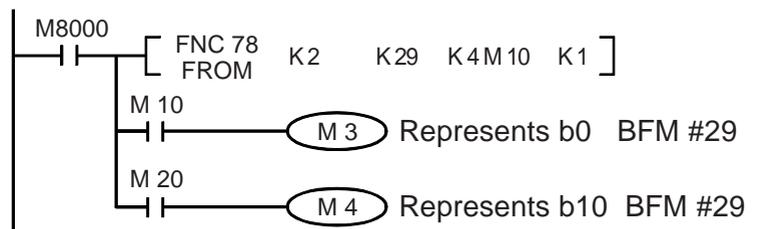
This step is the actual reading of the FX-2AD-PT input channels. It is essentially the only program step which is needed. The " TO " instruction in this example, sets the input channels, CH1 and CH2, to take the average reading of four samples.
The " FROM " instruction reads the average temperatures (BMF #5 and #6) for input channels CH1 and CH2 of the FX-2AD-PT. If direct temperature readings are required BFM #9 and #10 should be read instead, ex.

```
      ┌ FNC 78
──────┤ FROM    K2          K9          D0          K2 ┐
      └         special     FX-2AD-PT   result      No. of
                block No.2  BFM number  destination  words read
```

6.1   Preliminary checks

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

II   Check that the FX system configuration rules have not been broken, i.e. the number of special function blocks does not exceed 8 and the total system I/O is equal or less than 256, I/O.

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 an MPU or a powered extension unit varies according to the number of extension blocks or special function blocks connected.

V   Put the Main Processing Unit (MPU) into RUN.

6.2   Error checking

If the FX-2AD-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-2AD-PT).
  Lit   :   FX-2AD-PT is ON, 24V DC power source is ON.
  Otherwise :   Possible 24V DC power failure, if ON possible FX-2AD-PT failure.

- Check the status of the " A-D " LED (top right corner of the FX-2AD-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.

6.3   Checking special function block numbers

Other special units or blocks that use FROM/TO commands, such as analog input blocks, analog output blocks and high-speed counter blocks, can be directly connected to the base unit of the FX programmable controller or to the right side of other extension blocks or units. Each special block is consecutively numbered from 0 to 7 beginning from the one closest to the base unit. A maximum of eight special blocks can be connected.

FX-48MR-ES
X000 ~ X027
Y000 ~ Y027

FX-4AD
Special
block 0

FX-8EX
X030 ~
X037

FX-2DA
Special
block 1

FX-32ER
X040 ~ X057
Y030 ~ Y047

FX-2AD-PT
Special
block 2
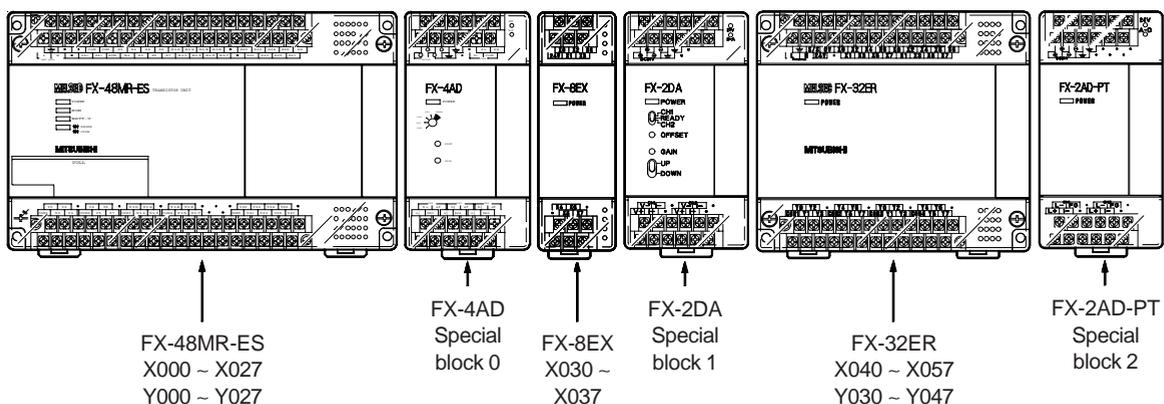
Electromagnetic compatibility or EMC must be considered before using the FX-2AD-PT.

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 $\boxed{\text{FG}}$ $\boxed{\perp}$ 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 ".

Guidelines for the safety of the user and protection of the FX-2AD-PT 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 FX-2AD-PT 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 FX-2AD-PT please consult the nearest Mitsubishi Electric distributor.

- Under on 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.

Effective MAR. 1996
Specifications are subject to
change without notice.

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