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MITSUBISHI
PROGRAMMABLE CONTROLLERS
MELSEC-F

FX0N

FX0N-3A SPECIAL FUNCTION BLOCK USER'S GUIDE

JY992D49001B

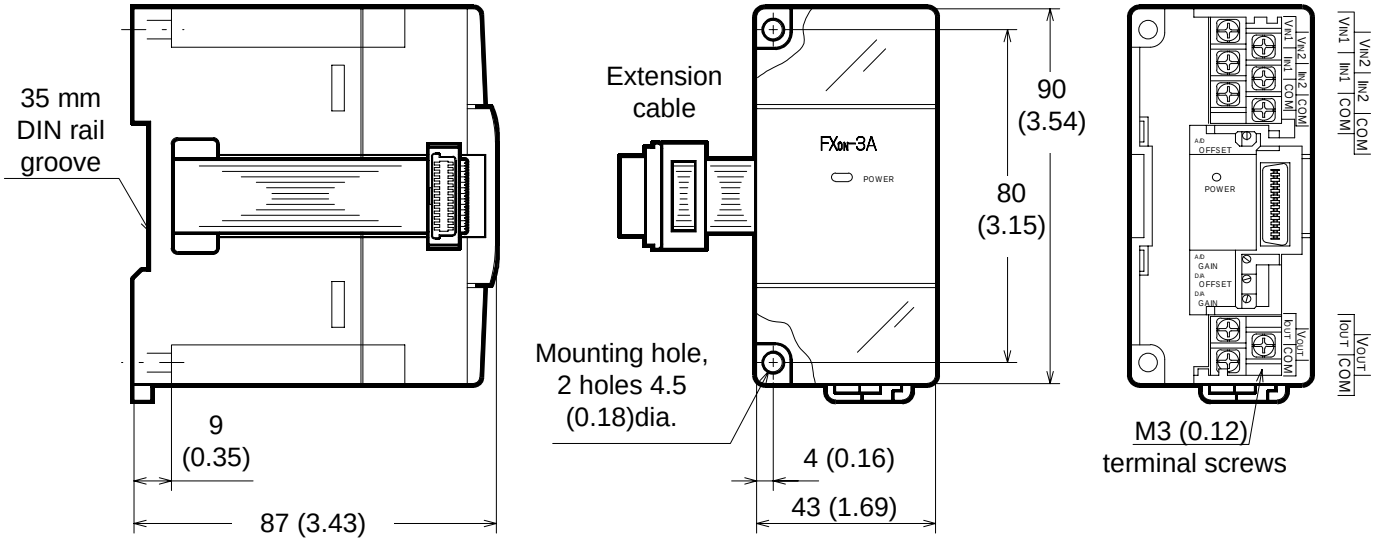
This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the FX0N-3A special function block and should be read and understood before attempting to install or use the unit. Further information can be found in the FX PROGRAMMING MANUAL and FX0/FX0N SERIES HARDWARE MANUAL.

1 INTRODUCTION

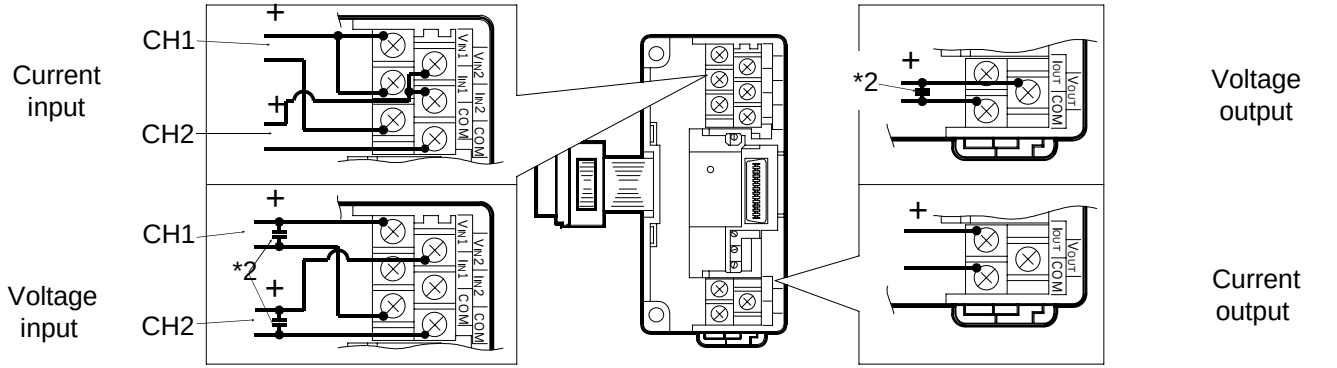
- The FX0N-3A analog special function block has two input channels and one output channel. The input channels receive analog signals and convert them into a digital value. This is called an A/D conversion. The output channel takes a digital value and outputs an equivalent analog signal. This is called a D/A conversion. The FX0N-3A has a maximum resolution of 8 bits.
- The selection of voltage or current based input/output is by user wiring. Analog ranges of 0 to 10V DC (resolution:40mV), 0 to 5V (resolution:20mV) and/or 4 to 20mA (resolution:64μA) may be selected.
- All data transfers and parameter setups are adjusted through software control of the FX0N-3A; by use of the TO/FROM applied instructions in the FX0N PC. Communications between the FX0N PC and FX0N-3A are protected by opto-coupler.
- The FX0N-3A occupies 8 points of I/O on the FX0N's expansion bus. The 8 points can be allocated from either inputs or outputs.

1.1 External dimensions

Weight: Approx. 0.2kg (0.44lbs). Dimensions: mm (inches)



2 TERMINAL LAYOUTS



- When a current input is used, ensure that the terminals marked [VIN*$_1$] and [IIN*$_1$] are linked. However, do not connect the [VOUT] and [IOUT] terminals when the current output is used. *$_1$ terminal number 1 or 2 is identified here.
- If any voltage ripple is experienced on the voltage inputs/outputs or if there is excessive electrical noise, connect a capacitor of 0.1 - 0.47µF, approx. 25V rating at position *2.

3 INSTALLATION NOTES AND USAGE

3.1 General specification

Item	Specification
General specifications (excluding withstand voltage)	Same as those for the FX0N base unit
Withstand voltage	500V AC for 1 minute (between grounding terminal and all the other terminals)

3.2 Power supply specification

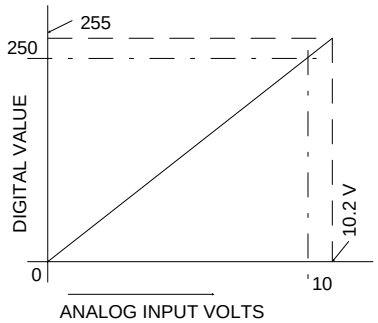
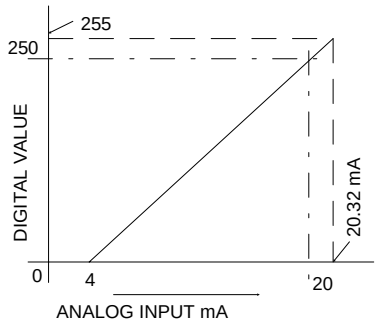
Item	Specification
Analog circuits	24V DC +/- 10%, 90mA (internal power supply from base unit)
Digital circuits	5V DC, 30mA (internal power supply from base unit)

3.3 Performance specifications

Analog inputs

	Voltage input	Current input
Analog input range	At shipment, the 0-250 range is selected for the 0-10V DC input. Readjustment for either 0-5V DC input or 4-20mA input will be required.	
	DC 0-10V, 0-5V, input resistance 200kΩ. Warning: this unit may be damaged by input voltages in excess of -0.5, +15V.	4-20mA, input resistance 250Ω. Warning: this unit may be damaged by input currents in excess of -2mA, +60mA
Digital resolution	8 bits	
Smallest input signal resolution	0-10V input: **40mV** (10V/250steps) 0-5V input: **20mV**(5V/250steps)	4-20mA input: **64μA** ((20-4mA)/250)
Overall accuracy	+/- 1%(full scale)	
Processing time	(TO command processing time × 2) + FROM command processing time	
A/D conversion time	100 μs	

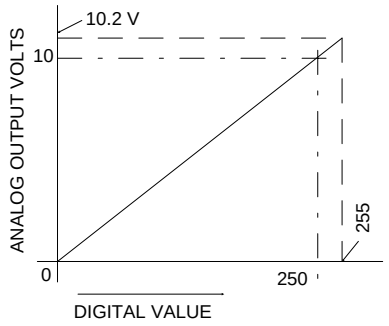
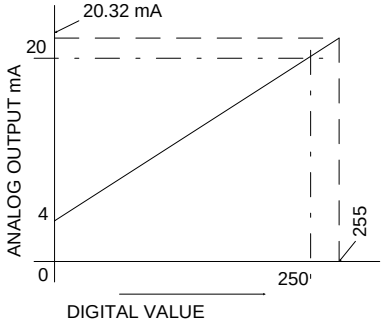
Analog inputs continued.....

Input characteristics		
	Note: The input characteristics are not affected by the number of input channels used	

Analog outputs

	Voltage output	Current output
Analog output range	At shipment, the 0-250 range is selected for the 0-10V DC input. Readjustment for either 0-5V DC input or 4-20mA input will be required.	
	DC 0-10V, 0-5V, external load: 1kΩ to 1MΩ	4-20mA, external load: 500Ω or less
Digital resolution	8 bits	
Smallest output signal resolution	0-10V input: **40mV** (10V/250steps) 0-5V input: **20mV**(5V/250steps)	4-20mA input: **64μA** ((20-4mA)/250)
Overall accuracy	+/- 1%(full scale)	
Processing time	(TO command processing time × 3)	

This table is continued at the top of the next column.....

Output characteristics		
	Note: If digital source data of greater than 8 bits is used only the lower 8 bit will be valid, and all additional (upper) bits will be ignored.	

Miscellaneous

Item	Specification
Isolation	Photo-coupler isolation between analog and digital circuits. DC/DC converter isolation of power from FX0N base unit. No isolation between analog channels
Number of occupied I/O points	8 points taken from the FX0N expansion bus (can be either inputs or outputs)

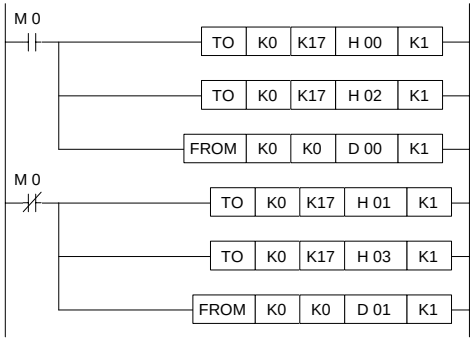
3.4 Allocation of buffer memories (BFM)

BFM No.	b15-b8	b7	b6	b5	b4	b3	b2	b1	b0
# 0	Reserved	Current value of input data (stored in 8 bits) of the A/D channel selected by b0 of BFM#17							
# 16		Current value of output data on D/A channel (stored in 8 bits)							
# 17	Reserved						D/A start	A/D start	A/D channel
# 1- # 15 #18-# 31	Reserved								

- BFM #17:
  b0 = 0 analog input channel 1 is selected
  b0 = 1 analog input channel 2 is selected
  b1 = 0 ⇨ 1, the A/D conversion process is started
  b2 = 1 ⇨ 0, the D/A conversion process is started
- Note: These buffer memory devices are stored/located within the FX0N-3A.

3.5 Using analog input

The buffer memories (BFM#) of the FX0N-3A are written to, or read from by the FX0N PC. The following program reads the analog input from channel 1 of the FX0N-3A when M0 is ON, and the analog input data of channel 2 when M0 is OFF.



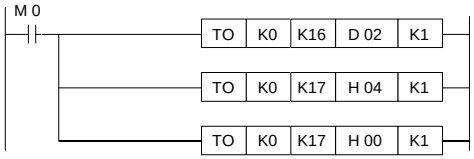
(H00) is written to BFM #17 selecting A/D input channel 1.
(H02) is written to BFM #17 starting the A/D conversion process for channel 1. BFM #0 is read, storing the current value of channel 1 in register D00.

(H01) is written to BFM #17 now selecting A/D input channel 2.
(H03) is written to BFM #17 to re-start the A/D conversion process but for channel 2. BFM #0 is read, storing the current value of channel 2 in register D01.

The time T*AD* required to read an analog input channel is calculated as follows:
T*AD* = (TO command processing time) X2 + (FROM command processing time)
Note: The 3 (TO/FROM) command format shown above should always be used when reading data from the FX0N-3A's analog input channels.

3.6 Using analog output

The buffer memories (BFM#) of the FX0N-3A are written to, or read from by the FX0N PC. In this case when M0 is turned ON, the following program executes the D/A conversion and outputs an analog signal equivalent to the selected digital value stored, in this example, in register D02.



The contents of D2 are written to BFM #16. This will be converted to an analog output.

(H04) is written to BFM #17 to start the D/A conversion process.

The time T*DA* required to write for analog output can be calculated with the following formula.

T*DA* = (TO command processing time) ×3

Note: The 3 (TO) command format shown above should always be used when writing data to the FX0N-3A's analog output channel.

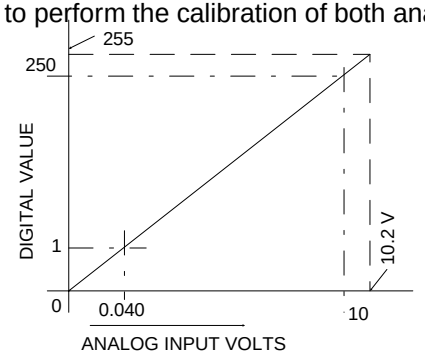
Details on both the FROM and TO (functions 78 and 79 respectively) instructions can be found in the "Programming Manual".

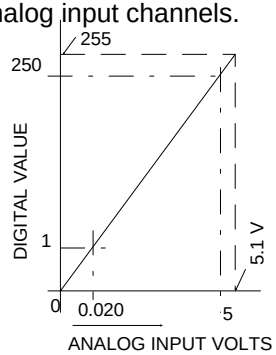
4 SELECTION AND CALIBRATION OF ANALOG INPUTS

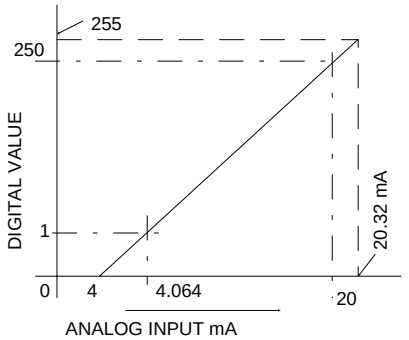
There are three different input formats which can be used with the FX0N-3A. These are:

- Voltage input, 0 to 10V format (These characteristics are set for shipment)
- Voltage input, 0 to 5V format
- Current input, 4 to 20mA format

Note: Both analog input channels share the same 'setup' and configuration. Hence, only one channel needs to be selected to perform the calibration of both analog input channels.

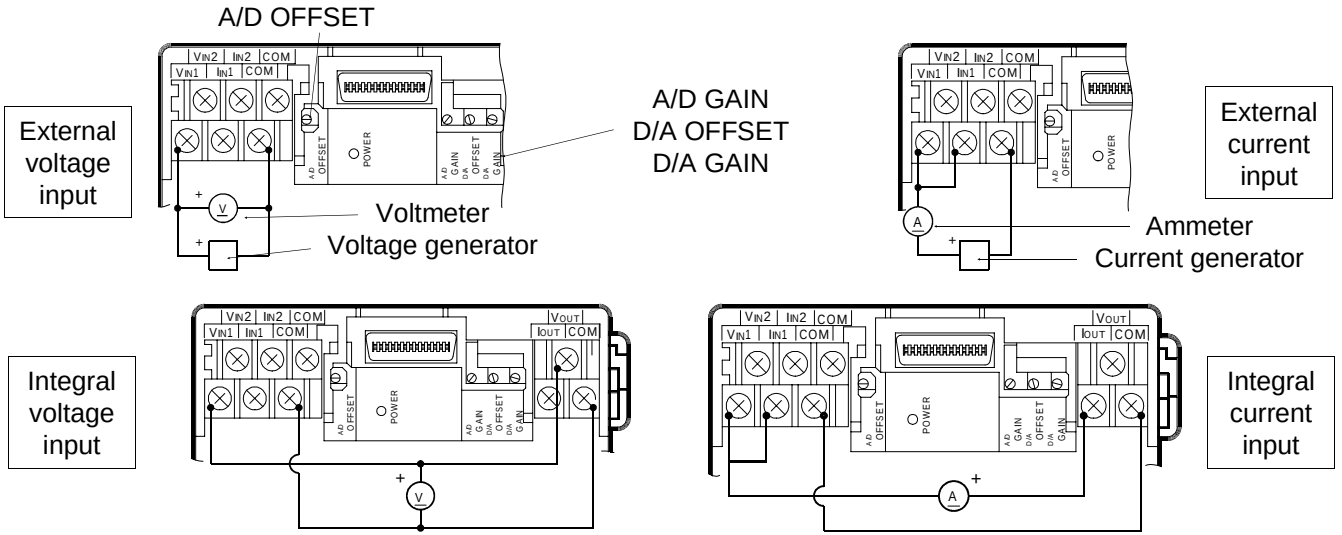




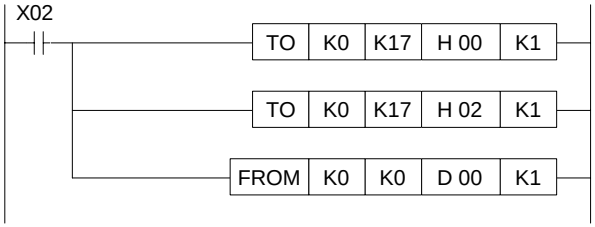


4.1 Method of calibration

Use the following program and the appropriate wiring configuration to calibrate input channel 1 (and indirectly channel 2) of the FX0N-3A.



Input calibration program



Calibrating the offset

1) Run the previously detailed program. Ensure X02 is ON.

2) Generate an offset voltage/current (in accordance with the analog operation range to be selected, see table below) using the selected generator or analog output.

3) Adjust the A/D OFFSET potentiometer ("pot") until a digital value of 1 is read in the data register D00. Note: turn the ’pot’ clockwise and the digital value will increase. The ’pot’ requires 18 revolutions to move between the minimum and maximum settings.

Analog input range	0 - 10 V DC	0 - 5 V DC	4 - 20 mA
Offset calibration value	0.040 V	0.020 V	4.064 mA

Calibrating the gain

1) Run the previously detailed program. Ensure X02 is ON.

2) Generate a gain voltage/current (in accordance with the analog operation range to be selected, see table below) using the selected generator or analog output.

3) Adjust the A/D GAIN potentiometer ("pot") until a digital value of 250 is read in the data register D00.

Note 1: turn the ’pot’ clockwise and the digital value will increase. The ’pot’ requires 18 revolutions to move between the minimum and maximum settings.

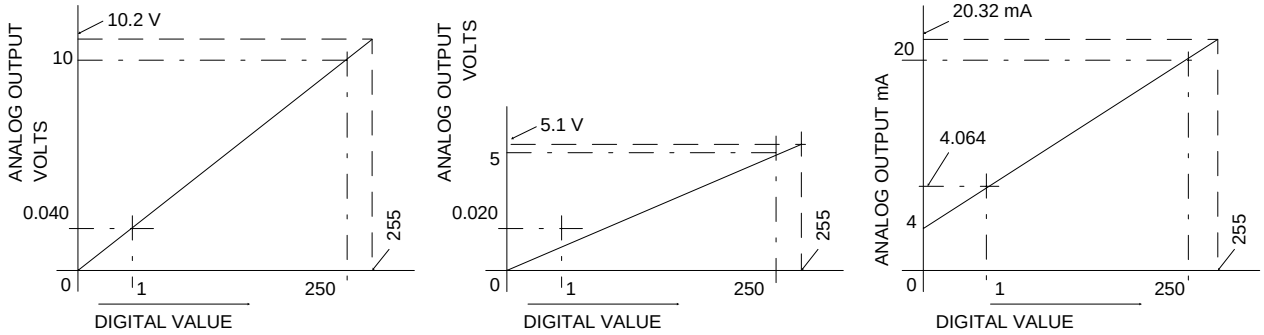
Note 2: When necessary, to maximise the 8 bit resolution, the digital value used in the gain adjustment (detailed above) should be replaced with 255. This section has been written to demonstrate a 250 full-scale.

Analog input range	0 - 10 V DC	0 - 5 V DC	4 - 20 mA
Gain calibration value	10.000 V	5.000 V	20.000 mA

5 SELECTION AND CALIBRATION OF ANALOG OUTPUTS

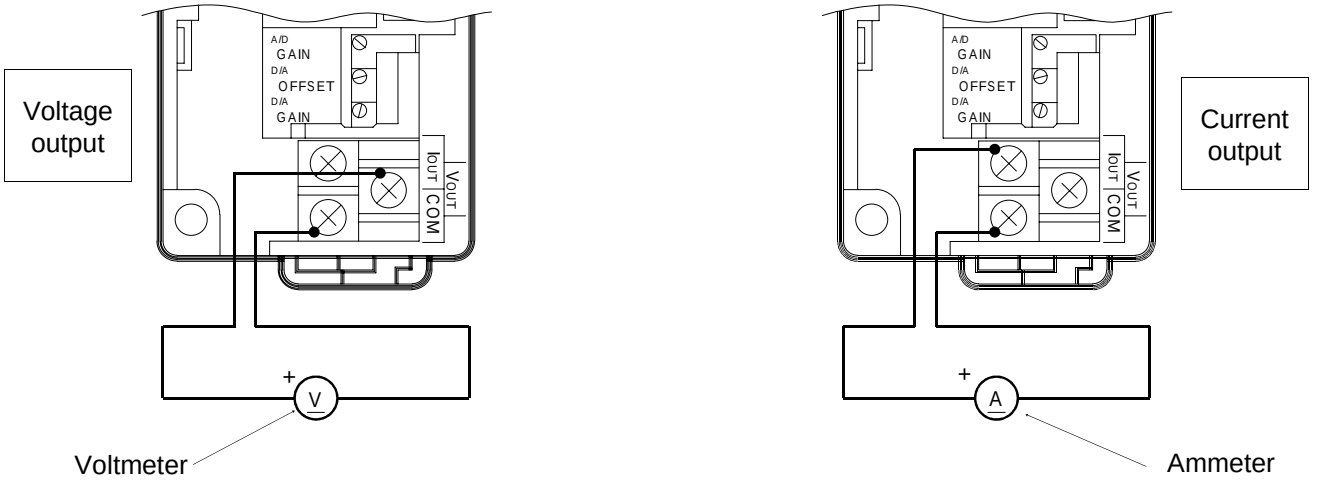
There are three different output formats which can be used with the FX0N-3A. These are:

- Voltage output, 0 to 10V format (These characteristics are set for shipment)
- Voltage output, 0 to 5V format
- Current output, 4 to 20mA format

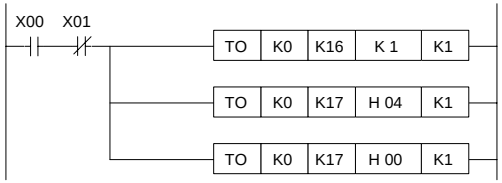


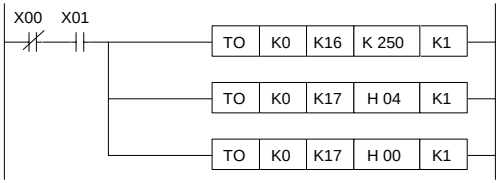
5.1 Method of calibration

Use the following program and the appropriate wiring configuration to calibrate the analog output channel of the FX0N-3A.



Output calibration program





Calibrating the offset

1) Run the previously detailed program. Ensure X00 is ON and X01 is OFF.

2) Adjust the D/A OFFSET potentiometer ("pot") until the selected meter displays the appropriate offset voltage/current (in accordance with the analog operation range selected, see table below). Note: turn the ’pot’ clockwise and the analog outputs signal will increase. The ’pot’ requires 18 revolutions to move between the minimum and maximum settings.

Analog output range	0 - 10 V DC	0 - 5 V DC	4 - 20 mA
Offset calibration: meter value	0.040 V	0.020 V	4.064 mA

Calibrating the gain

1) Run the previously detailed program. Ensure X00 is OFF and X01 is ON.

2) Adjust the D/A GAIN potentiometer ("pot") until the selected meter displays the appropriate gain voltage/current (in accordance with the analog operation range selected, see table below).

Note 1: turn the ’pot’ clockwise and the analog outputs signal will increase. The ’pot’ requires 18 revolutions to move between the minimum and maximum settings.

Note 2: When necessary, to maximise the 8 bit resolution, the digital value used in the gain adjustment (detailed above) should be replaced with 255. This section has been written to demonstrate a 250 full-scale.

Analog output range	0 - 10 V DC	0 - 5 V DC	4 - 20 mA
Gain calibration: meter value	10.000 V	5.000 V	20.000 mA

6 DIAGNOSTICS

6.1 Preliminary checks

6.1I Check whether the input/output wiring and/or expansion cables are properly connected on FX0N-3A analog special function block.

6.1II Check that the FX0N system configuration rules have not been broken, i.e. the number of local expansion blocks does not exceed 2 and the total system I/O is equal or less than 128 I/O.

6.1III Ensure that the correct operating range (0-10V, 0-5V or 4-20mA) has been selected for the application.

6.1IV As the status of the PC changes (RUN ⇨ STOP, STOP ⇨ RUN, etc), the analog output status will operate in the following manner.
Status change of the FX0N PC:
RUN ⇨ STOP: The last operational value used by the analog output channel during RUN operation is maintained during STOP mode.
STOP ⇨ RUN: Once the FX0N PC is switched back into RUN mode the analog output reacts as normal to the program controlled, digital values.
FX0N power shutdown: The analog output signal ceases operation.

6.1V Remember that only 8 bit digital values (0-255) are valid for use with the analog output of the FX0N-3A.

6.2 Error checking

If the FX0N-3A special function block does not seem to operate normally, check the following items.

- Check the status of POWER LED.
  Lit. : The extension cable is properly connected.
  Otherwise: Check the connection of the extension cable.
- Check the external wiring.
- Check whether the output load connected to the analog output terminal is within the following specified limits.
  Voltage output: 1kΩ to 1MΩ , Current output: 500Ω or less
- Check whether the impedance of the input device is within the specified limits.
  Voltage input: 200kΩ, Current input: 250Ω.
- Check the calibration of the FX0N-3A's analog channels (input and output) using a voltmeter/ammeter as required. See previous two sections for a detailed explanation.

Guidelines for the safety of the user and protection of the FX0N-3A 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 FX0N-3A 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 FX0N-3A 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.

Manual number : JY992D49001
Manual revision : B
Date : April 1997

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