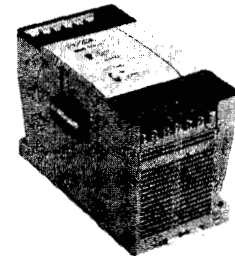


MITSUBISHI
PROGRAMMABLE CONTROLLERS
MELSEC-F

FX

FX-2DA

USER'S MANUAL



from the CPU unit, from the base or extension unit.

panel switches or by software settings by the TO instruction of the base unit.

Foreword

- This manual provides technical information on the use of the FX-2DA Analog Output Block in connection with the FX programmable controller.
- Users should ensure that the details of this manual are studied and understood before attempting to install or use these units.

CONTENTS	1. INTRODUCTION	1
	2. OUTLINE SPECIFICATION	2
	3. WIRING	4
	4. ASSIGNMENT OF BUFFER MEMORY (BFM)	6
	5. STATUS INFORMATION	9
	6. EXAMPLE PROGRAMS	10
	7. GAIN AND OFFSET ADJUSTMENT	13
	8. FROM/TO COMMANDS	16
	9. REFERENCE	17
	10. APPENDIX	18

1. INTRODUCTION

The FX-2DA analog output unit receives up to 2 channels of 12-bit digital data stored in 16-bit words from an FX series programmable controller and converts it into 2 channels of analog output (either voltage or current). Optical coupling is used to ensure that voltage surges do not damage other parts of your equipment.

(1) Compatible Programmable Controllers

The FROM-TO command is used for transferring data to/from the programmable controller, so versions 2.0 or subsequent versions of the FX series programmable controllers (those with serial no. 13XXXX or larger) are required.

(2) Configuration Specifications

The FX-2DA occupies 8 I/O points but does not affect the addressing of normal input and output relays. It is important only when maximum I/O is considered. The FX-2DA draws 30mA from the 5V rail from the base or extension unit.

(3) Analog Output Range

The preset ranges -10V to +10V and +4mA to +20mA can be selected individually for each channel. Current or voltage selection is made by buffer memory assignment and terminal wiring.

(4) Gain and Offset

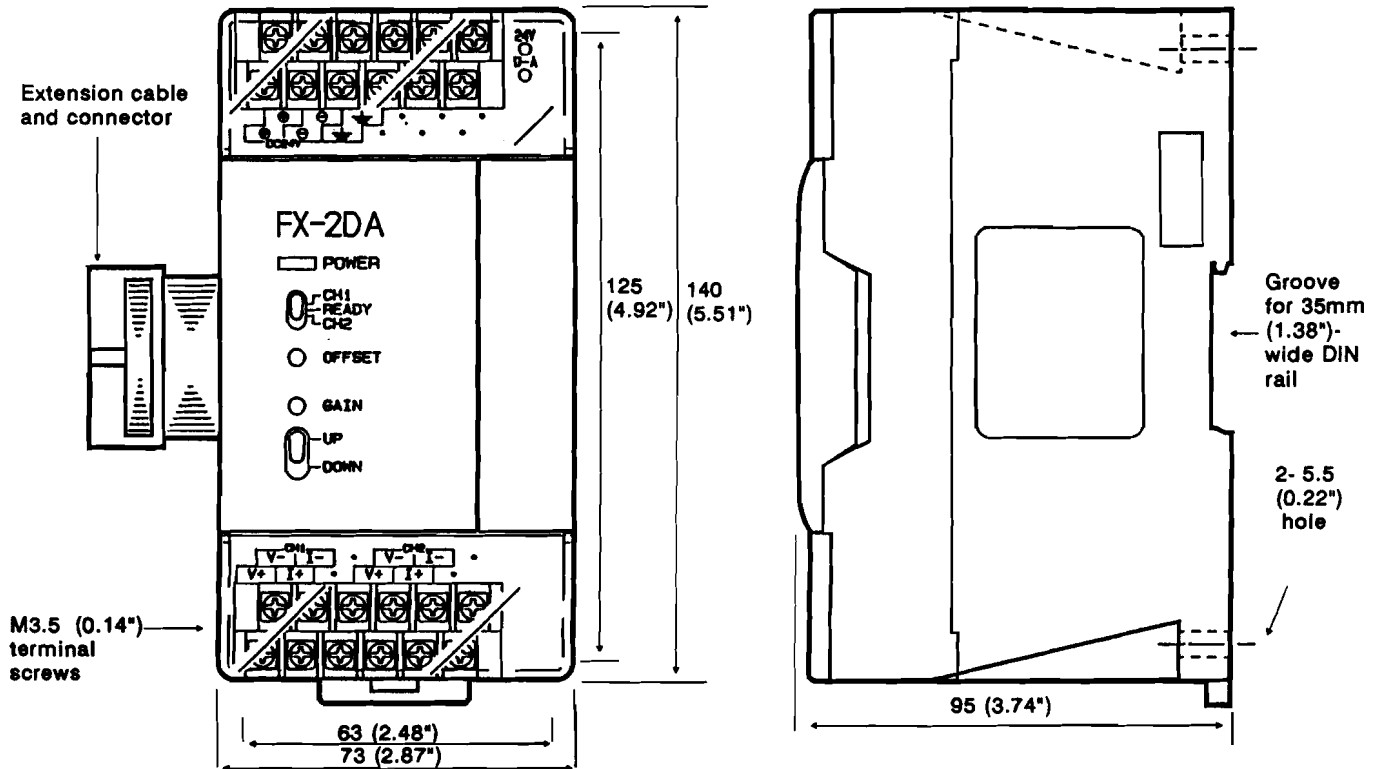
Gain and offset can be adjusted by the user to give the desired output range. The desired range must be within the convertible maximum of the unit.

Adjustment can be made by the front panel switches or by software settings by the TO instruction of the base unit.

2. OUTLINE SPECIFICATION

(1) Dimension mm (inch)

- Weight: Approx. 0.5 kg (1.1 lbs.)
- Accessories: Self-adhesive labels for special block number identification



2. OUTLINE SPECIFICATION

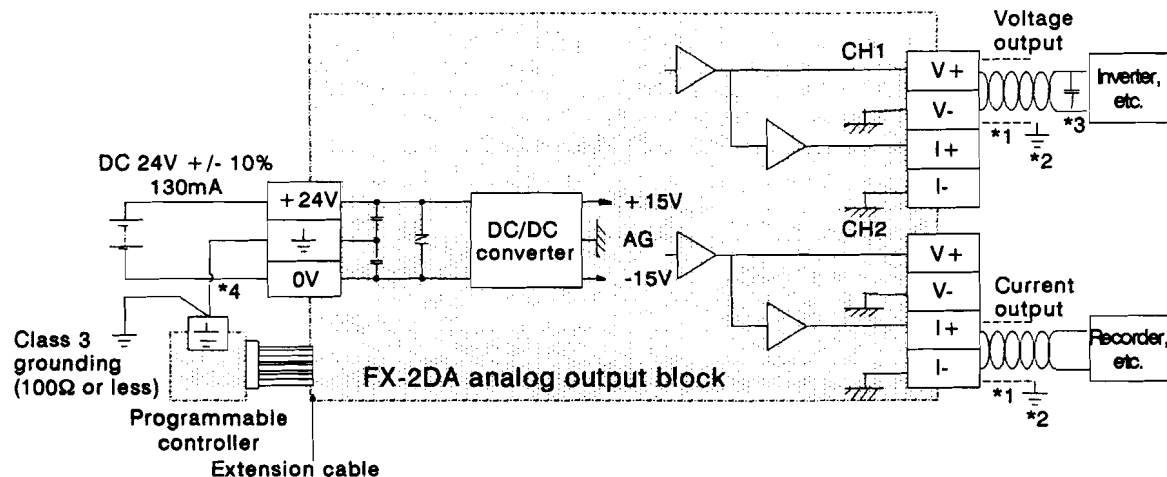
(2) Performance Specifications

The environmental specifications for the FX-2DA are the same as those for your base unit.

Item	Voltage output	Current output
	Voltage or current outputs can be individually selected with each output terminal. There are a total of 2 output points.	
Max. convertible output range	DC -10V to +10V (external load: 1k Ω to 1M Ω)	DC +4mA to +20mA (external load: 500 Ω or less)
Digital input	Voltage = -2048 to +2047	Current = 0 to +1000
Resolution	5mV (10V full scale 1/2000)	20 μ A (20mA full scale 1/1000)
Overall accuracy	+/-1% full scale (10V range)	+/-1% full scale (20mA range)
Conversion speed	18ms for 2 channels	
Isolation	Photo-coupler isolation between analog and digital circuits. DC/DC converter isolation of power from base unit. (No isolation between outputs)	
Power consumption	DC 24V +/-10% 130mA	
I/O Specifications	8 I/O points are occupied in the software (i.e. the base unit image table). They may be regarded as either inputs or outputs. Power consumption from base unit is 5V 30mA.	
Factory Presets Load: = 10k Ω (voltage Output) = 250 Ω (current output)	<p>Mode 0</p>	<p>Mode 1</p>

Gain and offset can be adjusted using the procedure described on pages 13 to 15.

3. WIRING



*1 Use a twisted pair shielded cable for the analog output. This cable should be wired away from power lines or any other lines which could induce noise.

*2 Apply 1-point grounding at the load side of the output cable (class 3 grounding: 100Ω or less). If electrical noise is caused from grounding, disconnect from ground.

*3 If electrical noise or a voltage ripple exists at the output, connect a smoothing capacitor of 0.1 to 0.47μF, 25V.

*4 Connect the ground terminal on the FX-2DA with the ground terminal on the base unit of the programmable controller. Use class 3 grounding on the base unit, if available.

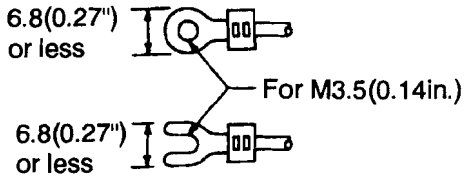
Caution:

(a) The same output channel cannot drive current and voltage output loads at the same time!

(b) Shorting the voltage output terminals may damage the unit!

3. WIRING

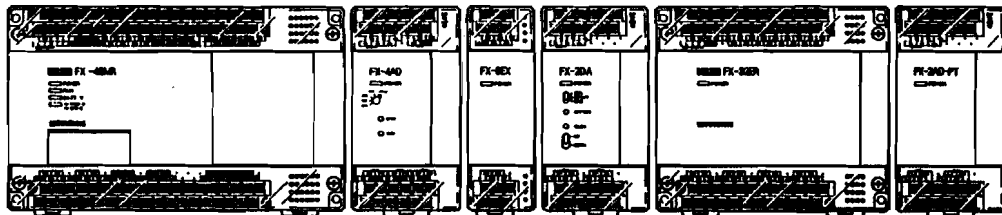
(1) Using crimp terminations



- * Use only crimp terminations of the type indicated in the figure at left.
- * Secure the termination using a tightening torque of between 5 and 8kg·cm.
- * Only use the terminations indicated at left.

(2) Use with other special blocks

The FROM and TO commands are also used by other Special Function Blocks, (e.g. the analog input blocks, high-speed counter blocks, pulse output blocks, etc.). These may be connected directly to the FX Programmable Controller's extension port or to any other extension unit's right side extension port. Each special unit or 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 to one base unit.



FX-48MR
X0-X27
Y0-Y27

FX-4AD
Special
block
No.0

FX-8EX
X30-
X37

FX-2DA
Special
block
No.1

FX-32ER
X40-X57
Y30-Y47

FX-2AD-PT
Special block
No.2

4. ASSIGNMENT OF BUFFER MEMORY (BFM)

(1) ASSIGNMENT OF BUFFER MEMORY (BFM)

Data transfer between the FX-2DA analog output unit and the programmable controller is through the FX-2DA's RAM buffer memory (32 addresses each of 16 bits).

BFM NO.	Contents
* #0	Analog output mode (current/voltage) default = (H00)
* #1	Output data CH1
* #2	Output data CH2
#3	Reserved
#4	Reserved
* #5	last data reset default = H00
* #6 to #19	Reserved

In BFM's (buffer memory) with an "*", data can be written from programmable controller using the TO command.

These BFM's should always be given when the programmable controller goes from STOP to RUN. Buffer memory (BFMs) are reset to their default settings upon power on.

1. Switching between voltage and current output modes. The value of BFM #0 switches the analog output between voltage and current on channels CH1 and CH2. It takes the form of a 2-character HEX number. The least significant character controls CH1 and the other controls CH2.

Control of each O HEX character of HOO:

O = 0 : Voltage output (-10V to + 10V)

O = 1 : Current output (+ 4mA to + 20mA)

Example : H10

CH1 : Voltage output, CH2: Current output

2. Output data:

BFM #1 : CH1 data (default = 0)

BFM #2 : CH2 data (default = 0)

3. If the programmable controller is changed to the STOP state, the FX-2DA will continue to output the last value. To reset the output to the offset value, set the HEX characters of BFM #5 to one of the appropriate settings below:

H01 : CH2 = Hold, CH1 = Reset

H10 : CH2 = Reset, CH1 = Hold

H11 : CH2 = Reset, CH1 = Reset

Both channels are held when

BFM #5 = HOO.

4. ASSIGNMENT OF BUFFER MEMORY (BFM)

The buffer memory also handles information used to adjust the gain and offsets of the FX-2DA unit. Status of the unit such as errors are also available.

BFM No.		b3	b2	b1	b0
* #20	Reset all to default default value: 0				
* #21	Gain/offset adjust prohibit Initial value (0,1)			Prohibit	Permit
* #22	Offset/gain setting command	G2	O2	G1	O1
* #23	Offset data (in mV or μ A units) default value: 0				
* #24	Gain data (in mV or μ A units) default value: 5,000				
#25- 28	Reserved				
#29	Error status (See next page)				
#30	Identification code K3010 (See next page)				
#31	Reserved				

- In "*" marked BFM's, data can be written from the programmable controller via the TO command. From BFM #29 and #30, data can be read via the FROM command.
- Offset value: the actual output value when the digital input is 0.
- Gain value: the actual output value when the digital input is + 1000.

4. ASSIGNMENT OF BUFFER MEMORY (BFM)

1. When BFM #20 is set to K1, all settings in the buffer memory are reset to their default settings. This allows the buffer memory settings to be set from the beginning again when many settings have been corrupted.
2. If (b1,b0) of BFM #21 is set to (1,0), gain and offset adjustments are prohibited. This is to prevent inadvertent misuse by the operator. To adjust the gain and offset, (b1,b0) of BFM #21 must have the values (0,1). The default is set at (0,1).
3. Each time a TO instruction is used to send data to BFM #22 (gain/offset setting command), the designated gain and offsets of each channel (G2O2 G1O1) are adjusted with the values in BFM #23 and #24. This action causes the adjustments to be written to internal non-volatile EEPROM memory. Limit this action to as little as possible to preserve the life of the EEPROM memory.
4. Gain and offset values in BFM #23 and #24 are set in units of mV or μA .
Due to the resolution of the unit, the actual response will be in steps of 5mV or 20 μA .

Caution

Because of the time taken to write to the EEPROM memory, a delay of 300ms is needed between instructions that cause a write to the EEPROM.

Therefore, a delay timer should be used before further writes to the EEPROM, after executing the following:

Writing to BFM #0, #5 or #21.

The gain/offset command with BFM #22.

The default command with BFM #20.

5. STATUS INFORMATION

(1) Status information BFM #29

Bit	ON	OFF
b0: error	When any of b1 to b4 is ON D/A conversion is stopped for the error channel	No error
b1: Offset/Gain error	Offset/Gain data in EEPROM is corrupted or adjustment error	Offset/Gain data normal
b2: Power abnormality	DC 24V power supply failure	Power supply normal
b3: Hardware error	D/A converter or other hardware failure	Hardware normal
b4: Program error	Incorrect installation or FROM/TO command misused (BFM data error)	No error
b8: Not READY	FX-2DA MODE switch is not set to READY.	READY mode
b10: Range error	Digital input value or analog output is outside the specified range	Analog output value is normal
b12: Offset/Gain adjust prohibit	Prohibit - (b1,b0) of BFM#21 is set at (1,0)	Permit - (b1,b0) of BFM#21 is set at (0,1)

Bits b5 to b7, b9, b11, and b13 are undefined.

(2) Model code number BFM #30

The Identification code for a Special Block is read using the FROM command.

The Identification code for the FX-2AD unit is K3010.

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

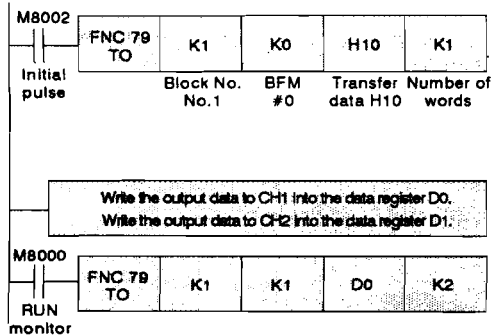
Caution

Values of BFM #0, #5, #23 and #24 are copied to EEPROM memory of the FX-2DA. BFM #21 and #22 are only copied when data is sent to gain/offset command BFM #22. BFM #20 also writes to the EEPROM memory. The EEPROM has a life of about 10,000 cycles (changes), so please do not use programs which frequently change these BFM's.

6. EXAMPLE PROGRAMS

Example #1

If the gain and offset settings are left at their default values, and the status information is ignored, you can use the simple program which follows.



Voltage output on both CH1 and CH2

Range: -2048 to +2047

(D0) BFM #1 (Output to CH1)
(D1) BFM #2 (Output to CH2)

Procedure

1. Write the program into the programmable controller.
2. Connect the FX-2DA unit to the base unit of the programmable controller as the 2nd special block.
3. Set the MODE switch on the FX-2DA panel to READY.
4. Turn on the programmable controller and the FX-2DA unit.

Result :

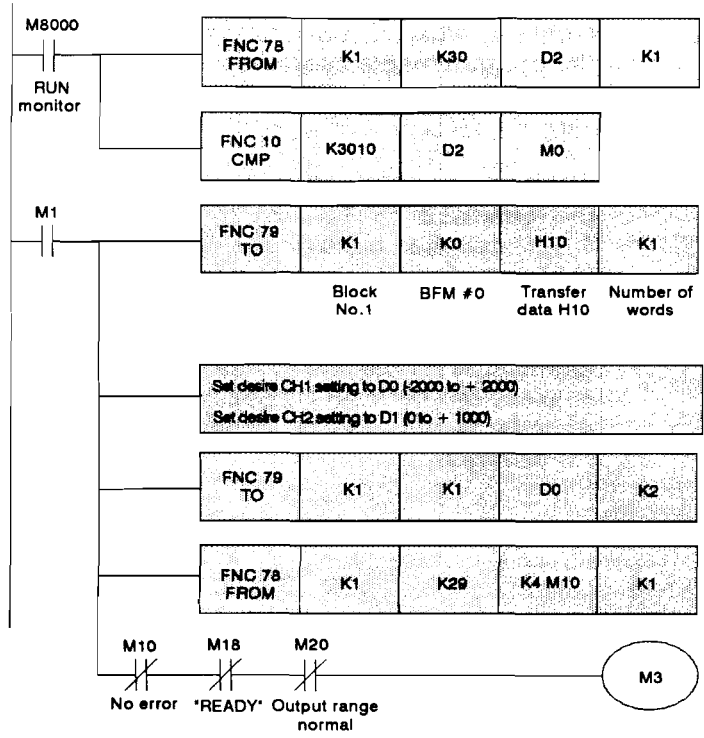
When the programmable controller is in RUN mode, the voltage output on channels CH1 and CH2 will vary according to the digital values in data registers D0 and D1. When the programmable controller is in STOP mode the last output made during RUN mode will be maintained.

In the above program the FX-2DA unit occupies the position of special block No.1 (that is the 2nd closest special block to the base unit). Voltage output from -10V to +10V is produced from channel CH1 and +4mA to +20mA from CH2.

6. EXAMPLE PROGRAMS

Example #2

In the following example, channel CH1 is set to voltage output, while CH2 is set to current output. The FX-2DA unit is connected at the position of special block No.1. If the programmable controller is changed to the STOP mode, the last data sent will remain and the outputs will hold.



Block No.1, BFM #30 (Identification code) Transfer to D2.

When Identification code is K3010 (FX-2DA), M1 becomes ON.

H10→unit No. 1 BFM #0
CH1: voltage output, CH2: current output

(D0)→BFM #1 (output to CH1)
(D1)→BFM #2 (output to CH2)

BFM #29 (b15 to b0)→(M25 to M10)
Reads the status information.

Output data normal

6. EXAMPLE PROGRAMS

(1) Operation

- 1) Check if the output wiring, power wiring, and extended cable for the FX-2DA are properly connected.
- 2) 5V, 30mA is supplied from the base and extension units for the FX-2DA. Check that power overload is not caused by this or any other special block.
- 3) When DC 24V power is supplied from the base and extension units of the programmable controller, check that the current is below the allowable service current on the programmable controller side (varies according to the number of extension blocks connected).
- 4) Set the MODE switch on the FX-2DA to the "READY" position, and turn the DC 24V power on.
- 5) Turn the programmable controller and RUN input ON. However, output mode of BFM #0 should be set in advance depending on voltage/current output.

(2) Abnormality check

The following can be checked with LEDs located on the main panel of the FX-2DA.

POWER LED

Lights up when 5V power is supplied from the programmable controller. If not, check if the extension cable is properly connected.

24V LED

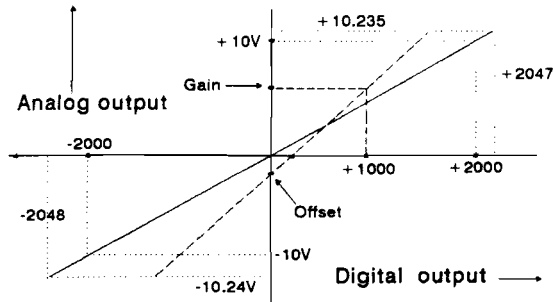
Lights up when DC 24V power is supplied to the terminal of the FX-2DA. If DC 24V $\pm 10\%$ is supplied but this does not light up, failure may have occurred on the base unit.

D-A LED

Lights up when Digital to Analog conversion is executing normally. It goes off if b1 to b4 of buffer memory #29 is generated ON for all the channels.

7. GAIN AND OFFSET ADJUSTMENT

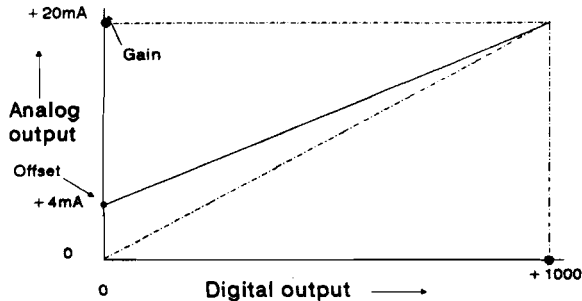
(1) Standard characteristics of voltage output



The solid lines show the I/O characteristics when the gain and offsets are left at their default settings. The dashed lines show examples of adjustments to the gain and offsets. Voltage or current output selection is set through the output wiring, and by a command from the programmable controller.

Gain and offset settings will remain even after power OFF.

(2) Standard characteristics of current output



- Offset value: the analog output when the digital input is 0.
- Gain value: the analog output when digital input is +1000.

When the gain value is small (implying a steep slope), a small change in analog input will produce a large change in digital output.

When the gain value is large (implying a gentle slope), a large change in analog input will only produce a small change in digital output.

7. GAIN AND OFFSET ADJUSTMENT

(3) Gain and Offset Adjustment Using Switches on the FX-2DA Unit

The gain and offsets can be adjusted by using the switches on the FX-2DA panel with the aid of a voltmeter and an ammeter which are to be connected to the FX-2DA. With these procedures you still need to set the input mode BFM #0.

After (b1, b0) of BFM #21 is changed to (1,0), you can no longer change the gain/offsets. You should therefore write (0,1) to (b1,b0) of BFM #21 prior to adjusting the gain/offset settings. (Note: (0,1) is the default value)

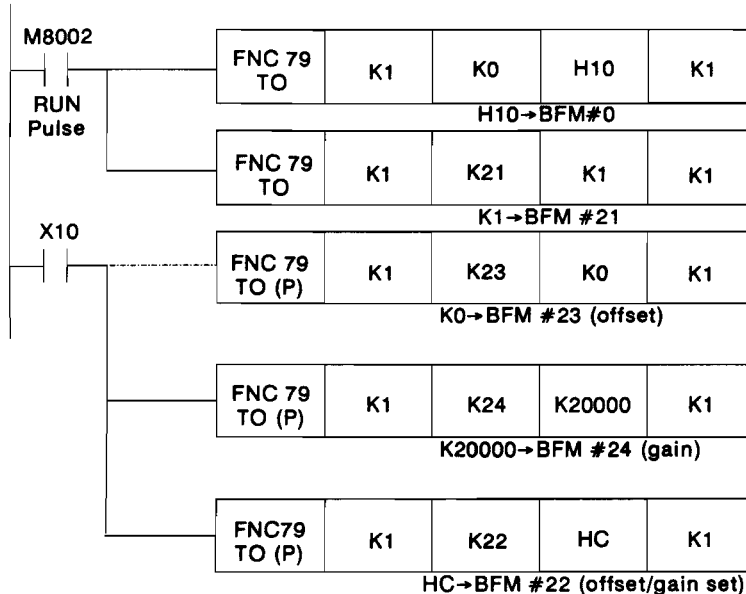
- 1 Turn on DC 24V power of the FX-2DA. The 24V LED lights up.
- 2 Turn on the FX series programmable controller connected with the FX-2DA. The POWER LED lights up. (The programmable controller should be in STOP mode.)
- 3 Connect the load and voltmeter or ammeter to the CH1 terminal. (between V+ and V- terminals for voltage output, and between I+ and I- terminals for current output)
- 4 Set the MODE switch to CH1.
- 5 Press the OFFSET button once with a ball point pen. The D-A LED lights up. The present offset value (voltage or current) is output.
- 6 Use the UP/DOWN switch to reach the desired OFFSET value. (range: -5V to +5V or -20mA to +20mA)
- 7 Press the GAIN button once with a ball point pen. The offset value is read and the GAIN value is output.
- 8 Use the UP/DOWN switch to reach the desired GAIN value.
range: Gain value - offset value
 = 1V to 15V (voltage output)
 = 4mA to 32mA (current output)
- 9 Set the MODE switch to the READY position. The gain value is read, the D-A LED goes off, and the offset value is output.
- 10 Repeat steps 3 to 9 for CH2 (if desired), then set the MODE switch to READY. Adjustment is completed.

7. GAIN AND OFFSET ADJUSTMENT

(4) ADJUSTMENT BY PROGRAMMABLE CONTROLLER

I/O characteristics of the FX-2DA can be adjusted by changing the gain and offset parameters. These can be changed by the switches of the FX-2DA with the aid of Voltage & Current meters or simply changed by writing these settings from the programmable controller.

The following is an example, changing the offset value to 0mA and gain value to 20mA on output channel CH2 of the FX-2DA connected as block No.1.



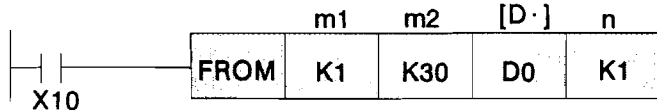
- In the program shown at left, the programmable controller should be in RUN status, and MODE switch of the FX-2DA in the READY position.
- BFM #0 should be of HEX value H10, and (b1,b0) of BFM #21 should be (0,1).

← This statement may be omitted if BFM #23 is already at its default value.

8. FROM/TO COMMANDS

(4) FROM/TO Commands Explained

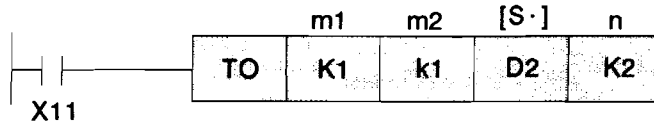
	FNC 78	
D	FROM	P



BFM #30 in special block No.0 is transferred to D0.

- m1: Special unit or block No. (K0 to K7 starting from the one closest to the base unit)
- m2: Head address of buffer memory (n2 = K0 to K31)
- [D·]: Head address of the transfer destination. T, C, D, KnM, KnY, KnS, V and Z can be specified and element No. can be coupled with an index.
- n: Number of transfer points (K1 to K32 but K1 to K16 for DFROM, DFROMP.)

	FNC 79	
D	TO	P

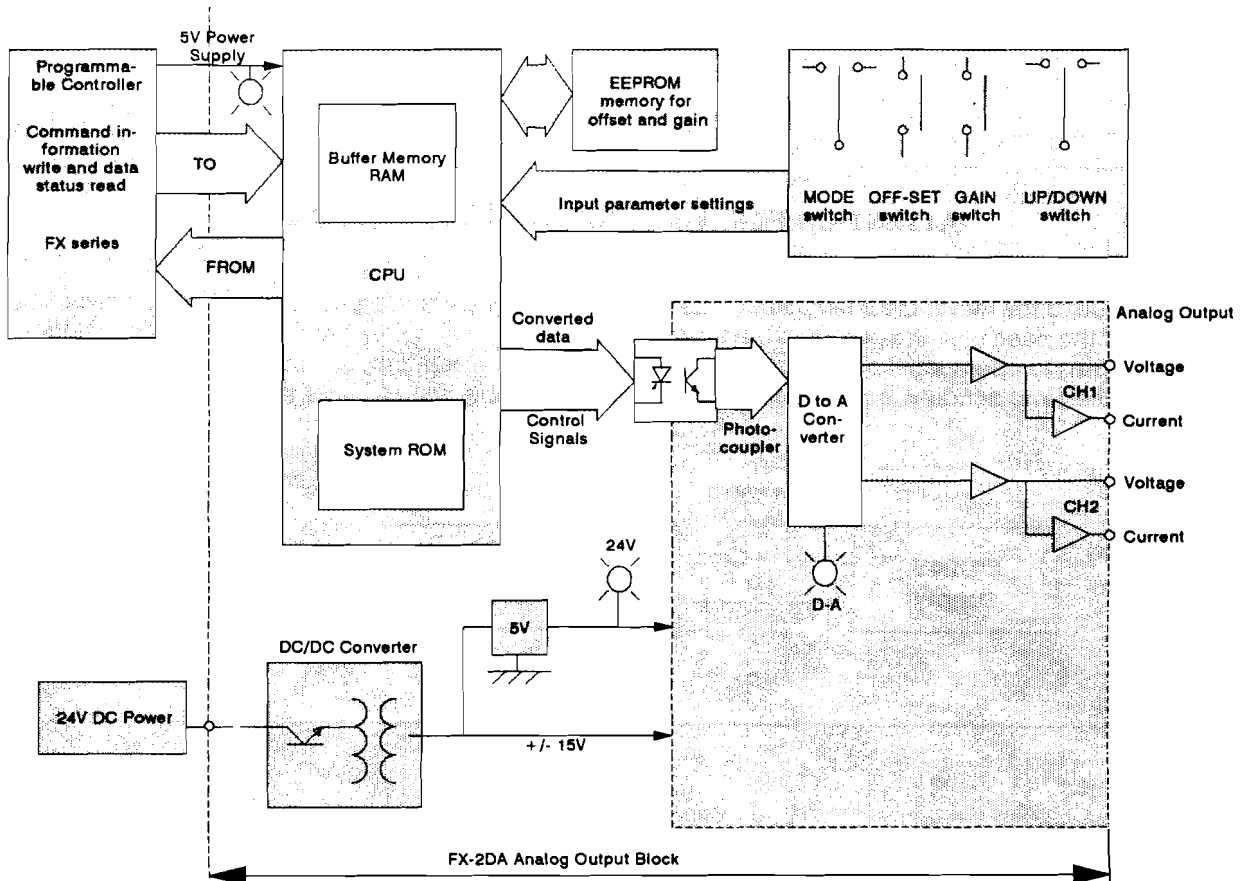


D3, D2 are transferred to special block No.1 BFM #2, #1.

- m1 ,m2 ,n: The same as above
- [S·]: Head device no. of source. T, C, D, KnX, KnM, KnY, YnS, V, Z, K, and H can be specified, and element No. can be coupled with an index.

- When X10 or X11 is OFF, transfer is not executed, and data at the transfer destination is not changed.

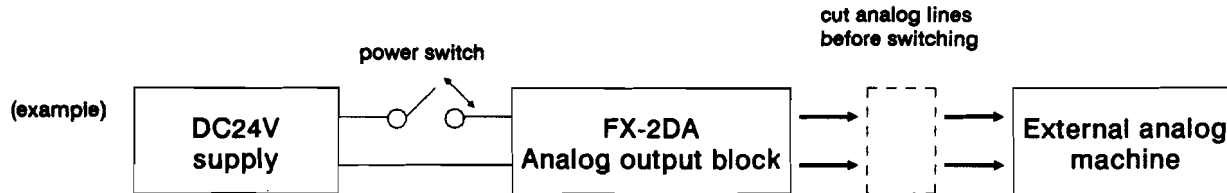
9. REFERENCE



10. APPENDIX

ATTENTION FOR WHEN SWITCHING SYSTEM ON/OFF

Due to the inevitable timing difference of the DC24v for the analog circuits and other power lines of the base unit, the output of the analog output block may behave erroneously before settling down to operational conditions in approximately 1sec. Therefore, ensure that this behavior is taken into account such that the end performance of the system is not degraded.



MEMO

Revisions

EDITION DATE	MANUAL NUMBER	REVISION
Jun. 1991	JY992D28301A	First edition
Aug. 1991	JY992D28301B	P.18 "ATTENTION FOR WHEN SWITCHING SYSTEM ON / OFF" added.
Nov. 1992	JY992D28301C	Diagram corrections : Page 4 Text corrections : Pages 6,9,14 EEPROM CAUTION : Page 8

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 applications of this equipment, you must satisfy yourself as to its suitability for your specific application.



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