INTRODUCTION

The FX-4DA analog special function block has four output channels. The output channels take a digital value and output an equivalent analog signal. This is called a D/A conversion. The FX-4DA has a maximum resolution of 12 bits.

The selection of voltage or current based input/output is by user wiring. Analog ranges of -10 to 10V (resolution: 5mV), and/or 0 to 20mA (resolution: 20µA) may be selected independently for each channel. FX programmable controllers versions 2.0 or later (those with serial number 133XXX or larger) are required; as these units have the TO/FRM applied instructions in their instruction set. Data transfer between the FX-4DA and the FX base unit is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the FX-4DA.

The FX-4DA occupies 8 points of I/O on the FX-FX expansion bus. The 8 points can be allocated from either inputs or outputs. The FX-4DA draws 30mA from the 5V rail of the base unit or powered extension unit.

EXTERNAL DIMENSIONS AND PARTS

The FX-4DA analog special function block has 8 input terminals for use with this unit. The 8 terminals connect to a 16-bit digital value from the MPU, and output an equivalent analog signal. The FX-4DA has a maximum resolution of 12 bits.

The selection of voltage or current based input/output is by user wiring. Analog ranges of -10 to 10V (resolution: 5mV), and/or 0 to 20mA (resolution: 20µA) may be selected independently for each channel. FX programmable controllers versions 2.0 or later (those with serial number 133XXX or larger) are required; as these units have the TO/FRM applied instructions in their instruction set. Data transfer between the FX-4DA and the FX base unit is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the FX-4DA.

The FX-4DA occupies 8 points of I/O on the FX-FX expansion bus. The 8 points can be allocated from either inputs or outputs. The FX-4DA draws 30mA from the 5V rail of the base unit or powered extension unit.

CONNECTION TO PROGRAMMABLE CONTROLLER

Various special blocks controlled by the FROM/TO commands, such as the analog input blocks high-speed counter blocks, etc. can be connected to the FX or FX2C programmable controller (MPU), or connected to the right side of the other extension blocks or units. Up to eight special blocks can be connected to a single MPU in the numeric order of No. 0 to No. 7.

WIRING:

The terminal layout shown below may differ from the actual layout. For the correct terminal layout, refer to section 2 External Dimensions and Parts.

DIAGRAMS:

1. Use a twisted pair shielded cable for the analog output. This cable should be wired away from power cables or other lines which may induce noise.
2. Apply 1-point grounding at the load side of the output cable. Class 3 (grounding: 100Ω or less).
3. If electrical noise or a voltage dip exists at the output, connect a smoothing capacitor of 0.1 to 0.47µF, 25V.

PERFORMANCE SPECIFICATIONS

The environment specifications are the same as those for the MPU of the programmable controller. Refer to the FX-series Hardware Manual.

Specifications

The environment specifications are the same as those for the MPU of the programmable controller. Refer to the FX-series Hardware Manual.

ENVIRONMENT SPECIFICATIONS

- Temperature: 0 to 55°C
- Humidity: 20 to 85%RH
- Altitude: 2000 m max.
- Power supply: 24V DC ±10% (max. 200mA)

INSTALLATION AND WIRING

Wiring: The terminal layout shown below may differ from the actual layout. For the correct terminal layout, refer to section 2 External Dimensions and Parts.

- Connect the terminal on the FX-DA with the terminal on the MPU of the programmable controller.
- Short the voltage output terminal or connecting the current output load to the voltage output terminal may damage the FX-4DA.
- The 24VDC service power of the programmable controller can also be used.
- Do not connect any unit to the unused terminal.

ALLOCATION OF BUFFER MEMORIES (BFM)

Data is transmitted between the FX-4DA and the MPU via buffer memories (16-bit or 32-point RAM).

- Buffer memories marked "A" can be written to using the TO instruction in the MPU.
- The status of BFM #0, #5, and #21, (marked E) will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- Printed on page 10 of the FX series Hardware Manual.
**Introduction**

The FX-4DA analog special function block has four output channels. The output channels take a digital value and output an equivalent analog signal. This is called a D/A conversion. The FX-4DA has a maximum resolution of 12 bits.

- The selection of voltage or current based input/output is by user wiring. Analog ranges of -10 to 10V (resolution: 5mV), and/or 0 to 20mA (resolution: 20µA) may be selected independently for each channel.
- FX programmable controllers versions 2.0 or later (those with serial number 13XXX or larger) are required; as these units have the TO/FROM applied instructions in their instruction set. Data transfer between the FX-4DA and the FX base unit is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the FX-4DA.
- The FX-4DA occupies 8 points of I/O on the FX-40 expansion bus. The 8 points can be allocated from either inputs or outputs. The FX-4DA draws 30mA from the 5V base of the power unit or base expansion unit.

**Wiring**

The terminal layout shown below may differ from the actual layout. For the correct terminal layout, refer to section 2 External Dimensions and Parts.

1. Use a twisted pair shielded cable for the analog output. This cable should be shielded away from power lines or any other current-carrying lines to minimize noise.
2. Apply 1-point grounding at the load side of the output cable (class 3 grounding: 100Ω or less).
3. The digital output or output resistance of the FX-4DA may damage the FX-4DA. The 24V DC service power of the programmable controller can also be used.
4. Do not connect any unit to the unused terminal.

**Connection to Programmable Controller**

Various special blocks controlled by the FROM/TO commands, such as the analog input blocks high-speed counter blocks, etc. can be connected to the FX or FX2 series programmable controller (MPU), or connected to the right side of the other extension blocks or units. Up to eight special blocks can be connected to a single MPU in the numeric order of: No. 0 to No. 7.

**Installation and Wiring**

**Environnement Specifications**

The environment specifications are the same as those for the MPU of the programmable controller. Refer to the FX series Hardware Manual.

- **BFM #1**: Output mode select: The value of BFM #0 switches the analog output between voltage and current on each channel. This takes the form of a 4 digit hexadecimal number. The first digit will be the command for channel 1 (CH1), and the second digit for channel 2 (CH2) etc. The numeric values of these four digits respectively represent the following items:
  - 0: Sets the voltage output mode (-10 V to +10 V).
  - 1: Sets the current output mode (+4 mA to +20 mA).
- Switching the output modes resets the I/O characteristics to the factory-set characteristics. Refer to the performance specifications described in section 4.

**Specifications**

In addition to the above functions, the buffer memories can adjust the I/O characteristics of the FX-4DA, and report the status of the FX-4DA to the programmable controller.

- **BFM #0**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.
  - 0: Sets the voltage output mode (-10 V to +10 V).
  - 1: Sets the current output mode (+4 mA to +20 mA).

**Allocating Buffer Memories (BFM)**

Data is transmitted between the FX-4DA and the MPU via buffer memories (16-32 point RAM).

- **BFM #0**: Output mode select: The value of BFM #0 switches the analog output between voltage and current on each channel. This takes the form of a 4 digit hexadecimal number. The first digit will be the command for channel 1 (CH1), and the second digit for channel 2 (CH2) etc. The numeric values of these four digits respectively represent the following items:
  - 0: Sets the voltage output mode (-10 V to +10 V).
  - 1: Sets the current output mode (+4 mA to +20 mA).
- Switching the output modes resets the I/O characteristics to the factory-set characteristics. Refer to the performance specifications described in section 4.

**Example:**

- **BFM #1**: CH1 Voltage output (-10 V to +10 V)
  - CH2 and CH3: Current output (+4 mA to +20 mA)
  - CH4: Current output (0 mA to +20 mA)
- **BFM #4**: Offset and gain data (BFM #1 through #4) is+1,000 µA (resolution: 5mV), and/or 0 to 20mA (resolution: 20µA).
- **BFM #5**: Digital input procedure
  - CH0 to CH3: Binary data (BFM #5)
  - CH4: Text data (BFM #6)

**BFM #0**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- **BFM #0**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.
- **BFM #1**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.
- **BFM #2**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- **BFM #3**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.
- **BFM #5**: Digital input procedure
  - CH0 to CH3: Binary data (BFM #6)
  - CH4: Text data (BFM #7)

**BFM #0**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- **BFM #1**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.
- **BFM #2**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

**BFM #3**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- **BFM #5**: Digital input procedure
  - CH0 to CH3: Binary data (BFM #5)
  - CH4: Text data (BFM #6)

**BFM #0**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- **BFM #1**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.
- **BFM #2**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

**BFM #3**: Output mode select: 0 to 7. The values of BFM #0 to #7 will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- **BFM #5**: Digital input procedure
  - CH0 to CH3: Binary data (BFM #5)
  - CH4: Text data (BFM #6)
CONNECTION TO PROGRAMMABLE CONTROLLER

Various special blocks controlled by the FRO/TO commands, such as the analog input blocks high-speed counter blocks, etc., can be connected to the FX or FX2C programmable controller (MPU), or connected to the right side of the other extension blocks or units. Up to eight special blocks can be connected to a single MPU in the numeric order of: No. 0 to No. 7.

INSTALLATION AND WIRES

WIRING: The terminal layout shown below may differ from the actual layout. For the correct terminal layout, refer to section 2 External Dimensions and Parts.

- Use a twisted pair shielded cable for the analog output. This cable should be wired away from power lines or other signal lines to prevent noise.
- Apply 1-point grounding at the load side of the output cable (class 3 grounding: 100Ω or less).
- 3 If electrical noise or a voltage triple exists at the output, connect a smoothing capacitor of 0.1 to 0.47μF, 25V.

ENVIROMENT SPECIFICATIONS

The environment specifications are the same as those for the MPU of the programmable controller. Refer to the FX-series Hardware Manual.

SPECIFICATIONS

PERFORMANCE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Analog output</th>
<th>100% to ±10V DC (external load resistance 10Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital input</td>
<td>16 bits, binary, with sign (effective bits for units: 11 bits and sign (1 bit)</td>
</tr>
<tr>
<td>Resolution</td>
<td>10V (1024)</td>
</tr>
<tr>
<td>DC power input</td>
<td>24V ± 5% (19.8 to 25.4)</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>2000 points/4 cables = 500 points/1 cable</td>
</tr>
<tr>
<td>Isolation</td>
<td>Maximum isolation between analog and digital circuits: 120Ω over 100Hz between FX base unit and isolation between analog channels</td>
</tr>
<tr>
<td>Environmental power supply</td>
<td>24V DC ± 10%</td>
</tr>
<tr>
<td>Number of points</td>
<td>8 points taken from the FX expansion bus (can be either inputs or outputs)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>35mA (internal power supply from MPU or powered extension unit)</td>
</tr>
<tr>
<td>Current consumption</td>
<td>5V, 30mA (Internal power supply from MPU or powered extension unit)</td>
</tr>
</tbody>
</table>

Specifications

- Weight: Approx. 0.3 kg
- Accessory: Special block number label

Handling of crimp-style terminal

- Be sure to use the crimp-style terminals that satisfy the dimensional requirements shown in the figure.
- Apply 0.5 to 0.8 mm (5 to 8 kgf/cm²) torque to tighten the terminals. Firmly tighten the terminals to prevent abnormal operation.

5 ALLOCATION OF BUFFER MEMORIES (BFM)

Data is transmitted between the FX-4DA and the MPU via buffer memories (16 to 33-point RAM).

BFM

<table>
<thead>
<tr>
<th>BFM</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Output mode select. Factory setting 00000</td>
</tr>
<tr>
<td>#1</td>
<td>Output data (Signed 16 binary; actual value)</td>
</tr>
<tr>
<td>#2</td>
<td>11 bits + sign</td>
</tr>
<tr>
<td>#3</td>
<td>CH1, CH2, CH3, CH4</td>
</tr>
<tr>
<td>#4</td>
<td>CH4</td>
</tr>
<tr>
<td>#5</td>
<td>Data holding mode. Factory setting 00000</td>
</tr>
<tr>
<td>#6</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

- (BFM #5): output mode select: The value of BFM #5 switches the analog output between voltage and current on each channel. It takes the form of a 4-digit hexadecimal number. The first digit will be the command for channel 1 (CH1), and the second digit for channel 2 (CH2) etc. The numeric values of these four digits respectively represent the following items:
  - 0: Sets the voltage output mode (-10 V to +10 V).
  - 1: Sets the current output mode (+4 mA to +20 mA).

- Selecting the output mode resets the I/O characteristics to the factory-set characteristics. Refer to the performance specifications described in section 4.

Example: H2110 CH1: Voltage output (-10 V to +10 V) CH2 and CH3: Current output (+4 mA to +20 mA) CH4: Current output (0 mA to +20 mA)

- (BFM #1, #2, #3, and #4): Output data channels CH1, CH2, CH3, and CH4
  - BFM #1: Output data of CH1 (Initial: 0) BFM #2: Output data of CH1 (Initial: 0) BFM #3: Output data of CH2 (Initial: 0) BFM #4: Output data of CH2 (Initial: 0)

- (BFM #5): Data holding mode: While the programmable controller is in the STOP mode, the last output value in the mode will be held. To reset the value to the offset value, write the hexadecimal value in BFM #5 as follows:
  - H0000: Loads the output. (OFF state) H0001: Data setting command (Set offset value)
  - H0002: Data setting command (Set gain value)

In addition to the above functions, the buffer memories can adjust the I/O characteristics of the FX-4DA, and report the status of the FX-4DA to the programmable controller. Buffers marked "W" can be written to using the TO instruction in the MPU.

The status of BFM #0, #4, and #11 (marked E) will be written to EEPROM, therefore the settings will be retained even after turning off the power.

Note

- The offset and gain data values are reset to zero at power ON. However, using the offset/gain setting commands (BFM #8, #9) causes the values to be saved to EEPROM. It is not necessary to write the data a second time.
- (BFM #20): When K1 is written in BFM #20, all values will be initialized to the factory-settings. (Note that the BFM #20 data will overwrite the BFM #21 data.) This initialize function is convenient if you have an error in adjustment.
- (BFM #21) I/O characteristics adjustment inhibit: Setting BFM #21 to 2 inhibits the user from inadvertent adjustment of I/O characteristics. The adjustment inhibit function, once set, will be valid until the Permit command (BFM #21 = 1) is set. The initial value is 1 (Permit). The set value will be retained even after power-off.
CAUTION REGARDING OPERATION

- Check that the output wiring and output expansion cables are properly connected on FX-4DA analog special function block.
- Check the FX system configuration rules have not been broken, i.e. the number of blocks does not exceed 8 and the total system I/O is equal or less than 256 I/O.
- Ensure that the correct output mode has been selected for the application.
- Check that there is no power overload on either the 5V or 24V power source, remember the loading on the FX MPU or a powered extension unit varies according to the number of extension blocks or special function blocks connected.
- Put the main processing unit into RUN.
- After turning on or off the 24V DC power for analog signals, the analog output may fluctuate for approximately 1 second. This is due to time delays in the power supply from the MPU or differences in start time. For this reason, be sure to take preventive measures so that this output fluctuation will not affect the external units.

(EXample of preventive measure):
- For the following program, CH1 and CH2 of the FX-4DA connected at special block position No. 1 are used as
- Analog values will be sent from D0 (BFM #1), D1 (BFM #2), D2 (BFM #3), and D3 (BFM #4) to the respective output channels of the FX-4DA. When the MPU is in STOP, the analog values set before stopping the MPU will remain unaltered. The output will be held. __Note__:
- If the FX-4DA does not operate properly, check the following items:
  - Check the external wiring. Refer to section 3 of this manual.
  - Check status of the POWER indicator lamp (LED) of the FX-4DA.
  - On the extension cable is properly connected.
  - Check the status of the A-A conversion indicator lamp (LED) of the FX-4DA.
  - Flash: A-A conversion is normal.
  - On or off. The ambient conditions are not suitable for the FX-4DA, or the FX-4DA is defective. Please consult the nearest Mitsubishi Electric distributor.
  - Check the output voltage or current value using a voltmeter or ammeter, and confirm that the output meets the I/O characteristics. If the output does not meet the I/O characteristics, adjust the offset and gain again. Refer to section 5.

OUTLINE OF FROM and TO COMMANDS: For a detailed description, refer to the FX Programming Manual.

TROUBLESHOOTING

- If no distress occurs, use the FROM command to read out the details of the error.
- If the FX-4DA does not operate properly, check the following items:
  - Check the external wiring. Refer to section 3 of this manual.
  - Check status of the POWER indicator lamp (LED) of the FX-4DA.
  - On the extension cable is properly connected.
  - Check the status of the A-A conversion indicator lamp (LED) of the FX-4DA.
  - Flash: A-A conversion is normal.
  - On or off. The ambient conditions are not suitable for the FX-4DA, or the FX-4DA is defective. Please consult the nearest Mitsubishi Electric distributor.
  - Check the output voltage or current value using a voltmeter or ammeter, and confirm that the output meets the I/O characteristics. If the output does not meet the I/O characteristics, adjust the offset and gain again. Refer to section 5.

Guidelines for the safety of the user and protection of the FX-4DA 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-4DA 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-4DA please consult the nearest Mitsubishi Electric distributor.
- Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential loss that may arise as a result of installation or use of this equipment.
- All examples and diagrams shown in this manual are intended only as an aid to understanding the text and to contribute to safe operation. Mitsubishi Electric will accept no responsibility for actual use of the product based on these illustrative examples.

Manual number : JY992D61001
Manual revision : B
Date : November 1996

Effective NOV. 1996 Specifications are subject to change without notice.
**Inhibits adjustment of I/O characteristics**

- Check whether the output wiring and extension cables are properly connected on FX-4DA analog special function block.
- Check that the FX system configuration rules have not been broken, i.e. the number of blocks does not exceed 8 and the total system I/O is equal or less than 256 I/O.
- Ensure that the correct output mode has been selected for the application.
- Check that there is no power overload on either the 5V or 24V power source, remember the loading on the FX MPU or a powered extension unit varies according to the number of extension blocks or special function blocks connected.
- Put the main processing unit into RUN.
- After turning on or off the 24VDC power for analog signals, the analog output may fluctuate approximately 1 second. This is due to time delays in the power supply from the MPU or differences in start time. For this reason, be sure to take preventive measures so that this output fluctuation will not affect the external units.

**ADJUSTMENT OF I/O CHARACTERISTICS**

The standard characteristics (factory default) are shown by the solid lines in the figure below. These characteristics can be adjusted according to the customer's system requirements.

- **Adjustment of I/O characteristics**
  - Set the offset and gain of the FX-4DA either using pushbutton switches connected to input terminals of the programmable controller or using the on/off function of a programming panel. To change the offset and gain, just change the version constants of the FX-4DA.
  - Adjusting the analog output is not needed for adjustment, however a program should be created in the MPU.
  - An example program for adjustment is shown below. The example shows that for channel CH2 of FX-4DA block No. 1, the offset value is changed from 2mA to 10mA, the gain value to 20mA. From CH1, CH2, and CH4, the standard voltage output characteristics are set.

**OPERATION AND PROGRAM EXAMPLES**

- The factory-set I/O characteristics are not changed and the status information is not used, you can operate the FX-4DA using the following simple program. For the FROM and TO commands, refer to the FX Programming Manual.
- CH1 and CH2: Voltage output mode (-10 V to +10 V)  CH3: Current output mode (+4mA to +20mA)
- CH4: Current output mode (0mA to +20mA)

**PROGRAM EXAMPLE**

For the following program, CH1 and CH2 of the FX-4DA connected at special block position No. 1 are used as voltage output channels (+4mA to +20mA), and CH4 as a current output channel (0mA to +20mA). When the MPU is in STOP, the output will be held. In addition, the status information is used.

---

**TROUBLESHOOTING**

- If the FX-4DA does not operate properly, check the following items:
  - Check the external wiring. Refer to section 3 of this manual.
  - Check status of the 24V power indicator lamp (LED) of the FX-4DA.
  - Check status of the 5V power supply capacity.

**Guidelines for the safety of the user and protection of the FX-4DA 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.

- In doubt at any stage during the installation of the FX-4DA always consult a professional electrical engineer who is qualified and trained to the local and national standards.

- Under no circumstances will Mitsubishi Electric be liable or responsible for any consequential loss or damage that may arise as a result of 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.
Inhibits adjustment of I/O characteristics

TO (K2)

Digital input

M3

OPERATION END

0

(M25 to M10)

→

P

K4

M10

K29

K1

FROM

JY992D61001B

Specifications are subject to change without notice.

CH2 offset/gain setting command

→

D2

→

(H1100)

Effective NOV. 1996

BFM #2 (CH2 output)

→

HIMEJI WORKS : 840, CHIYODA CHO, HIMEJI, JAPAN

BFM #12 (CH2 output)

→

K13

K8

TO

D4

M1 will be turned on when the model code is set to K3020.
The MPU can use this facility in the program to identify the special block before commencing any data transfer from and to the special block.

Note : BFM #’s marked E/(E).

Values of BFM #0, #5, and #21, (marked E) are stored in EEPROM memory of the FX-4DA.

BFM #10 to #17 are copied to EEPROM where the gain/settig setting command BFM #9, #9 is used. Also, BFM #0 is required to reset the EEPROM memory. The EEPROM has a life of about 100,000 cycles, so do not use programs which frequently change these BFM’s.

A mode change of BFM#0 automatically changes the value of the corresponding offset and gain values. Because of the time needed to write the new values to the internal EEPROM memory, a delay of 3 s is required between instructions changing BFM#0 and instructions writing to the corresponding BFM#10 through BFM#17.

Therefore, a delay timer should be used before writing to BFM#10 through BFM#17.

Operation procedure

① Turn off the power of the MPU, and then connect the FX-4DA. After that, write the I/O lines of the FX-4DA.

② Set the MPU to STOP, and turn on the power. Write the above program then switch the MPU to RUN.

③ Adjustable status

④ Write BFM to determine the current output and/or voltage output of the FX-4DA.

⑤ Write command to the number (m1,m2) set in STEP 2 and perform the output checking.

⑥ When the MPU is in STOP, the offset values can also be output. For a detailed description, refer to Section 5.

Program example

For the following program, CH1 and CH2 of the FX-4DA connected at special block position No. 1 are used as voltage output channel (-10 V to +10 V), and CH3 as a current output channel (0 mA to +20 mA). When the MPU is in STOP, the output will be held. In addition, the status information is used.

⑦ CAUTION REGARDING OPERATION

⑧ Guidelines for the safety of the user and protection of the FX-4DA special function block

This manual has been written to be read by trained and competent personnel. This is defined by the European directives for machinery, low voltage and EMC.

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Specifications

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MITSUBISHI ELECTRIC CORPORATION

Manual

Effective NOV. 1996

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The FX-4DA analog special function block has four output channels. The output channels take a digital value and output an equivalent analog signal. This is called a D/A conversion. The FX-4DA has a maximum resolution of 12 bits.

- The selection of voltage or current based output is by user wiring. Analog ranges of -10 to 10V (resolution: 5mV), and/or 0 to 20mA (resolution: 20µA) may be selected independently for each channel.

- FX programmable controllers versions 2.0 or later (those with serial number 13XXXX or larger) are required; as these units have the TO/FROM applied instructions in their instruction set. Data transfer for the FX-4DA and the FX base unit is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the FX-4DA.

- The FX-4DA occupies 8 points of I/O on the FX, FXc expansion bus. The 8 points can be allocated from either inputs or outputs. The FX-4DA draws 30mA from the 5V base of the power unit or base extension unit.

WIRING:

The terminal layout shown below may differ from the actual layout. For the correct terminal layout, refer to section 2 External Dimensions and Parts.

- Connect the terminal on the FX-4DA with the terminal on the MPU of the programmable controller
- Shorting the voltage output terminal or connecting the current output load to the voltage output terminal may damage the FX-4DA.
- The 24V DC service power of the programmable controller can also be used.
- Do not connect any unit to the unused terminal.

ENVIROMENT SPECIFICATIONS

The environment specifications are the same as those for the MPU of the programmable controller. Refer to the FX-series Hardware Manual.

PERFORMANCE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Performance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog output</td>
<td>+10V DC (external load resistance: 50Ω)</td>
</tr>
<tr>
<td>Digital input</td>
<td>16 bits, binary, with sign (Effective bits for numeric value: 11 bits and sign: 1 bit)</td>
</tr>
<tr>
<td>Resolution</td>
<td>19.024V (5mV)</td>
</tr>
<tr>
<td>Gain value</td>
<td>20 (10mA)</td>
</tr>
<tr>
<td>Conversion speed</td>
<td>2.1ms for 4 channels (Change in the number of channels used will not change the conversion speed.)</td>
</tr>
<tr>
<td>Isolation</td>
<td>±500V</td>
</tr>
<tr>
<td>Conversion precision</td>
<td>±1% (at full scale of +20mA)</td>
</tr>
<tr>
<td>External power supply</td>
<td>DC24V ±10% 200mA</td>
</tr>
</tbody>
</table>

Specifications

In addition to the above functions, the buffer memories can adjust the I/O characteristics of the FX-4DA, and report the status of the FX-4DA to the programmable controller.

Bufer memories marked "W" can be written to using the TO instruction in the MPU.

The status of BFM #0, #5, and #7, (marked E) will be written to EEPROM, therefore the set values will be retained even after turning off the power.

- BFM #0: Output mode select: The value of BFM #0 switches the analog output between voltage and current on each channel. It takes the form of a 4 digit hexadecimal number. The first digit will be the command for channel 1 (CH1), and the second digit for channel 2 (CH2) etc. The numeric values of these four digits respectively represent the following items:

  0: Sets the voltage output mode (-10 V to +10 V).
  1: Sets the current output mode (±4mA to ±20mA).

- BFM #5: Data holding mode: While the programmable controller is in the STOP mode, the last output value in the STOP mode will be held. To reset the value to the offset value, write the hexadecimal value in BFM #5 as follows:

  0: Holds the offset.
  1: Resets to the offset value.

Example: H9011----CH1 and CH2 Offset value CH3 and CH4: Output holding.
Inhibits adjustment of I/O characteristics
output range
BFM#21
In specified
M3
+1,000
(M25 to M10)
→
M20 M10
K4M10
FROM T1
CH2 offset/gain setting command
BFM #3 (CH3 output)
D2
→
Effective NOV. 1996
CH4: Current output (0 mA to +20 mA)
K1
K1
TOTO
BFM#13
+20mA
H2100
K1
TO
BFM #0 (unit No.1)
H2100
CH1 and CH2: Voltage output (-10 V to +10 V)
CH3: Current output (+4 mA to +20 mA)
CH4: Current output mode (9 mA to +20 mA)
→
Set the offset data.
BFM #10 through BFM#17.
After adjustment, the I/O characteristics
Permits adjustment of I/O characteristics.
K1
K1
TO
Permits adjustment of I/O characteristics.
Power switch
FX-4DA special function block
Adjustment of I/O characteristics
I/O characteristics
The standard characteristics (factory default) are shown by the solid lines in the figure below. These characteristics can be adjusted according to the customer's system requirements.
Standard characteristics of output voltage
-0.000
1.000
Digital input
Analog output 4V
1.000
Analog output value when the digital input is 1.000
Analog output value when the digital input is 0
When the slope of the I/O characteristic line is steep: Slight changes to the digital input will greatly increase or reduce the analog output.
When the slope of the I/O characteristic line is gentle: Slight changes to the digital input will not alter the analog output. Note that the resolution (minimum possible change of analog output) of the FX-4DA is fixed.
Adjustment of I/O Characteristics
To adjust the I/O characteristics, set the offset and gain of the FX-4DA either using pushbutton switches connected to input terminals of the programmable controller or using the flash memory function of a programming panel. To change the offset and gain, change the conversion constants of the FX-4DA. Metering of the analog output is not needed for adjustment, however a program should be created in the MPU.
An example program for adjustment is shown below. The example shows that for channel CH2 of FX-4DA block No. 1, the offset value is changed to 7 mA, and the gain value to 20 mA. Note that for CH1, CH3, and CH4, the standard voltage output characteristics are set.
Outline of FROM and TO commands: For a detailed description, refer to the FX Programming Manual.
If the FX-4DA does not operate properly, check the following items:
Check the external wiring. Refer to section 3 of this manual.
Check status of the POWER indicator lamp (LED) of the FX-4DA.
On: The extension cable is properly connected.
Off: Check connection of extension cable. Also check the 5 V power supply capacity.
Check status of the 24 V power indicator lamp (LED) of the FX-4DA. Flash: D-A conversion is normal. On or off: The ambient conditions are not suitable for the FX-4DA, or the FX-4DA is defective.
Check the external lead resistance connected to each analog output terminal does not exceed the capacity of the FX-4DA drive (voltage output: 20 kΩ, current output: 500 Ω).
Check the output voltage or current value using a voltmeter or ammeter, and confirm that the output meets the I/O characteristics. If the output does not meet the I/O characteristics, adjust the offset and gain again. Refer to section 5.
Guidelines for the safety of the user and protection of the FX-4DA 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 about the operation or use of the FX-4DA 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 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.

**Operation example**

To test the withstand voltage of the FX-4DA, connect all the terminals to the grounding terminal. No external units are connected.

1. Power up the system.
2. Write the data for CH1 to D0, CH2 to D1, CH3 to D2, and CH4 to D3.
3. Set the mode of the output channel.

**Program example**

For the following program, CH1 and CH2 of the FX-4DA connected at special block position No. 1 are used as output voltage channels (+4 mA to +20 mA), and CH3 as a current output channel (0 mA to +20 mA). When the MPU is in STOP, the output will be held. In addition, the status information is used.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FROM K1</td>
<td>C30 D4</td>
</tr>
<tr>
<td>FROM K0</td>
<td>C30 D4</td>
</tr>
<tr>
<td>FROM K1</td>
<td>C30 D4</td>
</tr>
<tr>
<td>FROM K9</td>
<td>C30 D4</td>
</tr>
</tbody>
</table>

With no error, the program will be executed.

**Error handling**

- If an error occurs, the status will be set to error (N1 = 1).
- If an error occurs, the status will be set to error (N1 = 1).
- If an error occurs, the status will be set to error (N1 = 1).
- If an error occurs, the status will be set to error (N1 = 1).

**Error status**

- N1: Status when bit 0 is set to “1” (turned on)
- N2: Error status when bit 0 is set to “1” (turned on)
- N2: Error status when bit 0 is set to “1” (turned on)
- N2: Error status when bit 0 is set to “1” (turned on)

**Errors**

- Bit 4 through bit 11, bit 13 through bit 15 are not defined.

Note:

- BFM#0 is marked E/(E).
- Values of BFM# 0, 4, and 21, (marked E) are stored in EEPROM memory of the FX-4DA. BFM# 10 to #17 are copied to EEPROM when the gain/output setting command BFM# 9 is used, also BFM#10 is used to reset the EEPROM memory. The EEPROM has a life of about 10,000 cycles (changes), so do not use programs which frequently change these BFM.
- A mode change of the FX-4DA automatically involves a change of the corresponding offset and gain values. Because of the need to write the new values to the internal EEPROM memory, a delay of 3 s is required between instructions changing BFM#0 and instructions writing to the corresponding BFM#10 through BFM#17.
- Therefore, a delay timer should be used before writing to BFM#10 through BFM#17.
- If K01 and K01 are off, transfer will not be executed, therefore the destination data value will not be changed.