MITSUBISHI ELECTRIC

Programmable Controller
MELSEC iQ-F

MELSEC iQ-F FX5-20PG-□

Hardware Manual

FX5

Manual Number	JY997D74101
Revision	C
Date	October 2019

This manual describes the part names, dimensions, installation, and specifications of the product. Before use, read this manual and manuals of relevant products fully to acquire proficiency in handling and operating the product. Make sure to learn all the product information, safety information, and precautions.
And, store this manual in a safe place so that you can take it out and read it whenever necessary. Always forward it to the end user.
Registration:
The company names, system names and product names mentioned in this manual are either registered trademarks or trademarks of their respective companies. In some cases, trademark symbols such as 'ᵀᴹ' or '®' are not specified in this manual.

Effective October 2019
Specifications are subject to change without notice.

Safety Precautions (Read these precautions before use.)

This manual classifies the safety precautions into two categories:
⚠WARNING and ⚠CAUTION.

⚠WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Depending on the circumstances, procedures indicated by ⚠CAUTION may also cause severe injury.
It is important to follow all precautions for personal safety.

Associated Manual

Manual name	Manual No.	Description
MELSEC iQ-F FX5 User's Manual (Positioning Control - Intelligent function module)	SH-081805ENG	Explains positioning module.
MELSEC iQ-F FX5UJ User's Manual (Hardware)	SH-082206ENG	Explains FX5UJ CPU module specification details for I/O, wiring, installation, and maintenance.
MELSEC iQ-F FX5U User's Manual (Hardware)	JY997D55301	Explains FX5U CPU module specification details for I/O, wiring, installation, and maintenance.
MELSEC iQ-F FX5UC User's Manual (Hardware)	JY997D61401	Explains FX5UC CPU module specification details for I/O, wiring, installation, and maintenance.

How to obtain manuals
For the necessary product manuals or documents, consult with your local Mitsubishi Electric representative.

Applicable standards

FX5-20PG-□ complies with the EC Directive (EMC Directive) and UL standards (UL, cUL). Further information can be found in the following manual.
→ **MELSEC iQ-F FX5 User's Manual (Positioning Control - Intelligent function module)**
Regarding the standards that relate to the CPU module, please refer to either the product catalog or consult with your local Mitsubishi Electric representative.
Attention
This product is designed for use in industrial applications.

1. Outline

FX5-20PG-□ 2-axis pulse train positioning module (hereinafter referred to as FX5-20PG-□) is an intelligent function module for high speed, high precision positioning with servo motors or stepping motors via drive units.

1.1 Incorporated Items
Check that the following product and items are included in the package:

Product	FX5-20PG-□ 2 axis pulse train positioning module
Included Items	FX2NC-100MPCB power cable: (1 m, three wire)
	Dust proof protection sheet (1 sheet)
	Hardware manual [Japanese /English] (This manual)
	Hardware manual [Chinese]

1.2 External Dimensions, Part Names

Unit: mm

MASS (Weight): Approx. 0.2 kg
Outer painting color: Munsell 0.6B7.6/0.2
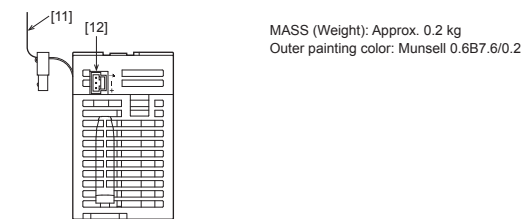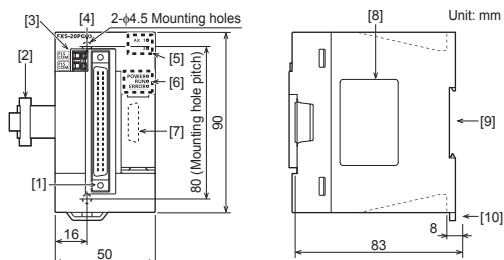
[1] Connector for external devices
[2] Extension cable
[3] Differential driver common terminal[*1]
[4] Direct mounting hole: 2 holes of φ4.5 (mounting screw: M4 screw)
[5] Axis display LED (AX1, AX2)
[6] Operation status display LEDs
[7] Extension connector (for next module)
[8] Name plate
[9] DIN rail mounting groove (DIN rail: DIN 46277, 35 mm wide)
[10] DIN rail mounting hook
[11] Pullout tab
[12] Power connector
*1 FX5-20PG-D only

1.3 Indications of LEDs
□: OFF, ■: ON, ●: Flashing (Flashing interval ON: 200 ms/OFF: 200 ms)

FX5-20PG-□ status	LED display		Indication
Power OFF	AX1 □ AX2 □	POWER □ RUN □ ERROR □	Power OFF
Normal operation (RUN LED is ON, ERROR LED is OFF)	AX1 □ AX2 □	POWER ■ RUN ■ ERROR □	Axes stopped Axes on standby
	AX1 ■ AX2 ■	POWER ■ RUN ■ ERROR □	Axes in operation
Operation failure	AX1 ● AX2 □	POWER ■ RUN ■ ERROR ■	Minor error
	AX1 □ AX2 □	POWER ■ RUN ■ ERROR ●	Moderate error

FX5-20PG-□ status	LED display		Indication
Operation failure	AX1 □ AX2 □	POWER ■ RUN □ ERROR □	Error (Initial not completed)

1.4 Signal Layouts
The signal layout of the FX5-20PG-□ connector for external devices is as follows:

1.4.1 40-pin connectors

	Axis 2 (AX2)		Axis 1 (AX1)	
	Pin No.	Signal	Pin No.	Signal
	B20	PULSER B-	A20	PULSER B+
	B19	PULSER A-	A19	PULSER A+
	B18	PULSE COM[*1]	A18	PULSE COM[*1]
	B17	PULSE R[*1]	A17	PULSE R[*1]
	B16	PULSE COM[*1]	A16	PULSE COM[*1]
	B15	PULSE F[*1]	A15	PULSE F[*1]
	B14	CLRCOM	A14	CLRCOM
	B13	CLEAR	A13	CLEAR
	B12	RDYCOM	A12	RDYCOM
	B11	READY	A11	READY
	B10	PG0COM	A10	PG0COM
	B9	PG05	A9	PG05
	B8	PG024	A8	PG024
	B7	COM	A7	COM
	B6	COM	A6	COM
	B5	CHG	A5	CHG
	B4	STOP	A4	STOP
	B3	DOG	A3	DOG
	B2	RLS	A2	RLS
	B1	FLS	A1	FLS

*1 The signal layouts of FX5-20PG-D are as follows.

Axis 2 (AX2)		Axis 1 (AX1)	
Pin No.	Signal	Pin No.	Signal
B18	PULSE R-	A18	PULSE R-
B17	PULSE R+	A17	PULSE R+
B16	PULSE F-	A16	PULSE F-
B15	PULSE F+	A15	PULSE F+

For further information on signal, refer to the following manual.
→ **MELSEC iQ-F FX5 User's Manual (Positioning Control - Intelligent function module)**

1.4.2 Differential driver common terminal (FX5-20PG-D only)

Differential driver common terminal

Signal
PLS COM (Differential driver common)

2. Installation

INSTALLATION PRECAUTIONS	⚠WARNING

- Make sure to cut off all phases of the power supply externally before attempting installation or wiring work.
  Failure to do so may cause electric shock or damage to the product.
- Use the product within the generic environment specifications described in the User's Manual (Hardware) for the CPU module to be used.
  Never use the product in areas with excessive dust, oily smoke, conductive dusts, corrosive gas (salt air, Cl2, H2S, SO2 or NO2), flammable gas, vibration or impacts, or expose it to high temperature, condensation, or rain and wind.
  If the product is used in such conditions, electric shock, fire, malfunctions, deterioration or damage may occur.

INSTALLATION PRECAUTIONS	⚠CAUTION

- Do not touch the conductive parts of the product directly.
  Doing so may cause device failures or malfunctions.
- When drilling screw holes or wiring, make sure that cutting and wiring debris do not enter the ventilation slits of the PLC.
  Failure to do so may cause fire, equipment failures or malfunctions.

INSTALLATION PRECAUTIONS	⚠CAUTION

- The dust proof sheet should be affixed to the ventilation slits before installation and wiring to block foreign objects such as cutting and wiring debris. However, when the installation work is completed, make sure to remove the sheet to provide adequate ventilation.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Install the product on a flat surface. If the mounting surface is rough, undue force will be applied to the PC board, thereby causing nonconformities.
- Install the product securely using a DIN rail or mounting screws.
- Connect the extension cables securely to their designated connectors.
  Loose connections may cause malfunctions.

For further information on mounting, refer to the following manual.
→ **MELSEC iQ-F FX5UJ User's Manual (Hardware)**
→ **MELSEC iQ-F FX5U User's Manual (Hardware)**
→ **MELSEC iQ-F FX5UC User's Manual (Hardware)**

3. Wiring

WIRING PRECAUTIONS	⚠WARNING

- Make sure to cut off all phases of the power supply externally before attempting installation or wiring work.
  Failure to do so may cause electric shock or damage to the product.
- The temperature rating of the cable should be 80℃ or more.
- Make sure to properly wire to the spring clamp terminal block in accordance with the following precautions.
  Failure to do so may cause electric shock, equipment failures, a shortcircuit, wire breakage, malfunctions, or damage to the product.
  - The disposal size of the cable end should follow the dimensions described in the manual.
  - Twist the ends of stranded wires and make sure that there are no loose wires.
  - Do not solder-plate the electric wire ends.
  - Do not connect more than the specified number of wires or electric wires of unspecified size.

WIRING PRECAUTIONS	⚠CAUTION

- Securely connect the connector to the module. Poor contact may cause malfunction.
- Make sure to observe the following precautions in order to prevent any damage to the machinery or accidents due to malfunction of the PLC caused by abnormal data written to the PLC due to the effects of noise:
  - Do not bundle the power line and communication cables together with or lay them close to the main circuit, high-voltage line, load line or power line.
  As a guideline, lay the power line, control line and communication cables at least 100 mm away from the main circuit, high-voltage line, load line or power line.

For further information on wiring, refer to the following manual.
→ **MELSEC iQ-F FX5 User's Manual (Positioning Control - Intelligent function module)**

3.1 Applicable Connector
Use the following 40 pin connectors.

Type	Model	Suitable wiring			
		Size	Type	Material	Temperature rating
Soldering type connector (straight type)	A6CON1[*1]	0.088 to 0.3 mm² (AWG28 to 22)	Strand wire	Copper wire	80℃ or more
Crimping type connector (straight type)	A6CON2	0.088 to 0.24 mm² (AWG28 to 24)			
Soldering type connector (dual purpose) (straight/oblique) type	A6CON4[*1]	0.088 to 0.3 mm² (AWG28 to 22)			

*1 Use wire with a sheath outside diameter of 1.3 mm or less when the 40 pins are used. Select appropriate cables according to the current value used.
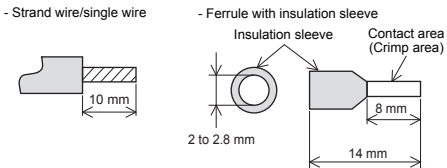
3.2 Differential Driver Common Terminal
3.2.1 Suitable wiring

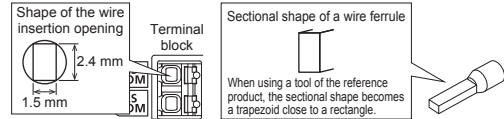| No. of wire per terminal		One wire
Wire size	Single wire, Strand wire (Material: Copper wire)	AWG24 to 16 (0.2 to 1.5 mm²)
	Ferrules with insulation sleeve	AWG23 to 19 (0.25 to 0.75 mm²)
	Ferrules without insulation sleeve	AWG23 to 16 (0.25 to 1.5mm²)
Temperature rating		80℃ or more

3.2.2 Wire end treatment

Strip the cable about 10 mm from the tip to connect a wire ferrule at the stripped area. Failure to do so may result in electric shock or short circuit between adjacent terminals because the conductive part. If the wire strip length is too short, it may result in the poor contact to the spring clamp terminal part.

When using a wire ferrule with an insulating sleeve, choose a wire with proper cable sheath referring to the above outside dimensions, otherwise the wire cannot be inserted easily

- Strand wire/single wire   - Ferrule with insulation sleeve

Insulation sleeve | Contact area (Crimp area)

10 mm

2 to 2.8 mm

8 mm

14 mm

Check the shape of the wire insertion opening with the following chart, and use the smaller wire ferrule than the described size. Also, insert the wire with care so that the wire ferrule is in proper orientation. Failure to do so may cause the bite of the terminal and the damage of the terminal block.

The following table shows wire ferrules and tools for wire ferrules compatible.

Shape of the wire insertion opening | Terminal block | Sectional shape of a wire ferrule

2.4 mm

1.5 mm

When using a tool of the reference product, the sectional shape becomes a trapezoid close to a rectangle.

The following table shows wire ferrules and its associated tools compatible with the terminal block. The shape of the wire ferrule differs depending on the crimp tool to be used, use the reference product. If the product other than referenced products is used, the wire ferrule cannot be removed. Sufficiently confirm that the wire ferrule can be removed before use.

<Reference product>

Manufacturer	Sleeve	Ferrules model	Suitable wiring size	Crimp tool
PHOENIX CONTACT GmbH & Co. KG	Ferrules with insulation sleeve	AI 0.25-8 YE	0.25 mm²	CRIMPFOX 6
		AI 0.34-8 TQ	0.3, 0.34 mm²	
		AI 0.5-8 WH	0.5 mm²	
		AI 0.75-8 GY	0.75 mm²	
	Ferrules without insulation sleeve	A 0,25-7	0.25 mm²	
		A 0,34-7	0.3, 0.34 mm²	
		A 0,5-8	0.5 mm²	
		A 0,75-8	0.75 mm²	
		AI 1.0-8	1.0 mm²	
		AI 1.5-7	1.25, 1.5 mm²	

3.2.3 Connecting a cable

- When ferrules with insulation sleeve are used
  Insert a wire with the ferrule with insulation sleeve into the wire insertion opening and push the wire.
- When stranded wires and solid wires are used
  Push the open/close button of the terminal block with a flathead screwdriver. While pushing the open/close button, insert the wire into the insertion opening until the wire reaches the back, and then release the open/close button.
Then, pull the wire lightly and check that it is clamped securely.

<Reference>

| Manufacturer	Model
PHOENIX CONTACT GmbH & Co. KG	SZS 0.4×2.5 VDE

3.2.4 Disconnection of the cable

Push the open/close button of the wire to be disconnected with a flathead screwdriver. Pull out the wire with the open/close button pushed.

3.3 Power Connector

For further information on the power supply wiring and power cable, refer to the following manual.

→ MELSEC iQ-F FX5 User's Manual (Positioning Control - Intelligent function module)
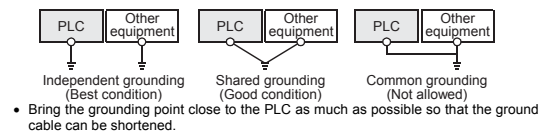
(Green)

− (Black)

+ (Red)
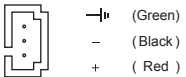
3.4 Grounding

Ground the PLC as stated below.
- Perform class D grounding. (Grounding resistance: 100 Ω or less)
- Ground the PLC independently if possible.
  If the PLC cannot be grounded independently, perform the "Shared grounding" shown below. For details, refer to the following manual.

→ MELSEC iQ-F FX5UJ User's Manual (Hardware)
→ MELSEC iQ-F FX5U User's Manual (Hardware)
→ MELSEC iQ-F FX5UC User's Manual (Hardware)

PLC | Other equipment

Independent grounding (Best condition)

PLC | Other equipment

Shared grounding (Good condition)

PLC | Other equipment

Common grounding (Not allowed)

- Bring the grounding point close to the PLC as much as possible so that the ground cable can be shortened.

4. Specification

4.1 Applicable CPU Module

Model name	Applicability
FX5UJ CPU module	From first production
FX5U CPU module	Ver. 1.050 or later
FX5UC CPU module[*1]	Ver. 1.050 or later

*1 FX5-CNV-IFC or FX5-C1PS-5V is necessary to connect FX5-20PG-P to the FX5UC CPU module.

4.2 Applicable Software Package

Software		Applicability	
		FX5-20PG-P	FX5-20PG-D
GXWorks3	FX5UJ CPU module	Ver. 1.060N or later	
	FX5U/FX5UC CPU module	Ver. 1.035M or later	Ver. 1.050C or later

4.3 General Specifications

The items other than the following are equivalent to those of the CPU module.
For the general specification, refer to the following manual.

→ MELSEC iQ-F FX5UJ User's Manual (Hardware)
→ MELSEC iQ-F FX5U User's Manual (Hardware)
→ MELSEC iQ-F FX5UC User's Manual (Hardware)

Items	Specifications	
Dielectric withstand voltage	500 V AC for 1 minute	Between all terminals and ground terminal
Insulation resistance	10 MΩ or higher by 500 V DC insulation resistance tester	

4.4 Power Supply Specifications

Items		Specifications	
		FX5-20PG-P	FX5-20PG-D
External power supply	Power supply voltage	24 V DC +20%, -15%	
	Allowable instantaneous power failure time	Operation continues when the instantaneous power failure is shorter than 5 ms.	
	Current consumption	120 mA	165 mA

4.5 Performance Specifications

Items	Specifications	
	FX5-20PG-P	FX5-20PG-D
Number of control axes	2 axes	
Pulse output form	Transistor	Differential driver
Interpolation function	2-axis linear interpolation, 2-axis circular interpolation	
Control method	PTP (Point To Point) control, path control (line and arc can be set), speed control, speed-position switching control, position-speed switching control	
Control unit	mm, inch, degree, pulse	
Positioning data	600 data/axis	
Maximum connection distance between servos	2 m	10 m
Number of write accesses to flash ROM	100000 times maximum	
Number of occupied I/O points	8 points	

4.6 Input Specifications

4.6.1 Drive unit READY signal (READY), Stop signal (STOP), Upper limit signal (FLS), Lower limit signal (RLS)

Items	Specifications
Signal voltage	24 V DC
Input current	5 mA
ON current	3.5 mA or more
OFF current	1.7 mA or less
Signal format	No-voltage contact input Sink: NPN open collector transistor Source: PNP open collector transistor
Response time	4 ms or less
Insulation of circuit	Photo-coupler insulation
Indication of operation	None (Operation check via buffer memory is possible.)

4.6.2 Zero signal (PG05/PG024)

Items	Specifications	
	PG05	PG024
Signal voltage	5 V DC	24 V DC
Input current	5 mA	
ON current	2 mA or more	3 mA or more
OFF current	0.5 mA or less	0.2 mA or less
Signal format	NPN open collector transistor	
Response time	1 ms or less	
Insulation of circuit	Photo-coupler insulation	
Indication of operation	None (Operation check via buffer memory is possible.)	

4.6.3 Manual pulse generator A phase (PULSER A)/ Manual pulse generator B phase (PULSER B)

Items	Specifications
Signal voltage	5 V DC
Input current	14 mA
ON current	2 mA or more
OFF current	0.2 mA or less
Signal format	NPN open collector transistor
Response frequency	100 kHz
Insulation of circuit	Photo-coupler insulation
Indication of operation	None (Operation check via buffer memory is possible.)

4.6.4 Near-point dog signal (DOG)

Items	Specifications
Signal voltage	24 V DC
Input current	5 mA
ON current	3.5 mA or more
OFF current	1.7 mA or less

Signal format	No-voltage contact input Sink: NPN open collector transistor Source: PNP open collector transistor
Response time	1 ms or less
Insulation of circuit	Photo-coupler insulation
Indication of operation	None (Operation check via buffer memory is possible.)

4.6.5 External command signal (CHG)

Items	Specifications
Signal voltage	24 V DC
Input current	5 mA
ON current	2.7 mA or more
OFF current	0.8 mA or less
Signal format	No-voltage contact input Sink: NPN open collector transistor Source: PNP open collector transistor
Response time	20 μs
Insulation of circuit	Photo-coupler insulation
Indication of operation	None (Operation check via buffer memory is possible.)

4.7 Output Specifications

4.7.1 Deviation counter clear signal (CLEAR)

Items	Specifications
Pulse output form	Transistor
Signal output time	1 to 65535 ms
Rated load voltage	5 to 24 V DC
Max. load current	100 mA
Output ON voltage	1.5 V or less
Indication of operation	None (Operation check via buffer memory is possible.)

4.7.2 Pulse output (PULSE R/ PULSE F) [FX5-20PG-P]

Items	Specifications
Pulse output form	Transistor
Output form	PULSE/SIGN mode, CW/CCW mode, A phase/B phase (multiple of 4), A phase/B phase (multiple of 1)
Output frequency	1 pps to 200 kpps
Rated load voltage	5 to 24 V DC
Max. load current	50 mA
Output ON voltage	1.0 V or less
Indication of operation	None (Operation check via buffer memory is possible.)

4.7.3 Pulse output (PULSE R+/PULSE F+) [FX5-20PG-D]

Specification of a differential driver (equivalent to AM26C31).

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

Warranty

Exclusion of loss in opportunity and secondary loss from warranty liability
Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:
(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

⚠ For safe use

- This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, consult with Mitsubishi Electric.
- This product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions in the system.

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