MITSUBISHI ELECTRIC

PROGRAMMABLE CONTROLLERS
MELSEC-F

FX3S

FX3S SERIES PROGRAMMABLE CONTROLLERS

Hardware Edition

Main Unit

AC Power Type

FX3S-□MR/ES

FX3S-□MT/ES

FX3S-□MT/ESS

Memory Cassette

FX3G-EEPROM-32L

Introduction

This manual explains the procedures for selecting the system components, main unit specifications and procedures for installing the main unit. FX3S PLCs can make various kinds of control in combination with the main unit functions and many extension devices (expansion board and special adapters).
The detailed explanation of the sequence instructions, communication control, analog control and positioning control are given in separate manuals.

→ **For information on manual organization, refer to Subsection 1.1.2.**

2. Features and Part Names

2.1 Major Features

1. Basic functions

[Up to 30 input/output points]
Main units are available in models of 10, 14, 20 and 30 total input/output points.
(It is not possible to extend inputs/outputs).

[Memory capacity]
The PLC has a 16 K-step EEPROM memory.
(Program capacity is 4 K-steps.)

[Built-in USB port]
The PLC has a built-in USB port for the programming communication function to enable high-speed communication at 12 Mbps.

[Built-in RUN/STOP switch]
The PLC can be started and stopped with the built-in switch.
RUN and STOP commands can be given to the PLC through a general-purpose input terminal or peripheral device.

[Built-in Variable analog potentiometers]
The PLC has two built-in variable analog potentiometers available for adjusting the timer set time.
Up to 8 points can be added by using the optional analog potentiometer expansion board.

[Writing during RUN]
The programming software for personal computer enables you to modify the program while the PLC is running.

[Built-in clock function]
The PLC has a clock function to control the time.

[Programming tool]
Use a version of a programming tool supporting the FX3S.

→ **Refer to Chapter 5.**

[Remote debugging of program]
Programming software enables you to remotely transfer programs and monitor PLC operation through a modem connected to the RS-232C expansion board or the RS-232C communication special adapter.

2. Input/output high-speed processing functions of main unit

[High-speed counter function]

- 1-phase 60 kHz × 2 points + 10 kHz × 4 points
- 2-phase 30 kHz × 1 points + 5 kHz × 1 point

→ **Refer to Chapter 10 and Programming Manual.**

[Pulse catch function]
Signals with short ON width or OFF width can be captured without a complicated program.

→ **Refer to Chapter 9 and Programming Manual.**

Input terminal	Signal ON/OFF width
X000, X001	10 μs
X002 to X005	50 μs

[Input interruption function]
The PLC can process interruption routines with higher priority using external signals whose minimum ON duration or OFF duration is 10 μs (X000, X001) or 50 μs (X002 to X005).
(The timer interruption function is also provided.)

→ **Refer to Chapter 9 and Programming Manual.**

[Pulse output function]
When output terminals in the transistor output type main unit are used, pulses (open collector outputs) of up to 100 kHz can be output simultaneously to 2 axes (Y000 and Y001).
Using a number of instructions programming is simplified.

→ **Refer to Positioning Control Edition.**

[Various positioning instructions]

Instruction	Description
DSZR	Mechanical zero return instruction with DOG search function.
ABS	Instruction to read the current value from our servo amplifier with absolute position (ABS) detecting function.
DRVI	Positioning (relative positioning) to specify the movement from the current position.
DRVA	Positioning (absolute positioning) to specify the target position based on the current value 0.
PLSV	Instruction to change the pulse train output frequency.

→ **Refer to Positioning Control Edition.**

4. Specifications, External Dimensions and Terminal Layout (Main Units)

This chapter explains the specifications, external dimensions and terminal layout of the main units.

4.1 Generic Specifications

The generic specifications for the main unit are explained below.

Item	Specification				
Ambient temperature	0 to 55 °C (32 to 131 °F) when operating and -25 to 75 °C (-13 to 167 °F) when stored				
Ambient humidity	5 to 95 %RH (no condensation) when operating				
Vibration resistance*1		Frequency (Hz)	Acceleration (m/s^2)	Half amplitude (mm)	
	When installed on DIN rail	10 to 57	-	0.035	Sweep Count for X, Y, Z: 10 times (80 min in each direction)
		57 to 150	4.9	-	
	When installed directly	10 to 57	-	0.075	
		57 to 150	9.8	-	
Shock resistance*1	147 m/s^2 Acceleration, Action time: 11 ms, 3 times by half-sine pulse in each direction X, Y, and Z				
Noise resistance	By noise simulator at noise voltage of 1,000 Vp-p, noise width of 1 μs, rise time of 1 ns and period of 30 to 100 Hz				
Dielectric withstand voltage	1.5 kV AC for 1 min	Between each terminals and ground terminal*2			
	500 V AC for 1 min				
Insulation resistance	5 MΩ or more by 500 V DC megger				
Grounding	Class D grounding (grounding resistance: 100 Ω or less) <Common grounding with a heavy electrical system is not allowed.>*3				
Working atmosphere	Free from corrosive or flammable gas and excessive conductive dust				
Working altitude	<2000 m*4				

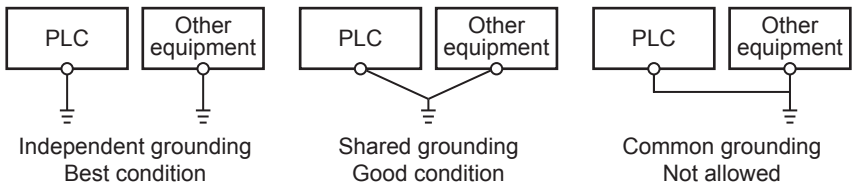
*1. The criterion is shown in IEC61131-2.

*2. For more information on the dielectric withstand voltage test and the insulation resistance test of the terminals of each product, refer to the following.

→ **Refer to Subsection 4.1.1.**

*3. Ground the PLC independently or jointly.

→ **Refer to Section 8.3.**



*4. The PLC cannot be used at a pressure higher than the atmospheric pressure to avoid damage.

4.1.1 Dielectric withstand voltage test and insulation resistance test

Perform dielectric withstand voltage test and insulation resistance test at the following voltage between each terminals and the main unit ground terminal.

Terminal	Dielectric strength	Insulation resistance	Remark
Terminals of main unit			
Between power supply terminal (AC power) and ground terminal	1.5 kV AC for 1 min	5 MΩ or more by 500 V DC megger	-
Between input terminal (24 V DC) and ground terminal	500 V AC for 1 min		-
Between output terminal (relay) and ground terminal	1.5 kV AC for 1 min		-
Between output terminal (transistor) and ground terminal	500 V AC for 1 min		-
Terminals of expansion boards, special adapters			
Between terminal of expansion board and ground terminal	Not allowed	Not allowed	Since the expansion board and the main unit CPU are not insulated, it is not allowed to perform the dielectric withstand voltage test and insulation resistance test between them.
Between terminal of special adapter and ground terminal	500 V AC for 1 min	5 MΩ or more by 500 V DC megger	-

4.2 Power Supply Specifications

The power supply specifications for the main unit are explained below.

Item	Specification			
	FX3S-10M□/E□	FX3S-14M□/E□	FX3S-20M□/E□	FX3S-30M□/E□
Supply voltage	100 to 240 V AC			
Allowable supply voltage range	85 to 264 V AC			
Rated frequency	50/60 Hz			
Allowable instantaneous power failure time	Operation can be continued upon occurrence of instantaneous power failure for 10 ms or less.			
Power fuse	250 V 1 A			
Rush current	15 A max. 5 ms or less/100 V AC, 28 A max. 5 ms or less/200 V AC			
Power consumption*1	19 W	19 W	20 W	21 W
24 V DC service power supply	400 mA			

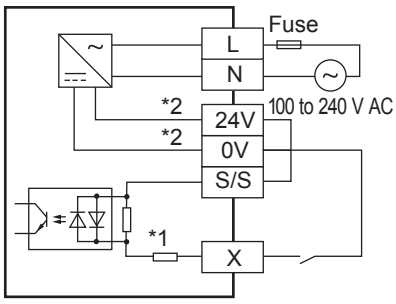
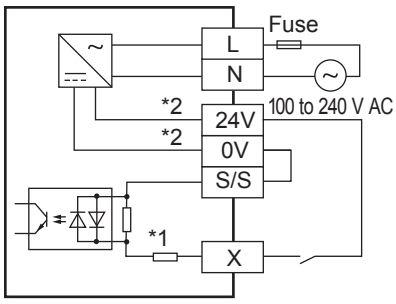
*1. This item shows values when all 24 V DC service power supplies are used in the maximum configuration connectable to the main unit, and includes the input current (5 or 7 mA per point).

4.3 Input Specifications

The input specifications for the main unit are explained below.

4.3.1 24 V DC Input (sink/source)

→ **For details on sink input and source input, refer to Subsection 9.1.1.**

Item		Specification			
		FX3S-10M□	**FX3S-14M□**	**FX3S-20M□**	**FX3S-30M□**
Number of input points		6 points	8 points	12 points	16 points
Input connecting type		Fixed terminal block (M3 screw)			
Input form		Sink/Source			
Input signal voltage		24 V DC +10%, -10%			
Input impedance	X000 to X007	3.3 kΩ			
	X010 to X017	-		4.3 kΩ	
Input signal current	X000 to X007	7 mA/24 V DC			
	X010 to X017	-		5 mA/24 V DC	
ON input sensitivity current	X000 to X007	4.5 mA or more			
	X010 to X017	-		3.5 mA or more	
OFF input sensitivity current		1.5 mA or less			
Input response time		Approx. 10 ms			
Input signal form	Sink input	No-voltage contact input NPN open collector transistor			
	Source input	No-voltage contact input PNP open collector transistor			
Input circuit insulation		Photocoupler insulation			
Input operation display		LED on panel lights when photocoupler is driven.			
Input circuit configuration		Sink input wiring 		Source input wiring 	

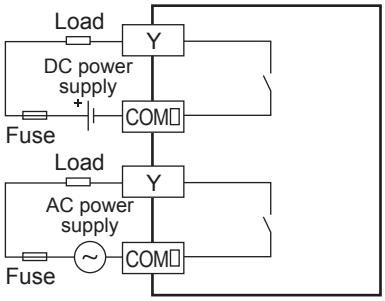
*1. Input impedance.

*2. The "24V" and "0V" terminals are located on the output terminal side.
For details on the terminal layout, refer to Section 4.7.

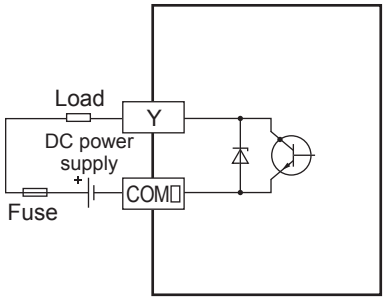
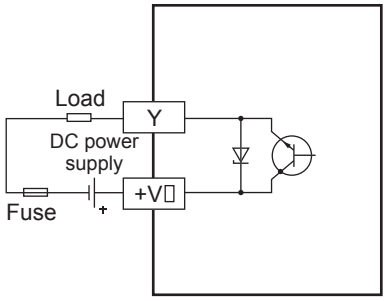
4.4 Output Specifications

The output specifications for the main unit are explained below.

4.4.1 Relay output specifications

Item		Relay output specification			
		FX3S-10MR□	**FX3S-14MR□**	**FX3S-20MR□**	**FX3S-30MR□**
Number of output points		4 points	6 points	8 points	14 points
Output connecting type		Fixed terminal block (M3 screw)			
Output form		Relay			
External power supply		30 V DC or less, 240 V AC or less (250 V AC or less when the unit does not comply with CE, UL or cUL standards.)			
Max. load	Resistance load	2 A/point The total load current of resistance loads per common terminal should be the following value. → **For details on the common terminal for each model, refer to the Section 4.7.** • 1 output point/common terminal: 2 A or less • 4 output points/common terminal: 8 A or less			
	Inductive load	80 VA (UL and cUL standards approved at 120 and 240 V AC.) → **For the product life, refer to Subsection 13.4.2.** → **For cautions on external wiring, refer to Subsection 11.1.3.**			
Min. load		5 V DC, 2 mA (reference value)			
Open circuit leakage current		-			
Response time	OFF→ON ON→OFF	Approx. 10 ms			
Output circuit insulation		Mechanical insulation			
Output operation display		LED on panel lights when power is applied to relay coil.			
Output circuit configuration		 A common number applies to the □ of [COM□].			

4.4.2 Transistor output specifications

Item		Transistor output specification			
		FX3S-10MT□	**FX3S-14MT□**	**FX3S-20MT□**	**FX3S-30MT□**
Number of output points		4 points	6 points	8 points	14 points
Output connecting type		Fixed terminal block (M3 screw)			
Output form		Transistor/sink output (FX3S-□MT/ES) Transistor/source output (FX3S-□MT/ESS)			
External power supply		5 to 30 V DC			
Max. load	Resistance load	0.5 A/point The total load current of resistance loads per common terminal should be the following value. → **For details on the common terminal for each model, refer to the Section 4.7.** • 1 output point/common terminal: 0.5 A or less • 4 output points/common terminal: 0.8 A or less			
	Inductive load	12 W/24 V DC The total of inductive loads per common terminal should be the following value. → **For details on the common terminal for each model, refer to the Section 4.7.** • 1 output point/common terminal: 12 W or less/24 V DC • 4 output points/common terminal: 19.2 W or less/24 V DC			
Open circuit leakage current		0.1 mA or less/30 V DC			
ON voltage		1.5 V or less			
Response time	OFF→ON ON→OFF	Y000, Y001: 5 μs or less/10 mA or more (5 to 24 V DC) Y002 to Y015: 0.2 ms or less/200 mA or more (at 24 V DC)			
Output circuit insulation		Photocoupler insulation			
Output operation display		LED on panel lights when photocoupler is driven.			
Output circuit configuration		Sink output wiring  A common number applies to the □ of [COM□].		Source output wiring  A common number applies to the □ of [+V□].	

4.5 Performance Specifications

The performance specifications for the main unit are explained below.

Item		Performance		
Operation control system		Stored program repetitive operation system with interruption function.		
Input/output control system		Batch processing system (when END instruction is executed) Input/output refresh instruction and pulse catch function are provided.		
Programming language		Relay symbol system + step-ladder system (SFC notation possible)		
Program memory	Built-in memory capacity/type	16,000 steps/EEPROM memory (Program capacity is 4000 steps.) Max. allowable write: 20,000 times		
	Memory cassette (Option)	32,000 steps/EEPROM memory (with loader function) The FX3S Series PLC is available only to 16,000 steps. (Program capacity is 4000 steps.) Max. allowable write: 10,000 times		
	Writing function during running	Provided (Program can be modified while the PLC is running.) → **For the writing function during running, refer to Subsection 5.2.5.**		
	Keyword function	With keyword/Customer keyword function		
Real-time clock	Clock function*1	Built-in 1980 to 2079 (with correction for leap year) 2- or 4-digit year, accuracy within 45 seconds/month at 25 °C		
Kinds of instructions	Basic instructions	Sequence instructions: 29 Step-ladder instructions: 2		
	Applied instructions	116 kinds		
Processing speed	Basic instructions	0.21 μs/instruction		
	Applied instructions	0.5 μs to several hundred μs/instruction		
Number of input/ output points	Input points	16 points or less (Extension is impossible.)		
	Output points	14 points or less (Extension is impossible.)		
Input/output relay	Input relay	X000 to X017	The device numbers are octal.	
	Output relay	Y000 to Y015		
Auxiliary relay	For general	M0 to M383	384 points	
	EEPROM keep	M384 to M511	128 points	
	For general	M512 to M1535	1024 points	
	For special	M8000 to M8511	512 points	
State	For initial state (EEPROM keep)	S0 to S9	10 points	
	EEPROM keep	S10 to S127	118 points	
	For general	S128 to S255	128 points	
Timer (on-delay timer)	100 ms	T0 to T31	32 points	0.1 to 3,276.7 sec
	100 ms/10 ms	T32 to T62	31 points	0.1 to 3,276.7 sec/0.01 to 327.67 sec When M8028 is driven ON, timers T32 to T62 (31 points) are changed to 10 ms resolution.
	1 ms	T63 to T127	65 points	0.001 to 32.767 sec
	1 ms accumulating type	T128 to T131	4 points	0.001 to 32.767 sec
	100 ms accumulating type	T132 to T137	6 points	0.1 to 3,276.7 sec
Variable analog potentiometers		Available as analog timers VR1: D8030 VR2: D8031		
Counter	16 bits up (For general)	C0 to C15	16 points	Counting from 0 to 32,767
	16 bits up (EEPROM keep)	C16 to C31	16 points	Counting from 0 to 32,767
	32 bits up/down (For general)	C200 to C234	35 points	Counting from -2,147,483,648 to +2,147,483,647
High-speed counter	1-phase 1-count input in both directions (32 bits up/down) (EEPROM keep)	C235 to C245	Counting from -2,147,483,648 to +2,147,483,647	
	1-phase 2-count input in both directions (32 bits up/down) (EEPROM keep)	C246 to C250		
	2-phase 2-count input in both directions (32 bits up/down) (EEPROM keep)	C251 to C255		

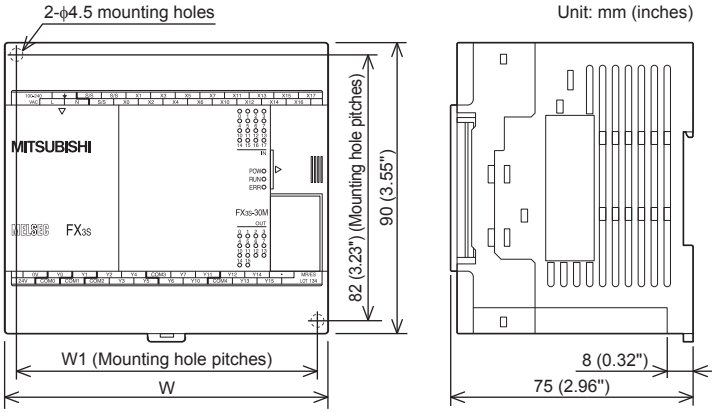
Item		Performance		
Data register (32 bits when paired)	For general (16 bits)	D0 to D127	128 points	
	For EEPROM keep (16 bits)	D128 to D255	128 points	
	For general (16 bits)	D256 to D2999	2744 points	
	File register (EEPROM keep)	D1000 to D2999	Max. 2000 points	Can be set as file registers in units of 500 points from D1000 in the program area (EEPROM) using parameters.
	For special (16 bits)	D8000 to D8511	512 points	
	For index (16 bits)	V0 to V7 Z0 to Z7	16 points	
Pointer	For branching of JUMP and CALL	P0 to P255	256 points	For CJ instructions and CALL instructions
	Input interruption	I0□□ to I5□□	6 points	
	Timer interruption	I6□□ to I8□□	3 points	
Nesting	For master control	N0 to N7	8 points	For MC instructions
Constant	Decimal number (K)	16 bits	-32,768 to +32,767	
		32 bits	-2,147,483,648 to +2,147,483,647	
	Hexadecimal number (H)	16 bits	0 to FFFF	
		32 bits	0 to FFFFFFFF	
	Real number (E)	32 bits	-1.0×2^{128} to -1.0×2^{-126}, 0 , 1.0×2^{-126} to 1.0×2^{128} Decimal-point and exponential notations are possible.	

*1. The current time of the clock is backed up by the capacitor built-in the PLC. Supply the power to the PLC for 30 minutes or more to completely charge this large-capacity capacitor.
(The capacitor works for 10 days (atmosphere: 25 °C)

4.6 External Dimensions (Weight/Accessories/Installation)

The external dimensions of the main unit are explained.

4.6.1 Main units



Series	Model name	W: mm (inches)	W1: mm (inches) Direct mounting hole pitches	MASS (Weight): kg (lbs)
FX3S-10M□	FX3S-10MR/ES	60 (2.37”)	52 (2.05”)	0.30 (0.66 lbs)
	FX3S-10MT/ES			
	FX3S-10MT/ESS			
FX3S-14M□	FX3S-14MR/ES	60 (2.37”)	52 (2.05”)	0.30 (0.66 lbs)
	FX3S-14MT/ES			
	FX3S-14MT/ESS			
FX3S-20M□	FX3S-20MR/ES	75 (2.96”)	67 (2.64”)	0.40 (0.88 lbs)
	FX3S-20MT/ES			
	FX3S-20MT/ESS			
FX3S-30M□	FX3S-30MR/ES	100 (3.94”)	92 (3.63”)	0.45 (0.99 lbs)
	FX3S-30MT/ES			
	FX3S-30MT/ESS			

1) Accessories
Dust proof protection sheet
Manual supplied with product

2) Installation
35 mm (1.38") wide DIN rail or Direct installation (with M4 screws)