JY997D49401E

MITSUBISHI ELECTRIC

PROGRAMMABLE CONTROLLERS

MELSEC-F

FX3GE SERIES PROGRAMMABLE CONTROLLERS

HARDWARE MANUAL

FX 3GE

Manual Number	JY997D49401
Revision	E
Date	July 2014

This manual describes the part names, dimensions, mounting, and specifications of the product. Before use, read this manual and the manuals of all relevant products fully to acquire proficiency in handling and operating the product. Make sure to learn all the product information, safety information, and precautions.
Store this manual in a safe place so that it can be taken out and read whenever necessary. Always forward it to the end user.
Registration
Ethernet is a trademark of Xerox Corporation.
Phillips is a registered trademark of Phillips Screw Company.
The company and product names described in this manual are registered trademarks or the trademarks of their respective companies.

Effective July 2014
Specifications are subject to change without notice.

Safety Precaution (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 medium or slight personal injury or physical damage.

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

STARTUP AND MAINTENANCE PRECAUTIONS ⚠WARNING

- Do not touch any terminal while the PLC's power is on.
  Doing so may cause electric shock or malfunctions.
- Before cleaning or retightening terminals, cut off all phases of the power supply externally.
  Failure to do so may cause electric shock.
- This product shall be powered by a UL Listed or Recognized 24 V DC isolating source when the DC power supply type product is powered by a power supply converted from hazardous voltages.
- Use the battery for memory backup correctly in FX3G Series User's Manual - Hardware Edition.
  - Use the battery only for the specified purpose.
  - Connect the battery correctly.
  - Do not charge, disassemble, heat, put in fire, short-circuit, connect reversely, weld, swallow or burn the battery, or apply excessive forces (vibration, impact, drop, etc.) to the battery.
  - Do not store or use the battery at high temperatures or expose to direct sunlight.
  - Do not expose to water, bring near fire or touch liquid leakage or other contents directly.
  - Incorrect handling of the battery may cause heat excessive generation, bursting, ignition, liquid leakage or deformation, and lead to injury, fire or failures and malfunctions of facilities and other equipment.
- Before modifying or disrupting the program in operation or running the PLC, carefully read through this manual and the associated manuals and ensure the safety of the operation.
  An operation error may damage the machinery or cause accidents.

STARTUP AND MAINTENANCE PRECAUTIONS ⚠CAUTION

- Turn off the power to the PLC before attaching or detaching the memory cassette.
  If the memory cassette is attached or detached while the PLC's power is on, the data in the memory may be destroyed, or the memory cassette may be damaged.
- Do not disassemble or modify the PLC.
  Doing so may cause fire, equipment failures, or malfunctions.
  For repair, contact your local Mitsubishi Electric representative.
- Turn off the power to the PLC before connecting or disconnecting any extension cable.
  Failure to do so may cause equipment failures or malfunctions.
- Turn off the power to the PLC before attaching or detaching the following devices.
  Failure to do so may cause equipment failures or malfunctions.
  - Peripheral devices, display module, and expansion boards
  - Extension units/blocks and special adapters
  - Battery and memory cassette

DISPOSAL PRECAUTIONS ⚠CAUTION

- Please contact a certified electronic waste disposal company for the environmentally safe recycling and disposal of your device.
  When disposing of batteries, separate them from other waste according to local regulations.
  (For details of the Battery Directive in EU countries, refer to FX3G Series User's Manual - Hardware Edition.)

TRANSPORTATION AND STORAGE PRECAUTIONS ⚠CAUTION

- When transporting the FX3GE Series PLC incorporating the optional battery, turn on the PLC before shipment, confirm that the battery mode is set using a parameter and the ALM LED is OFF, and check the battery life.
  If the PLC is transported with the ALM LED on or the battery exhausted, the battery-backed data may be unstable during transportation.
- The PLC is a precision instrument. During transportation, avoid impacts larger than those specified in Section 3.1. Failure to do so may cause failures in the PLC.
  After transportation, verify the operations of the PLC.
- When transporting lithium batteries, follow required transportation regulations.
  (For details of the regulated products, refer to FX3G Series User's Manual - Hardware Edition.)

Overview

FX3GE PLC has an Ethernet communication function and analog input/output function built into a base that is FX3G PLC.
The Ethernet communication function is equivalent to FX3U-ENET-ADP.
The analog input/output function (analog input 2 channels, analog output 1 channel) is equivalent to FX3U-3A-ADP.

Associated manuals

How to obtain manuals

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

Associated manuals
FX3GE Series PLC (main unit) comes with this document (hardware manual).
For a detailed explanation of the FX3GE Series hardware and information on instructions for PLC programming and special function unit/block, refer to the relevant documents.
Specifications not described in this manual are same as FX3G PLC. For details, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Manual name	Manual No.	Description
FX3G Series User's Manual - Hardware Edition	JY997D31301 MODEL CODE: 09R521	Explains FX3G Series PLC specification details for I/O, wiring, installation, and maintenance.
FX3S/FX3G/FX3GC/FX3U/FX3UC Series Programming Manual - Basic & Applied Instruction Edition	JY997D16601 MODEL CODE: 09R517	Describes PLC programming for basic/applied instructions STL/SFC programming and devices.
MELSEC-Q/L/F Structured Programming Manual (Fundamentals)	SH-080782 MODEL CODE: 13JW06	Programming methods, specifications, functions, etc. required to create structured programs.
FXCPU Structured Programming Manual [Device & Common]	JY997D26001 MODEL CODE: 09R925	Devices, parameters, etc. provided in structured projects of GX Works2.
FXCPU Structured Programming Manual [Basic & Applied Instruction]	JY997D34701 MODEL CODE: 09R926	Sequence instructions provided in structured projects of GX Works2.
FXCPU Structured Programming Manual [Application Functions]	JY997D34801 MODEL CODE: 09R927	Application functions provided in structured projects of GX Works2.
FX Series User's Manual - Data Communication Edition	JY997D16901 MODEL CODE: 09R715	Explains N:N link, parallel link, computer link, no protocol communication by RS instructions/FX2N-232IF.
FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition	JY997D16701 MODEL CODE: 09R619	Describes specifications for analog control and programming methods for FX3S/FX3G/FX3GC/FX3U/FX3UC Series PLC.
FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Positioning Control Edition	JY997D16801 MODEL CODE: 09R620	Explains the specifications for positioning control of FX3S/FX3G/FX3GC/FX3U/FX3UC Series and programming procedures
FX3U-ENET-ADP User's Manual	JY997D45801 MODEL CODE: 09R725	Describes FX3U-ENET-ADP Ethernet communication special adapter details.

Certification of UL, cUL standards

Please consult with Mitsubishi Electric for information on UL, cUL standard practices and the corresponding types of equipment.

Compliance with EC directive (CE Marking)

This document does not guarantee that a mechanical system including this product will comply with the following standards.
Compliance to EMC directive and LVD directive of the entire mechanical system should be checked by the user/manufacturer. For more details please contact the local Mitsubishi Electric sales site.

Requirement for Compliance with EMC directive

The following products have shown compliance through direct testing (of the identified standards below) and design analysis (through the creation of a technical construction file) to the European Directive for Electromagnetic Compatibility (2004/108/EC) when used as directed by the appropriate documentation.

Attention

- This product is designed for use in industrial applications.

Note

- Manufactured by:
  Mitsubishi Electric Corporation
  2-7-3 Marunouchi, Chiyoda-ku, Tokyo, 100-8310 Japan
- Manufactured at:
  Mitsubishi Electric Corporation Himeji Works
  840 Chiyoda-machi, Himeji, Hyogo, 670-8677 Japan
- Authorized Representative in the European Community:
  Mitsubishi Electric Europe B.V.
  Gothaer Str. 8, 40880 Ratingen, Germany

Type : Programmable Controller (Open Type Equipment)
Models : MELSEC FX3GE series, FX3G series, FX3U series manufactured

from June 1st, 2005	FX3U-232ADP	FX3U-485ADP
	FX3U-4AD-ADP	FX3U-4DA-ADP
	FX3U-4AD-PT-ADP	FX3U-4AD-TC-ADP
from April 1st, 2007	FX3U-232ADP-MB	FX3U-485ADP-MB
from December 1st, 2007	FX3U-4AD-PTW-ADP	
	FX3U-4AD-PNK-ADP	
from November 1st, 2008	FX3G-232-BD	FX3G-422-BD
	FX3G-485-BD	
	FX3G-EEPROM-32L	
	FX3G-2AD-BD	FX3G-1DA-BD
	FX3G-8AV-BD	FX3G-5DM
from June 1st, 2009	FX3U-3A-ADP	
from March 1st, 2013	FX3GE-★★MR/ES	
from June 1st, 2013	FX3GE-★★MT/ES	FX3GE-★★MT/ESS
from August 1st, 2013	FX3GE-★★MR/DS	FX3GE-★★MT/DS
	FX3GE-★★MT/DSS	
	Where ★★ indicates: 24, 40	
from September 1st, 2013	FX3G-4EX-BD	FX3G-2EYT-BD
	FX3G-485-BD-RJ	

Standard	Remark
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	Compliance with all relevant aspects of the standard. EMI • Radiated Emission • Conducted Emission EMS • Radiated electromagnetic field • Fast transient burst • Electrostatic discharge • High-energy surge • Voltage drops and interruptions • Conducted RF • Power frequency magnetic field

Models : MELSEC FX2N series manufactured

from July 1st, 1997	FX2N-★★ER-ES/UL	FX2N-★★ET-ESS/UL
	Where ★★ indicates:32,48	
	FX2N-16EX-ES/UL	FX2N-16EYR-ES/UL
	FX2N-16EYT-ESS/UL	
from April 1st, 1998	FX2N-48ER-DS	FX2N-48ET-DSS
from August 1st, 1998	FX2N-48ER-UA1/UL	
from August 1st, 2005	FX2N-8ER-ES/UL	FX2N-8EX-ES/UL
	FX2N-8EYR-ES/UL	FX2N-8EYT-ESS/UL
from September 1st, 2010	FX2N-8EYR-S-ES/UL	

For the products above, PLCs manufactured
before March 31st, 2002 are compliant with EN50081-2 (EN61000-6-4) and EN50082-2
from April 1st, 2002 to April 30th, 2006 are compliant with EN50081-2 (EN61000-6-4) and EN61131-2:1994+A11:1996+A12:2000
after May 1st, 2006 are compliant with EN61131-2:2007

Standard	Remark
EN61000-6-4:2007 - Generic emission standard Industrial environment EN50081-2:1993 Electromagnetic compatibility	Compliance with all relevant aspects of the standard. • Emission-Enclosure port • Emission-Low voltage AC mains port • Emission-Telecommunications/network port
EN50082-2:1995 Electromagnetic compatibility - Generic immunity standard Industrial environment	Compliance with all relevant aspects of the standard. • RF Immunity • Fast Transients • ESD • Conducted • Power magnetic fields
EN61131-2:1994 /A11:1996 /A12:2000 Programmable controllers - Equipment requirements and tests	Compliance with all relevant aspects of the standard. • Radiated electromagnetic field • Fast Transient burst • Electrostatic discharge • Damped oscillatory wave
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	Compliance with all relevant aspects of the standard. EMI • Radiated Emission • Conducted Emission EMS • Radiated electromagnetic field • Fast transient burst • Electrostatic discharge • High-energy surge • Voltage drops and interruptions • Conducted RF • Power frequency magnetic field

Requirement for Compliance with LVD directive

The following products have shown compliance through direct testing (of the identified standards below) and design analysis (through the creation of a technical construction file) to the European Directive for Low Voltage (2006/95/EC) when used as directed by the appropriate documentation.

Type : Programmable Controller (Open Type Equipment)

Models : MELSEC FX3GE series manufactured

from March 1st, 2013 FX3GE-★★MR/ES
from June 1st, 2013 FX3GE-★★MT/ES FX3GE-★★MT/ESS
from August 1st, 2013 FX3GE-★★MR/DS
Where ★★ indicates: 24, 40

Standard	Remark
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of EN61131-2:2007

Models :MELSEC FX2N series manufactured

from July 1st, 1997 FX2N-★★ER-ES/UL FX2N-★★ET-ESS/UL
Where ★★ indicates:32, 48
FX2N-16EYR-ES/UL
from April 1st, 1998 FX2N-48ER-DS
from August 1st, 1998 FX2N-48ER-UA1/UL
from August 1st, 2005 FX2N-8ER-ES/UL FX2N-8EYR-ES/UL
from September 1st, 2010 FX2N-8EYR-S-ES/UL

For the products above, PLCs manufactured
before March 31st, 2002 are compliant with IEC1010-1
from April 1st, 2002 to April 30th, 2006 are compliant with EN61131-2:1994+A11:1996+A12:2000
after May 1st, 2006 are compliant with EN61131-2:2007

Standard	Remark
IEC1010-1:1990 /A1:1992 Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of IEC 1010-1: 1990+A1:1992
EN61131-2:1994 /A11:1996 /A12:2000 Programmable controllers - Equipment requirements and tests	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of EN61131-2: 1994+A11:1996+A12:2000
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of EN61131-2:2007

Caution for compliance with EC Directive

Installation in Enclosure

Programmable logic controllers are open-type devices that must be installed and used within conductive control boxes. Please use the FX3GE Series programmable logic controllers while installed in conductive shielded control boxes. Please secure the control box lid to the control box (for conduction).
Installation within a control box greatly affects the safety of the system and aids in shielding noise from the programmable logic controller.

Analog input/output

The analog input/output have been found to be compliant to the European standards in the aforesaid manual and directive. However, for the very best performance from what are in fact delicate measuring and controlled output devices, Mitsubishi Electric would like to make the following points.
As analog devices are sensitive by nature, their use should be considered carefully. For users of proprietary cables (integral with sensors or actuators), these users should follow those manufacturers' installation requirements.
Mitsubishi Electric recommends that shielded cables be used. If NO other EMC protection is provided, users may experience temporary loss or accuracy between +10% / -10% in very heavy industrial areas.
However, Mitsubishi Electric suggests that adequate EMC precautions be followed for the users complete control system.

- Sensitive analog cables should not be laid in the same trunking or cable conduit as high voltage cabling. Where possible, users should run analog cables separately.
- Good cable shielding should be used. When terminating the shield at Earth, ensure that no earth loops are accidentally created.
- When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the analog products or through a user's program in the FX3GE Series PLC main unit.

Incorporated Items

Check if the following product and items are included in the package.

	Included Items	
■ Main units		
FX3GE-24M□, FX3GE-40M□	Product	1 unit
	Dust proof protection sheet	1 sheet
	Manuals [English]	1 manual

1. Features and cautions on using FX3GE PLC

FX3GE PLC has an Ethernet communication function and analog input/output function built into a base that is FX3G PLC.
This section describes below differences between FX3G and FX3GE and cautions on use.
For details, refer also to the FX3G Series User's Manual - Hardware Edition.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

1.1 Additional function from the FX3G series

- Ethernet communication function
  The PLC has a Ethernet communication function (Equivalent to FX3U-ENET-ADP).
- Analog input/output function
  The PLC has analog input 2 channels, analog output 1 channel (Equivalent to FX3U-3A-ADP). Specifications differ from FX3U-3A-ADP in part. For details, refer to Chapter 6.

1.2 Programming tool

GX Works2 Ver. 1.91V or later can be used. Select "FX3G" in "PLC Type". When setting "Ethernet port settings", using GX Works2 Ver.1.91V or later.
FX-30P and GX Developer can also be used. However, "Ethernet port setting" cannot be set.
In the case that the version does not support FX3G, the programming tool can still be used by choosing FX1N. However, programming is enabled only in the functional range such as instructions, device ranges and program sizes available in a PLC selected as the alternative model.

1.3 Using the built-in Ethernet

When GX Works2 or MX Component is used, set the parameter settings and connection destination settings of the built-in Ethernet using the same settings as FX3U-ENET-ADP.

1.4 Terminal block

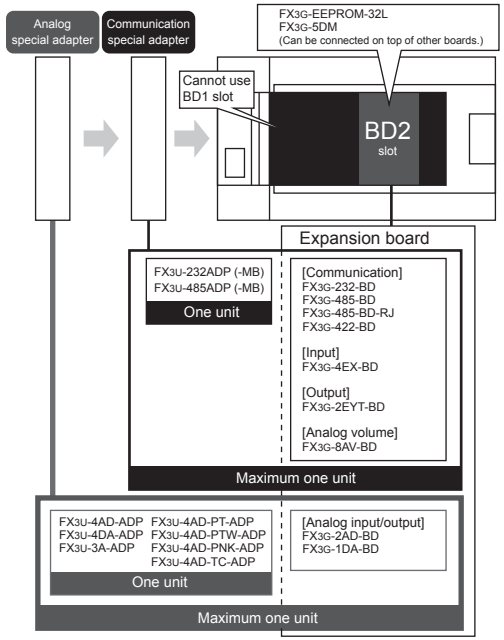
The input/output terminal block of FX3GE series PLC is built-in.
Terminal block cannot be removed.

1.5 System configuration

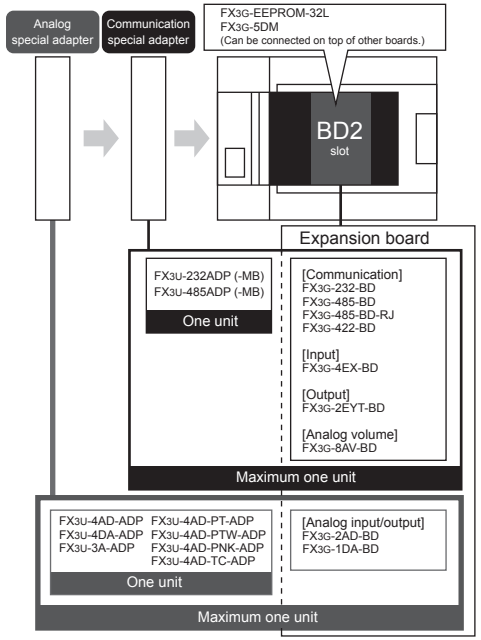
- Special adapters can be directly connected to the main unit.
  (It is not necessary to connect a connector conversion adapter.)
- One communication and one analog expansion option can be connected.
  Expansion is available for one expansion board and two special adapters. But the expansion board cannot be connected when two special adapters are connected.
- 40 point I/O type cannot use the BD1 slot.
- FX3G-CNV-ADP, FX3U-ENET-ADP cannot be connected.
- The communication channel of the built-in Ethernet is CH1. When a communication expansion board or a communication special adapter is connected to the PLC, that communication channel becomes CH2.
- The built-in analog is the analog special adapter first unit.
  When an analog expansion board is connected, the analog expansion board becomes second unit. When an analog special adapter is connected, the analog special adapter becomes second unit.

Please refer to the following for details.

1) In the case of 40 point type



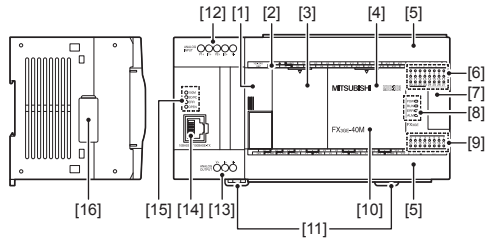
2) In the case of 24 point type



2. Outline

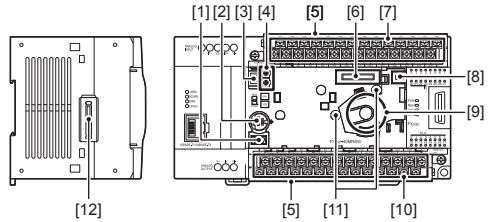
2.1 Part names

For the input/output extension units/blocks, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**



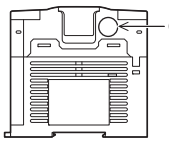
No.	Name		
[1]	Peripheral device connector cover		
[2]	Terminal names		
[3]	Top cover (S) (40points type only)		
[4]	Top cover		
[5]	Terminal block covers		
[6]	Input display LEDs (red)		
[7]	Extension device connector cover		
[8]	Operation status display LEDs		
	POW	Green	On while power is on the PLC.
	RUN	Green	On while the PLC is running.
	ERR	Red	Flashing when a program error occurs.
		Red	Lit when a CPU error occurs.
	ALM	Red	Lit when the battery voltage drops. (When the optional battery is used)
[9]	Output display LEDs (red)		
[10]	Model name (abbreviation)		
[11]	DIN rail mounting hooks		
[12]	Analog input terminal block		
[13]	Analog output terminal block		
[14]	10BASE-T/100BASE-TX connector (RJ45)		
[15]	Ethernet status LEDs		
[16]	Special adapter connector cover		

With terminal cover open



No.	Name
[1]	Peripheral device connector (USB)
[2]	Peripheral device connector (RS-422)
[3]	RUN/STOP switch
[4]	Variable analog potentiometers Upper side : VR1, Lower side : VR2
[5]	Terminal cover
[6]	Optional equipment connector
[7]	Power supply terminal, Input (X) terminals
[8]	Battery connector
[9]	Battery holder
[10]	Power supply terminal, Output (Y) terminals
[11]	Optional equipment connecting screw holes
[12]	Special adapter connector

Right side



The authentication label for authorized products is affixed to the right side of the product to avoid to be forged.
Products that do not have the genuine product certification label or nameplate are not covered by the warranty.

2.2 LED status

PLC part

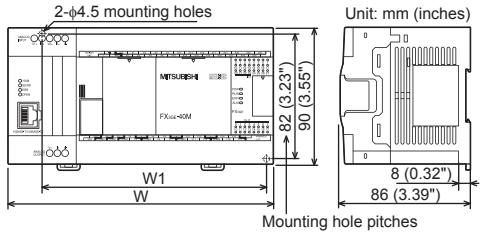
LED display	LED color	Status	Description
POW	Green	ON	Power is on
		OFF	Power is off
RUN	Green	ON	Running
		OFF	Stopped
ERR	Red	ON	When a CPU error occurs.
		Flicker	When a program error occurs.
		OFF	When a normal status.
ALM	Red	ON	When the battery voltage drops. (When the optional battery is installed.)
		OFF	When the battery voltage normal status. (When the optional battery is installed.)

Built-in Ethernet part

LED display	LED color	Status	Description
100M	Green	ON	100Mbps communication
		OFF	10Mbps communication or not connected
SD/RD	Green	ON	Data being sent or received.
		OFF	Data is not sent or received.
ERR	Red	ON	Setting errors, hardware errors, etc.
		Flicker	Communication errors
		OFF	Setting normal, communication normal
OPEN	Green	ON	TCP/IP: 1 or more connections are established. UDP: 1 or more connections are open.
		OFF	TCP/IP: All connections are unestablished. UDP: All connections are closed.

2.3 External dimensions and weight

For the input/output extension units/blocks, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**



Model name	W: mm (inches)	W1: mm (inches) Direct mounting hole pitches	MASS (Weight): kg (lbs)
FX3GE-24M□	130 (5.12")	105 (4.13")	Approx. 0.60 (1.32lbs)
FX3GE-40M□	175 (6.89")	150 (5.90")	Approx. 0.80 (1.76lbs)

Installation

- 35-mm-wide DIN rail or Direct (screw) mounting (M4)

3. Installation (general specifications)

As for installation of the input/output extension units/blocks, special adapters and expansion boards, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

INSTALLATION PRECAUTIONS ⚠**CAUTION**

- Use the product within the generic environment specifications described in section 3.1 of this manual.
  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.
- Do not touch the conductive parts of the product directly.
  Doing so may cause device failures or malfunctions.
- Install the product securely using a DIN rail or mounting screws.
- 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.
- When drilling screw holes or wiring, make sure that cutting and wiring debris do not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Be sure to remove the dust proof sheet from the PLC's ventilation port when installation work is completed.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Connect the extension cables, peripheral device cables, input/output cables and battery connecting cable securely to their designated connectors.
  Loose connections may cause malfunctions.
- Turn off the power to the PLC before attaching or detaching the following devices.
  Failure to do so may cause device failures or malfunctions.
  - Peripheral devices, display modules, and Extension units/blocks
  - Expansion boards, special adapters, battery and memory cassette

Notes

- When a dust proof sheet is supplied with units, keep the sheet applied to the ventilation slits during installation and wiring work.
- To prevent temperature rise, do not install the PLC on a floor, a ceiling or a vertical surface.
  Install it horizontally on a wall as shown in section 3.2.
- Keep a space of 50mm (1.97") or more between the unit main body and another device or structure (part A). Install the unit as far away as possible from high-voltage lines, high-voltage devices and power equipment.

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.

3.1 Generic specifications

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)	Sweep Count for X, Y, Z: 10 times (80 min in each direction)
	When installed on DIN rail	10 to 57	-	0.035	
		57 to 150	4.9	-	
	When installed directly	10 to 57	-	0.075	
		57 to 150	9.8	-	
Shock resistance*1	147m/s^2 Acceleration, Action time: 11ms, 3 times by half-sine pulse in each direction X, Y, and Z				
Noise resistance	By noise simulator at noise voltage of 1,000Vp-p, noise width of 1μs, rise time of 1ns and period of 30 to 100Hz				
Dielectric withstand voltage*2	1.5kV AC for one minute	Between each terminals*2 and ground terminal			
	500V AC for one minute				
Insulation resistance*2	5MΩ or more by 500V DC megger				
Grounding	Class D grounding (grounding resistance: 100Ω or less) <Common grounding with a heavy electrical system is not allowed.>*3				
Working atmosphere	Free from corrosive or flammable gas and excessive conductive dusts				
Working altitude	<2000m*4				

*1 The criterion is shown in IEC61131-2.

*2 Dielectric withstand voltage and insulation resistance are shown in the following table.

Terminal	Dielectric strength	Insulation resistance
■ Main units, Input/output extension units/blocks		
Between power supply terminal (AC power) and ground terminal	1.5kV AC for one minute	5MΩ or more by 500V DC megger
Between power supply terminal (DC power) and ground terminal	500V AC for one minute	
Between input terminal (24V DC) and ground terminal		
Between input terminal (100V AC) and ground terminal*5	1.5kV AC for one minute	
Between output terminal (relay) and ground terminal		
Between output terminal (transistor) and ground terminal	500V AC for one minute	
Between output terminal (triac) and ground terminal*5	1.5kV AC for one minute	
10BASE-T/100BASE-TX connector and ground terminal	500V AC for one minute	
Main unit analog terminal and ground terminal	Not allowed	Not allowed
■ Expansion boards, Special adapters, Special function blocks		
Between terminal of expansion board (except FX3G-4EX-BD and FX3G-2EYT-BD) and ground terminal	Not allowed	Not allowed
Between FX3G-4EX-BD input terminal (24V DC) and ground terminal	500V AC for one minute	5MΩ or more by 500V DC megger
Between FX3G-2EYT-BD output terminal (transistor) and ground terminal		
Between terminal of special adapter and ground terminal		
Special function block	Each manual	

For dielectric with stand voltage test and insulation resistance test of each product, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

*3 For common grounding, refer to section 4.3.

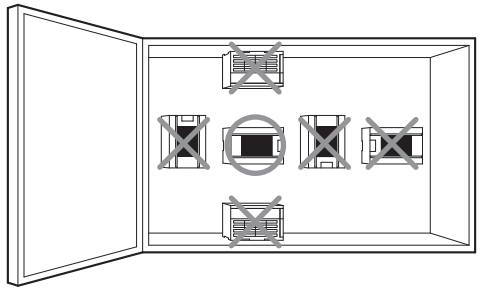
*4 The PLC cannot be used at a pressure higher than the atmospheric pressure to avoid damage.

*5 Input/output extension units/blocks only

3.2 Installation location

Install the PLC in an environment conforming to the generic specifications (section 3.1), installation precautions and notes.
For more details, refer to FX3G Series User's Manual - Hardware Edition.

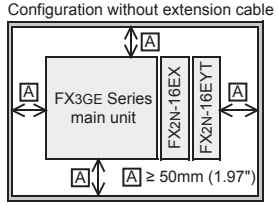
Installation location in enclosure



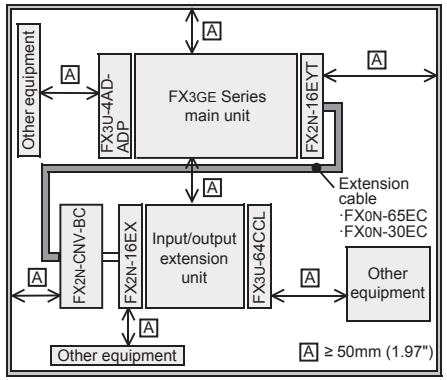
Space in enclosure

Extension devices can be connected on the left and right sides of the main unit of the PLC.
If you intend to add extension devices in the future, keep necessary spaces on the left and right sides.

Configuration without extension cable



Configuration in 2 stages with extension cable



3.2.1 Affixing The Dust Proof Sheet

The dust proof sheet should be affixed to the ventilation port before beginning the installation and wiring work.

→ **For the affixing procedure, refer to the instructions on the dust proof sheet.**

Be sure to remove the dust proof sheet when the installation and wiring work is completed.

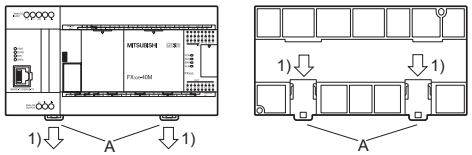
3.3 Procedures for installing to and detaching from DIN rail

The products can be installed on a DIN46277 rail [35mm (1.38") wide].
This section explains the installations of the main units.
For the input/output extension units/blocks and special adapters, refer to the following manual.

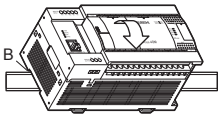
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

3.3.1 Installation

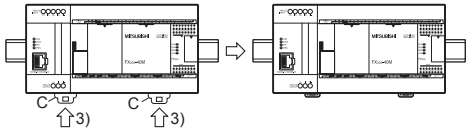
1) Push out all DIN rail mounting hooks (below fig.A).



2) Fit the upper edge of the DIN rail mounting groove (right fig.B) onto the DIN rail.



3) Lock the DIN rail mounting hooks (below fig.C) while pressing the PLC against the DIN rail.



3.4 Procedures for installing directly (with M4 screws)

The product can be installed directly on the panel (with screws).
This section explains the installation of the main units.
As for the details of the installation/detaching for input/output extension units/blocks and special adapters, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

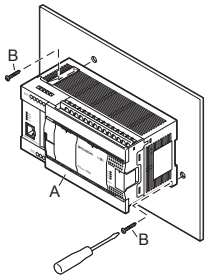
3.4.1 Mounting hole pitches

Refer to the external dimensions (section 2.3) for the product's mounting hole pitch information.
As for the details of the mounting hole pitches for extension unit/block and special adapters, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

3.4.2 Installation

1) Make mounting holes in the mounting surface referring to the external dimensions diagram.
2) Fit the main unit (A in the right figure) based on the holes, and secure it with M4 screws (B in the right figure). The mounting hole pitches and number of screws depend on the product. Refer to the external dimensions diagram (Section 2.3).



4. Power supply/input/output specifications and external wiring example of the main unit part

As for the details of the power supply wiring and input/output wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

DESIGN PRECAUTIONS ⚠**WARNING**

- Make sure to have the following safety circuits outside of the PLC to ensure safe system operation even during external power supply problems or PLC failure. Otherwise, malfunctions may cause serious accidents.
  1) Most importantly, have the following: an emergency stop circuit, a protection circuit, an interlock circuit for opposite movements (such as normal vs. reverse rotation), and an interlock circuit (to prevent damage to the equipment at the upper and lower positioning limits).
  2) Note that when the PLC CPU detects an error, such as a watchdog timer error, during self-diagnosis, all outputs are turned off. Also, when an error that cannot be detected by the PLC CPU occurs in an input/output control block, output control may be disabled.
     External circuits and mechanisms should be designed to ensure safe machinery operation in such a case.
  3) Note that when an error occurs in a relay, triac or transistor output device, the output could be held either on or off.
     For output signals that may lead to serious accidents, external circuits and mechanisms should be designed to ensure safe machinery operation in such a case.

DESIGN PRECAUTIONS ⚠**CAUTION**

- Do not bundle the control line together with or lay it close to the main circuit or power line. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit or power line.
  Noise may cause malfunctions.
- Install module so that excessive force will not be applied to the built-in programming connectors, power connectors or I/O connectors.
  Failure to do so may result in wire damage/breakage or PLC failure.

Notes

- Simultaneously turn on and off the power supplies of the main unit and extension devices.
- Even if the AC power supply causes an instantaneous power failure for less than 10 ms, the PLC can continue to operate.
- Even if the DC power supply causes an instantaneous power failure for less than 5 ms, the PLC can continue to operate.
- If a long-time power failure or an abnormal voltage drop occurs, the PLC stops, and output is turned off. When the power supply is restored, it will automatically restart (when the RUN input is on).

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.

WIRING PRECAUTIONS ⚠**CAUTION**

- Connect the AC power supply to the dedicated terminals specified in this manual. If an AC power supply is connected to a DC input/output terminal or DC power supply terminal, the PLC will burn out.
- Do not wire vacant terminals externally.
  Doing so may damage the product.
- Perform class D grounding (grounding resistance: 100Ω or less) to the grounding terminal on the FX3GE Series main unit with a wire 2 mm^2 or thicker.
  Do not use common grounding with heavy electrical systems (refer to section 4.3).
- When drilling screw holes or wiring, make sure cutting or wire debris does not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Make sure to properly wire to the terminal in accordance with the following precautions.
  Failure to do so may cause electric shock, equipment failures, a short-circuit, wire breakage, malfunctions, or damage to the product.
  - The disposal size of the cable end should follow the dimensions described in the manual.
  - Tightening torque should follow the specifications in the manual.
  - Tighten the screws using a Phillips-head screwdriver No.2 (shaft diameter 6mm (0.24") or less). Make sure that the screwdriver does not touch the partition part of the terminal block.

Notes

- Input/output wiring 50 to 100m (164'1" to 328'1") long will cause almost no problems of noise, but, generally, the wiring length should be less than 20m (65'7") to ensure the safety.
- Extension cables are easily affected by noise. Lay the cables at a distance of at least 30 to 50mm (1.19" to 1.97") away from the PLC output and other power lines.

4.1 Wiring

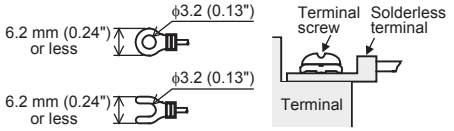
This section explains the wiring of the terminal type.
For the connectors types, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.1.1 Cable end treatment and tightening torque

For the terminals of FX3GE series PLC, M3 screws are used.
The electric wire ends should be treated as shown below.
Tighten the screws to a torque of 0.5 to 0.8 N•m.
Do not tighten terminal screws with a torque outside the above-mentioned range. Failure to do so may cause equipment failures or malfunctions.

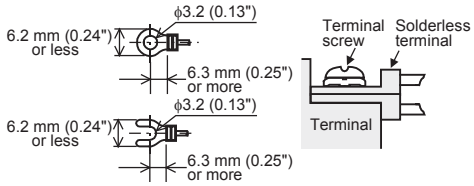
- When one wire is connected to one terminal



<Reference>

Terminal Manufacturer	Type No.	Certification	Pressure Bonding Tool
JAPAN SOLDERLESS TERMINAL MFG CO LTD (JST)	FV1.25-B3A FV2-MS3	UL Listed	YA-1(JST)

- When two wires are connected to one terminal



<Reference>

Terminal Manufacturer	Type No.	Certification	Pressure Bonding Tool
JAPAN SOLDERLESS TERMINAL MFG CO LTD (JST)	FV1.25-B3A	UL Listed	YA-1(JST)

4.2 Power supply specifications and example of external wiring

As for the details of the power supply specifications and example of external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.2.1 Power supply specifications[Main unit]

Item		Specification	
		AC power type	DC power type
Supply voltage		100 to 240V AC	24V DC
Allowable supply voltage range		85 to 264V AC	20.4 to 28.8V DC
Rated frequency		50/60Hz	-
Allowable instantaneous power failure time		Operation can be continued upon occurrence of instantaneous power failure for 10 ms or less.	Operation can be continued upon occurrence of instantaneous power failure for 5 ms or less.
Power fuse	FX3GE-24M□	250V 1A	125V 2.5A
	FX3GE-40M□	250V 3.15A	125V 3.15A
Rush current		30A max. 5ms or less/100V AC 50A max. 5ms or less/200V AC	30A max. 1ms or less/24 V DC
Power consumption*1	FX3GE-24M□	32W	21W
	FX3GE-40M□	37W	25W
24V DC service power supply		400mA	-

*1 This item shows values when all 24V DC service power supplies are used in the maximum configuration connectable to the main unit.
(The DC power type main unit does not have a 24V DC service power supply.)
Power (current) consumption of the input/output extension units/blocks.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

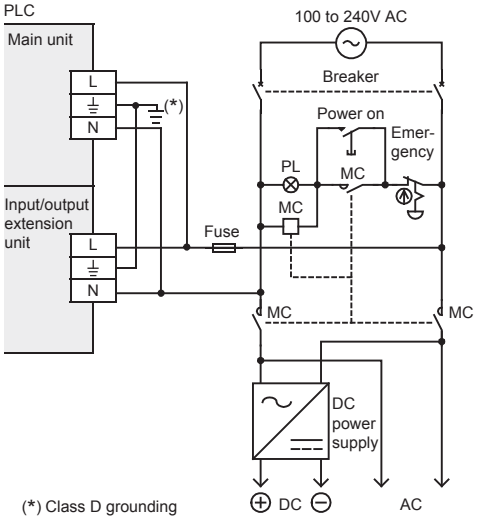
Power consumption of the special function blocks.

→ **Refer to the respective manual.**

4.2.2 Example of external wiring (AC power type)

100 to 240V AC power is supplied to the main unit and input/output extension unit.

→ **For the details of wiring work, refer to section 4.1.**



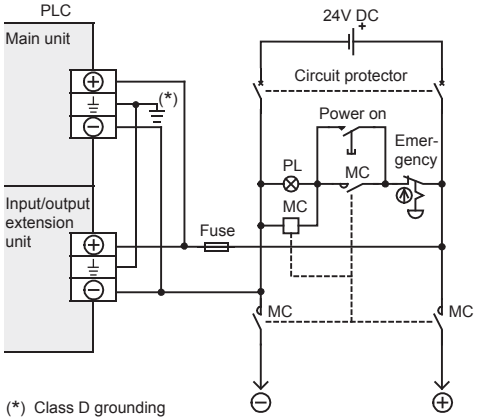
(*) Class D grounding
See section 4.3 for details.

Power supply for loads connected to PLC output terminals

4.2.3 Example of external wiring (DC power type)

24V DC power is supplied to the main unit and input/output extension unit.

→ **For the details of wiring work, refer to section 4.1.**



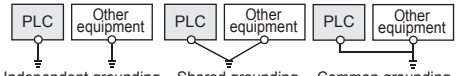
(*) Class D grounding
See section 4.3 for details.

Power supply for loads connected to PLC output terminals

4.3 Grounding

Ground the PLC as stated below.

- Perform class D grounding. (Grounding resistance: 100Ω or less)
- Ground the PLC independently if possible.
  If it cannot be grounded independently, ground it jointly as shown below.



Independent grounding (Best condition) | Shared grounding (Good condition) | Common grounding (Not allowed)

- Use ground wires thicker than AWG14 ($2mm^2$).
- Position the grounding point as close to the PLC as possible to decrease the length of the ground wire.

4.4 Input specifications and external wiring

As for the details of the input specifications of I/O extension unit/block and external wiring, refer to the following manual.

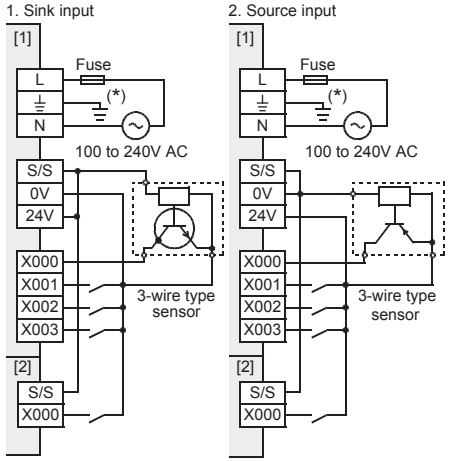
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.4.1 Input specifications [24V DC input type]

Item		Specification
Number of input points	FX3GE-24M□	14 points (16 points)*1
	FX3GE-40M□	24 points
Input connecting type		Terminal block (M3 screw)
Input form		Sink/Source
Input signal voltage	AC power type	24V DC +10%, -10%
	DC power type	20.4 to 28.8V DC
Input impedance	X000 to X007	3.3kΩ
	X010 or more	4.3kΩ
Input signal current	X000 to X007	7mA/24V DC
	X010 or more	5mA/24V DC
ON input sensitivity current	X000 to X007	4.5mA or more
	X010 or more	3.5mA or more
OFF input sensitivity current		1.5mA or less
Input response time		Approx. 10ms
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.

*1 Each value inside ( ) indicates the number of occupied points.

4.4.2 Examples of input wiring [AC power type]

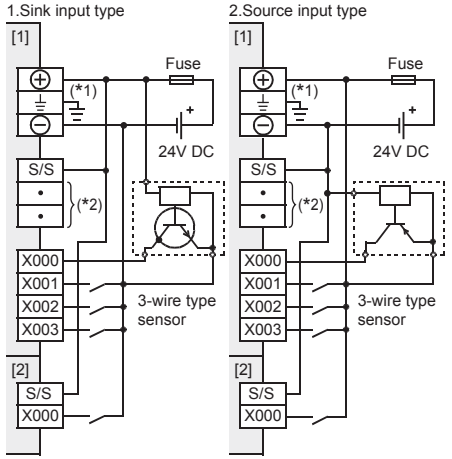


(*) Class D grounding
See section 4.3 for details.

[1]:Main unit, Input/output extension unit
(Common to both sink and source inputs)

[2]:Input/output extension block
(Common to both sink and source inputs)

4.4.3 Examples of input wiring [DC power type]



(*1) Class D grounding
See section 4.3 for details.

(*2) Do not connect the [•] terminals with others, since they are not available.

[1]:Main unit, Input/output extension unit
(Common to both sink and source inputs)

[2]:Input/output extension block
(Common to both sink and source inputs)

4.4.4 Instructions for connecting input devices

As for the details of Instructions for connecting input devices, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

1) In the case of no-voltage contact:
   The input current of this PLC is 5 to 7mA/24V DC.
   Use input devices applicable to this minute current.
   If no-voltage contacts (switches) for large current are used, contact failure may occur.
2) In the case of input device with built-in series diode:
   The voltage drop of the series diode should be approx. 4V or less.
   When lead switches with a series LED are used, up to two switches can be connected in series.
   Also make sure that the input current is over the input-sensing level while the switches are ON.
3) In the case of input device with built-in parallel resistance:
   Use a device with a parallel resistance of 15kΩ or more.
   When the resistance is less than 15kΩ, connect a bleeder resistance.
4) In the case of 2-wire proximity switch:
   Use a two-wire proximity switch whose leakage current is 1.5mA or less when the switch is off.
   When the current is larger than 1.5mA, connect a bleeder resistance.

4.5 Relay output specifications and example of external wiring

As for the details of the relay output specifications of I/O extension unit/block and external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.5.1 Relay output specifications

Item		Specification
Number of output points	FX3GE-24MR□	10 points (16 points)*1
	FX3GE-40MR□	16 points
Output connecting type		Terminal block (M3 screw)
Output form		Relay
External power supply		30V DC or less 240V AC or less*2
Max. load	Resistance load	2A/point*3
	Inductive load	80VA
Min. load		5V DC, 2mA (reference value)
Open circuit leakage current		-
Response time	OFF→ON ON→OFF	Approx. 10ms
Circuit insulation		Mechanical insulation
Display of output operation		LED lights when power is applied to relay coil.

*1 Each value inside ( ) indicates the number of occupied points.

*2 Between 250V and 240V CE, UL, and cUL are not compliant.

*3 The total load current of resistance loads per common terminal should be the following value or less.
- 1 output point/common terminal : 2A
- 4 output points/common terminal : 8A

As for the number of outputs per common terminal, refer to "Section 4.8 interpretation of partition" and the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.5.2 Life of relay output contact

The product life of relay contacts considerably varies depending on the load type used. Take care that loads generating reverse electromotive force or rush current may cause poor contact or deposition of contacts which may lead to considerable reduction of the contact product life.

1) Inductive load
   Inductive loads generate large reverse electromotive force between contacts at shutdown may cause arcing. At a fixed current consumption, as the power factor (phase between current and voltage) gets smaller, the arc energy gets larger.
   The standard life of the contact used for Inductive loads, such as contactors and solenoid valves, is 500 thousand operations at 20VA.
   The following table shows the approximate life of the relay based on the results of our operation life test.
   Test condition: 1 sec. ON / 1 sec. OFF.

Load capacity		Contact life
20VA	0.2A/100V AC	3 million times
	0.1A/200V AC	
35VA	0.35A/100V AC	1 million times
	0.17A/200V AC	
80VA	0.8A/100V AC	2 hundred thousand times
	0.4A/200V AC	

The product life of relay contacts becomes considerably shorter than the above conditions when the rush overcurrent is shut down.

→ **For countermeasures while using inductive loads, refer to Subsection 4.5.4.**

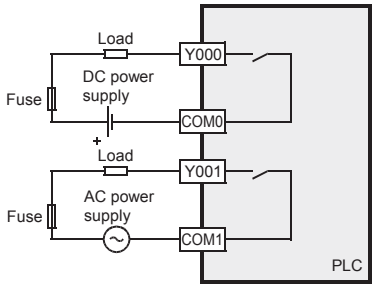
Some types of inductive loads generate rush current 5 to 15 times the stationary current at activation. Make sure that the rush current does not exceed the current corresponding to the maximum specified resistance load.

2) Lamp load
Lamp loads generally generate rush current 10 to 15 times the stationary current. Make sure that the rush current does not exceed the current corresponding to the maximum specified resistance load.

3) Capacitive load
Capacitive loads can generate rush current 20 to 40 times the stationary current. Make sure that the rush current does not exceed the current corresponding to the maximum specified resistance load. Capacitive loads such as capacitors may be present in electronic circuit loads including inverters.

→ **For the maximum specified resistance load, refer to Subsection 4.5.1.**

4.5.3 Example of relay output wiring



4.5.4 Cautions in external wiring

For attention in the external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Protection circuit for load short-circuiting
When a load connected to the output terminal short-circuits, the printed circuit board may be burnt out. Fit a protective fuse on the output circuit.

Protection circuit of contact when inductive load is used
An internal protection circuit for the relays is not provided for the relay output circuit in this product. It is recommended to use inductive loads with built-in protection circuits. When using loads without built-in protection circuits, insert an external contact protection circuit, etc. to reduce noise and extend the product life.

1) DC circuit
Connect a diode in parallel with the load.
Use a diode (for commutation) having the following specifications.

Item	Standard
Reverse voltage	5 to 10 times the load voltage
Forward current	Load current or more

2) AC circuit
Connect the surge absorber (combined CR components such as a surge killer and spark killer, etc.) parallel to the load.
Select the rated voltage of the surge absorber suitable to the output used. Refer to the table below for other specifications.

Item	Standard
Electrostatic capacity	Approx. 0.1μF
Resistance value	Approx. 100 to 200Ω

Interlock
Loads, such as contactors for normal and reverse rotations, that must not be turned on simultaneously should have an interlock in the PLC program and an external interlock.

Common mode
Use output contacts of the PLC in the common mode.

4.6 Transistor output specifications and example of external wiring

As for the details of the transistor output specifications of I/O extension unit/block and external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.6.1 Transistor output specifications

Item				Specification
Number of output points	FX3GE-24MT□			10 points (16 points)*1
	FX3GE-40MT□			16 points
Output connecting type				Terminal block (M3 screw)
Output form	FX3GE-□MT/□S			Transistor (Sink)
	FX3GE-□MT/□SS			Transistor (Source)
External power supply				5 to 30V DC
Max. load	Resistance load			0.5A/point*2
	Inductive load			12W/24V DC*3
Min. load				-
Open circuit leakage current				0.1mA or less/30V DC
ON voltage				1.5V or less
Response time	OFF → ON	FX3GE-24MT□	Y000, Y001	5μs or less/10mA or more (5 to 24V DC)
			Y002 or more	0.2ms or less/200mA or more (at 24V DC)
		FX3GE-40MT□	Y000 to Y002	5μs or less/10mA or more (5 to 24V DC)
			Y003 or more	0.2ms or less/200mA or more (at 24V DC)
	ON → OFF	FX3GE-24MT□	Y000, Y001	5μs or less/10mA or more (5 to 24V DC)
			Y002 or more	0.2ms or less/200mA or more (at 24V DC)
		FX3GE-40MT□	Y000 to Y002	5μs or less/10mA or more (5 to 24V DC)
			Y003 or more	0.2ms or less/200mA or more (at 24V DC)
Circuit insulation				Photocoupler insulation
Display of output operation				LED on panel lights when photocoupler is driven.

*1 Each value inside ( ) indicates the number of occupied points.

*2 The total load current of resistance loads per common terminal should be the following value or less.
- 1 output point/common terminal : 0.5A
- 4 output points/common terminal : 0.8A

As for the number of outputs per common terminal, refer to "Section 4.8 interpretation of partition" and the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

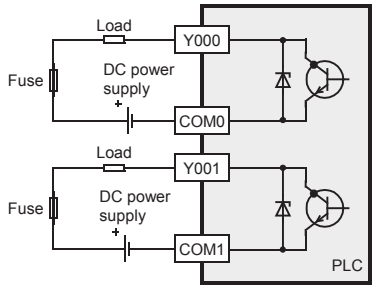
*3 The total of inductive loads per common terminal should be the following value or less.
- 1 output point/common terminal : 12W/24V DC
- 4 output points/common terminal : 19.2W/24V DC

As for the number of outputs per common terminal, refer to "Section 4.8 interpretation of partition" and the following manual.

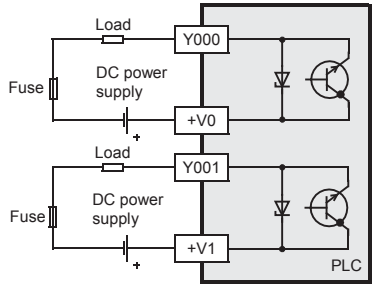
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.6.2 External wiring of transistor output

1. External Wiring of Sink Output Type



2. External Wiring of Source Output Type



4.6.3 Cautions in external wiring

As for the details of Instructions for connecting input devices, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Protection circuit for load short-circuits
A short-circuit at a load connected to an output terminal could cause burnout at the output element or the PCB. To prevent this, a protection fuse should be inserted at the output.
Use a load power supply capacity that is at least 2 times larger than the total rated fuse capacity.

Contact protection circuit for inductive loads
When an inductive load is connected, connect a diode (for commutation) in parallel with the load as necessary.
The diode (for commutation) must comply with the following specifications.

Item	Guide
Reverse voltage	5 to 10 times of the load voltage
Forward current	Load current or more

Interlock
Loads, such as contactors for normal and reverse rotations, that must not be turned on simultaneously should have an interlock in the PLC program and an external interlock.

4.7 Triac output specifications of I/O extension unit/block

As for the details of the triac output specifications and external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

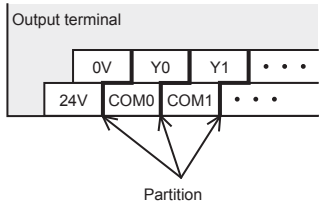
4.8 Terminal block layouts

For details on the terminal block layout, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Interpretation of partition
The partition of the output terminals (see following figure) indicates the range of the output connected to the same common.

Example: FX3GE-40MR/ES



5. Built-in Ethernet specifications and wiring

As for the details of the specifications and wiring, refer to the following manual.

→ **Refer to FX3U-ENET-ADP User's Manual.**

DESIGN PRECAUTIONS ⚠**WARNING**

- Make sure to have the following safety circuits outside of the PLC to ensure safe system operation even during external power supply problems or PLC failure.
  Otherwise, malfunctions may cause serious accidents.
  1) Above all, the following components should be included: an emergency stop circuit, a protection circuit, aninterlock circuit for opposite movements (such as normal vs. reverse rotation), and an interlock circuit (to prevent damage to the equipment at the upper and lower positioning limits).
  2) Note that when the PLC main unit detects an error during self diagnosis, such as a watchdog timer error, all outputs are turned off. Also, when an error that cannot be detected by the PLC main unit occurs in an input/output control block, output control may be disabled. External circuits and mechanisms should be designed to ensure safe machinery operation in such cases.

DESIGN PRECAUTIONS ⚠**CAUTION**

- Observe the following items. Failure to do so may cause incorrect data-writing through noise to the PLC and result in PLC failure, machine damage or other accident.
  1) Do not bundle the control line together with or lay it close to the main circuit or power line. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit or power line.
  Noise may cause malfunctions.
  2) Ground the shield wire or shield of a shielded cable. Do not use common grounding with heavy electrical systems.

STARTUP AND MAINTENANCE PRECAUTIONS ⚠**WARNING**

- Do not touch any terminals or connector while the PLC's power is on.
  Doing so may cause electrical shock or malfunctions.
- Before cleaning or retightening screws, externally cut off all phases of the power supply.
  Failure to do so may cause malfunction or failure of this adapter. When the screws are tightened insufficiently, they may fall out and cause a shortcircuit or malfunction. When tightened too much, the screws or the adapter may be damaged, resulting in short-circuit, or malfunction.
- When controlling the PLC (especially when changing data, the program or changing the operating conditions) during operation, ensure that it is safe to do so.

STARTUP AND MAINTENANCE PRECAUTIONS ⚠**CAUTION**

- Do not disassemble or modify this product.
  Doing so may cause fire, equipment failures, or malfunctions.
  For repair, contact your local Mitsubishi Electric representative.
- The adapter case is made of resin. If dropped or subjected to strong impact, the adapter may be damaged.
- When this adapter is installed or removed from the panel, make sure to externally cut off all phases of the power supply. Failure to do so may cause malfunction or failure of this adapter.

WIRING PRECAUTIONS ⚠WARNING

- Make sure to cut off all phases of the power supply externally before attempting wiring work.
  Failure to do so may cause electric shock or damage to the product.

WIRING PRECAUTIONS ⚠CAUTION

- When drilling screw holes or wiring, make sure that cutting and wiring debris do not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Make sure to observe the following precautions in order to prevent any damage to the machinery or accidents due to abnormal data written to the PLC under the influence of noise:
  - Do not bundle the main circuit line together with or lay it close to the main circuit, high-voltage line or load line.
    Otherwise, noise disturbance and/or surge induction are likely to take place. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit or high-voltage lines.

5.1 Specification

5.1.1 Communication specification

Item		Specification
Transmission specifications	Data transmission speed	100Mbps/10Mbps
	Communication method	Full-duplex/Half-duplex
	Transmission method	Base band
	Maximum segment length	100m (328'1")

5.1.2 Performance specification

Item	Specification
Functions	MELSOFT connections
	Communication Using MC Protocol
	MELSOFT Direct Connection (Simple Connection)
	Find CPU function
	Time setting function*1
	Diagnostics function from MELSOFT
	Data monitoring function
Number of simultaneously open connections allowed	MELSOFT connection + MC protocol + Data monitoring <= 4

*1 The time setting function (SNTP client) is enabled only after the trigger condition is established.

Caution

FX3U-ENET-ADP cannot be connected to the FX3GE Series PLC.

5.2 Wiring

5.2.1 Connecting to the network

The following explains how to connect the built-in Ethernet to 10BASE-T/100BASE-TX networks.
Pay close attention to safety and use the built-in Ethernet properly.

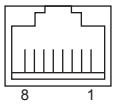
1) Sufficient network knowledge and safety precautions are required when installing 10BASE-T or 100BASE-TX networks. Consult a specialist when connecting cable terminals or installing trunk line cables, etc.
2) Use a connection cable conforming to the standards shown in Subsection 5.2.2.

Cautions regarding powering the hub, PLC and Ethernet simultaneously

On some hubs, for a fixed period of time immediately after powering up, even if packets are sent from the Ethernet device, there are cases when packets are not sent to the external device. In this case, create a sequence program that waits a sufficient amount of time after powering up before sending packets.

5.2.2 Applicable cable and connector

1) Connector
   RJ45 type modular jack
2) Pin Configuration
   The pin sequence of the 10BASE-T/100BASE-TX connection connector (RJ45 type modular jack) of the built-in Ethernet is as follows:



Pin No.	Signal	Direction	Contents
1	TD+	Out	+ side of sending data
2	TD-	Out	- side of sending data
3	RD+	In	+ side of receiving data
4	Not used	-	
5	Not used	-	
6	RD-	In	- side of receiving data
7	Not used	-	
8	Not used	-	

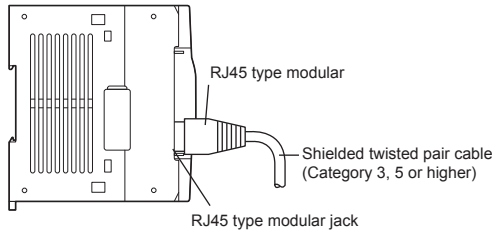
3) Applicable cable

10BASE-T	Cable conforming to Ethernet standard practice: Category 3 or higher (STP cable)
100BASE-TX	Cable conforming to Ethernet standard practice: Category 5 or higher (STP cable)

A straight cable is used. A cross cable can also be used when using direct connection (simple connection) between the personal computer and the FX3GE Series PLC.

5.2.3 Connecting to the 10BASE-T/100BASE-TX network

This section explains how to connect the built-in Ethernet to the 10BASE-T, 100BASE-TX network.
The following shows the connection diagram for the twisted paid cable.



<Operating procedure>
(Step 1) Connect the twisted pair cable to the hub.
(Step 2) Connect the twisted pair cable to the built-in Ethernet.

1) The built-in Ethernet detects whether it is 10BASE-T or 100BASE-TX, and in full-duplex or half-duplex transmission mode automatically according to the hub. (Auto detection function)
   For connection to a hub without the auto detection function, set the half-duplex mode on the hub side.
2) For 10BASE-T or 100BASE-TX connection required devices and a sample system configuration, refer to FX3U-ENET-ADP User's Manual.

6. Built-in analog specifications and wiring

As for the details of the specifications and wiring, refer to the following manual.
→ **Refer to FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition.**

STARTUP AND MAINTENANCE PRECAUTIONS ⚠CAUTION

- Do not disassemble or modify the PLC.
  Doing so may cause fire, equipment failures, or malfunctions.
  For repair, contact your local Mitsubishi Electric representative.
- Do not drop the product or exert strong impact to it.
  Doing so may cause damage.

WIRING PRECAUTIONS ⚠WARNING

- Make sure to cut off all phases of the power supply externally before attempting wiring work.
  Failure to do so may cause electric shock or damage to the product.

WIRING PRECAUTIONS ⚠CAUTION

- When drilling screw holes or wiring, make sure cutting or wire debris does not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Make sure to observe the following precautions in order to prevent any damage to the machinery or accidents due to abnormal data written to the PLC under the influence of noise:
  1) Do not bundle the power line or shield of the analog input/output cable together with or lay it close to the maincircuit, high-voltage line, or load line.
     Otherwise, noise disturbance and/or surge induction are likely to take place. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit, high-voltage line, or load line.
  2) Ground the shield of the analog input/output cable at one point on the signal receiving side.
     However, do not use common grounding with heavy electrical systems.
- Make sure to properly wire to the terminal block (European type) in accordance with the following precautions.
  Failure to do so may cause electric shock, equipment failures, a short-circuit, wire breakage, malfunctions, or damage to the product.
  - The disposal size of the cable end should follow the dimensions described in the manual.
  - Tightening torque should follow the specifications in the manual.
  - Twist the end of strand wire 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.
  - Affix the electric wires so that neither the terminal block nor the connected parts are directly stressed.

6.1 Analog input terminal block (European type)

1) Wire size
   Wiring to analog device should use 22-20 AWG wire.
2) Applicable cable

Item	Wire size
Single wire	0.3 to 0.5mm^2 (AWG22 to 20)
Double wire	0.3mm^2 (AWG22) × 2

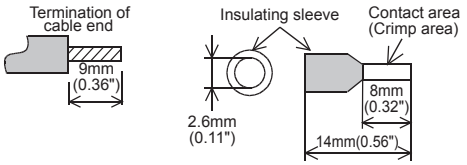
3) Termination
   Strip the coating of strand wire and twist the cable core before connecting it, or strip the coating of single wire before connecting it. An alternative connection is to use a ferrule with insulating sleeve.

Manufacturer	Model	Caulking tool
Phoenix Contact Co., Ltd.	AI 0.5-8WH	CRIMPFOX 6*1 (or CRIMPFOX 6T-F*2)

*1 Old model name: CRIMPFOX ZA 3

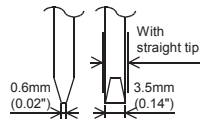
*2 Old model name: CRIMPFOX UD 6

• Stranded wire/solid wire • Bar terminal with insulating sleeve



When using a stick terminal with an insulating sleeve, choose a wire with proper cable sheath referring to the above outside dimensions, otherwise the wire cannot be inserted easily.
Tighten the screws to a torque of 0.22 to 0.25 N•m.
Do not tighten terminal screws exceeding with a torque outside the above-mentioned range.
Failure to do so may cause equipment failures or malfunctions.

4) Tool
   For tightening the terminal, use a commercially available small screwdriver having a straight form that is not widened toward the end as shown right.



Note:
If the diameter of screwdriver grip is too small, tightening torque will not be able to be achieved. To achieve the appropriate tightening torque shown in the table above, use the following screwdriver or appropriate replacement (grip diameter : approximately 25mm (0.98")).

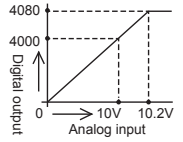
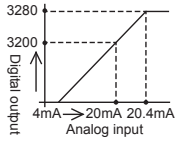
Manufacturer	Model names
Phoenix Contact Co., Ltd.	SZS 0.6×3.5

6.2 Input/output specifications and external wiring

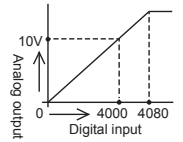
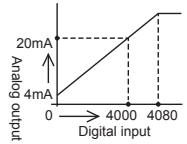
As for the details of the analog input/output specifications, refer to the following manual.

→ **Refer to FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition.**

Analog input performance specifications

Item	Specifications	
	Voltage input	Current input
Analog input range	0 to 10V DC (Input resistance: 198.7kΩ)	4 to 20mA DC (Input resistance: 250Ω)
Absolute maximum input	-0.5V, +15V	-2mA, +30mA
Resolution	2.5mV(10V/4000)	5μA(16mA/3200)
Overall accuracy	• ±0.5% (±50mV) for 10V full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±100mV) for 10V full scale (when ambient temperature is 0 to 55°C)	• ±0.5% (±80μA) for 16mA full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±160μA) for 16mA full scale (when ambient temperature is 0 to 55°C)
Input characteristics		

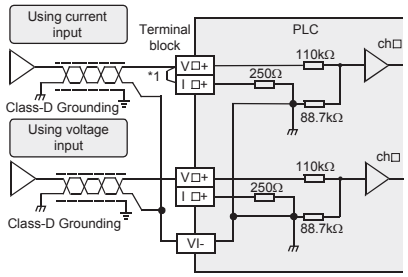
Analog output performance specifications

Item	Specifications	
	Voltage output	Current output
Analog output range	0 to 10V DC (External load: 2k to 1MΩ)	4 to 20mA DC (External load: 500Ω or less)
Resolution	2.5mV(10V/4000)	4μA(16mA/4000)
Overall accuracy	• ±0.5% (±50mV) for 10V full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±100mV) for 10V full scale (when ambient temperature is 0 to 55°C) Shipment adjustment is carried out by external load resistance 2kΩ. If external load resistance becomes larger than 2kΩ, the output voltage will increase slightly. When the load is 1MΩ, the output voltage becomes about 2% higher than the correct value.	• ±0.5% (±80μA) for 16mA full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±160μA) for 16mA full scale (when ambient temperature is 0 to 55°C)
Output characteristics	0 to 4000 are adjusted to 0 to 10V when the external load resistance is 2kΩ.  **Caution:** An area of dead band is located in the region of 0V. Therefore the output analog value may not represent the digital value accurately.	0 to 4000 are adjusted to 4 to 20mA when the external load resistance is 250Ω. 

Common Specifications of Analog Input and Output

Item	Specification
Digital input and output	12 bits, binary
Conversion time	90μs for each selected input channel + 50μs for each selected output channel (The data will be updated at every scan of the PLC.)
Insulation method	No insulation between each channel or the PLC.
Occupied points	0 point (This number is not related to the maximum number of input and output points of the PLC.)

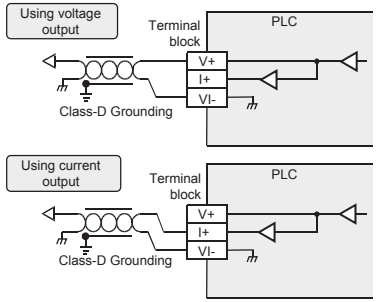
6.2.1 Example of analog input



V□+, I□+, ch□: □represents the channel number.

*1 Make sure to short-circuit the 'V□+' and 'I□+' terminals when current is input. (□: input channel number)

6.2.2 Example of analog output



Cautions in wiring

- Use 2-core shielded twisted pair cable for the analog output lines, and separate the analog output lines from other power lines or inductive lines.
- The grounding resistance should be 100Ω or less.

6.3 List of Special Devices

The built-in analog occupies the 1st device assignment.

R: Read W: Write

Special device	Device number	Description	R/W
	1st		
Special auxiliary relay	M8280	Switches the input mode of channel 1 OFF: Voltage input ON: Current input	R/W
	M8281	Switches the input mode of channel 2 OFF: Voltage input ON: Current input	R/W
	M8282	Switches the output mode OFF: Voltage output ON: Current output	R/W
	M8283 to M8285	Unused (Do not use.)	-
	M8286	Sets the cancel of output holding function. OFF: Holds the analog data output just before stop of the PLC. ON : Outputs the offset data at stop of the PLC.	R/W
	M8287	Sets whether or not input channel 1 is used. OFF: Channel is used. ON: Channel is not used.	R/W
	M8288	Sets whether or not input channel 2 is used. OFF: Channel is used. ON: Channel is not used.	R/W
	M8289	Sets whether or not output channel is used. OFF: Channel is used. ON: Channel is not used.	R/W
Special data register	D8280	Channel-1 input data	R
	D8281	Channel-2 input data	R
	D8282	Output setting data	R/W
	D8283	Unused (Do not use.)	-
	D8284	Averaging time for channel-1 (Setting range: 1 to 4095)	R/W
	D8285	Averaging time for channel-2 (Setting range: 1 to 4095)	R/W
	D8286	Unused (Do not use.)	-
	D8287		
	D8288	Error status b0: Channel-1 over-scale detection b1: Channel-2 over-scale detection b2: Output data setting error b3: Unused b4: EEPROM error b5: Averaging time setting error b6: Hardware error b7: Communication data error b8 to b15: Unused	R/W
	D8289	Model code = 51	R

As for the details of the special devices, refer to following manual.

→ **Refer to FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition.**

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : TOKYO BUILDING, 2-7-3 MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
HIMEJI WORKS : 840, CHIYODA CHO, HIMEJI, JAPAN

JY997D49401E

MITSUBISHI ELECTRIC
PROGRAMMABLE CONTROLLERS
MELSEC-F

FX3GE SERIES PROGRAMMABLE CONTROLLERS

HARDWARE MANUAL

FX 3GE

Manual Number	JY997D49401
Revision	E
Date	July 2014

This manual describes the part names, dimensions, mounting, and specifications of the product. Before use, read this manual and the manuals of all relevant products fully to acquire proficiency in handling and operating the product. Make sure to learn all the product information, safety information, and precautions.
Store this manual in a safe place so that it can be taken out and read whenever necessary. Always forward it to the end user.
Registration
Ethernet is a trademark of Xerox Corporation.
Phillips is a registered trademark of Phillips Screw Company.
The company and product names described in this manual are registered trademarks or the trademarks of their respective companies.

Effective July 2014
Specifications are subject to change without notice.

Safety Precaution (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 medium or slight personal injury or physical damage.

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

STARTUP AND MAINTENANCE PRECAUTIONS ⚠WARNING

- Do not touch any terminal while the PLC's power is on.
  Doing so may cause electric shock or malfunctions.
- Before cleaning or retightening terminals, cut off all phases of the power supply externally.
  Failure to do so may cause electric shock.
- This product shall be powered by a UL Listed or Recognized 24 V DC isolating source when the DC power supply type product is powered by a power supply converted from hazardous voltages.
- Use the battery for memory backup correctly in FX3G Series User's Manual - Hardware Edition.
  - Use the battery only for the specified purpose.
  - Connect the battery correctly.
  - Do not charge, disassemble, heat, put in fire, short-circuit, connect reversely, weld, swallow or burn the battery, or apply excessive forces (vibration, impact, drop, etc.) to the battery.
  - Do not store or use the battery at high temperatures or expose to direct sunlight.
  - Do not expose to water, bring near fire or touch liquid leakage or other contents directly.
  - Incorrect handling of the battery may cause heat excessive generation, bursting, ignition, liquid leakage or deformation, and lead to injury, fire or failures and malfunctions of facilities and other equipment.
- Before modifying or disrupting the program in operation or running the PLC, carefully read through this manual and the associated manuals and ensure the safety of the operation.
  An operation error may damage the machinery or cause accidents.

STARTUP AND MAINTENANCE PRECAUTIONS ⚠CAUTION

- Turn off the power to the PLC before attaching or detaching the memory cassette.
  If the memory cassette is attached or detached while the PLC's power is on, the data in the memory may be destroyed, or the memory cassette may be damaged.
- Do not disassemble or modify the PLC.
  Doing so may cause fire, equipment failures, or malfunctions.
  For repair, contact your local Mitsubishi Electric representative.
- Turn off the power to the PLC before connecting or disconnecting any extension cable.
  Failure to do so may cause equipment failures or malfunctions.
- Turn off the power to the PLC before attaching or detaching the following devices.
  Failure to do so may cause equipment failures or malfunctions.
  - Peripheral devices, display module, and expansion boards
  - Extension units/blocks and special adapters
  - Battery and memory cassette

DISPOSAL PRECAUTIONS ⚠CAUTION

- Please contact a certified electronic waste disposal company for the environmentally safe recycling and disposal of your device.
  When disposing of batteries, separate them from other waste according to local regulations.
  (For details of the Battery Directive in EU countries, refer to FX3G Series User's Manual - Hardware Edition.)

TRANSPORTATION AND STORAGE PRECAUTIONS ⚠CAUTION

- When transporting the FX3GE Series PLC incorporating the optional battery, turn on the PLC before shipment, confirm that the battery mode is set using a parameter and the ALM LED is OFF, and check the battery life.
  If the PLC is transported with the ALM LED on or the battery exhausted, the battery-backed data may be unstable during transportation.
- The PLC is a precision instrument. During transportation, avoid impacts larger than those specified in Section 3.1. Failure to do so may cause failures in the PLC.
  After transportation, verify the operations of the PLC.
- When transporting lithium batteries, follow required transportation regulations.
  (For details of the regulated products, refer to FX3G Series User's Manual - Hardware Edition.)

Overview

FX3GE PLC has an Ethernet communication function and analog input/output function built into a base that is FX3G PLC.
The Ethernet communication function is equivalent to FX3U-ENET-ADP.
The analog input/output function (analog input 2 channels, analog output 1 channel) is equivalent to FX3U-3A-ADP.

Associated manuals

How to obtain manuals

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

Associated manuals
FX3GE Series PLC (main unit) comes with this document (hardware manual).
For a detailed explanation of the FX3GE Series hardware and information on instructions for PLC programming and special function unit/block, refer to the relevant documents.
Specifications not described in this manual are same as FX3G PLC. For details, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Manual name	Manual No.	Description
FX3G Series User's Manual - Hardware Edition	JY997D31301 MODEL CODE: 09R521	Explains FX3G Series PLC specification details for I/O, wiring, installation, and maintenance.
FX3S/FX3G/FX3GC/FX3U/FX3UC Series Programming Manual - Basic & Applied Instruction Edition	JY997D16601 MODEL CODE: 09R517	Describes PLC programming for basic/applied instructions STL/SFC programming and devices.
MELSEC-Q/L/F Structured Programming Manual (Fundamentals)	SH-080782 MODEL CODE: 13JW06	Programming methods, specifications, functions, etc. required to create structured programs.
FXCPU Structured Programming Manual [Device & Common]	JY997D26001 MODEL CODE: 09R925	Devices, parameters, etc. provided in structured projects of GX Works2.
FXCPU Structured Programming Manual [Basic & Applied Instruction]	JY997D34701 MODEL CODE: 09R926	Sequence instructions provided in structured projects of GX Works2.
FXCPU Structured Programming Manual [Application Functions]	JY997D34801 MODEL CODE: 09R927	Application functions provided in structured projects of GX Works2.
FX Series User's Manual - Data Communication Edition	JY997D16901 MODEL CODE: 09R715	Explains N:N link, parallel link, computer link, no protocol communication by RS instructions/FX2N-232IF.
FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition	JY997D16701 MODEL CODE: 09R619	Describes specifications for analog control and programming methods for FX3S/FX3G/FX3GC/FX3U/FX3UC Series PLC.
FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Positioning Control Edition	JY997D16801 MODEL CODE: 09R620	Explains the specifications for positioning control of FX3S/FX3G/FX3GC/FX3U/FX3UC Series and programming procedures
FX3U-ENET-ADP User's Manual	JY997D45801 MODEL CODE: 09R725	Describes FX3U-ENET-ADP Ethernet communication special adapter details.

Certification of UL, cUL standards

Please consult with Mitsubishi Electric for information on UL, cUL standard practices and the corresponding types of equipment.

Compliance with EC directive (CE Marking)

This document does not guarantee that a mechanical system including this product will comply with the following standards.
Compliance to EMC directive and LVD directive of the entire mechanical system should be checked by the user/manufacturer. For more details please contact the local Mitsubishi Electric sales site.

Requirement for Compliance with EMC directive

The following products have shown compliance through direct testing (of the identified standards below) and design analysis (through the creation of a technical construction file) to the European Directive for Electromagnetic Compatibility (2004/108/EC) when used as directed by the appropriate documentation.

Attention

- This product is designed for use in industrial applications.

Note

- Manufactured by:
  Mitsubishi Electric Corporation
  2-7-3 Marunouchi, Chiyoda-ku, Tokyo, 100-8310 Japan
- Manufactured at:
  Mitsubishi Electric Corporation Himeji Works
  840 Chiyoda-machi, Himeji, Hyogo, 670-8677 Japan
- Authorized Representative in the European Community:
  Mitsubishi Electric Europe B.V.
  Gothaer Str. 8, 40880 Ratingen, Germany

Type : Programmable Controller (Open Type Equipment)
Models : MELSEC FX3GE series, FX3G series, FX3U series manufactured

from June 1st, 2005	FX3U-232ADP	FX3U-485ADP
	FX3U-4AD-ADP	FX3U-4DA-ADP
	FX3U-4AD-PT-ADP	FX3U-4AD-TC-ADP
from April 1st, 2007	FX3U-232ADP-MB	FX3U-485ADP-MB
from December 1st, 2007	FX3U-4AD-PTW-ADP	
	FX3U-4AD-PNK-ADP	
from November 1st, 2008	FX3G-232-BD	FX3G-422-BD
	FX3G-485-BD	
	FX3G-EEPROM-32L	
	FX3G-2AD-BD	FX3G-1DA-BD
	FX3G-8AV-BD	FX3G-5DM
from June 1st, 2009	FX3U-3A-ADP	
from March 1st, 2013	FX3GE-★★MR/ES	
from June 1st, 2013	FX3GE-★★MT/ES	FX3GE-★★MT/ESS
from August 1st, 2013	FX3GE-★★MR/DS	FX3GE-★★MT/DS
	FX3GE-★★MT/DSS	
	Where ★★ indicates: 24, 40	
from September 1st, 2013	FX3G-4EX-BD	FX3G-2EYT-BD
	FX3G-485-BD-RJ	

Standard	Remark
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	Compliance with all relevant aspects of the standard. EMI • Radiated Emission • Conducted Emission EMS • Radiated electromagnetic field • Fast transient burst • Electrostatic discharge • High-energy surge • Voltage drops and interruptions • Conducted RF • Power frequency magnetic field

Models : MELSEC FX2N series manufactured

from July 1st, 1997	FX2N-★★ER-ES/UL	FX2N-★★ET-ESS/UL
	Where ★★ indicates:32,48	
	FX2N-16EX-ES/UL	FX2N-16EYR-ES/UL
	FX2N-16EYT-ESS/UL	
from April 1st, 1998	FX2N-48ER-DS	FX2N-48ET-DSS
from August 1st, 1998	FX2N-48ER-UA1/UL	
from August 1st, 2005	FX2N-8ER-ES/UL	FX2N-8EX-ES/UL
	FX2N-8EYR-ES/UL	FX2N-8EYT-ESS/UL
from September 1st, 2010	FX2N-8EYR-S-ES/UL	

For the products above, PLCs manufactured
before March 31st, 2002 are compliant with EN50081-2 (EN61000-6-4) and EN50082-2
from April 1st, 2002 to April 30th, 2006 are compliant with EN50081-2 (EN61000-6-4) and EN61131-2:1994+A11:1996+A12:2000
after May 1st, 2006 are compliant with EN61131-2:2007

Standard	Remark
EN61000-6-4:2007 - Generic emission standard Industrial environment	Compliance with all relevant aspects of the standard. • Emission-Enclosure port • Emission-Low voltage AC mains port • Emission-Telecommunications/network port
EN50081-2:1993 Electromagnetic compatibility	
EN50082-2:1995 Electromagnetic compatibility - Generic immunity standard Industrial environment	Compliance with all relevant aspects of the standard. • RF Immunity • Fast Transients • ESD • Conducted • Power magnetic fields
EN61131-2:1994 /A11:1996 /A12:2000 Programmable controllers - Equipment requirements and tests	Compliance with all relevant aspects of the standard. • Radiated electromagnetic field • Fast Transient burst • Electrostatic discharge • Damped oscillatory wave
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	Compliance with all relevant aspects of the standard. EMI • Radiated Emission • Conducted Emission EMS • Radiated electromagnetic field • Fast transient burst • Electrostatic discharge • High-energy surge • Voltage drops and interruptions • Conducted RF • Power frequency magnetic field

Requirement for Compliance with LVD directive

The following products have shown compliance through direct testing (of the identified standards below) and design analysis (through the creation of a technical construction file) to the European Directive for Low Voltage (2006/95/EC) when used as directed by the appropriate documentation.

Type : Programmable Controller (Open Type Equipment)
Models : MELSEC FX3GE series manufactured

from March 1st, 2013	FX3GE-★★MR/ES	
from June 1st, 2013	FX3GE-★★MT/ES	FX3GE-★★MT/ESS
from August 1st, 2013	FX3GE-★★MR/DS	
	Where ★★ indicates: 24, 40	

Standard	Remark
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of EN61131-2:2007

Models :MELSEC FX2N series manufactured

from July 1st, 1997	FX2N-★★ER-ES/UL	FX2N-★★ET-ESS/UL
	Where ★★ indicates:32, 48	
	FX2N-16EYR-ES/UL	
from April 1st, 1998	FX2N-48ER-DS	
from August 1st, 1998	FX2N-48ER-UA1/UL	
from August 1st, 2005	FX2N-8ER-ES/UL	FX2N-8EYR-ES/UL
from September 1st, 2010	FX2N-8EYR-S-ES/UL	

For the products above, PLCs manufactured
before March 31st, 2002 are compliant with IEC1010-1
from April 1st, 2002 to April 30th, 2006 are compliant with EN61131-2:1994+A11:1996+A12:2000
after May 1st, 2006 are compliant with EN61131-2:2007

Standard	Remark
IEC1010-1:1990 /A1:1992 Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of IEC 1010-1: 1990+A1:1992
EN61131-2:1994 /A11:1996 /A12:2000 Programmable controllers - Equipment requirements and tests	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of EN61131-2: 1994+A11:1996+A12:2000
EN61131-2:2007 Programmable controllers - Equipment requirements and tests	The equipment has been assessed as a component for fitting in a suitable enclosure which meets the requirements of EN61131-2:2007

Caution for compliance with EC Directive

Installation in Enclosure
Programmable logic controllers are open-type devices that must be installed and used within conductive control boxes. Please use the FX3GE Series programmable logic controllers while installed in conductive shielded control boxes. Please secure the control box lid to the control box (for conduction).
Installation within a control box greatly affects the safety of the system and aids in shielding noise from the programmable logic controller.

Analog input/output
The analog input/output have been found to be compliant to the European standards in the aforesaid manual and directive. However, for the very best performance from what are in fact delicate measuring and controlled output devices, Mitsubishi Electric would like to make the following points.
As analog devices are sensitive by nature, their use should be considered carefully. For users of proprietary cables (integral with sensors or actuators), these users should follow those manufacturers' installation requirements.
Mitsubishi Electric recommends that shielded cables be used. If NO other EMC protection is provided, users may experience temporary loss or accuracy between +10% / -10% in very heavy industrial areas.
However, Mitsubishi Electric suggests that adequate EMC precautions be followed for the users complete control system.

- Sensitive analog cables should not be laid in the same trunking or cable conduit as high voltage cabling. Where possible, users should run analog cables separately.
- Good cable shielding should be used. When terminating the shield at Earth, ensure that no earth loops are accidentally created.
- When reading analog values, EMC accuracy can be improved by averaging the readings. This can be achieved either through functions on the analog products or through a user's program in the FX3GE Series PLC main unit.

Incorporated Items

Check if the following product and items are included in the package.

	Included Items	
■ Main units		
FX3GE-24M□, FX3GE-40M□	Product	1 unit
	Dust proof protection sheet	1 sheet
	Manuals [English]	1 manual

1. Features and cautions on using FX3GE PLC

FX3GE PLC has an Ethernet communication function and analog input/output function built into a base that is FX3G PLC.
This section describes below differences between FX3G and FX3GE and cautions on use.
For details, refer also to the FX3G Series User's Manual - Hardware Edition.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

1.1 Additional function from the FX3G series

- Ethernet communication function
  The PLC has a Ethernet communication function (Equivalent to FX3U-ENET-ADP).
- Analog input/output function
  The PLC has analog input 2 channels, analog output 1 channel (Equivalent to FX3U-3A-ADP). Specifications differ from FX3U-3A-ADP in part. For details, refer to Chapter 6.

1.2 Programming tool

GX Works2 Ver. 1.91V or later can be used. Select "FX3G" in "PLC Type". When setting "Ethernet port settings", using GX Works2 Ver.1.91V or later.
FX-30P and GX Developer can also be used. However, "Ethernet port setting" cannot be set.
In the case that the version does not support FX3G, the programming tool can still be used by choosing FX1N. However, programming is enabled only in the functional range such as instructions, device ranges and program sizes available in a PLC selected as the alternative model.

1.3 Using the built-in Ethernet

When GX Works2 or MX Component is used, set the parameter settings and connection destination settings of the built-in Ethernet using the same settings as FX3U-ENET-ADP.

1.4 Terminal block

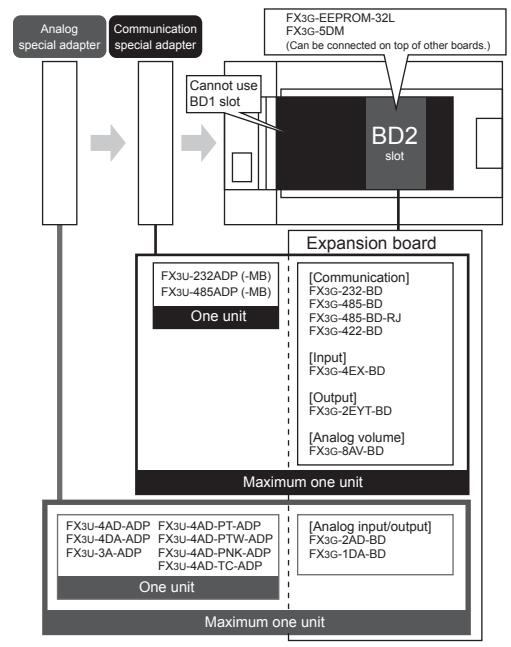
The input/output terminal block of FX3GE series PLC is built-in.
Terminal block cannot be removed.

1.5 System configuration

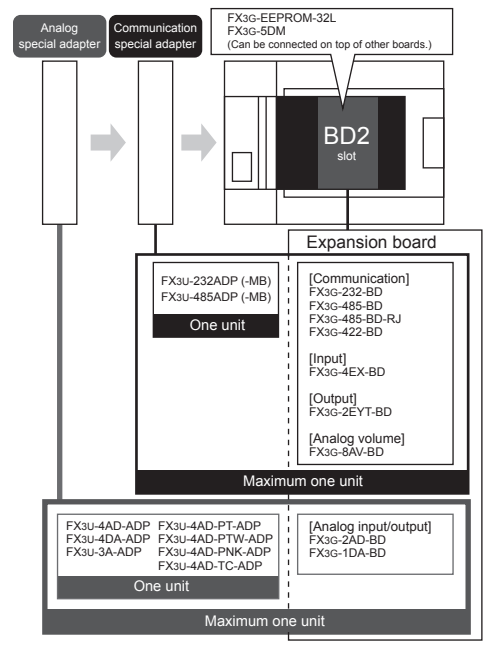
- Special adapters can be directly connected to the main unit.
  (It is not necessary to connect a connector conversion adapter.)
- One communication and one analog expansion option can be connected.
  Expansion is available for one expansion board and two special adapters. But the expansion board cannot be connected when two special adapters are connected.
- 40 point I/O type cannot use the BD1 slot.
- FX3G-CNV-ADP, FX3U-ENET-ADP cannot be connected.
- The communication channel of the built-in Ethernet is CH1. When a communication expansion board or a communication special adapter is connected to the PLC, that communication channel becomes CH2.
- The built-in analog is the analog special adapter first unit.
  When an analog expansion board is connected, the analog expansion board becomes second unit. When an analog special adapter is connected, the analog special adapter becomes second unit.

Please refer to the following for details.

1) In the case of 40 point type



2) In the case of 24 point type

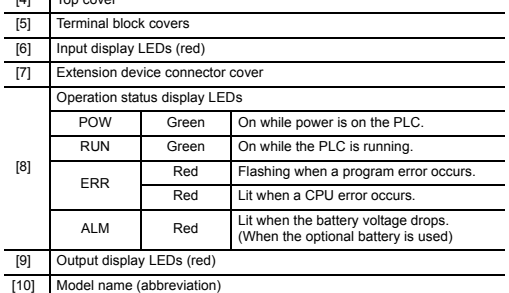


2. Outline

2.1 Part names

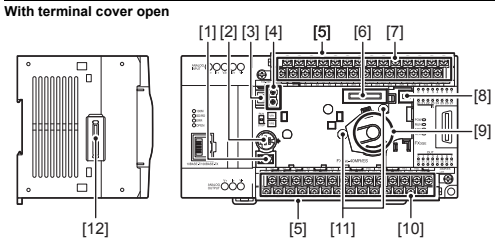
For the input/output extension units/blocks, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**



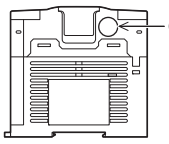
No.	Name		
[1]	Peripheral device connector cover		
[2]	Terminal names		
[3]	Top cover (S) (40points type only)		
[4]	Top cover		
[5]	Terminal block covers		
[6]	Input display LEDs (red)		
[7]	Extension device connector cover		
[8]	Operation status display LEDs		
	POW	Green	On while power is on the PLC.
	RUN	Green	On while the PLC is running.
	ERR	Red	Flashing when a program error occurs.
		Red	Lit when a CPU error occurs.
	ALM	Red	Lit when the battery voltage drops. (When the optional battery is used)
[9]	Output display LEDs (red)		
[10]	Model name (abbreviation)		
[11]	DIN rail mounting hooks		
[12]	Analog input terminal block		
[13]	Analog output terminal block		
[14]	10BASE-T/100BASE-TX connector (RJ45)		
[15]	Ethernet status LEDs		
[16]	Special adapter connector cover		

With terminal cover open



No.	Name
[1]	Peripheral device connector (USB)
[2]	Peripheral device connector (RS-422)
[3]	RUN/STOP switch
[4]	Variable analog potentiometers Upper side : VR1, Lower side : VR2
[5]	Terminal cover
[6]	Optional equipment connector
[7]	Power supply terminal, Input (X) terminals
[8]	Battery connector
[9]	Battery holder
[10]	Power supply terminal, Output (Y) terminals
[11]	Optional equipment connecting screw holes
[12]	Special adapter connector

Right side



The authentication label for authorized products is affixed to the right side of the product to avoid to be forged.
Products that do not have the genuine product certification label or nameplate are not covered by the warranty.

2.2 LED status

PLC part

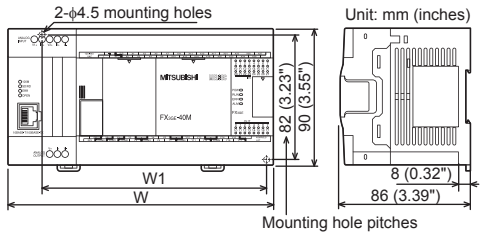
LED display	LED color	Status	Description
POW	Green	ON	Power is on
		OFF	Power is off
RUN	Green	ON	Running
		OFF	Stopped
ERR	Red	ON	When a CPU error occurs.
		Flicker	When a program error occurs.
		OFF	When a normal status.
ALM	Red	ON	When the battery voltage drops. (When the optional battery is installed.)
		OFF	When the battery voltage normal status. (When the optional battery is installed.)

Built-in Ethernet part

LED display	LED color	Status	Description
100M	Green	ON	100Mbps communication
		OFF	10Mbps communication or not connected
SD/RD	Green	ON	Data being sent or received.
		OFF	Data is not sent or received.
ERR	Red	ON	Setting errors, hardware errors, etc.
		Flicker	Communication errors
		OFF	Setting normal, communication normal
OPEN	Green	ON	TCP/IP: 1 or more connections are established. UDP: 1 or more connections are open.
		OFF	TCP/IP: All connections are unestablished. UDP: All connections are closed.

2.3 External dimensions and weight

For the input/output extension units/blocks, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**



Model name	W: mm (inches)	W1: mm (inches) Direct mounting hole pitches	MASS (Weight): kg (lbs)
FX3GE-24M□	130 (5.12")	105 (4.13")	Approx. 0.60 (1.32lbs)
FX3GE-40M□	175 (6.89")	150 (5.90")	Approx. 0.80 (1.76lbs)

Installation

- 35-mm-wide DIN rail or Direct (screw) mounting (M4)

3. Installation (general specifications)

As for installation of the input/output extension units/blocks, special adapters and expansion boards, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

INSTALLATION PRECAUTIONS ⚠**CAUTION**

- Use the product within the generic environment specifications described in section 3.1 of this manual.
  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.
- Do not touch the conductive parts of the product directly.
  Doing so may cause device failures or malfunctions.
- Install the product securely using a DIN rail or mounting screws.
- 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.
- When drilling screw holes or wiring, make sure that cutting and wiring debris do not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Be sure to remove the dust proof sheet from the PLC's ventilation port when installation work is completed.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Connect the extension cables, peripheral device cables, input/output cables and battery connecting cable securely to their designated connectors.
  Loose connections may cause malfunctions.
- Turn off the power to the PLC before attaching or detaching the following devices.
  Failure to do so may cause device failures or malfunctions.
  - Peripheral devices, display modules, and Extension units/blocks
  - Expansion boards, special adapters, battery and memory cassette

Notes

- When a dust proof sheet is supplied with units, keep the sheet applied to the ventilation slits during installation and wiring work.
- To prevent temperature rise, do not install the PLC on a floor, a ceiling or a vertical surface.
  Install it horizontally on a wall as shown in section 3.2.
- Keep a space of 50mm (1.97") or more between the unit main body and another device or structure (part A). Install the unit as far away as possible from high-voltage lines, high-voltage devices and power equipment.

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.

3.1 Generic specifications

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/s²)	Half amplitude (mm)	Sweep Count for X, Y, Z: 10 times (80 min in each direction)
	When installed on DIN rail	10 to 57	-	0.035	
		57 to 150	4.9	-	
	When installed directly	10 to 57	-	0.075	
		57 to 150	9.8	-	
Shock resistance*1	147m/s² Acceleration, Action time: 11ms, 3 times by half-sine pulse in each direction X, Y, and Z				
Noise resistance	By noise simulator at noise voltage of 1,000Vp-p, noise width of 1μs, rise time of 1ns and period of 30 to 100Hz				
Dielectric withstand voltage*2	1.5kV AC for one minute	Between each terminals*2 and ground terminal			
	500V AC for one minute				
Insulation resistance*2	5MΩ or more by 500V DC megger				
Grounding	Class D grounding (grounding resistance: 100Ω or less) <Common grounding with a heavy electrical system is not allowed.>*3				
Working atmosphere	Free from corrosive or flammable gas and excessive conductive dusts				
Working altitude	<2000m*4				

*1 The criterion is shown in IEC61131-2.

*2 Dielectric withstand voltage and insulation resistance are shown in the following table.

Terminal	Dielectric strength	Insulation resistance
■ Main units, Input/output extension units/blocks		
Between power supply terminal (AC power) and ground terminal	1.5kV AC for one minute	5MΩ or more by 500V DC megger
Between power supply terminal (DC power) and ground terminal	500V AC for one minute	
Between input terminal (24V DC) and ground terminal		
Between input terminal (100V AC) and ground terminal*5	1.5kV AC for one minute	
Between output terminal (relay) and ground terminal		
Between output terminal (transistor) and ground terminal	500V AC for one minute	
Between output terminal (triac) and ground terminal*5	1.5kV AC for one minute	
10BASE-T/100BASE-TX connector and ground terminal	500V AC for one minute	
Main unit analog terminal and ground terminal	Not allowed	Not allowed
■ Expansion boards, Special adapters, Special function blocks		
Between terminal of expansion board (except FX3G-4EX-BD and FX3G-2EYT-BD) and ground terminal	Not allowed	Not allowed
Between FX3G-4EX-BD input terminal (24V DC) and ground terminal	500V AC for one minute	5MΩ or more by 500V DC megger
Between FX3G-2EYT-BD output terminal (transistor) and ground terminal		
Between terminal of special adapter and ground terminal		
Special function block	Each manual	

For dielectric with stand voltage test and insulation resistance test of each product, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

*3 For common grounding, refer to section 4.3.

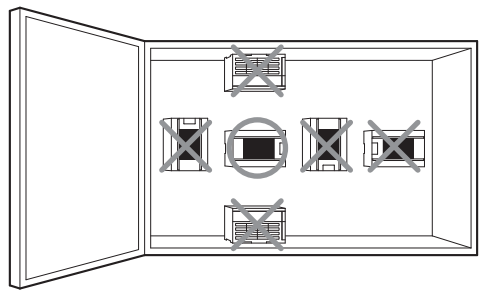
*4 The PLC cannot be used at a pressure higher than the atmospheric pressure to avoid damage.

*5 Input/output extension units/blocks only

3.2 Installation location

Install the PLC in an environment conforming to the generic specifications (section 3.1), installation precautions and notes.
For more details, refer to FX3G Series User's Manual - Hardware Edition.

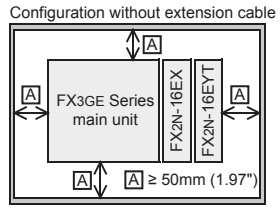
Installation location in enclosure



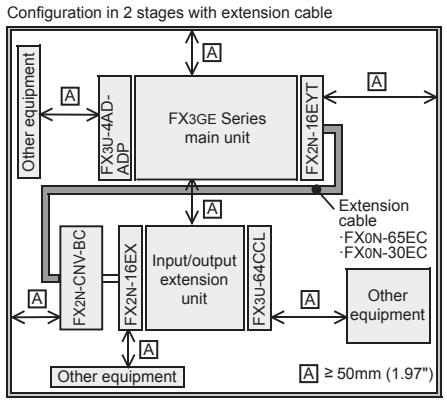
Space in enclosure

Extension devices can be connected on the left and right sides of the main unit of the PLC.
If you intend to add extension devices in the future, keep necessary spaces on the left and right sides.

Configuration without extension cable



Configuration in 2 stages with extension cable



3.2.1 Affixing The Dust Proof Sheet

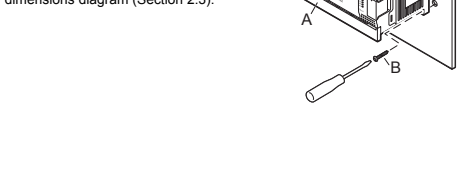
The dust proof sheet should be affixed to the ventilation port before beginning the installation and wiring work.
→ **For the affixing procedure, refer to the instructions on the dust proof sheet.**
Be sure to remove the dust proof sheet when the installation and wiring work is completed.

3.3 Procedures for installing to and detaching from DIN rail

The products can be installed on a DIN46277 rail [35mm (1.38") wide].
This section explains the installations of the main units.
For the input/output extension units/blocks and special adapters, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

3.3.1 Installation

1) Push out all DIN rail mounting hooks (below fig.A).



2) Fit the upper edge of the DIN rail mounting groove (right fig.B) onto the DIN rail.

3) Lock the DIN rail mounting hooks (below fig.C) while pressing the PLC against the DIN rail.

3.4 Procedures for installing directly (with M4 screws)

The product can be installed directly on the panel (with screws).
This section explains the installation of the main units.
As for the details of the installation/detaching for input/output extension units/blocks and special adapters, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

3.4.1 Mounting hole pitches

Refer to the external dimensions (section 2.3) for the product's mounting hole pitch information.
As for the details of the mounting hole pitches for extension unit/block and special adapters, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

3.4.2 Installation

1) Make mounting holes in the mounting surface referring to the external dimensions diagram.
2) Fit the main unit (A in the right figure) based on the holes, and secure it with M4 screws (B in the right figure). The mounting hole pitches and number of screws depend on the product. Refer to the external dimensions diagram (Section 2.3).

4. Power supply/input/output specifications and external wiring example of the main unit part

As for the details of the power supply wiring and input/output wiring, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

DESIGN PRECAUTIONS ⚠**WARNING**

- Make sure to have the following safety circuits outside of the PLC to ensure safe system operation even during external power supply problems or PLC failure.
  Otherwise, malfunctions may cause serious accidents.
  1) Most importantly, have the following: an emergency stop circuit, a protection circuit, an interlock circuit for opposite movements (such as normal vs. reverse rotation), and an interlock circuit (to prevent damage to the equipment at the upper and lower positioning limits).
  2) Note that when the PLC CPU detects an error, such as a watchdog timer error, during self-diagnosis, all outputs are turned off. Also, when an error that cannot be detected by the PLC CPU occurs in an input/output control block, output control may be disabled.
     External circuits and mechanisms should be designed to ensure safe machinery operation in such a case.
  3) Note that when an error occurs in a relay, triac or transistor output device, the output could be held either on or off.
     For output signals that may lead to serious accidents, external circuits and mechanisms should be designed to ensure safe machinery operation in such a case.

DESIGN PRECAUTIONS ⚠**CAUTION**

- Do not bundle the control line together with or lay it close to the main circuit or power line. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit or power line.
  Noise may cause malfunctions.
- Install module so that excessive force will not be applied to the built-in programming connectors, power connectors or I/O connectors.
  Failure to do so may result in wire damage/breakage or PLC failure.

Notes

- Simultaneously turn on and off the power supplies of the main unit and extension devices.
- Even if the AC power supply causes an instantaneous power failure for less than 10 ms, the PLC can continue to operate.
- Even if the DC power supply causes an instantaneous power failure for less than 5 ms, the PLC can continue to operate.
- If a long-time power failure or an abnormal voltage drop occurs, the PLC stops, and output is turned off. When the power supply is restored, it will automatically restart (when the RUN input is on).

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.

WIRING PRECAUTIONS ⚠**CAUTION**

- Connect the AC power supply to the dedicated terminals specified in this manual. If an AC power supply is connected to a DC input/output terminal or DC power supply terminal, the PLC will burn out.
- Do not wire vacant terminals externally.
  Doing so may damage the product.
- Perform class D grounding (grounding resistance: 100Ω or less) to the grounding terminal on the FX3GE Series main unit with a wire 2 mm² or thicker.
  Do not use common grounding with heavy electrical systems (refer to section 4.3).
- When drilling screw holes or wiring, make sure cutting or wire debris does not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Make sure to properly wire to the terminal in accordance with the following precautions.
  Failure to do so may cause electric shock, equipment failures, a short-circuit, wire breakage, malfunctions, or damage to the product.
  - The disposal size of the cable end should follow the dimensions described in the manual.
  - Tightening torque should follow the specifications in the manual.
  - Tighten the screws using a Phillips-head screwdriver No.2 (shaft diameter 6mm (0.24") or less). Make sure that the screwdriver does not touch the partition part of the terminal block.

Notes

- Input/output wiring 50 to 100m (164'1" to 328'1") long will cause almost no problems of noise, but, generally, the wiring length should be less than 20m (65'7") to ensure the safety.
- Extension cables are easily affected by noise. Lay the cables at a distance of at least 30 to 50mm (1.19" to 1.97") away from the PLC output and other power lines.

4.1 Wiring

This section explains the wiring of the terminal type.
For the connectors types, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.1.1 Cable end treatment and tightening torque

For the terminals of FX3GE series PLC, M3 screws are used.
The electric wire ends should be treated as shown below.
Tighten the screws to a torque of 0.5 to 0.8 N•m.
Do not tighten terminal screws with a torque outside the above-mentioned range. Failure to do so may cause equipment failures or malfunctions.

- When one wire is connected to one terminal

<Reference>

Terminal Manufacturer	Type No.	Certification	Pressure Bonding Tool
JAPAN SOLDERLESS TERMINAL MFG CO LTD (JST)	FV1.25-B3A	UL Listed	YA-1(JST)
	FV2-MS3		

- When two wires are connected to one terminal

<Reference>

Terminal Manufacturer	Type No.	Certification	Pressure Bonding Tool
JAPAN SOLDERLESS TERMINAL MFG CO LTD (JST)	FV1.25-B3A	UL Listed	YA-1(JST)

4.2 Power supply specifications and example of external wiring

As for the details of the power supply specifications and example of external wiring, refer to the following manual.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.2.1 Power supply specifications[Main unit]

Item		Specification	
		AC power type	DC power type
Supply voltage		100 to 240V AC	24V DC
Allowable supply voltage range		85 to 264V AC	20.4 to 28.8V DC
Rated frequency		50/60Hz	-
Allowable instantaneous power failure time		Operation can be continued upon occurrence of instantaneous power failure for 10 ms or less.	Operation can be continued upon occurrence of instantaneous power failure for 5 ms or less.
Power fuse	FX3GE-24M□	250V 1A	125V 2.5A
	FX3GE-40M□	250V 3.15A	125V 3.15A
Rush current		30A max. 5ms or less/100V AC 50A max. 5ms or less/200V AC	30A max. 1ms or less/24 V DC
Power consumption*1	FX3GE-24M□	32W	21W
	FX3GE-40M□	37W	25W
24V DC service power supply		400mA	-

*1 This item shows values when all 24V DC service power supplies are used in the maximum configuration connectable to the main unit.
(The DC power type main unit does not have a 24V DC service power supply.)
Power (current) consumption of the input/output extension units/blocks.
→ **Refer to FX3G Series User's Manual - Hardware Edition.**
Power consumption of the special function blocks.
→ **Refer to the respective manual.**

4.2.2 Example of external wiring (AC power type)

100 to 240V AC power is supplied to the main unit and input/output extension unit.
→ **For the details of wiring work, refer to section 4.1.**

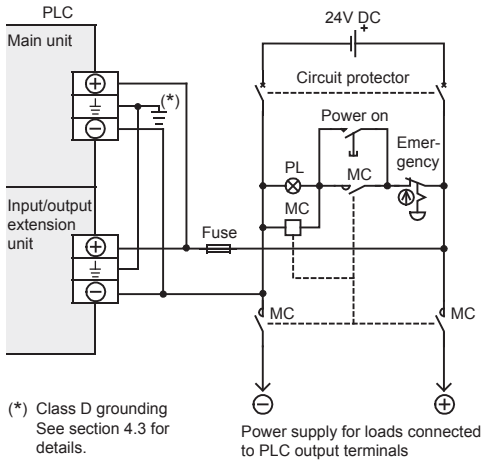
(*) Class D grounding
See section 4.3 for details.

Power supply for loads connected to PLC output terminals

4.2.3 Example of external wiring (DC power type)

24V DC power is supplied to the main unit and input/output extension unit.

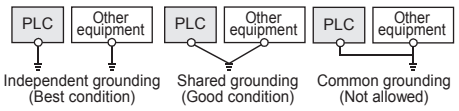
→ **For the details of wiring work, refer to section 4.1.**



4.3 Grounding

Ground the PLC as stated below.

- Perform class D grounding. (Grounding resistance: 100Ω or less)
- Ground the PLC independently if possible.
  If it cannot be grounded independently, ground it jointly as shown below.



- Use ground wires thicker than AWG14 (2mm^2).
- Position the grounding point as close to the PLC as possible to decrease the length of the ground wire.

4.4 Input specifications and external wiring

As for the details of the input specifications of I/O extension unit/block and external wiring, refer to the following manual.

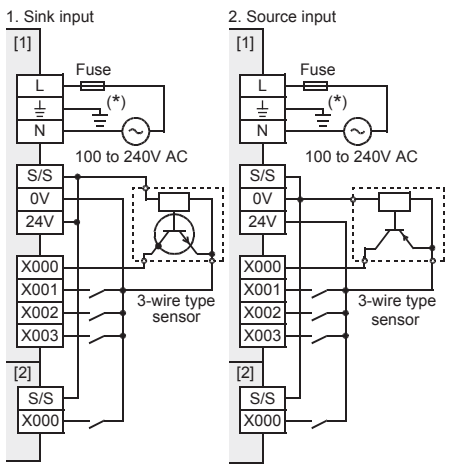
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.4.1 Input specifications [24V DC input type]

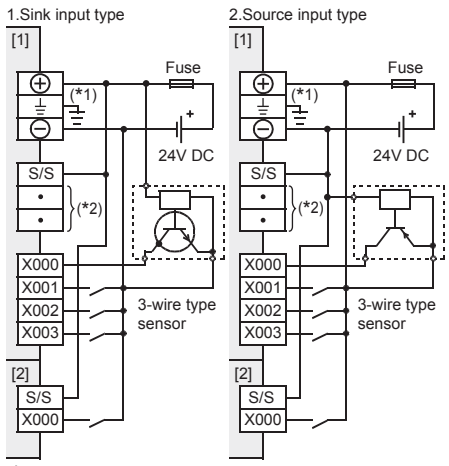
Item		Specification
Number of input points	FX3GE-24M□	14 points (16 points)*1
	FX3GE-40M□	24 points
Input connecting type		Terminal block (M3 screw)
Input form		Sink/Source
Input signal voltage	AC power type	24V DC +10%, -10%
	DC power type	20.4 to 28.8V DC
Input impedance	X000 to X007	3.3kΩ
	X010 or more	4.3kΩ
Input signal current	X000 to X007	7mA/24V DC
	X010 or more	5mA/24V DC
ON input sensitivity current	X000 to X007	4.5mA or more
	X010 or more	3.5mA or more
OFF input sensitivity current		1.5mA or less
Input response time		Approx. 10ms
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.

*1 Each value inside ( ) indicates the number of occupied points.

4.4.2 Examples of input wiring [AC power type]



4.4.3 Examples of input wiring [DC power type]



4.4.4 Instructions for connecting input devices

As for the details of Instructions for connecting input devices, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

1) In the case of no-voltage contact:
   The input current of this PLC is 5 to 7mA/24V DC.
   Use input devices applicable to this minute current.
   If no-voltage contacts (switches) for large current are used, contact failure may occur.
2) In the case of input device with built-in series diode:
   The voltage drop of the series diode should be approx. 4V or less.
   When lead switches with a series LED are used, up to two switches can be connected in series.
   Also make sure that the input current is over the input-sensing level while the switches are ON.
3) In the case of input device with built-in parallel resistance:
   Use a device with a parallel resistance of 15kΩ or more.
   When the resistance is less than 15kΩ, connect a bleeder resistance.
4) In the case of 2-wire proximity switch:
   Use a two-wire proximity switch whose leakage current is 1.5mA or less when the switch is off.
   When the current is larger than 1.5mA, connect a bleeder resistance.

4.5 Relay output specifications and example of external wiring

As for the details of the relay output specifications of I/O extension unit/block and external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.5.1 Relay output specifications

Item		Specification
Number of output points	FX3GE-24MR□	10 points (16 points)*1
	FX3GE-40MR□	16 points
Output connecting type		Terminal block (M3 screw)
Output form		Relay
External power supply		30V DC or less 240V AC or less*2
Max. load	Resistance load	2A/point*3
	Inductive load	80VA
Min. load		5V DC, 2mA (reference value)
Open circuit leakage current		-
Response time	OFF→ON ON→OFF	Approx. 10ms
Circuit insulation		Mechanical insulation
Display of output operation		LED lights when power is applied to relay coil.

*1 Each value inside ( ) indicates the number of occupied points.

*2 Between 250V and 240V CE, UL, and cUL are not compliant.

*3 The total load current of resistance loads per common terminal should be the following value or less.
- 1 output point/common terminal : 2A
- 4 output points/common terminal : 8A

As for the number of outputs per common terminal, refer to "Section 4.8 interpretation of partition" and the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.5.2 Life of relay output contact

The product life of relay contacts considerably varies depending on the load type used. Take care that loads generating reverse electromotive force or rush current may cause poor contact or deposition of contacts which may lead to considerable reduction of the contact product life.

1) Inductive load
   Inductive loads generate large reverse electromotive force between contacts at shutdown may cause arcing. At a fixed current consumption, as the power factor (phase between current and voltage) gets smaller, the arc energy gets larger.
   The standard life of the contact used for Inductive loads, such as contactors and solenoid valves, is 500 thousand operations at 20VA.
   The following table shows the approximate life of the relay based on the results of our operation life test.
   Test condition: 1 sec. ON / 1 sec. OFF.

Load capacity		Contact life
20VA	0.2A/100V AC	3 million times
	0.1A/200V AC	
35VA	0.35A/100V AC	1 million times
	0.17A/200V AC	
80VA	0.8A/100V AC	2 hundred thousand times
	0.4A/200V AC	

The product life of relay contacts becomes considerably shorter than the above conditions when the rush overcurrent is shut down.

→ **For countermeasures while using inductive loads, refer to Subsection 4.5.4.**

Some types of inductive loads generate rush current 5 to 15 times the stationary current at activation. Make sure that the rush current does not exceed the current corresponding to the maximum specified resistance load.

2) Lamp load
   Lamp loads generally generate rush current 10 to 15 times the stationary current. Make sure that the rush current does not exceed the current corresponding to the maximum specified resistance load.
3) Capacitive load
   Capacitive loads can generate rush current 20 to 40 times the stationary current. Make sure that the rush current does not exceed the current corresponding to the maximum specified resistance load. Capacitive loads such as capacitors may be present in electronic circuit loads including inverters.

→ **For the maximum specified resistance load, refer to Subsection 4.5.1.**

4.5.3 Example of relay output wiring

4.5.4 Cautions in external wiring

For attention in the external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Protection circuit for load short-circuiting
When a load connected to the output terminal short-circuits, the printed circuit board may be burnt out. Fit a protective fuse on the output circuit.

Protection circuit of contact when inductive load is used
An internal protection circuit for the relays is not provided for the relay output circuit in this product. It is recommended to use inductive loads with built-in protection circuits. When using loads without built-in protection circuits, insert an external contact protection circuit, etc. to reduce noise and extend the product life.

1) DC circuit
   Connect a diode in parallel with the load.
   Use a diode (for commutation) having the following specifications.

Item	Standard
Reverse voltage	5 to 10 times the load voltage
Forward current	Load current or more

2) AC circuit
   Connect the surge absorber (combined CR components such as a surge killer and spark killer, etc.) parallel to the load.
   Select the rated voltage of the surge absorber suitable to the output used.
   Refer to the table below for other specifications.

Item	Standard
Electrostatic capacity	Approx. 0.1μF
Resistance value	Approx. 100 to 200Ω

Interlock
Loads, such as contactors for normal and reverse rotations, that must not be turned on simultaneously should have an interlock in the PLC program and an external interlock.

Common mode
Use output contacts of the PLC in the common mode.

4.6 Transistor output specifications and example of external wiring

As for the details of the transistor output specifications of I/O extension unit/block and external wiring, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.6.1 Transistor output specifications

Item				Specification
Number of output points	FX3GE-24MT□			10 points (16 points)*1
	FX3GE-40MT□			16 points
Output connecting type				Terminal block (M3 screw)
Output form	FX3GE-□MT/□S			Transistor (Sink)
	FX3GE-□MT/□SS			Transistor (Source)
External power supply				5 to 30V DC
Max. load	Resistance load			0.5A/point*2
	Inductive load			12W/24V DC*3
Min. load				-
Open circuit leakage current				0.1mA or less/30V DC
ON voltage				1.5V or less
Response time	OFF→ON	FX3GE-24MT□	Y000, Y001	5μs or less/10mA or more (5 to 24V DC)
			Y002 or more	0.2ms or less/200mA or more (at 24V DC)
		FX3GE-40MT□	Y000 to Y002	5μs or less/10mA or more (5 to 24V DC)
			Y003 or more	0.2ms or less/200mA or more (at 24V DC)
	ON→OFF	FX3GE-24MT□	Y000, Y001	5μs or less/10mA or more (5 to 24V DC)
			Y002 or more	0.2ms or less/200mA or more (at 24V DC)
		FX3GE-40MT□	Y000 to Y002	5μs or less/10mA or more (5 to 24V DC)
			Y003 or more	0.2ms or less/200mA or more (at 24V DC)
Circuit insulation				Photocoupler insulation
Display of output operation				LED on panel lights when photocoupler is driven.

*1 Each value inside ( ) indicates the number of occupied points.

*2 The total load current of resistance loads per common terminal should be the following value or less.
- 1 output point/common terminal : 0.5A
- 4 output points/common terminal : 0.8A

As for the number of outputs per common terminal, refer to "Section 4.8 interpretation of partition" and the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

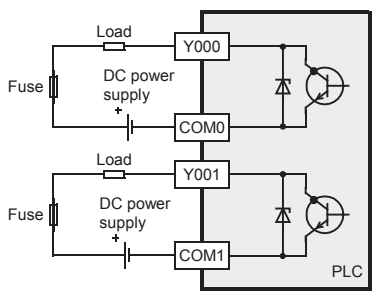
*3 The total of inductive loads per common terminal should be the following value or less.
- 1 output point/common terminal : 12W/24V DC
- 4 output points/common terminal : 19.2W/24V DC

As for the number of outputs per common terminal, refer to "Section 4.8 interpretation of partition" and the following manual.

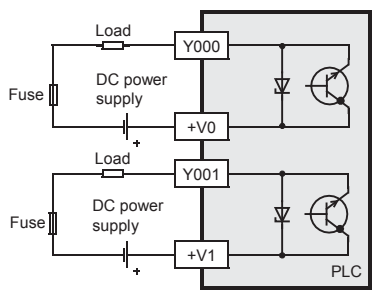
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.6.2 External wiring of transistor output

1. External Wiring of Sink Output Type



2. External Wiring of Source Output Type



4.6.3 Cautions in external wiring

As for the details of Instructions for connecting input devices, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Protection circuit for load short-circuits
A short-circuit at a load connected to an output terminal could cause burnout at the output element or the PCB. To prevent this, a protection fuse should be inserted at the output.
Use a load power supply capacity that is at least 2 times larger than the total rated fuse capacity.

Contact protection circuit for inductive loads
When an inductive load is connected, connect a diode (for commutation) in parallel with the load as necessary.
The diode (for commutation) must comply with the following specifications.

Item	Guide
Reverse voltage	5 to 10 times of the load voltage
Forward current	Load current or more

Interlock
Loads, such as contactors for normal and reverse rotations, that must not be turned on simultaneously should have an interlock in the PLC program and an external interlock.

4.7 Triac output specifications of I/O extension unit/block

As for the details of the triac output specifications and external wiring, refer to the following manual.

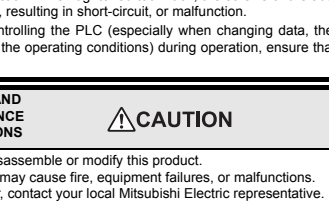
→ **Refer to FX3G Series User's Manual - Hardware Edition.**

4.8 Terminal block layouts

For details on the terminal block layout, refer to the following manual.

→ **Refer to FX3G Series User's Manual - Hardware Edition.**

Interpretation of partition
The partition of the output terminals (see following figure) indicates the range of the output connected to the same common.



5. Built-in Ethernet specifications and wiring

As for the details of the specifications and wiring, refer to the following manual.

→ **Refer to FX3U-ENET-ADP User's Manual.**

DESIGN PRECAUTIONS ⚠**WARNING**

- Make sure to have the following safety circuits outside of the PLC to ensure safe system operation even during external power supply problems or PLC failure.
  Otherwise, malfunctions may cause serious accidents.
  1) Above all, the following components should be included: an emergency stop circuit, a protection circuit, aninterlock circuit for opposite movements (such as normal vs. reverse rotation), and an interlock circuit (to prevent damage to the equipment at the upper and lower positioning limits).
  2) Note that when the PLC main unit detects an error during self diagnosis, such as a watchdog timer error, all outputs are turned off. Also, when an error that cannot be detected by the PLC main unit occurs in an input/output control block, output control may be disabled. External circuits and mechanisms should be designed to ensure safe machinery operation in such cases.

DESIGN PRECAUTIONS ⚠**CAUTION**

- Observe the following items. Failure to do so may cause incorrect data-writing through noise to the PLC and result in PLC failure, machine damage or other accident.
  1) Do not bundle the control line together with or lay it close to the main circuit or power line. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit or power line.
     Noise may cause malfunctions.
  2) Ground the shield wire or shield of a shielded cable. Do not use common grounding with heavy electrical systems.

STARTUP AND MAINTENANCE PRECAUTIONS ⚠**WARNING**

- Do not touch any terminals or connector while the PLC's power is on.
  Doing so may cause electrical shock or malfunctions.
- Before cleaning or retightening screws, externally cut off all phases of the power supply.
  Failure to do so may cause malfunction or failure of this adapter. When the screws are tightened insufficiently, they may fall out and cause a shortcircuit or malfunction. When tightened too much, the screws or the adapter may be damaged, resulting in short-circuit, or malfunction.
- When controlling the PLC (especially when changing data, the program or changing the operating conditions) during operation, ensure that it is safe to do so.

STARTUP AND MAINTENANCE PRECAUTIONS ⚠**CAUTION**

- Do not disassemble or modify this product.
  Doing so may cause fire, equipment failures, or malfunctions.
  For repair, contact your local Mitsubishi Electric representative.
- The adapter case is made of resin. If dropped or subjected to strong impact, the adapter may be damaged.
- When this adapter is installed or removed from the panel, make sure to externally cut off all phases of the power supply. Failure to do so may cause malfunction or failure of this adapter.

WIRING PRECAUTIONS ⚠WARNING

- Make sure to cut off all phases of the power supply externally before attempting wiring work.
  Failure to do so may cause electric shock or damage to the product.

WIRING PRECAUTIONS ⚠CAUTION

- When drilling screw holes or wiring, make sure that cutting and wiring debris do not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Make sure to observe the following precautions in order to prevent any damage to the machinery or accidents due to abnormal data written to the PLC under the influence of noise:
  - Do not bundle the main circuit line together with or lay it close to the main circuit, high-voltage line or load line.
    Otherwise, noise disturbance and/or surge induction are likely to take place. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit or high-voltage lines.

5.1 Specification

5.1.1 Communication specification

Item		Specification
Transmission specifications	Data transmission speed	100Mbps/10Mbps
	Communication method	Full-duplex/Half-duplex
	Transmission method	Base band
	Maximum segment length	100m (328'1")

5.1.2 Performance specification

Item	Specification
Functions	MELSOFT connections
	Communication Using MC Protocol
	MELSOFT Direct Connection (Simple Connection)
	Find CPU function
	Time setting function*1
	Diagnostics function from MELSOFT
	Data monitoring function
Number of simultaneously open connections allowed	MELSOFT connection + MC protocol + Data monitoring <= 4

*1 The time setting function (SNTP client) is enabled only after the trigger condition is established.

Caution

FX3U-ENET-ADP cannot be connected to the FX3GE Series PLC.

5.2 Wiring

5.2.1 Connecting to the network

The following explains how to connect the built-in Ethernet to 10BASE-T/100BASE-TX networks.
Pay close attention to safety and use the built-in Ethernet properly.

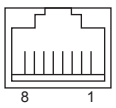
1) Sufficient network knowledge and safety precautions are required when installing 10BASE-T or 100BASE-TX networks. Consult a specialist when connecting cable terminals or installing trunk line cables, etc.
2) Use a connection cable conforming to the standards shown in Subsection 5.2.2.

Cautions regarding powering the hub, PLC and Ethernet simultaneously

On some hubs, for a fixed period of time immediately after powering up, even if packets are sent from the Ethernet device, there are cases when packets are not sent to the external device. In this case, create a sequence program that waits a sufficient amount of time after powering up before sending packets.

5.2.2 Applicable cable and connector

1) Connector
   RJ45 type modular jack
2) Pin Configuration
   The pin sequence of the 10BASE-T/100BASE-TX connection connector (RJ45 type modular jack) of the built-in Ethernet is as follows:



Pin No.	Signal	Direction	Contents
1	TD+	Out	+ side of sending data
2	TD-	Out	- side of sending data
3	RD+	In	+ side of receiving data
4	Not used	-	
5	Not used	-	
6	RD-	In	- side of receiving data
7	Not used	-	
8	Not used	-	

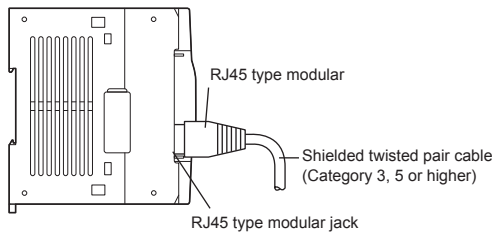
3) Applicable cable

10BASE-T	Cable conforming to Ethernet standard practice: Category 3 or higher (STP cable)
100BASE-TX	Cable conforming to Ethernet standard practice: Category 5 or higher (STP cable)

A straight cable is used. A cross cable can also be used when using direct connection (simple connection) between the personal computer and the FX3GE Series PLC.

5.2.3 Connecting to the 10BASE-T/100BASE-TX network

This section explains how to connect the built-in Ethernet to the 10BASE-T, 100BASE-TX network.
The following shows the connection diagram for the twisted paid cable.



<Operating procedure>
(Step 1) Connect the twisted pair cable to the hub.
(Step 2) Connect the twisted pair cable to the built-in Ethernet.

1) The built-in Ethernet detects whether it is 10BASE-T or 100BASE-TX, and in full-duplex or half-duplex transmission mode automatically according to the hub. (Auto detection function)
   For connection to a hub without the auto detection function, set the half-duplex mode on the hub side.
2) For 10BASE-T or 100BASE-TX connection required devices and a sample system configuration, refer to FX3U-ENET-ADP User's Manual.

6. Built-in analog specifications and wiring

As for the details of the specifications and wiring, refer to the following manual.
→ **Refer to FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition.**

STARTUP AND MAINTENANCE PRECAUTIONS ⚠CAUTION

- Do not disassemble or modify the PLC.
  Doing so may cause fire, equipment failures, or malfunctions.
  For repair, contact your local Mitsubishi Electric representative.
- Do not drop the product or exert strong impact to it.
  Doing so may cause damage.

WIRING PRECAUTIONS ⚠WARNING

- Make sure to cut off all phases of the power supply externally before attempting wiring work.
  Failure to do so may cause electric shock or damage to the product.

WIRING PRECAUTIONS ⚠CAUTION

- When drilling screw holes or wiring, make sure cutting or wire debris does not enter the ventilation slits.
  Failure to do so may cause fire, equipment failures or malfunctions.
- Make sure to observe the following precautions in order to prevent any damage to the machinery or accidents due to abnormal data written to the PLC under the influence of noise:
  1) Do not bundle the power line or shield of the analog input/output cable together with or lay it close to the maincircuit, high-voltage line, or load line.
     Otherwise, noise disturbance and/or surge induction are likely to take place. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit, high-voltage line, or load line.
  2) Ground the shield of the analog input/output cable at one point on the signal receiving side.
     However, do not use common grounding with heavy electrical systems.
- Make sure to properly wire to the terminal block (European type) in accordance with the following precautions.
  Failure to do so may cause electric shock, equipment failures, a short-circuit, wire breakage, malfunctions, or damage to the product.
  - The disposal size of the cable end should follow the dimensions described in the manual.
  - Tightening torque should follow the specifications in the manual.
  - Twist the end of strand wire 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.
  - Affix the electric wires so that neither the terminal block nor the connected parts are directly stressed.

6.1 Analog input terminal block (European type)

1) Wire size
   Wiring to analog device should use 22-20 AWG wire.
2) Applicable cable

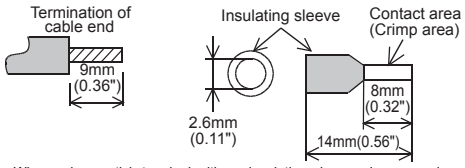
Item	Wire size
Single wire	0.3 to 0.5mm^2 (AWG22 to 20)
Double wire	0.3mm^2 (AWG22) × 2

3) Termination
   Strip the coating of strand wire and twist the cable core before connecting it, or strip the coating of single wire before connecting it. An alternative connection is to use a ferrule with insulating sleeve.

Manufacturer	Model	Caulking tool
Phoenix Contact Co., Ltd.	AI 0.5-8WH	CRIMPFOX 6*1 (or CRIMPFOX 6T-F*2)

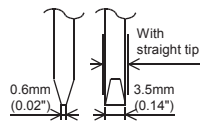
*1 Old model name: CRIMPFOX ZA 3
*2 Old model name: CRIMPFOX UD 6

• Stranded wire/solid wire • Bar terminal with insulating sleeve



When using a stick terminal with an insulating sleeve, choose a wire with proper cable sheath referring to the above outside dimensions, otherwise the wire cannot be inserted easily.
Tighten the screws to a torque of 0.22 to 0.25 N•m.
Do not tighten terminal screws exceeding with a torque outside the above-mentioned range.
Failure to do so may cause equipment failures or malfunctions.

4) Tool
   For tightening the terminal, use a commercially available small screwdriver having a straight form that is not widened toward the end as shown right.



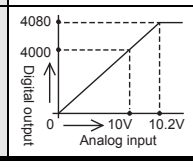
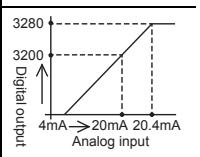
Note:
If the diameter of screwdriver grip is too small, tightening torque will not be able to be achieved. To achieve the appropriate tightening torque shown in the table above, use the following screwdriver or appropriate replacement (grip diameter : approximately 25mm (0.98")).

Manufacturer	Model names
Phoenix Contact Co., Ltd.	SZS 0.6×3.5

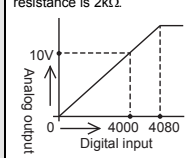
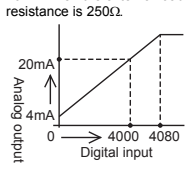
6.2 Input/output specifications and external wiring

As for the details of the analog input/output specifications, refer to the following manual.
→ **Refer to FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition.**

Analog input performance specifications

Item	Specifications	
	Voltage input	Current input
Analog input range	0 to 10V DC (Input resistance: 198.7kΩ)	4 to 20mA DC (Input resistance: 250Ω)
Absolute maximum input	-0.5V, +15V	-2mA, +30mA
Resolution	2.5mV(10V/4000)	5μA(16mA/3200)
Overall accuracy	• ±0.5% (±50mV) for 10V full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±100mV) for 10V full scale (when ambient temperature is 0 to 55°C)	• ±0.5% (±80μA) for 16mA full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±160μA) for 16mA full scale (when ambient temperature is 0 to 55°C)
Input characteristics		

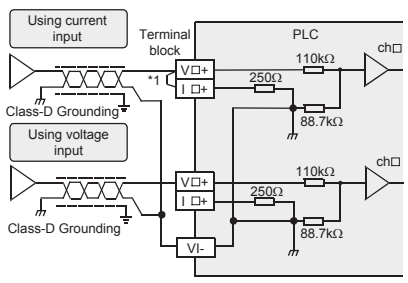
Analog output performance specifications

Item	Specifications	
	Voltage output	Current output
Analog output range	0 to 10V DC (External load: 2k to 1MΩ)	4 to 20mA DC (External load: 500Ω or less)
Resolution	2.5mV(10V/4000)	4μA(16mA/4000)
Overall accuracy	• ±0.5% (±50mV) for 10V full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±100mV) for 10V full scale (when ambient temperature is 0 to 55°C) Shipment adjustment is carried out by external load resistance 2kΩ. If external load resistance becomes larger than 2kΩ, the output voltage will increase slightly. When the load is 1MΩ, the output voltage becomes about 2% higher than the correct value.	• ±0.5% (±80μA) for 16mA full scale (when ambient temperature is 25 ± 5°C) • ±1.0% (±160μA) for 16mA full scale (when ambient temperature is 0 to 55°C)
Output characteristics	0 to 4000 are adjusted to 0 to 10V when the external load resistance is 2kΩ.  **Caution:** An area of dead band is located in the region of 0V. Therefore the output analog value may not represent the digital value accurately.	0 to 4000 are adjusted to 4 to 20mA when the external load resistance is 250Ω. 

Common Specifications of Analog Input and Output

Item	Specification
Digital input and output	12 bits, binary
Conversion time	90μs for each selected input channel + 50μs for each selected output channel (The data will be updated at every scan of the PLC.)
Insulation method	No insulation between each channel or the PLC.
Occupied points	0 point (This number is not related to the maximum number of input and output points of the PLC.)

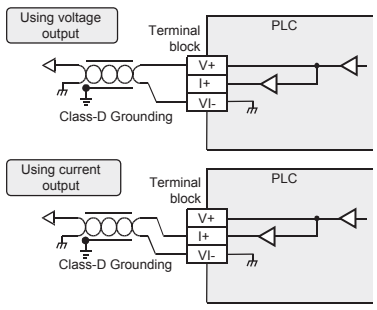
6.2.1 Example of analog input



V□+, I□+, ch□: □represents the channel number.

*1 Make sure to short-circuit the 'V□+' and 'I□+' terminals when current is input. (□: input channel number)

6.2.2 Example of analog output



Cautions in wiring

- Use 2-core shielded twisted pair cable for the analog output lines, and separate the analog output lines from other power lines or inductive lines.
- The grounding resistance should be 100Ω or less.

6.3 List of Special Devices

The built-in analog occupies the 1st device assignment.

R: Read W: Write

Special device	Device number 1st	Description	R/W
Special auxiliary relay	M8280	Switches the input mode of channel 1 OFF: Voltage input ON: Current input	R/W
	M8281	Switches the input mode of channel 2 OFF: Voltage input ON: Current input	R/W
	M8282	Switches the output mode OFF: Voltage output ON: Current output	R/W
	M8283 to M8285	Unused (Do not use.)	-
	M8286	Sets the cancel of output holding function. OFF: Holds the analog data output just before stop of the PLC. ON : Outputs the offset data at stop of the PLC.	R/W
	M8287	Sets whether or not input channel 1 is used. OFF: Channel is used. ON: Channel is not used.	R/W
	M8288	Sets whether or not input channel 2 is used. OFF: Channel is used. ON: Channel is not used.	R/W
	M8289	Sets whether or not output channel is used. OFF: Channel is used. ON: Channel is not used.	R/W
Special data register	D8280	Channel-1 input data	R
	D8281	Channel-2 input data	R
	D8282	Output setting data	R/W
	D8283	Unused (Do not use.)	-
	D8284	Averaging time for channel-1 (Setting range: 1 to 4095)	R/W
	D8285	Averaging time for channel-2 (Setting range: 1 to 4095)	R/W
	D8286	Unused (Do not use.)	-
	D8287		
	D8288	Error status b0: Channel-1 over-scale detection b1: Channel-2 over-scale detection b2: Output data setting error b3: Unused b4: EEPROM error b5: Averaging time setting error b6: Hardware error b7: Communication data error b8 to b15: Unused	R/W
	D8289	Model code = 51	R

As for the details of the special devices, refer to following manual.
→ **Refer to FX3S/FX3G/FX3GC/FX3U/FX3UC Series User's Manual - Analog Control Edition.**

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : TOKYO BUILDING, 2-7-3 MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
HIMEJI WORKS : 840, CHIYODA CHO, HIMEJI, JAPAN