MITSUBISHI ELECTRIC
FACTORY AUTOMATION

FX-Family

MELSEC PLC

The world's favorite micro PLCs

6 Million FX PLCs Worldwide /// Over 25 Years Experience ///
Expanded Micro PLC Control /// Networking Solutions ///
Analog Solutions /// Positioning Solutions ///

Global Leader

The FX3U is the latest addition to Mitsubishi Electric's FX PLC Family. It provides increased networking and positioning control solutions.

Mitsubishi Electric Corporation Himeji Works is a factor ycertified for ISO14001 (standards for environmental management systems) and ISO9001(standards for quality assurance management systems)

6 Million FX

The FX Family of PLCs is the PLC of choice across the world, industries and applications.

Mitsubishi Electric has always worked closely with its customers to design the PLC that they want for their applications. The manufacturing and use of 6 million FX CPUs is a demonstration that this close working relationship has delivered quality, reliability and the product that customers want.

Over 25 Years

The FX Family of PLCs has been an important part of control engineering for over 25 years. Throughout its history, the product has evolved from the original F Series into today's new FX3U.

The FX Family has proven to be highly reliable and it consistently improves its compatibility with previous PLC generations.

Number 1 in the world

Mitsubishi Electric was shown to be the largest volume producer of PLCs in the world following the 2004 Worldwide PLC survey by the respected American automation research company ARC.

Contents

What makes a world leading

Global use

Wide range power supply means your FX solution will work all over the world.

International acceptance

Shipping approvals such as Lloyds, German Lloyds, ABS, RINA, Det Norse Vetaritas, for example plus CE and E1 compliance for Low Voltage and EMC directives as well as manufacturing to Automotive industry quality levels, make the FX Family PLCs products to trust.

Flexible design

The FX Family is designed so that the main PLC CPU acts as a platform to which you can add and customize the special functions you need – making every FX your personal PLC.

Adapter or "ADP" units are used on the left hand side of the main PLC unit.

Memory cassette port is located under the removable front cover.

Optional communication boards are available in USB, RS232C, RS422 and RS485 formats.

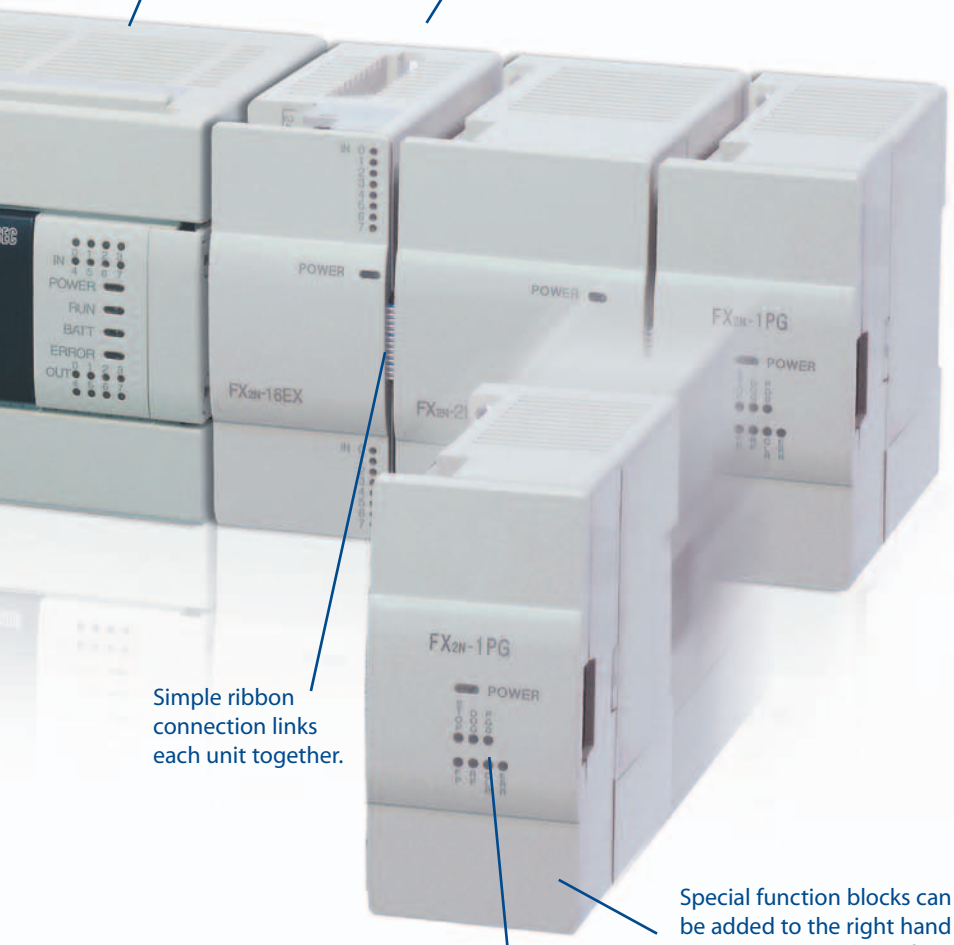
The RUN/STOP switch has become a familiar feature with all FX Family PLCs.

The standard RS422 Mini-DIN programming port can also be used for HMI connection.

g PLC range?

Main base unit where CPU, I/O and power supply are contained in a single unit.

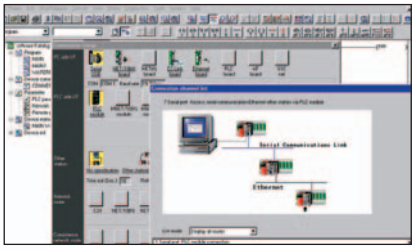
All FX PLC units can be mounted on a DIN rail or directly mounted with screw fixings.



Simple ribbon connection links each unit together.

Special function blocks can be added to the right hand communications bus of the PLC.

Bright LED lamps indicate I/O and power status.



Easy Programming

The FX Family incorporates an easy programming concept where several complex tasks can be reduced to a single instruction.

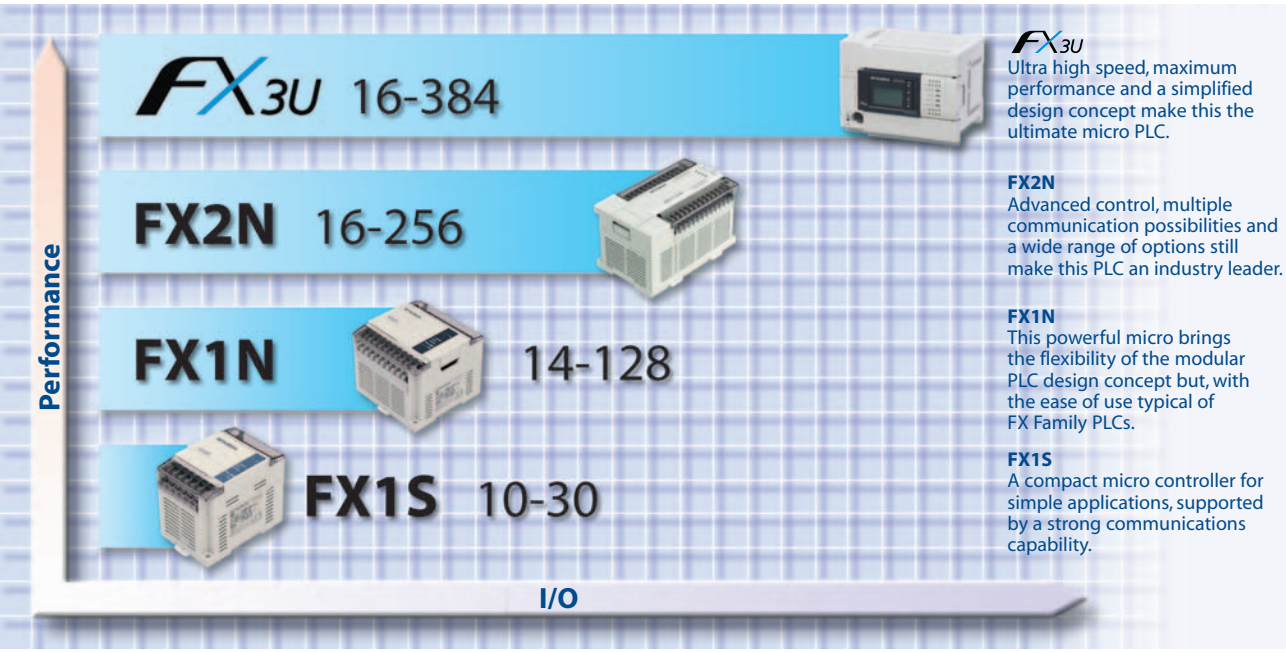
Fast and reliable

FX PLCs continually push the limits of high speed operation to process your applications more effectively and accurately.

Compatibility

The FX Family of PLCs continues to raise the level of backward compatibility with many existing FX PLC programs being transferable. And in later models, sharing common peripherals and special function blocks means even greater protection for your investment in both FX and the machine or process being controlled.

The power to perform



The FX Family of PLCs builds on previous performance and capability, ensuring you have a comprehensive range of control and automation options to choose from.

Model	FX1S	FX1N	FX2N	FX3U
Power supply	100-240V AC, 24V DC	100-240V AC, 12-24V DC	100-240V AC, 24V DC	100-240V AC 24V DC
Maximum I/O	30 (34 optional)	128 (132 optional)	256	384*
Digital I/O	Relay/Transistor	Relay/Transistor	Relay/Transistor /Triac	Relay/Transistor
Cycle period/ logical instruction	0.55 µs	0.55 µs	0.08 µs	0.065 µs
PLC program memory	2k steps	8 k steps	8k expandable to 16k steps	64k steps

Summary table of FX PLCs
Note*: When networked with CC-Link or AS-Interface (Discrete I/O, maximum 256)

A solution for every application

Micro PLCs have opened up a world of opportunities in Industrial Automation due to their small size and low cost. Now many applications benefit from enhanced performance, easier manufacturing, maintenance and greater reliability.

The FX Family has been a part of this revolution for over 25 years and has developed and redeveloped a range of products to suit most applications. The FX Family consists of four main ranges which are distinct and independent but compatible.

Depending on your application and control needs, you can choose from; the simple FX1S CPU, the modular FX1N range, the powerful FX2N and now the new and dynamic FX3U.

With the FX Family there really is a solution to most applications.

FX3U a new PLC concept

The new FX3U CPU brings a combination of greater flexibility and increased performance to the FX Family.

New high speed bus

The FX3U design has increased the opportunity to configure the PLC directly for your needs.

Following the standard FX Family configuration, the FX3U CPU can be expanded to the right hand side using a wide range of options. These include input and output blocks as well as special function blocks such as analog, pulse train and network communication units.

The FX3U can use new FX3U blocks as well as standard FX2N and FX0N expansion blocks..

The FX3U has an enhanced communications bus that automatically switches into high speed mode for communication with new FX3U expansion modules.

Full compatibility is still available with FX2N and FX0N expansion blocks, and when these are configured the FX3U automatically reduces the bus speed to suit.

This means greater support for existing installed systems as well as delivering high performance and greater response with new installations.

Adapters add flexibility

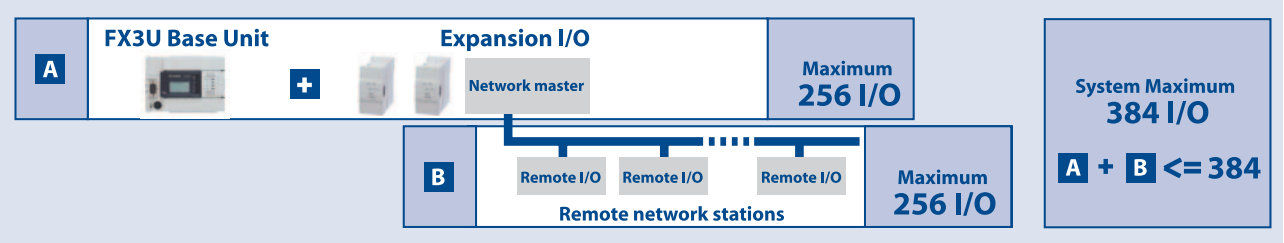
A major design enhancement of FX3U is the new adapter expansion bus on the left hand side of the FX3U CPU. Through this bus users can add additional analog and temperature units as well as multiple communications and positioning blocks.

FX3U has a unique new system of directly programmable adapters.

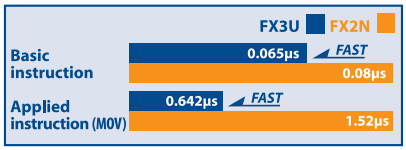
However, the major benefit for the user is that the analog and positioning adapter units no longer require the use of the traditional To/From instruction to configure and operate.

All control is through direct access data registers and setting bits. This means quicker set-up, easier use, and above all much higher processing speeds.

FX3U. More power. More performance.

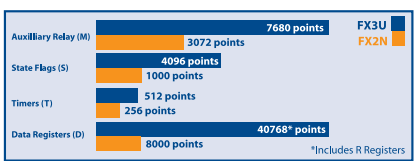


FX3U provides additional I/O and networking capacity.



FX3U provides increased performance in all areas.

Note: 4.5 times increase in speed is measured under the following conditions: program capacity=16k step, with an I/O usage of 144 points. Program scan time is then; FX3U: 4.6ms and FX2N: 21.0ms, an increase in processing speed of 4.56 times.



FX3U offers increased resources as well as increased performance.

Increased I/O capacity

With enhanced networking functions, the FX3U requires an increased input/output (I/O) range. FX3U can support systems with combined local I/O and networked I/O up to a total of 384 I/O points. For users, this means increased system control and added possibilities for advanced networks.

In addition FX3U also fully supports Profibus/DP as well as Ethernet using TCP and UDP protocols.

Up to 4.5 times faster

This means the PC MIX value has been greatly improved with basic instructions now being processed in 0.065µsec.

For users this means quicker program response and more accurate process performance as inputs, outputs and actions are processed and monitored more times per second.

8 times more memory

FX3U comes with a standard internal memory of 64k steps, which is 8 times more memory than FX2N.

More memory means users can write larger and more complex programs, store more data in file registers, or take greater advantage of using IEC 61131-3 style programming tools.

5 times more data storage

With a larger program memory comes the need for more operational devices such as timers, state flags, auxiliary relays and data registers. The FX3U has increased capacity in all of these major areas making program construction easier. Data register capacity has increased by a factor of 5 reflecting the needs of users who have an increased requirement to log operation information against products or batches of products being manufactured.

A typical example of this can be found in the Food and Pharmaceutical industries. Here exact process data such as oven temperatures and cooking times or quantities of ingredients mixed need to be stored against production batches – all this requires increased data handling and data capacity within the PLC.

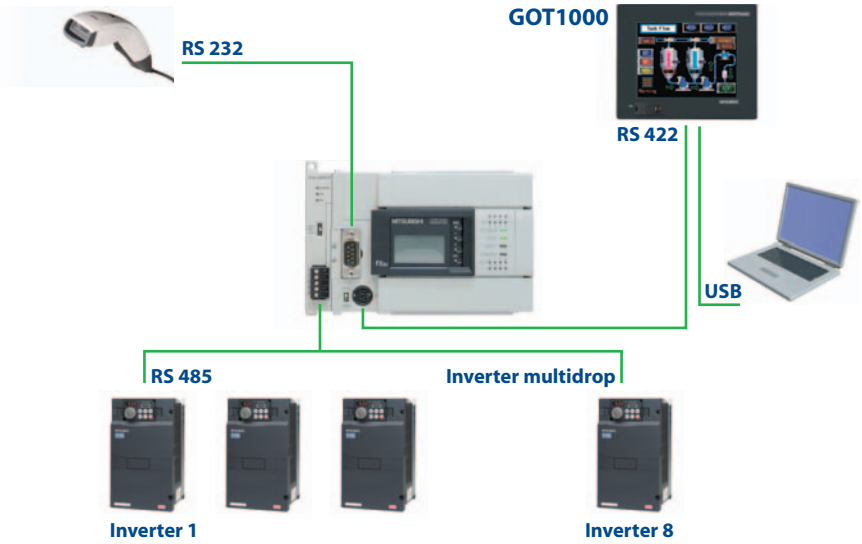
75 new instructions

The FX3U has 75 new instructions in comparison with FX2N. This now makes available 249 instructions for program creation. All of the instructions follow the traditional FX Applied instruction concept designed to make the task of application building and program writing easier and quicker, with less chance for errors.

New instructions include greater control over data processing with a range of new comparison and string manipulation commands.

LOGE (Nr. 125)
Calculates the natural logarithm in floating point
SORT2 (Nr.149)
Sort tabulated data
TBL (Nr. 152)
Batch data positioning mode
BAND (Nr.257)
Defines a band or range of valid numbers
IVWR (Nr.273)
Write parameter to inverter

Some examples of new instructions from the FX3U.



FX3U has a range of flexible communication options.

Simple high speed positioning

The FX3U has been designed with six high speed counters that can each count up to 100kHz simultaneously per channel. This, combined with three 100kHz pulse train outputs, means users can directly configure simple 3-axis positioning systems without the use of additional modules.

However, the new high speed counter ADP and pulse train ADPs can provide the FX3U with maximum positioning performance. Each unit can process signal speeds of up to 200kHz.

Adapter modules increase positioning performance.

A great communicator

FX3U has strengthened the communications capability of the FX Family even further.

The new adapters allow up to three RS communication channels to be operated simultaneously allowing multiple HMIs to be connected to a single FX3U CPU or combinations of HMIs, third party devices and programming tools – the choice is yours.

The FX3U also supports a wide range of network options including AS-interface, Profibus-DP, CC-Link, DeviceNet, CANopen as well as Ethernet.

FX3U at a glance

I/O range
16 – 384 (Discrete I/O, maximum 256)
Program memory
64k steps (standard)
Basic instruction processing
0.065µsec/logical instruction
Analog signal processing
Up to 80 analog inputs,
48 analog outputs
Analog resolution
8, 12 and 16 bits
Analog options
16 analog input, output and temperature blocks available for selection
Positioning
Internal:
6 high speed counters (100kHz)
2 high speed counters (10kHz)
3 pulse train outputs (100kHz), transistor unit only
External:
High speed counter ADP module (200kHz)
Pulse train ADP (200kHz)
Pulse train output block (1MHz)

FX2N an industry standard

FX2N has six shipping approvals. It has been used in applications from controlling temperature in containers to managing diesel engines.

Since its launch, the FX2N has been a standard of micro PLC control.

Packed with features

The FX2N is full of advanced functions and features such as floating point math, 32 bit numerical processing, and fully configurable communication options. However, it still follows the basic FX Family principle of delivering advanced control with simple, easy to use instructions.

Part of your control network

The FX2N has a flexible range of communication options from simple RS232/485 modules to specialist connection to leading networks such as Profibus-DP, CC-Link, DeviceNet, CANopen and AS-interface.

Example of remote communications application

Flexible design

Over 30 types of special function and additional I/O modules are available to customize your FX2N to the automation task you have.

Advanced analog designs mean that in many cases the same block can be used for voltage or current operation and, in the case of the FX2N-8AD, additional temperature options as well.

FX2N at a glance

I/O range
16 – 256
Program memory
16k steps (with memory cassette)
Basic instruction processing
0.08µsec/logical instruction
Analog signal processing
Up to 64 points
Analog resolution
8, 12 and 16 bits
Analog options
10 analog input, output and temperature blocks available for selection
Positioning
Internal:
2 high speed counters 60kHz, 4 high speed counters 10kHz
2 pulse train outputs (20kHz)
External:
High speed counter block (50kHz)
Pulse train output block (1MHz)

FX1N the modular micro

FX Family PLCs are used in many applications for processing and packaging as well chilled storage and transportion of food items.

The FX1N offers comprehensive expansion options.

The FX1N provides a simple introduction to modular micro control offering comprehensive functionality and expansion options.

Compatibility cuts costs

The FX1N provides many user benefits including excellent compatibility with other FX Family PLCs. The FX1N is upwardly compatible to the FX2N using many of the FX2Ns I/O and special function blocks. It also shares the same programming structure as the FX1S. This means that users benefit from learning and using one PLC programming syntax; resulting in faster program development and reduced programming errors.

In addition, users benefit from a reduced stock and spare parts requirement as the FX1N uses the same expansion boards as the FX1S and the same special function and expansion I/O blocks as the FX2N.

Powerful performance

The FX1N saves space, cost and engineering time with the use of powerful, built in, positioning tools such two 100kHz pulse train outputs and up to two 60kHz high speed counters. These can be used to create simple 2-axis positioning systems, linked to servo amplifiers or stepper motor drivers without the need for additional PLC hardware saving space, cost and engineering time.

FX1N at a glance

I/O range
14 - 132
Program memory
8k steps (standard)
Basic instruction processing
0.55µsec/logical instruction
Analog signal processing
66 analog inputs
33 analog outputs
Analog resolution
8, 12 and 16 bits
Analog options
12 analog input, output and temperature blocks available for selection
Positioning
Internal:
2 high speed counters 60kHz, 4 high speed counters 10kHz
2 pulse train outputs (100kHz), transistor unit only

FX1S micro control

FX1S has been used in a wide range of embedded control applications.

Remote control

The FX1S has an additional range of BD expansion boards providing RS232, RS485 and RS422 communications options. These can be used to connect and control various third party products such as bar code readers or panel printers.

Simple programming

The FX Family has a simple programming structure combining Basic and Applied instructions. The Basic instructions are common to all FX Family PLCs. Applied instructions provide the specialist control options such as data comparisons, PID and communications control, all of which are available on FX1S. As each FX PLC range increases in capability (FX1S, FX1N, FX2N, FX3U) so do the number of available Applied instructions.

FX1S at a glance

I/O range
10 - 34
Program memory
2k steps (standard)
Basic instruction processing
0.55µsec/logical instruction
Analog signal processing
Up to 2 points
Analog resolution
12 bits
Analog options
2 analog input BD board
1 analog output BD board
Positioning
Internal:
2 high speed counters 60kHz, 4 high speed counters 10kHz
2 pulse train outputs (100kHz), transistor unit only

FX1S offers communication and real time control from a single unit.

Fit and forget

Typically FX1S applications are small, embedded control functions that are hidden away or unaccessible under normal maintenance activities. This is why the FX1S has been designed to be a robust low maintenance PLC. Features such as the maintenance free, 2000 step EEPROM memory and real time clock management all help to make the FX1S a self managing system, reducing the impact on the maintenance engineer.

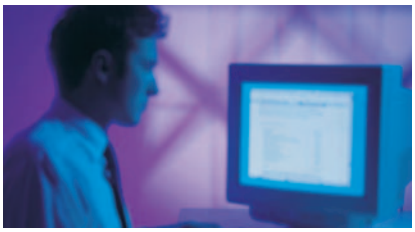
Example of connectivity to 3rd party products

Progressive software concepts

The Mitsubishi FX PLC Family has a worldwide reputation for reliability, performance and ease of use. These key values have also been used to form Mitsubishi's integrated software concept, MELSOFT.

Productivity tools

Programming software for PLCs is constantly evolving. Users are placing more focus on reusable program code and function block concepts. This helps to reduce errors, reduce programming time and to help manage the whole programming process – increasing overall productivity.

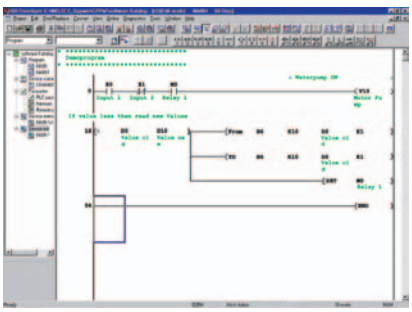


Often the biggest cost on a project is engineering time.

Simple and intuitive

The key to any good software is that it is simple to use. Mitsubishi's GX Developer PLC programming packages have achieved this by using intuitive design.

They also have comprehensive help functions and an advanced communi-cations layer, ensuring safe reliable communication to the target PLC.



GX Developer offers ease of use for programmers of all skill levels.

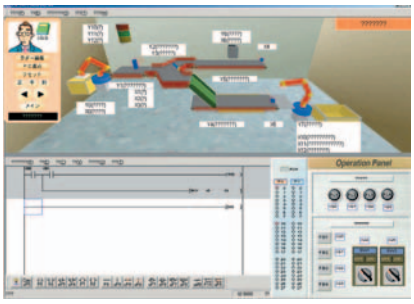
Choose what you need

GX Developer offers users the chance to program all Mitsubishi MELSEC PLCs from a single package. However, for users who only need support for FX based systems there is GX Developer FX.

Mitsubishi also provide GX IEC Developer packages, providing IEC61131-3 compliant programming in; Instruction List, Ladder, Function Block, Structured Text and SFC formats. Using standard programming languages, like IEC61131-3, on large programming projects can help users save costs by creating reusable PLC code and Function Blocks.

First time user?

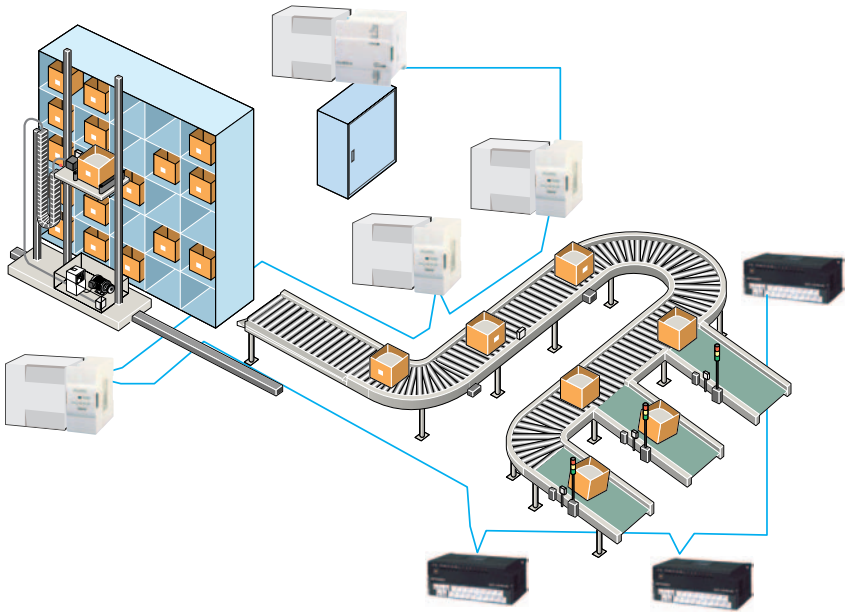
For users who do not have the time to take local training, there is the option of using Mitsubishi's home study software, FX-TRN-BEG, where PLC programs can be created, simulated and debugged in the safety of a PC simulation.



Learning to program can be achieved quickly using interactive software.

MELSOFT is a wide range of software solutions designed to optimize your plant productivity.

Networking and communication solutions



FX Family PLCs have a wide range of communications options.

Applications are often required to integrate between each other across a factory, to report production or tracking data back for office based processing and in some cases be remotely monitored and maintained when the application is in an inaccessible location. The FX Family of PLCs has evolved to match this demand at all levels.

Networks make sense

Networked solutions to complex applications often make the overall solution easier to achieve and more cost effective. For example a conveyor system integrated with a warehouse pick and place system may extend over many hundreds of meters, and by using a fieldbus, such as CC-Link, wiring, troubleshooting and maintenance can be dramatically reduced.

Remote maintenance

With communications technology it is now possible to put PLC control in the most remote locations. Using a PLC with a RS232 interface to a telemetry solution, such as a GSM modem, allows the user the ability to remotely monitor and maintain the system. It can also allow the remote system to send alarm messages, warnings or general status information back to the user's central data processing centre.

Example of remote pumping station.

Easy communications

Today's FX Family of PLCs share a basic communication concept where additional RS232, RS422 or RS485 communications boards can be added to the main base unit without increasing the required cabinet space. These can then be used for communication to various third party devices like bar code readers, printers and modems.

FX Family PLCs, such as FX1N, FX2N and FX3U, have a wider range of communications modules. These include options for connection to open and bespoke networks such as Ethernet, Profibus-DP, CC-Link, DeviceNet, CANopen and AS-interface for example.

Analog solutions

Analog control is one of the most important areas for any automation system. Critically for users the concern is to match the performance demanded by the application to the available solutions in a cost effective way.

Where is analog used?

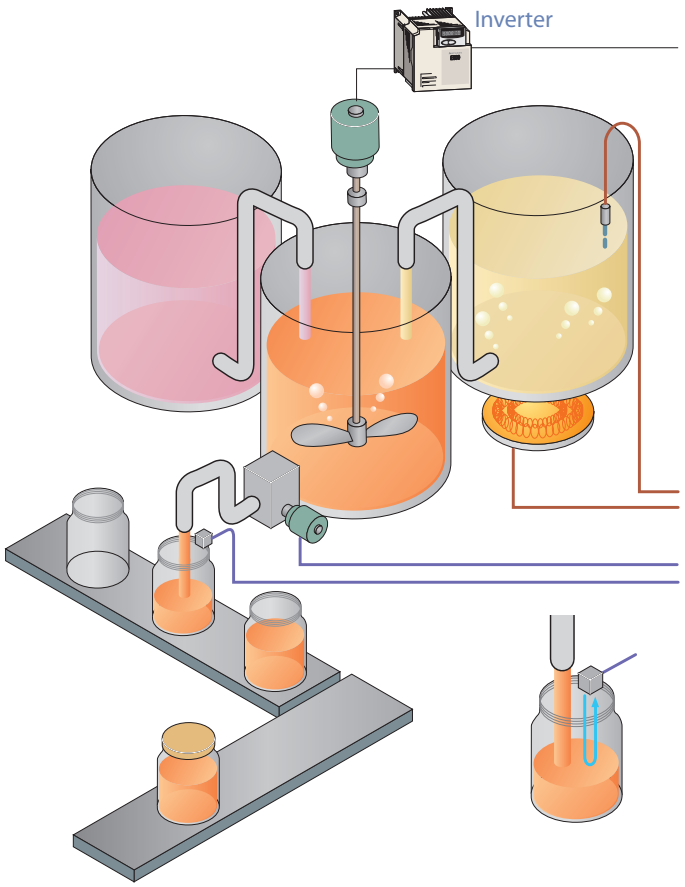
Analog control is widely used. In simple terms it allows a variable signal to be used to control items such as a motor's speed or to sense inputs such as fluid levels.

■ **Digital to analog (D-A) control**
Here a digital PLC value is output as an analog signal. It can be used, for example, to send a speed command to an inverter which in turn causes the motor to increase or decrease speed.

■ **Analog to digital (A-D) control**
In this type of control a variable signal is sent to a PLC where it is converted in to a direct digital value. An example of this could be the measurement of the level of a liquid in a storage tank so that the exact amount of stored liquid can be controlled by the PLC.

■ **Temperature control**
Temperature control is the third type of analog control. An example of use could be where the temperature of a furnace is measured and compared by the PLC against a set range. Additional heating or cooling can then be applied to maintain a constant temperature.

Example of temperature control.



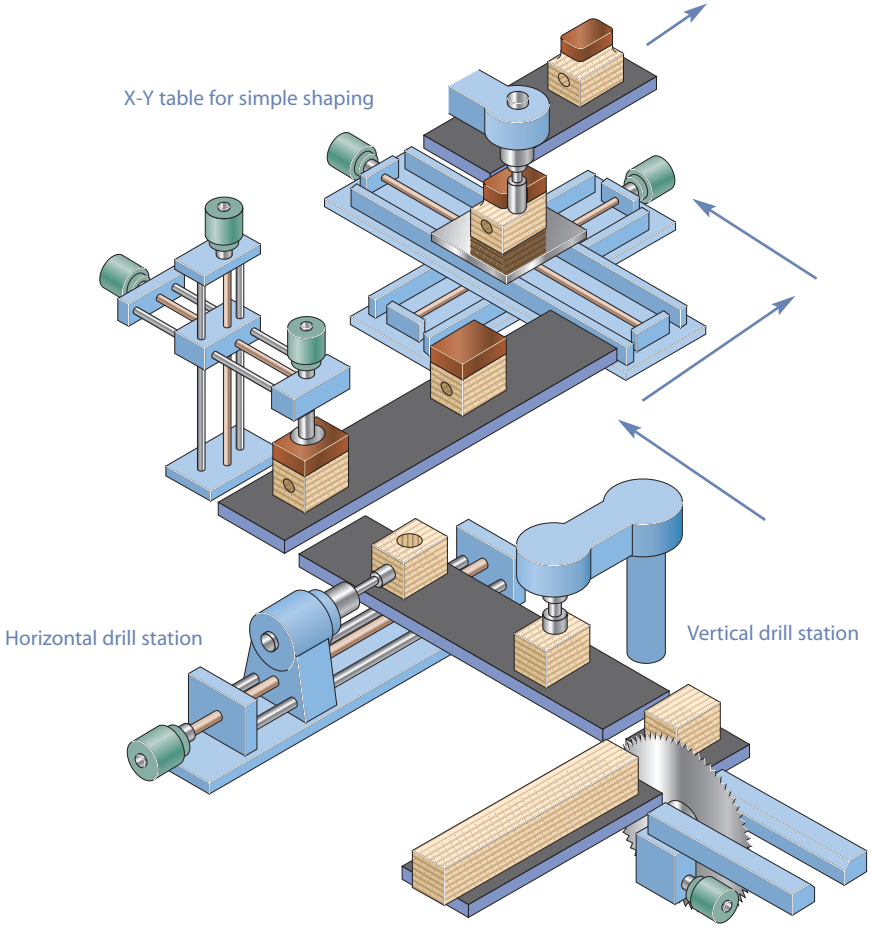
Analog solutions are an important part of control engineering and can be used to simplify and accurately control actions happening in the production environment.

16 solutions to choose from

The FX Family offers a wide range of analog solutions from 1 and 2 channel BD boards for FX1S up to 8 channel input blocks like the FX2N-8AD where temperature, voltage and current input can be mixed on the same block. FX analog blocks also come in a range of resolutions from 8 bit up to 16 bit signal processing. Overall there are 16 different analog options available to users of the FX PLC Family.

With this range of choice and flexibility it is sure that there will be a solution here for most applications.

Positioning solutions



Simple positioning solutions can be effectively managed within a standard FX PLC.

Using simple positioning solutions can help increase the accuracy of the work process, reduce waste and rework as well as provide a higher quality of production.

Typical applications

Simple positioning applications typically involve independently controlled operational axis and can sometimes have many requirements. In the example of an X-Y table, a relative position is achieved by driving each axis until its target position is achieved, regardless of what happens with the other axis. There are two main elements to achieve this type of positioning control.

■ Pulse train outputs
A stream of output pulses can be used as a drive signal to a line driver, stepper motor or servo amplifier, which then causes the connected motor to perform the positioning activity.

The larger the range of output pulse frequencies available means greater speed and/or accuracy is achievable. For example, if a stepper motor with a larger number of steps is used, the travel distance per step can be reduced, resulting in an increased system accuracy.

■ High speed counter input
When a motor is being driven, its relative position can be controlled by counting the number of output pulses.

However, for a more accurate process, reading the actual position from an encoder feedback directly into a high speed counter is preferred. This helps to overcome issues of backlash and slippage as the actual position is measured and not assumed.

Positioning built in as standard

FX PLCs come with high speed counters (in some cases up to 100kHz) and pulse train outputs (also in some cases up to 100kHz) as standard. The high speed counters can be configured in single pulse train inputs, The high speed counters can be configured in a single or two phase input.

Pulse train outputs can be configured to provide continuous pulse streams at different frequencies or a set quantity of pulses at a single frequency.

There are also optional modules and adapters that can provide additional high speed counters with performance up to 200kHz. The same is true for pulse train outputs with 200kHz and 1Mpps (1MHz) output options available.

Example of conveyor belt control.

Display solutions

An increasingly important area of any automation solution is the reporting and display of operational information. This data enables operators, maintenance teams and business managers to make informed decisions in the best interests of the business.

The right tool for the right job

For maximum efficiency, each user requires access to information at their work place in a form that highlights the important data for them first. This means a range of different tools are required. As an example, here are three possible scenarios.

■ The machine operator

Machines often have a lot of manufacturing debris around or are subject to hygienic cleaning as in the food industry. Any display located in this environment would need to have a high Ingress Protection (IP) rating, indicating a high degree of waterproofness.

In the food industry hygiene is very important.

It may also be a benefit to the operator to have a large and clear display to reduce the chances for error from misreading, due to poor light or small fonts being used. It is also recognized that the use of graphics also reduces the chances for reading errors with complex data.

■ The maintenance team

The critical information for a maintenance engineer is the error and diagnostic data within the PLC as this is used to diagnose any process problems. However, additional information regarding the operational "hours run" or cycles processed, which could be called soft information as it is calculated on operational parameters, could allow the maintenance engineer to predict possible failure and arrange preventative maintenance.

Access to this data could be through the machine operator's terminal, across a network or through a dedicated display mounted inside or on the control cabinet itself.

The FX3U-7DM can be directly mounted within the PLC (FX3U) or mounted on the front cabinet.

■ The business manager

In a production controllers office it would be better to display information through a network to their existing desktop PC. In this application a piece of software such as an OPC server/client, a Java applet, an Active X control or a SCADA system would allow lots of data from lots of sources to be displayed in a clear and concise way giving the production controller the overview of the business operation that they need.

Data the way you want it

Mitsubishi offers a wide range of visualization solutions from simple data displays such as the FX3U-7DM, advanced Graphic Operator Terminals like the GOT1000 Series and E1000 Series, and a wide choice of software solutions from the MELSOFT software suite.

This powerful combination of hardware and software means there is a cost effective solution for most applications.

The GOT1000 is a typical HMI.

Where have FX PLCs been used?

Sanitation management on Eurostar rollingstock.

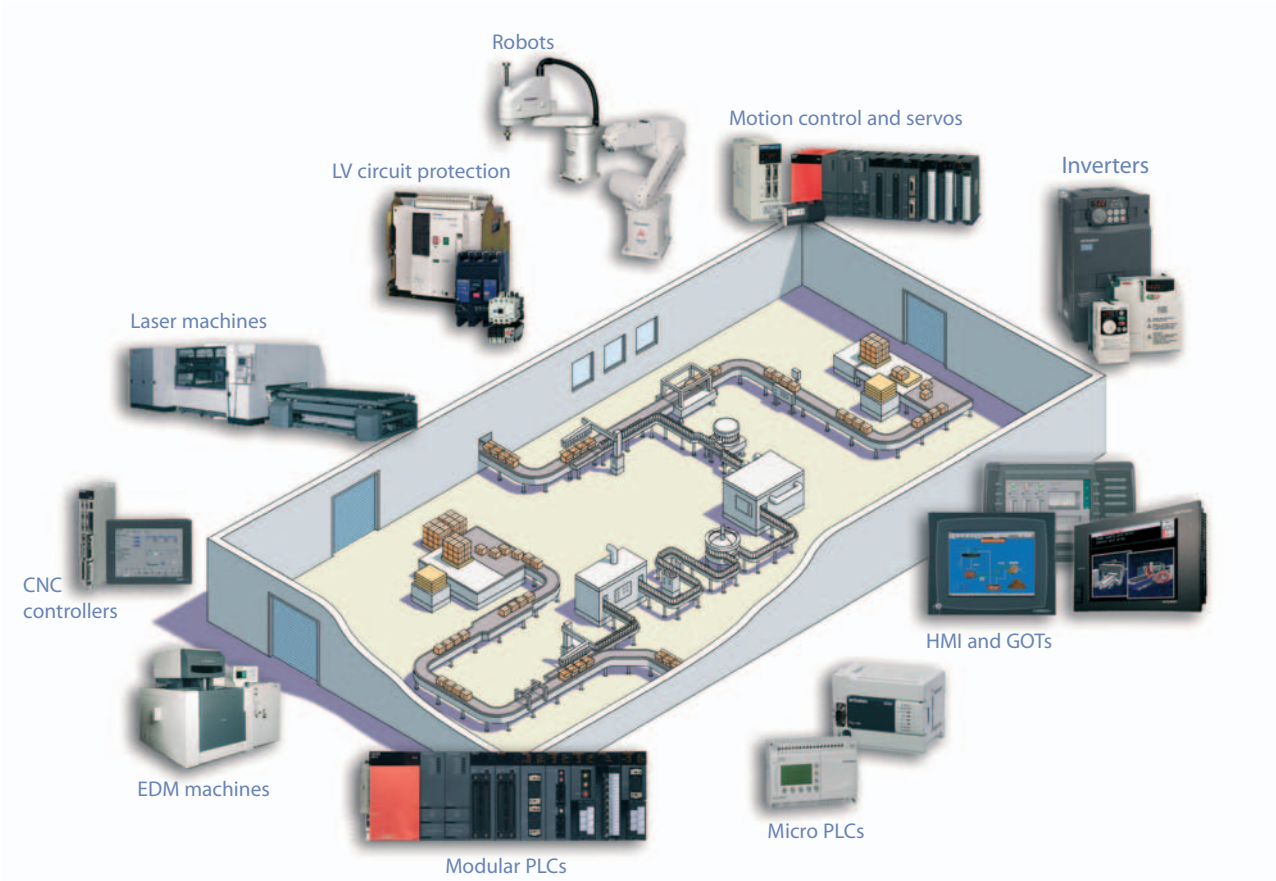
Customer applications with FX PLCs have been wide spread from critical applications in pharmaceutical industries to sublime applications in the leisure industry. However, the FX PLC Family still remains the PLC of choice for many machine builders as it is flexible, compact and easy to use, which is why it is so often used.

Here are just a few examples of applications that customers have completed in the past

- Agriculture
  - Plant watering systems
  - Plant handling systems
  - Saw mill (wood)
- Building management
  - Smoke detection monitoring
  - Ventilation and temperature control
  - Lift (elevator) control
  - Automated revolving doors
  - Telephone management
  - Energy management
  - Swimming pool management
- Construction
  - Steel bridge manufacturing
  - Tunnel boring systems
- Food and drink
  - Bread manufacture (mixing/baking)
  - Food processing (washing/sorting/slicing/packaging)
- Leisure
  - Multiplex cinema projection
  - Animated mechatronics (museums/theme parks)
- Medical
  - Respiration machine testing
  - Sterilization
- Pharmaceutical/chemical
  - Dosing control
  - Polution measurement systems
  - Cryogenic freezing
  - Gas chromotography
  - Packaging
- Plastics
  - Plastic welding systems
  - Energy management systems for injection molding machines
  - Loading/unloading machines
  - Blow molding test machines
  - Injection molding machines
- Printing
- Textiles
- Transportation
  - Sanitation on passenger ships
  - Sanitation on rail rolling stock
  - Fire tender, pump management
  - Waste disposal truck management
- Utilities
  - Waste water treatment
  - Fresh water pumping

Swimming pools are managed using FX PLCs.

A world of automation solutions



Mitsubishi offer a wide range of automation equipment from PLCs and HMIs to CNC and EDM machines.

A name to trust

Since its beginnings in 1870, some 45 companies use the Mitsubishi name, covering a spectrum of finance, commerce and industry.

The Mitsubishi brand name is recognized around the world as a symbol of premium quality.

Mitsubishi Electric Corporation represents space development, transportation, semiconductors, energy systems, communications and information processing, audio visual equipment, home electronics, building and energy management and automation systems, and has 237 factories and laboratories worldwide in over 121 countries.

This is why you can rely on a Mitsubishi automation solution – because we know first hand about the need for reliable, efficient, easy-to-use automation and control.

As one of the world's leading companies with a global turnover of 3.4 trillion Yen (approximately $30.8 billion), employing over 100,000 people, Mitsubishi Electric has the resource and the commitment to deliver the ultimate in service and support as well as the best products.

Global Partner. Local Friend.

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