

ALPHA and MELSEC PLC Systems

The ALPHA Series

The ALPHA closes the gap between single components and a PLC system. It combines all advantages of a PLC system in a very compact housing and therefore provides a space and cost saving alternative to relays and contactors.

The ALPHA series is suited to applications in industrial machines and in automated building services.

Key enhancements in the ALPHA2 include a program capacity of 200 function blocks, an extra-large display, expansion options and a second communications port. The instruction set, includes math operations, PWM and SMS text messaging functions. All this opens up possibilities for analog and temperature control as well as remote operation.

The MELSEC FX Family

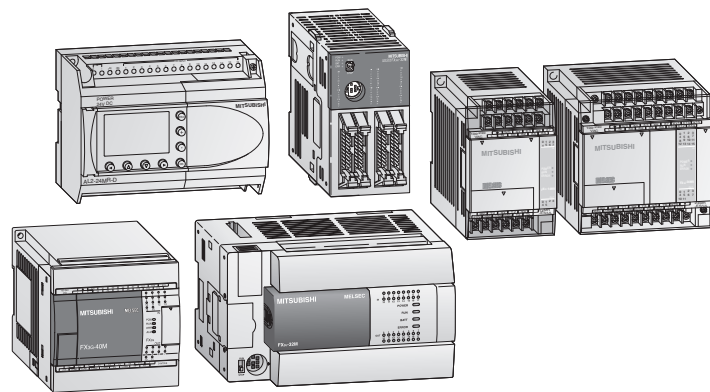
The MELSEC FX family includes a very comprehensive range of base and expansion modules, enabling you to configure a customised system tailored to your precise requirements.

Depending on your application and control needs you can choose from the small, attractively-priced, "stand-alone" FX1S series, the expandable FX1N series or the more powerful FX3G and FX3U series.

With the exception of the FX1S all FX series can be expanded to adapt them to the changing needs of your installations and applications.

Network integration is also supported, making it possible for your FX controllers to communicate with other PLCs, controllers and HMIs. The PLC systems can be configured as local stations in MITSUBISHI networks. In addition these flexible units can also be used as master or slave units on fieldbus's like Profibus/DP and CC-Link.

The MELSEC FX Family controllers also support CANopen, DeviceNet, AS-Interface and Ethernet. Special versions with E-Mark label (ECE request) are available upon request for vehicle application.



Expandability and Power

The MELSEC FX family is highly flexible, enabling fast and efficient configuration and programming for the application at hand.

It is the ideal choice, no matter whether you need to install a simple control application requiring 30 I/Os (FX1S) or a demanding, complex system with up to 384 I/O points (FX3U).

The use of memory cassettes can expand the available programming space on some FX Family PLCs while generally providing a long term program storage option for all FX PLC users. In addition, memory cassettes can also allow programs to be switched at very short notice simply by replacing the cassette.

There are five series in the MELSEC FX family, each of which is designed for a different application profile:

● The FX1S Series

The MELSEC FX1S series is the inexpensive entry to the MELSEC FX family. With its small dimensions it is also an excellent alternative to relay/contactors control configurations.

● The FX1N Series

The CPUs of the FX1N series offer more power than the FX1S series, plus modular

expansion capabilities. You can choose from I/O expansion modules and special function modules for a wide variety of applications.

● The FX3G Series

The FX3G is an introductory compact PLC and is the newest addition to the FX3 series, designed for simple yet performance-critical applications. Incorporating innovative FX3 series technology the customer is presented with a suite of benefits.

● The FX3U Series

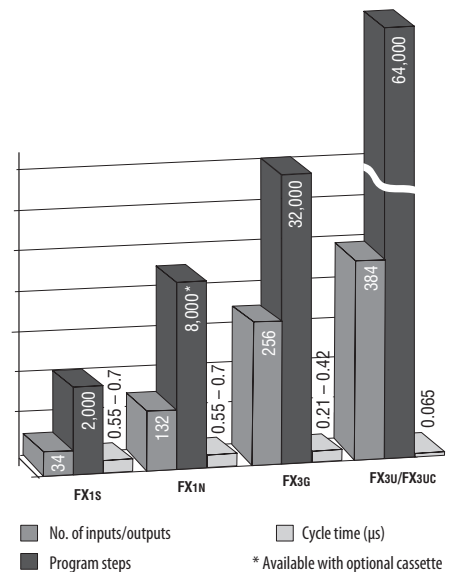
The FX3U series gives you the freedom of modular expandability, with a wide selection of expansion modules and special function modules.

The FX3U is the fastest PLC systems available, with a cycle time of just 0.065 μ s per logical instruction. This gives users a powerful CPU delivering modular PLC performance in a compact PLC design.

● The FX3UC Series

The performance of the FX3UC is the same as that of the FX3U series, but it has more compact dimensions. It is the ideal choice for applications where little space is available for the controller.

Thus the FX3U and FX3UC series give you the most powerful CPU for your application and combines all benefits of a compact PLC system with the performance of a modular PLC system.



Features

The modular design of the FX family makes it extremely flexible, enabling it to be used for a very broad range of applications.

You can configure tailor-made systems by combining modules from a variety of different categories (see figure).

All modules are electrically isolated from their environment with optocouplers for maximum reliability.

Communications modules

Interface modules with RS232/RS422/RS485 interfaces for the connection of peripherals and PLC-PLC links.

Network modules for Ethernet, Profibus/DP, CC-Link, AS-Interface, DeviceNet, CANopen and for the configuration of proprietary Mitsubishi networks

Positioning modules

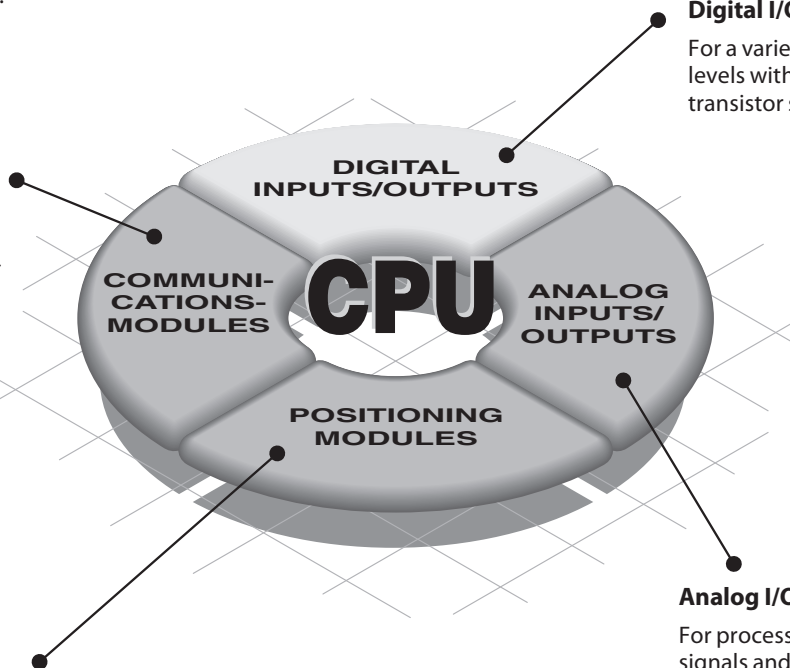
High-speed counter modules with support for the connection of incremental rotary transducers and positioning modules for servo and stepping motor drives

Digital I/O modules

For a variety of signal levels with relay or transistor switches

Analog I/O modules

For processing current/voltage signals and temperature registration with a direct connection option for PT100 resistance thermometers and thermocouples



Digital and special function modules – configuration

The options for using digital and special function modules are dictated by the CPU used in the system.

When calculating the number of special function modules you can use in a system you must take both the number of digital modules and the maximum number of special function modules that can be used into account.

The table on the right provides a simplified guide to the number of modules you can use in each system type. More detailed information and the basic principles of system configuration can be found in the corresponding manuals.

CPU type	System restrictions
FX1S	Stand-alone PLC with 10 / 14 / 20 or 30 I/Os; no special function modules but 1 I/O adapter board can be installed
FX1N	PLC with max. 132 I/Os A maximum of 2 special function modules or digital expansion modules with up to 32 inputs and outputs (4x8 I/Os or 2x16 I/Os) or one special function module and one digital extension module with up to 16 inputs and outputs (2x8 I/Os or 1x16 I/Os) can be connected.
FX3G	PLC with max. 256 I/Os A maximum of 8 special function modules and digital extension modules with up to 128 I/Os can be connected to the right side of the main unit. In addition, a maximum of 4 special adapters from the FX3U series can be connected to the left side.
FX3U	PLC with max. 384 I/Os To the left side of the main unit, a maximum of 10 special adapters from the FX3U series can be connected. To the right side of the main unit, up to 8 special function modules and digital extension modules with up to 256 I/Os can be connected.
FX3UC	PLC with max. 384 I/Os To the left side of the main unit, a maximum of 6 special adapters from the FX3U series can be connected. To the right side of the main unit, up to 4 special function modules and digital extension modules with up to 256 I/Os can be connected.

The Components for an FX PLC System

A basic FX PLC system can consist of a stand alone base unit, with the functionality and I/O range increased by adding extension I/O and special function modules. The following section provides an overview of options available.

Base Units

The entire FX PLC range can be AC or DC powered with a mix of input and output styles. The PLCs can be programmed with the user friendly GX or GX IEC Developer programming software, allowing programs to be transferred between different FX PLCs. All PLC base units include an integrated real time clock.

Base units are available with different I/O configurations from 10 to 128 points but can be expanded to 384 points depending upon the FX range selected.

Extension Boards

Extension adapter boards can be installed directly into the base unit and therefore do not require any additional installation space. For a small number of I/O (2 to 4) an extension adapter boards can be installed directly into the (left-hand side) FX1S, FX1N, FX3G or FX3U controller. Interface adapter boards can also provide the FX PLC with additional RS232, RS422, RS485 or USB interfaces. To connect special function modules (e.g. Ethernet module) a communication adapter has to be installed (except FX3UC).

Extension I/O Modules

Unpowered and powered extension I/O modules can be added to the FX1N/FX3U and FX3UC PLCs.

For expansion modules powered by the base unit, the power consumption has to

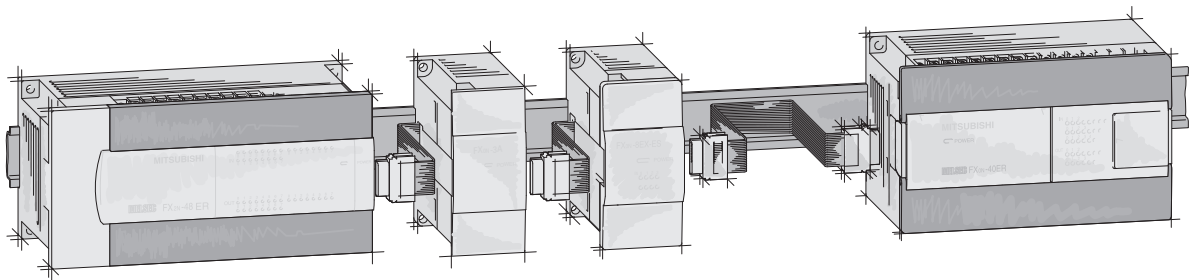
be calculated as the 5 V DC bus can only support a limited number of expansion I/O (for further details please refer to next page – calculation of the power consumption).

Special Function Modules

A wide variety of special function modules are available for the FX1N, FX3G, FX3U and FX3UC PLCs. They cover networking functionality, analog control, pulse train outputs, data logging function and temperature inputs.

Memory extension and operator terminals

Each FX family base unit can be equipped with a memory cassette. The programming unit interface enables the connection of programming tools like PC and hand held programming units as well as graphical operator terminals.



Expansion possibilities		ALPHA2	FX1S	FX1N	FX3G	FX3U	FX3UC	Reference page
Extensions for inside PLC installation	Digital	●	●	●	●	●	●	11, 45
	Analog	●	●	●	●	●	●	11, 46
Extension modules (installation outside the PLC)	Digital	—	—	●	●	●	●	29
	Analog	—	—	●	●	●	●	33
	Temperature	●	—	●	●	●	●	11, 34
Network modules	AS-Interface	●	—	●	—	●	●	12, 39
	CC-Link	—	—	●	●	●	●	38
	CAN open	—	—	●	●	●	●	43
	Ethernet	—	●	●	●	●	●	40
	Profibus/DP	—	—	●	●	●	●	41
	DeviceNet	—	—	—	—	●	●	43
	Modbus RTU/ASCII	—	—	—	①	●	●	44
	SSCNET	—	—	—	—	●	●	37
Communications boards	RS232	●	●	●	●	●	—	48
	RS422	—	●	●	●	●	—	48
	RS485	—	●	●	●	●	—	48
	USB	—	—	—	—	●	—	47
Communications modules	RS232	—	●	●	●	●	●	44
	RS485	—	●	●	●	●	●	44
Dedicated function modules	High speed counter	—	—	—	—	●	●	36
	Positioning	—	—	—	—	●	●	37
Memory cassettes	●	●	●	●	●	●	12, 49	
External Display	—	●	●	●	●	—	54	

① only via IEC function blocks

Calculation of the Power Consumption

The power consumption figures on the 5 V DC bus for the special function modules are shown in the specifications tables on the following pages.

The maximum permissible currents on the 5 V DC and 24 V DC bus are shown in the table below.

Modules	Max. current	
	5 V bus	24 V bus
FX3G-14/24M□-ES(ESS)	—	400 mA
FX3G-40/60M□-ES(ESS)	—	400 mA
FX3U-16/32M□-ES(ESS)	500 mA	400 mA
FX3U-48-128M□-ES(ESS)	500 mA	600 mA
FX3UC-16MT/D(DSS)	600 mA	—
FX3UC-32MT/D(DSS)	560 mA	—
FX3UC-64MT/D(DSS)	480 mA	—
FX3UC-96MT/D(DSS)	400 mA	—

The residual currents for the 24 V DC service voltage at different input/output configurations are shown in the tables on the right.

A maximum of 256 I/Os are possible for FX3U/FX3UC (128 I/Os for FX3G).

Max. residual current values (in mA) for FX3U-16M□-E□□ through FX3U-32M□-E□□ for the permissible configuration

Number of additional outputs	40	25										
	32	100	50	0								
	24	175	125	75	25							
	16	250	200	150	100	50	0					
	8	325	275	225	175	125	75	25				
	0	400	350	300	250	200	150	100	50	0		
Number of additional inputs												
	0	8	16	24	32	40	48	56	64			

Max. residual current values (in mA) for FX3U-48M□-E□□ through FX3U-128M□-E□□ for the permissible configuration

Number of additional outputs	64	0																	
	56	75	25																
	48	150	100	50	0														
	40	225	175	125	75	25													
	32	300	250	200	150	100	50	0											
	24	375	325	275	225	175	125	75	25										
	16	450	400	350	300	250	200	150	100	50	0								
	8	525	475	425	375	325	275	225	175	125	75	25							
	0	600	550	500	450	400	350	300	250	200	150	100	50	0					
Number of additional inputs																			
	0	8	16	24	32	40	48	56	64	72	80	88	96						

An external power supply is necessary, if the residual current for the 24 V supply of the special function modules is not sufficient.

Sample Calculations

The tables below and on the right show different examples for sample power calculation for a PLC system.

The current values for the special function modules can be found in the specifications on the following pages.

Comparison with the current value tables show that the calculated figures for the 5 V bus lie within the allowable ranges.

In the example below all units can be supplied sufficiently with the internal 24 V power supply.

Module	No.	24 V DC calculation		5 V DC calculation		
		Current / module	Calculation	Current / module	Total current	
FX3U-80MR/ES	1	600 mA	+600 mA	+500 mA	+500 mA	
FX3U-4AD	3	90 mA	-180 mA	110 mA	-220 mA	
FX3U-4DA	2	160 mA	-320 mA	120 mA	-240 mA	
FX3U-ENET	1	240 mA	-240 mA	—	—	
				-140 mA !!!		500 – 460 mA
					Result:	40 mA (OK !)

An external 24 V power supply has to be added in the example above.

Module	No.	Number of I/Os			24 V DC calculation		5 V DC calculation		
		X	Y	X/Y	Total ①	Total current ②	Current / module	Total current	
FX3U-48MR/ES	1	24	24	—	X = 8 Y = 24 →	+325 mA	500 mA	+500 mA	
FX2N-16EYR-ES/UL	1	—	16	—			—	0 mA	
FX2N-8EX-ES/UL	1	8	—	—			—	0 mA	
FX2N-8EYR-ES/UL	1	—	8	—			—	0 mA	
FX3U-4AD-PT-ADP	1	—	—	—		-50 mA	30 mA	-15 mA	
						+275 mA (OK!)		+485 mA (OK!)	
FX2N-32ER-ES/UL	1	16	16	—	X = 16 Y = 0 →	+150 mA residual current for extension unit FX2N-32ER-ES/UL	690 mA	+690 mA	
FX2N-16EX-ES/UL	1	16	—	—			—	0 mA	
FX2N-10PG	1	—	—	8			0 mA	120 mA	-120 mA
FX2N-32CCL	1	—	—	8			-50 mA	130 mA	-130 mA
Result:		64 + 64 + 16 = 144! (< 256) OK!				+100 mA (OK!)		+440 mA (OK!)	

① Total no. of I/Os which are connected to a base unit to calculate the max. residual current values (see tables) ② see tables above (max. residual current values)