Technical Information

Range-free Multi-controller FA-M3R Overview

FA-M3™ REVOLUTION

The IT M@chine Controller

www.yokogawa.com/itc/

YOKOGAWA
Yokogawa Electric Corporation

TI 34M6A01-01E
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Information in this document is current as of Feb. 2009. For the latest product information, contact Yokogawa sales office.

This document does not include detailed description of the latest F3SP66-4S and F3SP67-6S Sequence CPU Modules (with network functions).
See “Sequence CPU Module (with network functions): New Product Introduction” (TI34M6A08-01E) instead.

Contents

Introduction to FA-M3R **1**

FA-M3R Features **2**

Ultra-fast Processing Speed **3**

Comparison with Competitors **4**

Postcard-sized Controller **5**

Universal I/O Range Achievable with One PLC **6**

Mixed Installation of Different CPUs within One Unit **7**

Sequence CPU Modules 8

(F3SP08-SP, F3SP21-0N, F3SP28-3S, F3SP38-6S, F3SP53-4S, F3SP58-6S, F3SP59-7S, F3SP66-4S, F3SP67-6S)

BASIC CPU Modules 9

(F3BP20-0N, F3BP30-0N, SF560-ECW)

Easy Real-time Processing with BASIC 10

FA-M3 Value 2 11

(F3SC23-1A, F3SC23-1F, F3SC23-2F)

FA-M3R Programming Tools

FA-M3R Programming Tool WideField2 (SF620-MCW)

Ladder Programming Tool Designed for Engineers 12

Object Ladder 13

Structure 14

Input Macro 16

Indirect Specification 17

Downloading Comments 18

Program Component 19

Index View 20

Collective Change of I/O Positions 21

Logical Design by Tag Name 22

Group Tag Name 23

Flexible Find Function 24

Advantages of Windows Environment 25

Flexible Operability 26

Sophisticated Debugging Functions 27

Enriched Help Provides Convenient Help Information 28

System Log 29

User log 30

Sampling Trace 31

Remote OME in Your Preferred Way **32**
Remote OME by E-mail via Internet 33
Remote OME via Ethernet Network 36
Remote OME via Public Telephone Line using Analog Modem 38
Advanced Function Modules
Analog Input/Output Modules 39
(F3AD04-0□, F3AD08-□V, F3AD08-□R, F3DA02-0N, F3DA04-1N, F3DA08-5N)
High-speed Data Acquisition Module 40
(F3HA08-0N)
Memory Card Module 41
(F3EM01-0N)
Temperature Control/PID Modules 42
(F3CU04-0S, F3CU04-1S)
Temperature Monitoring Module 43
(F3CX04-0N)
Positioning Modules 44
Positioning Modules for Controlling Every Type of Motor
Positioning Modules with Pulse Output
(F3NC32-0N, F3NC34-0N)
Positioning Modules with Analog Voltage Output
(F3NC51-0N, F3NC52-0N)
Positioning Modules with Multi-channel Pulse Output
(F3YP14-0N, F3YP18-0N)
Positioning Module with MECHATROLINK-II Interface
(F3NC96-0N)
ToolBox Software for Advanced Function Modules **48**
ToolBox for Temperature Control and Monitoring Modules (SF661-ECW)
ToolBox for Positioning Modules (SF662-ECW)
Communications
Information Network
Ethernet Interface Module 51
(F3LE01-5T, F3LE11-0T, F3LE12-0T)
NX Interface Module 52
(F3NX01-0N)
Control Network
FL-net (OPCN-2) Interface Module 53
(F3LX02-1N)
FA Link H Module 54
(F3LP02-0N)

Field Network

Fiber-optic FA-bus Module 55
(F3LR01-0N)

Fiber-optic FA-bus Type 2 Module 56
(F3LR02-0N)

DeviceNet Interface Module 57
(F3LD01-0N)

YHLS Master Module and Slave Units 58
(F3LH01-1N, F3LH02-1N, TAH Series)

Peripheral Modules

Applications of Personal Computer Link Interface 59
(Connecting personal computer/display)

Personal Computer Link Modules 60
(F3LC11-1F, F3LC12-1F, F3LC11-2F)

Personal Computer Link via Programming Port 61

UT Link Module (for connecting temperature controllers and recorders from Yokogawa) 62
(F3LC51-2N)

GP-IB Communication Module (for connecting GP-IB instruments) 63
(F3GB01-0N)

RS-232-C and RS-422/485 Communication Modules 64
(F3RZ81-0F, F3RZ82-0F, F3RZ91-0F, F3RS22-0N, F3RS41-0N)

Terminal Block Units 66

FA-M3R I/O Open Concept Allows FA-M3R-Compatible User I/O Modules 67

Reduced Wiring System 68

From **EVOLUTION** to **REVOLUTION**

The FA-M3 has reborned as the FA-M3R,
to revolutionize users' equipment.

for ***R***evolution!

- FA-M3R is the new generic name for FA-M3 controllers installed with one or more of the ultra-fast CPU modules.
- FA-M3R can simply be called the "M3R".
- FA-M3R and FA-M3 are upward compatible.

The IT M@chine Controller

Transforms Equipment Using IT

Range-free Controller FA-M3R
Transforms user “Machine” into “M@chine”.

FA-M3R Features

The IT M@chine Controller

■ Ultra-fast Processing Speed

- 20K steps of ladder program scanned per millisecond*
- Minimum scan time of 200 µs
- Sensor control function with constant scan from 200 µs
- Quick response from input to output of 10 µs
- Quick response of 100 µs to an interrupt signal

■ Postcard-size Controller

- Compact, 147 (W) x 100 (H) x 88 (D) mm size handles 192 points.

■ Universal I/O Range Achievable with One PLC

- Controls up to 8,192 points and contain devices of up to 344K words per system.
- Capabilities of a high-end PLC at the cost of a low- or mid-range PLC
- One third to one half the price of competitors' PLC for 1000- to 2000-point range

■ Mixed Installation of Different CPUs within 1 Unit

- Tasks can be divided among multiple ladder CPUs
- Data processing using BASIC CPU

■ FA-M3R Programming Tool WideField2

- Object ladder, a new programming paradigm after structured programming
- Structure facilitates data reuse.
- Program componentization using Indirect specification and input macro instructions
- Circuit comments/subcomments and tag name definitions can be stored in CPU to speed up maintenance.
- Partial download increases debugging efficiency
- Blocks and macros can be coded independently, thus dramatically increasing reusability.
- Improved visibility increases efficiency of reuse
- Easy data exchange with Windows-based applications
- System logs and user logs for troubleshooting
- Sampling trace for troubleshooting

■ Remote OME** in Your Preferred Way

- Remote OME by E-mail via Internet
- Remote OME via Ethernet network
- Remote OME via public telephone line and analog modem

* These figures indicate the performance when running a program with typical ratio of basic instructions to application instructions. Not all user programs are guaranteed to run at this speed.

** Acronym of remote ***O***peration ***M***aintenance and ***E***ngineering proposed by Yokogawa Electric Corporation.

The FA-M3R outclasses the capabilities of today's PLCs and offers the functionality, performance, choice of languages and expandability provided by a microcomputer board.

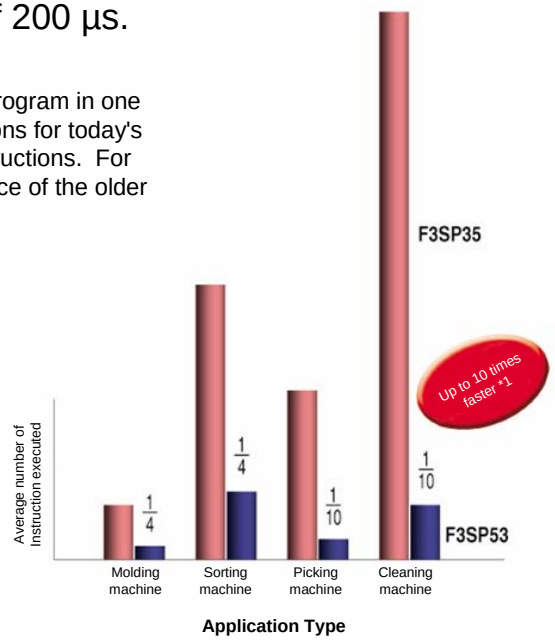
No more tedious quality control of huge variety of boards or discontinuation of parts - Users can now concentrate on adding value to equipment.

Ultra-fast Processing Speed

The IT M@chine Controller

World's fastest processing speed realized by triple processors.
20K steps of ladder program scanned per millisecond.
Minimum scan time of 200 µs.

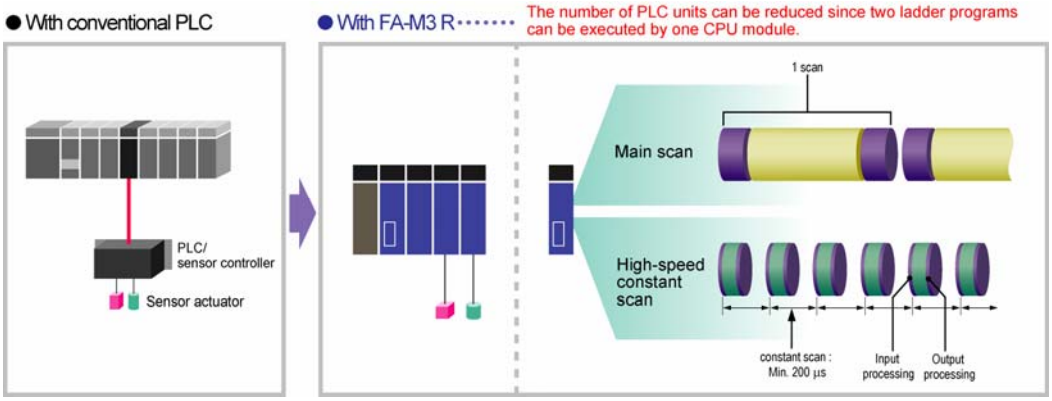
The FA-M3R delivers high-speed in all aspects, running a 20K steps of program in one millisecond (ratio of application instructions used: 50%). Actual applications for today's functionally-enhanced equipment contain a larger ratio of application instructions. For such applications, the FA-M3R achieves at least ten times the performance of the older CPU modules for the FA-M3.
The graph on the right shows examples of performance improvements.



*1: In comparison with Yokogawa's older CPU modules using actual applications

Sensor Control Function

- One CPU can carry out a high-speed constant scan (from 200 µs) independently besides the normal scan.
- The same CPU can also be used to achieve quick response.



Quick 10 µs response from input to output

- Ultra-quick response
  ON->OFF: 100 µs, OFF->ON: 300 µs
  F3XD08-6F, F3XD16-3F/4F, F3XD32-3F/4F, F3XD64-3F/4F, F3WD64-3F/4F (with 32 inputs)
- Ultra-quick response to input: 10 µs
  F3XD16-3H
- Option to HOLD/RESET outputs when CPU fails
  F3YD64-1P, F3WD64-3F/4F (with 32 outputs)

Faster Response to Interrupt Signal

- DC input module allows quick response of 100 µs to an interrupt input
- Swift response to a change in input level to implement instantaneous high-speed control

Comparison with Competitors

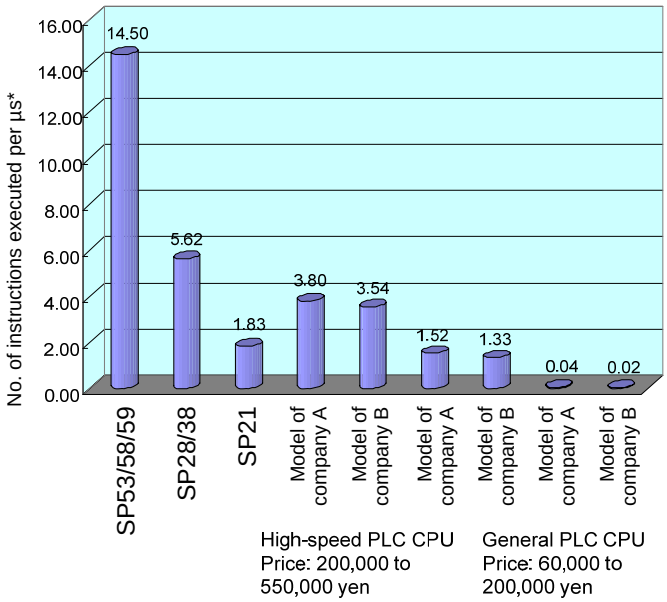
The IT M@chine Controller

Thanks to the ultra-fast processing speed, there's no need to worry about processing time during programming.

Why is high-speed processing necessary?

- To carry out complicated calculations (using application instructions) quickly
- To stabilize high-speed mechanical control for higher productivity
- To allow enhanced HMI and diagnostic programs for better operator interface
- To reduce unstable scan time by using network

Comparison of Processing speed



* No. of instructions executed per µs means the average number of instructions executed in 1 µs by the PLC.

Ultra-fast Execution of Instructions

Basic instruction: 0.0175 µs minimum
Application instruction: 0.070 µs minimum

Comparison with Yokogawa's Older CPU Model on Basic Instruction Execution

Instruction	SP53, SP58, SP59, SP66 or SP67	SP35 (older model)
LD, AND, OR	17.5 to 35 ns	90 ns
Timer	175 ns	360 ns
Transfer	70 ns	180 ns
Comparison	70 ns	180 ns
Addition, subtraction	105 ns	270 ns
Logic operation	105 ns	270 ns

Comparison with Yokogawa's Older CPU Model on Application Instruction Execution

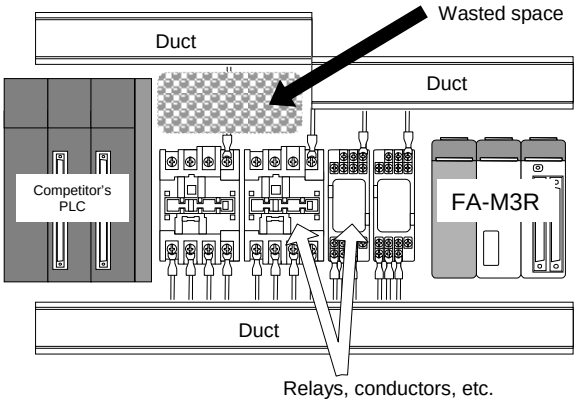
Instruction	SP58 vs. SP35
Transfer between file registers	74.1 times faster
Index modification (LD)	10.7 times faster
Index modification (MOV)	30.4 times faster
Read/write	6.4 times faster
Timer update	6.7 times faster
BMOV/BSET	12.8 times faster
FOR-NEXT	7.7 times faster

Postcard-sized Controller

The IT M@chine Controller

Why do we need smaller controllers?

- To provide ample room for additional modules
- To allow installation of the controllers without affecting the machine design and safety of the factory (allowing perspective facilities)
- To help standardize control panels
- To minimize the size of the control panel regardless of the controller scale
- To cut cost



Design concept: PLC is a substitute for relays

The FA-M3R is packaged into the size of usual relays and conductors and is designed for installation in the same row inside a panel, thus allowing efficient internal panel design.

Dimensions

Base Module	Slots	Mounting Dimensions (mm)	Depth of Module* (mm)
F3BU04-0N	4	100 x 147	88.5
F3BU05-0D	5	100 x 205	88.5
F3BU06-0N	6	100 x 205	88.5
F3BU09-0N	9	100 x 322	88.5
F3BU13-0N	13	100 x 439	88.5
F3BU16-0N	16	100 x 537	88.5

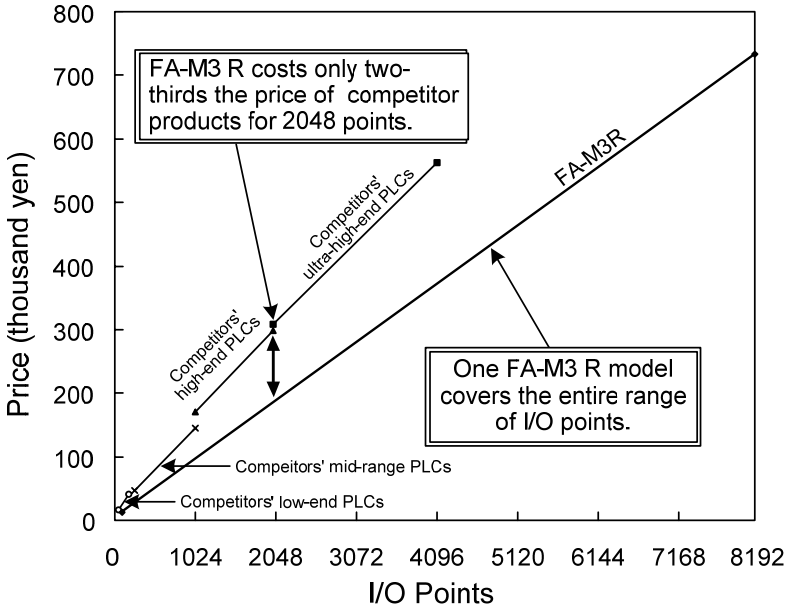
* Dimensions of a base module with I/O modules installed in it (excluding protrusions such as connectors and terminals blocks)

Universal I/O Range Achievable with One PLC

The IT M@chine Controller

Whatever the number of I/O points, one PLC covers all.

- Better functionality than competitors' high-end PLC, yet cheaper than competitors' low-end PLC
- One model covers an entire range of I/O points, from small to large
- Good expandability independent of scale
- Common modules and parts eliminates need for diverse spares.



Flexible Combination of Diverse Types of I/O Modules

- Offered with various types of I/O modules normally used in high-end PLCs
- Simple access to advanced I/O modules

Number of I/O Points

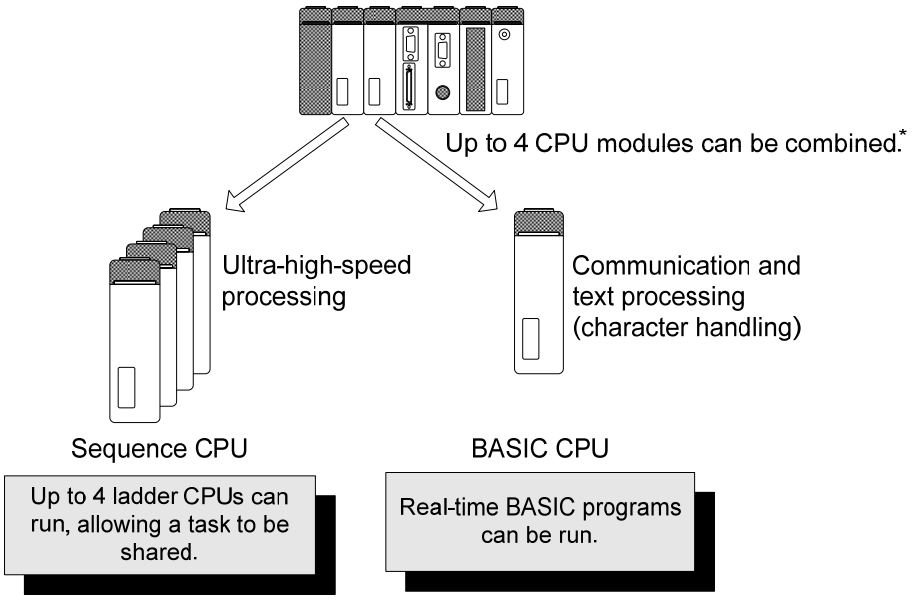
- 4 to 288 analog inputs
- 2 to 288 analog outputs
- 1 to 288 axes for positioning
- 4 to 144 pulse inputs
- 1 to 36 serial communication ports (F3RZ□□, F3RS41)
- 2 to 72 serial communication ports (F3RS22)
- 1 to 8 GP-IB communication ports

Note: Shown above are the maximum numbers of points and ports when the corresponding modules are installed for the maximum numbers independently, and do not mean that all these maximums are available at the same time for the same controller. The maximum number for each item depends on the combination of modules actually installed.

Mixed Installation of Different CPUs within One Unit

The IT M@chine Controller

- Use any programming language you like.
- Use the optimal language for your applications.
- Combine languages freely.



* Only one BASIC CPU module can be installed per controller.

■ Electrical and mechanical engineers may prefer a ladder diagram, while production engineers may prefer BASIC.
→ The FA-M3R allows free choice of CPUs and programming languages to fit application needs.

Module	Model	Specifications
Sequence CPU module	F3SP21-0N	Object ladder language 10K steps, 0.18 µs/basic instruction
	F3SP28-3S	Object ladder language 30K steps, 0.045 µs/basic instruction
	F3SP38-6S	Object ladder language 120K steps, 0.045 µs/basic instruction
	F3SP53-4S	Object ladder language 56K steps, 0.0175 µs/basic instruction
	F3SP58-6S	Object ladder language 120K steps, 0.0175 µs/basic instruction
	F3SP59-7S	Object ladder language 254K steps, 0.0175 µs/basic instruction
	F3SP66-4S	Object ladder 56K steps, 0.0175 µs/basic instruction, with network functions
	F3SP67-6S	Object ladder 120K steps, 0.0175 µs/basic instruction, with network functions
BASIC CPU Module	F3BP20-0N	YM-BASIC/FA language, 120KB
	F3BP30-0N	YM-BASIC/FA language, 510KB

- Any CPU can directly access I/O modules.
- Different types of CPU modules can exchange data with each other.
- A controller can comprise of a single CPU module or CPU modules of a single type.
- FA-M3R (Sequence CPU or BASIC CPU) can be combined in a multi-CPU configuration.

All CPU types do not require replacement of the memory battery (maintenance free). The service life of this battery exceeds 10 years in standby mode at room temperature but may be shortened when exposed to extreme low or high temperatures.

Larger Program Capacity, Device Capacity and Variety of Instructions than High- end PLCs

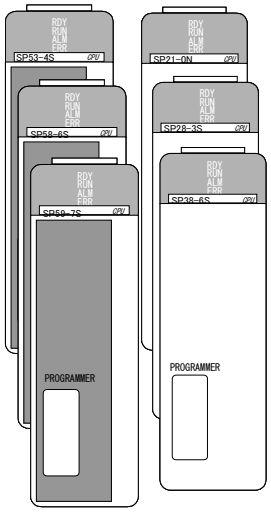
A lineup of modules to meet various application needs.

Item		F3SP08	F3SP21	F3SP28	F3SP38	F3SP53	F3SP58	F3SP59	F3SP66	F3SP67
Number of inputs/outputs		2,048	2,048	4,096	8,192,	4,096	8,192	8,192	4,096	8,192
Number of instructions	Basic	25	25	37	37	37	37	37	37	37
	Application	227	227	324	324	324	324	324	389	389
Processing speed per instruction	Basic (µs)	0.18–0.36	0.18–0.36	0.045–0.18	0.045–0.18	0.0175–0.07	0.0175–0.07	0.0175–0.07	0.0175–0.07	0.0175–0.07
	Application (µs)	Min. 0.36	Min. 0.36	Min. 0.18	Min. 0.18	Min. 0.07	Min. 0.07	Min. 0.07	Min. 0.07	Min. 0.07
Program capacity (steps)		10K	10K	30K	120K	56K	120K	254K	56K	120K
Number of program blocks		32	32	1,024	1,024	1,024	1,024	1,024	1,024	1,024
Devices	Timers*	512	512	2,048	3,072	2,048	3,072	3,072	2,048	3,072
	Counters*	512	512	2,048	3,072	2,048	3,072	3,072	2,048	3,072
Relays	Internal	4,096	4,096	16,384	32,768	16,384	32,768	65,535	16,384	32,768
	Shared	—	2,048	2,048	2,048	2,048	2,048	2,048	2,048	2,048
	Link	2,048	2,048	8,192	16,384	8,192	16,384	16,384	8,192	16,384
	Special	2,048	2,048	9,984	9,984	9,984	9,984	9,984	9,984	9,984
Registers	Data	5,120	5,120	16,384	32,768	16,384	32,768	65,535	16,384	32,768
	File	—	—	32,768	262,144	32,768	262,144	262,144	32,768	262,144
	Link	2,048	2,048	8,192	16,384	8,192	16,384	16,384	8,192	16,384
	Special	512	512	1,024	1,024	1,024	1,024	1,024	1,024	1,024
	Index	32	32	256	256	256	256	256	256	256
	Shared	—	1,024	1,024	1,024	1,024	1,024	1,024	1,024	1,024

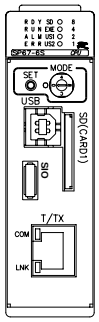
*** Total number of timers and counters combined

F3SP08-SP, F3SP21-0N, F3SP28-3S, F3SP38-6S, F3SP53-4S, F3SP58-6S, F3SP59-7S, F3SP66-4S and F3SP67-6S Sequence CPU Modules

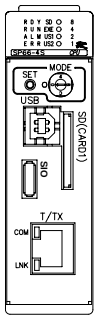
- High-speed execution of instructions easily handles high-speed processing and response. (Scan time of 1 ms for a 20K step program when using an F3SP53/58/59/66/67).
- Sensor control function enables quick scan (input → program execution → output) besides normal scan . This allows stable input/output response of 400 µs (200 µs x 2) (for F3SP28/38/53/58/59/66/67).
- Index modification for F3SP08 and the object ladder programming facilitates program development and modification (for F3SP28/38/53/58/59/66/67).
- Enriched functions, such as forced set/reset that are not affected by the results of program computations as well as a scan operation, facilitate program debugging and modification.
- The PROGRAMMER port (connection port for programming tool) supports a personal computer link, allowing linkage to upper-level computers and display units without need for a personal computer link module (at baud rate of 115K bps for F3SP28/38/53/58/59).
- The use of structure facilitates data reuse (for F3SP28/38/53/58/59/66/67).
- Circuit comments, circuit subcomments, tag name definitions (including I/O comments) can be stored in the program area of the CPU for more efficient maintenance (for F3SP28/38/53/58/59/66/67).
- Indirect specification and input macro instructions simplify program code sharing and program componetization (for F3SP28/38/53/58/59/66/67).
- Partial download can be used for more efficient debugging (for F3SP28/38/53/58/59/66/67).



F3SP53-4S F3SP21-0N
F3SP58-6S F3SP28-3S
F3SP59-7S F3SP38-6S



F3SP66-4S



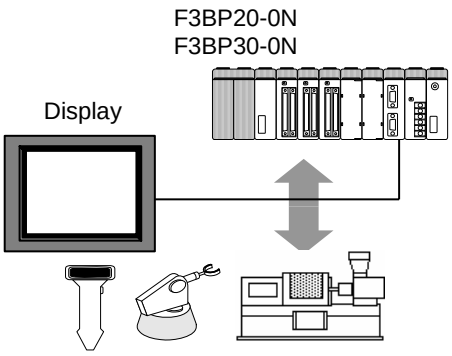
F3SP67-6S

BASIC CPU Modules

The IT M@chine Controller

Installed with high-speed YM-BASIC for real-time control

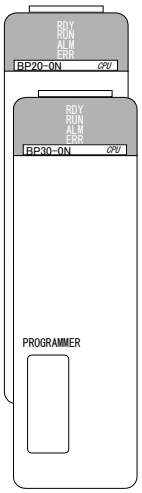
- Realizes a BASIC program-based controller (no need for a sequence CPU module).
- Can directly access inputs and outputs.
  Direct I/O access without going through a sequence CPU enables field data to be read and written at high speed. (16 I/O points can be accessed within 5.2 ms.)



- Ideal for high-level computations
- Simplifies character and array computations.
- Dedicated interpreter realizes high-speed processing.

BASIC CPU Modules (F3BP20-0N, F3BP30-0N)

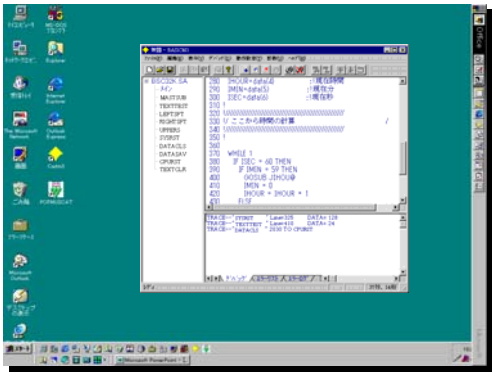
- Useful for communication tasks or high-level computations that are not easily controlled by a ladder program.
- A standalone BASIC CPU module can be configured as a BASIC controller without need of a sequence CPU module.
- When installed in slots 2 to 4, BASIC CPU modules act as add-on BASIC CPU modules for a sequence CPU module.
- Can directly access input and output modules.
- Can exchange data with ladder programs and synchronize with ladder programs using events.
- Allows structured programming using subprograms.
- Can access common data using a personal computer link module (can also connect a display unit and access data via Ethernet).
- The PROGRAMMER port (connection port for programming tool) provided with each BASIC CPU module allows programming for each CPU.
- Programs can be developed and debugged on a personal computer.
- By installing an optional ROM pack, programs and common data can be saved in the ROM pack and programs stored in the ROM pack can be run. The ROM pack is useful when performing program replacement and making many copies of the same program on site.



F3BP20−0N
F3BP30−0N

BASIC Programming Tool M3 for Windows (SF560-ECW)

- This tool supports BASIC module application development, from programming, debugging and CPU environment setup of the BASIC CPU Module (F3BP20 or F3BP30) through application programming, debugging and maintenance.
- Windows98/Me/NT4.0/2000/XP compatible

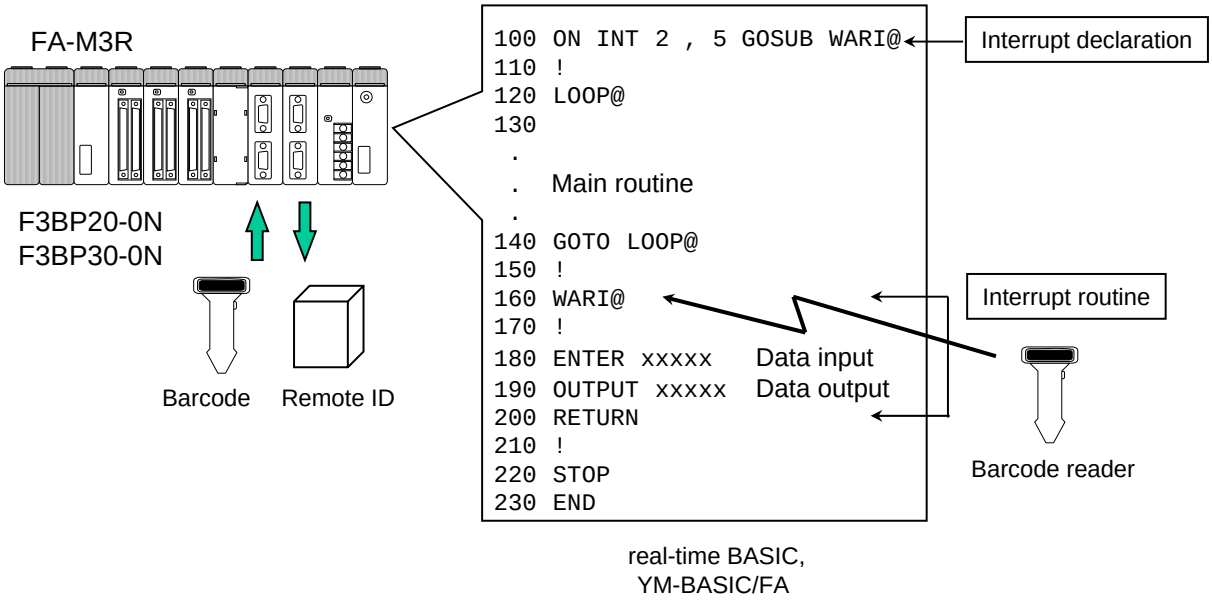


Easy Real-time Processing with BASIC

The IT M@chine Controller

Declaration of an interrupt routine needs only one statement.

F3BP20-0N and F3BP30-0N



YM-BASIC/FA

- On-line real-time processing
  - Supports extensive interrupt methods to enable immediate response of a BASIC program to external events.
  - Facilitates development of on-line real-time programs.
- Modular program structure
  - Supports the use of subprograms.
  - Variables, line numbers and labels in the main and individual subprograms are independent. This simplifies program development, maintenance and reuse.
  - The main program and subprograms can be developed separately, and combined later using the APPEND command.
- Combination with sequence programs
  - Variables used in a BASIC program can be combined with shared registers simply using a common variable statement, facilitating data exchange with sequence CPU modules. Synchronization with sequence CPU modules can also be achieved by using SIGNAL, ON SEQEVT, ENTER and OUTPUT statements.
  - Device values in CPU modules can be read and written using ENTER and OUTPUT statements.
- I/O support
  - Can access various communication modules such as serial communication modules, various digital I/O modules, and various analog I/O modules by using ENTER statements for input and OUTPUT statements for output.

FA-M3 Value 2

The IT M@chine Controller

FA-M3R's extensive functions and unrivaled performance available at an attractive price.
Special sets of CPU, power supply and I/O modules are offered
at discounted prices as value packs.

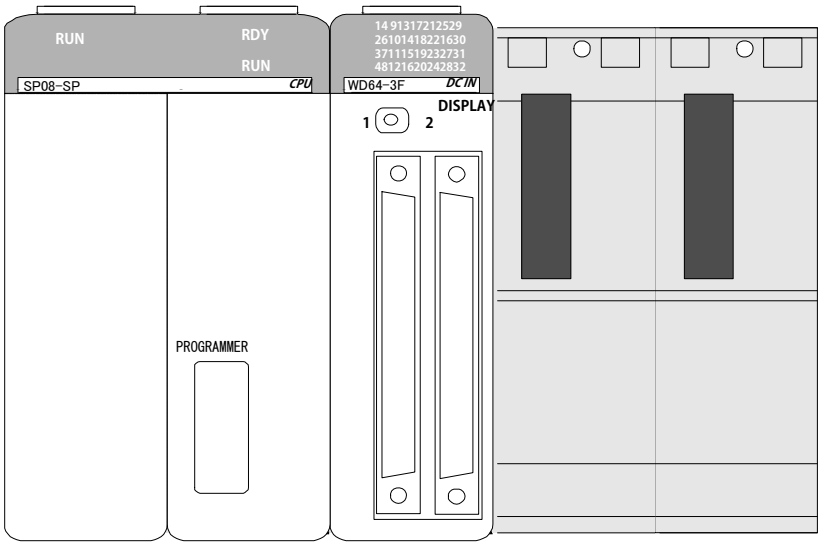
Each FA-M3 value2 pack (F3SC23-1A, F3SC23-1F or F3SC23-2F) is a compact controller composed of different modules:

- F3SC23-1A comprises F3SP08-SP, F3BU04-0N, F3XD16-3F, F3YD14-5A.
- F3SC23-1F comprises F3SP08-SP, F3BU04-0N, F3WD32-3F.
- F3SC23-2F comprises F3SP08-SP, F3BU04-0N, F3WD64-3F.

Item			Specification
F3BU04-0N base module	**Number of slots**		4 (available spare I/O slots: 2)
F3SP08-SP sequence CPU module	**Power supply unit**	**Input power supply voltage**	100-240 V AC, single phase, 50/60 Hz
		Rated output	5 V DC, 2.0 A
		Others	The same as F3PU10-0S
	Sequence CPU	**Programming language**	Structured ladder, mnemonic
		Instructions	Basic instructions:25 kinds; application instructions:227 kinds
		Program capacity	10K steps (can be saved to a ROM)
		Number of I/O points	Max.2048
		Others	The same as F3SP21-0N
F3WD64-3F input/output module	**Input**		32 DC voltage inputs, rated voltage: 24 VDC
	Output		32 transistor contacts (sink); rated voltage: 24 VDC
F3WD32-3F input/output module	**Input**		16 DC voltage inputs, rated voltage: 24 VDC
	Output		16 transistor contacts (sink); rated voltage: 24 VDC
F3XD16-3F input module			16 DC voltage inputs (sink/source), rated voltage: 24 VDC
F3YD14-5A output module			14 transistor contacts (sink); rated voltage: 12-24 VDC

FA-M3 Value 2 packs (F3SC23-1A, F3SC23-1F and F3SC23-2F)

- Ultra-compact for space saving inside the panel.
- The sequence CPU module can receive universal power supply voltage ranging from 100 to 240 V AC, so the power supply need not be considered.
- High-speed execution of instructions facilitates development of applications requiring fast response.
- Installing an optional ROM pack allows programs and data to be saved.



F3SC23-2F

Ladder Programming Tool Designed for Engineers

The IT M@chine Controller

WideField slashes machine customization cost.
WideField2 lowers total cost of ownership (TCO) further by enhancing **reusability** of user-developed software assets.

FA-M3R Programming Tool WideField2

■ New features of WideField2

★ Enhanced object ladder
"structure" for reuse of data structures

★ Structure
Structure members are assigned addresses automatically and can be monitored collectively.

★ Input macro
Input macro is added to component macro. Componentization using input macro instruction.

★ Indirect specification
Indirect specification simplifies program sharing

★ Downloading comments
Circuit comments/subcomments & tag name definitions can be stored in CPU for faster maintenance.
Partial download saves debugging time.
Support for FL-net connection (R3 or later)

■ Easier program development

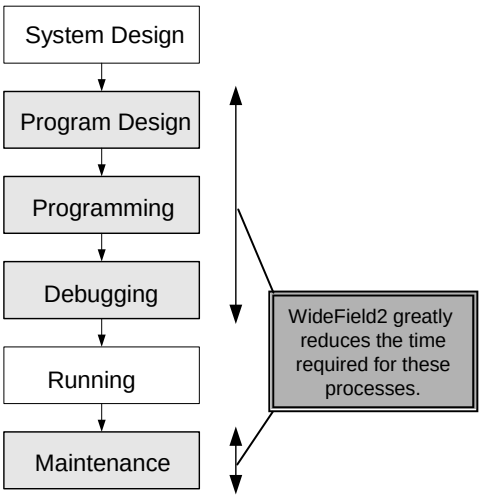
- Componentization
- Change of I/O positions
- Logical design by tag name
- Flexible search
- Group tag name

■ Improved debugging (visibility)

- Index view
- Advantages of Windows environment
- Flexible operability
- Sophisticated debugging functions
- Enriched help

■ Easier maintenance

- System log
- User log
- Sampling trace

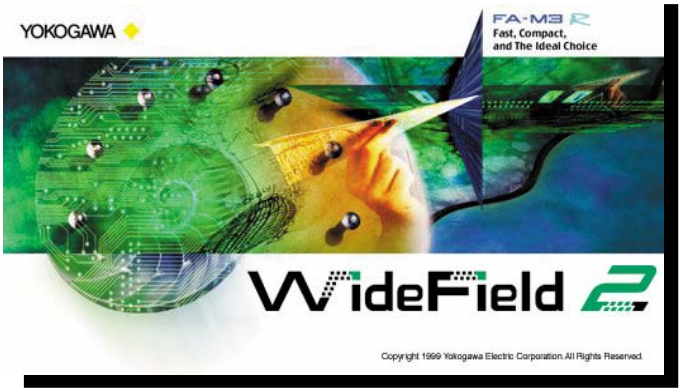


* An asterisk indicates a new feature added in WideField2.

FA-M3R Programming Tool WideField2 (SF620-MCW)

WideField2 enables even more efficient program development in the Windows environment by providing enhanced functions that support program componetization with clear device structures and improved visibility.
In addition to program block, local device and component macro, the new "structure" feature enables device structures to be defined for further componentization of programs and device structures.
This results in higher program reusability and in turn lower total cost of ownership (TOC)

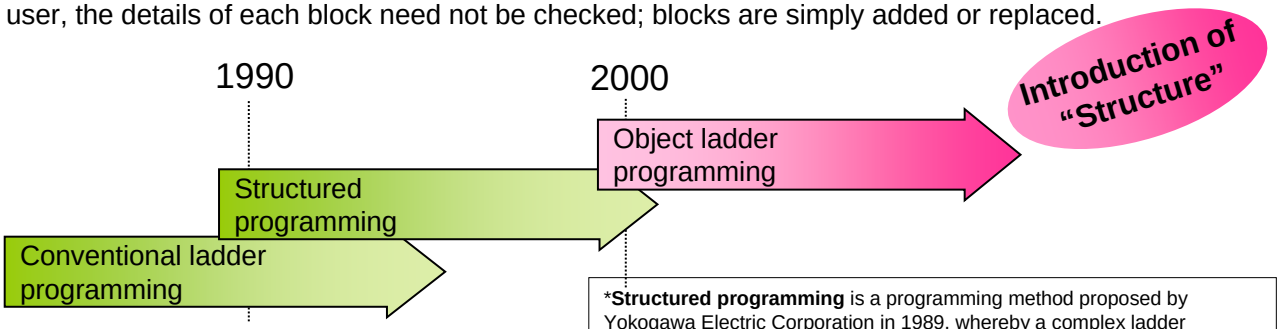
- Product concepts:
  - Customized program design
  - Operability
  - Reusability
  - Link with other applications
  - Visibility
  - Ease of debugging and maintenance
  - Concurrent development by multiple engineers
  - Improved software quality
  - Shorter development cycle



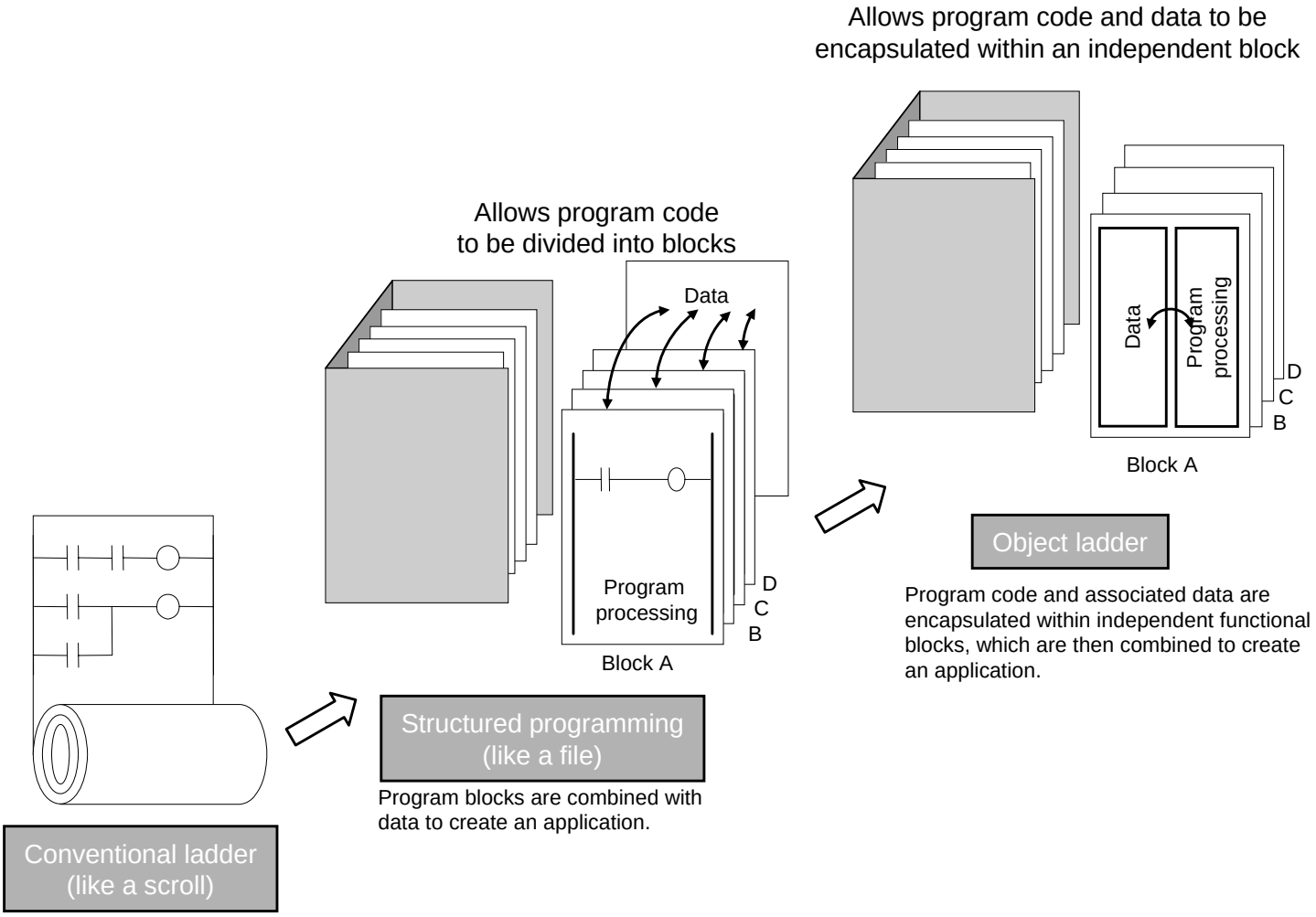
- WideField2 is ready for use through simple installation on your PC.
- WideField2 can run under Windows 2000, XP and Vista.

Independent program blocks and data structures improve reusability

- The FA-M3R Programming Tool WideField2 is a revolutionary application for object ladder programming – a successor of structured ladder programming in program development.
- In object ladder programming, program code for a function unit and its related devices are combined in an object called a block. Blocks are then combined to form a ladder program. Each block is functionally independent, thus improving productivity and program maintainability over and above structured programming*.
- Object ladder code is highly reusable. When customizing an existing machine control program for a user, the details of each block need not be checked; blocks are simply added or replaced.



***Structured programming** is a programming method proposed by Yokogawa Electric Corporation in 1989, whereby a complex ladder program is divided into parts by functional unit so that developers can more easily understand the program structure, leading to improved productivity and program maintainability. Along with recognition of its advantages, use of structured programming grew rapidly in the 1990's as other PLC manufacturers rolled out products based on the same concept. Today structured programming is the de facto standard in PLC programming.

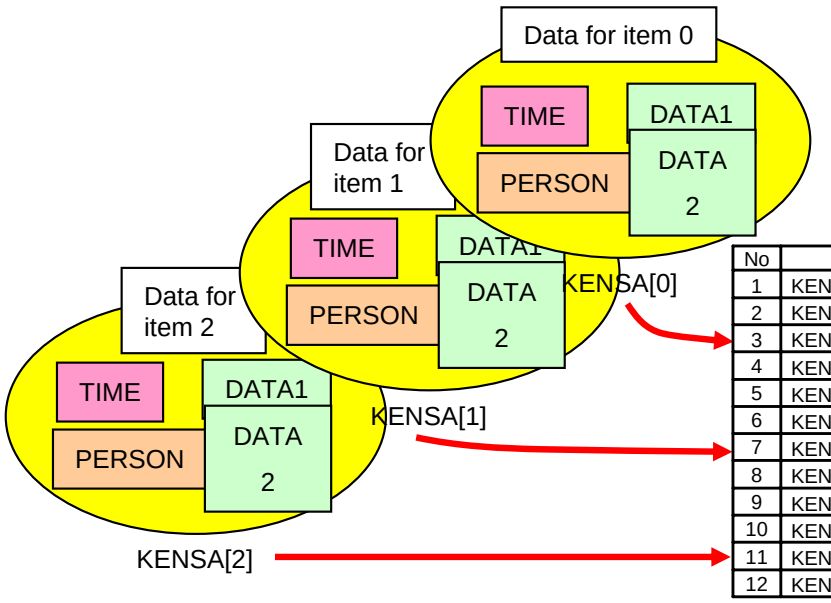


Structure

A structure defines a collection of devices (relays and registers)

- A collection of devices of an individual machine or a production line can be defined as a structure to facilitate understanding of tag names in program source code.
- If new data items are added to a structure, only processing for the added data needs to be added. No checking or modification of existing data (signals) is required.
- Addresses are automatically allocated to structure members and so are transparent to a programmer.

WideField2 introduces the concept of “structure,”
which is available in C and other high-level programming languages,
to the PLC industry to improve program reusability.



Addresses are allocated automatically

No	Tag name	Data type	Comment	Address
1	KENSA[0]. TIME	Integer(DEC)	Inspection time	D00100
2	KENSA[0]. PERSON	Char	Inspector	D00101
3	KENSA[0]. DATA1	Integer(DEC)	Inspection data 1	D00102
4	KENSA[0]. DATA2	Long Integer(HEX)	Inspection data 2	D00103
5	KENSA[1]. TIME	Integer(DEC)	Inspection time	D00105
6	KENSA[1]. PERSON	Char	Inspector	D00106
7	KENSA[1]. DATA1	Integer(DEC)	Inspection data 1	D00107
8	KENSA[1]. DATA2	Long Integer(HEX)	Inspection data 2	D00108
9	KENSA[2]. TIME	Integer(DEC)	Inspection time	D00100
10	KENSA[2]. PERSON	Char	Inspector	D00111
11	KENSA[2]. DATA1	Integer(DEC)	Inspection data 1	D00112
12	KENSA[2]. DATA2	Long Integer(HEX)	Inspection data 2	D00113

■ Sample structure definition

A structure definition defines the name, data type and comment of each structure member.

Structure type definition:MOTION

	Member Name	Data Type	I/O Comment
1	TIME	Integer(DEC)	Inspection time
2	PERSON	Char	Inspector
3	DATA1	Integer(DEC)	Inspection data 1
4	DATA2	Long Integer(HEX)	Inspection data 2
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

■ Sample structure entity

This is an array of structures.
Addresses are automatically allocated.

No	Tag Name	Address	Data Type	Comment
1	KENSA[0]. TIME	D00100	Integer(DEC)	Inspection time
2	KENSA[0]. PERSON	D00101	Char	Inspector
3	KENSA[0]. DATA1	D00102	Integer(DEC)	Inspection data 1
4	KENSA[0]. DATA2	D00103	Long Integer(HEX)	Inspection data 2
5	KENSA[1]. TIME	D00105	Integer(DEC)	Inspection time
6	KENSA[1]. PERSON	D00106	Char	Inspector
7	KENSA[1]. DATA1	D00107	Integer(DEC)	Inspection data 1
8	KENSA[1]. DATA2	D00108	Long Integer(HEX)	Inspection data 2
9	KENSA[2]. TIME	D00100	Integer(DEC)	Inspection time
10	KENSA[2]. PERSON	D00111	Char	Inspector
11	KENSA[2]. DATA1	D00112	Integer(DEC)	Inspection data 1
12	KENSA[2]. DATA2	D00113	Long Integer(HEX)	Inspection data 2
13				

Collection of data = structure named “KENSA”
An array of structures can also be defined.

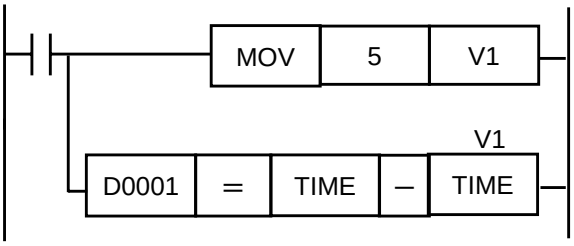
■ Sample program using structures

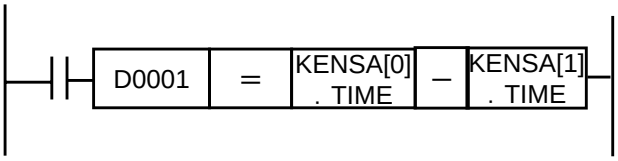
Previously: Data is read/written using index modification (e.g. inspection data DATA)

No	Address	Tag name	Comment
1	D00100	TIME	Inspection time of item 0
2	D00101	PERSON	Inspector of item 0
3	D00102	DATA1	Data 1 of item 0
4	D00103 D00104	DATA2	Data 2 of item 0
5	D00105	TIME	Inspection time of item 1
6	D00106	PERSON	Inspector of item 1
7	D00107	DATA1	Data 1 of item 1
8	D00108 D00109	DATA2	Data 2 of item 1
9	D00110	TIME	Inspection time of item 2
10	D00111	PERSON	Inspector of item 2
11	D00112	DATA1	Data 1 of item 2
12	D00113 D00104	DATA2	Data 2 of item 2

Enables highly visible programs, and thus easier debugging compared to index modification.

No	Tag name	Data type	Comment	Address
1	KENSA[0]. TIME	Integer(DEC)	Inspection time	D00100
2	KENSA[0]. PERSON	Char	Inspector	D00101
3	KENSA[0]. DATA1	Integer(DEC)	Inspection data 1	D00102
4	KENSA[0]. DATA2	LongInteger(HEX)	Inspectiondata 2	D00103
5	KENSA[1]. TIME	Integer(DEC)	Inspection time	D00105
6	KENSA[1]. PERSON	Char	Inspector	D00106
7	KENSA[1]. DATA1	Integer(DEC)	Inspection data 1	D00107
8	KENSA[1]. DATA2	LongInteger(HEX)	Inspection data 2	D00108
9	KENSA[2]. TIME	Integer(DEC)	Inspection time	D00100
10	KENSA[2]. PERSON	Char	Inspector	D00111
11	KENSA[2]. DATA1	Integer(DEC)	Inspection data 1	D00112
12	KENSA[2]. DATA2	LongInteger(HEX)	Inspection data 2	D00113

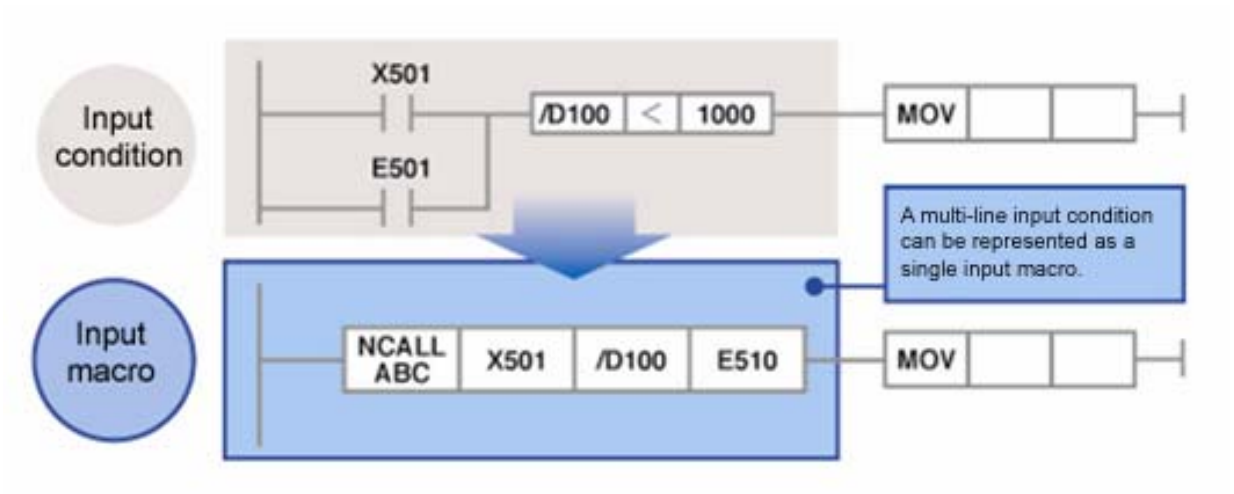




Conversion of complex input conditions into a macro improves reusability and visibility.

- Converts input conditions into a macro
- Facilitates reuse of input conditions
- Improves visibility by representing complex input conditions in a compact form.

The output of an input macro can be defined within the input macro using an NMOUT instruction.

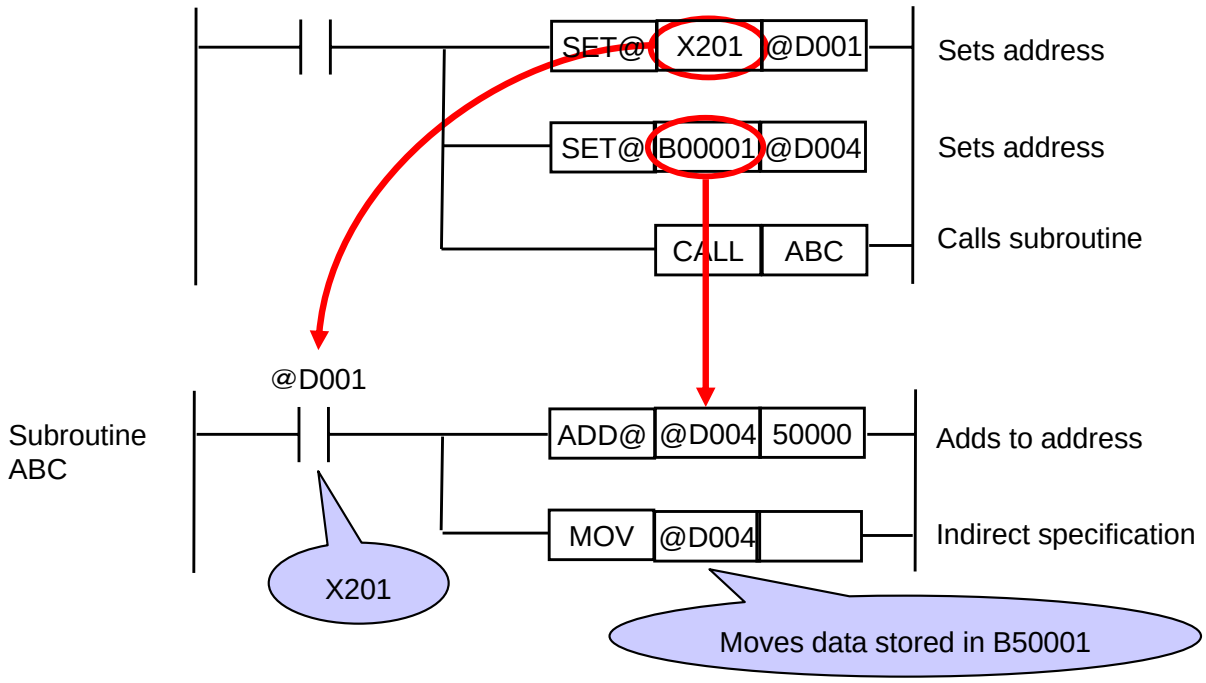


Indirect Specification

A device can be passed as a parameter
to a subroutine or block using indirect specification.

- Improves parameter visibility and program reusability.
- Improves program reusability by allowing pointer-like address modification provided in the C programming language.

Indirect specification simplifies program code sharing.

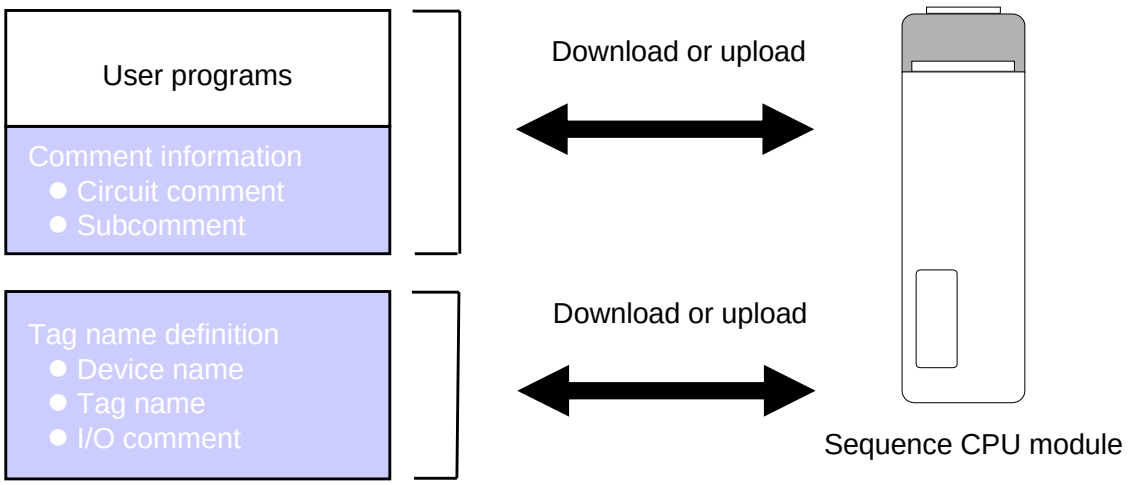


Downloading Comments

Programs and all comments created in WideField2 can be stored in the sequence CPU or ROM pack.

- By uploading programs stored in the CPU, software maintenance can be done even without the PC previously used for program development.
- Partial download is also allowed to save debugging time.

Circuit comments/subcomments and tag name definitions can be saved in the CPU for more efficient maintenance.



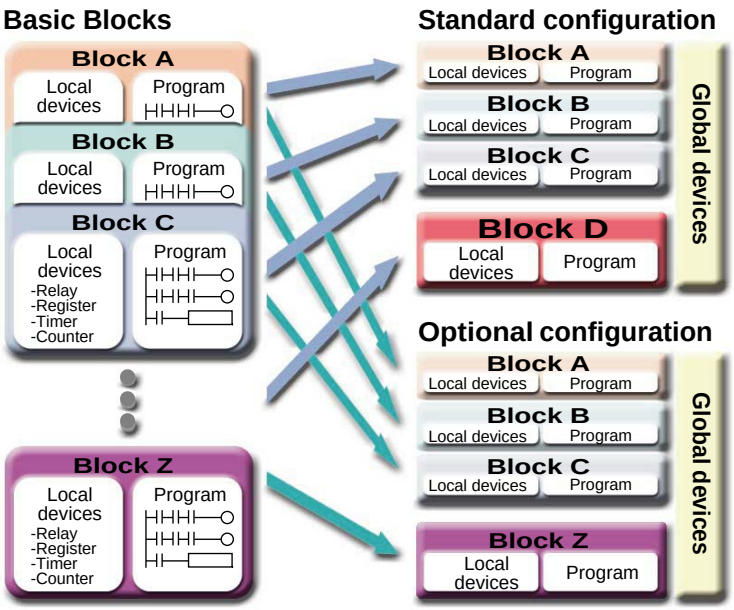
Program Component

Independent blocks and independent macros improve reusability dramatically.

- Previously, blocks and macros are pieces of program that use devices in the common area as data. Thus, devices must be allocated uniquely to blocks and macros with no duplication to avoid device conflict.

- By using the concept of *local device* in each block and macro, devices can be handled independently within each block and macro.
- Different macros and blocks can each have a local device having the same name as different physical addresses will be assigned to these local devices, thus avoiding device conflict.

A program and its local devices can be handled as a set and thus reused easily as a component.



- Address representation
  Local device

MOV	/D1

Global device

MOV	D1

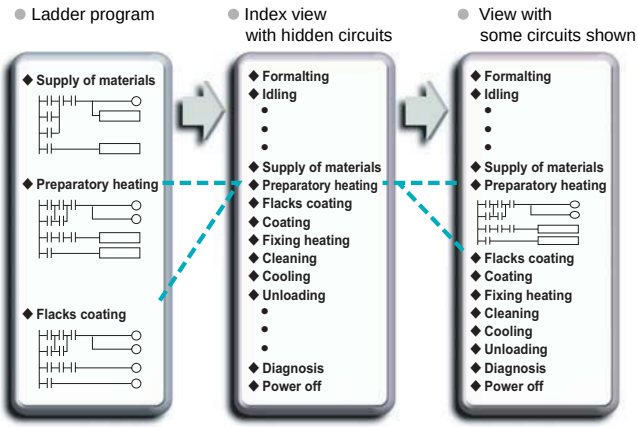
- Local devices and global devices can be used as different devices.
- When reusing a block, device addresses need not be changed.
- When a local device needs to be added within a block, no change to other blocks is needed.

Improved visibility increases efficiency of reuse

- Previously, a ladder program is coded as a long strip of diagram, which makes it difficult to visualize the overall logic flow.

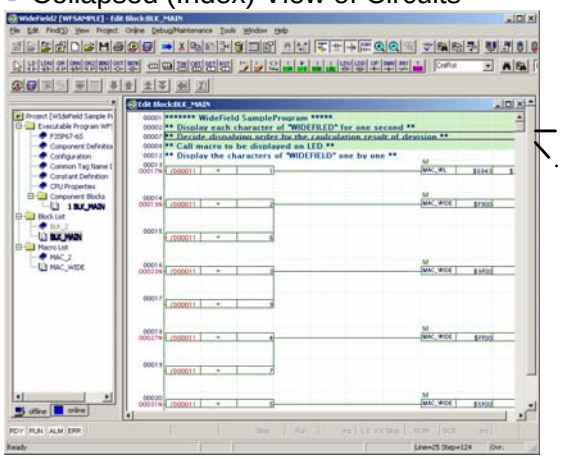
- Index view allows the overall program structure to be understood easily.
- You can hide or show the circuit blocks under each circuit comment (just like expanding and collapsing a tree) to view the overall program structure or go to the corresponding parts.
- Even programs written long ago or written by another engineer can be easily understood and modified.

■ Index View

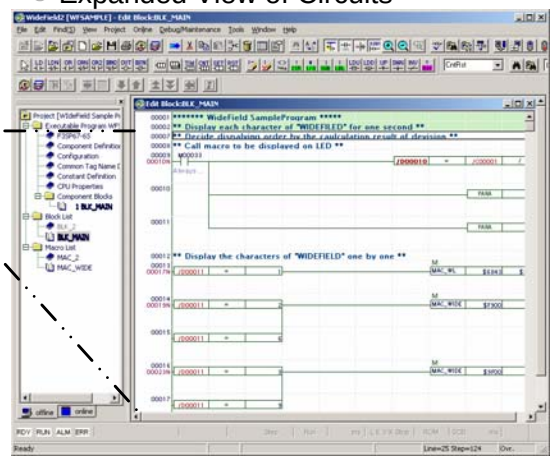


View the overall logic flow before proceeding to detailed debugging

Collapsed (Index) View of Circuits



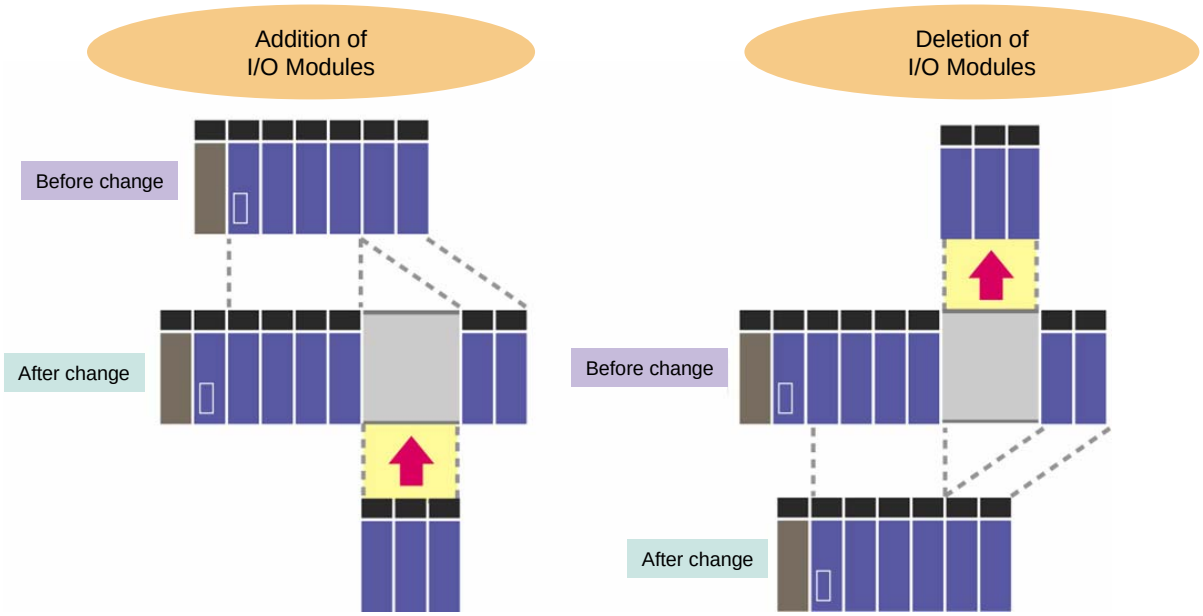
Expanded View of Circuits



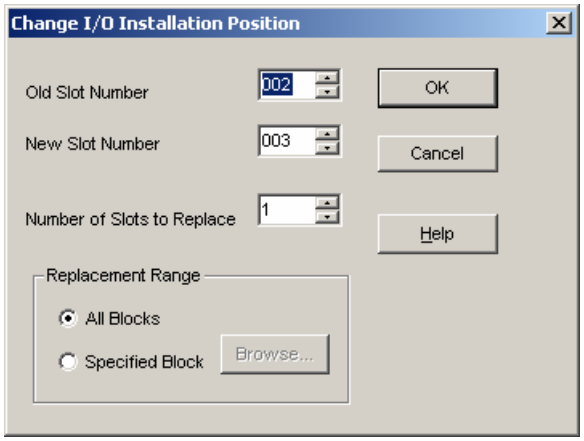
Collective Change of I/O Positions

The IT M@chine Controller

When the installed position of an I/O module is changed,
all corresponding I/O addresses in the program can be changed instantly.



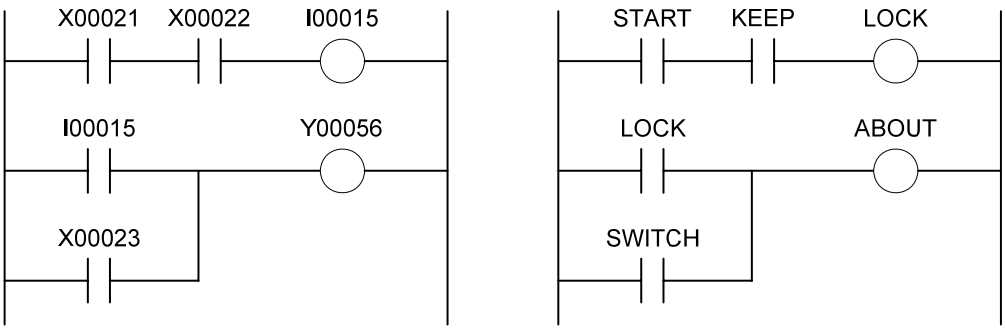
- I/O modules need to be added or moved when customizing a standard machine control program, the corresponding I/O addresses in the program for each slot can be changed collectively.
- The slot number parameters of I/O devices, READ, WRITE, HRD and HWR instructions can be replaced collectively.
- Common tag name definition assignments and block tag name definition assignments can also be changed concurrently.



Display Example

Logical Design by Tag Name

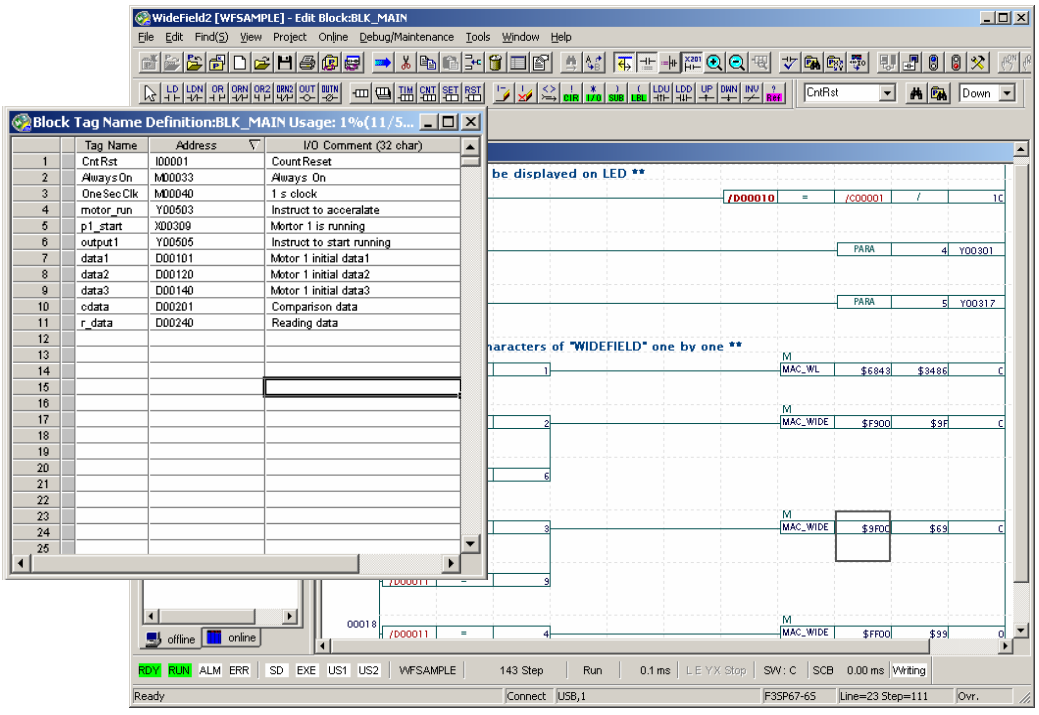
- A meaningful name can be assigned to each device to improve maintainability.
- Arbitrary tag names for individual devices can be used in programs before terminal assignment is decided. This separation of logical design and physical design (i.e., program design and terminal assignment) shortens engineering time significantly.
- Wiring changes can be accomplished simply by changing tag definitions.
- Use of tag names helps standardize circuits and facilitates reuse of programs.



Conventional PLCs require terminal addresses to be used in programs.

The FA-M3 R allows you to use logical addresses (tag names) in programs.

- Tag names can be defined easily (see the figure on the right); Moreover, tag names can be used in ladder diagrams even before they are defined.
  - → In other words, programs can be developed using tag names even before terminal assignments are decided.
- Tag names must be up to 8 characters long, beginning with 2 alphanumeric characters. Tag names are case insensitive.



Display Example

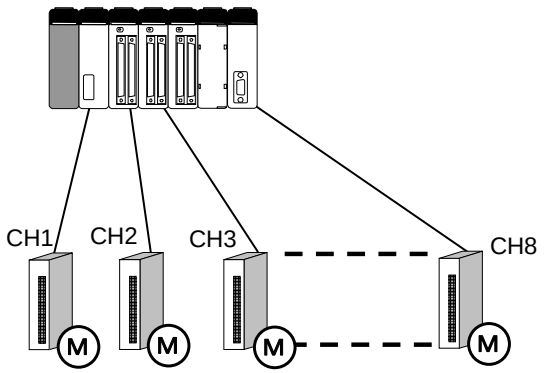
Group Tag Name

The IT M@chine Controller

Sets of tag names can be named
so that data sets can be managed under group names.

■ System Configuration

Multi-axis positioning control



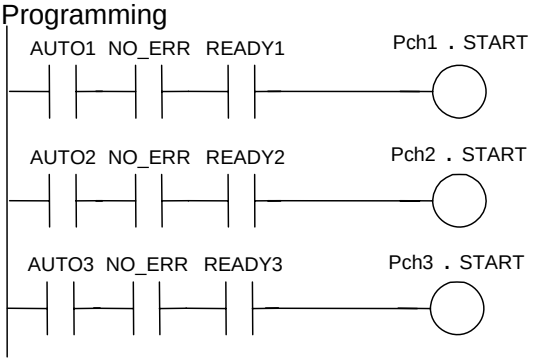
- Intuitive understanding with group representation
- Efficient programming by group handling of data

■ Group Name Settings

Group name
PCH1

Tag Name	Address
START	Y00233
STOP	Y00234
ERROR	X00201
PAUSE	Y00235

■ Programming



■ Related tag names can be grouped under a group tag and be used like a data structure.

■ Group representation shows the interdependency, structure and grouping of group members in a glance.

■ Standardization through the use of group member names standardizes programming.

Flexible Find Function
increases programming and debugging efficiency

Major improvements to the “Find” function,
which is used frequently in application programming and debugging.

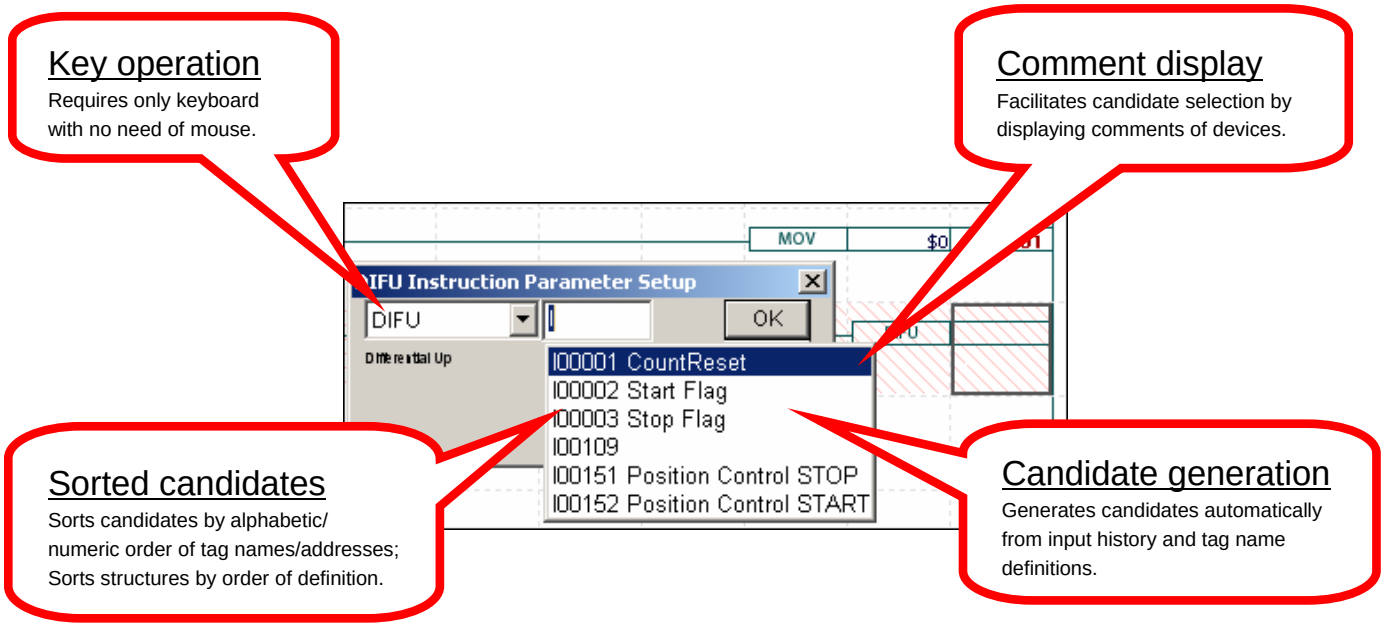
■ Standardized “Find” operation
Both finding within a block and finding within an entire project can be initiated from a Find toolbar located at the top of the screen.
Using this function, you can search for the same device within a single block, as well as within an entire project.

■ Quick find
Simply pressing the [Shift+F3] finds the next instance of the device name at the cursor position.

■ Finding hidden devices
Instructions such as BMOV which use multiple devices are displayed only with the first device on the screen even though subsequent devices are actually also used. WideField2 allows you to find even such hidden devices.

■ Finding using tag names or addresses
If tag names are used in programming, tag names are displayed in circuits.
A tag name will be found even if a search request uses the address assigned to the tag name.

■ Auto Completion
As a user enters devices during programming, the auto-completion feature, which is provided in many Windows applications, speeds up the process and prevents misspelling by displaying a list of candidates for selection. This is especially useful for entering long tag names and structures. Requiring only keyboard input, it can also be used in the field when no mouse input is available.



Advantages of Windows Environment

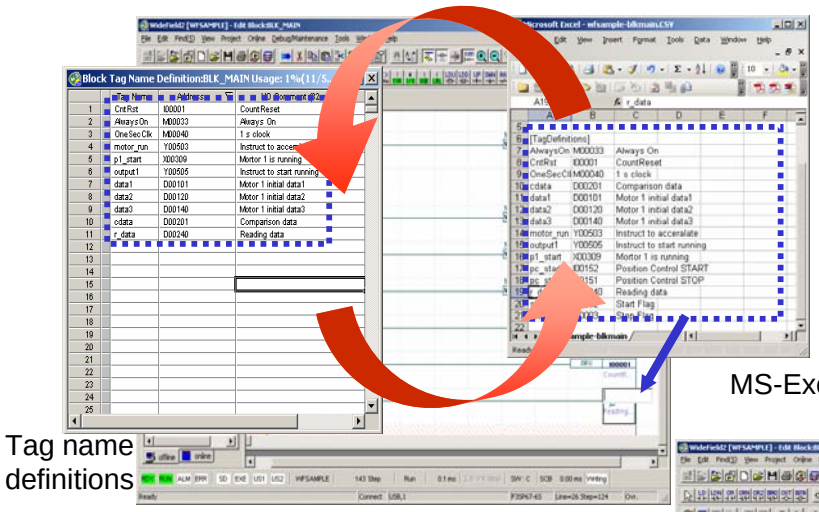
Effortless data exchange with Windows-based applications.

Support for versatile Windows technologies such as OLE.

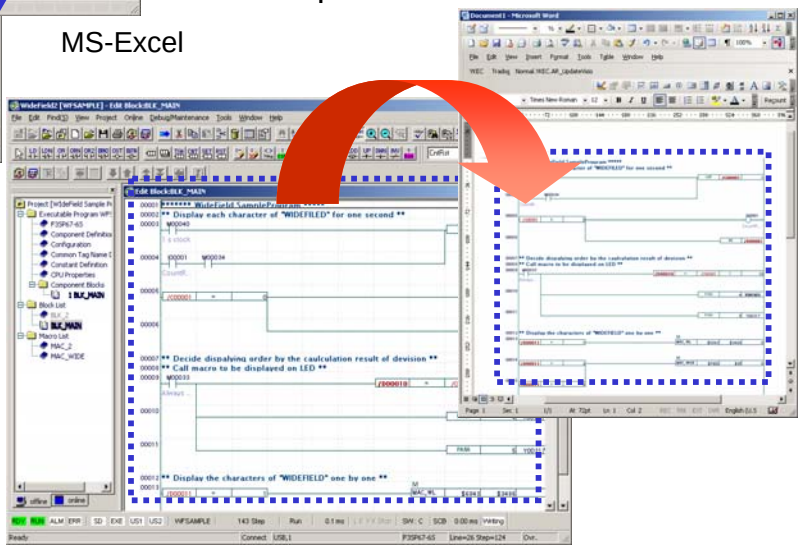
- Tag name definitions in a Microsoft Excel sheet can be imported easily into WideField2.
- Data in WideField2, such as ladder diagrams, can be utilized for the As Built Drawings.
- An Engineering Document can be easily created.

Note: The As Built Drawings and Engineering Document refer to documents prepared using a Windows-based application.

- Practical use of Microsoft Excel
  Tag name definitions can be copied and pasted not only between Excel and WideField2 but also to engineering documents.



- Microsoft word documents of As Built Drawings and other engineering documents can be created easily using copy and paste.



Flexible Operability

Ladder diagrams can be modified like editing a document with a word processor.

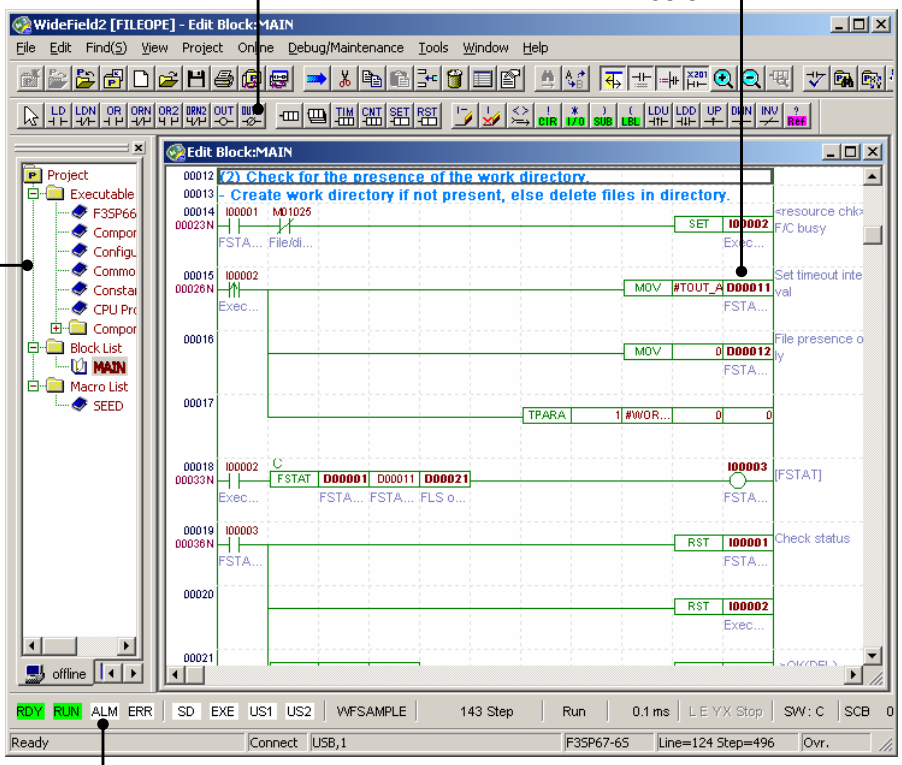
Programming problems are minimized and operability maximized.

- Program modification and monitoring can be done simultaneously by opening multiple windows.
- Both mouse and key operations are supported.
- Connection lines can be dawn and deleted by dragging.
- Shortcut menus displayed by right-clicking provide quick access to commands valid for that screen region or selection.
- A range of a ladder diagram can be copied and pasted between different programs.
- From a list of search results, a desired point can be retrieved.
- All instructions can be entered by typing their mnemonics, and automatically converted to the corresponding device on the screen.
- You can select a device type from the I/O configuration and monitor the statuses of the corresponding devices.

Intuitive operations using visual icons.

Comments and circuits are differentiated by color.

File structure can be viewed during programming.



Display Example

Allows constant monitoring of CPU operating status.

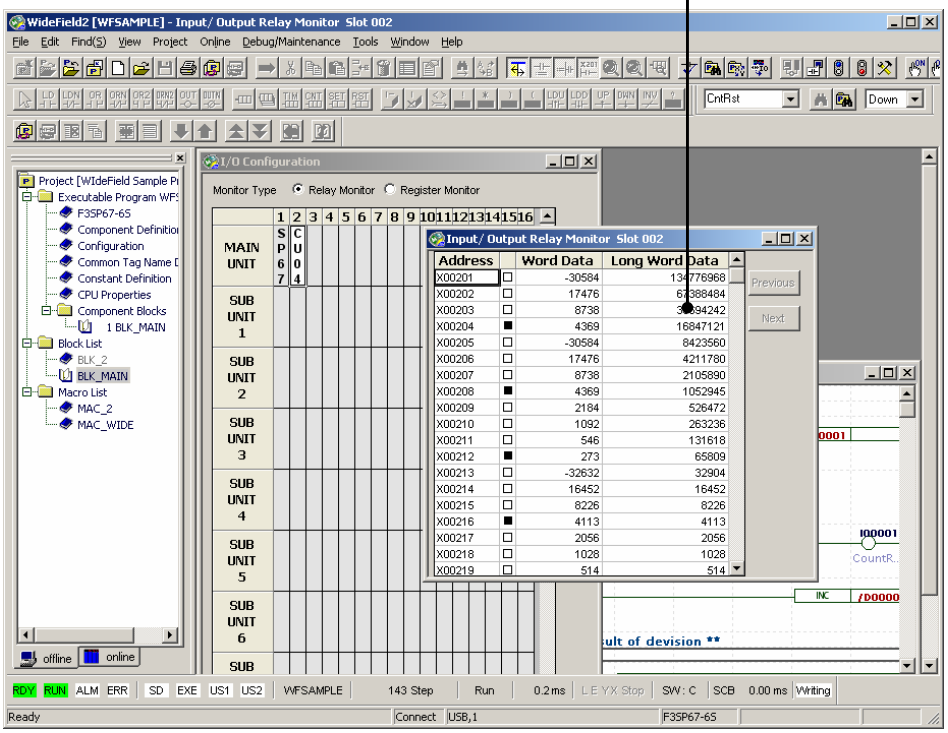
Sophisticated Debugging Functions

Ladder diagrams can be modified even during execution.

User-oriented debugging functions help program development and modification.

- A log of CPU-detected errors can be viewed as the System Log, while system execution status can be managed as a User Log.
- Multiple parts of a circuit diagram can be changed at once and modified parts can be reverted at once, all while online.
- Monitoring can be done concurrently from multiple PCs.
- Fast scrolling quickly brings onto the screen the part of the circuit diagram to be monitored.
- Monitored data values can be displayed as decimal, hexadecimal, binary, character string or floating-point values as you choose.
- Security protection can be set for a program.

Choosing a device type, as well as monitoring, setting and resetting device values.



Device Monitor Display Example

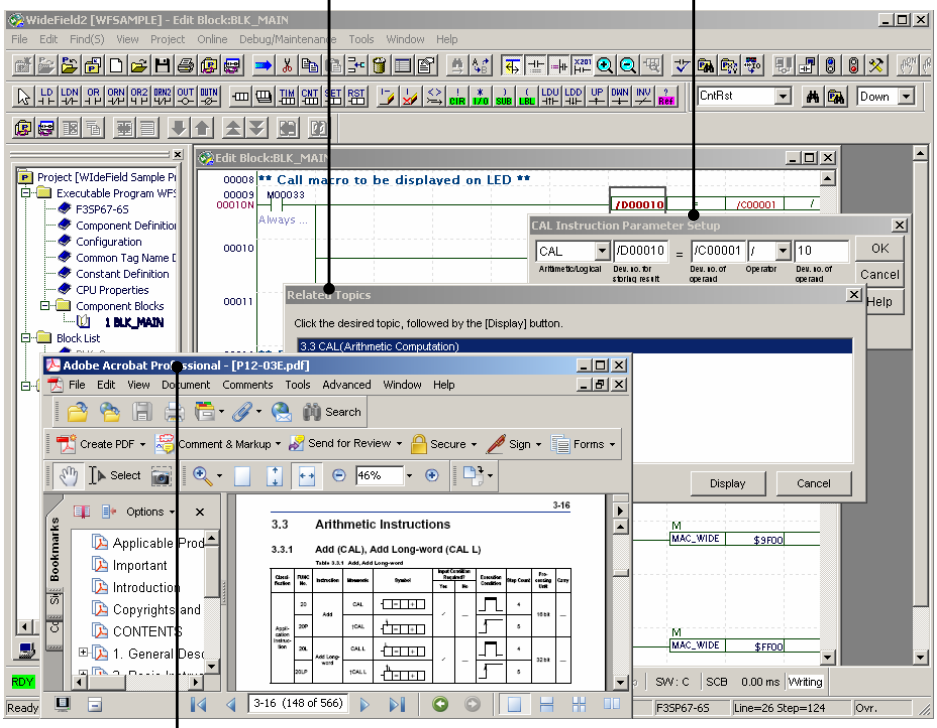
Enriched Help Provides Convenient Help Information

Simple help information are provided on screen for easy reference with detailed specifications provided as PDF pages.

- For an instruction, a short description of its function and operands are provided on screen.
- Detailed context-sensitive help information is displayed as a PDF page.
- Detailed description of the function and usage of an instruction can be referenced.
- Possible causes and remedies for an error can be referenced.
- Required help information can be selected from a displayed list of relevant topics.
- A required instruction can be selected from a displayed list of instructions.

Relevant references pages can be selected from a list.

Short descriptions of an instruction and its operands are displayed.



Help Display Example

Detailed description of the instruction is displayed as a PDF page.

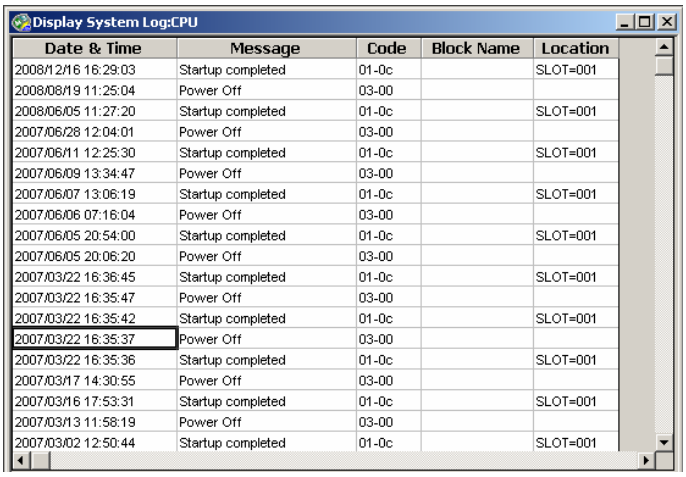
Status changes, failures and errors during FA-M3R operation can be logged.

- The system log lists the date, time and message of each event to allow you to understand past operation, as well as analyze changes in the system status and results of program failures.
- The information displayed as the system log can also be printed and saved to a file, which can then be read or printed later.

Date	Time	Message	Detailed Code	Block Name	Instruction/ Slot No.
2002/07/07	15:12:15	Startup Completed	01-00		
2002/07/29	15:11:03	Power Off	03-00		
2002/07/29	15:10:50	I/O Check Error	24-01	ACT3	00013N
2002/07/29	15:09:20	I/O Check Error	24-01	ACT3	00013N
2002/07/29	15:08:05	I/O Check Error	24-01	ACT3	00013N
2002/07/29	15:07:55	I/O Check Error	24-01	ACT3	00013N
2002/07/29	15:07:20	I/O Check Error	24-01	ACT3	00013N
2002/07/29	15:06:22	I/O Check Error	24-01	ACT3	00013N
2002/07/29	15:05:33	I/O Check Error	24-01	ACT3	00013N
2002/07/29	14:04:45	Subunit Communication Error	06-00		SLOT=1607
2002/07/29	12:43:51	I/O Check Error	24-02	READST	00012N

- Display
  System status changes (power-on/off), failures and errors occurring in the past are displayed in chronological order with the latest event at the top. A maximum of 70 to 150 of such events (the actual limit depends on the contents of event data) can be stored. When the stored event data reaches the storage capacity, the latest event data overwrites the oldest event data.
- Printout
  The displayed log can be printed in the same format.
- Storage and retrieval
  The displayed log can be saved to a file for retrieval later.

Note: The system log can be monitored from a remote location via E-mail or Ethernet.


Display System Log:CPU

Date & Time	Message	Code	Block Name	Location
2008/12/16 16:29:03	Startup completed	01-0c		SLOT=001
2008/08/19 11:25:04	Power Off	03-00		
2008/06/05 11:27:20	Startup completed	01-0c		SLOT=001
2007/06/28 12:04:01	Power Off	03-00		
2007/06/11 12:25:30	Startup completed	01-0c		SLOT=001
2007/06/09 13:34:47	Power Off	03-00		
2007/06/07 13:06:19	Startup completed	01-0c		SLOT=001
2007/06/06 07:16:04	Power Off	03-00		
2007/06/05 20:54:00	Startup completed	01-0c		SLOT=001
2007/06/05 20:06:20	Power Off	03-00		
2007/03/22 16:36:45	Startup completed	01-0c		SLOT=001
2007/03/22 16:35:47	Power Off	03-00		
2007/03/22 16:35:42	Startup completed	01-0c		SLOT=001
2007/03/22 16:35:37	Power Off	03-00		
2007/03/22 16:35:36	Startup completed	01-0c		SLOT=001
2007/03/17 14:30:55	Power Off	03-00		
2007/03/16 17:53:31	Startup completed	01-0c		SLOT=001
2007/03/13 11:58:19	Power Off	03-00		
2007/03/02 12:50:44	Startup completed	01-0c		SLOT=001

Example of System Log

Alarms, events and errors for equipment and machines (controlled by an FA-M3R) occurring during operation can be logged.

- In addition to the system log, user-defined messages can be recorded (for up to 64 messages per CPU) as the user log.
- The user log lists the date, time and message of each event to allow you to understand past operation, as well as analyze system errors and results of improper equipment/machine operations.
- The information displayed as the user log can also be printed and saved to a file, which can then be read or printed later.

Date	Time	Message No./Parameter/Message Text		
2002/07/28	11:59:09	main= 18	sub= 1	Heater Failure
2002/07/28	10:34:48	main= 14	sub= 1	Run Out Of Material
2002/07/28	08:30:32	main= 1	sub= 1	Machine Start
2002/07/27	17:34:27	main= 2	sub= 1	Machine Stop
2002/07/27	17:05:40	main= 6	sub= 1	Lot End
2002/07/27	17:00:10	main= 4	sub= 1	Product Departure
2002/07/27	16:05:32	main= 40	sub= 5	Alarm On
2002/07/27	15:59:58	main= 12	sub= 1	Limiter Off
2002/07/27	15:57:24	main= 11	sub= 1	Limiter On
2002/07/27	08:55:32	main= 3	sub= 1	Product Entry
2002/07/27	08:45:40	main= 5	sub= 1	Lot End
2002/07/27	08:30:51	main= 1	sub= 1	Machine Start

By simply defining user messages in the dialog box shown on the right, and executing ULOG instructions in a ladder program, the defined main code, subcode, as well as the time and date of occurrence of each event will be stored in the user log data area. You can also send user log information to other equipment using the ULOGR instruction.

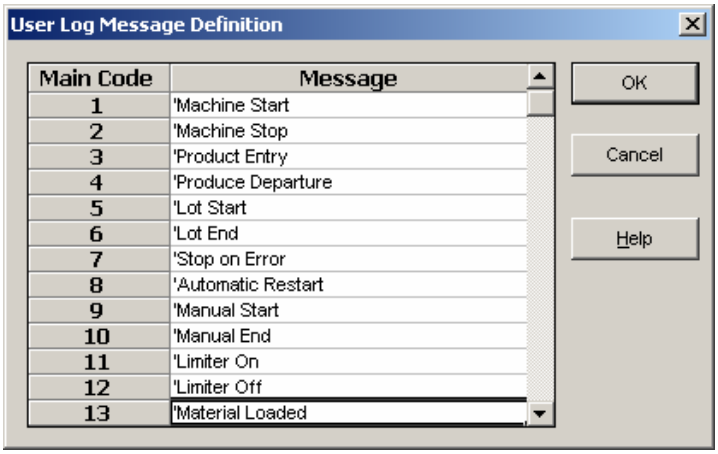
- Other related instructions and devices
  - UCLR instruction: Clears the user log.
  - Z105 register: Special register for defining the number of user log messages to be stored

- Display
  User log messages occurring in the past are displayed in chronological order with the latest event at the top.
  Up to 64 messages corresponding to the main codes can be stored per CPU. When the stored message data reaches the storage capacity, the latest message data overwrites the oldest message data.

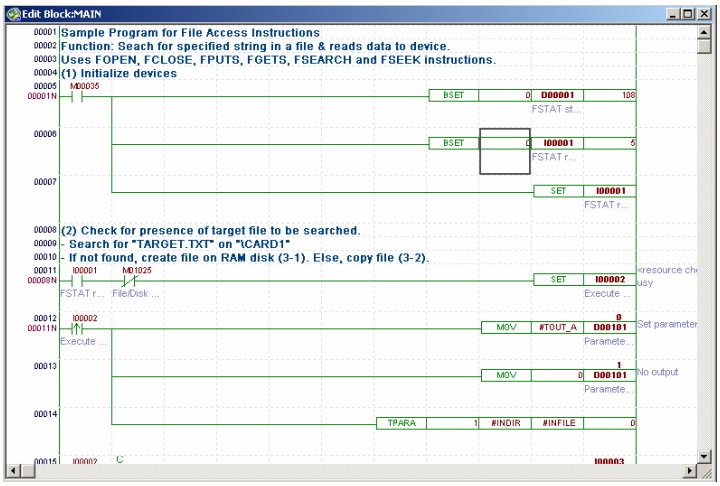
- Printout
  The displayed log can be printed in the same format.

- Storage and retrieval
  The displayed log can be saved to a file for retrieval later.

Note: The user log can be monitored from a remote location via E-mail or Ethernet.



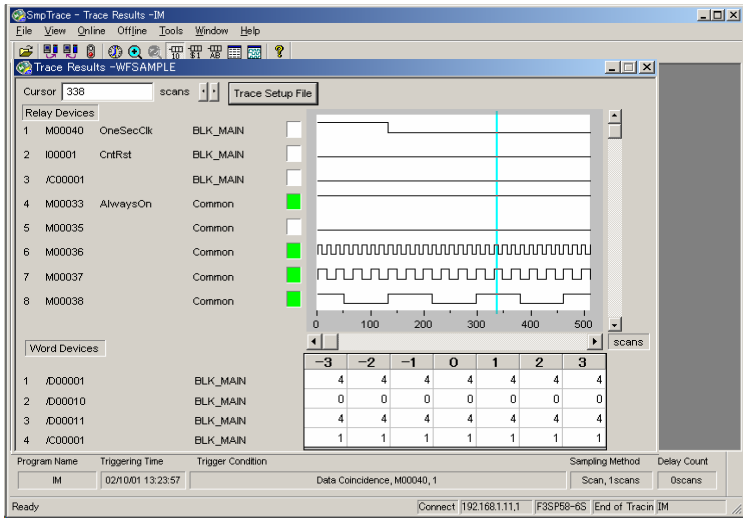
User Log Message Definition



Block Edit Window Display

Sampling Trace

- You can trace device values while running a program.
- You can also record device values before the trigger condition is established.
- You can use sampling traces not only during debugging but also during operation for troubleshooting and failure analyses (no other manufacturer's PLC provides this function).
- Use of the sampling trace function does not affect the scan time.
- Sampling traces are very useful for capturing phenomena that seldom occur (e.g. occurring once a week or once a month).



Specifications

Number of sampling points: 16 relays and 4 registers.

Sampling timing:

- Whenever a TRC instruction is executed
- At specified intervals (10 to 2000 ms)
- At the end of every 1 to 1000 scan intervals

Number of traces: 1024

Trigger condition:

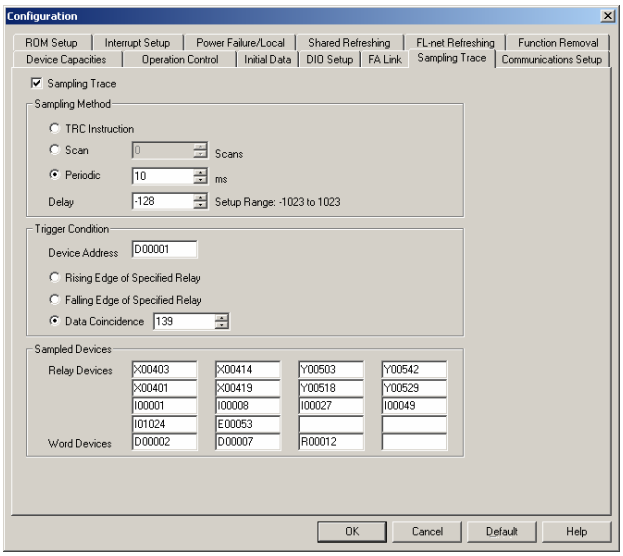
- Specified relay
- Data coincidence of a specified device

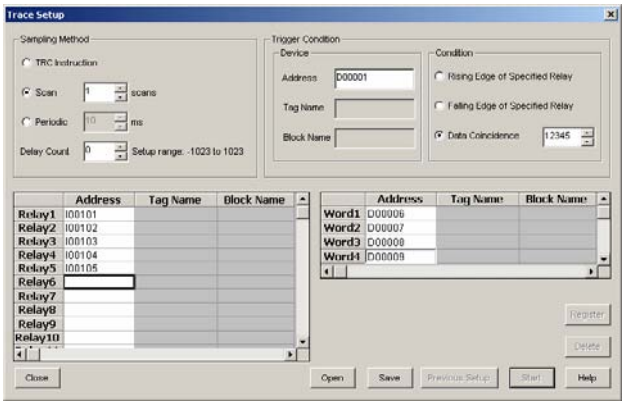
By configuring a trigger condition using a ladder program, you can obtain traces of the values of desired devices when complex conditions including status transitions are met.

Sampling traces can be obtained without affecting the scan time of the ladder program.

→ Non-conformities occurring at irregular times can be detected.

- There are two methods for defining sampling traces:
  - Define the setting in the configuration of the user program.
  - Define settings as and when required during operation.
- Display
  Sampling traces can be displayed in a time chart format together with sampled relay statuses and register values.
- Pre-define settings in configuration prior to runtime
  You can define sampling trace settings in the configuration so that sampling traces are obtained during normal operation.
- Define settings on demand
  You can define sampling trace settings at any time.
- Storage and retrieval
  Sampling trace results can be saved to a file for retrieval later.





Sampling Trace Setup

Remote OME in Your Preferred Way

The IT M@chine Controller

The FA-M3R supports remote equipment maintenance, called "Remote OME. "

Remote OME involves performing the following activities remotely:

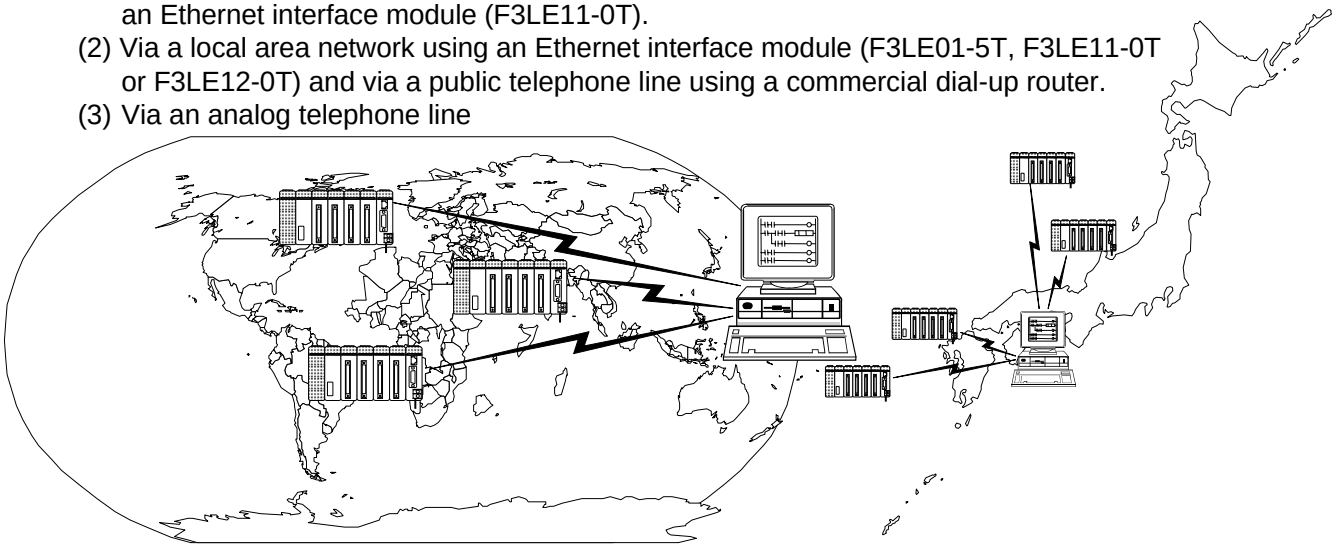
- Operation: Operation and monitoring
- Maintenance: Troubleshooting
- Engineering: Program modification and debugging

Remote OME can be achieved:

(1) By E-mail via Internet using FA-M3R Programming Tool WideField2 (SF620-MCW) and an Ethernet interface module (F3LE11-0T).

(2) Via a local area network using an Ethernet interface module (F3LE01-5T, F3LE11-0T or F3LE12-0T) and via a public telephone line using a commercial dial-up router.

(3) Via an analog telephone line



- FA-M3R's remote-OME allows you to access data and programs of an FA-M3R controller embedded in a remote system and thus monitor the status, as well as perform maintenance and inspection of the remote system.

- You can perform the following activities against an FA-M3R incorporated within a system from a personal computer located at a remote location:
  - Machine maintenance and inspection using the device monitoring and diagnostics functions
  - Checking machine operating status by monitoring FA-M3R devices online; performing machine operation test by changing device values
  - Troubleshooting and failure analyses using FA-M3R's diagnostics functions (system log, user log and sampling traces)
  - Improvement of machine operation by adding, modifying and debugging a ladder diagram.

- The following methods for remote OME are provided:
  - Remote OME by E-mail via Internet
  - Remote OME via Ethernet network (with option for concurrent use of a network camera)
  - Remote OME via public telephone line using analog modem

Remote maintenance can be carried out in your preferred way.

Remote OME on Internet

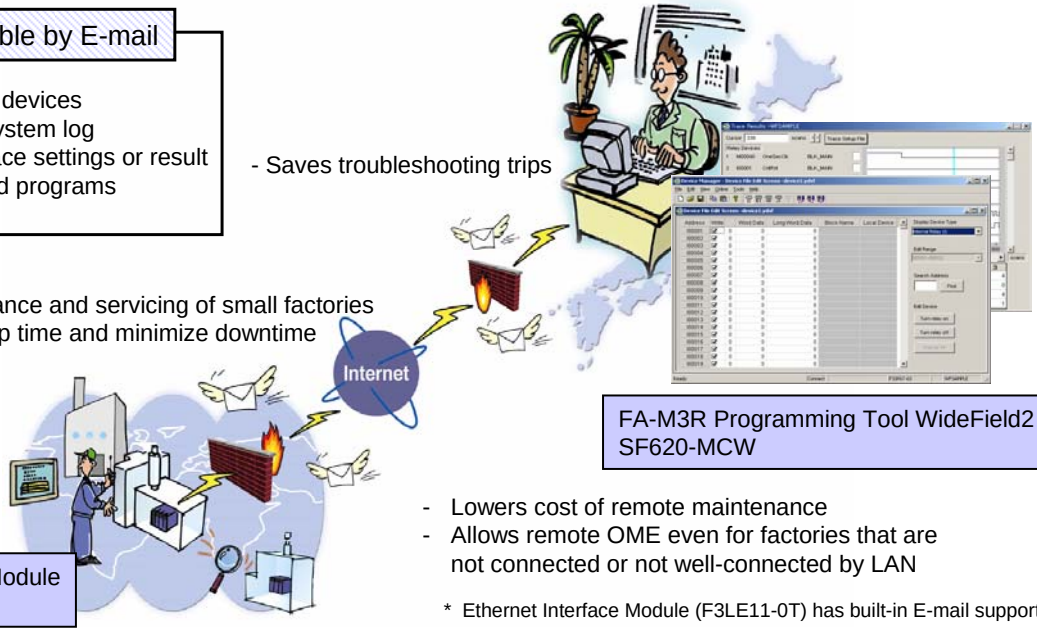
Remote maintenance can be achieved simply by sending and receiving E-mails via Internet from any part of the world.

Functions available by E-mail

- Read/write various devices
- Read user log or system log
- Check sampling trace settings or result
- Upload or download programs

- Saves troubleshooting trips

- Enables remote maintenance and servicing of small factories
- Shortens machine boot up time and minimize downtime



FA-M3R Programming Tool WideField2
SF620-MCW

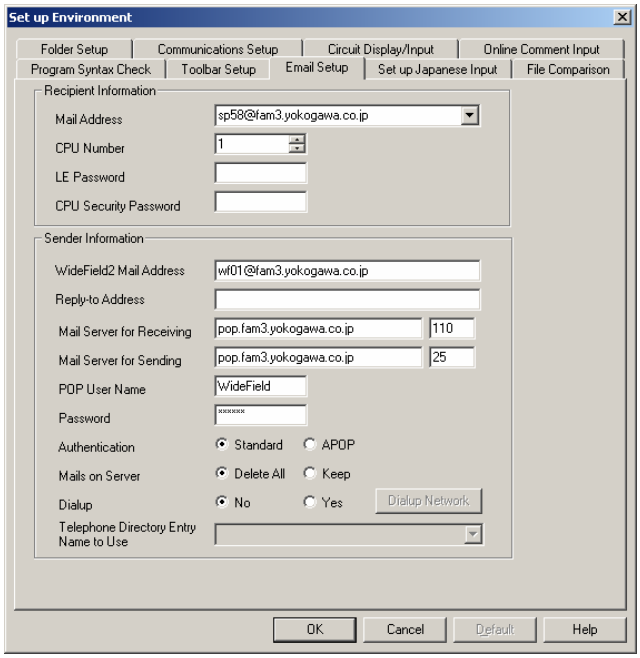
Ethernet Interface Module
F3LE11-0T

- Lowers cost of remote maintenance
- Allows remote OME even for factories that are not connected or not well-connected by LAN

* Ethernet Interface Module (F3LE11-0T) has built-in E-mail support.

Features of Remote OME via Internet

- Convenient remote access by E-mail
  - Remote maintenance only requires PC or equipment setup in E-mail environment.
  - Firewall configuration is not required.
- Use of Internet allows worldwide connection
  - E-mail is used for remote maintenance so machines or systems can be accessed worldwide.
- No additional communication equipment and charges means lower cost
  - In an Internet environment, no additional communication equipment such as dialup router or modem is required and no additional line and communication charges are incurred.
- Configuration and monitoring of logic analyzer-like function
  - The sampling trace function, which can be used like a logic analyzer to capture device data changes using triggers, can be configured and monitored simply by E-mail.



E-mail Setup

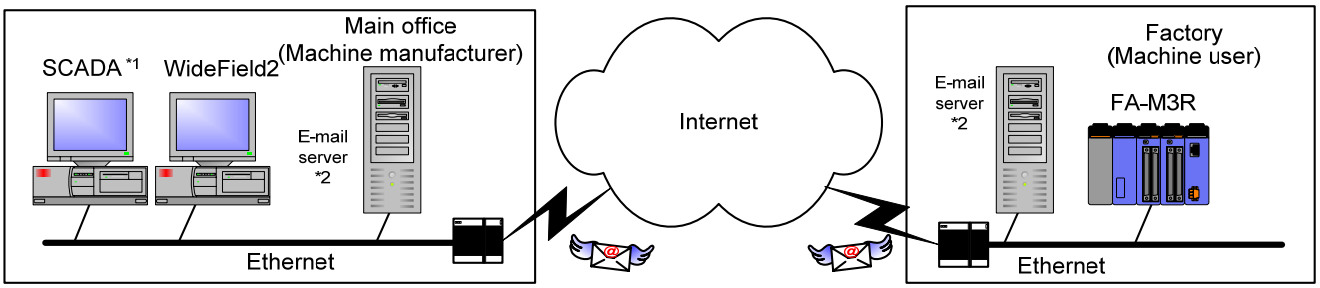
Easy equipment setup in E-mail environment and simple E-mail setup using software tool.

● Remote OME by E-mail

Shown below are example configurations for transmitting alarm E-mails and transmitting user E-mails by programs for remote OME by E-mail. The Ethernet Interface Module (F3LE11-0T) has built-in E-mail support.

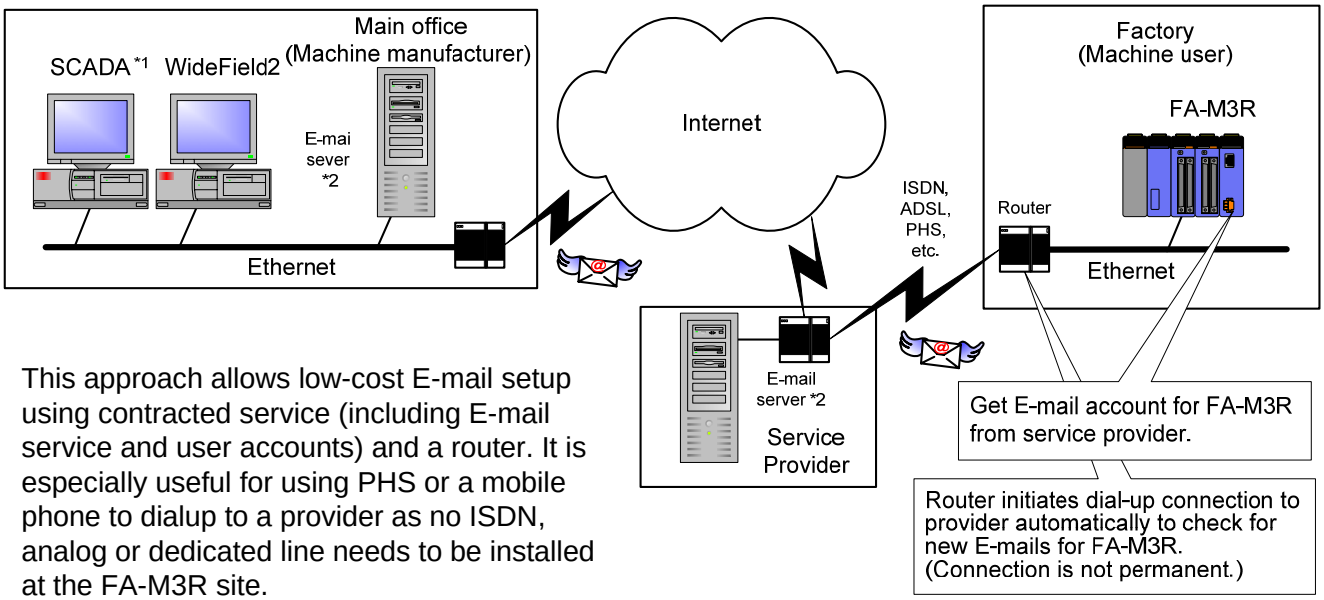
<<Connection using Internet>>

■ Connection using an existing E-mail environment



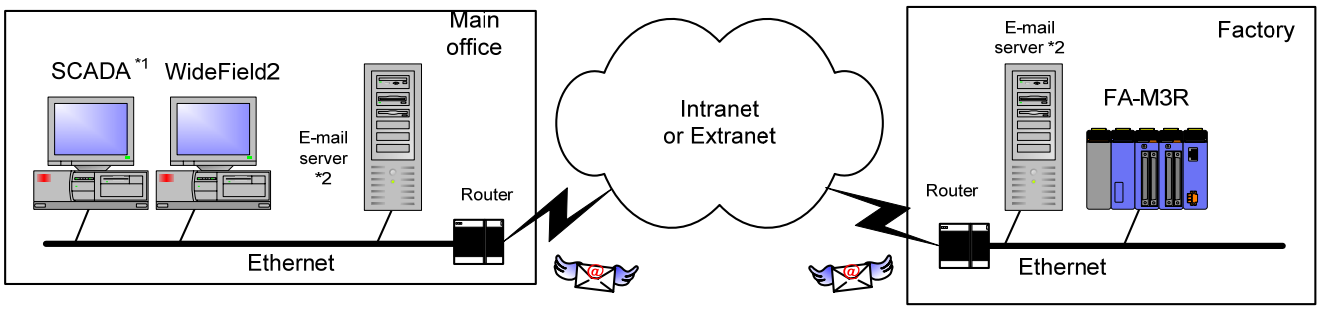
The only setup required is E-mail account information for WideField2, SCADA and FA-M3R issued by E-mail servers.

■ Connection by configuring a new E-mail environment on the FA-M3R end



This approach allows low-cost E-mail setup using contracted service (including E-mail service and user accounts) and a router. It is especially useful for using PHS or a mobile phone to dialup to a provider as no ISDN, analog or dedicated line needs to be installed at the FA-M3R site.

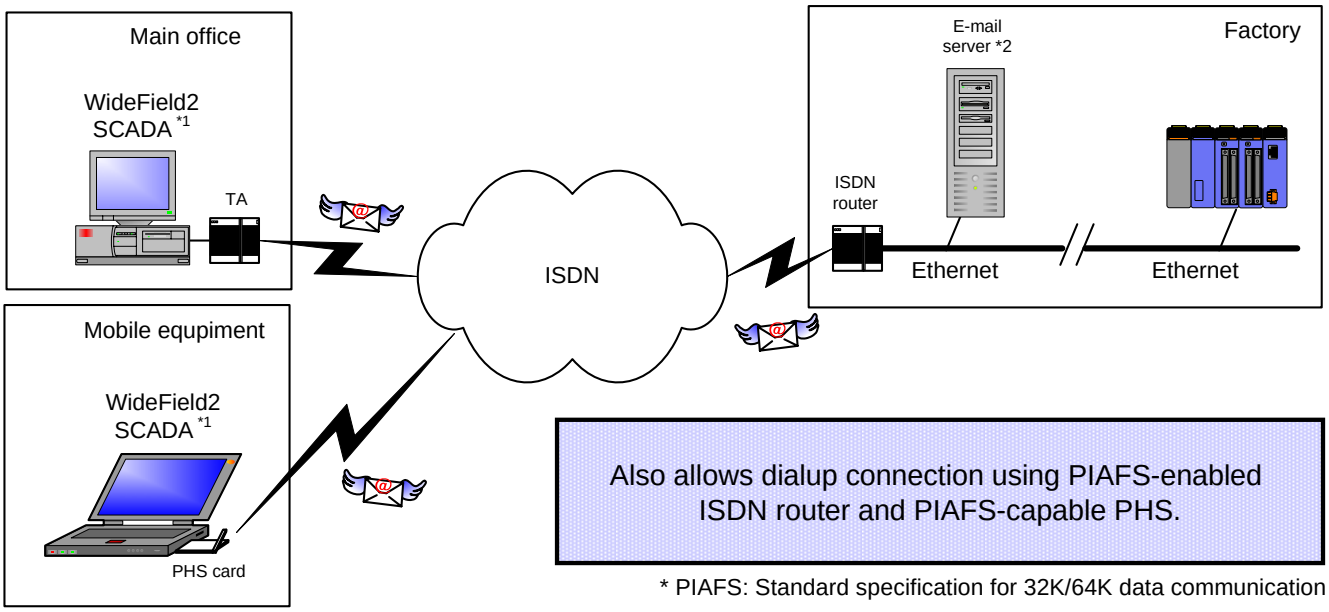
<<Connection Using Intranet or Extranet>>



An E-mail server is required on either the LAN connected to WideField2/SCADA (maintenance PC) or the LAN connected to FA-M3R or both LANs.

<<Connection Using Public Line>>

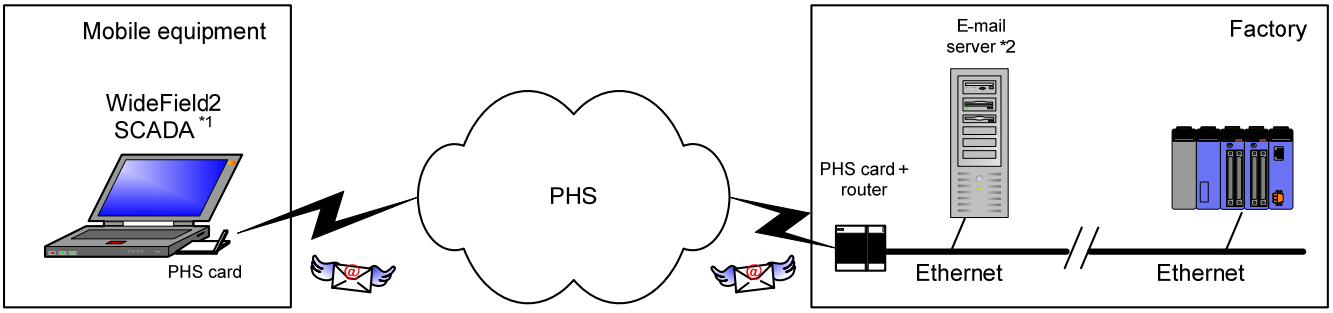
■ ISDN Connection



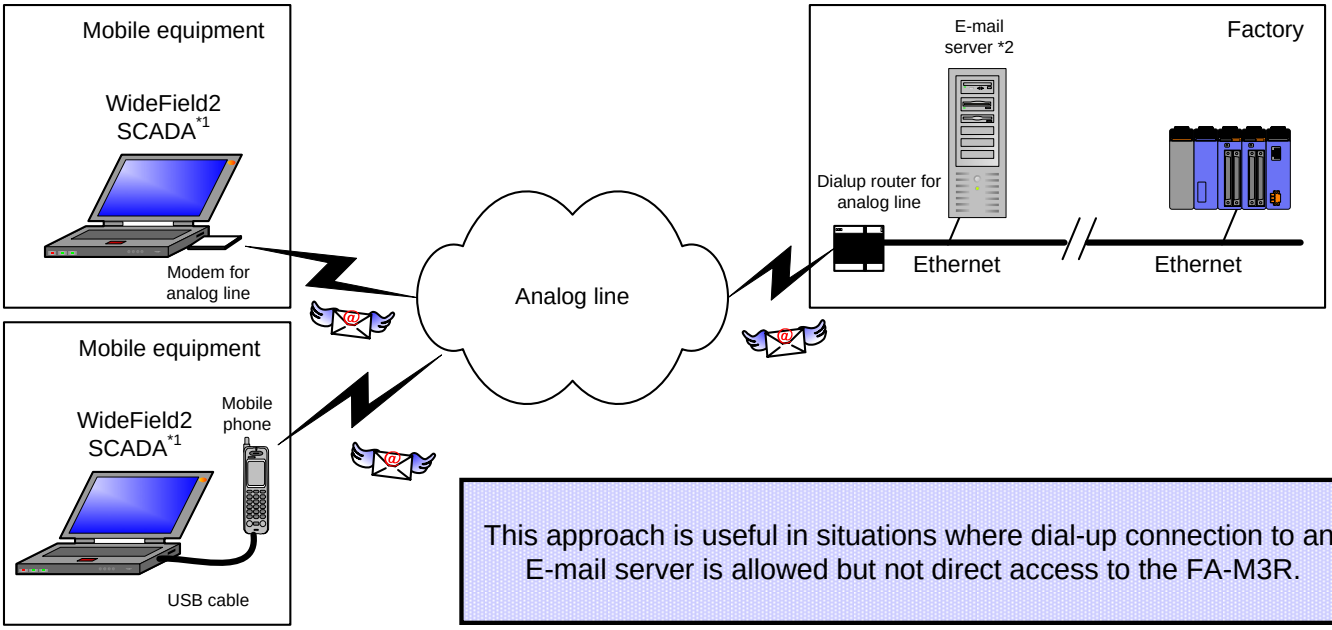
Also allows dialup connection using PIAFS-enabled ISDN router and PIAFS-capable PHS.

* PIAFS: Standard specification for 32K/64K data communication

■ PHS Connection



■ Analog Connection



This approach is useful in situations where dial-up connection to an E-mail server is allowed but not direct access to the FA-M3R.

*1: Remote OME via E-mail requires a separate E-mail-capable OPC server.
*2: An SMTP/POP3 E-mail server is required for connection using WideField2 and F3LE11-0T Ethernet Interface Module.

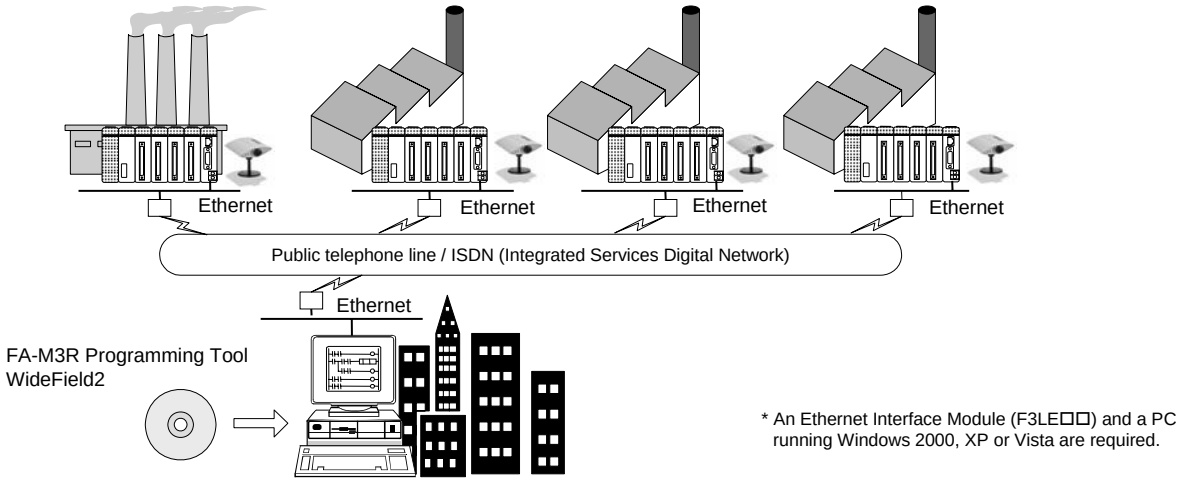
Remote OME via Ethernet Network

The IT M@chine Controller

The FA-M3R supports remote maintenance of multiple machines installed in distant locations via Ethernet networks. Using a network camera, remote maintenance can also be performed while actually monitoring the equipment.

The following activities can be performed remotely using standard features of the FA-M3R Programming Tool WideField2:

- Editing/loading/saving programs, monitoring ladder diagrams, monitoring devices, monitoring operation statuses and reading various data. The personal computer link feature can also be used.
- System log, user log and sampling traces that fully support remote OME

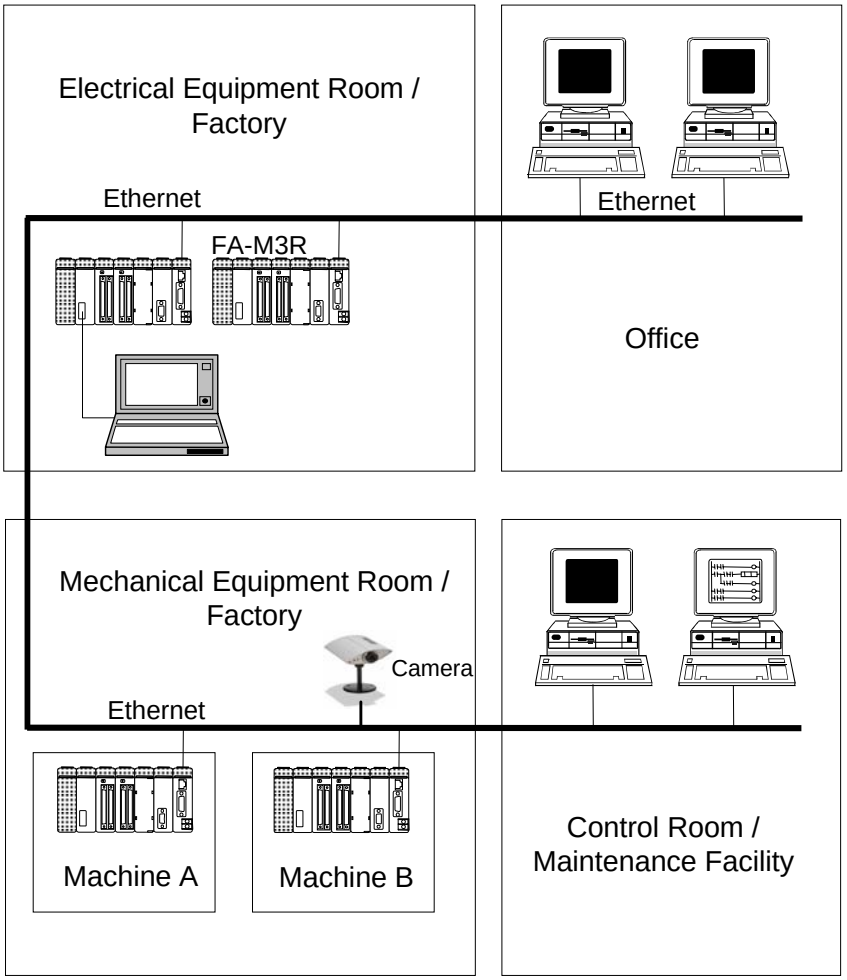


* An Ethernet Interface Module (F3LE□□) and a PC running Windows 2000, XP or Vista are required.

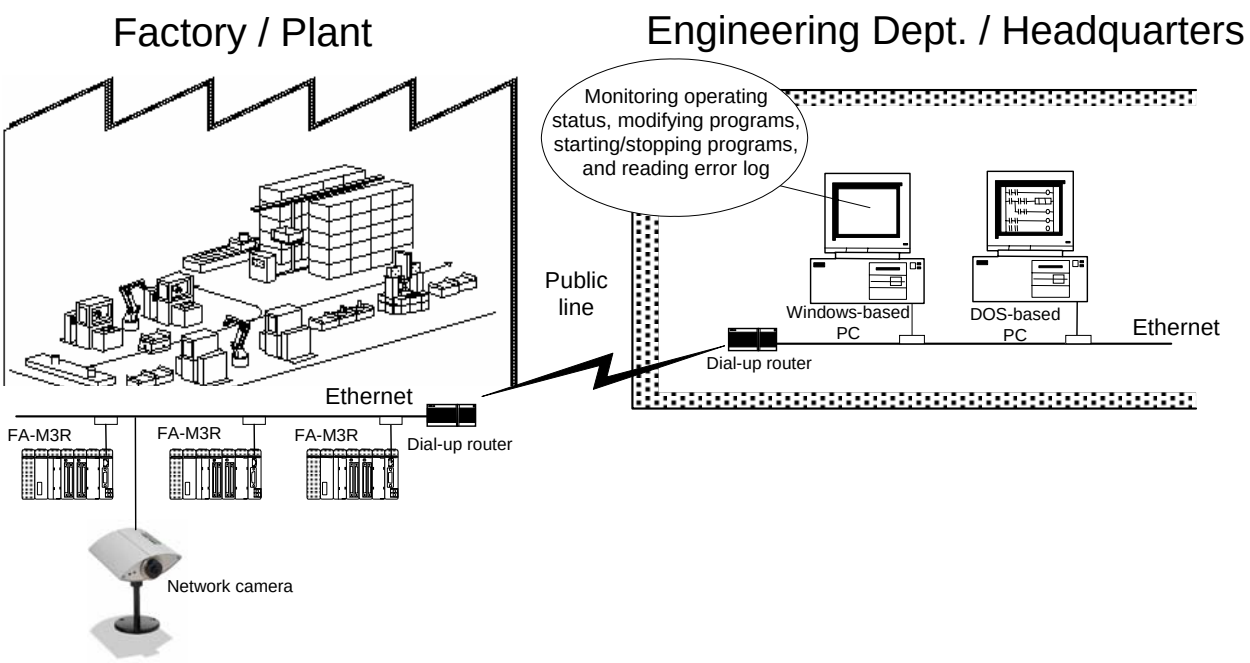
● Remote OME via Ethernet

- By connecting all the FA-M3R controllers incorporated in equipment at a plant using Ethernet, all machine statuses can be viewed from a personal computer in an office or control room.
- All functions of the FA-M3R Programming Tool WideField2 can be applied to remote FA-M3R controllers.
- Monitoring and data modification of one FA-M3R controller can be performed concurrently from multiple personal computers via Ethernet.

  However, multiple concurrent connections using FA-M3R Programming Tool WideField2 is not allowed.



● Remote OME via Ethernet and Dial-up Router



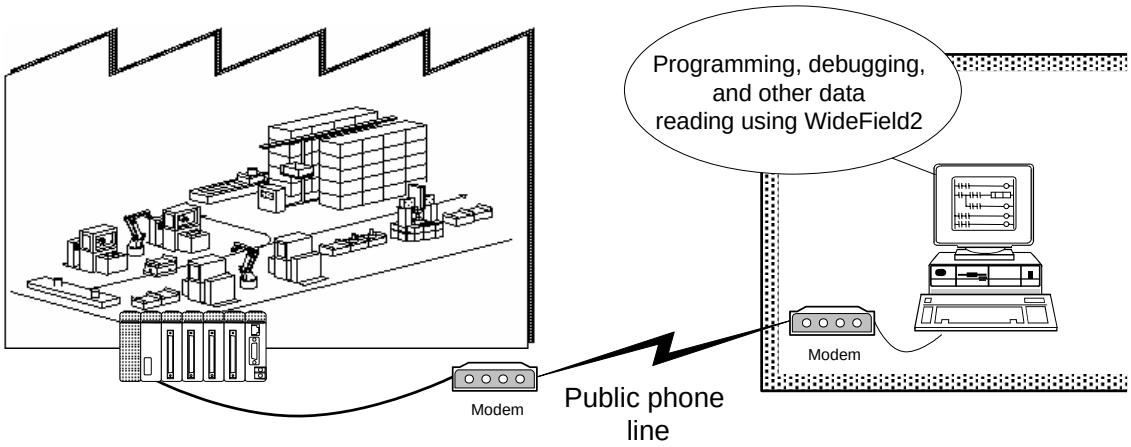
- Remote OME is made available via Ethernet within individual plants. Moreover, by using a public line with dial-up routers as shown in the figure above, remote OME of equipment from headquarters is made possible via FA-M3R controllers connected to Ethernet networks inside individual plants, whether located locally or overseas.

Remote OME Via Public Telephone Line Using Analog Modem

The IT M@chine Controller

An FA-M3R installed in a distant location can be maintained via a public telephone line.

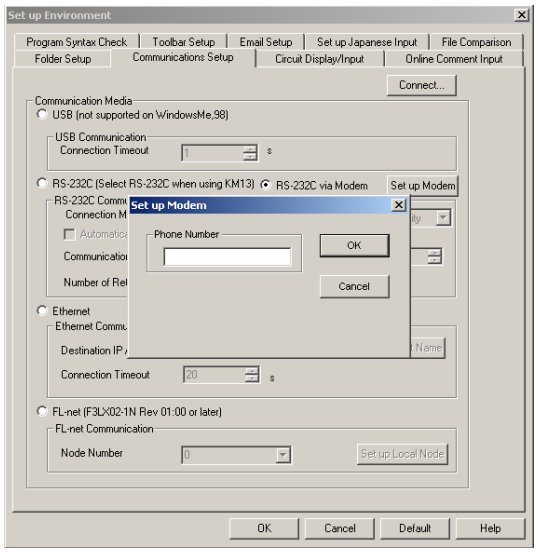
The following can be performed remotely using standard features of FA-M3R Programming Tool WideField2: Editing/loading/saving programs, monitoring ladder diagrams, monitoring devices, monitoring operation statuses, reading system log, reading various data, and more.

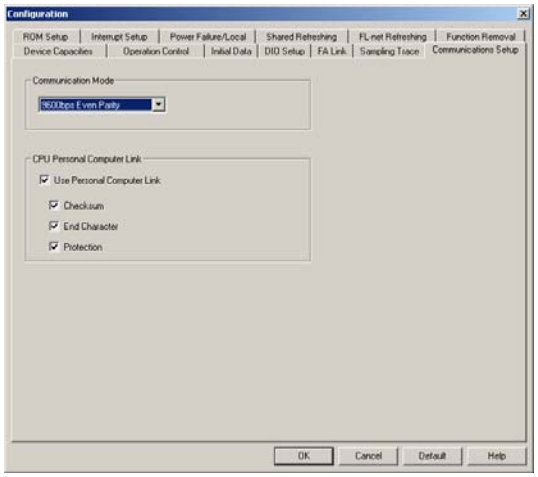


For connection, you need to do the following:

- Modem for the personal computer
  - Set the communications protocol (baud rate, data length, etc.) using AT commands.
- FA-M3R programming Tool WideField2.
  - Use RS-232C via modem:
    Tool → Setup Environment → Communications Setup → Setup Modem
- FA-M3R
  - In the configuration settings, set the CPU communication port as follows:
    - Select communication mode
    - Use personal computer link

  The program in which the above configuration is set up needs to be downloaded in advance. When downloading a program via a public telephone line, make sure that the program configuration is set as above.
- Modem for the FA-M3R
  - Switch on the automatic terminal mode.
  - Set the communications protocol using AT commands.





Communication Setup

High-speed Conversion, High Accuracy and Excellent Noise Immunity

Modules can be combined with high-speed CPU modules to build high-speed analog I/O control systems.

(1) Analog Input Modules

Item	Specifications			
	F3AD08-4R	F3AD08-5R	F3AD08-6R	F3AD08-4V
No. of inputs	8			
Resolution	16bit A/D			12bit A/D
Input signal range	Current signals only 0-20mADC, 4-20 mADC	Voltage signals only 0-5VDC, 1-5VDC, -10 to 10VDC, 0-10VDC	Current or voltage signals 0-5VDC, 1-5VDC, -10 to 10VDC, 0-10VDC 0-20mADC, 4-20mADC	Current signals only 0-20mADC, 4-20 mADC
Overall accuracy	0.1%of F.S. (23℃±2℃), 0.2% of F.S. (0-55℃)			0.2% of F.S.(23℃±2℃), 0.5% of F.S. (0-55℃)
Conversion speed	50μs/250μs/1ms/16.6ms/20ms/100ms/166ms/200ms			1ms
Others	Supports filtering, scaling, channel skipping and noise-tolerant conversion			—

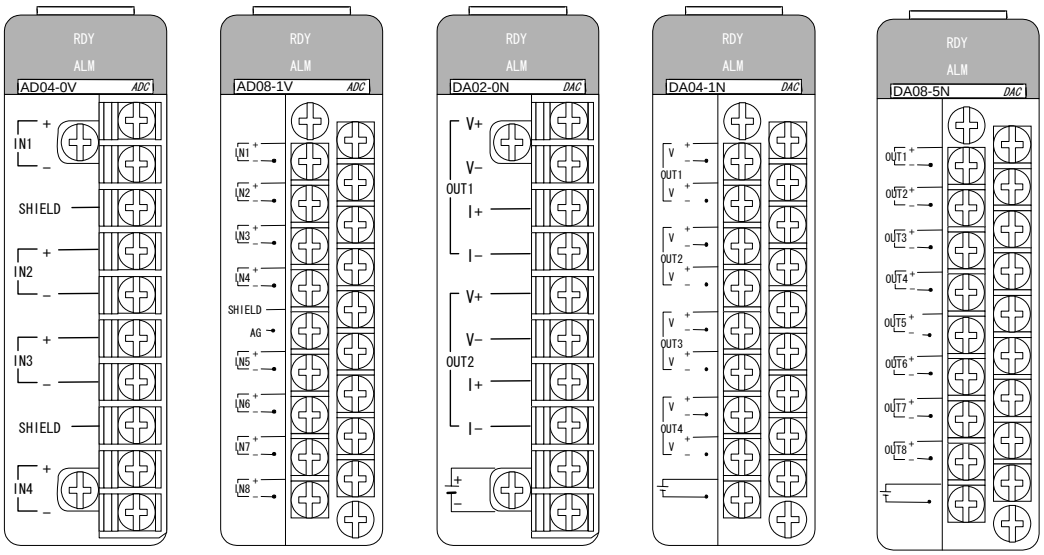
Item	Specifications		
	F3AD04-0V	F3AD08-1V	F3AD04-0R
No. of inputs	4	8	4
Resolution	12-bit A/D		16-bit A/D
Input signal range	0-5 VDC , 1-5 VDC, -10 to 10 VDC		
Overall accuracy	0.2% of F.S. (23℃±2℃), 0.5% of F.S. (0-55℃)		0.1% of F.S. (23℃±2℃), 0.3% of F.S. (0-55℃)
Conversion speed	1ms per input		
Others	Supports filtering, scaling, channel skipping and noise-tolerant conversion		

(2) Analog Output Modules

Item	Specifications		
	F3DA02-0N	F3DA04-1N	F3DA08-5N
No. of outputs	2	4	8
Resolution	12bit A/D		
Output signal range	-10 to 10VDC, 4-20mADC		-10 to 10VDC
Overall accuracy	0.2% of F.S. (23℃±2℃), 0.5% of F.S. (0-55℃)		
Conversion speed	2ms	4ms	
Others (output on CPU failure)	Hold outputs	Hold outputs or outputs specified value	

Analog Input Module F3AD04-0□, F3AD08-□V, F3AD08-□R
Analog Output Module F3DA02-0N, F3DA04-1N, F3DA08-5N

- Many models are available, including normal 12-bit and high resolution 16-bit models.
- Conversion speed options, ranging from 50μs to 200ms, are provided to suit different applications.
- Four or eight inputs can be read and scanned as they are switched by multiplexer. One D/A converter output is distributed to 2 or 4 output points by multiplexer, and the output for each output point is retained.
- Input filter and scaling processing functions allow processing of data into easily usable forms.



F3AD04-0V F3AD08-□V F3DA02-0N F3DA04-1N F3DA08-5N
F3AD04-0R F3AD08-□R

Four Built-in A/D Converters

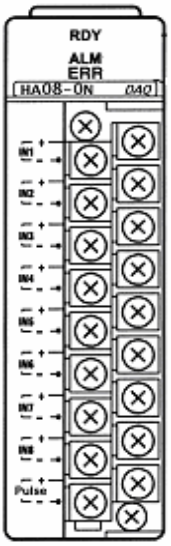
Capturing fast changing analog data at sampling period shorter than PLC cycle time
(Concurrent data acquisition for 4 channels)

Item	Specifications
Number of inputs	8 differential inputs
Input signal range*1	0 to 5 VDC (-0.25 to 5.25 VDC) -10 to 10 VDC (-11.0 to 11.0 VDC)
Isolation method	Isolated by photocouplers between input terminals and internal circuitry No isolation between input terminals
Input resistance	2M Ω
Resolution (12 bit ADC)	1.4 mV (for 0-5 V DC); 5.7 mV (for -10 to 10 V DC range)
Overall accuracy	23±2ºC: ±0.2% of F. S. 0-55ºC: ±0.5% of F. S.
Sampling period*2	50 µs min. when channels 1 to 4 are used. 500 µs min. when channels 1 to 8 are used.
Input buffer	24 K word
Scaling	Yes
Filter	Yes
A/D conversion	Activation by periodic timer or by external pacer input

* 1 Configurable independently for each channel by software.
* 2 Configurable on module basis. Valid data values depend on the number of channels used and whether filtering is used.

High-speed Data Acquisition Module (F3HA08-0N)

- This analog input module can acquire data from up to 8 input channels at high speed.
- 4 built-in A/D converters allow concurrent analog data acquisition for 4 channels with sampling period as short as 50 μ s (microseconds) – the fastest class in the PLC industry. It enables comparison and analysis of multiple data signals (pressure, voltage, etc.)
- Up to 24 K words of data may be accumulated in the buffer for each input channel. The module enables high-speed, high-density data acquisition over an extended duration, either at periodic intervals or driven by external triggers or triggers from the CPU.



F3HA08-0N

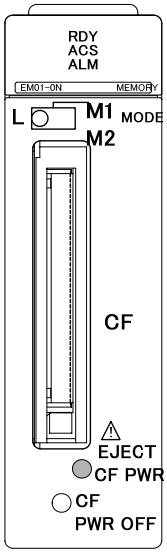
Maintenance Support without Programming

- Enables large volume of data to be used in various applications.
- Enables contents of CPU module devices to be saved as files to the memory card. Likewise, device data can be read from such files and be written to the CPU module.
- Allows easy access in Windows environment without need for any special software or hardware.

Item	Specifications
Memory media	Compact flash (Type1) (from SanDisk)
Media file system	FAT16 (supports long file names)
Number of media	1
Data types that can be stored	All devices in the CPU module, Ladder programs
Media insertion and removal	Online media insertion or removal is allowed
Functions	Reading from and writing to various devices using a ladder program, Maintenance function

Memory Card Module (F3EM01-0N)

- Commercially-available compact flash memory is adopted as media
  Compact flash is widely available in the market at competitive prices.
- Data exchange between PC and FA-M3R
  PC-compatible FAT16 file system is adopted so files saved to a memory card by FA-M3R is accessible by a PC.
  Conversely, files saved to a memory card by a PC is also accessible by FA-M3R.
- Maintenance mode
  In maintenance mode, programs and device data can be uploaded and downloaded without using any ladder program.
- Flexible system configuration
  Device data of multiple CPU modules can be written to or read from one memory card.
  Conversely, one CPU module can read from or write to multiple memory card modules.



F3EM01-0N

Four temperature control loops implemented by one compact FA-M3R module

Item		Specification	
		F3CU04-0S	F3CU04-1S
No. of loops		4 loops	
Isolation method		Between input terminals and internal circuit: Isolation by photocouplers and transformers Between input terminals: Independent circuits for different channels	
Input type		Universal input (individual inputs configurable separately by software or collectively by hardware): 15 thermocouples, 9 RTDs, 2 DC mV ranges, and 4 DC V ranges	
Input sampling cycle		100 ms for 2 channels or 200 ms for 4 channels	
Input impedance		1MΩ or more	
Allowable signal impedance		250Ω max. for thermocouple and DC mV, 100Ω max. for RTD (with same wire resistance), and 2 kΩ max. for DC V	
Burnout detection function		Yes	
Output type	Time proportioning PID (Open collector output)	Yes (ON/OFF control, forward/reverse)	
	Continuous PID (4-20 mA output)	No	Yes
Control section	Control function	ON/OFF, PID, heating/cooling, setting output, dynamic auto-tuning, and "Super"	
	Control cycle	Same as input sampling cycle	

Temperature Control/PID Modules (F3CU04-0S, F3CU04-1S)

- High-speed, High-Accuracy, High-Resolution
  Input sampling cycle is 100 ms for 2 loops or 200 ms for 4 loops.
  Input conversion accuracy is ±0.1% of F.S.
  Input resolution is 0.1ºC (5-digit display).
- Universal Input
  Thermocouple, RTD, DC mV and DC V
- Versatile Control Modes
  Supports single-loop, cascade, two-input changeover, heating/cooling output and continuous output control with output overshooting suppression function
- Simple Control using Dynamic Auto-tuning
  Simply setting the input type, output type and control set point is sufficient to start operation.
- ToolBox for Temperature Control and Monitoring Modules
  Can be used to set up operation parameters easily

F3CU04-0S F3CU04-1S

Temperature monitoring implemented with minimal cost

Item	Specification
	F3CX04-0N
No. of channels	4 channels
Isolation method	Between input terminals and internal circuit: Isolation by photocouplers and transformers Between input terminals: Independent circuits for different channels
Input type	Universal input (individual inputs configurable separately by software or collectively by hardware): 15 thermocouples, 9 RTDs, 2 DC mV ranges, and 4 DC V ranges
Input sampling cycle	100 ms for 2 channels or 200 ms for 4 channels
Input impedance	1MΩ or more
Allowable signal impedance	250 Ω max. for thermocouple and DC mV, 100Ω max. for RTD (with same wire resistance), and 2 kΩ max. for DC V
Burnout detection function	Yes

Temperature Monitoring Module (F3CX04-0N)

- High-speed, High-Accuracy, High-Resolution
  Input sampling cycle is 100 ms for 2 channels or 200 ms for 4 channels.
  Input conversion accuracy is ±0.1% of F.S
  Input resolution is 0.1ºC (5-digit display).

- Universal Input
  Thermocouple, RTD, DC mV and DC V

- Low channel unit cost

F3CX04-0N

Positioning Modules for Controlling Every Type of Motor

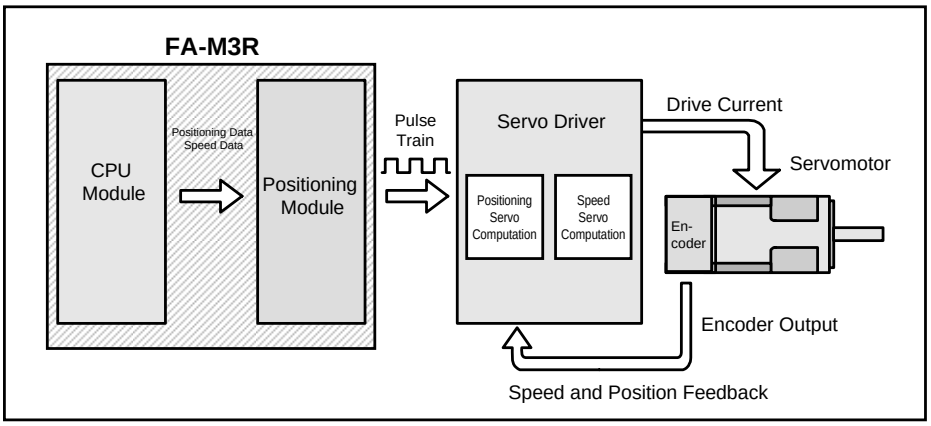
The IT M@chine Controller

Module	Features	Applicable Motor
F3YP14 F3YP18	● Open-loop control ● Controls up to 8 axes per module (up to 288 axes per system) - Fast response (0.09 ms startup time) • multi-axial linear interpolated positioning - Trapezoidal and S-shaped acceleration/deceleration	stepping motor Servomotor DD motor
F3NC32 F3NC34	● Open-loop control ● Fast, accurate positioning control - Output pulse rate of 5 Mpps for servomotor control or 1 Mpps for stepping motor control ● Rich positioning control functions - position control (PTP, CP and indexing), - speed control (switchover between speed-control and position-control) - interpolation modes (linear, circular, and helical interpolation) - operation modes (pattern operation using preset actions, direct operation by a ladder program) ● Built-in pulse counters and general purpose I/O contacts	
F3NC51 F3NC52	● Semi closed-loop control ● Good controllability - Fast response (6 ms startup time) - En-route action, control mode switching by an external trigger signal - Biaxial arc interpolation; trapezoidal acceleration/deceleration - Position control, speed control, switchover between position-control and speed-control	
F3DA□□	● Speed control in combination with an inverter	Induction motor

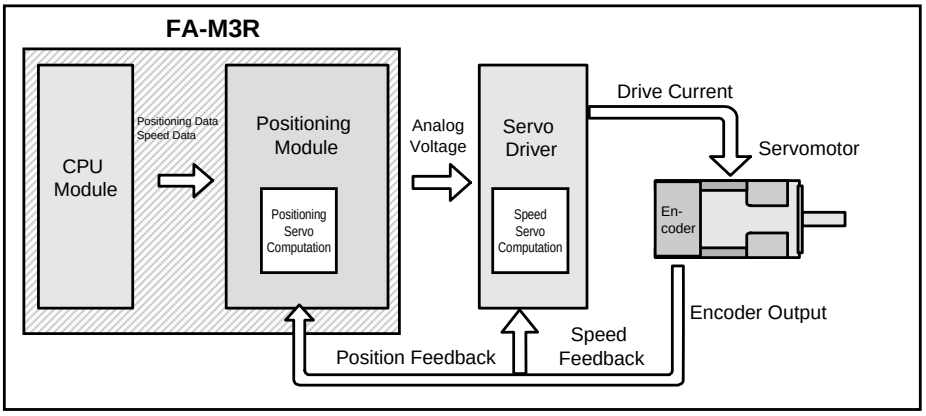
Network enabled

Module	Features	Applicable Motor
F3NC96	● Built-in MECHATROLINK-II network interface for open, high-speed motion control - Controls up to 15 axes per module - Network connection enables lower cost and reduced wiring - High baud rate of 10Mbps supports short cycle time of 1 ms per set of 8 axes	MECHATROLINK-Ⅱ compatibles

- Open-loop control (F3NC32-0N, F3NC34-0N, F3YP14-0N, F3YP18-0N)
  Based on reference data sent from a CPU module, the positioning module computes the positioning reference values and outputs them as pulse trains.

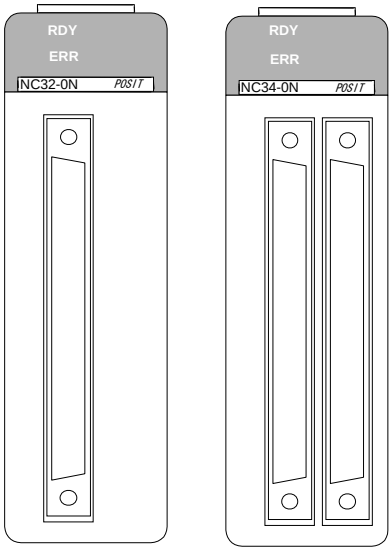


- Semi-closed-loop control (F3NC51-0N and F3NC52-0N)
  Based on reference data sent from a CPU module, the positioning module performs position servo computation based on position feedback signal input from the external position sensor, and outputs speed reference values as an analog voltage signal.



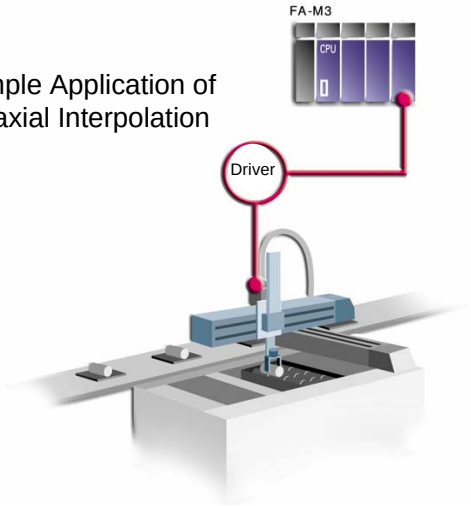
Positioning Modules with Pulse Output (F3NC32-0N, F3NC34-0N)

- For motor control on either 2 or 4 axes per module. High speed position reference pulse output at 5 Mpps max. for servo motor control and 1 Mpps max. for stepping motor control.
- High speed response of 0.15 ms per axis from activation to pulse output
- Position control (PTP control, CP control and indexing control),
- Speed control (switchover between speed-control and position-control)
- Available interpolation modes include linear interpolation, arc interpolation and helical interpolation.
- Supports pattern operation using preset actions and direct operation using a ladder program to specify target position and speed for each positioning action.
- A 5-Mpps pulse counter (supporting absolute encoders) is provided for each axis.
- 6 general inputs and 3 general outputs are provided for each control axis.



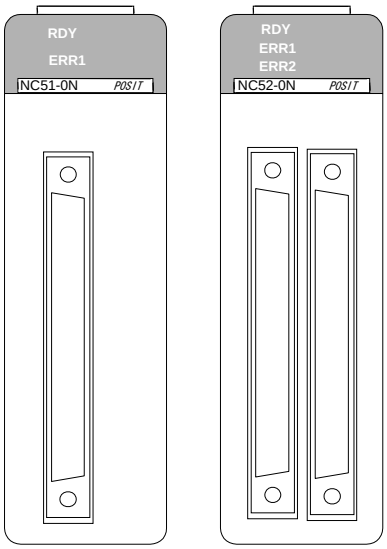
F3NC32-0N F3NC34-0N

Example Application of Multiaxial Interpolation



Positioning Modules with Analog Voltage Output (F3NC51-0N and F3NC52-0N)

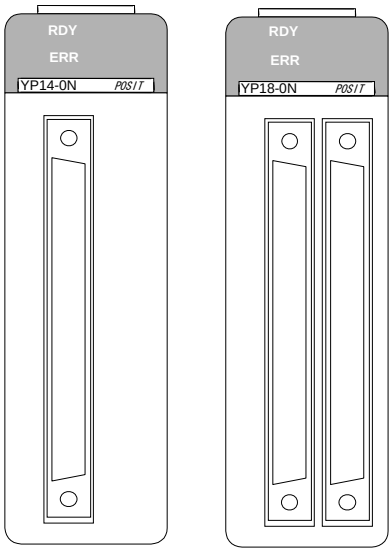
- For motor control on either 1 or 2 axes per module. Outputs speed reference values as analog voltages to servomotors and servo drivers based on feedback signal from an external position sensor (encoder).
- High speed response of 6 ms max. from activation to pulse output
- Suitable for various encoders:
  - Incremental encoders, including:
    General-purpose two-phase rotary encoders
  - Absolute encoders, including:
    Yaskawa Electric serial absolute encoder
    Sanyo Denki serial absolute encoders and their compatibles
- Motor control at a maximum speed of 2 Mpps in quad-speed mode
  - Can control a motor axis of 8000 pulses/rotation at 12000 rpm (equivalent to 1.6 Mpps).
- A variety of available functions include:
  - Switching between speed control and position control, target position changes, linear interpolation, arc interpolation and en-route movement
- Trapezoidal, two-line segment and three-step S-shaped drives are available in both acceleration and deceleration modes.
  - No mechanical shock to transported goods
  - No mechanical stress to machines



F3NC51-0N F3NC52-0N

Positioning Modules with Multi-channel Pulse Output (F3YP14-0N and F3YP18-0N)

- For motor control on either 4 or 8 axes per module. Best suited for position-reference servomotors and servo drivers as well as stepping motors and drivers.
- High speed response of 0.09 ms max. from activation to pulse output.
- Multiaxial linear interpolation is supported.
- Line-driver pulse outputs (RS-422A-compliant differential signals) at the output pulse rate of as high as 4Mpps for driving servomotors and 500 Kpps for driving stepping motors.
- An S-shape acceleration/deceleration speed control function allows a work piece to be transported smoothly with shorter acceleration and deceleration.



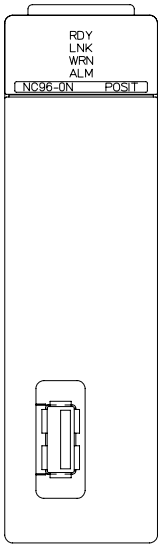
F3YP14-0N F3YP18-0N

Comparison of Positioning Modules

Item	F3NC32/F3NC34	F3NC51/F3NC52	F3YP14/F3YP18
No. of axes per module	2/4	1/2	4/8
Axes per system	32/64	36/72	144/288
Control method	Open-loop control	Closed-loop control	Open-loop control
Control output	RS-422A-compliant differential pulse output	-10 to 10 V DC	RS-422A-compliant differential pulse output
Control mode	Position control Speed control Position-speed control switching	Position control Speed control Position-speed control switching	Position control
Interpolation	Axis-by-axis independent interpolation Multiaxial linear interpolation Biaxial arc interpolation Helical interpolation (for F3NC34)	Axis-by-axis independent interpolation Multiaxial linear interpolation Biaxial arc interpolation	Axis-by-axis independent interpolation Multiaxial linear interpolation
Position reference	-2,147,483,648 to 2,147,483,648 pulses	-134,217,728 to 134,217,727 pulses	-2,147,483,648 to 2,147,483,648 pulses
Speed reference	1 to 5,000,000 pulses/s	0.1 to 2,000,000 pulses/s	0.1 to 3,998,000 pulses (for servomotor) 0.1 to 449,750 pulses/s (for stepping motor)
Functions	En-route action Change in target position during movement Change in specified speed during movement	En-route action Change in target position during movement Change in specified speed during movement Absolute and relative position designations Axis feed by manual pulser	Absolute and relative position designations
Acceleration and deceleration method	Automatic trapezoidal, Automatic S-shaped	Trapezoidal, two-line segment, S-shaped (three-line segment)	Trapezoidal, S-shaped
Acceleration and deceleration time	0 to 32,767 ms configurable independently for acceleration and deceleration	0 to 32,767 ms configurable independently for acceleration and deceleration	0 to 32,767 ms configurable independently for acceleration and deceleration

Positioning Module with MECHATROLINK-Ⅱ Interface (F3NC96-0N)

- One module can control up to 15 axes (motors)..
- Easy connection using connector. Enables lower cost and reduced wiring.
- High baud rate of 10 Mbps supports short cycle time of 1 ms per set of 8 axes or 2 ms per set of 15 axes and enables synchronization with peripheral equipment.



F3NC96-0N

Item		Specification
Interface		MECHATROLINK-II compliant
Transmission rate		10Mbps
Transmission bytes		32 bytes (including subcommands)
Cycle time/ no. of stations		1.0 ms for up to 8 axes, 2.0 ms for up to 15 axes (user selectable)
Network Topology		Bus (multi-drop)
Communications method		Master/slave synchronous
Transmission media		2-wire shielded twisted pair cable (proprietary cable)
Max. transmission distance		50 m (total length)
Min. distance between stations		0.5m
Positioning functions	Position reference	-2, 147, 483, 648 to 2, 147, 483, 647 (reference unit)
	Functions	- Linear interpolation movement (simultaneous starting and stopping) - Independent axis movement using MECHATROLINK-II commands (depends on connected equipment and supported MECHATROLINK-II commands)
	Others	- Reading statuses (target position, current position, etc.) of external equipment - Reading/writing parameters of external equipment
No. of installed modules		8 modules max. (120 axes max.)

ToolBox Software for Advanced Function Modules

The IT M@chine Controller

- Software tool lineup for tapping performance of advanced function modules with ease
  ToolBox for Temperature Control and Monitoring Modules (for F3CU04, F3CX04)
  ToolBox for Positioning Modules (for F3NC32, F3NC34)

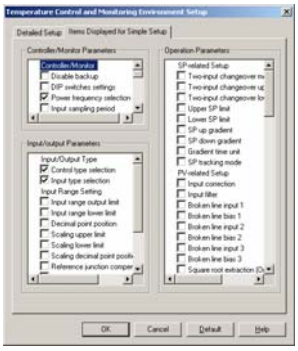
- Supports concurrent use with FA-M3R Programming Tool WideField2
- Supports network connection (via Internet) using Ethernet Interface Module (F3LE□□)
- FL-net connection via FL-net Interface Module（F3LX02) is also supported.
- Can be executed from common ToolBox environment (by selecting the required advanced function module from the ToolBox icon)

- Future support for other modules expected

ToolBox for Temperature Control and Monitoring Modules
Simple Setup Windows

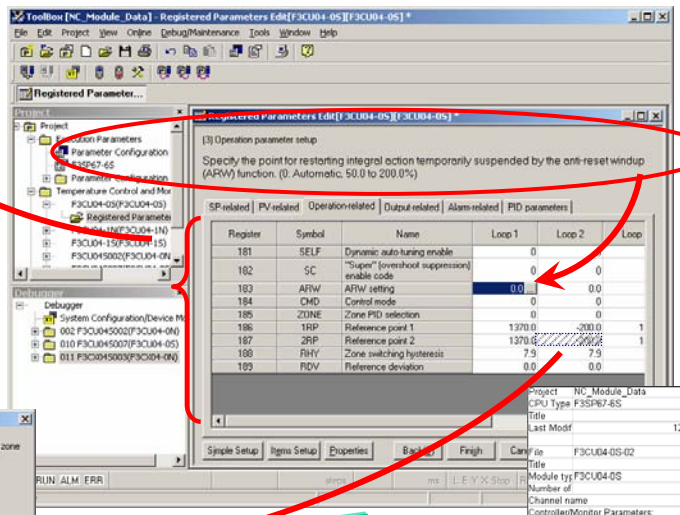
The IT M@chine Controller

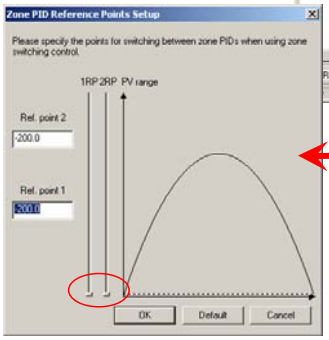
＜Environment setup window＞



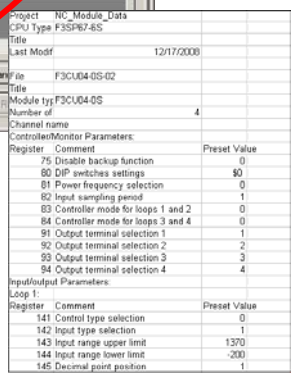
Window layout (including items displayed) for simple setup and detailed setup can be customized for a more friendly user interface.

＜Detailed setup window＞
For each parameter, help information on its definition and valid values are displayed to facilitate parameter input.





＜Input helper window＞
Help information is displayed. A displayed slider can be used to specify a value easily.



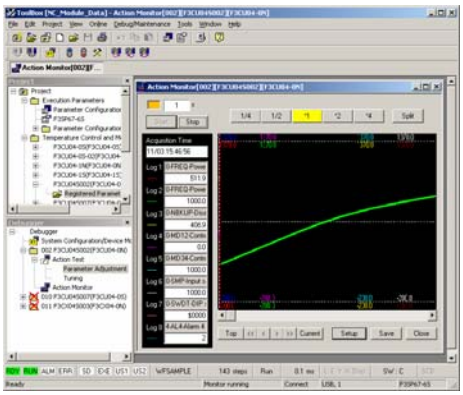
Parameter data can be exported to a CSV formatted file.

ToolBox for Temperature Control and Monitoring Modules (SF661-ECW)

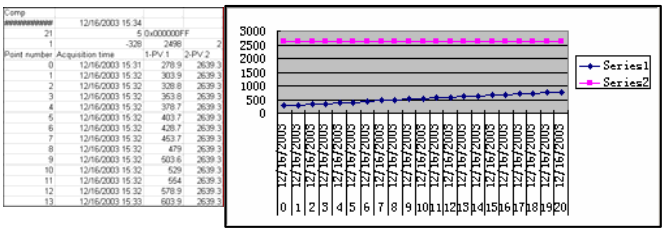
This software is a parameter setup tool for use with the FA-M3R Temperature Control and PID Modules and the Temperature Monitoring Module. It supports a range of functions from initial setup to action testing, and simplifies the tedious tuning process by enabling graphical display of monitored values.

■ Powerful debugging and data logging

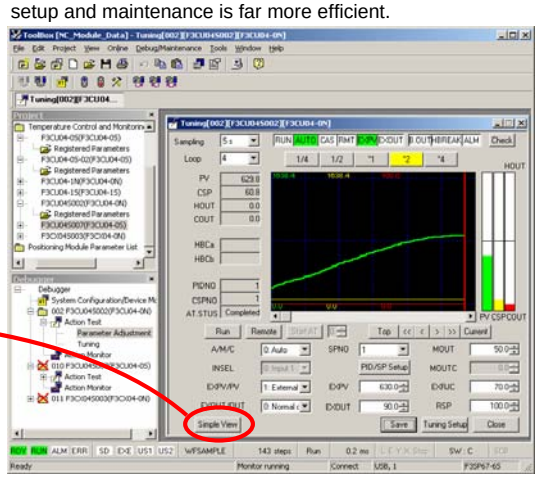
＜Action monitor window＞
Channel control status of a Temperature Control and PID module can be saved as log data to allow analysis of application characteristics from measured data.



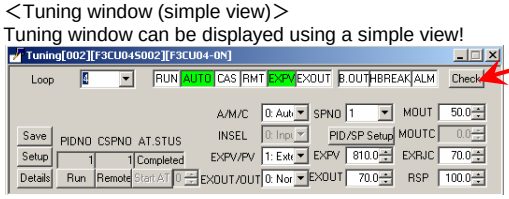
Data can be saved to CSV formatted file



＜Tuning window＞
Individual parameters can be fine tuned during operation. By opening the Turning window and the Action Monitor window concurrently, system setup and maintenance is far more efficient.



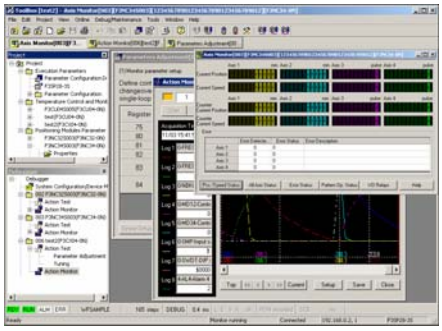
＜Tuning window (simple view)＞
Tuning window can be displayed using a simple view!



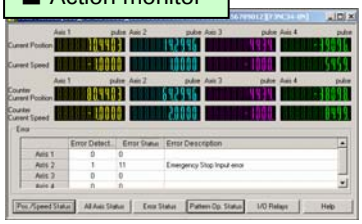
Improved Development Efficiency and Reusability

- <u>Integrated Development Environment for High Reusability</u>
  Management of advanced function modules by project
  Standard operation interface for different module types
  Temperature control and monitoring modules, etc.
  Allows concurrent editing and communication with WideField2

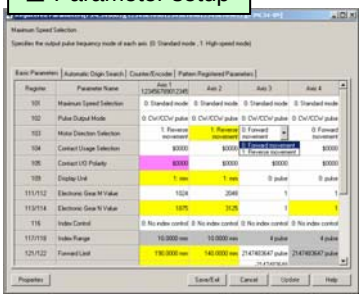
- <u>Full support from setup to maintenance</u>
  - Parameter configuration definition
  - Parameter setup
  - Action pattern setup
  - Position data setup
  - Action monitor
  - Action test
  - Teaching
  - Action pattern monitor
  - XY relay monitor (with comments)



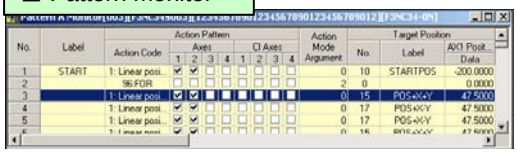
■ Action monitor



■ Parameter setup



■ Pattern monitor



ToolBox for Positioning Modules (SF662-ECW)

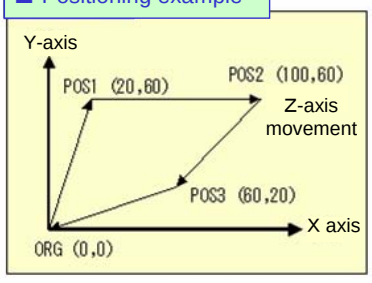
ToolBox for Positioning Modules is a Window-based software tool for configuring positioning modules with pulse output (F3NC32-0N and F3NC34-0N). It can be used to set up registered parameters, action pattern data and position data, as well as perform action test and monitoring.
With ToolBox, configuration and debugging of positioning modules becomes an easy job!

■ <u>Action pattern definition for higher development efficiency and reusability</u>

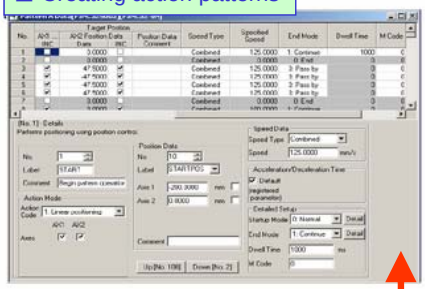
- Separate creation of action patterns and position data
  Action patterns can be created during design while position data can be created in the field by teaching
  - Only teaching of position data is required for the same machine model
  - Action pattern data and position data can be simply pasted from MS-Excel
- Creation of action patterns using position names
  Position data can be assigned meaningful names for easy maintenance
- Creation of action pattern for required movement
  Action pattern and position data for all 4 axes can be created.

- Only position data is modified in the field. Action pattern setup need not be repeated.
- Only position data modification is required for size customization of the same equipment.

■ Positioning example



■ Creating action patterns

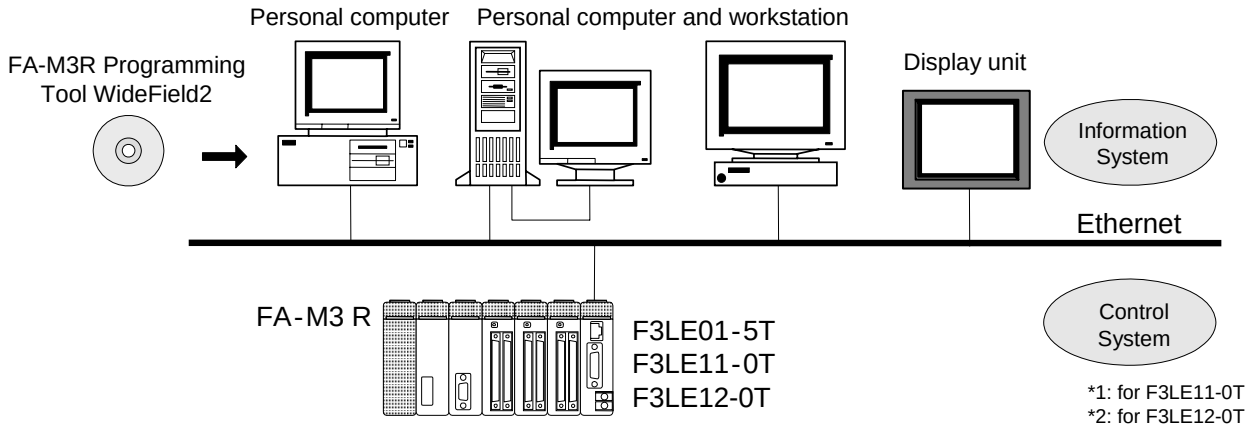


■ Creating position data

Created separately

Ethernet Interface Module

- Enables connection to IEEE802.3-compliant (10BASE5/10BASE-T/100BASE-TX) networks.
- Enables direct access to data of FA-M3R from a PC or a workstation and direct integration of the information and control systems.
- Enables remote maintenance by E-mail using SMTP/POP3 *1
- Enables user monitoring of CPU module statuses and automatic transmission of alarm E-mails when an equipment failure occurs *1
- Enables E-mails to be transmitted from a ladder program *1
- Enables exchange of messages with other nodes via UDP/IP using sockets *2

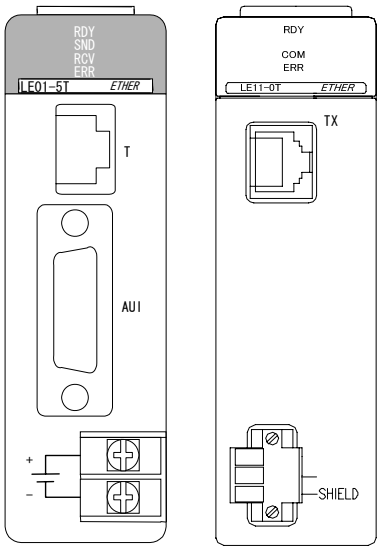


*1: for F3LE11-0T
*2: for F3LE12-0T

Ethernet Interface Modules (F3LE01-5T, F3LE11-0T, F3LE12-0T)

This module enables connection to IEEE802.3-compliant (10BASE5/10BASE-T /100BASE-TX) networks.
It performs equivalent functions to the Personal Computer Link Module (n:n) but via Ethernet instead of serial communication.
F3LE11-0T also supports remote maintenance by E-mail via SMTP/POP3.

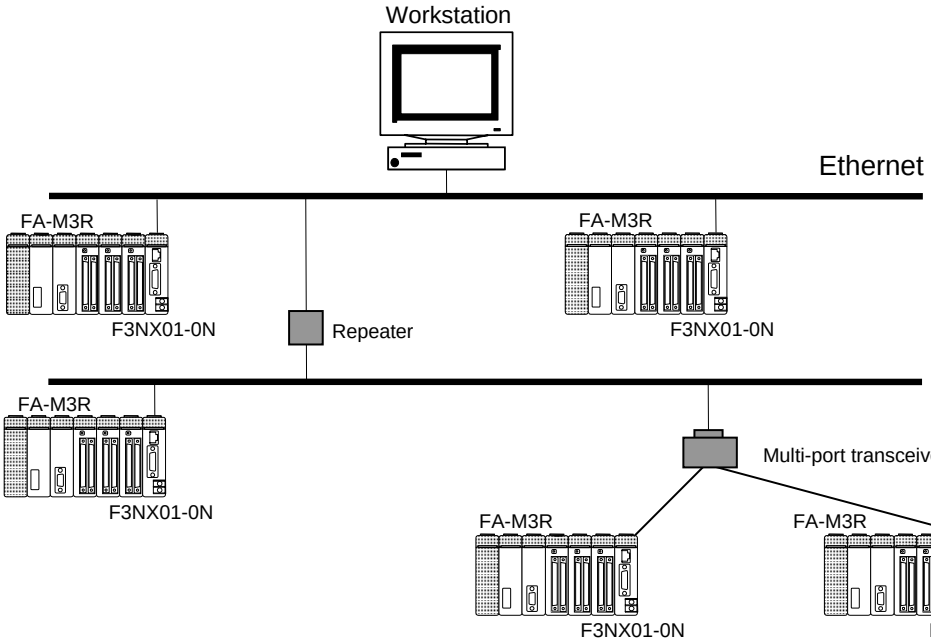
- Remote programming
  Enables a user to create and maintain programs from a computer on the same network using FA-M Programming Tool WideField2.
- E-mail
  Enables a user to transmit device data of a sequence CPU by E-mail, upload/download programs and perform sampling trace remotely.
  (for F3LE11-0T)
- 100Mbps support
  Supports 100BASE-TX for fast transmission over a network.
  Automatically switches between 10 Mbps and 100 Mbps.
  (for F3LE11-0T, F3LE12-0T)
- Personal computer link
  Enables a user to monitor or write to devices of a sequence CPU from another network node, and upload, download, start, or stop a program remotely.



F3LE01-5T F3LE11-0T F3LE12-0T

Note: 10Base-T requires no external power supply.
When a 10Base5 network is used and the connected Ethernet equipment requires power to be supplied to its AUI connector, a 12 V DC power supply must be connected to the Ethernet module.

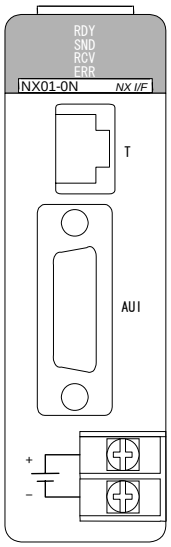
Interface module for connection to Autonomous Distributed *1 Systems (NeXUS).



*1: Autonomous Distribution" is registered trademark of Hitachi Ltd.

NX Interface Module (F3NX01-0N)

- This module supports the Autonomous Distribution protocol for data exchange between FA-M3Rs, as well as connection to PCs, FA computers and other NeXUS-compatible external devices.
- Each node transmits data to the data field to which it belongs by multicast communication via Ethernet; Other nodes in the same data field can select to receive this data autonomously. There is no need for identification of or synchronization with communication counterparts.
- By using alive signals, status of individual equipment, as well as status of programs and hardware in equipment can be autonomously collected. Fault information can also be added to alive signals.

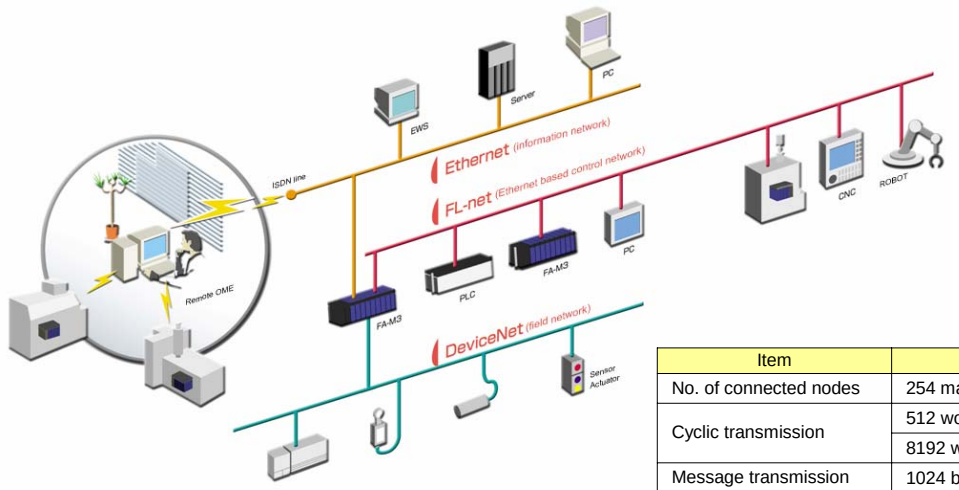


F3NX01-0N

Autonomous Decentralized System (ADS) is a vendor-independent, open FA network system which has been standardized and verified through a demonstration project by universities, users and vendors under the lead of the Manufacturing Science and Technology Center (MSTC) of Japan (an extra-governmental organization of MITI) and the Japan FA Open Promotion Group (JOP). As part of ADS, its network specification has been established as ADS-net.
The ADS-net is expected to be widely accepted in the future as an international standard network specification initiated by Japan.

FL-net (OPCN-2) Interface Module

This module supports an open, vendor-independent network for connecting FA machines.
The FL-net, which sits between an information network and field network,
is intended for high-speed data exchange between FA controllers.
It allows a user to easily build a multi-vendor system.



FA-M3R Programming Tool WideField2

In addition to RS-232-C and Ethernet connection, connection using FL-net protocol is added (in R3 and later versions) to enable application development and maintenance from a PC within an FL-net network.

Item	Specifications
No. of connected nodes	254 max.
Cyclic transmission	512 words in area 1
	8192 words in area 2
Message transmission	1024 bytes max.
No. of installed modules	2 max. (modules cannot be installed in a sub-unit)
Transmission rate	10Mbps
Topology	Bus
Transmission distance	500m max. (2.5 km when using repeaters)
Transmission media	Compliant to IEEE802.3

FL-net (OPCN-2) Interface Module (F3LX02-1N)

OPCN-2 Ver.2.00

FL-net (OPCN-2) is a vendor-independent, open FA network standard defined by the Manufacturing Science and Technology Center (MSTC) of Japan for data exchange between control instruments.

The module allows up to 254 nodes (one module is counted as one node) to be connected.

F3LX02-1N

- The built-in proprietary RRR technology* enables short delivery time (between PLC applications) of 12 ms for 8 nodes and 2048 points (2048bits+2048 words), which is about 4 times the speed of data transfer using conventional high-speed PLC networks.
- Up to 2 modules can be installed in an FA-M3R main unit, allowing for multi-layer data linking.
- The number of link points (8192 max. per module) can be configured independently for each module.
- Good expandability as it is based on standard Ethernet protocol
- Supports both cyclic transmission (data acquisition from each node at regular intervals) and message transfer (event notification).
- Guarantees data transfer within a given time frame by managing and controlling communication media access by individual nodes on the network.

*: The RRR technology, short for Rapid Refresh and Reflection, thanks to fast data processing within the module and fast data exchange between the interface module and the CPU module, reduces the time taken for ladder application programs to recognize transferred data (delivery time) between PLCs (FA-M3R).

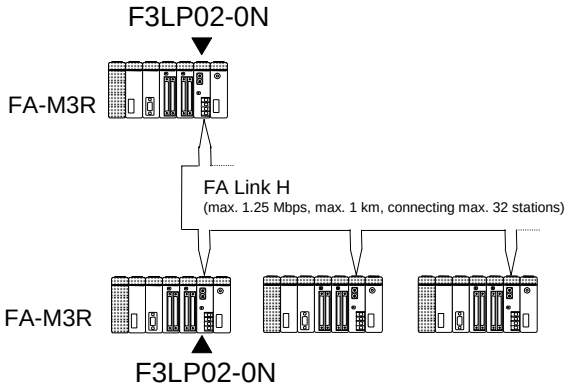
High-speed data transmission between FA-M3R controllers for data sharing

F3LP02-0N

Item	Specification
Link relays	Up to 8192 (up to 2048 per link)
Link registers	Up to 8192 (up to 2048 per link)
Transmission speed	Max. 1.25 Mbps (selectable from 125 Kbps,250 Kbps,625 Kbps and 1.25 Mbps).
Maximum transmission distance	1 km, 500 m, 200 m or 100 m depending on the transmission speed (see the table below).
Transmission media	Shielded twisted-pair cable

Transmission Speed vs. Transmission Distance

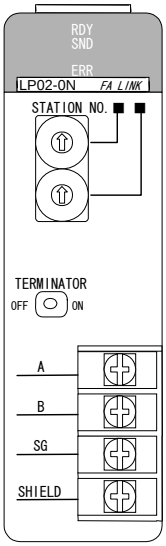
Transmission speed	125 Kbps	250 Kbps	625 Kbps	1.25 Mbps
Maximum transmission distance	1 km	500 m	250 m	100 m



FA Link H Module (F3LP02-0N)

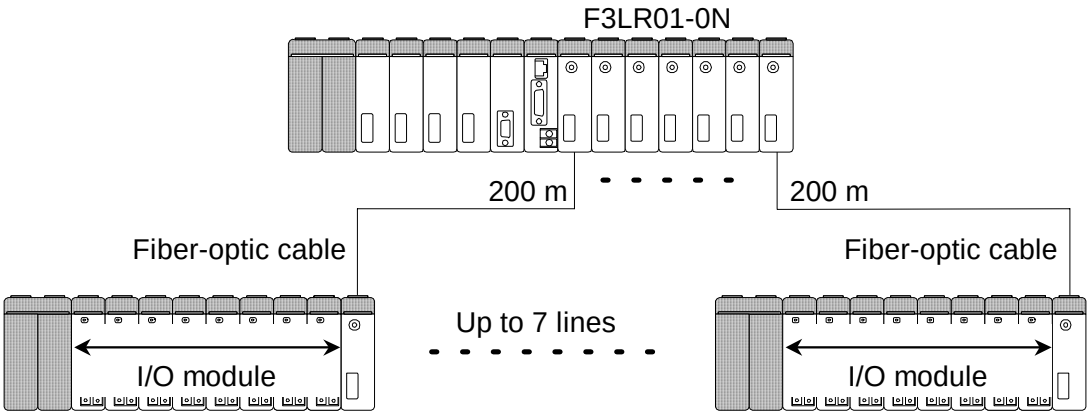
FA link H is a high-speed network for data exchange between FA-M3R controllers. Up to 32 stations, where one station corresponds to one FA link H module, can be linked together for data sharing.

- Up to 8 FA link H modules can be installed in an FA-M3R main unit (for the SP28, SP38, SP53, SP58, SP59, SP66 and SP67; up to 2 modules for the SP21) to allow data links to be structured hierarchically.
- The numbers of link devices can be set arbitrarily for each CPU.
- There are two operation modes for each FA link H: normal mode and high-speed mode. In the normal mode, up to 2048 link relays and 2048 link registers can be used per module. In the high-speed mode, up to 1024 link relays and 1024 link registers can be used per module.
- The transmission speed can be selected from 125 Kbps, 250 Kbps, 625 Kbps and 1.25 Mbps. The transmission speed setting determines the maximum transmission distance as 1 km, 500 m, 250 m and 100 m, respectively.
- The bus-like multi-drop network topology facilitates expansion of the link.
- Modules can be easily connected to each other with shielded twist-pair cables.



F3LP02-0N

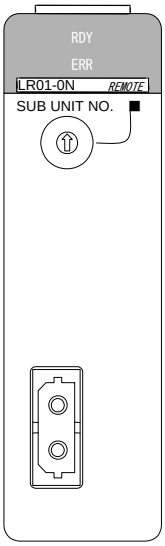
- The fiber-optic FA-bus module enables data to be sent at high-speed of 10 Mbps. Modules in subunits can be handled like those in the main unit without affecting the scan time. (Data refresh rate: 1 ms for 1024 devices)
- No transmission delay by direct access to I/O devices
- Not just digital I/O modules but almost all FA-M3R I/O modules including analog I/O, temperature control modules and pulse input modules can be handled.
- Up to 7 fiber-optic FA-bus modules (for up to 7 subunits) can be installed in main unit for the maximum number of I/O points allowed for the CPU module used.



Fiber-optic FA-bus Module (F3LR01-0N)

The fiber-optic FA-bus module is an interface module used for configuring a fiber-optic FA-bus system to perform distributed control. To build an efficient remote I/O system, simply install fiber-optic FA-bus modules in an FA-M3R main unit and in subunits, and connect them with fiber-optic FA-bus cables.

- Many advanced modules can be installed in subunits, and be accessed in the same way as the modules in the main unit. (The FA link, FA link H, fiber-optic FA link H and Ethernet interface modules are exceptions.)
- No specific configuration settings are required for remote I/O.
- Fiber-optic data transmission provides high noise tolerance.

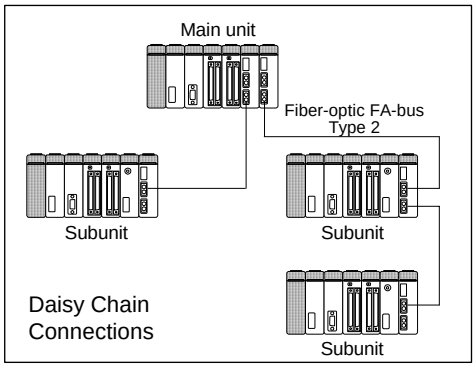


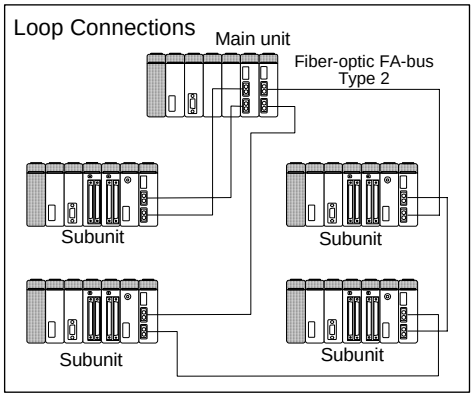
F3LR01-0N

Multi-station remote I/O system with high-speed transmission over a long distance

F3LR02-0N

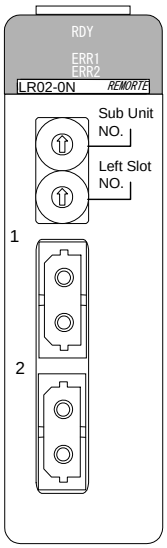
Item	Specification
Transmission speed	10 Mbps
Transmission media	Two-core fiber optic cable
Transmission distance	Between stations : 500 m Total extension : 1.4 km
Maximum number of subunits	56 (32 per line)
Network topology	Daisy chain or loop





Fiber-optic FA-bus Type 2 Module (F3LR02-0N)

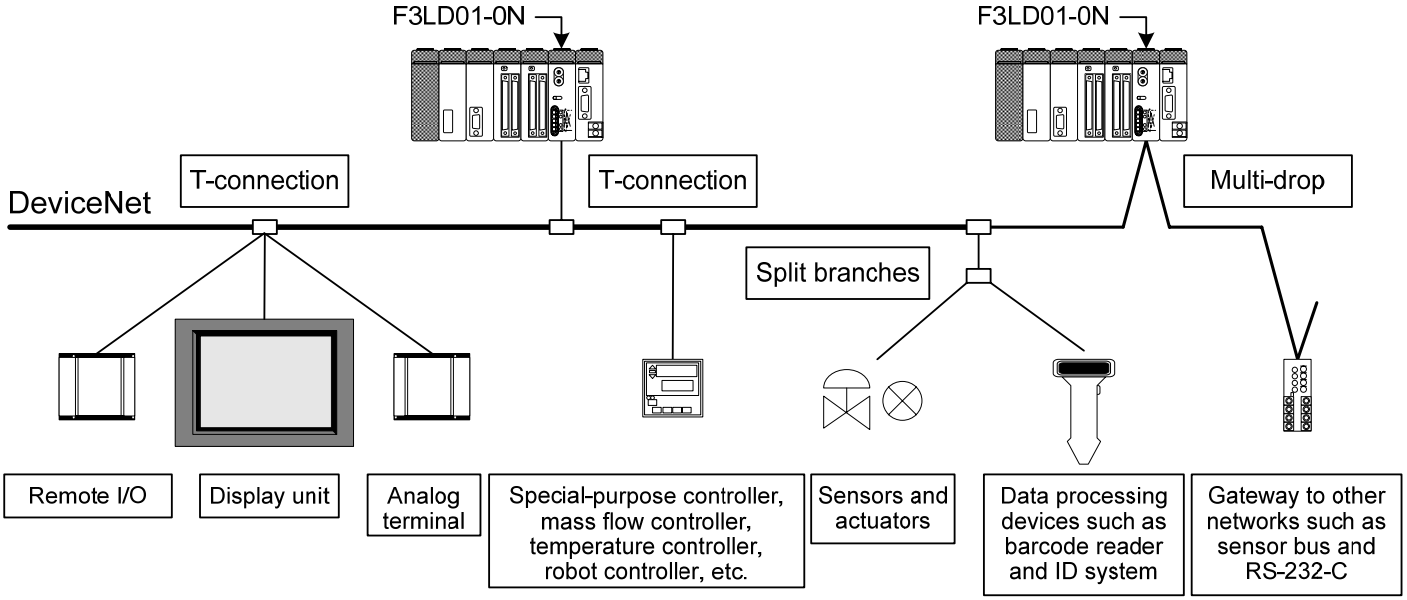
The fiber-optic FA-bus type 2 module is an interface module used for configuring a system with highly-distributed I/O units. To build an efficient, highly distributed remote I/O system, simply install fiber-optic FA-bus type 2 modules in an FA-M3R main unit and in subunits, and connect them with fiber-optic FA-bus cables.



F3LR02-0N

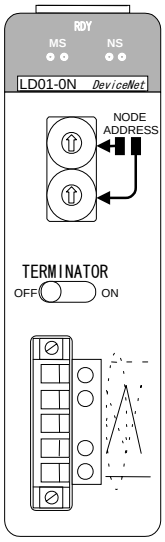
- Many advanced modules can be installed in subunits, and be accessed in the same way as the modules in the main unit. (The FA link, FA link H, fiber-optic FA link H and Ethernet interface modules are exceptions.)
- A subunit can be distributed to up to 8 subunits.
- Each module has 2 pairs of transmission and reception ports to allow daisy chain connections.
- If the network is configured by loop connections, it is automatically switched into two daisy chain networks when there is a line breakage, thus enhancing reliability.
- No specific configuration settings are required for remote I/O.
- Fiber-optic data transmission provides high noise tolerance.
- For point-to-point connections, lower-priced F3LR01-0N fiber-optic FA-bus modules may be used instead.

De Facto Standard, Reduced-cabling System



DeviceNet* Interface Module (F3LD01-0N)

This module is a master interface module compliant to DeviceNet,* an international open field network standard.

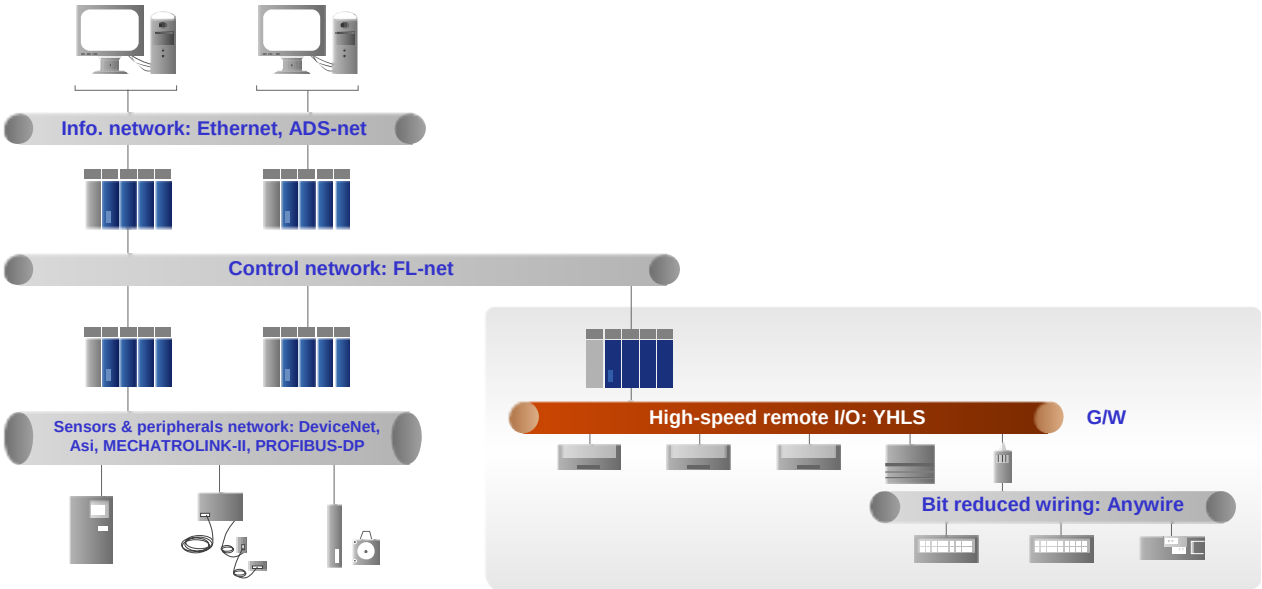


F3LD01-0N

- World-standard open field network
  - Field-proven worldwide
  - Connectable to various devices sold around the world
- Adopted as the standard sensor bus by SEMI **
  - Ideal for semiconductor manufacturing equipment
- Flexible connections
  - Multi-drop connection with T-connectors allows flexible cabling and network expansion and modification.
- Various applications supported
  - Extension distance: Max. 500 m (when using a thick cable with a transmission speed of 125 kbps)
  - Transmission speed: Max. 500 kbps (with cable extension distance of 100 m or less)
  - Number of devices connected: Up to 64 (including the master device)
- Extensive transmission data
  - Up to 8000 inputs and 8000 outputs, a total of up to 16,000 input/output points (1000 words)

* DeviceNet is a registered trademark of Open DeviceNet Vendor Association.
** Acronym of Semiconductor Equipment and Materials International

High-speed remote I/O providing flexibility for development, production and maintenance



YHLS Master Module – F3LH01-1N, F3LH02-1N

F3LH01-1N F3LH02-1N

- Fast
  - Up to 12 Mbps. Scans 63 slave units in just 0.96 ms in full-duplex mode.
  - High-speed scan of 243 ms per 256 I/O points
- Compact
  - Slave unit size is halved (32-point slave the same size as competitors' 16-point slave.)
- Reliable
  - Guaranteed constant scan time (not affected by noise and online connection/disconnection of slave units)
  - Protected against short-circuit of I/O power supply of slave. (Error is reported to master)
  - Protected against short-circuit of output terminals of slave unit.
- Maintainable
  - Both power and communication connectors of slave support insertion/removal of live wires.
  - Allows online replacement of slave units.
  - Supports maintenance of individual sensors (I/O is equipped with individual power and ground signals and supports e-CON like wiring.)
  - Both master module and slave units have communications quality indicators.
- Open
  - Allows connection of third-party HLS devices.
  - Adopts "HLS" open protocol, allowing user development of proprietary slave units.

YHLS Slave Units - TAH Series

Model	Suffix Code	Description
TAHWD32	-3PAM	16 DC inputs (positive common), 24 V DC, MIL
		16 TR outputs (sink-type, with short-circuit protection), 24 V DC 0.1 A, MIL
	-3NBM	16 DC inputs (negative common), 24 V DC, MIL
		16 TR outputs (source-type, with short-circuit protection), 24 V DC 0.1 A, MIL
TAHXD16	-3PEM	16 DC inputs (positive common), 24 V DC, MIL
	-3NEM	16 DC inputs (negative common), 24 V DC, MIL
TAHYD16	-3EAM	16 TR outputs (sink-type, with short-circuit protection), 24 V DC 0.1 A, MIL
	-3EBM	16 TR outputs (source-type, with short-circuit protection), 24 V DC 0.1 A, MIL

Applications of Personal Computer Link Interface

The personal computer link:

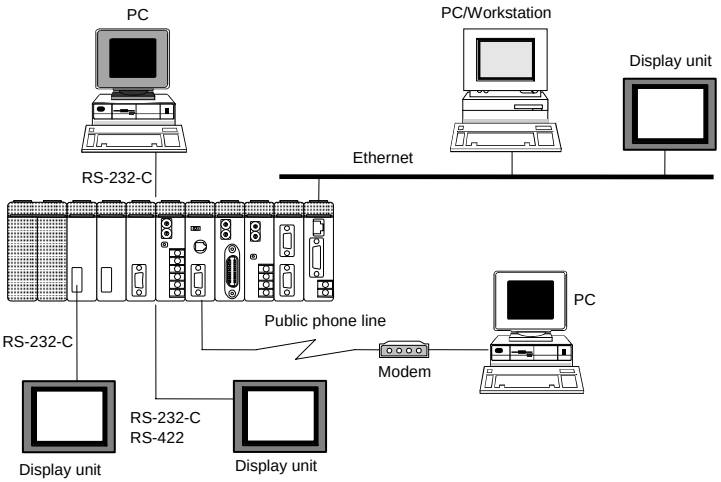
(1) Is a communication link which is dedicated for the FA-M3R and allows device data within sequence CPUs to be read or written from other equipment (PCs, display units, etc.) without intervention of a sequence program, and also allows a sequence program to notify events.

(2) Allows selection of network hardware specification from RS-232-C, RS-422, Ethernet and public phone line as required.

(3) Allows use of display units from various manufacturers that support the FA-M3R-specific personal computer link protocol.

Communication Specification	Module Name
RS-232C	F3LC11-1F
	F3LC12-1F
	F3SP□□-□□*1
RS-422/485	F3LC11-2F
Ethernet	F3LE01-5T
	F3LE11-0T
	F3LE12-0T
GP-IB	F3GB01-0N

* The PROGRAMMER port on the CPU module is used.
(for F3SP08/21/28/38/53/58/59)

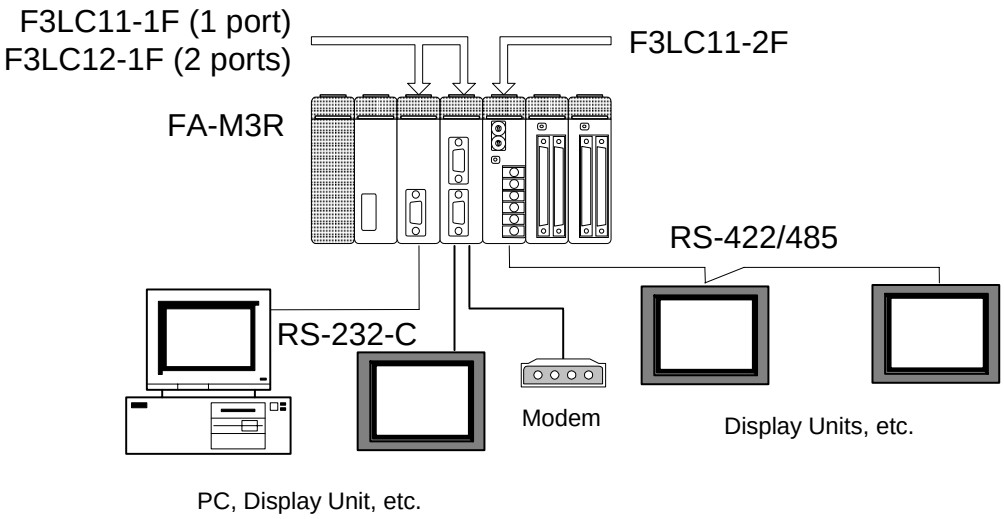


Modules that support personal computer link commands:

- Personal computer link module (F3LC11-□F, F3LC12-1F)
- Sequence CPU module (F3SP□□-□□)
- Ethernet interface module (F3LE01-5T, F3LE11-0T, F3LE12-0T)
- GP-IB interface module (F3GB01-0N) when running in slave mode.
- Differences in personal computer link between Ethernet interface module and other modules:
  All modules support ASCII-coded commands and responses, but only the Ethernet interface module supports binary-coded commands and responses. Note that the Ethernet interface module uses different header and termination codes in ASCII mode from those of other modules.

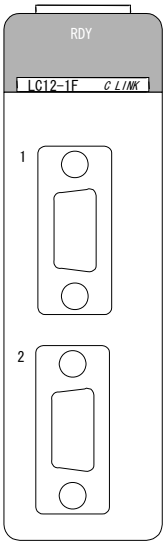
A personal computer link module provides the FA-M3R with the personal computer link feature via RS-232-C or RS-422/485.

The built-in communications protocol allows connections to be made to other equipment that supports the same protocol without requiring any program, and facilitates system configuration. A personal computer link module is typically used to connect display units.

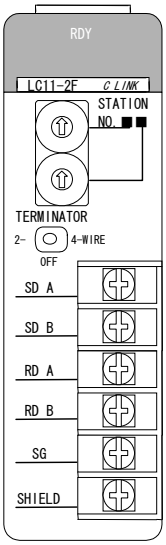


Personal Computer Link Modules (F3LC11-1F, F3LC11-2F and F3LC12-1F)

- Read/Write all devices in sequence CPU modules
- Read/Write common variables in the BASIC CPU module
- User program for data transmission is not needed. Devices can be read or written even if no ladder program is running.
- Direct connection to a display unit having a programmable controller interface
- Run/Stop a sequence CPU module remotely
- Load/Save a sequence program
- Read sequence program information such as program names, program size and block names, as well as error logs and user logs
- An external modem can be optionally attached for use of PHS or mobile phone in locations with no 56 Kbps high-speed communication or telephone line. *1
- Both ports can be used concurrently as personal computer links. *2



F3LC11-1F (1 port)
F3LC12-1F (2 ports)
For RS-232-C



F3LC11-2F
For RS-422/485

*1: For F3LC11-1F and F3LC12-1F only

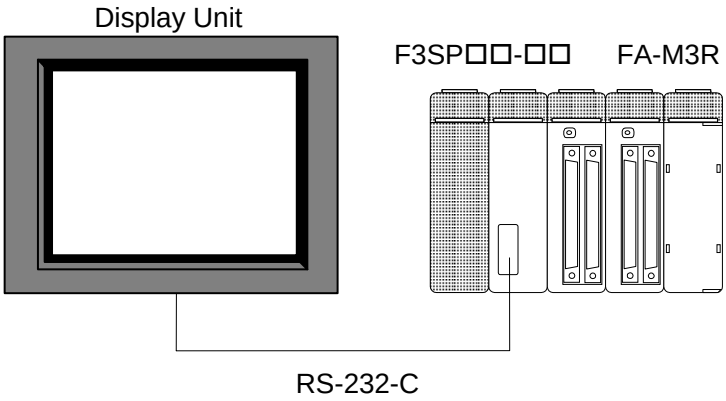
*2: For F3LC12-1F only

Personal Computer Link via PROGRAMMER Port

The IT M@chine Controller

A personal computer or display unit can be connected to the PROGRAMMER port of a sequence CPU module, providing an instant and low-cost personal computer link.

Supports high-speed display units of up to 115 Kbps



The same commands used for personal computer link modules are used with the sequence CPU modules.

Note: The following cables are available for connection from Yokogawa.

Model:	KM11-2T
Specification:	D-sub 9-pin female; approx. 3 meters long
Model :	KM10C-0C
Specification :	D-sub 9-pin female; approx. 0.5 meter long

Note: For details, see the General Specifications, FA-M3 CPU Port Cables (GS 34M6C91-01E).

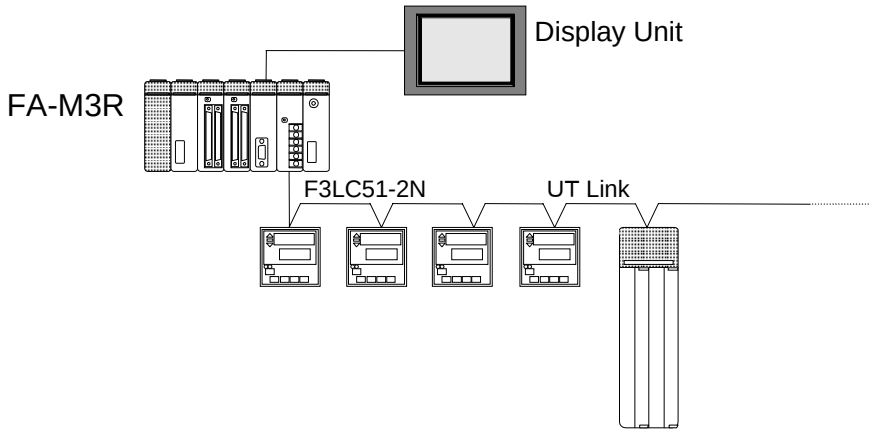
Easy Monitoring and Setting of UT Series Temperature Controllers

Features:

(1) Data access from ladder programs with transparent communications.
Data can be acquired with just a READ instruction.

(2) Up to a total of 31 UT100 series temperature controllers, GREEN series digital indicating controllers, POWERCERT power monitors, JUXTA FV V3 series signal conditioners from Yokogawa can be connected.

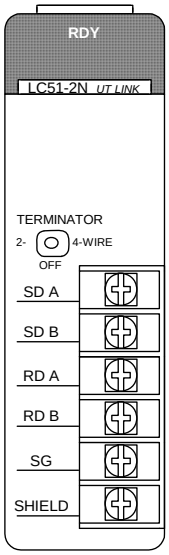
(3) Field data from the above instruments can be acquired and stored to data registers via hardware connections only, thus allowing field data to be accessed by accessing the data registers.



UT Link Module (F3LC51-2N)

The UT link module achieves simple connections between an FA-M3R controller and external instruments, such as temperature controllers, that support the protocol and commands of the personal computer link.

- The module continuously refreshes the data of the linked external instruments. Without need for a user program for communication, data exchange with external instruments is performed simply by accessing the registers of the module. Data access can also be performed upon occurrence of a specified event.
- A total of up to 31 external instruments can be connected per UT link module over the maximum cable extension of 1200 m (for RS-485).



F3LC51-2N

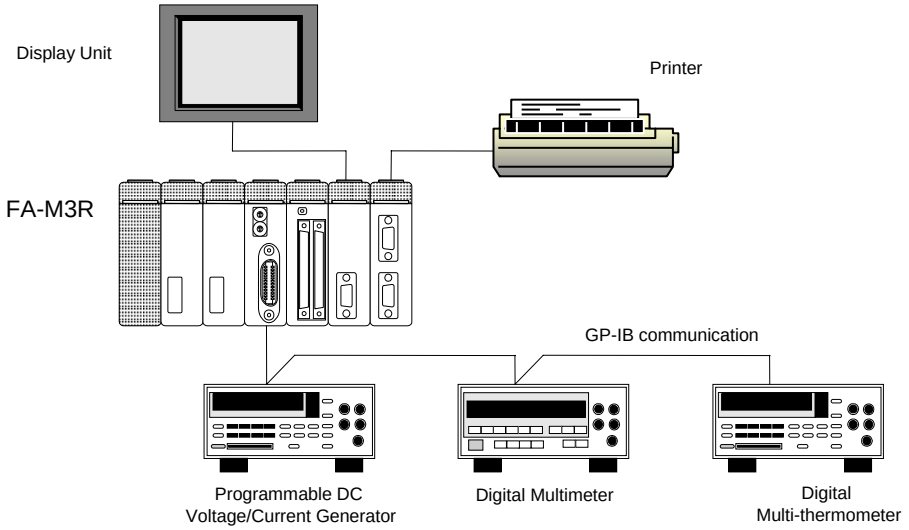
External instruments from Yokogawa that can be connected:
- Temperature controllers UT100 series（UT130, UT150, UT152/UT155）
- Digital indicating controllers GREEN series
（UT320, UT350, UT420, UT450, UT520, UT550, UT750, US1000, UP350, UP550, UP750, UM330, UM350, UT2400, UT2800）
- Power monitor POWERCERT (PR488)
- Signal conditioners JUXTA JV V3 series（VJU7, VJH7, VJA7, VJS7, VJP8, VJQ8, VJQ7, VJX7）

Note: For details on the above external instruments, contact Yokogawa IA Business Headquarter Product Center.

GP-IB Communication Module

High-speed Communication with Testing and Measuring Instruments, as Well as Various Signal Generators

- Accessible from ladder and BASIC programs
- Enables arbitrary waveform generators, digital multimeters, LCR meters, etc. to be connected, their signal generation conditions to be set, and the measured data to be read easily via GP-IB, thus reducing the lead time of testing and inspections.

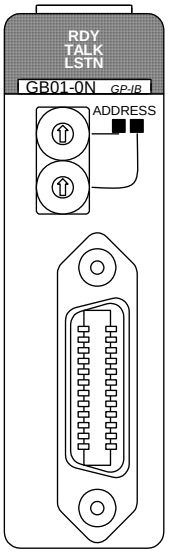


GP-IB Communication Module (F3GB01-0N)

The GP-IB communication module connects the FA-M3R to instruments having a GP-IB interface, such as testing and measuring instruments.

- Has one GP-IB port.
- Supports GP-IB controller functions for transmission of interface messages.

Note: Conforms to ANSI/IEEE standard 488.



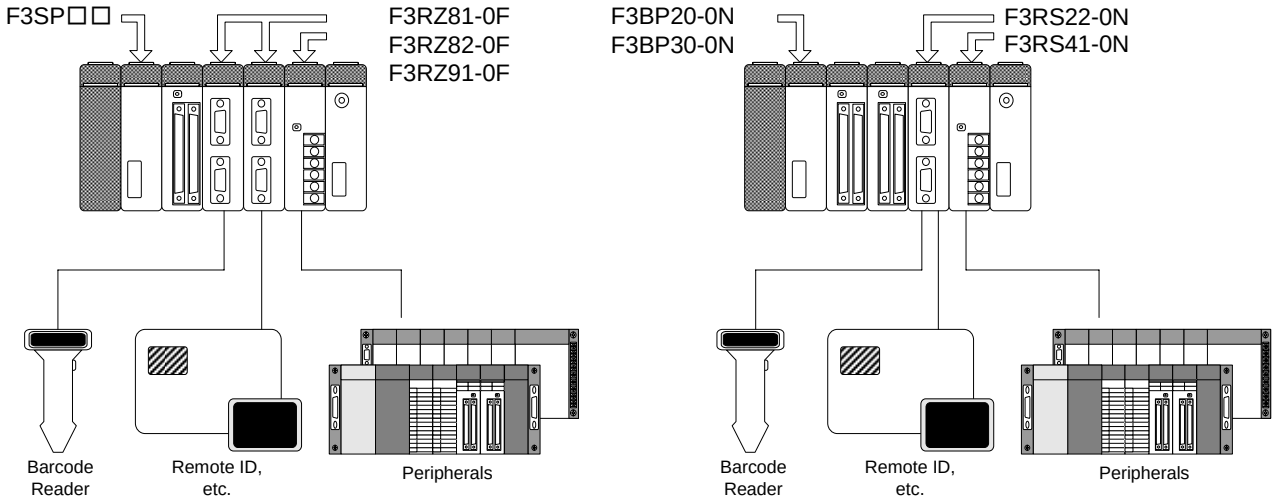
F3GB01-0N

RS-232-C and RS-422/485 Communication Modules (1)

Access from Ladder and BASIC Programs to Field Instruments via RS-232-C or RS-422/485 Interface

Sequence CPU Module — Ladder sequence + ladder communication

BASIC CPU Module — BASIC program + serial communication

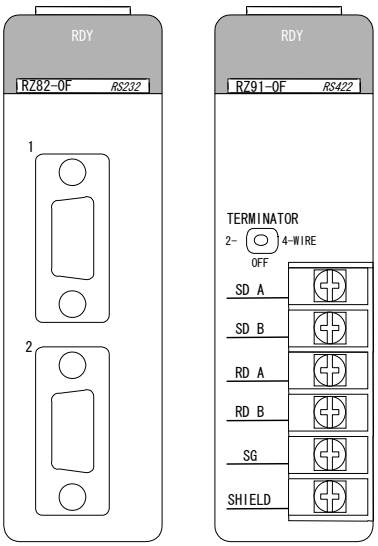


Ladder Sequence + Ladder Communication
RS-232-C Communication Module (F3RZ81-0F, F3RZ82-0F)

- The module is used to perform RS-232-C communication from a ladder program in a sequence CPU module.
- The F3RZ81-0F has one RS-232-C port while the F3RZ82-0F has two RS-232-C ports with a D-sub 9-pin connector and allows maximum transmission distance of 15 meters.

RS-422 Communication Module (F3RZ91-0F)

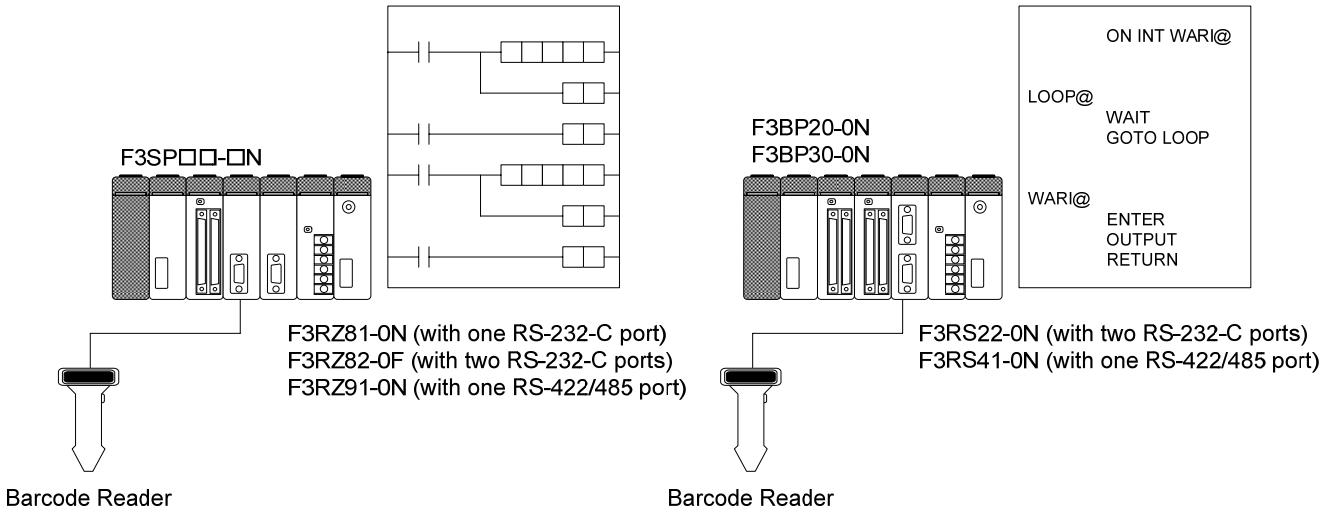
- The module is used to carry out RS-422 or RS-485 communication from a ladder program in a sequence CPU module.
- The module uses a terminal block for connection and allows maximum transmission distance of 1200 meters.



F3RZ81-0F F3RZ91-0F
F3RZ82-0F

■ Accessing from a Ladder Sequence Program by Combination of a Sequence CPU Module and a Ladder Communication Module

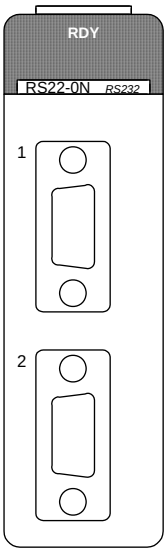
■ Accessing from a BASIC Program by Combination of a BASIC CPU Module and a Serial Communication Module



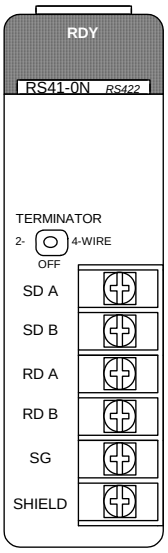
BASIC Program + Serial Communication
RS-232-C Communication Module (F3RS22-0N)

- The F3RS22-0N module is used to carry out RS-232-C communication from a BASIC program running on a BASIC CPU module.
- The module has two RS-232-C ports with D-sub 9-pin connectors and allows the maximum transmission distance of 15 meters.
- BASIC statements for transmission and reception to/from communication lines are provided.

Note: This module is dedicated for use with a BASIC CPU module.



F3RS22-0N



F3RS41-0N

RS-422 Communication Module (F3RS41-0N)

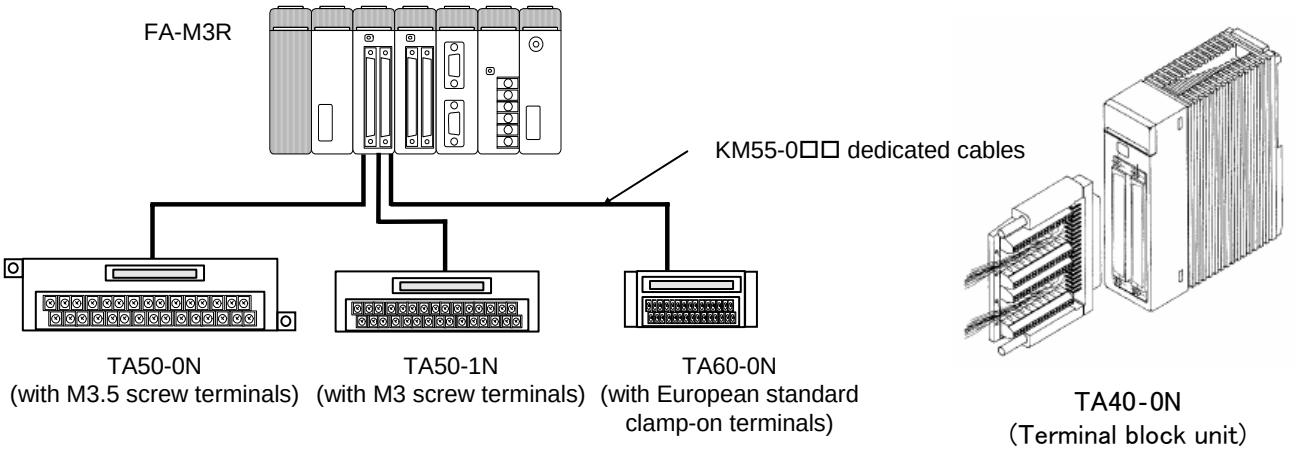
- The F3RS41-0N module is used to carry out RS-422 or RS-485 communication from a BASIC program running on a BASIC CPU module.
- The module uses a terminal block for connection and allows maximum transmission distance of 1200 meters.
- BASIC statements for data transmission and reception to/from the communication lines are provided.

Note: This module is dedicated for use with a BASIC CPU module.

Terminal Block Units

The FA-M3R offers terminal blocks and dedicated connector cables.

The FA-M3R employs market standard connectors for its 32- and 64-point I/O modules, so a wide selection of cables and terminal blocks from other vendors can be used.



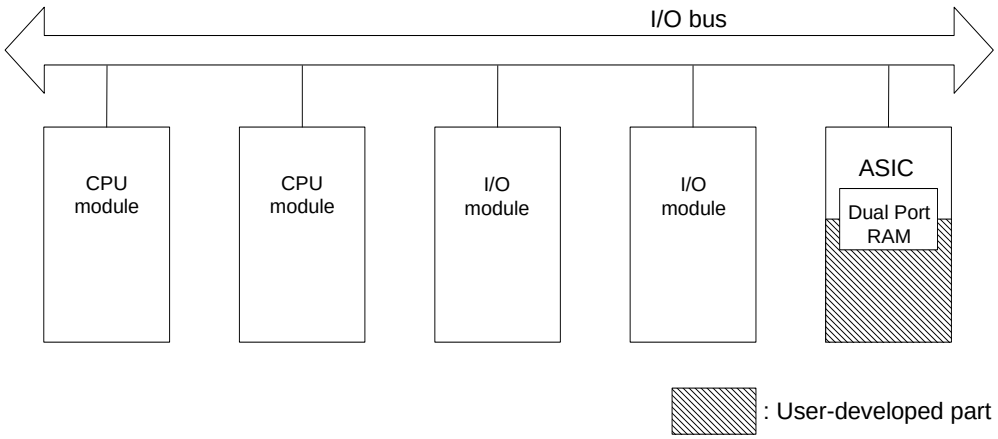
Terminal Block Units	TA40-0N
Connector Terminal Blocks	TA50-0N, TA50-1N, TA60-0N
Dedicated Cables	KM55-0□□

FA-M3R I/O Open Concept Allows FA-M3R -Compatible User I/O Modules

The IT M@chine Controller

Open design rules
enable implementation of customer know-how as FA-M3R user I/O modules

- User-developed I/O module reduces system size.
- Complex data transfer between the CPU and I/O modules is handled by ASIC interface, which only requires data to be written into the Dual Port RAM.
- Yokogawa supplies ASIC and module casing with cost.



FA-M3R I/O Open Concept

- The FA-M3R I/O Open concept allows a user to develop a value-added PC board for incorporation as an FA-M3R user I/O module, while letting FA-M3R handle the other general control tasks, thus concentrating precious financial and manpower resources on value creation without worrying about parts obsolescence, extensive man-hours for quality enhancements and other issues involved in the development of a machine controller.
- Seamless system integration
  An FA-M3R user I/O module forms a part of the FA-M3R system and thus enjoys enhanced functionality and easy connectivity to higher-level equipment or other FA-M3R systems.
- Flexibility
  An FA-M3R user I/O module allows flexible system configuration.
- Low cost
  An FA-M3R user I/O module eliminates the need of a separate external controller, thus reducing system size, software development effort and system cost.
- YOKOGAWA-supplied parts
  YOKOGAWA supplies ASIC and FA-M3R module casing so to create an FA-M3R user module, a user only needs to design and develop a PC board.

*: Using YOKOGAWA's smart interface module (F3DR01-0N[*1]) with built-in dual port RAM interface, a user simply includes a dual port RAM in his instrument to convert it into an FA-M3R-compatible user I/O module. For details on the smart interface module, contact your YOKOGAWA representative.

*1: special order item.

Reduced Wiring System

- Distributed I/O to required locations
- Reduced wiring cost
- No communication program needed

Method	Features	Distance /No. of nodes	Transmission cable	I/O Types	Recommended usage
Fiber-optic FA bus system	Ultra-high speed, Diverse I/O	200m, 7 stations	Dedicated fiber-optic cable	FA-M3R (D/IO, A/IO, pulse, temperature control)	Transmission within panel
Fiber-optic FA bus 2 system	Ultra-high speed, Diverse I/O	500m, 56 stations*1	Dedicated fiber-optic cable	FA-M3R (D/IO, A/IO, pulse, temperature control)	Transmission within panel
DeviceNet	High-speed	500m, 64 nodes	5-wire dedicated cable	D/IO, various instruments, sensors, actuators	Reduced wiring within panel or factory
Uni-wire system	High-speed	200m, 20 stations	4-wire cabtire cable	Uni-wire (D/IO, manifold)	Reduced wiring within panel
Vity Liner	Long-distance with many nodes	2km, 128 stations	Twist-pair cable	D/IO, A/IO	Transmission within factory
SAVE NET	High-speed	500m, 63 stations	Twist-pair cable	D/IO, A/IO	Reduced wiring within panel or equipment

*1: For Fiber-optic FA bus 2, max. distance between stations is 500 m and max. total distance is 1.4 km, 32 stations per system

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