

# FA-M3V V I T E S S E <sup>TM</sup>

## Leading Edge Controller



[www.yokogawa.com/itc/](http://www.yokogawa.com/itc/)

## INTRODUCTION

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Clip art: BB-WAVE

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# Sequence CPU Module New Products Introduction

## FA-M3 CPU Product History (positioning of new series)

- Since its debut in 1992, the FA-M3 CPU has been the industry leader in PLC concepts.
- In 2010, we launch a new CPU series after 4 years of R&D!

2010

### New FA-M3 series!

#### F3SP71, 76

- Program size 260K steps max.
- Min. scan time 100µs
- Basic instructions from 3.75 ns
- 64-bit integer arithmetic
- Double-precision floating point
- Object ladder
- Multi-CPU
- Network functions
- 100Mb Ethernet
- Enhanced security
- SDHC (32GB)

Let's Network!  
(with network support)

#### F3SP66, 67

- Program size 120 K steps max.
- Min. scan time 200µs
- Basic instructions from 17.5 ns
- Object ladder
- Multi-CPU
- Network functions
- 100Mb Ethernet
- SD memory (1GB)

2001  
Equipment changes with IT  
**the IT Machine Controller**



1999  
FA-M3R series  
From evolution to revolution



AT-compatible CPU

BASIC CPU

1992  
Debut of FA-M3!



#### SP10, 20, 30

- Program size 20 K steps max.
- Basic instructions from 90 ns
- Structured ladder
- Multi-CPU

#### SP21, 25, 35

- Program size 100 K steps max.
- Basic instructions from 90 ns
- Structured ladder
- Multi-CPU

#### SP28, 38, 53, 58, 59

- Program size 256 K steps max.
- Basic instructions from 17.5 ns
- Object ladder
- Multi-CPU



100Kstep/1ms

10Kstep/1ms 20Kstep/1ms

'92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10

## Leading-edge controller The new FA-M3 “V” series!



\* The “V” in FA-M3V stands for “vitesse,” which means speed in French.

The FA-M3 is designed and best known for its speed.  
It's only natural that the new series be named “Vitesse”,  
which means speed in French.

## FA-M3V's Design Concept

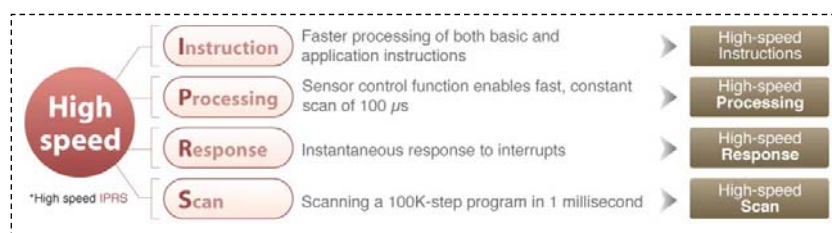
### Stretching the High Speed IPRS design concept

From day one, FA-M3 has relentlessly pursued higher speeds as the most effective means to solving customer challenges.

Over time, this has evolved into the High Speed IPRS (Instruction, Processing, Response and Scan) design concept.

The new FA-M3V series offers extensibility and reliability at incredible speed.

It's the leading edge controller for customers who demand the world's best.



Leading Edge Controller



## ❖ Creating the Leading Edge Controller

### ❖ The controller is powered by two core speed technologies

FA-M3V's two core technologies add stable control at the highest speed to customer systems.

#### – FA-M3 “Vitesse Engine” for ladder processing · · · Supreme processing capability

- Fastest in the industry! \* **100K-steps in 1 ms.** \* As of Nov 2010
- Basic instructions: **3.75 ns min.**
- Application instructions : **7.5ns min.**
- Floating-point Add instruction: **37.5 ns**
- Minimum scan time: **100 μs** (Resolution: **10μs** when using SCB)

New R&D result:  
Vitesse Engine for ladder processing

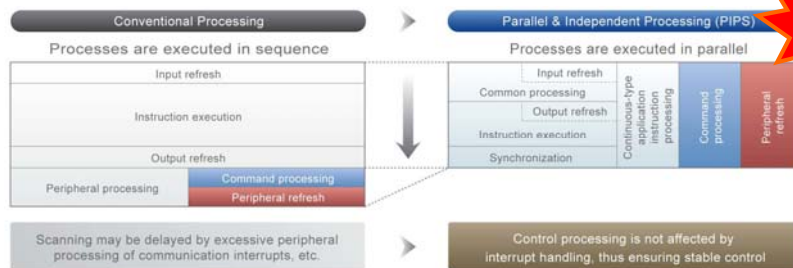


**Fastest  
in the  
industry!**

#### – New control method (PIPS) · · · fast, stable control for achieving high quality production

##### Parallel & Independent Processing System

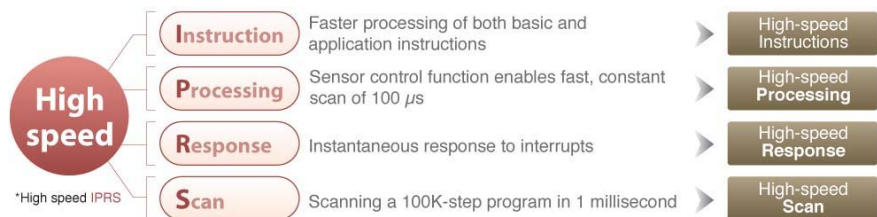
Ladder instruction processing and peripheral processing are carried out independently and in parallel. This ensures fast, stable control under all conditions.



**Achieving  
fast, stable  
control!**

## ❖ Quadruple Speed Quest

### ❖ Quadruple speed quest based on High-speed IPRS design concept



#### ◆ High-speed Instructions

- Basic instructions: **3.75ns~** Application instructions: **7.5ns~**
- Floating-point Add instruction: **37.5ns**

#### ◆ High-speed Processing

- Sensor control function allows constant scan at **100us~**
- **10μs** resolution when using sensor control block (SCB)

#### ◆ High-speed Response

- Instantaneous response to interrupts of **85μs**

#### ◆ High-speed Scan

- Fastest in the industry! **100Ksteps/1ms** scan time

**4.6x faster!**  
Basic instructions: 17.5ns→3.75ns

**2x shorter! 10x better!**  
Scan time: 200μs→100μs  
Resolution: 100μs→10μs

**1.2x faster!**  
Interrupt response: 100μs→85μs

**5x faster!**  
20K steps→100K steps

## FA-M3V solves development process problems with speed

From CPU model selection all-the-way to maintenance, the FA-M3V promises stress-free development by enabling development according to design and reducing development effort from ladder program design to engineering.



To improve development efficiency, program reuse and programming ease are important. Coding complex arithmetic expressions in ladder programs is a pain!

Computational load increases along with quality control and recipe data. With existing PLCs, processing is prolonged so device fails to operate as expected.

Using password to protect software assets affects operability.



I want to choose a CPU without worrying about processing speed, memory size and cost. Picking the right CPU from so many product models is tough!

Processing is sometimes delayed by data accesses from PCs, etc. I need stable operation under all circumstances!

System upgrade requires a larger program but memory is insufficient and processing is slower.

FA-M3V offers a **stress-free** solution

## Truly Range-free Controllers

The FA-M3 family is consolidated into two new CPU models of 60K-step and 260K-step program size to deliver best performance in the industry with incredible cost-performance ratio!

– Sequence CPU modules (with network functions)

• **F3SP71-4S NEW**

60K ladder steps, basic instruction 3.75 ns min., built-in network functions

• **F3SP76-7S NEW**

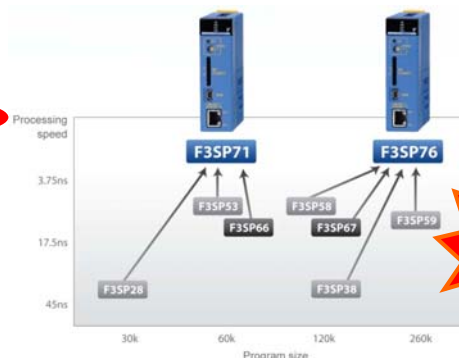
260K ladder steps, basic instruction 3.75 ns min., built-in network functions



\* Use F3SP71 and F3SP76 CPUs with FA-M3 Programming Tool WideField3 (SF630-MCW) R1.01 or a later version

| Item                                            | Specifications                              |                                 |
|-------------------------------------------------|---------------------------------------------|---------------------------------|
|                                                 | F3SP71                                      | F3SP76                          |
| Control mode                                    | Stored program, repetitive operation        |                                 |
| I/O control mode                                | Refreshing method / direct I/O instructions |                                 |
| Programming language                            | Object ladder language                      |                                 |
| Number of instructions                          | Basic                                       | 40 types                        |
|                                                 | Application                                 | 445 types                       |
| Processing speed                                | Basic                                       | 0.00375 $\mu$ s per instruction |
|                                                 | Application                                 | 0.0075 $\mu$ s per instruction  |
| Program size                                    | 60K steps                                   | 260K steps                      |
| Project size                                    | 120K steps max.                             | 520K steps max.                 |
| Number of inputs/outputs (including remote I/O) | 4096 points max.                            | 8192 points max.                |
|                                                 | Internal relay                              | 16384 points (16K)              |
| Device size                                     | Data register                               | 65535 points (64K)              |
|                                                 | File register                               | 65535 points (64K)              |
|                                                 | Cache register                              | 32768 points (32K)              |
|                                                 | Cache register                              | 524288 points (512K)            |
| Communication ports                             | USB2.0 (12 Mbps), Ethernet                  |                                 |
| Memory card slot                                | SD memory card (SDHC compatible)            |                                 |

3 basic & 56 application instructions added



Model selection is easy!

### ❖ Built-in Ethernet network support

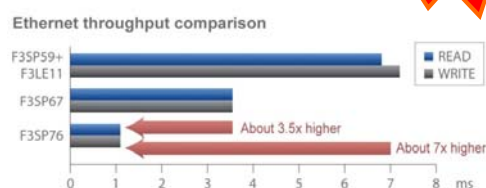
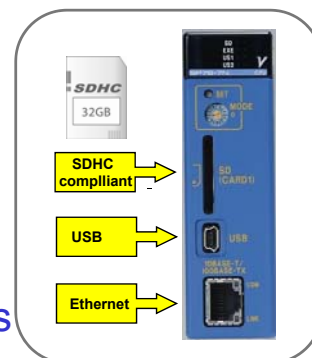
The FA-M3V has built-in network support, which enables fast, stable communication, just like the F3SP6□. In addition to space and cost savings, it enables networking without affecting control processing.

### ❖ Enhanced integration with higher-level systems

Fast communication response is achieved without compromising stable control.

Scaling up for large production data is simple.

- Much higher Ethernet throughput
- Easy storage of large data
  - Large memory and SD memory card (SDHC compliant 32 GB max.)
  - Cache registers (1 MB max.)
    - F3SP71: 0.25 MB (128K words)
    - F3SP76: 1 MB (512K words)
- Modbus/TCP Slave (server) function



## ❖ Network Functions (Handling of Large Data)

### ❖ Large production data can be stored in the CPU.

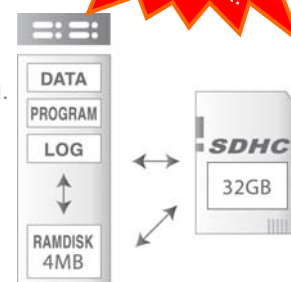
The FA-M3V comes standard with an SD memory card slot and a RAM disk for storing large data required for ever faster and more advanced devices.

#### – Built-in SD memory card slot

- **Up to 32 GB** SDHC memory cards are supported for storing data, programs and log records as files.
- Compatible with off-the-shelf SD memory cards
- Redundancy of the file control area (FAT) reduces risk of file system damage due to power outage or card removal during writing.

#### – Built-in RAM disk

- **4 MB RAM** disk included for storing data and log records as temporary files (volatile memory)



- Accumulating routine data
- Saving error log
- Saving reliable raw field data even when the network is down.

## Network Functions (Handling of Large Data)

### FTP client and server functions

Stored data can be transferred between CPU and host PC or server.

#### – FTP client functions

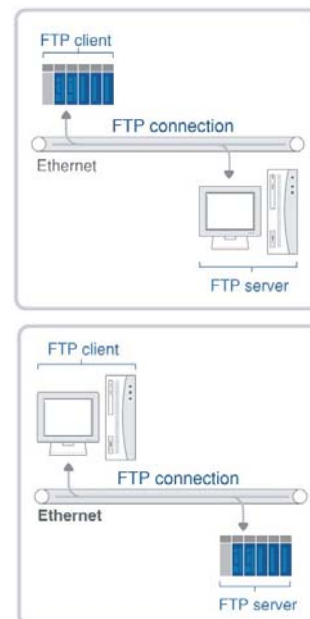
Stored data can be transferred from CPU to host PC or server autonomously and collectively with no need of programming.  
Reduces load on the production line or control system network.  
Large data can be sent or received in one go.

#### – FTP server functions

Easy FTP connection from the host PC by software or from a command line. Virtual directory allows program, data and log files to be loaded or saved using simple file operations.

#### – FTP server access and response log

FTP server accesses and responses are logged for convenience of debugging and access management



## Network Functions (“PC-less” Maintenance)

### Card batch file function

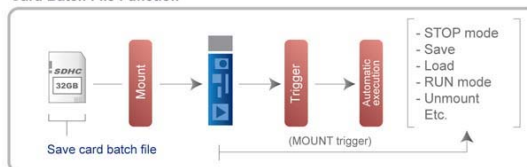
#### “PC-less” maintenance using SD memory card

- Batch commands coded in auto-execute files stored on a SD memory card can be automatically executed in response to various execution triggers (e.g. card insertion or error events, etc.)
- Routine operations such as recipe loading or log acquisition for troubleshooting can be executed automatically simply by inserting an SD memory card.

List of execution triggers

| Execution triggers                                                           |
|------------------------------------------------------------------------------|
| Startup (power on or system reset)                                           |
| Run program event                                                            |
| Stop program event                                                           |
| Mount memory card event                                                      |
| Error                                                                        |
| Alarm                                                                        |
| FTP (receipt of virtual memory command or card batch file execution command) |

Card Batch File Function



### Rotary switch functions

#### Maintenance using rotary switch with no need of PC (WideField3)

- Maintenance such as program loading, log file retrieval can be performed simply by turning a rotary switch (MODE switch) and pressing a push button (SET switch) located on the front panel of the module.

Easy maintenance without need of CPU and being on-site!

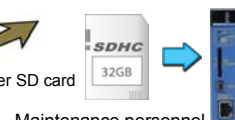
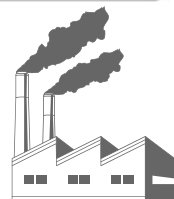


Device developer  
• Save settings (including programs) on SD card

Send content of SD card by Email



Courier SD card



Maintenance personnel  
• Insert SD card  
• Set rotary switch  
• Power on

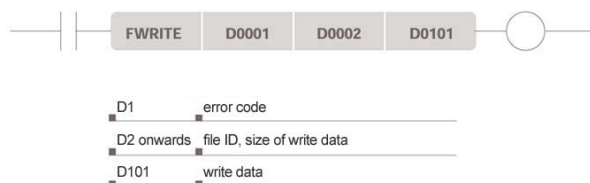
## Network Functions (Easy Network & File Access)

### Network & file processing instructions

Handle large data easily by executing dedicated ladder instructions.

- Socket (TCP/IP, UDP/IP) communications instructions
- FTP client instructions
- File access instructions
- File operation instructions
- Disk operation instructions

Example: FWRITE (file block write) instruction



### Continuous-type application instructions

Time-consuming processing does not affect control processing

- ▶▶▶ Instruction is executed when input condition is TRUE.  
Actual processing is done in background without affecting control.



- ▶▶▶ When instruction execution is completed, the output turns ON.  
You can check the error code stored in device D1.

## Network Functions (Easy Network & File Access)

### Constant definition (header file)

Data creation: creation of transmission text and file data made easy

- Constant names can be defined with assigned values separately from programs, and then coded in programs (like tag names).
- Strings, numerical values and contiguous binary data can be defined as constants

[Example] Constant definition

| Constant name | Value             |
|---------------|-------------------|
| #TEXT1        | 01010WRDD00001,01 |

Program Code



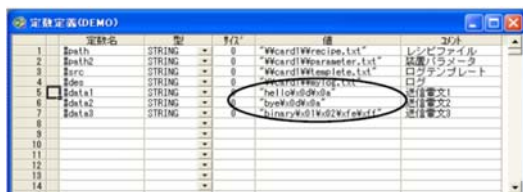
### M3 escape sequences

Data creation: defining hexadecimal representation codes within strings

- Text messages and control characters (STX, ETX, etc.) can be coded at the same time when creating telegram messages.
- Newline code (CRLF or LF) can be inserted easily into text when creating a text file.

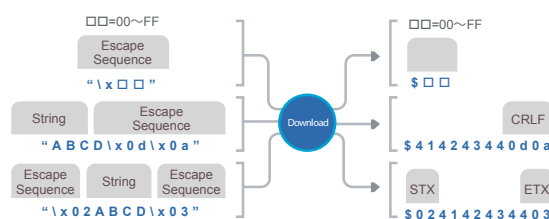
Defining escape sequences

Define escape sequences (hexadecimal representation codes) within strings.



Downloading escape sequences

Escape sequences are replaced with binary codes upon download.



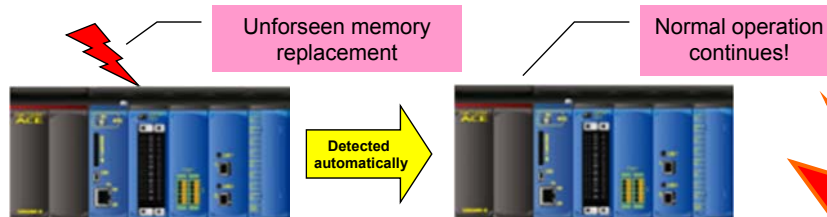
## High Precision & Reliability (Enhanced Memory)

### High-reliability design reduces failure rate

#### A measure for ensuring stable system operation

##### – SRAM hardware error check and correction (ECC)

- Hardware error check and correction (ECC) within ASIC and external SRAM
- ECC does not impair performance.
- Improved reliability through patrol check\* (only for backup SRAM)



Hardware ECC improves reliability!

##### – Use of flash memory

Flash memory is used for storing programs.

This minimizes the impact of memory data loss at power off.

## High Precision & Reliability (Hardware ECC)

### Corrects single-bit errors; detects multi-bit errors

No memory access cycle time loss (unless error is detected)

#### • In case of a single-bit error:

Automatically corrected

within the same access cycle  
and system operation continues normally.

#### • In case of a multi-bit error:

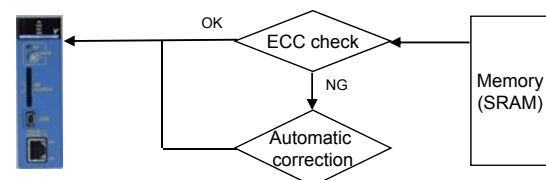
Transit to error handling instantly  
in the cycle immediately following the error.

#### • In case of multiple single-bit errors:

To prevent degeneration to multi-bit errors.

patrol check is executed by hardware  
for the entire external backup SRAM.

■ Process flow in the case of correctable single-bit error



## High-precision calculations

Operations preserving 32-bit significant digits

- 64-bit integer arithmetic
  - No need to convert all the way to floating point data for calculation
- Double-precision floating point operations
  - Built-in floating-point unit (FPU) for floating-point operations
  - No precision loss even if converted to floating-point data for calculations

Improved computational precision

## Single board design

- Less components means less failure sources.
- Efficient natural cooling provides reliability.

Pursues fundamental reliability

## Security Functions

### Security functions for protecting program assets

#### User management function

- Appropriate access permissions can be defined for administrator, service and user personnel so that better security and work efficiency can be achieved concurrently.

#### Operation log function

- Keeps a history of operations performed on the CPU module.
- With the use of the user authentication function, the user name of the person performing an operation can also be recorded.

Prevents unauthorized copying of user intellectual property!

Auto log of maintenance history

**STEP 1: Define user account**

**STEP 2: Define user permissions**

**Administrator**  
All operations allowed

**User**  
Online edit, initialization reset, file operation disallowed

Operations performed on CPU can be checked using operation log.

Operation log dialog

| Date       | Time     | Route | Main Message    | Sub Message | User Name |
|------------|----------|-------|-----------------|-------------|-----------|
| 2010/06/11 | 08:53:22 | SWL_1 | Cpu Reset       |             | User      |
| 2010/06/11 | 10:02:14 | USB   | Download ybjt   | FTTPUT      | User      |
| 2010/06/12 | 11:06:20 | SIO   | Set a date-time |             | Service   |
| 2010/06/12 | 12:27:37 | ETH   | Switch Run mode | FTTPUT      | Service   |

When? Via? What? by whom?

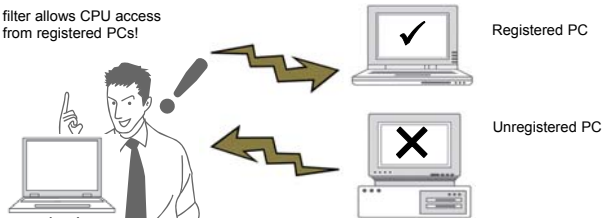


Log file can be saved to SD card.

### Network filter function

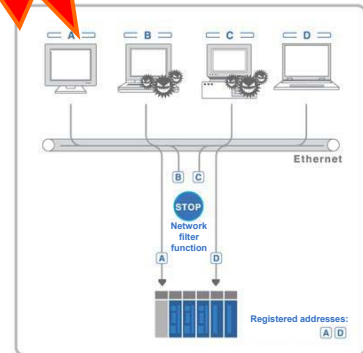
- Connection to CPU can be restricted to IP addresses (16 max.) registered in the CPU properties.
- Subnet mask can be used to grant access to a subnet.
- Unauthorized access attempts are counted in a special register.

Network filter allows CPU access only from registered PCs!



Registered PC

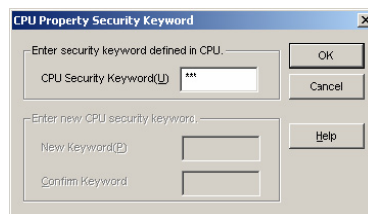
Unregistered PC



Prevent unauthorized access and intrusions!

### CPU properties protection

- In addition to executable program protection, CPU property data such as network settings are can be protected against unauthorized read/write access using a password.



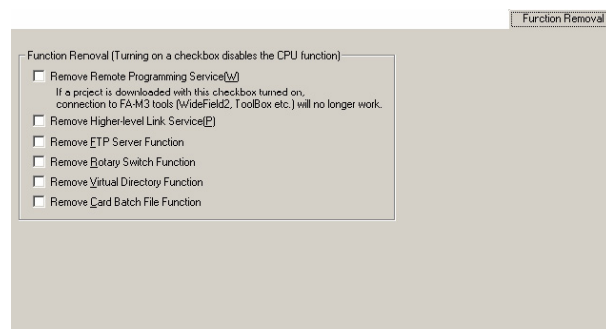
Protect programs & configuration data!

### Function Removal

- Selected CPU functions can be disabled (removed).  
Functions not to be used by end users can be removed before system delivery.

Removable functions:

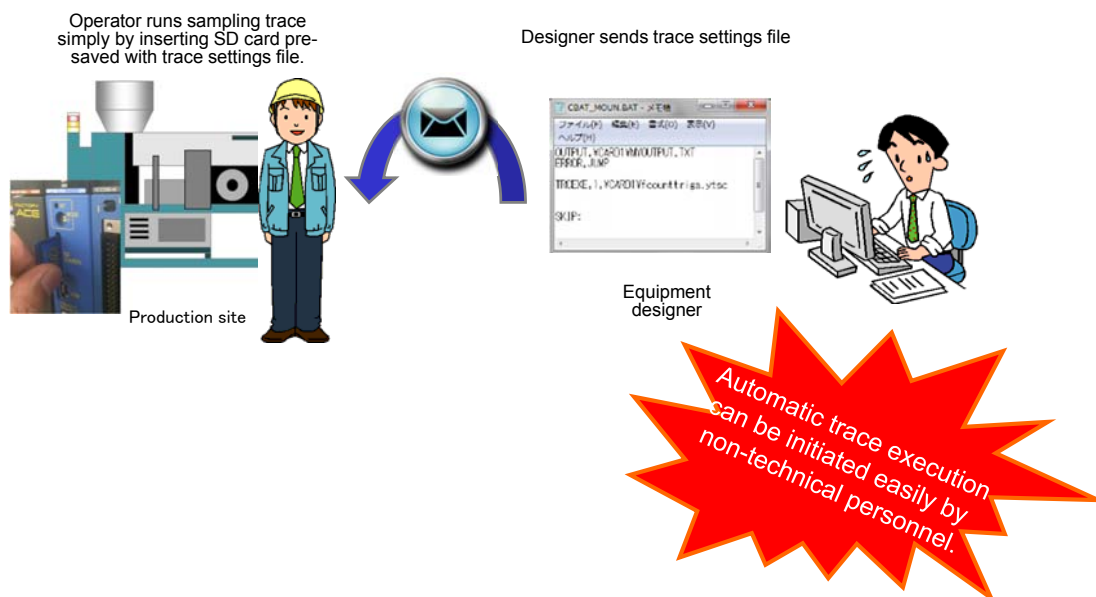
- Remote programming service  
(Access via an external module such as an Ethernet interface module cannot be disabled).
- Higher-level link service
- FTP server
- Rotary switch function
- Virtual directory function
- Card batch file function



Disables selected functions & tool connections!

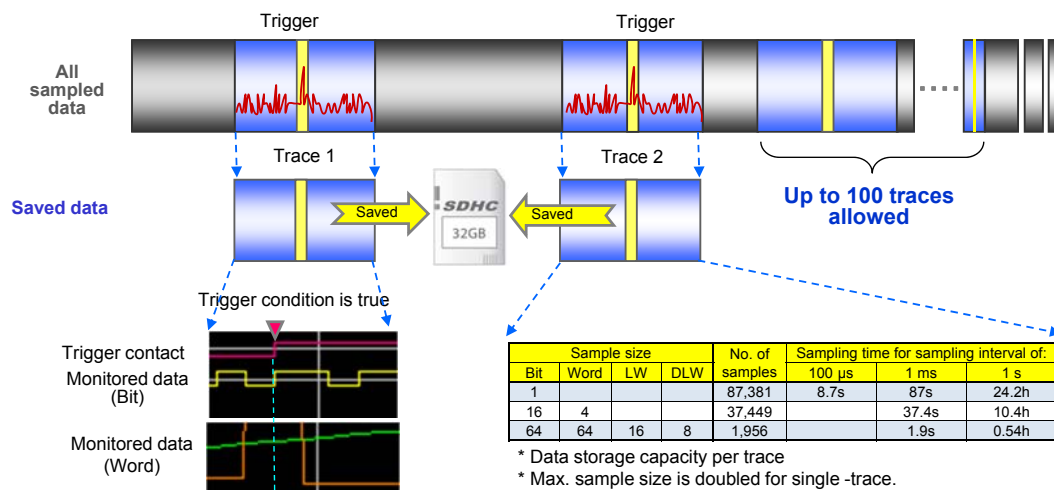
## Tool-less maintenance

Sampling trace can be run simply by inserting an SD card pre-stored with a trace settings file (batch file) without need of PC (Windows) or WideField3 operation.



## Multi-trace

- Up to 100 successive traces (100x increase) can be run.
- Trace data is stored in SD card or RAM disk.
- Ideal for tracing and trace data comparison over extended period.



Data is saved to the SD card a specified number of times when the trigger condition is established. Moreover, pre-trigger state can be saved to facilitate failure analysis by specifying a delay.

Much more data can be saved per trace and up to 100 traces can be run successively. Saving only the required data at the required timings enables easy comparison of saved results and more efficient analysis.

## ❖ FA-M3V Offers Stress-free Solution for All Systems/Devices

### ❖ Fast, stable control backed by two core technologies

- The new FA-M3 Vitesse Engine for ladder processing is fastest in the industry.
- The new Parallel & Independent Processing System (PIPS) control method ensures fast, stable control.



### ❖ Formidable computation power

- High-precision computations for supporting positioning and other applications
- Built-in cache registers for storing calculation tables for fast access



### ❖ Protection of program assets and efficient problem analysis

- Login control function
- Operation log function
- Other security functions



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## Stress-free

Relieves all sources of stress from development to maintenance



**FA-M3V**  
VITESSE™

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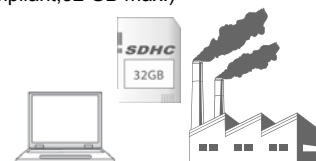
### ❖ Truly range-free

- Only two streamlined models of 60K or 260K program size
- CPU selection is easy!



### ❖ Easy networking with production control systems

- All models have built-in Ethernet port
- Fast, stable control even during production data transmission
- Large memory and SD memory card (SDHC compliant, 32 GB max.)



### ❖ User-friendly high-reliability design

- Hardware error check and correction
- Use of flash memory
- Single board design

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## ❖ System Migration Precautions

### Test user applications thoroughly.

#### ❖ Check application behavior changes accompanying speed increase

- Timing changes arising from higher processing speed
  - Scan, SD, Ethernet, refresh, etc.
- Speed and value changes arising from migration to floating point computation by hardware
  - Beware especially for applications that perform comparison and manipulate floating-point values (including constants).

#### ❖ Precautions when migrating from F3SP2□/3□/5□ to F3SP7□

- F3SP7□ uses an internal flash ROM and SD memory card (in place of ROM pack).
- No more support for discontinued products
- Application programming changes
  - Socket communications using built-in Ethernet port (F3LE12), file handling and batch file (F3EM01)

#### ❖ Differences from predecessor CPU modules

- Partial download → Use Download All instead.

\* Refer to user manuals for details before system migration.

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# Field Application Examples

## ❖ Harnessing FA-M3V's Speed to Shorten Scan Time (example 1)

### ❖ Control application example

- Positioning for discrete motion (semiconductor, electric, and electronic parts handling)

### ❖ Solution

- Solution to shorten machine tact time**

### ❖ Effect

#### ■FA-M3V

Positioning command setup time (machine idle time), which is dependent on PLC (controller) is reduced.

Example: Supposing that motor operation time plus motor startup time is 15 ms.

#### ◆ Average cycle time

If F3SP53 is used: 15 ms + 7.5 ms (assuming 1.5 scans on average) = 22.50 ms

If F3SP7□ is used: 15 ms + 1.05 ms = 16.05 ms

↓  
Cycle time is reduced by 29% resulting in 40% increase in working efficiency. This translates into productivity increase from 500 to 700 units with no machine upgrade or manpower increase!

For machines with short cycle time, reducing setup time (sequence CPU processing time) is key to reducing machine idle time and increasing productivity.

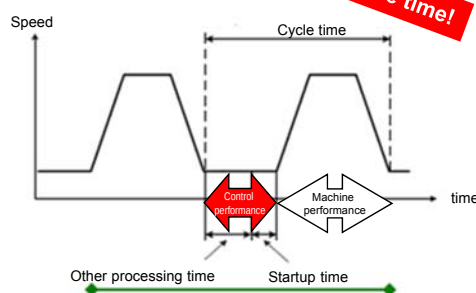
Reduce controller-dependent user machine waiting (idle) time.

↓  
Shorter cycle time

↓  
Shorter tact time for user machine

↓  
Maximizes user machine utilization!  
Increases accuracy and productivity!

#### ◇ Motor operation pattern example



## ❖ Harnessing FA-M3V's Speed to Shorten Scan Time (example 2)

### ❖ Control application example

- Positioning for continuous motion (sheet cutter for cutting paper, film, etc.)

### ❖ Solution

- **Solution to improve yield**

### ❖ Effect

#### ■ Predecessor CPU

Cutting starts within 1 or 2 scans after a sensor detects the edge of running paper or film.

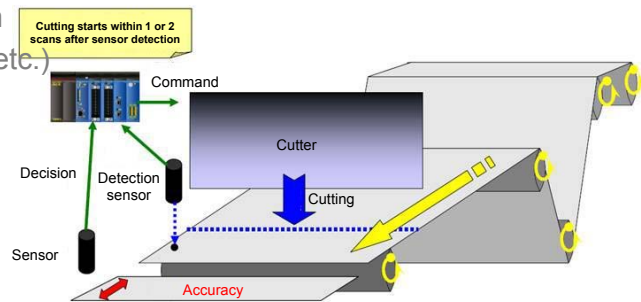
If cutting fails to start within 1 scan, cutting will be delayed by 1 scan time, resulting in dimensional error:

- $\text{Error} = V (\text{paper speed}) \times \text{scan time}$



#### ■ FA-M3V

Scan time is **about 5 times** shorter, translating approximately into **5 times** more accurate product dimension, as well as **5 times** faster running speed and thus **5 times** higher productivity.



Improved communications performance

↓  
Better dimensional accuracy

↓  
Improved product yield

↓  
**Faster cutter response for higher accuracy and productivity!**

## ❖ Harnessing FA-M3V's Speed to Shorten Scan Time (example 3)

### ❖ Control application example

- Inspection application (for inspecting semiconductor, electric, and electronic parts)

### ❖ Solution

- **Solution to improve yield**

### ❖ Effect

#### ■ Predecessor CPU

A PC accepts or rejects products based on information from an inspection PLC. When the PLC fails to respond in time due to, say, prolonged interrupt processing, the PC may wrongly reject a good product.



#### ■ FA-M3V

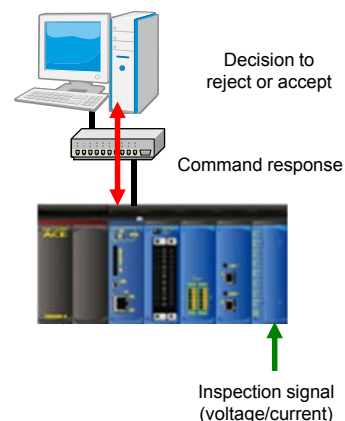
FA-M3V rarely fails to respond in time thanks to shorter response time (due to shorter scan time). False rejects are significantly reduced.

Shorter response time

↓  
Shorter inspection time

↓  
Improved product yield

↓  
**Much fewer false rejects!  
Decision accuracy improved!**

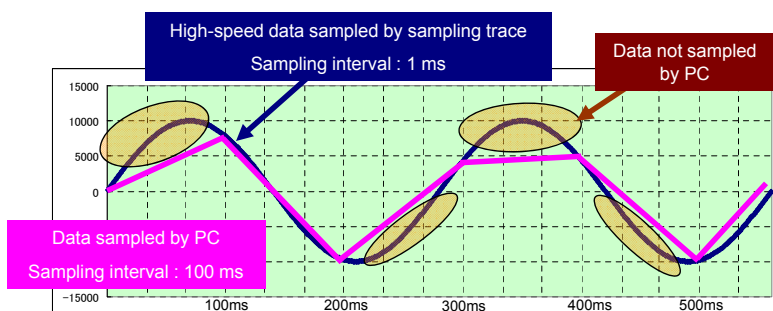


## ❖ Harnessing FA-M3V's Functions (Sampling Trace)

→ The PC is too slow for sampling high-speed machine monitoring data. The high-speed FA-M3V CPU module enables such high-speed data to be sampled using the sampling trace function's SOE (Sequence On Event) feature. Additional sampled data facilitates machine failure cause analysis.

### ■ Sampling & analysis of small control data variation using FA-M3V ■ Acquires required data only easily

- Sample size: 64 points of bit data or 128 points of word data
- Sampling capacity: 3,956 to 209,715 samples  
(dependent on specified sample size and approx. halved for multi-trace)  
209,715 samples for 1-bit samples;  
80,659 samples for 16-bit and 4-word samples;  
3971 samples for 64-bit, 64-word and 8-long-word samples
- Trace data can be converted into CSV files for easier analysis.



Example of data sampling using Sampling Trace:  
More sampled data facilitates problem analysis.

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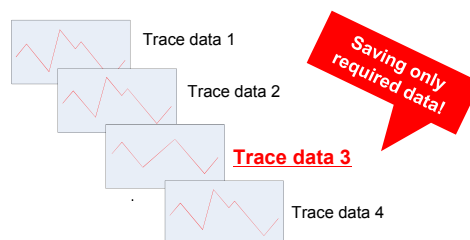
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### • **Tool-less maintenance**

Sampling trace initiated simply by inserting SD card containing batch file.

### • **Multi-trace**

Runs up to 100 successive traces. More data can be sampled per trace. Results stored on SD card or RAM disk. Enables tracing and results comparison over extended period.



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## ❖ Harnessing FA-M3V's Functions for Efficient Maintenance

→ Fast system information gathering is crucial for recovery from system problems. Unfortunately, ease of information gathering and security are often trade-offs. The FA-M3V enables easy system information gathering without sacrificing security.

### → SD card improves maintenance efficiency

- Ladder programs can be loaded or saved.
- System log and other system information can be retrieved.
- Operation log can be retrieved
- Sampling trace settings and results can be retrieved.

### → FA-M3V Defender ensures information security

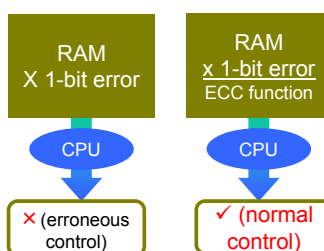
- Operation permissions are defined by the login control function.
- Operation history is automatically saved as operational log.

### → Hardware reliability is improved

- Single board design means fewer components.
- SRAM features hardware ECC. Nonrecurring problems due to single-bit errors are reduced.



Operation information including date and time, details and operator is recorded automatically. Operation log can be saved to SD card.



Single-bit error correction by hardware ECC

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# FA-M3 Programming Tools New Products Introduction



## Software Product Lineup

- ❖ FA-M3 Programming Tool WideField3  
SF630-MCW R2
- ❖ ToolBox for Temperature Control and Monitoring Modules  
SF661-MCW R6
- ❖ ToolBox for Positioning Modules (for F3NC32/34)  
SF662-MCW R4
- ❖ ToolBox for Positioning Modules (for F3YP22/24/28)  
SF663-MCW



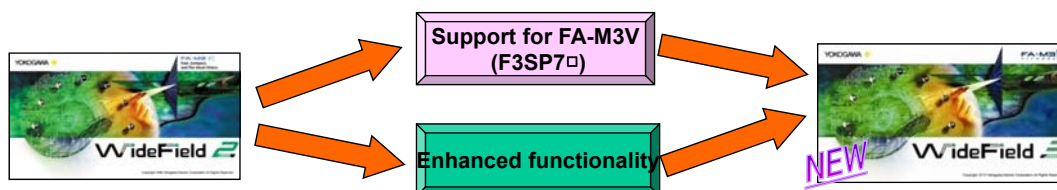
## FA-M3 Programming Tool WideField3 (SF630-MCW R2)



- FA-M3 Programming Tool WideField3 is a new product, which needs to be purchased for existing WideField2 users.
- Registered WideField3 R1 users may, however, download the free upgrade patch from the Users Page on the FA-M3 website ([www.yokogawa.com/itc](http://www.yokogawa.com/itc)).

### From WideField2 to WideField3

- WideField3 supports the new FA-M3V (F3SP7□), which is the fastest CPU in the industry today, and has enhanced functionality to meet customer requirements.



- WideField2 design assets can be migrated to WideField3 without modification.

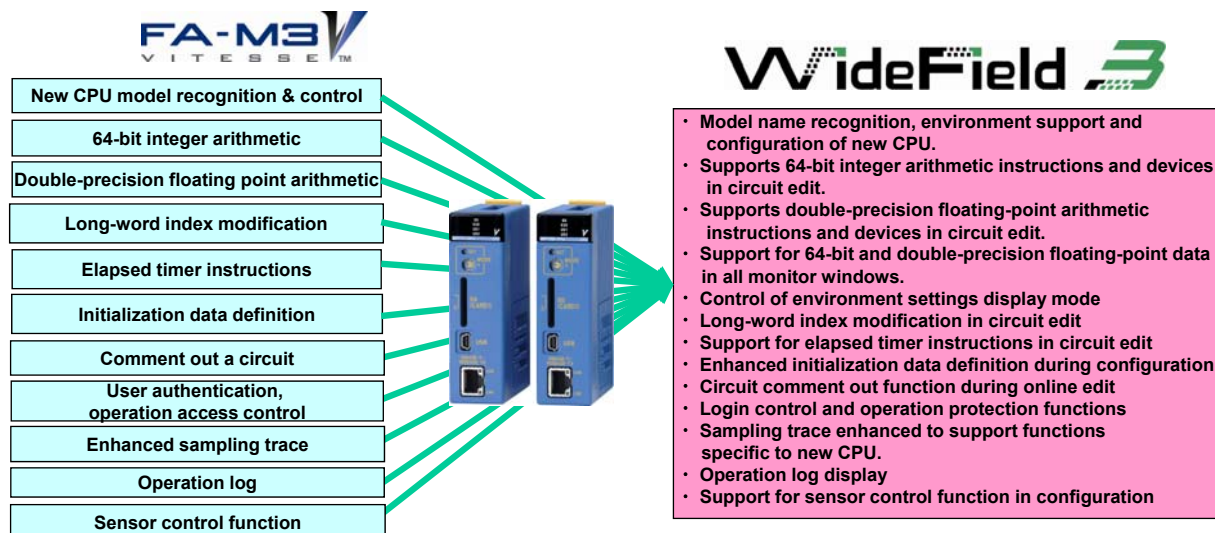
- Both ladder programs created using WideField2 and older CPU module models (F3SP2□/3□/5□/6□) used to create these programs can be used as-is with WideField3.

\* Project data created using WideField2, when opened in WideField3, will be automatically converted to WideField3 format.

\* If necessary, you can either select [Downgrade & Save] in WideField3 to resave an existing project created using WideField2 or back up the WideField2 project before migration.

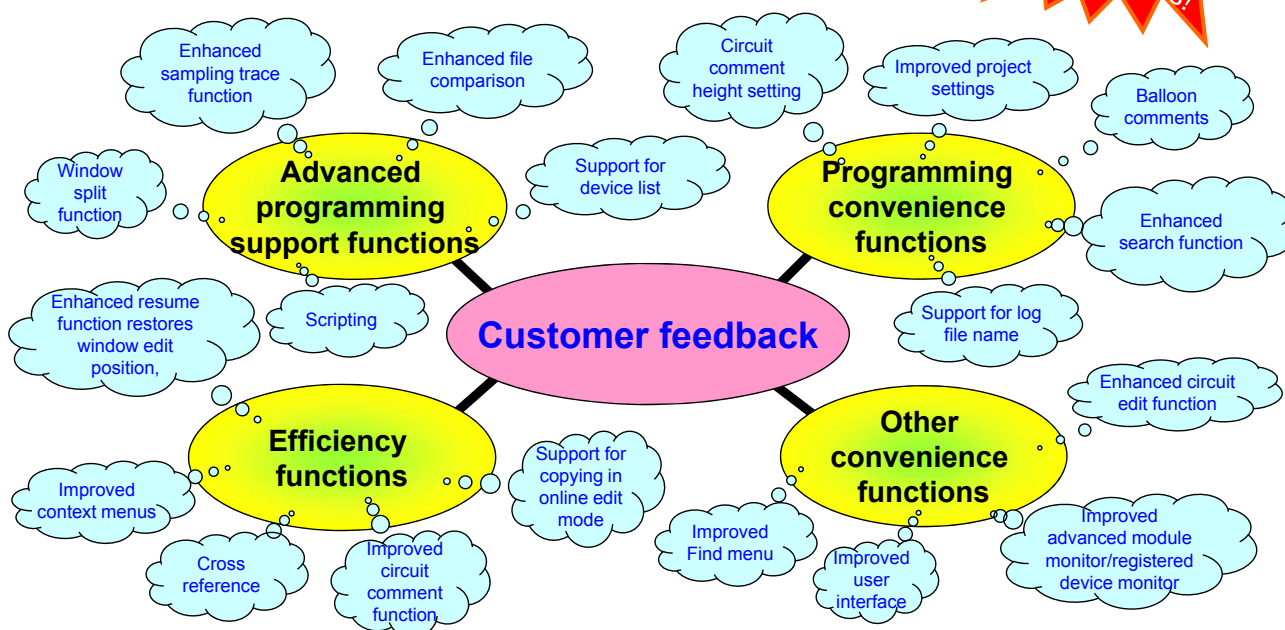
## Harness the full power of the new CPU!

WideField3 is developed alongside the new FA-M3V sequence CPU module and is designed to fully support all functions of the new CPU.



## WideField3 includes useful functional enhancements based on client feedback

More than 100 functional enhancements!



## Advanced Programming Support Functions

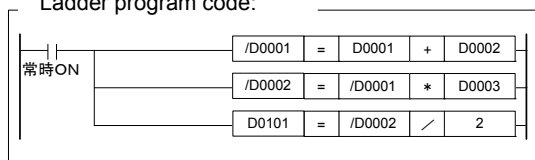
### Script Coding and Monitoring Function New

Advanced Programming Support Functions

- ❖ Computations and text manipulations not easily coded using ladder language can now be coded easily using intuitive expressions.

- Example: calculating the area of a trapezium

Ladder program code:

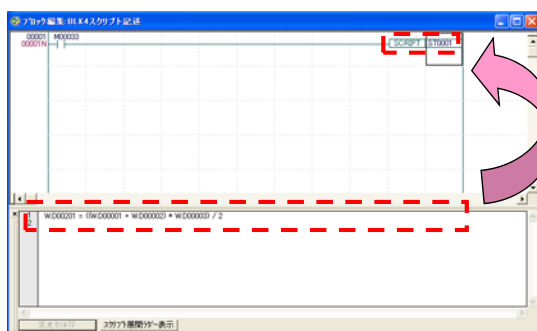


Script code:

```
W.D0101 := ((W.D0001 + W.D0002) * W.D0003) / 2
```

Efficient  
single-line  
coding!

Readable  
script code!



Script code is converted automatically into ladder code before execution.

Example: Integer arithmetic

```
D00001 = D00002 + D00003
```

```
→ CAL D00001 D00002 + D00003
```

Example: Byte swap

```
HSWAP(D00001)
```

```
→ BSET P 0 /D00001 2
```

```
PMOVX P D00001 8 8 /D00001
```

```
MOV P D00001 /D00002
```

```
LSFT P /D00002 8
```

```
CAL P D00001 /D00001 | /D00002
```

## Script Coding and Monitoring Function New

Advanced Programming Support Functions

### Supported scripting language

- 2 basic functions (LDU, LDD)
- 18 arithmetic functions (SUM, MAX, POW, etc.)
- 31 data processing functions (byte handling, etc.)
- 20 string manipulation functions (replacement, etc.)

### Monitoring scripting

- Allows in-script monitoring

```
:BMOV D001;V001 D100;v002 100
W.D200=W.D100+10
W.D201=W.D101+11
W.D202=W.D102+12
```

### Control statement scripting

- IF ~ THEN ~ ELSE/SELECT ~ CASE
- FOR ~ NEXT (up to 8 levels of nesting)

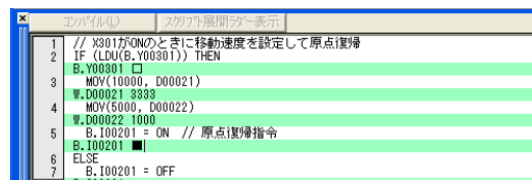
### Comments & indentation

- Readable script

```
// Calculate X- and Y-axis speeds
W.D100=AWE (W.D101,10) // X-axis speed
W.D200=AWE (W.D201,10) // Y-axis speed
IF (W.100 > W.D200) THEN
  B.Y00301=ON // Large X-axis speed
ELSE
  B.Y00301=OFF // Large Y-axis speed
ENDIF
```

### Script monitoring (industry-first)

- Devices can be inserted into script for monitoring purposes



## Sampling Trace Function New

Advanced Programming Support Functions

### Advanced analysis environment with oscilloscope-like view

- Supports Sampling Trace function of FA-M3V.
- Enables efficient debugging and timely troubleshooting!

Easy  
report  
creation!

Complex configuration is made easy using software wizards!

Supports loading of past data for combined display, as well as CSV and image output, enabling effective use of analysis assets!

Supports advanced, flexible configuration with intuitive representation!

Analysis convenience functions:

- Inter-point analysis
- Range zooming
- Filter settings

Device list gives an overview of used and unused devices within a project.

Display range options:  
global devices,  
local devices,  
macro devices,  
all devices

Cross references can be generated from a displayed device.

Each cell shows whether the device at the corresponding address is used within the project.

## Other Advanced Programming Support Functions

Split window display Improved

- Split block edit window

File comparison Improved

- Enhanced comparison!

Vertical split

Horizontal split

Movable boundary

Even files having different names can be compared according to their order in the configuration!

|                  |      |     |   |   |
|------------------|------|-----|---|---|
| BLK_MAIN/INIT    | 700% | 不一致 | 1 | 1 |
| BLK_MAIN/INIT    | 700% | 不一致 | 1 | 1 |
| BLK_MAIN/INIT    | 700% | 不一致 | 1 | 1 |
| BLK_INDEX/SVON   | 700% | 不一致 | 2 | 2 |
| BLK_INDEX/SVON   | 700% | 不一致 | 2 | 2 |
| INDEX/SVON       | 700% | 一致  | 2 | 2 |
| ブロック内にて-さん/SVOFF | 700% | 不一致 | 3 | 3 |
| ブロック内にて-さん/SVOFF | 700% | 不一致 | 3 | 3 |

# Efficiency Functions

## Cross Reference Function New

Efficiency Functions

### Cut debug man-hours! Prevent regressive programming

- Real-time display of devices used in a project!
- Search used devices easily! Prevent missing amendments in programming.

#### ■ Cross reference search object ■

Address, tag name, constant definition, structure name (including structure member names), label block, macro name

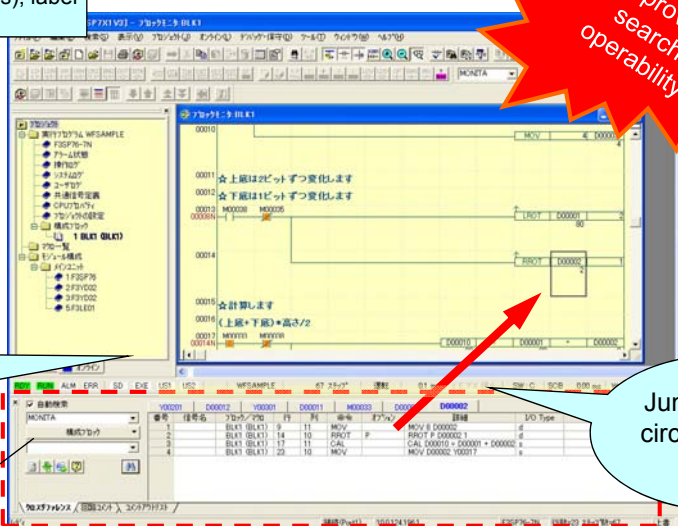
Eliminate duplicate use of devices!

Search results are displayed by tab for better readability!

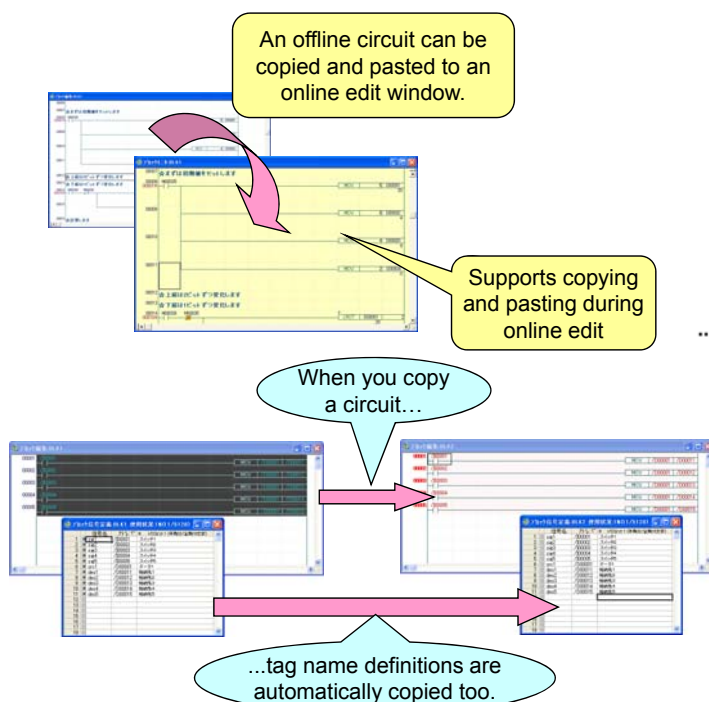
Output window  
"Cross Reference Tab"

Improved search operability!

Jump to found circuit with one click!

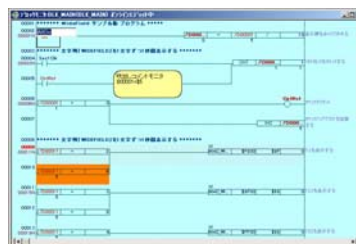


## ❖ Copy and paste Improved



## ❖ Monitoring during online edit

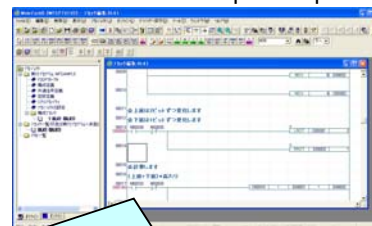
- Values of contacts and devices can be displayed in online-edit windows for monitoring purposes.



New

## ❖ Resume function Improved

- The state of a displayed window is saved and can be restored upon reopening!



Reopening a window restores its last edit position (line/cursor position) for better efficiency!

# Programming Convenience Functions

## Balloon comments and monitors can be placed onto ladder programs like post-it notes.

- Operation history and handover memos can be written and even devices can be monitored within comments.

Balloon comments can be displayed anywhere on circuits in any font, color and size, even transparently so that underlying circuits are visible.

A device can be specified within a comment so that its data can be monitored at any preferred location.

Individual balloons on the balloon list can be defined as visible or hidden.

Up to 32 lines of 128 characters can be defined for each balloon.

## More powerful Find function!

- More search object options and search condition options are available.

Search object options:  
tag name or address,  
circuit comment,  
subcomment,  
Block or macro name,  
label,  
I/O comment

More search  
object options!

More search  
condition options!

Jump to a found  
location from the  
search results  
window!

Search condition options:  
component blocks,  
all project blocks,  
all project macros,  
all project blocks and macros

## Revamped Print function!

- An image of the ladder edit window can be printed.

Color printout is available with a color printer!

All pages can be previewed!

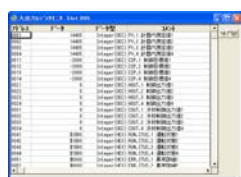
Optimized print layout reduces paper wastage!

Flexible and detailed print setup is available!

## Other Programming Convenience Functions

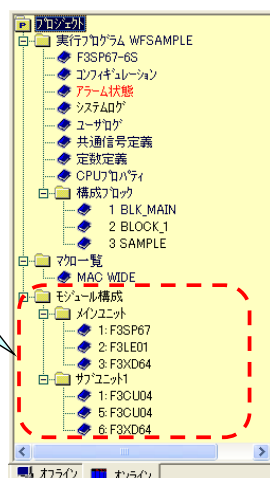
## Optimized online project tree Improved

Installed modules are displayed in the online project window. Selecting a module displays its I/O relay monitor window and advanced module register monitor window!



I/O relay monitor

Advanced module register monitor window

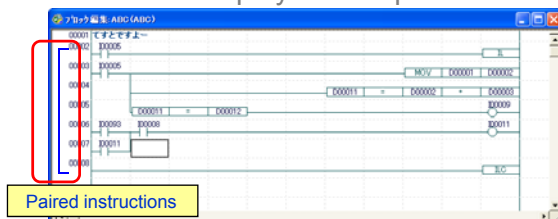


## Other Convenience Functions

### Improved Convenience Functions

#### Display of paired instructions New

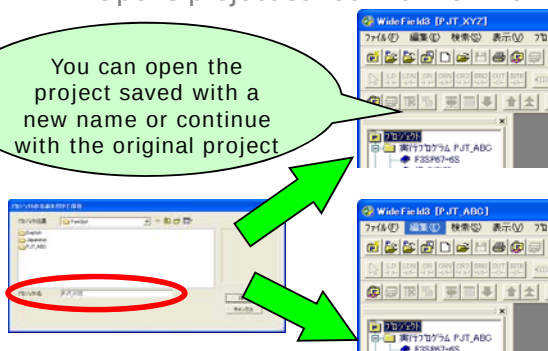
- Paired instructions (IL-ILC, SUB-RET, FOR-NEXT, etc.) can be displayed to improve readability.



#### [Save As...] function Improved

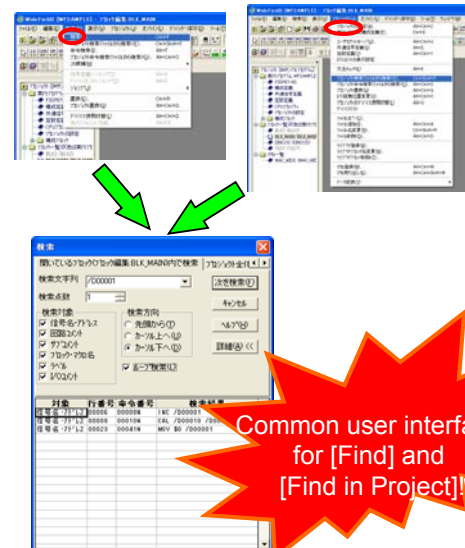
- Opens project saved with new name.

You can open the project saved with a new name or continue with the original project



#### Find function Improved

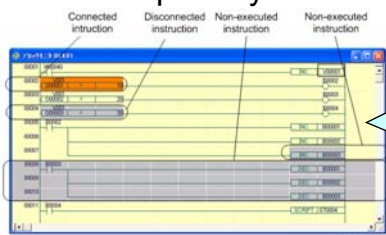
- The Find dialog window can be opened from Find or Project menu.



Common user interface for [Find] and [Find in Project]!

### ❖ Circuit comment-out

- Selected instructions or circuits can be connected or made non-executable temporarily.



Comment-out to deactivate instructions temporarily during debugging or back up a circuit before modification.

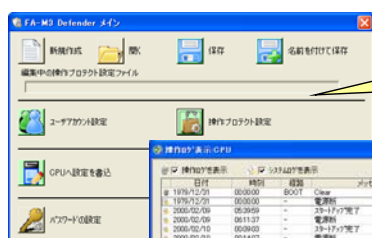
### ❖ Support for double float & double long word data

| Tag Name | Value | Unit |
|----------|-------|------|
| 000000   | 15.01 |      |
| 000001   | 15.01 |      |
| 000002   | 15.01 |      |
| 000003   | 15.01 |      |
| 000004   | 15.01 |      |
| 000005   | 15.01 |      |
| 000006   | 15.01 |      |
| 000007   | 15.01 |      |
| 000008   | 15.01 |      |
| 000009   | 15.01 |      |
| 000010   | 15.01 |      |
| 000011   | 15.01 |      |
| 000012   | 15.01 |      |
| 000013   | 15.01 |      |
| 000014   | 15.01 |      |
| 000015   | 15.01 |      |
| 000016   | 15.01 |      |
| 000017   | 15.01 |      |
| 000018   | 15.01 |      |
| 000019   | 15.01 |      |
| 000020   | 15.01 |      |
| 000021   | 15.01 |      |
| 000022   | 15.01 |      |
| 000023   | 15.01 |      |
| 000024   | 15.01 |      |
| 000025   | 15.01 |      |
| 000026   | 15.01 |      |
| 000027   | 15.01 |      |
| 000028   | 15.01 |      |
| 000029   | 15.01 |      |
| 000030   | 15.01 |      |
| 000031   | 15.01 |      |
| 000032   | 15.01 |      |
| 000033   | 15.01 |      |
| 000034   | 15.01 |      |
| 000035   | 15.01 |      |
| 000036   | 15.01 |      |
| 000037   | 15.01 |      |
| 000038   | 15.01 |      |
| 000039   | 15.01 |      |
| 000040   | 15.01 |      |
| 000041   | 15.01 |      |
| 000042   | 15.01 |      |
| 000043   | 15.01 |      |
| 000044   | 15.01 |      |
| 000045   | 15.01 |      |
| 000046   | 15.01 |      |
| 000047   | 15.01 |      |
| 000048   | 15.01 |      |
| 000049   | 15.01 |      |
| 000050   | 15.01 |      |
| 000051   | 15.01 |      |
| 000052   | 15.01 |      |
| 000053   | 15.01 |      |
| 000054   | 15.01 |      |
| 000055   | 15.01 |      |
| 000056   | 15.01 |      |
| 000057   | 15.01 |      |
| 000058   | 15.01 |      |
| 000059   | 15.01 |      |
| 000060   | 15.01 |      |
| 000061   | 15.01 |      |
| 000062   | 15.01 |      |
| 000063   | 15.01 |      |
| 000064   | 15.01 |      |
| 000065   | 15.01 |      |
| 000066   | 15.01 |      |
| 000067   | 15.01 |      |
| 000068   | 15.01 |      |
| 000069   | 15.01 |      |
| 000070   | 15.01 |      |
| 000071   | 15.01 |      |
| 000072   | 15.01 |      |
| 000073   | 15.01 |      |
| 000074   | 15.01 |      |
| 000075   | 15.01 |      |
| 000076   | 15.01 |      |
| 000077   | 15.01 |      |
| 000078   | 15.01 |      |
| 000079   | 15.01 |      |
| 000080   | 15.01 |      |
| 000081   | 15.01 |      |
| 000082   | 15.01 |      |
| 000083   | 15.01 |      |
| 000084   | 15.01 |      |
| 000085   | 15.01 |      |
| 000086   | 15.01 |      |
| 000087   | 15.01 |      |
| 000088   | 15.01 |      |
| 000089   | 15.01 |      |
| 000090   | 15.01 |      |
| 000091   | 15.01 |      |
| 000092   | 15.01 |      |
| 000093   | 15.01 |      |
| 000094   | 15.01 |      |
| 000095   | 15.01 |      |
| 000096   | 15.01 |      |
| 000097   | 15.01 |      |
| 000098   | 15.01 |      |
| 000099   | 15.01 |      |
| 000100   | 15.01 |      |

Tag name definition monitor

Device monitor

### ❖ Operation access control & operation log



Operation access control manages user permissions for CPU operations.

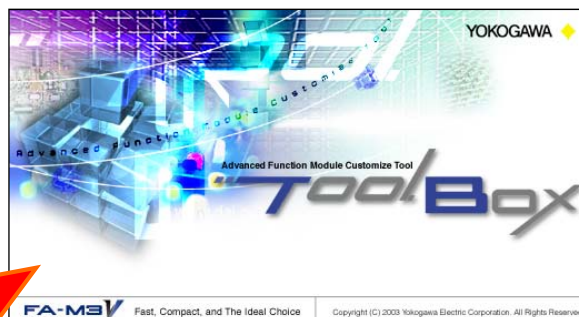
| 日付         | 時刻       | 操作    | ユーザ名 |
|------------|----------|-------|------|
| 2000/12/01 | 00:00:00 | BOOT  | ユーザ名 |
| 2000/12/01 | 00:00:01 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:02 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:03 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:04 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:05 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:06 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:07 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:08 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:09 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:10 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:11 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:12 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:13 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:14 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:15 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:16 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:17 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:18 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:19 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:20 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:21 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:22 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:23 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:24 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:25 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:26 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:27 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:28 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:29 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:30 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:31 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:32 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:33 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:34 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:35 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:36 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:37 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:38 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:39 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:40 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:41 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:42 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:43 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:44 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:45 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:46 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:47 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:48 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:49 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:50 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:51 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:52 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:53 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:54 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:55 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:56 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:57 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:00:58 | 電源OFF | ユーザ名 |
| 2000/12/01 | 00:00:59 | 電源ON  | ユーザ名 |
| 2000/12/01 | 00:01:00 | 電源OFF | ユーザ名 |

Operation log maintains a record of past operations performed on the CPU

## ❖ Precautions for WideField2 to WideField3 Migration

- ❖ A project created in WideField2 (SF620) will be automatically upgraded to WideField3-compatible format when opened in WideField3 (SF630).
- ❖ If necessary, you can either select [Downgrade & Save] in WideField3 to resave an existing project created in WideField2 (SF620) or back up the WideField2 project before migration.
- ❖ For project data compatibility reason, do not install both WideField2 (SF620) and WideField3 (SF630) on the same PC.
- ❖ When migrating to WideField3 (SF630), you should also upgrade the ToolBox (SF661/SF662) software. The ToolBox upgrade patch can be downloaded from the FA-M3 website ([www.yokogawa.com/itc/](http://www.yokogawa.com/itc/)) free of cost.
- ❖ When using FL-net communications, beware that tighter OS security control may affect online connection based on the FL-net protocol using WideField3 (SF630) so additional OS configuration may be required, just as for WideField2 (SF620) previously.
- ❖ The programming tool cable (KM13-1S) has been upgraded to support Windows 7. The latest cable driver software can be downloaded from the FA-M3 website ([www.yokogawa.com/itc/](http://www.yokogawa.com/itc/)) free of cost.

ToolBox for Temperature Control and Monitoring Modules SF661-MCW R6  
ToolBox for Positioning Modules (for F3NC32/34) SF662-MCW R4  
ToolBox for Positioning Modules (for F3YP22/24/28) SF663-MCW



- Upgrade improvements (SF661-MCW, SF662-MCW)
  - Support for FA-M3V (F3SP7□)
  - Support for multiple online connections.

\* Existing users may download the free upgrade patch from the FA-M3 website ([www.yokogawa.com/itc](http://www.yokogawa.com/itc)).

## List of New Products & User Manuals



## List of New Products

### ■ Hardware

| Product Name                                 | Model    | Suffix code | Specification                                                                                                                              |
|----------------------------------------------|----------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Sequence CPU module (with network functions) | F3SP71*1 | -4S         | Ladder 60K steps, basic instruction 3.75 ns or longer, with network (USB 2.0 (12 Mbps), Ethernet) and Modbus/TCP slave (server) functions  |
|                                              | F3SP76*1 | -7S         | Ladder 260K steps, basic instruction 3.75 ns or longer, with network (USB 2.0 (12 Mbps), Ethernet) and Modbus/TCP slave (server) functions |

\*1: When using F3SP71 or F3SP76 sequence CPU module, use SF630-MCW R2 or a later version.

### ■ Software

| Product Name                                                     | Model | Suffix code | Specification                                                                                                                                                       |
|------------------------------------------------------------------|-------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FA-M3 Programming Tool WideField3 *2                             | SF630 | -MCW        | Windows 2000, XP, Vista, 7 compatible, multi-lingual version, CD-ROM                                                                                                |
| ToolBox for Temperature Control and Monitoring Modules *3        | SF661 | -ECW        | Windows 2000, XP, Vista, 7 compatible, multi-lingual version, CD-ROM (for F3CU04 and F3CX04)<br>* Existing users may download upgrade patch from the FA-M3 website. |
| ToolBox for Positioning Modules (for F3NC32/34) *3               | SF662 | -ECW        | Windows 2000, XP, Vista, 7 compatible, multi-lingual version, CD-ROM (for F3NC3□) * Existing users may download upgrade from FA-M3 website.                         |
| <b>NEW</b> ToolBox for Positioning Modules (for F3YP22/24/28) *3 | SF663 | -ECW        | Windows 2000, XP, Vista, 7 compatible, multi-lingual version, CD-ROM (for F3NC3□) * Existing users may download upgrade from FA-M3 website.                         |

\*2: FA-M3 Programming Tool WideField3 is a new product, which needs to be purchased for existing WideField2 users.

Existing WideField3 R1 users may download the upgrade patch from the FA-M3 website ([www.yokogawa.com/itc](http://www.yokogawa.com/itc)) free of cost.

\*3: Existing ToolBox users may download the ToolBox upgrade patch from the FA-M3 website ([www.yokogawa.com/itc](http://www.yokogawa.com/itc)) free of cost.

### ■ Peripheral Devices

| Product Name                  | Model | Suffix code | Specification                                                                                                     |
|-------------------------------|-------|-------------|-------------------------------------------------------------------------------------------------------------------|
| Cable for programming tool *4 | KM13  | -1S         | USB 1.1 compliant USB-serial converter, cable length approx. 3 m, Windows 98SE, Me, 2000, XP, Vista, 7 compatible |

\*4: The programming tool cable (KM13-1S) has been upgraded to support Windows 7. The latest cable driver software can be downloaded from the FA-M3 website ([www.yokogawa.com/itc](http://www.yokogawa.com/itc)) free of cost.

## User Manuals

These user manuals are revised or newly issued with the new products.

### ■ Hardware

| New /Revised | Document Number     | Document Name                                                                                                  | Applicable module                |
|--------------|---------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------|
| Revised      | IM 34M06C11-01E     | Hardware Manual                                                                                                | FA-M3                            |
| Revised      | IM 34M06P12-03E     | Sequence CPU – Instructions                                                                                    | F3SP□□                           |
| Revised      | IM 34M06P13-01E     | Sequence CPU – Functions (for F3SP22-0S, F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S, F3SP58-6H/6S and F3SP59-7S) | F3SP22                           |
| Revised      | IM 34M06P15-01E-T01 | Sequence CPU – Functions (for F3SP71-□N, F3SP76-□S)                                                            | F3SP71<br>F3SP76                 |
| Revised      | IM 34M06P15-02E     | Sequence CPU – Network Functions (for F3SP71-□N, F3SP76-□S)                                                    | F3SP71<br>F3SP76                 |
| Revised      | IM 34M06P15-03E-T01 | Sequence CPU – Modbus/TCP Slave Function                                                                       | F3SP71<br>F3SP76                 |
| Revised      | IM 34M06P41-01E     | Personal Computer Link Commands                                                                                | F3LE12-0T<br>F3SP□□<br>F3GB01-0N |

### ■ Software

| New /Revised   | Document Number | Document Name                                                        | Applicable software |
|----------------|-----------------|----------------------------------------------------------------------|---------------------|
| Revised        | IM 34M06Q16-01E | FA-M3 Programming Tool WideField3 – Introduction and Troubleshooting | SF630               |
| Revised        | IM 34M06Q16-02E | FA-M3 Programming Tool WideField3 – Offline Functions                | SF630               |
| Revised        | IM 34M06Q16-03E | FA-M3 Programming Tool WideField3 – Online Functions                 | SF630               |
| New            | IM 34M06Q16-04E | FA-M3 Programming Tool WideField3 – Script Functions                 | SF630               |
| Revised        | IM 34M06Q30-01E | FA-M3 ToolBox Manual                                                 | SF66□               |
| Revised        | IM 34M06Q31-02E | FA-M3 ToolBox for Temperature Control and Monitoring Modules         | SF661               |
| Revised        | IM 34M06Q31-01E | FA-M3 ToolBox for Positioning Modules (for F3NC32/34)                | SF662               |
| <b>NEW</b> New | IM 34M06Q31-02E | FA-M3 ToolBox for Positioning Modules (for F3YP22/24/28)             | SF663               |

\*1: These documents are supplied with the software package as PDF files. Please procure paper documentation separately if required.

## Other New Products

## Positioning Modules (with multi-channel pulse output)

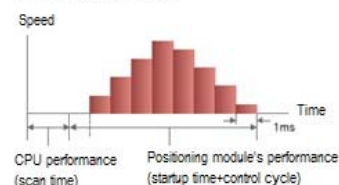
- F3YP22-0P (2 axes) **NEW**
- F3YP24-0P (4 axes) **NEW**
- F3YP28-0P (8 axes) **NEW**

### Cutting time loss in positioning control!

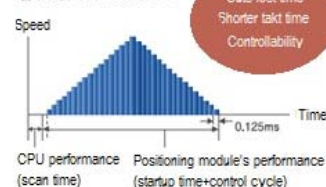
- Industry's fastest control cycle of **0.125 ms**.  
Even smoother positioning control
- Industry's highest output pulse rate of **7.996 Mpps** max.  
Controls hi-speed, hi-precision linear motors and DDM
- Industry's highest input pulse rate **8 Mpps** max.  
High-speed pulse counter included  
Supports a wide range of applications
- Industry's top-of-class startup time from **40 μs**.  
Cuts time loss before positioning begins
- Ideal for use with FA-M3V (F3SP71/F3SP76)  
Support for fast scans



F3SP6X+F3YP1X



F3SP7X+F3YP2X



➤ A high-speed version of the F3SP28 (with 10K ladder steps) sequence CPU module is added to the FA-M3 product family.

- F3SP22-0S Sequence CPU module  
10K ladder steps, basic instruction 45 ns min., with memory
- Higher processing speed (from 45 ns for basic instructions) at the same price
- More instructions available (37 basic instructions and 324 application instructions)

