Fujitsu Microcontrollers welcome your unlimited ideas.

All for answering to any imaginations and requirements from designers.
Fujitsu Microcontrollers are advancing to be more convenient, more preferable, and more user-friendly.
Designers only need to express images in their minds over Fujitsu Microcontrollers.
Fujitsu Microcontrollers shape your imaginations into new values on your products.

[ Value1 Easy to Start ]
Anyone can use, anyone can buy

Start now
For an easy start with a Fujitsu microcontroller, we have prepared a starter kit with everything you need for development and evaluation. All you have to do is to install the integrated development environment SOFTUNE (evaluation version) and connect the BGM adaptor to your PC. You can start software development and evaluation from day one. Document downloads are available from the web site.

Speedy anytime
In addition to easy development, the key is speed. Market competitiveness is dependent on reduction in the lead time from development to mass-production. Fujitsu microcontrollers are produced domestically in Iwate and Aizu to offer flexibility for a small quantity of numerous models. Fujitsu's production system is focused on speed to help our customers' timely and stable release of their products.

[ Value2 Easy to Select ]
A stimulating variety of choice

From 8-pin to over 176-pin
Fujitsu has expanded its product range from the low-end 8-bit, mid-range 16-bit, and high-end 32-bit. The pin count ranges from small count 8-pin to large count over 176-pin. Also, there are various ROM sizes to choose from.

A model for any application
A wide range of choice for general household appliances, digital AV, PC peripherals, automotive, and industrial devices. Microcontrollers are classified into functions required by applications to help you in choosing the exact match for your idea.

[ Value3 Easy to Use ]
Program and hardware development made easier

Comprehensive support
More support for program development and software development engineers. One of them is our web site. You can easily obtain FAQ support, hardware manuals, data sheets, reference software, etc. not to mention a swift response to telephone and e-mail queries, proposals, and requests. We are also providing support for writing programs using third-party tools.

e-Learning from home
We are deploying e-Learning services on the web as a place to learn basics of microcontrollers for beginners. You can learn the basics of microcontrollers such as operations, peripheral functions, and programming with peripherals at your own pace.
**Flash Microcontroller**

- **Flash Microcontroller Features**
  - **Dual Operation Flash**
    - Freely able to program other Flash banks while executing a program.
    - Can replace E2PROM
  - **Flash Memory Reliability**
    - Guaranteed rewrites: Standard 10,000 times (separately guaranteed 100,000)
    - Data retention period: 20 years (Ta = +85°C)
    - Operating temperature range: Ta = -40°C to +85°C
    - (Can be certified for Ta = 105°C, 125°C support)

**FRAM Microcontroller**

FRAM microcontrollers are the next generation device. These microcontrollers are capable of high-speed writing with low power consumption. They are installed with FRAM which possesses both characteristics of ROM and RAM. Fujitsu Semiconductor is the first in the world to launch mass-production of 8-bit FRAM microcontroller the “MB95R203A”. This product is suitable for obtaining logs at detection of low-voltages and backing up digital devices.

- **FRAM Microcontroller Features**
  - **Retains data when the power is off**
    - The microcontroller retains data when the power is off since FRAM is non-volatile memory
    - High-speed byte-write
    - No special command required for erase and rewrite (overwritable)
    - Instant data rewrite even at an unpredicted power failure
  - **Stores programs and data in the FRAM area**
    - The FRAM area can be used as ROM or RAM
    - The ranges of ROM and RAM can be defined by the user
    - The user can write-protect desired areas (program-areas) and byte-write randomly to writable areas (data areas).
  - **Low power consumption**
    - FRAM does not require power to retain the data except when in operation
    - The data before turning off the power is instantly recovered after turning the power back on
Fujitsu ARM® Core Microcontroller FM3 Family is newly released!

Fujitsu Semiconductor Limited has newly added the FM3 Family of microcontrollers with the ARM® "Cortex™-M3 Core" to our existing lineup with Fujitsu original CPU cores. This family targets a variety of markets such as office automation, digital audio-visual, major home appliance, medical, security, factory automation, and industrial. Both "High Performance Line" product lineup to meet the demands of DSP ~ 32-bit class products and "Low Power Line" product lineup to meet the demands of 8- ~ 16-bit class products are available. The FM3 Family provides customers with an even easier to use and even more value-added product by inheriting the Flash technology and peripheral functions that were developed for products with original cores together with a built-in "Cortex™-M3 Core", which is optimal for the embedded market.
The FM3 family products are 32-bit general-purpose microcontrollers that employ the ARM Cortex-M3™ CPU core. The combination of ARM technology applying global CPU core with Fujitsu Semiconductor’s proprietary flash technology offers a complete product lineup suitable for industrial and consumer applications respectively.

### FM3 Family Features

- **Employing ARM Cortex-M3**
  1. Rich software library
  2. Development tools with creditable achievements of our partner vendors

- **Fujitsu Semiconductor’s unique flash technology**
  1. Program cycles: Maximum 100,000 cycles
  2. Data retention period: Maximum 20 years
  3. Supporting data protection functions

- **Rich variety of communication control macros**
  1. CAN communication macro
  2. USB communication macro (Host and Function)
  3. Ethernet communication macro

### Fujitsu Semiconductor’s proprietary flash technology

- **High reliability/high quality**
  - Program cycles: 100,000 cycles
  - Data retention: 20 years
  - High reliability: Employing the same technology as in-vehicle microcontrollers

- **Data protection function**
  - External data read is absolutely impossible!

- **High-speed flash**
  - High performance with zero-wait access

### FM3 family product lineup

- **High Performance Group**
  - Maximum operating frequency 144 MHz, Operating voltage 2.7 to 5.5 V
  - Ether, CAN, and USB IP

- **Basic Group**
  - Maximum operating frequency 40 MHz, Operating voltage 2.7 to 5.5 V
  - CAN and USB IP
  - Mass market model mainly for home appliances

- **Low Power Group**
  - Maximum operating frequency 40 MHz, Operating voltage 1.8 to 3.6 V
  - USB and LCDC IP
  - Energy-saving model for general home appliances

- **Ultra Low Leakage Group**
  - Maximum operating frequency 20 MHz, Operating voltage 1.8 to 5.5 V
  - LCDC IP
  - Low leakage model suitable for battery-driven applications

Customer developments are supported with development tools which respective partner vendors have creditable achievements.

---

**Notes:**

- ARM is a registered trademark of ARM Limited in the EU and other countries.
- Cortex-M3 is trademark of ARM Limited of ARM Limited in the EU and other countries.
The FR family are 32-bit RISC controllers with Fujitsu original architecture whose functions are optimized for embedded device control. These microcontrollers are widely used in fields such as digital home electronics, PC peripherals, and vehicles, and are the optimal microcontrollers for applications that demand high speed computer processing functions.

**FR CPU Features**
- High-performance 32-bit RISC microcontroller
  1) High-speed operation using 5-stage pipeline processing
  2) Parallelization of processing by separation of the instruction, data, and resource buses
- Low power consumption operation
  1) Delivering low clock rates by high unit performance functions through increased MIPS value
  2) The operating frequencies of each of the CPU, built-in peripheral function, and external bus can be configured separately to suit the customer system
- Instruction set optimized for embedded applications
  1) Delivering compact object sizes with 16-bit instruction length
  2) A variety of bit processing instructions and addressing instructions
  3) Delayed-branch instructions (reduces branch processing overhead)

**FR80/FR81S Features**

**FR80 Features**
- Built-in high-performance FR80 core
  CPU performance increased by more than 30% compared to the FR60 core
  Inherits the instruction set from existing FR
- Built-in 8-channel DMAC
  Capable of highly efficient data transfer to reduce CPU load
- Crossbar switch bus
  • Instructions in Flash memory and data in RAM can be accessed simultaneously
  • Even while the CPU is accessing instructions in Flash memory, the DMAC can access data in RAM
- Multi-layer bus
  • Data can be transferred by DMAC at the same time that CPU instructions are executed
  Example: CPU: External bus
  DMAC: Peripheral bus

**FR81S Features**
- ECC (Error Correction Coding)
  Flash memory with an ECC function
- FPU (Floating Point Unit)
  IEEE 754 compliant
  Single-precision
- MPU (Memory Protection Unit)
  Suitable up to 8 areas (areas can be overlapped)
  The areas can be set by the page address and page size (16K x 2n)
- On-chip debug unit
  Enables debugging with a single wire

**FR80 product lineup**
- Lineup includes a wide range of memory and pin counts
  Supports a wide range of models to suit customer applications
- Built-in high-speed A/D converter (conversion time: approx. 1.2 µs)*
  FR80 series (144/176 pin models) have two 32-channel A/D converters
  (Supports simultaneous conversion)
  Supports continuous A/D conversion with built-in 16-stage FIFO
- Built-in multichannel serial interface (maximum 12 channels)
  Able to support a variety of serial interfaces
  (SPI/UART/I2C mode)
  4 channels equipped with 16-byte receive FIFO and 16-byte transmit FIFO
- Maximum of 26 pins with 5V withstand voltage
  Can be connected to 5V peripheral I/O output ports without a level shifter
- Lineup includes products supporting USB full-speed
  Product with built-in Function and Host
  * Varies depending on the operating frequency and external circuit conditions.

**FR Family Lineup**
- Built-in PLL clock circuit
  Can be set to a maximum of 20 times multiplication
  (for products guaranteed for an 80 MHz operating frequency)
- Built-in DMAC and multiply and accumulate circuit that can operate in parallel with CPU processing
- Built-in cache memory focusing on ROM less products
- Lineup of a wide variety of Flash memory microcontrollers
  Maximum 2MB built-in Flash memory
- Wide range of peripheral functions
  USB (Function, Mini-Host, Full-Host), FlexRay, MediaLB, CAN, SPI, 1-bit A/D

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  Enables debugging with a single wire
### Fujitsu Microcontrollers

#### Family: 32-bit MICROCONTROLLER

<table>
<thead>
<tr>
<th>ROM (byte)</th>
<th>48pin</th>
<th>64pin</th>
<th>100pin</th>
<th>120pin</th>
<th>128pin</th>
<th>144pin</th>
<th>176pin</th>
<th>208pin</th>
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<th>320pin</th>
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<td>128K</td>
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</tbody>
</table>

### ROM-less MICROcontroller

<table>
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<tr>
<th>ROM (byte)</th>
<th>48pin</th>
<th>64pin</th>
<th>100pin</th>
<th>120pin</th>
<th>128pin</th>
<th>144pin</th>
<th>176pin</th>
<th>208pin</th>
<th>216pin</th>
<th>320pin</th>
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<tr>
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</tr>
</tbody>
</table>

### Applications

- Flash ROM product
- Mask ROM product
- ROM-less products

### Lead pitch

<table>
<thead>
<tr>
<th>Lead pitch (mm)</th>
<th>Package name</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>TQFP-100P</td>
<td>12 x 12 x 1.5</td>
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<tr>
<td>0.5</td>
<td>LFQFP-100P</td>
<td>14 x 14 x 1.5</td>
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<tr>
<td>0.65</td>
<td>LFQFP-100P</td>
<td>16 x 16 x 1.5</td>
<td></td>
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<tr>
<td>0.8</td>
<td>LFQFP-100P</td>
<td>20 x 20 x 1.5</td>
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</tr>
</tbody>
</table>

### Dual Operation Flash

- Under developing
- Under planning

---

**Note:** The document is structured to provide comprehensive information about Fujitsu's 32-bit microcontroller families, including their pin counts, ROM sizes, and application functionalities. The table and diagram illustrate the wide lineup of pin counts and ROM sizes available, with a focus on 32-bit capabilities. The lead pitch details offer specific package information for each size.
The F2MC-16FX family are Fujitsu original microcontrollers. A wide variety of products are available, from automotive products that support CAN networks to systems controllers and subcontrollers for audiovisual equipment, household appliances, office equipment, and industrial equipment. The F2MC-16FX family are the optimal products that support CAN networks to systems controllers and subcontrollers for audiovisual equipment.

**FMC-16FX • 16-bit MICROCONTROLLER**

The FMC-16FX family are Fujitsu original microcontrollers. A wide variety of products are available, from automotive products that support CAN networks to systems controllers and subcontrollers for audiovisual equipment, household appliances, office equipment, and industrial equipment. The FMC-16FX family are the optimal products that support CAN networks to systems controllers and subcontrollers for audiovisual equipment.

- **FMC-16FX CPU Features**
  - CPU operating frequency: Up to 56 MHz
  - Basic instructions execute in one cycle: Example) (16-bit x 16-bit) - 4 cycles (16LX: 11 cycles)
  - Division (16-bit x 8-bit) - 9 cycles (16LX: 15 cycles)
  - High-speed processing using a 5-stage pipeline and instruction queue (8 Bytes)
  - High-speed interrupts: Interrupt handling time (start time): 10 cycles (16LX: 24 cycles)
  - High-performance interrupts: Increased transfer speed of simple DMA transfers
  - Built-in CR oscillator clock for the system wake-up signal.
  - Low power consumption operation by CR oscillator clock

- **FMC-16FX Current Consumption**
  - Operating at 24 MHz: 56% (60% includes CPU & Memory)
  - Operating at 4 MIPS: 75% (60% includes CPU & Memory)

- **FMC-16LX CPU Features**
  - Built-in PLL clock circuit: High-speed processing with operating frequencies up to 33 MHz
  - Wide variety of communication functions: USB (Full-Speed Function, Host), CAN, UART, SIO, I²C
  - Various clock gear settings using PLL division function: Highly efficient power management by low-speed clock with high-speed operation PLL and frequency division function (indicates the clock gear setting)
  - Lineup includes a wide range of products from 48 pins to 144 pins
  - Lineup includes a wide range of products that support an external bus
  - Program patch function (achieves zero faulty MASK products in production)

**Product Lineup (FMC-16FX Family)**

- Wide lineup that are easy to choose to suit the application
  - Built-in CAN products (Single CAN to Triple CAN)
  - Built-in USB Full-Speed products (Support Function and Host)
  - Support 3.0 V to 5.5 V system power supplies

A development environment is available that is common to all 16FX.

**FMC-16LX • 16-bit MICROCONTROLLER**

- Built-in PLL clock circuit: High-speed processing with operating frequencies up to 33 MHz
- Wide variety of communication functions: USB (Full-Speed Function, Host), CAN, UART, SIO, I²C
- Various clock gear settings using PLL division function: Highly efficient power management by low-speed clock with high-speed operation PLL and frequency division function (indicates the clock gear setting)
- Lineup includes a wide range of products from 48 pins to 144 pins
- Lineup includes a wide range of products that support an external bus
- Program patch function (achieves zero faulty MASK products in production)
### Wide Lineup of Pin Counts and ROM Sizes

<table>
<thead>
<tr>
<th>Number of pins</th>
<th>48pin</th>
<th>64pin</th>
<th>80pin</th>
<th>100pin</th>
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</tr>
</tbody>
</table>

#### Memory Sizes
- **ROM**: 8K, 16K, 32K, 64K, 128K, 256K, 512K, 1K
- **RAM**: 2K, 4K, 8K, 16K, 32K, 64K, 96K, 128K, 256K

#### Package Options
- **LQFP**: 48P, 64P, 80P, 100P, 120P, 144P
- **QFP**: 64P, 80P
- **SH-QFP**: 64P, 80P

---

### Fujitsu Microcontrollers
- **Development assistance tools**
- **Product selection**
- **Applications**
- **Functionality**

---

**Note**: This table summarizes various product specifications, including memory capacities, pin counts, package types, and sizes. It provides a comprehensive view of the product lineup, allowing for easy comparison and selection based on specific requirements.
The New 8FX family are Fujitsu original microcontrollers. These microcontrollers are used in a wide range of applications and products, including system control of small household appliances and subsystem control of digital home appliances, and factory automation equipment.

### New 8FX CPU Features
- **CPU operating frequency**: Up to 16.25MHz
- **Minimum instruction execution time**: 61.5 ns
- **Offers a high-speed instruction execution cycle**
  - Example: Multiplication (8-bit x 8-bit) - 16 cycles
  - Division (16-bit ÷ 16-bit) - 17 cycles
- **Interrupt levels**: 4 levels
- **Clock control unit offers a wide range of operating frequencies**
  - Built-in PLL multiplier circuit
  - Built-in divider circuit

### New 8FX product features
- **Cost reduction by using third-party parts**
  - Oscillator
  - Main CR oscillator circuit
  - Sub built-in CR oscillator circuit
  - Reset IC
  - Low-voltage detection circuit (LVD)
  - eProm
  - Dual operation flash enabling eProm emulation
- **Flash memory security**
  - Customer software resources are protected by the flash security function.
- **Watchdog timer and clock supervisor counter**
  - The watchdog timer and clock supervisor counter constantly monitor the CPU and external clock by a built-in CR oscillator.

### Product lineup [New 8FX MB9S20H, MB9S30H, MB9S400 series]
- **Handy low pin count series**
  - 8-pin to 80-pin product lineup
  - Suitable for small system control and as a sub-microcontroller
  - Can be used for power supply management to reduce power consumption
- **Comprehensive development environment**
  - Starter kit consists of an evaluation board, BGM adapter, and an evaluation version of SOFTUNE.
- **Supports single wire on-chip debugging**
- **Abundant technical information on the web**
- **FRAM microcontrollers in the lineup**
  - MB9S200 series
- **High quality flash memory**
  - Standard 10,000 (individual guarantee 100,000) rewritings
  - Data retention period: 20 years

### Low voltage detection reset
When the operating voltage drops, a reset occurs automatically.

### Voltage drop
Because the interrupt voltage and reset voltage can be set separately, voltage errors can be processed in an interrupt routine before the reset.
<table>
<thead>
<tr>
<th>Package name</th>
<th>D×W×H(mm)</th>
<th>Lead pitch (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QFN-32P</td>
<td>5×5×0.75</td>
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<tr>
<td>LQFP-32P</td>
<td>10×10×1.5</td>
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<td>BCC-44P</td>
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<tr>
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Number of pins

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<tr>
<th>Number of pins</th>
<th>8pin</th>
<th>16pin</th>
<th>20pin</th>
<th>24pin</th>
<th>28/30pin</th>
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<th>48pin</th>
<th>52pin</th>
<th>64pin</th>
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<td>20K</td>
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<td>60K</td>
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<td>32K</td>
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Number of pins

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<thead>
<tr>
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<th>28/30pin</th>
<th>32pin</th>
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<td>8K</td>
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Package name

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<th>D×W×H(mm)</th>
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<tr>
<td>QFN-32P</td>
<td>5×5×0.75</td>
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<tr>
<td>LQFP-32P</td>
<td>10×10×1.5</td>
<td>0.65</td>
</tr>
<tr>
<td>BCC-44P</td>
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<td>0.65</td>
</tr>
<tr>
<td>DIP-28P</td>
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<td>0.81</td>
</tr>
<tr>
<td>LQFP-44P</td>
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<td>1.27</td>
</tr>
<tr>
<td>QFP-44P</td>
<td>14×20×3.0</td>
<td>1.778</td>
</tr>
<tr>
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<td>2.54</td>
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Package name

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<tr>
<th>Package name</th>
<th>D×W×H(mm)</th>
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<tbody>
<tr>
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<tr>
<td>LQFP-100P</td>
<td>14×14×1.5</td>
<td>2.54</td>
</tr>
</tbody>
</table>
Expanding the possibility of applications

Fujitsu Semiconductor microcontrollers

Digital audio-visual
- Players/ recorders
- Home theaters
- Digital TV, etc.

Home appliances
- Air conditioners
- Refrigerators
- Washing machines
- Microwave ovens, etc.

32-bit
- MB91260B series
- MB91265A series
- MB91470 series
- MB91490 series

16-bit
- MB90460 series
- MB90820B series

8-bit
- MB95200 series
- MB95300 series

Automotive
- Dashboard
- Navigation systems
- Body control modules, etc.

Industrial equipment
- Robots
- Inverter control
- Automatic vending machines
- Medical equipment

PC peripheral devices
- Printers
- Scanners
- Notebook PCs
- Multifunction printers, etc.

32-bit
- MB91635A series
- MB91645A series
- MB91665 series

16-bit
- MB9130A series
- MB90335 series
- MB90880 series

8-bit
- MB95100AM series
- MB95120MB series
- MB95130MB series

Fujitsu Microcontrollers
Product Selection by Application
Built-in CAN microcontroller features

CAN is an abbreviation of Controller Area Network, and is a standardized network protocol proposed by Robert Bosch GmbH. CAN was originally developed as a LAN for automotive systems; however, it is being watched with keen interest from various areas due to its reliability and sophisticated error detection.

1. High-speed access (up to 1 Mbps)
2. Error detection
3. Short message structure
4. Multi-master
5. Bus access priority order

Overview

- High-speed processing by the high-performance 32-bit CPU core “FR81S”

The MB91590 series and MB91570 series deploy the “FR81S” which is 30% faster than the Fujitsu’s previous 32-bit CPU core “FR60”.

- High-performance “FR81S” CPU core
- ECC (Error Correction Coding)
- FPU (Floating Point Unit)
- IEEE 754 compliant
- Single-precision
- MPU (Memory Protection Unit)
- Settable up to 8 areas (areas can be overlapped)
- The areas can be set by the page address and page size (16KB x 2n)

- Built-in graphics display controller
- Built-in sprite engine
- Capable of using 512 sprites of up to 512 x 512 dots
- A special sprite function which offers the three types of operations as blinking, auto movement, and image switching without any CPU intervention is also available.
- Built-in frame buffer memory for graphics (VRAM) 260 KB to 800 KB
- Built-in video capture decoder that can directly input an NTSC signal (also supporting input of digital RGB/YUV)
- Communication interface for automotive as standard
- CAN
- Number of message buffers: 32 msg (2ch) + 64 msg (1ch)
- Multi-function serial interface
- Selectable from LIN, UART, SIO, and I²C
- On Chip Debug Unit
- An On Chip Debug Unit is implemented on the debug interface. Enables debugging with a single wire on the actual device.
- Key specifications
- Maximum operating frequency: CPU: 128 MHz (oscillation=4.0 MHz, 32 multiplication <PLL clock multiplication method>)
- *The MB91570 has a maximum of 80 MHz
- Package: 208-pin (MB91590), 144-pin (MB91570)
- Flash capacity: 576 KB to 1088 KB + WorkFlash 64 KB
- RAM capacity: 48 KB to 72 KB

Features

- Built-in CAN microcontroller features
- CAN is an abbreviation of Controller Area Network, and is a standardized network protocol proposed by Robert Bosch GmbH.
- CAN was originally developed as a LAN for automotive systems; however, it is being watched with keen interest from various areas due to its reliability and sophisticated error detection.

MB91590/MB91570 series

- High-speed access (up to 1 Mbps)
- Error detection
- Short message structure
- Multi-master
- Bus access priority order

Dashboard (MB91590 series) system block diagram

- Built-in CAN microcontroller features
- CAN is an abbreviation of Controller Area Network, and is a standardized network protocol proposed by Robert Bosch GmbH.
- CAN was originally developed as a LAN for automotive systems; however, it is being watched with keen interest from various areas due to its reliability and sophisticated error detection.

MB91460 Series Product Lineup

- High-performance FR80 core, Maximum operation frequency: 100 MHz
- Wide lineup suitable for automotive system control such as the dashboard, car audio, and body control modules.
- AUTOSAR support
- AEC-Q100 compliance
- Built-in CAN microcontroller features
- CAN is an abbreviation of Controller Area Network, and is a standardized network protocol proposed by Robert Bosch GmbH.
- CAN was originally developed as a LAN for automotive systems; however, it is being watched with keen interest from various areas due to its reliability and sophisticated error detection.

Fujitsu Microcontrollers
FlexRay is a next-generation vehicle-mounted network protocol. FlexRay supports high reliability, high-performance control (maximum communication speeds of up to 10Mbps), and has drawn attention in a wide range of fields as a next-generation, high-performance automotive network protocol aimed at X-by-Wire replacement of mechanical control systems with electronic control systems.

The standardization of FlexRay as a next-generation vehicle-mounted communication protocol is being promoted by the FlexRay Consortium.

**FlexRay features**

- Vehicle-mounted LAN communication for X-by-Wire (limit of CAN)
- Time Trigger Protocol
- Max 10Mbps
- Communication protocol considering high reliability → Demanded by X-by-Wire applications
  - Supports completely duplicated networks (redundant communication)
  - Scheduling monitoring (bus guardian)
- Supports flexible topologies
  - Supports Bus, Star, and Hybrid topologies
  - Segment structure: static and dynamic segment

**Built-in FlexRay microcontrollers**

**Features**

- Built-in FlexRay controller macro from Robert Bosch GmbH supporting FlexRay Protocol Ver 2.1
- Supporting FlexRay communication speeds of 10Mbps, 5Mbps, and 2.5Mbps
- Built-in PLL oscillator circuit exclusively used for FlexRay system clock

**FlexRay MCU roadmap**

**MB91F465X block diagram**

- MCU with FlexRay
- ASSP (Standalone CC)
Built-in USB microcontroller features
USB is an abbreviation of Universal Serial Bus.
In recent years, support for USB interfaces has been spreading to various devices.
Fujitsu Semiconductor is expanding our lineup of microcontrollers with built-in USB Function (compliant with USB Full-Speed).
Products are also available with built-in simple Host functionality, making it possible to implement a system that can use a USB interface even without a PC.

FAMILY MB91660 series

- Overview
  The MB91660 series of high-performance 32-bit USB microcontrollers has a built-in FR80 core, improving the CPU processing performance by approximately 1.3 times over previous Fujitsu products.

- Features
  - FR80 high-performance 32-bit RISC CPU core
    Inherits the instruction set from previous FR products
  - Maximum CPU operating frequency: 33MHz
  - USB Full-Speed (12Mbps) compliant USB Function
    Flash memory built into the microcontroller can be programmed via the USB interface
  - USB Host Full-Speed (12Mbps)
    Offers connectivity with USB devices even without a PC
  - Slave interface
    A USB interface can be added to a system by connecting this microcontroller via the slave interface to a host CPU that does not have USB
  - Supports driver software (USB Function, USB Host) from Interface Corporation

- Sample label printer application: system block diagram

Series lineup

- Devices with USB connectivity
  - Printers
  - Scanners
  - Notebook PCs
  - SLR cameras
  - Stereos
  - Scales
  - FA devices
  - Measuring devices
**Built-in LCD controller microcontroller features**

LCDs (Liquid Crystal Displays) are widely used as the display device in general home appliances and digital home applications. Fujitsu offers a lineup of microcontrollers with built-in LCD controller for embedded systems that require an LCD display.

1. Selectable frame cycle
2. Supports 4-common output/40 segment LCD (maximum)
3. Lit/not-lit is set by display RAM data

**Overview**

An 8-bit microcontroller with a built-in LCD controller. This product has a built-in LCD controller and operates at 3V. This also supports human interface control applications such as LCD display units and key input in general home appliances such as refrigerators and microwave ovens.

**Features**

- The display clock source can be selected from the main and sub clocks. The frame rate can also be selected from 4 patterns
- 40 segment x 4 common output
- Able to display a maximum of 160 characters
- Blinking control function
- Offers hardware controlled blinking, reducing software load
- Selectable from:
  - 1/2 bias, 1/2 duty
  - 1/3 bias, 1/3 duty
  - 1/3 bias, 1/4 duty
- Built-in resistance divider
  - Contributes to reducing the number of parts

**Sample application in microwave oven: system block diagram**

- Door switch
- Various key inputs
- Cooking temperature
- Oven temperature
- Various sensors
- Heater control
- Turntable control
- Buzzer

---

**Series lineup**

**New 8FX MB95310L series**

- **Overview**
  - An 8-bit microcontroller with a built-in LCD controller. This product has a built-in LCD controller and operates at 3V. This also supports human interface control applications such as LCD display units and key input in general home appliances such as refrigerators and microwave ovens.

- **Features**
  - The display clock source can be selected from the main and sub clocks. The frame rate can also be selected from 4 patterns
  - 40 segment x 4 common output
  - Able to display a maximum of 160 characters
  - Blinking control function
  - Offers hardware controlled blinking, reducing software load
  - Selectable from:
    - 1/2 bias, 1/2 duty
    - 1/3 bias, 1/3 duty
    - 1/3 bias, 1/4 duty
  - Built-in resistance divider
    - Contributes to reducing the number of parts

---

**Values in parentheses are number of segments x number of common**

**New 8FX • 8 bit MICROCONTROLLER**

<table>
<thead>
<tr>
<th>Number of pins (pin)</th>
<th>48</th>
<th>52</th>
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<td></td>
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<tr>
<td>MB9S160(16×4)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>MB9S370L(32×4)</td>
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<td></td>
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<td></td>
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<tr>
<td>MB9S310L(40×4)</td>
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**New 8FX • 16 bit MICROCONTROLLER**

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<td>265K</td>
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<td>256K</td>
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<td>MB9S140M(32×4)</td>
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</tr>
<tr>
<td>MB9S310L(40×4)</td>
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**New 8FX • 32 bit MICROCONTROLLER**

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<tr>
<td>MB9S310L(40×4)</td>
<td></td>
<td></td>
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</tbody>
</table>
Features of microcontrollers for inverter control

This product is equipped with a variety of timers suitable for inverter control and a high-performance A/D converter suitable for feedback control in order to meet demands for energy efficiency in general home appliances such as air conditioners, washing machines and driers, refrigerators, induction cookers, etc.

1) Built-in multifunction timer capable of three-phase PWM control
2) The functionality that suits the application can be freely selected from a variety of timers (PPG, PWM, PWC, input capture) using the built-in base timer
3) Built-in multi-unit multi-channel high-performance A/D converter that can operate in conjunction with the multifunction timer and DMAC
4) Built-in dedicated high-speed multiply and accumulate calculation macro that can perform vector calculation processing in parallel with the CPU

Example application to air conditioner outdoor unit: system block diagram

- Air conditioners
- Refrigerators
- Washing machines
- Industrial motors
Development assistance tools (software tools)

Development environment solution: Fujitsu AUTOSAR development environment

About AUTOSAR

AUTOSAR (Automotive Open System Architecture) is a standardization organization established in July 2003 mainly by Daimler-Chrysler, BMW AG, Robert Bosch GmbH in order to modularize and commoditize automotive software. The AUTOSAR software platform was prepared as a solution for the demands for in-vehicle system software and is being investigated by various OEM and ECU manufacturers for its application to in-vehicle software.
- Standardizing software frameworks
- Standardizing design processes
- Commonizing and modularizing application software by introducing a common runtime environment (RTE)
- Providing a microcontroller abstraction layer (MCAL) that absorbs the hardware differences and commoditizes upper layer software

Scalable AUTOSAR compliant with HIS recommended specifications

The Herstellerinitiative Software (HIS) software initiative was established by five German automobile manufacturers Audi, BMW, Daimler, Porsche, and Volkswagen in order to assist with ECU related standardized software and modules, process maturity, software testing, software tools, and programming. Scalable AUTOSAR compliant with HIS recommended specifications provides guidelines for implementing BSW functions optimized for small size without violating the AUTOSAR specifications and contributes to cost reductions.

System configuration example

![System configuration example](image)

Product line-up

<table>
<thead>
<tr>
<th>Parts</th>
<th>Version</th>
<th>Provided by</th>
<th>Support MCU</th>
</tr>
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<tbody>
<tr>
<td>OS/BSW</td>
<td>R2.0/2.1</td>
<td>Elektrobit, Vector, KFIT, etc.</td>
<td>MB91460 series (32-bit), MB96300 series (16-bit), etc.</td>
</tr>
<tr>
<td>R3.0/3.1 HIS recommended version</td>
<td>Elektrobit, Vector, KFIT, etc.</td>
<td>MB91460 series (32-bit), MB96300 series (16-bit), etc.</td>
<td></td>
</tr>
<tr>
<td>MCAL</td>
<td>R2.0/2.1</td>
<td>Elektrobit and Fujitsu Semiconductor</td>
<td>MB91460 series (32-bit), MB96300 series (16-bit), etc.</td>
</tr>
<tr>
<td>R3.0/3.1 HIS recommended version</td>
<td>Fujitsu Semiconductor</td>
<td>MB96300 series (16-bit)</td>
<td></td>
</tr>
</tbody>
</table>

Development assistance tools

Scalable AUTOSAR compliant with HIS recommended specifications provides guidelines for implementing BSW functions optimized for small size without violating the AUTOSAR specifications and contributes to cost reductions.

AUTOSAR product roadmap

![AUTOSAR product roadmap](image)

Types of AUTOSAR MCAL

Examples in AUTOSAR MCAL R3.0 for F2MC-16FX

<table>
<thead>
<tr>
<th>Product name</th>
<th>AUTOSAR MCAL R3.0 for F2MC-16FX*</th>
<th>Description</th>
<th>Usage period</th>
<th>Storage period</th>
<th>Area</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Evaluation license</td>
<td>SP36080241EVC</td>
<td>Can only be used by customers for evaluations.</td>
<td>3 months</td>
<td>None</td>
<td>Limited countries</td>
<td>No source code</td>
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<tr>
<td>Development license</td>
<td>SP36080241QAC</td>
<td>Can only be used for customer’s test integration.</td>
<td>Unlimited</td>
<td>World wide</td>
<td>World wide</td>
<td>Source code available</td>
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<tr>
<td>Development license with source</td>
<td>SP36080251QAC</td>
<td>Can only be used for customer’s mass-production integration.</td>
<td>Unlimited</td>
<td>World wide</td>
<td>World wide</td>
<td>Source code available</td>
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<tr>
<td>Production license with source</td>
<td>SP36080261QAC</td>
<td>Can only be used for one product.</td>
<td>Unlimited</td>
<td>World wide</td>
<td>World wide</td>
<td>Source code available</td>
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<tr>
<td>Basic Support Service</td>
<td>-</td>
<td>Bug support - Version upgrade and manual support</td>
<td>6 months</td>
<td>Limited countries</td>
<td>Included as standard with Development/Production license</td>
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<tr>
<td>Basic Upgrade Support Service</td>
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<td>Extended the period of basic support (6 months)</td>
<td>6 months</td>
<td>Limited countries</td>
<td>Extends the basic support by 6 months to have the support for 12 months. Can only be purchased once.</td>
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</tr>
<tr>
<td>Extended Support Service</td>
<td>-</td>
<td>- Version upgrade and manual support - Phone and email support</td>
<td>12 months</td>
<td>Limited countries</td>
<td>Included as standard with Development/Production license</td>
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<tr>
<td>Premium Support Service</td>
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<td>- Version upgrade and manual support - Phone and email support</td>
<td>24 months</td>
<td>Limited countries</td>
<td>Included as standard with Development/Production license</td>
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</table>
Fujitsu Semiconductor provides "REALOS" the real-time OS that complies with the industry-standard µITRON specifications and "µT-REALOS" the real-time OS that complies with the µT-Kernel specifications. Configurator and Analyzer are available as the tools for assisting with efficient development of application programs using the REALOS kernel. Configurator, OS-aware tools (under planning), and ITRON Extension (under developing) are provided for the µT-REALOS kernel.

Configurator features

- Employs projects
  The development environment can be easily structured both for a single person performing multiple tasks in parallel or for a single developer within a group by using project files.
- Offers superior usability
  1. Editor provided as standard
     The standard built-in editor offers a wide variety of functionality, including syntax highlighting and auto-indenting.
  2. Jump to errors and online help
     Errors that occur during a build are displayed in an output window at the bottom of the screen. It is easy to jump to the tag or display the error details from the errors displayed here.
  3. Capable of operating with commercial editors
     Capable of integrating commercial editors to meet the wishes of users wanting to use an editor with more functionality. (Mites V1.0/V3.0, WZ Editor, Hidemaru, Power Editor, CodeWright32, TextPAD32, etc.)
- Customizable working environment
  The development environment is able to be customized by the developer, such as by working with source control tools when sharing files, or calling file format conversion tools.
- Debugging functions
  Supports all three kinds of debuggers required in the various stages of development: emulator debugger, monitor debugger, simulator debugger. The optimal debugging environment can be selected to suit the conditions.

Analyzer and OS-aware tool (under planning) features

- Analyzer and OS-aware tool are debugging support tools for systems incorporating REALOS.
- They graphically display the states of tasks and objects being used and task state transitions.
- This allows for grasping the system operations.
- Configuration information definitions
- Configuration information consistency checks
- OS size computation
- System configuration in GUI format

ITRON Extension (under developing) features

ITRON Extension is middleware for supporting µITRON specification system calls. This enables to run applications that use µITRON system calls in combination with µT-REALOS.

Overall Development Environment Solution: SOFTUNE Integrated Development Environment

- Program development for integrated systems consists of a repeating cycle of coding, building, and debugging. Fujitsu Semiconductor provides the SOFTUNE Integrated development environment to perform these operations smoothly, and each individual operation can be conducted reliably.
- Integrated development environment delivering simple operability and high efficiency.
- Resolves complicated configuration procedures during program development.
- Works in conjunction with a variety of tools that support seamless development with SOFTUNE.
- Professional Pack evaluation version available for download: http://jp.fujitsu.com/microelectronics/support/

Features

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Development assistance tools (software tools)

Overview

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- Resolves complicated configuration procedures during program development
- Works in conjunction with a variety of tools that support seamless development with SOFTUNE

Features

- Employs projects
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     Capable of integrating commercial editors to meet the wishes of users wanting to use an editor with more functionality. (Mites V1.0/V3.0, WZ Editor, Hidemaru, Power Editor, CodeWright32, TextPAD32, etc.)
- Customizable working environment
  The development environment is able to be customized by the developer, such as by working with source control tools when sharing files, or calling file format conversion tools.
- Debugging functions
  Supports all three kinds of debuggers required in the various stages of development: emulator debugger, monitor debugger, simulator debugger. The optimal debugging environment can be selected to suit the conditions.
Fujitsu Semiconductor provides development tools such as emulators and adapters for developing software for the FR family and FM4C family.

**Features of the MB2100-01-E emulator**
- Debug using a flash microcontroller on a mass-production board
- Connect to the flash microcontroller using a single wire coaxial cable
- Read from and write to memory without stopping the CPU
- Connect to a flash microcontroller at up to 10 m
- Configure traces and multiple events
- Security function with password
- Compact size 84.8mm x 53.6mm x 21.3mm, 70.3g
- Connect using USB 2.0 High Speed
- The power supply is USB bus-powered
- Power supply isolation
- Supports all flash microcontrollers that includes the single-wire coaxial cable debugging interface

**System Configuration**
- United States Integrated Development Environment (Debugger)
- Communication speed maximum 12Mbps
- Single-wire coaxial connection (maximum 10m)
- Built-in debugging circuit
- Dedicated DMA for debugging
- Pre-mounted USB cable (included)

**External view of system**
- Mass production board of target device
- Flash microcontroller
- CPU
- BGM adapter
- USB bus
- Workbench Emulator debugging software
- Integrated Development Environment ( Debugger )

**Features of the MB2146-08-E (BGM adapter)**
- Supports microcontroller operating voltages of +2.9 to +5.5V
- Compact development environment, with small lightweight BGM adapter
- Debugging possible over single-wire serial
- Because the monitor program executes in a dedicated memory space, it does not consume any of the user memory space
- Built-in continuous execution, step execution, and forced break functions
- Software breakpoints: 256 points
- Host interface: Able to connect using USB1.1

**System Configuration**
- Pre-mounted on the evaluation board
- Personal computer
- Workbench Emulator debugging software
- Integrated Development Environment

**External view of system**
- MB2146-08-E
- MB2146-4xx-E
- MB95200 series
- BGM adapter
- USB cable (included)
- Pre-mounted on the evaluation board
- Mass-production product

Fujitsu Microcontrollers Development assistance tools (hardware tools)
Features of the MB2198-01-E emulator

• Supported DSU: DSU3, DSU4
• Power supply voltage: Supports linear +2.7V to +5.5V
  (The upper and lower limits on the microcontroller operating voltage and operating
  frequency vary between each of the devices. For the operating voltage and operating
  frequency of each MCU, see the documentation related to that device (data sheet,
  hardware manual, etc.).)
• Capable of source-level debugging (assembler, C, mixed display)
• Simple GUI operation using pull-down menu buttons
• Real-time trace function
• Multiple window display, including source code, variables, registers, memory, trace, etc.
• Hardware break x 5, Software break x 4096, Code event x 2, Data event x 2
• Execution cycle measurement function
• Host interface: Equipped standard with RS-232C (max. 115kbps),
  LAN (10BASE-T, 100BASE-TX), and USB1.1

External view of system
Features of the MB2147-01-E (version that supports high speeds)

- Supports a maximum microcontroller operating frequency of 33MHz
- Supports microcontroller operating voltages of +2.7V to +5.5V
  (The upper and lower limits on the microcontroller operating voltage and operating frequency vary between each of the devices. For the operating voltage and operating frequency of each MCU, see the documentation related to that device (data sheet, hardware manual, etc.).)
- Emulator memory (1M x 4 areas)
- Capable of source-level debugging (assembler, C, mixed display)
- Simple GUI operation using pull-down menu buttons
- On-the-fly function (execute commands during microcontroller execution)
- Powerful real-time trace function
- Multiple window display, including source code, variables, registers, memory, trace, etc.
- Event triggers that allow a wide variety of conditions to be specified (code x 8, data x 8)
- Sequential control by sequencer (4 conditionals, 3 levels)
- Performance measurement function (function to measure the execution time between 2 points, measure elapsed cycles)
- C0 coverage measurement function (measures program execution coverage)
- Host interface: Equipped standard with RS-232C (max. 115kbps), LAN (10BASE-T, 100BASE-TX), and USB1.1

System Configuration

External view of system

Development assistance tools (hardware tools)
Fujitsu Semiconductor provides evaluation boards for developing embedded systems equipped with the FR family and F'MC family.

Evaluation Board for FR Family MB91590 (MB2198-751-E)

**Features**
This is an evaluation board supporting the Fujitsu Semiconductor FR family MB91590 series. Equipped with RF and D-sub video inputs, D-sub video output, CAN/LIN/UART I/O, LEDs, and switches (detachable). This board contributes to improving the development efficiency because it can perform a simplified evaluation of operations before a mounting attempt in a customer's system.

Evaluation Board for the FR Family and F'MC-16LX/FX (BBF2004)

**Features**
This is an evaluation board manufactured by Sunhayato that supports the F'MC-16LX/FX and FR family. This makes it possible to perform simple operational testing of the MCU before embedding it into your system, contributing to increased development efficiency. This board is made up of a main board and a daughter board. By changing the daughter board, this evaluation board can be used to perform debugging using tools that incorporate an emulator debugger (ICE), to evaluate microcontrollers with built-in flash memory, and as a serial writer. The main board is common to all models, and can support different models by changing the daughter board.

The Jouet Bleu (Blue Toy) is a microcontroller starter kit for people learning about microcontrollers and embedded systems. It can be used as an effective tool for educating students and new recruits about developing embedded software.

**Features**
- Microcontroller board equipped with a high-performance 16-bit microcontroller
- Software development environment
- Enables learning about microcontrollers from the basics to applications
- Notebook PCs can be used for software development

New 8FX MB95200 Series Starter Kit

This is a starter kit for the New 8FX MB95200 series of Fujitsu low pin count 8-bit microcontrollers. The MB95200 series starter kit includes a BGM adapter and evaluation board, and is optimal for evaluating performance and functionality and testing operation before embedding an MCU into users' system. The SOFTUNE V3 integrated development environment (evaluation version), various sample software, application notes, etc. are available on the Fujitsu Semiconductor website and can be downloaded free of charge.

The following two starter kits are available:
- Starter kit with FRAM microcontroller: MB2146-430A-01-E
- Starter kit with Flash microcontroller: MB2146-420A-01-E

**FRAM microcontroller evaluation board**
This evaluation board is equipped with an FRAM microcontroller as the target MCU together with a variety of peripheral resources. The target MCU can be evaluated easily by connecting using a BGM adapter. This board is included in the FRAM Microcontroller Starter Kit (MB2146-430A-01-E).
- Equipped with an MB95R203A (8 KByte FRAM, 496 Byte RAM)
- Board functions
  - Buzzer, temperature sensor, LED, serial (RS-232C), interrupt button, LIN/UART pins, I'C, BGM adapter pins

**Flash microcontroller evaluation board**
This evaluation board is equipped with a Flash microcontroller as the target MCU together with a variety of peripheral resources. The target MCU can be evaluated easily by connecting using a BGM adapter. This board is included in the Flash Microcontroller Starter Kit (MB2146-420A-01-E).
- Equipped with an MB95F264K (20 KByte Flash, 496 Byte RAM)
- Board functions
  - Buzzer, temperature sensor, LED, interrupt button, serial (RS-232C), LIN/UART pins, BGM adapter pins

FR80 MB91665 Series USB Evaluation Kit (MB91972EVB-1/MB91972EVB-2)

**Features**
This is a USB evaluation kit supporting Fujitsu Semiconductor 32-bit FR80 family MB91665 series microcontrollers. This kit can run USB host and USB function application software using Fujitsu Semiconductor original USB microcontroller middleware.

The evaluation kit includes the following:
- USB middleware (sample)
- Application software (sample)
- Evaluation board
- Integrated development environment
Bits pot* is a series of microcontroller boards that allows you to easily get to know, evaluate, and study microcontrollers. There is a series of five-color boards equipped with the microcontroller providing how to learn in-vehicle network technology, CAN, LIN, FlexRay and USB I/F using each of the 8-, 16-, and 32-bit New 8FX/16FX/FR microcontrollers. A combination of the kits can easily construct in-vehicle networks, control USB devices in a standalone configuration, etc. Furthermore, the development environment, test books, and sample software required for developing software can all be downloaded from the website, creating a starter kit that allows you to study in-vehicle networks and USB from the basics to applications.

* "bits pot" means putting a lot of things (functions) in a small jar (board).

Developer: TSUZUKI DENSAN Co., Ltd.
2-5-3, Nishi-shinbashi, Minato-ku, Tokyo, 105-8420, Japan
E-mail : pd-bitspot@tsuzuki-densan.co.jp
URL : http://www.tsuzuki-densan.co.jp/bitspot/

Kit for Learning CAN communication and brushless DC motor control (bits pot red)
CAN-MOTOR [CAN-100]
- Microcontroller: 32bit-FR60Lite MB91F267N
  - Brushless DC motor control using MOTOR driver circuit
  - Motor control using temperature sensor
  - Connecting with bits pot white, it controls the motor by the CAN communication.

Kit for Learning LIN communication (bits pot yellow)
LIN [LIN-100]
- Microcontroller: 8bit-F/MC-8FX MB95F136J
  - Buzzer output control using slide volume
  - LED control using temperature sensor
  - Connecting with bits pot white, it communicates by LIN using LIN slave sample software (supports LIN 2.0*)
* : Does not support config, diag, etc.

Kit for Learning CAN-LIN communication (bits pot white)
CAN-LIN [CAL-100]
- Microcontroller: 16bit-F/2MC-16FX MB96F356
  - Basic function of board by SW operation (LED, 7seg, temperature sensor, and buzzer)
  - Control motor and receive motor RPM and temperature sensor information using CAN communication with a bits pot red
  - Connecting with bits pot white, it communicates by LIN using LIN master sample software (supports LIN2.0*)
*2: Does not support config, diag, etc.

Kit for Learning FlexRay communication (bits pot blue)
FlexRay [FLR-100] Note: One set consists of two boards.
- Microcontroller: 32bit-FR60 MB91F465X
  - Basic function operation of FR60 MB91460 series
  - Understand the FlexRay communication specifications by connecting two bits pot blue
  - The bus evaluation is also possible with the FlexRay transceiver (austriamicrosystems company’s AS8221C).
  - Connecting with bits pot red or blue, it communicates by CAN.

Learning CAN/LIN communication with a particular aim is also possible by combining with a bits pot white (CAN-LIN), bits pot red (CAN-Motor), or bits pot yellow (LIN), and sample programs are also available depending on the combination.

The bits pot blue (FlexRay) has two board per set, allowing you to quickly learn FlexRay, which is the next generation in-vehicle network technology.
This section introduces the development supporting tools for developing embedded systems for the FM3 family, FR family, and FMC family.

### Tools supporting FM3 Family (ARM Cortex-M3 core)

<table>
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<tr>
<th>Vendor</th>
<th>Debugger</th>
<th>Overview</th>
<th>Compiler support</th>
<th>Emulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computex</td>
<td>CSIDE</td>
<td>This inherits the PARMICE idea and actualizes comfortable operations throughout its ease of use such as compatibility and connections without any dedicated power. In addition, this supports multiserial, Serial Wire Debug (SWD) and Serial Wire Viewer (SWV) by ARM CoreSight™ technology, and Embedded Trace Macrocell (ETM).</td>
<td>IAR, KEIL, GNU</td>
<td>PALMICE3, J- Stick</td>
</tr>
<tr>
<td>IAR Systems</td>
<td>EWARM</td>
<td>Embedded Workbench for ARM is a development environment with integrated C/C++ compiler, assembler, linker, editor, and C-SPY® debugger that allows a user to perform the full sequence of operations from creating a project to editing files, compiling, assembling, linking, and debugging applications.</td>
<td>IAR’s ISO C/C++ and Embedded C++</td>
<td>AnsysICE, ARM RealView ICE, J-Link, Microsuit Wiggler, and RDI-based JTAG interface</td>
</tr>
<tr>
<td>KEIL</td>
<td>uVISION4 (MDK-ARM)</td>
<td>This is an integrated software development environment for microcontrollers based on Cortex-M, Cortex-R, ARM 7, and ARM 9 that also supports the use of full-spec real-time OS and libraries for networking, file systems, and peripherals.</td>
<td>ARM, GNU &amp; EABI-compliant</td>
<td>ULINK2, ULINK3pro, Segger J-link</td>
</tr>
</tbody>
</table>

### Tool supporting FR Family and FMC Family (Fujitsu original core)

#### Integrated Development Environments

<table>
<thead>
<tr>
<th>Product name</th>
<th>Overview</th>
<th>Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFTUNE</td>
<td>An integrated development environment that is user-friendly and highly-efficient. - Integrates language tools and debugger tools that increase the efficiency of the work cycle of coding, compiling, and debugging - Interpreters with a variety of tools, supporting seamless development with SOFTUNE.</td>
<td>Fujitsu Semiconductor Limited <a href="http://jp.fujitsu.com/fsl/en/">http://jp.fujitsu.com/fsl/en/</a></td>
</tr>
<tr>
<td>MULTI 5.0</td>
<td>MULTI 5.0 is an integrated development environment that supports each of the phases in the process of system development. It consists of a compiler, builder, editor, debugger, etc. and is GUI-based, focusing on ease of use. This provides a total solution that increases the reliability, safety, and performance of developed products and contributes to shortening development times and reducing development costs through various functions and new technologies such as the DoubleCheck static source code analysis tool and TimeMachine dynamic analysis tool.</td>
<td>Advanced Data Controls Corp. TEL: +81-3-3576-5351 <a href="http://www.adac.co.jp/">http://www.adac.co.jp/</a></td>
</tr>
</tbody>
</table>
### Real-Time Operating System

<table>
<thead>
<tr>
<th>Product name</th>
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<th>Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFTUNE REALOS</td>
<td>- A JTRON compliant real-time OS for the Fujitsu FMC16FX/FR family microcontrollers. Can be used for a broad range of development, from products with tight resource limitations to large-scale systems. An analyzer is included as a debugging support tool.</td>
<td>Fujitsu Semiconductor Limited <a href="http://g.fujitsu.com/fsl/en/">http://g.fujitsu.com/fsl/en/</a></td>
</tr>
<tr>
<td>SOFTUNE oTREALOS</td>
<td>- A JKernel compliant real-time OS for the Fujitsu FR family of microcontrollers. The kernel overhead is extremely small, making it optimal for products that demand power-saving functionality and real-time performance. An analyzer is included as a debugging support tool.</td>
<td>Fujitsu Semiconductor Limited <a href="http://g.fujitsu.com/fsl/en/">http://g.fujitsu.com/fsl/en/</a></td>
</tr>
<tr>
<td>EB tresos</td>
<td>EB, which is a full member of JASPAR that is working to standardize electronic control unit (ECU) software evaluation work and vehicle-mounted LAN interface ratings, provides the EB tresos ECU development tool for AUTOSAR compliant vehicle-mounted products. EB tresos AutoCore/AUTOSAR compliant middleware (BSW and RTE). Graphical user interface for EB tresos Studio and embedded software configuration. Real-time OS for AUTOSAR compliant real-time OS.</td>
<td>Elektrobit Nippon KK TEL: +81-3-5775-6160 <a href="http://www.elektrobit.com/">http://www.elektrobit.com/</a></td>
</tr>
<tr>
<td>osCAN</td>
<td>osCAN is a pre-emptive, real-time, multitasking operating system that has the optimal functions for operating on a microcontroller. Features: - Seamless integration with CAN/based from Vector. - Wide range of supported processors. - Static OS that is compact and fast. - All OS objects can be specified using a graphical configuration tool before compilation. - Conforms to OSIX/VDOX/2, providing long-term usability and stability.</td>
<td>Vector Japan Co., Ltd. TEL: +81-3-5769-6972 Embedded software department <a href="http://www.vector-japan.co.jp/">http://www.vector-japan.co.jp/</a></td>
</tr>
<tr>
<td>MICROSOAR product group (AUTOSAR embedded software product)</td>
<td>Configuration: - MICROSOAR RTE: AUTOSAR RTE - MICROSOAR BSW: AUTOSAR Basic software - MICROSOAR Configuration Suite/MICROSOAR EAD: AUTOSAR BSW configurator set Features: - Strong experience and track record with previous CAN/bdedded and osCAN products. - Full BSW supporting AUTOSAR specification release 3.0. - Covers applications from development to ECU implementation in concert with the DaVinci Tool Suite (from prototypes and evaluation units to mass production products). - Can be configured in combination with MCAL from other manufacturers or EAD. - Full featured technical service and training, assistance migrating to AUTOSAR, etc.</td>
<td>Vector Japan Co., Ltd. TEL: +81-3-5769-6972 Embedded software department <a href="http://www.vector-japan.co.jp/">http://www.vector-japan.co.jp/</a></td>
</tr>
<tr>
<td>KPIT AUTOSAR BSW Package</td>
<td>This software package consists of BSW (basic software) for the hardware-independent layer optimized for &quot;FMC-16FX Family&quot; and the ECU Spectrum integrated tool for generating ECU configuration and RTE (AUTOSAR Runtime Environment). Features of this software package include the code size optimization for 16-bit microcontrollers with small ROM sizes, and it allows AUTOSAR to be introduced even on ECU with small configurations regardless of ROM sizes.</td>
<td>KPIT Cummins Infosystems Limited TEL: +81-3-6913-8501 <a href="http://www.kpitis.com/japanese/index.html">http://www.kpitis.com/japanese/index.html</a></td>
</tr>
</tbody>
</table>

### Middleware

<table>
<thead>
<tr>
<th>Product name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>RELC</td>
<td>- This is a data compression and decompression library. It can be incorporated into devices using microcontrollers. - Useful for reducing transfer time and packet communication time. - Useful for efficient usage of flash memory and write time reduction. - Employs a Fujitsu Laboratories’ lossless data compression method that is secure in terms of compression patents. - The decompression function is also available as a hardware macro.</td>
<td>Fujitsu Electronics Inc. <a href="http://g.fujitsu.com/fsl/en/">http://g.fujitsu.com/fsl/en/</a></td>
</tr>
<tr>
<td>Mult Dev File Access Library(MDF) for FR V03</td>
<td>- Used for handling PC-compatible data on a target embedded device. - Because the embedded device and PC data are managed in the same files and directories, it is easy to pass data between PCs and embedded devices. - Supports exFAT, which is employed in the &quot;SDXC&quot; the large capacity SD card standards.</td>
<td>Fujitsu Semiconductor Limited <a href="http://g.fujitsu.com/fsl/en/">http://g.fujitsu.com/fsl/en/</a></td>
</tr>
<tr>
<td>Cryptography and security library</td>
<td>Library for encryption (AES ECB/ CBC, AES CTR, DES, 3DES, RSA, RSA-OAEP), hash functions (SHA-1, SHA-2, MD5), message authentication (HMAC SHA-1, HMAC MD5, AES OMAC1), digital signatures (DSA, ECDSA, RSA-PSS, PKCS#1v1.5), pseudo random number generation (FIPS186-2 Appendix A.1), key exchange (DH, ECDO), and modular exponentiation arithmetic.</td>
<td>Fujitsu Semiconductor Limited <a href="http://g.fujitsu.com/fsl/en/">http://g.fujitsu.com/fsl/en/</a></td>
</tr>
<tr>
<td>JPEG library</td>
<td>- This is middleware that performs compression and decompression (non-reversible) of image data in compliance with the DCT method baseline and process from the JPEG standards.</td>
<td>Fujitsu Semiconductor Limited <a href="http://g.fujitsu.com/fsl/en/">http://g.fujitsu.com/fsl/en/</a></td>
</tr>
<tr>
<td>KASAGO (TCP/IP stack)</td>
<td>- This is a TCP/IP protocol stack (supports IPv4/IPv6 dual stacks) specialized for embedded systems. Focusses on compactness and fast responsiveness to deliver efficient communication.</td>
<td>Zuken Elkemi, Inc. TEL: +81-45-654-5171 <a href="http://www.elkemi.co.jp/">http://www.elkemi.co.jp/</a></td>
</tr>
<tr>
<td>CANdriver</td>
<td>- Provides a hardware independent interface to the upper level software layer, making it possible to use and reuse components without regard to the hardware platform. Parameters for initializing the hardware can be configured in advance using a settings/generation tool.</td>
<td>Vector Japan Co., Ltd. TEL: +81-3-5769-6972 (Embedded software department) <a href="http://www.vector-japan.co.jp/">http://www.vector-japan.co.jp/</a></td>
</tr>
<tr>
<td>LINdriver</td>
<td>- Satisfies all requirements of the current LIN specifications (supports LIN 1.2/3 and LIN 2.0). Enables simple implementation of a CAN-LIN gateway when combined with the Vector CAN/bdedded component.</td>
<td>Vector Japan Co., Ltd. TEL: +81-3-5769-6972 (Embedded software department) <a href="http://www.vector-japan.co.jp/">http://www.vector-japan.co.jp/</a></td>
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</table>

### Analysis Tools

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<tr>
<th>Product name</th>
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<th>Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGRelief</td>
<td>This is a static analysis tool for identifying bugs in C/C++ source code. - Identifies bug locations from data structures and processing flows. - Checks conformance with SEC coding standards and MISRA-C guidelines. - Analysis is performed by integration with SOFTUNE make/build, allowing checking and correction of bugs by simple operations.</td>
<td>Fujitsu Software Technologies Limited TEL: +81-45-475-5600 <a href="http://g.fujitsu.com/fei/services/pg/">http://g.fujitsu.com/fei/services/pg/</a></td>
</tr>
<tr>
<td>QAC/MCM</td>
<td>QAC is a static analysis tool for C source code that is used to improve the quality of software. - MCM is an optional product for QAC that can evaluate conformance with MISRA C coding standards. - QAC/MCM integrates with SOFTUNE make/build to check violations of standards, etc.</td>
<td>Toyo Corporation Software Solutions TEL: +81-3-3245-1248 <a href="http://www.toyo.co.jp/">http://www.toyo.co.jp/</a></td>
</tr>
</tbody>
</table>
## CASE Tools

<table>
<thead>
<tr>
<th>Product name</th>
<th>Overview</th>
<th>Inquiries</th>
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</thead>
<tbody>
<tr>
<td>IBM Rational Rose® Technical Developer</td>
<td>Supports the most powerful model-driven development, such as executing models and generating completely executable code. This allows developers of specialist systems and embedded systems to also realize a high level of productivity.</td>
<td>IBM Corporation <a href="http://www-01.ibm.com/software/awdtools/technical/">http://www-01.ibm.com/software/awdtools/technical/</a></td>
</tr>
<tr>
<td>IBM Rational Test RealTime™</td>
<td>This is a cross-platform solution for component testing and runtime analysis. In particular, this is for developers writing code for embedded, real-time, and other types of cross-platform software products.</td>
<td>IBM Corporation <a href="http://www-01.ibm.com/software/awdtools/test/realtime/index.html">http://www-01.ibm.com/software/awdtools/test/realtime/index.html</a></td>
</tr>
<tr>
<td>Telelogic Statemate</td>
<td>Statemate is a graphical modeling toolset for system engineers. This offers powerful support for the upper development processes by functions for graphically modeling request specifications, detailed specifications, and function specifications.</td>
<td><a href="http://www-01.ibm.com/software/products/0056040/">http://www-01.ibm.com/software/products/0056040/</a></td>
</tr>
<tr>
<td>Visual STATE</td>
<td>This is a tool for designing using state charts, generating code, testing, and creating documents for embedded applications.</td>
<td>IAR Systems <a href="http://www.iarsys.co.jp/">TEL: +81-3-5298-4800</a></td>
</tr>
<tr>
<td>MATLAB/Simulink®</td>
<td>MATLAB provides functions and analysis environment for efficiently developing scientific calculation programs. Simulink is a simulation environment for efficiently designing and verifying real-time systems that runs in MATLAB. Algorithms designed based on models using Simulink can be automatically converted into C code for embedded systems using Real-Time Workshop Embedded Coder; MATLAB/Simulink can perform advance evaluation of C code for embedded systems using PIL simulation by interoperating with the SOFTUNE debugger.</td>
<td>MathWorks Japan <a href="http://www.mathworks.co.jp/">TEL: +81-3-3867-6700</a></td>
</tr>
<tr>
<td>ZIPC</td>
<td>This is a CASE tool that uses extended hierarchical state transition chart design methods. C source is automatically generated from the state transition chart.</td>
<td>CATS Co. Ltd. <a href="http://www.zipc.com/">TEL: +81-45-473-2816</a></td>
</tr>
<tr>
<td>SystemDesk</td>
<td>Designs AUTOSAR compliant software components and graphically models hardware independent software architectures. Automatically generates the AUTOSAR definition file, and interoperates with the TargetLink automatic code generation tool to create RUNNABLE. Configuring the network between ECU and assigning functions to multiple ECU can be easily performed using this tool, and the AUTOSAR runtime environment is automatically generated for each ECU. Interoperates with BWL tools such as Tressos (EB) to create production SW packages.</td>
<td>dSPACE Japan <a href="http://www.dspace.jp/">TEL: +81-3-5798-5460</a></td>
</tr>
<tr>
<td>TargetLink</td>
<td>Directly generates C code for mass production from MATLAB/Simulink/Stateflow. Generates ANSI C code efficiently that is suitable for the code developed by an actual programmer. Embedded simulation and test environment that uses an actual processor. Further optimized for the processor. Can generate AUTOSAR compliant code</td>
<td>dSPACE Japan <a href="http://www.dspace.jp/">TEL: +81-3-5798-5460</a></td>
</tr>
</tbody>
</table>

## Verification Tools

<table>
<thead>
<tr>
<th>Product name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CANoe</td>
<td>CANoe is an all-round tool for developing, testing, and analyzing networks and ECU, and supports users throughout the entire development process.</td>
<td>Vector Japan Co., Ltd. <a href="http://www.vector-japan.co.jp/">TEL: +81-3-5769-6972</a></td>
</tr>
<tr>
<td>CANAnalyzer</td>
<td>CANAnalyzer is a general-purpose analysis tool for distributed network systems that make it possible to easily monitor, analyze, and send messages on a network.</td>
<td>Vector Japan Co., Ltd. <a href="http://www.vector-japan.co.jp/">TEL: +81-3-5769-6972</a></td>
</tr>
<tr>
<td>RAMScope</td>
<td>RAMScope is a unit for extracting in real-time the data from build-in RAM using debugging interfaces such as NBD, AUI, RTD, NEXUS that are incorporated in vehicle-mounted MCUs. Because the extracted RAM data is saved directly into PC memory a large amount of data can be accumulated, making it easy to analyze the operation of a control application.</td>
<td>Yokogawa Digital Computer Corporation <a href="http://www.yokogawa-digital.com/">TEL: +81-422-52-5698</a>(Instrument business vehicle instrument center) <a href="http://www.yokogawa-digital.com/">http://www.yokogawa-digital.com/</a></td>
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* IBM, Rational, Rational Rose, and Rational Test Realtime are trademarks of IBM Corporation USA in the USA and other countries.
Flash write support
Fujitsu Semiconductor provides a support environment for writing programs that is tailored to the needs of our customers from development through to mass production and shipping. The most efficient mass production method for you can be chosen based on delivery schedules and production volumes.

The case of delivery of products that have been programmed by
Fujitsu Semiconductor or an authorized agent

Request for pre-programmed products

Fujitsu Semiconductor factory
Fujitsu Electronics
Programming house
Pre-programmed products
Mounted by customer

Advantage: Large lots

The case of products programmed by the customer

Request for programming prior to mounting

Unprogrammed products
Programmed using a parallel writer
Mounted by the customer

Advantage: Short delivery time

Request for on-board programming

Unprogrammed products
Mounted by the customer
On-board programmer (programmed after mounting)

Advantages: Short delivery times, high maintainability

Pre-programmed device support

- **Programmed externally:** Can be handled by a programming house
  - Can also handle small programming volumes
  - Provides pre-programmed products with short delivery times
- **Pre-programmed products:** Can be programmed when shipped from the factory
  - Same shipping format as mask ROM products
  - Can handle short delivery times similar to mask ROM products

Programming before mounting support

- **Parallel writers for microcontrollers with built-in Flash**
- **Serial on-board writers**

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<tr>
<th>Serial on-board writers</th>
<th>New EPX (956352013)</th>
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 successive

Development assistance tools (writing programs)

Pre-programmed device support

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Programming before mounting support

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 successors
You can learn microcontroller basics such as microcontroller operations, peripheral functions, and programming using peripherals.


You can learn the following about microcontroller development.
- Features of embedded software
- Development steps
- Operations of microcontrollers
- Peripherals of a microcontroller

You can run the sample program used in the peripheral study on a Sunhayato 16-bit microcontroller starter kit jouet bleu to see the operation. The sample program is available for download from the e-Learning page.

Suitable for beginners and new developer training.

**Sunhayato Corp. jouet bleu page** : [http://www.sunhayato.co.jp/products_html/f2mc/index_e.html](http://www.sunhayato.co.jp/products_html/f2mc/index_e.html)