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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 get

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 8-pin to 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, automobiles, 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 launching e-Learning services for beginners from October. You can learn the basics of microcontrollers such as operations, peripheral functions, and programming with peripherals at your own pace.

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Features of Fujitsu Microcontrollers

Series Features
- Guaranteed flash memory rewrites: Standard 10,000 times (individual guarantee 100,000 times)
- Dual Operation Flash that can be rewritten during program execution
- Built-in FRAM microcontrollers in the lineup
- Use lead-free packages that comply with the RoHS directive (guaranteed operating temperature: standard products -40 to +85°C, automotive products -40 to +125°C)

Package Lineup

CPU Lineup

Flash Microcontroller

- 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 (separate 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 “MB9S5203A”. 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 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

FRAM family

Number of rewrites (compared to other companies)
- Other companies: 1000 rewrites
- Fujitsu Semiconductor: Guaranteed 100,000 rewrites

FRAM microcontroller

No boundary between ROM and RAM
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) A variety of bit processing instructions and addressing instructions
  - 2) 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

**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 (16KB x 2n)
- **On chip debug unit**
  - Enables debugging with a single wire

**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, 12-bit A/D

**New product lineup (FR80)**

- **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 16 channels)
  - Able to support a variety of serial interfaces (SPI/UART/IC 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.

*Many other models are planned.
## Wide Lineup of Pin Counts and ROM Sizes

<table>
<thead>
<tr>
<th>Package Name</th>
<th>D x W x H (mm)</th>
<th>Lead Pitch (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LQFP-48P</td>
<td>12 x 12 x 1.5</td>
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<tr>
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<tr>
<td>QFP-100P</td>
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<tr>
<td>FLGA-128P</td>
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### ROM Sizes

<table>
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<tr>
<th>ROM Size</th>
<th>Package Name</th>
<th>Number of Pins</th>
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<tbody>
<tr>
<td>48K</td>
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</tr>
<tr>
<td>1024K</td>
<td>MB91F471K</td>
<td>819K</td>
</tr>
</tbody>
</table>

### Lead Pitch

- **0.4 mm**: LQFP-48P, LQFP-64P, QFP-100P, FLGA-128P
- **0.8 mm**: LQFP-100P, LQFP-128P, QFP-100P, FLGA-128P

---

**Fujitsu Microcontrollers**
**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 audio visual equipment, household appliance, office equipment, and industrial equipment. The FMC-16FX family are the optimal microcontrollers for next-generation systems.

### FMC-16FX CPU Features

- **CPU operating frequency**: Up to 56 MHz
  - Minimum instruction execution time: 17.8 ns
- **Basic instructions execute in one cycle**
  - Example: Multiplication (16-bit x 16-bit) - 4 cycles (16LX: 11 cycles)
- **Division (16-bit ÷ 8-bit)** - 9 cycles (16LX: 15 cycles)

### Development Environment

- A development environment is available to suit application
- Products in production
- Support 3.0 V to 5.5 V system power supplies
- A development environment is available to suit application
- Common evaluation device

### 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 to suit application**
- Common evaluation device

### FMC-16FX Current Consumption

- **Operating at 4 MIPS**
  - The current consumption of the 16FX is approximately 1/4 that of the 16LX when compared at the same operating frequency (4 MIPS).
  - The current consumption of the 16FX is approximately 1/2 that of the 16FX when compared at the same operating frequency (4 MIPS).

### 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, SPI, I2C
- **Various clock gear settings using PLL division function**
  - Highly efficient power management by low-speed operation PLL and frequency division function (indicates the clock gearing.)
  - 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

### 16-bit Microcontrollers

<table>
<thead>
<tr>
<th>Number of pins</th>
<th>48pin</th>
<th>64pin</th>
<th>80pin</th>
<th>100pin</th>
<th>120pin</th>
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</tr>
</tbody>
</table>
8 bit Core

The FMC-8FX family are Fujitsu original microcontrollers. These microcontrollers can be 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.

FMC-8FX • 8 bit MICROCONTROLLER

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) - 8 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

Pipelining of internal devices
FMC-8FX family
Can perform instruction fetch and data access in one clock

Pipelining of internal devices
FMC-8L family (conventional 8-bit product)

Built-in PLL multiplier circuit (maximum 4 times multiplication) (MB95100 series)
Capable of internal high-speed operation with external low-speed clock

Hardware assisted reduced system power consumption
Interval counting of 125ns to 63sec (maximum) using a clock timer/clock counter implemented in hardware!

Cost reduction by using thirdparty parts
- Oscillator
- Main CR oscillator circuit (MB95200 series)
- Sub built-in CR oscillator circuit (MB95200 series)
- Reset IC
- Low-voltage detection circuit (LVD)
- EPPROM
- Dual operation flash enabling EPPROM emulation

Composite timer and serial communication function features
- "Composite timer" with user-selectable functionality
- Serial communication function
  Supports both high speeds and low speeds

Available communication transfer rates

Composite timer
- Sets the period and L pulse width of a square wave, or the H pulse width at a fixed period.
- This function counts a fixed interval.
- A square wave can also be output timed with the count.
- Detects the rising and falling edges of input pulses and can measure the H width/L width and period.
- Detects the rising and falling edges of input pulses and saves the count value at those times.

Product lineup (FMC-8FX MB95100 series)

Lineup of series that are easy to choose to suit the application
Lineup of products from 28 to 100 pins
Wide range of products with built-in LCD controllers and standard products
Support system power supplies of 1.8 to 5.5 V
Common development environment for the series
Provides a common evaluation device
High quality Flash memory
Standard 10,000 (individual guarantee 100,000) rewrites
Data retention period: 20 years

Product lineup (FMC-8FX MB95200 series)

Handy low pin count series
8-pin to 24-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 adaptor, and an evaluation version of SOFTTUNE
Supports single wire on-chip debugging

Abundant technical information on the web
FPGA microcontrollers in the lineup
FRAM microcontrollers in the lineup
High quality flash memory
Standard 10,000 (individual guarantee 100,000) rewrites
Data retention period: 20 years
Wide Lineup of Pin Counts and ROM Sizes

### 8-bit MICROCONTROLLER 8K

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<tr>
<th>Package Name</th>
<th>8-pin</th>
<th>16-pin</th>
<th>20/24-pin</th>
<th>28/30-pin</th>
<th>32-pin</th>
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</tr>
</tbody>
</table>

### Additional Information

- **Product name:** Flash ROM product
- **Product name:** MASK ROM product
- **Product name:** FRAM product

---

**Wide Lineup of Pin Counts and ROM Sizes**

- **Product selection**
- **Development assistance tools**
- **Functionality**
- **Applications**

---

**32/16/8-bit core lineup**

- **ROM, RAM, Pins**
- **Applications**
- **Functionality**
- **Development**
- **assistance tools**

---

**32/16/8-bit core lineup**

- **ROM, RAM, Pins**
- **Applications**
- **Functionality**
- **Development**
- **assistance tools**
Expanding the possibility of applications
Fujitsu Semiconductor microcontrollers

Digital audio-visual

- DVD players/recorders
- Home theaters
- Digital TV, etc.

PC peripheral devices

- Printers
- Scanners
- Notebook PCs
- Multifunction printers, etc.

Home appliances

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

Automotive

- Dashboard
- Car audio
- Body control modules, etc.

Industrial equipment

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

32-bit:
- MB91305 series
- MB91310 series
- MB91319 series
- MB91605A series
- MB91610 series
- MB91635A series
- MB91645A series
- MB91665 series
- MB91666 series

16-bit:
- MB91300 series
- MB90330 series
- MB90500 series
- MB90630 series

8-bit:
- MB95130A series
- MB95120 series
- MB91460 series
- MB96380 series
- MB90920 series
- MB90880 series

Development assistance tools

Product selection

32/16/8-bit core lineup
ROM, RAM, Pins
Applications
Functionality

Fujitsu Microcontrollers

Fujitsu Microcontrollers
**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

**Features**

- **High-speed processing by the high-performance 32-bit CPU core “FR81S”**
  The MB91770 series and MB91725 series deploy the “FR81S” which is 30% faster than the Fujitsu’s previous 32-bit CPU core “FR60”. The FR81S has superior operation performance at 1.3 MIPS/MHz being able to process large volume of information in real-time.

- **Overview**
  - High-speed processing by the high-performance 32-bit CPU core “FR81S”
  - CAN protocol ver. 2.0 A/B compliant
  - Number of channels: 2 to 6 channels (Varies depending on product.)
  - Number of message buffers: 32 to 128 (Varies depending on product.)
  - LIN-UART
  - LIN communication support
  - SPI communication support
  - Clock synchronous/asynchronous communication support
  - Maximum 4 Mbps

- **Built-in multi-unit high-speed A/D converter**
  - Minimum conversion time per channel: 3.0µs
  - Number of channels: 8 to 32 channels (Varies depending on product.)

- **Development environment and software resources can be reused between series**
  Development environment, including evaluation chip and ICE, is the same. Software resources can be reused because the peripheral functions and register maps have common specifications

---

**MB91460 series Product Lineup**

- **Features**
  - Vehicle-oriented communication interface built-in as standard
  - CAN
    - CAN protocol ver. 2.0 A/B compliant
    - Number of channels: 2 to 6 channels (Varies depending on product.)
    - Number of message buffers: 32 to 128 (Varies depending on product.)
  - LIN-UART
    - LIN communication support
    - SPI communication support
    - Clock synchronous/asynchronous communication support
    - Maximum 4 Mbps
  - Built-in multi-unit high-speed A/D converter
    - Minimum conversion time per channel: 3.0µs
    - Number of channels: 8 to 32 channels (Varies depending on product.)
  - Development environment and software resources can be reused between series
    - Development environment, including evaluation chip and ICE, is the same. Software resources can be reused because the peripheral functions and register maps have common specifications

- **MB91460 Series Product Lineup**

  - **Features**
    - High-performance FR81S core, Maximum operation frequency: 100 MHz
    - Wide range suitable for automotive system control such as the dashboard, car audio, and body control modules.
    - AUTOSAR support
    - AEC-Q100 compliance

---

**Dash board (MB91770 series) system block**

- Display brightness adjustment, etc.
- Multi-function serial interface
  - CAN
  - LIN-UART
  - I2C
  - UART
- Multi-function analog interface
  - A/D
  - Analog input
- Multi-function digital interface
  - Synchronous/timed
  - SPI
  - CAN

---

**Car air conditioner (MB91725 series) system block**

- Multi-function serial interface
  - CAN
  - LIN-UART
  - I2C
  - UART
- Multi-function analog interface
  - A/D
  - Analog input
- Multi-function digital interface
  - Synchronous/timed
  - SPI
  - CAN
Built-in CAN microcontrollers

Overview
The MB96300 series of high-performance 16-bit CAN microcontrollers offer power consumption of approximately 1/4 that of earlier Fujitsu products. Furthermore, the maximum operating frequency has been increased from 33 MHz to 56 MHz, and the processing performance has been increased approximately 5 times over earlier Fujitsu products by implementing a pipelining function.

Features
- Built-in high-performance 16-bit CPU core
- Object code and pin layout compatible with the FMC-16LX family
- Built-in CAN controller supporting 32 message buffers (C-CAN support)
- CPU performance approx. 2.5 times that of the 16LX at the same frequency

CPU core: CISC, 5-stage pipeline
RAM capacity: 12 kBytes to 24 kBytes
Internal operating frequency: 56 MHz (max)
Operating voltage: VCC=3.0V to 5.5V
Flash capacity: 288 kBytes to 544 kBytes

Series lineup

<table>
<thead>
<tr>
<th>Number of pins</th>
<th>48</th>
<th>64</th>
<th>80</th>
<th>100</th>
<th>120</th>
<th>144</th>
<th>176</th>
<th>208</th>
<th>320</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROM[Byte]</td>
<td>2112K</td>
<td>1152K</td>
<td>1088K</td>
<td>768K</td>
<td>576K</td>
<td>544K</td>
<td>512K</td>
<td>461K</td>
<td>416K</td>
</tr>
<tr>
<td>MB96320</td>
<td>MB96310</td>
<td>MB96300</td>
<td>MB96295</td>
<td>MB96290</td>
<td>MB96285</td>
<td>MB96280</td>
<td>MB96275</td>
<td>MB96270</td>
<td>MB96265</td>
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<tr>
<td>MB90940</td>
<td>MB90935</td>
<td>MB90930</td>
<td>MB90925</td>
<td>MB90920</td>
<td>MB90915</td>
<td>MB90910</td>
<td>MB90905</td>
<td>MB90900</td>
<td>MB90895</td>
</tr>
</tbody>
</table>

What is FlexRay
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)
  - 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
Built-in USB microcontroller features

USB is an abbreviation of Universal Serial Bus. Support for USB interfaces is continuing to grow in the variety of devices that connect to recent computers. Fujitsu Semiconductor is expanding our lineup of microcontrollers with built-in USB Function (compliant with USB2.0 Full-Speed: 12Mbps). 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.

**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**

**FAMILY **

<table>
<thead>
<tr>
<th>Device</th>
<th>Number of pins [pin]</th>
<th>ROM[Byte]</th>
<th>RAM[KB]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR16LX</td>
<td>48</td>
<td>1024K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>64</td>
<td>512K</td>
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<td></td>
<td>120</td>
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<td></td>
<td>144</td>
<td>256K</td>
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<tr>
<td></td>
<td>178</td>
<td>128K</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>64K</td>
<td></td>
</tr>
</tbody>
</table>

**Devices with USB connectivity**

- Printers
- Scanners
- Notebook PCs
- SLR cameras
- Stereos
- Scales
- FA devices
- Measuring devices
Built-in LCD controller microcontrollers

**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.

- Selectable frame cycle
- Supports 4-common output / 40 segment LCD (maximum)
- 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 5V. 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 × 4 common output
- Able to display a maximum of 160 characters
- Blinking control function

**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**

- Family: 32-bit MICROCONTROLLER
  - Number of pins [pin]
  - MB95120MB series
    - MB95120 (40×4)
    - MB95150M (16×4)
    - MB95160M (32×4)
    - MB95160 (32×4)
  - MB95120MB (32×4)
  - MB95120MB (40×4)

- Values in parentheses are number of segments × number of common
Microcontrollers for inverter control

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 dryers, 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

FAMILY MB91480 series

Overview

This microcontroller is aimed at 5V interface home electronics and is equipped with a Fujitsu original RISC CPU core. Offers a built-in 32-bit CPU core with a maximum operation processing rate of 80 MHz, a multifunction timer capable of three-phase PWM control, a high-performance A/D converter, and a dedicated 32-bit high-speed multiply and accumulate macro in order to offer inverter control for home appliances such as air conditioners, washing machines and dryers, refrigerators, and induction cookers.

Features

- CPU core: FR60 RISC, 5-stage pipeline
- Internal operating frequency: 80MHz
- Package: LQFP-100 (0.5mm pitch, 14mm × 14mm)
- Flash capacity: 512 kBytes
- RAM capacity: 32 kBytes
- Operating voltage: Vcc = 4.0V to 5.5V
- Main functions
  - Analog 8/10-bit A/D function (2 units × 4 channels , 1 unit × 10 channels)
  - Multifunction timer capable of controlling 2 motors (2 units)
  - 16-bit reload timer (2 channels)
  - 8/16-bit PPG timer function (16 channels × 8-bit, 8 channels × 16-bit)
  - 16/32-bit base timer function (4 channels × 16-bit, 2 channels × 32-bit)
  - Multiply and accumulate circuit (1 unit) (32-bit × 32-bit + 72-bit = 72-bit)

Example application to air conditioner outdoor unit: system block diagram

Motor control equipment

- Air conditioners
- Refrigerators
- Washing machines
- Industrial motors
Development environment solution: SOFTUNE integrated development environment

**Overview**
Program development for integrated systems consists of a repeating cycle of coding, building, and debugging. Fujitsu Semiconductors provides the SOFTUNE integrated development environment to perform these operations smoothly, and each individual operation can be conducted reliably:
- **8 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**

SOFTUNE Professional Pack evaluation version available for download
http://jp.fujitsu.com/microelectronics/support/

**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. (Mifes V1.0/V3.0, WZ Editor, Hidemaru, Power Editor, CodeWright/S2, 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.

Real-time OS: REALOS

**SOFTUNE REALOS**

Fujitsu Semiconductor provides the "REALOS" real-time OS which is compliant with the industry standard µITRON specifications, and the "µT-REALOS/FR" real-time OS optimized for embedded systems that has been migrated to the FR microcontrollers and is compliant with the µT-Kernel specifications. A configurator, multitasking debugger, and analyzer are available as assistance tools for improving the efficiency of developing application programs that use the REALOS kernel.

**Fujitsu MCU products with real-time OS support**

<table>
<thead>
<tr>
<th>MCU</th>
<th>µITRON spec</th>
<th>µT-Kernel spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR</td>
<td>REALOS/FR, REALOS/FR Spec.4</td>
<td>µT-REALOS/FR</td>
</tr>
<tr>
<td>F*MC-16LX</td>
<td>REALOS/907</td>
<td>-</td>
</tr>
</tbody>
</table>

**SOFTUNE Workbench multitasking debugger features**
Systems that use REALOS can be debugged by using the SOFTUNE Workbench multitasking debugger.
- Object state display
- Issue system calls
- Task trace function
- System call breakpoints
- Task dispatch breakpoints

**SOFTUNE REALOS configurator features**

Tool for constructing system programs that use REALOS. Allows kernel configuration to be performed by configuring setting following displayed screens.
- System configuration using a tree view format
- Definition of configuration data
- Integrity checking of configuration data
- OS size calculation

**SOFTUNE REALOS analyzer features**
Analyzer is an analysis tool for system programs that use REALOS. Graphically displays the performance and task state transitions of systems that incorporate REALOS. This allows the operation of the system to be understood visually.
- Object display
- Trace log (statistical information, transition diagrams)
- OS breakpoints
- Task context display
- Stack information display
- Issue system calls

Development assistance tools (software tools)

<table>
<thead>
<tr>
<th>Development assistance tools (software tools)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configurator Analyzer</td>
</tr>
<tr>
<td>Multitasking debugger</td>
</tr>
</tbody>
</table>

32/16/8-bit core lineup

<table>
<thead>
<tr>
<th>ROM, RAM, Pins</th>
<th>Applications</th>
<th>Functionality</th>
<th>Development assistance tools</th>
<th>Product selection</th>
</tr>
</thead>
</table>
**Development assistance tools (hardware tools)**

Fujitsu Semiconductor provides development tools such as emulators and adapters for developing software for the FR family and FMC 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 include the single-wire coaxial cable debugging interface

### System Configuration

**Communication speed**
- Maximum 50Mbps

**Flash microcontroller**
- Single-wire coaxial connection (maximum 10m)
- Built-in debugging circuit - Run to Break - Event setting - Trace (instruction & data)
- Dedicated DMA for debugging - Memory access

**Mass production board of target device**

**CPU**

**BGM adapter**
- Pre-mounted on the evaluation board

**Evaluation board (Starter kit)**
- MB2146-08-E

**Personal computer**
- Workbench Emulator (debugging software, SnipsG3 Professional pack)

**USB cable** (included)

**Mass production board of target device**

### System Configuration

**External view of system**

**Features of the MB2146-08-B (BGM adapter)**
- Supports microcontroller operating voltages of +2.9 to +5.5V
  - Upper and lower limits on 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.)
- 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

### External view of system
Development assistance tools (hardware tool)

**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, Data 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

**Features of the MB2198-01-E emulator**
- Supported DSU: 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 4, Software break x 2048, Data break x 4
- Execution cycle measurement function
- Host interface: Equipped standard with RS-232C (max. 115kbps), LAN (10BASE-T, 100BASE-TX), and USB1.1

**System Configuration**

**Example System Configuration for the MB96300 Series**

- Personal computer
- USB, LAN or RS-232C (crossover) Socket
- User target system
- Evaluation chip
- MB2198-500-E MB2198-5xx-E
- MB2198-01-E
- MB2198-xxx-E
- MB2198-xxx-xxx

*Optional product
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.).)
- Evaluator 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 conditions, 3 levels)
- Performance measurement function (function to measure the execution time between 2 points, measure elapsed cycles)
- CO coverage measurement function (measures program execution coverage)
- Host interface: Equipped with standard RS-232C, LAN (10BASE-T, 100BASE-TX), and USB1.1

System Configuration

External view of system

Features of the MB2146-09A-E (BGM adapter)

- 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.).)
- Compact development environment, with small lightweight BGM adapter
- Because the monitor program executes in a dedicated memory space, it does not consume any of the user memory space
- Supports continuous execution, step execution, instruction break, data break, and sequential break
- Time measurement
- RAM monitoring
- Capable of instruction trace (maximum 16 branches)
- Host interface: Able to connect using USB

System Configuration

External view of system
Evaluation board

Fujitsu Semiconductor provides evaluation boards for developing embedded systems equipped with an FR family F2MC.

### Evaluation Board for the FR Family and F2MC-16LX/FX (BBF2004)

**Features**
- This is an evaluation board manufactured by Sunhayato that supports the F2MC-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.

### Evaluation Board for the F2MC-8FX (MB95100) Series (MB2146-401)

**Features**
- This evaluation board supports the Fujitsu F2MC-8FX MB95100 series. This makes it possible to perform simple operational testing of the MCU before embedding it into your system, contributing to increased development efficiency. This evaluation board can be used to perform debugging using tools that incorporate an emulator debugger (ICE). This board can be used as a common evaluation board that supports each model of the F2MC-8FX MB95100 series.

### Microcontroller Starter Kit (Jouet Bleu)

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

---

**F2MC-8FX MB95200 Series Starter Kit**

This is a starter kit for the F2MC-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' systems. 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: MB2146-430-01-E
- Starter kit with Flash microcontroller: MB2146-410-01-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 (MB2146-430-01-E),

- Equipped with an MB95R203 (8 KByte FRAM, 496 Byte RAM)
- Board functions
  - Buzzer, temperature sensor, LED, serial (RS-232C), interrupt button, LIN/UART pins, I²C, 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 (MB2146-410-01-E),

- Equipped with an MB95F204K (16 KByte Flash, 496 Byte RAM)
- Board functions
  - Buzzer, temperature sensor, LED, interrupt button, serial (RS-232C), LIN/UART pins, BGM adapter pins
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 F2MC-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).

**Notes:**
- CAN-LIN: One set consists of two boards.
- CAN-MOTOR: Connecting with bits pot white, it controls the motor by the CAN communication.

### 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 USB (bits pot black)

**USB [USB-100]**
- **Microcontroller:** 32bit-FR80 MB91F662
  - Learn mouse function using HID class driver
  - Fabricate a humidity gauge using a humidity sensor
  - Learn about FRAM (ferroelectric memory)

### Kit for Learning LIN communication (bits pot yellow)

**LIN [LIN-100]**
- **Microcontroller:** 8bit-FMC-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*1)
  - *1: Does not support config, diag, etc.

### Kit for Learning CAN-LIN communication (bits pot white)

**CAN-LIN [CAL-100]**
- **Microcontroller:** 16bit-FMC-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 yellow, it communicates by LIN using LIN master sample software (supports LIN2.0*2)
  - *2: Does not support config, diag, etc.

### Kit for Learning FlexRay communication (bits pot blue)

**FlexRay [FLR-100]**
- **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.

**Notes:**
- Learning CAN/LIN communication with a particular aim is also possible by combining a bits pot red (CAN-LIN), 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.

---

**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/](http://www.tsuzuki-densan.co.jp/bitspot/)

---

**Product selection**

<table>
<thead>
<tr>
<th>32/16/8-bit core lineup</th>
<th>ROM, RAM, Pins</th>
<th>Applications</th>
<th>Functionality</th>
<th>Development assistance tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>32/16/8-bit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**32-bit**

**16-bit**

**8-bit**
Development assistance tools (development environment/OS/middleware/tools)

Fujitsu Semiconductor provides development support tools for developing embedded systems using FR and FMC.

### Integrated Development Environments

<table>
<thead>
<tr>
<th>Product name</th>
<th>Overview</th>
<th>Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>MULTIS.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 TimeMachien dynamic analysis tool.</td>
<td>Advanced Data Controls Corp. TEL: +81-3-3576-5361 <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>
<th>Overview</th>
<th>Inquiries</th>
</tr>
</thead>
</table>

### Middleware

<table>
<thead>
<tr>
<th>Product name</th>
<th>Overview</th>
<th>Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELC</td>
<td>• Data compression/decompression library that can be embedded in devices. • Compression reduces the time to read from Flash memory, and is useful for reducing the start-up time of digital home electronics, etc. • Utilizes a lossless compression scheme from Fujitsu Laboratories that can be embedded in products securely in terms of compression patents, quality, and support. • RELC delivers compression and decompression speeds approximately 2 times faster than the ZLIB free software. • The decompression function is also available as a hardware macro (RTL).</td>
<td>Fujitsu Electronics Inc. <a href="http://jp.fujitsu.com/fsl/en">http://jp.fujitsu.com/fsl/en</a></td>
</tr>
<tr>
<td>eFILES2</td>
<td>• This is a file system for embedded applications that has a broad track record for utilization in mobile phones, etc. • Supported MCUs are the Fujitsu FMC-16 family and FR family, with the ARM7 and 9 also supported for ASIC. • Supports FAT12, FAT16, FAT32 and VFAT, and also supports Japanese filenames. • Supports FAT and file system recovery functionality for power cuts. • Supports multiple drives, and can handle multiple devices/media simultaneously.</td>
<td>Fujitsu Electronics Inc. <a href="http://jp.fujitsu.com/fsl/en">http://jp.fujitsu.com/fsl/en</a></td>
</tr>
<tr>
<td>eTCP/IP</td>
<td>• eTCP/IP is a TCP/IP stack for embedded devices offering high compatibility, implementation in small amounts of memory, high performance, and finely detailed control. • Broad track record of utilization in wireless LAN projectors, printers, mobile phones, etc. • The interface supports the μT-KRON TCP/IP API and socket interface, delivers high compatibility between various platforms. • Supported MCUs are the Fujitsu FMC-16 family and FR family, with the ARM7 and 9 also supported for ASIC.</td>
<td>Fujitsu Electronics Inc. <a href="http://jp.fujitsu.com/fsl/en">http://jp.fujitsu.com/fsl/en</a></td>
</tr>
<tr>
<td>Multi Device File Access Library/MDF for FR V02</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.</td>
<td>Fujitsu Electronics Inc. <a href="http://jp.fujitsu.com/fsl/en">http://jp.fujitsu.com/fsl/en</a></td>
</tr>
<tr>
<td>Cryptography/Authentication library</td>
<td>• This is a library for cryptography (RSA, AES, DES, 3DES), authentication (SHA-1, MD5), and pseudo-random number generation (FIPS186-2) processing.</td>
<td>Fujitsu Electronics Inc. <a href="http://jp.fujitsu.com/fsl/en">http://jp.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 Electronics Inc. <a href="http://jp.fujitsu.com/fsl/en">http://jp.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. Focuses on compactness and fast responsiveness to deliver efficient communication.</td>
<td>Zuken Elmic, Inc. TEL: +81-45-664-5171 <a href="http://www.zukelinc.com">http://www.zukelinc.com</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 <a href="http://www.vector-japan.co.jp">Embedded software department</a></td>
</tr>
<tr>
<td>LINdriver</td>
<td>• Satisfies all requirements of the current LIN specifications (supports LIN 1.2/1.3 and LIN 2.0). • Enables simple implementation of a CAN/LIN gateway when combined with the Vector CANbridged component.</td>
<td>Vector Japan Co., Ltd. TEL: +81-3-5769-6972 <a href="http://www.vector-japan.co.jp">Embedded software department</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/MICROSAR EAD AUTOSAR BSW configurator set Features: • Strong experience and track record with previous CANbridged 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 • Fully featured technical service and training, assistance migrating to AUTOSAR, etc.</td>
<td>Vector Japan Co., Ltd. TEL: +81-3-5769-6972 <a href="http://www.vector-japan.co.jp">Embedded software department</a></td>
</tr>
</tbody>
</table>
Development assistance tools
(devolution environment/OS/middleware/tools)

■ Analysis Tools

<table>
<thead>
<tr>
<th>Product name</th>
<th>Overview</th>
<th>Inquiries</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCNetflex</td>
<td>This is a static analysis tool for identifying bugs in C/C++ source code.</td>
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<tr>
<td></td>
<td>- Identifies bug locations from data structures and processing flows.</td>
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<tr>
<td></td>
<td>- Checks conformance with CODE coding standards and MISRA-C guidelines.</td>
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<tr>
<td></td>
<td>- Analysis is performed by integration with SOFTUNE make/build, allowing checking and correction of bugs by simple operations.</td>
<td></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.</td>
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<tr>
<td></td>
<td>- MOM is an optional product for QAC that can evaluate conformance with MISRA-C coding standards.</td>
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<tr>
<td></td>
<td>- QAC/MCM integrates with SOFTUNE make/build to check violations of standards, etc.</td>
<td></td>
</tr>
</tbody>
</table>

Fujitsu Software Technologies Limited
TEL: +81-45-975-9887
http://jp.fujitsu.com/etl/services/page/

■ CASE Tools

<table>
<thead>
<tr>
<th>Product name</th>
<th>Overview</th>
<th>Inquiries</th>
</tr>
</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></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></td>
</tr>
<tr>
<td>Telelogic Rhapsody</td>
<td>Rhapsody is a development environment for improving the efficiency of model driven development (MDD) which promotes development focusing on &quot;models&quot; created using UML. Even among the uncountable development tools that use UML, this is a unique development environment that optimizes the development process specifically for embedded development.</td>
<td></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></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. Enables simply design under the concept of drawing a sketch, and reduces design man-hours.</td>
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<tr>
<td></td>
<td>- Errors detected in design upper phase using powerful formal verification tool</td>
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<tr>
<td></td>
<td>- Improves quality by automated tests and coverage analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Price half of equivalent products</td>
<td></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 with Simulink can be automatically converted into C code for embedded systems using Real-Time Workshop Embedded Coder. MATLAB/Simulink can perform advanced evaluation of C code for embedded systems by PL simulation by interoperating with the SOFTUNE debugger.</td>
<td></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>
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<tr>
<td></td>
<td>- Supports REALOS system calls.</td>
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<tr>
<td></td>
<td>- Offers debugging using state transition chart integrated with SOFTUNE.</td>
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<tr>
<td>SystemDesk</td>
<td>Designs AUTOSAR compliant software components and graphically models hardware independent software architectures.</td>
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<td></td>
<td>- Automatically generates the AUTOSAR definition file, and interoperates with the TargetLink automatic code generation tool to create RUNNABLE.</td>
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<tr>
<td></td>
<td>- 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.</td>
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<tr>
<td></td>
<td>- Interoperates with BSW tools such as Tresos® to create production SW packages.</td>
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</tr>
</tbody>
</table>

IBM Corporation
http://www-01.ibm.com/software/awdtools/developers/technical/

Vector Japan Co., Ltd.
TEL: +81-3-5769-6797
http://www.vector-japan.co.jp/

IBM Corporation

IAR Systems
TEL: +81-3-5298-4680
http://www.iarsys.co.jp/

Itochu Techno-Solutions Corporation
TEL: +81-3-6417-5434
http://www.ctc-g.co.jp/solutions/embedded/index.html

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http://www.dspace.jp/

TEL: +81-422-52-5698
http://www.dspace.jp/

TEL: +81-3-5769-6792
http://www.vector-japan.co.jp/

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http://www.vector-japan.co.jp/

TEL: +81-3-5769-6792
http://www.vector-japan.co.jp/

■ Verification Tools

<table>
<thead>
<tr>
<th>Product name</th>
<th>Overview</th>
<th>Inquiries</th>
</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>
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</tr>
<tr>
<td></td>
<td>- Capable of network-wide simulation and analysis using simulation nodes created using CAPL/NET or models created using MATLAB/Simulink.</td>
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<tr>
<td></td>
<td>- Capable of performing various tests of bus data, and displaying in a Window or recording in a log file.</td>
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<tr>
<td></td>
<td>- Capable of of offline playback using log files.</td>
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<tr>
<td></td>
<td>- Send and evaluation of messages using the programming function using CAPL.</td>
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</tr>
<tr>
<td></td>
<td>- Supports CAN, LIN, MOST, and FlexRay.</td>
<td></td>
</tr>
<tr>
<td>CANAnalyzer</td>
<td>CANalyzer 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>
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</tr>
<tr>
<td></td>
<td>- Simplifies testing using the user display panel.</td>
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</tr>
<tr>
<td></td>
<td>- Enables networkwide and offline playback using log files.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Sends and evaluates messages using the programming function using CAPL.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Supports CAN, LIN, MOST, and FlexRay.</td>
<td></td>
</tr>
<tr>
<td>CANScope</td>
<td>CANScope is a software that provides a complete development environment for measurement, compliance, and diagnosis.</td>
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</tr>
<tr>
<td></td>
<td>- Capable of monitoring RAM without stopping operation right from the microcontroller.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Communicates with monitor RAM not needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Almost no affect on microcontroller operation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Capable of monitoring RAM synchronizing to the microcontroller control cycle (scanstart function)</td>
<td></td>
</tr>
</tbody>
</table>

Fujitsu Software Technologies Limited
TEL: +81-3-5798-5460
http://www.dspace.jp/

Vector Japan Co., Ltd.
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TEL: +81-3-5769-6792
http://www.vector-japan.co.jp/

Vector Japan Co., Ltd.
TEL: +81-3-5769-6792
http://www.vector-japan.co.jp/

TEL: +81-23-2245-1248
http://www.toyo.co.jp/ss/

TEL: +81-3-3245-1248
http://www.toyo.co.jp/
Development assistance tools (writing programs)

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 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
Customers who desire pre-written products can be accommodated by factory writing or programming house.

- 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
Several parallel writers are available to suit customer applications and budgets.

- Parallel writers for microcontrollers with built-in Flash

<table>
<thead>
<tr>
<th>Family</th>
<th>Parallel writer</th>
<th>32-bit</th>
<th>16-bit</th>
<th>8-bit</th>
<th>FR-family</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2MC-8FX</td>
<td>F2MC-16LX</td>
<td>F2MC-16FX</td>
<td>F2MC-8FX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32-bit</td>
<td>16-bit</td>
<td>8-bit</td>
<td>FR-family</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mitsubishi Inc.

- Single-unit programmers
  - MODEL1893
  - MODEL1931
  - MODEL1930+
  - MODEL1931
- Gang programmers
  - OCTAL
  - FlashPAK/FlashPAK II

* Data I/O Corporation (USA) (Represented in Japan by Toyo Corporation)

Onboard programming support
Several on-board writers are available to suit customer applications and budgets.

- Serial on-board writers

<table>
<thead>
<tr>
<th>Serial on-board writers</th>
<th>32-bit</th>
<th>16-bit</th>
<th>8-bit</th>
<th>FR-family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fujitsu Semiconductor Limited</td>
<td>Flash USB Programmer (SDRAM adapter) MB2146/2148 etc. needs to be purchased separately</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Flash ROM Programmer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Yohogawa Computer Corporation</td>
<td>AF3200/AF3200/AF2000/AF1000</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
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

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Sunhayato Corp. jouet bleu page: http://www.sunhayato.co.jp/products_html/f2mc/index_e.html

---

**e-Learning Services**

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


You can learn the following about microcontroller development.

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- 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.

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Suitable for beginners and new developer training.

Sunhayato Corp. jouet bleu page: http://www.sunhayato.co.jp/products_html/f2mc/index_e.html

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**Unit 1**  
**Embedded Application Development**

1.2.5 Application development and execution environments

**Unit 2**  
**Microcontroller and External Peripheral Devices**

2.1.2 CPU operations

**Unit 3**  
**Programs Using Peripheral Functions**

3.2.2 Mechanism: LED

3.2.7 Sample program using an I/O ports

**Unit 4**  
**Programs Used with Interrupts**

4.1.2 Interrupt processing

4.1.3 Types of hardware interrupt