

Microcontrollers & Development Tools EMBEDDED SOLUTIONS



PRODUCT OVERVIEW MICROCONTROLLERS

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Introducing Fujitsu Semiconductor Europe

Fujitsu Semiconductor Europe (FSEU) is a major supplier of semiconductor products to the European and global market. The company's main business focus is on providing system solutions to the automotive, industrial/home appliance, networking/telecommunications and multimedia markets.

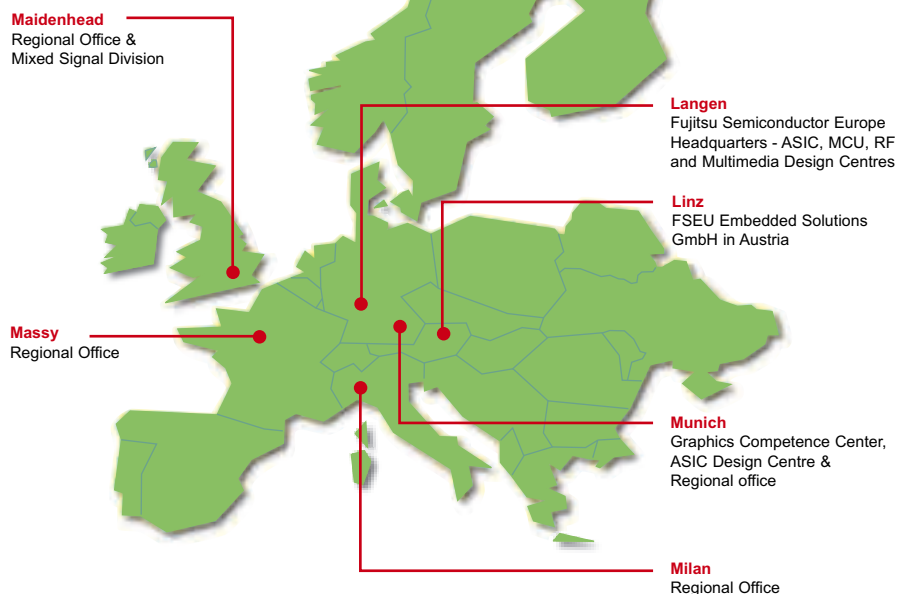
Engineering support from experts in both the application areas and Fujitsu products saves customers time and effort enabling a short and trouble-free time to market.

Fujitsu offers a broad range of semiconductor devices, including sensors, ASICs, RF devices, MPEG encoders & decoders, microcontrollers, graphics controllers, micro-processors, FRAM and FCRAM™.



Fujitsu Semiconductor Europe's headquarters in Langen

Fujitsu's design centres and sales offices



“Engineering Support saves customers time and effort enabling a short and trouble-free time to market”



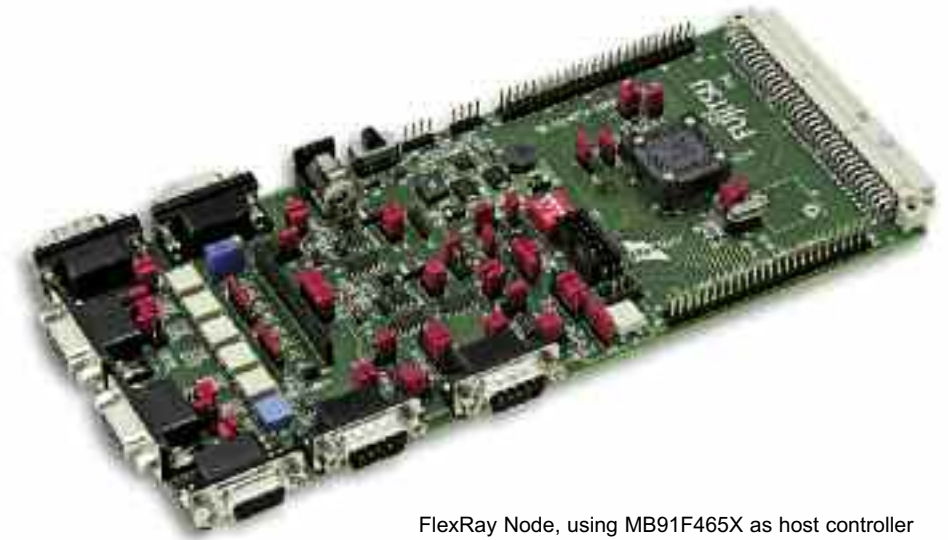
Expertise in Automotive & Industrial Markets

Fujitsu's microcontroller product portfolio offers more than 500 products based on 8-, 16- and 32-bit MCU architectures. Continuous development activities and the know-how that Fujitsu's engineering departments world wide have built up in close co-operation with Fujitsu's customers are the basis for these successful product families.

A dedicated business unit is focusing on the home, industrial and automotive market with the mission to support European customers with right-sized products and solutions.

These markets require high quality products with state-of-the-art communication and networking interfaces such as CAN, LIN, USB, MediaLB (MOST), IDB1394, and FlexRay™. The product portfolio ranges from smart and small 8-bit to high performance 32-bit RISC microcontrollers.

Fujitsu embedded flash technology has always been the basis for reliable products. The latest generation of this technology is being used by leading European car manufacturers and their suppliers.



FlexRay Node, using MB91F465X as host controller

European Microcontroller Design Centre (EMDC)

Being as close as possible to our customers has always been a major success factor. The European MCU design centre has completed more than 100 MCU development projects since its foundation in 1997. In close partnership with our European customers, innovative products have been specified and give our customers a competitive edge in global competition. Fujitsu is a leader in fully-featured flash memory based CAN and LIN MCUs and the steadily growing design centre has already completed some of the next product generations, such as products with on-chip FlexRay or high speed APIX® data links.

Dedicated local application support team

FSEU's application engineering group provides hard- and software solutions for our customers. They find expertise in their application area, deep knowledge of Fujitsu's products and a

high level of experience with the tool environment, which Fujitsu also provides.

The Fujitsu Softune Workbench is the development environment of choice for all Fujitsu MCUs (8- to 32-bit) and includes a state-of-the-art C-Compiler, Assembler and Debugger. It is free-of-charge in Europe. Getting started is easy with the evaluation boards, starter kits and training on offer. Application notes, software examples and EMC support complete the picture.

MCU Software Design Centre (MSDC) shortens time to market

Software engineers can be booked by our customers as an extension to their in-house design resources - shortening the entire software design cycle and helping our customers to maintain their leading position in the market.

Quality

Formal Quality Systems like ISO9000, have been established since 1994. Products for automotive systems are certified to ISO/TS 16949. All newly developed, Fujitsu automotive MCUs are fully AEC-Q100 compliant.

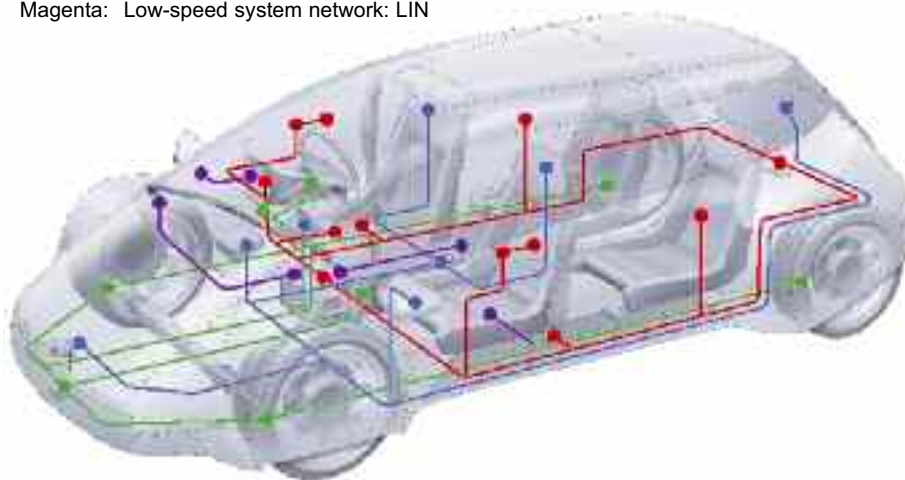
Environmental Support

Fujitsu's use of materials is fully compliant with the time plan for implementation of RoHS and WEEE programmes.

More information is available at FSEU's MCU Web page:
<http://mcu.emea.fujitsu.com>

Key

Blue: Information system network: MOST, IDB-1394
 Green: X-by-Wire system network: FlexRay
 Red: Control system network: CAN
 Magenta: Low-speed system network: LIN



Access to partners

These partners complement Fujitsu's offerings especially with regard to operating systems, driver software and development tools. Please see the **3rd party support** page at <http://mcu.emea.fujitsu.com> for more information.

Industrial market requires high quality products with state-of-the-art network interfaces such as CAN, LIN and IDB-1394

Automotive strengths

Fujitsu's European Microcontroller Design Centre today has extensive experience gained from more than 100 automotive development projects.

This is demonstrated by a host of smart on-chip features that meet the requirements of our automotive customers. Substantial software support and software services for Fujitsu microcontrollers is also in place.

Programmable port levels

Many CAN microcontrollers feature programmable port levels. In addition to TTL and CMOS levels, so-called 'automotive levels' (with VIL = 0.5Vcc) can be selected. This is a valuable feature as ground levels in vehicles may show offsets of several volts.

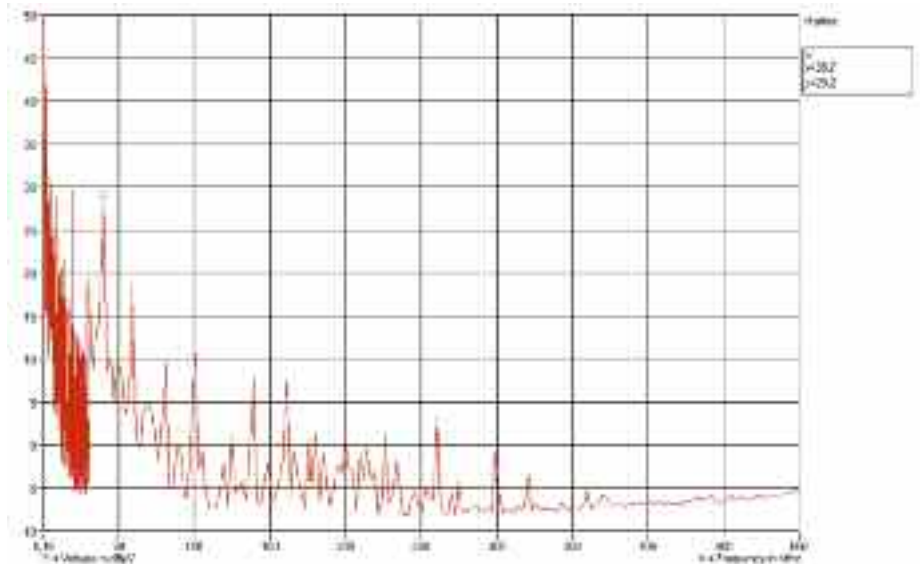
Clock modulation

This feature improves electromagnetic compatibility which is becoming an ever-important requirement with increasing CPU speeds.

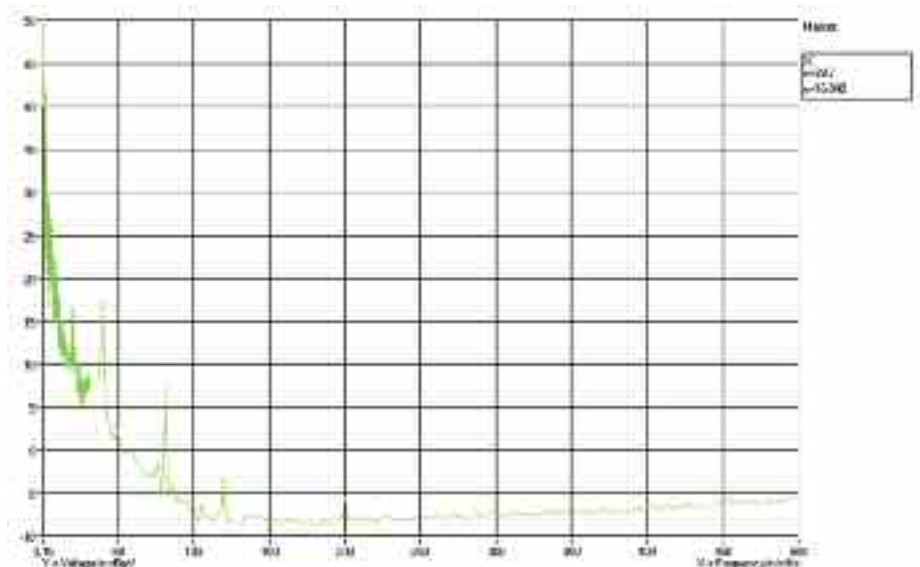
Clock modulation reduces emission peak levels by distributing the system clock frequency over a defined frequency range. This means that sharp high peaks are converted to a wider slewed signal in the frequency spectrum – with reduced emission levels. Graph 1 shows EMI measurement without clock modulation; Graph 2 shows clock modulation switched on.

LIN USART

A powerful serial communication interface with hardware support for LIN protocol is incorporated into every new Fujitsu CAN microcontroller. This interface supports SPI mode and baud rates up to 4MBaud in USART mode.



Graph 1: Emission IEC Norm 61967 part 4, MB90F394, Clock modulation=off

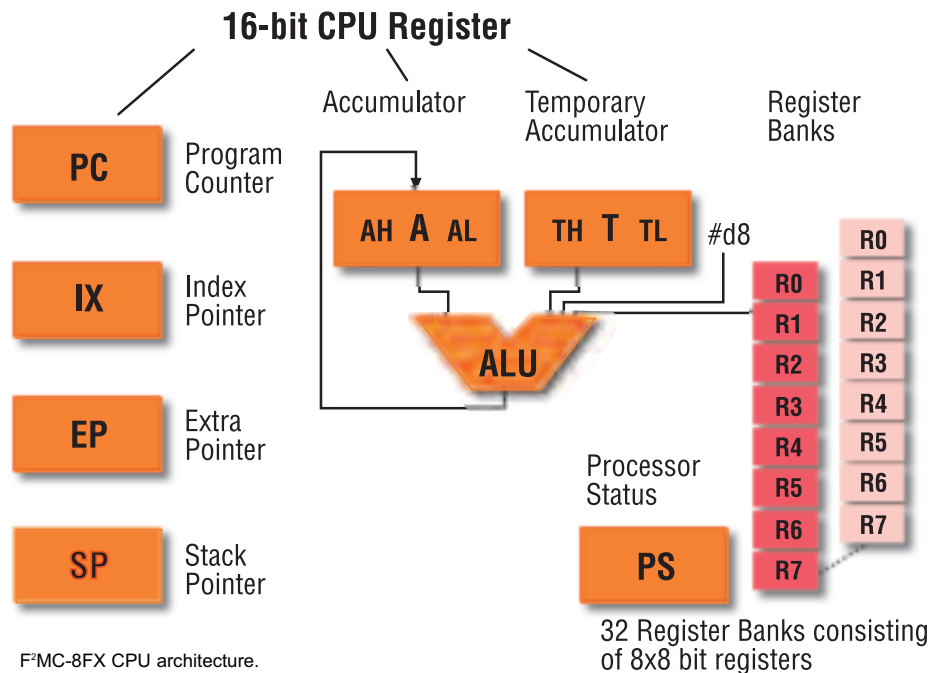


Graph 2: Emission IEC Norm 61967 part 4, MB90F394, Clock modulation=on

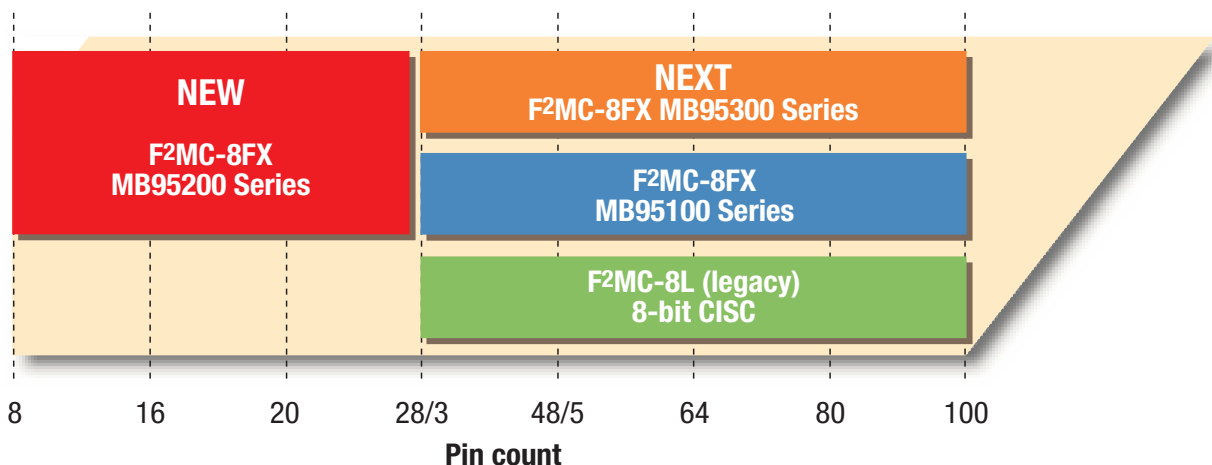
8-bit F²MC-8FX MCU family

F²MC-8FX Family overview

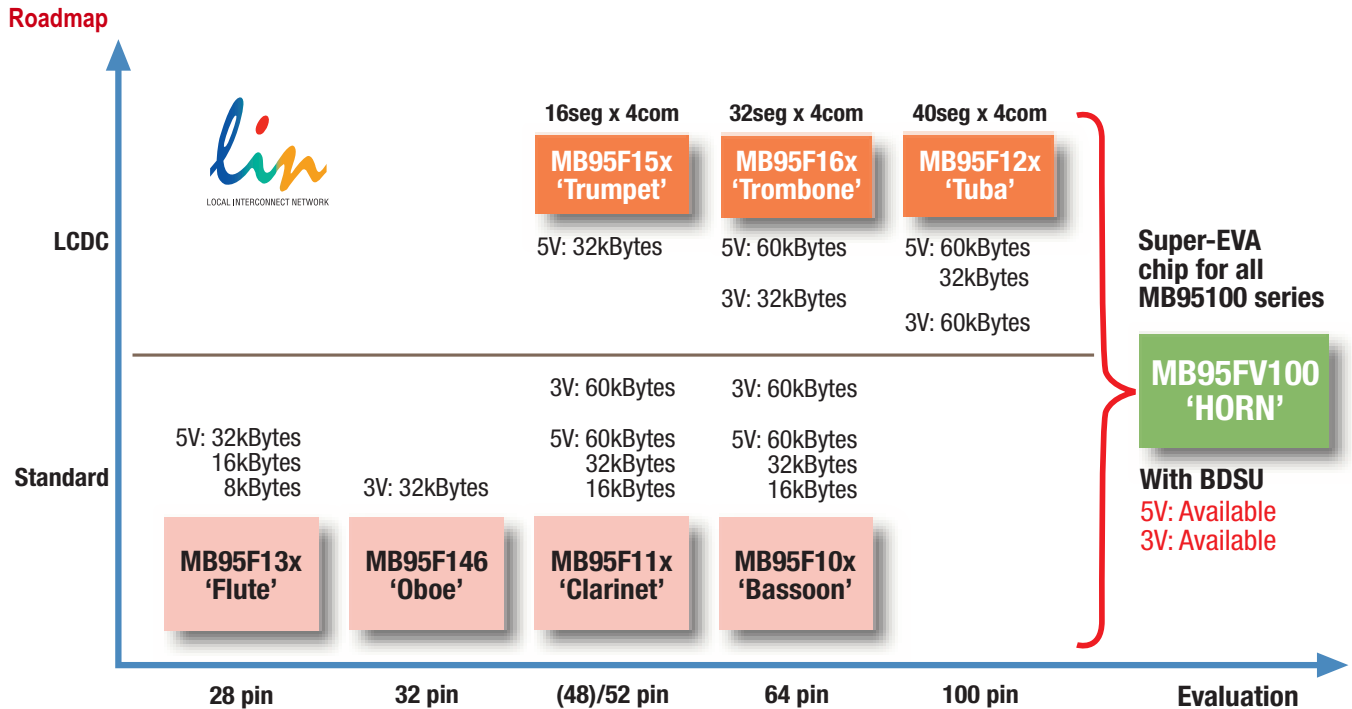
- Instruction compatible with F²MC-8L
- Enhanced 8-bit CPU
 - Eight 16-bit registers
 - High speed, 62.5ns cycle time @ 16MHz CPU clock
 - Up to 32 memory mapped register banks (each bank consists of eight 8-bit registers)
 - A-T architecture
- Optimised internal bus
 - Reduced instruction cycles
 - Pipelining of the internal bus
- 64kByte linear addressing space
- Powerful arithmetic operation and transmission
 - Division instruction: 16-bit / 16-bit = 16-bit
 - Data transmission up to 16-bit
- Clock multiplier circuit
 - PLL x1, x2, x2.5, x4
- Enhanced Interrupt
 - Four interrupt levels selectable for each interrupt



Line-up and Roadmap



8-bit F²MC-8FX MB95100 series



Features of MB95100 series

- All flash, scalable memory approach
- Dual-operation flash to emulate E²PROM (only MB95F128J, MB95F118J, MB95108J)
- Serial interfaces support LIN, synchronous/asynchronous USART and SPI
- Flexible composite timers (interval timer, PWM, PWC, input capture)
- 10-bit ADC on every device
- Flash security feature on every device (read-out protection)
- Low voltage detection on 5V devices
- Clock supervisor (no external watchdog necessary)

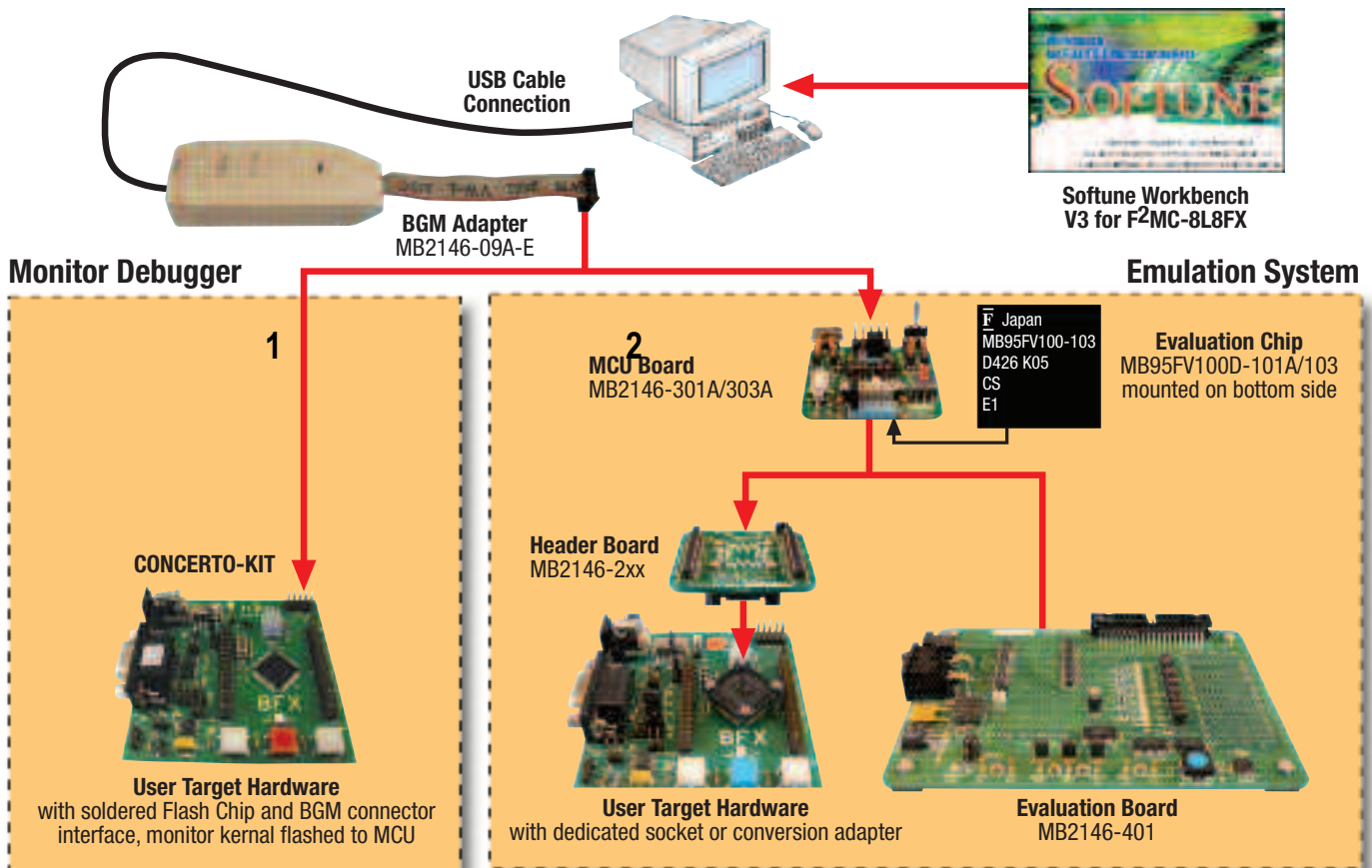
Development tools

MB95100 series

- Softune Workbench IDE for software development
- MB2146-09A-E BGM adaptor for debugging and programming
- CONCERTO-Kit starter board with monitor debugger
- MB2146-401 + MB2146-3xx MCU board for full emulation system

Customers can choose between

- (1) Monitor Debugger or
- (2) Hardware Emulation System as indicated on the facing page.



(1) Monitor debugger

Evaluation kit

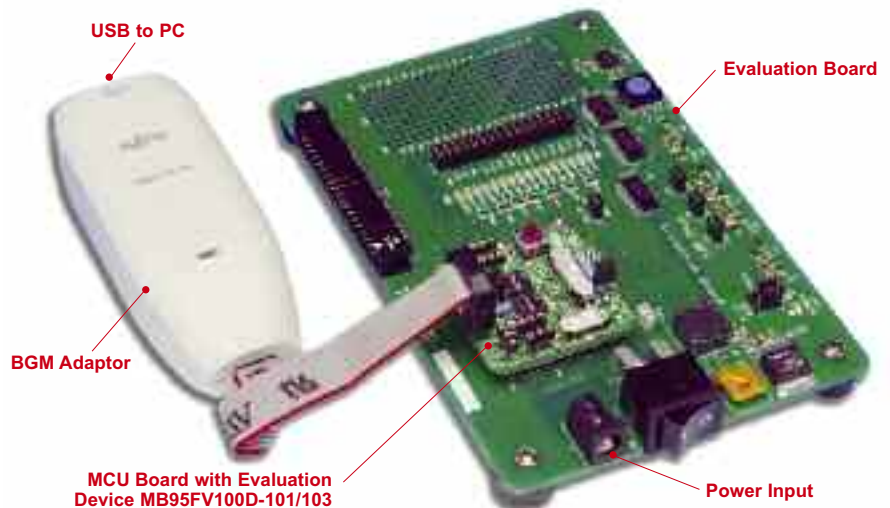
CONCERTO-Kit with MB95F108 on board, provides the opportunity to program dual-operation flash, and test 8FX core and the peripherals at low cost and with minimal effort.

F²MC-8FX monitor debugger

As low cost alternative to the full evaluation system, the BGM Adaptor MB2146-09A-E can be used to connect the Debugger-PC directly to a flash MCU on the target system. Softune Workbench incorporates the corresponding monitor debugger user interface.

- USB connection via BGM adaptor MB2146-09A-E
- Fully integrated into Softune Workbench
- Standard debug functionality
2 code breakpoints, single step, register-, watch-, memory windows, etc.
- Very efficient (little resource requirements)

(2) Hardware emulation system



Compact and low cost 8FX development set-up

FEATURE OF THE BGM ADAPTOR FOR F²MC-8FX FAMILY

Adaptor model for debugging	MB2146-09A-E
Host interface (download time)	USB: 12Mbps (125kbps: at an operating frequency of 4MHz)
Execution control	Continuous execution, step execution
Instruction execution break	256 points
Data break	2 points
Emulation memory	The size equivalent to flash ROM MB95FV100 (60kBytes)
Trace capacity	16 branches
Sequential break	2 levels (only code)

PRODUCT OVERVIEW MICROCONTROLLERS

Device examples MB95110 and MB95160 series

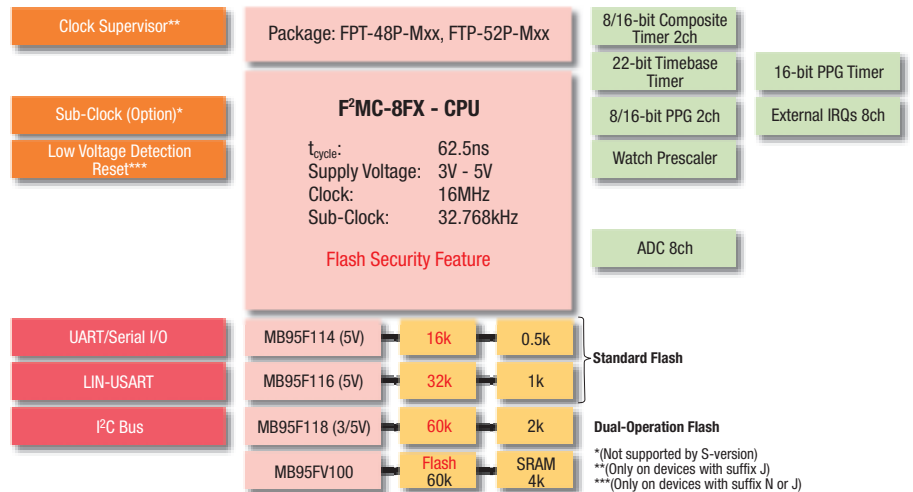
MB95110 is a series of general-purpose microcontrollers. It is available in 52-pin packages (48-pin package for 3V only) with different memory configurations to best fit application needs. The 60kBytes flash version features dual-operation flash enabling E²PROM emulation or conformable boot loaders. 16 and 32kByte versions feature segmented, single-bank flash memory.

It supports serial communication protocols like serial synchronous, serial asynchronous, SPI, LIN and I²C.

Its flexible composite timers can be used as interval timer, PWM, PWC and input capture functions. Two composite timers can be used to fully control one DC motor. In addition 2 PPGs (programmable pulse generators) are available, which can be used as 2 channel 16-bit PPG or 4 channel 8-bit PPG. In addition, a dedicated 16-bit PPG is available.

A very fast 10-bit successive approximation ADC with 8 channels, features a conversion time of only 1.2µsecs! The resources are rounded-off by 8 programmable external interrupt inputs.

Low-voltage detection with reset and clock supervisor (both only for 5V versions) eliminate the need for external watchdogs and supply-voltage supervisor ICs thus saving total system cost.

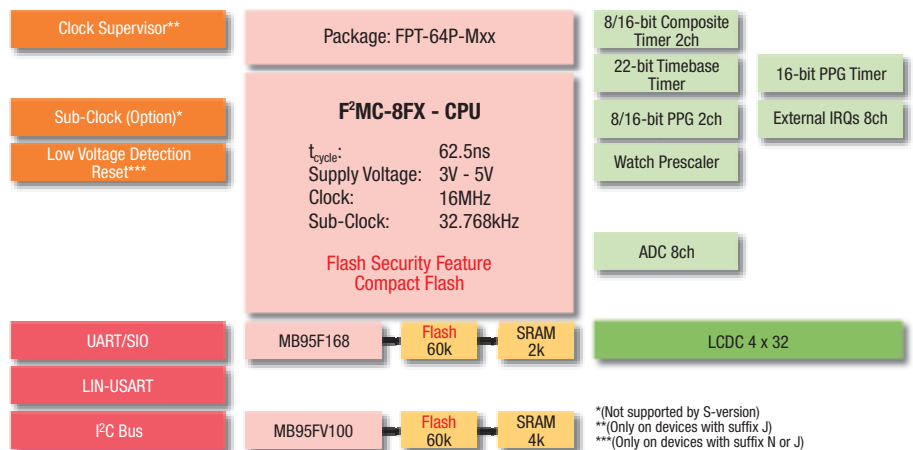


MB95110 series block diagram

MB95160 series features the same resources as MB95110 series adding an on-chip LCD controller. LCDs with 4COM and up to 32SEG lines can be directly driven by the MCU. Functions like internal reference voltage dividers

and automatic blinking, ease integration of a low-cost LCD into the target application.

The flash memory is a 60kByte compact flash.



MB95160 series with LCDC block diagram

8-bit product line-up

Overview of MB95100 series

Features	Part	ROM/Flash (kByte)	RAM (Byte)	Power Supply Voltage (Sub-clock option)	Max. Clock MHz	Max Ports	Ext. Inter.	PWM Functions	Timer Functions	16-bit Reload Timer	LIN-UART	UART/SIO	I _C	ADC	LCDC	Special Features	Power Saving Mode	Pin Count
Series																		
MB95100 (3V)	MB95F108B MB95107B (S/W)	60 48	2k 2k	1.8-3.3V 1.8-3.6V	16 (32kHz)	55	12	6 (2ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	9 (2ch composite timer*, 6 PPG timers, 16-bit reload timer)	1	1	1	1	12 x 10-bit	No	Dual-Operation flash (60kBytes version only) SPI, Watch timer	SLEEP STOP WATCH TIMER	64
MB95100 (5V)	MB95F104 MB95F106 MB95F108 MB95108 (MA/NA/JA) (S/W)	16 32 60 60	512 1k 2k 2k	2.3-5.5V 2.3-5.5V 2.3-5.5V 2.3-5.5V	16 (32kHz)	54	12	6 (2ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	9 (2ch composite timer*, 6 PPG timers, 16-bit reload timer)	1	1	1	1	12 x 10-bit	No	Low-Voltage-Detection, Dual-Operation flash (60kBytes version only) SPI, Watch timer	SLEEP STOP WATCH TIMER	64
MB95110 (3V)	MB95F118B MB95116 (S/W)	60 32	2k 1k	1.8-3.3V 1.8-3.6V	16 (32kHz)	39	8	5 (1ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	7 (2ch composite timer*, 5 PPG timers)	No	1	1	1	8 x 10-bit	No	Dual-Operation flash (60kBytes version only) SPI, Watch timer	SLEEP STOP WATCH TIMER	48, 52
MB95110 (5V)	MB95F114 MB95F116 MB95F118 MB95117 (MA/NA/JA) (S/W)	16 32 60 48	512 1k 2k 2k	2.3-5.5V 2.3-5.5V 2.3-5.5V 2.3-5.5V	16 (32kHz)	39	8	5 (1ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	7 (2ch composite timer*, 5 PPG timers)	No	1	1	1	8 x 10-bit	No	Low-Voltage-Detection, Dual-Operation flash (60kBytes version only) SPI, Watch timer	SLEEP STOP WATCH TIMER	52
MB95120	MB95F128 MB95128 (D/E)	60 60	2k 2k	1.8-3.3V 1.8-3.6V	16 (32kHz)	87	12	6 (2ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	9 (2ch composite timer*, 6 PPG timers, 16-bit reload timer)	1	1	1	1	12 x 10-bit	4 x 40	Dual-Operation flash (60kBytes version only) SPI, Watch timer	SLEEP STOP WATCH TIMER	100
MB95120MB	MB95F124 MB95F126 MB95F128 MB95128 (MB/NB/JB) (S/W)	16 32 60 60	512 1k 2k 2k	2.3-5.5V 2.3-5.5V 2.3-5.5V 2.3-5.5V	16 (32kHz)	87	12	6 (2ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	9 (2ch composite timer*, 6 PPG timers, 16-bit reload timer)	1	1	1	No	12 x 10-bit	4 x 40	Low-Voltage-Detection, Dual-Operation flash (60kBytes version only) SPI, Watch timer	SLEEP STOP WATCH TIMER	100
MB95130MB	MB95F133 MB95F134 MB95F136 MB95136 (MB/NB/JB) (S/W)	8 16 32 32	256 512 1k 1k	2.3-5.5V 2.3-5.5V 2.3-5.5V 2.3-5.5V	16 (32kHz)	20	8	3 (1ch x 16-bit, 1ch x 8-bit PPG, 1ch composite timer)	4 (1ch composite timer*, 3 PPG timers)	No	1	1	No	8 x 10-bit	No	Low-Voltage-Detection, SPI, Watch timer	SLEEP STOP WATCH TIMER	28
MB95140	MB95F146 (S/W)	32	1k	1.8-3.3V	16 (32kHz)	24	8	3 (1ch x 16-bit, 1ch x 8-bit PPG, 1ch composite timer)	5 (2ch composite timer*, 3 PPG timers)	No	1	1	No	8 x 10-bit	No	Low-Voltage-Detection, SPI, Watch timer	SLEEP STOP WATCH TIMER	32
MB95150	MB95F156 MB95156 (MIN/J)	32 32	1k 1k	2.3-5.5V 2.3-5.6V	16 (32kHz)	39	8	5 (1ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	7 (2ch composite timer*, 5 PPG timers)	No	1	1	No	8 x 10-bit	4 x 16	Low-Voltage-Detection, SPI, Watch timer	SLEEP STOP WATCH TIMER	48
MB95160	MB95F166 MB95166 (D/E)	32 32	1k 1k	1.8-3.3V 1.8-3.6V	16 (32kHz)	53	8	5 (1ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	7 (2ch composite timer*, 5 PPG timers)	No	1	1	1	8 x 10-bit	4 x 32	Low-Voltage-Detection, SPI, Watch timer	SLEEP STOP WATCH TIMER	64
MB95160MB	MB95F168 MB95168 (MIN/J)	60 60	2k 2k	2.3-5.5V 2.3-5.5V	16 (32kHz)	53	8	5 (1ch x 16-bit, 2ch x 8-bit PPG, 2ch composite timer)	7 (2ch composite timer*, 5 PPG timers)	No	1	1	1	8 x 10-bit	4 x 32	Low-Voltage-Detection, SPI, Watch timer	SLEEP STOP WATCH TIMER	64

Notes:

- S Single clock
- W Dual clock
- M Without LVD (low voltage detector) and CSV (clock supervisor)
- N With LVD, without CSV
- J With LVD/CSV
- D With LCD voltage booster
- E Without LCD voltage booster
- A,B Revision numbers

* Composite timer can be used as 2ch x 8-bit timer or 1ch x 16-bit timer or built-in timer function, PWC function, PWM function, capture function and square waveform output.

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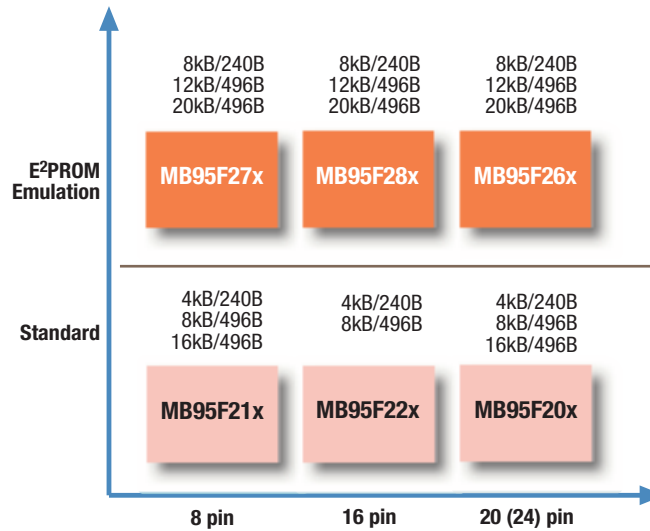
MB95200 series - low pin count devices

MB95200 series overview

MB95200 series is a new member of F²CM-8FX family targeting home appliances, electrical tools, consumer health care products as well as car accessories.

Features of MB95200 series

- 2.3V to 5.5V operation
- Flash content protection
- Low voltage reset
- Clock supervisor
- ± 2% on-chip RC oscillator
- 10-bit ADC on every device
- Serial interfaces support LIN, synchronous/asynchronous USART and SPI (not on 8-pin devices)
- Flexible composite timers (interval timer, PWM, PWC, input capture)
- Single wire debug interface with low cost development system



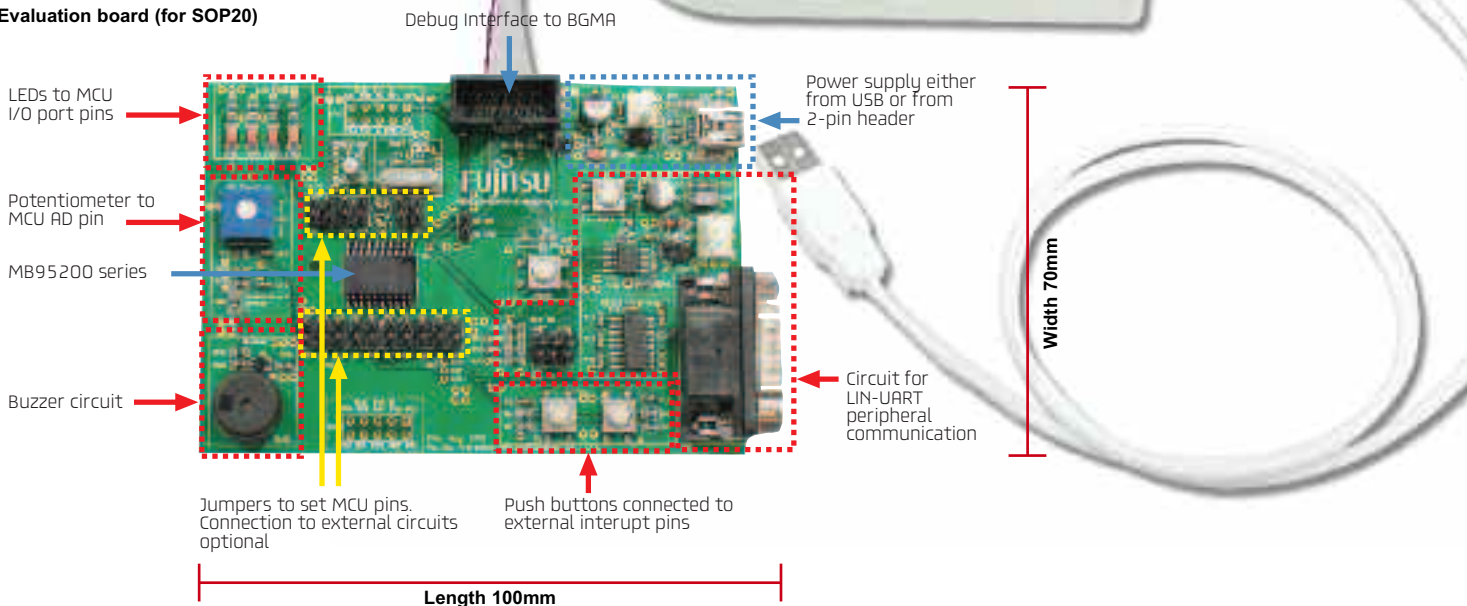
MB95200 Series line up

Development tool

Starter kit MB2146-410-01-E enables easy evaluation of MB95200 series and its peripherals.

BGM-Adapter (MB2146-08-E)

Evaluation board (for SOP20)



BGM Adapter

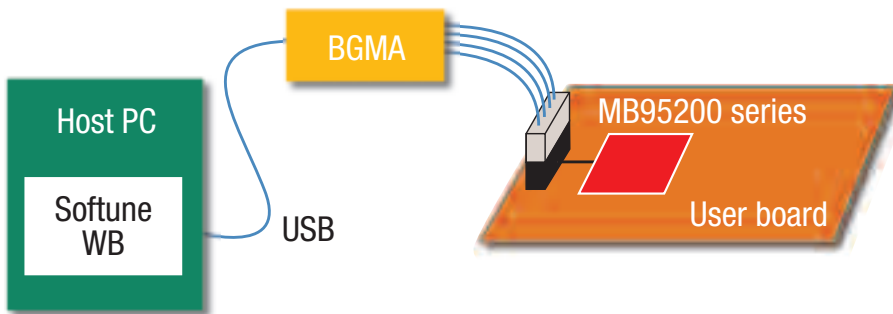
- Low cost
- Small size
 - 128 x 55 x 29mm
- USB interface to PC/SOFTUNE
 - Compliance with USB 1.1
- Single-wire interface to MB95200 series (Total 5-pins needed to connect to the target MCU board)

Starter kit features

- BGM Adapter
- Evaluation board
- Sample codes (Users can easily evaluate MB95200 series and its peripherals based on starter kit board and sample codes)
- Starter kit order number MB2146-410-01-E

Web support

- MCU Portal address - <http://mcu.emea.fujitsu.com>



On-chip debugging system block diagram



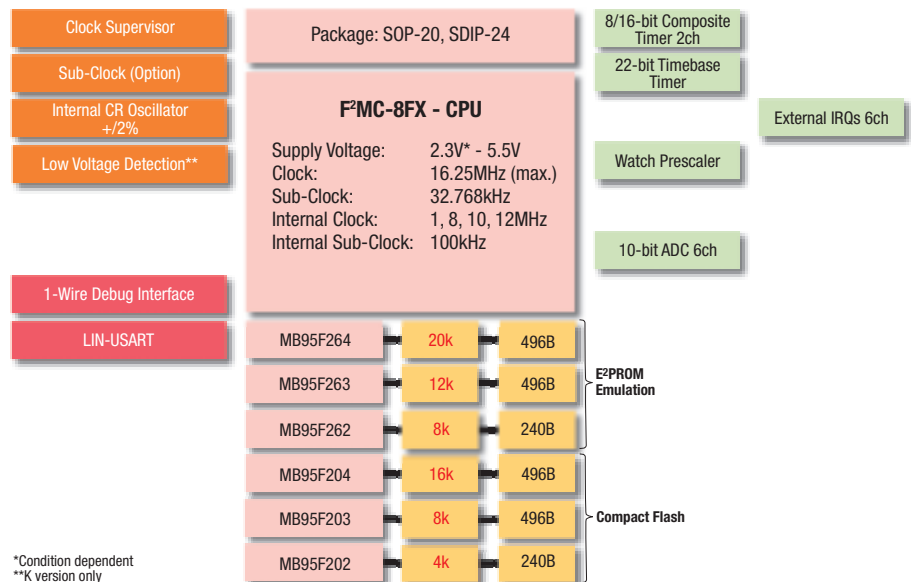
Fujitsu IDE Softune

MB95200 series – device examples

MB95200 is a series of general purpose microcontrollers with pin counts of 8, 16 and 20 pins. The embedded resources are derived from MB95100 Series.

The series offers derivatives with compact flash memory (external erase voltage necessary) as well as pin-compatible derivatives with dual-operation flash (no external erase voltage necessary). The dual-operation flash derivatives come with an E²PROM emulation.

MB95200/260 Series of 20-pin Microcontrollers with derivatives from 4kB flash / 240B RAM up to 20kB dual-operation flash / 496B RAM includes 6ch 10-bit ADC, 6ch external interrupts, 2ch composite timer, 2ch PPG (PWM) and 1ch LIN-USART. The LIN-USART supports serial communication protocols like synchronous and asynchronous serial,



*Condition dependent
**K version only

MB95200/260 series 20 pin microcontrollers

SPI and LIN. The flexible composite timer can be configured to work as interval timer, PWM, PWC or input capture function. 2ch of composite timers can be used to fully control one DC motor (forward/backward/speed).

The devices can run on the internal RC oscillator with $\pm 2\%$ precision, the integrated clock supervisor and watch dog combined with the low voltage reset, eliminate the necessity for external components.

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8-bit product line-up

Overview of MB95200 series

Features Series	Part	Flash (kByte)	RAM (Byte)	Power Supply Voltage	Max. Clock MHz	Max Ports	Ext. Inter.	PWM Functions	Timer Functions	LIN-UART	ADC	Special Features	Power Saving Mode	Pin Count
MB95200	MB95F202	4	240	2.3-5.5V	16	17	6	2 (2ch composite timer)	2 (2ch composite timer) 22-bit time base timer watch prescaler	1	6 x 10-bit	1-wire debug +/-2% RC oscillator	SLEEP STOP WATCH TIMER	SOP20 SDIP24
	MB95F203	8	496	2.3-5.5V	10 (with internal RC)									
	MB95F204 (K/H)	16	496	2.3-5.5V										
MB95210	MB95F212	4	240	2.3-5.5V	16	5	2	1 (1ch composite timer)	1 (1ch composite timer) 22-bit time base timer watch prescaler	0	2 x 10-bit	1-wire debug +/-2% RC oscillator	SLEEP STOP WATCH TIMER	SOP8 DIP8
	MB95F213	8	496	2.3-5.5V	10 (with internal RC)									
	MB95F214 (K/H)	16	496	2.3-5.5V										
MB95220	MB95F222	4	240	2.3-5.5V	16	13	6	1 (1ch composite timer)	1 (1ch composite timer) 22-bit time base timer watch prescaler	1	5 x 10-bit	1-wire debug +/-2% RC oscillator	SLEEP STOP WATCH TIMER	SOP16 DIP16
	MB95F223 (K/H)	8	496	2.3-5.5V	10 (with internal RC)									
MB95260	MB95F262	8	240	2.3-5.5V	16	17	6	2 (2ch composite timer)	2 (2ch composite timer) 22-bit time base timer watch prescaler	1	6 x 10-bit	1-wire debug +/-2% RC oscillator E ² PROM emulation	SLEEP STOP WATCH TIMER	SOP20 SDIP24
	MB95F263	12	496	2.3-5.5V	10 (with internal RC)									
	MB95F264 (K/H)	20	496	2.3-5.5V										
MB95270	MB95F272	8	240	2.3-5.5V	16	5	2	1 (1ch composite timer)	1 (1ch composite timer) 22-bit time base timer watch prescaler	0	2 x 10-bit	1-wire debug +/-2% RC oscillator E ² PROM emulation	SLEEP STOP WATCH TIMER	SOP8 DIP8
	MB95F273	12	496	2.3-5.5V	10 (with internal RC)									
	MB95F274 (K/H)	20	496	2.3-5.5V										
MB95280	MB95F282	8	240	2.3-5.5V	16	13	6	1 (1ch composite timer)	1 (1ch composite timer) 22-bit time base timer watch prescaler	1	5 x 10-bit	1-wire debug +/-2% RC oscillator E ² PROM emulation	SLEEP STOP WATCH TIMER	SOP16 DIP16
	MB95F283	12	496	2.3-5.5V	10 (with internal RC)									
	MB95F284 (K/H)	20	496	2.3-5.5V										

Notes:

K Low voltage reset

H No low voltage reset

* Composite timer can be used as 2ch x 8-bit timer or 1ch x 16-bit timer or built-in timer function, PWC function, PWM function, capture function and square waveform output.

Features of 16-bit families

F²MC-16FX device features

- 20 Dhrystone MIPS computing performance (V.2.1)
- On-chip oscillators for short start-up, clock supervisor function, sub-clock or main clock operation
- Start-up time <1ms to RC run mode, <8ms to PLL run mode
- Operating voltage range 3.0-5.5V
- Internal CPU voltage reduced to 1.8V (less current consumption, less EM emissions)
- New energy-saving options: separate clock dividers for core and peripherals
- DMA: several channels that can be assigned to any peripheral resource
 - One Byte per clock cycle transfer speed
- Embedded Debugging: firmware support for debugging via USART (no need to link a monitor kernel to application software)
- Low voltage detection reset: available on all 16FX devices
- Interrupt: every resource has its own interrupt. A table base register allows relocating the base address of the interrupt vector table
- Ports: up to 4 different input levels selectable by software 'port input enable' function allows pins to be left open (no termination by resistor required)
- CAN: each channel offers 32 message buffers. Bosch C-CAN.
- PWM generation: improved programmable pulse generators offer more channels at full 16-bit resolution. Duty cycle and frequency are controlled in separate registers.

F²MC-16LX device features

- Mask ROM and flash
- Up to 24MHz (42ns) maximum internal clock speed from external 4MHz



Next generation 16FX microcontroller delivers 5x the computing power, 78% less power consumption and is pin compatible with its proven predecessor - the 16LX

- On-chip PLL multiplies the external clock speed. PLL factor can be selected by software
- Optimised instruction set for controller applications
 - bit, byte, word, long word data types
 - 23 addressing modes
 - variety of pointers
- Signed multiply instruction 16-bit x 16-bit
- Signed divide instruction 32-bit / 16-bit
- 18-bit Time-base timer
- 15-bit Watch timer, (devices with 32kHz sub-clock only)
- Watch-dog timer
- Fast interrupt processing
- Powerful interrupt functions – 8 programmable priority levels, more than 30 possible hardware vectors and more than 200 software vectors
- Program Patch function
 - facility to 'patch over' mask programmed code with update from external memory
 - hardware breakpoints to support remote system debugging with a monitor debugger
- Power saving modes
 - 7 for single clock or 10 for dual clock
 - sleep, stop, CPU intermittent, hardware standby ...

F²MC-16 CPU-core architecture

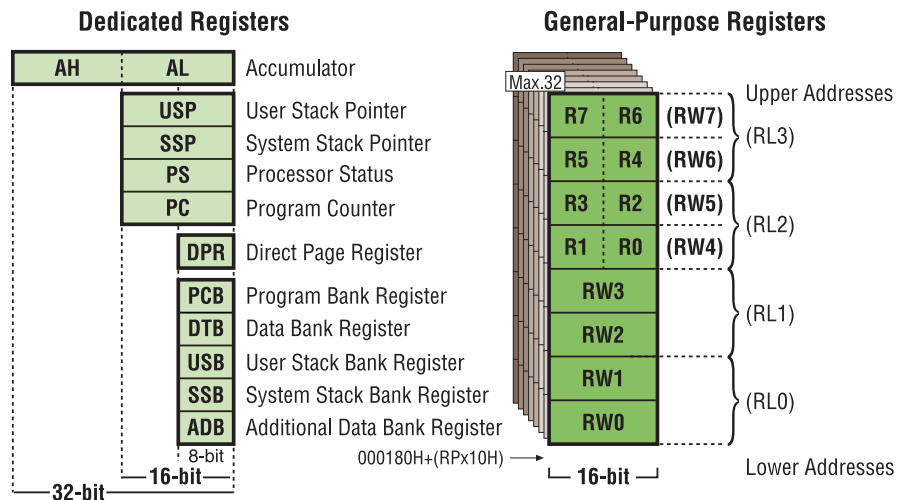
One obvious strength of this 16-bit architecture is its excellent code efficiency. As Fujitsu has a long record in Compiler business, dating back to the early days of mainframe computers, it was a logical move not only to equip the 16-bit architecture with an instruction set that is C-code optimised but also to supply the actual C-compiler which draws on this architectural strength - for example flexible addressing options. Bank registers for program code and data allow the use of 16-bit addresses - thus reducing code size while at the same time increasing processing performance.

Alternatively, several memory models exist, allowing linear addressing over the complete memory range.

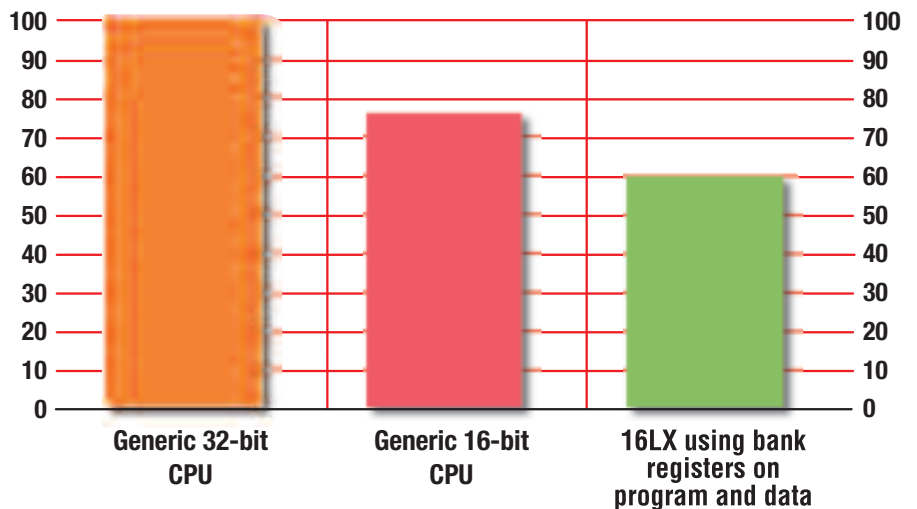
As the die size of MCUs mainly depends on memory resources, it is obvious that fitting more lines of C-code into the same physical memory, saves cost.

This is particularly easy with 16-bit instruction sets. 32-bit instruction sets in general produce less efficient code resulting in larger chips and more cost.

The new 16FX products inherit the 16LX instruction set and use the same C-compiler, which allow them to achieve the same efficiency in memory utilisation.



16-bit CPU-core programming model



Graph shows memory use (kB) for example program written in C

F²MC-16FX the new 16-bit MCU family

Fujitsu is introducing the next generation of 16-bit MCU, 16FX series.

Fast

The 16FX series is based on an improved CPU with significantly increased internal Bus bandwidth. As a result, program execution is accelerated, as can be seen in the Dhrystone benchmark (Dhrystone 2.1 compared to MB90340 series). 16FX is about 3 times faster (depending on the memory model used) than 16LX at the same clock frequency. For example at 24MHz 16FX achieves more than 11 real MIPS (Dhrystone 2.1). The architecture improvement is particularly visible when handling large data structures (see memory model 'Large' in graph 1).

But that's not all. New technology and improved design allow for CPU frequencies up to 56MHz - thus achieving processing performance ranges of 32-bit processors.

Efficient

16FX combines the advantages of 16- and 32-bit architectures. The C-code efficiency benefits from the 16-bit instruction set. Instruction pipelining, a technique widely used in the 32-bit RISC, world, allows 16FX to reach RISC-like performance. With instructions completed in less clock cycles, the same performance is achieved with less power consumption (compared to architectures without pipelining).

The 16-bit bus width again is an advantage for a low power consumption result compared to 32-bit architectures. A 32-bit bus will have a higher capacitance which

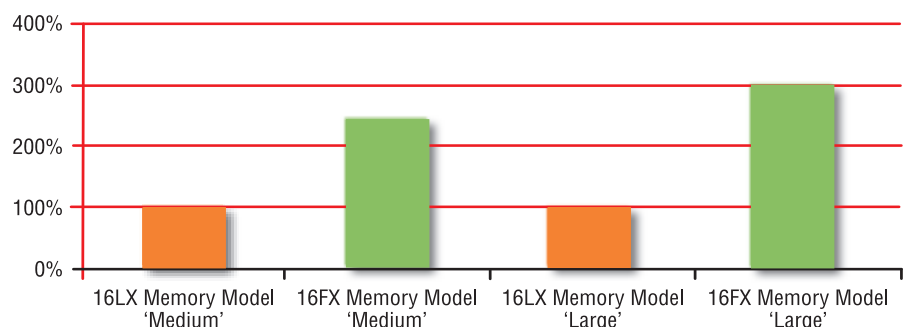
increases current consumption particularly at high frequencies. The use of latest CMOS technology also translates into efficient use of silicon space (smaller chip) and lower power consumption.

16FX specific power reduction features include a reduced internal CPU supply voltage, peripheral clock speed selectable independently from CPU speed, and reduced number of clocks per instruction (CPI). The result is an 80% reduction in power consumption compared to 16LX at the same performance.

16LX compatible

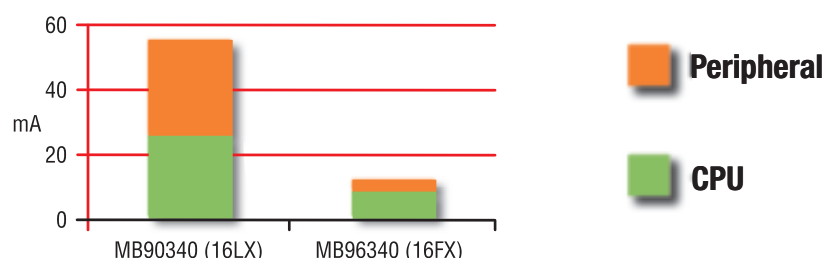
The 16FX CPU uses all 16LX machine instructions. With the same instruction set, the Assembler and C-compiler are also unchanged when switching from LX to FX CPU. Quite a few of the 16LX peripherals can be found again on 16FX - making software conversion from LX to FX an easy task. On the hardware side it is even easier. The first 16FX product is fully pin-compatible to the successful MB90340 (16LX) series. No need for a PCB change. You can even use the same Fujitsu Starter Kit (Flash-CAN-100P-340).

Performance comparison 16lx and 16fx



Graph 1 shows the performance ratio (Dhrystone 2.1) of 16FX compared to 16LX at 24MHz CPU frequency for different memory models. 16LX = 100%

Operating current at same performance (5V)



Graph 2 compares 16FX operating current simulation result to 16LX typical values, both operating at 4MIPS (Dhrystone 2.1) performance. 16FX achieves the performance at lower frequency with only 22% of the power consumption

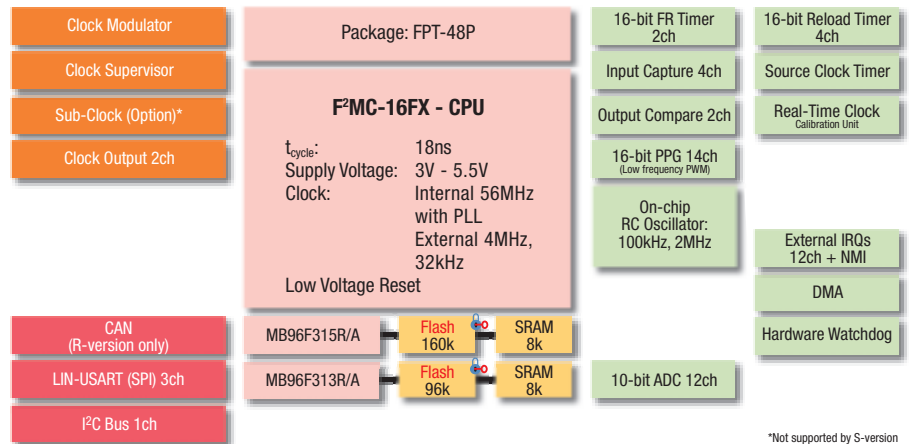
F²MC-16FX CAN bus microcontrollers (48-pin) MB96310

The MB96310 series is a sub-set of the powerful MB96340 series condensed in to a compact 48 pin package (7 x 7mm) - offering 16-bit performance at low cost and a rich feature mix. It provides an entry level to the scalable platform of fully soft- and hardware compatible 16FX devices with packages ranging from 48 pin to 144 pin .

A security feature is incorporated, preventing unauthorised reading of the contents of the 96kB respectively 160kB flash memory.

Feature

- Fujitsu F²MC-16FX microcontroller architecture
- Max. 56MHz CPU clock
- Flash security function
- Full CAN 2.0A/2.0B interface with flexible buffering
- 32kHz sub-clock option
- LIN-USART 3ch (offering SPI mode)
- External interrupts 12ch
- A/D converter 10-bit x 12ch
- Input capture 16-bit x 4ch
- Output compare unit 16-bit x 2ch
- Reload timers 16-bit x 4ch
- Programmable pulse generator 16-bit x 14ch
- QFP 48 package
- 3V to 5.5V supply voltage



MB96310 FX series block diagram - maximum functionality in a small foot print package

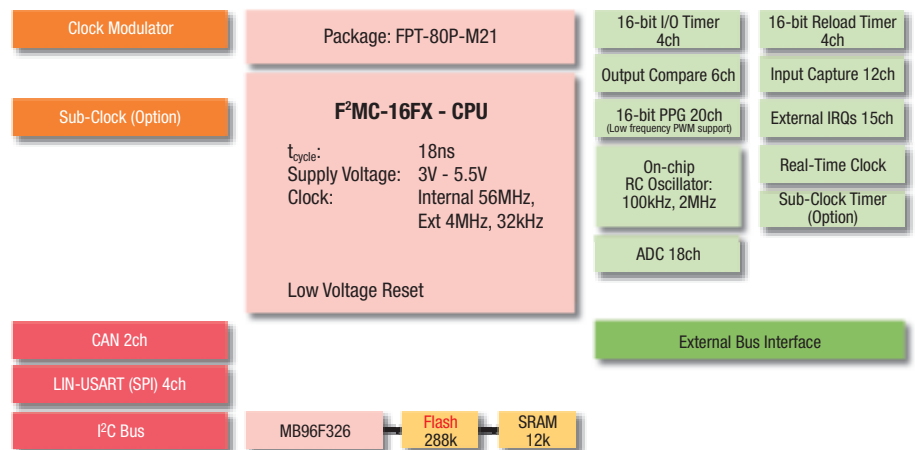
F²MC-16FX CAN bus microcontrollers (80-pin) MB96320

The MB96320 series offers 16-bit performance at low cost and a rich feature mix in a small 80-pin package. It provides an entry level to the new MB96340 and an upgrade path to MB96350 series whenever more I/Os are required.

CAN, I²C bus, flexible UART interface providing LIN support and 18 analogue input channels are some of the main features. A security feature is incorporated, preventing unauthorised reading of the contents of the 288kB flash memory.

Features

- Fujitsu F²MC-16FX microcontroller architecture
- Max. 56MHz CPU clock
- Flash security function
- Full CAN 2.0A/2.0B interface with flexible buffering
- 32kHz sub-clock option
- LIN-USART 4ch (offering SPI mode)
- External interrupts 15ch
- A/D converter 10-bit x 18ch
- Input capture 16-bit x 12ch
- Output compare unit 16-bit x 6ch
- Reload timers 16-bit x 4ch
- Programmable pulse generator 16-bit x 20ch
- QFP 80 package
- 3V to 5.5V supply voltage



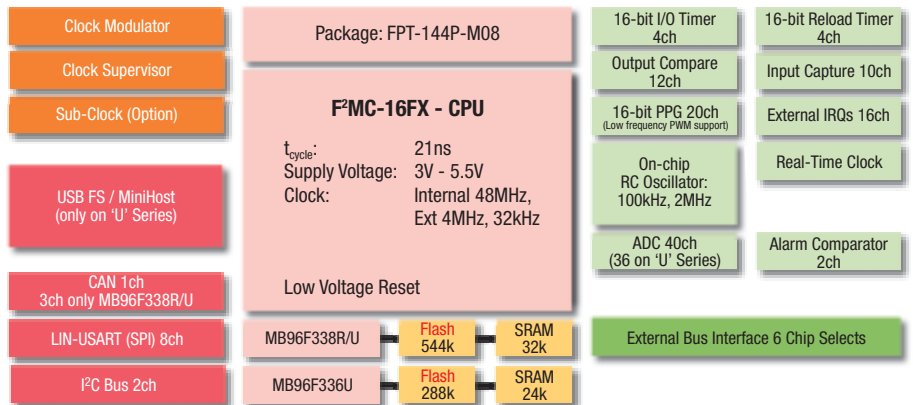
MB96320 FX series block diagram

F²MC-16FX CAN bus & USB microcontrollers (144-pin) MB96330

The MB96330 series offers a scalable family concept approach to CAN applications such as automotive body control, comfort applications and infotainment. The series features up to 544kB flash and 32kB RAM and different mixtures of peripherals allowing for easy migration to other F²MC-16FX MCUs, which saves development time and costs.

LIN support, I²C bus interface, up to 40 analogue input channels, external bus interface, selectable port levels for CMOS, TTL and automotive levels are some of the enhanced features of this series.

The MB96F336U / MB96F338U features a USB FS & MiniHost interface targeting industrial applications that need to connect to a USB device (e.g. USB Memory Sticks) or PC.



MB96330 FX series block diagram

Features

- Fujitsu F²MC-16FX microcontroller architecture
- Max. 48MHz CPU clock
- Flash security function
- Full CAN 2.0A/2.0B interface with flexible buffering
- USB FS + MiniHost (MB96F336U / MB96F338U only)
- External bus interface
- LIN-USART 8ch (offering SPI mode)
- I²C 2ch
- External interrupts 16ch
- A/D converter up to 10-bit x 40ch
- Input capture 16-bit x 10ch
- Output compare 16-bit x 12ch
- Reload timers 16-bit x 4ch
- Programmable pulse generator 16-bit x 20ch with low frequency support
- QFP 144 package
- 3V to 5.5V supply voltage

“The series offers a scalable family concept approach to CAN applications”

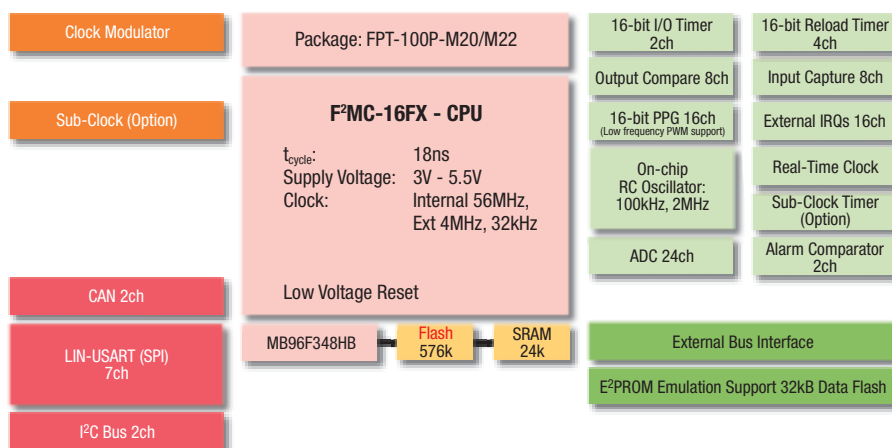


F²MC-16FX CAN bus microcontrollers (100-pin) MB96340

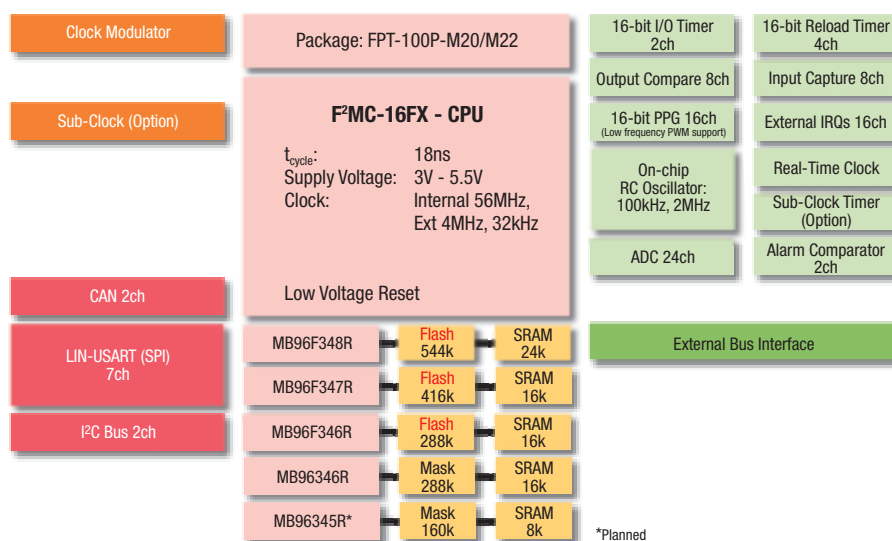
The MB96340 series offers a scalable family concept approach to CAN applications such as automotive body control, comfort applications, infotainment as well as industrial applications. The series features different RAM/ROM sizes and different mixtures of peripherals allowing for easy migration to other MCUs in this series, which saves development time and costs. LIN support, I²C bus interface, 24 analogue input channels, external bus interface, selectable port levels for CMOS, TTL and automotive levels are some of the enhanced features of this series.

Features

- Fujitsu F²MC-16FX microcontroller architecture
- Pin-compatible to F²MC-16LX MB90340 series
- Max. 56MHz CPU clock
- Flash security function
- Full CAN 2.0A/2.0B interface with flexible buffering
- External bus interface
- LIN-USART 7ch (offering SPI mode)
- I²C 2ch
- External interrupts 16ch
- A/D converter 10-bit x 24ch
- Input capture 16-bit x 8ch
- Output compare 16-bit x 8ch
- Reload timers 16-bit x 4ch
- Programmable pulse generator 16-bit x 16ch with low frequency support
- QFP 100 package
- 3V to 5.5V supply voltage



MB96340H FX series block diagram. Pin compatible to MB90340



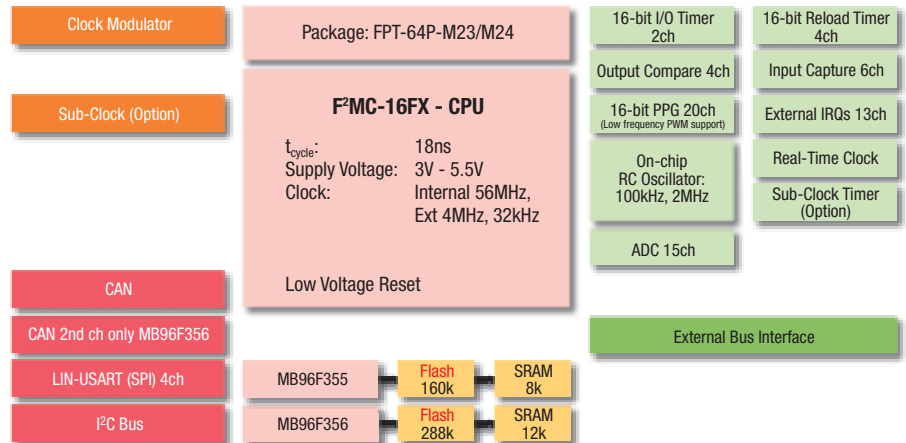
MB96340R FX series block diagram. Pin Compatible to MB90340

F²MC-16FX CAN bus microcontrollers (64-pin) MB96350

The MB96350 series offers 16-bit performance at low cost and a rich feature mix in a small package. It provides an entry level to the new MB96340 series with full soft- and hardware compatibility of the embedded peripherals. CAN, I²C bus, flexible UART interface providing LIN support and 15 analogue input channels are some of the main features. A security feature is incorporated, preventing unauthorised reading of the contents of the 288kB flash memory.

Features

- Fujitsu F²MC-16FX microcontroller architecture
- Pin-compatible to F²MC-16LX MB90350 series
- Max. 56MHz CPU clock
- Flash security function
- Full CAN 2.0A/2.0B interface with flexible buffering
- 32kHz sub-clock option
- LIN-USART 4ch (offering SPI mode)
- External interrupts 13ch
- A/D converter 10-bit x 15ch
- Input capture 16-bit x 6ch
- Output compare unit 16-bit x 4ch
- Reload timers 16-bit x 4ch
- Programmable pulse generator 16-bit x 20ch
- QFP 64 package
- 3V to 5.5V supply voltage



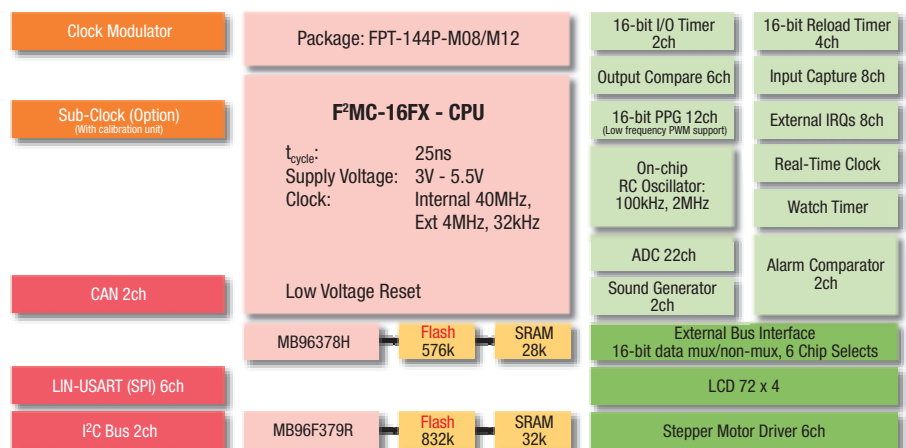
MB96350 FX series block diagram. Pin compatible to MB90350

F²MC-16FX CAN bus microcontrollers (144-pin) MB96370

The MB96370 is designed for demanding 16-bit automotive applications, especially instrument clusters. It offers a 6ch Stepper Motor controllers and an integrated LCD controller especially designed to ease vehicle dashboard developments.

Features

- Fujitsu F²MC-16FX microcontroller architecture
- Max. 40MHz CPU clock
- 576kB and 832kB flash ROM
- Up to 2ch full CAN 2.0A/2.0B interfaces with flexible buffering
- 28kB to 32kB RAM
- Stepper motor controller-driver 6ch
- 72 x 4 LCD on-chip controller
- 2ch sound generator
- LIN-USART 6ch (offers SPI mode)
- External interrupts 8ch
- A/D converter 10-bit x 22ch
- Input capture 16-bit x 8ch
- Output compare 16-bit x 6ch
- Reload timers 16-bit x 4ch
- I²C 2ch
- Programmable pulse generator 16-bit x 12ch with low frequency support
- On-chip RC oscillator 100kHz/2MHz
- QFP 120 package
- 3V to 5.5V supply voltage



MB96370 FX series block diagram 'Speedo-144'

“ Specially designed to ease vehicle dashboard developments ”



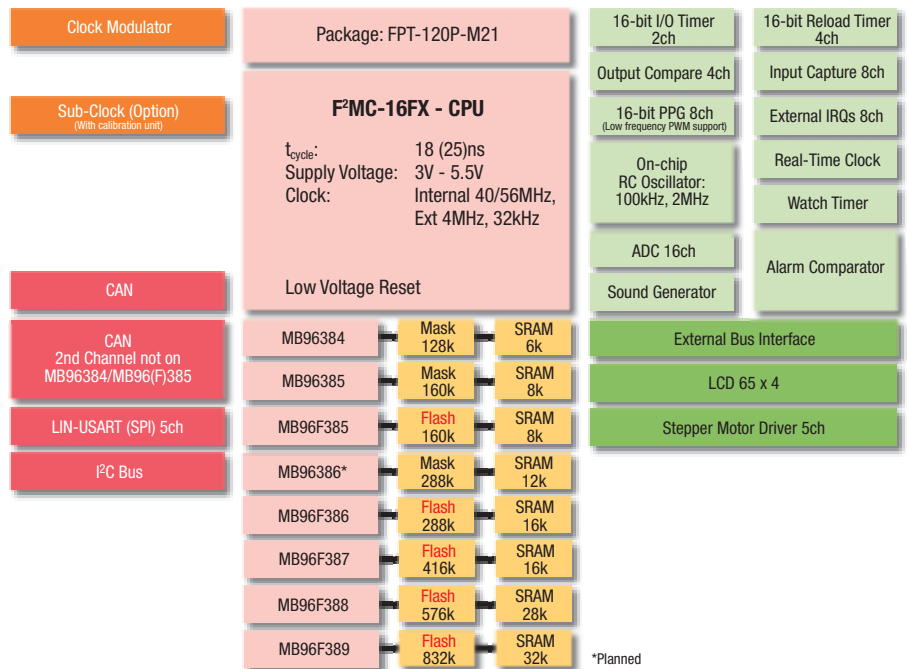
PRODUCT OVERVIEW MICROCONTROLLERS

F²MC-16FX double CAN bus MCUs with stepper motor controller (120-pin) MB96380

The MB96380 is designed for demanding 16-bit automotive applications, especially instrument clusters. Integrated Stepper Motor and LCD controllers enable quick and cost effective vehicle dashboard developments.

Features

- Fujitsu F²MC-16FX microcontroller architecture
- Max. 40/56MHz CPU clock
- 288kB to 832kB flash ROM, or 128kB to 288kB mask ROM
- 2 full CAN 2.0A/2.0B interfaces with flexible buffering
- 16kB to 32kB RAM
- Stepper motor controller-driver 5ch
- 65 x LCD on-chip controller
- Sound generator
- LIN-USART 5ch (offers SPI mode)
- External interrupts 8ch
- A/D converter 10-bit x 16ch
- Input capture 16-bit x 8ch
- Output compare 16-bit x 4ch
- Reload timers 16-bit x 4ch
- I²C 1ch
- Programmable pulse generator 16-bit x 8ch with low frequency support
- QFP 120 package
- 3V to 5.5V supply voltage



MB96380 FX series block diagram 'Speedo-120'

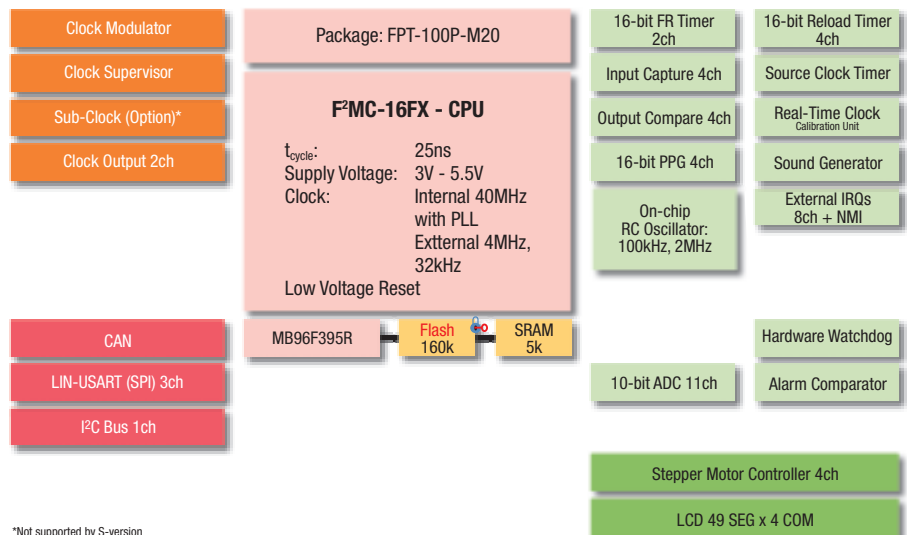
F²MC-16FX low cost CAN bus MCUs with stepper motor controller (100-pin) MB96390

The MB96390 is a low cost entry level to the Speedo series of 16FX instrumentation MCUs.

The new 100 pin series includes all application specific peripherals, like LCD controller/driver, stepper motor controller and sound generator. Developed using a new 'low leakage' technology the new series' stand-by current has been significantly reduced.

Features

- Fujitsu F²MC-16FX microcontroller architecture
- Max. 40MHz CPU clock
- 160kB flash, ROM versions planned
- Full CAN 2.0A/2.0B interfaces with flexible buffering
- 5kB RAM
- Stepper motor controller-driver 4ch
- 49 x 4 segments LCD controller on-chip
- Sound generator
- LIN-USART 3ch (offers SPI mode)
- External interrupts 8ch
- A/D converter 10-bit x 11ch
- Input capture 16-bit x 4ch
- Output compare 16-bit x 4ch
- Reload timers 16-bit x 4ch
- I²C 1ch
- Programmable pulse generator 16-bit x 4ch with low frequency support
- QFP 100 package
- 3V to 5.5V supply voltage



*Not supported by S-version

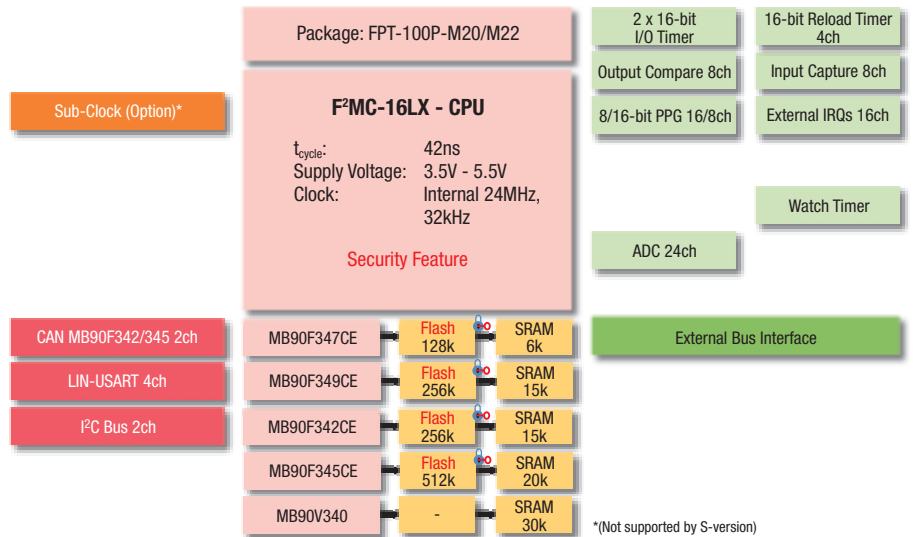
MB96390 FX series block diagram - 'Speedo-100' for low cost instrumentation

F²MC-16LX CAN bus microcontrollers (100-pin) MB90340

The MB90340 series offers a scalable family concept approach to CAN applications such as automotive body control, comfort applications and infotainment. The series features different RAM/ROM sizes and different mixtures of peripherals allowing for easy migration to other MCUs in this series, which saves development time and costs.

LIN support, I²C bus interface, 24 analogue input channels, external bus interface, selectable port levels for CMOS, TTL and automotive levels are some of the enhanced features of this series. Options for CAN range are from CANless devices to 2ch CAN.

A security feature is incorporated, preventing unauthorised reading of the contents of the flash memory.



Shows the MB90340 series with LIN-USART I²C-bus, 24 AD-channels, external bus and full CAN performance

Features

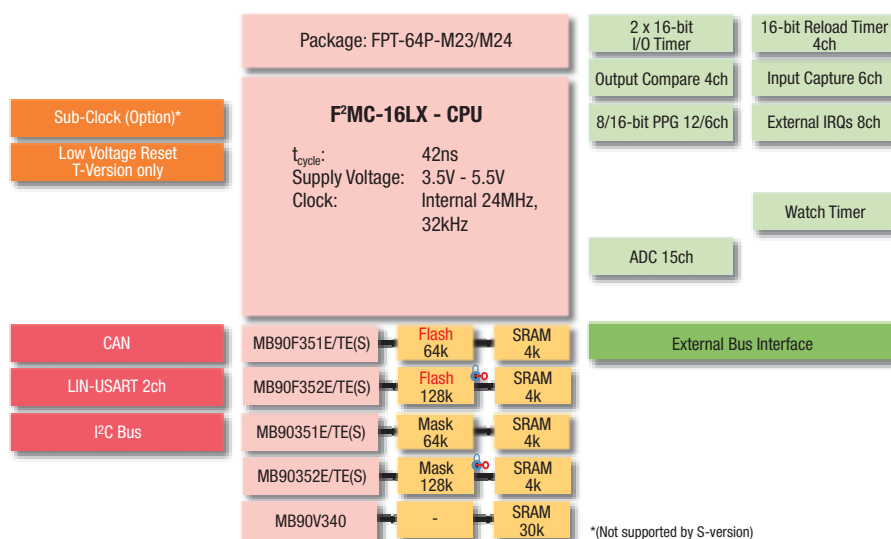
- Fujitsu F²MC-16LX microcontroller architecture
- Max. 24MHz CPU clock
- Flash security function
- Full CAN 2.0A/2.0B interface with flexible buffering
- External bus interface
- LIN-USART 4ch (offering SPI mode)
- I²C 2ch
- External interrupts 16ch
- A/D converter 10-bit x 24ch
- Input capture 16-bit x 8ch
- Output compare 16-bit x 8ch
- Reload timers 16-bit x 4ch
- Programmable pulse generator 16-bit x 8ch or 8-bit x 16ch
- QFP 100 package

Part number	Memory type	Size (kB)	RAM (kB)	Sub-clock	CAN ch
MB90F347CE	Flash*	128	6	Yes	1
MB90F347CES	Flash*	128	6	No	1
MB90F867E	Flash*	128	6	Yes	0
MB90F867ES	Flash*	128	6	No	0
MB90F349CE	Flash*	256	15.75	Yes	1
MB90F349CES	Flash*	256	15.75	No	1
MB90F342CE	Flash*	256	15.75	Yes	2
MB90F342CES	Flash*	256	15.75	No	2
MB90F345CE	Flash	512	20	Yes	2
MB90F345CES	Flash	512	20	No	2

Note: *Mask ROM version is also available

F²MC-16LX CAN bus microcontrollers (64-pin) MB90350

The MB90350 series is a derivative of the new MB90340 series for applications that require small packages. This series offers 16-bit performance at low cost and a rich feature mix in a small package. It provides an entry level to the new MB90340 series with full soft- and hardware compatibility of the embedded peripherals. CAN, I²C bus, flexible UART interface providing LIN support and 15 analogue input channels are some of the main features. A security feature is incorporated, preventing unauthorised reading of the contents of the 128kB flash memory.



Shows the small sized MB90350 series with LIN-USART, I²C-bus, 15 AD-channels, external bus and full CAN performance

Features

- Fujitsu F²MC-16LX microcontroller architecture
- Max. 24MHz CPU clock
- Flash security function
- Full CAN 2.0A/2.0B interface with flexible buffering
- 32kHz sub-clock
- LIN-USART 2ch (offering SPI mode)
- External interrupts 8ch
- A/D converter 10-bit x 15ch
- Input capture 16-bit x 6ch
- Output compare unit 16-bit x 4ch
- Reload timers 16-bit x 4ch
- Programmable pulse generator 16-bit x 6ch or 8-bit x 12ch
- Option for E²PROM emulation by dual-operation flash
- QFP 64 package

Part number	Memory type	Size (kB)	Sub-clock	Low voltage detection reset
MB90F352E(S)	Flash*	128	Not on S-version	No
MB90F351E(S)	Flash*	64	Not on S-version	No
MB90F352TE(S)	Flash*	128	Not on S-version	Yes
MB90F351TE(S)	Flash*	64	Not on S-version	Yes

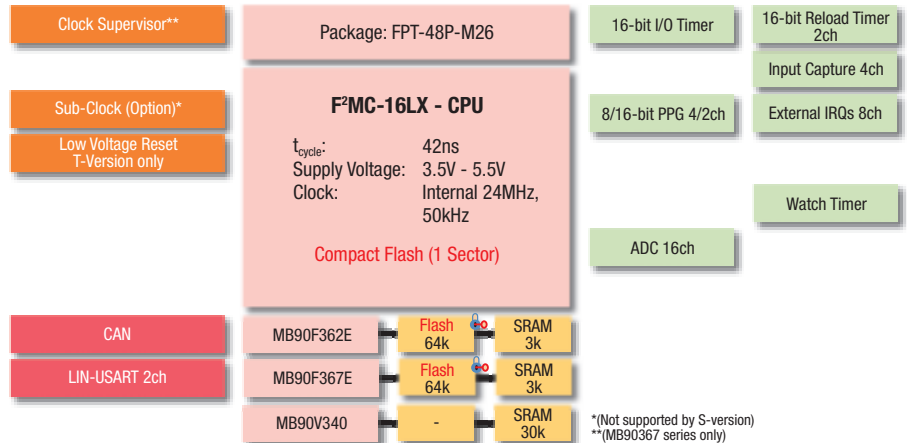
Note: *Dual-operation flash; mask ROM version is also available

F²MC-16LX CAN bus microcontrollers (48-pin) MB90360

The MB90360 series is a sub-set of the powerful MB90340 series condensed in to a compact 48-pin package (7 x 7mm). It has a pin-compatible footprint to other Fujitsu 48-pin CAN series (MB90385, MB90895).

Features

- Fujitsu F²MC-16LX microcontroller architecture
- Max. 24MHz CPU clock
- 64kB flash ROM (with single voltage and 10k erase cycles), or mask ROM
- Full CAN 2.0A/2.0B interface with flexible buffering (16 message buffers)
- 3kB RAM
- 32kHz sub-clock option
- LIN USARTs 2ch (offering SPI mode)
- External interrupts 8ch
- A/D converter 10-bit x 16ch
- Input capture 16-bit x 4ch
- Reload timers 16-bit x 2ch
- Programmable pulse generator 8-bit or 16-bit x 2ch
- Option for low voltage/CPU operation detection reset
- QFP 48 package



Shows the MB90360 series available in compact 48-pin package

Part number	Memory type	Size (kB)	Sub-clock	Low voltage detection reset
MB90F362E(S)	Flash*	64	Not on S-version	No
MB90F362TE(S)	Flash*	64	Not on S-version	Yes

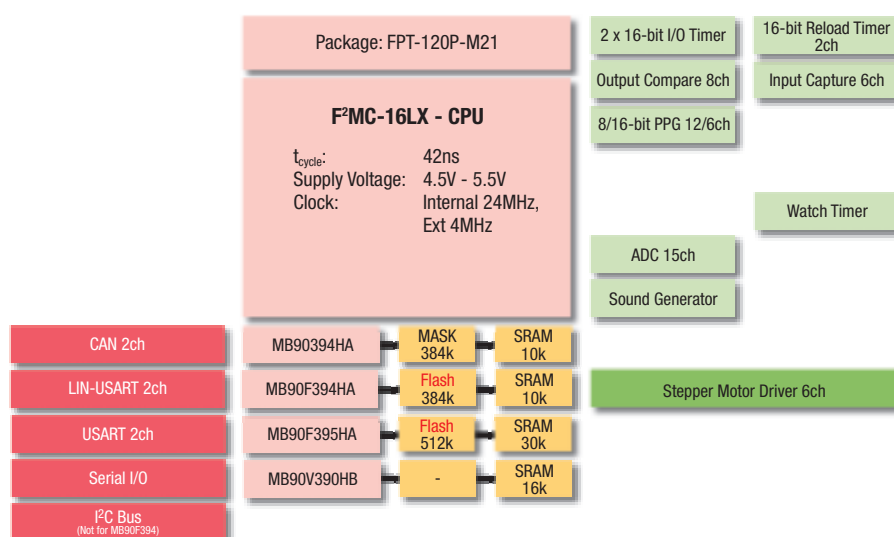
Note: *Mask ROM version is also available

F²MC-16LX double CAN bus microcontrollers (120-pin) MB90390

The MB90390 is designed for demanding 16-bit automotive applications, especially instrument clusters.

Features

- Fujitsu F²MC-16LX microcontroller architecture
- Max. 24MHz CPU clock
- 384kB, 512kB flash ROM (with single voltage and 10k erase cycles), or mask ROM
- 2 full CAN 2.0A/2.0B interfaces with flexible buffering
- 10kB, 30kB RAM
- Stepper motor controller-driver 6ch
- Sound generator
- UART 2ch
- LIN-USART (offers SPI mode) 1ch
- Synchronous serial I/O
- External interrupts 8ch
- A/D converter 10-bit x 15ch
- Input capture 16-bit x 6ch
- Output compare 16-bit x 6ch
- Reload timers 16-bit x 2ch
- I²C (MB90F395HA only)
- Programmable pulse generator 16-bit x 6ch or 8-bit x 12ch
- QFP 120 package



Flash version = MB90F395HA (512kB flash, 30kB RAM)
 = MB90F394HA (384kB flash, 10kB RAM)

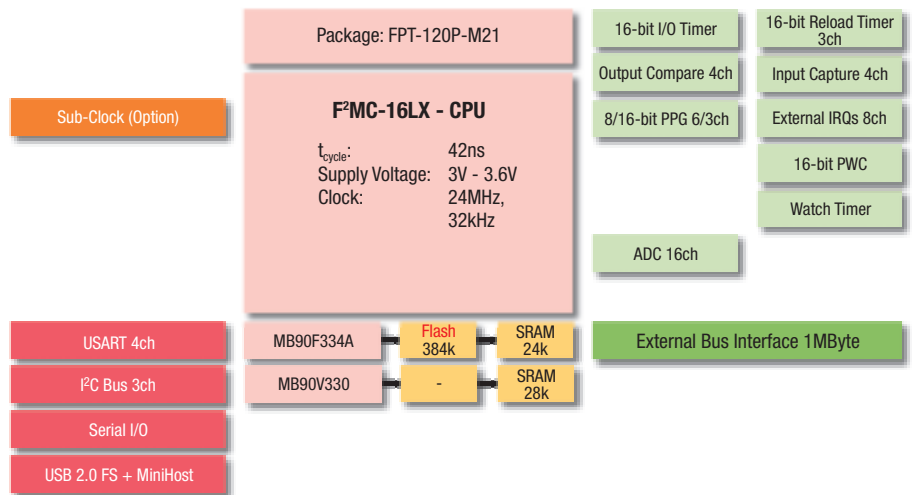
Shows the MB90390 series with 6 stepper motor controller-drivers, LIN-USART and full dual CAN performance

F²MC-16LX USB microcontrollers (120-pin) MB90330/335

The MB90330/335 series are line-ups of high-performance 16-bit MCUs (F²MC-16LX family) with built-in USB macros, supporting USB-Function and simplified USB-Minihost. This allows a USB device to act either as a USB-Host or as a USB-Function. In this way, USB peripheral devices can exchange data without the mediation of a PC. USB drivers are available free-of-charge.

Features

- Technology 0.35µm CMOS
- Max. 24MHz CPU clock
- Operating voltage 3.0-3.6V
- USB 2.0 compliant
- 12Mbps full-speed
- Up to 6 endpoints
- DMAC supported
- SIO
- 16-bit reload timer
- 16-bit pulse width counter
- 8 x external interrupts
- **USB driver available free**
http://www.thesycon.de/eng/prod_usbfirmware.shtml



Shows the MB90F334 series with USB and USB MiniHost function

Product Line-up

Device	MB90F334	MB90333	MB90F337	MB90337
ROM density	384kBytes flash	256kBytes ROM	64kBytes flash	64kBytes ROM
RAM density	24kBytes	16kBytes	4kBytes	
Packaging	120-pin LQFP	120-pin LQFP	64-pin LQFP	64-pin LQFP
A/D converter	8/10-bits, 16ch	8/10-bits, 16ch	-	-
UART	4ch	4ch	2ch	2ch
I ² C	3ch	3ch	1ch	1ch
PPG timer	3 x 16-bit / 6 x 8-bit	3 x 16-bit / 6 x 8-bit	2 x 16-bit / 4 x 8-bit	2 x 16-bit / 4 x 8-bit

16-bit F²MC-LX compatibility overview

2 CAN	MB90F543G 128kB Flash, 6kB RAM	MB90F594G 256kB Flash, 6kB RAM	MB90543G 128kB ROM, 6kB RAM	MB90F342 256kB Flash, 16kB RAM		16FX 64-pin MB96350
	MB90F591G 384kB Flash, 8kB RAM	MB90F394 384kB Flash, 10kB RAM	MB90F395 512kB Flash, 30kB RAM		MB90342 256kB Flash, 16kB RAM	16FX 80-pin MB96320
	MB90591G 384kB ROM, 8kB RAM	MB90594G 256kB ROM, 6kB RAM	MB90F423G 128kB Flash, 6kB RAM	MB90394 384kB ROM, 10kB RAM	MB90F345 512kB Flash, 20kB RAM	16FX 100-pin MB96340
1 CAN	MB90F598G 128kB Flash, 4kB RAM	MB90598G 128kB ROM, 4kB RAM			MB90F349 256kB Flash, 16kB RAM	16FX Speedo 120-pin
	MB90F428G 128kB Flash, 6kB RAM	MB90428G 128kB ROM, 6kB RAM	MB90427G 64kB ROM, 4kB RAM	MB90351 64kB ROM, 4kB RAM	MB90F367 64kB Flash, 3kB RAM	16FX Speedo 144-pin
	MB90F546G 256kB Flash, 8kB RAM	MB90548G 128kB ROM, 4kB RAM	MB90F347 128kB Flash, 6kB RAM	MB90349 256kB ROM, 16kB RAM	MB90367 64kB ROM, 3kB RAM	16FX 144-pin
	MB90F548G 128kB Flash, 4kB RAM	MB90547G 64kB ROM, 2kB RAM	MB90549G 256kB ROM, 6kB RAM	MB90F362 64kB Flash, 3kB RAM	MB90362 64kB ROM, 3kB RAM	
	MB90F497G 64kB Flash, 2kB RAM	MB90F498G 128kB ROM, 2kB RAM	MB90347 128kB ROM, 6kB RAM	MB90F351 64kB Flash, 4kB RAM	MB90947A 128kB ROM, 6kB RAM	
	MB90497G 64kB ROM, 2kB RAM	MB90F897 64kB Flash, 2kB RAM	MB90F352 128kB Flash, 4kB RAM	MB90352 128kB ROM, 4kB RAM	MB90351 128kB ROM, 4kB RAM	
	MB90F947A 128kB Flash, 6kB RAM	MB90F387 64kB Flash, 2kB RAM	MB90387 64kB ROM, 2kB RAM	MB90F949A 256kB Flash, 12kB RAM	MB90F946A 128kB Flash, 16kB RAM	
	MB90F457 64kB Flash, 2kB RAM	MB90457 64kB ROM, 2kB RAM	MB90F438L 128kB Flash, 4kB RAM	MB90F439 256kB Flash, 6kB RAM	MB90F867 128kB Flash, 6kB RAM	
No CAN			MB90438L 128kB ROM, 4kB RAM		MB90867 128kB ROM, 6kB RAM	

48-pin 7 x 7mm	100-pin External Bus	100-pin Stepper Motor LCD	100-pin Stepper Motor	100-pin External Bus	100-pin Stepper Motor	120-pin Stepper Motor
80-pin External Bus	64-pin External Bus	64-pin External Bus	100-pin Cost Optimised	120-pin 16FX Speedo	144-pin 16FX Speedo	144-pin with 3ch CAN

Same colour = same pin-out

PRODUCT OVERVIEW MICROCONTROLLERS

F²MC-16LX latest product line-up

Overview of 16LX families

Series	Device Part Number	Group Features	RAM	Flash/Mask (ROM)	Flash Code Security	Max. Frequency (MHz)	Sub-clock	Operating Voltage	Operating Temp	Package	Max. I/Os	Watchdog	CAN interface	CAN Message Buffers/channel	UART Standard	USART LIN	SIO
MB90330	MB90F334	USB with Min-Host function	24k	384k	No	24	Yes	3.0V to 3.6V	-40 to +85°C	QFP-120	94	Yes	No	No	4	No	1
MB90335	MB90F337	USB with Min-Host function	4k	64k	No	24	Yes	3.0V to 3.6V	-40 to +85°C	QFP-64	45	Yes	No	No	2	No	1
MB90340	MB90(F)347CE(S) MB90(F)349CE(S) MB90(F)342CE(S) MB90(F)345CE(S)	'S': version for single clock (with two additional I/O ports) 'C' version with I ² C bus and 24ch ADC	6k 15.75k 15.75k 20k	128k 256k 256k 512k	Yes	24	not for S-versions	3.5 to 5.5V*	-40 to 105°C	QFP-100	80 (82 for S-version)	Yes	1 1 2 2	16	No	4	No
MB90350	MB90(F)351/E/TE(S) MB90(F)352/E/TE(S)	Subset of MB90340 'T': low voltage detection	4k	64k 128k	No Yes	24	not for S-versions	3.5 to 5.5V*	-40 to 105°C	QFP-64	49 (51 for S-version)	Yes	1	16	No	2	No
MB90360	MB90F362/E/TE(S)***	Subset of MB90350 'T': low voltage detection	3k	64k	Yes	24	not for S-versions	3.5 to 5.5V	-40 to 105°C	QFP-48	34 (36 for S version)	Yes	1	16	No	2	No
MB90385/S	MB90F387/S MB90387/S	Pin compatible to dual operation flash MB90895	2k 2k	64k 64k	No	16	not for S-versions	3.5 to 5.5V*	-40 to 105°C	LQFP-48	34 (36 for S-version)	Yes	1	8	1	No	No
MB90390	MB90F394HA MB90F395HA MB90394HA	6 x stepper motor PWM, sound generator, RTC clock timer	10k 30k 10k	384k 512k 384k	No	24	No	3.5 to 5.5V*	-40 to 85°C	LQFP-120	96	Yes	2	16	2	1	1
MB90420G/425G	MB90F428GA/GB/GC MB90428GA/GB/GC MB90427GA/GB/GC MB90F423GA/GB/GC MB90423GA/GB/GC	'A': single clock, CPU operating detect unit. 'B': dual clock, CPU operation detect unit. 'C': dual clock	6k 6k 4k 6k 6k	128k 128k 64k 128k 128k	No	16	not for A-versions	3.7V to 5.5V* 3.0 to 5.5V for C version	-40 to 105°C	QFP-100	58	Yes	1 1 1 2 2	16	2	No	No
MB90455	MB90F455/S MB90F456/S MB90F457/S MB90455/S MB90456/S MB90457/S	Pin compatible to MB90385 series	2k 2k 2k 2k 2k 2k	24k 32k 64k 24k 32k 64k	No	16	not on S-version	4.5V to 5.5V	-40 to +105°C	QFP-48	34 (36 for S-version)	Yes	No	No	1	No	1
MB90460	MB90F462A MB90462A	Inverter PWM for 2 Motors (AC/DC)	2k 2k	64k 64k	Yes	16	No	4.5V to 5.5V	-40 to +85°C	QFP-64	50	Yes	No	No	2	No	No
MB90480	MB90F481 MB90F482	3V supply, 2 x 8-bit Up/Down counter	4k 6k	192k 256k	No	25	Yes	2.7V to 3.6V	-40 to +85°C	QFP-100	84	Yes	No	No	1	No	2
MB90800	MB90F804-101 MB90F804-201 MB90803/S	3V, 4 x 48 LCD	16k 16k 4k	256k 256k 128k	No	25	No	2.7V to 3.6V	-40 to +85°C	QFP-100	70 72 70 / 72 for S-Version	Yes	No	No	2	No	2
MB90820	MB90F823B MB90F822B MB90822B	Inverter PWM for 1 Motor (AC/DC)	4k	128k 64k 64k	Yes Yes	24	Yes Not on S-Version	5V +/- 10%	-40 to +85°C	QFP-80	66	Yes	No	No	2	No	No

Note: * supply voltage 4.5V - 5.5V if AD converter is used • ** watch mode only for devices with sub-clock • Part numbers with prefix F are flash versions • Part numbers without prefix F are mask ROM versions • ***under development. F²MC-16LX product line-up continues onto pages 32 & 33.

ADC	PPG	OCU	ICU	16-bit I/O Timer	Pulse Width Counter	16-bit Reload Timer	Timebase Timer	Watch Timer	External Bus	Stepper Motor Interface	External Interrupts Drivers	I ² C Channel	Sound Generator	LCD Interface	Power Saving Modes	Evaluation Board
10-bit 16ch	3 x 16-bit / 6 x 8-bit	4	4	1	1 x 16-bit	3	Yes	1	Yes (1MB)	No	8	3	No	No	Sleep, Stop, Timer, Watch	MB2031-01 +MB2031-20
No	2 x 16-bit / 4 x 8-bit	4	4	1	1 x 16-bit	3	Yes	1	No	No	8	1	No	No	Sleep, Stop, Timer, Watch	—
10-bit 16/24ch	8 x 16-bit / 16 x 8-bit	8	8	2	No	4	Yes	Not on S-version	Yes	No	16	2	No	No	Sleep, stop, timer, watch	FLASH-CAN-100P-340
10-bit 15ch	6 x 16-bit / 12 x 8-bit	4	6	2	No	4	Yes	Not on S-version	Yes	No	8	1	No	No	Sleep, stop, timer, watch	FLASH-CAN-64P-350PMC
10-bit 16ch	2 x 16-bit / 4 x 8-bit	No	4	1	No	2	Yes	Not on S-version	No	No	8	No	No	No	Sleep, stop, timer, watch**	FLASH-CAN-48P-M26
10-bit 8ch	2 x 16-bit / 4 x 8-bit	No	4	1	No	2	Yes	Not on S-version	No	No	4	No	No	No	Sleep, stop, timer, watch	FLASH-CAN-48P-M26
10-bit 8ch	6 x 16-bit / 12 x 8-bit only 6 connected to I/Os	8	6	2	No	2	Yes	No	No	6ch	8	1 (MB90F395)	Yes	No	Sleep, stop, timer	FLASH-CAN-120-390
10-bit 8ch	3 x 16-bit / 6 x 8-bit only 3 connected to I/Os	No	4	1	No	2	Yes	Not on A-version	No	4ch	8	No	Yes	4 x 24	Sleep, stop, timer, watch	FLASH-CAN-100P-M06
10-bit 8ch	2 x 16-bit / 4 x 8-bit	0	4	1	No	2	Yes	not on S-version	No	No	4	No	No	No	Sleep, Stop, Timer, Watch**	FLASH-CAN-48P-M26
10-bit 8ch	3 x 16-bit / 6 x 8-bit	6	4	1	2 x 16-bit	2	Yes	No	No	No	8	No	No	No	Sleep, Stop, Timer, Watch	FLASH-CAN-64P-M09
10-bit 8ch	3 x 16-bit / 6 x 8-bit	6	2	1	No	1	Yes	Yes	Yes	No	8	1	No	No	Sleep, Stop, Timer, Watch	FLASH-CAN-100P-M06
10-bit 12ch	2 x 16-bit / 4 x 8-bit, 2 connected to pins	2	2	1	No	3	Yes	No Yes	No	No	4	1	No	4 x 48	Sleep, Stop, Timer, Watch	FLASH-CAN-100P-340
10-bit 16ch	4 x 16-bit	6	4	1	2	2	Yes	No	No	No	8	No	No	No	Sleep, Stop, Timer, Watch	SK-90820-80PFM-562

PRODUCT OVERVIEW MICROCONTROLLERS

F²MC-16LX & 16FX product line-up

Overview of 16LX latest products continued

Series	Device Part Number	Group Features	RAM	Flash/ Mask (ROM)	Flash Code Security	Max. Frequency (MHz)	Sub-clock	Operating Voltage	Operating Temp	Package	Max. I/Os	Watchdog	CAN interface	CAN Message Buffers/channel	UART Standard	USART LIN	SIO
MB90865/S	MB90F867E(S) MB90867E(S)	Pin compatible to MB90340 series	6k	128k	Yes	24	not on S-Version	3.5V to 5.5V	-40 to +105°C	QFP-100	80	Yes	No	No	No	4	No
MB90890	MB90F897/S	Dual operation flash, pin compatible to MB90385 series	2k	64k	No	16	not on S-Version	4.5V to 5.5V	-40 to +105°C	QFP-48	34 / 36 for S-Version	Yes	1	8	2	0	No
MB90945	MB90F947A MB90F949A MB90F946A	Cost optimised	6k 12k 16k	128k 256k 384k	No	24	No	3.5V to 5.5V	-40 to +105°C	QFP-100	82	Yes	1	16	1	1	1
MB90960	MB90F962S	Low cost, pin compatible MB90360	3k	64k	No	24	No	3.5 to 5.5V*	-40 to 105°C	QFP-48	34	Yes	No	No	No	2	No

Note: Part numbers with prefix F are flash versions • Part numbers without prefix F are mask ROM version.

Overview of 16FX family

Series	Device Part Number	Group Features	RAM	Flash/ Mask (ROM)	Flash Code Security	Max. Frequency (MHz)	Operating Voltage	Low Voltage Reset	Alarm Comparator	Operating Temp (Standard)	Package	Max. I/Os	CAN interface	CAN Message Buffers/channel	USART LIN
MB96310	MB96F313RS	Small footprint	8K	96k	yes	56	3.0V to 5.5V	Yes	No	105°C	LQFP-48	36	1	32	3
	MB96F313RW		8K	96k								34			
	MB96F315RS		8K	160k								36			
	MB96F315RW		8K	160k								34			
	MB96F313AS		8K	96k								36			
	MB96F313AW		8K	96k								34			
	MB96F315AS		8K	160k								36			
MB96F315AW	8K	160k	34												
MB96320	MB96F326RS	Many PWM channels	12k	288k	Yes	56	3.0V to 5.5V	Yes	No	105°C	LQFP-80	66	2	32	4
	MB96F326RW		12k	288k											
MB96330R	MB96F338RS	3ch CAN	32k	544k	Yes	48	3.0V to 5.5V	Yes	2	105°C	QFP-144	124	3	32	8
	MB96F338RW		32k	544k								122			
MB96330U	MB96F338US	3ch CAN + USB	32k	544k	Yes	48	3.0V to 5.5V	Yes	2	105°C	QFP-144	124	3	32	8
	MB96F338UW		32k	544k								122			
	MB96F336US		24k	288k								124			
	MB96F336UW		24k	288k								122			
MB96340	MB96F348HS	Pin compatible MB90340 series	24k	544k+32k	Yes	56	3.0V to 5.5V	Yes	2	105°C	QFP/LQFP-100	82	2	32	7
	MB96F348HW		24k	544k+32k								80			
	MB96F348RS		24k	544k								82			
	MB96F348RW		24k	544k								80			
	MB96F347RS		16k	416k								82			
	MB96F347RW		16k	416k								80			
	MB96F346RS		16k	288k								82			
	MB96F346RW		16k	288k								80			
	MB96346RW		16k	288k								82			
	MB96346RS		16k	288k								80			
	MB96F348CS		24k	544k+32k								82			
	MB96F348CW		24k	544k+32k								80			
	MB96F348AS		24k	544k								82			
	MB96F348AW		24k	544k								80			
	MB96F347AS		16k	416k								82			
	MB96F347AW		16k	416k								80			
	MB96F346AS		16k	288k								82			
	MB96F346AW		16k	288k								80			

Note: Part numbers with prefix F are flash versions • Part numbers without prefix F are mask ROM versions

ADC	PPG	OCU	ICU	16-bit I/O Timer	Pulse Width Counter	16-bit Reload Timer	Timebase Timer	Watch Timer	External Bus	Stepper Motor Interface	External Interrupts Drivers	I ² C Channel	Sound Generator	LCD Interface	Power Saving Modes	Evaluation Board
10-bit 24ch	8 x 16-bit / 16 x 8-bit	8	8	2	No	4	Yes	not on S-version	Yes	No	16	2	No	No	Sleep, Stop, Timer, Watch	FLASH-CAN-100P-340
10-bit 8ch	2 x 16-bit / 4 x 8-bit	0	4	1	No	2	Yes	not on S-Version	No	No	8	No	No	No	Sleep, Stop, Timer, Watch	FLASH-CAN-48P-M26
10-bit 15ch	6 x 16-bit / 12 x 8-bit	4	6	2	No	1	1	No	No	No	8	1	No	No	Sleep, Stop, Timer, Watch	FLASH-CAN-100P-340
10bit 16ch	2 x 16-bit / 4 x 8-bit	No	4	1	No	2	Yes	No	No	No	8	No	No	No	sleep, stop, timer	FLASH-CAN-48P-M26

DMA	ADC	PPG	OCU	ICU	16-bit I/O Timer	16-bit Reload Timer	Main-clock Timer	Sub-clock Timer	External Bus Interface	Stepper Motor Drivers	External Interrupts	I ² C Channel	Sound Generator	LCD Interface	Evaluation Board
3	10-bit 12ch	16-bit 14ch	2	4	2	4	Yes	only on W-version	No	No	11	No	No	No	SK-96310-48PMC
4	10-bit 18ch	16-bit 19ch	5	12	4	4	Yes	only on W-version	Yes	No	15	1	No	No	SK-96320-80PMC
10	10-bit 40ch	16-bit 20ch	12	10	4	4	Yes	only on W-version	Yes		16	2		No	SK-96330-144PMC-GDC
10	10-bit 36ch	16-bit 20ch	12	10	4	4	Yes	only on W-version	Yes		16	2		No	SK-96330-144PMC-GDC
6	10-bit 24ch	16-bit 16ch	8	8	2	4	Yes	only on W-version	Yes	No	16	2	No	No	Flash-CAN-100P-340 (V.1.2)

PRODUCT OVERVIEW MICROCONTROLLERS

F²MC-16FX product line-up

Overview of 16FX family continued

Series	Device Part Number	Group Features	RAM	Flash/Mask (ROM)	Flash Code Security	Max. Frequency (MHz)	Operating Voltage	Low Voltage Reset	Alarm Comparator	Operating Temp (Standard)	Package	Max. I/Os	CAN interface	CAN Message Buffers/channel	USART LIN						
MB96350	MB96F356RS	Pin compatible MB90350 series	12k	288k	Yes	56	3.0V to 5.5V	Yes	No	105°C	QFP/LQFP-64	51	2	32	4						
	MB96F356RW		12k	288k								49									
	MB96F353RS		8K	96k								51									
	MB96F353RW		8K	96k								49									
	MB96F355RS		8K	160k								51									
	MB96F355RW		8K	160k								49									
	MB96F353AS		8K	96k								51									
	MB96F353AW		8K	96k								49									
	MB96F355AS		8K	160k								51									
	MB96F355AW		8K	160k								49									
MB96370	MB96F378HS	Large LCD, 6 SMC	28k	544k+32k	Yes	40	3.0V to 5.5V	Yes	2	105°C	QFP/LQFP-144	96	2	32	6						
	MB96F378HW		28k	544k+32k																	
	MB96F379RS		32k	832K																	
	MB96F379RW		32k	832K																	
MB96380	MB96F387RS	Large LCD	16k	416k	Yes	56	3.0V to 5.5V	Yes	2	105°C	LQFP-120	96	2	32	5						
	MB96F387RW		16k	416k								94									
	MB96F386RS		16k	288k								96									
	MB96F386RW		16k	288k								94									
	MB96F385RS	Large LCD	8k	160k	Yes	40	3.0V to 5.5V	1	105°C	LQFP120	96	1	32	5							
	MB96F385RW		8k	160k							94										
	MB96F384RS		6k	128k							Yes				56	3.0V to 5.5V	Yes	1	105°C	LQFP120	96
	MB96F384RW		6k	128k																	94
	MB96F385RS		8k	160k																	96
	MB96F385RW	8k	160k	94																	
	MB96F388HS	28k	544k+32k	Yes	40			2	105°C		96	2	32								
	MB96F388HW	28k	544k+32k								94										
	MB96F389RS	32k	832k								96										
MB96F389RW	32k	832k	94																		
MB96390	MB96F395RS	low cost with LCD / SMC	8K	160k	Yes	56	3.0V to 5.5V	Yes	1	105°C	LQFP-100	76	1	32	3						
	MB96F395RW		8K	160k								74									

Note: Part numbers with prefix F are flash versions • Part numbers without prefix F are mask ROM versions

DMA	ADC	PPG	OCU	ICU	16-bit I/O Timer	16-bit Reload Timer	Main-clock Timer	Sub-clock Timer	External Bus Interface	Stepper Motor Drivers	External Interrupts	I ² C Channel	Sound Generator	LCD Interface	Evaluation Board
4	10-bit 15ch	16-bit 12ch	4	6	2	4	Yes	only on W-version	Yes	No	13	1	No	No	Flash-CAN-64P-350
7	10-bit 22ch	16-bit 12ch	6	8	2	4	Yes	only on W-version	Yes	6	8	2	2	4 x 72	SK-96370-144PMC
7	10-bit 16ch	16-bit 8ch	4	8	2	4	Yes	only on W-version	Yes	5	8	1	2	4 x 65	SK-96380-120PMC
7	10-bit 16ch	16-bit 8ch	4	8	2	4	Yes	only on W-version		5	8	1	2	4 x 65	SK-96380-120PMC
7	10-bit 16ch	16-bit 8ch	4	8	2	4	Yes	only on W-version only on W-version		5	8	1	2	4 x 65	SK-96380-120PMC
No	10-bit 11ch	16-bit 4ch	4	4	2	4	Yes	only on W-version	No	4	8	1	2	4 x 49	SK-96390-100PMC

“ With CPU frequencies up to 56MHz, the 16FX achieves processing performance ranges of 32-bit processors ”



16FX QUICK START KIT – on-chip debugging for Fujitsu 16FX microcontrollers



Description

SK-16FX-EUROScope is a complete development / debugging kit for Fujitsu's new 16FX MCU family. It contains the Starterkit 'SK-16FX-100PMC' including Fujitsu's Softune Workbench integrated development software as well as 'EUROScope lite 16FX', an exclusive version source-level debugger for Fujitsu's 16FX family.

Together with the available application notes and software examples, this kit provides designers with a low-cost, fast time-to-market!

Kit content

- Integrated Development Environment 'Softune Workbench'
- 'EUROScope lite 16FX' source-level debugger
- Target board 'SK-16FX-100PMC'
- USB- and RS232 cable
- Software examples, application notes, manuals

Order code:

SK-16FX-EUROSCOPE

16FX On-chip debugging

The 16FX family supports on-chip debugging without the need for boxes and adaptors as might be required for ordinary JTAG-based systems.

The microcontroller can be connected directly to the Host-PC via a serial RS232 or USB interface (with a converter IC). Since an on-chip hardware module and the firmware (boot ROM) of the MCU completely implement the debug functionality, loading of kernels or linking of a library is not necessary.



SK-16FX-EUROSCOPE:
On-chip debugger with target board.

EUROScope lite 16FX

Fujitsu and EUROS teamed-up to provide a special 'lite' version of EUROScope that contains all the standard functions of an 'everyday' debugger that a developer would normally require.

The sophisticated user interface helps keep track of every important piece of information: Windows can be docked to the edge of the main window

without obscuring important data. The multi-threading makes the user interface highly responsive and extremely easy to work with.

A full version of EUROScope, available from EUROS, offers further features such as OS support and visualisation of task- and other OS objects.

The inexpensive Quick Start Kit and an attractive licence scheme 'buy one, use on multiple PCs' makes EUROScope lite an interesting alternative to full-blown emulator systems (which are available for 16FX as well).

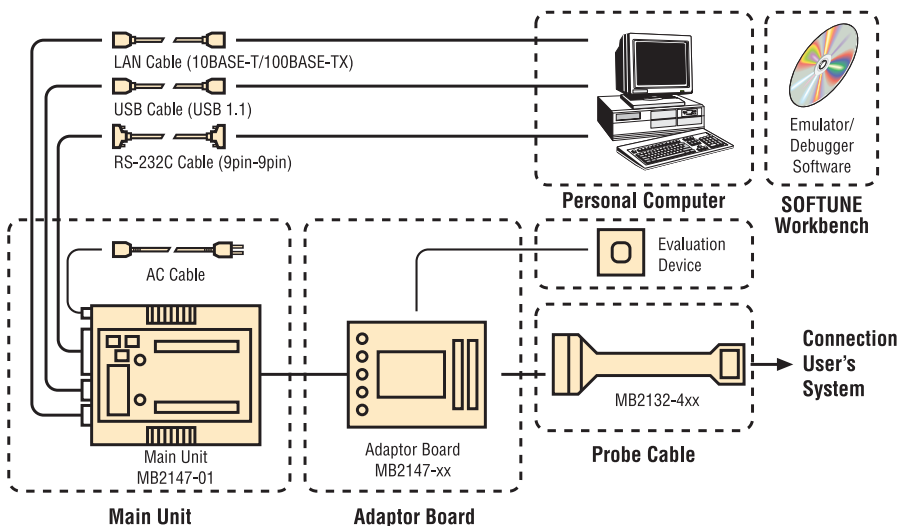
Features

- No kernel linkage/upload required
- Utilises on-chip debug interface of all 16FX MCUs
- Set/clear breakpoints
- Set/clear range breakpoint
- Run, stop, abort
- Single-step debugging (step, step-in, step-out)
- Memory window
- Watch window
- Mixed source code view
- CPU register window

“ The 16FX family supports on-chip debugging without the need for boxes and adaptors ”



16-bit support tools



System configuration



MB2198-500 Main unit and adaptor board of the 16FX high-speed emulator



MB2198-01 Fujitsu's emulation system for 32-bit RISC architecture

16FX tools

16FX is supported by Fujitsu's proven emulator main unit MB2198-01-E.

The Software tools (Softune Workbench) are free-of-charge for customers in Europe.

One evaluation chip covers a host of future 16FX products. A complete system comprises the following items:

- Emulator: MB2198-01-E (see page 56)
- MCU adaptor board (for Eva-chip connection) MB2198-500
- Eva-chip MB96V300
- IC package specific header board (for connection to target hardware)
- Target board (see next pages)

MB2147-01 16LX emulator

Features

- Supports all Fujitsu 16LX microcontroller series
- Microcontroller operating frequency: max 25MHz
- Emulation memory: 1M x 4 area
- Fully Softune Workbench integrated user interface
- Simplified graphic interface operation using pull-down menu and buttons
- On-the-fly function (commands can be run during microcontroller execution)
- Powerful trace function
- Displays source codes, variables, register, memory and trace on multi-windows
- Event trigger allows a wide range of conditions to be specified (code x 8 / data x 8)
- Sequential control in 4 conditions and 3 levels
- Performance measurement function (measurement of execution speed between two points, iteration count measurement)

- Code coverage measurement function (program execution coverage rate measurement)
- Host I/F (standard accessories): RS-232C (max 115kbps), LAN (10BASE-T, 100BASE-TX), USB 1.1
- LCD display for set-up and emulator status
- Menu keys for LCD dialogue

Evaluation boards

Fujitsu supports development engineers with low cost multi-functional evaluation boards for almost every Fujitsu 16-bit flash microcontroller.

These boards can be used stand-alone for software development and testing or as a simple target board to work with the emulator system. The boards allow the designer to start immediately with the software development.

Features

- In-circuit serial flash programming
- All resources available for evaluation
- All pins routed to connectors
- 8 user LEDs
- Reset button
- Crystal for main clock and for sub-clock where applicable
- 9 to 12V unregulated external DC power supply usable
- English documentation and CD-ROM included

FLASH-CAN-48P evaluation board

- 16LX series supported: MB90360, MB90385, MB90455 and MB90890
- 1 UART interface
- 1 LIN transceiver
- 1 high-speed CAN transceiver
- 8 user LEDs, optional: alphanumeric standard LCD connectable instead of LEDs
- 5 user-buttons configurable for INT4, INT5, TIN0, IN0 and ADTG*
- 64-pin VG connector (same pin-out as Flash-CAN-64P-M09-V2)

Order code:

FLASH-CAN-48P-M26 with 48-pin QFP socket and MB90F387.

FLASH-CAN-64P-350 evaluation board

- 16LX series supported: MB90350 series with package code 'PFM', 'PMC', 'PMC1'
- 16FX: MB96350 series with package codes PMC, PMC1
- 2 UART interfaces
- 2 LIN transceivers
- 1 high-speed CAN transceiver
- 8 user LEDs, optional: alphanumeric standard LCD connectable
- 5 user buttons configurable for INT10, INT11, IN0, IN1, TIN1*
- QFP-64 socket
- 96-pin VG connector
- Delivered with MB90F352PFM

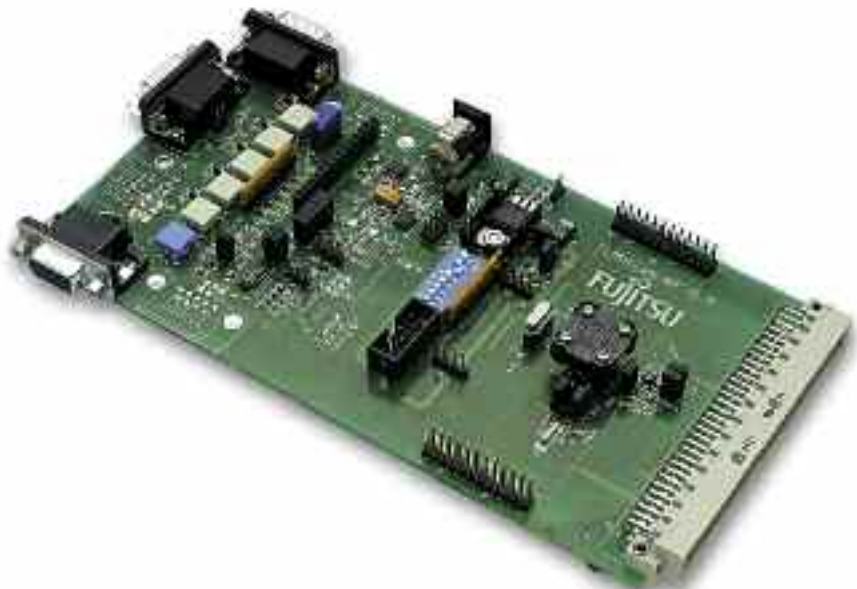
Order code:

Flash-CAN-64P-350-PMC for QFP package

Flash-CAN-64P-350-PMC1 for LQFP package (0.5mm pitch)



Flash-CAN-64P-350 evaluation board



Flash-CAN-48P evaluation board

*The functions assigned to user buttons may vary depending on which MCU is used

FLASH-CAN-100P-340 evaluation board

- 16LX series supported: MB90340, MB90865. Version 2.0 onward also MB90800, MB90945 package code 'PF' or 'PQC'
- MB90340 series: MB90V340, MB90F34x
- 16FX series MB96340 support version 1.2 onward
- 2 UART interfaces
- 2 LIN transceivers
- 2 high-speed CAN transceivers
- 8 user LEDs, optional: alphanumeric standard LCD connectable instead of LEDs
- 5 user-buttons configurable for INTO, INT1, TIN1, IN0 and ADTG/TIN0*
- QFP-100 socket for device (with package code 'PF') or emulator connection
- 96-pin VG connector
- Delivered with flash microcontroller MB90F34x

Order code:

Flash-CAN-100P-340



Flash-CAN-100P-340 evaluation board

FLASH-CAN-120-390 evaluation board

- 16LX series supported: MB90390
- 5 and 3V internal power supply available
- 5 MHz main crystal
- 2 UART interfaces (3 and 5V operating)
- LIN-transceiver
- 2 high-speed CAN transceiver
- 2 buttons configurable for external interrupts
- Prototyping area
- QFP-120 socket for device or emulator connection
- Delivered with flash microcontroller MB90F394H

Order code:

Flash-CAN-120-390



Flash-CAN-120-390 evaluation board

*The functions assigned to user buttons may vary depending on which MCU is used

Evaluation boards

SK-96380-120PMC evaluation board for Speedo-120 series

- Supports Fujitsu's MB96380-LQFP (M21) MCU in 120 PMC package or the MB2198 emulator system with the probe cable MB2198-16FX-120P-M21
- 9-15V unregulated external DC power supply
- 5V, 3.3V, 2.5V and 1.8V on-board switching mode voltage regulators
- Power-LEDs for all supply voltages
- On-board voltage supervisor monitors 3 of 4 supply voltages
- In-circuit serial flash programming (UART0 or UART1)
- All resources available for evaluation
- All MCU pins routed to connectors
- 4 MHz main-crystal
- 32kHz crystal for sub-clock operation
- 2 RS232- or LIN interfaces and 2 CAN interfaces are usable simultaneously 3V capable CAN, LIN and RS232 transceivers
- 8 user LEDs
- Optional: alphanumeric standard LCD connectable instead of LEDs
- Reset-button, Reset-LED
- SK-96380-120PMC-GDC with on-board graphics memory and option to connect GDC board (Lime)
- 5 user-buttons

Order code:

SK-96380-120PMC



SK-96390-100PMC evaluation board

SK-96390-100PMC evaluation board for Speedo-100 series

- Supports Fujitsu's 16FX MB96390 series with 100 pin 'PMC' (M20) package or the MB2198 Emulator System with the Probe Cable MB2198-510-E
- 9-15V unregulated external DC power supply
- On-board 5.0V and 3.3V linear voltage regulator
- Power-LEDs for all supply voltages
- Onboard voltage supervisor monitor
- In-Circuit serial flash programming (UART0, UART1 or SIO2)
- All resources available for evaluation
- All MCU pins routed to connectors
- 4 MHz main crystal
- 32 kHz crystal for sub clock operation
- Two RS232 interfaces
- One LIN Interface
- One CAN interface
- 3 V capable CAN, LIN, and RS232 transceivers
- 8 User LEDs
- Optional: alphanumeric standard LC-Display connectable instead of LEDs
- Reset button, Reset LED
- 5 User buttons

Order code:

SK-96390-100PMC

SK-90820-80PFM-562 evaluation board for motor control series

- 16LX series supported: MB90820 in 'PFM' package
- 80-pin socket for device (package code PFM) or in-circuit emulator connection
- 9-12V unregulated external DC power supply usable
- 5V internal power supply, Power-LED
- In-circuit serial flash programming
- All resources available for evaluation
- All pins routed to connectors
- 4MHz main-crystal
- 2 UART interfaces
- 2 LIN interfaces
- 8 User LEDs, optional: alphanumeric standard LCD connectable instead of LEDs
- Reset-button, Reset-LED
- 5 user-buttons
- 96-pin VG connector
- Delivered with flash microcontroller MB90F823

Order code:

SK-90820-80PFM-562



SK-90820-80PFM-562 evaluation board



SK-96380-120PMC evaluation board

SK-96310-48PMC evaluation board for MB96310 series

- Supports Fujitsu's 16FX MB96310 series with 48 pin 'PMC' (M26) package or the MB2198 Emulator System with the Probe Cable MB2198-509-E
- 9-15V unregulated external DC power supply
- On-board 5.0V and 3.3V linear voltage regulator
- Power-LEDs for all supply voltages
- Onboard voltage supervisor monitor
- In-Circuit serial flash programming (UART2, UART7, UART8 or SIO8)
- All resources available for evaluation
- All MCU pins routed to connectors
- 4 MHz main crystal
- 32 kHz crystal for sub clock operation
- 2 RS232 interfaces
- Two LIN Interface
- One CAN interface
- 3 V capable CAN, LIN, and RS232 transceivers
- 8 User LEDs
- Optional: alphanumeric standard LC-Display connectable instead of LEDs
- Reset button, Reset LED
- 5 User buttons

Order code:

SK-96310-48PMC

SK-96320-80PMC

- Supports Fujitsu's MB96320 Series in FPT-80P-M21 package or the MB2198 Emulator System with the Probe Cable MB2198-505
- 9-12V unregulated external DC power supply
- 5V and 3.3V on-board voltage regulators
- Power-LEDs
- On-board voltage supervisor monitor
- In-circuit serial flash programming
- All resources available for evaluation
- All MCU pins routed to edge connectors
- 2 RS232, 2 LIN and 2 CAN interfaces are usable simultaneously
- 3V capable CAN, LIN and RS232 transceivers
- 8 user LEDs, optional: alphanumeric standard LCD connectable instead of LEDs
- Reset button, Reset LED
- 5 user buttons
- 96-pin VG connector
- Delivered with MB96F326RS

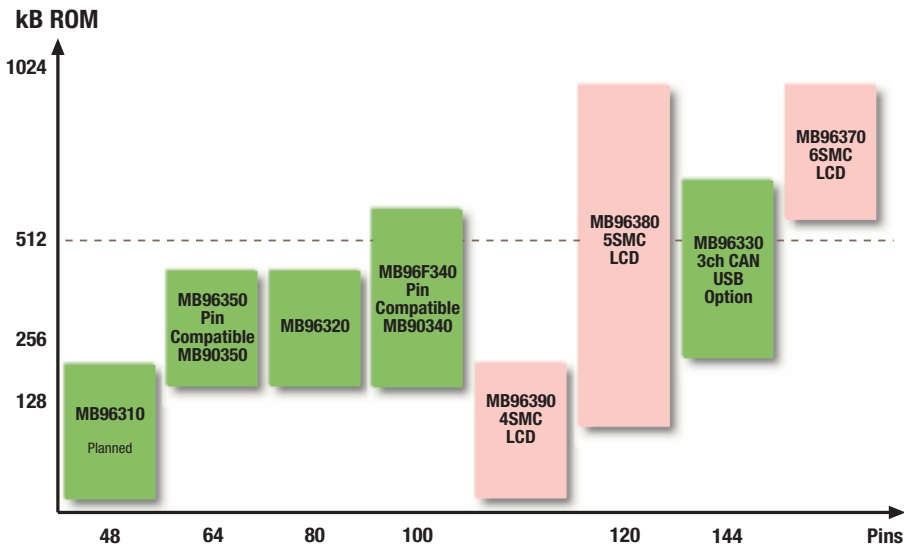
Order code:

SK-96320-80PMC



SK-96320-80PMC-562 evaluation board

16-bit F²MC-LX/FX compatibility overview



16LX/FX line-up

The 16LX family consists of several different series with different pin-counts and pin-outs, different peripheral types, and different port-pin function shares. The 16LX family is manufactured using a 0.35 μ m technology. In contrast, the new 16FX family offers a new core based on a 0.18 μ m technology. Though different series with different pin-counts will be available, the port-pin function shares are the same among all series.

The 16FX family is instruction-set-compatible with the 16LX family. For a quick and easy transition, there are pin-compatible devices in the 16FX family to the MB90340 and MB90350 series of the 16LX family.

Both are using the Softune Workbench as a software development environment to develop programs for the Fujitsu F²MC-16FX and F²MC-16LX microcontroller families. It is a combination of a development manager, emulator debugger, simulator and an integrated development environment for efficient development.

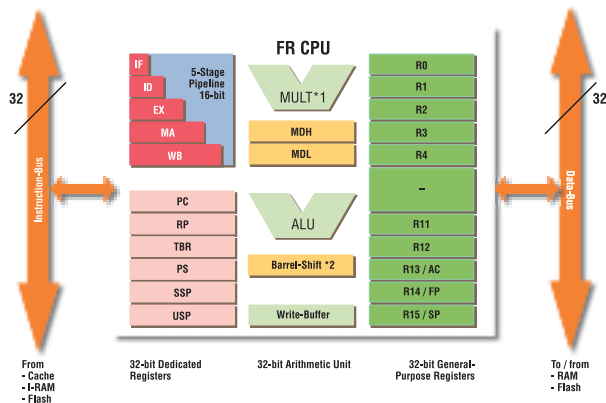
More information about the migration of designs from F²MC-16LX to the new F²MC-16FX products can be found on our web site

<http://mcu.emea.fujitsu.com> in the apps notes section under **MCU-AN-300026**

Introduction to the FR family

32-bit risc architecture

FR CPU core block diagram



*1: 32-bit x 32-bit: 5 clock cycles, 16-bit x 16-bit: 3 clock cycles
 *2: 1 cycle
 IF: Instruction Fetch. ID: Instruction Decode. EX: Execution. MA: Memory Access. WB: Write Back. PC: Program Counter. RP: Return Pointer. TBR: Table Base Register. PS: Program Status. SSP: System Stack Pointer. USP: User Stack Pointer. AC: Accumulator. FP: Frame Pointer. SP: Stack Pointer

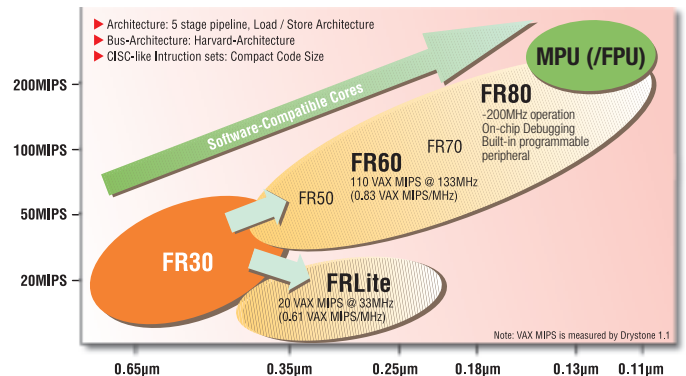
The Fujitsu RISC (FR) architecture is a 32-bit microprocessor core that is dedicated to resolving the twin demands of high performance coupled with low cost, which are needed by today's high-end automotive, consumer and industrial applications. Designed from the outset to be optimised for embedded applications, the CPU has 16-bit instructions, enabling maximum performance from low-cost, half-word external memory or else allowing double instruction fetches for each bus cycle. The CPU employs a five-stage pipeline, a 32 x 32 multiplier, a barrel shifter and a bit search unit which finds the first 1, 0 or change in a data word in a single cycle.

The CPU has eight dedicated 32-bit registers: program counter, processor status, interrupt table base register, return pointer, system and user stack pointers, and two for multiply/divide result. There are sixteen 32-bit, general-purpose registers arranged as a single bank. The functions of R13 to R15 are reserved as virtual

accumulator, frame pointer and stack pointer respectively. The instruction set contains bit manipulation instructions and data moving instructions, which are very helpful in supporting the on-chip peripheral blocks. Although the FR is a RISC, it contains a number of extended instructions, which help assembly level programming, often unavoidable in embedded applications. An example is the store of half of the register bank to memory.

Blocks that require fast access are connected to the FR-core within a 32-bit Harvard Bus system. These units are the internal RAM, the DMA-controller and the bit search unit. Resources that require simple control or status access, such as UARTs, timers, etc., are hooked up on a peripheral bus known as the R-Bus. The external bus gives the user the opportunity to access external memory or other memory-mapped devices on the target application, supporting up to 8 fully configurable chip-select areas.

FR 32-bit RISC core performance road map



From FRLite's low power/low cost technology to FR80's optimised performance. The FR core roadmap offers a wide range of software-compatible cores dedicated to embedded applications

Fujitsu has developed a suite of FR cores from FRLite to FR80 – for different performance requirements. The FRLite core has been designed with the aim of reducing die size, power consumption and the design turn-around time.

Most of the current families are based on the FR60 core family containing the FR50 and FR70 core variants.

The FR80 is offered in several variants, as a processor core with both data and instruction cache as well as an optimised controller core with direct access to the on-chip flash memory.

PRODUCT OVERVIEW MICROCONTROLLERS

MB91460 automotive series

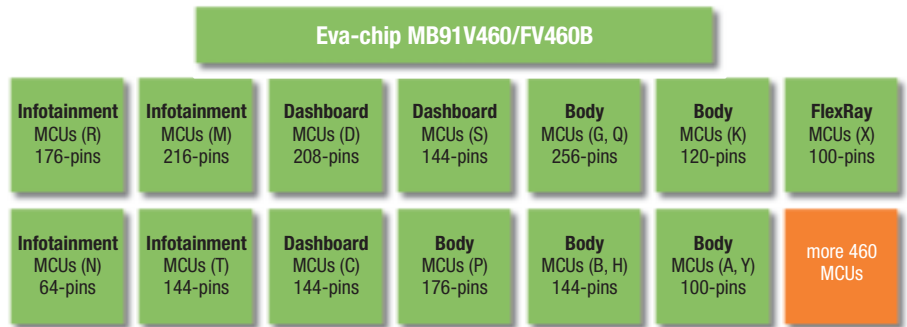
The FR-based MB91460 series (based on 0.18µm embedded flash technology) offers devices for car dashboard, car body control, car infotainment and also FlexRay™ applications, e.g. in the chassis area. It is a successor of the well-established MB91360G series.

Most of the devices feature a common set of basic features like:

- FR70 core (out of the FR60 core family), operating up to 100MHz
- Up to 2MB embedded flash with 64kB and 8kB sectors
- Flash security (read-out protection, additional write protection for selected sectors)
- Prefetch/Cache architecture to speed-up access to the on-chip flash
- An EDSU/MPU unit, which either will be used for on-chip debugging using the ACCEMIC MDE environment or as a memory protection unit
- A BootROM to support initialisation of the MCU and also safe reprogramming in the field
- A hardware watchdog, which is running based on the on-chip RC oscillator and independent of the main clock
- A clock modulator to significantly improve EMC behavior
- DMA, with 5 channels, which can be configured in a very flexible way (see hardware manual for details)

For other features see the detailed block diagrams.

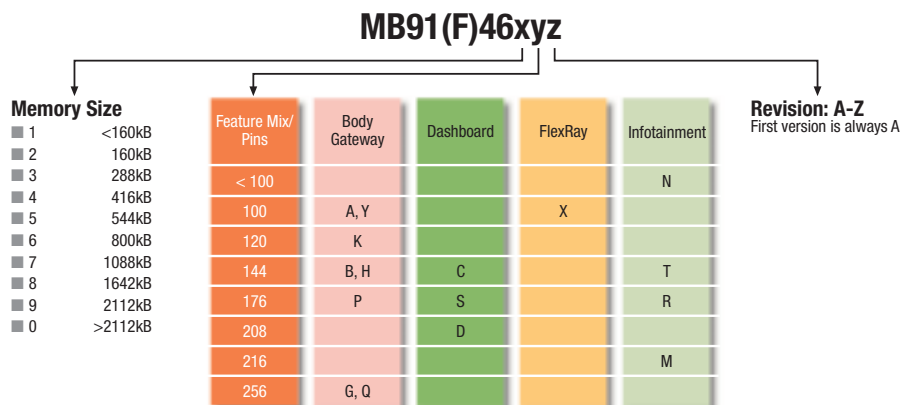
The devices are operating on a single supply voltage between 3.0 and 5.5V. The standard operating temperature is



Key



MB91460 line-up



MB91460 naming conventions

between -40 and +105°C. Operation up to 125°C is possible (check details with Fujitsu, please).

The current MB91460 line-up (MCUs, which are available, under development or under planning) is shown on the diagram.

See the other diagram for the naming rules of the MB91460 series, for additional feature mix / package combinations other characters will be defined according to demand.

The portfolio overviews show available MB91460 MCUs and those currently under development. More will be added according to market demands.

The assignment of the MB91460 MCUs to a certain application area should be seen as suggestions. It is of course possible to use the dashboard MCUs for body control. In such cases the SMC outputs could e.g. serve as high current ports.

	< 144 pins	144 pins	176 pins	208 pins	216 pins
3 CAN		*MB91F467C 1088kB/64kB *MB91F465C 544kB/32kB *MB91F463C 288kB/24kB		*MB91F467D 1088kB/64kB *MB91F465D 544kB/48kB	
2 CAN		MB91F467T 1088kB/64kB	**MB91F467S 1088kB/64kB MB91F467R 1088kB/64kB		***MB91F467M 1088kB/64kB
1 CAN					

Key Available Under development *SMC **APIX ***MLB/PS

MB91460 dashboard / infotainment portfolio overview

	64 pins	100/120 pins	144 pins	176 pins	256 pins
6 CAN			MB91F467B 1MB/40kB		MB91F469G 2MB/96kB
3 CAN			MB91F465B 544kB/40kB MB91F463B 288kB/24kB	MB91F467P 1088kB/64kB/80kB MB91F465P 544kB/40kB MB91F464P 416kB/40kB	MB91F469Q 2MB/96kB
2 CAN	MB91F463N 544kB/16kB	*MB91F465X 544kB/32kB	MB91F469T 2MB/128kB MB91F467T 1MB/64kB		
1 CAN		MB91F465K 544kB/16kB MB91F464A 416kB/16kB	MB91F464H 416kB/32kB		

Key Available Under development *FlexRay

MB91460 body portfolio overview

PRODUCT OVERVIEW MICROCONTROLLERS

MB91460 automotive series

MB91F464A is a 100-pin device developed for various body control applications.

Features of MB91F464A

- 416kB flash
- 16kB RAM,
- CAN 1ch, 32 message buffers
- LIN-USART: 5ch
- 10-bit ADC: 21ch
- PPG: 10ch
- RTC module, which can operate based on the external 4MHz or 32kHz crystals
- Various timers

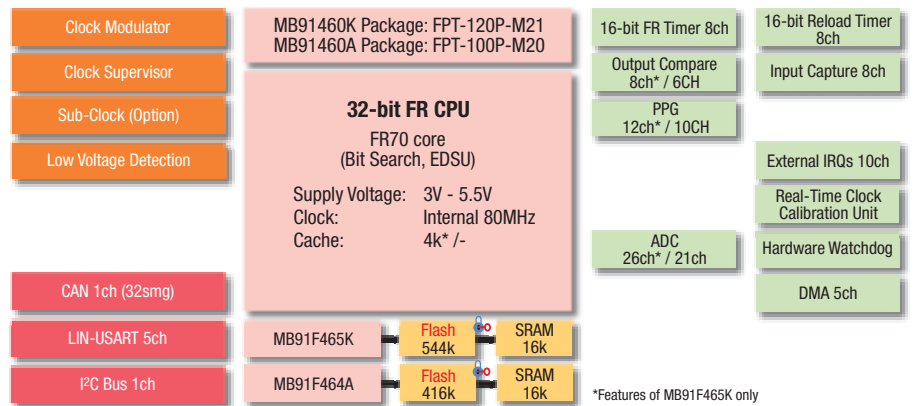
MB91F465K is a sister device of MB91F464A, with some additional functions:

- 544kB flash
- QFP-120
- PPG: 12ch
- 10-bit ADC: 26ch

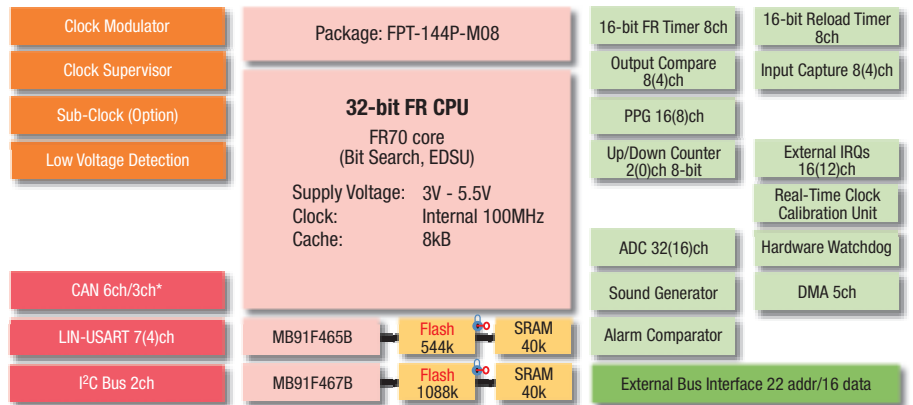
Features of MB91F467B

The **MB91460B sub-series** offers devices with up to 6 CAN channels, a high count of other communications interfaces (LIN-USART, I²C), the full MB91460 set of 32 ADC channels and 16 PPG channels. The devices feature an optional external bus. If the bus is required some other peripherals cannot be used at the same time (see the block diagram for more details).

MB91460T is a MB91460 sub-series primarily targeting infotainment. The devices of this series can also be used for body control and offer a 2-CAN alternative to the MB91460B sub-series.



MB91460A / MB91460K series block diagram



*6ch on MB91F467B
3ch on others

(x) Resources in case of Bus interface option

MB91460B sub-series: 144-pin body control MCUs

MB91F467D, a member of the **MB91460D sub-series** primarily targets instrumentation, but its rich feature mix also makes it suitable for various other applications.

Features of MB91F467D

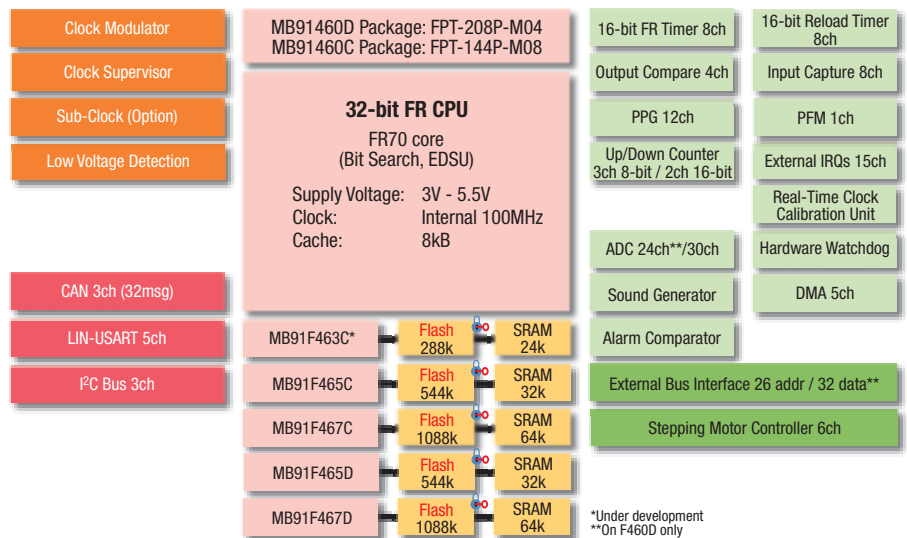
- 1088kB of flash memory directly connected to the CPU core via an advanced pre-fetch/caching system. The device includes Fujitsu's flash security feature
- 64kB of RAM
- SMC: (stepper motor controller) 6ch
- CAN: 3ch with 32 message buffers each
- LIN-UART: 5ch, (4ch are equipped with transmit and receive FIFOs)
- External bus interface, which supports various memories, but can also be used to connect Fujitsu graphics controllers or the FlexRay ASSP device

A starter kit in two variants (with and without the FlexRay ASSP) is currently available:

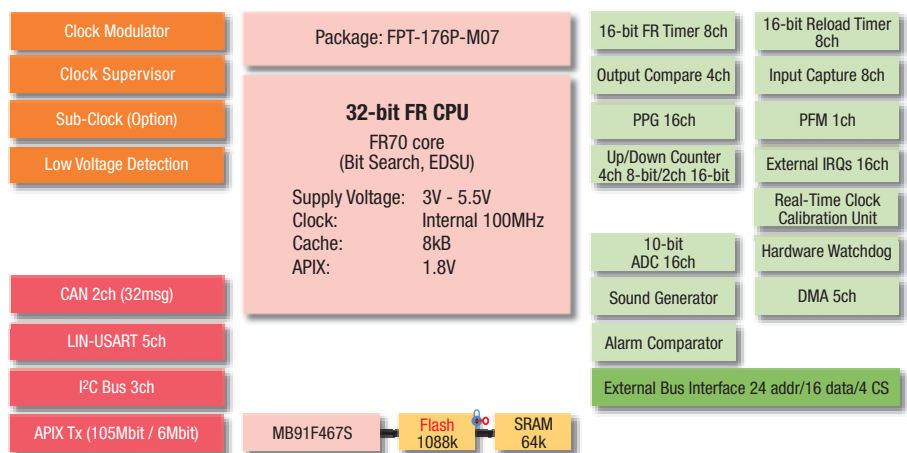
SK-91F467D-FLEXRAY or
SK-91F467D-208PFV

The **MB91F460C sub-series** provides single-chip devices with the same feature mix as the MB91F460D MCUs, but without external bus and in a QFP-144 package. Please see the block diagram for more details.

MB91F467S is developed from the MB91460S sub-series as the ideal counterpart to MB88F332 – Fujitsu's GDC with APIX® receiver. Both devices will communicate over the APIX®. MB91F467S will download graphics data to MB88F332 via the main link, commands/feedback and interrupts will be exchanged via the side bands of the APIX® line.



MB91460C / MB91460D series block diagram



MB91F460S series block diagram with APIX®

Features of MB91F467S

- 1088kB of flash memory
- 64kB of RAM
- APIX® transmitter
- CAN: 2ch with 32 message buffers each
- LIN-USART: 5ch
- External bus interface to, e.g. connect external flash for graphics data for download to MB88F332.

PRODUCT OVERVIEW MICROCONTROLLERS

MB91460 automotive series

MB91F469G so far is the flagship of the MB91460 series with 2MB of embedded flash, 6 CAN channels with 128 message buffers each, and a large set of other peripherals. It comes in a BGA-320 package offering a flexible external bus interface.

Features of MB91F469GA

- 2MB flash
- 96kB RAM
- CAN 6ch. 128 message buffers
- LIN-USART: 8ch
- I²C: 4ch
- 10-bit ADC: 32ch
- Various timers and pulse generators

MB91F469Q is a 3 CAN variant of **MB91F469G**, it however offers more LIN-USARTs and a second ADC module

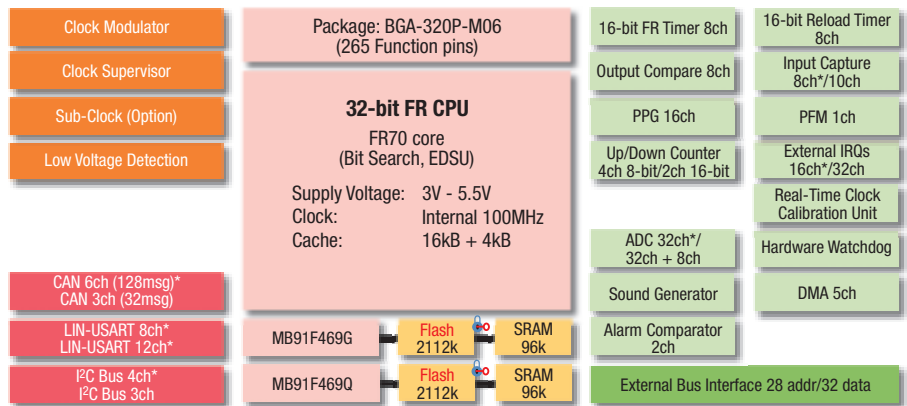
Characterising features of the **MB91460P sub series** are 176 pins, 3 CAN modules and 32 PPG channels. The first MCU from this body control series to become available is MB91F465P

Features of MB91F465P

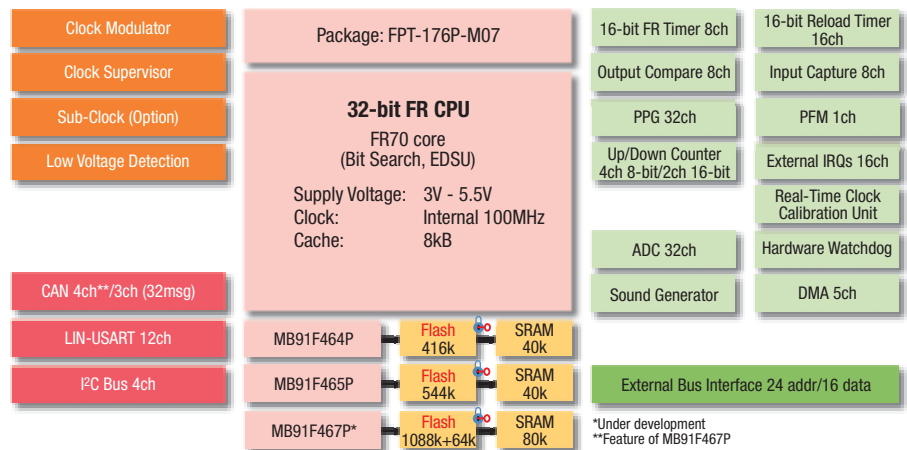
- 544kB flash
- 40kB RAM
- CAN 3ch, 32 message buffers each
- LIN-USART: 8 ch
- I²C: 3ch
- 10-bit ADC : 32ch
- 16-bit PPG: 32ch
- RTC module, which can operate base on the external 4MHz or 32kHz crystals
- Various timers, compare and capture units like MB91F465x on page 49.

MB91F467P is under development and will offer additional new features:

- Data flash for E²PROM emulation (4x16kB sectors)
- 1MB flash
- 80kB RAM



MB91F460G/Q series block diagram



MB91F460P series block diagram

*Feature of MB91F469G

*Under development
**Feature of MB91F467P

MB91F467M has been developed for car audio solutions. It contains a MediaLB (MLB) to I²S gateway and can be used to connect up to 10 I²S devices to the MOST bus.

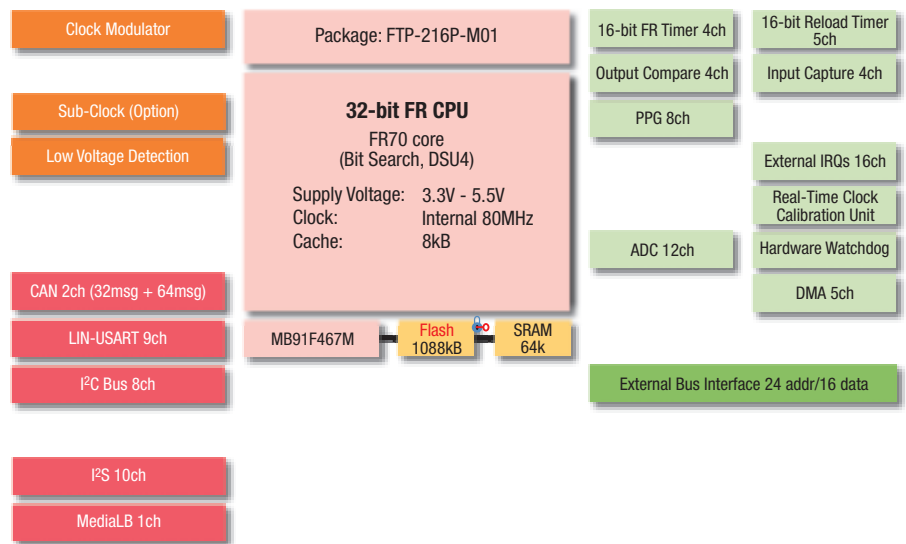
Features of MB91F467M:

- Flash: 1088kB
- RAM: 64kB
- CAN: 2 ch (32 message buffer and 64 message buffers)
- I²C: 8ch
- I²S: 10ch
- MediaLB: 1ch

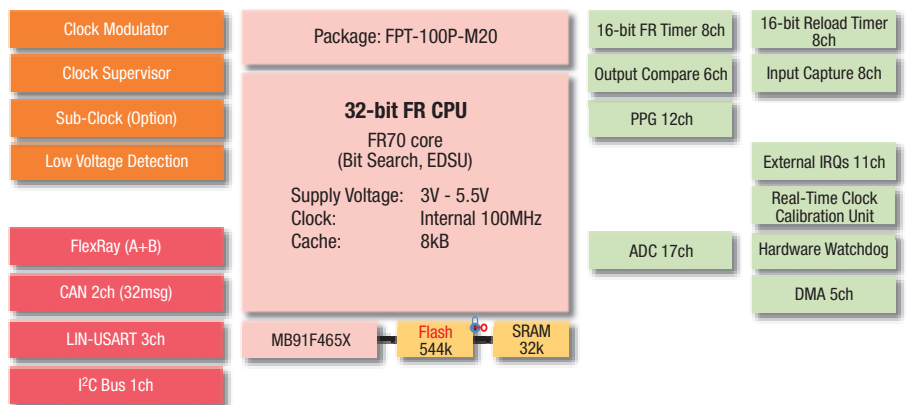
MB91F465X is the first MB91460 MCU with an embedded FlexRay interface.

Features of **MB91F465X**

- FlexRay interface
 - supports protocol specification 2.1
 - double-channel (A+B)
 - 8kB message buffer memory
 - up to 128 different identifiers
- Flash: 544kB
- RAM: 32kB
- CAN: 2ch, 32 message buffers each
- LIN-USART: 3ch
- I²C: 1ch
- 16-bit PPG: 12ch
- 10-bit ADC: 17ch
- Various timers, compare and capture units
- Starter kit: SK-91465X-100PMC



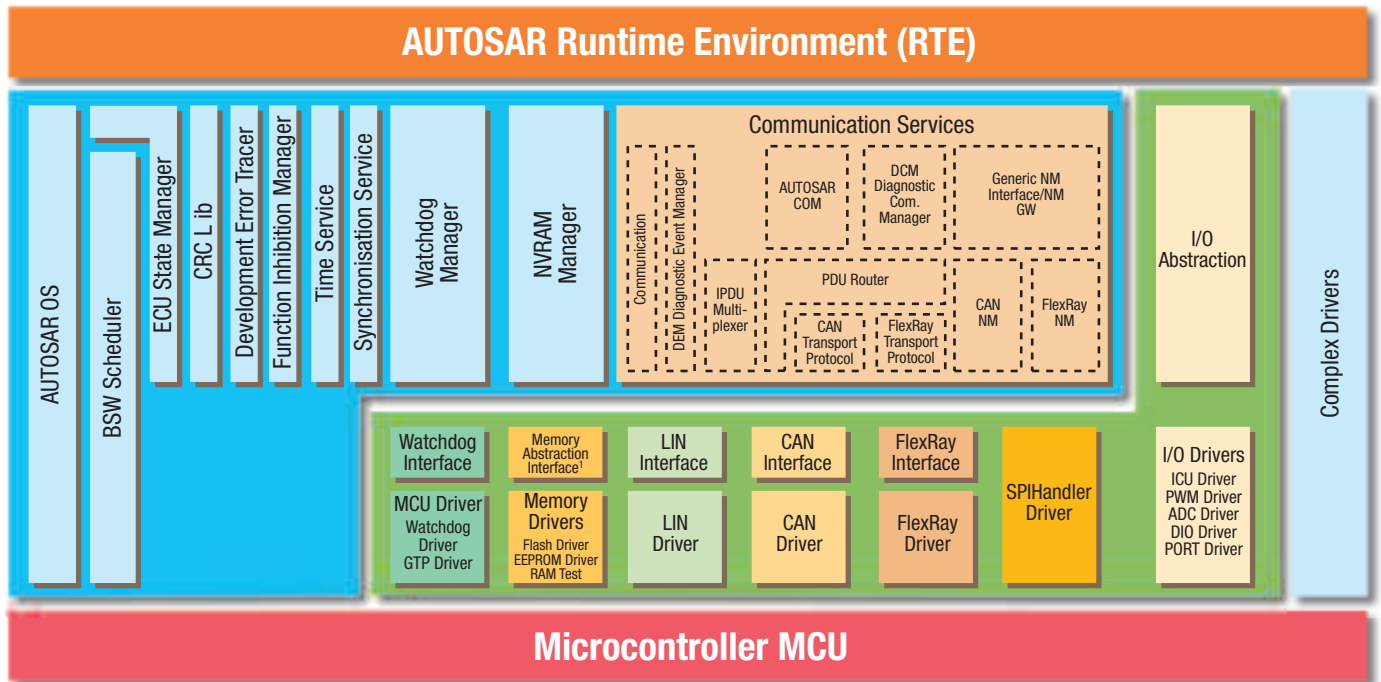
MB91F460M series block diagram



MB91F460X block diagram

PRODUCT OVERVIEW MICROCONTROLLERS

Autosar package for MB91460



AutoSAR software layers

In co-operation with Elektrobit Automotive GmbH (EB) a complete AUTOSAR solution is offered for the MB91460 series MCUs. The EB tresos AutoCore (Automotive Standard Core) is based on the ICC3-compliant AUTOSAR layered architecture and contains the modules listed below. The configuration of the target run-time software can be done via EB tresos Studio.

- Communication service (AUTOSAR COM, network management, transport logs, PDU router)
- Diagnostic service (DEM, DET, DCM)
- ECU abstraction layer
 - I/O hardware abstraction
 - Interfaces for all peripheral, communication, and storage drivers

- Microcontroller abstraction layer (MCAL)
 - Storage driver (flash, E²PROM)
 - Peripheral driver (on-chip resources, I/O)
 - Communication driver (CAN, LIN)

FlexRay modules are available separately. Please contact EB or Fujitsu for more details.

Modules included in the EB tresos AutoCore for MB91460:

- Application abstraction layer
 - AUTOSAR Run-Time Environment (RTE)
- Service layer
 - AUTOSAR OS
 - State manager (ECU, COM manager)
 - Memory services (NVRAM manager)



AUTOSAR Roadster featuring Fujitsu's 32-bit microcontrollers series MB91460



Discover the Experience



MB88121 FlexRay communication controller

Description

The MB88121C is an application-specific standard product (ASSP) that provides the protocol engine to service the FlexRay™ bus system. MB88121C adds FlexRay connectivity to 16-bit and 32-bit microcontrollers that lack embedded FlexRay protocol engines. The 64-pin device acts as a companion chip to a vast number of embedded microcontrollers used in automotive applications.

Features of MB88121C

- FlexRay communication controller supporting protocol version 2.1
- Configurable parallel host interface compatible with most 16-bit and 32-bit microcontrollers.
 - 16-bit multiplex and non-multiplexed access
- SPI host interface (Max. 8Mbit/s)
- DMA support accessing receive message buffer data
- On-chip PLL
- Input clock
 - 4/5/8/10/16MHz with quartz or
 - 4/5/8/10/16/20MHz for square wave input
 - 80MHz square wave input in test mode
- Low voltage monitoring support
- Stopwatch function
 - External event capture
- 3.0 - 5.5V single voltage supply
 - $T_A = -40^{\circ}\text{C} - +125^{\circ}\text{C}$
- Package:
 - 64-pin plastic LQFP
 - 0.5mm pin pitch



MB88121 adds FlexRay connectivity to 16-bit and 32-bit microcontrollers that lack embedded FlexRay protocol engines

Software

- Fujitsu FlexRay Driver (FFRD)
 - Free licence for evaluation purposes
 - Source code delivery
- DECOMSYS::COMMSTACK as driver to the FlexRay interface
 - Free object code licence for use on Fujitsu development platform
- Software examples
 - FlexRay-CAN bridge
 - Keyboard demo

Development tools

- SK-91F467-FLEXRAY
 - Starter kit featuring MB91F467D 32-bit microcontroller and MB88121B
- ADA-96340-88121-FLEXRAY
 - Adapter board for 16FX MCU starterkits featuring MB88121B

- ADA-91460-88121-FLEXRAY
 - Adapter board for MB91F460 MCU starterkits featuring MB88121B
- All development tools contain 'light' or trial versions of FlexRay configuration tools from
 - Elektrobit Austria GmbH
 - J. Eberspächer GmbH & Co. KG

Ordering Information

- P/N: MB88121CPMC1-GSE2
 - ES available
 - CS Q2 2009

Support

- mail: flexray_info@fme.fujitsu.com
- web: http://mcu.emea.fujitsu.com/fme_content/static_pages/MB88121.htm

MB91260/265 series 3-phase motor control MCUs

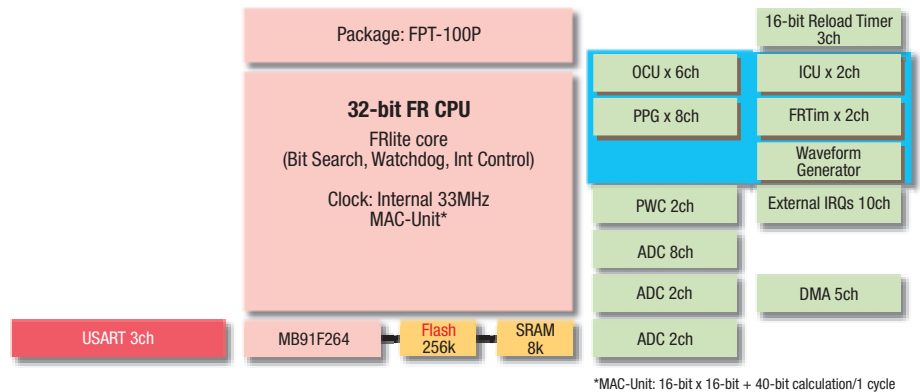
With its high-speed MAC (multiply/accumulate) unit, multi-function timer and 3 high-speed (1.2µs) A/D converter units, this embedded flash microcontroller is optimal for 3-phase motor control applications.

The multi-function timer consists of a free-running timer (up/down), output compare and input capture units, 16-bit PPG timer units and a waveform generator.

The MAC unit executes 16-bit x 16-bit multiplications and the calculation of a 40-bit sum in a single cycle of its 32MHz clock. As an added feature 64 word X- and Y-RAMs are built-in. MB91F264 features 256kB embedded flash and 8kB RAM, and comes in a 100-pin package. MB91F267 features 128kB embedded dual-operation flash and 4kB RAM plus 1 channel of CAN with a 64-pin package.

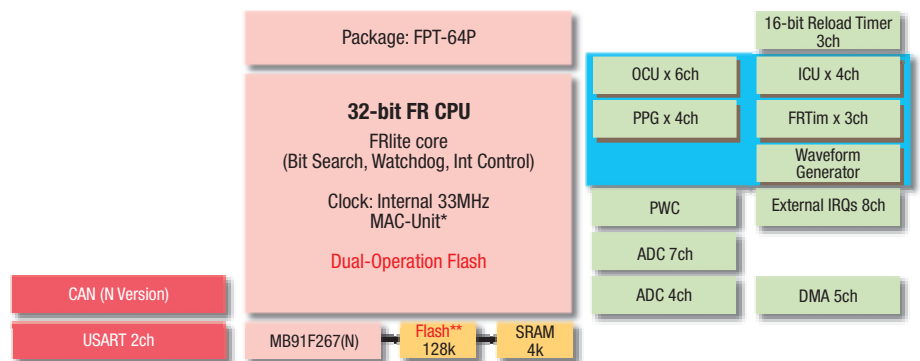
Features

- Process technology: CMOS 0.35µm
- Supply voltage: 4.0 to 5.5V
- Operating frequency: 32MHz
- UART communication function
- Timer function: PPG, up/down counter, reload timer, free-running timer, watch timer, PWC timer, U-timer, watchdog timer function, ICU, OCU
- Waveform generator (for motor drive)
- Low-power consumption mode: sleep, stop, and timer modes



*MAC-Unit: 16-bit x 16-bit + 40-bit calculation/1 cycle

MB91F264 including dedicated resources for motor control



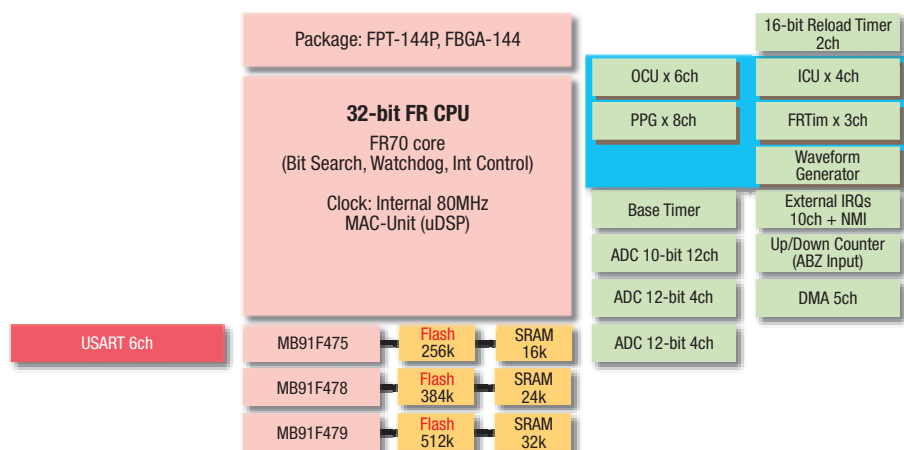
*MAC-Unit: 16-bit x 16-bit + 40-bit calculation/1 cycle
**Dual Operation

MB91F267, a compact device for motor control with an optional CAN interface

	MB91F264	MB91F267
Package	LQFP-100	LQFP-64
A/D	2ch 2 units, 8ch 1 unit	4ch 1 unit, 7ch 1 unit
USART	3ch	2ch
PWC	2ch	1ch
Ext. Int	10ch + NMI	8ch + NMI
RTim	3ch	3ch
PPG	8ch 16-bit (16ch 8-bit)	4ch 16-bit (8ch 8-bit)
CAN	-	1ch

Next generation 32-bit motor control MCUs

The new MB91470/480 series extends the 32-bit MCU family to even higher performance for motor control applications. It includes many features of the MB91265 series, such as the flexible multi-function timer, the waveform generator and the fast 10-bit ADC, combined with a powerful FR70 core with up to 80MHz main clock, a 32-bit wide MAC unit, two additional 12-bit ADC units and an up/down counter with index input for encoder applications.



MB91470 block diagram

MB91F470/480 Series common features

- FR70 core, max. 80MHz (with PLL)
- MAC unit: 32-bit x 32-bit + 72-bit in 1 cycle
- Up to 512kB flash, 32kB RAM
- Multi-function timer:
 - Output compare 6ch, input capture 4ch
 - PPG 4ch (16-bit) or 8ch (8-bit)
 - Free-run timer 3ch 16-bit
 - Waveform generator with dead-time generation and fault input
- Reload timer 2ch 16-bit
- Base timer 4ch 16-bit, can be used for PWM, PWC, PPG, RLT
- Up to 6ch UART with sync. / async. modes, I²C, SPI
- 10 external interrupts + NMI
- DMA 5ch

Product Line-up

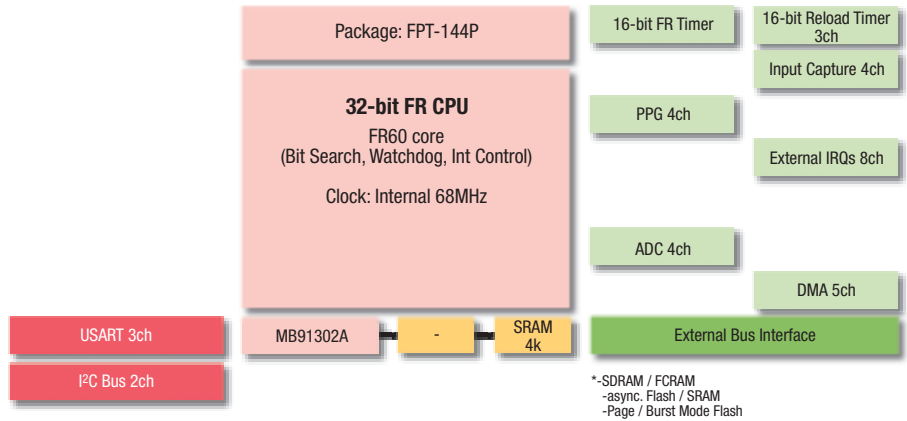
Device	MB91470 Series	MB91480 Series
Package	LQFP-144, FBGA-144	LQFP-100
External bus	yes	No
Up/down counter (ABZ)	yes	No
3-phase motor driver	1ch	2ch
ADC	8/10-bit, 12ch	8/10-bit, 10ch
12-bit, 4ch	8/10-bit, 4ch	
12-bit, 4ch	8/10-bit, 4ch	
USARTS	6ch	3ch

PRODUCT OVERVIEW MICROCONTROLLERS

MB91301 series

The MB91301 series features a powerful device based on the FR65E core fabricated in 0.25µm CMOS technology.

This SDRAM controller embedded MCU MB91302A is developed as a successor to MB91101. Operation is available at a maximum frequency of 68MHz. A 4kB instruction cache guarantees high-speed code execution. The external bus interface is compatible with a wide variety of memories, from asynchronous SRAM to page-mode and burst-mode flash. The SDRAM controller also supports FCRAM™. Five externally controllable DMA channels support many transfer modes thereby ensuring efficient transfer of data within the device. The supply voltage is 3.3V.



MB91302 offers a dedicated SDRAM interface and 4kB cache memory

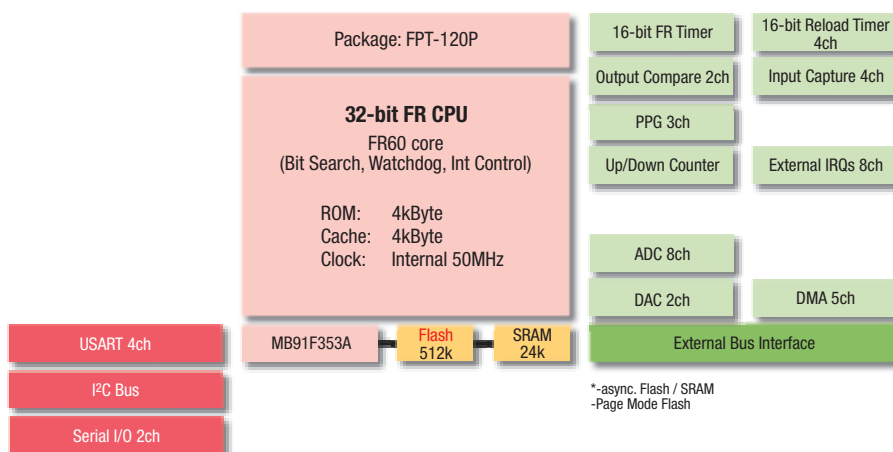
“ Operation available at a maximum frequency of 68MHz. A 4kB instruction cache guarantees high-speed code execution ”



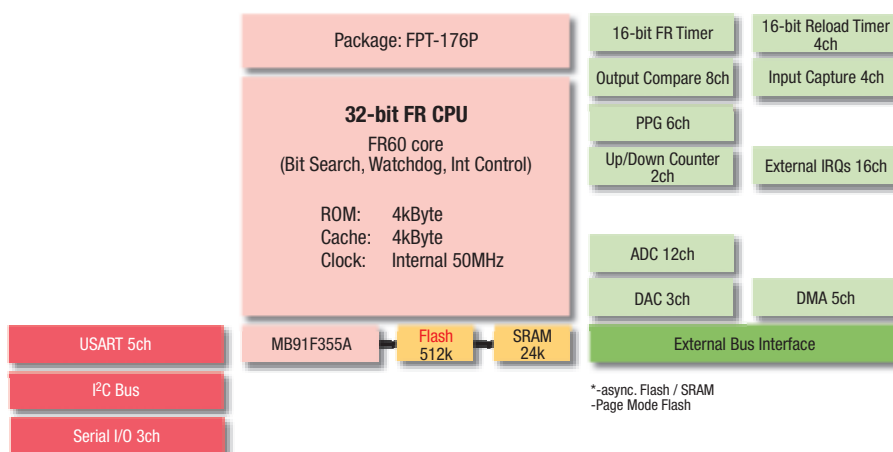
MB91350A series

This series of single-chip embedded flash microcontrollers includes feature-rich devices for digital home appliances and other 3.3V embedded control applications. The devices run at an operating frequency of up to 50MHz. In addition to various timers, the devices include several serial communication interfaces (up to 5 USART, 3 SIO as well as an I²C interface). A/D and D/A converters support the processing of analogue signals.

The series includes MB91F353A housed in a 120-pin package and MB91F355A with more features in a 176-pin package.



MB91F353A offers 512kByte flash and 24kByte of RAM on-chip



MB91F355A offers 512kByte flash and 24kByte of RAM on-chip

	MB91F353A	MB91F355A
Package	LQFP-120	LQFP-176
ICU	4ch	4ch
OCU	2ch	8ch
RTim	4ch	4ch
U/D counter	1ch	2ch
ADC	8ch	12ch
DAC	2ch	3ch
PPG	3ch	6ch
NMI	1ch	1ch
Ext. IRQ	8ch	16ch
I/O ports	84	141
I²C	1ch	1ch
SIO	2ch	3ch
USART	4ch	5ch

FR series in-circuit emulator

The MB2198 is Fujitsu's emulation system for 32-bit RISC FR architecture microcontrollers.

It makes use of the DSU (Debug Support Unit) integrated within the FR evaluation devices, to provide a powerful debugging environment without compromising full system operating speed.

The system comprises the MB2198-01 emulation unit, which connects to the host PC via RS232, integrated (10BASE-F, 10BASE-F+) LAN or USB interface. The MB91VxxxCR FR evaluation device plugs into a pod or adaptor board and this, depending on the family, then plugs into either a suitable IC socket located on the target hardware, or connects to a header board and NQ-PACK on the target hardware.

Features

- Source level debugging
- Real-time trace
- 5 hardware breakpoints and 8,192 software breakpoints



MB2198-01 Fujitsu's emulation system for 32-bit RISC architecture

MB91460 Emulation System

The typical emulation system for MB91460 MCUs consists of the following parts, see also the related picture:

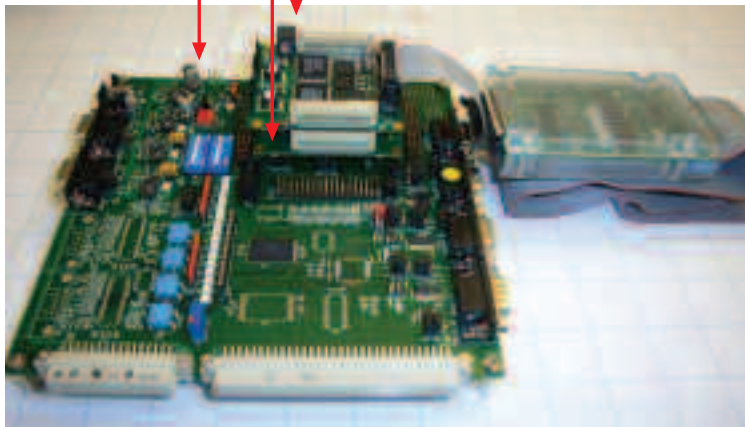
- MB2198-01-E the emulator main unit
- MB2198-10-E the DSU cable to connect the main unit to the emulation adaptor board
- EMA-MB91FV460B-001 the emulation adaptor board carrying the EVA chip MB91FV460 Which also can be used in connection to the Green Hills tools

- EMA-MB91F46xn-N(LS)-yyyzz the MCU specific socket adaptor board, shown here is MB91F467D-LS-208M04, the adaptor board for MB91460D sub-series MCUs

Shown on the picture as well is the evaluation board or starterkit for MB91F467D. Similar boards are available for all members of the MB91460 series.

- Emulator
- DSU cable
- Adapter board
- Socket adapter board
- Evaluation board

- (MB2198-01-E)
- (MB2198-10-E)
- (EMA-MB91FV460B-001)
- (EMA-MB91F467D-NLS-208M04)
- (SK-91F467D-208PFV)



MB91460 Fujitsu's emulation system

FR series evaluation boards

Fujitsu supports development engineers with low cost multi-functional evaluation boards for almost every Fujitsu microcontroller.

These boards can be used stand-alone for software development and testing or as a simple target board to work with the emulator system. (Fujitsu in-circuit emulators require a target system that provides Vcc and GND, as well as a clock-circuit and reset). The boards allow the designer to start immediately with the software development.

Features

- In-circuit serial flash programming
- All resources available for evaluation
- All pins routed to connectors
- 8 user LEDs
- Reset button
- Crystal for main clock and for sub-clock where applicable
- 9 to 12V unregulated external DC power supply usable
- English documentation and CD-ROM included



Starterkit SK-91F467D-208PFV

PRODUCT OVERVIEW MICROCONTROLLERS

32-bit FR product line-up

Overview of 32-bit families

Series	Device Part Number	Package (pin)	Operating voltage: Vcc 3V 5V system (V)	Max. internal clock frequency (MHz)	Clock	Memory Type	ROM (Byte)	RAM (Byte)	Cache (kByte)	External Interrupts (ch)	External Bus	A/D converter (bit x ch)	D/A converter (bit x ch)	16-bit timer (ch)	Input capture (ch)
MB91101	MB91101A	100	3 or 5	50	1	No ROM / External ROM	-	2kB	1	5	Yes	10-bit x 4	-	3	-
MB91230	MB91233L	120	3	33.6	2	Mask	256kB	16kB	-	16	-	10-bit x 8	8-bit x 2	4	16-bit x 2
	MB91F233	120	3	33.6	2	Flash	256kB	16kB	-	16	-	10-bit x 8	8-bit x 2	4	16-bit x 2
	MB91F233L	120	3	33.6	2	Flash	256kB	16kB	-	16	-	10-bit x 8	8-bit x 2	4	16-bit x 2
MB91260B	MB91263B	100	5	33	1	Mask	128kB	8kB	-	10	-	10-bit x 12	-	3	16-bit x 4
	MB91F264B	100	5	33	1	Flash	256kB	8kB	-	10	-	10-bit x 12	-	3	16-bit x 4
MB91265	MB91266	64	5	33	1	Mask	64kB	2kB	-	8	-	10-bit x 11	-	3	16-bit x 4
	MB91F267	64	5	33	1	Flash	128kB	4kB	-	8	-	10-bit x 11	-	3	16-bit x 4
	MB91F267N	64	5	33	1	Flash	128kB	4kB	-	8	-	10-bit x 11	-	3	16-bit x 4
MB91270	MB91F272	100	5	32	2	Flash	256kB	10kB	-	16	Yes	10-bit x 24	-	3	16-bit x 8
	MB91F272S	100	5	32	1	Flash	256kB	10kB	-	16	Yes	10-bit x 24	-	3	16-bit x 8
MB91301	MB91302A	144	3	68	1	Mask	4kB	4kB	4	9	Yes	10-bit x 4	-	3	16-bit x 4
	MB91302A-020	144	3	68	2	No ROM / External ROM	-	4kB	4	9	Yes	10-bit x 4	-	3	16-bit x 4
MB91350A	MB91351A	120	3	50	2	Mask	384kB	24kB	-	9	Yes	10-bit x 8	8-bit x 2	4	16-bit x 4
	MB91352A	120	3	50	2	Mask	384kB	16kB	-	9	Yes	10-bit x 8	8-bit x 2	4	16-bit x 4
	MB91353A	120	3	50	2	Mask	512kB	24kB	-	9	Yes	10-bit x 8	8-bit x 2	4	16-bit x 4
	MB91F353A	120	3	50	2	Flash	512kB	24kB	-	9	Yes	10-bit x 8	8-bit x 2	4	16-bit x 4
	MB91354A	176	3	50	2	Mask	384kB	16kB	-	17	Yes	10-bit x 12	8-bit x 3	4	16-bit x 4
	MB91355A	176	3	50	2	Mask	512kB	24kB	-	17	Yes	10-bit x 12	8-bit x 3	4	16-bit x 4
	MB91F355A	176	3	50	2	Flash	512kB	24kB	-	17	Yes	10-bit x 12	8-bit x 3	4	16-bit x 4
	MB91F356B	176	3	50	2	Flash	256kB	24kB	-	17	Yes	10-bit x 12	8-bit x 3	4	16-bit x 4
	MB91360	MB91F362GB	208	5	64	1	Flash	512kB	20kB	-	8	Yes	10-bit x 16	10-bit x 2	6
MB91F364G		120	5	64	1	Flash	256kB	16kB	-	8	-	10-bit x 12	10-bit x 2	3	16-bit x 4
MB91F365GB		120	5	64	1	Flash	512kB	36kB	-	8	-	10-bit x 8	10-bit x 2	6	16-bit x 4
MB91F366GB		120	5	64	2	Flash	512kB	36kB	-	8	-	10-bit x 8	-	6	16-bit x 4
MB91F367GB		120	5	64	1	Flash	512kB	36kB	-	8	-	10-bit x 8	-	3	16-bit x 4
MB91F368GB		120	5	64	2	Flash	512kB	36kB	-	8	-	10-bit x 8	-	3	16-bit x 4
MB91F369GA		160	5	64	1	Flash	512kB	36kB	-	8	Yes	10-bit x 10	-	6	-
MB91F376G		120	5	64	2	Flash	768kB	36kB	-	8	-	10-bit x 8	-	6	16-bit x 4
MB91460		MB91461*	176	3	80	1	No ROM / External ROM	-	64kB	4	16	Yes	10-bit x 13	-	4
	MB91F464A	100	3 to 5	80	2	Flash	416kB	16kB	-	10	-	10-bit x 21	-	8	16-bit x 8
	MB91F467B	144	3 to 5	100	2	Flash	1088kB	40kB	8	16	Yes	10-bit x 32	-	8	16-bit x 8
	MB91F465B	144	3 to 5	100	2	Flash	544kB	40kB	8	16	Yes	10-bit x 32	-	8	16-bit x 8
	MB91F467C	144	3 to 5	96	2	Flash	1088kB	64kB	8	14	-	10-bit x 24	-	8	16-bit x 8
	MB91F465C	144	3 to 5	96	2	Flash	544kB	32kB	8	14	-	10-bit x 24	-	8	16-bit x 8
	MB91F463C*	144	3 to 5	96	2	Flash	288B	24kB	8	14	-	10-bit x 24	-	8	16-bit x 8
	MB91F467D	208	3 to 5	96	2	Flash	1088kB	64kB	-	14	Yes	10-bit x 24	-	8	16-bit x 8
	MB91F465D	208	3 to 5	96	2	Flash	544kB	48kB	8	14	Yes	10-bit x 24	-	8	16-bit x 8
	MB91F469G	256	3 to 5	100	2	Flash	2112kB	96kB	16	16	Yes	10-bit x 32	-	8	16-bit x 8
	MB91F464H	144	3 to 5	100	2	Flash	416kB	32kB	8	16	Yes	10-bit x 32	-	8	16-bit x 8
	MB91F465K	120	3 to 5	80	2	Flash	544kB	16kB	4	10	-	10-bit x 26	-	8	16-bit x 8
	MB91F467M	216	3 to 5	80	2	Flash	1088kB	64kB	8	16	Yes	10-bit x 12	-	5	16-bit x 4
	MB91F463N	64	3	64	1	Flash	256kB	10kB	-	8	-	10-bit x 8	-	4	16-bit x 4
	MB91F467P*	176	3 to 5	100	2	Flash	1088kB+64kB	80kB	8	16	Yes	10-bitx32	-	16	16-bit x 8
	MB91F465P	176	3 to 5	100	2	Flash	544kB	40kB	8	16	Yes	10-bitx32	-	8	16-bit x 8
	MB91F469Q*	256	3 to 5	100	2	Flash	2112kB	96kB	16	32	Yes	10-bit x 32 +8	-	8	16-bit x 10
	MB91F467R	176	3	75	2	Flash	1088kB	40kB	8	16	Yes	10-bit x 16	-	4	16-bit x 4
	MB91F467S	176	3 to 5	100	2	Flash	1088kB	64kB	8	16	Yes	10-bit x 16	-	8	16-bit x 8
	MB91F467T	144	3 to 5	100	2	Flash	1088kB	64kB	8	12	Yes	10-bit x 32	-	8	16-bit x 8
MB91F465X	100	3 to 5	100	2	Flash	544kB	32kB	8	11	-	10-bit x 17	-	8	16-bit x 6	
MB91470/480	MB91F475	144	4 to 5.5	80	1	Flash	256kB	16kB	-	10	Yes	10-bit x 1 x 12 012-bit x 2 x 4	-	2	16-bit x 4
	MB91F478	144	4 to 5.5	80	1	Flash	384kB	24kB	-	10	Yes	10-bit x 1 x 12 12-bit x 2 x 4	-	2	16-bit x 4
	MB91F479	144	4 to 5.5	80	1	Flash	512kB	32kB	-	10	Yes	10-bit x 1 x 12 12-bit x 2 x 4	-	2	16-bit x 4
	MB91F487	100	4 to 5.5	80	1	Flash	512kB	32kB	-	10	-	10-bit x 2 x 4 10-bit x 1 x 10	-	2	16-bit x 8

Note: * Under development

Output compare (ch)	Timer PPG timer (ch)	PWM timer (ch)	PWC timer (ch)	Up/Down counter (ch)	I-C (ch)	UART/SIO (ch)	CAN (ch/MSG)	USB (ch)	SMC (ch)	LCDC (seg x com)	DMAC (ch)	Note	Evaluation device
-	-	16-bit x 4	-	-	-	3/-	-	-	-	-	8	DRAM I/F	MB91V101A
16-bit x 4 16-bit x 4 16-bit x 4	16-bit x 6 16-bit x 6 16-bit x 6	- - -	8-bit x 2 8-bit x 2 8-bit x 2	8-bit x 2 8-bit x 2 8-bit x 2	- - -	4/- 4/- 4/-	- - -	- - -	- - -	32 x 4 32 x 4 32 x 4	- - -	- - -	MB91V230 MB91V230 MB91V230
16-bit x 6 16-bit x 6	16-bit x 8 16-bit x 8	- -	16-bit x 2 16-bit x 2	- -	- -	3/- 3/-	- -	- -	- -	- -	5 5	1ch motor control MAC Unit 1ch motor control MAC Unit	MB91V260B MB91V260B
16-bit x 6 16-bit x 6 16-bit x 6	16-bit x 4 16-bit x 4 16-bit x 4	- - -	16-bit x 1 16-bit x 1 16-bit x 1	- - -	- - -	2/- 2/- 2/-	- - 1/32	- - -	- - -	- - -	5 5 5	1ch motor control MAC Unit 1ch motor control MAC Unit 1ch motor control MAC Unit	MB91V265 MB91V265 MB91V265
16-bit x 8 16-bit x 8	16-bit x 8 16-bit x 8	- -	- -	8-bit x 2 8-bit x 2	3 3	7/- 7/-	1/32 1/32	- -	- -	- -	5 5	LIN USART LIN USART	MB91V280 MB91V280
- -	16-bit x 4 16-bit x 4	- -	- -	- -	2 2	3/- 3/-	- -	- -	- -	- -	5 5	SDRAM I/F Program Loader	MB91V301A MB91V301A
16-bit x 2 16-bit x 2 16-bit x 2 16-bit x 2 16-bit x 8 16-bit x 8 16-bit x 8 16-bit x 8	16-bit x 3 16-bit x 3 16-bit x 3 16-bit x 3 16-bit x 6 16-bit x 6 16-bit x 6 16-bit x 6	- - - - - - - -	- - - - - - - -	8-bit x 1 8-bit x 1 8-bit x 1 8-bit x 1 8-bit x 2 8-bit x 2 8-bit x 2 8-bit x 2	1 1 1 1 1 1 1 1	4/2 4/2 4/2 4/2 5/3 5/3 5/3 5/3	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	5 5 5 5 5 5 5 5	- - - - - - - -	MB91V350A MB91V350A MB91V350A MB91V350A MB91V350A MB91V350A MB91V350A MB91V350A
16-bit x 4 16-bit x 2 16-bit x 2 16-bit x 2 16-bit x 2 16-bit x 2 - 16-bit x 2	16-bit x 8 16-bit x 4 16-bit x 8 16-bit x 8 16-bit x 4 16-bit x 4 16-bit x 4 16-bit x 8	16-bit x 8 - - - - - - -	- - - - - - - -	- - - - - - - -	1 1 1 1 1 1 1 1	3/2 2/2 2/2 2/2 1/2 1/2 1/2 2/2	3/16 1/16 2/16 2/16 2/16 2/16 2/16 2/16	- - - - - - - 4	4 - 4 - - - - -	- - - - - - - -	5 5 5 5 5 5 5 5	Sound generator - Sound generator Sound generator - - - Sound generator Sound generator	MB91FV360GA MB91FV360GA MB91FV360GA MB91FV360GA MB91FV360GA MB91FV360GA MB91FV360GA MB91FV360GA
16-bit x 4 16-bit x 6 16-bit x 8 16-bit x 8 16-bit x 4 16-bit x 4 16-bit x 4 16-bit x 4 16-bit x 4 16-bit x 8 16-bit x 8 16-bit x 8 16-bit x 4 16-bit x 4 16-bit x 8 16-bit x 8 16-bit x 4 16-bit x 4 16-bit x 8 16-bit x 8 16-bit x 4 16-bit x 8 16-bit x 6	16-bit x 8 16-bit x 10 16-bit x 16 16-bit x 16 16-bit x 12 16-bit x 12 16-bit x 12 16-bit x 12 16-bit x 12 16-bit x 16 16-bit x 16 16-bit x 12 16-bit x 8 16-bit x 8 16-bit x 16 16-bit x 12 16-bit x 8 16-bit x 32 16-bit x 32 16-bit x 16 16-bit x 16 16-bit x 8 16-bit x 14 16-bit x 12	- -	- -	- - 2 2 2 2 2 2 2 4 2 2 4 2 2 4 3 3 4 4 3 4 4 1	3 1 2 2 3 3 3 3 3 4 2 8 2 2 8 2 4 4 3 3 4 4 1	7/- 3/- 7/- 7/- 5/- 5/- 5/- 5/- 5/- 8/- 7/- 5/- 79/- 4/- 12 8 12/- 7/- 5/- 711/- 3/-	2/32 1/32 6/32 6/32 3/32 3/32 3/32 3/32 6/128 1/32 1/32 2/32+64 2/32 4/32 3/32 3/32 2/32 2/32 2/32 2/32 2/32	- -	5 5	LIN USART LIN USART LIN USART LIN USART LIN USART LIN USART LIN USART LIN USART LIN USART LIN USART LIN USART LIN USART, I ² S, MLB LIN USART LIN USART, data flash LIN USART LIN USART LIN USART LIN USART, APIX [®] LIN USART FlexRay (A+B)	MB91V460/FV460B MB91V460/FV460B		
16-bit x 6 16-bit x 6 16-bit x 6 16-bit x 12	16-bit x 4 16-bit x 4 16-bit x 4 16-bit x 8	4 4 4 4	4 4 4 4	1 1 1 -	6 6 6 3	6 6 6 3	- - - -	- - - -	- - - -	- - - -	5 5 5 5	1ch motor control MAC Unit 1ch motor control MAC Unit 1ch motor control MAC Unit 2ch motor control MAC Unit	MB91FV470 MB91FV470 MB91FV470 MB91FV470

Integrated software development environment - 'Solutions for V'

Fujitsu's Softune Workbench offers a development environment integrated with the C/C++ compiler, assembler, linker, debugger and editor.

Softune can be used on its own in the development of embedded software for microcontrollers. Fujitsu's 'Solutions for V' can provide an even more advanced program development environment for designers who need to develop high quality embedded software for example for in-vehicle electrical equipment.

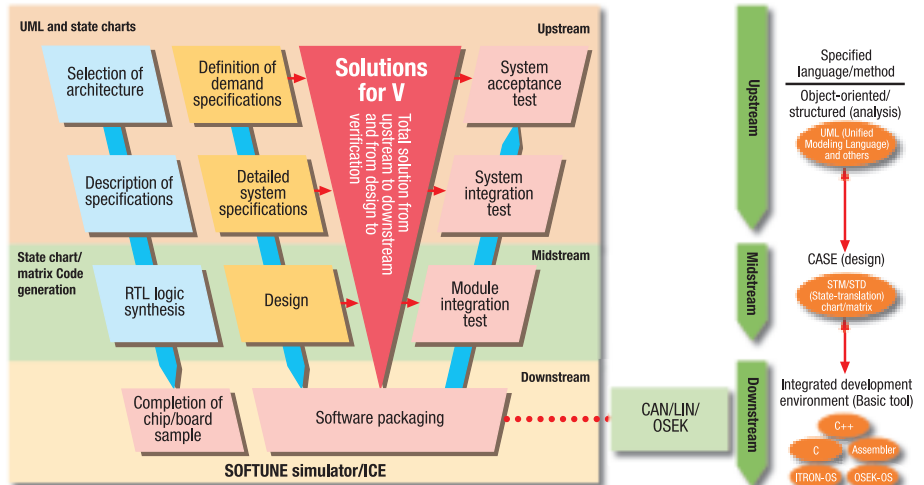
The development environment offered by Solutions for V allows the use of CASE tools, consulting and contracted development with UML (Unified Modeling Language), and state charts in the upstream and downstream phases.

State-transition charts are commonly used in the development of in-vehicle equipment, and Softune enables direct connection to CASE tools such as Statemate MAGNUM, RiMC (Rhapsody in MicroC), and ZIPC.

'Solutions for V' tools examples

Upstream Case tool Statemate MAGNUM

I-Logix's Statemate MAGNUM describes the static structure of a control system using an activity chart, which is an extended version of a data flowchart, and describes the system operation using a state chart. A state chart is an extended state-transition chart that enables the hierarchical deployment of the state, the expression of parallelism, and the expression of time, allowing complex system operations to be described easily.



Solutions for V block diagram

The tool features high descriptive capability and enables the simulation of a specification model for which the specifications are still incomplete.

Following the confirmation of operation, it can generate a C code able to achieve the same operation as the specifications, and can also execute the C code on a prototype for verification purposes.

Midstream Case tool ZIPC

ZIPC from CATS CO. LTD. is a CASE tool that supports software development in the midstream stage using 'Extended-Hierarchy State-Transition-Matrix Design Method Version 2.0.' By using the state-transition matrix, it enables the creation of designs with no missing data. Because ZIPC is equipped with functions for editing the state-transition matrix, for debugging OSEK, ITRON (REALOS), and others in the design stage, and for automatically generating C-source code, it contributes to the

improvement of software quality and reduction of development man-hours.

It uses a converter for linkage to upstream Statemate MAGNUM, and uses state-transition animation and break-point setting during C-source generation and debugging for connection to downstream Softune.



Softune - Fujitsu's integrated software development package

Fujitsu offers its complete range of MCU software tools as part of an integrated package called Softune Workbench, which operates under Windows 95/98, Windows NT4.0, Windows 2000, and Windows XP. This standard package can be used for all Fujitsu MCUs and includes:

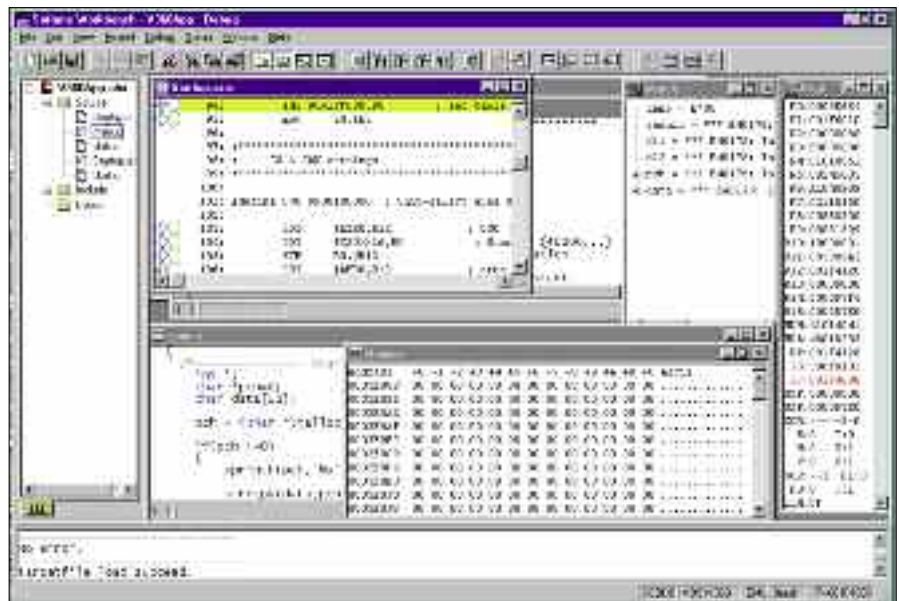
- ANSI C/C++ Compiler***
- Macro Assembler**
- Linker**
- Simulator**
- Emulator**
- C/C++ Checker***
- C/C++ Analyser***

* C++ is only available for 32-bit MCUs.

At the user interface, the Softune Workbench provides easy access to all the tools with improved performance and more features. With this, the designer can concentrate on coding and debugging with improved efficiency but without knowledge of how to start the compiler or linker, etc.

Operational features

- Simple menu-based, mouse-driven operations
 - GUI language tools
 - Automatic compiling and linking of associated pre-input files
 - Dialogue boxes to facilitate selection of tool options and project settings
- Automatic start by linking editor, compiler, assembler, linker and debugger
- JError jump to error by simple double click, allowing editor to point automatically to errors



Softune Workbench - user interface Softune GUI simplifies system development

- Selection of built-in editor with syntax highlighting feature, or user's own preferred editor
- On-line compiler and assembler manual help display
- Customisable environment
- Set-up Wizard for debugging environment
- Save / Restore debugging environment
- Watch (Variables): automatic update (x sec), format (Hex, Bin, etc.), structures
- View of global and local variables
- Register Window: configurable, updated = red
- Memory Window: format, symbolic edit, direct edit, ASCII
- Dis-assembler Window and in-line assembler
- Trace Window (various display modes) including backtrace function
- Misc: stack follower, time measurement, vector display
- Simulator: I/O-Port stimulus and logging, interrupt simulation
- Tool-control: command input, log-files and batch files

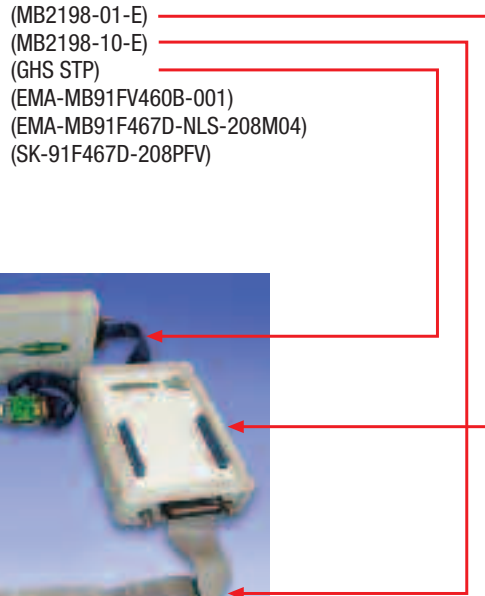
Debugger features

- Source-level debugging (C, Assembler or Mixed)/files appear as designed
- Breakpoints code/data (6 HW, 65536 SW) possible on every source-line
- Navigate functions: go, go to line, step, step out, step over, call function, reset

PRODUCT OVERVIEW MICROCONTROLLERS

Green Hills Tools for MB91460 MCUs

- Emulator
- DSU Cable
- GHS Super Trace Probe
- Adapter Board
- Socket Adapter Board
- Evaluation Board



Debugging with SuperTrace Probe.

The Green Hills product suite, including the MULTI 5 integrated development environment (IDE), TimeMachine tool suite, Green Hills compilers, and SuperTrace Probe are available for the MB91460 series.

Trace collection is done via the Fujitsu emulation environment, using a dedicated EVA adaptor board. Please see the picture for details.

Key features of MULTI 5 and the SuperTrace Probe

MULTI 5

- Based on proven debug technology of previous versions
- Debug the future:
 - MISRA
 - New static analysis - double check
- Debug the present:
 - Run-time error checking
 - Run-time memory checking
- Debug the past:
 - Profiling
 - New improved TimeMachine
- New fast simulator
- New distributed build

SuperTrace Probe

- Supports CPUs exceeding 300MHz traceport speed
- 1 GB standard trace buffer size
- Built on proven Green Hills probe technology
- Tightly integrated with MULTI debugger
- TimeMachine enabled:
 - back-in-time debugging
 - Path analyser
 - Profiling



Accemic MDE monitor debugger

Fujitsu Microelectronics offers a monitor debugger for its 16LX and FR series that allows the debugging of single-chip, MCU embedded applications. The Accemic monitor debugger enables downloading of the debugger kernel and the application into the embedded flash memory of the MCU. The monitor kernel can be started directly to load new programs and execute them under control. There is also the option to start the user application directly after reset and enter debug mode on demand.

A special feature of this debugger is the processor status window, which shows all internal peripherals of the MCU, including pin status and direction. Detailed peripheral windows allow the user to check and modify peripheral settings. Beside the usual available debug functionalities, on-line monitoring, powerful messaging functions can be linked to the application in order to send data and messages to the PC screen.

As well as a standard version, a professional version is also available, offering more powerful features. This version supports up to 16 breakpoints and the multi-processor/multi-core debugging feature allows different processors in a CAN network to be controlled at the same time. With the Accemic HSCI option, several communication channels to the target MCU can be used: CAN, UART asynchronous mode, UART synchronous mode and emulation of serial communication via free I/O ports.

Accemic is a Munich-based third party supplier to Fujitsu.

A demonstration version of the Accemic MDE can be downloaded from the Accemic (www.accemic.com) web site.

Main features

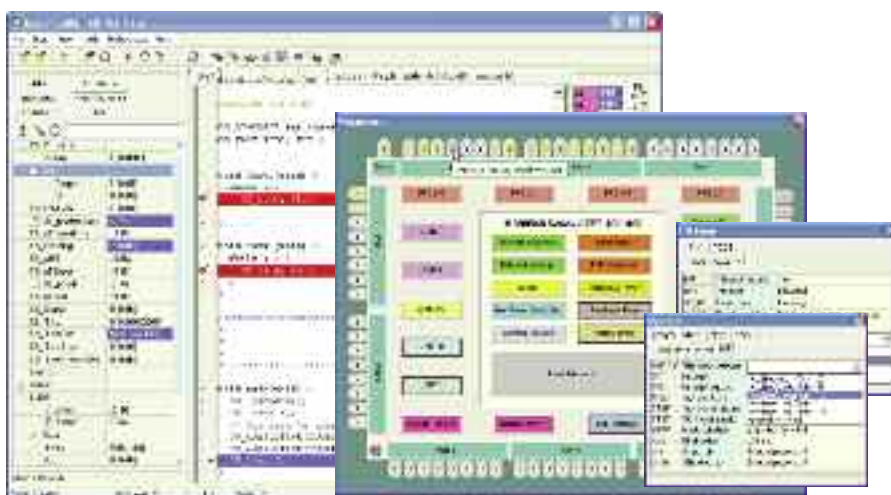
- Memory usage
 - ROM: 8kByte monitor kernel size + 256Byte configuration data
 - RAM: 128Byte used by kernel
- Two hardware breakpoints
- Single step, step-in, step-out, step-over functions
- CALL function
- Target message window

- Debugging on C-Source code or assembler level
- Dedicated debug windows
 - Source window
 - Mixed mode view for C-Source and assembler view
 - Watch window
 - Memory window
 - Stack window
 - Interrupt vector table
 - CPU core register window
 - Peripheral status window
 - Processor status window shows register contents of the internal MCU peripherals
- Browser window
 - Interrupts, functions, units, local/global variables, I/O registers
- On-line help
- Supported devices:
 - MB90330 & MB90340 series
 - MB90350 & MB90385 series
 - MB90390 & MB90425 series
 - MB90435 & MB90455 series
 - MB90460 & MB90470 series
 - MB90495 & MB90520 series
 - MB90540/545 series
 - MB90560/565 series
 - MB90570 & MB90580 series
 - MB90590/595 series
 - MB90800 & MB90820 series
 - MB90945 series
 - MB91265 series
 - MB91470 series
 - MB91350 Series, MB91270 series
 - MB91F364G, MB91F376G series
 - MB91460 series

To order these tools, please ask Fujitsu or Accemic for the correct part number..



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GALEP-5 universal serial/parallel MCU programmer

Conitec's new fifth generation GALEP-5 is a professional palm-sized device programmer with 48 universal pin drivers and USB port. It supports almost all 16- and 32-bit Fujitsu microcontrollers.

GALEP-5 uses a highly integrated FPGA device that controls the pin drivers and supports hardware acceleration of the programming algorithms by setting up internal state machines and UARTs.

Via special programming adapters, Fujitsu MCUs can be programmed parallel or serial in-circuit (ISP). For serial in-circuit programming both serial synchronous and asynchronous programming modes are supported.

Features

- High speed programming e.g. 1MB/19sec (MB91F467D)
- Free software updates in regular intervals available
- Editor supports binary, Intel-Hex, Motorola-S or JEDEC file formats
- Power supply via USB only (in case <500mA)
- Supports remote control
- Batch mode: Run GALEP-5 from the command line, or implement GALEP commands in the own production software

Technical Specifications

- Pocket format: approx. 80 x 115 x 33mm (+7mm socket), weight: approx. 185g
- 48-pin ZIF socket with 48 universal pin drivers
- Programs low-voltage components down to 1.3V
- USB 2.0 high-speed port
- AC adapter plus battery compartment for high-power devices



GALEP-5 is a professional palm-sized field programmer with universal I/O capability

GALEP-5 – ISP adapter

- Supports in-circuit serial synchronous and serial asynchronous programming
- Supports almost all 16 and 32-bit Fujitsu microcontroller
- Target power supply by Galep (max 200mA) or external source selectable

System requirements

- Windows 32-bit OS (98SE / ME / NT4 / 2000 / XP / Vista)
- USB 1.1 or USB 2.0 port



GALEP-5 with ISP

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<http://www.conitec.de/>

Real-time operating systems

OSEK/VDX OS targeted for automotive applications

OSEK/VDX is a real-time operating system targeted for automotive applications. It consists of three parts, the OSEK kernel, the communications interface and the network management. Mainly automotive controller networks using CAN interfaces will employ the OSEK operating system. The FR series of microcontrollers is supported with optimised drivers for the Fujitsu CAN controller.

OSEK-OS defines the task types 'Basic' and 'Extended'. Basic tasks cannot have a waiting state and so are suitable for those that run completely after each activation. Extended tasks can react to events; they can have a waiting state. OSEK-OS also defines four conformance classes:

- BCC1 - basic tasks, single activation
- BCC2 - basic tasks, multiple activation
- ECC1 - basic and extended tasks, single activation
- ECC2 - basic and extended tasks, multiple activation

The FR series OSEK without CAN driver and network management requires 3.2kB ROM for class ECC1 (standard status)

embOS OS targeted for embedded applications

embOS* is a real-time operating system for embedded applications designed to offer the benefits of a fully featured multi-tasking system even for hard real-time applications using minimal resources.

All functions of embOS have been placed in individual modules to ensure that only the functions needed are actually linked into the application program, leaving maximum room for the user-program.

Features

- Pre-emptive multi-tasking
- Priority-controlled scheduling
- Round robin scheduling
- Intertask communication
- Software timer
- Minimum interrupt latency
- Fast & efficient
- Small footprint (can be used in single-chip mode)
- Easy-to-use start project
- Versatile
- Support directly by developers
- System analysis via UART
- Profiling support
- TCP/IP - and other network stacks available

Developing applications with embOS

embOS is available in source or object code form. Both come with a ready-to-go start project:

The first multi-task program is running within five minutes. The start application and usable samples are supplied in source code form. Libraries for all memory models and initialisation of the controller in 'C'-source are included to tailor the system to any application.

Check out the free full-functional trial version, which can be downloaded from the website: www.segger.com

TCP/IP stacks for embOS

As connectivity and the Internet became a major issue even in embedded systems, embOS is designed to support TCP/IP and other network stacks. We offer a fully-featured, 100% RFC-compliant TCP/IP stack, that runs on any supported 16- or 32-bit target CPU. It provides virtually all of the protocols, link layers, interfaces and device drivers that are required for networking connectivity applications.

*embOS is a product of Segger.



www.vector-informatic.com



Further information: www.segger.de

Real-time operating systems continued

EUROS Enhanced Universal Real-Time Operating System

EUROS is an innovative real-time operating system characterised by short response times, robustness, scalability and flexibility. The primary aim of EUROS development was to create a uniform, hardware-independent operating system for real-time and embedded applications, which takes into account the growing complexity and diversity of processor architectures in order to make software engineering as economical as possible. It separates the user-software from the hardware so that the application can easily be ported to state-of-the-art hardware.

Key features

- Supports Fujitsu F²MC-16LX and FR series
- Unlimited number of system objects (tasks, mailboxes, signals, events, semaphores, drivers)
- Up to 256 priorities
- Synchronous and asynchronous system calls
- Memory management supports fixed and variable size memory blocks
- Waiting on multiple objects
- Flexible open driver interface
- Priority-based scheduler with round robin support
- Named system objects organised in clusters (hierarchical object trees)
- Re-entrant ANSI compatible C runtime library
- Generic graphic library
- TCP/IP network stack (BSD4.4 socket interface)
- Web server, FTP server, SMTP client, BOOTP client

- PPP, Ethernet
- CAN / CANopen
- MS-DOS™ compatible file system
- IDE hard disk drivers
- Floppy disk drivers
- Ramdisk, FTL for Flashdisks
- IrDA (IrLAP, IrLMP, IrComm)
- Profibus (slave)
- IEEE1394 (Firewire)

EUROSvm Euros virtual machine

EUROSvm is an implementation of the Java Virtual Machine Specification V1.2. It has been designed for real-time and embedded systems and offers unparalleled support for this target domain. Among the extraordinary features of EUROSvm are:

- Hard real-time execution
- Minimal footprint
- ROMable code
- Native code support
- Dynamic linking
- Fast execution

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