32-bit Microcontroller with Built-in FlexRay for Automotive Control Systems
FR Family MB91F465XA

Optimal for next-generation automotive control systems with built-in FR CPU cores capable of fast control and peripheral resources with reinforced functions.
This product is a 100MHz-operation microcontroller that offers various built-in functions including FlexRay, which is under the spotlight for the next-generation automotive network, and already widely used CAN.

Overview

In recent years, X-by-Wire technology, which is used to electrically control conventional hydraulically controlled systems, has been receiving increased attention for its use in next-generation automotive systems. Automobile data has been increasing in volume and becoming more and more complex. As such, faster and more reliable networks are necessary. In this context, FlexRay shows great promise as a next-generation automotive network.

The FlexRay microcontroller "MB91F465XA" that FUJITSU has developed has a built-in 32-bit RISC, FR core to increase the maximum operation frequency to 100MHz. Its high versatility and compact specifications will allow a flexible shift from the various existing CAN bus systems to FlexRay. Furthermore, it can be applied as a gateway between conventionally used CAN and FlexRay.

Fig.1 shows the target applications of FlexRay.

Product Features

Fig.2 presents the block diagram.

The built-in resources in this product deliver the following features:

Photo 1 External View

FR60 core

This product adopts an FR60 core that is instruction-compatible with the FR series. The FR60 core is FUJITSU's 32-bit RISC CPU core that realizes high performance and low power consumption and is capable of operation at a maximum operation frequency of 100MHz.

Built-in Flash memory capacity

- Main Flash memory: 544Kbytes
- Flash memory security addressed

Built-in RAM capacity

- 32Kbytes
- Instruction cache: 8Kbytes

FlexRay communication controller

An IP provided under license from German Bosch that conforms to FlexRay Ver2.1. Supports communication speed up to 10Mbps.

CAN controller

Conforms to Parts A and B of CAN specification version 2.0. There are 32 built-in message buffers for data and ID with ranking. Supports communication speed up to 1Mbps.

Various timers

- 16-bit free-run timer
- 16-bit input capture
- 16-bit output compare
- 16-bit PPG: Selection possible from one-shot output/PWM output (synchronous output possible up to 4 channels)
- 16-bit reload timer

Various interfaces

- LIN-supporting USART (with 16bytes FIFO)
- I2C interface

High-speed A/D converter

Sequential conversion A/D converter realizing 10-bit resolution (Minimum conversion time 3μs, total error $\pm$3LSB: Vcc=Avcc=3.0V to 5.5V)

Figure 1 Target Applications for FlexRay

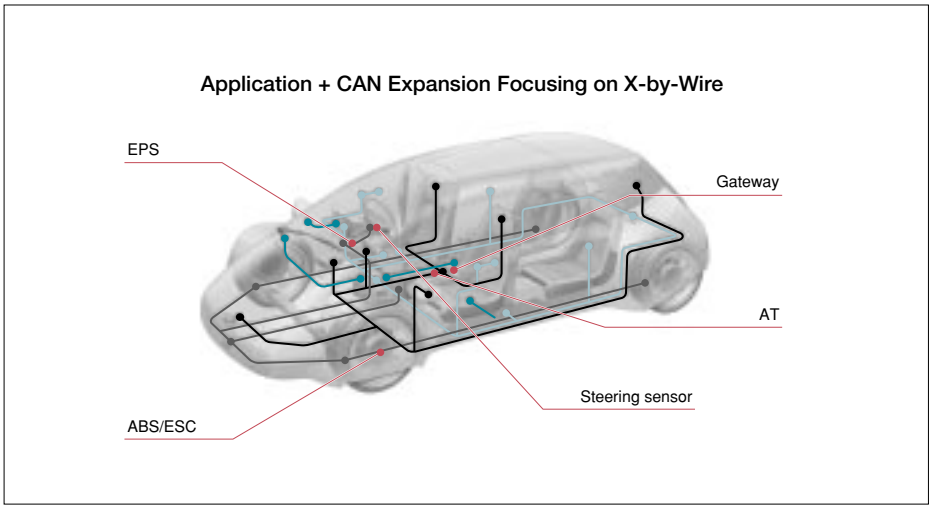
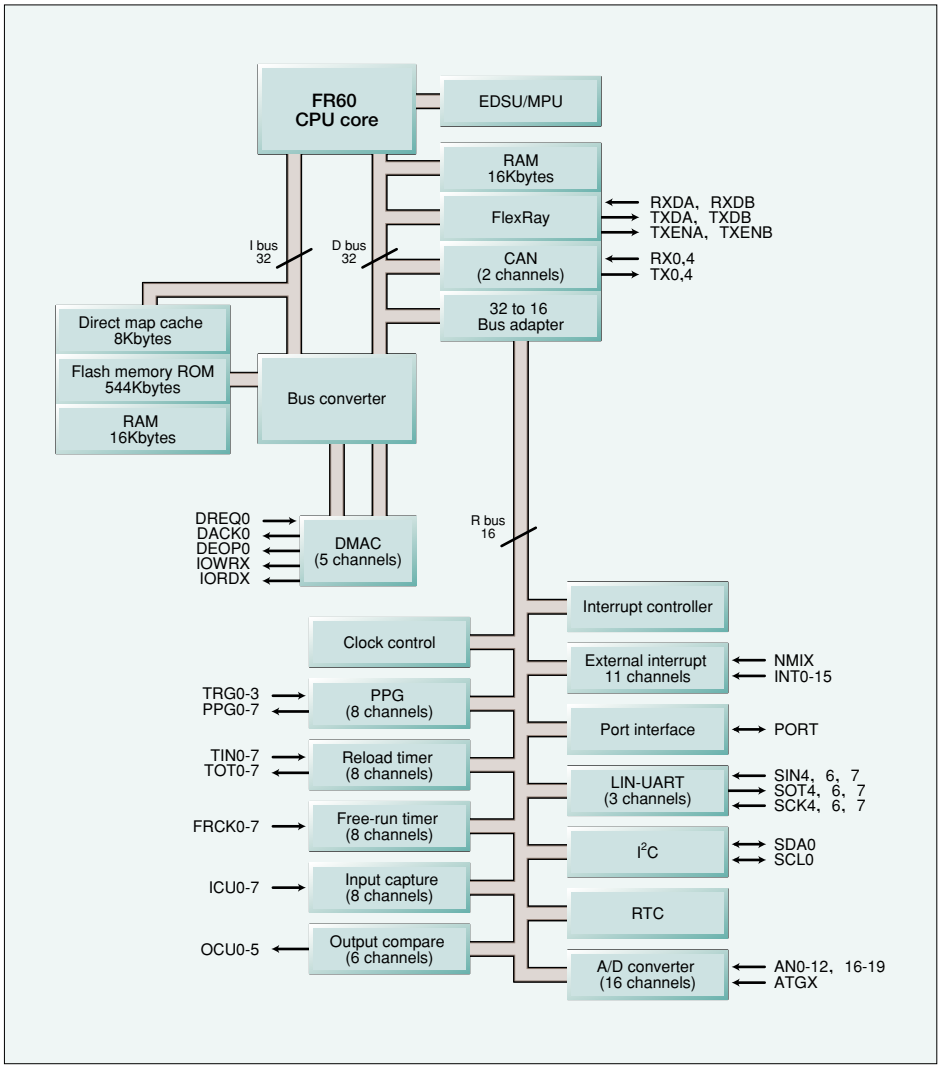


Figure 2 Block Diagram



Low power consumption mode: Sleep/stop functions

The low power consumption modes are sleep mode (program stops) and stop mode (device stops). Utilizing them, standby current consumption can be reduced dramatically.

I/O port

- Input permission setting: Setting possible for each port
- Input level setting: Selection possible from 4 input levels; CMOS /CMOS hysteresis /Automotive/TTL
- Pull-up resistor setting: Setting possible for each port (standard: 50kΩ)

Table 1 presents the voltage for each input level.

Other peripheral functions

- External interrupt
- DMAC
- Watchdog timer
- Real-time clock
- Clock monitor
- Low voltage detection circuit
- Power-supply voltage: 3.0V to 5.5V

Application Fields

The number of applications that utilize the motor in automobiles has been increasing and many of these applications are connected to the CAN bus network. Specifically, EPS (electric power steering) executes CAN communication, sensing by AD converter, and so forth during high-speed operation to control the motor.

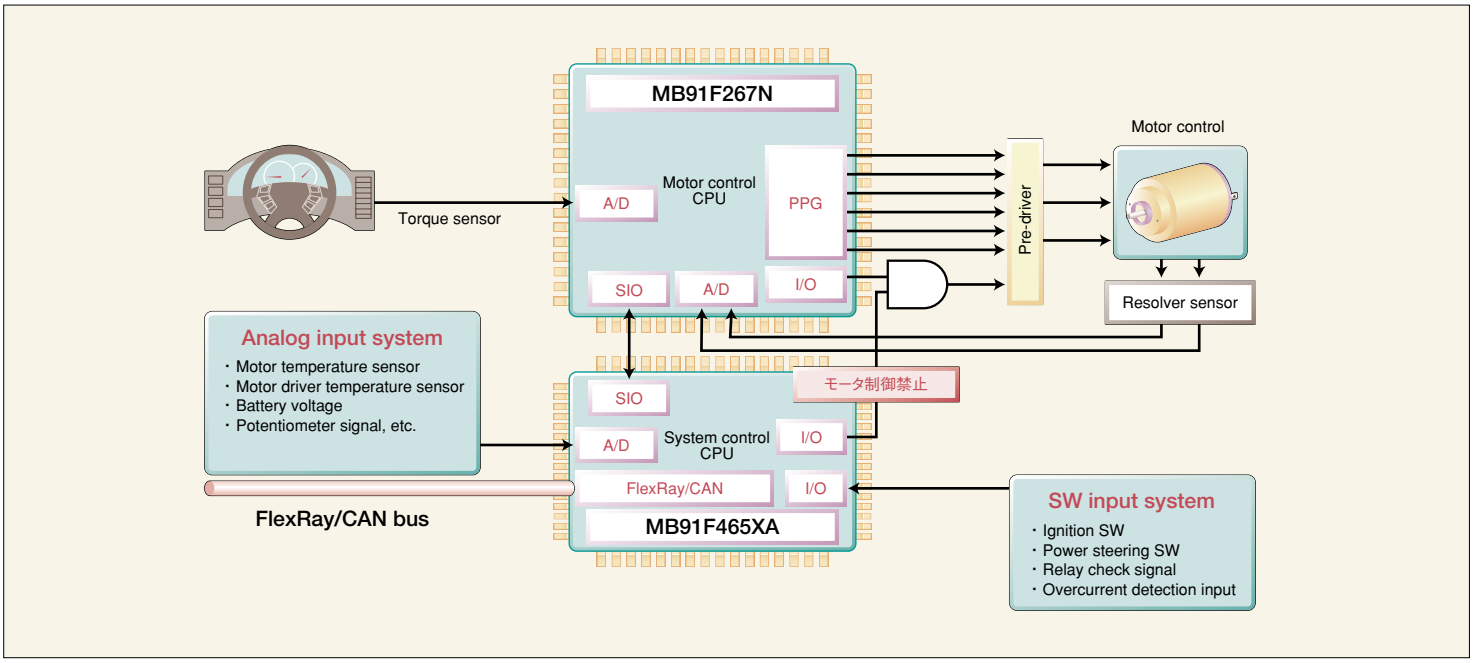
In the future, the EPS system is expected to be connected to the FlexRay network. In this case, motor control must be implemented to suit the carrier frequency and FlexRay will require processing within the communication cycle, resulting in many restrictions in terms of time. This problem can be solved using separate microcontrollers for motor control and system control. This allows this product to be used for system control including FlexRay control with fewer restrictions in system control or time as well as lower program development difficulty.

Fig.3 presents the EPS system block diagram with adoption of this product.

Table 1 Input Level Settings and Input Voltage

Item	VIL (V)	VIH (V)	Input level
Input voltage	0.3Vcc	0.7Vcc	CMOS input
	0.2Vcc	0.8Vcc	CMOS hysteresis input
	0.5Vcc	0.8Vcc	Automotive input
	0.8	2.1	TTL input

Figure 3 EPS System Block Diagram



Development Environment

Like the conventional FR Series, this product is supported by the FUJITSU integrated development environment SOFTUNE V6. SOFTUNE V6 application software is designed to simplify programming tasks in order to meet the diverse needs of program designers.

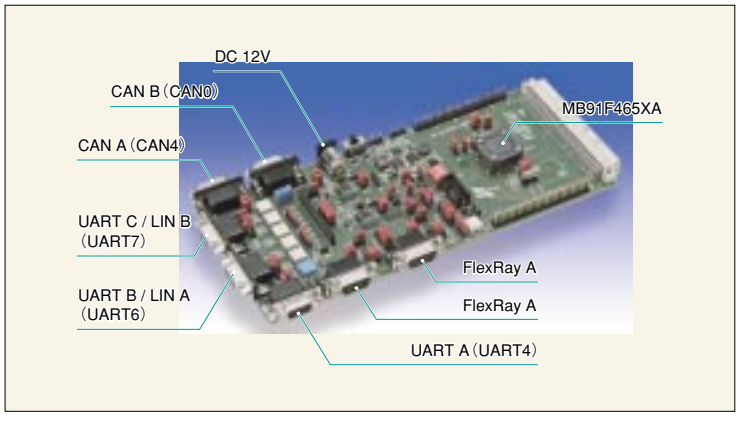
Furthermore the evaluation board for FlexRay (MB2006-02), which is capable of immediately evaluating FlexRay, is available.

Table 2 lists the development tools. *

Table 2 Development Tools

Hardware	Emulator main unit	MB2198-01
	Adapter board	MB2198-600
	Evaluation chip	MB91V460 (already on the adapter board)
	Header board	MB2198-602 (LQFP-100: 0.5mm-pitch, 14mm×14mm)
	FlexRay expansion board	MB2198-603
	Evaluation board	MB2006-02 (MB91F465XA incorporated)
Software	SOFTUNE V6 Workbench	
	SOFTUNE V6 C compiler	
	SOFTUNE V6 assembler	
	SOFTUNE V6 C/C++ analyzer	
	SOFTUNE V6 C checker	

Photo 2 Evaluation Board for FlexRay (MB2006-02)



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