

32-bit Microcontrollers with Built-in CAN Communication Controllers for Automotive Systems

Realizing High Performance, Low Power Consumption, and Low Noise

FR Family

MB91210 Series

Microcontrollers (MCUs) for automotive system control are now being offered with built-in CAN communication controllers and high quality, high performance, low price, low power consumption, and low noise features. Equipped with rich elements such as various timers, a serial data input port capable of LIN communication, and an analog input port for an A/D converter, this product can be applied in various different control systems. We offer a wide product memory lineup from 288Kbytes to 544Kbytes and can realize an increase in programs in concurrence with the expansion of system functions.

Overview

In recent years, more comfortable and safer control has been strongly demanded in automotive systems. There is a great need for systems that are capable of detecting the conditions and changes in the driving environment promptly and controlling minutely to suit the situation.

To enable the prompt detection of conditions and changes, there has been a trend in automotive systems to have an increasing number of built-in sensors such as acceleration

sensors and angular velocity sensors. Information from these sensors is transmitted as analog or digital signals. MCUs need to have multiple analog ports to input these signals as well as CAN controllers and serial communication ports to transmit/receive data.

Advanced CPU performance is required for minute control. Since it is necessary to operate based on the sensed information and conduct complex control in a short period, demands have shifted from conventional 16-bit MCUs to 32-bit MCUs with higher processing capabilities.

In addition to the diversified roles of MCU, the need to consider reduction in power consumption for the overall system and the effects of electromagnetic interference (EMI) on the external devices has been growing. In light of this, measures to realize power saving during high-speed operation of MCU and measures against EMI are extremely important.

This product is a 32-bit MCU with built-in CAN controller that satisfies all of these diversifying demands and is optimal for automotive systems of the future.

Product Features

This product is a 32-bit MCU with a built-in FR60Lite CPU core, CAN communication controller, various serial communication controllers, high-speed A/D converter, and various timers for automotive applications such as power train systems, safety control systems, and body control systems.

Realizing high-speed operation and low power consumption by adopting CMOS 0.18 μm

The FR60Lite CPU core has the same architecture as FUJITSU's high-performance 32-bit MCU "FR Family." The conventional feature of this CPU core was that it realized low power consumption equivalent to 16-bit MCUs while maintaining the high performance of FR. This product realized high-speed operation at 40MHz, which is better than that of the conventional FR60Lite CPU core by adopting 0.18 μm CMOS technology. Furthermore, its power consumption has been reduced to two-thirds or less than that of the FR60Lite CPU core.

Memory expansion and pin number expansion

FUJITSU offers a memory lineup of 288Kbytes to 544Kbytes and a pin lineup of 100-pin and 144-pin. It is possible to flexibly realize hardware and software changes in concurrence with function enhancement in the system.

CAN communication controller with 32 message buffers

This product has up to 3 channels of built-in CAN interface with 32 message buffers.

Table 1 Main Specifications

	MB91V210	MB91F211	MB91211	MB91F213	MB91213	MB91F218
Application/program memory type	For evaluation	Flash memory	Mask ROM	Flash memory	Mask ROM	Flash memory
Package	—	LQFP-100		LQFP-144		
ROM/Flash memory density	External SRAM	288Kbytes		544Kbytes		
RAM density	4Kbytes+32Kbytes	4Kbytes+12Kbytes		4Kbytes+20Kbytes		
External interrupt	16 channels	16 channels		16 channels		
DMA controller	5 channels	5 channels		5 channels		
External sub-clock	Supported	Supported		Supported		
Pseudo sub-clock	Not supported	Supported		Not supported		
RTC	Included	Included		Included		
CAN controller	3 channels 128msg/channel	1 channel 32msg/channel		3 channels 32msg/channel		
LIN UART	7 channels	4 channels (LIN supported) 1 channel (LIN not supported)		7 channels		
Reload timer	3 channels	3 channels		3 channels		
Free-run timer	4 channels	2 channels		4 channels		
Input capture	8 channels	4 channels		8 channels		
Output compare	8 channels	4 channels		8 channels		
8-/16-bit PPG	8-bit×16 channels (16-bit×8 channels)	8-bit×8 channel (16-bit×4 channels)		8-bit×16 channels (16-bit×8 channels)		
AD converter	32 channels	16 channels		32 channels		

Rich analog input ports and serial communication ports

This product has up to 32 channels of built-in analog input ports to A/D converters and up to 7 channels of built-in serial communication input/output ports.

Table 1 presents the specifications.

Low-noise design

FUJITSU has worked continuously on measures against EMI from MCUs (Fig.1). As an outcome of our efforts, we developed many automotive MCU products with good noise characteristics and they have been received well by our customers.

In addition to this, this product adopts the following EMI measures to realize an extremely high EMI suppression effect:

Noise suppression by low power consumption

• Clock gating

By stopping clock supply to unused logic area, power consumption as well as noise are reduced.

Fig.2 presents the clock gating in unused logic area.

• Special step-down circuit for oscillation

Noise is suppressed by reducing the operation voltage for the oscillator circuit to 1.9V and reducing the power consumption.

Multiple assignment of bypass capacitors at logic power supply and GND

In the conventional block layout method, the power-supply and GND lines were wired near the logic blocks. In

this case, countermeasure capacitors were to be inserted/assigned in a very limited area as measures against noise in the layout design by our manual.

This product adopts a flat layout as the layout design method. Since this layout method wires the power-supply and GND lines in mesh on each layer, it was possible to insert/assign the noise measure capacitors nearly anywhere in the entire logic area.

Fig.3 presents the flat layout and concentrated assignment of bypass capacitors.

Bypass capacitor assignment on the I/O ring and optimization of driving capability

One cause of EMI is outward emission by I/O operation. In this product, the I/O operation capability was optimized as a measure to minimize emission. A space to insert the I/O power-

Figure 1 Attempts for Noise Reduction

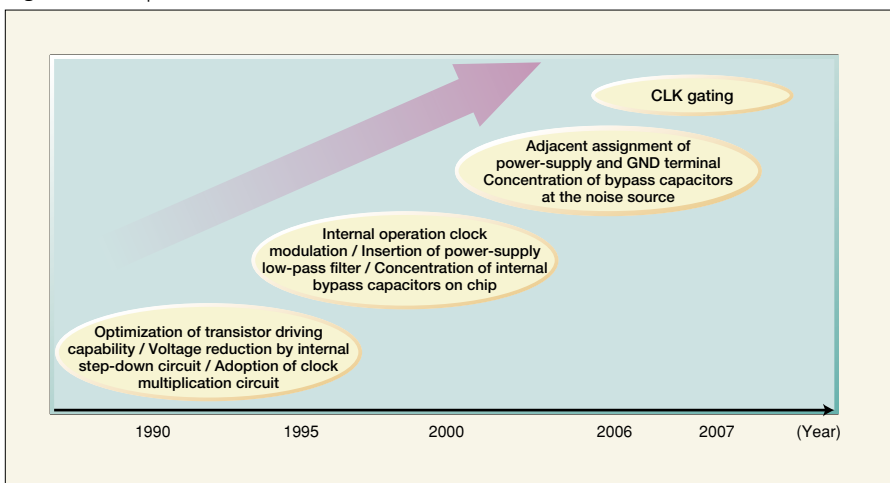


Figure 2 Clock Gating for Unused Logic Area

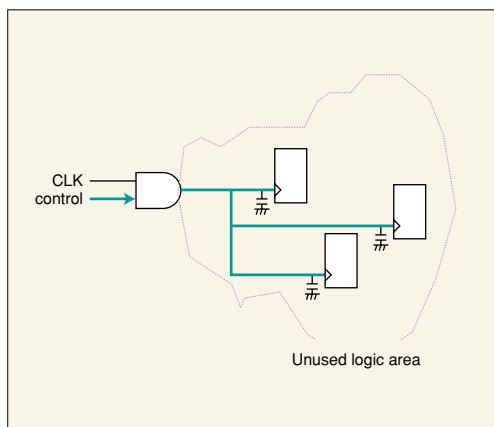


Figure 3 Flat Layout and Concentrated Assignment of Bypass Capacitors

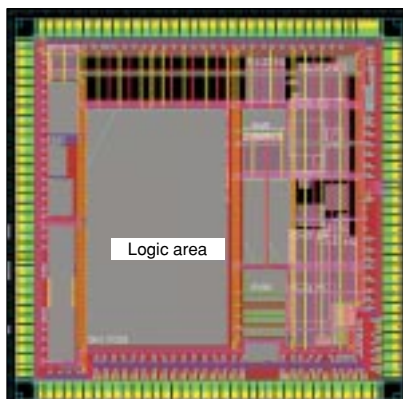
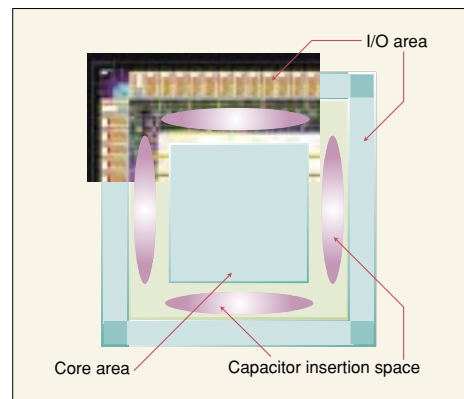


Figure 4 Ensuring Power-Supply Ring Space for I/O and Measures against Noise



supply ring is ensured between the logic core area and the I/O area on chip. By inserting many capacitors as EMI measures in the power-supply ring section, the impedance of each port is reduced and the effect of I/O operation on external devices is minimized.

Fig.4 presents the ensuring of the power-supply ring space for I/O and the measures against noise.

Electromagnetic interference characteristic of MB91210 Series

As a result of the above three measures, this product delivers extremely favorable EMI characteristics compared to other automotive MCUs.

Fig.5 presents the electromagnetic interference characteristics.

Application Eamples

An application example in an engine control system

In engine control systems it is necessary to monitor the inflow rate of the air constantly by inputting from the throttle sensor and adjusting the fuel injection volume to realize the optimal mixture ratio. MCUs that are used in electronic fuel injection (EFI) systems are required to have many analog input ports and communication ports for inputting various data including data from the O₂ sensor, accelerator sensor, and acceleration sensor.

Fig. 6 presents the configuration of an engine control system.

In addition to these performance and function requirements, high reliability is demanded in engine control MCUs. This product is guaranteed to have the highest quality in automotive grade from design and manufacture to testing.

An application example in an air-bag system

The basic operation of an air-bag system is to detect a collision by calculating the data from the acceleration sensor and outputting instruction to expand the air

bags to the inflator.

MCUs for air-bag control need to have serial communication ports and general-purpose I/Os for communication with sensor modules and signal output to the squib controller. They also need to be equipped with SPI (Serial Peripheral Interface), CAN interface, and so forth to coordinate control with other ECUs. In recent years, the number of built-in sub-sensors to detect collision has been increasing in order to improve

Figure 5 Electromagnetic Interference Characteristics

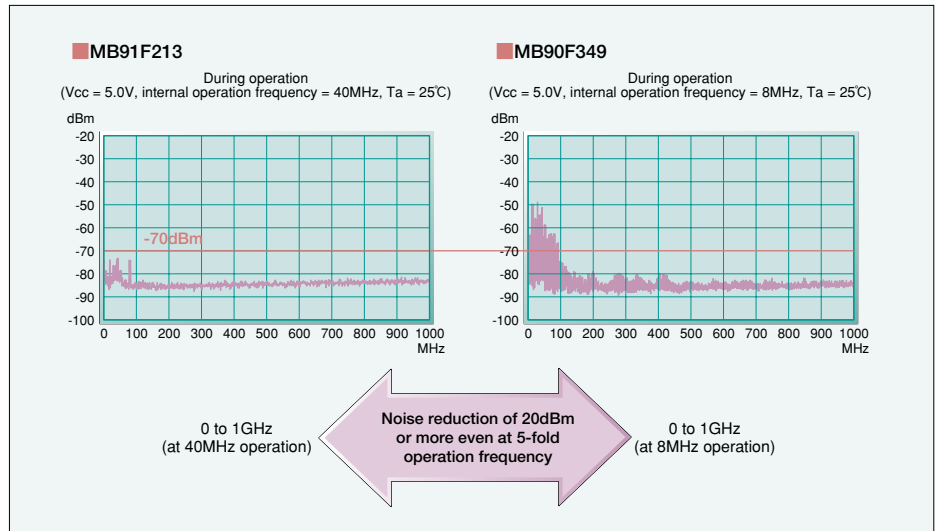
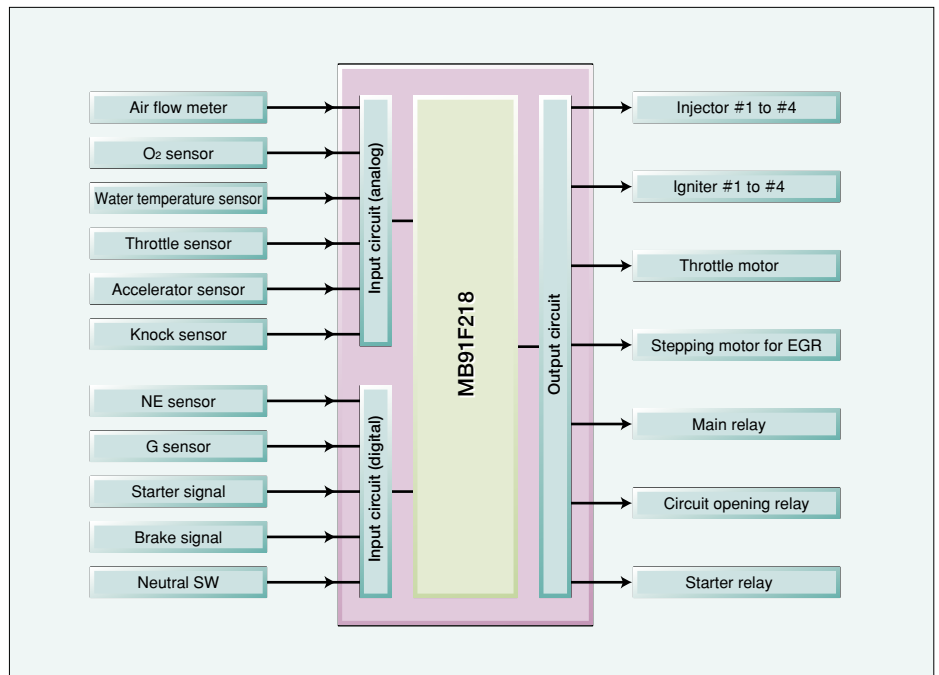


Figure 6 Configuration of an Engine Control System



passenger safety; the information may be directly input into the SPI or AD converter port.

To process the large amount of data input from the sensors at high speed, MCUs are demanded to have higher processing performance. This product has sufficient specifications to address these demands as an MCU for air-bag systems.

Fig.7 presents the block diagram of an air-bag system.

An application example in body system

A Body Control Module (BCM) requires many analog ports as input ports for various sensors. It also requires a serial interface supporting LIN protocol as the output port for control signals. The BCM is the integrated control system for the body system and high processing performance is therefore demanded. This product has sufficient specifications to satisfy such BCM requirements.

Fig.8 presents the block diagram of a BCM system. *

NOTES

* Other company names and brand names are the trademarks or registered trademarks of their respective owners.

Figure 7 Block Diagram of an Air-bag System

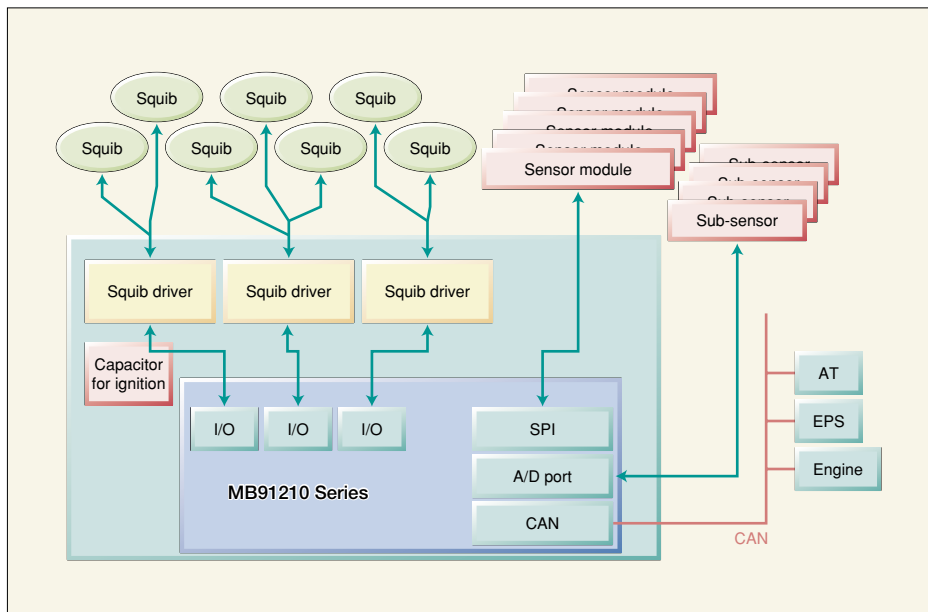


Figure 8 Block Diagram of a BCM System

