

High-Performance 32-bit Microcontrollers with Built-in “FR81S” Core for Automotive Applications MB91770 Series/MB91725 Series

High-performance microcontrollers for meter cluster control and body control with built-in “FR81S,” our proprietary new 32-bit CPU core.

Introduction

In recent years, improved functions related to safety, comfort, and environmental friendliness have been demanded in automobile performance in addition to an improvement in driving functions such as driving, turning, and stopping. While built-in microcontrollers are currently used in many automotive systems, their performance and function improvement is important in order to realize safer, more comfortable, and environmentally friendly systems in the future.

Overview/Product Features

■ Addressing a safer, more comfortable, and more environmentally friendly system

We have developed MB91770 Series and MB91725 Series, new microcontrollers with built-in “FR81S,” our proprietary 32-bit high-performance CPU core, which is capable of controlling next-generation automotive systems. Meter cluster control is the main application for the MB91770 Series and body control (air conditioning, BCM, etc.) is the main application for the MB91725 Series.

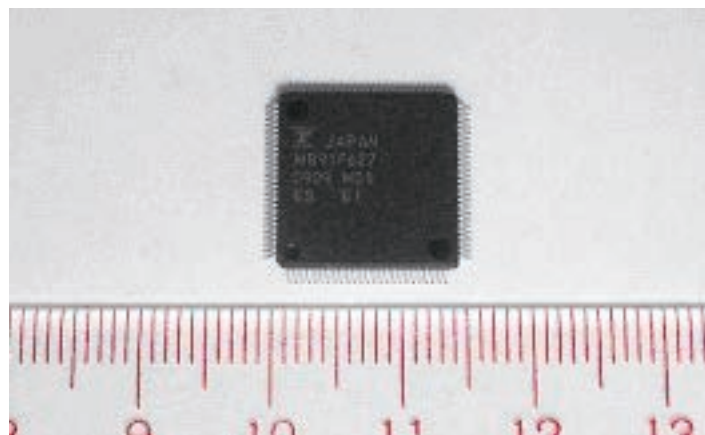
Figure 1 presents an application image within an automobile.

■ New built-in high-performance 32-bit CPU core “FR81S”

This product adopts an FR81S core that offers processing

performance that is 30% or more that of our conventional 32-bit “FR60” CPU core. The operating performance of FR81S is 1.3MIPS/MHz, which delivers very high processing performance as a microcontroller for automotive applications. It also has a built-in single precision floating-point operation unit (FPU) capable of addressing image processing systems and systems that require floating-point operation such as actuator control. While operation methods such as fixed-point operation were hitherto necessary for conventional products without a FPU, this product is supported by hardware and is thus capable of realizing software program simplification and operation performance speedup.

Photo 1 External View



■ CAN controller with 64 built-in message buffers

There are many built-in ECUs in the CAN network of recent automobiles; their scale continues to increase in concurrence with the increase in the number of nodes. While our conventional 32-bit CAN microcontrollers mainly have 32 built-in message buffers, this product has 64 built-in message buffers that enable support for systems with a large number of nodes. Furthermore, it supports ver.2.0A/B as the CAN protocol and up to 1M-bit/sec as the bit rate.

■ Connectable to many peripheral functions via a switchable serial interface and LIN-UART

This product has a built-in multifunction serial interface as the interface for serial communication (2 channels in the MB91770 Series and 4 channels in the MB91725 Series). This multifunction serial interface can select UART, clock synchronous serial, LIN-UART, and I²C for each channel by software switching. This provides flexible support for the communication specifications of external devices and improves the freedom in system design. This product also has 6 channels of LIN-UART in addition to this multifunction serial interface, enabling communication with more control units.

■ Functions to widen the range of board layout

● Special power supply for the external bus interface terminal

This product is equipped with a separate power supply for the external bus interface terminal. It therefore requires no level shifter on the ECU board (this was previously required when connecting with external devices that had different operating voltage in conventional products with a single power supply). Furthermore, the voltage range of 3.0V to 5.5V is supported as the power supply voltage for this external bus interface terminal and it can thus connect flexibly to single-unit memories, ASIC for images, and so forth.

● I/O relocation function

The assignment and wiring patterns for the peripheral elements of a microcontroller depend largely on the pin assignment of the microcontroller. To reduce the physical restrictions of board layout by pin assignment, this product has a built-in I/O relocation function that can change the assignment of the I/O port by software setting. Since the I/O relocation functions allow the selection of the peripheral terminal to be used from the assigned terminals, freedom in board layout is improved dramatically.

The subject peripherals and number of branches (number of terminals that can be relocated) are listed as follows.

Figure 2 presents an outline of the I/O relocation functions.

[Subject peripherals and number of branches]

- PPG: 11 channels×3 branches
- Input capture: 6 channels×3 branches
- LIN-UART: 4 channels×2 branches
- Reload timer: 4 channels×3 branches

Figure 1 Application Image for MB91770 Series/MB91725 Series in an Automobile

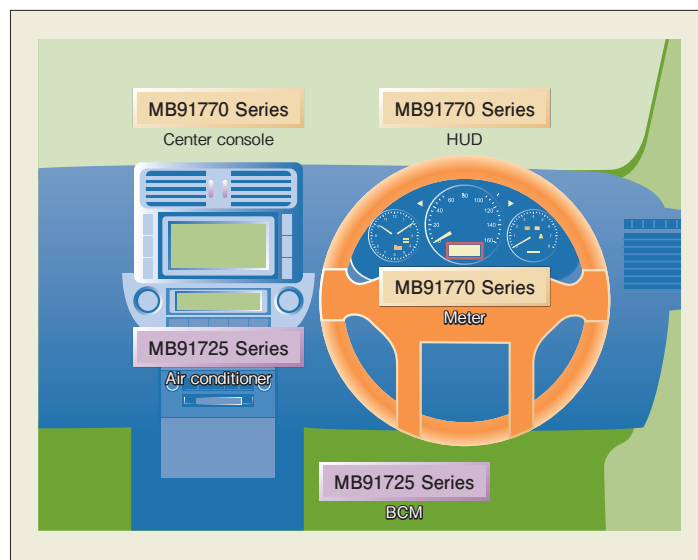
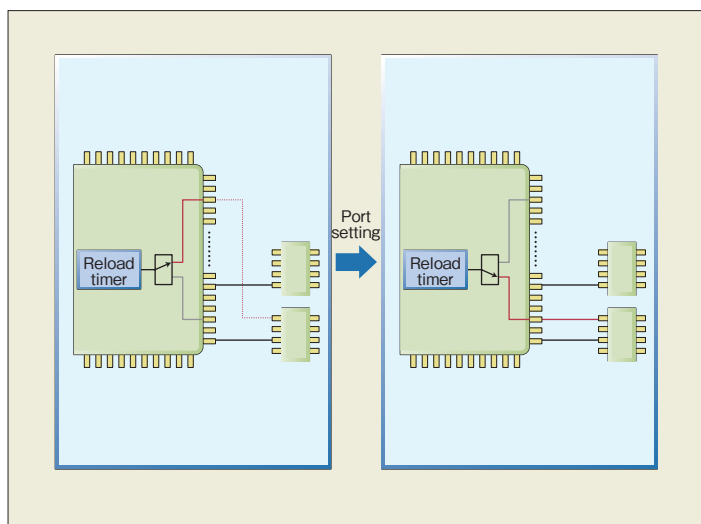


Figure 2 Schematic Drawing for I/O Relocation Functions



Application Examples

MB91770 Series (for meter cluster application)

Although there have been many different types of meter cluster indications in recent vehicles, the meter cluster system that handles visual information needs to convey the necessary information for driving to the driver in a short time without error. The MB91770 Series realizes the real-time processing of a system with the high processing performance of an FR81S core; it has built-in peripheral functions that are optimal for meter cluster control using the STN method and an LCD panel.

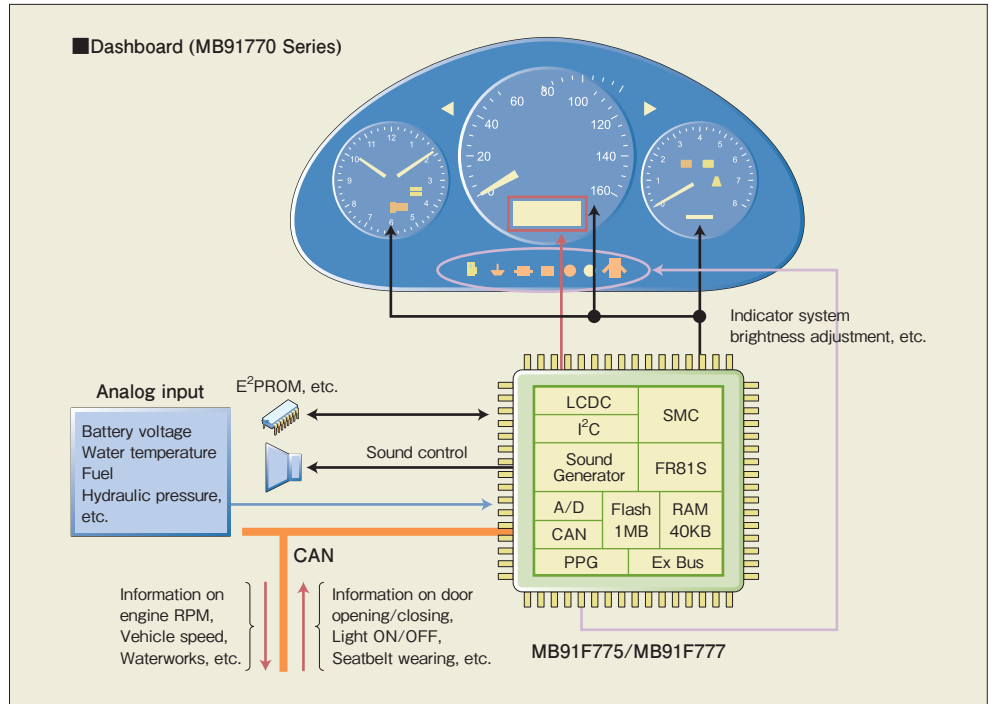
It has 6 channels of a built-in stepper motor controller capable of controlling the indicator needles of a speedometer, tachometer, and so forth. It also has a segment-type LCD controller (32seg×4com) for odometer/tripmeter indication and a sound generator to generate the waveforms that are used as the source of the turn signal sound. The functions of this sound generator have been greatly expanded compared to the conventional product. Whereas conventional sound generators only had a fade-out effect function to allow gradual volume reduction when the volume was modified, the MB91770 Series is capable of reducing or increasing the volume at a specified rate in addition to the fade-out effect. Furthermore, minute volume adjustment is possible with 16-bit resolution to address smoother sound changes.

Figure 3 presents an application example for the MB91770 Series.

MB91725 Series (for body control application)

Air conditioning and BCM systems in automobiles are controlled via various switch inputs in the vehicle as well as information from built-in vehicle sensors. Air conditioning is required to maintain comfortable interior conditions regardless of the weather conditions outside or the vehicle driving conditions. Optimal control is executed to cool the interior of a vehicle quickly to a comfortable temperature after it has been parked in the hot sun and to maintain a comfortable interior temperature based on information from various sensors. BCM is a system that implements centralized control on multiple body-system ECUs

Figure 3 Application Example for MB91770 Series



such as door, seat, and combination switches. Manufacturers are also considering integrating the ECU functions of keyless entry and so forth.

The MB91725 Series has numerous built-in serial interfaces and it can thus be connected to multiple ECUs using the CAN/LIN network. It also has many channels of timer functions and A/D converters that enable the integration of various functions.

Furthermore, the MB91725 Series has a built-in Flash memory for data in addition to the main Flash memory for programs. This enables writing/erasing in Flash memory for data during program execution from the main Flash memory for programs; in this way, application as a replacement of E²PROM is possible. This will contribute to a reduction in the number of parts on the ECU board.

[Advantages of data Flash]

- E²PROM is no longer required and the board area can be reduced
- Facilitates speedup in data writing speed
- Data, programs, and so forth are stored in the Flash memory inside the microcontroller, which helps prevent information leaks.

Figure 4 presents an application example for the MB91725 Series.

Product Specifications

Table 1 presents the main specifications of this product.

Development Environment

This product adopts on-chip debugging method. In conventional products it is necessary to implement debugging using the ICE main unit and an evaluation chip for verification and to then implement system evaluation by utilizing the actual device on the actual vehicle. This product allows single-unit system evaluation and evaluation on an actual vehicle using the actual device. In addition, it adopts a single-wire debugging interface that enables evaluation on actual vehicles or conformance tests and is capable of communication with a distance of up to 10m between the compact ICE main unit and the target board using a general-purpose coaxial cable. This will simplify the evaluation based on actual vehicles, which was conventionally difficult.

Figure 5 presents an image of the development environment, and Table 2 the development environment configuration.

Future Developments

After developing products for meter cluster control and body control applications, we will continue to substantiate the lineup of microcontrollers with a built-in FR81S CPU core, including products for motor control applications. *

Figure 4 Application Example for MB91725 Series

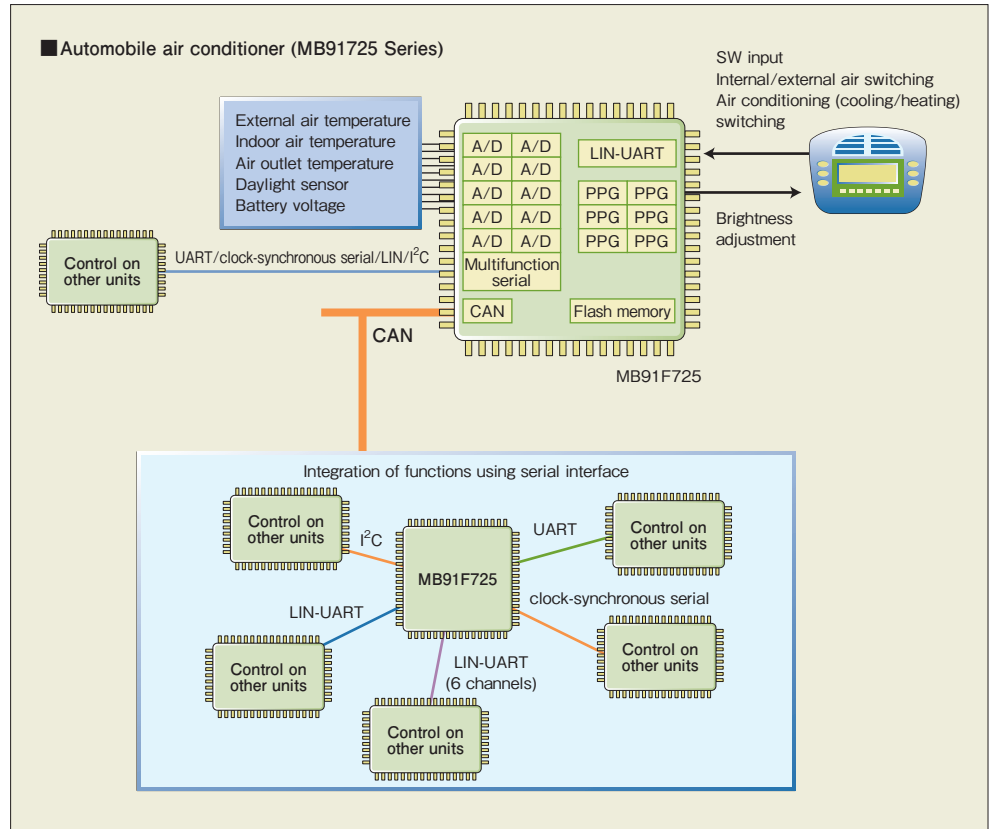


Figure 5 Image for the Development Environment

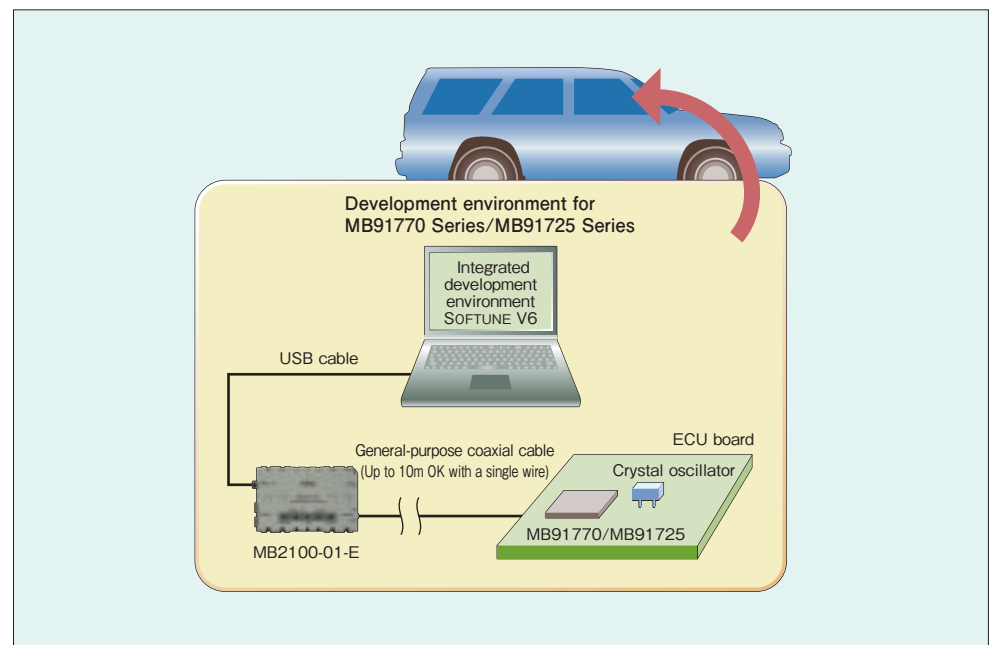


Table 1 Main Specifications of this Product

Series	MB91770 Series		MB91725 Series
Model	MB91F775R	MB91F777R	MB91725R
CPU core	FR81S Family 32-bit RISC CPU		
Pin number	144		
Maximum operating frequency	CPU: 64 MHz, peripheral: 32 MHz		
Power supply voltage	5.0V		
Flash memory capacity	512K + 64Kbytes	1024K + 128Kbytes	512K + 64Kbytes
Data Flash memory capacity	—		32Kbytes
RAM capacity	28 + 4Kbytes	40 + 8Kbytes	28K + 4Kbytes
External bus I/F	Address 22-bit, data 16-bit		
I/O port (max.)	109		112 (1 clock system) 110 (2 clock systems)
DMAC	8 channels		
16-bit base timer	2 channels (selection of PWM/PWC/PPG/reload timer possible)		
Free-run timer	2 channels		6 channels
Input capture	6 channels		12 channels
Output compare	4 channels		6 channels
16-bit reload timer	4 channels		4 channels
Updown counter	—		2 channels
PPG	11 channels		10 channels
External interrupt	16 channels		16 channels
A/D converter (10-bit)	32 channels		32 channels
D/A converter (8-bit)	—		1 channel
LIN-UART	6 channels		6 channels
Multifunction serial	2 channels		4 channels
	(Selection of UART/CSIO/LIN-UART/I ² C possible)		
LCD controller	32seg×4com (static driving 8seg×1com)		—
CAN	64msb×1 channel, 32msb×2 channels		64msb×1 channel 32msb×1 channel
Stepping motor controller	6 channels		—
Sound generator	2 channels		—
Software watchdog	Included		
Hardware watchdog	Included		
Real-time clock	Included		
Low-voltage detection reset	Included		
Package	LQFP-144 (0.5mm-pitch, 20mm square)		
Debugging interface	Built-in OCD (on-chip debugging unit)		

Table 2 Development Environment Configuration

Item		Description
Model		MB91F775, MB91F777, MB91F725
Development environment hardware	ICE	MB2100-01-E (SPEED-BOX)
	Evaluation board	Main board: BBF2004-MB Daughter board: BBF2004-FR144 SCL-CB Manufactured by Sunhayato
Development environment software	Integrated development environment	SOFTUNE V6 Professional Package (FR81 S support version)
Writer for Flash microcontroller	Serial writer	· Fujitsu MCU Programmer (writing via RS232C I/F) · Manufactured by Yokogawa Digital Computer
	Adapter for parallel writer	Manufactured by Flash Support Group