32-bit Microcontrollers with Built-in USB2.0 for Digital Home Appliance Printers, Audio, and FA
FR Family FR80S/T2 Series
MB91F662

Products with reinforced communication functions such as USB2.0 with FR80S CPU core with improved CPU performance and many built-in peripheral functions that allow flexible applications. Optimal for system control in various digital devices and USB products such as printers, audio, and FA products.

Overview

In recent years, as a result of diversifying market needs, large-scale applications such as digital home appliances have necessitated the introduction of product groups with many variations, timely product provision, and efficient development style.

To satisfy such market demands, we have added to the product lineup the "FR80S/T2 Series" with low power consumption microcontrollers and reinforced communication functions such as USB. This is the second release of products from this series, which integrates our latest CPU core "FR80S." Since the specifications of the peripheral functions of each product are identical, it is possible to divert the software assets and realize changes in peripheral functions flexibly. These products also enable simple application model development by our customers.

Lineup

To realize low power consumption processing, FUJITSU will be releasing the FR80S/T2 Series product "MB91F662" that has reinforced communication functions such as USB in addition to the high-speed A/D converter and rich peripheral functions of the FR80S/T1 Series. This product reduces the clock frequency of the CPU core compared to the high-speed operation version products of the FR80S/T1 Series, suppresses the power consumption, and adds a USB2.0 function. This provides optimal functions for consumer devices such as photo printers, label printers, and audio devices as well as devices that require high-level additional functions such as controllers for controlling FA devices and inverter controller devices.
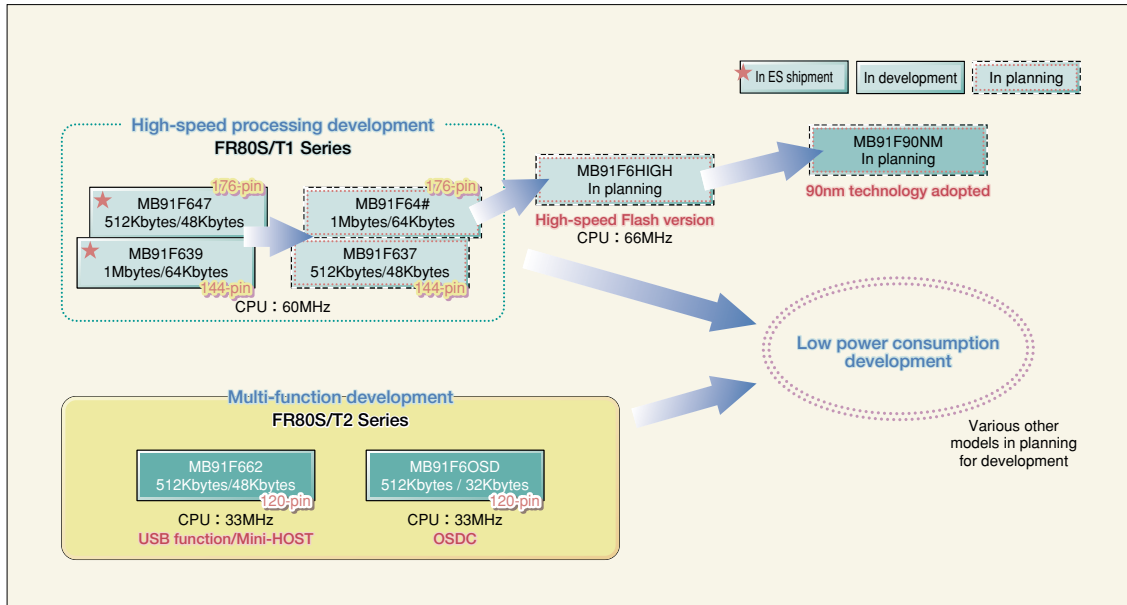
In the future, we will further increase the product lineup to include ultra-low power consumption versions to satisfy the diverse demands of our customers.

Fig.1 presents the development of the FR80S/T2 Series.

Product Features

■ Improved processing performance by integrating the new CPU core "FR80S"

This product integrates an FR80S core that offers a CPU processing performance improvement of 30% or more compared to the existing FR core as a result of improved pipeline processing and

Figure 1 Development of the FR80S/T2 Series

product area because it integrates the USB2.0 function and requires no external USB chip.

### ■ One built-in unit of the industry's top-level A/D converter

This product has 1 built-in unit of a high-speed converter capable of converting analog signals into digital signals at approximately $1.2\mu s^{*1}$. This allows the high-speed processing of data from various different sensors. It is also capable of A/D conversion with reduced CPU load owing to the 16 built-in FIFO steps for A/D conversion data storage.

so forth. In addition, frequency has been reduced compared to the FR80S/T1 Series to lower power consumption. Since FR80S inherits the instruction set of the existing FR, it allows diversion of our customers' conventional software assets.

Fig.2 presents a comparison of CPU performance between FR80S and FR60.

1: Approx. $1.2\mu s$: The minimum A/D conversion time varies depending on the operation clock for peripheral functions and the conditions of the external circuits.

■ Flexibility and rich peripheral functions

This product inherits rich peripheral functions, which are the main features of the FR80S/T Series and allow flexible function combinations.

Integrating numerous peripheral functions including 24 channels of A/D converter, 3 channels of D/A, 12 channels of serial, 8 channels of DMAC, 26 ports of 5V I/O, and a base timer unit, it allows flexible pin assignment changes. It is possible to customize our customer development platform in each system, enhance the freedom in board layout, and assist in measures against noise.

■ Offering both USB2.0 Mini-HOST and FUNCTION communication functions

By integrating the USB2.0 Mini-HOST function (simple control function) in addition to the high-speed communication functions adopting the USB2.0 FUNCTION, it provides USB control and slave functions to commercial products such as photo printers, label printers, audio devices, controllers for FA devices, and inverter control devices and enables a wide range of system device applications.

Furthermore, it will help in the reduction of cost and total

■ Total of 12 built-in serial interface channels—the most in the industry

This product has 12 built-in multi-function serial interface channels for controlling various devices for moving image and audio processing. The multi-function serial interface is capable of supporting SIO, UART, and I^2C communication modes by software switching. It also integrates 16bytes of FIFO for both

Figure 2 Comparison of CPU Performance between FR80S and FR60
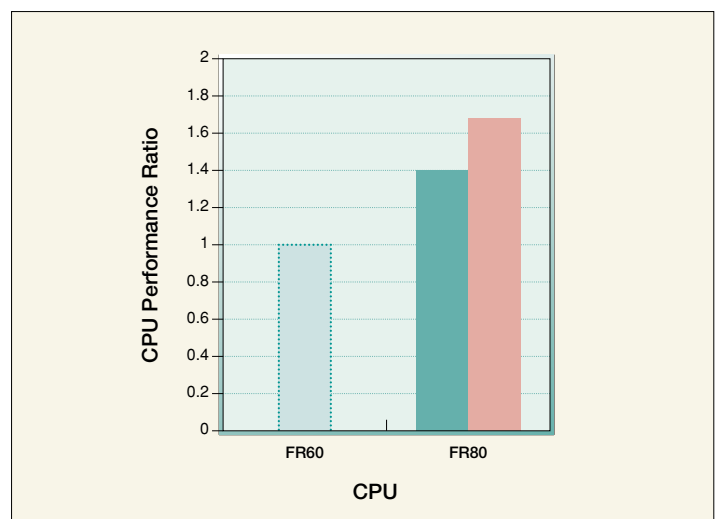
reception and transmission in 4 channels; some channels offer 5V withstand voltage terminals.

Table 1 presents a list of FR80S/T2 Series functions.

Development Environment

Table 2 presents the development environment configuration for the FR80S/T2 Series.

Table 1 List of FR80S/T2 Series Functions

Series: Type	FR80S/T2: Reinforced telecommunication functions
Model name: Pin number	MB91F662: 120-pin USB product
Technology/process	0.18μm/Lowleak
Operating frequency	33MHz
Power supply voltage	Single power supply 3.0 to 3.6V
ROM/RAM size	Flash memory 512Kbytes/48Kbytes
I/O port (Max.)	99 ports
External bus mode	Separate/multiplexed bus supported, 24 addresses and 4 chip selections
DMAC	8 channels
External division	32 channels (some 5V withstand voltage terminals)
A/D (10-bit)	24 channels (1 unit)
D/A (8-bit)	3 channels
16-bit base timer	16 channels (PWC/PPG/PWM/reload timer can be selected)
32-bit FRT/ICU/OCU	FRT 2 channels/ICU 8 channels/OCU 8 channels
8/16-bit U/D counter	4 channels
Reload timer	3 channels (including 1 channel for REALOS)
Clock counter (32KHz)	Included (2 clock systems)
Multi-function serial I/F	12 channels, UART/SIO/I^{2}C can be selected (4 channels with 16-byte FIFO, some 5V withstand voltage terminals)
USB FUNCTION with Mini-HOST	1 channel (FUNCTION, Mini-HOST: FS)
Slave I/F	Included
Package	LQFP-120 (0.5mm-pitch, 16mm×16mm)

Table 2 Development Environment Configuration for FR80S/T2 Series

Product		MB91F662
Development environment hardware	ICE	MB2198-01
	Adapter board	MB2198-700-E
	Evaluation chip	MB91V650 PB-ESE1
	Header board	MB2198-701-E: LQFP-120 (0.5mm pitch, 16mm×16mm)
	Evaluation board	BBF2004-MB main board manufactured by Sunhayato Corp. BBF2004-FR120SUS-NB daughter board manufactured by Sunhayato Corp.
Development environment software	Unified development environment	Softune V6 Professional Pack (SP365030118QAC)
Writer for Flash microcontrollers	Serial writer	FUJITSU USB Programmer (writing using MB2146-09A-E) FUJITSU MCU Programmer (writing using RS232C I/F) AF9101 by Flash Support Group, Inc.MegaNETIMPRESS series by Yokogawa Digital Computer Corporation
	Parallel writer	AF9709B or MB9708 (for writing 1 piece) AF9723 (for writing several pieces simultaneously)
	Parallel writer adapter	LQFP-120: In development

Application Examples

Fig.3 presents a product application example. USB is adopted for connection with a PC and a multi-channel serial interface and multi-unit A/D are integrated. By utilizing the features of the various detection functions, it can be utilized as the main control microcontroller not only in consumer devices such as photo printers, label printers, and audio devices but also in controllers for FA devices and inverter control devices. ✱

Figure 3 Application Example

Application in a printer

MB91660 Series

FR80S CPU core	FLASH 512Kbytes RAM 48Kbytes
16-bit base timer (RLT/PPG/PWM/PMC) 16 channels	10-bit A/D 24 channels
8-bit D/A 3 channels	External interrupt 32 channels
Multi-function serial interface (UART/SIO/I²C mode) 12 channels	I/O port
16-bit reload timer 3 channels	USB Mini-HOST USB FUNCTION
U/D counter 4 channels	OCU 8 channels 16-bit free-run timer 2 channels ICU 9 channels

Label feeding motor

Label cutter motor

Printing unit

LCD controller

Paper clogging detection Label cartridge attachment/ detachment detection

Key input

PC