

Media Processor FR-V Family SoC Mounting Peripheral Functions for Digital AV MB93461

The latest SoC from the high-performance media processor FR-V family. Optimal for digital AV devices such as TV accessories, high-function projectors, IP TV phones, mobile media players, and photo printers.

* SoC: System on a Chip

Background

In the digital AV device market, digital AV products mounting new functions are being introduced one after another during this era of rapid development in video/audio data compression technology, popularization of broadband internet, miniaturization/higher capacity in recording media, etc. “MB93461” is an upwardly compatible product of FR-V family FR400 Series (MB93403, MB93423, MB93405) that FUJITSU has provided to the market. It is a SoC in which the newly developed MMU-mounting FR-V processor core “FR450” and peripheral functions such as video, audio, communication, etc. are integrated on a single chip. Using a bridge chip that simplifies the extension of this product and peripheral interface functions, it realizes advanced function development, miniaturization, cost reduction, and power consumption reduction in digital AV device systems.

Product Features

This product is a SoC in which the FR-V processor core FR450, input/output functions for video/audio by the companion chip “MB93495A”, and the USB (Universal Serial Bus) host are integrated on a single chip. Through combination with middleware

optimized for FR-V, processing performance twofold that of the conventional SoC product MB93423, has been realized. For example, processing of 30 frames per second, which is twofold that of the conventional product, is possible for MPEG-4 recording of QVGA size (320×240 dots). In addition, MPEG-4 can be played while processing 30 frames per second in VGA size (640×480 dots).

The built-in FR450 core built in this product is a MMU-

Photo 1 External View (FBGA 400 pin: left, PBGA 420 pin: right)



mounted processor core with a maximum supported operation frequency of 400 MHz; this has been developed as an upwardly compatible product of the FR-V processor core FR405 by adopting two-way VLIW (Very Long Instruction Word) architecture to enable up to two simultaneous execution of integer operation and media-processing command. The mounting of MMU supports standard Linux as well, and asset utilization of Linux applications is easy.

Furthermore, by connecting bridge chip that can be connected directly to FR-V family processor, MB93441 (PCI I/F) or MB93443 (IDE/PC-Card I/F), expansion of peripheral interface functions such as LANs, USBs, microdrives, and PC cards can be realized simply.

This product is optimal for digital AV devices in which high-performance media processing is required such as TV accessories, high-function projectors, IP TV phones, mobile media players, set-top boxes, and photo printers.

Specifications

Table 1 presents the major specifications, **Fig.1** the block diagram for the FR450 core, and **Fig.2** the block diagram for this product.

Table 1 Main Specifications

Product name	MB93461
Architecture	2-way VLIW, MMU-mounted
Process technology	0.13 μ m process CMOS
Operation power supply	External: 3.3 V \pm 0.15 V, Internal: 1.4 V \pm 5%
Power consumption	500 mW (at maximum operation)
Cache	Command: 32 Kbytes (2-way), Data: 32 Kbytes (2-way)
Clock	400 MHz (Various low power consumption modes including sleep and clock gear can be controlled with software)
Maximum performance	800MIPS+3,200MOPS
MMU (memory management unit)	<ul style="list-style-type: none"> • Both a static address translator and a dynamic address translator are supported • Attributes of address space: Protection from user mode, Write protection, Cacheable/Non-Cacheable • Segment/page size: Address translation area: 16 Kbytes to 512 Mbytes • Count of AMR (Address Map Register) entries: 8 entries of instruction, 12 entries of data • TLB (Translation Look-aside Buffer) configuration: 64 entries\times2-way (set associative) • Dynamic address translation method: Software table walk
Built-in peripheral circuit (core part)	<ul style="list-style-type: none"> • SDRAM interface (32-bit width at maximum, 133 MHz operation) • DMAC (8 channels) • Local bus interface (32-bit width at maximum, 66 MHz operation) • Interrupt controller (8 external interrupts and 15 internal interrupts are supported.) • UART (2 channels) • Timer (3 channels, 16-bit timer/counter) • DSU (debug support unit) • GPIO (22-bit)
Built-in peripheral circuit (AV peripherals)	Video input/output, scaler, audio input/output, I ² C (2 channels), DMAC (8 channels), GPIO (32-bit), USB2.0 FS host, USB2.0 FS function, memory stick MS1.4, SD memory /IO
Package	FBGA 400 pin (15 mm \times 15 mm), PBGA 420 pin (27 mm \times 27 mm)

Development Environment

FUJITSU offers the following development environments to shorten the system development period for digital AV devices, etc. with this product:

■ Software Development Kit for VDK (SDK)

SDK is a development environment for applications based on the Linux software development environment for FR-V.

■ FR-V Design Kit (VDK)

This is the reference board for system evaluation and application development of this system.

■ Integrated Development Environment SOFTUNE™/REALOS™

SOFTUNE is an integrated development environment that integrates language tools such as a C/C++ compiler, assembler, and linkage kit and debuggers such as a simulator debugger, an emulator debugger, and a monitor debugger. It supports the overall process of program development, debugging, and creating data to be written in ROM.

Furthermore, REALOS is a real-time OS with μ ITRON specification that operates on FR-V. The combination of SOFTUNE/REALOS, the FR-V Design Kit (VDK), and an emulator

supporting FR-V allows the construction of an efficient development environment.

Open-source development environment

As a cross-software tool for OS and its development environment, uClinux2.4 and Linux2.4/GNU Pro for FR-V by Red Hat, Inc, can be used.

Emulators supporting FR-V

The following emulators support the FR-V family, including this product:

- FUJITSU ICE (MB2199-01, MB2199-10)
- ICE by Sophia Systems Co., Ltd.
- ICE by Yokogawa Digital Computer Corporation

Software Development Kit for VDK (SDK)

SDK is a development environment for applications that integrates the reference applications, sub applications, middlewares, and abstraction device drivers based on the Linux software development environment for FR-V.

Fig.3 presents the positioning of SDK in the FR-V development environment including MB93461.

Features

Provision of reference application

Three types of reference applications, AV Player, AV Recorder, and Audio Player, are provided. These reference applications are equipped with a power-saving control in addition to basic functions such as playing/recording of media files. It is possible to develop applications in a short period by customizing these reference applications.

Support for highly portable application development

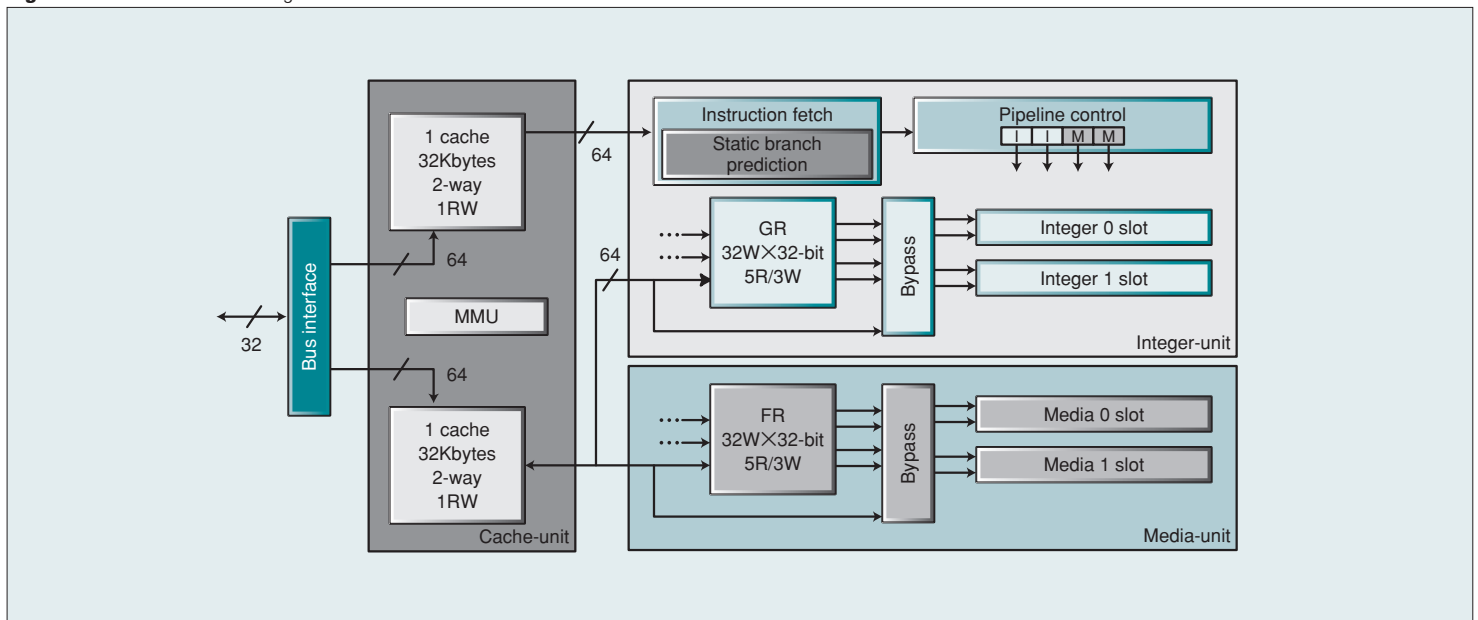
Reference applications have been prepared using the sub application, layer API and an abstraction device driver API included in the common API for SPD (Solution Package for Development)* these realize the development of highly portable applications.

**SPD: The development platform for application consists of software package, reference board, and Linux OS. At present, we offer SPDs for personal media players and IP TV phones.*

Rich media-processing library

A media-processing library optimized for FR-V is provided. The reference applications provided in Linux SDK for FR-V use these libraries, and evaluation is possible without newly programming.

Figure 1 FR450 Core Block Diagram



■ Uses

- It is possible to check the system performance, power consumption, etc. including access to each I/O mounted on the reference board VDK incorporating FR-V, etc.
- Since SDK is comprised of software modules with which recomposition is easy, middleware evaluation is possible by recomposing the video codec, communication protocol, etc.
- Various drivers required the operation of the FR-V mounted reference board VDK and its expansion boards are included. As such, it can be utilized to develop drivers for customer's board.

■ Supported hardware

To use SDK, a FR-V-mounted reference board VDK is necessary.

■ Reference applications supported by Linux SDK for FR-V

It is possible to check the basic performance of the FR-V processor using reference applications. Their major functions are as follows:

AV player

- Playing function (playing start/stop/pause/fast forward/rewind)
- MP4/ASF format files can be played
- Supports MPEG-4 SP video decoder
- Addresses MPEG-4 SP video performance of VGA 30fps
- Supports MPEG-4/2AAC/G.726 (ADPCM) audio decoder

AV recorder

- Recording function (recording start/recording stop/preview)
- Recording in MP4/ASF format possible
- Supports the MPEG-4 SP video encoder
- Addresses the MPEG-4 SP video performance of QVGA 30fps
- Supports the MPEG-4/2AAC/G.726 (ADPCM) audio encoder

Audio player

- Playing function (playing start/stop/pause/fast forward/rewind)
- Supports MPEG-4/2AAC LC, MP3, WMA, and G.726 (ADPCM) sound encoding methods
- Tag information acquisition

Power-supply control daemon

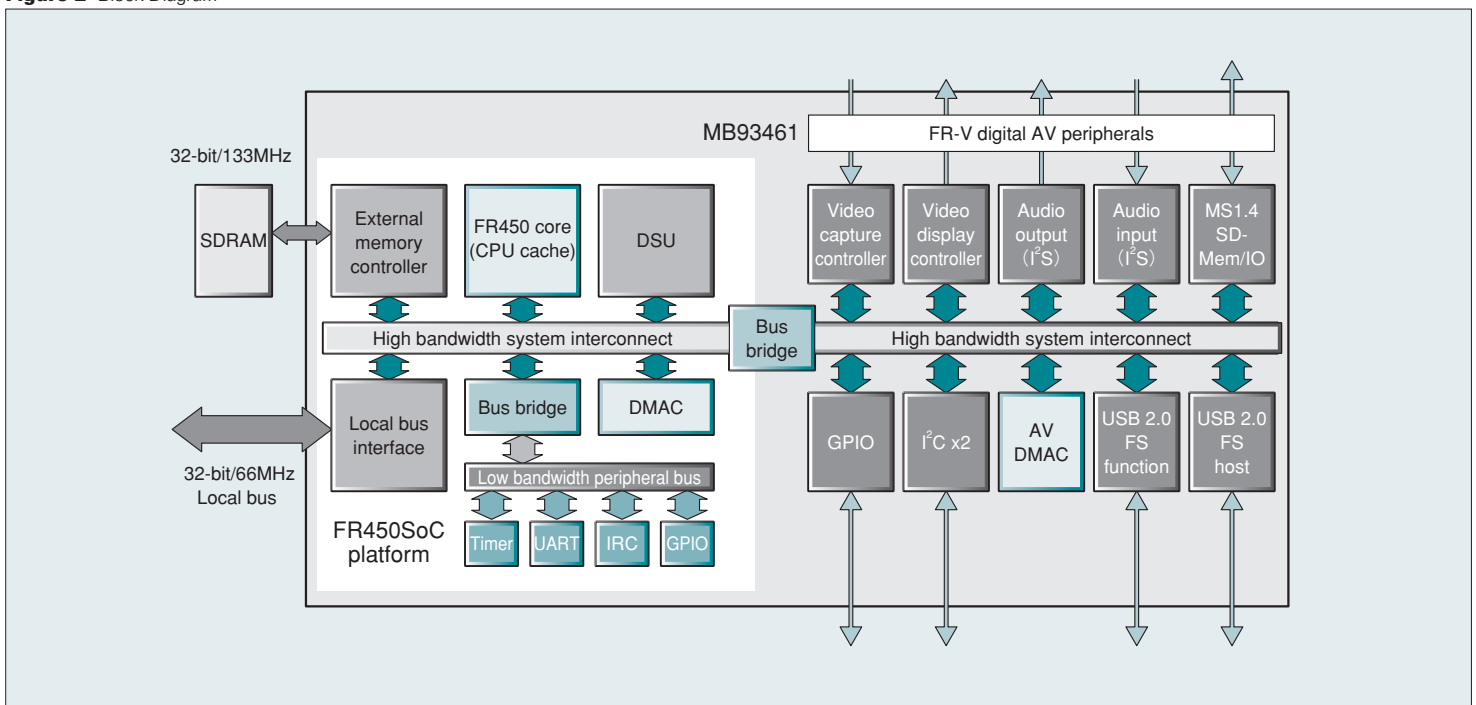
- Controls power saving for the above three applications
- Controls the power-saving mode of FR400/FR450 Series processors

■ Middleware products offered by Linux SDK for FR-V

At present, the following products are offered as middleware that composes of SDK:

- Media Play Master Library for FR400 (uClinux) V01
- Media Record Master Library for FR400 (uClinux) V01
- MPEG-4/2AAC LC Decoder Library for FR400 (uClinux) V01
- MPEG-4/2AAC LC Encoder Library for FR400 (uClinux) V01

Figure 2 Block Diagram



- MPEG-4 Visual Simple Profile Decoder Library for FR400 (uClinux) V01
- MPEG-4 Visual Simple Profile Encoder Library for FR400 (uClinux) V01
- G.726 Library for FR400 (uClinux) V01
- MP4 File Format Library for FR400 (uClinux) V01
- ASF File Format Library for FR400 (uClinux) V01
- MP3 Decoder Library for FR400 (uClinux) V01
- 2D Graphics Library for FR400 (uClinux) V01
- JPEG Baseline Process Encoder/Decoder Library for FR400 (uClinux) V04
- Windows Media Audio Decoder Library for FR400 (uClinux) V01

■ Device drivers offered by Linux SDK for FR-V

The abstraction device drivers that comprise SDK are provided as a library. The following device drivers are included in the library:

- VDC
- VCC
- I²S (in/out)

In addition, the following drivers are provided for the bus bridge board:

- PCI driver
- PCMCIA driver
- IDE driver

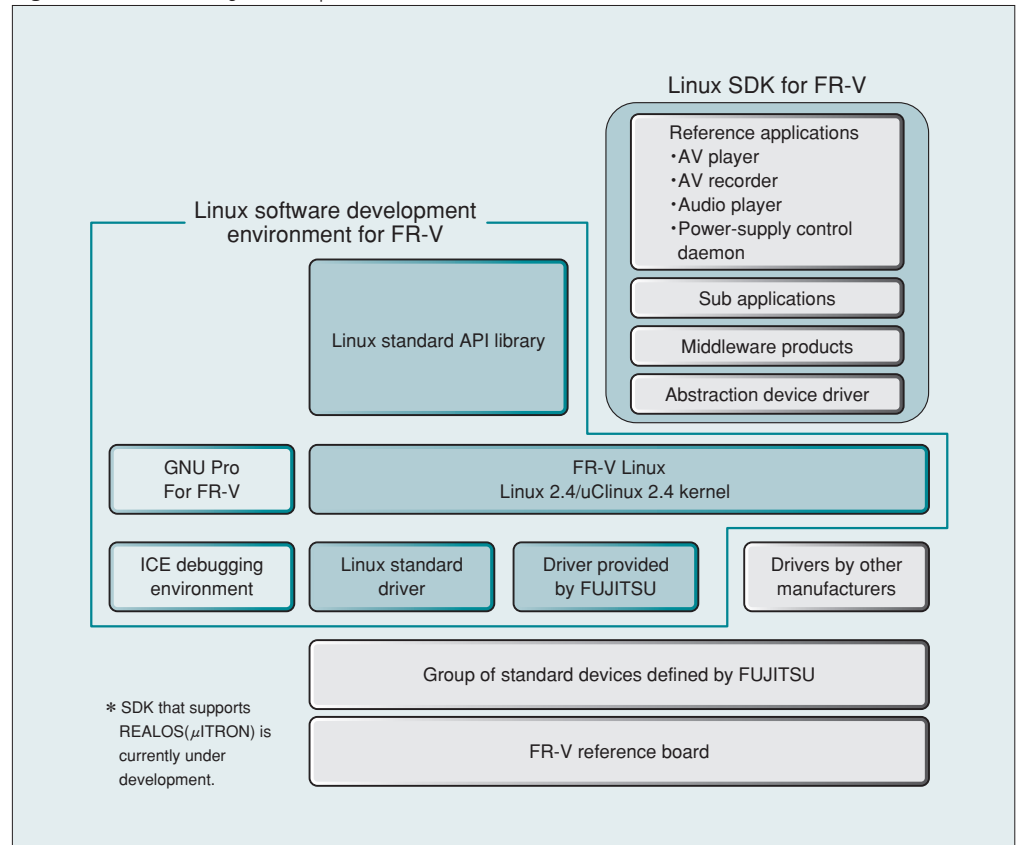
FR-V design kit (VDK)

We offer the VDK FR450 Series as a reference board for system evaluation and application development with this product. VDK is composed of a CPU subboard mounting this product and a SoC baseboard with peripheral circuits and an external interface.

■ Features

- Provides a set of hardware environments for system evaluation and development of this product.

Figure 3 SDK Positioning in Development Environment



- It can be used with a simple setup.
- It can be used from initial performance/function evaluation to as a full-scale reference board for application development.

■ Supported software

- Software Development Kit for VDK (SDK)
- Integrated development environment SOFTUNE/REALOS
- Open source environment (GNU Pro, uClinux 2.4/Linux 2.4)

■ Supported hardware

- Emulators supporting FR-V
- Option board: Bus bridge board mounting “MB93441/MB93443”

Table 2 presents the main specifications of VDK. **Fig.4** shows the external interface of VDK, which can be supported by SDK. **Photos 2** and **3** show the CPU subboard mounting this product and the SoC baseboard, and the bus bridge board.

Future Development

FUJITSU plans to pursue performance improvement by

multi-core development and to substantiate the lineup of FR-V family products including a multi-codec SoC for digital AV devices capable of supporting D1/VGA 30fps full-duplex (encoding+decoding) and SoC for amusement/imaging devices that require highly advanced image-processing capacity.

We also plan to expand our middleware including H.264/AVC, MPEG2-ML, DivX, and WMV (Windows Media Video). In addition, we will strongly support the short-term system development of digital AV devices, etc. by substantiating the SDK in which basic functions are grouped for each application, reference board mounting the next-generation FR-V processor (VDK), and providing technical support. *

NOTES

- * SOFTUNE and REALOS are trademarks of FUJITSU LIMITED.
- * uClinux is a trademark of Arcturus Networks Inc.
- * Linux is a registered trademark or trademark of Linus Torvalds in the U.S. and other nations.
- * Other company names and product names are trademarks or registered trademarks of each corresponding company.

* I²C Licensing:

The Royal Philips Electronics I²C patent is licensed when the customer uses it within the I²C system conforming to the I²C standard specification provided by Royal Philips Electronics.

Table 2 Main Specifications of VDK

Board	Item	Specification outline	
MB93461 CPU board (SoC type) Model: MB93091-SOC461A-P	CPU	MB93461 (400MHz)	
	RS232C	High-speed UART: Built-in MB93461/2 channels (D-sub 9 pins)	
	Ethernet	100BASE-TX 1 channel	
	Power supply	5V/6A, 3.3V/6A	
	Connector	Expansion connector×2	
	Memory	ROM (Flash)	4 Mbytes (16-bit×2 Mbytes×2 pcs)
		ROM (Flash)	16 Mbytes (16-bit×8 Mbytes×2 pcs)
		SDRAM	PC133SDRAM: 16-bit×256 M-bit×4 pcs
	Video output S-video output	NTSC/PAL digital video encoder RCA connector×1, S-video connector×1	
	Video input S-video input	NTSC/PAL digital video decoder RCA connector×1, S-video connector×1	
	Analog RGB output	Video DAC, Analog RGB connector×1	
	Audio input/output	Audio codec 32/44.1/48 kHz sampling rate RCA connector: Line out×2 (L, R), Line in×2 (L, R)	
	D-connector output	D-connector×1	
	USB	Series A receptacle×1, Series B receptacle×1	
	MS/SD Card I/F	MS/SD card dual-purpose socket×1	
	SDPIF	SPDIF connector×1	
	GPIO	GPIO connector 8 channels	
RTC	Real-time clock mounted		
Bus bridge board Model: MB93092-EXB1	Bridge chip	MB93441 (PCI I/F bus bridge)	
		MB93443 (IDE/PC card I/F bus bridge)	
	Power supply	3.3V supply from CPU board possible	
	PCI	PCI host ver. 2.2 bus bridge: 32-bit/66 MHz	
	PC card I/F	16-bit PC card I/F (conforms to PCMCIA2.1/JEIDA4.2, card bus not supported)	
	IDE	IDE I/F ultra DMA 66 MHz	
Connector	PC card socket×1 (3.3 V/5 V) PCI connector× 2 (only for 3.3 V) IDE connector× 1		

Photo 2 CPU subboard and SoC baseboard



Photo 3 Bus bridge board

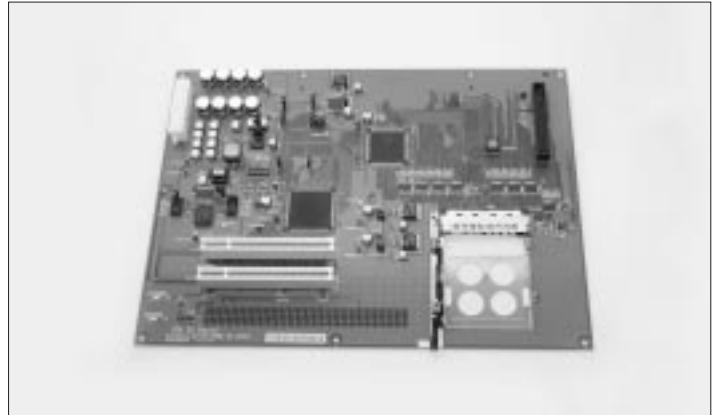


Figure 4 VDK interfaces that can be supported by SDK

