

8-bit Proprietary Microcontrollers

CMOS

F²MC-8FX MB95130H Series

MB95F136HW/F136TW/F136KW/FV100B-103

■ DESCRIPTION

The MB95130H series is general-purpose, single-chip microcontrollers. In addition to a compact instruction set, the microcontrollers contain a peripheral functions for small package.

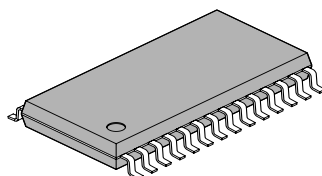
■ FEATURES

- F²MC-8FX CPU core
 - Instruction set that is optimum to the controllers
 - Multiplication and division instructions
 - 16-bit arithmetic operation
 - Bit test branch instruction
 - Bit manipulation instructions etc.
- Clock
 - Main clock
 - Main PLL clock
 - Subclock (for dual clock product)
 - Sub PLL clock (for dual clock product)

(Continued)

■ PACKAGES

28-pin plastic SOP



(FPT-28P-M17)

MB95130H Series

(Continued)

- Timer
 - 8/16-bit compound timer × 1 channels
 - 8/16-bit PPG × 1 channels
 - 16-bit PPG
 - Timebase timer
 - Watch prescaler (for dual clock product)
- LIN-UART
 - Full duplex double buffer
 - Clock asynchronous or synchronous serial transfer capable
- UART/SIO
 - Clock asynchronous or synchronous serial transfer capable
- External interrupt
 - Interrupt by edge detection (rising, falling, or both edges can be selected)
 - Can be used to recover from low-power consumption modes.
- 10-bit A/D converter
 - 10-bit resolution
- Low-power consumption (standby mode)
 - Stop mode
 - Sleep mode
 - Watch mode (for dual clock product)
 - Timebase timer mode
- I/O port: Max 20
 - General-purpose I/O ports (CMOS) : 20 ports

■ PRODUCT LINEUP

Part number Parameter		MB95F136HW MB95F136TW MB95F136KW	MB95FV100B-103
Type		FLASH product	EVA product
ROM capacity		32 Kbytes	
RAM capacity		1 Kbytes	3.75 Kbytes
Reset output		No	
Option		Dual clock	Selectable single/dual clock*1
CPU functions		Number of basic instructions : 136 Instruction bit length : 8 bits Instruction length : 1 to 3 bytes Data bit length : 1, 8, and 16 bits Minimum instruction execution time : 0.1 μ s (at internal 10 MHz) Interrupt processing time : 0.9 μ s (at internal 10 MHz)	
Peripheral functions	Ports (Max 20 ports)	General-purpose I/O port (CMOS) : 20 ports	
	Timebase timer	Interrupt cycle : 0.5 ms, 2.05 ms, 8.2 ms, 32.8 ms (at main oscillation clock 4 MHz)	
	Watchdog timer	Reset generated cycle At main oscillation clock 10 MHz : Minimum 105 ms At sub oscillation clock 32.768 kHz (for dual clock product) : Minimum 250 ms	
	Wild register	Capable of replacing 3 bytes of data	
	UART/SIO	Data transfer capable in UART/SIO Full duplex double buffer, variable data length (5/6/7/8-bit), built-in baud rate generator Transfer rate : 2400 bps to 125000 bps (at machine clock 10 MHz) NRZ type transfer format, error detected function LSB-first or MSB-first can be selected. Clock synchronous (SIO) or clock asynchronous (UART) data transfer capable	
	LIN-UART	Dedicated reload timer allowing a wide range of communication speeds to be set. Capable of data transfer synchronous or asynchronous to clock signal. LIN functions available as the LIN master or LIN slave.	
	A/D converter (8 channels)	8-bit or 10-bit resolution can be selected.	
8/16-bit compound timer (1 channels)		Each channel of the timer can be used as "8-bit timer $\times$ 2 channels" or "16-bit timer $\times$ 1 channel". Built-in timer function, PWC function, PWM function, capture function and square waveform output Count clock : 7 internal clocks and external clock can be selected.	

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MB95130H Series

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Part number Parameter		MB95F136HW MB95F136TW MB95F136KW	MB95FV100B-103
Peripheral functions	16-bit PPG	PWM mode or one-shot mode can be selected. Counter operating clock : Eight selectable clock sources Support for external trigger start	
	8/16-bit PPG (2 channels)	Each channel of the PPG can be used as "8-bit PPG × 2 channels" or "16-bit PPG × 1 channel". Counter operating clock : Eight selectable clock sources	
	Watch counter (for dual clock product)	Count clock : Four selectable clock sources (125ms, 250ms, 500ms, or 1s) Counter value can be set from 0 to 63. (Capable of counting for 1 minute)	
	Watch prescaler (for dual clock product)	Four selectable interval times (125 ms, 250 ms, 500 ms, or 1 s)	
	External interrupt (8 channels)	Interrupt by edge detection (rising, falling, or both edges can be selected) Can be used to recover from standby modes.	
Standby mode		Sleep, stop, watch, and timebase timer	

*1 : Change by the switch on MCU board.

*2 : Specify clock mode when ordering MASK ROM.

■ PACKAGES AND CORRESPONDING PRODUCTS

Part number Package	MB95F136HW MB95F136TW MB95F136KW	MB95FV100B-103
FPT-28P-M17	○	×
BGA-224P-M08	×	○

○ : Available
× : Unavailable

MB95130H Series

■ DIFFERENCES AMONG PRODUCTS AND NOTES ON SELECTING PRODUCTS

• Notes on Using EVA Products

The EVA product has not only the functions of the MB95130H series but also those of other products to support software development for multiple series and products of F²MC-8FX family. The I/O addresses for peripheral resources not used by the MB95130H series are therefore access-barred. Read/write access to these access-barred addresses may cause peripheral resources supposed to be unused to operate, resulting in unexpected malfunctions of hardware or software.

Take particular care not to use word, long word, or similar access to read or write odd numbered bytes in the prohibited areas.

Note that the values read from barred addresses are different between the EVA product and the FLASH or MASK product. Therefore, the data must not be used for software processing.

The EVA product does not support the functions of some bits in single-byte registers. Read/write access to these bits does not cause hardware malfunctions. Since the EVA, FLASH, and MASK products are designed to behave completely the same way in terms of hardware and software, you do not have to pay special attention to specific products.

• Difference of Memory Spaces

If the amount of memory on the EVA product is different from that of the FLASH or MASK product, carefully check the difference in the amount of memory from the product to be actually used when developing software.

• Current Consumption

- The current consumption of FLASH product is typically greater than for MASK product.
- For details of current consumption, refer to "■ ELECTRICAL CHARACTERISTICS".

• Package

For details of information on each package, see "■ PACKAGE DIMENSIONS".

• Operating voltage

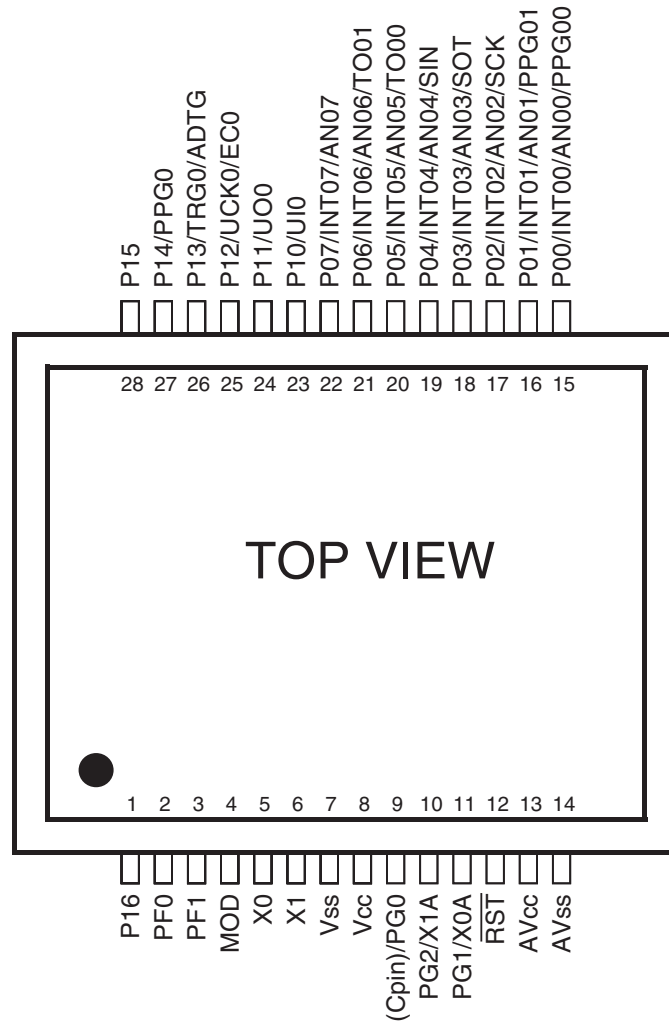
The operating voltage are different among the EVA, FLASH and MASK products.

For details of operating voltage, refer to "■ ELECTRICAL CHARACTERISTICS"

• Difference between $\overline{\text{RST}}$ and MOD pins

The $\overline{\text{RST}}$ and MOD pins are hysteresis inputs on the MASK product. A pull-down resistor is provided for the MOD pin of the MASK product.

■ PIN ASSIGNMENTS



(FPT-28P-M17)

MB95130H Series

■ PIN DESCRIPTION

Pin no.	Pin name	Circuit type	Description
1	P16	H	General-purpose I/O port.
2	PF0/HC10	K	General-purpose I/O port. Large current port.
3	PF1/HC11		
4	MOD	B	Operation mode specification pin.
5	X0	A	Crystal oscillation pin.
6	X1		
7	Vss	-	Power supply (GND) pin.
8	Vcc	-	Power supply pin.
9	PG0/(Cpin)	H	General-purpose I/O port (at 3 V). Capacitance connection pin (at 5 V).
10	X1A/PG2	A/H	Crystal oscillation pin (32KHz). Single clock product is general-purpose port.
11	X0A/PG1		
12	$\overline{\text{RST}}$	B'	Reset pin.
13	AVcc	-	Power supply pin for A/D.
14	AVss	-	Power supply (GND) pin for A/D.
15	P00/INT00/ AN00/PPG00	D	General-purpose I/O port. These pins are also used for external interrupt input (INT00), A/D analog input (AN00) and 8/16-bit PPG ch0 output (PPG00).
16	P01/INT01/ AN01/PPG01		General-purpose I/O port. These pins are also used for external interrupt input (INT01), A/D analog input (AN01) and 8/16-bit PPG ch0 output (PPG01).
17	P02/INT02/ AN02/SCK		General-purpose I/O port. These pins are also used for external interrupt input (INT02), A/D analog input (AN02) and LIN UART clock I/O(SCK).
18	P03/INT03/ AN03/SOT		General-purpose I/O port. These pins are also used for external interrupt input (INT03), A/D analog input (AN03) and LIN UART data output (SOT).
19	P04/INT04/ AN04/SIN	E	General-purpose I/O port. These pins are also used for external interrupt input (INT04), A/D analog input (AN04) and LIN UART data input (SIN).
20	P05/INT05/ AN05/T000	D	General-purpose I/O port. These pins are also used for external interrupt input (INT05, INT06), A/D analog input (AN05, AN06) and 8/16-bit compound timer ch0 output (TO00, TO01).
21	P06/INT06/ AN06/T001		
22	P07/INT07/ AN07		

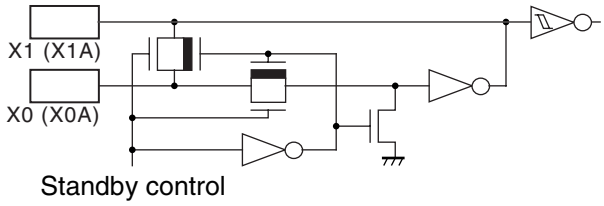
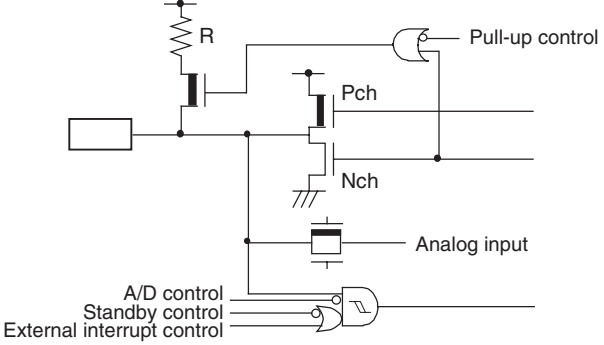
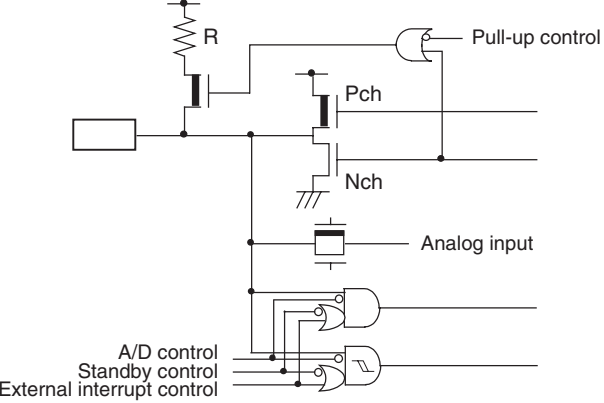
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Pin no.	Pin name	Circuit type	Description
23	P10/U10	G	General-purpose I/O port. These pins are also used for UART/SIO ch0 data input.
24	P11/U00	H	General-purpose I/O port. These pins are also used for UART/SIO ch0 data output.
25	P12/UCK0/ EC0		General-purpose I/O port. These pins are also used for UART/SIO ch0 clock I/O (UCK0) and 8/16-bit compound timer ch0 clock input (EC0).
26	P13/TRG0/ ADTG		General-purpose I/O port. These pins are also used for 16-bit PPG ch0 trigger input (TRG0) and A/D trigger input (ADTG).
27	P14/PPG0		General-purpose I/O port. These pins are also used for 16-bit PPG ch0 output.
28	P15		General-purpose I/O port.

MB95130H Series

I/O CIRCUIT TYPE

Type	Circuit	Remarks
A		· Oscillation circuit · Main-clock Feedback resistance value : approx. 1 MΩ · Sub-clock Feedback resistance : 10 MΩ (MB95FV100B:without dumping resistance)
B		· Only for input · Hysteresis input only for MASK product · With pull-down resistor only for MASK product
B'		· Hysteresis input only for MASK product
D		· CMOS output · Hysteresis input · Analog input · Pull-up control is available.
E		· CMOS output · CMOS input · Hysteresis input · Analog input · Pull-up control is available.

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Type	Circuit	Remarks
G		• CMOS output • CMOS input • Hysteresis input • With pull-up control
H		• CMOS output • Hysteresis input • With pull-up control
K		• CMOS output • Hysteresis input

MB95130H Series

■ HANDLING DEVICES

- Preventing Latchup

Care must be taken to ensure that maximum voltage ratings are not exceeded when it is used.

Latchup may occur on CMOS ICs if voltage higher than V_{CC} or lower than V_{SS} is applied to input and output pins other than medium- and high-withstand voltage pins or if higher than the rating voltage is applied between V_{CC} and V_{SS} .

When latchup occurs, power supply current increases rapidly and might thermally damage elements.

Also, take care to prevent the analog power supply voltage (AV_{CC}) and analog input voltage from exceeding the digital power supply voltage (V_{CC}) when the analog system power supply is turned on or off.

- Stable Supply Voltage

Supply voltage should be stabilized.

A sudden change in power-supply voltage may cause a malfunction even within the guaranteed operating range of the V_{CC} power-supply voltage.

For stabilization, in principle, keep the variation in V_{CC} ripple (p-p value) in a commercial frequency range (50 Hz to 60 Hz) not to exceed 10% of the V_{CC} value and suppress the voltage variation so that the transient variation rate does not exceed 0.1 V/ms during a momentary change such as when the power supply is switched.

- Treatment of Unused Input Pin

An unused input pin may cause a malfunction if it is left open. It should be connected to a pull-up or pull-down resistor.

- Treatment of Power Supply Pins on A/D Converter

Connect to be $AV_{CC} = V_{CC}$ and $AV_{SS} = V_{SS}$ even if the A/D converter is not in use.

- Precautions for Use of External Clock

Even when an external clock is used, oscillation stabilization wait time is required for power-on reset, wake-up from subclock mode or stop mode.

- Precaution against Noise to the External Reset Pin ($\overline{RST}$)

An input of a reset pulse below the specified level to the external reset pin ($\overline{RST}$) may cause malfunctions. Be sure not to allow an input of a reset pulse below the specified level to the external reset pin ($\overline{RST}$).

■ PROGRAMMING AND ERASE FLASH MEMORY ON THE MB95F136H

1. Flash Memory

The flash memory is located between 8000_H and FFFF_H in the CPU memory map and incorporates a flash memory interface circuit that allows read access and program access from the CPU to be performed in the same way as mask ROM. Programming and erasing flash memory is also performed via the flash memory interface circuit by executing instructions in the CPU. This enables the flash memory to be updated in place under the control of the CPU, providing an efficient method of updating program and data.

2. Flash Memory Features

- 32 K byte x 8-bit configuration
- Automatic programming algorithm (Embedded algorithm*)
- Data polling and toggle bit for detection of program/erase completion
- Detection of program/erase completion via CPU interrupt
- Compatible with JEDEC-standard commands
- No. of program / erase cycles : Minimum 10,000

* : Embedded Algorithm is a trademark of Advanced Micro Devices.

3. Procedure for Programming and Erasing Flash Memory

Programming and reading flash memory cannot be performed at the same time. Accordingly, to program or erase flash memory, the program must first be copied from flash memory to RAM so that programming can be performed without program access from flash memory.

4. Flash Memory Status Register (FMS)

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
Address			RDYIRQ	RDY	Reserved	IRQEN	WRE	Reserved	Initial value
072 _H	-	-							000X0000B
	-	-	R/W	R	R	R/W	R/W	R	

5. Memory Space

The memory space for the CPU access and for the parallel flash programmer access is listed below.

Memory size	CPU address	Programmer address
32 K bytes	FFFF _H to 8000 _H	1FFFF _H to 18000 _H

MB95130H Series

6. Flash Programmer Adaptor and Recommended Flash Programmers

Package	Applicable adapter model	Parallel programmers
FPT-28P-M17	TEF110-95F136HSPF	AF9708 (Ver 02.35G or more) AF9709/B (Ver 02.35G or more) AF9723+AF9834 (Ver 02.08E or more)

Notes: • For information on applicable adapter models and parallel programmers, contact the following:
Flash Support Group, Inc. TEL: (81)53-428-8380

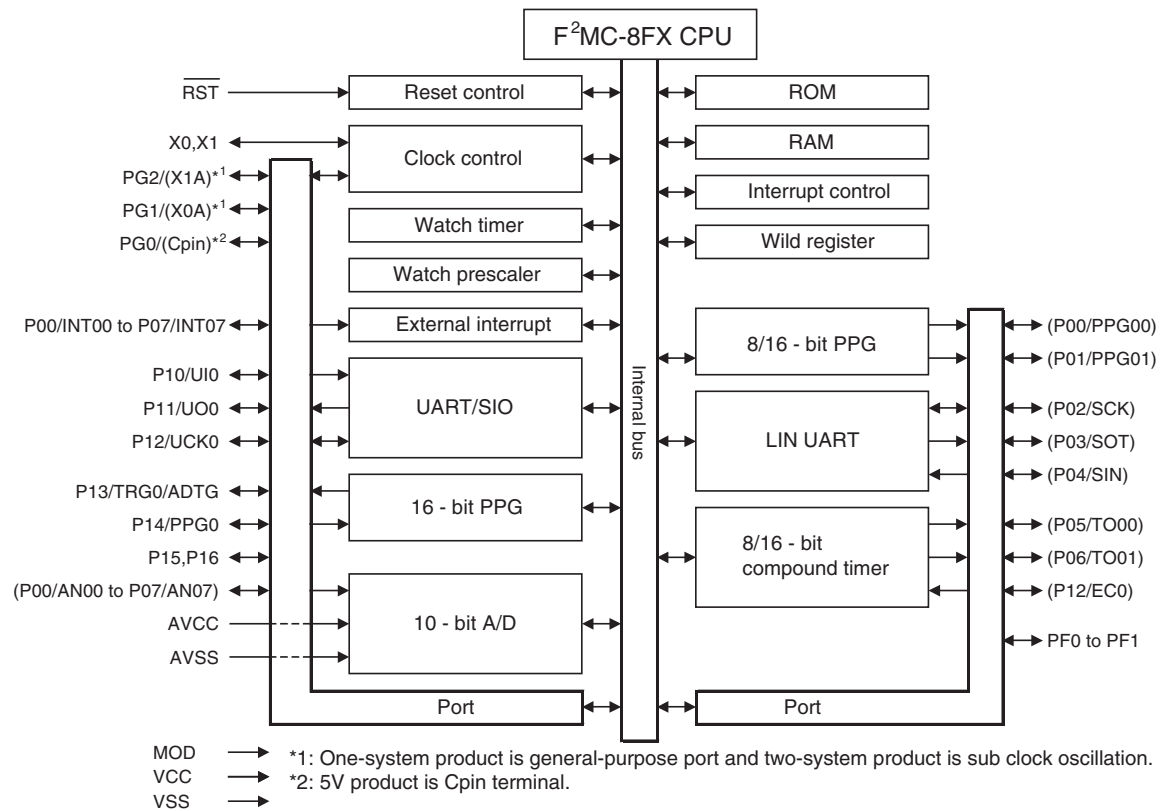
7. Flash Content Protection

Flash content can be read using parallel / serial programmer if the flash content protection mechanism is not activated.

One predefined area of the flash (8000_H) is assigned to be used for preventing the read access of flash content. If the protection code "01_H" is written in this address (8000_H), the flash content cannot be read by any parallel / serial programmer.

Note : The program written into the flash cannot be verified once the flash protection code is written ("01_H" in 8000_H). It is advised to write the flash protection code at last.

■ BLOCK DIAGRAM



* : Single-system product is general-purpose port, and dual-system product is subclock oscillation.

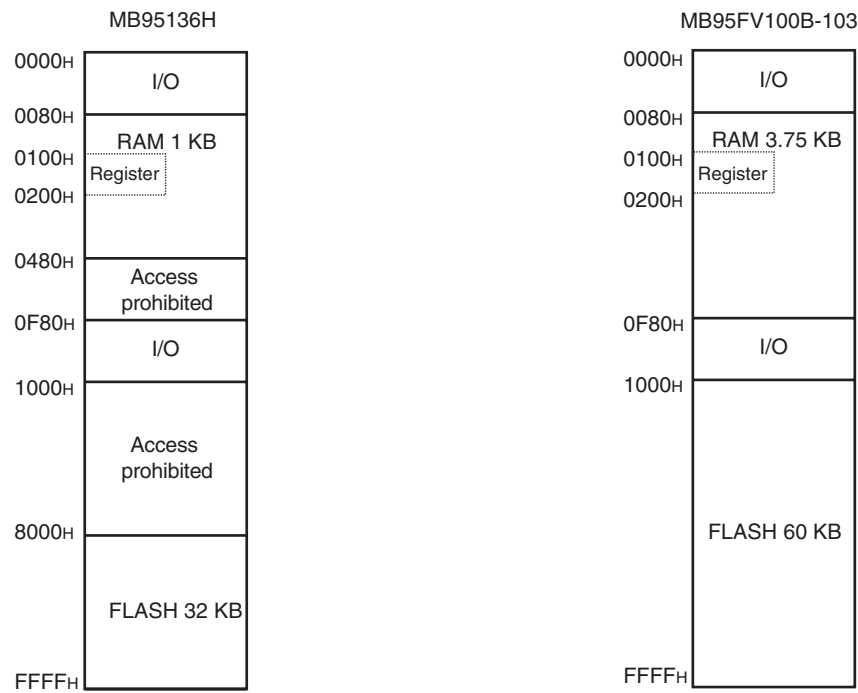
MB95130H Series

■ CPU CORE

1. Memory space

Memory space of the MB95130H series is 64 Kbytes and consists of I/O area, data area, and program area. The memory space includes special-purpose areas such as the general-purpose registers and vector table. Memory map of the MB95130H series shown in below.

· Memory Map



2. Register

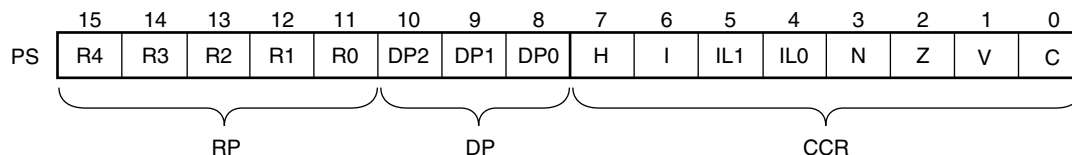
The MB95130H series has two types of registers; dedicated registers in the CPU and general-purpose registers in the memory. The dedicated registers are as follows:

- Program counter (PC) : A 16-bit register to indicate locations where instructions are stored.
- Accumulator (A) : A 16-bit register for temporary storage of arithmetic operations. In the case of an 8-bit data processing instruction, the lower one byte is used.
- Temporary accumulator (T) : A 16-bit register which performs arithmetic operations with the accumulator. In the case of an 8-bit data processing instruction, the lower one byte is used.
- Index register (IX) : A 16-bit register for index modification
- Extra pointer (EP) : A 16-bit pointer to point to a memory address.
- Stack pointer (SP) : A 16-bit register to indicate a stack area.
- Program status (PS) : A 16-bit register for storing a register bank pointer, a direct bank pointer, and a condition code register

16-bit		Initial Value
PC	: Program counter	FFFD _H
A	: Accumulator	0000 _H
T	: Temporary accumulator	0000 _H
IX	: Index register	0000 _H
EP	: Extra pointer	0000 _H
SP	: Stack pointer	0000 _H
PS	: Program status	0030 _H

The PS can further be divided into higher 8 bits for use as a register bank pointer (RP) and a direct bank pointer (DP) and the lower 8 bits for use as a condition code register (CCR). (See the diagram below.)

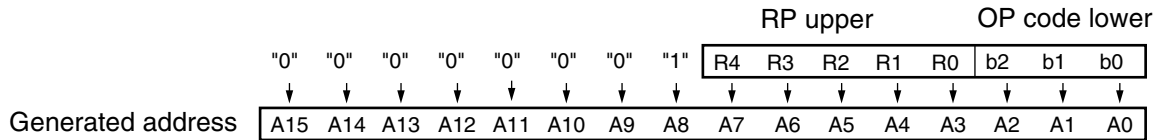
· Structure of the program status



MB95130H Series

The RP indicates the address of the register bank currently being used. The relationship between the content of RP and the real address conforms to the conversion rule illustrated below:

• Rule for Conversion of Actual Addresses in the General-purpose Register Area



The DP specifies the area for mapping instructions (16 different instructions such as MOV A, dir) using direct addresses to 0080_H to 00FF_H.

Direct bank pointer (DP2 to DP0)	Specified address area	Mapping area
Don't care	0000 _H to 007F _H	0000 _H to 007F _H (without mapping)
000 _B (initial value)	0080 _H to 00FF _H	0080 _H to 00FF _H (without mapping)
001 _B		0100 _H to 017F _H
010 _B		0180 _H to 01FF _H
011 _B		0200 _H to 027F _H
100 _B		0280 _H to 02FF _H
101 _B		0300 _H to 037F _H
110 _B		0380 _H to 03FF _H
111 _B		0400 _H to 047F _H

The CCR consists of the bits indicating arithmetic operation results or transfer data contents and the bits that control CPU operations at interrupt.

- H flag : Set to "1" when a carry or a borrow from bit 3 to bit 4 occurs as a result of an arithmetic operation. Cleared to "0" otherwise. This flag is for decimal adjustment instructions.
- I flag : Interrupt is enabled when this flag is set to "1". Interrupt is disabled when this flag is set to "0". The flag is set to "0" when reset.
- IL1, IL0 : Indicates the level of the interrupt currently enabled. Processes an interrupt only if its request level is higher than the value indicated by this bit.

IL1	IL0	Interrupt level	Priority
0	0	0	High ↑↓ Low = no interruption
0	1	1	
1	0	2	
1	1	3	

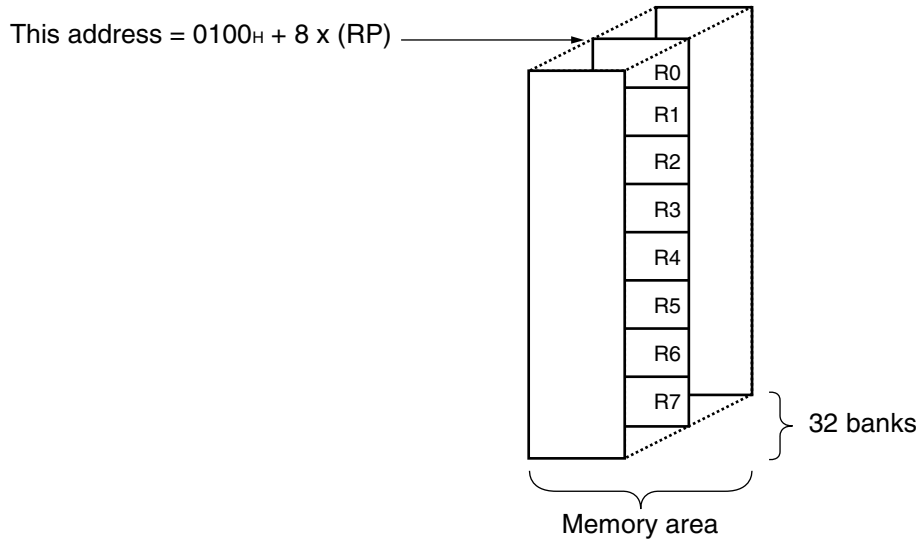
- N flag : Set to "1" if the MSB is set to "1" as the result of an arithmetic operation. Cleared to "0" when the bit is set to "0".
- Z flag : Set to "1" when an arithmetic operation results in 0. Cleared to "0" otherwise.
- V flag : Set to "1" if the complement on 2 overflows as a result of an arithmetic operation. Cleared to "0" otherwise.
- C flag : Set to "1" when a carry or a borrow from bit 7 occurs as a result of an arithmetic operation. Cleared to "0" otherwise. Set to the shift-out value in the case of a shift instruction.

The following general-purpose registers are provided:

General-purpose registers: 8-bit data storage registers

The general-purpose registers are 8 bits and located in the register banks on the memory. One bank contains eight registers. Up to a total of 32 banks can be used on the MB95130H series. The bank currently in use is indicated by the register bank pointer (RP).

- Register Bank Configuration



MB95130H Series

■ I/O MAP

Address	Register abbreviation	Register name	R/W	Initial value
0000 _H	PDR0	Port 0 data register	R/W	00000000 _B
0001 _H	DDR0	Port 0 direction register	R/W	00000000 _B
0002 _H	PDR1	Port 1 data register	R/W	00000000 _B
0003 _H	DDR1	Port 1 direction register	R/W	00000000 _B
0004 _H	—	(Vacancy)	—	—
0005 _H	WATR	Oscillation stabilization wait time setting register	R/W	11111111 _B
0006 _H	PLLC	PLL control register	R/W	00000000 _B
0007 _H	SYCC	System clock control register	R/W	1010X011 _B
0008 _H	STBC	Standby control register	R/W	00000000 _B
0009 _H	RSRR	Reset source register	R	XXXXXXXX _B
000A _H	TBTC	Timebase timer control register	R/W	00000000 _B
000B _H	WPCR	Watch prescaler control register	R/W	00000000 _B
000C _H	WDTC	Watchdog timer control register	R/W	00000000 _B
000D _H to 0027 _H	—	(Vacancy)	—	—
0028 _H	PDRF	Port F data register	R/W	00000000 _B
0029 _H	DDRF	Port F direction register	R/W	00000000 _B
002A _H	PDRG	Port G data register	R/W	00000000 _B
002B _H	DDRG	Port G direction register	R/W	00000000 _B
002C _H	PUL0	Port 0 pull-up register	R/W	00000000 _B
002D _H	PUL1	Port 1 pull-up register	R/W	00000000 _B
002E _H to 0034 _H	—	(Vacancy)	—	—
0035 _H	PULG	Port G pull-up register	R/W	00000000 _B
0036 _H	T01CR1	8/16-bit compound timer 01 control status register 1 ch0	R/W	00000000 _B
0037 _H	T00CR1	8/16-bit compound timer 00 control status register 1 ch0	R/W	00000000 _B
0038 _H	—	(Vacancy)	—	—
0039 _H	—	(Vacancy)	—	—
003A _H	PC01	8/16-bit PPG1 control register ch0	R/W	00000000 _B
003B _H	PC00	8/16-bit PPG0 control register ch0	R/W	00000000 _B
003C _H to 0041 _H	—	(Vacancy)	—	—

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Address	Register abbreviation	Register name	R/W	Initial value
0042 _H	PCNTH0	16-bit PPG status control register (Upper byte) ch0	R/W	00000000 _B
0043 _H	PCNTL0	16-bit PPG status control register (Lower byte) ch0	R/W	00000000 _B
0044 _H to 0047 _H	—	(Vacancy)	—	—
0048 _H	EIC00	External interrupt circuit control register ch0/1	R/W	00000000 _B
0049 _H	EIC10	External interrupt circuit control register ch2/3	R/W	00000000 _B
004A _H	EIC20	External interrupt circuit control register ch4/5	R/W	00000000 _B
004B _H	EIC30	External interrupt circuit control register ch6/7	R/W	00000000 _B
004C _H to 004F _H	—	(Vacancy)	—	—
0050 _H	SCR	LIN-UART serial control register	R/W	00000000 _B
0051 _H	SMR	LIN-UART serial mode register	R/W	00000000 _B
0052 _H	SSR	LIN-UART serial status register	R/W	00001000 _B
0053 _H	RDR/TDR	LIN-UART reception/transmission data register	R/W	00000000 _B
0054 _H	ESCR	LIN-UART extended status control register	R/W	00000100 _B
0055 _H	ECCR	LIN-UART extended communication control register	R/W	000000XX _B
0056 _H	SMC10	UART/SIO serial mode control register 1 ch0	R/W	00000000 _B
0057 _H	SMC20	UART/SIO serial mode control register 2 ch0	R/W	00100000 _B
0058 _H	SSR0	UART/SIO serial status register ch0	R/W	00000001 _B
0059 _H	TDR0	UART/SIO serial output data register ch0	R/W	00000000 _B
005A _H	RDR0	UART/SIO serial input data register ch0	R	00000000 _B
005B _H to 006B	—	(Vacancy)	—	—
006C _H	ADC1	A/D control register 1	R/W	00000000 _B
006D _H	ADC2	A/D control register 2	R/W	00000000 _B
006E _H	ADDH	A/D data register (Upper byte)	R/W	00000000 _B
006F _H	ADDL	A/D data register (Lower byte)	R/W	00000000 _B
0070 _H	WCSR	Watch counter status register	R/W	00000000 _B
0071 _H	—	(Vacancy)	—	—
0072 _H	FSR	Flash memory status register	R/W	000X0000 _B
0073 _H	SWRE0	Flash memory sector writing control register 0	R/W	00000000 _B
0074 _H	SWRE1	Flash memory sector writing control register 1	R/W	00000000 _B
0075 _H	—	(Vacancy)	—	—

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MB95130H Series

Address	Register abbreviation	Register name	R/W	Initial value
0076 _H	WREN	Wild register address compare enable register	R/W	00000000 _B
0077 _H	WROR	Wild register data test setting register	R/W	00000000 _B
0078 _H	—	(Mirror of register bank pointer (RP) and direct bank pointer (DP))	—	—
0079 _H	ILR0	Interrupt level setting register 0	R/W	11111111 _B
007A _H	ILR1	Interrupt level setting register 1	R/W	11111111 _B
007B _H	ILR2	Interrupt level setting register 2	R/W	11111111 _B
007C _H	ILR3	Interrupt level setting register 3	R/W	11111111 _B
007D _H	ILR4	Interrupt level setting register 4	R/W	11111111 _B
007E _H	ILR5	Interrupt level setting register 5	R/W	11111111 _B
007F _H	—	(Vacancy)	—	—
0F80 _H	WRARH0	Wild register address setting register (Upper byte) ch0	R/W	00000000 _B
0F81 _H	WRARL0	Wild register address setting register (Lower byte) ch0	R/W	00000000 _B
0F82 _H	WRDR0	Wild register data setting register ch0	R/W	00000000 _B
0F83 _H	WRARH1	Wild register address setting register (Upper byte) ch1	R/W	00000000 _B
0F84 _H	WRARL1	Wild register address setting register (Lower byte) ch1	R/W	00000000 _B
0F85 _H	WRDR1	Wild register data setting register ch1	R/W	00000000 _B
0F86 _H	WRARH2	Wild register address setting register (Upper byte) ch2	R/W	00000000 _B
0F87 _H	WRARL2	Wild register address setting register (Lower byte) ch2	R/W	00000000 _B
0F88 _H	WRDR2	Wild register data setting register ch2	R/W	00000000 _B
0F89 _H to 0F91 _H	—	(Vacancy)	—	—
0F92 _H	T01CR0	8/16-bit compound timer 01 control status register 0 ch0	R/W	00000000 _B
0F93 _H	T00CR0	8/16-bit compound timer 00 control status register 0 ch0	R/W	00000000 _B
0F94 _H	T01DR	8/16-bit compound timer 01 data register ch0	R/W	00000000 _B
0F95 _H	T00DR	8/16-bit compound timer 00 data register ch0	R/W	00000000 _B
0F96 _H	TMCR0	8/16-bit compound timer 00/01 timer mode control register ch0	R/W	00000000 _B
0F97 _H to 0F9B _H	—	(Vacancy)	—	—
0F9C _H	PPS01	8/16-bit PPG1 cycle setting buffer register ch0	R/W	11111111 _B
0F9D _H	PPS00	8/16-bit PPG0 cycle setting buffer register ch0	R/W	11111111 _B
0F9E _H	PDS01	8/16-bit PPG1 duty setting buffer register ch0	R/W	11111111 _B
0F9F _H	PDS00	8/16-bit PPG0 duty setting buffer register ch0	R/W	11111111 _B

(Continued)

Address	Register abbreviation	Register name	R/W	Initial value
0FA0 _H to 0FA3 _H	—	(Vacancy)	—	—
0FA4 _H	PPGS	8/16-bit PPG starting register	R/W	00000000 _B
0FA5 _H	REVC	8/16-bit PPG output inversion register	R/W	00000000 _B
0FA6 _H to 0FA9 _H	—	(Vacancy)	—	—
0FAA _H	PDCRH0	16-bit PPG down counter register (Upper byte) ch0	R	00000000 _B
0FAB _H	PDCRL0	16-bit PPG down counter register (Lower byte) ch0	R	00000000 _B
0FAC _H	PCSRH0	16-bit PPG cycle setting buffer register (Upper byte) ch0	R/W	11111111 _B
0FAD _H	PCSRL0	16-bit PPG cycle setting buffer register (Lower byte) ch0	R/W	11111111 _B
0FAE _H	PDUTH0	16-bit PPG duty setting buffer register (Upper byte) ch0	R/W	11111111 _B
0FAF _H	PDUTL0	16-bit PPG duty setting buffer register (Lower byte) ch0	R/W	11111111 _B
0FB0 _H to 0FBB _H	—	(Vacancy)	—	—
0FBC _H	BGR1	LIN-UART baud rate generator register 1	R/W	00000000 _B
0FBD _H	BGR0	LIN-UART baud rate generator register 0	R/W	00000000 _B
0FBE _H	PSSR0	UART/SIO prescaler selection register ch0	R/W	00000000 _B
0FBF _H	BRSR0	UART/SIO baud rate setting register ch0	R/W	00000000 _B
0FC0 _H to 0FC2 _H	—	(Vacancy)	—	—
0FC3 _H	AIDRL	A/D input disable register (Lower byte)	R/W	00000000 _B
0FC4 _H to 0FE2 _H	—	(Vacancy)	—	—
0FE3 _H	WCDR	Watch counter data register	R/W	00111111 _B
0FE4 _H to 0FE9 _H	—	(Vacancy)	—	—
0FEA _H	CSVCR	Clock supervisor control register	R/W	00011100 _B
0FEB _H to 0FED _H	—	(Vacancy)	—	—
0FEE _H	ILSR	Input level select register	R/W	00000000 _B
0FEF _H	WICR	Interrupt pin control register	R/W	01000000 _B
0FF0 _H to 0FFF _H	—	(Vacancy)	—	—

MB95130H Series

- Read/write access symbols

R/W : Readable and Writable

R : Read only

W : Write only

- Initial value symbols

0 : The initial value of this bit is "0".

1 : The initial value of this bit is "1".

X : The initial value of this bit is undefined.

■ INTERRUPT SOURCE TABLE

Interrupt source	Interrupt request number	Vector table address		Bit name of interrupt level setting register	Same level priority order (at simultaneous occurrence)
		Upper	Lower		
External interrupt ch0	IRQ0	FFFA _H	FFFB _H	L00 [1 : 0]	High ↑ ↓ Low
External interrupt ch4					
External interrupt ch1	IRQ1	FFF8 _H	FFF9 _H	L01 [1 : 0]	
External interrupt ch5					
External interrupt ch2	IRQ2	FFF6 _H	FFF7 _H	L02 [1 : 0]	
External interrupt ch6					
External interrupt ch3	IRQ3	FFF4 _H	FFF5 _H	L03 [1 : 0]	
External interrupt ch7					
UART/SIO ch0	IRQ4	FFF2 _H	FFF3 _H	L04 [1 : 0]	
8/16-bit compound timer ch0 (Lower)	IRQ5	FFF0 _H	FFF1 _H	L05 [1 : 0]	
8/16-bit compound timer ch0 (Upper)	IRQ6	FFEE _H	FFEF _H	L06 [1 : 0]	
LIN-UART (reception)	IRQ7	FFEC _H	FFED _H	L07 [1 : 0]	
LIN-UART (transmission)	IRQ8	FFEA _H	FFEB _H	L08 [1 : 0]	
(Unused)	IRQ9	FFE8 _H	FFE9 _H	L09 [1 : 0]	
(Unused)	IRQ10	FFE6 _H	FFE7 _H	L10 [1 : 0]	
(Unused)	IRQ11	FFE4 _H	FFE5 _H	L11 [1 : 0]	
8/16-bit PPG ch0 (Upper)	IRQ12	FFE2 _H	FFE3 _H	L12 [1 : 0]	
8/16-bit PPG ch0 (Lower)	IRQ13	FFE0 _H	FFE1 _H	L13 [1 : 0]	
(Unused)	IRQ14	FFDE _H	FFDF _H	L14 [1 : 0]	
16-bit PPG ch0	IRQ15	FFDC _H	FFDD _H	L15 [1 : 0]	
(Unused)	IRQ16	FFDA _H	FFDB _H	L16 [1 : 0]	
(Unused)	IRQ17	FFD8 _H	FFD9 _H	L17 [1 : 0]	
10-bit A/D converter	IRQ18	FFD6 _H	FFD7 _H	L18 [1 : 0]	
Timebase timer	IRQ19	FFD4 _H	FFD5 _H	L19 [1 : 0]	
Watch prescaler/counter	IRQ20	FFD2 _H	FFD3 _H	L20 [1 : 0]	
(Unused)	IRQ21	FFD0 _H	FFD1 _H	L21 [1 : 0]	
(Unused)	IRQ22	FFCE _H	FFCF _H	L22 [1 : 0]	
FLASH	IRQ23	FFCC _H	FFCD _H	L23 [1 : 0]	

MB95130H Series

■ ELECTRICAL CHARACTERISTICS

1. Absolute Maximum Ratings

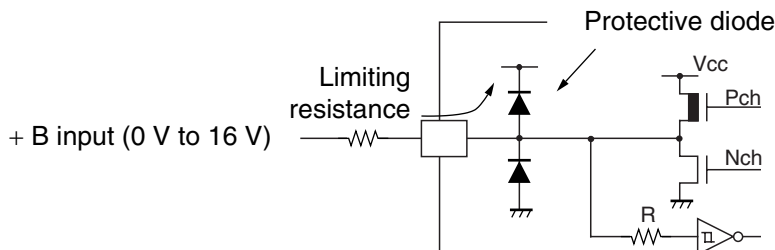
Parameter	Symbol	Rating		Unit	Remarks
		Min	Max		
Power supply voltage*1	V _{CC} , AV _{CC}	V _{SS} – 0.3	V _{SS} + 6.0	V	*2
	AV _R	V _{SS} – 0.3	V _{SS} + 6.0		*2 MB95FV100B-103 only
Input voltage*1	V _I	V _{SS} – 0.3	V _{SS} + 6.0	V	*3
Output voltage*1	V _O	V _{SS} – 0.3	V _{SS} + 6.0	V	*3
Maximum clamp current	I _{CLAMP}	– 2.0	+ 2.0	mA	Applicable to pins*4
Total maximum clamp current	Σ I _{CLAMP}	—	20	mA	Applicable to pins*4
"L" level maximum output current	I _{OL1}	—	15	mA	Other than PF0 to PF1
	I _{OL2}		15		PF0 to PF1
"L" level average current	I _{OLAV1}	—	4	mA	Other than PF0 to PF1 Average output current = operating current × operating ratio (1 pin)
	I _{OLAV2}		12		PF0 to PF1 Average output current = operating current × operating ratio (1 pin)
"L" level total maximum output current	ΣI _{OL}	—	100	mA	
"L" level total average output current	ΣI _{OLAV}	—	50	mA	Total average output current = operating current × operating ratio (total of pins)
"H" level maximum output current	I _{OH1}	—	– 15	mA	Other than PF0 to PF1
	I _{OH2}		– 15		PF0 to PF1
"H" level average current	I _{OHAV1}	—	– 4	mA	Other than PF0 to PF1 Average output current = operating current × operating ratio (1 pin)
	I _{OHAV2}		– 8		PF0 to PF1 Average output current = operating current × operating ratio (1 pin)
"H" level total maximum output current	ΣI _{OH}	—	– 100	mA	
"H" level total average output current	ΣI _{OHAV}	—	– 50	mA	Total average output current = operating current × operating ratio (total of pins)
Power consumption	P _d	—	320	mW	
Operating temperature	T _A	– 40	+ 85	°C	Other than MB95FV100B-103
Storage temperature	T _{stg}	– 55	+ 150	°C	

(Continued)

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- *1 : The parameter is based on $AV_{CC} = V_{SS} = 0.0 \text{ V}$.
- *2 : Apply equal potential to AV_{CC} and V_{CC} . AVR should not exceed $AV_{CC} + 0.3 \text{ V}$.
- *3 : V_{I1} and V_O should not exceed $V_{CC} + 0.3 \text{ V}$. V_{I1} must not exceed the rating voltage. However, if the maximum current to/from an input is limited by some means with external components, the I_{CLAMP} rating supersedes the V_{I1} rating.
- *4 :
 - Applicable to pins : P00 to P07, P10 to P15, PF0 to PF1
 - Use within recommended operating conditions.
 - Use at DC voltage (current).
 - The + B signal should always be applied a limiting resistance placed between the + B signal and the microcontroller.
 - The value of the limiting resistance should be set so that when the + B signal is applied the input current to the microcontroller pin does not exceed rated values, either instantaneously or for prolonged periods.
 - Note that when the microcontroller drive current is low, such as in the power saving modes, the +B input potential may pass through the protective diode and increase the potential at the VCC pin, and this may affect other devices.
 - Note that if the + B signal is inputted when the microcontroller power supply is off (not fixed at 0 V), the power supply is provided from the pins, so that incomplete operation may result.
 - Note that if the + B input is applied during power-on, the power supply is provided from the pins and the resulting power supply voltage may not be sufficient to operate the power-on reset.
 - Care must be taken not to leave the + B input pin open.
 - Sample recommended circuits :

Input/Output Equivalent Circuits



WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

MB95130H Series

2. Recommended Operating Conditions

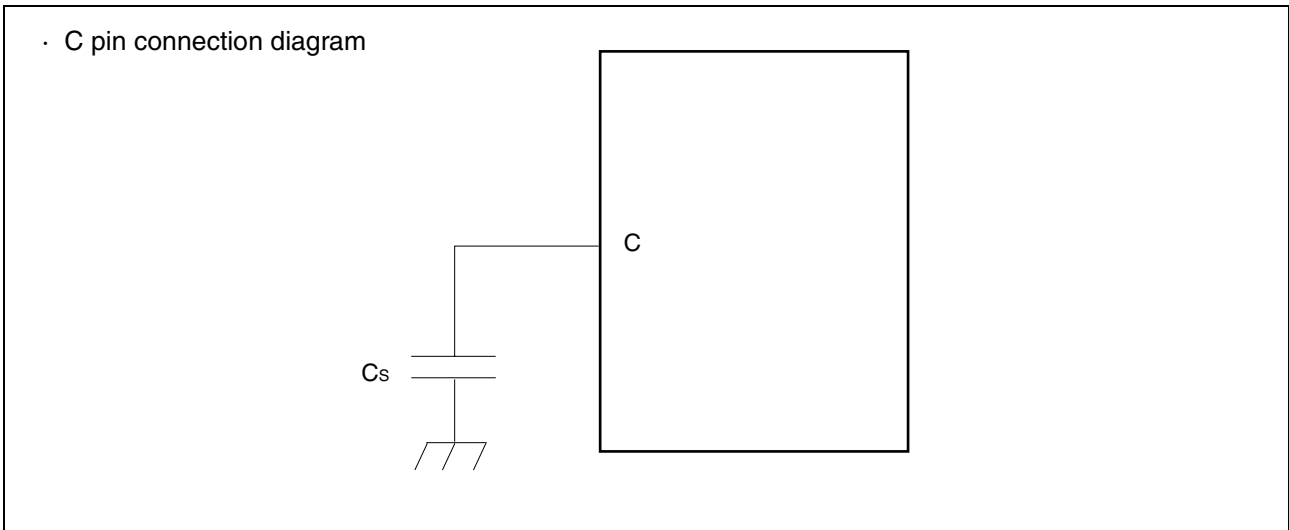
(AV_{SS} = V_{SS} = 0.0 V)

Parameter	Symbol	Value		Unit	Remarks
		Min	Max		
Power supply voltage	V _{CC} , AV _{CC}	2.5 ^{*1}	5.5 ^{*2}	V	At normal operating
		2.6	5.5		MB95FV100B-103
		2.4	5.5 ^{*2}		Retain status of stop operation
Smoothing capacitor	C _S	0.1	1.0	μF	*3
Operating temperature	T _A	− 40	+ 85	°C	Other than MB95FV100B-103

*1 : The values vary with the operating frequency.

*2 : The value is 2.9 V when the low voltage detection reset is used.

*3 : Use a ceramic capacitor or a capacitor with equivalent frequency characteristics. A bypass capacitor of V_{CC} pin must have a capacitance value higher than C_S. For connection of smoothing capacitor C_S, see the diagram below



WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.

3. DC Characteristics

($V_{CC} = AV_{CC} = 5.0\text{ V}$, $AV_{SS} = V_{SS} = 0.0\text{ V}$, $T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ [MB95FV100B-103 is $T_A = +25\text{ }^{\circ}\text{C}$])

Parameter	Symbol	Pin name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
"H" level input voltage	V_{IH1}	P04(at SIN selection), P10(at UI selection)	*1	$0.7 V_{CC}$	—	$V_{CC} + 0.3$	V	At selecting of CMOS input level (hysteresis input)
	V_{IHS1}	P00 to P07, P10 to P15, PF0 to PF1, PG1, PG2	*1	$0.8 V_{CC}$	—	$V_{CC} + 0.3$	V	Hysteresis input
	V_{IHM}	$\overline{RST}$, MOD	—	$0.7 V_{CC}$	—	$V_{CC} + 0.3$	V	CMOS input (FLASH product)
			—	$0.8 V_{CC}$	—	$V_{CC} + 0.3$	V	Hysteresis input (MASK product)
"L" level input voltage	V_{IL}	P04(at SIN selection), P10(at UI selection)	*1	$V_{SS} - 0.3$	—	$0.3 V_{CC}$	V	At selecting of CMOS input level (hysteresis input)
	V_{ILS}	P00 to P07, P10 to P16, PF0 to PF1, PG1, PG2	*1	$V_{SS} - 0.3$	—	$0.2 V_{CC}$	V	Hysteresis input
	V_{ILM}	$\overline{RST}$, MOD	—	$V_{SS} - 0.3$	—	$0.3 V_{CC}$	V	CMOS input (FLASH product)
			—	$V_{SS} - 0.3$	—	$0.2 V_{CC}$	V	Hysteresis input (MASK product)
"H" level output voltage	V_{OH1}	Output pin other than PF0 to PF1	$I_{OH} = -4.0\text{ mA}$	4.0	—	—	V	
	V_{OH2}	PF0 to PF1	$I_{OH} = -8.0\text{ mA}$	4.0	—	—	V	
"L" level output voltage	V_{OL1}	Output pin other than PF0 to PF1	$I_{OL} = 4.0\text{ mA}$	—	—	0.4	V	When no clock supervisor is specified
	V_{OL2}	PF0 to PF1	$I_{OL} = 12\text{ mA}$	—	—	0.4	V	
Input leakage current (High-Z output leakage current)	I_{LI}	P00 to P07, P10 to P16, PF0 to PF1, PG0 to PG1	$0.0\text{ V} < V_I < V_{CC}$	-5	—	+5	μA	When no pull-up resistor is specified

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MB95130H Series

(Continued)

($V_{CC} = AV_{CC} = 5.0\text{ V}$, $AV_{SS} = V_{SS} = 0.0\text{ V}$, $T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ [MB95FV100B-103 is $T_A = +25\text{ }^{\circ}\text{C}$])

Parameter	Symbol	Pin name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Pull-up resistor	R_{PULL}	P00 to P07, P10 to P16, PF0 to PF1, PG0 to PG1	$V_I = 0.0\text{ V}$	25	50	100	$k\Omega$	When pull-up resistor is specified
Pull-down resistor	R_{MOD}	MOD	$V_I = V_{CC}$	50	100	200	$k\Omega$	MASK product only
Power supply current*3	I_{CC}	V_{CC} (external clock operation)	$V_{CC}=5.5\text{ V}$ $F_{CH} = 20\text{ MHz}$ $f_{mp} = 10\text{ MHz}$ Main clock mode (divided by 2)	—	T.B.D	T.B.D	mA	FLASH product
				—	—	—	mA	MASK product
				—	30	35	mA	FLASH product (at FLASH writing and erasing)
	I_{CCS}		$V_{CC}=5.5\text{ V}$ $F_{CH} = 20\text{ MHz}$ $f_{mp} = 10\text{ MHz}$ Main Sleep mode (divided by 2)	—	T.B.D	T.B.D	mA	
	I_{CCL}		$V_{CC}=5.5\text{ V}$ $F_{CL} = 32\text{ kHz}$ $f_{mpl} = 16\text{ kHz}$ Subclock mode (divided by 2) , $T_A = +25\text{ }^{\circ}\text{C}$	—	45	100	μA	
	I_{CCLS}		$V_{CC}=5.5\text{ V}$ $F_{CL} = 32\text{ kHz}$ $f_{mpl} = 16\text{ kHz}$ Sub sleep mode (divided by 2) , $T_A = +25\text{ }^{\circ}\text{C}$	—	10	81	μA	

(Continued)

(Continued)

(V_{CC} = AV_{CC} = 5.0 V, AV_{SS} = V_{SS} = 0.0 V, T_A = - 40 °C to + 85 °C [MB95FV100B-103 is T_A = +25 °C])

Parameter	Sym- bol	Pin name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Power supply current*3	I _{CC} T	V _{CC} (external clock operation)	V _{CC} =5.5V F _{CL} = 32 kHz Watch mode Main stop mode T _A = + 25 °C	—	4.6	27	μA	
	I _{CC} MPLL		V _{CC} =5.5V F _{CH} = 4 MHz f _{mp} = 10 MHz Main PLL mode (multiplied by 2.5)	—	T.B.D	T.B.D	mA	FLASH product
				—	—	—	mA	MASK product
	I _{CC} SPLL		V _{CC} =5.5V F _{CL} = 32 kHz f _{mpl} = 128 kHz Sub PLL mode (multiplied by 4) , T _A = + 25 °C	—	160	400	μA	
	I _{CT} S		V _{CC} =5.5V F _{CH} = 10 MHz Timebase timer mode T _A = + 25 °C	—	0.15	1.1	mA	
	I _{CC} H		V _{CC} =5.5V Substop mode T _A = + 25 °C	—	5	20	μA	
	I _A	AV _{CC}	V _{CC} =5.5V F _{CH} = 10 MHz At A/D converting	—	2.4	4.7	mA	
	I _{AH}		V _{CC} =5.5V F _{CH} = 10 MHz At A/D converting stop T _A = + 25 °C	—	1	5	μA	
Input capacitance	C _{IN}	Other than AV _{CC} , AV _{SS} , V _{CC} , and V _{SS}	—	—	5	15	pF	

*1 : The power-supply current is determined by the external clock.

*If you select the "low voltage detection" and "clock supervisor clock" as the option, please adds the value at "9. Low Voltage Detection" and "10. Clock Supervisor Clock" to above supply current.

- Refer to "4. AC characteristics (1) Clock Timing" for F_{CH} and F_{CL}.
- Refer to "4. AC characteristics (2) Source Clock/Machine Clock" for f_{mp} and f_{mpl}.

MB95130H Series

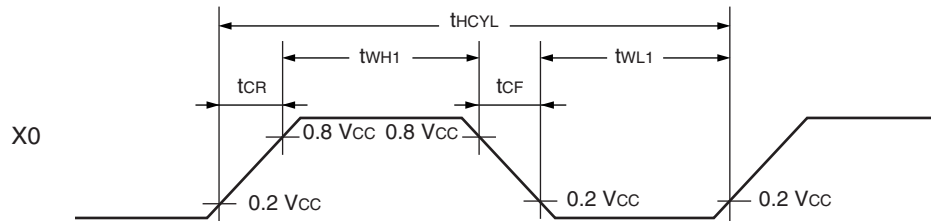
4. AC Characteristics

(1) Clock Timing

(V_{CC} = 5.0 V, AV_{SS} = V_{SS} = 0.0 V, T_A = - 40 °C to + 85 °C)

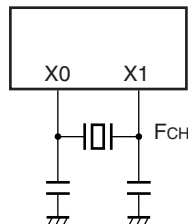
Parameter	Sym- bol	Pin	Condi- tions	Value			Unit	Remarks
				Min	Typ	Max		
Clock frequency	F _{CH}	X0, X1	—	1	—	10	MHz	When using Main oscilla- tion circuit
				1	—	20	MHz	When using external clock
				3	—	10	MHz	Main PLL multiplied by 1
				3	—	5	MHz	Main PLL multiplied by 2
				3	—	4	MHz	Main PLL multiplied by 2.5
	F _{CL}	X0A, X1A		—	32.768	—	kHz	When using Sub oscilla- tion circuit
				—	32.768	—	kHz	When using sub PLL V _{CC} = 2.3 V to 3.6 V
Clock cycle time	t _{H CYL}	X0, X1		100	—	1000	ns	When using Main oscilla- tion circuit
				50	—	1000	ns	When using Sub oscilla- tion circuit
	t _{L CYL}	X0A, X1A		—	30.5	—	μs	Subclock
Input clock pulse width	t _{WH1} t _{WL1}	X0		10	—	—	ns	When using external clock Duty ratio is about 30% to 70%.
	t _{WH2} t _{WL2}	X0A		—	15.2	—	μs	
Input clock rise time and fall time	t _{CR} t _{CF}	X0, X0A		—	—	5	ns	When using external clock

- X0 and X1 Timing and Applying Conditions

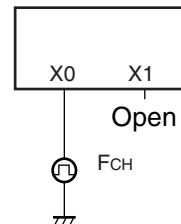


- Main Clock Applying Conditions

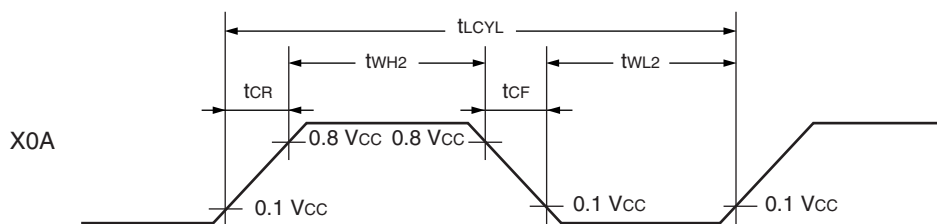
When using a crystal or ceramic oscillator



When using external clock

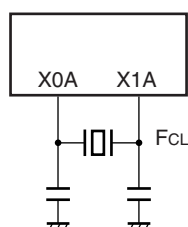


- X0A and X1A Timing and Applying Conditions

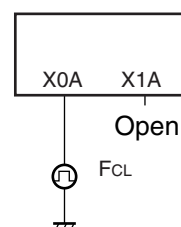


- Subclock Applying Conditions

When using a crystal or ceramic oscillator



When using external clock



MB95130H Series

(2) Source Clock/Machine Clock

(V_{CC} = 5.0 V, AV_{SS} = V_{SS} = 0.0 V, T_A = - 40 °C to + 85 °C)

Parameter	Symbol	Pin name	Value			Unit	Remarks
			Min	Typ	Max		
Source clock* ¹ (Clock before setting division)	SCLK	—	100	—	2000	ns	When using Main clock Min : F _{CH} = 10 MHz, PLL multiplied by 1 Max : F _{CH} = 1 MHz, divided by 2
			7.6	—	61.0	μs	When using Subclock Min : F _{CL} = 32 kHz, PLL multiplied by 4 Max : F _{CL} = 32 kHz, divided by 2
Source clock frequency	f _{sp}	—	0.5	—	10.0	MHz	When using Main clock
	f _{spl}	—	16.384	—	131.072	kHz	When using Subclock
Machine clock* ² (Minimum instruction execution time)	MCLK	—	100	—	32000	ns	When using Main clock Min : SLCK = 10 MHz, no division Max : SLCK = 0.5 MHz, divided by 16
			7.6	—	976.5	μs	When using Subclock Min : SLCK = 131 kHz, no division Max : SLCK = 16 kHz, divided by 16
Machine clock frequency	f _{mp}	—	0.031	—	10.000	MHz	When using Main clock
	f _{mpl}	—	1.024	—	131.072	kHz	When using Subclock

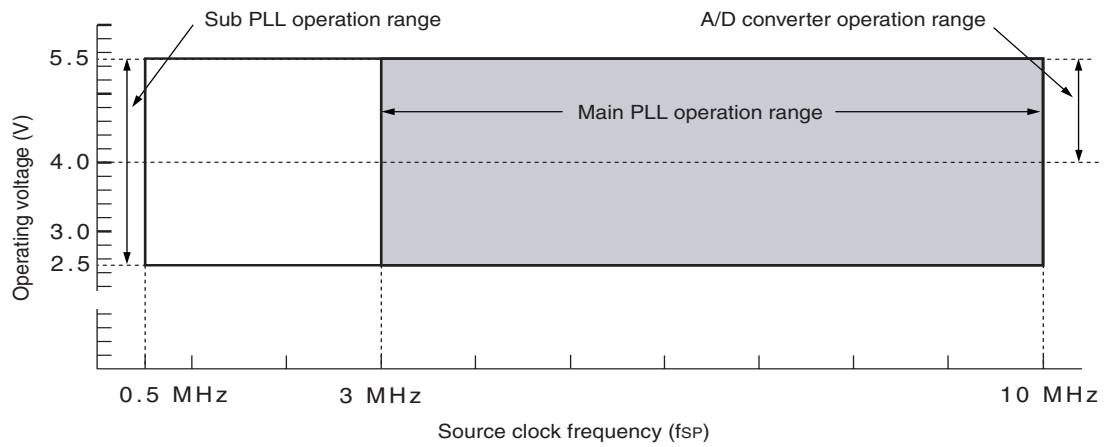
*1 : Clock before setting division due to machine clock division ratio selection bit (SYCC : DIV1 and DIV0) . This source clock is divided by the machine clock division ratio selection bit (SYCC : DIV1 and DIV0) , and it becomes the machine clock. Further, the source clock can be selected as follow.

- Main clock divided by 2
- PLL multiplication of main clock (select from 1, 2, 2.5 multiplication)
- Subclock divided by 2
- PLL multiplication of subclock (select from 2, 3, 4 multiplication)

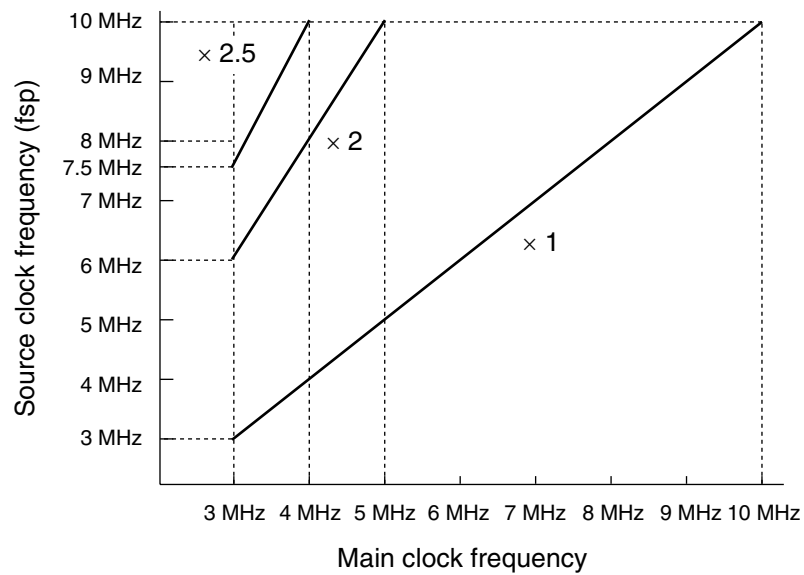
*2 : Operation clock of the microcontroller. Machine clock can be selected as follow.

- Source clock (no division)
- Source clock divided by 4
- Source clock divided by 8
- Source clock divided by 16

• Operating voltage – Operating frequency



• Main PLL operation frequency



MB95130H Series

(3) Reset Timing

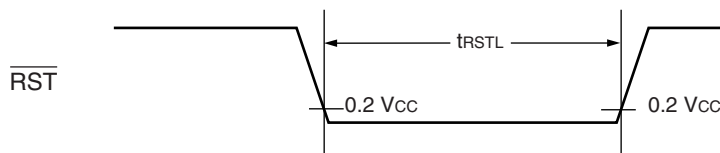
($V_{CC} = 5.0\text{ V}$, $A/V_{SS} = V_{SS} = 0.0\text{ V}$, $T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$)

Parameter	Symbol	Value		Unit	Remarks
		Min	Max		
$\overline{\text{RST}}$ "L" level pulse width	t_{RSTL}	2 MCLK^{*1}	—	ns	At normal operating
		Oscillation time of oscillator ^{*2} + 100	—	ns	At stop mode, subclock mode, Sub sleep mode, and watch mode
		100	—	μs	At timebase timer mode

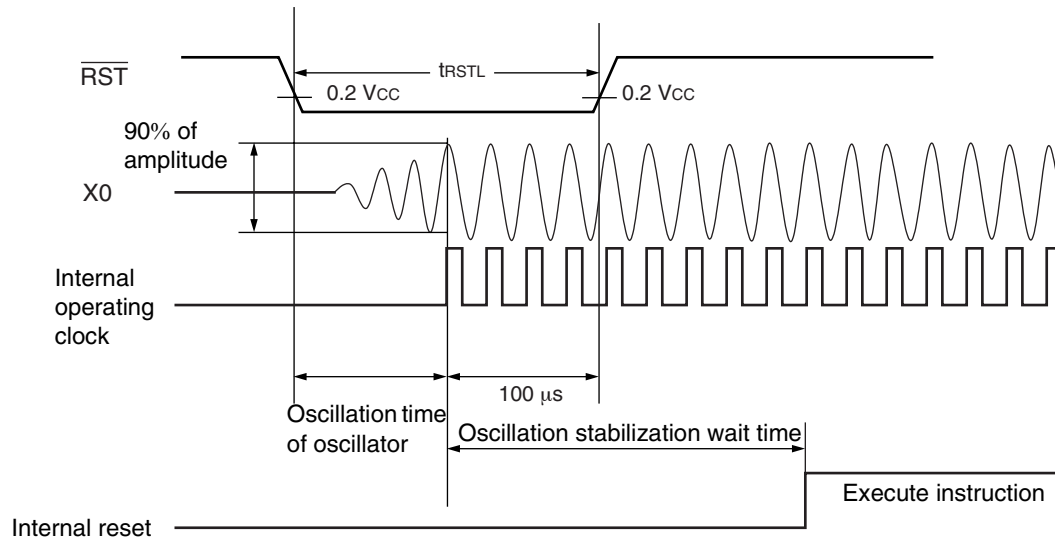
*1 : Refer to " (2) Source Clock/Machine Clock" for MCLK.

*2 : Oscillation time of oscillator is the time that the amplitude reaches 90 %. In the crystal oscillator, the oscillation time is between several ms and tens of ms. In FAR/ceramic oscillators, the oscillation time is between hundreds of μs and several ms. In the external clock, the oscillation time is 0 ms.

- At normal operating



- At stop mode, subclock mode, sub sleep mode, and watch mode

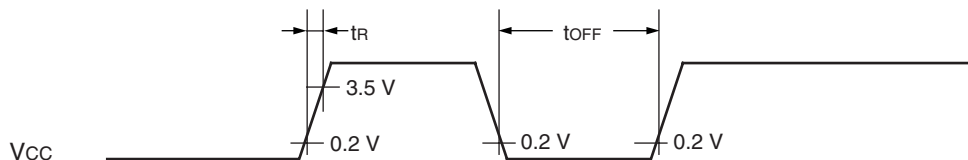


(4) Power-on Reset

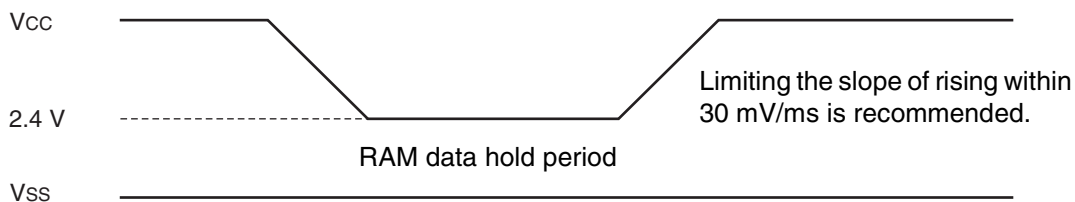
($V_{SS} = V_{SS} = 0.0 \text{ V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$)

Parameter	Symbol	Conditions	Value		Unit	Remarks
			Min	Max		
Power supply rising time	t_R	—	—	36	ms	
Power supply cutoff time	t_{OFF}	—	1	—	ms	Due to repeated operations

Note : The power supply must be turned on within the selected oscillation stabilization time.



Sudden change of power supply voltage may activate the power-on reset function. When changing power supply voltages during operation, set the slope of rising within 20 mV/ms as shown below. In this case, do not use PLL clock. However, if voltage drop is 1V/s or less, use of PLL clock is allowed during operation.



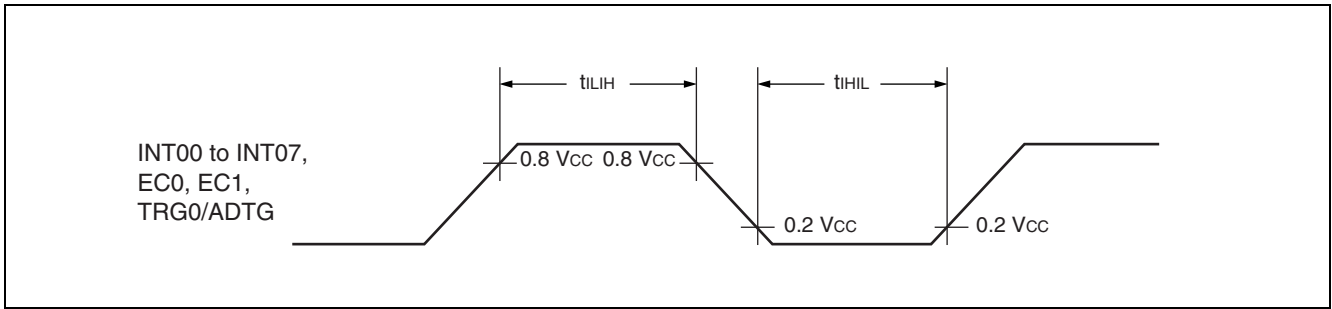
MB95130H Series

(5) Peripheral Input Timing

(Vcc = 5.0 V, AVss = Vss = 0.0 V, TA = - 40 °C to + 85 °C)

Parameter	Symbol	Pin name	Value		Unit	Remarks
			Min	Max		
Peripheral input "H" pulse width	t _{LIH}	INT00 to INT07, EC0, EC1, TRG0/ADTG	2 MCLK*	—	ns	
Peripheral input "L" pulse width	t _{HL}		2 MCLK*	—	ns	

* : Refer to "(2) Source Clock/Machine Clock" for MCLK.



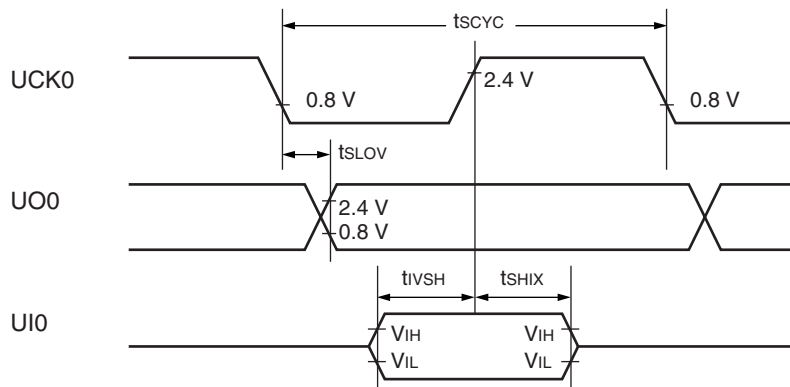
(6) UART/SIO, Serial I/O Timing

($V_{CC} = 5.0\text{ V}$, $A/V_{SS} = V_{SS} = 0.0\text{ V}$, $T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$)

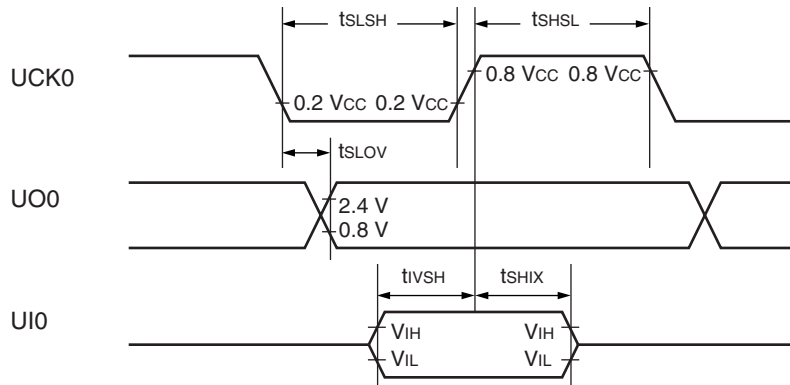
Parameter	Symbol	Pin name	Conditions	Value		Unit	Remarks
				Min	Max		
Serial clock cycle time	t_{SCYC}	UCK0	Internal clock operation	4 MCLK*	—	ns	
UCK ↓ → UO time	t_{SLOV}	UCK0, UO0		— 190	190	ns	
Valid UI → UCK ↑	t_{IVSH}	UCK0, UI0		2 MCLK*	—	ns	
UCK ↑ → valid UI hold time	t_{SHIX}	UCK0, UI0		2 MCLK*	—	ns	
Serial clock "H" pulse width	t_{SHSL}	UCK0	External clock operation	4 MCLK*	—	ns	
Serial clock "L" pulse width	t_{SLSH}	UCK0		4 MCLK*	—	ns	
UCK ↓ → UO time	t_{SLOV}	UCK0, UO0		—	190	ns	
Valid UI → UCK ↑	t_{IVSH}	UCK0, UI0		2 MCLK*	—	ns	
UCK ↑ → valid UI hold time	t_{SHIX}	UCK0, UI0		2 MCLK*	—	ns	

* : Refer to " (2) Source Clock/Machine Clock" for MCLK.

• Internal shift clock mode



• External shift clock mode



MB95130H Series

(7) LIN-UART Timing

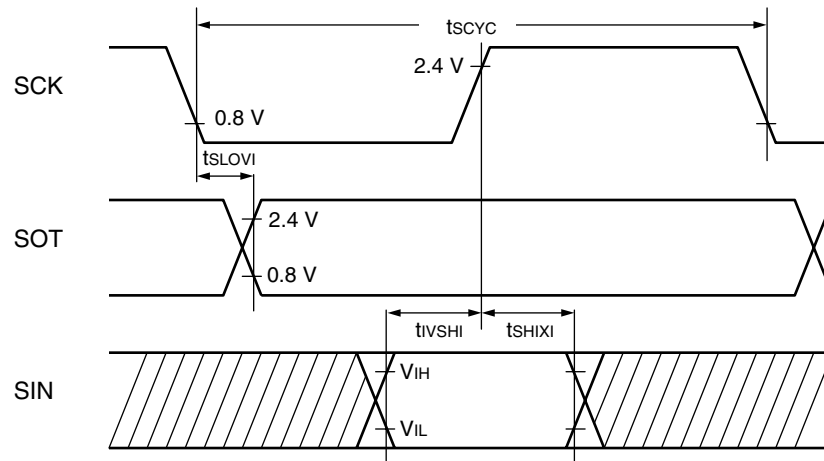
ESCR : SCES = 0, ECCR : SCDE = 0

(Vcc = 5.0 V, AVss = Vss = 0.0 V, TA = -40 °C to + 85 °C)

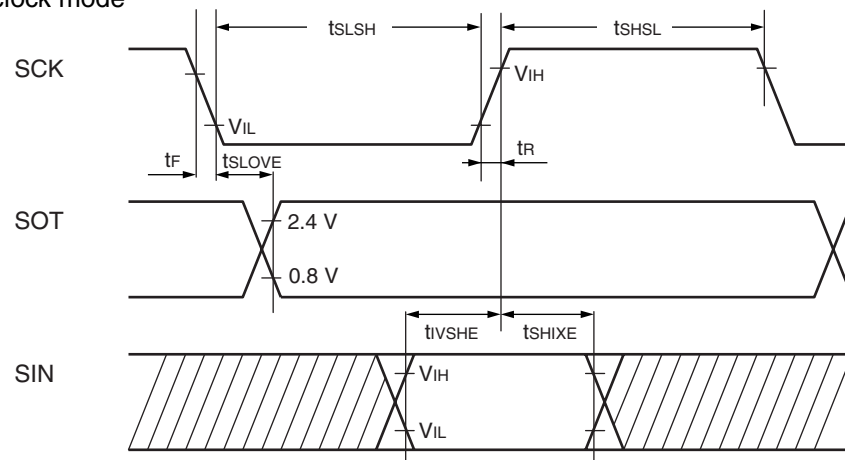
Parameter	Sym- bol	Pin name	Conditions	Value		Unit
				Min	Max	
Serial clock cycle time	tSCYC	SCK	Internal clock operation output pin : CL = 80 pF + 1 TTL.	5 MCLK*	—	ns
SCK ↑ → SOT delay time	tSLOVI	SCK, SOT		-95	95	ns
Valid SIN → SCK ↑	tIVSHI	SCK, SIN		MCLK* + 190	—	ns
SCK ↑ → valid SIN hold time	tSHIXI	SCK, SIN		0	—	ns
Serial clock "L" pulse width	tSLSH	SCK	External clock operation output pin : CL = 80 pF + 1 TTL.	3 MCLK* - tR	—	ns
Serial clock "H" pulse width	tSHSL	SCK		MCLK* + 95	—	ns
SCK ↓ → SOT delay time	tSLOVE	SCK, SOT		—	2 MCLK* + 95	ns
Valid SIN → SCK ↑	tIVSHE	SCK, SIN		190	—	ns
SCK ↑ → Valid SIN hold time	tSHIXE	SCK, SIN		MCLK* + 95	—	ns
SCK fall time	tF	SCK		—	10	ns
SCK rise time	tR	SCK		—	10	ns

* : Refer to " (2) Source Clock/Machine Clock" for MCLK.

· Internal shift clock mode



· External shift clock mode



MB95130H Series

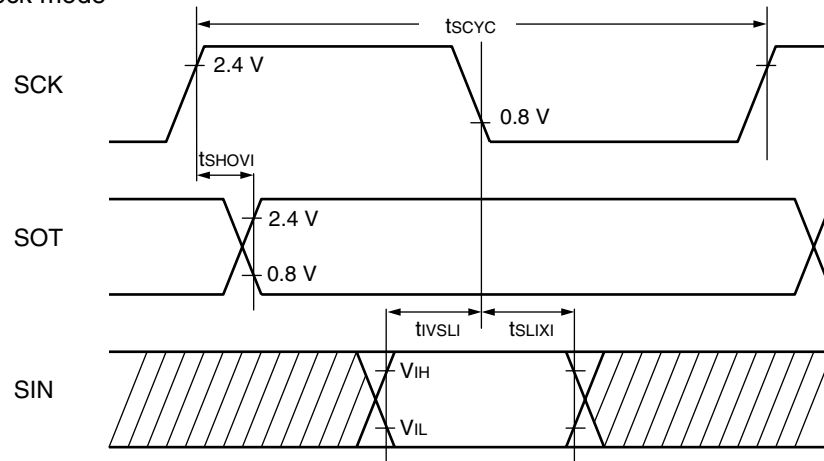
ESCR : SCES = 1, ECCR : SCDE = 0

(Vcc = 5.0 V, AVss = Vss = 0.0 V, TA = -40 °C to + 85 °C)

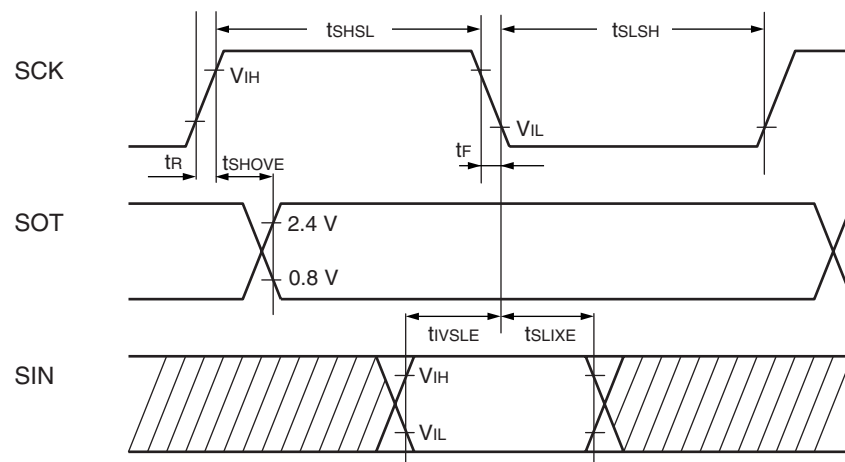
Parameter	Symbol	Pin name	Conditions	Value		Unit
				Min	Max	
Serial clock cycle time	tSCYC	SCK	Internal clock operation output pin : CL = 80 pF + 1 TTL.	5 MCLK*	—	ns
SCK ↑ → SOT delay time	tSHOVI	SCK, SOT		-95	95	ns
Valid SIN → SCK ↓	tIVSLI	SCK, SIN		MCLK* + 190	—	ns
SCK ↓ → Valid SIN hold time	tSLIXI	SCK, SIN		0	—	ns
Serial clock "H" pulse width	tSHSL	SCK	External clock operation output pin : CL = 80 pF + 1 TTL.	3 MCLK* - tR	—	ns
Serial clock "L" pulse width	tSLSH	SCK		MCLK* + 95	—	ns
SCK ↑ → SOT delay time	tSHOVE	SCK, SOT		—	2 MCLK* + 95	ns
Valid SIN → SCK ↓	tIVSLE	SCK, SIN		190	—	ns
SCK ↓ → Valid SIN hold time	tSLIXE	SCK, SIN		MCLK* + 95	—	ns
SCK fall time	tF	SCK		—	10	ns
SCK rise time	tR	SCK		—	10	ns

* : Refer to " (2) Source Clock/Machine Clock" for MCLK.

· Internal shift clock mode



· External shift clock mode



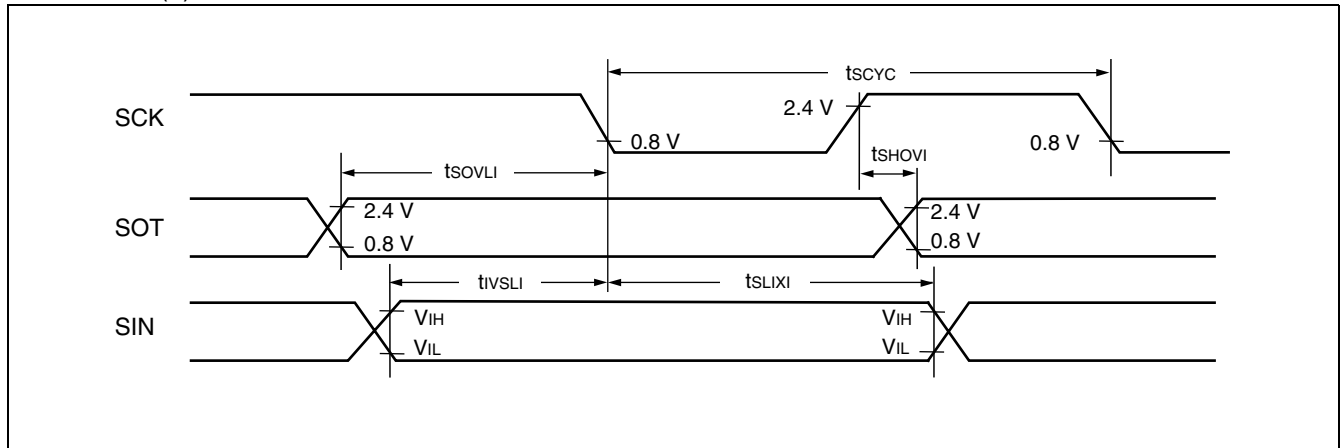
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ESCR : SCES = 0, ECCR : SCDE = 1

(V_{CC} = 5.0 V, AV_{SS} = V_{SS} = 0.0 V, T_A = -40 °C to + 85 °C)

Parameter	Symbol	Pin name	Conditions	Value		Unit
				Min	Max	
Serial clock cycle time	t _{SCYC}	SCK	Internal clock operation output pin : C _L = 80 pF + 1 TTL.	5 MCLK*	—	ns
SCK ↑ → SOT delay time	t _{SHOVI}	SCK, SOT		-95	95	ns
Valid SIN → SCK ↓	t _{IVSLI}	SCK, SIN		MCLK* + 190	—	ns
SCK ↓ → valid SIN hold time	t _{SLIXI}	SCK, SIN		0	—	ns
SOT → SCK ↓ delay time	t _{SOVLI}	SCK, SOT		—	4 MCLK*	ns

* : Refer to " (2) Source Clock/Machine Clock" for MCLK.

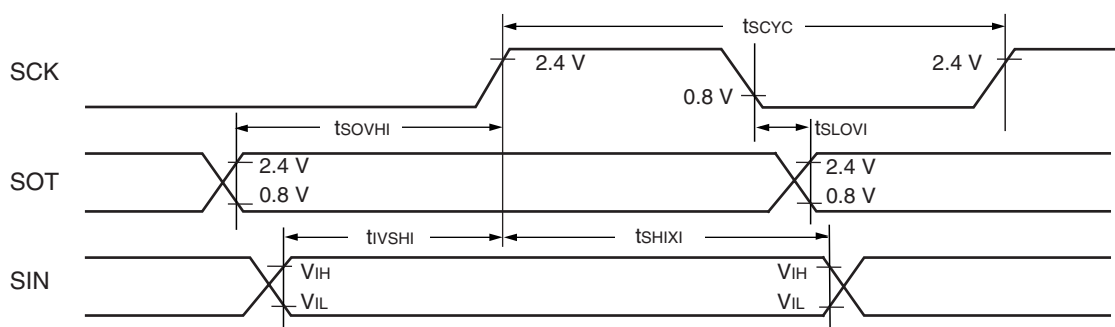


ESCR : SCES = 1, ECCR : SCDE = 1

(V_{CC} = 5.0 V, AV_{SS} = V_{SS} = 0.0 V, T_A = -40 °C to + 85 °C)

Parameter	Symbol	Pin name	Conditions	Value		Unit
				Min	Max	
Serial clock cycle time	t _{SCYC}	SCK	Internal clock operation output pin : C _L = 80 pF + 1 TTL.	5 MCLK*	—	ns
SCK ↓ → SOT delay time	t _{SLOVI}	SCK, SOT		-95	95	ns
Valid SIN → SCK ↑	t _{IVSHI}	SCK, SIN		MCLK* + 190	—	ns
SCK ↑ → valid SIN hold time	t _{SHIXI}	SCK, SIN		0	—	ns
SOT → SCK ↑ delay time	t _{SOVHI}	SCK, SOT		—	4 MCLK*	ns

* : Refer to " (2) Source Clock/Machine Clock" for MCLK.

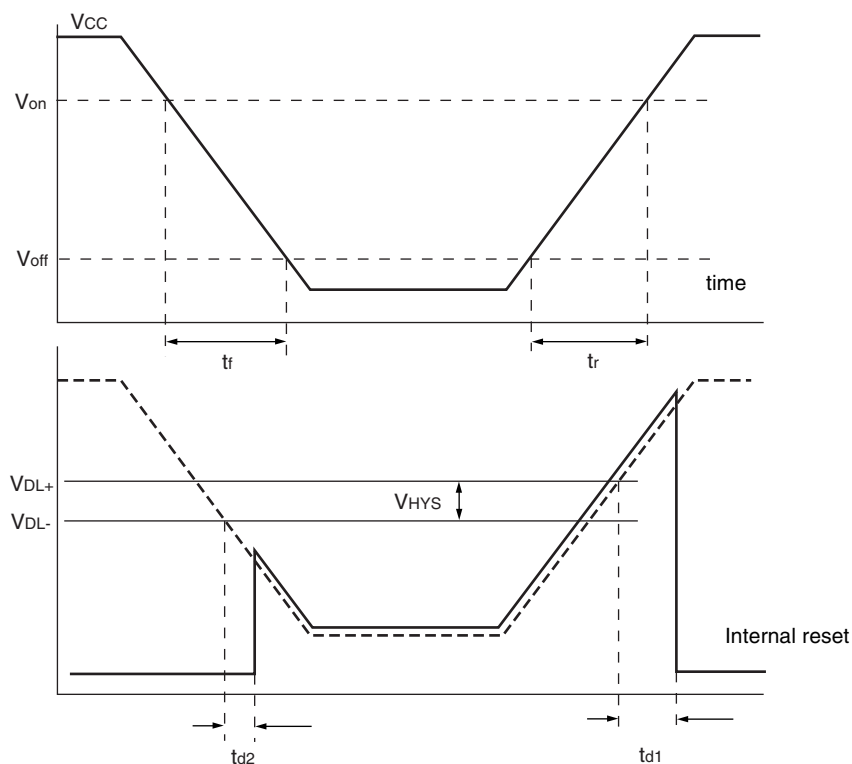


MB95130H Series

(9) Low Voltage Detection

($A_{VSS} = V_{SS} = 0.0 \text{ V}$, $T_A = -40 \text{ }^{\circ}\text{C}$ to $+85 \text{ }^{\circ}\text{C}$)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Release voltage	V_{DL+}	2.47	2.7	2.93	V	At power-supply rise
Detection voltage	V_{DL-}	2.37	2.6	2.83	V	At power-supply fall
Hysteresis width	V_{HYS}	70	100	—	mV	
Power-supply start voltage	V_{off}	—	—	2.3	V	
Power-supply end voltage	V_{on}	4.9	—	—	V	
Power-supply voltage change time (at power supply rise)	t_r	0.3	—	—	μs	Slope of power supply that reset release signal generates
		—	3000	—	μs	Slope of power supply that reset release signal generates within rating (V_{DL+})
Power-supply voltage change time (at power supply fall)	t_f	300	—	—	μs	Slope of power supply that reset detection signal generates
		—	300	—	μs	Slope of power supply that reset detection signal generates within rating (V_{DL-})
Reset release delay time	t_{d1}	—	—	400	μs	
Reset detection delay time	t_{d2}	—	—	30	μs	
Current consumption	—	—	38	50	μA	Current consumption only in low voltage detection circuit



(10) Clock Supervisor Clock

($V_{CC} = AV_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$, $AV_{SS} = V_{SS} = 0.0 \text{ V}$, $T_A = -40 \text{ }^{\circ}\text{C to } +85 \text{ }^{\circ}\text{C}$)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Oscillation frequency	f_{OUT}	50	100	200	kHz	
Oscillation start time	t_{wk}	—	—	10	μs	
Current consumption	—	—	20	36	μs	Current consumption of internal CR oscillator At 100 kHz oscillation

MB95130H Series

5. A/D Converter

(1) A/D Converter Electrical Characteristics

(AVcc = Vcc = 4.0 V to 5.5 V, AVss = Vss = 0.0 V, TA = - 40 °C to + 85 °C)

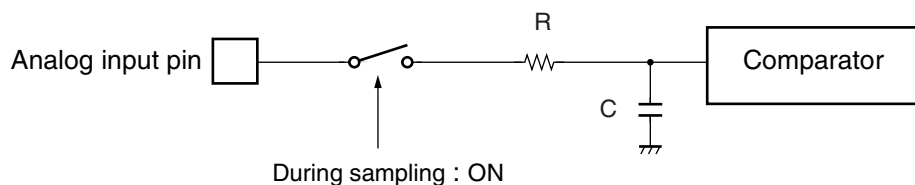
Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
Resolution	—	—	—	10	bit	
Total error		- 3.0	—	+ 3.0	LSB	
Linearity error		- 2.5	—	+ 2.5	LSB	
Differential linear error		- 1.9	—	+ 1.9	LSB	
Zero transition voltage	V _{OT}	AVss - 1.5 LSB	AVss + 0.5 LSB	AVss + 2.5 LSB	V	
Full-scale transition voltage	V _{FST}	AVcc - 3.5 LSB	AVcc - 1.5 LSB	AVcc + 0.5 LSB	V	
Compare time	—	0.6	—	16,500	μs	4.5 V ≤ AVcc ≤ 4.5 V
		20	—	16,500	μs	4.0 V ≤ AVcc < 4.5 V
Sampling time	—	0.6	—	∞	μs	4.5 V ≤ AVcc ≤ 4.5 V external impedance < at 5.4 kΩ
		1.2	—	∞	μs	4.0 V ≤ AVcc < 4.5 V external impedance < at 2.4 kΩ
Analog input current	I _{AIN}	-0.3	—	0.3	μA	
Analog input voltage range	V _{AIN}	AVss	—	AVcc	V	
Reference voltage	—	AVss + 4.0	—	AVcc	V	AVcc pin
Reference voltage supply current	I _R	—	600	900	μA	AVcc pin, During A/D operation
	I _{RH}	—	—	5	μA	AVcc pin, at stop mode

(2) Notes on Using A/D Converter

• About the external impedance of analog input and its sampling time

- A/D converter with sample and hold circuit. If the external impedance is too high to keep sufficient sampling time, the analog voltage charged to the internal sample and hold capacitor is insufficient, adversely affecting A/D conversion precision.

• Analog input circuit model



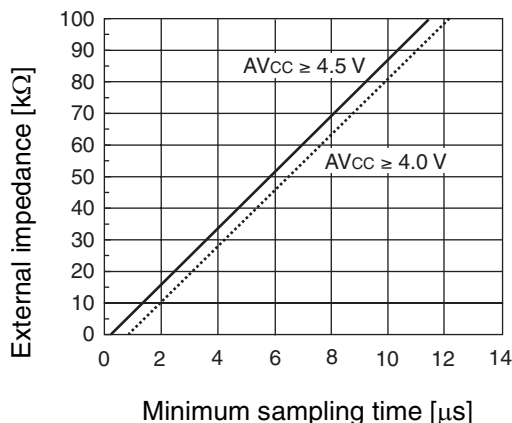
	R	C
$4.5\text{ V} \leq AV_{CC} \leq 5.5\text{ V}$	2.0 k Ω (Max)	16 pF (Max)
$4.0\text{ V} \leq AV_{CC} < 4.5\text{ V}$	8.2 k Ω (Max)	16 pF (Max)

Note : The values are reference values.

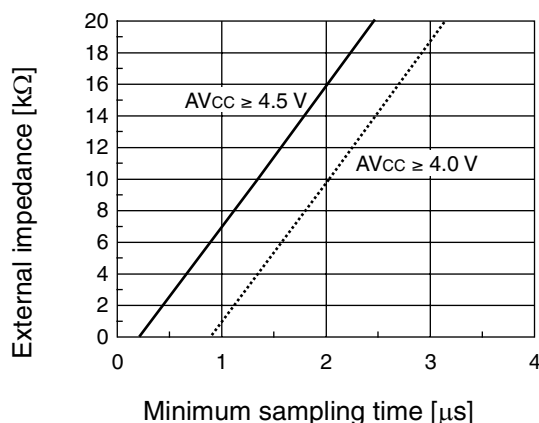
- To satisfy the A/D conversion precision standard, consider the relationship between the external impedance and minimum sampling time and either adjust the resistor value and operating frequency or decrease the external impedance so that the sampling time is longer than the minimum value.

• The relationship between external impedance and minimum sampling time

(External impedance = 0 k Ω to 100 k Ω)



(External impedance = 0 k Ω to 20 k Ω)



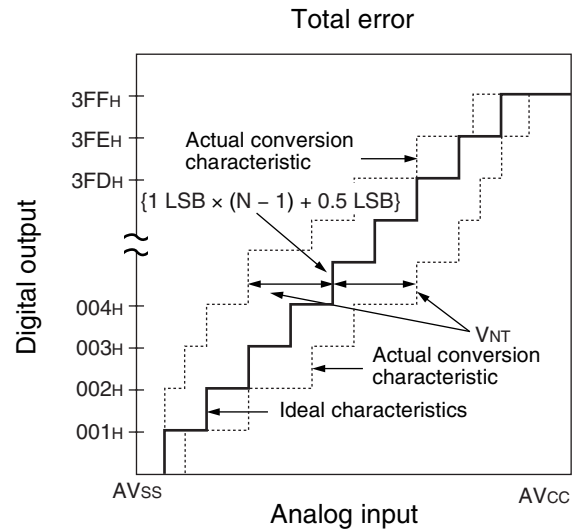
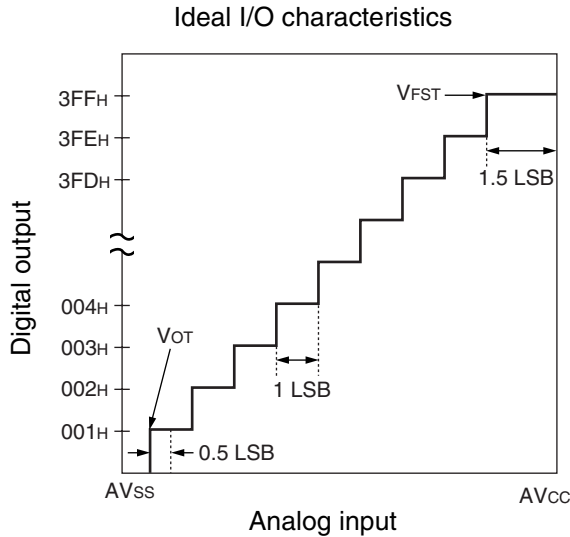
- If the sampling time cannot be sufficient, connect a capacitor of about 0.1 μF to the analog input pin.

• About errors

As $|AV_{CC} - AV_{SS}|$ becomes smaller, values of relative errors grow larger.

(3) Definition of A/D Converter Terms

- Resolution
The level of analog variation that can be distinguished by the A/D converter.
When the number of bits is 10, analog voltage can be divided into $2^{10} = 1024$.
- Linearity error (unit : LSB)
The deviation between the value along a straight line connecting the zero transition point ("00 0000 0000" ← → "00 0000 0001") of a device and the full-scale transition point ("11 1111 1111" ← → "11 1111 1110") compared with the actual conversion values obtained.
- Differential linear error (Unit : LSB)
Deviation of input voltage, which is required for changing output code by 1 LSB, from an ideal value.
- Total error (unit: LSB)
Difference between actual and theoretical values, caused by a zero transition error, full-scale transition error, linearity error, quantum error, and noise.



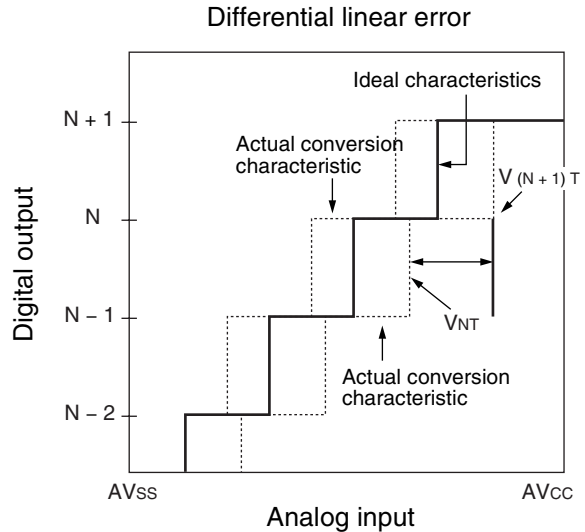
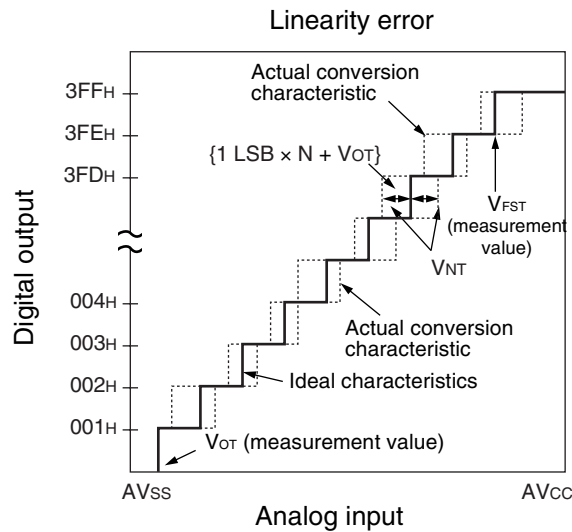
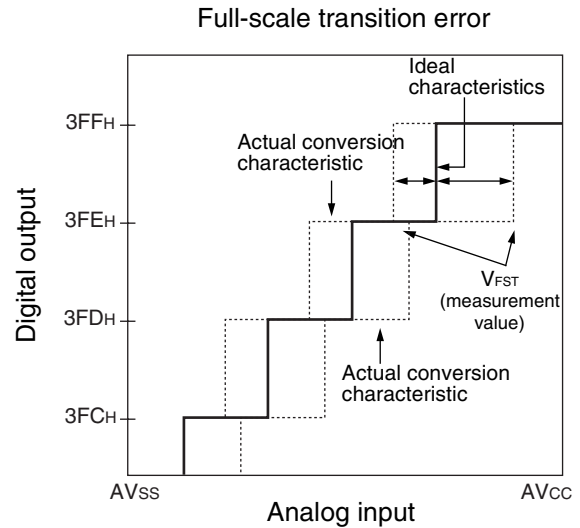
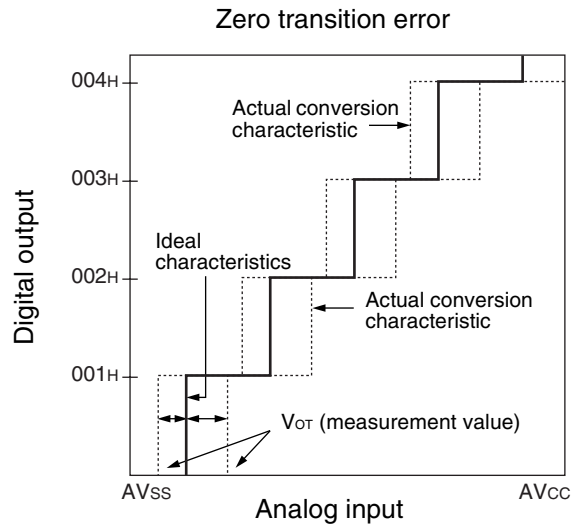
$$1 \text{ LSB} = \frac{AV_{CC} - AV_{SS}}{1024} \text{ (V)}$$

$$\text{Total error of digital output } N = \frac{V_{NT} - \{1 \text{ LSB} \times (N - 1) + 0.5 \text{ LSB}\}}{1 \text{ LSB}} \text{ [LSB]}$$

V_{NT} : A voltage at which digital output transits from $(N - 1)$ to N .

(Continued)

(Continued)



$$\text{Linear error in digital output } N = \frac{V_{NT} - \{1 \text{ LSB} \times N + V_{OT}\}}{1 \text{ LSB}}$$

$$\text{Differential linear error in digital output } N = \frac{V_{(N+1)T} - V_{NT}}{1 \text{ LSB}} - 1$$

V_{NT} : A voltage at which digital output transits from $(N - 1)$ to N .

V_{OT} (Ideal value) = $AV_{SS} + 0.5 \text{ LSB [V]}$

V_{FST} (Ideal value) = $AV_{CC} - 1.5 \text{ LSB [V]}$

MB95130H Series

6. Flash Memory Program/Erase Characteristics

Parameter	Value			Unit	Remarks
	Min	Typ	Max		
Byte programming time	—	32	3600	μs	Excludes system-level overhead
Erase/program cycle	10,000	—	—	cycle	
Power supply voltage at erase/program	4.5	—	5.5	V	
Flash data retention time	20*3	—	—	year	Average T _A = +85 °C

*1 : T_A = + 25 °C, V_{CC} = 5.0 V, 10,000 cycles

*2 : T_A = + 85 °C, V_{CC} = 4.5 V, 10,000 cycles

*3 : This value comes from the technology qualification (using Arrhenius equation to translate high temperature measurements into normalized value at +85 °C) .

■ MASK OPTIONS

No	Part number	MB95F136HW MB95F136KW MB95F136TW	MB95FV100B-103
	Specifying procedure	Setting disabled	Setting disabled
1	Clock mode select • Single clock mode • Dual clock mode	Dual clock mode	Changing by the switch on MCU board
2	Selection of oscillation stabilization wait time • Selectable the initial value of main clock oscillation stabilization wait time	Fixed to oscillation stabilization wait time of $(2^{14}-2) / F_{CH}$	Fixed to oscillation stabilization wait time of $(2^{14}-2) / F_{CH}$
3	Low voltage detection (LVD)	MB95F136HW MB95F136TW	Changing by the switch on MCU board
4	Clock supervisor (CSV)	MB95F136KW	Changing by the switch on MCU board

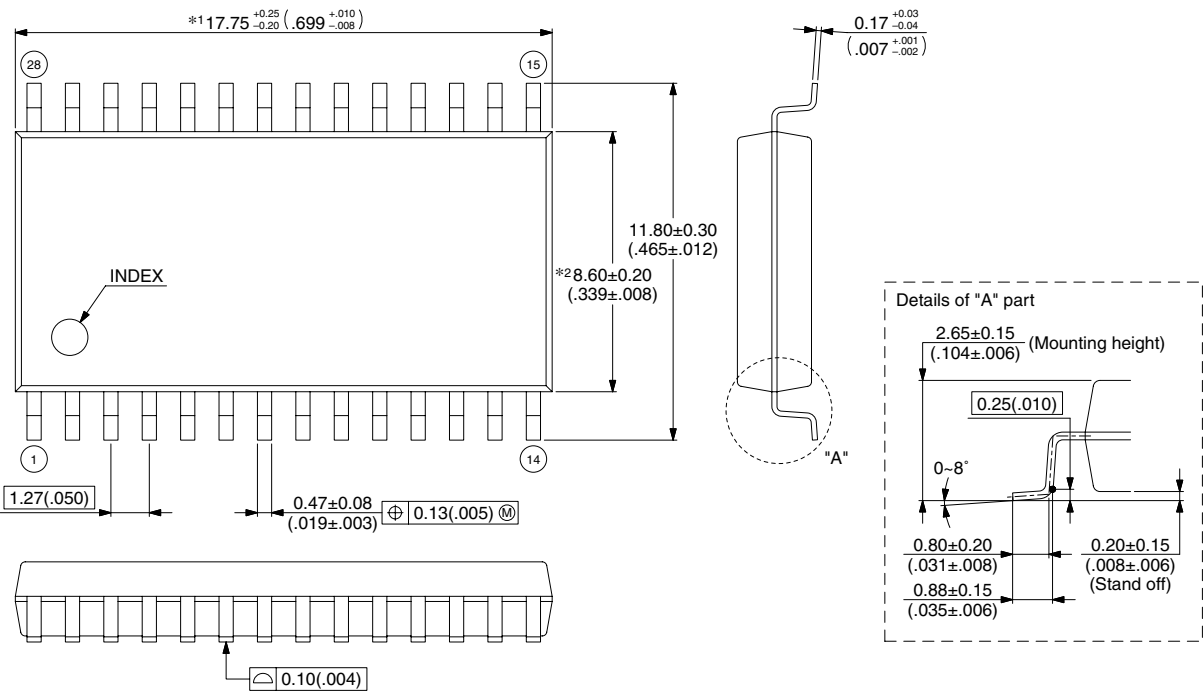
■ ORDERING INFORMATION

Part number	Package	Remarks
MB95F136HWPF	28-pin plastic SOP (FPT-28P-M17)	
MB2146-303 (MB95FV100B-103PBT)	MCU board 244-pin plastic PFBGA (BGA-244P-M08)	

MB95130H Series

■ PACKAGE DIMENSIONS

28-pin plastic SOP
(FPT-28P-M17)



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Dimensions in mm (inches).
Note: The values in parentheses are reference values.

(Continued)

MEMO

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