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Renesas Electronics website: <http://www.renesas.com>

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

PRELIMINARY
 Notice: This is not a final specification.
 Some parametric limits are subject to change.

MITSUBISHI MICROCOMPUTERS
M37903S4CHP

16-BIT CMOS MICROCOMPUTER

DESCRIPTION

These are microcomputers designed with high-performance CMOS silicon gate technology. These microcomputers support the 7900 Series instruction set, which is enhanced and expanded instruction set and is upper-compatible with the 7700/7751 Series instruction set.

The CPU of these microcomputers is a 16-bit parallel processor that can also be switched to perform 8-bit parallel processing. Also, the bus interface unit of these microcomputers enhances the memory access efficiency to execute instructions fast. Therefore, these microcomputers are suitable for office, business, and industrial equipment controller that require high-speed processing of large data.

DISTINCTIVE FEATURES

<Microcomputer mode>

- Number of basic machine instructions 203
- Memory
 - ROM External
 - RAM 2048 bytes

- Instruction execution time
 - The fastest instruction at 26 MHz frequency 38 ns
- Single power supply 5 V ± 0.5 V
- Interrupts 6 external sources, 15 internal sources, 7 levels
- Multi-functional 16-bit timer 5 + 3
- Serial I/O (UART or Clock synchronous) 2
- 10-bit A-D converter 8-channel inputs
- 8-bit D-A converter 2-channel outputs
- Real-time output
 - 4 bits × 2 channels, or 6 bits × 1 channel + 2 bits × 1 channel
- 12-bit watchdog timer
- Programmable input/output (ports P0, P2–P8, P11) 65

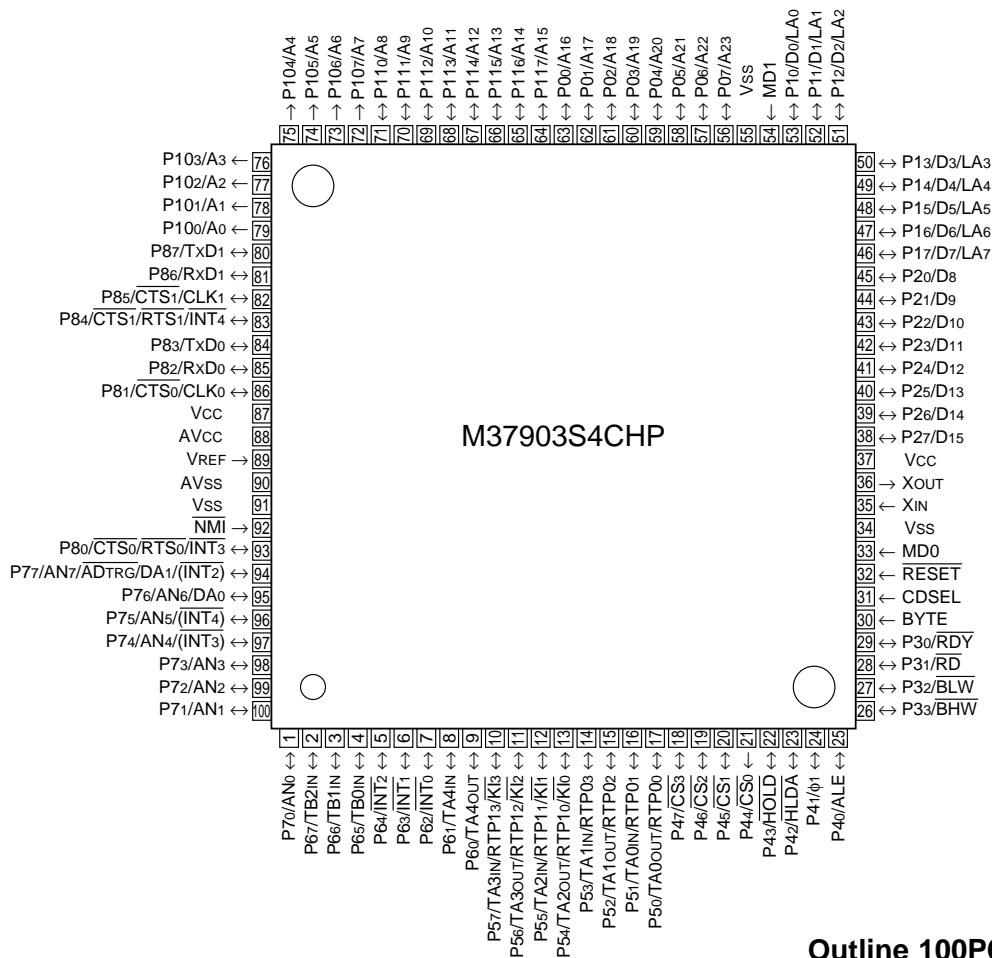
APPLICATION

Control devices for personal computer peripheral equipment such as CD-ROM drives, DVD-ROM drives, hard disk drives, high density FDD, printers

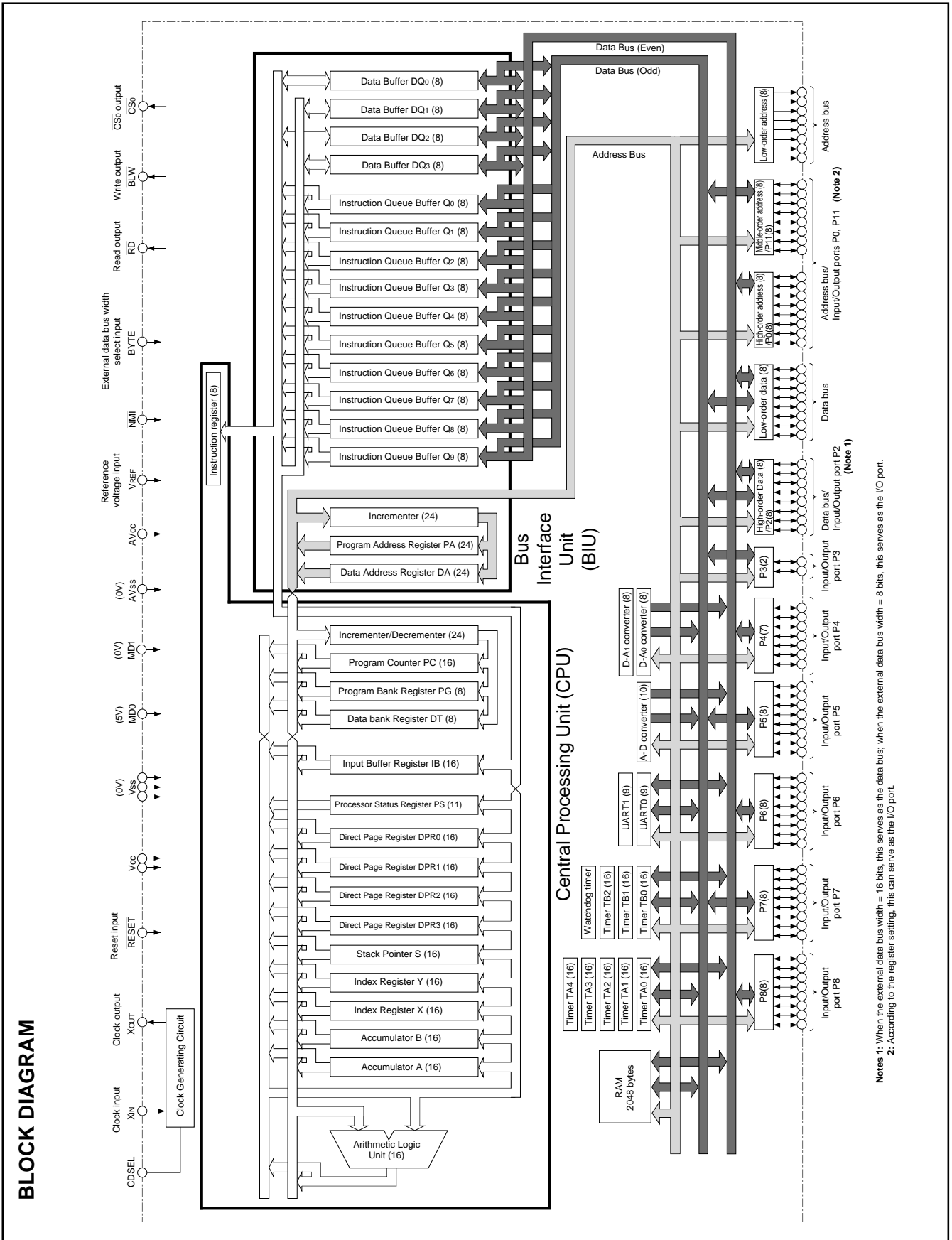
Control devices for office equipment such as copiers and facsimiles

Control devices for industrial equipment such as communication and measuring instruments

M37903S4CHP PIN CONFIGURATION (TOP VIEW)



Outline 100P6Q-A



PRELIMINARY
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FUNCTIONS (Microcomputer mode)

Parameter		Functions
Number of basic machine instructions		203
Instruction execution time		38 ns (the fastest instruction at $f(f_{sys}) = 26$ MHz)
External clock input frequency $f(XIN)$		26 MHz (Max.) (Note)
System clock frequency $f(f_{sys})$		26 MHz (Max.)
Memory size	ROM	External
	RAM	2048 bytes
Programmable input/output ports	P0, P2, P5–P8, P11	8-bit X 7 (Max.)
	P3	2-bit X 1 (Max.)
	P4	7-bit X 1 (Max.)
Multi-functional timers	TA0–TA4	16-bit X 5
	TB0–TB2	16-bit X 3
Serial I/O	UART0 and UART1	(UART or Clock synchronous serial I/O) X 2
A-D converter		10-bit successive approximation method X 1 (8 channels)
D-A converter		8-bit X 2
Watchdog timer		12-bit X 1
Chip-select wait control		Chip select area X 4 ($\overline{CS0}$ – $\overline{CS3}$). A bus cycle type and bus width can be set for each chip select area.
Real-time output		4 bits X 2 channels; or 6 bits X 1 channel + 2 bits X 1 channel
Interrupts	Maskable interrupts	5 external types, 13 internal types. Each interrupt can be set to a priority level within the range of 0–7 by software.
	Non-maskable interrupts	1 external type, 2 internal types.
Clock generating circuit		Built-in (externally connected to a ceramic resonator or quartz crystal resonator).
Power supply voltage		5 V \pm 0.5 V
Power dissipation		150 mW (at $f(f_{sys}) = 26$ MHz, Typ.)
Ports' input/output characteristics	Input/Output withstand voltage	5 V
	Output current	5 mA
Memory expansion		Up to 16 Mbytes. Note that bank FF16 is a reserved area.
Operating ambient temperature range		–20 to 85 °C
Device structure		CMOS high-performance silicon gate process
Package		100-pin plastic molded QFP

Note: When the XIN-input-clock division select bit = "0", the maximum value = 52 MHz.

PRELIMINARY
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PIN DESCRIPTION (MICROCOMPUTER MODE)

Pin	Name	Input/ Output	Functions
Vcc, Vss	Power supply input	—	Apply 5 V±0.5 V to Vcc, and 0 V to Vss.
MD0	MD0	Input	Connect this pin to VCC.
MD1	MD1	Input	Connect this pin to Vss.
$\overline{\text{RESET}}$	Reset input	Input	The microcomputer is reset when Vss-level voltage is applied to this pin.
XIN	Clock input	Input	These are input and output pins of the internal clock generating circuit. Connect a ceramic or quartz- crystal resonator between the XIN and XOUT pins. When an external clock is used, the clock source should be connected to the XIN pin, and the XOUT pin should be left open.
XOUT	Clock output	Output	
BYTE	External data bus width select input	Input	This pin determines whether the external data bus has an 8-bit width or 16-bit width for the memory expansion mode or microprocessor mode. The width is 16 bits when Vss-level voltage is input, and 8 bits when Vcc-level voltage is applied. When BYTE = Vss level, by the register setting, the external data bus for each of areas CS1 to CS3 can have a width of 8 bits.
CSEL	Clock division select input	Input	This pin determines the XIN-input-clock division select bit's (Note) state at reset and the input level at pin XIN.
AVcc, AVss	Analog power supply input	—	Power supply input pins for the A-D converter and the D-A converter. Connect AVcc to Vcc, and AVss to Vss externally.
VREF	Reference voltage input	Input	This is the reference voltage input pin for the A-D converter and the D-A converter.
P00/A16– P07/A23	Address (high-order) output	Output	Address (A16–A23) is output. These pins also function as I/O port pins according to the register setting.
P10/D0– P17/D7	Data (low-order) I/O	I/O	The low-order 8 bits of data (D0–D7) are input/output. When the external data bus has an 8-bit width, address (LA0–LA7) output and data (D0–D7) input/output can be performed with the time-sharing method, according to the register setting.
P20/D8– P27/D15	I/O port P2, Data (high-order) I/O	I/O	<ul style="list-style-type: none"> ■ When 8-bit external data bus is used Port P2 is an 8-bit I/O port. This port has an I/O direction register, and each pin can be programmed for input or output. These pins enter the input mode at reset. ■ When 16-bit external data bus is used The high-order 8 bits of data (D8–D15) are input or output.
P30–P33	I/O port P3	I/O	P30 functions as an input pin of $\overline{\text{RDY}}$; and P31, P32, P33 function as the output pins of RD, BLW, BHW, respectively. P30 also functions as an I/O port pin according to the register setting. When the external data bus has a width of 8 bits, the BHW pin functions as an I/O port pin (P33).
P40–P47	I/O port P4	I/O	P40–P44 function as output or input pins of ALE, ϕ 1, HLDA, HOLD, CS0, and P45–P47 as I/O port pins, respectively. According to the register setting, P40–P43 also function as I/O port pins, and P45–P47 as output pins of CS1–CS3.
P50–P57	I/O port P5	I/O	Port P5 is an 8-bit I/O port. This port has an I/O direction register, and each pin can be programmed for input or output. These pins enter the input mode at reset. These pins also function as I/O pins for timers A0–A3, output pins for the real-time output, and input pins for the key-input interrupt.
P60–P67	I/O port P6	I/O	Port P6 is an 8-bit I/O port. This port has an I/O direction register, and each pin can be programmed for input or output. These pins enter the input mode at reset. These pins also function as I/O pins for timer A4, input pins for external interrupt inputs INT0–INT2, and input pins for timers B0–B2.
P70–P77	I/O port P7	I/O	Port P7 is an 8-bit I/O port. This port has an I/O direction register, and each pin can be programmed for input or output. These pins enter the input mode at reset. These pins also function as input pins for the A-D converter, output pins for the D-A converter, and input pins for INT2, INT3, and INT4.
P80–P87	I/O port P8	I/O	Port P8 is an 8-bit I/O port. This port has an I/O direction register, and each pin can be programmed for input or output. These pins enter the input mode at reset. These pins also function as I/O pins for UART0, UART1, and input pins for INT3 and INT4.
P100/A0–P107/A7	Address (low-order) output	Output	Address (A0–A7) is output.
P110/A8– P117/A15	Address (middle-order) output	Output	Address (A8–A15) is output. Also, these pins function as I/O port pins according to the register setting.
$\overline{\text{NMI}}$	Non-maskable interrupt	Input	This pin is for a non-maskable interrupt.

Note: The XIN-input-clock division select bit is used to determine whether the input clock to pin XIN is to be divided or not.

BASIC FUNCTION BLOCKS

The M37903S4CHP has the same function as that of the M37903F8CHP except for the following. Therefore, refer to the datasheet of the M37903F8CHP.

- The memory allocation of the M37903S4CHP differs from that of the M37903F8CHP.
- The M37903S4CHP operates only in the microprocessor mode.

MEMORY

Figure 1 shows the memory map. The address space is 16 Mbytes from addresses 0₁₆ to FFFFFFF₁₆. The address space is divided into

64-Kbyte units called banks. The banks are numbered from 0₁₆ to FF₁₆. Bank FF₁₆ is a reserved area for the development support tool. Therefore, do not use bank FF₁₆.

Internal RAM is assigned as shown in Figure 1.

Addresses FFC0₁₆ to FFFF₁₆ contain the RESET and the interrupt vector addresses, and the interrupt vectors are stored there. For these addresses, use the ROM.

For details, refer to the section on interrupts.

Assigned to addresses 0₁₆ to FF₁₆ are peripheral devices such as I/O ports, A-D converter, D-A converter, UART, timers, interrupt control registers, etc. Figures 2 and 3 show the location of SFRs.

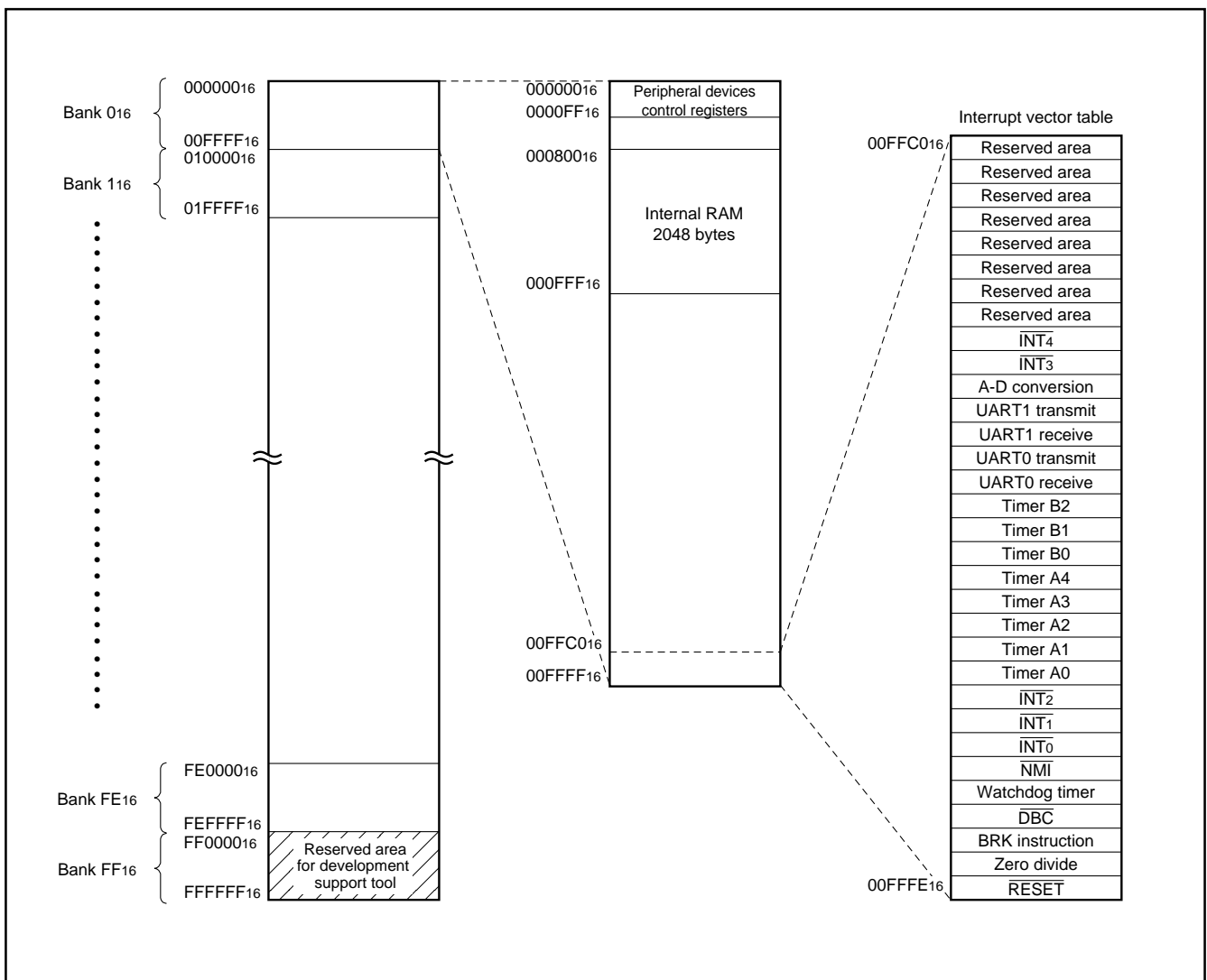


Fig. 1 Memory map of M37903S4CHP

PRELIMINARY
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Address (Hexadecimal notation)	Address (Hexadecimal notation)
000000 ¹⁶	
000001 ¹⁶	
000002 ¹⁶	Port P0 register
000003 ¹⁶	Port P1 register
000004 ¹⁶	Port P0 direction register
000005 ¹⁶	Port P1 direction register
000006 ¹⁶	Port P2 register
000007 ¹⁶	Port P3 register
000008 ¹⁶	Port P2 direction register
000009 ¹⁶	Port P3 direction register
00000A ¹⁶	Port P4 register
00000B ¹⁶	Port P5 register
00000C ¹⁶	Port P4 direction register
00000D ¹⁶	Port P5 direction register
00000E ¹⁶	Port P6 register
00000F ¹⁶	Port P7 register
000010 ¹⁶	Port P6 direction register
000011 ¹⁶	Port P7 direction register
000012 ¹⁶	Port P8 register
000013 ¹⁶	
000014 ¹⁶	Port P8 direction register
000015 ¹⁶	
000016 ¹⁶	Port P10 register
000017 ¹⁶	Port P11 register
000018 ¹⁶	Port P10 direction register
000019 ¹⁶	Port P11 direction register
00001A ¹⁶	
00001B ¹⁶	
00001C ¹⁶	
00001D ¹⁶	
00001E ¹⁶	A-D control register 0
00001F ¹⁶	A-D control register 1
000020 ¹⁶	A-D register 0
000021 ¹⁶	
000022 ¹⁶	A-D register 1
000023 ¹⁶	
000024 ¹⁶	A-D register 2
000025 ¹⁶	
000026 ¹⁶	A-D register 3
000027 ¹⁶	
000028 ¹⁶	A-D register 4
000029 ¹⁶	
00002A ¹⁶	A-D register 5
00002B ¹⁶	
00002C ¹⁶	A-D register 6
00002D ¹⁶	
00002E ¹⁶	A-D register 7
00002F ¹⁶	
000030 ¹⁶	UART0 transmit/receive mode register
000031 ¹⁶	UART0 baud rate register (BRG0)
000032 ¹⁶	UART0 transmit buffer register
000033 ¹⁶	
000034 ¹⁶	UART0 transmit/receive control register 0
000035 ¹⁶	UART0 transmit/receive control register 1
000036 ¹⁶	UART0 receive buffer register
000037 ¹⁶	
000038 ¹⁶	UART1 transmit/receive mode register
000039 ¹⁶	UART1 baud rate register (BRG1)
00003A ¹⁶	UART1 transmit buffer register
00003B ¹⁶	
00003C ¹⁶	UART1 transmit/receive control register 0
00003D ¹⁶	UART1 transmit/receive control register 1
00003E ¹⁶	UART1 receive buffer register
00003F ¹⁶	
000040 ¹⁶	Count start register
000041 ¹⁶	
000042 ¹⁶	One-shot start register
000043 ¹⁶	
000044 ¹⁶	Up-down register
000045 ¹⁶	Timer A clock division select register
000046 ¹⁶	
000047 ¹⁶	Timer A0 register
000048 ¹⁶	
000049 ¹⁶	Timer A1 register
00004A ¹⁶	
00004B ¹⁶	Timer A2 register
00004C ¹⁶	
00004D ¹⁶	Timer A3 register
00004E ¹⁶	
00004F ¹⁶	Timer A4 register
000050 ¹⁶	
000051 ¹⁶	Timer B0 register
000052 ¹⁶	
000053 ¹⁶	Timer B1 register
000054 ¹⁶	
000055 ¹⁶	Timer B2 register
000056 ¹⁶	Timer A0 mode register
000057 ¹⁶	Timer A1 mode register
000058 ¹⁶	Timer A2 mode register
000059 ¹⁶	Timer A3 mode register
00005A ¹⁶	Timer A4 mode register
00005B ¹⁶	Timer B0 mode register
00005C ¹⁶	Timer B1 mode register
00005D ¹⁶	Timer B2 mode register
00005E ¹⁶	Processor mode register 0
00005F ¹⁶	Processor mode register 1
000060 ¹⁶	Watchdog timer register
000061 ¹⁶	Watchdog timer frequency select register
000062 ¹⁶	Particular function select register 0
000063 ¹⁶	Particular function select register 1
000064 ¹⁶	Particular function select register 2
000065 ¹⁶	Reserved area (Note)
000066 ¹⁶	Reserved area (Note)
000067 ¹⁶	Reserved area (Note)
000068 ¹⁶	
000069 ¹⁶	
00006A ¹⁶	
00006B ¹⁶	
00006C ¹⁶	
00006D ¹⁶	
00006E ¹⁶	INT ₃ interrupt control register
00006F ¹⁶	INT ₄ interrupt control register
000070 ¹⁶	A-D conversion interrupt control register
000071 ¹⁶	UART0 transmit interrupt control register
000072 ¹⁶	UART0 receive interrupt control register
000073 ¹⁶	UART1 transmit interrupt control register
000074 ¹⁶	UART1 receive interrupt control register
000075 ¹⁶	Timer A0 interrupt control register
000076 ¹⁶	Timer A1 interrupt control register
000077 ¹⁶	Timer A2 interrupt control register
000078 ¹⁶	Timer A3 interrupt control register
000079 ¹⁶	Timer A4 interrupt control register
00007A ¹⁶	Timer B0 interrupt control register
00007B ¹⁶	Timer B1 interrupt control register
00007C ¹⁶	Timer B2 interrupt control register
00007D ¹⁶	INT ₀ interrupt control register
00007E ¹⁶	INT ₁ interrupt control register
00007F ¹⁶	INT ₂ interrupt control register

Note: Do not write to this address.

Fig. 2 Location of SFRs (1)

PRELIMINARY
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Address (Hexadecimal notation)		Address (Hexadecimal notation)	
000080 ₁₆	CS ₀ control register L	0000C0 ₁₆	
000081 ₁₆	CS ₀ control register H	0000C1 ₁₆	
000082 ₁₆	CS ₁ control register L	0000C2 ₁₆	
000083 ₁₆	CS ₁ control register H	0000C3 ₁₆	
000084 ₁₆	CS ₂ control register L	0000C4 ₁₆	
000085 ₁₆	CS ₂ control register H	0000C5 ₁₆	
000086 ₁₆	CS ₃ control register L	0000C6 ₁₆	
000087 ₁₆	CS ₃ control register H	0000C7 ₁₆	
000088 ₁₆		0000C8 ₁₆	
000089 ₁₆		0000C9 ₁₆	
00008A ₁₆	Area CS ₀ start address register	0000CA ₁₆	
00008B ₁₆		0000CB ₁₆	
00008C ₁₆	Area CS ₁ start address register	0000CC ₁₆	
00008D ₁₆		0000CD ₁₆	
00008E ₁₆	Area CS ₂ start address register	0000CE ₁₆	
00008F ₁₆		0000CF ₁₆	
000090 ₁₆	Area CS ₃ start address register	0000D0 ₁₆	
000091 ₁₆		0000D1 ₁₆	
000092 ₁₆	Port function control register	0000D2 ₁₆	
000093 ₁₆		0000D3 ₁₆	
000094 ₁₆	External interrupt input control register	0000D4 ₁₆	
000095 ₁₆	External interrupt input read-out register	0000D5 ₁₆	
000096 ₁₆	D-A control register	0000D6 ₁₆	
000097 ₁₆		0000D7 ₁₆	
000098 ₁₆	D-A register 0	0000D8 ₁₆	
000099 ₁₆	D-A register 1	0000D9 ₁₆	
00009A ₁₆	Reserved area (Note)	0000DA ₁₆	
00009B ₁₆		0000DB ₁₆	
00009C ₁₆	Reserved area (Note)	0000DC ₁₆	
00009D ₁₆	Reserved area (Note)	0000DD ₁₆	
00009E ₁₆	Reserved area (Note)	0000DE ₁₆	
00009F ₁₆		0000DF ₁₆	
0000A0 ₁₆	Real-time output control register	0000E0 ₁₆	
0000A1 ₁₆		0000E1 ₁₆	
0000A2 ₁₆	Pulse output data register 0	0000E2 ₁₆	
0000A3 ₁₆		0000E3 ₁₆	
0000A4 ₁₆	Pulse output data register 1	0000E4 ₁₆	
0000A5 ₁₆		0000E5 ₁₆	
0000A6 ₁₆	Reserved area (Note)	0000E6 ₁₆	
0000A7 ₁₆		0000E7 ₁₆	
0000A8 ₁₆		0000E8 ₁₆	
0000A9 ₁₆		0000E9 ₁₆	
0000AA ₁₆		0000EA ₁₆	
0000AB ₁₆		0000EB ₁₆	
0000AC ₁₆	Serial I/O pin control register	0000EC ₁₆	
0000AD ₁₆		0000ED ₁₆	
0000AE ₁₆		0000EE ₁₆	
0000AF ₁₆		0000EF ₁₆	
0000B0 ₁₆		0000F0 ₁₆	
0000B1 ₁₆		0000F1 ₁₆	
0000B2 ₁₆		0000F2 ₁₆	
0000B3 ₁₆		0000F3 ₁₆	
0000B4 ₁₆		0000F4 ₁₆	
0000B5 ₁₆		0000F5 ₁₆	
0000B6 ₁₆		0000F6 ₁₆	
0000B7 ₁₆		0000F7 ₁₆	
0000B8 ₁₆		0000F8 ₁₆	
0000B9 ₁₆		0000F9 ₁₆	
0000BA ₁₆	Reserved area (Note)	0000FA ₁₆	
0000BB ₁₆	Reserved area (Note)	0000FB ₁₆	
0000BC ₁₆	Clock control register	0000FC ₁₆	
0000BD ₁₆	Reserved area (Note)	0000FD ₁₆	
0000BE ₁₆	Reserved area (Note)	0000FE ₁₆	
0000BF ₁₆	Reserved area (Note)	0000FF ₁₆	

Note: Do not write to this address.

Fig. 3 Location of SFRs (2)

PRELIMINARY
Notice: This is not a final specification.
Some parametric limits are subject to change.

ELECTRICAL CHARACTERISTICS

As for the following, the M37903S4CHP is the same as the M37903F8CHP. Therefore, for the following, refer to the datasheet of the M37903F8CHP.

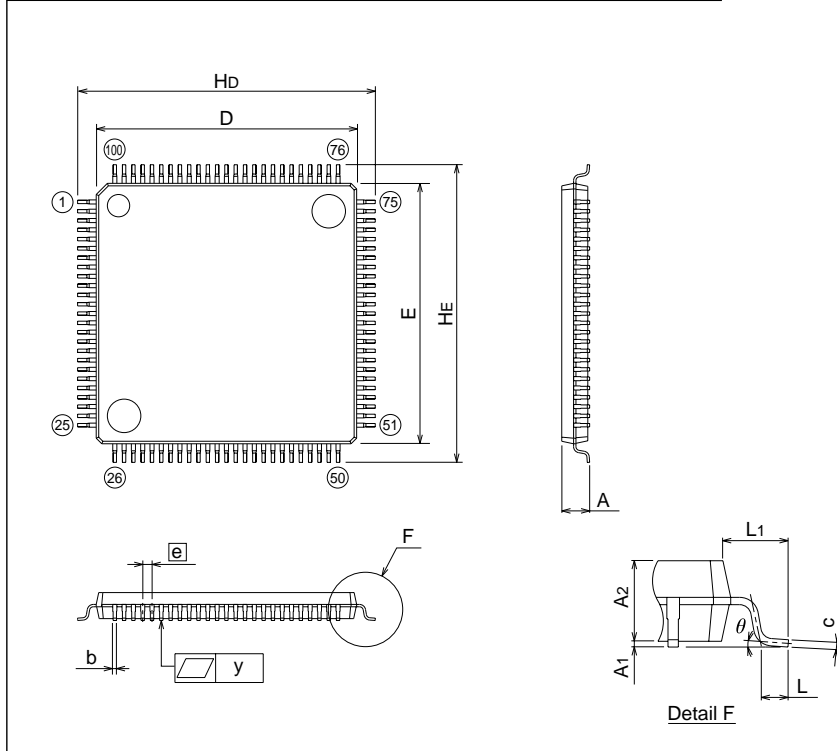
- ABSOLUTE MAXIMUM RATINGS
- RECOMMENDED OPERATING CONDITIONS
- DC ELECTRICAL CHARACTERISTICS
- A-D CONVERTER CHARACTERISTICS
- D-A CONVERTER CHARACTERISTICS
- TIMING REQUIREMENTS
- SWITCHING CHARACTERISTICS

PACKAGE OUTLINE

100P6Q-A

Plastic 100pin 14X14mm body LQFP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
LQFP100-P-1414-0.50	-		Cu Alloy



Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	-	-	1.7
A1	0	0.1	0.2
A2	-	1.4	-
b	0.13	0.18	0.28
c	0.105	0.125	0.175
D	13.9	14.0	14.1
E	13.9	14.0	14.1
e	-	0.5	-
HD	15.8	16.0	16.2
HE	15.8	16.0	16.2
L	0.3	0.5	0.7
L1	-	1.0	-
y	-	-	0.1
θ	0°	-	10°
b2	-	0.225	-
l2	1.0	-	-
MD	-	14.4	-
ME	-	14.4	-

Renesas Technology Corp.

Nippon Bldg.,6-2,Otemachi 2-chome,Chiyoda-ku,Tokyo,100-0004 Japan

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Revision History

M37903S4CHP Datasheet

Rev. No.	Revision Description	Rev. date
1.0	First Edition	001004