

To all our customers

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

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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

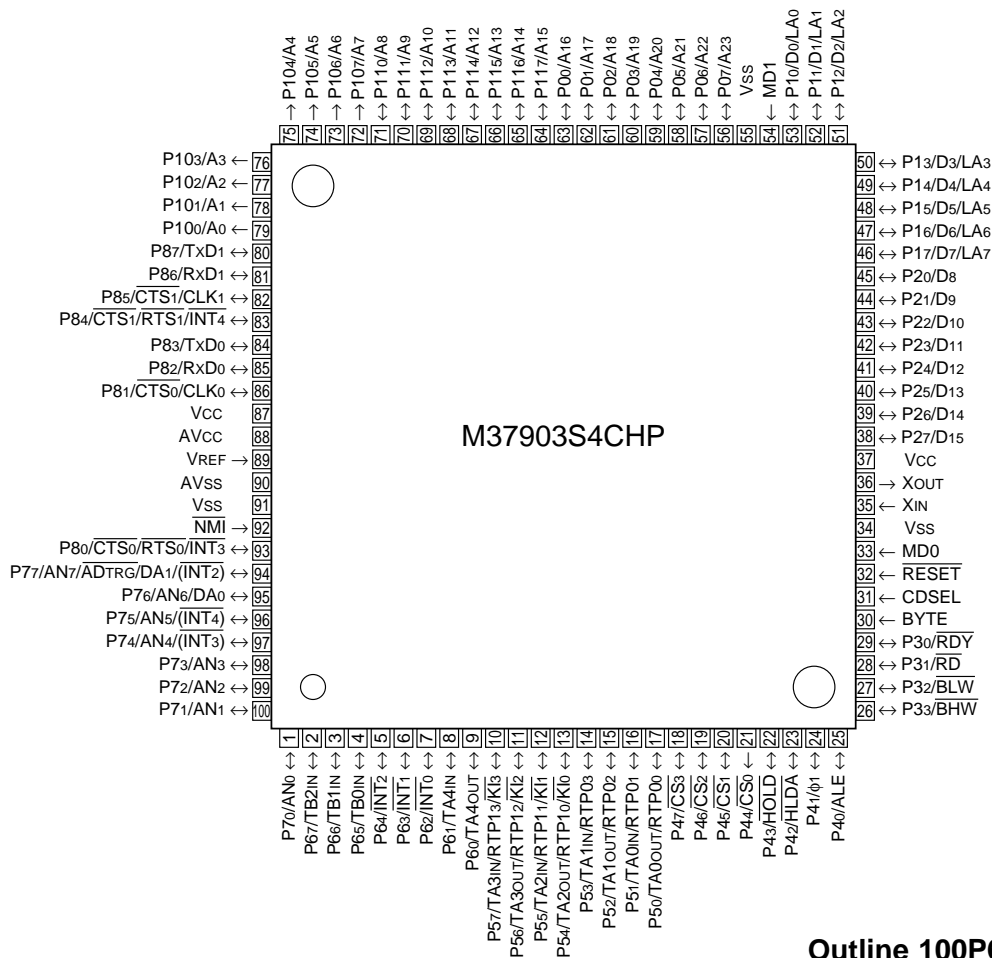
**APPLICATION**

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

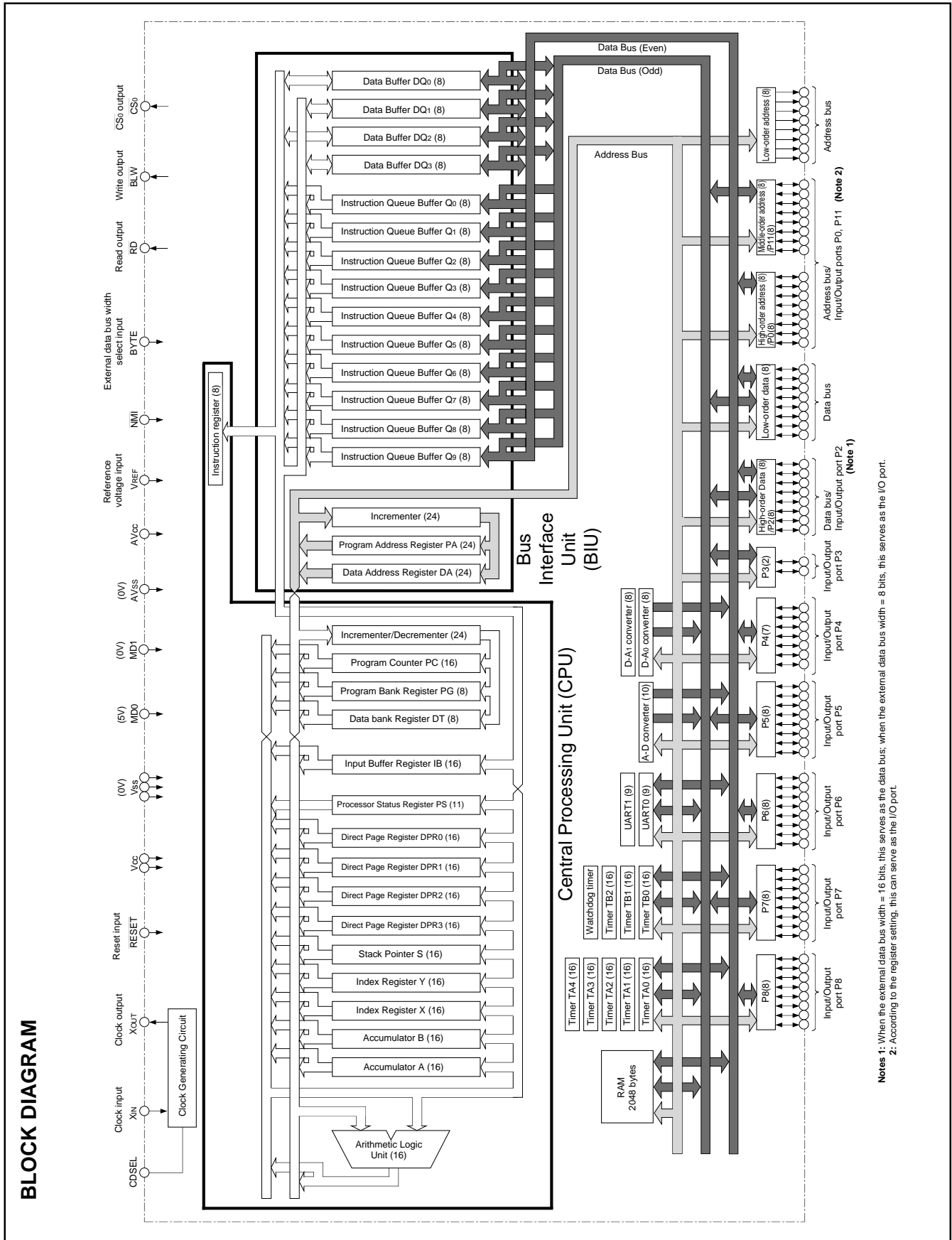
Control devices for office equipment such as copiers and facsimiles

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.) <b>(Note)</b>
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"> <li>■ 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.</li> <li>■ When 16-bit external data bus is used The high-order 8 bits of data (D8–D15) are input or output.</li> </ul>
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, $\phi$ 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 0<sub>16</sub> to FFFFFFF<sub>16</sub>. The address space is divided into

64-Kbyte units called banks. The banks are numbered from 0<sub>16</sub> to FF<sub>16</sub>. Bank FF<sub>16</sub> is a reserved area for the development support tool. Therefore, do not use bank FF<sub>16</sub>.

Internal RAM is assigned as shown in Figure 1.

Addresses FFC0<sub>16</sub> to FFFF<sub>16</sub> 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 0<sub>16</sub> to FF<sub>16</sub> 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.

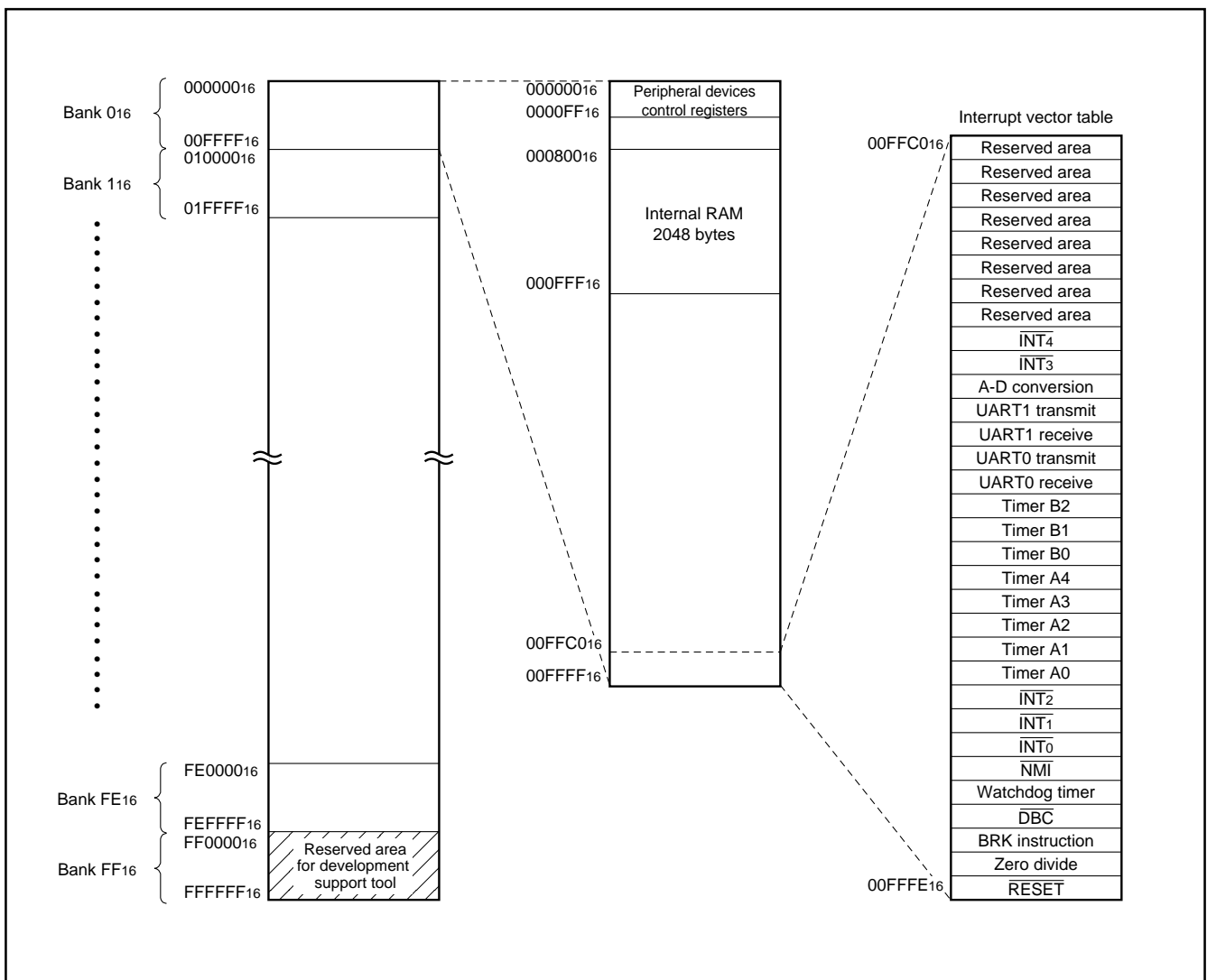


Fig. 1 Memory map of M37903S4CHP

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

**Note:** Do not write to this address.

Fig. 2 Location of SFRs (1)

**PRELIMINARY**  
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Some parametric limits are subject to change.

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

**Note:** Do not write to this address.

Fig. 3 Location of SFRs (2)



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## **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

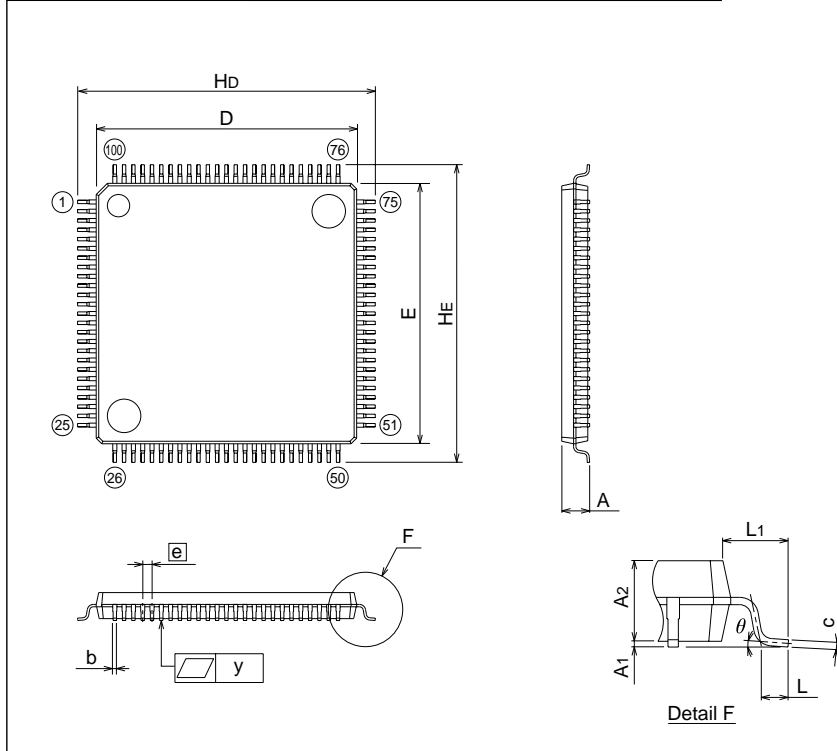
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**PACKAGE OUTLINE**

**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	-
I2	1.0	-	-
MD	-	14.4	-
ME	-	14.4	-

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## Revision History

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